SCOTTISH BEAVER TRIAL

The Scottish Beaver Trial: The story of Britain's first licensed release into the wild

Final Report, 2014

Scottish Wildlife Trust and Royal Zoological Society of Scotland
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> **The Scottish Beaver Trial is one of the most considered and well-organised species reintroductions ever. Thanks to this project, we can once again see these beautiful creatures at work.**
>
> Ray Mears, broadcaster and the UK's leading bushcraft expert

> **I naturally love beavers, as Beaver is my nickname. We didn't see any, but we did see human tracks, the beginnings of a dam and some footprints as well as caterpillars, butterflies and dragonflies. We'll definitely be coming back!**
>
> Beth Mackenzie, visitor to the Trial, aged 10

> **Here in the Heart of Argyll, we have been pleased to host the Scottish Beaver Trial. We have had lots more visitors as a result, and the pools the beavers have constructed have encouraged diversity in the forest.**
>
> Andrew Wilson, local business owner and Chair of the Heart of Argyll Tourist Alliance

This report does not cover any of the independent scientific monitoring findings or results of the Scottish Beaver Trial. The Trial has been independently monitored by Scottish Natural Heritage (SNH) in collaboration with Independent Monitoring Partners (see Appendix 6) on behalf of the Scottish Government. As such, the data and findings produced will be made available by SNH to the Scottish Government and, in time, to the wider public.

1

Executive summary

FIVE

years ago, the UK's first ever trial reintroduction of a mammal began, with …

FOUR

beaver families reintroduced to Knapdale Forest in the Heart of Argyll by …

THREE

organisations, the Royal Zoological Society of Scotland, the Scottish Wildlife Trust and host Forestry Commission Scotland, backed up by over …

TWO

hundred messages of support from local people and businesses. Together, over the last five years, they've helped deliver …

ONE

groundbreaking project, the
Scottish Beaver Trial

1. Executive summary

The Eurasian (also known as the European[1]) beaver (*Castor fiber*) is thought to have become extinct in Scotland in the 16th century as a result of over-exploitation by humans. Discussions began in the late 1990s with the aim of reintroducing this species to Scotland, following similar initiatives across Europe.

Public consultation exercises indicated that, although there was support for the return of the beaver in Scotland, there were some concerns about the potential negative impacts of the species. Therefore a trial reintroduction was proposed by Scottish Natural Heritage (SNH) in 2000. The site deemed most suitable for such a trial was identified as Knapdale Forest, Mid-Argyll, which is largely managed by Forestry Commission Scotland (FCS). In 2002, an application was submitted to the Scottish Government by SNH for a licence to run such a trial. However, this application was rejected in 2005, largely due to perceived legal problems with the potential impacts on some of the designated sites within Knapdale.

In 2007, the publication of the 'Species Action Framework' and a change of government in Scotland created an opportunity for a fresh trial proposal to be considered. In the same year, the 'Scottish Beaver Trial' partnership was formed, bringing together the Scottish Wildlife Trust and the Royal Zoological Society of Scotland (RZSS). Following a local public consultation exercise in autumn 2007, which indicated local majority support for such a project, a new licence application to the Scottish Government was made. A licence to undertake a five-year, scientifically monitored trial reintroduction of Eurasian beavers to Knapdale Forest was granted in May 2008. The Scottish Beaver Trial was the first licensed release of a mammal species ever to take place in the UK.

The Scottish Beaver Trial had five main aims:

i. to study the ecology and biology of the Eurasian beaver in the Scottish environment;
ii. to assess the effects of beaver activities on the natural and socio-economic environments;
iii. to generate information during the proposed trial release that will inform a potential further release of beavers at other sites with different habitat characteristics;
iv. to determine the extent and impact of any increased tourism generated through the presence of beavers; and
v. to explore the environmental education opportunities that may arise from the Trial itself and the scope for a wider programme should the Trial be successful.

The Trial was independently monitored by SNH, who also advised the Scottish Government on the outcomes of the Trial and on whether the various licence conditions were met by the Scottish Wildlife Trust and RZSS.

In 2008, a total of 17 wild Eurasian beavers were caught in Telemark, Norway, by experts from Telemark University College (TUC) for the purposes of the Trial. These animals were quarantined for six months at specialist facilities in Devon prior to release.

On 28 and 29 May 2009, three families of beavers (totalling 11 animals) were released at three separate freshwater lochs within Knapdale Forest. There was considerable media interest in the release, and it is estimated that over 10 million people watched, listened to or read about the release in the subsequent days. Over the following five years, a detailed scientific monitoring programme, coordinated by SNH and

[1] Since 2010, the term *Eurasian* has tended to replace the use of the word *European* in scientific literature. At the time of the licence application, all parties involved and documents used the term *European* rather than *Eurasian*.

led by a group of Independent Monitoring Partners, collected data on the ecology of the released beavers and their impacts on a variety of environmental, social and historic features in and around the Trial area. The findings of the Independent Monitoring Programme, which ceased in May 2014, are (at the time of writing) being analysed by the independent partners. The final results will be collated and presented by SNH to the Scottish Government in May 2015, after which the Scottish Government will decide the future of the Knapdale beavers and of beaver reintroductions to Scotland.

The educational outputs associated with the Trial resulted in an estimated 2.9 million people engaging with the project through television programmes, websites and social media and through formal and informal educational activities, making the project one of the highest-profile wildlife stories in Scotland at the time of writing.

The methods and techniques used and developed to deliver many elements of the Trial have resulted in some recommendations for further consideration. These include key considerations such as the welfare implications of trapping and quarantining wild beavers, the provision of education and communication programmes, and the overall resource implications of delivering such a reintroduction project.

2

Introduction and aims of this report

13 independent monitoring partners, led by Scottish Natural Heritage

2015 Independent monitoring report submitted to Scottish Government

2. Introduction and aims of this report

This report captures the notable events and planning activities covering the period November 2008 to June 2014, which included the first formal release of Eurasian beavers to the wild in the UK after an absence of over 400 years.

In May 2008, the Scottish Government granted a licence to a partnership between the Royal Zoological Society of Scotland (RZSS), the Scottish Wildlife Trust and the host, Forestry Commission Scotland (FCS), to undertake a time-limited, five-year trial reintroduction of the Eurasian beaver to Knapdale, Mid-Argyll.

The Scottish Beaver Trial was an international project involving many dozens of people from numerous organisations, including nature conservation charities, government agencies, funding bodies and academic institutions, as well as local stakeholders and individual volunteers.

This report, produced by the Scottish Wildlife Trust and RZSS, has two specific aims:

i. to record, for the historical record, the process of the Scottish Beaver Trial from inception to licence application, animal capture, quarantine, releases and the events following release between 2009 and 2014;
ii. to look objectively at the Trial process and, by learning through experience, look to improve methods and systems for any potential subsequent releases and projects of a similar nature.

NB: This report does not cover any of the independent scientific monitoring findings or results of the Scottish Beaver Trial. The Trial has been independently monitored by Scottish Natural Heritage (SNH) in collaboration with Independent Monitoring Partners (see Appendix 7) on behalf of the Scottish Government. As such, the data and findings produced will be made available by SNH to the Scottish Government and, in time, to the wider public.

Image 1 (© Phillip Price, www.lochvisions.co.uk).

3

Background

400 years
since beavers were hunted to extinction

3. Background

3.1 Historical context

The Eurasian beaver is a large, semi-aquatic, herbivorous rodent that was once found from the Chinese–Mongolian border in the east to Europe (including Britain) in the west. By the beginning of the 20th century, the species had been driven to near-extinction, largely as a result of over-exploitation by humans, who hunted beavers largely for their fur but also for meat and the glandular secretion castoreum, which was used for medicinal and perfumery purposes (Nolet and Rosell 1998). The species is thought to have become largely extinct in England and Wales between the 12th and 13th centuries and in Scotland by the 16th century (Conroy and Kitchener 1996). However, by the end of the 20th century, the species had shown a remarkable recovery across Europe. Hunting pressure had markedly declined, and the species found its way back into much of its former range in western and eastern Europe through both natural recolonisation and, latterly, artificial reintroduction programmes which led to a sharp rise in the population (Halley and Rosell 2002).

The idea of reintroducing the Eurasian beaver to Scotland goes back to 1995, when the first discussions began to take place among interested individuals and national agencies about the concept of beaver reintroduction. Nature conservationists had seen the animal return to many parts of its former range in Europe, and they considered whether, in time, the beaver could also return to Britain.

In 1995, Scottish Natural Heritage (SNH) began to commission work on the feasibility of beaver reintroduction (Tattersall and Macdonald 1996; SNH 1998, 2001 and 2007), and in 1998 commissioned a national consultation exercise (Scott Porter Research & Marketing 1998) to investigate the desirability of reintroducing beavers to Scotland. Of a total of over 4,000 responses received from three target audiences, an average of two-thirds of respondents were supportive of beaver reintroduction, although reservations were expressed by some, chiefly (but not exclusively) in the agricultural, forestry, field-sports and fishing sectors, who feared potential detrimental impacts that the species may have caused. Therefore, a trial reintroduction was viewed as the best mechanism for addressing some of these concerns.

In 1998, SNH's Board approved in principle a time-limited, geographically restricted trial reintroduction of the Eurasian beaver to Scotland. By 2000, a site-selection process – run by SNH and Forest Enterprise (FE) – had identified Knapdale Forest in Mid-Argyll as the most suitable site for a trial reintroduction. This selection was for a number of reasons: Knapdale Forest has relatively short river systems, good natural containment, abundant suitable riparian habitat, a good access network with minimal disturbance and a predominant land-use (forestry) with minimal potential for conflict.

There followed later in 2000 an SNH-led local consultation exercise around the Knapdale area, which showed that a clear majority of respondents were supportive and were content for a trial project to proceed. Under domestic legislation, it is illegal to release into the wild any animal which is a species not ordinarily resident in Great Britain (Section 14 of the Wildlife and Countryside Act 1981). In order for the trial reintroduction to proceed at Knapdale, a licence was therefore required from the (then) Scottish Executive, and an application for a licence for the Trial was made to the Deputy Minister for Environment and Rural Development in 2002.

Despite SNH's extensive preparatory work, and active lobbying by the Scottish Wildlife Trust, the Scottish Government failed to reach a decision on the scheme and deferred further consideration, requesting additional information from SNH. In 2005, this licence application was eventually turned down by the

Scottish Government, largely on the grounds that the Trial may have resulted in a potentially damaging impact upon the Special Area for Conservation (SAC) in Knapdale and that the implementation of the exit strategy for the Trial may have resulted in the culling of a European protected species.

In January 2007, the Scottish Government, in partnership with SNH, launched the 'Species Action Framework' (SAF). This five-year framework aimed to provide a strategic approach to species management in Scotland and identified certain species requiring targeted management and action. Two reintroductions are included in the SAF: white-tailed eagle (*Haliaetus albicilla*) and Eurasian beaver (referred to as the 'European beaver' at that time). Through the SAF, organisations outwith SNH were also encouraged to lead on actions for individual species. In July 2007, senior managers at both the Scottish Wildlife Trust and the Royal Zoological Society of Scotland (RZSS) agreed to work together in partnership to secure the future reintroduction of the Eurasian beaver to Scotland, under the title of the 'Scottish Beaver Trial' (the SBT). After discussions with SNH and Forestry Commission Scotland (FCS) regarding the proposal to resurrect the Knapdale trial, the SBT partnership – with financial support from the People's Trust for Endangered Species (PTES, formerly known as the Mammals Trust UK) – launched a two-month public consultation in the vicinity of the preferred trial site of Knapdale Forest in order to establish the levels of support and opposition to the Trial proposal. The results of this autumn 2007 consultation led in turn to an agreement to rapidly pursue a government licence for a controlled release. This effectively began the project in earnest.

3.2 Why reintroduce the beaver?

Many people, including the SBT partners, believe that the Eurasian beaver is a missing element in our native biodiversity, lost entirely as a result of human actions. The beaver is widely considered to be a 'keystone species' in forest and riverbank environments (Huntly 1995; Davic 2003), and the species is thought to have a significant and positive influence on ecosystem health and function.

By modifying their habitats through their feeding, digging and, in some cases, damming behaviours, beavers are known to provide a net positive effect on biodiversity (Rosell *et al*. 2005), although these impacts can on occasion produce negative impacts and require subsequent management by humans.

Beavers are, in effect, a natural way of creating, maintaining and diversifying habitats and have been referred to as 'ecosystem engineers' (Wright *et al*. 2002). Additionally, beaver activity can have positive environmental and socio-economic effects for humans. Their dams can hold water in periods of drought, regulate flooding and improve water quality by holding silt behind dams, and catch acidic and agricultural run-off (Parker 1986). Experience from elsewhere in Europe has shown that beavers can become eco-tourism attractions in some areas and, in so doing, attract external income into some local communities (Campbell *et al*. 2007).

Under the EU's Directive 92/43/EEC Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats and Species Directive) Article 22, there is responsibility for member states to consider reintroductions of extinct native species in Annex IV. The Eurasian beaver is currently listed as an Annex IV species and additionally as an Annex III species of the Bern Convention. The Directive aspires to achieve a favourable-condition status of the priority habitats and species listed in its annexes.

Beavers are also considered a 'flagship' species in that they can help to raise awareness about nature conservation, and they fulfil philosophical and aesthetic ideals associated with returning native species to the wild (Gurnell *et al*. 2008).

4

Licensing and legislation

4. Licensing and legislation

4.1 Scottish Government licence

In 2007, no standard format existed for making an application to the Scottish Government for a species reintroduction project. Therefore, a document containing all the required information was written and submitted on behalf of the Scottish Beaver Trial (SBT) partnership by the Royal Zoological Society of Scotland (RZSS), drawing upon content from the previous application and supporting information prepared by Scottish Natural Heritage (SNH).

The document was entitled 'Application to Scottish Government by The Royal Zoological Society of Scotland and Scottish Wildlife Trust for a Licence under Section 16(4) of The Wildlife and Countryside Act 1981, as amended, to release Eurasian beaver,[2] *Castor fiber*, for a trial Reintroduction in Knapdale, Argyll. The Royal Zoological Society of Scotland, Scottish Wildlife Trust, 21st December 2007', and can be obtained by contacting any of the SBT partners.

The application laid out the five main aims of the SBT:

i. to study the ecology and biology of the Eurasian beaver in the Scottish environment;
ii. to assess the effects of beaver activities on the natural and socio-economic environments;
iii. to generate information during the proposed trial release that will inform a potential further release of beavers at other sites with different habitat characteristics;
iv. to determine the extent and impact of any increased tourism generated through the presence of beavers; and
v. to explore the environmental education opportunities that may arise from the Trial itself and the scope for a wider programme should the Trial be successful.

Included with the licence request was essential additional information in support of the application to the Scottish Government. These included sections on: legal matters, the public consultation summary report, the proposed release area and sites, budgets, public-health issues, education initiatives, socio-economic impacts, source population and animal health, quarantine methods, post-release management methods, exit strategy, research and monitoring methods, risk assessment and dealing with potentially damaging effects, success and failure criteria, and project-management structure.

Compensation and insurance

The process of public and stakeholder consultation had, over the years, revealed that there was some concern regarding where liability rested in cases of beavers having damaging impacts upon outside interests – for example, flooding, burrowing, tree-felling and crop damage. This point was addressed specifically in the Scottish Government licence condition number 18:

'Arrangements must be put in place by the licence applicants to ensure that local businesses and properties have a clear route to pursue compensation claims for damage caused by the beavers during the period of the Trial.'

[2] At the time of application, the term *European* beaver was used. This has since been largely replaced by the use of the term *Eurasian* beaver.

It was necessary, therefore, to provide both insurance cover for this purpose during the period of the Trial, and a clear compensation protocol (see Appendix 3) and dedicated budget. These measures were put in place by the SBT partners prior to the release date and were based upon information presented in an overall risk assessment (see Appendix 4) for the Trial which was supplied to Wills & Co., the insuring body.

4.2 Agreements

The Scottish Beaver Trial was a relatively large-scale project involving several organisations over a number of years, with considerable resource implications for all of the main partners and SNH. With this in mind, there was consensus by all involved that it would be necessary to draw up legal agreements or Memoranda of Agreement (MOA) between the various parties in order to clarify roles and responsibilities and to protect individual organisations' interests. Therefore, prior to release, a number of agreements were drawn up. First, an MOA was drawn up between the SBT partners, the Scottish Wildlife Trust and RZSS; next, an agreement was drawn up between the partners and the hosts FCS, as well as an MOA between the partners and SNH. RZSS and Telemark University College (TUC) also drew up an MOA focusing on beaver-related research. Additionally, a series of agreements were drawn up between SNH and the various Independent Monitoring Partners that were involved in the Independent Monitoring Programme. The MOAs involving SNH also covered the issue of ownership and use of data collected during the Trial.

4.3 Legal status of beavers in the UK

On 20 May 2008, Michael Russell MSP – then Scottish Minister for the Environment – granted a licence for the SBT on behalf of the Scottish Government.

'The licence allows the Scottish Wildlife Trust and RZSS to release up to four families of beavers (each family to comprise not more than two adults and their kits) within the Knapdale release site as defined in the application. The release of the beavers will not take place until 2009. There will then be a period of five years to assess the viability of the reintroduction. Any further releases of beavers at the end of the Trial or in relation to any other trial will require a further licence from the Scottish Government. The decision on whether to grant any further licence is a matter for the Scottish Government.'

The licence is subject to 31 conditions which broadly cover the following aspects:

i. the role of SNH
ii. beaver management
iii. project management
iv. research, survey and monitoring
v. mitigation measures.

A full copy of the licence and accompanying conditions can be found in Appendix 1.

Protected status of beavers

There was also a need to clarify the legal status of the beavers themselves, as there was no clear view on whether or not the Trial animals would have any form of protected status. Discussions with the Scottish Government and the Wildlife Crime Officer Coordinator for the then Strathclyde Police

concluded that, in the eyes of the authorities at the time, Eurasian beavers did not have any form of specific legal protection within the UK.

The Eurasian beaver is listed as an Annex IV species and additionally an as Annex III species of the Bern Convention, and this was interpreted as giving it protection in EU countries where it is considered resident. In 2008 as a non-resident species in the UK, it was not considered to be covered by this legislation. However, since the Trial beavers were the property of the SBT partners, Strathclyde Police advised that any deliberate attempt to damage or destroy them could be argued in a court as being the offence of 'malicious mischief' under common law.

4.4 Recommendations

1. Though no template existed for a species reintroduction licence application prior to the SBT, the work of the Scottish National Species Reintroduction Forum has – partly based on the experience of beaver releases in Scotland – produced guidelines entitled 'The Scottish Code for Conservation Translocations' and the accompanying 'Best Practice Guidelines for Conservation Translocations in Scotland' (Scottish Natural Heritage 2014). These documents provide greater clarity to the reintroduction process and help to provide a checklist of actions for applicants to consider, including aspects of planning, legal status, permissions, consultation, resources and monitoring.

2. The experience of the SBT suggests that clarity is important in the licensing stage, and that the organisations and partnerships which form in order to deliver reintroduction projects must ensure that individual roles and responsibilities are made clear in the early stages, and that all parties sign up to the resource implications of planning and delivery. Such roles and responsibilities should be captured in specific Memoranda of Agreement between the relevant partners.

3. Although at the time of writing the need for insurance cover has been untested at the SBT, it is likely that the provision of such cover, along with a compensation procedure, will be important elements to put in place for future trial reintroductions of this nature. This is in order to reassure any licensing authorities and neighbouring landowners who may have concerns over potential negative impacts that beavers may cause following release and how these would be subsequently managed. The long-term sustainability and suitability of insurance cover and compensation is, however, a matter that would require further careful consideration and discussion among the trial operators and the licensing authorities to assess the long-term requirement in relation to the legal framework of any wider-scale beaver reintroduction.

5

Capture and transportation

27 beavers captured in Norway to supply pool of animals for release in Scotland, with quarantine in England.

