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Alternative perspectives of the angling community on Eurasian beaver (*Castor fiber*) reintroduction in the River Otter Beaver Trial

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Eurasian beaver (*Castor fiber*) reintroduction is taking place in England with potential benefits for flood alleviation and biodiversity; however there is also opposition. One area of controversy relates to fish and fishing. A previous meta-analysis of research into beaver-fish relationships found perceived benefits of beavers amongst fish and beaver "experts" included increased fish abundance and productivity, whilst perceived negatives included impeded fish passage and reduced spawning habitat availability. We further this understanding using Q-Methodology (a social science technique) to reveal three nuanced and contrasting perspectives that exist amongst the angling community in the catchment of a trial reintroduction. Due to a conflict potential between groups, we suggest management themes to help reduce this where reintroduction occurs: open, cross-sectoral dialogue about research into beaver-fish relationships and management; a management strategy which supports ecosystem benefits whilst providing a sense of empowerment for individuals to respond to negative impacts.

Keywords: angling; Eurasian beaver; perceptions; Q-Methodology; reintroduction

1. Introduction

Ecological restoration projects are often driven by environmental scientific goals, but social attitudes are becoming increasingly recognized as important in whether projects are successful (Eden and Tunstall 2006; Martin 2017; Jellinek *et al*. 2019). As such, restoration projects (particularly river restoration projects) should be considered as both environmental and social (Eden and Tunstall 2006) so as to ensure that a consideration of how people understand the environment can be built into environmental policy (Eden 1996; Eden, Donaldson, and Walker 2006).

The reintroduction of formerly resident species of wildlife is a growing practice, sometimes undertaken to facilitate ecological restoration (Ewen and Armstrong 2007; Corlett 2016). It is recognized that social science should be integrated into reintroduction projects (Seddon, Armstrong, and Maloney 2007; Crowley, Hinchliffe, and McDonald 2017b) particularly as potential human-wildlife conflicts or conflicts between people over wildlife could occur or escalate if not properly considered (Auster, Puttock, and Brazier 2020). An understanding of the social implications of wildlife reintroduction is required according to guidelines set by the International

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Union for the Conservation of Nature (IUCN & SSC 2013) and it has been suggested that these considerations should also include social attitudes toward potential management of the reintroduced species (Auster, Puttock, and Brazier 2020), particularly as many conflicts between people over wildlife manifest where there are disagreements over management (Marshall, White, and Fischer 2007; Redpath, Bhatia, and Young 2015).

To gain an understanding of attitudes in reintroduction projects, it is vital to engage with publics and key stakeholders (Auster, Puttock, and Brazier 2020). Appropriate and transparent engagement will be more likely to give insights into how people interact and relate to the environment and democratize the decision-making process (Eden, Donaldson, and Walker 2006; Decker *et al*. 2016; Treves and Santiago-Ávila 2020). This would be more likely to lead to outcomes that are more socially acceptable, enabling stakeholders to feel that their views are valid, taken seriously and considered (Decker *et al*. 2014; Young *et al*. 2016). If a reintroduction then proceeds, this would be likely to foster greater trust in management authorities and reduce potential for later conflict escalation (Decker *et al*. 2016; Young *et al*. 2016).

The Eurasian beaver (*Castor fiber*) is being reintroduced to parts of Britain. It is a species of rodent which physically alters the landscape through dam-building and tree-felling activity (Stringer and Gaywood 2016). The species was historically resident in Great Britain until approximately 500 years ago when they were hunted to extinction by humans (Halley and Rosell 2003). Their reintroduction is now being considered at a devolved level: in Scotland, Eurasian beavers were listed as a European Protected Species in May 2019 (Scottish Government 2019); in England national consultations are due later in 2020 on the future of Eurasian beavers in the country, meanwhile the UK Government included a reference in their 25-year environmental plan to "providing opportunities for reintroduction of species such as beavers" (HM Government 2018, 57) and a small population is to be legally allowed to remain in Devon following a reintroduction trial (which is later discussed) (UK Government 2020); in Wales there is currently no official reintroduction project, although there are proposals being made by the "Welsh Beaver Project" following an earlier feasibility study (Jones *et al*. 2012).

