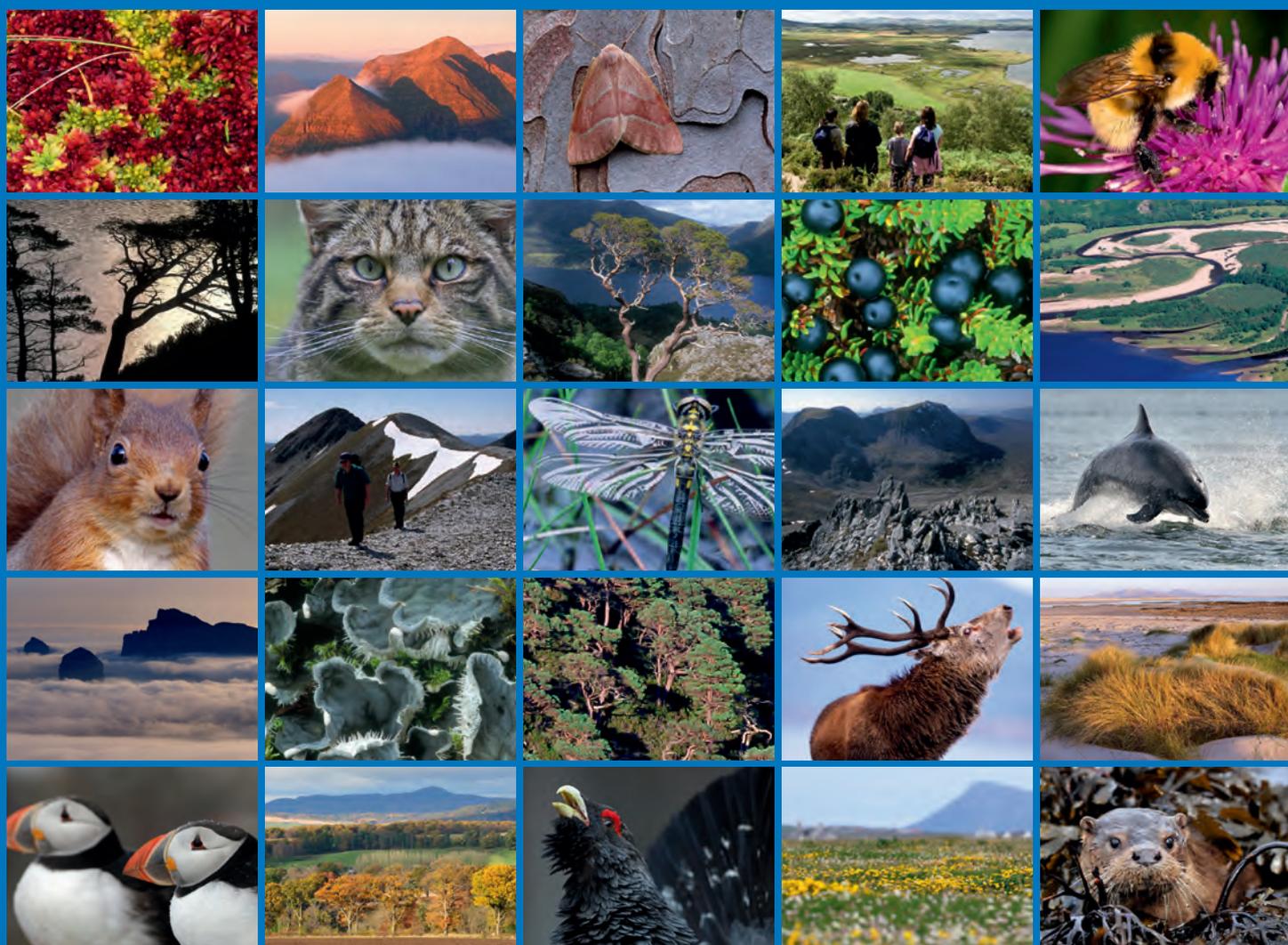


# The Scottish Beaver Trial: Socio-economic monitoring, final report





**Scottish Natural Heritage**  
**Dualchas Nàdair na h-Alba**

All of nature for all of Scotland  
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# COMMISSIONED REPORT

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**Commissioned Report No. 799**

## **The Scottish Beaver Trial: Socio-economic monitoring, final report**

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## COMMISSIONED REPORT

# Summary

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## The Scottish Beaver Trial: Socio-economic monitoring, final report

**Commissioned Report No. 799**

**Project No: 7062**

**Contractor: Scotland's Rural College (SRUC)**

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### **Keywords**

Beaver; monitoring; Knapdale; Scottish Beaver Trial; socio-economic.

### **Background**

In May 2008, the Scottish Government licensed a trial reintroduction of European beavers (*Castor fiber*) to Knapdale Forest, mid-Argyll. The first animals were caught in Norway in 2008, quarantined for six months and released in spring 2009. The Scottish Beaver Trial (SBT) ended in May 2014, and this report is the final output of the socio-economic monitoring. The work has been undertaken independently by researchers at Scotland's Rural College (SRUC). It follows initial and interim reports that outlined the commonly used methodologies that could be used for a socio-economic assessment of reintroductions.

This report focuses on discernible benefits associated with beavers during the full SBT period, and these include impacts on:

- 1) Local business activity;
- 2) Site visitors and public talks;
- 3) Educational value;
- 4) Volunteering;
- 5) Media coverage and stakeholder perceptions; and
- 6) Non-use value.

We compare these to discernible costs associated with beavers' activity at Knapdale, such as damage to forestry. We also consider the administration costs associated with the SBT. As this is a trial rather than a full reintroduction, we can expect the specific economic effects to be more limited relative to what may happen in the event of a wider reintroduction.

### **Main findings**

#### Benefits

- *Local business activity*: we found no reported negative impacts to recruitment or turnover as a result of the trial. However, there is little evidence of increases in recruitment as a result of the trial, and positive impacts on turnover appear to be modest: respondents to the 2014 survey reported a mean additional annual turnover of under £3,000. Local tourist and retail operators are generally favourable in their assessment of the local and regional added-value of the trial.

- *Site visitors and public talks:* between May 2008 and May 2014, over 32,000 members of the general public, school students, higher education students and society members were involved in various activities held by SBT staff. The number of guided walks is used as a proxy for “wildlife experiences”, and these are calculated to have a value of between £355,000 and £520,000.
- *Educational value:* we estimate an educational value of approximately £56,000 by considering the resource investment costs of the equivalent time spent on educational activities by both primary and secondary schools. This value does not reveal the longer term benefit of ecological knowledge and the possible impacts of pro-social and environmental behaviours. As such the value is highly conservative.
- *Volunteering:* between July 2012 and December 2013, Scottish Wildlife Trust (SWT) staff recorded 3,882 volunteer hours. During this period, 42 individuals volunteered to assist staff with beaver tracking/monitoring, and help with public events. Assuming a similar level of activity throughout the duration of the trial, we estimate the value of volunteering to be at least £84,000.
- *Media coverage and stakeholder perceptions:* the SBT has generated a high level of media interest that has been instrumental in forming wider public opinion about the merits and demerits of the reintroduction. Local businesses acknowledged the role of the media coverage, but many stated that it had not impacted directly on visitors. Stakeholder interviews found evidence of concerns about the consultation process and independence of the SBT.
- *Non-use value:* the SBT is associated with an element of value related to mere existence of a species, and this ‘non-use value’ associated with the reintroduction of a charismatic species might be significant, even in a trial context. Evidence is contested, and we have suggested a wide range of possible monetary values for this benefit category.

### Costs

- *Ecosystem disservices:* The negative impacts of beaver activity include possible damage to woodland, roads and fisheries. Estimates of monetary costs related to these ecosystem disservices are uncertain for the SBT, and we have suggested a range of possible values.
- *Administration costs:* These relate to beaver capture and quarantine, to scientific monitoring, to general administration and education costs. For the seven years between 2008 and 2015, these are estimated to total at least £2 million.

### Future reintroduction scenarios

- In a post-trial period, administration costs would be significantly reduced, whereas benefits could likely be sustained at Knapdale. In a limited release scenario, it may be possible that Knapdale retains its status as a pioneer site with a head-start on visitor infrastructures and an advantage in terms of marketing. Part of this status may depend on local businesses taking decisions to invest in their own facilities and marketing.
- In the event of a wider release, the balance of impacts would fundamentally depend on the characteristics of each site. For example, where beavers are active in the vicinity of agricultural land they can cause localised damage. On the other hand, beavers are associated with many ecosystem benefits, such as sediment control and flood regulation.

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## **LIST OF ABBREVIATIONS**

ESF	Ecosystem Services Framework
FCS	Forestry Commission Scotland
MEA	Millennium Ecosystem Assessment
NEA	National Ecosystem Assessment
NGO	Non-Governmental Organisation
NUV	Non-use value
RZSS	Royal Zoological Society of Scotland
SBT	Scottish Beaver Trial
SNH	Scottish Natural Heritage
SRUC	Scotland's Rural College
SWT	Scottish Wildlife Trust
WTP	Willingness to pay

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## 1. INTRODUCTION

This report represents the final output of the socio-economic component of the Knapdale-based Scottish Beaver Trial (SBT). The report follows initial<sup>1</sup> and interim reports that outlined the objectives of a socio-economic evaluation and the methodological approaches that can be used to evaluate the benefits and costs of a reintroduction. The study has been undertaken by researchers in the Land Economy, Environment and Society research group as SRUC (formerly the Scottish Agricultural College, SAC), and forms part of a suite of technical studies being developed to provide an evidence base to inform policy on any general reintroduction of beavers to Scotland.

The key objective of this socio-economic evaluation is to identify baseline information prior to the start of the beaver trial, and to consider socio-economic activity above or additional to this baseline that can be wholly or partly attributable to the trial. The baseline represents a trajectory of what we estimate would have happened in the absence of the trial. To this end a number of key metrics are identified to be explored using a range of approaches, with the objective of:

- Characterising the level of economic activity in the Knapdale area before release (the 'status quo ante');
- Determining the additional positive and/or negative impacts on economic activity in the area as a result of the beavers; and
- Exploring the environmental, educational and cultural opportunities arising from the trial itself, and the scope for these opportunities in the event of a wider reintroduction.

Though more specific to the socio-economic part of the trial evaluation, these objectives are consistent with the more general aims for all scientific final reports for the SBT, which are to provide:

- A broad overview of the changes observed throughout the whole trial period from the first surveys through to the final surveys;
- An examination of how the observations and experience at Knapdale compare and contrast with beaver effects observed elsewhere (e.g. Europe and North America);
- A forward look at possible future changes at Knapdale, which may continue to take place in the short (approximately five years) and long term. This will be based on expert judgement, with areas of uncertainty set out; and
- A forward look at possible implications for wider beaver reintroductions in Scotland in the long term. This will be based on expert judgement, with areas of uncertainty set out.

We do not repeat all of the information in the initial report, which provides the methodological basis for our work described here. This final report is organised as follows: **Section one** provides a brief background to the beaver trial and considers some of the methodological approaches available for measuring net socio-economic impacts (i.e. benefits minus costs), as recommended by government appraisal guidance. The section also briefly summarises some of the international literature on species reintroductions as a basis for understanding and comparing the valuation information presented later in the report. **Section two**

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<sup>1</sup> Moran, D. & Hanley-Nickolls, R. 2012. The Scottish Beaver Trial: Socio-economic monitoring – First report 2011. *Scottish Natural Heritage Commissioned Report No. 482*. [http://www.snh.org.uk/pdfs/publications/commissioned\\_reports/482.pdf](http://www.snh.org.uk/pdfs/publications/commissioned_reports/482.pdf)

considers the data sources and other information used to develop a picture of the trial's benefits. **Section three** considers the data sources and other information used to develop a picture of the trial's costs. **Section four** compares benefits and costs, and comments upon reintroduction scenarios for Knapdale (and elsewhere in Scotland).

## **1.1 Background to the Scottish Beaver Trial**

In May 2008, the Scottish Government licensed a trial reintroduction of European beaver (*Castor fiber*) to Knapdale Forest, mid-Argyll. The licence was granted to the Scottish Wildlife Trust (SWT) and the Royal Zoological Society of Scotland (RZSS). The trial site is managed by Forestry Commission Scotland (FCS). The first beavers were caught in Norway in 2008, quarantined for six months and released in spring 2009. The trial period ended in May 2014.

A condition of the licence stipulated that Scottish Natural Heritage (SNH) coordinate the independent scientific monitoring of the trial. This report forms part of the socio-economic monitoring. The other scientific monitoring comprises beaver and riparian mammals; fish; odonata; woodland; macrophytes/loch ecology; hydrology; river habitat/geomorphology; water chemistry; animal health; public health; and scheduled monuments. Data are currently being analysed, and a synthesis report will be produced and handed over by SNH to the Scottish Government in May 2015.

Since the commencement of the SBT at Knapdale, a population of beavers has become established in Tayside. This Tayside population is the subject of a separate study, including its socio-economic impacts.