5. Capture and transportation

5.1 Source population

The Scottish Beaver Trial (SBT) partnership collaborated with Telemark University College (TUC) for the sourcing of wild Eurasian beavers because, at the time, Norway was identified as the most suitable donor country and source population for animals to be used as part of the Trial. Initially, there were several reasons for this selection:

i. The International Union for Conservation of Nature (IUCN) has strict guidelines on the reintroduction and translocation of species (IUCN 1998, IUCN/SSC 2013). These guidelines recommend that, as far as possible, the taxonomically closest population should be used in any reintroduction. In 2000, Scottish Natural Heritage (SNH) commissioned a study to compare the skulls of fossil British and extant Eurasian beavers (Kitchener and Lynch 2000). The general conclusion was that the skulls of Scandinavian beavers are the most morphologically similar to fossil British beavers. The authors also recommended that it would 'perhaps be beneficial to select animals which survive in a similar climate with a similar selection of food plants and trees'. Telemark County – the location of the source of beavers for the project – is in a relatively mild region of Norway; and, although winter temperatures are lower than in Mid-Argyll, it was anticipated that animals from this area would readily adapt. There was initially some concern about using Norwegian beavers for a reintroduction project, based on the fact that the population has very few founders from the Norwegian relict population, representing a relatively low genetic diversity. However, researchers have not observed any problems in an intensively studied population in southern Norway that can be linked to low genetic diversity (Rosell, pers. comm.); and, given the short timeframe and trial nature of the project, this was something that could be addressed and rectified in the future, pending the Scottish Government decision.

ii. The collection of this donor stock was also undertaken in conjunction with the expertise provided by staff from TUC. In 2000, SNH established links with Professor Rosell and Professor Howard Parker, both highly respected in beaver behavioural ecology and management, who later went on to work with the SBT partners in 2007. The involvement of TUC staff did result in a relatively high resource cost to the project, but this should be placed in the context of the added longer-term value associated with working in a partnership with a renowned beaver research institution. In addition, highly experienced trapping staff were required, as were purpose-built quarantine facilities, transport crates (which had to be constructed) and paid animal-care staff in Norway. Ongoing research links have been established between TUC and SBT partnership organisations throughout the life of the Trial, which have led to ongoing advisory communications and numerous publications (see section 10).

iii. The Telemark research area from which the beavers were sourced had no evidence of the waterborne fish parasite *Gyrodactylus salsii*, the disease *Giardia lambia* or the potentially pathogenic and zoonotic parasite *Echinococcus multiloris*. The introductions of any of these species through the release of beavers were all raised as a matter of concern by some stakeholder groups.

iv. The use of wild-caught animals did, however, result in more complex importation, quarantine and logistical arrangements than would have been required for captive-held beavers. The additional decision to use only family groups (along with the Scottish Government licence

requirement that a family could not exceed two adults and two dependent offspring) saw increased field-work requirements in Norway, particularly in terms of identifying suitable families and then subsequently ensuring that all members had been successfully identified and removed into captivity.

During the second part of the Trial, a series of investigations on the genetic structure of the Eurasian beaver were undertaken by the Royal Zoological Society of Scotland (RZSS) in collaboration with numerous research institutions working with beavers across Europe. The main finding from this work was that the previous evolutionarily significant unit (ESU) divisions suggested for Eurasian beavers (separate eastern and western European ESUs: Durka *et al*. 2005) were not as genetically distinct as formerly described. Also, the genetic diversity of beavers from the original refugial populations is remarkably low, therefore their sole use as a source population is undesirable if no future mixing with other populations is possible. Using a genetically diverse founder stock of a large number of animals represents the lowest-risk genetic strategy for ensuring the long-term survival of a full reintroduction (Senn *et al*. 2014). As the SBT was only intended as a time-limited scientific trial, sourcing for any potential future reintroductions is not a key consideration here as, in theory, animals may be removed under instruction from the Scottish Government.

5.2 Trapping

Following the award of the Scottish Government licence, RZSS – acting on behalf of the SBT partnership – liaised with TUC and requested the trapping, holding and supply of four complete beaver families (comprising a maximum of between 12 and 18 animals) for use in the Trial. It was intended that three of the families would be released in Scotland, depending upon the need to hold back one family as a reserve in case of unforeseen circumstances (such as unexpectedly high levels of mortality in quarantine or following release).

Image 2: Trapping site in Norway for a family that landowners wished to be removed. In the foreground are Hancock traps set to try to capture the last remaining family members (photo: F. Rosell).

Image 3: TUC staff members searching for beavers to trap (photo: Mary Lou Aitchison).

Prior to the capture of the main group of four SBT families outlined above, a batch of eight animals (comprising two families, each with a breeding adult pair and two offspring) was wild-trapped for RZSS in January 2008. These animals were for use by RZSS as holding stock for their collections at Edinburgh Zoo and the Highland Wildlife Park, but with some consideration given to the fact that a larger pool of animals may be required to draw upon for the purposes of the Trial at a future date (should any further releases be permitted).

All originally imported beavers for use in the first release of the SBT were trapped during September 2008 using the Norwegian boat-and-landing-net method (Rosell and Hovde 2001), along with Hancock traps at some locations to ensure the capture of any remaining family members. Supplementary individuals were later trapped via the boat method by TUC and SBT staff on 30 April 2010 (one male sub-adult and one female sub-adult) and on 17 September 2010 (two sub-adult males).

All beavers were wild-trapped from the freshwater river systems in the Skien and Nome municipalities of Telemark (see image 4). Families were selected based upon the size and density of the local population, incorporating the views of local landowners in relation to the removal of entire family units. Most families were considered as 'surplus' and were likely to have been shot or trapped by local hunters if not removed for inclusion in the Trial. One of the original beaver families and all later trapped ('replacement') individuals were trapped from the study population area on the Straumen, Gvarv and Sarv rivers in Telemark, so individual animal details were well known.

For the initial trapping process, TUC staff spent many weeks identifying potential sites and families – and talking to landowners – while, in contrast, the actual trapping of each family tended only to take a few nights. Supplementary individuals were later selected based on their age and reproductive status. As these individuals resided within the long-term study area, they could be identified through micro-chip tags, having previously been trapped as kits, so their age and breeding status were known. By selecting sub-adults from a monitored family unit, we could be certain that they had not previously bred and were not paired at the time of trapping.

Image 4: The Nome and Skien municipalities of Telemark, Norway.

Due to the Trial's quarantine and release deadline and the family make-up constraints placed upon the trappers, some of the families captured during October 2008 in the Ulevannet and Rekatjønn areas were not considered to be in optimal condition for reintroduction purposes. However, they were still considered healthy and passed fit enough for importation and quarantine, with an expectation that body condition would improve following release. This fact may or may not be related to the subsequent poor condition and mortality of some animals during the UK quarantine process and is a consideration for any potential beaver releases in the future.

5.3 The use of family groups

Following on from SNH's original plans to release whole family units in Knapdale, a decision was taken by RZSS and Scottish Wildlife Trust staff at the time of application to trap, quarantine and release complete family groups. The rationale for this decision was based on the theory that a well-bonded family unit may settle more readily in captivity and hence be more likely to remain together following release. In effect, for the purpose of the Trial, small established groups would be translocated directly into the wild at Knapdale, which would facilitate their study within the relatively short time period of five years. This approach was also considered necessary to potentially reduce any rapid dispersal out of the Trial area – a sensitive issue for some local stakeholders worried about 'straying beavers'.

However, there are challenges associated with this approach. Firstly, it requires considerably more time and effort on the part of trappers to catch up entire family units within a given period and also to ensure that all members of a targeted family have been trapped (so as to guarantee that dependent young are not left behind). This had a resultant effect of increasing associated labour costs. Secondly, losses of individual animals during the UK quarantine period (six months' statutory rabies quarantine) considerably affected the composition of the majority of the family units, which subsequently impacted upon their suitability for release as a family. The experience of the SBT was that the resources required to ensure the trapping of whole family units, coupled with the mortality experienced in quarantine, meant that there was an increase in resource requirements and that a highly flexible approach to the final composition and use of family units was a practical necessity.

Image 5: Siblings in UK rabies quarantine (photo: M. L. Aitchison).
Image 6: Single replacement male sub-adult in Norwegian quarantine (photo: Prof. Frank Rosell).

In subsequent beaver importations, wild-caught individuals of dispersal age (two to three years old) were purposely selected, then either introduced to each other in captivity during the Norwegian quarantine period to try and establish pairs, or released as singletons in close proximity to available mates at the Trial site to try to facilitate the rapid formation of breeding pairs at the release site.

While the SBT partners originally chose to capture and release complete families, it is possible that the use of younger, paired animals *may* have resulted in lower mortality levels in quarantine if this approach had been employed from the beginning of the project. Some individuals and organisations also have the view that the use of captive-bred Eurasian beavers could be a more cost-effective way of obtaining acclimatised animals for such projects, particularly as there is a need to remove and relocate captive-bred juveniles from breeding groups at several locations within the UK. Although the cost of sourcing beavers for any future projects should not steer the decision-making process in relation to implementing a scientific trial reintroduction following IUCN guidelines, it remains a practical consideration for those planning a release.

5.4 Transportation to the UK

After the completion of quarantine in Norway, all the original animals were transported in custom-built transportation crates – following International Air Transport Association (IATA) Live Animals Regulations (IATA 2010) – by road to Gardermoen airport, Oslo, and then flown via Frankfurt airport (including an overnight stay) to London Heathrow airport. The first families captured were transported from Norway to the UK on 27 February 2008 and the second group on 20 November 2008. At Heathrow, the imported animals and their documentation were inspected by a veterinary surgeon appointed by the Department for Environment, Food and Rural Affairs (DEFRA). Following a satisfactory inspection, the beavers were transferred to a specialist captive-animal transportation contractor, James Cargo Services (Livestock), and driven directly to the quarantine facilities in Devon. The transportation of the initial batch of beavers – both in Norway and in the UK – was supervised in person by Professor Frank Rosell.

Images 7 and 8: Beaver transport crate (IATA regulation).

For the two later importations, the wild-caught beavers were held for a minimum of four weeks in Norway in an approved quarantine facility before being imported to Scotland under the Rabies Importation Order 1974 (as amended). In these instances, the beavers were flown directly from Oslo to Edinburgh airport, where they were inspected and processed by Extrordinair (approved by the Animal Health and Veterinary Laboratories Agency (AHVLA), DEFRA and EU Federal Veterinary Office) at the Border Inspection Post at Edinburgh airport. Based on an extensive veterinary risk assessment, on the absence of any rabies in the wild in Norway at the time, and on the absence of clinical signs in the beavers while being held in quarantine, the beavers were then issued release papers from rabies quarantine in the UK. These individuals were then transported by SBT and RZSS staff to either Edinburgh Zoo or the Highland Wildlife Park for a further four weeks for pre-release health screening (see section 7.2).

5.5 Recommendations

1. Provenance and sourcing of beavers for British reintroductions project should be discussed and agreed at a national level, including a pragmatic discussion on the latest genetic and veterinary information, IUCN guidelines, the status of beavers already present both in the wild and in captive collections, and the need for further beaver importation.

2. The trapping of wild animals is a stressful experience for these individuals, and the subsequent health effects of this stress should not be underestimated. Therefore, careful consideration of trapping, handling and transportation procedures and protocols, and temporary holding methods used should be carefully managed, and best practice employed at all times, as detailed in Campbell-Palmer and Rosell (2013).

3. The selection of suitable individuals should be done carefully and within sufficient time to ensure that only the healthiest and most suitable beavers are selected. Consideration should also be given to likely welfare challenges faced both by released beavers and by those deemed unsuitable for release.

4. If possible, a wider pool of animals should be trapped from the source area; and, following timely body-condition scoring and suitable health-screening procedures, only those best adapted and in the best physical condition should be selected for further transport, quarantine and release. The potential future consequences and welfare challenges for any individuals not deemed suitable for reintroduction should be considered and a strategy put in place to deal with these animals.

5. The capture of entire beaver families can be problematic and resource-heavy. Instead, the selection of young pairs or single animals of dispersal age (two to three years old), which can then be paired in captivity or left to pair naturally on release, should be favoured.

6. The duration of transport and number of loading/unloading events should be minimised for beavers in transit, along with associated noise, light, temperature fluctuations and sudden movement.

7. If beaver families are imported, it is important to consider the family-group structure, including age, sex and potential reproductive status of all individuals, as this may create various constraints upon their use and placement. The welfare of any unpaired and unused animals must be considered, including appropriate provisions for a life in captivity if they cannot be released.

6 Quarantine

6. Quarantine

6.1 Quarantine in Norway

All the wild-caught beavers were housed in their family groups, newly formed pairs or, on the last occasion, singly (two unrelated sub-adult males), within four separate pens at a specially constructed holding facility at Professor Frank Rosell's home farm in Telemark. All beavers underwent one month of statutory quarantine as required by the governing body, the Norwegian Food and Safety Authority (Mattilsynet), and were supervised by veterinary officers of the Norwegian Government for any notifiable diseases during this time. All enclosure designs, husbandry protocols and animal-welfare procedures followed regulations set down by Mattilsynet. One kit died during this quarantine period, and the cause of death was not established, therefore the rest of this family was subsequently released back to its own territory (Rekatjønn). Otherwise, all animals appeared healthy with no clinical signs of disease, poor body condition or behaviours causing any concern.


Images 9 and 10: Beavers in holding facilities in Norway (photo Prof. Frank Rosell).

All beavers had access to bedding materials, a submersible freshwater pool, *ad lib.* supply of fresh browse (including aspen, rowan and willow) and a daily provision of apples and carrots. A heat lamp was placed in the corner of each pen for individuals to seek if required.

A legal requirement of the Norwegian Food and Safety Authority for any animals intended for export is that a one-month quarantine period be undertaken and appropriate health-screening procedures be carried out within this time to prevent animals from exporting any disease or parasites of zoonotic concern to Britain, but also to ensure that all individuals are in a suitable condition for exportation. All individuals were passed suitable for importation by a veterinary surgeon from the Norwegian Food and Safety Authority. This procedure was followed regardless of whether individual beavers were required to undertake a further six-month statutory rabies quarantine in the UK, or were to be kept in captivity or put forward for future release.

6.2 Quarantine in the UK (England and Scotland)

The importation of wild-caught Norwegian beavers falls under the Rabies Importation Order 1974, as amended. Consequently, these initially imported animals were subject to statutory rabies quarantine in facilities approved by the Department for Environment, Food and Rural Affairs (DEFRA) for a statutory period of six months. All beaver families were quarantined by Derek Gow Consultancy Ltd in purpose-

built facilities at Broadwoodwidger Farm, Devon, between February 2008 (first families) and May 2009 (second families). These facilities were located on a working farm within a large, purposely adapted agricultural barn. The decision to outsource the quarantine of the majority of Scottish Beaver Trial (SBT) beavers to the south-west of England, rather than closer to the Trial site at in-house facilities belonging to the Royal Zoological Society of Scotland (RZSS), was due to the large number of animals involved and the need to follow strict DEFRA regulations throughout. Derek Gow Consultancy Ltd facilities were, with minor modifications, able to deal simultaneously with the large number of animals involved. This facility was run by staff with numerous years' experience in handling and quarantining beavers in captive settings.

Images 11 and 12: Rabies quarantine facilities in the UK.

Each beaver family was kept together within a metal-walled indoor holding pen, each provisioned with a heat lamp in one corner and with access to bedding, water pool and food. Small artificial lodges were built in advance of the animals' arrival, being placed in the corner of each pen and consisting of a straw bale wall and Onduline© sheeting roof. Each beaver family soon modified these materials and constructed its own lodges: within weeks, all the family groups had built substantial lodges from woodchip bedding, straw and the remains of browse material. Water was changed every other day, bedding added as appropriate, and the beavers fed on a diet of carrots, apples, fodder beet and willow. Fresh bedding was always quickly gathered up by the beavers and added to the lodge – and this presented quarantine staff with a dilemma over cleaning the pens. Pens require cleaning out each day, but removing soiled bedding and partially eaten food items that have already been 'built' into a lodge would potentially risk disturbing the beavers. As a consequence, staff tried to strike a balance on this matter.

6.3 Health screening during quarantine

In accordance with DEFRA regulations, all originally imported beavers were quarantined and were systematically health-screened to monitor for the presence of any potentially harmful pathogens. The fitness of the animals was also assessed. These animals underwent quarantine in England and were visually inspected once a week by an approved vet from the Penbode Vet Group, Holsworthy, Devon, who reported to the animal-health office on a monthly basis. For later importations, beavers were not quarantined in these English facilities and did not undergo the further health screening or inspection described above after the one-month quarantine period in Norway. However, extra health screening was undertaken prior to release by RZSS veterinary staff, largely to ensure individual suitability for release (see sections 6.4 and 7.2). Early release from rabies quarantine was issued for later beavers, based on veterinary risk assessments and the absence of clinical signs of rabies prior to exportation.



Images 13 and 14: Health screening by RZSS vets during quarantine.

Quarantine enabled the collection and analysis of faecal and blood samples to screen for notable diseases, potential zoonotic diseases and rodent pathogens. These included: *Tularaemia*, *Giardia*, *Cryptosporidium*, *Salmonella*, *Campylobacter*, *Yersinia*, *Shigella*, *Leptospirosis*, *Rickettsia*, *Mycobacterium microti*, lymphocytic choriomeningitis virus, cow pox and *Toxoplasma gondii*. All animals tested were negative for all of the above, with the exception of three individuals. Two of these displayed evidence of *Leptospirosis* antibodies, indicating that they had been exposed to this in the past; and a single animal that died in quarantine was found to be positive for *Giardia* (of origin unknown).

The presence of the *Leptospirosis* antibodies was not considered by the independent veterinary surgeon (Royal (Dick) Vet, University of Edinburgh) to be a problem in relation to the use of those animals in the Trial, as this is present in native Scottish mammal populations, and therefore released beavers were likely to be exposed to it regardless. The only parasite reported in many of the animals was the host-specific intestinal fluke, *Stichorchis subtriquetrus*. This is present in beaver populations across Europe and does not infect other species, nor is it of health concern to humans. As such, it is not considered a significant issue for any potential future releases. In addition, treatment for this parasite was not available in the UK or the EU – and, as the parasite appears non-pathogenic, the decision was taken not to treat the infected individuals. A summary of the health-screening procedures and findings was published (Goodman *et al*. 2012).

6.4 Mortality during rabies quarantine

A statutory six-month quarantine period can be a challenging experience for any wild-trapped animal. In order to allow vets to follow UK rabies legislation inspections, animals have to be easily accessible, and this means placing them in confined conditions that are clearly sub-optimal for many species. The SBT partners believe that they provided the best facilities available at the time for such a number of animals, but clearly these beavers could not express the normal range of natural behaviours and activity while dwelling for an extended period in an enclosed and high-density environment. It is not uncommon for animals, including beavers, to lose body condition or to develop illness in quarantine, resulting in a worsening of their condition or even death. Mortality of quarantined beavers has been reported in the past (D. Gow and F. Rosell, pers. comm.), and the Trial partners suspected that some animals could be lost through this process.

The first two families quarantined by Derek Gow Consultancy Ltd on behalf of RZSS all survived and were passed fit in August 2008 before being transported to the Highland Wildlife Park and to Edinburgh Zoo in November 2008. The second batch of animals (those specifically trapped for the SBT), however, did not fare as well. Out of a total of 17 animals, five died during rabies quarantine and two in captivity

shortly afterwards. Detailed post-mortems were carried out by independent veterinary pathologists (Veterinary Laboratories Agency, Starcross, Exeter; and Scottish Agricultural College, Bush Estate, Penicuik), and all animal health and welfare matters were overseen by the independent Trial veterinary surgeon. The findings reported that these individuals died as a result of a variety of infections and illnesses, leading on the whole to very poor body conditions with no common causative factor.

It is not possible to state conclusively whether the quarantine conditions specifically caused the death of these individuals; but very few animals seem to thrive during the quarantine process. On average, most beavers lost bodyweight and condition between their capture in Norway and their subsequent release in Knapdale. Juvenile adults displayed increases in body mass, but their release weights tended to be lower than wild individuals of similar age and season. This was most marked in the second batch of beavers, which progressed directly from quarantine to release and, unlike the first batch, did not spend time in larger enclosures following quarantine.

6.5 Reduced rabies quarantine requirements

Prior to the capture of the four additional beavers in March 2010, the RZSS Head of Veterinary Services had begun discussions with Scottish Government veterinary advisors regarding the details of the rabies quarantine requirements for the SBT beavers. The beavers having successfully passed through health checks (including blood and faecal screening for diseases stated above) and having exhibited no signs of rabies during the one-month quarantine period in Norway, the Scottish Government granted permission for the latter sub-adults (two individuals captured in March 2010 and a further two sub-adult males in September 2010) to be imported in accordance with The Rabies (Importation of Dogs, Cats and Other Mammals) (England) (Amendment) Order 2004, which permits the importing of rodents to zoos and research institutes without rabies quarantine. It was therefore possible for these particular beavers to be immediately released without undergoing any further quarantine in the UK and, pending negative test results, to be made available for release into Knapdale.