Many of the motivations for reintroducing Eurasian beavers are due to a number of beneficial impacts, such as the slowing of peak water flows leading to a reduction in flooding downstream (Puttock *et al*. 2017; Brown *et al*. 2018) and the creation of complex and dynamic wetland habitats from their landscape alterations, leading to an increase in both terrestrial and aquatic biodiversity (Stringer and Gaywood 2016; Law, McLean, and Willby 2016; Law *et al*. 2017; Willby *et al*. 2018; Law *et al*. 2019; Nummi *et al*. 2019). However, there is also some opposition to their reintroduction with such narratives of controversy including debate about beaver-induced flooding of agricultural land; impacts upon trees of significance; responsibilities for and costs of beaver management; and the impacts of beaver activity upon fish and fishing activity (Kemp *et al*. 2012; Morzillo and Needham 2015; Campbell-Palmer *et al*. 2016; Crowley, Hinchliffe, and McDonald 2017b; Gaywood 2018; Auster, Puttock, and Brazier 2020). In this paper, we investigate the last of these – beaver reintroduction's effects on fish and fishing activity – from the perspectives of anglers.

Prior to this study, we undertook a nationwide questionnaire in 2017 which identified groups of respondents who were less likely to have a more positive view of the impacts of Eurasian beavers than the remainder of the respondent pool ($n = 2759$) and

are consequently groups of people with whom there is an increased risk of conflicts between humans and beavers, or between humans about beavers. One of these groups was respondents who identified their occupation as being related to "Fisheries & Aquaculture". Amongst this occupational group ($n = 34$), 44.12% indicated that they would not support beaver reintroduction to Great Britain, whilst 44.12% indicated that they would and 11.76% were undecided. Respondents who had heard about the survey through a fishing organization, thus implying a potential interest in fishing ($n = 90$), exhibited a division of opinion with a greater proportion opposed to reintroduction than amongst those whose occupation was related to "Fisheries & Aquaculture"; 65.55% of this group were opposed, whilst 22.22% were in favor and 12.22% were undecided (Auster, Puttock, and Brazier 2020). These findings indicate diverse perspectives amongst both those whose occupation was in the sector and those who have a potential interest in fishing.

We now seek to use a technique from the social sciences - known as "Q-Methodology" - to further our understanding in this new study, and describe the contrasting subjective viewpoints that exist amongst an angling community that has co-existed alongside beavers in an official reintroduction trial in England. We will first use relevant literature to provide the research context, before introducing and describing the Q-Method process. We will then outline the contrasting and nuanced perspectives that we identified amongst the respondent pool, before finally discussing what the implications of these may be for the management of potential future conflicts.

1.1. Context

The science of the ecological relationship between Eurasian beavers and fish is still under debate. A meta-analysis of research pertaining to the relationship between fish and both the Eurasian beaver and the similar North American beaver (*Castor canadensis*) was published in 2012. In the analysis of literature (88% of which had been conducted in North America) it was found that, whilst there is no consensus within the literature, the benefits of beaver reintroduction were cited more frequently than the costs, with "habitat heterogeneity, rearing and overwintering habitat and flow refuge, and invertebrate production" being the most frequently cited (and fisheries relevant) benefits (Kemp *et al*. 2012, 158). For example, beaver ponds in Poland were found to provide habitat for large brown trout (*Salmo trutta*) (Kukula and Bylak, 2010) and there are numerous river restoration projects in North America with the explicit intention of enhancing river health via beaver reintroductions so as to support better populations of Steelhead Salmon (Bouwes *et al*. 2016). However, there were also cited negative impacts, the most common of which were "impeded fish movement because of dams, siltation of spawning habitat and low oxygen levels in ponds" (Kemp *et al*. 2012, 158).

As the importance of integrating social science research into ecological sciences is becoming increasingly recognized (Redman, Grove, and Kuby 2004; Redpath, Bhatia, and Young 2015; Bennett *et al*. 2017), the meta-analysis study then went further by asking 49 North American and European experts to complete a questionnaire. From this, it was identified that the majority of these experts viewed beavers to have an overall positive impact on fish, particularly through influences upon abundance and productivity. However, perceived negative impacts were also recognized, particularly related to the movement of aquatic organisms in tributary streams and availability of spawning habitat (Kemp *et al*. 2012). These are similar to the reasons given by those who did not support the process of beaver reintroduction amongst respondents who

identified their occupation as in "Fisheries & Aquaculture" in our nationwide survey; the majority of comments from this group related to concerns that beaver dams (or "semi-permeable barriers" (Bylak, Kukuła, and Mitka 2014)) may obstruct fish migration, particularly that of salmonids (Auster, Puttock, and Brazier 2020).