## **1.2 Defining socio-economic impacts**

A reintroduction can result in ecological, economic and social impacts that affect human wellbeing in both positive and negative ways. Some of these impacts might be obvious – e.g. job creation and tourism activity. Others, such as non-use values (NUV) related to the mere existence of the animals, can be more contentious.

A socio-economic evaluation of a reintroduction should involve two stages of analysis:

- 1) Identification of relevant changes against a baseline of no trial; and
- 2) Conversion of these changes into monetary values that allow a calculation of overall benefits and costs of the trial.

As far as possible, these should be totalled to provide a clear view of the net benefits (or costs) to society, and this information should be provided to the ultimate decision maker(s). Such evaluations are challenging because it is often difficult to exhaustively characterise the baseline conditions. Perhaps most importantly, a single - typically monetary - metric may not provide an unambiguous basis for such an evaluation. Note also that some of the impacts are incurred by private agents, while others accrue to society more generally.

The evaluation must also go beyond the calculation of net impacts, to consider the actual incidence or distribution of costs and benefits (e.g. on local people versus wider society): it is not enough to state that a release provides a social net benefit. This distributional issue takes the analysis into the more subjective terrain of fairness and equity, and will not be considered in any detail in this report.

Wellbeing impacts related to environmental change have recently been formalised, albeit conceptually, using the Ecosystem Services Framework (ESF). This is an analytical framework that has been promoted in the Millennium Ecosystem Assessment (2005), and

which has guided the development of the UK National Ecosystem Assessment (2011). The terminology of the ESF provides a categorisation of benefits based on the relationship between ecosystem functions and related services they generate: provisioning, regulating, supporting and cultural. These services are deemed to influence the constituents of human wellbeing in different ways, including human security (e.g. personal safety); basic material for a good life (e.g. nutritious food and shelter); health (e.g. access to clean air and water); and good social relations (e.g. social cohesion) - see Figure A1 in Annex 1 for further information.

While all-encompassing in ambition, the ESF requires pragmatism and judgement in its focussed application to specific ecosystem changes engendered by a reintroduction. This exercise should identify the relevant subset of the more significant ecosystem services, and recognise that some impacts cannot be easily quantified and valued. For example, a release may occasion some ecosystem changes that are not identifiably damaging or beneficial in ecological terms and therefore do not warrant quantification or valuation.

In the Knapdale case, relevant data on changes can be drawn from other parts of the scientific evaluation – e.g. water quality or forest conditions. More obvious market impacts relate to the levels of economic activity and site visitation. The release also engenders non-market impacts, in particular due to NUV - see Figure A2 in Annex 1. The concept of NUV is generally accepted as legitimate, though is contested in terms of measurement. Data collection on the effects of the release has coincided with an SNH-funded PhD on reintroduced species, which has considered some of the non-market values of reintroductions. This analysis is available to inform this element of trial, though at the time of writing (October 2014), this thesis is incomplete.

### **1.3 Measuring socio-economic impacts**

Measurement of socio-economic impacts needs to be undertaken within a spatial scale that defines the relevant extent of economic impacts and the linkages within that area and outward into the broader economic region. This spatial distinction has a bearing on the potential analytical approaches and specifically the choice between top-down versus bottom-up approaches.

A bottom-up approach derives relevant evidence on impact (to employment, incomes and spending) from surveys conducted with key businesses in the project area. These surveys typically try to establish baseline intentions, before considering how local businesses have made hiring and spending decisions in the context of detectable impacts related to the release. In the assessment consideration needs to be given to the extent of additionality of the impact relative to what would have happened anyway.

If the scale of the trial has wider (i.e. regional) impacts then a bottom-up approach should be complemented by some top-down analysis. Top-down approaches are more technical and dependent on the existence of regional economic models that estimate the linkages between businesses, and therefore the knock-on or multiplier impacts occasioned when one or more businesses change their level of activity in response to an external stimulus like a visitor attraction. Because such models are not always readily available or up-to-date, a common shortcut in evaluation is to borrow employment or income multipliers from other similar case studies. These multipliers can then be used to calculate the increase in activity for every extra pound spent in the area of the trial.

Given the geographical remoteness of the trial site and its economically marginal location, it is our judgement that the scale of the Knapdale trial is too small for a meaningful top-down approach. That is, the economic signals from the likely levels of additional activity are

unlikely to engender any wider regional impact of the trial. However, using a bottom-up methodology we are able to identify a range of data to estimate impacts.

The exception to this relates to the issue of NUV, which is concerned with the general preferences of wider populations for the existence of a reintroduced species. These values may be considerable and have potentially been amplified by media coverage that extends the population of preference holders to the national level and even beyond. However, their treatment in impact appraisal is contentious and although this study uses evidence, we may need to treat this value category as residual in the sensitivity analysis that compares benefits and costs of the trial and of any potential wider reintroduction.

The discussion in this section is consistent with recommended forms of evaluation set out for central government decisions including environmental appraisal, and other government advice on judging evidence for impact assessments. This includes basing the socio-economic evaluation on the ESF, which offers an alternative interpretation of the way ecological and economic links can be represented when data are available. The important issue is to identify impacts that are linked to human wellbeing. Readers can find further information in HM Treasury's Green Book (HM Treasury 2011a) and Magenta Book (HM Treasury 2011b).

#### **1.4 Further methodological challenges**

As noted in the initial report we are dealing with a trial rather than a full reintroduction and we can therefore expect the specific economic effects to be more limited relative to what may happen in the event of a wider reintroduction. In evaluation terms, the terms of reference for this study are a mix of *ex post* (looking back at what has happened during the SBT) and *ex ante* (looking forward to what might happen in the event of a wider reintroduction programme). Both perspectives are relevant to policy decisions, but the *ex ante* evaluation will necessarily be more subjective. We can, however, set out potential scenarios for a more general reintroduction of beavers to Scotland, and discuss associated costs and benefits.

The trial period has been subject to considerable media scrutiny that significantly biases the *ex post* data, and which therefore informs our *ex ante* evaluation of the potential wider reintroduction. The Knapdale trial has provoked much interest that is unlikely to be sustained under more general release conditions. While indicative of the potential effects, the level of economic activity may not be typical of what might happen as a result of a more general release in Scotland.

#### **1.5 Existing beaver evaluations**

Some existing global literature on the costs and benefits of mammal reintroductions was examined in the initial report. Costs of reintroductions often refer to damages from predator species such as wolves or raptors. Beaver studies typically highlight the costs due to damage to forests and potential perturbation of salmonid fisheries. Management expenditure (e.g. controlled culling) can be added to these costs and more detailed scenarios involving site remediation and compensation can also be envisaged.

Noteworthy qualitative studies include McKinstry and Anderson (1999), which looks at attitudes of land owners in Wyoming. In a large survey of 5,265 private-land managers and 124 public-land managers, primary concerns about beaver damage centred on (in decreasing order of importance) blocked irrigation ditches, girdled timber, blocked culverts, and flooded pastures/roads/crops/timber. Primary benefits mentioned were (again, in decreasing order of importance) elevated water tables, increased riparian vegetation, and increased stock-watering opportunities. Over 45% of private-land managers with beavers on

their property - and all of the public-land managers - displayed an interest in a beaver reintroduction programme, and in more proactive management.

Other studies focus on either the market values associated with releases (e.g. recreation) or the more contentious non-market values (e.g. NUVs). The latter studies are often based on willingness to pay (WTP) values that can vary depending on the nature of the hypothetical market constructed to describe the species' status and potential role in its ecosystem. Clearly some species are more appealing than others and such preferences are reflected in WTP studies that can often report very large aggregate values for certain species, depending on the number of people considered to be affected by the reintroduction.

A study by Campbell et al. (2007) estimates a potential value of a beaver population in Scotland using a survey of companies specialising in wildlife tourism, and utilising a regional multiplier of the associated visit revenue. The analysis is somewhat heroic but indicated a potential input of £1 million per annum to the Argyll economy as a result of such companies including the Knapdale area in their itineraries. The main flaw of the analysis is that companies may not actually offer tours and the regional multiplier is too generous to represent the economic flows for the Argyll economy, which is economically marginal. The study also estimated the possible NUV of the reintroduced population to the Scottish public at £65 million per annum. This is based on the transfer of a WTP study by MacMillan et al (2001) which indicated that people in the Glen Affric and Strathspey areas were willing to pay £67 and £91 respectively (per household per annum) to include a beaver reintroduction with restoration of the Caledonian Pine Forest. Again, the hypothetical nature of this study means that the value may not apply to the Knapdale area. But we can at least compare this value to that derived in section 2.6 of this report.

While informative, none of the aforementioned studies provide a clear template for the trial evaluation. In terms of categorising relevant values associated with beaver populations, a recent study from the USA (Buckley et al. 2011) shows how the ESF might be used to describe the impacts of beavers. More specifically, regulating and supporting services deriving from alterations they cause to ecological structures and processes in the Escalante River basin in Utah (Figure 1).

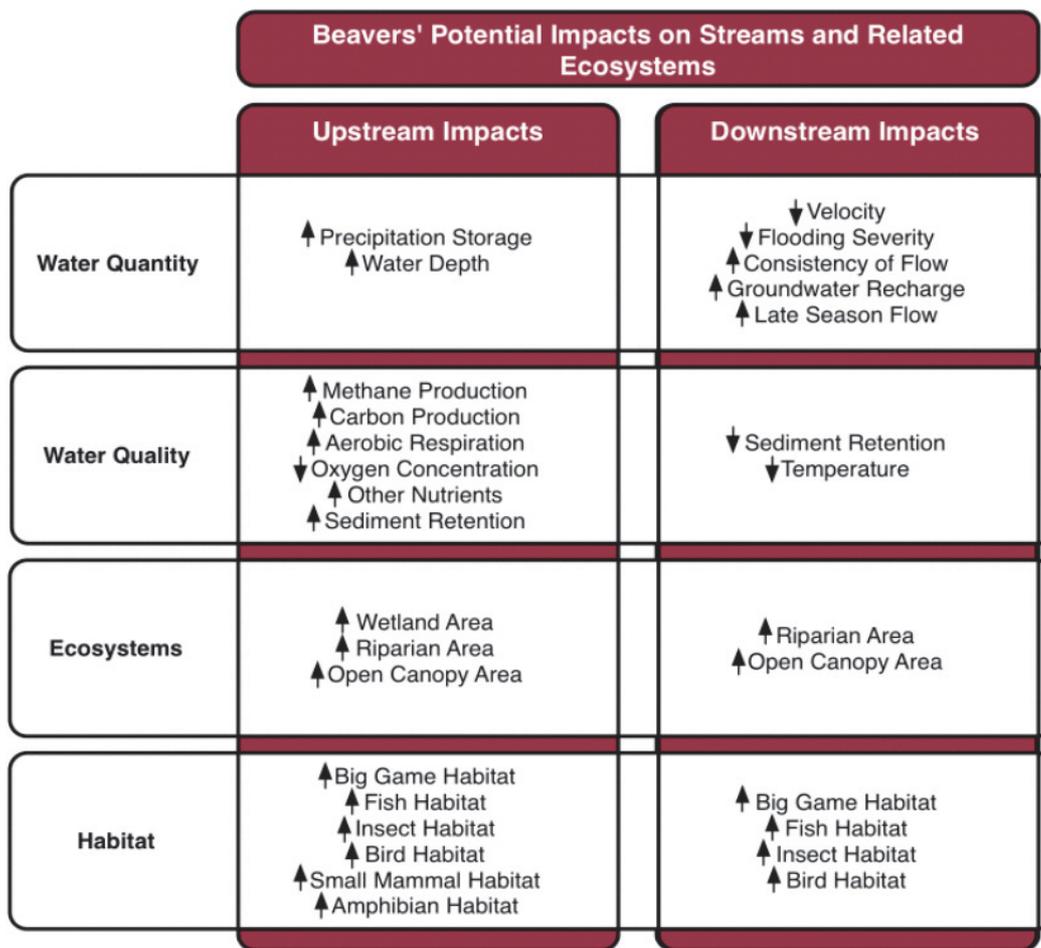


Figure 1. Beavers' potential impacts<sup>2</sup> (Buckley et al. 2011)

The North American beavers (*Castor canadensis*) are different from the Scottish population (*Castor fiber*), and impacts may differ between the two species. Nevertheless, Buckley *et al.*'s predominantly positive evidence accords with evidence from beaver reintroductions across Europe. In Latvia for example, beavers reportedly purify 34 billion m<sup>3</sup> of water a year, which if done artificially would cost in the region of £40 million per annum (Balodis, 1994).

The categories identified by Buckley *et al.* (2011) partly correspond to the scientific studies being conducted for the SBT, and although many of the impacts (e.g. sediment retention, increase in wetland area) are likely to be small in Knapdale, they may be more significant in the event of a wider release. For lack of available information, none of the ecosystem service benefits itemised in Figure 1 are explicitly considered in this report, leading to a likely underestimate of the benefits of the trial. The synthesis report will discuss wider reintroduction scenarios for Scotland, and will draw together evidence from all of the SBT's scientific studies<sup>3</sup>. The ESF will therefore be particularly applicable for the synthesis report.