6.6 Recommendations

The mortality levels associated with the main batch of wild-caught beavers quarantined for the SBT suggests that further research and management improvements need to be made to increase survival rates and animal welfare during the quarantine process. Post-quarantine discussions with various expert personnel generated the following recommendations for any future quarantine of beavers:

1. Further research should be undertaken to investigate mortality rates for beaver quarantine and captive holding facilities currently within the UK, with potential extension to European collections and projects.

2. Action should be taken to develop and roll out ‘best practice’ guidelines for beaver quarantine and holding facilities. Existing captive-collection holders are encouraged to review current husbandry protocols and to implement methodologies as detailed in Campbell-Palmer and Rosell (2013).

3. Small water pools are not recommended, particularly when they are shared with a number of individuals. If these must be used, they should be changed every day to prevent the potential accumulation of ammonia levels and faeces, which could lead to health issues. Such daily cleaning regimes should also ensure that beavers have an appropriately covered area within the enclosure where they can retreat, particularly while humans are in such close proximity and while entry to water is temporarily prevented. Alternatively, a suitable filtration system could be implemented

into bathing pools, producing a water current which would make the beavers actively swim and would potentially provide a form of exercise for them in captivity. Ideally, water pools should be as large as possible while maintaining optimum hygiene conditions.

4. Wild shrub browse taken from the release site should be introduced to the animals while in captivity to allow a gradual change in gut flora. A diet based predominantly on root vegetables and fruit is not recommended for nutritional, physiological and behavioural reasons, especially for wild-caught beavers, even though this is currently a common practice for captive beaver diets.

5. Beavers should be quarantined in low densities or small batches.

6. If possible, beavers should be quarantined in an open environment in outside captive pens, with larger pools.

7. Discussions at a national statutory level are required within the UK in order to determine whether the six-month quarantine period is a practical necessity for imported wild-caught Norwegian beavers.

7

Trial area and beaver releases

7. Trial area and beaver releases

7.1 Trial area

Knapdale Forest (see image 15) was selected as the Trial site, as it was considered to have the following positive characteristics:

i. it was thought to be ecologically suitable for beavers;
ii. it provides a range of terrestrial and freshwater habitats and species, which could be evaluated during monitoring;
iii. natural containment was considered to be relatively good, with steep ridges to the east and the sea to the west;
iv. it is a working forest, which allowed an assessment of beaver impacts on forestry practices;
v. there is one main landowner, Forestry Commission Scotland (FCS) (with four small private properties found within the Trial area);
vi. there is good access for field workers and visitors, with an extensive network of forest roads and trails;
vii. local Scottish Natural Heritage (SNH) and FCS offices are located nearby;
viii. local people were generally supportive and interested;
ix. visitor facilities were already on-site;
x. visitor disturbance was likely to be low in the core part of the Trial site; and
xi. the Scottish Wildlife Trust had over 25 years of experience working in partnership with FCS at the Faery Isles in Knapdale Forest, which was for many years a leased Scottish Wildlife Trust wildlife reserve.

The Trial site includes a Site of Special Scientific Interest (Knapdale Woods SSSI), notified for its breeding birds, bryophytes, lichens, dragonflies, loch trophic ranges and upland oak woodland. The SSSI is also part of a wider Special Area of Conservation (Taynish and Knapdale Woods SAC), designated for its oak woodland, freshwater lochs, marsh fritillary butterfly *Euphydryas aurinia* and otter *Lutra lutra* interests. The Trial site also contains part of the Knapdale Lochs Special Protection Area (SPA), cited for its black-throated diver *Gavia arctica* population. At the time of the previous SNH licence application in 2002, an 'appropriate assessment' of the proposed Trial was undertaken for Taynish and Knapdale Woods SAC (in terms of Articles 6.3 and 6.4 of the Habitats Directive, as enacted through Regulation 48 of the Conservation (Natural Habitats etc.) Regulations 1994 (the 'Habitats Regulations'), for the trial reintroduction of the Eurasian beaver to Taynish and Knapdale Woods SAC). On the basis of the analysis undertaken, it was considered that there would be no adverse impact on site integrity as a result of the trial reintroduction of beavers to Knapdale, if subject to certain conditions. In 2008, SNH also provided detailed advice to the Scottish Government regarding an appropriate assessment of the SBT partnership's proposal. The area also forms part of the North Knapdale National Scenic Area, and the forest also hosts a number of low-key FCS recreation facilities comprising an information centre, a series of walking and cycling trails, and several public car parks. While most of the local lochs are leased to the local angling association for fishing, the whole site has open access as covered by the Scottish Outdoor Access Code (SOAC).

Image 15: Trial area and designated sites. Inset 1: Knapdale Peninsula. Inset 2: Location in Scotland.

The Knapdale peninsula (see inset 1 of image 15) in Mid-Argyll is bounded by the Crinan Canal to the north, by East and West Loch Tarbert to the south, by Loch Fyne to the east and by the Sound of Jura to the west. The northern part of the locality containing the Trial site comprises a series of ridges (knaps) and small valleys (dales) aligned north-east to south-west, which range in altitude from sea level to 276 metres. The western (sea-bound) and central sections of Knapdale Forest are bisected by heavily wooded knaps and a series of sea and freshwater lochs. The freshwater bodies range in size from small lochans to lochs 2 km long, which are interconnected by small burns draining to the sea in a southerly direction.

Knapdale Forest comprises a complex mosaic of native broadleaf woodland and 20th-century conifer plantations. From 1985 onwards, following a review of broadleaf forest policy, a major restoration programme of conifer harvesting and felling to recycle took place in the core area of native woodland in Knapdale. This was accompanied by a major effort by FCS to reduce the resident deer population from over 20+ per square km to the current level of 15 per square km. This has resulted gradually in significant levels of natural regeneration of native woodland. Broadleaves, predominantly birch (*Betula* spp.), and

to a lesser extent willow (*Salix* spp.), alder (*Alnus glutinosa*) and hazel (*Corylus avellana*), are mainly associated with the lochs. Oak (*Quercus* spp.), scattered sycamore (*Acer pseudoplatanus*) and aspen (*Populus tremula*) also occur but are mostly confined to slopes along Loch Linne and to the Fairy Isles and Bàrr Mor peninsulas in the south-west of the area.

The Trial area (image 15) covers approximately 44 square km, with the Trial boundary being set by FCS as their area of national forest estate in Knapdale. At the time of licence application, there existed in the area approximately 15 km of riparian habitat thought to be suitable for beavers. The landform and resultant hydrology, coupled with the distribution of forest and riparian habitats suitable for beavers, was thought to provide a degree of natural containment. The steep escarpment along the north boundary, the conifer plantations to the east and west, and the saltwater lochs to the south and west were considered to be deterrents to beaver movements.

Knapdale Forest, like much of the surrounding area, is rich in archaeological history and remains. The Trial area contains 13 Scheduled Ancient Monuments (SAMs) and 125 Unscheduled Ancient Monuments (UAMs). All scheduled sites were covered by legally binding SAM management plans between FCS and the national governing body, Historic Scotland. One of these SAMs is a submerged crannog in the south-east corner of Loch Coille-Bharr and is a site considered potentially susceptible to disturbance and damage from beaver activity.

The Trial area also has a relatively good visitor infrastructure owned and managed by FCS, which includes five forest trails (Dunardry, Coille-Bharr, Barnluasgan Oakwood, Arichonan and Crinan), four car parks (Dunardry, Barnluasgan, Coille-Bharr and Gleann a Gealbhan), two picnic areas, an interpretation centre and an all-abilities trail at Barnluasgan. Additionally, FCS has other forest trails, car parks, interpretation panels and a mountain-bike trail in the wider forest beyond the Trial area.

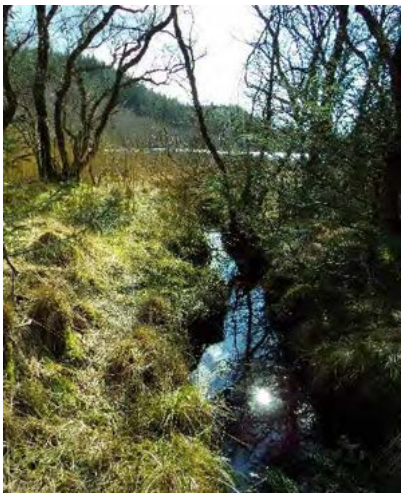
The release lochs

Initially, three freshwater lochs within the Trial area were identified in the site-selection process as the most suitable release sites. These were Loch Coille-Bharr (NR 783902; images 16–17), Loch Linne/Fidhle (NR 797908; images 18–19) and Creag Mhor Loch (NR803909; image 20). These lochs were chosen following a site visit in November 2008 by experts from Telemark University College (TUC), Norway. The sites were considered to be of sufficient area and habitat quality to each prove adequate for at least one average-sized beaver territory. All the large waterbodies in the Trial area were visited and ranked according to their suitability for beavers. Most of the release lochs were in close geographic proximity and were connected to varying degrees by watercourses. The locations of the networks of waterbodies were thought to be likely to increase the chances of dispersing beavers meeting one another and potentially establishing new territories. According to Rushton *et al*. (2002) and Rosell (pers. comm.), it was estimated that, based upon an average territory size of around 2 km of riparian bank, the Trial area contained sufficient habitat for around 25 beaver territories in total.

Images 16 and 17: Loch Coille-Bharr.

Images 18 and 19: Loch Linne/Fidhle.

Image 20: Creag Mhor Loch.

Images 21 and 22: Lochan Buic and outflow – typical of watercourses connecting some of the release lochs


Images 23 and 24: 'Lily Loch' (also referred to as 'Unnamed lochan south of Lochan Buic' in independent monitoring reports).

Later release lochs – Lochan Buic (NR 788889; image 21) and the 'Lily Loch' (NR 788887; images 23–24) – were also selected based on these previous recommendations, but also on site assessments and views of the SBT field staff, taking into account connectivity with other beaver families. Creag Mhor was used again as a release site, as the dispersal of the original family was not deemed to be due to the habitat quality of this site.

7.2 Selection of release animals

As the end of the quarantine period approached for the initial 17 individuals captured in October 2008, it became clear that as a result of mortality in quarantine there would not be three complete families suitable for release by the scheduled release date (end of May 2009). It was decided, therefore, to investigate the use of the previously quarantined animals (two families) held by the Royal Zoological Society of Scotland (RZSS) at Edinburgh Zoo and the Highland Wildlife Park for the purposes of the release. Following discussions with the Scottish Government (Landscapes and Habitats Division), permission was granted to draw upon these eight individuals, as they had all been wild-caught in the Telemark region of Norway and had been quarantined and appropriately health-screened.

The main rabies quarantine period in Devon was completed on Friday 22 May 2009. A veterinary surgeon registered with the Department for Environment, Food and Rural Affairs (DEFRA) completed a final health check on all individuals, which were passed fit for release in terms of disease absence (notably rabies). However, it was noted that some individuals remained in relatively poor body condition following their lengthy period in captivity. Of the four beaver families remaining in rabies quarantine at that time, only a single complete family of three animals (captured on the River Lunde in Telemark) was considered fit for the initial release as a family unit.

In the weeks prior to release, further health screening was undertaken for the two beaver families held by RZSS, along with the complete family from rabies quarantine. Holes for tail-tags were made in all adult animals. These holes were kept open with short sections of thin plastic tubing and spacing washers. This was to facilitate the use of tail-mounted radio transmitters on release which could be inserted into the pre-punched holes prior to (rather than at) release, reducing the likelihood of tail infections after release. Pre-release health screening was undertaken by the independent veterinary surgeon, while the RZSS Head of Veterinary Services undertook later pre-release examinations. These pre-release health screens were based on International Union for Conservation of Nature (IUCN) (Woodford 2000) and DEFRA guidelines, and are well documented (Goodman *et al*. 2012; Campbell-Palmer and Rosell 2013). Their main purpose was to ensure that each individual was in good body condition, had no dental complications that could interfere with normal feeding, and had no obvious indications of illness or injuries (and hence was determined capable of survival upon release).

Image 25: Tail-bolting with temporary washers to keep the hole open during quarantine for later tail-tag attachment upon release (left); and Image 26: a dental check (on an anaesthetised animal) pre-release (right).

7.3 First release of Trial animals

Prior to the release of the first three beaver families, considerable effort was spent on the planning of the release process by various Scottish Wildlife Trust, RZSS, FCS and SNH staff members. Not only did the release need to consider the transportation, temporary holding, health-checking and physical release of the beavers themselves, but also ground preparations were required at the release site, and the complicated logistics of the release 'event' for the media, Trial funders and other personnel involved needed to be arranged.

Inevitably, any project of the scale and profile of the Scottish Beaver Trial will always involve many different organisations and individuals, sometimes with differing objectives – and this can be a challenging process to manage. Through the planning and implementation phase of the Trial, it was

considered essential to focus on the core objectives of the release process to successfully launch a scientifically monitored reintroduction trial. This would also help to ensure that the welfare of the animals came above any other considerations such as media coverage or funder care.

Animal processing

Beavers were directly transported either from the Highland Wildlife Park, Edinburgh Zoo or the Devon quarantine to a holding facility at the Trial site (see section 7.4). All beavers were transported in individual crates, apart from the single yearling which was crated with its mother. As releases were due to take place in the morning, all animals were transported to the site the day before and held in transport crates overnight. The pre-release processing procedure saw each individual removed from the transport crate at the holding facility, checked by the independent veterinary surgeon, weighed and fitted with a tail-tag before being re-crated in lightweight plastic 'Vari-kennels' and transported to their respective release lochs. This process was filmed, and a number of key personnel were involved.

Timetable of the first release

A detailed release plan was drawn up in advance of the release, aiming to identify and clarify all the timescales, locations and various tasks involved on the two initial release days. This was circulated to all relevant staff ahead of the release. In total, 11 beavers consisting of three complete families were released into the Knapdale Trial area on 28 and 29 May 2009 on Loch Linne, Loch Coille-Bharr and Creag Mhor Loch. The release points (including subsequent release points) are shown in image 27.

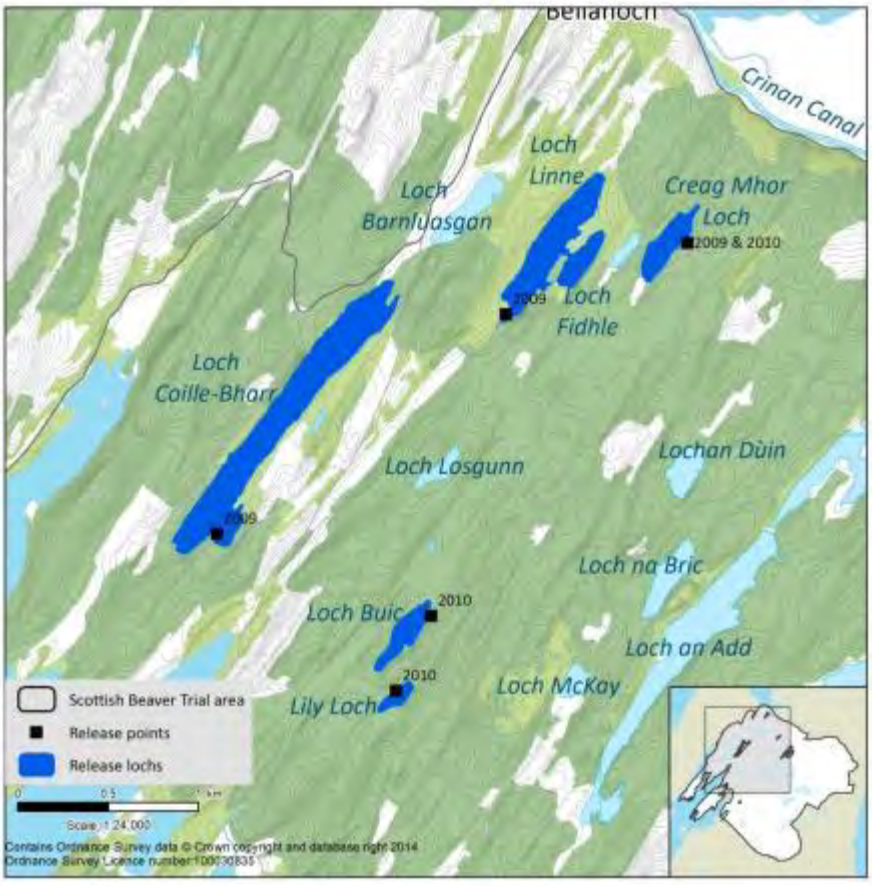


Image 27: Beaver release sites.

The chronological order of actions listed in the following table is a brief summary of the release timetable and is taken from a more detailed release plan. The decision to phase the release of the beaver families over two consecutive days rather than on one day was made in order to ensure that the Scottish Minister for the Environment and Climate Change could be present for a release process and the official launch of the Trial. For the purposes of the official independent monitoring of the Trial, all releases were observed by SNH staff.

Wednesday 27 May 2009	• Media Invite was issued to all local and national press. • Briefing for all personnel involved. • Animals from Edinburgh Zoo and Highland Wildlife Park were transported to Knapdale.
Thursday 28 May 2009	• Animal processing at the holding facility at the Trial site. Each individual was taken from its transportation crate; PIT tags were checked, and radio transmitter tags fitted to selected individuals by SBT and RZSS staff. Sample collection (hair, faeces, castoreum, anal gland secretions and blood) and body measurements (tail and body dimensions and weight) were collected under the supervision of a veterinary surgeon. Due to time and animal welfare constraints within the holding facility, it was not possible to collect all samples and measurements from every individual at this time. All processed animals were then transferred to release crates (Vari-kennels). This pre-release processing was filmed and photographed.
<u>Loch Coille-Bharr and Loch Linne/Fidhle releases</u>	• After animal processing was completed, the accompanying staff, SNH observers and invited guests were transported from the holding facility to the release sites (Loch Coille-Bharr and Loch Linne/Fidhle). • Animals were carried on foot from the vehicles to the respective artificial lodges and then transferred from their respective release crates into the artificial lodges. The releases were filmed and photographed. • While this first family was being released, the second family was being processed at the holding facility.
<u>Post-release</u>	• Each family was observed every three hours by field staff until nightfall, via visual observation and radio telemetry.
<u>Other activities</u>	• VIPs arrived at a nearby hotel and were given a short presentation on the release process, followed by a site visit with the SBT Field Officer to see a release lodge.
	• Breakfast news media activity (interviews, photos, filming) on site at Loch Barnluasgan. • Animals were processed at the holding facilities, then transported to the release point at Creag Mhor Loch and were met by VIPs. This family was released in same manner as above. The entire process was filmed and photographed. • The Scottish Government Minister presented the official launch of the SBT to various representatives, funders, delegates and VIPs at Loch Barnluasgan. The process was filmed and photographed.
<u>Post-release</u>	• Lunchtime until early evening: news broadcast activity at Barnluasgan. • Each released family was observed every three hours by field staff until nightfall, via visual observation and radio telemetry.

Image 28: SBT staff transfer a beaver into an artificial lodge.

Image 29: Roseanna Cunningham MSP and Allan Bantick (ex-Scottish Wildlife Trust Chairman) assist in transportation.

Review of the first release event

By early evening on Friday 29 May 2009, three beaver families had been released successfully into three separate lochs within the Trial area, and the associated media event and Ministerial launch had gone well and largely to plan. The Trial had now officially begun, and the first tracking and observation sessions were under way – the start of a five-year-long monitoring programme. While this was considered by many to be a successful and historic day for Scottish conservation, it was important to critically review the release process and to establish lessons learned for any future events. To achieve this, all of the personnel involved in the release and media launch were asked for their feedback on the planning and execution of the releases and associated activity. Some key learning points that emerged from this review included:

- There was good preparation and detailed forward planning of the releases.
- The public-awareness and media aspect of the releases was executed well, with good provision of interpretation, VIP management and media handling.
- The number of personnel in the immediate vicinity of the beavers prior to release could have been managed better in order to reduce noise and scent levels, which may have potentially stressed the animals during processing.
- The immediate post-release surveillance period could have been better coordinated among staff from the partner organisations.

7.4 Holding facilities

Prior to the initial release, it became clear that a suitable animal-holding facility would be required close to the Trial area. It was hoped that this facility would have the following functions:

- to provide a secure, sheltered environment to undertake any pre-release processing of the beavers (e.g. tail-tagging, welfare checks, sample collection and so on);
- to provide an environment where a small number of animals could be temporarily housed (if required) during the initial post-release phase of the Trial, i.e. injured animals awaiting veterinary inspection or treatment, replacement animals and so on.