Since the time of publication of the meta-analysis, further research has been taking place upon the relationship between Eurasian beavers and fish in Great Britain. (From this point forwards, we now only discuss the Eurasian beaver which will henceforth be referred to as "beavers"). Prior to the Scottish Government's decision to protect beavers legally, a licensed reintroduction trial had taken place in Mid-Argyll (Gaywood 2018). As part of this project, a Beaver-Salmonid Working Group was established which consisted of multiple organizations. In their final report, the group concluded that beavers can have a positive effect on the production of some salmonid species, however ambiguity remained over their influence on Atlantic salmon due to their vulnerability to obstructed passage and reliance on "swift waters, which would be reduced by extensive beaver damming" (Beaver Salmonid Working Group 2015, 74). Therefore, although there is seemingly a net positive impact reported in some of the literature, there are still uncertainties and a lack of consensus about the potential relationship between beavers and fish.

Fishing is also a significant activity in England and Wales. In an economic evaluation report published by the Environment Agency in 2009 it was stated that there were over one-million licensed anglers in 2005 and that expenditure on freshwater angling supported £1billion of household income (the equivalent of 37,000 full-time jobs, with over 20,000 directly dependent on angling) (Mawle and Peirson 2009). The licensed "River Otter Beaver Trial", taking place in England, monitors and conducts research upon a free-living population of beavers in the catchment of the River Otter in Devon. Within the scope of the project, research must include impacts upon fish populations and fishing (amongst other areas including hydrology, agriculture and wider biodiversity) (Devon Wildlife Trust 2017). The full body of work has now been reported upon to UK Government (Brazier *et al.* 2020) alongside a proposed management framework (River Otter Beaver Trial 2019). UK Government announced on 6th August 2020 that the River Otter beavers may stay and spread naturally, with consultations led by Natural England on national management and further releases in England due later in 2020 (UK Government 2020).

If and where beavers are reintroduced, then subsequent decisions on management will need to consider perceptions held about beaver reintroduction. This is important (alongside an understanding of the ecological relationship between beavers and fish) if they are to reduce the potential for conflicts between people and beavers or between people about beavers (Auster, Puttock, and Brazier 2020). As such, we here provide a more detailed understanding of perspectives that exist amongst anglers who have lived alongside beaver presence in England. We focused upon anglers within the River Otter catchment as they are the first to have experienced fishing on an English river in which an official population of beavers is present and thus may also provide insights from where human-beaver interactions may have occurred, or indeed may occur as/if beaver populations become more widespread in years to come.

2. Methods

It was known that the pool from which participants were recruited would be limited as very few people in England have experienced living/fishing alongside this native animal (see Section 2.2), so a method was required which would be valid with a small

number of participants. Q-Methodology is a technique used to explore the subjectivities of the research participants within a specific context (Eden, Donaldson, and Walker 2005). The method asks participants to arrange a number of statements into a matrix (see Section 2.3) and uses a factor analysis to provide a holistic understanding of viewpoints that exist amongst the respondent group (Eden, Donaldson, and Walker 2005; Watts and Stenner 2012, 4). It does not require large numbers of participants (and can even be undertaken with a sample of one) since, rather than explore the prevalence of viewpoints in a population, it seeks to establish the existence of viewpoints and understand them (Watts and Stenner 2012, 72), as is exactly the aim of this particular study.

2.1. Designing the Q-Set

This research method involves the sorting of a number of statements (see Section 2.3). This set of statements, otherwise known as the Q-Set, was designed to include the relationship between beavers and fish or fishing as well as other variables in order to explore how the views in these areas relate.

The statements were designed based upon findings from a previous nationwide questionnaire study, as outline above (Auster, Puttock, and Brazier 2020), a review of beaver reintroduction literature and the personal experiences of the researcher working within the field. As this study deals with opinion, the statements may or may not necessarily be factually correct, and they were designed to evoke a response of agreement or disagreement. 46 statements were written in order to ensure adequate coverage of the subject area whilst not having too many statements for the participants to sort. The final set of statements is represented in Table 1.

The statements were piloted by colleagues working within the subject field prior to the study to ensure there were no obvious omissions. Each study participant was also asked if there was anything missing at the end of their participation. All respondents stated that they felt that the key areas had been represented, although one respondent further added that they would have included a statement about the tradition of fishing.

2.2. Participants

The target pool of participants were people who identified as members of the fishing community within the catchment of the River Otter. This was determined as this is the boundary area of the "River Otter Beaver Trial" and, therefore, these are anglers who have experienced fishing upon a river alongside beaver presence. The majority of fishing activity in this catchment is for brown trout or sea trout (*Salmo trutta*), with the occasional salmon (*Salmo salar*) catch recorded. (Further details on fishing activity in this catchment are given in an appendix to the ROBT *Science and Evidence Report* – [Auster 2019]).