<sup>2</sup> Note that the arrow direction indicates an increase (up) or reduction (down) in the *impact* of beavers. For instance, it is suggested that beavers mitigate the severity of downstream flooding.

<sup>3</sup> At the time of writing – October 2014 – many of the scientific studies are yet to be published. As stated in section 1.1 the synthesis report will be produced by May 2015.

## 2. DATA ANALYSIS: BENEFITS

In the confined context of the Knapdale trial we have restricted our focus to discernible benefits:

- 1) Local business activity (section 2.1);
- 2) Site visitors and public talks (2.2);
- 3) Educational value (2.3);
- 4) Volunteering (2.4);
- 5) Media coverage and stakeholder perceptions (2.5); and
- 6) Non-use value (2.6).

These categories emphasise the importance of local economic impacts as well as the potential impacts in terms of community development, resilience and social capital. We have analysed various datasets that provide a combination of evidence on the baseline and counterfactual levels of socio-economic activity. Baseline data have been collected from SBT staff to determine levels of economic activity – e.g. visitor numbers and spending.

In terms of the ESF, the categories above mainly relate to cultural services. The other categories of services (provisioning, regulating and supporting) are not explicitly discussed in this section. There are three noteworthy reasons for this. The first is that – as discussed in section 1.2 – we need to identify the relevant subset of the most significant ecosystem services, and recognise that some benefits at Knapdale cannot be easily quantified and valued. The second is that some of the scientific evidence from the SBT is not yet available. Relevant additional evidence will be considered in the synthesis report, and more of the ESF categories will be applicable for wider reintroduction scenarios. The third reason is in order to avoid double-counting of benefits: ecosystem services are linked, and the economic value of beavers' activity (e.g. dam building, habitat creation) is partly captured by many of the categories discussed below.

### 2.1 Local business activity

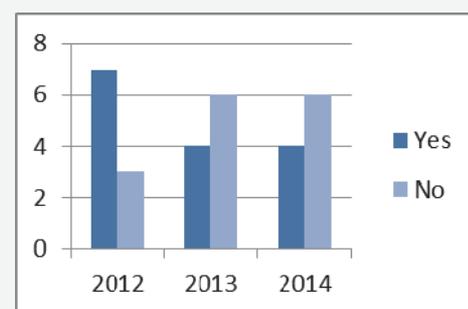
Online surveys targeting local business were conducted in 2012, 2013 and 2014. These surveys revealed qualitative and quantitative information regarding changes in activity levels. Because of the small number of businesses in the Knapdale area it was not possible to use any form of stratification, so the sample is essentially self-selecting. We used a variety of formal and informal contacts to improve the response rate to the online surveys.

The surveys focused on changes in turnover and employment rates. Further questions were included regarding the use of beavers in promotional material, and there was an opportunity to provide qualitative information in relation to more general aspects of the SBT<sup>4</sup>. Since the questions were specific about additional activity, we can legitimately assume this information to be above baseline.

There were a total of 32 independent responses (with 10 businesses completing more than one of the surveys). The majority were accommodation providers, though retailers, tour operators and visitor attraction companies also participated (for full details refer to Annex 3). Most were smaller businesses with an annual turnover below

#### Box 1. Responses to:

Has the trial to date had any discernible impact on your business activity?



<sup>4</sup> Some of this information is presented in section 2.5.

£30,000, though several had higher revenues, some in excess of £100,000 per year. The mean number of staff employed by each business was between three and four full-time, two and five part-time, and three temporary. For each survey, respondents expressed difficulty in identifying additional turnover due to the trial, partly because the period coincided with a more general economic recession, though half believed that the SBT was having a discernible impact on their business (Box 1).

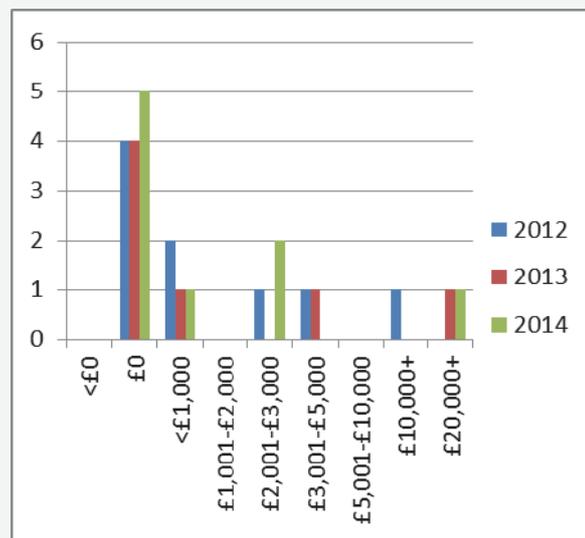
In the first survey in 2012, several participants did not feel that the trial impacted their business positively, with one respondent suggesting that, of all visitors to the area, "...less than 5% were beaver 'stays'." Another said that the beavers' presence, "...put anglers off visiting the lochs". More positively, one respondent believed that although the SBT did not initially motivate visitors to come to the area, "many are interested to see them while they are here."

Many businesses in 2012 indicated no change in turnover (Box 2). Of those who did discern an impact, it was generally below £5,000 (though one respondent reported an increase of over £10,000). Despite the increase in turnover for some of the surveyed businesses, no participants in 2012 had hired more employees or thought that they would need to over the whole trial period.

The majority of participants in the 2013 survey reported no change in turnover, but two estimated an increase of up to £5,000, and one believed that the trial had boosted their revenues by £20,000. Participants had hired no additional employees since the trial began, though two indicated that they may need to employ more staff in the future, albeit temporarily: "Yes I think it opens up a number of opportunities for encouraging people to explore the area for longer and stay extra days."

**Box 2.** Responses to:

To the nearest £1000, can you estimate whether the Beaver trial has increased or decreased your turnover (please indicate £ +/- per annum)?



The final survey, completed in January 2014, showed similar results to the previous years. Despite eight out of 12 participants using the trial to advertise their business, the majority did not report a noticeable increase in the number of "website hits". The majority of participants did not feel that the trial had had any discernible positive impact on their turnover, though three participants indicated an increase of up to £3,000, and – as in the 2013 survey - one respondent believed the trial had increased their annual turnover by at least £20,000. We can therefore roughly approximate the mean additional annual turnover to be £2,833<sup>5</sup>.

A majority of participants in 2014 believed that the trial would affect their business in the future: one respondent stated that there was an, "... increased number of people travelling to area stating that the trial influenced their destination choice". Another, "...expected the trial to increase visitors to my cottages... [Yet] feedback from visitors shows that very few bookings are as a result of the trial and most visitors did not know about the beavers until they arrived here."

<sup>5</sup> This is based upon the nine responses to the 2014 survey. The calculation is (((1 \* £20,000) + (5 \* £0) + (1 \* £500) + (2 \* £2,500)) / 9).

In 2014 one business claimed to have hired temporary staff (1-2 months) due to the beavers' presence, and another noted that they may employ more staff as a result of the trial, though again this would be temporary. Several participants claimed there were effects other than financial as a result of the trial: "No discernible financial impact - although many guests include SBT in their planned visits" and: "[The SBT] does add more use as a destination."

To understand broader stakeholder perceptions of the trial, we asked respondents how positively they viewed the trial in terms of its potential economic contribution to the region. The majority of participants over the three surveys responded between "neutral" and "very favourable". When asked about their response to a wider reintroduction across Scotland, we saw a slight majority of negative responses in 2012, but far more positive responses in 2013 and 2014 (see Box 3).

In summary, the responses to the three surveys showed that any significant turnover increase was confined to a minority of businesses. There has only been a small indication of employment additionality among the sample, with few visitors apparently aware of the trial prior to arriving. It is important to highlight, however, that there was no indication of any significant negative effects on business activity. Participants generally perceived the SBT as having a positive economic contribution to the region over the course of the trial, and most were neutral or favourable with regards to a wider reintroduction of beavers throughout Scotland.

Businesses have also had the opportunity to attend business events that highlighted the potential to harness the SBT site as a tourist attraction. At a beaver tourism event in May 2013, one individual stated that their business had seen, "an estimated 100 extra bed-nights and over £20,000 in extra turnover from 'beaver tourists.'"<sup>6</sup> Event feedback indicated that approximately 40% of attendees believed the SBT had affected their business to date. However, feedback also confirms our own surveys' findings that most visitors only hear of the trial once in the local area<sup>7</sup>.

## 2.2 Site visitors and public talks

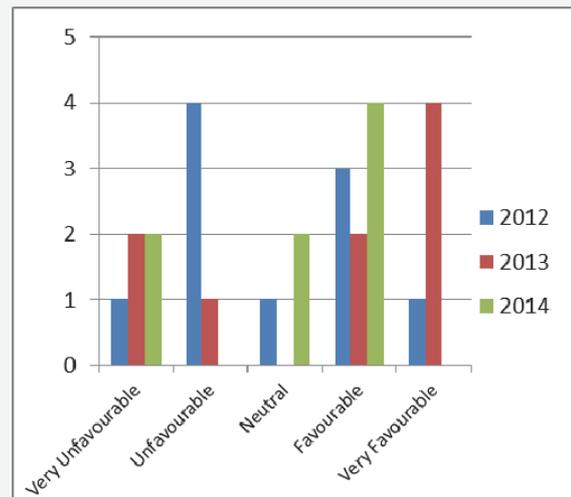
The beavers' presence at the trial site may be a significant attraction for both casual visitors and those specifically motivated to see the beavers' habitat. Again, a considerable amount of this activity is likely to be above the baseline level of visitation and we consider alternative approaches to valuing these additional benefits.

### 2.2.1 Scotland/regional data

Since 2006, Visit Scotland has collected visitor data on an annual basis, and we can use this information to provide one estimate of value that might be assigned to Knapdale trips. The data indicate that the average duration of tourist trips to Scotland has decreased since 2006, but that average expenditure (per person, per night) has increased. Regional data collected

#### Box 3. Responses to:

How would you view a wider reintroduction of beavers across Scotland?



<sup>6</sup> Darren Dobson, owner of Cairnbaan Hotel talking to 'Beaver Tourism Experience' delegates.

<sup>7</sup> Tracy Lambert, Scottish Wildlife Trust. Personal communication.

in the area<sup>8</sup> since 2009 show trends in visitor expenditure per trip (see Figure 2). This is broken down for visitors from within Scotland, other UK visitors and overseas visitors.

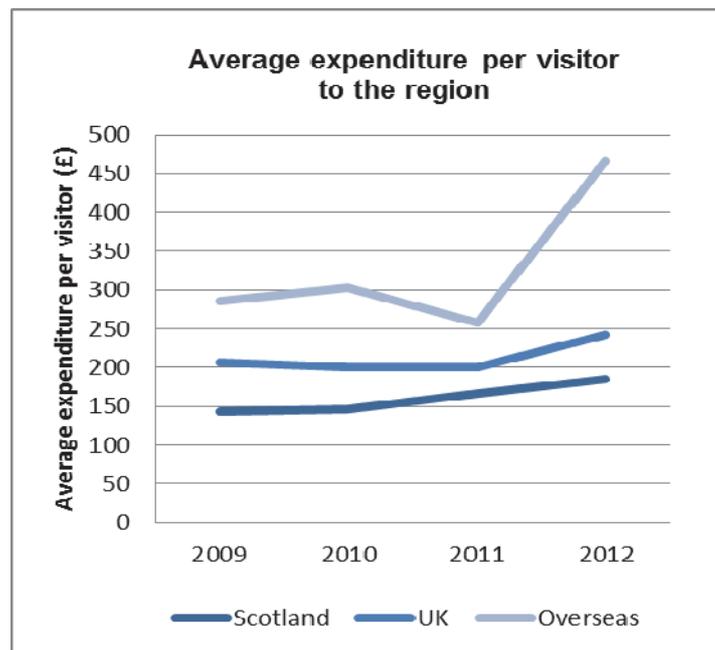


Figure 2. Average expenditure in the region (Visit Scotland, 2012)

In 2012, Scottish, UK and overseas visitors had a mean expenditure per trip of £185, £242 and £467 respectively. The mean number of nights per trip to the region was 3.4 days for those originating from the UK (including Scotland), and 4.7 for those coming from overseas<sup>9</sup>. Using this information we can suggest a lower bound value per visitor day of around £54 (derived as  $185/3.4$ )<sup>10</sup>.

In 2010, a report by Scottish Government Social Research indicated that in 2008, 5.2% of domestic tourists to Scotland were primarily motivated by wildlife watching. Over one million trips, 3.5 million overnight stays and expenditure of £276 million are estimated to be made each year in Scotland, where the primary motivation is wildlife watching (Scottish Government, 2010). This would suggest that more motivated visitors could value a day of wildlife experience at about £79 (derived as  $276m/3.5m$ ).

### 2.2.2 Specialist visits, talks and events

To value visits, we want to distinguish casual visitors to the trial area from those holding specific preferences for beaver experiences. We are keen not to attribute visitor values specifically to the trial when it is clear that many visitors have multiple destinations, and may not previously have known about the beavers at Knapdale.