A suitable outbuilding was secured at Dunans Farmhouse within the Trial area (grid reference NR808905). The owner of the building gave the SBT permission to use one room of this building in which to erect two metal dog-runs to create a temporary holding facility, which was erected two weeks prior to the initial beaver release. After the first releases, it was decided that this facility was no longer required, as rapid capture and transportation methods were available through RZSS which allowed any beavers requiring medical attention or captive holding to be moved at short notice to veterinary facilities either at Edinburgh Zoo or at the Highland Wildlife Park. Therefore, after discussion with the property owner, the metal dog-runs and associated materials were dismantled and removed from site.

7.5 Release methods

The release of animals in reintroduction projects is generally undertaken through one of two different approaches, by either 'hard' or 'soft' release (Bright and Morris 1994; Letty *et al*. 2000). Hard release involves the release of animals directly into their new environment from transit crates, without provisioning of any holding structures, and is based upon the presumption that the animals will quickly find their own food and shelter. The soft-release process involves the release of animals into their new environment in a more controlled manner, using pre-prepared holding structures to retain animals at the release point and allow them to acclimatise to their new surroundings in a more gradual manner before they are fully released to fend for themselves. Supplementary food may also be provided for the first few days following release. Soft release is designed to provide animals with a degree of support to allow them to cope better with the stress of the release process, as well as encouraging them to remain at the specific release site. Stress associated with translocations is known to have a negative impact upon animal health and can be related to post-release mortality levels (Teixeira *et al*. 2007). Both hard and soft release methods were described in the licence application made to the Scottish Government; but, for the initial release, it was decided that a soft release would be the main approach taken.

Following designs used for beaver releases into enclosures elsewhere in the UK, artificial release lodges were constructed on the water's edge of the three initial release lochs by SBT field staff and volunteers a few days prior to release. These lodges were constructed in order to hold the animals and allow them time to settle immediately after release, providing shelter and supplementary food until they constructed their own burrows and started foraging independently. The exits/entrances to the artificial lodges were blocked using vertically-driven brushwood pieces designed to provide a temporary barrier which the animals would eventually gnaw through to exit the lodge. On the day of release, these barriers proved ineffective, and all the beavers broke through the brushwood barriers from the artificial lodges within minutes of their placement into the rear of those lodges, so in reality the soft-release process turned into a hard release.

Image 30: Building an artificial lodge structure; and Image 31: a finished artificial lodge pre-release covered in brash materials.

The ability of the beavers to immediately exit the lodges was attributed to the 'doors' of the lodges not being solid enough, allowing too much light to enter internally into the artificial lodge. This encouraged the animals to immediately break free. Following this initial release, none of these three family groups appeared to return to the artificial lodges. There was evidence that family members constructed burrows or land 'nests' in their own preferred locations within 150 to 1,500 metres of the point of release.

While the use of artificial lodges of varying designs is widespread in many beaver-release programmes across Europe, there is currently no scientific evidence to demonstrate that they are effective in contributing either to the success of the release or to post-release survival rates. There is, however, anecdotal evidence that the use of subterranean sealed lodges helps to reduce rapid individual dispersal when a family group is simultaneously released (Andrzej Czech (Poland), pers. comm.). Some experts are of the opinion that the deliberate confinement of beavers in an artificial lodge, which has a strong scent of humans and is usually immediately preceded by a stressful transportation period, can only increase stress levels for the animals concerned. This indicates that research is needed to clarify the situation, as has been undertaken on other species (Molony *et al.* 2006; Hardman and Moro 2006) to further understand the differences in approach and to improve release and reintroduction success rates.

For later releases in Knapdale (in 2010), the procedure was changed following discussions between the SBT team and TUC. This decision was based on animal requirements, considerations of mortality in quarantine and amended quarantine requirements, considerations of potential stressors and mortality experienced during the first release, and the lack of successful retention of beavers in artificial lodges. A major difference between the initial and latter releases was the family composition, age class and breeding status of the individuals involved. Primarily, subsequent releases did not use whole family groups. The release process was therefore modified in light of these considerations. Artificial lodges were still built in advance, but these were not used as the actual release point. Instead, prior to the release, food and used bedding from the individuals being released were placed inside these lodges. The theory behind this was that the beavers would have shelter if required and a source of food (similar to their diet in quarantine), and familiar scent without any of the stress and human handling associated with being placed into an artificial lodge.

The beavers were released in the late afternoon, instead of in the morning, at a point on the shore of the loch opposite the artificial lodge (so that they were likely to find it easily if needed). The process involved far fewer personnel, with noise kept to a minimum. The animals were carried in their travel crates to the water's edge and the doors opened. Animals were allowed to exit in their own time and investigate their new surroundings. The personnel present observed this to be a quicker, calmer process; and, in total, five beavers were released in this manner in three separate release events (see section 7.6).

In each instance, the beavers were observed from the loch shore for one to two hours after release. All of these individuals tended to display the same behaviours, being generally slow and deliberate in their behaviour, without any sudden movements or bursts of speed (of which beavers are capable), taking their time to come out of their travel crates. Individuals tended to stay in close proximity to each other and worked their way around the edges of their respective release lochs, swimming and coming onto land at various points to sniff and feed.

The last release (21 September 2010) was slightly different again. In this case, only a single male animal was released in the hope that it would form a pair with a previously released but 'widowed' female. The procedure was a soft release, but in this case scent (castoreum) from the individual being released was

placed into both the artificial lodge and around the bottom end of the release loch (at the opposite end from the occupied lodge), where there was also a loch outflow. The aim here was to replicate the behaviour of a new potential mate investigating the borders of an occupied territory and scent-marking. Dispersing beavers will make exploratory investigations, and it was theorised that the artificial scent-marking would alert the resident female that a male and potential mate was in the area. It was hoped that this would give her time to investigate the scents and the information they contained, so that when the male was released she might recognise him and seek to form a pair bond rather than attack him as an unknown animal. This approach appeared, from observations and behaviour, to be successful: on the evening of the release, the resident female came out of her lodge about 20 minutes after the male was released. They engaged with each other immediately – and, though she did display more dominant behaviours ('wrestling'), there was no fighting, and the beavers interacted with each other for the entire time until the observers left the site.

Images 32 and 33: Subsequent 'hard' releases (2010), with a smaller number of observers, and beavers allowed to exit travel crates in their own time.

7.6 Subsequent releases

Following the initial 2009 release of three beaver families, the view held by the SBT partners and SNH was that at least four established breeding pairs were required for the purposes of the Trial so that enough data could be generated for the Independent Monitoring Partners to draw their conclusions. The release of the fourth family was considered necessary in order to form a 'critical mass' and allow meaningful interpretation of the Trial population, observing and scientifically demonstrating effects of beavers living in a modern Scottish context. This led to detailed discussions between the SBT partners and SNH about the potential need to use replacement beavers to meet this four-beaver-family/pair threshold, should adults of breeding age suffer significant levels of mortality or dispersal from the Trial site. In mid-May 2010, the SBT partners wrote to the Scottish Government (via SNH) to request permission to release replacement, wild-caught adult Norwegian beavers if necessary, within the first two years of the Trial, for the purposes of maintaining four breeding pairs (and thus ensuring that the scientific monitoring aspects of the Trial could be completed). This proposal fell outside of the existing Scottish Government licence, and an amendment to the licence was therefore required. Permission was granted by the Scottish Government on 10 June 2010 and an amendment to the licence confirmed (see Appendix 2).

Release of the fourth beaver pair – 4 May 2010

After local consultation and site visits with FCS and experts from TUC in November 2008 and December 2009, a suitable release site for the fourth pair was chosen at the unnamed loch (south), or 'Lily Loch' as it was known locally (see image 27). The site was considered to have good habitat for beavers and able

to support a family group. The loch was also situated in an area with other suitable beaver habitat nearby, including watercourses which potentially link this area with some of the lochs in the first release area to the north-east. These routes were considered to be important dispersal corridors for beavers, particularly any future juveniles attempting to set up new territories and meet potential mates from neighbouring family groups.

An important experience of the first releases had been the rapid dispersal of the first Creag Mhor family (discussed in section 8.1). Therefore, in an effort to reduce the likelihood of the fourth pair dispersing completely from the release site and potentially the southern extent of the Trial area, two sections of beaver-deterrent fencing were built by a local contractor ahead of release on the far end of both outflow burns in the vicinity of the release loch. These deterrent fences (see section 9.7) were designed to turn any dispersing beavers around and to encourage dispersal in the opposite direction, i.e. back into the release site as opposed to leaving the Trial area via these two outflow burns.


Images 34 and 35: Male, 'Tallak', and female, 'Trude', being transported to and released at Lily Loch, 4 May 2010.

As a result of the mortality levels experienced in quarantine, there were no remaining complete families or established adult pairs of beavers to draw upon, and therefore it was necessary for the SBT partners to establish a new pair of beavers from healthy individuals remaining in captivity. The beavers – a 'widowed' adult male ('Tallak') and a female sub-adult ('Trude') from separate families quarantined in Devon between November 2008 and May 2009 – were gradually pair-bonded in captivity at the Highland Wildlife Park facility. The pair had no surviving or dependent offspring.

The release took place on 4 May 2010 and went according to plan, with the pair of beavers being regularly observed by field staff and exhibiting normal behaviour for the first few weeks. The pair also took up temporary residence in the most southerly of the artificial lodges. Unfortunately, the adult male was found dead nearly a month later (see section 7.7, final paragraph). Soon afterwards, the now unpaired female beaver moved from Lily Loch to the neighbouring Lochan Buic, where she has remained for the rest of the Trial period, behaving in a natural manner, passing all health checks and later going on to re-pair and breed.

Release of the pair to replace dispersal of Creag Mhor family – 23 June 2010

In line with the Scottish Government permission to release replacement animals, a pair of young beavers (trapped in Norway and held temporarily at the Highland Wildlife Park) were subsequently released onto Creag Mhor Loch on 23 June 2010 to act as a replacement for the original family that had been released at that site in May 2009 but had subsequently dispersed and become lost from the Trial (see section 8.1).

The release of this fourth pair in June 2010 meant that there were no suitable remaining beavers left in captivity from the original quarantine batches. This meant that it was necessary to capture, quarantine and transport a new pair of wild beavers from Norway. Therefore, ahead of the release of the fourth pair, a juvenile male and female were captured individually from separate families in Telemark on 26 March 2010 by staff from TUC. They were then held in quarantine conditions for one month and gradually pair-bonded in the process. After completing all necessary health checks by Norwegian state vets, they were transported to Edinburgh Zoo prior to release.

As described in section 7.5, these beavers were hard-released at the water's edge by a small team including SBT field staff, observers from FCS and SNH, a representative of the local branch of the National Farmers' Union Scotland and a local councillor, who also chaired the SBT Local Stakeholders' Forum. A 100-metre-long section of deterrent electric fencing was erected ahead of the release at the north end of the loch, and was designed to deter the beavers from dispersing northwards from the release site towards the nearby Crinan Canal. Two artificial lodges were also built prior to release on the western shore of the loch. After exploring their new surroundings, the pair settled and also began to frequent the neighbouring Lochan Beag (NR802910) along with the original release loch. Several days after release, field staff radio-tracked the female moving approximately 2 km further south into the Trial area along a narrow stretch of burn towards Lochan Buic, where the unpaired female beaver 'Trude' was resident. She then appears to have returned the following night. There was no evidence that any beavers attempted to breach the deterrent electric fencing.

Image 36: Replacement beaver pair 'Eoghann' and 'Elaine' emerging after release at Creag Mhor on 23 June 2010.
Image 37: attached ear-tags and RF transmitter on rump.

Image 38: Electric deterrent fencing at Creag Mhor Loch.

Release of single male at Lochan Buic – 21 September 2010

The last animal release to occur as part of the SBT was of a single male sub-adult that was wild-trapped in Norway along with another male approximately two years old. These individuals were selected for potential pair formation with 'Trude', the single female remaining after the death of the adult male she was paired with as part of the fourth pair release. Again, both these males underwent reduced rabies quarantine. The male selected for release, 'Christian', had slightly better body condition and weight. The release process mirrored that of June 2010; and this seemed to be successful, with the pair being regularly observed together and the male soon taking up residence with the female in the lodge she had created.

7.7 Release-associated mortality

Of all the releases, only one juvenile male beaver died within a few hours of release, at Loch Linne on 28 May 2009. During the animal-processing period, this individual had been observed staggering slightly when coming out of the transportation crate at the holding facility. It was then examined by the veterinary surgeon present; a swollen toe and missing nail on the fourth digit of the right forepaw were observed. This appeared to have been an older injury, probably picked up in captivity. Terramycin spray and Meloxicam were administered to clean the wound and provide pain relief in case the animal was in discomfort. Afterwards, this individual was considered fit for release. Following re-crating and transfer to the release site, just prior to release, this individual was observed to be lying on its side. It was again visually examined by the veterinary surgeon present and was left to recover in a darkened travel crate for approximately 20 minutes. After this time, the animal had righted itself and was responding to stimuli. The decision was taken to release this individual rather than separate it from its family. Overnight post-release observations by SBT field staff confirmed that the beaver had been seen in the loch attempting to feed, but it was bumping into obstacles and swimming in an abnormal manner. On check-up the following morning, this individual was unfortunately found dead along the water's edge close to the artificial lodge.

Until this time, the animal had exhibited a normal range of results during quarantine and holding, and the follow-up post-mortem suggested that it had suffered heart failure. The causatory factors were inconclusive, although the effects of stress associated with capture, transport and release cannot be ruled out. Regardless of the actual cause, this incident reinforces the need to minimise stress to an animal when carrying out animal-handling and transportation activities.

For all releases, beavers were monitored by field staff and local volunteers twice every 24 hours in order to get a visual observation from a discreet distance, assess their condition and behaviour (using binoculars and a telescope) and verify their radio-tag signal by telemetry. This post-release tracking programme lasted for 10 days before visits were reduced to every other day, then every third day and eventually to the normal frequency of all tracking Trial animals: once a month.

After a couple of weeks, the post-release tracking showed that the adult male beaver released on to Lochan Buic as part of the fourth release had not been seen for several days, although his radio-tag signal was still very strong. On 27 May 2010, SBT field staff decided to enter the artificial lodge and unfortunately discovered that the male had died. His body was removed, and the subsequent post-mortem revealed that he had lost body condition rapidly after release, apparently as a result of not feeding adequately and failing to adjust to his new surroundings. Although a blow to the Trial, such mortality needs to be seen in context with similar beaver reintroduction programmes in Europe. The capture, handling and translocation of wild animals are recognised as stressful procedures, though they

are essential to the reintroduction process. First-year mortality rates in translocated beavers have been reported as 14% in Poland (Zurowski and Kasperczyk 1988), 17% in Germany (Heidecke 1986) and 36% in the Netherlands (Nolet *et al.* 1997).

7.8 Recommendations

The lessons learned from the release process range from relatively straightforward improvements in organisation and communications, to significant strategic issues which require further consideration and discussion at a national level. It is worth briefly mentioning the more significant considerations with a view to making some recommendations in these areas:

1. Keep the number of personnel involved in any release to a minimum. This helps to reduces levels of associated noise, strong smells and movements.
2. Animals should be transported to release sites and released as soon after crating as possible.
3. Transport crates should be covered with a soft, breathable material and kept dark to reduce stress to the animals concerned. Crates should be kept as level as possible and be slowly carried to release sites, secured to prevent movement within any vehicles used. Crates and vehicles should be well ventilated. Beavers should not be allowed to overheat.
4. All personnel involved in animal-handling and transportation should be suitably trained and experienced. Animal-handling and processing should be kept to a minimum prior to release.
5. All those involved in the release should be suitably aware of the potential implications of pre-release stress in animals and instructed accordingly.
6. All equipment should be sourced in advance and kept close to hand during the process. A pre-release plan, checklist and timetable should be made in advance so that these needs are identified.
7. Unique ear-tags are the most recommended method to ensure individual identification for non-invasive, post-release monitoring.
8. Further investigation is required into the various ‘hard’ and ‘soft’ release methods for beavers and their implications upon the success of reintroduction programmes.

8

Beaver activities and behaviours

The largest beaver lodge (on the Dubh Loch) measures 7.78 m long, 2.14 m high and 11.29 m wide.

This is around the same size as a double garage!

The largest dam (on the Dubh Loch) is 18 m long and 1.6 m high

13,045 m²

Surface area of new freshwater habitat created. This is approximately the same size as 10 Olympic-sized swimming pools

8. Beaver activities and behaviours

This section aims to capture the main significant events and activities associated with the Scottish Beaver Trial (SBT) beavers.

NB: This report <u>does not</u> include any of the independent scientific monitoring outputs or findings of the SBT, as these will be produced by the coordinating body, Scottish Natural Heritage (SNH), and the various Independent Monitoring Partners.

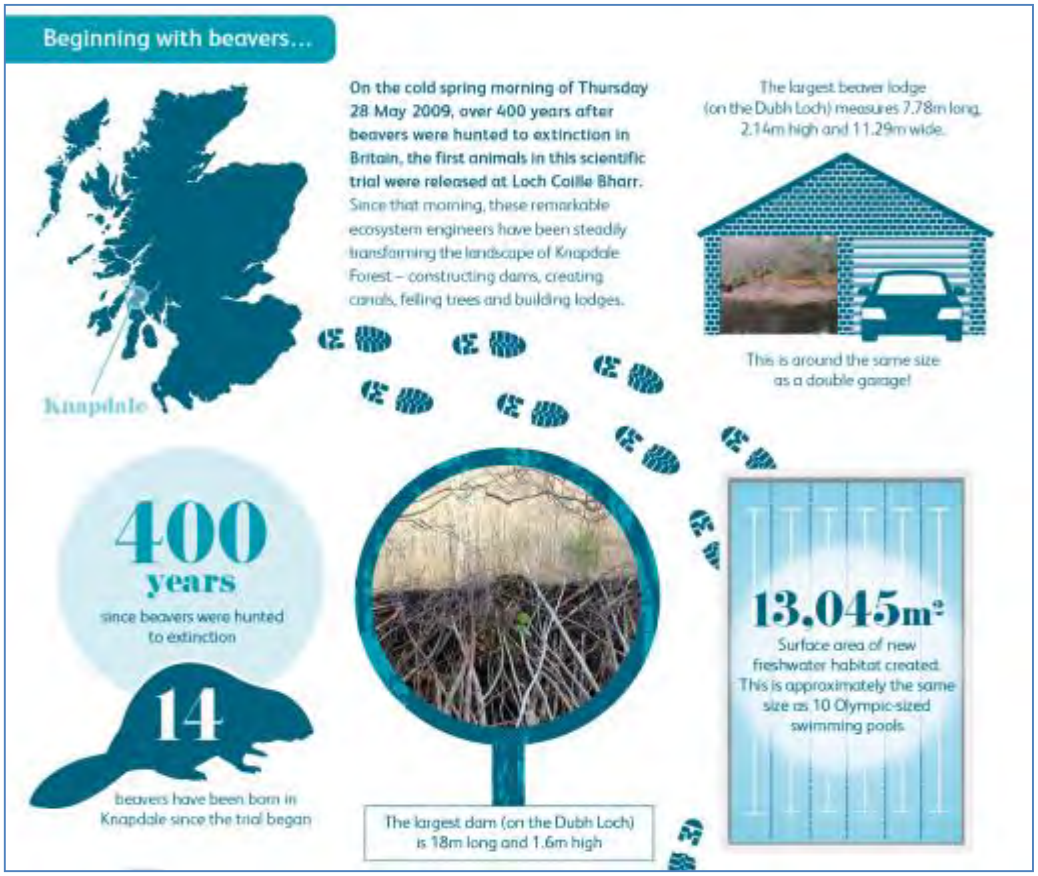


Image 39: Infographic showing key activity figures.

Weather patterns

The climate of Knapdale on the west coast of Mid-Argyll is predominantly mild and wet, with rainfall reaching nearly 3,000 mm per year on average, making it one of the wettest parts of the UK. The wettest months of the year are typically October to December, with April to June being the driest months. Over the period of the Trial, the UK experienced two successive prolonged cold and dry winters (2009–10 and 2010–11), during which all the main waterbodies of the Trial area remained frozen for a number of months. By contrast, the winters of 2012–13 and 2013–14 were mild, wet and windy and more reflective of an average Argyll winter. The late winter to early spring periods of 2013 and 2014 were considered to be unusually prolonged, cold and dry, resulting in a delayed start to the growth of spring vegetation, with the summer of 2013 being unusually warm and dry.

Image 40: SBT field vehicle and canoe, Knapdale, December 2010.

8.1 Beaver establishment and immediate post-release behaviours

In the planning phases of the Trial, a number of lochs were selected and ranked by experts from Telemark University College (TUC) for their habitat suitability as release sites. Dispersal from the release site is a particular concern in many reintroduction projects; and, as beavers are highly territorial, these selected lochs were also selected for the extended watercourses that existed between family groups, creating a buffer zone so that, if exploratory dispersal occurred, individuals from different families would not immediately be encountered and potentially attacked.