Purposive sampling (where recruitment criteria is based on individuals who will provide useful insights [Etikan, Musa, and Alkassim 2016]) was used to recruit as many members of this community as possible. The majority of the catchment's fishing rights are owned or leased by syndicates or a business. Those identified - three major syndicates and one business as described in Auster 2019 - were contacted to invite participation and to request the invitation was extended toward their members or other individuals of which they knew who had an interest in fishing on the River Otter. The total number of invites then shared further is unknown, but the number of possible

Table 1. List of statements and the factor arrays.

Statements		Factor Arrays		
		Factor 1 – "Beaver-Accepting"	Factor 2 – "Beaver-Apprehensive"	Factor 3 – "Managed-Beaver"
1	There is a sufficient toolbox of beaver management techniques	2	−3	−2
2	Beavers would have a negative impact on agriculture	0	1	−1
3	Beavers are a native species in England	3	−1	3
4	Beaver activity would damage human infrastructure	−2	−1	−1
5	England would become overpopulated with beavers	−1	0	−2
6	Beaver activity would increase flood risk	−4	−2	−1
7	Beaver welfare would be at risk from riverbank users	1	0	−1
8	Bureaucratic processes would make it difficult to receive support for managing beavers	0	2	2
9	Beavers would increase river biodiversity	4	0	3
10	Beaver presence would mean I need to change where I fish	−3	1	−1
11	Beaver activity would contribute toward carbon storage	1	1	−1
12	Beaver dams would obstruct fish migration	−3	3	−2
13	Anglers contribute toward the conservation of nature	0	4	4
14	Beaver presence would increase opportunities for leisure activities	−1	−1	0
15	Beaver presence would lead to reduced fish size	−3	1	−3
16	Human physical health would increase from visiting beaver sites	−2	−1	1
17	Seeing beavers is a positive experience	3	0	2
18	Fishing does not improve physical health	−2	−4	−4
19	Beavers would negatively damage trees	0	1	0
20	Beaver activity would decrease the amount of sediment in rivers	−1	−1	3
21	Beaver activity would reduce riverbank erosion	2	−2	0
22	Beaver activity would improve water quality	2	0	2
23	Beavers are intimidating	−4	−1	−3
24	Legal protection of beavers would make it difficult to manage negative beaver impacts	−2	2	1
25	Legal protection of beaver habitats would protect river ecology	1	−2	0
26	Beavers lead to conflict between anglers and beaver-watchers	−3	2	0
27	Humans have affection for beavers	3	1	0

(*Continued*)

Table 1. (*Continued*).

Statements		Factor Arrays		
		Factor 1 – "Beaver-Accepting"	Factor 2 – "Beaver-Apprehensive"	Factor 3 – "Managed-Beaver"
28	Fishing improves mental health	2	4	4
29	Beavers would create opportunities to engage people with nature	1	0	1
30	Human mental health would decrease due to the impacts of beavers	−4	−2	−4
31	Beavers would create fish spawning habitats	1	−4	3
32	Beavers should be in Great Britain	4	0	2
33	My quality of life relies upon fishing	1	4	4
34	Beavers would create new habitats for other wildlife	4	1	2
35	Beaver activity would reduce numbers of commercially important fish	−3	2	−3
36	It is clear who would be responsible for funding beaver management	−1	−4	−2
37	Beaver activity would lead to a greater diversity in fish	0	−3	1
38	Beaver activity would obstruct physical access to current fishing spots	−1	2	−2
39	Beaver presence would lead to a boost for local businesses	0	0	0
40	Beaver reintroduction would lead to other species reintroductions	2	−1	1
41	The science of the relationship between beavers and fish is unclear	0	3	−1
42	It is unclear who would be responsible for managing beaver impacts	0	2	1
43	Beaver activity would increase local esthetics	3	−2	0
44	Fishing does not contribute toward local business	1	−3	−4
45	Beavers would carry risky diseases	−4	−2	−3
46	Beavers would create new places to fish	−1	−3	1

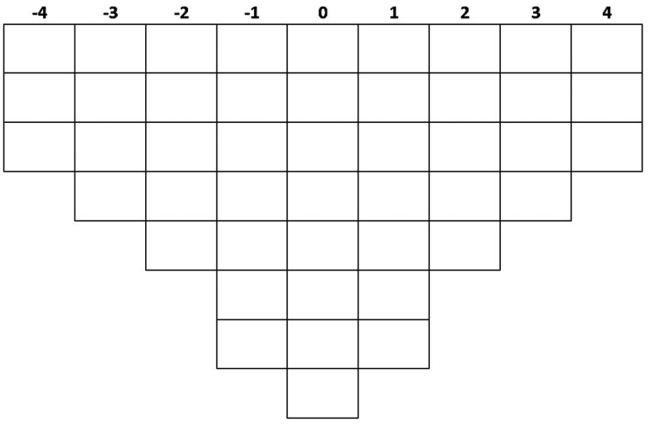

Figure 1. Example of the Q-Sort distribution matrix.

relevant paying syndicate members for the three syndicates is estimated to be between 55 and 85 (Auster 2019). There is one area of free fishing in the lower catchment area, but the research was not advertised in this location as the landowner did not wish it to indirectly advertise the fishing there. To participate (and abide by data protection laws by preventing sharing contact details of others) respondents were invited to voluntarily respond to the researcher's invitation. 11 respondents volunteered for the study from throughout the river catchment.