Staff at SBT have been recording forms of visitor data since the start of the trial. These activities can be considered as entirely additional to baseline, since we assume that there were no such opportunities prior to the reintroduction. Between May 2008 and May 2014, over 32,000 members of the general public, school students, higher education students and society members were involved in various activities held by SBT staff (see Table 1).

<sup>8</sup> Specifically, in the 'Argyll & the Isles, Loch Lomond, the Trossachs and Forth Valley' region.

<sup>9</sup> Data source: Visit Scotland (2012) [http://www.visitscotland.org/research\\_and\\_statistics/regions.aspx](http://www.visitscotland.org/research_and_statistics/regions.aspx)

<sup>10</sup> Overseas visitors' daily expenditure is likely to be much higher, at almost £100 on average ( $467/4.7$ ).

Table 1. Audience for activities coordinated by SBT staff (May 2008 to May 2014)

	Held in Mid-Argyll	Held outside Mid-Argyll	Total
<b>Education session</b>	1,181	6,369	7,550 <sup>11</sup>
<b>Event</b>	4,384	13,968	18,352
<b>Talk</b>	482	3,594	4,076
<b>Teacher training</b>	32	78	110
<b>Walk</b>	2,194	0	2,194
<b>Total</b>	<b>8,273</b>	<b>24,009</b>	<b>32,282</b>

Over 8,000 individuals attended education sessions, events, talks and walks that were held in the Knapdale/Mid-Argyll area. The remaining activities were held in other locations including zoos, parish halls, schools, universities and clubs throughout the UK and Europe.

Teacher training activity comprised six events (total audience of 110) to show teachers how to help students understand biodiversity. For instance, events were held at Edinburgh Zoo and Glasgow Science Festival entitled, “teaching biodiversity with beavers”.

### 2.2.3 Visitor trends at the SBT release site

The 2,194 guided walk attendees had the opportunity to see the beavers’ habitat, plus the possibility of spotting the animals themselves. We suggest that these numbers can be used as a proxy for “wildlife experience” visitation to the site, as individuals have specifically attended to see the beavers.

The area within the trial site was used as a place to walk prior to the SBT. Therefore, we are able to see visitors attending these guided walks (free of charge, donations only) as truly additional, as no such activities were available prior to the release. But it is important to note that this figure is an underestimate because the guided walks were deliberately limited to a maximum number of participants. Furthermore, the data do not account for a large number of casual or “unguided” visitors that arrived at the site at all times of year. We would suggest that a ratio of 1:2 (guided: unguided) would be a very conservative estimate, but this provides us with a basis for valuing visitor scenarios.

Hence, we estimate that 6,582 walks (2,194 guided, 4,388 unguided) were made due to the beavers’ presence, and this is our proxy for “wildlife experience” visitation.

### 2.2.4 Valuing recreational visits

Site visits are a form of revealed preference in the sense that the visitor is effectively giving up time and resources to experience the site, and its value may be partly inferred from what is given up. This is the essence of the travel cost approach, which is often used to value recreational visitation. Under ideal conditions, visitors from alternative locations and

<sup>11</sup> Comprised of 5,308 school students (for a full analysis see section 2.3), 188 children from scouts etc., and 2,054 adults.

spending different amounts of time and money to visit a site reveal a demand curve, which in turn allows us to make an inference about the site's overall value. There are issues with applying this approach to the SBT site, not least that we suspect that few people have travelled significant distances expressly to visit Knapdale, and that meandering visits call into question the rationale of assigning a significant proportion of value to one site<sup>12</sup>.

As an alternative, we can use the visitor expenditure figures previously determined from the Visit Scotland data, combined with relevant (above baseline) visitor data that we can attribute mainly to the trial. Although this is an imprecise estimate of visitor preferences, the approach is nevertheless rooted in more demonstrable market data. For our purposes we infer a range of between £54 and £79 as the approximate daily visitor expenditure, based upon Visit Scotland and Scottish Government data (section 2.2.1). We further infer that a total of 6,582 visitors revealed a preference for wildlife experiences (section 2.2.3). The overall value is therefore estimated to be between £355,000 and £520,000. We note that this is an overstatement insofar as it includes expenditure on goods and services (e.g. food and accommodation) which are valued in their own right.

We also note that the methods of valuation based on visitor expenditure may actually be capturing, and hence double counting, much of the value included under the business turnover (described in section 2.1). To the extent that this is true, we need to be careful not to simply add these two amounts together.

### 2.3 Educational value

Throughout the trial there has been a strong emphasis on education, with field trips to the site, as well as visits to schools from the SBT's staff. The trial has been involved in the education of over 5,300 pupils (Table 2). The education has reached out to 135 schools across Scotland, with events being hosted at Edinburgh Zoo and Aberdeen Science and Technology Festival, as well as within schools and at the beaver release sites in Knapdale.

Table 2. Student audience for activities coordinated by SBT staff (May 2008 to May 2014)

<b>Secondary School students</b>	3,088
<b>Primary School students<sup>13</sup></b>	2,220
<b>Total</b>	<b>5,308</b>

Educational benefits can be considered as a form of social capital, recognised as contributing to social cohesion and the delivery of associated health outcomes (Ferlander, 2007; Lynch *et al.*, 2000).

<sup>12</sup> Furthermore, while the travel cost approach can be relatively precise in the case of approximating a value for one unique attraction, the information is of limited use if the analysis does not account for potential substitute sites (that would exist in the event of a larger reintroduction). Essentially the method can lead to biased site valuations and would be of limited use in inferring the value of sites in the event of any wider release.

<sup>13</sup> This includes 39 pupils from 'mixed' schools (a combination of primary-age and secondary-age children).

Within the UK National Ecosystem Assessment (NEA), some attempt has been made to value these benefits. This is based upon the premise that the time and resources spent on the acquisition of ecological knowledge are a lower bound estimate of their social value. Mourato *et al.* (2010) consider how to value educational benefits as a component of the investment in human capital. We adopt a similar approach, using the Scottish Government's estimates of the cost of students in primary and secondary education. The information does not reveal the benefit of ecological knowledge acquired by the pupils, but provides an indication of the financial outlay for an activity that can contribute to the acquisition of ecological knowledge. The assumption is that the ecological knowledge gained must be at least equivalent to this value.

To undertake this value calculation, a number of assumptions are necessary. The latest figures for total gross expenditure per pupil in primary and secondary schools (2008-09) were used to base the cost of investment approach<sup>14</sup>. Due to the wide distribution of schools selected, the Scottish average data was used and was calculated at £6,665 per pupil per annum for secondary schools and £4,833 for primary schools. Further, in consultation with the SBT education ranger, the average time spent in activities was estimated<sup>15</sup>. The school day was based on an average time spent in Scottish schools (24 hours per week for primary schools, and 27 hours per week for secondary schools)<sup>16</sup>. The number of school days per year was based on the requirement of 380 half-day sessions (190 days in each school year<sup>17</sup>).

The results indicate that the ecological knowledge attained since 2009 through engagement with the trial is currently equivalent to a total investment in excess of £55,000 (Table 3).

*Table 3. Cost of investment results for primary and secondary schools*

	Cost per pupil per day (£)	Cost per pupil per hour (£)	Total education cost of SBT activities (£) <sup>18</sup>
<b>Secondary Schools</b>	35.08	6.50	35,100
<b>Primary Schools</b>	25.44	5.30	20,590
<b>Total</b>			<b>55,690</b>

We are unable assign a monetary value for the use of the educational 'tool packs' that were provided to all local schools. These are available to download from the SBT website, and the topics covered meet Curriculum for Excellence 'experiences and outcomes' for a range of subjects from the early levels through to the fourth level<sup>19</sup>. The exact time spent travelling

<sup>14</sup> The value of teacher time was implicit in the value of student times. <http://www.scotland.gov.uk/Publications/2010/05/11134917/7>

<sup>15</sup> Personal communication with Oly Hemmings. This was an average of 2 hours for a class, talk and event; and 1 hour 45 minutes per walk. We have used 1 hour 45 minutes as our conservative estimate for all activities.

<sup>16</sup> <http://www.educationscotland.gov.uk/parentzone/yourchildatschool/attendingschool/schooldayandtermdates/index.asp>

<sup>17</sup> <http://www.education.gov.uk/schools/pupilsupport/behaviour/attendance/a00216341/advice-on-school-attendance>

<sup>18</sup> For instance, 3,088 secondary school pupils (Table 2) attend for 1 hour 45 minutes at a 'cost' of £6.50 an hour (3,088\*1.75\*6.5 = 35,100).

<sup>19</sup> <http://www.scottishbeavers.org.uk/beaver-facts/learning-zone/>

to events from the school of origin was also not included in the assessment. Therefore, the results of this analysis can be seen as the minimum value of the benefits to those pupils and schools in the region. However, as the SBT activities may have displaced other educational endeavours, these 'cost of investment' results are not fully additional<sup>20</sup>.

Importantly, the analysis is a snapshot based on cost and, like all educational investments, can only be realistically approximated by understanding the present value of the impacts of pro-social and environmental behaviours that cumulate over an individual's lifetime as a result of the initial investment outlay. Educational economists (e.g. Hartog, 2000) frequently advocate such human capital approaches to the valuation of education returns, but the estimation is more tenuous when it comes to measuring returns from positive environmental behaviour (Vila, 2000).

A final educational element, albeit in a more instrumental sense, is the scientific value of the trial itself, which we have not attempted to quantify. Suffice to say that engagement of a range of scientists in the evaluation of a 'live' reintroduction is an infrequent event that will undoubtedly be of use to develop scientific careers and generate research impacts. While scientists have been remunerated by their institutions, it is likely to be the case that most participants will have allocated more time than contractually required.

## 2.4 Volunteering

Between July 2012 and December 2013, 3,882 volunteer hours were recorded for SBT-related work. At least 42 individuals (27 female, 15 male) gave their time to help SBT staff with beaver tracking, monitoring and the organisation of public events.

The latest statistics on volunteering in Argyll & Bute from the Scottish Household Survey (2009-10)<sup>21</sup> indicate that 39% - an estimated 29,000 adults - volunteered formally through an organisation or group, which is well above the national average of 30%. A significantly higher proportion of women volunteered in comparison to men and formal volunteers living in Argyll & Bute contribute 2.5 million hours of help per year, and this is worth £42 million annually to the local economy.

Volunteering is a contributor to, and a symptom of, strong social capital. Some (e.g. Harper and Rutherford, 2013) suggest that rural volunteering can be particularly important in maintaining economic participation in the labour force, and with more general social connections.

The economic literature has explored alternative methods for valuing volunteer time, with a general preference for the replacement cost of volunteer hours (Salamon et al. 2011). A rudimentary replacement calculation can be expressed as: the number of volunteer hours multiplied by an average hourly wage<sup>22</sup>. Using the SBT data (3,882 hours) and assuming the minimum wage (£6.50) suggests a value of £25,233 for this 18-month period. Note that this is an underestimate to the extent that the minimum wage is probably not the appropriate shadow wage rate applicable to skilled or semi-skilled environmental volunteers. We also note that these volunteers are likely to be specifically motivated for this initiative rather than displaced from any notional generic volunteer labour pool: that is, they are additional.

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<sup>20</sup> SBT student activities which have taken place outside of normal school hours will be additional. We do not know the proportion of activities which took place outside of normal school hours.

<sup>21</sup> <http://www.volunteerscotland.net/policy-and-research/data-and-graphs/local-area-profiles/argyll-bute/>

<sup>22</sup> <http://www.volunteering.org.uk/component/gpb/is-there-any-way-of-measuring-the-economic-value-of-the-work-our-volunteers-are-doing>

Extrapolating these data to the whole five-year period of the trial, we can infer an approximate value of volunteering of £84,000<sup>23</sup>. This is based upon the assumption that our volunteering data were replicated during the other years of the trial.

## 2.5 Media coverage and stakeholder perceptions

The SBT has generated a high level of media interest that has been instrumental in forming wider public opinion about the merits and demerits the trial. Here we briefly outline some of the relevant evidence and explore wider qualitative evidence that has been collected from stakeholders. It is important to consider how the media interventions have influenced the profile of the trial and thus render its socio-economic impact atypical. It is equally important to understand the perceptions of stakeholders, and how these have evolved through the trial period, irrespective of economic signals of employment and turnover.

### 2.5.1 Media

Between June and December 2008, press coverage from the trial produced 16,220 column cm<sup>2</sup>, potentially reaching 14,536,452 people via the UK press alone. There were 16 press stories associated with the arrival of Knapdale's beavers to the UK (on 21 November 2008), along with 23 radio and TV broadcasts and coverage on 15 international websites. Between July 2009 and December 2013 there were 32 media items mentioning the SBT, including local news and national wildlife programmes. Significant viewing figures were recorded for Springwatch (4 million) and Autumnwatch (2.9 million).