The first few weeks following release were critical as the various families settled into their new surroundings. To encourage a smooth start to the Trial, it was hoped that the beaver families would soon settle in or near to their individual release lochs. Following release, an intensive observation period began, involving field staff, student placements and volunteers. Visual observations on each beaver family continued throughout the five years of the Trial, and so numerous behaviours, activities and family composition changes were recorded.

Loch Coille-Bharr–Dubh Loch family

At release, this family comprised an adult pair (female 'Katrina' and male 'Bjornar') with two female sub-adult offspring (approximately two years old, 'Marlene' and 'Mille'). All individuals were released into an artificial lodge at the far south-eastern end of Loch Coille-Bharr on the early morning of 28 May 2009. The family remained on this loch for a period of approximately two months, during which time they were regularly seen swimming and feeding by observers and the public. Although no lodges, nests or burrows were found, their activity patterns suggested that they may have had at least one burrow at the north end of the loch. All family members were observed and/or recorded through telemetry for two to three weeks after release, after which one of the sub-adults ('Marlene') dispersed from the release loch. Radio telemetry signals (see section 9.4) indicated that this individual was in the south-western part of the Trial site near the Faery Isles and Scotnish locations (NR765880). However, despite

frequent searching and tracking efforts in this area by the SBT field team, there was no further confirmed presence of this individual from 5 June 2009 until the conclusion of the Trial.

At some point between August and October 2009, the remaining family members appeared to relocate from Loch Coille-Bharr onto the nearby Dubh Loch. This relocation followed the construction of a beaver dam on an old forestry drainage ditch which runs from the Dubh Loch into Loch Coille-Bharr and which was discovered by SBT field staff on 27 July 2009. This dam has continued to grow steadily throughout the duration of the Trial and, by 2014, measured approximately 25 metres in length and stood over one metre high.

Loch Linne family

At release, this family comprised an adult pair (female 'Frid' and male 'Frank') with two sub-adult male offspring ('Biffa' and one unnamed). This family was released into an artificial lodge at the far south-western end of Loch Linne on the late morning of 28 May 2009. Despite the unfortunate death of one of the sub-adult males (unnamed) on the day after release (see section 7.7), the remaining three individuals were regularly observed, and this family has remained on this release loch for the duration of the Trial. A substantial lodge was discovered in the south-east corner of Loch Linne in early November 2009.

Creag Mhor family

Comprising an adult pair (female 'Gunna Rita' and male 'Andreas Bjorn') with a single female kit ('Mary Lou'), this family was released into an artificial lodge on the eastern shore of Creag Mhor Loch in the mid-morning of 29 May 2009. The family was observed behaving normally for the first week following release, but in the second week field staff failed to observe or radio-track the adult female; and, two weeks later, radio signals from the male suggested that he was moving between the release loch and the nearby Crinan Canal (outwith the Trial area). Observations and radio signals from this male beaver were lost in the following week. By mid-July, approximately five to six weeks after release, observations of the kit had also failed to establish her location. Field staff swept the surrounding area using radio telemetry and looking for any field signs, but no evidence was found in the Trial area of these animals after this time. It appears that, one by one, the entire family had either disappeared from the site or had dispersed outwith the Trial area.

Shortly after this event, the SBT Field Officer reported that she and her partner had heard gunshots close to Creag Mhor Loch near the time that the adult female had disappeared from the site. This resulted in an investigation by local police and some media interest that a beaver may have been shot or scared off, but to date there has been no evidence to support this suggestion.

Image 41: Radio-tracking beavers by canoe. (Photo Claire Gresswell)

Following the SBT protocol for locating missing beavers (see Appendix 5), field staff and volunteers swept the surrounding area for several weeks, but no evidence of the presence of any beavers was located until August 2009, when a local landowner reported a felled tree and a beaver swimming at a marine fish farm near Port na Mòine by Loch Craignish, north of the Trial area (grid reference NM804011). SBT field staff investigated the reports and confirmed (by radio-tracking) that the adult male beaver ('Andreas Bjorn') was living in nearby coastal woodland along a narrow stretch of freshwater burn. Although it was not possible to confirm the exact route of dispersal, it appeared likely that the beaver had made its way along small ditches and burns northwards from the release site into the Crinan Canal and then westwards into the sea, before following the coast northwards for some 10 km to Port na Mòine. This incident is important, as it illustrates the fact that beavers will disperse through seawater.

The animal was caught on 12 August 2009 by Royal Zoological Society of Scotland (RZSS), Scottish Wildlife Trust and Forestry Commission Scotland (FCS) staff who, operating in two teams of two, steadily walked up and down the burn in tandem and easily guided the animal into a handheld net. The beaver had lost weight and body condition since release, but, after an Argos PTT tag was refitted (see section 9.4 and image 43), the animal was taken back to Creag Mhor Loch and re-released.

Image 42: Coastal woodland by Port na Mòine fish farm, where a dispersed beaver was trapped (left); and
Image 43: Argos PTT tag fitted to the original adult male ('Andreas Bjorn') released at Creag Mhor Loch (right).

Lily Loch pair

As described in section 7.6 above, this pair ('Tallak' and 'Trude') only remained at the release site for approximately three weeks, after which the male was found dead, and the female soon relocated to nearby Lochan Buic and remained there for the duration of the Trial. She appeared to behave normally and was regularly seen swimming and feeding on this loch, and constructed a lodge on the eastern shore.

Creag Mhor replacement pair

The sub-adult male ('Eoghann') and sub-adult female ('Elaine') were released at this site on 23 June 2010 as replacements for the original family released in May 2009. The pair of animals began to build a lodge on the western side of the loch in the second half of 2010, but, a few weeks later, observations and field surveys confirmed that the beavers had moved from Creag Mhor Loch onto the neighbouring loch immediately to the west, known as 'the Wee Loch' or Lochan Beag. Originally it appeared that the animals were living in temporary nests above ground; however, they soon began building a burrow lodge on the eastern side of the loch.

Lochan Buic single male

In an attempt to re-create a stable fourth pair at the Lily Loch/Lochan Buic site, a replacement male beaver ('Christian') was released into Lochan Buic on 21 September 2010. This release was carried out in the same manner as the releases in May and June 2010, although in this case the artificial lodge and the outflow from the loch were artificially marked with scent from the male ahead of release. As this site already contained the resident, 'widowed' female released in May, it was hoped that she would accept this new male into her territory and gradually create a new pair-bond with him. Post-release observations by field staff recorded the beavers wrestling soon after their first meeting, which is an expected behaviour in such circumstances; and, to date, the animals appear to have formed a pair-bond and are both still resident and active at the site, with early signs of lodge-building activity being evident.

Image 44: Artificial scent mound created with scent placed in the centre of a plastic lid. Image 45: The plastic lid as found after male scent was introduced – bite marks indicating clear interest from the resident (single) female.

8.2 Field signs and habitat modifications

Soon after release, beaver field signs – most obviously tree-felling – were noted on every release loch. These signs were regularly photographed, marked by the field team and reported on by visitors to the Trial, causing particular excitement and interest. Beaver-peeled sticks, indicative of bark feeding, were also a common field sign and again were collected by many visitors as a souvenir. Much tree-felling – particularly of saplings – was evident in the first six months following beaver releases into an area, especially as lodges (and in one case a dam) were constructed.

Throughout the course of the Trial, increased felling of saplings for food-cache construction in autumn became a regular and conspicuous feature in the landscape. As the Trial progressed, other field signs became readily recognisable, including more subtle feeding on a range of non-woody vegetation, and beaver 'day nests'. Beaver habitat-modifying behaviours also became more evident, specifically the building of dams, lodges, burrows and canals.

Image 46 and 47: SBT Field Officers Christian Robstad and Robert Needham with beaver 'carvings', Knapdale.

Dam-building behaviours

The first dam to be recorded in the SBT was situated on a small burn running between the Dubh Loch and Loch Coille-Bharr. This resulted in an expansion of the Dubh Loch up to five times its original size after the beavers had dammed it by November 2011, and remaining more stable at four times its original size thereafter. The discovery of the dam resulted in discussions between the SBT partners, FCS and SNH regarding the interpretation of Scottish Government licence condition number 24:

'Beaver dam construction on loch outflows to be carefully monitored and SNH to be informed immediately once new dams are created. If beaver dams are constructed on the outflows of oligo-mesotrophic lochs within the Special Area of Conservation (SAC), then the natural water levels of the lochs must be maintained, either through the use of beaver-specific devices which can be incorporated to manage water flow, or through removing the dam. The details to be discussed and agreed with SNH.'

Initially, the outcome of these discussions was the insertion of a length of narrow-gauge drainage pipe through the dam in an effort to maintain water levels and to prevent any detrimental impact upon the aquatic macrophytes of the Dubh Loch by a rapid rise in water levels. However, further investigations by SNH revealed that the Dubh Loch was not part of the oligo-mesotrophic loch feature of the SAC, so dam management was not considered necessary. The drainpipe was left in place and was quickly subsumed into the growing body of the dam. The expansion of the Dubh Loch as part of a new beaver pond led to the flooding of a 100-metre-long section of an FCS access track, which was also part of the Loch Coille-Bharr circular trail and was well used by walkers in the area. Signage warning visitors of the flooded section of trail was erected by FCS, but it soon became apparent that a formal trail detour would be required in order to allow walkers to circumnavigate the beaver pond and reconnect to the Loch Coille-Bharr circular trail. An informal desire-line around the flooded area quickly formed as walkers found their own route, not only to rejoin the trail but also to get a good view of the beaver dam, which by now was proving a popular attraction for visitors to the site. After several months of planning, led by FCS, work began on the construction of a formal trail route in August 2010 and was completed by October 2010. The cost of this trail detour was met jointly by FCS and the SBT partners as part of their legal Memorandum of Agreement covering the Trial.

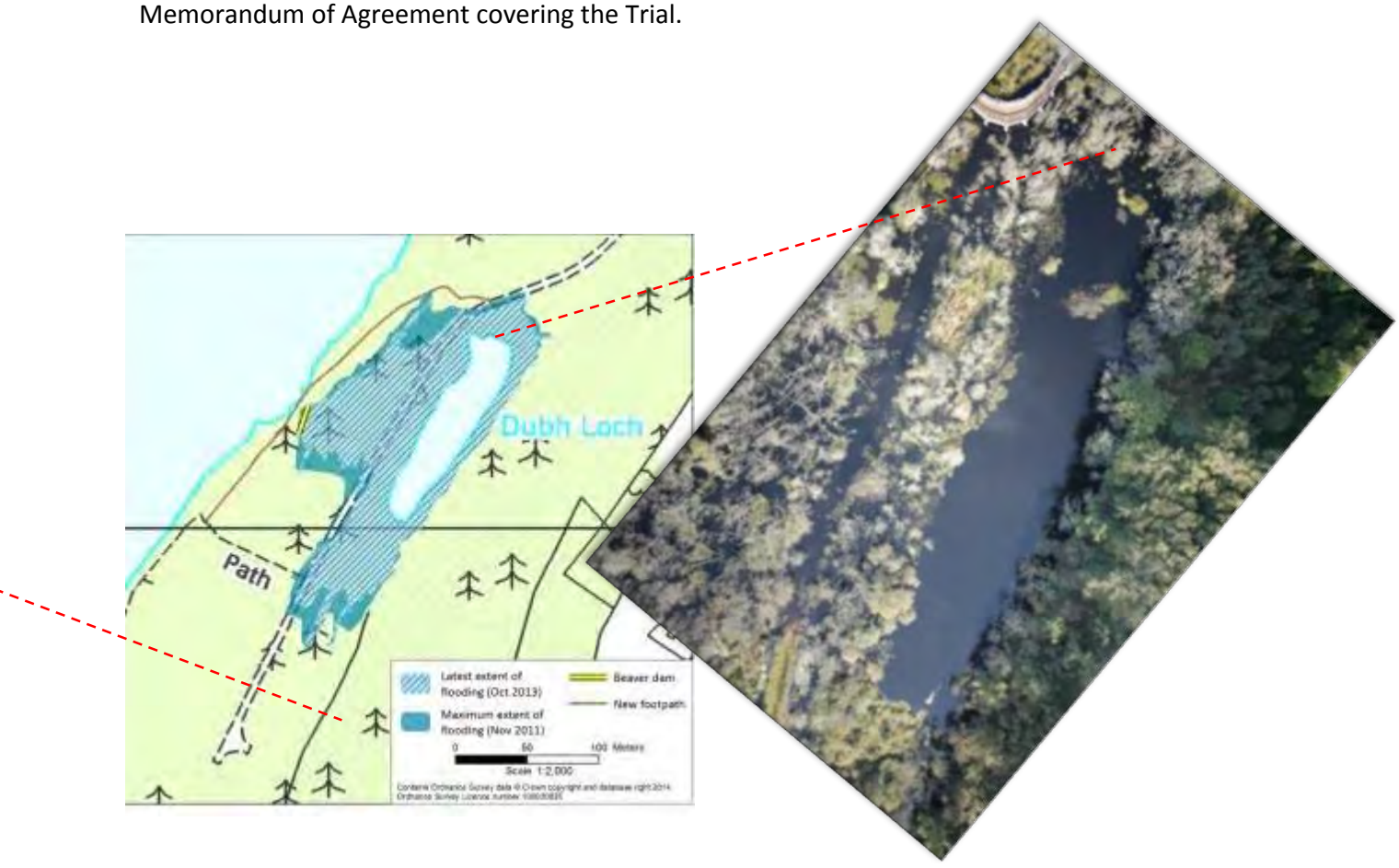


Image 48: Aerial image of part of the beaver-created Dubh Loch flooded forest area.

Image 49: Flooding extent of Dubh Loch caused by a beaver dam.


Image 50: Beaver pond, and Image 51: Dam between Dubh Loch and Loch Coille-Bharr, 2009 (photographs © Laurie Campbell).

The Loch Linne family also built several small dams on both the inflow and outflow burns from the main body of Loch Linne and Loch Fidhle, most likely to access feeding areas along these watercourses. The first dams were recorded in August 2009, at which point any dams on the outflow burn had to be dismantled by SBT field staff (following SNH instructions) in order to prevent a potential detrimental impact upon the aquatic macrophytes of the main lochs. Small dams, measuring approximately 1.5 to 3 metres wide by 0.5 metres high, were dismantled five times by SBT field staff on the outflow burn.

Following discussions – and concerns raised largely by various Independent Monitoring Partners – SNH made the decision that any subsequent damming on Loch Linne could remain in place for monitoring purposes. This family only constructed one further dam on this outflow; however, this was located close to a culvert through a well-used forestry track, and FCS were concerned that the rising water levels could potentially undermine the track. A joint decision was made to remove this dam, which was undertaken by FCS staff. Two small dams on the inflow were left in place, though these were not regularly maintained by the beavers, and, being small and leaky, did not cause significant impacts.


Image 52: Beaver dam on Loch Linne outflow, August 2009, later dismantled; and Image 53: small dam on Loch Fidhle inflow.

Lodge-building and burrowing behaviours

Lodges were built by all the beaver families/pairs soon after their release, with the exception of the original Creag Mhor family, which dispersed soon after release. The adult male remained on this loch for the longest time period, but only constructed a burrow. The replacement pair released here in 2010

did construct a single lodge, which they occupied before relocating to the smaller Lochan Beag nearby, where they subsequently constructed two lodges. They first constructed a small, free-standing lodge, which was then abandoned following the construction of a much larger bank lodge (still occupied by the remaining single male at the time of writing).

Over the course of the Trial, some lodges have been abandoned and second lodges constructed. By 2014, the Linne and Buic families have only one substantial bank lodge each, whereas the Dubh Loch family originally constructed and remained in a single substantial bank lodge on the Dubh Loch for the first three years, then constructed another lodge near their original release point on Loch Coille-Bharr. They occupied this lodge during the winter of 2012, then returned to the Dubh Loch lodge for the spring/summer of 2013. However, they returned to the Coille-Bharr lodge in the autumn of 2013 and remain there at the time of writing.

Lodge-building behaviours were regularly observed through the use of remote camera traps (see section 9.4).

Canal-building

Canal-building has been another important habitat-modification behaviour exhibited by all beaver families in the Trial. The vast majority of these were very short in length (less than 2 metres), adjoining the main loch body itself. These were mostly formed at the point where open water joins regular forage trails. The most impressive canals have been formed on the Dubh Loch, where three canals – measuring on average over 30 metres in length, 1 metre in width and half a metre in depth – lead from the loch and into the surrounding forest of regenerated birch saplings. As these canals have developed and aged, aquatic plants have colonised them, with sticklebacks *Gasterosteus aculeatus*, amphibians and aquatic invertebrates all recorded here in an area of flooded forest floor.

Image 54: Freshly dug beaver canal (photo: R. Needham); and Image 55: more mature canal colonised by aquatic plants.

8.3 Breeding

The first beaver breeding occurred at the Trial in the spring of 2010. Discussions between the SBT partners and SNH in 2010 led to an agreement that, as part of the monitoring programme, weekly lodge observation sessions would be undertaken by SBT field staff at every beaver loch where there was potential for breeding, between July and September. This was to observe and record the emergence of

any new beaver kits at these territories. In late July 2010, successful breeding by the Loch Linne adult pair was confirmed by the observation of a single kit. Shortly afterwards, a similar observation was made with a single kit recorded at the Dubh Loch site. It is not known whether any additional kits were born (and subsequently died) at either of these sites in this first breeding season; nor can we be certain about kits at the Creag Mhor and Lochan Buic sites.

The emergence of the first kits born in the Trial prompted significant media interest, and it became a priority for the SBT partners to capture good-quality stills and video images, with some determined methods undertaken to try and achieve this without disturbing the beavers. A Scottish Wildlife Trust staff member (an ex-professional photographer) used a camouflaged floating fishing seat to successfully obtain some of the first images (see image 56).

Image 56: Floating photography hide. Image 57: The hide sets off to capture the first image of SBT-born kits.

The presence of kits allowed the observation of some new behaviours (including social and food-provisioning) not previously witnessed. Both kits were seen regularly and were quite independent on their excursions from the lodge. They were seen feeding on a range of vegetation including willow, bracken and water lilies in and around the lodge in the first few weeks after emergence.

Image 58: Mother and first kit born in the SBT, 2010, (photo Steve Gardner).

Weekly lodge observations over this summer period were repeated on an annual basis. With the help of camera traps later on in the Trial, early indications of pregnancy and lactation were recorded. Camera traps placed around lodges also successfully captured kit images around the time of emergence and, on

occasions, verified the presence of kits before visual observations could be made (for example at Lochan Buic in 2012). That said, a combined approach of visual watches and camera traps was deployed throughout the Trial, as neither method was fully successful on its own.

The Loch Linne and Dubh Loch/Coille-Bharr families continued to breed every year of the Trial, though some mortality was subsequently recorded. In 2011, single kits were again recorded at both of these lochs. As with 2010, it is not known whether more kits were born (and subsequently died) at either of these sites – the same being true for the Creag Mhor and Lochan Buic sites – although close observations of the adult female at Lochan Beag in the late spring of 2011 suggested that she may have been pregnant.

2012 saw the most successful breeding in the SBT – at least according to observations – with five kits emerging from three out of the four beaver families. Again, only a single kit was recorded at Loch Linne, but for the first time the pair on Lochan Buic produced a kit. Both of these adults had recently become fully sexually mature during the Trial, so this was seen as a great success. The new kit (named 'Woody') emerged later than the others – only seen for the first time in mid-September via camera traps – and was considered smaller than other kits recorded elsewhere. Numerous film clips of this individual were captured via the camera traps; and the kit seemed in good body condition, regularly seen feeding well and interacting with its parents.

Meanwhile, on the Dubh Loch, three kits had emerged – a real high point for the Trial – with footage captured of the kits playing and feeding together. This generated more media interest; and clips of this footage were used on television news reports.

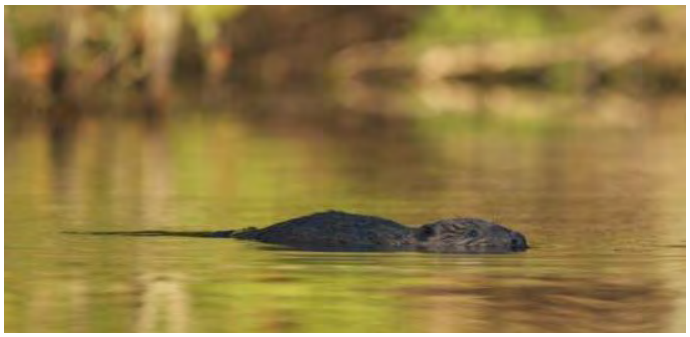


Image 59: Kit from 2012 (photo: R. Needham); and Image 60: 2013 on the Dubh Loch (photo: R. Campbell-Palmer).