Prior to participation, all respondents were provided with statements regarding the study's ethics and data protection (provided here as Supplementary Information). Participants were required to agree to these statements and give written consent prior to participation.

2.3. Administering the Q-Sort

There were three stages to administering the Q-Sort which took place between 8th November 2018 and 23rd July 2019 (within the time frame of the "River Otter Beaver Trial"). First, participants were asked to sort statements into three piles: statements they agreed with, statements they disagreed with and statements that they were unsure about. The statements within each pile were recorded to aide later interpretation.

Second, respondents were asked to sort the statements into a matrix. This matrix essentially required participants to rank the statements between a score of 4 (statements which they most strongly agreed with) and a score of −4 (statements which they most strongly disagreed with). A fixed quasi-normal distribution matrix was provided for the sort, demonstrated in Figure 1, in order to facilitate the sorting process for the participants. As the distribution does not influence the end result, however (Watts and Stenner 2012, 78), participants were allowed to place statements outside of the matrix if they chose in order for it to be a comfortable process for the participants. Throughout the sorting process, any comments made by the participants about particular statements were recorded to aide interpretation.

Third, a discussion was held with the participants after the sorting process about their final configuration and any other points they would like to raise in order to aide interpretation of the results. The entire process took approximately one hour for each participant.

2.4. Statistical analysis

In Q-Method, the analysis looks at the configuration as a whole and how the statements relate to one another, rather than the placing of individual statements. The participants' statement configurations were analyzed using "PQMethod" software (Schmolk 2014). The perspectives shared by groups of people, known as factors, were extracted using a centroid factor analysis with Varimax rotation; this computerized rotation is mathematically superior to manual rotations and explains the maximum amount of variance, allowing us to derive and understand as many perspectives as possible from the group as a whole (Watts and Stenner 2012, 122–126; Nost, Robertson, and Lave 2019). As is often convention to provide objectivity, factors were retained if two or more participants significantly loaded onto (statistically correlated with) a factor and the Eigenvalue was greater than 1. Two factors were initially retained. However, a third factor with an Eigenvalue of lower than 1 was still retained as it represented a perspective recognizable to the researcher as "meaningful" from their experience of the Q-Study; eigenvalues guide decisions on which factors to retain but final decisions rest with the researcher (Watts and Stenner 2012, 105–107). From the weighted averages of the significantly loaded configurations, factor arrays were generated. Factor arrays are a single Q-Sort representative of the factor (Watts and Stenner 2012, 140). The factor arrays for the three retained factors are presented in Table 1. Four respondents were either confounded (loaded onto multiple factors) or did not statistically load onto any factors.

2.5. Interpretation

The factors (perspectives) were interpreted from the factor arrays and recorded comments from the participants whose Q-Sorts loaded onto (statistically correlated with) these factors. This included examining which statements were ranked at the highest or lowest positions as well as which statements were ranked higher or lower in each factor compared to their ranks within the other factors. As such, the entire configuration was reviewed with every statement engaged with at least once (Watts and Stenner 2012, Chapter 7).

3. Results

Throughout this section, we have referenced the relevant statements from the Q-Set when appropriate. These are represented in brackets with the formula S*XX* where "S" stands for "Statement" and "XX" represents the relevant statement number. We have also included demonstrative quotes from the participants where appropriate.

3.1. Factor 1 – "beaver-accepting"

This factor had an eigenvalue of 3.9971 and two respondents define this factor: participants 4 and 11.

The anglers loaded onto this factor viewed fishing as an opportunity to engage with nature and the wider ecosystem.

> "Fishing is a channel to get in touch with nature." (Participant 4)

There appeared to be a sense of responsibility to look after the environment and angling was viewed as an avenue to monitor the health of it. They felt that the majority of anglers contributed toward the conservation of nature (S13).

> Fishermen are those on the ground. Some say that we don't need fishermen but we do as they are the ones that see what's going on. (Participant 11)

> [Regarding Statement 13] Some do, others don't; others just fish. (Participant 11)

These anglers strongly agreed that beavers should be in Great Britain (S32), particularly due to potential benefits for biodiversity (S9) and habitat creation (S34).