As mentioned in section 2.1, several businesses reported that media activity may have been a factor in encouraging visitors. Some businesses also identified media coverage as a factor that will influence future visitor numbers: "The fact that the trial has been getting UK wide publicity...has meant that many more people are aware of the area as a holiday destination"<sup>24</sup>. A government report (Scottish Government 2010, page 34) noted the significant influence of wildlife television programmes, which are:

*"...frequently mentioned by wildlife tourists and operators alike... 32% of all visitors claimed that a television or radio programme prompted them to take their trip to a wildlife site, with Springwatch and Autumnwatch being programmes that prompted visits by 15% of visitors, and Coast prompting 14% of visits."*

It is possible that the media impact of the trial may have been slightly attenuated by the coverage of the Tayside beavers, which has been more prominent since 2013. Overall, the level of trial coverage is unlikely to be replicated elsewhere, in the event of a wider release.

### 2.5.2 Stakeholder interviews

In 2012, interviews with landowners and other local stakeholders were conducted anonymously as part of an SNH-funded PhD. These qualitative data can provide additional insights into underlying attitudes towards the trial. The analysis reveals some of the broader socio cultural trade-offs that underpin current preferences for reintroductions and provides insights for future conservation projects. Note however that since the interviews were not repeated, some of the key issues may have been resolved over the course of the trial. For instance, the trial has improved education around beaver ecology.

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<sup>23</sup> £25,233 is the value for the 18-month period. This is equivalent to about £1,400 per month, or £84,000 for the five year (i.e. 60 month) trial period.

<sup>24</sup> SRUC Business survey 2012.

A total of 23 interviewees were engaged. Interviews were semi-structured and were analysed<sup>25</sup> to identify themes across responses and to highlight any trial-related conflicts. The key issues raised relate to the following:

- The place of beavers in the cultural landscape;
- The consultation process and information provided by the trial;
- The trial status of the project; and
- Independence in monitoring and decision making.

Annex 4 contains details of some of the interviews. Concerns raised include beavers' potential impact on fishing communities; a distrust of the outcomes of the pre-trial consultation; whether the trial was necessary given the evidence available in other countries; and SNH's role as independent monitors for the SBT.

## 2.6 Non-use value

In addition to what we might call the 'use values' associated with the beaver trial (as described in sections 2.1 to 2.5), the trial also includes an element of value termed 'non-use value' (NUV). NUV is a significant value category relevant to the social impact of reintroducing a charismatic species, even if in a trial context. It is associated with the mere existence<sup>26</sup> of a species irrespective of any type of direct or indirect use.

Research on NUV is not specific on how this value varies between a restricted presence of an attribute or animal (e.g. in the trial site) versus any wider presence of populations. Aside from this insensitivity to scale, NUVs are often contested since value aggregation needs to make assumptions about the populations holding these values or preferences. Aggregating over large populations, including many people who may hold no demonstrable preferences for the species can lead to large aggregate value, which can overwhelm other benefit categories related to the reintroduction. Moreover, the juxtaposition of these wider benefits with more localised costs is often a consideration for those ultimately taking decisions when NUV is significant. As discussed in section 1.2, issues of fairness and equity may be particularly relevant in the context of NUVs.

As described in section 1.5, there is some evidence of willingness to pay (WTP) from previous studies, but no existing study is exactly applicable to trial conditions, and we have to be judicious in interpreting the existing evidence.

In Scotland, the most recent relevant evidence derives from a choice experiment<sup>27</sup> as part of an SNH-funded PhD. This study is unpublished but indicated that Scottish participants would be willing to pay approximately £56 per household per year in a scenario of a reintroduction of beavers to over 50% of the national territory (i.e. something more significant than the extent of the trial). We have no basis for adjusting this value to fit preferences for the trial and we note that this value is less than that suggested by MacMillan *et al.* (2001) - cited in section 1.5 - which indicated that people in the Glen Affric and Strathspey areas were willing to pay £67 and £91 per household per annum respectively to include a beaver reintroduction alongside restoration of the Caledonian Pine Forest.

Given the difference in scale between the choice experiment scenarios and the trial, it would seem reasonable to test this value in sensitivity analysis. For example, we might test values from £5.60<sup>28</sup> per household up to £56. Similarly we might also test the extent of value

<sup>25</sup> Using NVivo 9 (QSR International, 2011).

<sup>26</sup> Note that NUV also includes bequest and altruism values, as shown in Figure A2 in Annex 1.

<sup>27</sup> Further details on a choice modelling approach are set out in Annex 2.

<sup>28</sup> Sensitivity to scale is uncertain, and we acknowledge that a WTP of £56 for a 50% reintroduction does not necessarily equate to a WTP of £5.60 for a 5% reintroduction.

aggregation - i.e. the population deemed to hold preferences for reintroduction. At the upper limit this population could include all tax paying households in Scotland (2,386,207)<sup>29</sup> or the number of households in Argyll & Bute (40,253), or perhaps half of the households in Argyll & Bute (20,126) – see Table 4. As an alternative we may also wish to limit the population in reference to some kind of behavioural indicators that suggest active interest in the trial. Obvious surrogate “behaviours” could include audiences for relevant TV programmes about the trial, or website hits.

*Table 4. Non-use value estimates of willingness-to-pay for the SBT (annual amounts)*

	<b>2,386,207</b> <b>(all Scottish households)</b>	<b>40,253</b> <b>(Argyll &amp; Bute)</b>	<b>20,126</b> <b>(half of Argyll &amp; Bute households)</b>
<b>£5.60 WTP</b>	£13,362,759	£225,417	£112,706
<b>£30 WTP</b>	£71,586,210	£1,207,590	£603,780
<b>£56 WTP</b>	£133,627,592	£2,254,168	£1,127,056

Table 4 shows the WTP based upon various assumptions, and we suggest a minimum WTP per year of £5.60 for half of the Argyll & Bute households. This means that the minimum NUV is £112,706 per year, or £563,530 for the five-year period to May 2014.

A high estimate for the SBT is unlikely to be £56. We suggest a maximum WTP per year of £30 for each Argyll & Bute household. This equates to a NUV of £1,207,590 per year, or £6,037,950 for the five-year period.

<sup>29</sup> Figures for 2012 from General Register Office for Scotland <http://www.gro-scotland.gov.uk/files2/stats/household-estimates/he-12/j287707/j28770707.htm>

### 3. DATA ANALYSIS: COSTS

Costs estimated here comprise ecosystem disservices (negative impacts) associated with beavers' activity at Knapdale (section 3.1), as well as administration costs associated with the SBT (section 3.2).

#### 3.1 Ecosystem disservices

##### 3.1.1 Woodland and timber

The woodland monitoring for the trial<sup>30</sup> suggests that birch, alder, hazel, ash, rowan and willow are the most prevalent native tree species at the site. There is limited information by which to judge economic losses due to beaver activity (e.g. blocking drainage channels), which has caused flooding in areas containing harvested tree species. Forestry Commission Scotland (FCS) suggest that 1.59 hectares of flooded land is now not utilisable for forest operations and that there has been a level of inconvenience to tree felling and thinning operations within the trial site. An initial estimate of the value of this lost area can be approximated by a calculation of the value of the most likely foregone revenue stream.

This cost can be derived by assuming that the lost area is of some productive value. The UK NEA suggests a value of £68/hectare for softwood production<sup>31</sup>. Thus, an annual cost figure would amount to £108, which if lost for the trial period (and assuming a 3% discount rate) would imply a value of £603. The value in perpetuity (based on the assumption that the 1.59 hectares of land is not available for forestry operations at any point in the future) is £3,604.

Alternatively, an estimate can be derived with reference to ONS<sup>32</sup> data which suggests a volume per hectare (assuming age class 41-60) of 304m<sup>3</sup> and an average stumpage value for conifers sold (2013) of £12.99/m<sup>3</sup>. Together these would suggest a one-off lost output value of £6,279. Even with restocking, this stumpage value would only be available approximately every 50 years, which equates to a value of around £8,200 in perpetuity (assuming a constant 3% discount rate).

Clearly this calculation is important in establishing the extent of possibly the most significant opportunity cost of beaver habitat. Further detailed analysis of the definition of harvestable species and the status of mature stock would be required to test the assumptions underlying these cost estimates. As we note later, this category of costs could be more significant in the event of a wider reintroduction.

##### 3.1.2 Road and other civil engineering costs

FCS report<sup>33</sup> a range of engineering costs attributable to beaver damages that are estimated to have cost up to £38,000:

- Flooding of approximately 400 metres of road, replacement cost between £22,000 and £25,000;
- Improvement of road (height raised to avoid future flooding) to maintain access route, overall cost approximately £5,500 for first section and £7,500 for second section (Lochan Buic).

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<sup>30</sup> <http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1989>

<sup>31</sup> Table 8.12 in chapter 8 of the NEA Technical Report.

<sup>32</sup> Khan, Greene and Wei Hoo. 2013. Office for National Statistics Monetary Valuation of UK Timber Resources <http://www.ons.gov.uk/ons/guide-method/user-guidance/well-being/publications/monetary-valuation-of-uk-timber-resources.pdf>

<sup>33</sup> David Jardine (personal communication). Note that we have separated these impact costs from other reported costs that would come under the administration cost category below.

These costs are generally associated with flooding caused by beaver activity. In this respect, beavers are providing an ecosystem disservice.

### 3.1.3 Fishery impacts

A further concern raised about the reintroduction of beavers was their potential to impact on salmonids by blocking migration and altering water conditions (Kemp *et al.* 2010 Tweed Foundation 2009, Collen 1997, MacDonald *et al.* 1995). The scale of this impact is highly disputed and is currently being reviewed by the Beaver-Salmonid Working Group. At the present time we have no basis for estimating a potential damage cost or benefit.

## 3.2 Administration costs

As described in section 1.1, the SBT was licensed in May 2008. The licence partners (SWT and RZSS) have budgeted costs of almost £1.6 million<sup>34</sup> for the seven year period to 2015, the main elements of which are:

- Beaver capture, quarantine and transport £375k;
- SWT and RZSS staff, equipment and premises £640k;
- Scientific monitoring £180k;
- Management overheads £245k; and
- Interpretation and communication £85k.

The scientific monitoring was led by SNH<sup>35</sup>, and in addition to the £180k contribution mentioned above, there were further contributions of £275k (from SNH) and £176k (various other monitoring partners) towards this work. An Education Ranger was funded by an anonymous third party, and the cost for this was £56k (between 2012 and 2014). Therefore, the overall administration costs of the trial total just over £2m<sup>36</sup>.

It should be noted that this estimate does not include the cost of SNH or FCS staff members' time. It also excludes the cost of the four scientific monitoring projects which were not led by SNH. As such, £2m is a minimum estimate of the costs incurred between 2008 and 2015.

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<sup>34</sup> Estimates correct at time of writing (October 2014). The precise estimate is £1,573,000.

<sup>35</sup> As well as the socio-economic work, SNH are leading the scientific monitoring and reporting of beaver & riparian mammals; fish; odonata; woodland; macrophytes/loch ecology; hydrology; and river habitat/geomorphology. The four which are not SNH-led are i) water chemistry (led by Scottish Environment Protection Agency); ii) animal health (Royal (Dick) School of Veterinary Studies); iii) public health (Argyll & Bute Council); and iv) scheduled monuments (Historic Scotland).

<sup>36</sup> £2,080,000. For more detail see the SBT official website: <http://www.scottishbeavers.org.uk/beaver-facts/beaver-trial-faqs/how-much-will-the-project-cost-and-where-is-the-money-coming-from-2010-10-04/>

## 4. COMPARING COSTS AND BENEFITS

### 4.1 Costs and benefits of the trial

A formal cost-benefit comparison for the trial is not straightforward: many of the categories of costs and benefits do not lend themselves to straightforward monetary valuation. Moreover, as noted throughout this report, the trial assessment only partly reflects what might happen to costs and benefits in the event of a wider reintroduction (in particular in relation to provisioning, regulating and supporting ecosystem services).

As shown in Table 5, quantifiable benefits amount to at least £500,000 without NUV, which, given its uncertain magnitude, we suggest should be treated as a residual value in a sensitivity analysis of benefits. The extent of NUV is clearly important in any cost-benefit calculation. As shown in section 2.6, this value can vary depending on assumptions about the WTP and the relevant population of preference holders.

*Table 5. Summary of estimated monetary benefits for the full trial period (to May 2014)*

Category	Value	Comments
<b>Provisioning, regulating and supporting ecosystem services</b>	Uncertain/partially valued in other categories	We are not able to estimate a monetary value for these impacts
<b>Business turnover (section 2.1)</b>	N/A	Mean additional annual turnover increase of £2,833 per 2014 survey. Excluded in this summary table due to likely double-counting with recreational visitors' expenditure
<b>Recreational visitors (2.2)</b>	£355,000 - £520,000	Based on inferred number of 6,582 visitors since the trial began and regional expenditure data
<b>Educational value (2.3)</b>	£56,000	Educational investment value since the trial began
<b>Volunteer time (2.4)</b>	£84,000	Replacement calculation based on volunteer hours between July 2012 and December 2013. Extrapolated to cover the full trial period
<b>Non-use value (2.6)</b>	£564,000 - £6,038,000	The low estimate of NUV is based upon half the households in Argyll & Bute with a WTP of £5.60 per year. The high estimate is based upon all households in Argyll & Bute with WTP of £30 per year (see Table 4)
<b>Total</b>	Low £1,059,000	High £6,698,000

Costs associated with the trial are shown in Table 6. Uncertainties are noted, as is the fact that in the event of a wider reintroduction, many of the administration costs can be significantly mitigated, or even eliminated. Notwithstanding these caveats, the known costs of the trial might be as high as £2,124,000.