Interestingly, the births of the three kits at the Dubh Loch raised questions about their parentage – specifically about the potential for in-breeding in small beaver populations. At this site, the long-established older pair ('Bjornar' and 'Katrina', who were originally trapped along with their two female offspring in Norway) had bred and produced a single kit in both 2010 and 2011. Evidence of lactation in 'Katrina' was also recorded in both years, so there was no doubt that she had given birth to these kits. The pair's older female offspring, 'Mille', had remained with her parents after her sister's dispersal soon after the initial release (see section 8.1).

By the end of 2011/beginning of 2012, 'Mille' was a very healthy four- or five-year-old animal, heavier than either of her parents. Camera-trap footage had indicated that prominent nipples could be seen; and evidence of lactation was later confirmed during trapping for the annual health check. Unfortunately, 'Katrina' could not be trapped to confirm if she had also suckled kits that year, which was unusual for her, as she had readily entered the beaver traps for food previously. SBT staff felt it was most likely that 'Mille' was the mother of these kits, which were fathered by her own father, 'Bjornar'.

Father–daughter matings are not unknown in beavers, and this event *may* have been the result of the very small numbers of beavers present in Knapdale. The connectivity of the Dubh Loch and Loch Coille-Bharr to other beaver lochs is poor; and, at the time of this first and the subsequent breeding, no other known males existed in the vicinity.

In the last breeding year of the Trial (2013), two kits were observed on the Dubh Loch, and the same parentage was assumed. 'Katrina', the original adult female, remained with the family and was observed bringing food to the lodge and displaying kit-protective behaviours, as were other family members. However, this parentage was not confirmed, as none of the five kits was ever live-trapped for blood-sampling and hence genetic testing.

Attempts were made each year to live-trap and re-release all individual beavers in Knapdale in order to carry out health checks and assess the animals' body condition. Overall, it proved harder to trap locally born individuals, especially if we were relying on Bavarian beaver traps.

Breeding on the other beaver lochs in the last monitored year of the Trial also saw two kits emerge on Lochan Buic, plus another single kit on Loch Linne. No breeding was ever observed on Lochan Beag or Creag Mhor, as from 2012 until 2014 only a single male resided here.

Over the course of the SBT – four breeding seasons in all – 14 kits from three breeding families/pairs were recorded.

8.4 Dispersal

The dispersal of beavers from the Trial site was a behaviour for which protocols and resources were put in place from the outset. However, the actual extent of beaver dispersals was greater than anticipated, particularly because the Trial site was not as enclosed an area as was first presumed. With the beavers establishing themselves at the northern end of the Trial site, the lochs and waterways here all drain in a southerly direction to a sea loch, and this did not present a total barrier for sub-adult and adult dispersal. Whether yearlings and kits dispersed into the sea and were less likely to survive cannot be confirmed.

An additional factor to consider is the small population size of animals associated with the Trial. Even though offspring of dispersal age could in theory have met and formed a mating pair within the Trial site (as some lochs were connected and a large amount of suitable habitat was present), a number of factors could easily reduce this chance, all of which are exaggerated in a small population. These include:

- timing of individual dispersal;
- connectivity of occupied lochs;
- sex ratio of dispersers;
- availability of the opposite sex at the time of dispersal;
- route taken at the time of dispersal;
- age of the dispersing individual, and the amount of time the disperser remains with its family group.

The family tree (see Appendix 9) highlights the number of potential dispersers available per year of the Trial. Further examination shows that, in 2009, five sub-adults (two males and three females) were present, while one male had died and the remaining male stayed with his family until 2011. Therefore, the two females that dispersed had no opportunity to meet an unpaired male, unless they entered a

territory held by a resident family. The location of the lochs in question also made pairing less likely, as two lochs had no connecting waterways, while the ones that did were separated by a very steep waterfall. The Creag Mhor family dispersed completely from the Trial site (see section 8.1).

In 2010, no real dispersal occurred, with the sub-adults (a three-year-old male and female) remaining with their respective families. The single adult female ('Trude') released on the Lily Loch did disperse a short distance to the neighbouring loch, but was monitored continually and then paired with an additional male brought in from Norway ('Christian').

In 2011, the sub-adult male ('Biffa') dispersed from Loch Linne, whereas his female counterpart ('Mille') remained with her family on the Dubh Loch. Over the course of the Trial, it became obvious that the individuals born into the SBT proved more difficult to observe and trap. 2010 and 2011 saw a skewed sex ratio of kits, with three males confirmed and one untrapped, and therefore unsexed, individual recorded. The first female kits were not confirmed until 2012, with the three kits born on the Dubh Loch remaining unsexed and indeed unseen in 2013, at which point they were presumed dead as opposed to dispersed (see section 8.5). Again, this population number and age structure will have had an impact on dispersal and future pair-formation.

In 2011, an interesting case of related dispersal occurred between the beaver pair on Lochan Buic ('Trude' and 'Christian') and the replacement pair on Loch Creag Mhor ('Elaine' and 'Eoghann'). Annual trapping revealed that the adult males in each pair had dispersed to the other's respective territory and formed a new pairing with the resident female. These lochs are directly connected via a fairly straight watercourse and are approximately 2.5 km apart. These were all younger adults (around three years of age), and the pairs were either put together in quarantine or were formed by the release of a single male in the Trial (see section 7.6).

In 2012, the unsexed offspring from the Coille-Bharr/Dubh Loch family was presumed to have dispersed, though a search effort did not reveal further field signs, potential sightings or cadavers. No further dispersal was thought to have occurred that year.

The adult female ('Elaine') from the Creag Mhor replacement pair was last confirmed present and paired (with 'Christian') on Lochan Beag in February 2013. She was presumed to have dispersed that spring – and, despite repeated searching and observations on this lochan, has not been seen since, while the male remains alone here and has not dispersed from the Trial site. Kits born in 2012 and 2013 were not expected to disperse within the lifetime of the Trial's monitoring period.

Over the course of the Trial, it is presumed that six beavers dispersed, consisting of two adult females and four sub-adults. Field-sign evidence of surviving beavers outside the Trial area has been recorded, though no visual reports or presence of beavers have been confirmed at the time of writing.

8.5 Mortality

During the Trial period, total recorded mortality included the two males who died shortly after release (previously described in section 7.7), one adult male that was removed from the Trial and died later in captivity, and two kits that were found predated.

'Andreas Bjorn', the original adult male released on Creag Mhor Loch and then re-released there after dispersing northwards to a marine fish farm (described in section 8.1), was later re-trapped on this loch, still living alone, in December 2009. He was trapped using the boat-and-net method (see section 9.4) as

part of the annual live-trapping health-monitoring programme, and on this occasion was found to have lost further weight and body condition. Under the Animal Health and Welfare (Scotland) Act 2006, the SBT partners (as the owners of the beavers) have a 'duty of care' for the beavers and must intervene if necessary to avoid any unnecessary suffering. Following veterinary advice, the male beaver was taken into captivity at Edinburgh Zoo, where he remained under veterinary supervision until mid-May 2010, when he died. A post-mortem showed that the beaver had good body condition but had died of heart failure.

Image 61: Weighing a beaver in a hessian sack in the field as part of annual health checks.

Two kits were also found predated during the course of the Trial. One of these was a Dubh Loch kit found dead on 8 September 2011 in shallow water at the edge of a flooded track at the marshy eastern end of the loch by the SBT Field Officer while carrying out a routine field-sign survey. The cadaver was collected and taken for full post-mortem examination, which indicated that the beaver had been in good body condition but had died as a result of traumatic injuries to the head, possibly caused by a large predator. Although unconfirmed, it was felt by SBT staff that this could have been caused by a domestic dog – a diagnosis strengthened by later comparison with a kit killed by a fox. The second kit was found on Loch Linne by researchers from the University of Stirling, who were undertaking vegetation transects as part of their annual data collection. This kit was quite badly decomposed, and all internal organs were missing, so full post-mortem examination was not possible, though from the location of the puncture wound and marks on the bones it was presumed that this individual had been predated by a fox.

Over 2012 and 2013, it was observed that at least four or five kits had been born and had successfully emerged from lodges belonging to three family groups. All of these kits were regularly observed over the months following their first sightings. However, such observations rapidly reduced in their first winter, with only two kits on two separate lochs being seen the following spring. It cannot be concluded that these kits died, as no further cadavers were recovered; but, given their age, it was concluded that these individuals had died rather than dispersed. It is possible that some of these individuals have survived but remain undetected – and wild-born individuals became noticeably more secretive than imported animals – but SBT staff felt that every effort was made to observe these offspring, and it is most likely that they are deceased (though the likely cause remains unknown).

The dispersal of animals from the Trial and/or the occurrence of missing observed kits is likely to indicate that a greater level of mortality occurred than was confirmed by the number of cadavers recovered. It

is also possible that missing sub-adults may still be surviving outside the Trial area, having naturally dispersed to seek mating opportunities, but it is considered more probable that missing kits and yearlings are deceased.

8.6 Recommendations

In relation to post-release monitoring and animal management, the following recommendations are made:

1. Management methods, staff and resource allocation should be planned well in advance, and staff should be cognisant of the potential impact of monitoring on beavers, especially during the sensitive establishment stage.
2. The monitoring of beaver field signs and activities provides very useful information on habitat use and distribution, which may prove more valuable than visual observations, especially when these prove difficult to achieve or are too resource-intensive to achieve.
3. Consistent visual observations of the lodge during kit emergence can give a good indication of breeding rates; and the use of camera traps should also be considered, especially in determining the number of family members or whether breeding has occurred or not.
4. Beaver dispersal from any trial site is highly likely, so protocols and provisions should be in place beforehand, including: good communication networks and facilities with neighbouring landowners (so that any sightings or field signs can be reported); resources and equipment to trap and relocate animals as required and maintain productive public relations; and informal education and engagement programmes to disseminate information about any beaver projects.
5. The impact of beaver dispersals on any small population or project should not be underestimated. The welfare of both dispersing and remaining animals should be taken into account, particularly in relation to the future management of individuals that cannot be returned to the project (e.g. due to health issues), and/or the breakdown of family groups/creation of unpaired singletons.
6. Access to temporary holding facilities and veterinary care should be secured in advance.
7. Provisions should be made to search for, collect and undertake post-mortem examination on any cadavers. This can provide vital information on animal health, mortality rates and causes.

9

Survey, monitoring and animal management

11,817 hours of field work

Video capture and analysis

Field search for beaver signs

Lodge surveillance

Checking for presence of mink

Night tracking sessions

Guided walks and tours

Beaver trapping

Day tracking sessions

1,034

Water collection and sampling

Other activities

9. Survey, monitoring and animal-management methods

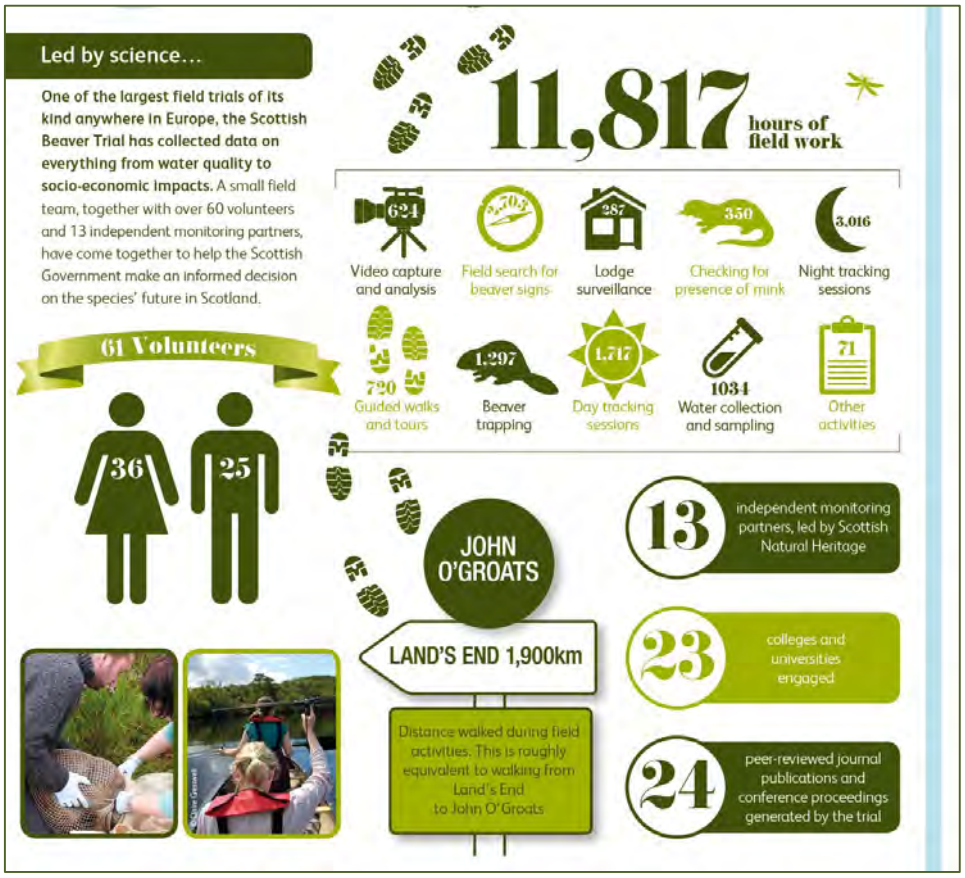


Image 62: Infographic showing key survey and monitoring figures.

9.1 Independent Monitoring Programme and the role of Scottish Natural Heritage

Coordination of the independent monitoring of the Scottish Beaver Trial (SBT) was the responsibility of Scottish Natural Heritage (SNH), and readers should visit the Scottish Beaver Trial pages on the SNH website for further information on the Independent Monitoring Programme.

The role of SNH in the Trial is outlined in the Scottish Government licence conditions 3 and 4 (reproduced fully in Appendix 1):

'Condition 3: SNH to coordinate a monitoring programme in collaboration with the project partners through an appropriate group, and involving SNH's Scientific Advisory Committee. The group, chaired by SNH, will maintain a suitable level of scientific independence from the other project groups.

'Condition 4: SNH to report to the Scottish Government on whether the conditions of any licence are being fully addressed on the ground.'

The monitoring programme had a key role in the project and in the delivery of the Trial. The programme, which was coordinated by SNH, was designed to scientifically test the main aims of the Trial in Scotland. These were: (i) to study Eurasian beaver ecology and biology; (ii) to assess the effects of beaver activities; (iii) to inform potential further releases; and (iv) to determine impacts on tourism. It covered all of the designated features of natural-heritage interest contained within the Knapdale Trial area, along with

areas such as beaver ecology and health, fish communities, public health, archaeology, water chemistry and socio-economics.

The delivery of the programme, which by necessity was varied and complex, involved many organisations and individuals including SNH staff, SBT field staff and volunteers, independent field scientists and other governmental agencies. A full copy of the monitoring programme can be found on the SNH website, but a summary of the programme projects and the Independent Monitoring Partners is given below.

Beaver ecology (annual live trapping, direct observations, radio and satellite telemetry and field-sign surveys)	Oxford University Wildlife Conservation Research Unit (data collected by SBT field staff and volunteers)
Riparian mammals (otter and mink field-sign surveys)	Oxford University Wildlife Conservation Research Unit
Beaver veterinary health monitoring (health status and body condition)	Royal (Dick) School of Veterinary Studies (data collected by SBT field staff and volunteers)
Beaver population modelling	University of Newcastle
Woodland vegetation (surveys of vegetation communities and related beaver/deer-grazing impacts)	James Hutton Institute
Aquatic macrophytes (plant community surveys of lochs)	University of Stirling
Hydrology (standing and running water levels, rainfall)	University of Stirling
River habitat (River Habitat Surveys)	University of Stirling
Water chemistry (analysis of surface waters)	Scottish Environmental Protection Agency (data collected by SBT field staff and volunteers)
Odonata (surveys of dragonflies and damselflies)	British Dragonfly Society
Black-throated diver (field surveys)	SNH
Marsh fritillary butterfly (field surveys)	SNH
Fish communities (surveys of fish in surface waters)	Argyll Fisheries Trust
Public health (testing of surface waters for *Giardia* and *Cryptosporidium*)	Argyll & Bute Council Environmental Health Department (some data collected by SBT field staff and volunteers)
Scheduled Ancient Monuments	Historic Scotland
Socio-economic effects	Scottish Rural College

Prior to the first release of beavers in May 2009, independent baseline survey work was carried out on the majority of monitoring programme areas mentioned above. The protocols and preliminary results of the above programme have been available throughout the course of the Trial and can be found on the SNH website.

9.2 Data collection and management

In order to provide adequate information to meet its aims, the Trial needed to collect a sufficient quantity and quality of data over a wide range of topics. This section only deals with the techniques and

procedures employed by the SBT partners in relation to the Trial and does not cover those used by the Independent Monitoring Partners as part of the SNH-coordinated Independent Monitoring Programme.

The methods and systems employed by the SBT partners to capture, store, transfer and interrogate such a quantity of data required careful consideration and planning. A decision was taken prior to release of beavers that field staff would focus on the use of Geographical Information Systems (GIS) as the main medium for capturing spatial data. This was largely related to the needs of the independent beaver-ecology monitoring programme, but also ensured the development of a compatible and user-friendly system.

A geodatabase was developed for this purpose in ArcGIS, by the Scottish Wildlife Trust's Biodiversity Data Manager, in conjunction with GIS staff at SNH. This system enabled data generated from the Trial to be electronically captured in the field using a laptop (a Panasonic 'Toughbook') linked to an active Global Positioning System (GPS). A series of detailed protocols were developed to ensure a consistent approach to data collection, storage, back-up and transfer. All data collected was subject to quality assurance monitoring by the Biodiversity Data Team at the Scottish Wildlife Trust and was transferred electronically from the SBT to SNH on a regular basis. All data methods and protocols were continuously reviewed and amended in an adaptive management approach as required in order to improve efficiency and accuracy.

An important learning point from the first year of the Trial was the need to develop and regularly adapt a robust range of protocols for virtually every aspect of the field work, from methodologies for beaver-observation work, field-sign surveying and water-chemistry sampling to set protocols on data storage and transfer. These protocols were vital for ensuring consistency and accuracy of data collection, particularly when a variety of different personnel, including volunteers, are used for field work. A list of protocols employed by SBT field staff is given below:

- beaver-trapping, handling and health-check protocols
- beaver observations*
- missing-beaver search effort
- mink-raft monitoring and mink control
- field-sign and riparian corridor surveys*
- recording land-use impacts
- photography*
- water-chemistry sampling*
- water-level and rain-gauge recording*
- public-health water-sampling*
- GIS/GPS field manual
- datasets and data flow.

NB: Those protocols (marked *) which contribute data to the Independent Monitoring Programme are based upon methodologies supplied by either SNH or the Independent Monitoring Partners.

Image 63: Mink-raft monitoring; and Image 64: water depth-logger reading – various field-work tasks were carried out by SBT field staff.

SNH coordinated the overall bank of data associated with the Trial and was responsible for ensuring that it was accessible to the SBT partners, the Independent Monitoring Partners, the Scottish Government and eventually the public.

9.3 Individual animal identification

All beavers released as part of the SBT, and all trapped wild-born offspring, were microchipped with unique Passive Integrated Transponder (PIT) tags. These are inserted under the skin along the dorsal midline around the shoulders and lower neck region. This ensured that even if an animal lost all other tags it could, if trapped, be identified with a PIT reader and be traced to SBT should it disperse from the Trial site.

Identification from a distance was an essential component in data collection, ensuring that the beavers were minimally disturbed. This was largely achieved – particularly for visual observations – through the use of ear-tags. As animals settled, and field staff became more familiar with the features, size and behaviour of individual beavers, identification was still possible (in many cases) even without the continual presence of double ear-tags. Beavers were not trapped solely to replace lost ear-tags, so a combination of one or no ear-tags could often be seen, which was why unique coloration tag combinations were important to distinguish individuals.

Image 65: Beaver restrained in a hessian sack for (Image 66) ear-tagging in the field.

Many of the originally imported adult beavers had unique scarring patterns on their tails as a result of previous territorial disputes. This offered a means of identifying individuals, particularly when reviewing camera-trap images, where ear-tags are not always visible and coloured tags are not particularly useful.