> I have strong feelings about the potential for biodiversity increase. Beavers should be part of the landscape. (Participant 4)

They agreed more than the other factors that beavers would create new fish spawning habitats (S31) and that their presence would lead to a greater diversity of fish (S37). They also felt that beavers were not intimidating (S23) and agreed that seeing them was a positive experience (S17).

> Beavers on the Otter have hugely increased my pleasure in fishing. They are a privilege to see. (Participant 4)

These respondents were less concerned about possible negative impacts of beavers, including less agreement with statements referring to beavers leading to a reduction in fish size (S15) or leading to changes in where they fished (S10). These respondents were more uncertain as to whether beaver dams would obstruct fish migration (S12), but were less concerned about this than the anglers on the other factors and felt that, on the whole, beavers would be beneficial for fish.

> I feel strongly that, on the catchment-scale, beavers will be beneficial to fishing. (Participant 4)

These respondents agreed more that if there were negative impacts there is a sufficient toolbox of management techniques with which to be able to respond to them (S1) and if their fishing activity was negatively affected they would be more willing to accept it due to wider ecosystem benefits of beavers.

> I fish a lot. If there is some negative impact on fishing due to beavers, that is a price I am willing to pay. (Participant 4)

3.2. Factor 2 – "beaver-apprehensive"

This factor had an Eigenvalue of 1.2843 and two respondents define this factor: participants 1 and 2

The anglers loaded onto this factor were very passionate about their fishing activity and viewed it as an important tradition.

> I would include something about the tradition of fishing. (Participant 1)

They strongly agreed that their quality of life relied upon fishing (S33) and that the activity was beneficial toward both mental and physical health (S18, S28).

> I think it is worth adding that one syndicate member is recovering from cancer and has said that the prospect of fishing in future was one of the things that gave him the strength to cope and fight on. (Participant 1)

> Fishing gives me a great sense of freedom. (Participant 1)

These respondents also felt more strongly than anglers associated with other factors that anglers contributed toward the conservation of nature (S32).

Anglers of this factor were more skeptical about the possible benefits of beaver reintroduction compared to the other factors. In particular, respondents strongly disagreed that beavers create spawning habitats (S31), led to a greater diversity in fish (S37) or create new places to fish (S46) and strongly agreed that beaver dams would obstruct fish migration (S12).

> Pools behind dams are not good fishing spots. (Participant 1)

> Beavers might reduce habitats as well. (Participant 1)

> [Regarding Statement 12] This is the most important factor. (Participant 1)

These respondents were apprehensive about beaver reintroduction and nervous of its implications, and they agreed more so than the other factors that the science of the relationship between beavers and fish is unclear (S41).

> We are in a different situation to elsewhere. The impact on England's rivers is unknown. (Participant 1)

> It is opening a door without knowing what's coming through it. (Participant 1)

Beaver reintroduction was viewed as something that is likely to challenge their fishing activity and they were unwilling to accept that.

> I believe fishing has the right to continue. (Participant 1)

These participants agreed more than the others that there would be conflict between anglers and beaver-watchers (S26) and they felt that beavers or their impacts would require managing, but had reservations about what management may look like. Respondents of this factor agreed less than the others that there was a sufficient toolbox of management techniques (S1) and that it is clear who would be responsible for funding beaver management (S36), and agreed more than the other factors that legal protection of beavers would make it difficult to manage negative beaver impacts (S24).

> Who will manage the negative impacts? (Participant 1)

> We definitely need to be able to control them if they get too many. (Participant 2)

3.3. *Factor 3 – "managed-beaver"*

This factor had an Eigenvalue of 0.3577 and three respondents define this factor: participants 7, 9 and 10.

The respondents loaded onto this factor exhibited a hybridization of traits associated with the other two factors. Similar to Factor 2, these respondents strongly agreed that their quality of life relied upon fishing (S33) and felt strongly that it contributed toward their physical and mental health (S18, S28).

> [Regarding Statement 33] This is top of the list. (Participant 9)

However, this group agreed more than Factor 2 and more similarly to Factor 1 that beavers should be in Great Britain (S32) and that they would increase river biodiversity (S9).

> I consider them [beavers] a species which should be there. (Participant 7)

These respondents were less concerned about negative impacts on fishing, agreeing quite strongly that beavers would create habitat for fish spawning (S31) and disagreeing that they would reduce fish size (S15) or numbers of commercially important fish (S35), but they were uncertain about the potential impact of beaver dams upon fish migration (S12).