*Table 6. Summary of estimated monetary costs for the full trial period (to May 2014)*

Category	Value	Comments
<b>Woodland and timber (section 3.1.1)</b>	£1,000 - £6,000	Based upon 1.59 hectares of flooded land now unavailable for forest operations
<b>Road and other civil engineering costs (3.1.2)</b>	£35,000 - £38,000	Costs to repair flooding, and mitigate the future risk of flooding
<b>Fishery impacts (3.1.3)</b>	Uncertain	We are not able to estimate a monetary value for this impact
<b>Administration costs (3.2)</b>	£2,080,000	This excludes some staff costs and certain elements of the scientific monitoring. It includes projected costs to 2015
<b>Total</b>	Low £2,116,000	High £2,124,000

In the post-trial period in Knapdale we can expect a significant reduction in the overall project management costs, meaning that benefits are likely to exceed costs in the medium term. The current calculation of lost land (i.e. foregone timber sales in perpetuity) expressed as a present value is likely to be no more than £8,200 and, apart from maintenance and staffing of road and visitor facilities, no other annual cost seems relevant. If the reintroduction were to be confined to the Argyll area, we can expect the relative novelty of animals to be maintained, thereby sustaining the levels of visitation, educational and volunteering benefits. We can also suppose that local businesses will feel more confident to invest in longer-term facilities and marketing, thereby increasing the “honeypot” effect of the site.

#### **4.2 Scenarios for a wider reintroduction**

The SBT only offers a partial guide to what might happen in the event of a wider reintroduction. The levels of some of the benefits identified in relation to a single field trial are likely to be disproportionate to those that can be expected at numerous sites, in the event of a wider reintroduction. Knapdale can potentially maintain the allure and marketing appeal of being the “original” release site<sup>37</sup> and, with the benefit of a head-start, maintain their share of visits. Elsewhere, and depending on location, the level of recreational and educational visits and the volunteering value may all be lower, since Knapdale conditions may not apply to the same extent at substitute sites. In terms of overall benefits, crucial

<sup>37</sup> In a similar way that Loch Garten does for ospreys.

assumptions relate to wider net impacts to ecosystems and NUV. In truth, both are uncertain.

The costs in terms of likely foregone forest revenues and potential damage to agricultural land are likely to be amplified in the event of a wider reintroduction. We can only speculate about the extent of this damage, which largely depends on where the animals are dispersed. It also depends on how populations are monitored and controlled, and the associated management costs. Hence, the variables (and associated uncertainties) need to be quantified at multiple sites. The SNH synthesis report – to be completed by May 2015 – will contain more information.

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## ANNEX 1: ECOSYSTEM SERVICES, WELLBEING AND TOTAL ECONOMIC VALUE

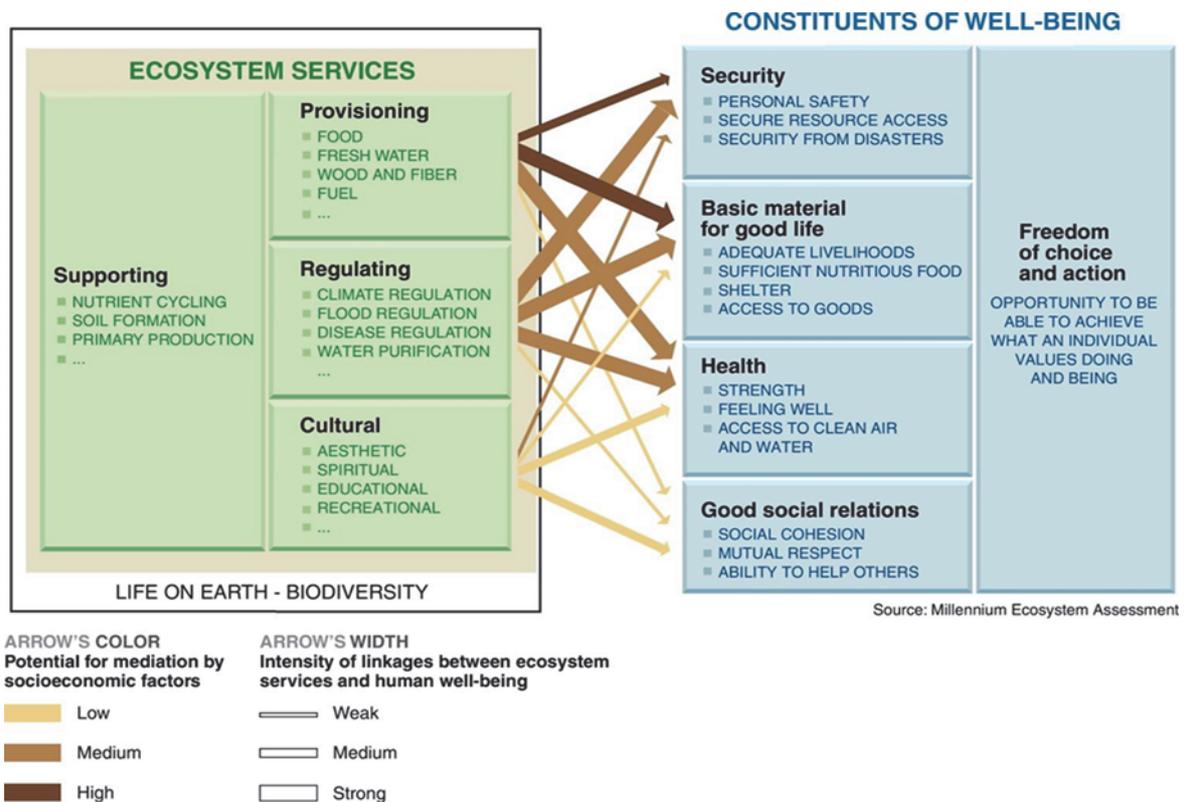


Figure A1. The Millennium Ecosystem Assessment (MEA) analytical framework. The MEA service categories (left) and their links to human wellbeing categories (right). MEA (2005)

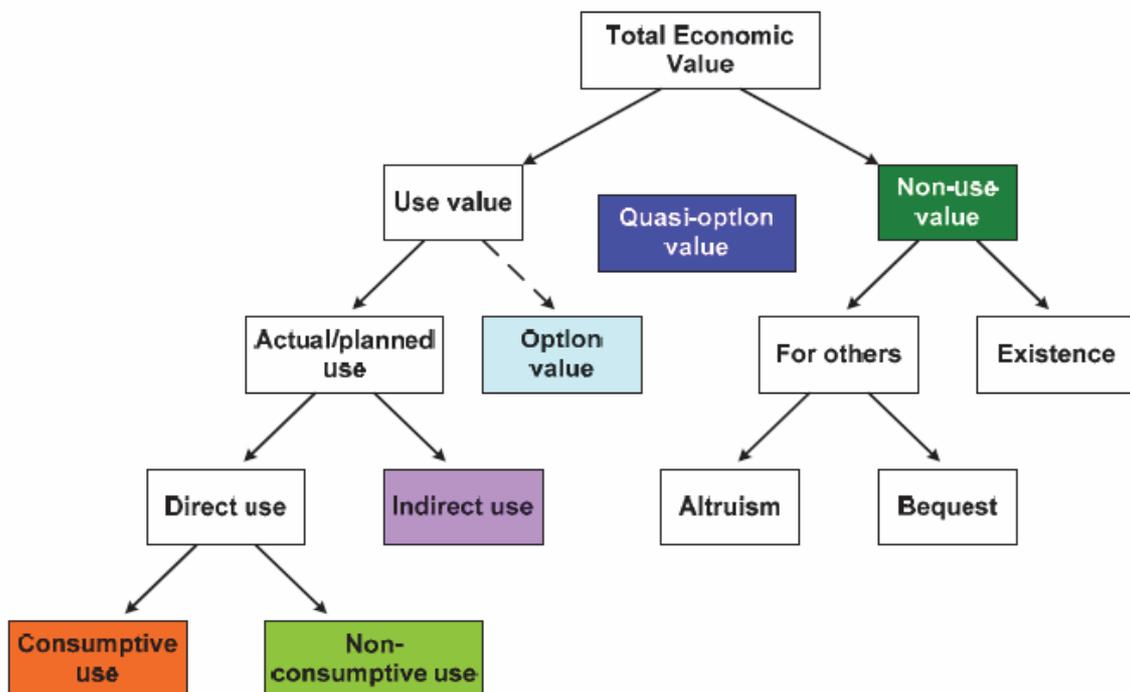


Figure A2. Total economic value. Economic value categories as constituents of human wellbeing.

## ANNEX 2: NON-MARKET VALUATION

Over the last three decades environmental economics has made considerable progress in methodological development of valuation measures for the environment. Environmental impacts are typically not valued using markets, and it is therefore necessary to use other approaches to elicit preferences for environmental change. Pearce (2002) discusses this history. These methods can roughly be divided into revealed preference and stated preference approaches. The revealed preference approach assumes that observed behaviour follows from an intrinsic utility maximization process – a core assumption in mainstream economics that explains how individuals behave faced with choice. Thus, observed behaviours are assumed to be relevant for welfare analysis. Revealed preference is the basis for standard market good valuation and for non-market good valuation approaches such as the hedonic price and travel cost methods. In contrast, stated preference approaches elicit individual valuations through surveys. Note that these techniques are complementary. Revealed preference approaches primarily allow us to measure the value of consumptive uses, while stated preference approaches generally allow us to measure the value of non-consumptive or non-use values (existence or option values). See Figure A2 in Annex 1.

The main stated preference methods are contingent valuation and choice modelling. Both methods are survey-based exercises that use representative samples of the general public to derive average values for defined (but typically hypothetical) environmental changes. Contingent valuation normally describes the change and asks individual participants to state their willingness to pay for the change. Choice modelling is more detailed and provides participants with scenarios or choice sets defined by varying levels of pre-defined attributes. These attributes describe the key changes at issue. In the case of a reintroduced species, this might include attributes about the number of species, the levels of a specific benefit their presence may entail, any costs they may entail, and crucially, a cost variable that changes across the different scenarios. This cost might be framed in terms of a realistic tax increment to pay for the change. By observing and analysing the choices made by a respondent sample of the wider population, it is possible to derive the values of each attribute and its various levels. This information then allows the analyst to define the policy benefits of alternative scenarios.

The NUV estimate used in this analysis was derived from a survey administered to over 350 participants from the general public. These were collected via a postal survey across Scotland. The survey was designed to elicit WTP for the three different conservation management options: The conservation of native species, the control of invasive species and the reintroduction of formerly native species. The experiment was divided into two sections; first to investigate generic preferences for these broad policy options (see example choice card below), and then to investigate how the specification of different species within these categories can change relative preferences and thus WTP. This part of the work allows for the estimation of a distinct value for beaver reintroduction over a percentage of Scotland's land area.

The results show that in terms of preference ordering the public is more willing to pay to prevent the loss of existing native species relative to any reintroduction. Such loss aversion is actually a typical finding in many economic and psychological studies. For the species-specific values, as noted the exact values can vary by changing the species mentioned in each category. However, as a mean value the study indicated that Scottish participants would be willing to pay approximately £56 per household per year related to a scenario of reintroduction over 50% of the national territory; i.e. something more significant than the extent of the trial. We use this value to derive our NUV scenarios, but present a range of estimates assuming that the actual household value is something less than £56.