It was not always possible to identify every individual during all data collection tasks, for a variety of reasons. These included: missing ear-tags; lack of successful trapping; untagged individuals; and poor observation conditions (such as weather and distance from the animal in question, or specific animal behaviour, e.g. repeated underwater foraging that prohibited good views of ear-tags).

9.4 Tracking methods

The tracking of the beavers throughout the Trial was critical to the success of the project, for three main reasons. Firstly, provided that the tracking was done in a systematic, regular manner, it would provide essential scientific data on the movements and interactions of the beavers in the Trial. This backs up the independent monitoring methodology used by the Oxford University Wildlife Conservation Research Unit (WildCru) for collecting data on beaver ecology during the Trial. Secondly, tracking was an important management tool for SBT field staff, who needed to locate, observe and individually identify animals in a large, unfenced area of dense forests and waterbodies. Thirdly, the locations of the beavers was a very important public and PR issue, as there was both public interest and some public concern surrounding the whereabouts of the beavers, notably some local and national stakeholders who were worried about beavers moving outwith the Trial area and potentially having detrimental impacts further afield.

For tracking to be effective, it is important that both telemetry and ear-tagging methods allow the identification of individual beavers in the wild, ideally both by visual identification and unique telemetry frequencies. It was the intention of SBT staff to fit two types of tag to every animal released and/or born during the Trial: ear-tags, and tags mounted with either a radio or a satellite telemetry device. As the Trial progressed and methodology was reviewed, this objective was modified, taking into account these devices' effectiveness and the overall scarcity of resources in this area. For example, the extent and challenging terrain of the Knapdale Trial area meant that a variety of tracking methods would likely be more effective in successfully locating and following the animals post-release. In fact, in the licence condition 20, the Scottish Government stated: '*a suite of tracking methodologies should be employed*'.

The various methods and equipment used to track the beavers post-release are described below, along with some of the practical experiences of the field staff and volunteers who used them.

Ear-tagging

Based upon experience gained predominantly in Norway by experts from Telemark University College (TUC), individually coded, coloured plastic or metal ear-tags – similar in nature to livestock (sheep) ear-tags – were attached to all animals, using specific applicators. These tags, depending upon their visibility, are useful to observers in the field for identifying individual beavers based upon which ear they are placed in and the particular combination of colours used.

Unfortunately, the preferred type of ear-tag for use in the Trial was not used at the point of processing of the first two families, and therefore these animals were not ear-tagged before release. When processing the final family of beavers on the second release day, a decision was taken to use larger plastic ear-tags that were to hand; and these were placed on the animals prior to release.

Aside from the lack of ear-tags on some beavers at the first release, all beavers involved in subsequent releases were ear-tagged. Post-release observation work has shown that the usefulness of collected data appears to be reduced if it is not possible to positively identify individual beavers in the wild.

It has also been noted that, along with larger telemetry devices such as radio or satellite transmitters, it is difficult to ensure that these remain in place long-term, with most lasting between 2 and 12 months. If tags are lost or groomed out by beavers, they can on occasion result in the ear being split, and this may make the attachment of replacement tags either difficult or impossible. For this reason, the precise placement of ear-tags is important, particularly because beavers have small, fine external ear structures. These issues are also noted from many years of beaver field work in Norway (Rosell, pers. comm.).



Image 67: Ear-tags clearly visible (photo: Roo Campbell) – (Image 68) even underwater and from a distance. Coloured reflective tape was glued to tags to make more visible during night work.

Ear-tagging is a useful management tool for identification of individuals (Sharpe and Rosell 2003). In the SBT, plastic (Dalton) rotatags (approximately 35 mm x 10 mm) were used on beavers from two years old upwards. For smaller animals, particularly kits or animals with split ears, a smaller metal tag (e.g. BARR no. 3 INOX Chasse MQN, from Chevillot SAS) was used. Ear-tags were replaced as required when individuals were trapped for annual health checks, or when trapped and sexed for the first time. Visibility of tags was enhanced by using bright, contrasting colours, adding reflective tape or fluorescent spray paint. Such modifications should, however, be used with caution, as the addition of glue, tape or spray paint to tags can interfere with correct tag closure or hinder their fit into applicators. Retention rates varied, with some individuals (e.g. 'Bjornar') retaining their original ear-tag through the entire duration of the Trial, while others (e.g. 'Frid') continually lost their ear-tags after a couple of weeks. In most cases, ear-tag loss mainly occurred with the plastic rotatags as a result of grooming by other family members (evident as intact holes were left in ears, as opposed to ears splitting). Over the course of the Trial, ear-splitting did occur in some animals, most likely as tags became caught on vegetation or potentially during animal-handling procedures such as trapping.

Telemetry tagging

It was decided during the planning of the Trial that the use of telemetry to track radio frequency (RF) and/or satellite tags (Platform Transmitting Terminal – PTT) attached to beavers would be a key method for locating animals in the field. The details of these types of technology are discussed later in section 15, but the attachment methods used at time of release will be covered here. All bar one of the animals released in May 2009 were fitted with a tail- or posterior-mounted RF transmitter tag. The exception was the adult female ('Katrina') from the Loch Coille-Bharr family, whose body condition was poorer than other family members. As such, on veterinary advice, a decision was taken not to attach a

transmitter to this animal. The intention was to attach a tag at a later date in the field once body condition had improved.

Both types of transmitter need to be mounted onto a surface which can be attached to the animal. For a tail-tag, this is a large, flat, plastic cattle ear-tag. The transmitter is glued to the tag, which is then attached to the animal's tail by a bolt which sits in a hole punched by a standard leather punch through the fatty part of the beaver's tail. When this operation is carried out in the field, the target area of the tail is normally sprayed liberally with sports 'ice spray' in order to numb the area. However, for the SBT animals, the presence of a vet meant that it was possible to use injected local anaesthetic for pain relief. For posterior-mounted transmitters, the device is first attached to a section of webbing material, and then the whole assemblage is glued using quick-setting epoxy resin onto the fur of the animal, approximately 15 cm above the base of its tail.

Unfortunately, prior to release in May 2009, the RF and PTT transmitters did not arrive in Knapdale in sufficient time ahead of animal processing, and SBT staff had insufficient preparatory time to mount the transmitters onto the plastic tags and webbing material. This resulted in additional delays at the time of processing for some beavers while the epoxy resin glues were mixed and applied. It also meant that the team was unable to attach any of the PTT transmitters to any of the animals at this time. This incident shows the importance of having equipment available, tried and tested well ahead of release.

However, despite these technical setbacks, nine beavers had tail-mounted RF transmitters attached, and one beaver had a posterior-mounted RF transmitter attached for the first releases. All tags were colour-coded using unique combinations of fluorescent marker tape to assist visual identification in the field, and were then sealed in a film of epoxy resin to give them further protection from the elements.

Image 69: Tail-mounted radio (RF) tag. Image 70: Platform Transmitting Terminal (PTT) satellite tag mounted on webbing patch prior to mounting on posterior location.

Radio telemetry

In the licence application to the Scottish Government, the SBT partners stated (section 7.5.1) that all released animals would be radio-tagged prior to release. With the exception of one adult female (see previous subsection), this was carried out.

The principle of radio tracking (telemetry) is that a radio-frequency transmitter is mounted onto to a tag on the beaver and emits a relatively low-powered radio-wave pulse at a set frequency, uniquely different from all other transmitters in the general area. Field workers track the signal by using a directional antenna attached to a radio receiver to pinpoint the direction of the RF tag, finding the direction from which the signal is at its strongest and then taking a magnetic compass bearing. Radio signals can, however, be deflected, reflected and blocked by objects such as rock faces, hillsides, dense tree cover and waterbodies, and this can result in trackers receiving either false bearings or no signal at all. To overcome this problem, trackers need to collect several bearings over a short time interval from at least three locations (known as triangulation), or use the signal to visually locate and observe the beaver concerned. The hilly, heavily wooded terrain of Knapdale made the radio tracking of beavers in or close to waterbodies very challenging and time-consuming.

Advice on the telemetry requirements of the project was supplied by Skorpa Consultancy Ltd. The radio telemetry equipment was purchased from Wildlife Materials International Inc., Carbondale, Illinois, USA.

Ideally, RF tags of this nature need to be temporarily activated well in advance in order to identify their exact radio frequency and to check that they are working. All the RF tags were checked and were found to be working in advance of deployment on the beavers; however, it would have been preferable to have them available at least two weeks ahead of use in order to trial different colour coding and attachment techniques.

Radio tracking began immediately after the release of the animals and was found to be quite successful in identifying individual RF tag (and therefore beaver) locations when in close proximity to the animals, either on the lochsides or from boats out on the open water. Further away from the release sites, however (i.e. over hills and through dense forest), the signals were found – as expected – to be weaker and less directly traceable to source, and therefore less useful for pinpointing RF tag and beaver locations. It is also important to emphasise that radio tracking is as much an art as a science, and it takes a considerable length of time for individuals to become fully competent in this skill. This has provided challenges to the SBT, where the practicalities of resourcing the field work mean that numerous members of staff, as well as volunteers, were required to carry out radio-tracking field work. Furthermore, it has been found that, in the initial post-release period, RF tags have remained attached for an average period of one to three months before they are lost from or pulled out by the beavers. Provision had been made, therefore, to attach replacement RF tags on adult and juvenile beavers caught for monitoring purposes, post-release.

Satellite telemetry

The principle of the satellite telemetry technology purchased for the SBT is that Argos system PTT tags, mounted onto an animal, send out a signal that is picked up by a low earth-orbiting satellite, and, using Doppler analysis, it is then possible to ascertain where the transmitter is radiating its signal from. The orbiting satellite then re-transmits this data to CLS/Argos (Collecte Localisation Satellites), based in Toulouse, France, who then email this data to the customer or allow it to be viewed online with specialist software. The system has the advantage that the location of the PTT tags can be viewed remotely; and CLS/Argos also offer a service which sends an alarm to the customer when an animal moves out of a predefined area.

However, the system is expensive compared to radio-tracking telemetry and can have very variable accuracy (150–1,500 metres) depending on the quality of the received signal at the satellite, which is affected by satellite position and factors such as tree and cloud cover and (particularly) immersion in

water. The system is, therefore, useful as a broad management tool to view rough locations of PTT tags and beavers on a regular basis, but it currently does not supply sufficient, detailed data for use in the scientific monitoring of the Trial.

It was not possible to deploy any PTT tags at the first releases; however, on subsequent capture-releases, PTT tags were deployed on the original adult male beaver from Creag Mhor Loch ('Andreas Bjorn') and the juvenile male beaver from Loch Linne ('Biffa'). In both cases, the tags – as with the RF tags – only remained attached to the beavers for relatively short periods of time (approximately 67 and 27 days respectively), and the accuracy of the satellite tracking proved to be so variable as to be unusable for field staff for the management purposes of the Trial.

The high cost of the PTT tags (around £2,000 per unit), and the practical and technical difficulties associated with retrieving them in aquatic conditions, meant that neither tag was subsequently retrieved. This fact, combined with the above factors, led the SBT partners to abandon their use for the purposes of the Trial. Agreement was subsequently reached to sell the remaining PTT tags back to the manufacturer in the USA.


Image 71: Gluing of monitoring tags on a beaver's back – in the field and (Image 72) pre-release.

Global Positioning System (GPS) tags

Given the issues with the RF and PTT tags, and ongoing tag-retention problems, the decision was made (following discussions with SNH and WildCru staff) to trial the use of 'i-gotU' GPS tags. These are cheap (around £50 per unit), lightweight tags that come with software allowing the data to be downloaded and either viewed in Google Maps or saved as Universal Transverse Mercator (UTM) coordinates for import into a GIS. These tags had a maximum battery life of around 10 days when deployed, and collected data every 15 minutes. To make them beaver-proof, they were covered in epoxy resin and attached to flexible plastic mesh to create a larger surface area for gluing to a beaver's back. Given both the battery life and the likely retention time of the tag itself (before the beavers gnawed through the epoxy resin and potentially exposed the non-waterproof tag to the elements), tags were only left on for approximately two weeks, after which attempts were made to re-trap individual beavers and remove the tags. These tags did have Bluetooth capabilities; however, once epoxy resin was added and/or beavers entered their lodge, this stopped working, therefore data had to be manually downloaded from any retrieved tags.

Attempts were made to tag every adult in the Trial for a two-week summer and a two-week winter period over the last two years of the Trial. The findings of this monitoring will be reported separately by WildCru as the independent monitors of beaver ecology in the SBT.


Image 73: 'i-gotU' GPS tag newly attached to 'Frid', female adult at Loch Linne, and (Image 74) three weeks later, before the tag was removed (in this case, data was successfully retrieved) – but gnawing on the tag by the beaver is clear.

Visual observations

In the first few weeks following a beaver release, field staff and volunteers attempted to verify the presence and location of each beaver on a daily basis for the first week, then on a weekly basis for the next six months. This was done through a rota system of field staff and appropriately trained volunteers, using radio telemetry but also visual observations and field signs. Visual observations of the beavers themselves were frequent, with animals regularly seen from the shoreline and, in particular, from boats on the lochs themselves. The animals tended to be relatively unconcerned by the presence of boats or canoes if more than 20 metres away. Visual observations had the benefit of providing first-hand data on the behaviour, body condition and habitat use of the beavers.

Image 75: 'Trude', Lochan Buic adult female. (Credit: Phillip Price, lochvisions.)

Visual observations continued throughout the course of the Trial, with the aim of confirming the presence of each individual on a monthly basis (as far as possible). The longer days in spring and summer made visual observations relatively straightforward, especially from the shoreline of each loch, though canoes and boats were also used in particular locations. Autumn and winter observation sessions, on the other hand, required the use of canoes or boats with high-powered, handheld hunting spotlights, which the animals habituated to quite readily as long as they did not come too close or shine light directly on the beavers for extended periods of time. Precautionary observation protocols were put in place in order to minimise any influence of the observer and the associated equipment on the beavers and their behaviours, with animal welfare taking priority over any data-collection requirements.

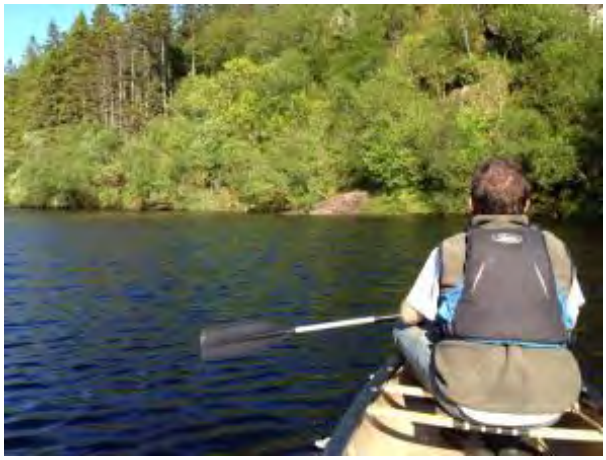


Image 76: Animal observations took place from shore and (Image 77) from canoe or boat. (Photos: R. Campbell-Palmer.)

Visual observation protocols evolved over the course of the Trial. These started as intensive monthly night watches lasting eight hours, and took place on every beaver loch. Locations and behaviours of all observed beavers were recorded every 15 minutes. However, following discussion and agreement from all parties concerned, this methodology evolved into one where only the initial location and behaviour of an observed beaver was recorded on a monthly basis. This had a direct impact on field staff resource requirements, with the duration of visual observations in any one session greatly reduced, but the frequency of observation events tending to increase over a month, at least until an individual had been recorded (at which point no further observation attempts were made to locate that individual until the following month). Later in the Trial process, camera traps were used to reduce the requirement for staff to make visual observations in the field. This also enabled more secretive individuals and behaviours to be recorded.

Field-sign surveys

Beavers leave readily identifiable field signs, which are a huge help in presence/absence surveys and habitat-use surveys, especially if visual observations are difficult to achieve. Field-sign searches were regularly undertaken throughout the course of the Trial, not only on the known beaver-occupied lochs, but also on lochs presumed unoccupied within the Trial site and on all interconnecting waterways (to document beaver dispersal). Field-sign surveys were a valuable management tool throughout the Trial. The findings of the field surveys will be reported separately by WildCru as part of the Independent Monitoring Programme.

Image 78: All beaver field signs were recorded and mapped directly into a GIS using a Panasonic 'Toughbook'.

Camera traps

Camera traps were used throughout the Trial site from 2011 onwards and proved invaluable for capturing secretive individuals, signs of pregnancy, kit emergence, body condition and rarely observed behaviours in a non-invasive manner. Cameras were typically placed in or close to areas of fresh activity, such as dams, lodges, feeding stations or felling sites, with fresh forage trails being very productive in terms of images captured.

Camera trapping also provided information on activity patterns, as dates and times were simultaneously recorded along with images; and the presence of ear-tags, tail-scarring and the size of individuals helped to identify beavers within the Trial. The location of camera traps was always carefully considered to ensure the best possible chance of capturing beaver images while also protecting the equipment from theft and reducing the chances of people being caught on camera.

Image 79: Camera trap (in red circle) placed at the beginning of a foraging trail overlooking the land and the water. The blue arrow shows the angle of the camera lens. Note the large feeding station along the water's edge. (Photo: R. Needham.)

Image 80: Remote camera-trap image showing adult beaver displaying interest in a set beaver trap. Note that the time of activity is useful information here.

Camera traps tended to be set on video-footage function, as opposed to still images (typically less informative), to record an animal's behaviour and provide greater detail that increased the chances of identification.




Images 81, 82 and 83: Camera-trap images of SBT beavers.

The placement of camera traps around the Trial site also helped to capture footage of other wildlife, in particular activity associated with newly created beaver-habitat features such as ponds, lodges and canals. Camera traps were also vital in monitoring the beaver traps set as part of the annual health-screening process (see section 6.3). This helped not only to monitor beaver use and behaviours in and around the traps, but also captured use by other wildlife to help determine if accidental trapping was likely to be an issue. The accidental trapping of otters was a particular concern raised by some stakeholders, but this did not occur during the Trial.

Image 84: Pine marten. Lots of other wildlife was caught on the camera traps – set traps were monitored for risk of incidental trapping of non-target species. Image 85: Badger.

9.5 Trapping, sample collection and sexing kits

As part of the Independent Monitoring Programme, there was a requirement to monitor animal health throughout the course of the Trial. This, along with animal-management requirements such as tag replacement and sexing of kits, resulted in an agreed strategy of catching every individual beaver at least once a year. Trapping also took place more than once a year if particular individuals were being targeted for GPS tracking, or if a tag required removal, or if there were any concerns over welfare and body condition. In the first year of the SBT, it became evident that some individuals were relatively easy to trap, while others proved difficult or even impossible.

Two trapping methods were employed. The boat-and-landing-net method – based on Norwegian methods (see section 5.2) – could only be employed on the larger lochs, where conditions were suitable with clear water, a lack of submerged obstacles and shallow shorelines to allow a beaver to be corralled with a boat and netted by a trapper. This method allowed individual animals to be successively identified and then targeted for trapping, and was regularly used on Loch Linne, Loch Coille-Bharr and to a lesser extent Lochan Buic and Creag Mhor Loch.

However, given the smaller area and dark waterbodies of the Dubh Loch, Lochan Beag and the Lily Loch, boat trapping was not possible, and specifically designed Bavarian beaver traps were deployed instead. Trapping in Bavarian traps was successfully employed on all beaver lochs, even where boat trapping could be used, as an additional management method for trapping difficult-to-capture individuals. Bavarian traps, other than being non-targeted, did save time in the field, as they could be set for longer periods and only required one staff member to check them. Boat trapping requires an experienced trapping team and calm weather conditions, but is a very effective way to trap beavers and greatly reduces the time any individual is restrained.

Once trapped, all individuals were checked as per the methods set out in 'Captive Management Guidelines for Eurasian Beaver' (Campbell-Palmer and Rosell 2013). Beavers were checked for any injuries or external parasites, and their body condition was scored against set criteria as laid out in the beaver body-condition scoring system developed by RZSS (see Appendix 10). They were weighed, biological samples were collected (faeces, hair and blood as required), various body and tail measurements were taken, and any ear or telemetry tags were removed or replaced as required. Blood samples were only taken from an individual once a year, and these were taken by a vet from the local Dalriada Veterinary Surgery, Lochgilphead. The findings from trapping monitoring will be reported separately at the end of the Trial by the University of Edinburgh and WildCru as part of the independent monitoring process.

Image 86: Transferring a beaver from a capture net into a hessian sack for examination; and Image 87: measuring tail width in the field.