> I'd welcome research on fish migration. (Participant 10)

What characterized this factor was a favorable view upon beavers, but with a firm view on a need to be able to manage beavers. These respondents felt that bureaucratic processes would make it difficult to manage the negative impacts (S8) and that it is unclear who would be responsible for management funding (S36), but there was a feeling of a need to be in control, including the need to respond if there is a barrier to fish migration.

> The more [beavers] the merrier. Let them spread, provided there's some control of barriers for migrating fish. (Participant 7)

> It's our job to control nature as we don't have a choice. If we don't, we could end up with horrendous situations which we can't control. (Participant 7)

4. Discussion

Although members of the fishing community are often cited as having more negative views of beavers and their reintroduction than other people may hold, our research appears to indicate that opinion within the context of this specific community can in fact be much more nuanced and diverse. This is similar to how the national survey illustrated differences in whether respondents supported the process of beaver reintroduction amongst those who identified their occupation as within "Fisheries & Aquaculture" or had heard about the survey from a "Fishing Organization" (see Section 1) (Auster, Puttock, and Brazier 2020). With this Q-Method study we found the existence of three distinct perspectives, two of which appeared to contrast with one

another and a third which exhibited some similarities with both of the other two. (It is also possible that further factors may emerge if the participant pool were to be expanded, to which the four respondents who did not load onto a factor may associate with.)

The "*beaver-accepting"* and "*beaver-apprehensive*" anglers in particular exhibited differences in their perspectives with little commonality between the factors, and notably they held different levels of agreement with the view that beavers should be in Great Britain (S32). Thus, there is a potential risk of conflict between these groups. This is exemplified in additional comments from respondents made during the post-Q-Sort interview. A *"beaver-accepting"* participant stated: "I find it very annoying that certain anglers have already made up their minds that beavers will have a negative impact on fishing. It's not a helpful position to take. I think there is probably, in fact, a strong core of anglers who are willing to accept beavers" (as is perhaps evidenced in Auster, Puttock, and Brazier 2020). Meanwhile, a *"beaver-apprehensive"* respondent stated: "Do-gooders can be antagonistic. They want to impose their own views. Activists would stop the removal of beavers if they could." Thus, subsequent decision-making will need to consider these perspectives in the development of a management strategy least likely to cause conflicts. Meanwhile, *"managed-beaver"* participants were observed to be accepting of the potential of beavers, however, they exemplified a need to feel that they (or someone) would be "in control".

Therefore, we suggest key elements of each perspective that will need to be taken forwards for consideration in management decisions where beavers are reintroduced: for *"beaver-accepting"* anglers, the potential opportunities that beavers may pose for biodiversity and ecosystems; for *"beaver-apprehensive"* anglers, the protection of the tradition, right and ability to fish; for *"managed-beaver"* anglers, the ability to manage potential negative impacts caused by beavers. To address these elements as a collective may be challenging, particularly as reintroduction projects bring together stakeholders with differing values who may present the nature of the interactions between people and the reintroduced species in a manner consistent with their respective agendas (Hill 2015). For example, the white-tailed sea eagle (*Haliaeetus albicilla*) was reintroduced to a national park in Ireland and there were observed tensions between farmers who perceived the eagles as a "threat" to rural living and feared predation upon lambs, and conservationists who emphasized the eagle's potential in ecotourism and its feeding on fish and carrion (O'Rourke 2014). However, we propose two particular themes which may go some way toward meeting this objective in the case of beaver reintroduction and angling in England, beyond continuing scientific research into the relationships between beavers and fish, if the reintroduction in England is to continue.

Firstly, we propose that information about the impacts of beaver reintroduction is accessible and that there is an open forum for discussion. This will enable anglers to gain a deeper understanding of the subject and learn from one another of their experiences. We include within this the sharing of scientific findings from ongoing research into the relationship between beavers and fish, as this will be important to address the concerns of the *"beaver-apprehensive"* anglers, who agreed more than the other factors that "the science of the relationship between beavers and fish is unclear" (S41). In particular, the ongoing research into beaver dams and fish migration (such as recent European discussions in Bylak and Kukuła 2018 and Malison and Halley 2020) will need to be communicated, as this was one of the particular aspects about which there was most uncertainty (S12). We further propose this should be accompanied with

scientific information about the relationship between beavers and other variables such as biodiversity and ecosystems, as this will reassure the "*beaver-accepting*" anglers that the potential benefits of beavers are being recognized. Additionally, information about what support is available if there are negative impacts which may require management should also be accessible, which will be of particular interest to the *"managed-beaver"* anglers. Such an approach has similarly been advocated by Lynch *et al*. (2017) to address management and conservation issues in North American inland fisheries. Resulting from a "grand challenges" exercise with a group of disciplinary experts, they suggest that strategies to improve science-policy communication would provide greater involvement of the public and effective communication of science may help minimize the potential for conflict between social groups. They advise cross-sectoral communication and highlight the need for an understanding of both ecosystem processes and the management goals of the fisheries sector. They then propose the establishment of a centralized research data sharing framework to integrate cross-sectoral management and research efforts (Lynch *et al*. 2017).