Table A2. Example choice experiment choice card

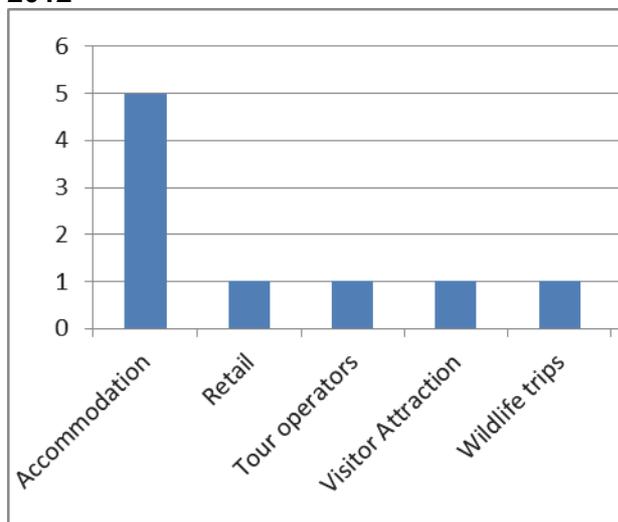
CHOICE A	DO NOTHING	CONSERVE NATIVE SPECIES	CONTROL INVASIVE SPECIES	REINTRODUCE SPECIES
AREA	0	25%	25%	75%
LAND USE RESTRICTIONS	No restrictions	No restrictions	High level of restrictions	No restrictions
COST TO YOU	£0	£50	£50	£100
YOUR CHOICE (please tick <b>ONE</b> only)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### ANNEX 3: SUMMARY OF BUSINESS RESPONSES

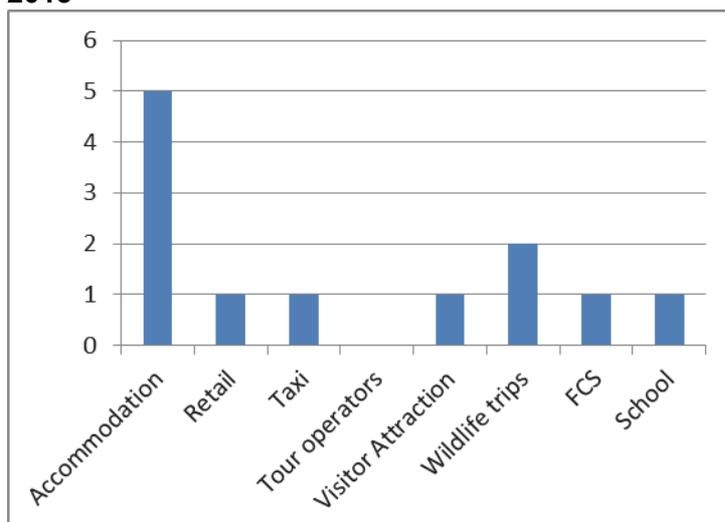
This annex covers the responses to some of the questions in the 2012, 2013 and 2014 SRUC online business surveys. The surveys covered different aspects of business activity and sought qualitative information about wider aspects and perceptions of the SBT. The following figures represent the combined responses to some of the questions asked over the three surveys during the SBT trial period. Note that there were a total of 32 independent participants with 10 participants completing two or more surveys over the trial period. Participants were contacted through SBT stakeholder newsletters and the Heart of Argyll Tourism Alliance (HOATA) businesses in the local area.

*Question 1: Please provide the nature and name of your business or organisation (e.g. hospitality, retail, visitor attraction):*

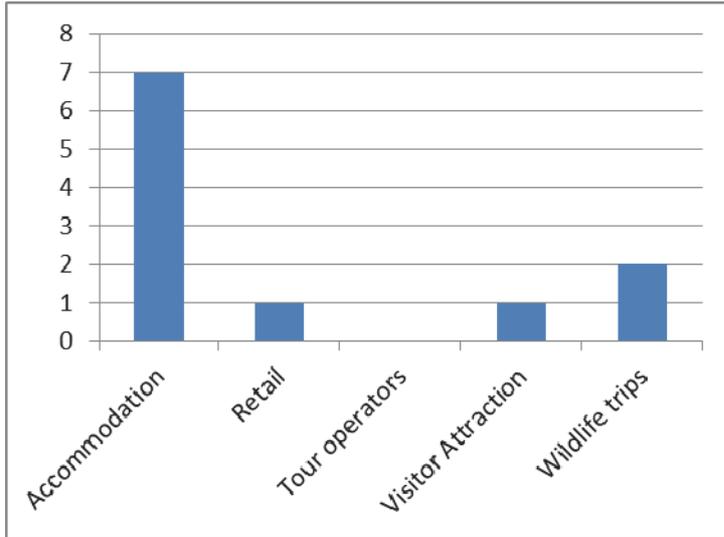
#### 2012



#### 2013

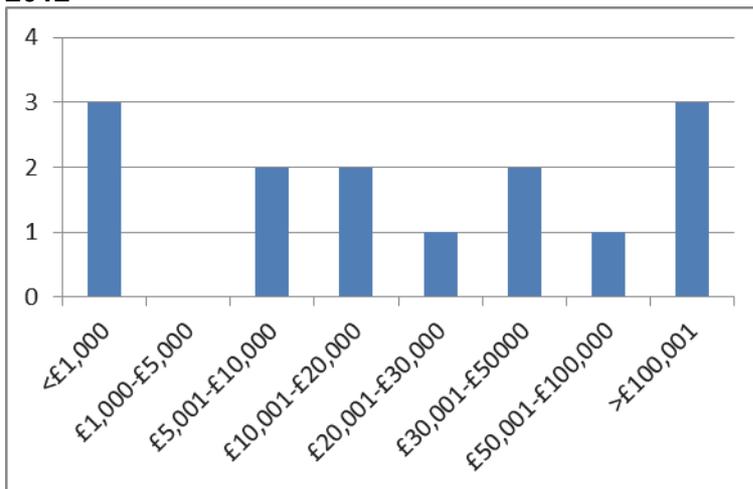


**2014**

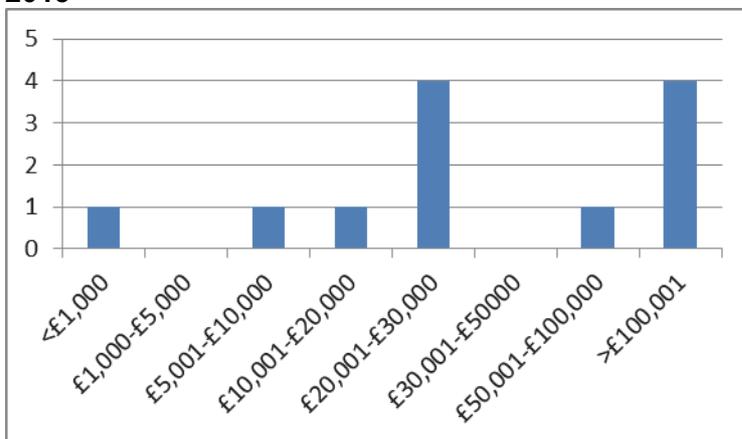


Question 2: To the nearest £1,000, what is your annual sales volume (turnover)?

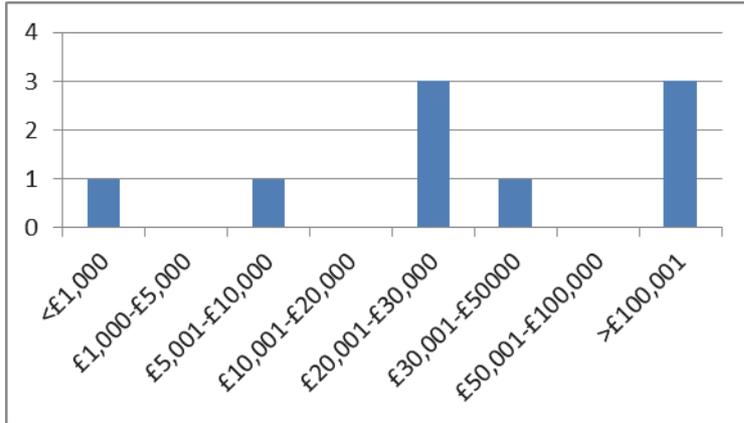
**2012**



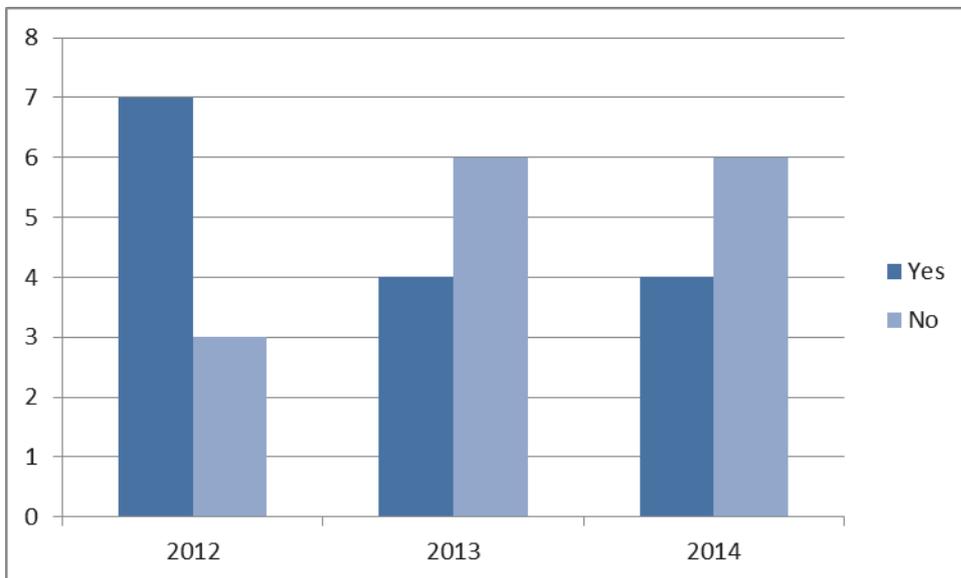
**2013**



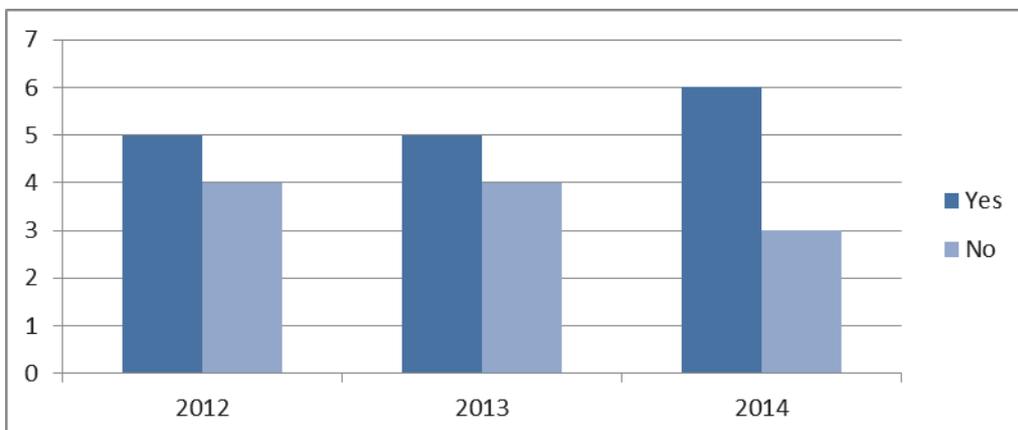
**2014**



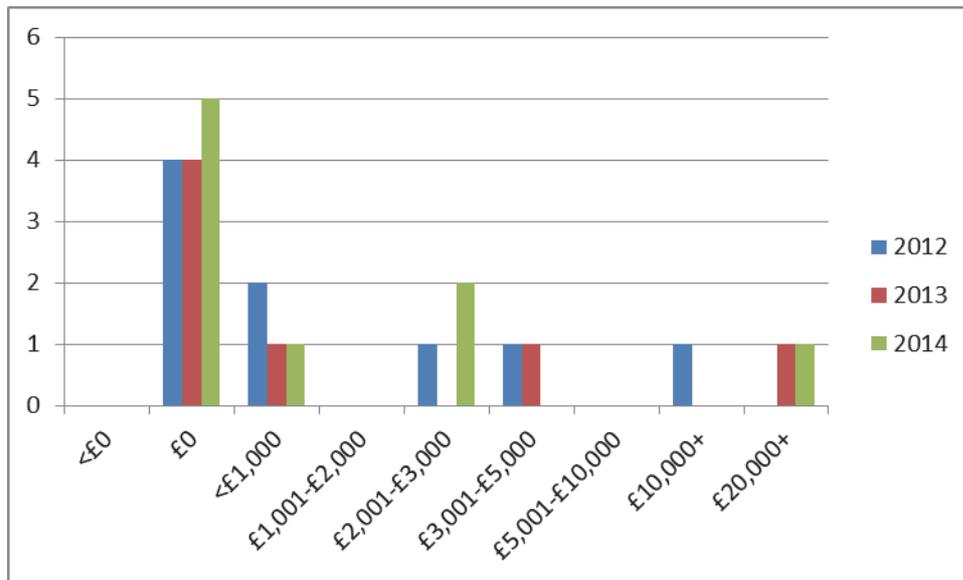
*Question 3: Has the trial to date had any discernible impact on your business activity?*



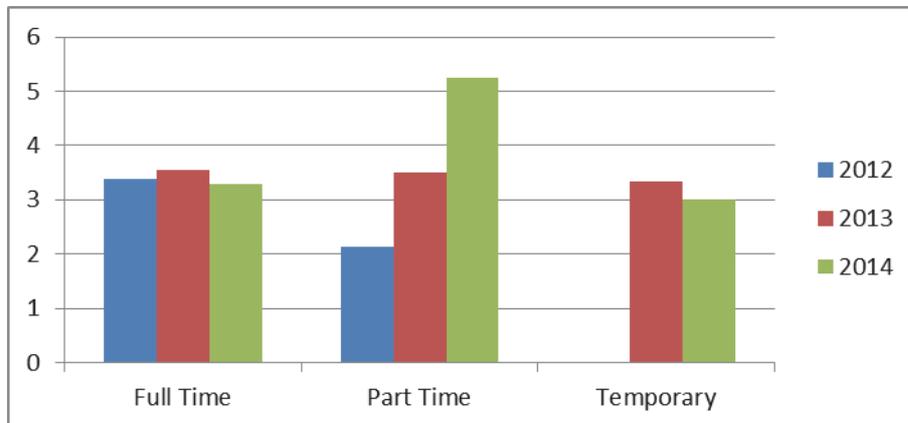
*Question 4: Do you think the trial over the period [to end of trial] will have any effect on your business? If yes, please describe briefly.*



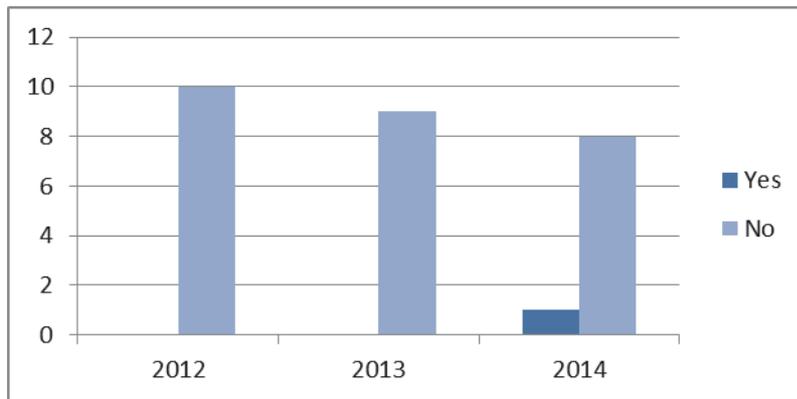
Question 5: To the nearest £1,000 can you estimate whether the Beaver trial has increased or decreased your turnover (please indicate £ +/- per annum)



Question 6: In 2010 how many employees including you were employed in the business? (Represented as mean)

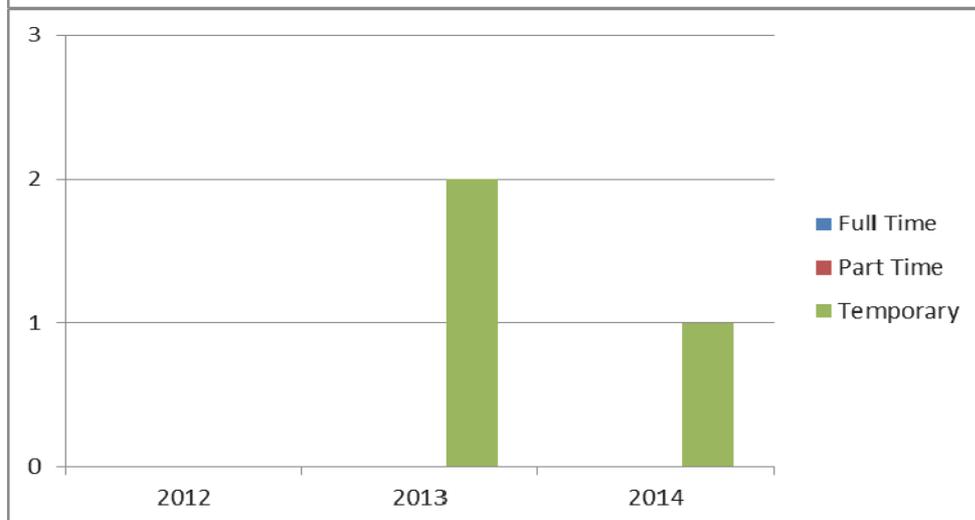
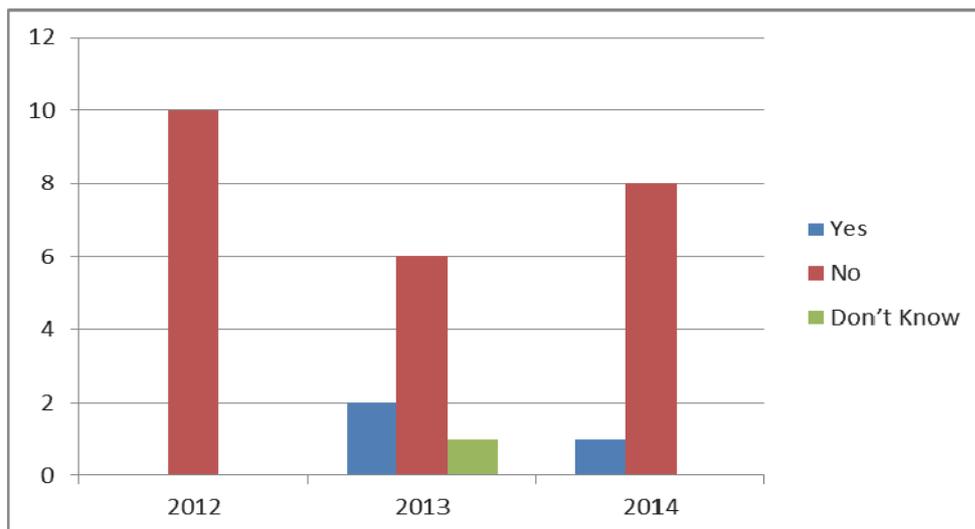


*Question 7: Have you hired more employees that you might attribute to increased business as a result of the trial?*

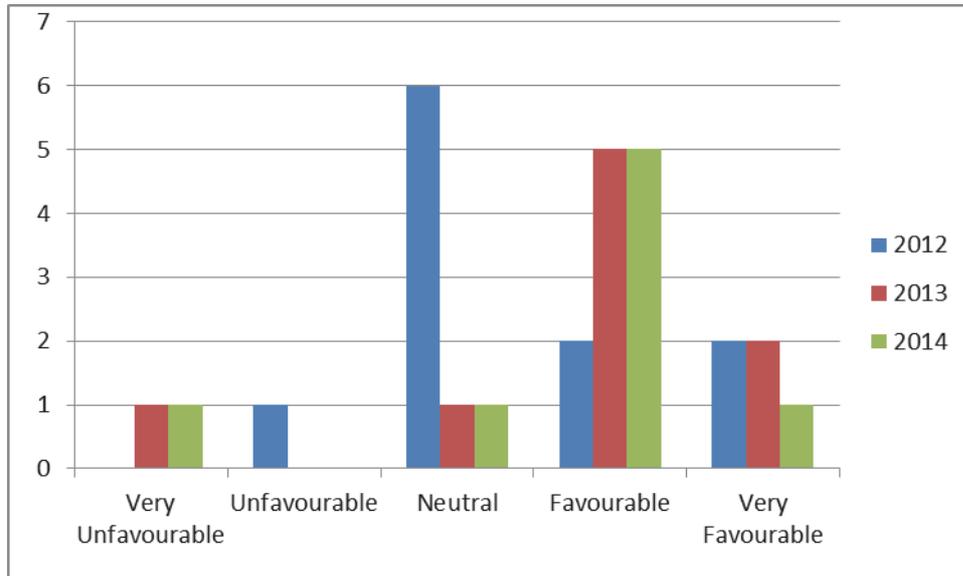


The respondent in 2014 indicated this was a temporary employee for 1-2 months.

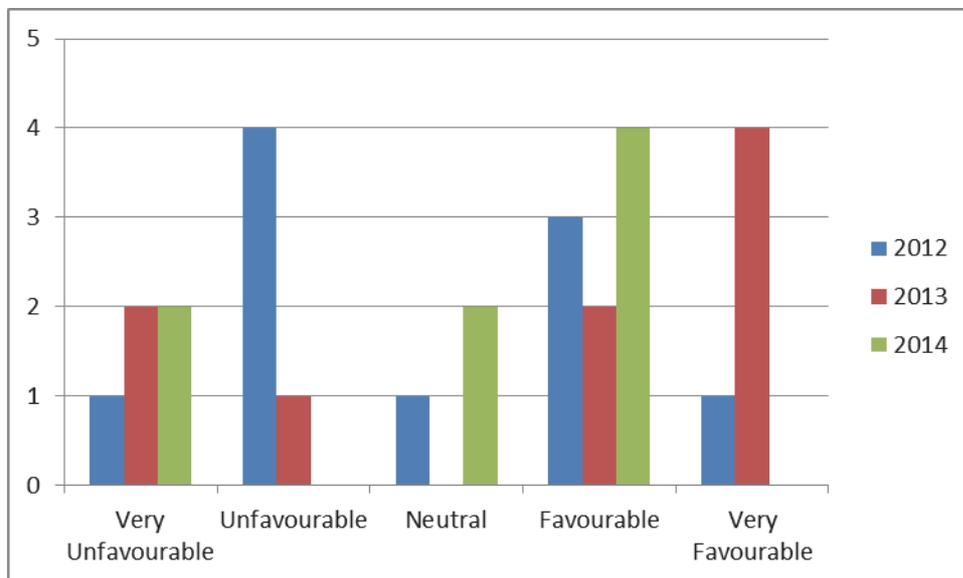
*Question 8: Do you think you might need to increase the number of employees at your business over the whole period (2010-2014)?*



Question 9: Looking beyond your business, on a scale of 1 to 5 (1 being very unfavourable, 3 being neutral and 5 being very favourable) how positively do you view the trial in terms of its potential economic contribution to the region?



Question 10: On a scale of 1 to 5 (1 being very unfavourable, 3 being neutral and 5 being very favourable), how favourable are you in regards to a wider reintroduction of Beavers in Scotland?



## ANNEX 4: STAKEHOLDER PERCEPTIONS

This annex contains some of the responses to interviews carried out in 2012 as part of an SNH-funded PhD which has not been published to date. Participants included landowners and other local stakeholders, and a total of 23 interviewees were engaged.

### *Beavers and the cultural landscape*

Some participants felt that beavers were no longer part of the Scottish culture due to the length of time that they have been absent from the Scottish landscape. This removal from cultural memory is seen as a barrier to their reintroduction. Beavers are also seen by some as a threat to culturally important activities. For instance, some participants identified the cultural and economic value of fishing to rural communities, and were concerned about beavers' impact:

*"..One of the great claims about beavers is that what they do is hold back water with their lagoons. Well if they do that, there'll be no fish, end of river... and it's one that's been enjoyed by anglers for years... It just seems to me completely irresponsible to take that attitude."*

Local land owner

### *The consultation process*

There was a common feeling in the community that the desires of a remote, unaffected public were put above their concerns. This is linked to a distrust of the outcomes of the pre-trial consultation, with a feeling that the sampled population was designed to give the desired result:

*"I don't really know the ins and outs of how they went about the trial but there's quite a lot of local people... say they felt like it was a done deal, that... actually they'd got a negative response from the local land owners so they just widened the consultation area to include Lochgilphead where there is quite a big population of people who would not be individually affected."*

Local business owner

*"... if we had our time again, I think we would have tried harder and not taken so much for granted from the politicians that our views were taken seriously... I think we needed to get ratty in order to get the politicians' attention."*

Stakeholder representative

Participants with both pro- and anti- beaver views identified the perceived reluctance of the trial to release negative information as a key factor affecting the conflict. This perceived withholding of information was seen to both arise from - and to create further - distrust between the trial and the local community:

*"A bit more honesty, in terms of letting us know negative things that happened would have made us feel better about the... way the whole thing was managed. But it did appear that we never heard about anything negative."*

Local land owner

### *Trial status*

The decision to have a trial project rather than a small scale reintroduction was a common theme for all participants, with concerns being raised on all sides. By its nature, a trial can become more contentious than a straightforward reintroduction project. Issues of trust, independence and impartiality become more important, especially with respect to the groups involved in the decision making process at the end of the trial period.

For some, a trial was seen as unnecessary given the wide range of experience of beaver reintroductions to be found across Europe and beyond. Others argued that the uniqueness of the Scottish physical and cultural landscapes meant the trial was justified:

*“...I rather feel that what goes on in Norway or Germany or Poland or America is really of no consequence here, it’s interesting academically. What the issue here is how beavers behave in Scotland and we need to trial that carefully and to determine if that’s a risk, if the risks presented by that are acceptable to society and it’s willing to take them.”*

Stakeholder representative

### *Monitoring and decision making*

A main source of concern for many participants was the independence of the trial, and in particular SNH’s changing role: SNH were advocates for the beaver reintroduction, but their role became one of independent monitoring. This led to distrust in SNH’s ability to fulfil this latter responsibility:

*“...if they’d been a lot clearer themselves about who was actually going to carry out the monitoring, because it’s not SNH really, it’s people contracted to SNH, who theoretically don’t have any biases towards them. [The SBT] might have been slightly more successful in making it clear that SNH were supposed to be an independent body.”*

Remote conservationist

*“But since SNH are the overseers of this exercise, and they think it’s a jolly good idea, I mean, they’re not even independent overseers. They’re the ones who applied for the licence in the first place.”*

Local landowner

Some participants felt that the social, political and economic concerns would outweigh the scientific output of the trial in the government’s decision making process at the end of the trial period:

*“[The minister] signed the import licence with I have to say a very encouraging letter which makes me think that the trial is a complete farce because I think that no matter what the outcome is, if [they have] anything to do with this they’re going to rubber stamp it...”*

Local landowner

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