However, it is important to recognize that the priorities in the identified factors are value-laden (e.g. the "beaver-accepting" group prioritized wider biodiversity, whereas the "beaver-apprehensive" group valued tradition and ability to fish). Value-laden conflicts can be difficult to overcome (O'Rourke 2014); an availability of information may not necessarily influence attitudes when values are held most deeply (Elliott 2019; Treves and Santiago-Ávila 2020), and information can be presented by individuals or groups in a way that is consistent with their own values, as observed in the case of the white-tailed sea eagles (O'Rourke 2014). As such, some disagreement may always be inevitable, but we believe that where it persists a recognition of how people understand and interpret the situation through the suggested discussion forum would help to facilitate decisions that can distinguish between evidence and ethical judgments, leading to more equitable outcomes (Stirling 2010; Crowley, Hinchliffe, and McDonald 2017a; Elliott 2019; Treves and Santiago-Ávila 2020).

This leads us to our second and arguably more important theme: we propose that management decisions will need to enable a sense of empowerment for individuals. Empowerment within wildlife management has been recognized in the human-wildlife conflict literature as a factor which may contribute toward long–term solutions for conflict resolution (Linnell *et al*. 2010; Redpath, Bhatia, and Young 2015; Dubois *et al*. 2017). In the context of beavers and anglers, the aforementioned communication may contribute toward this empowerment goal to some degree. Of particular note however, the *"beaver-apprehensive"* and the *"managed-beaver"* anglers (with whom the need to manage beavers particularly resonated) agreed that bureaucratic processes would make it difficult to manage negative beaver impacts (S8). Thus, we propose that a simplified route toward managing potential negative impacts of beavers with minimal bureaucracy or administrative procedures could provide a sense of empowerment and go some way to reducing potential conflicts. As an example, in Bavaria, two state-employed Beaver Managers oversee a trained team of volunteer Beaver Wardens who are spread throughout the state (and contactable through a central register). These wardens will rapidly respond to concerns raised and work with the affected parties to determine any necessary action to be taken (Campbell-Palmer *et al.* 2016, 112). However, the same management structure will also need to support the benefits for biodiversity and ecosystems in order to prevent the potential for conflicts with the *"beaver-accepting"* anglers and other non-angler groups who may similarly hold more positive views of the impacts of beavers. We suggest that the basis for such a

management strategy exists in "*The Eurasian Beaver Handbook: Ecology and Management of Castor fiber"* (Campbell-Palmer *et al*. 2016) and that the pragmatic approaches therein should be reflected in any future beaver management framework.

5. Summary

In summary, we found that the perspectives held by anglers are diverse: for *"beaver-accepting"* anglers the potential biodiversity and ecosystem benefits were of high importance; for *"beaver-apprehensive"* anglers the tradition and health benefits of fishing were viewed as of high importance and beaver reintroduction was viewed as something which may affect the ability of fishing to continue; *"managed-beaver"* anglers exhibited a hybrid of these values, believing in the benefits of fishing for their quality of life whilst being supportive of beaver reintroduction, provided that there is the ability to manage potential negative impacts. As there is the potential for conflict between these groups where beaver reintroduction occurs, we propose that these perspectives will need to be factored into possible beaver management decisions. We suggest that an open dialogue about the scientific research about beavers and fish, their effects on the wider ecosystem and how beavers can be managed will go some way toward reducing the potential for future conflicts. We exemplify this approach ourselves by ensuring that all beaver research papers that we have produced are available open-access to all (Puttock *et al*. 2015; Puttock *et al*. 2017, Campbell-Palmer *et al*. 2018; Puttock *et al*. 2018, Auster, Puttock, and Brazier 2020; Graham *et al*. 2020). Even more-so, we argue that a management strategy which supports the possible biodiversity and ecosystem benefits of beaver reintroduction whilst providing a sense of empowerment to respond to possible negative impacts could help to reduce potential future conflict risks.

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Supplemental data

Supplemental data for this article can be accessed here.

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Data availability statement

The completed participant Q-Sort configurations are available publicly in the University of Exeter CREWW GitHub repository, online at: https://github.com/exeter-creww/Participant-Q-Sort-Configurations_Auster-Brazier-Barr_Angling-Perceptions-and-Beavers (University of Exeter CREWW GitHub 2019).

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