During each trapping event, handling and restraint times were kept to a minimum. All animals were processed on the shoreline of their respective loch. Longer handling times occurred when monitoring tags were being removed or attached (as time was required for glues to harden), or when a blood sample was being taken by a vet (who first had to be called out by one of the SBT trapping team). Otherwise, processing times tended to take around 15 to 20 minutes, with the animal being released immediately afterwards. All biological samples were sent to independent veterinary laboratories at the Scottish Agricultural College in Edinburgh for analysis.

If a new kit was trapped for the first time, it would be sexed, microchipped and ear-tagged with small metal ear-tags, in addition to routine sample collection and body measurements being taken.

NB: For welfare reasons, no external monitoring tags were attached to any beavers under two years of age.

Image 88: First trapping of beaver kit 'Logan' on Loch Linne (2011) – notice yellow tag in right ear. Image 89: Lochan Buic kit 'Woody' (2012) being released after sexing and health check.

Full descriptions of the trapping methods, various sample collection protocols, sexing methods in the field and restraint techniques are available in Campbell-Palmer and Rosell (2013).

9.6 Search effort

Following the SBT protocol on attempting to locate and recapture missing beavers (see Appendix 5), field staff and volunteers carried out systematic sweeps of all suitable waterbodies and nearby coastline over a period of several months post-release in an effort to search for beaver field signs and track radio signals from animals that had dispersed outwith the Trial area.

By May 2014, SBT staff and volunteers had covered 817 hectares and had spent 301 hours searching for missing beavers. The areas searched are shown in image 90 below.

There were two confirmed and seven unconfirmed sightings of beavers outwith the Trial area over the course of the Trial, largely centred on the Crinan Canal and surrounding area. Field staff investigated all locations to search for field signs and the animals themselves, but at no point did the sightings lead to confirmation of a beaver's location, with the exception of the adult male found and subsequently trapped at Port na Mòine, north of the Trial area. Field staff were called out to nine reported sightings which, on inspection, were confirmed as a badger, roe deer and otter road traffic casualties. It is likely that most of the unconfirmed sightings may have been a case of species misidentification, with otters being a species frequently seen in the local area.

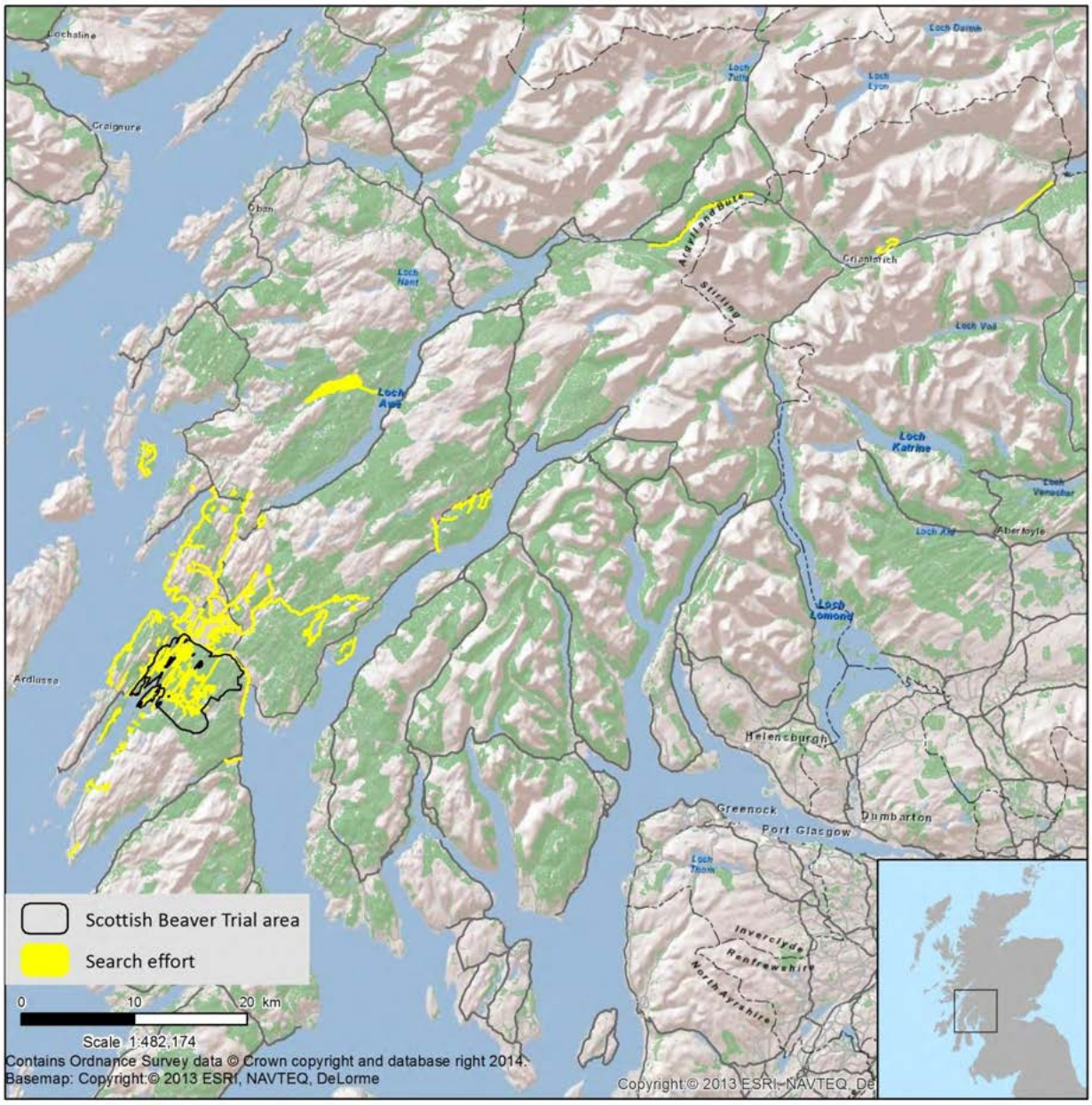


Image 90: Extent of the search effort for missing beavers.

9.7 Deterrent fencing, beaver-related damage and mitigation

Containment of the beavers during the Trial was an issue that prompted much discussion. The various containment options for the Trial were laid out in section 7.5.1 of the licence application to the Scottish Government and cover physical barriers (such as fencing), habitat manipulation (including the creation of beaver 'firebreaks' in woodland habitat) and the recapture and removal of straying animals. The SBT partners felt that the only reliable and efficient method of containing animals in the Trial area was the recapture and removal method. That being said, the use of relatively short sections of deterrent electric fencing was considered to be a useful form of animal management in particular areas for specific reasons.


Images 91 and 92: Deterrent fencing trialled – electric fencing used at Creag Mhor Loch (left); and fencing used on the outflow of Lily Loch.

Condition 27 of the Scottish Government licence stated that important stands of hazel within the Trial area (which support significant communities of lichens) should be protected from beaver impacts where necessary. Discussions with local SNH staff identified Barnluasgan Hazelwood (NR796916) being the only important stand of hazel within the Trial area considered at significant risk from beaver impacts. The wood has a deer fence running around much of its perimeter; but, to add to this barrier (a few weeks prior to the first releases), local fencing contractors were employed to build a very short section of watergate across the outflow burn in order to deter beavers from entering the wood along this watercourse. Other than this section, no other beaver-management fencing was erected in the Trial area prior to the first releases.

A local landowner report to SNH staff in the late summer of 2009 indicated that there were trees potentially felled by beavers along a short section of the River Add near the Drimvore property (NR834939), approximately 3.5 km north of the Trial area. Investigations by field staff confirmed that approximately 20 small to medium-sized willow trees and side stems had been felled along a one-kilometre section of the river, and two burrows were discovered in the riverbank near these trees. It was presumed that this activity had been caused by either one or both of the missing beavers (adult female and kit) from the Creag Mhor Loch family, or by the missing juvenile female from the Loch Coille-Bharr family.

An evening observation of the area soon afterwards confirmed the presence of at least one beaver swimming in the river. As a result, trapping plans were put in place to attempt to capture the beaver(s) and return them to the Trial area. Unfortunately, before the recapture attempt could take place, heavy rain caused a marked rise in the water level on the river, and the burrows were flooded out. No further signs of beavers were recorded at this location. Discussions and liaison between the SBT and the Drimvore landowner on the River Add resulted in mutually agreed mitigation measures – carried out at the expense of the SBT partners – to ameliorate the perceived damage caused by the beaver tree-felling and burrowing. As a replacement for the felled trees, originally planted as part of a FCS Woodland Grant Scheme, a local contractor was employed to plant 100 replacement willow saplings, all protected by staked tree tubes. Of the trees originally felled by the beaver(s), many subsequently regenerated from side shoots and remained alive. It was also agreed to attempt to protect the eroded riverbank by driving in sections of live, locally-cut willow poles into the banks at the water's edge to stabilise erosion. This work was duly implemented by SBT field staff.

This mitigation work was in accordance with the Scottish Government licence condition number 18:

'Arrangements must be put in place by the licence applicants to ensure that local businesses and properties have a clear route to pursue compensation claims for damage caused by the beavers during the period of the Trial.'

Image 93: Beaver burrows (circled) and tree-felling, with (Image 94) replacement tree-planting and willow spiling (right), near Drimvore on the River Add, February 2010.

9.8 Recommendations

The post-release phase has highlighted the following issues regarding the methods used for monitoring and managing wild beavers in the SBT:

1. Consideration should be given in the planning stage of any future release projects to what specific monitoring programme elements are required. The SBT was a unique scientific trial, and the monitoring programme devised also had to incorporate several existing and long-term monitoring elements from existing designated feature programmes. As a result, methods used here are not necessarily required for every beaver-release project, and it is possible that monitoring for any future projects could be significantly reduced, incorporating elements not explored by the SBT Independent Monitoring Programme (such as the study of other taxa not represented, for example amphibians, reptiles and birds).
2. Revisions and advances in beaver veterinary care have been made throughout the course of the Trial, and up-to-date advice should be sought in the planning stage of any beaver-release process. The provision of veterinary time and resources should be made before any release programme gets under way, including appropriate levels of veterinary intervention following release.
3. Research and experimentation should continue into improving attachment methods for external monitoring tags, in order to increase the effectiveness of data collection and tracking methods of beavers in the wild, as well as for animal-welfare considerations.
4. Research and experimentation should continue into identifying the most suitable, accurate and cost-effective bio-logger device(s) – similar to the 'i-gotU' devices used in the Trial – in order to improve the quality and quantity of data collection and to reduce the likelihood of human error.
5. Serious consideration should be given to the purpose of, and need for, data collection through repeated trapping and tagging. Tagging of beavers, and their removal and replacement, is resource-intensive and has animal-welfare implications (due to the need for repeat trapping of individual beavers).

6. Field-sign surveys provide valuable data on habitat use and dispersal and so are useful monitoring tools in their own right. They are less resource-intensive than other methods, and the skills required are easily taught, meaning that non-expert personnel, including volunteers, can be used effectively.
7. Careful consideration should be given to the need for ongoing trapping and monitoring programmes, especially the requirement for repeated, invasive sample collection. A great deal of valuable data has been collected through these protocols, but any future projects should consider whether further replication is needed. Any monitoring by trapping and tagging is very resource-intensive, requiring experienced, trained personnel and custom-built equipment. Consideration of animal welfare should always be weighed against the essential need to collect such data.
8. There is the need to develop and regularly adapt a robust range of protocols for virtually every aspect of field work for release projects such as this. These should range from methodologies for beaver-observation work, field-sign surveying and water-chemistry sampling to set protocols on data storage and transfer.

10

SBT project partner research

10.1 Recommendations

23 colleges and universities engaged

24 peer-reviewed journal publications and conference proceedings generated by the Trial partnerships

10. SBT project partner research

The Trial provided an opportunity to undertake beaver-related research over and above the implementation of the official scientific monitoring programme overseen by Scottish Natural Heritage (SNH). While such external research projects were not considered core objectives of the Scottish Beaver Trial (SBT), the extensive collection of data, associated with the collaborative research links made throughout, provided opportunities for a variety of work experience, student project studies and peer-reviewed scientific papers. It was important that such research did not detract from delivering the core monitoring outputs of the SBT. Student projects based on field work did not involve any of the essential data gathered for the core monitoring programme or impact upon its collection. Such projects and work-experience opportunities generally involved animal-management-related topics, the study of specific beaver field signs and/or the analysis of data from other beaver populations, specifically from Tayside, captive beavers or wild Norwegian animals.

Over the course of the five-year Trial period, the SBT hosted 20 students, ranging from local secondary-school work placements to MSc thesis projects. The Trial site also acted as a field-trip opportunity for many universities; and SBT staff gave over 80 lectures on ecology, animal health, beaver reintroduction and conservation.

Students were hosted from institutions across Scotland and Europe, including Lochgilphead High School, Napier University, University of Edinburgh, University of Glasgow, AgroParisTech, University of Bonn, University of Burgundy, and Van Hall Larenstein University (the Netherlands).

Image 95: Students learning a range of field skills, including camera-trap deployment; and Image 96: field-sign survey techniques.

Supported by the research links and agreement between the Royal Zoological Society of Scotland (RZSS) and Telemark University College (TUC), a number of peer-reviewed publications and academic conference proceedings (listed in Appendix 8) were achieved. As the Trial progressed, a number of research questions and topics requiring further examination (outside of the independent monitoring process) presented themselves; and these were married up well with areas of expertise in-house, specifically in relation to animal health, welfare and genetic research. Research collaborations included experts from the following institutions (listed alphabetically): BUND Naturschutz, Charles University Prague, Helmholtz Centre for Environmental Research, Martin-Luther Universität, National University of

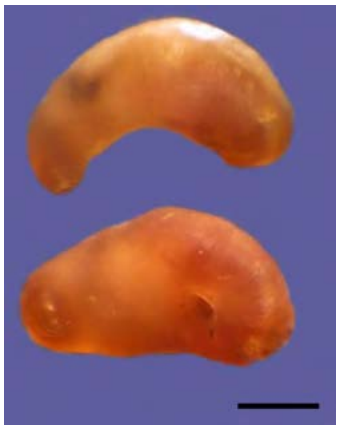
Mongolia, North Wales Wildlife Trust, Norwegian Food Safety Authority, Norwegian Veterinary Institute, Royal (Dick) School of Veterinary Studies, Russian Academy of Sciences, Senckenberg Research Institute and Natural History Museum Frankfurt, Telemark University College, University of Bern, University of Liège, Vilnius University, and Voronezh State Biosphere Reserve.

Images 97 and 98: Camera-trap-monitored scent-behavioural experiment undertaken by University of Glasgow honours student.

Some of the most significant research findings were:

- the establishment of a health-screening protocol for any future release of beavers in Scotland (Goodman *et al*. 2012);
- how chemical communication may aid beaver conservation (Campbell-Palmer and Rosell 2010);
- advances in genetic analysis, including the development of technical methods, species identification, and informing future beaver reintroductions and their management (Senn *et al*. 2013; McEwing *et al*. 2014; Senn *et al*. 2014);
- the identification of beaver parasites new to Britain (Duff *et al*. 2013; Campbell-Palmer *et al*. 2013);
- captive-management guidelines for beaver care (Campbell-Palmer and Rosell 2013);
- the risk and diagnosis of *E. multilocularis* associated with beaver translocations (Campbell-Palmer *et al*. 2012; Pizzi *et al*. 2012; Gottstein *et al*. 2014).

SBT staff also had a number of guest articles discussing beaver reintroduction and the Trial process in publications such as *British Wildlife* and *Mammal News*, and presented at many special-interest groups, such as the 5th and 6th International Beaver Symposiums (Glasgow and Edinburgh Natural History Societies).



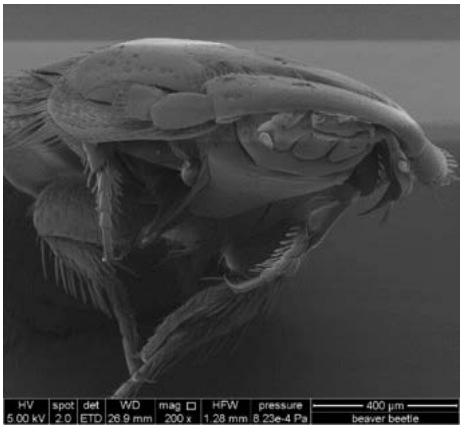


Image 99: The host-specific parasite, beaver fluke *Stichorchis subtriquetrus*, recorded for the first time in Britain in wild, unlicensed beavers living within the River Tay catchment (Photo: J. del Pozo). Image 100: The host-specific beaver beetle *Platypsyllus castoris*, first recorded on an SBT beaver, (Photo: S. Gschmeissner).

Image 101: The majority of external research opportunities were generated by health-screening, physical examination and analysis of biological samples collected.

The SBT partners aimed to facilitate as many student placements as possible, providing experience in a range of field-work, public-engagement and data-collection skills. Participants came from a range of educational backgrounds, from high school to adult night classes and university placements. These placements also assisted the SBT with additional human resources to undertake monitoring tasks, including additional search effort and visual observations. Feedback from participants in SBT placements has been very positive, with students commenting on the learning of applicable field skills, assistance in the securing of future jobs and/or course places, enjoyable experiences, and help with English-language skills, among other achievements.

10.1 Recommendations

1. The high-profile nature of this project – with many organisations involved, multiple connections made, and 'in-house' expertise across a range of scientific fields – resulted in the generation of a considerable volume of non-essential but valuable research being produced that will aid any future release of beavers. To achieve this research, links should be maintained with relevant organisations, and project partners should be flexible enough to consider and respond to any emerging research gaps and opportunities. Playing to the organisational strengths of the various partners is a key consideration. Student and work-experience placements were very valuable on the whole, providing additional resource through which pilot studies could be undertaken without any

commitment to further research time. By facilitating as many placements as possible, the project's profile was raised among the wider academic community.

2. Although a range of placement durations was accommodated, longer placements were more beneficial not only to students but also to the Trial, resulting in more thorough completion of work tasks and a reduction in staff resource investment.
3. Demand for placements on a project of this nature can be high and constant, though all requests were accommodated as far as possible. Consideration should be given to limiting places, especially at peak times. More even distribution of placements throughout the year – and the requirement to complete a set application form for potential applicants – could save staff time.
4. With a fixed-term, high-profile project, there is always the temptation for (and demand from) external institutions to consider numerous research outputs. Being selective about any project, setting SMART aims and requiring outputs in advance is essential in order to ensure successful completion and to produce projects of higher scientific value.

11

Public engagement

2,950,778 people engaged

2.81 million viewers on the BBC's *Springwatch*

5,343 children and 2,092 adults engaged by our formal education programmes

31,100 people engaged in Beaver Trial walks, talks, events and education sessions

Nearly 100,000 online visitors from 150 countries

Over 200 schools and colleges visited (nursery, primary, secondary, tertiary and continued education)

1,165 Facebook likes
1,078 Twitter followers

11. Public engagement

11.1 Public consultations and feedback

The public consultation process is a key element of any reintroduction proposal; and both the International Union for Conservation of Nature (IUCN) Reintroduction Guidelines and Directive 92/43/EEC Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive) Article 22 state that any reintroduction should only take place after proper consultation with the public concerned.

Building upon the national and local consultations in 1998 and 2000, the Scottish Beaver Trial (SBT) partnership ran two public consultations in relation to the project, the first in 2007 (prior to the licence application to the Scottish Government) and the second in 2014 (towards the end of the five-year field monitoring period).

A separate Local Stakeholders' Forum was also established prior to the first beaver releases in order to meet the Scottish Government licence condition 12 (see Appendix 1), and to provide a transparent line of communication between the project partners and local stakeholders, and to allow local stakeholders' views to be fed into the decision-making process for the Trial. Regardless of the Scottish Government licence condition, the Trial partners would have worked to establish such a forum as part of best practice for reintroductions of this nature. The group, independently chaired by a local councillor from Argyll & Bute Council, proved extremely useful in helping to guide the management of many aspects of the Trial, particularly in relation to public relations, communications and marketing.

2007 public consultation

The first, two-month-long consultation ran from 1 October to 30 November 2007 and aimed to gauge the level of support for a trial reintroduction of Eurasian beavers in Knapdale. All local residents, landowners, Community Councils and representatives of stakeholder groups in the Mid-Argyll area were asked two key questions:

i. Would you like to see beavers in Scotland?
ii. Would you support a trial reintroduction of beavers to Knapdale?

All postcodes in the Mid-Argyll area (PA29, PA30 and PA31) were posted a leaflet regarding the proposed Trial containing these questions; and a local stakeholders' information event and a public drop-in session were held at a local venue, the Cairnbaan Hotel.

The results of the consultation are summarised in images 102 and 103 below.

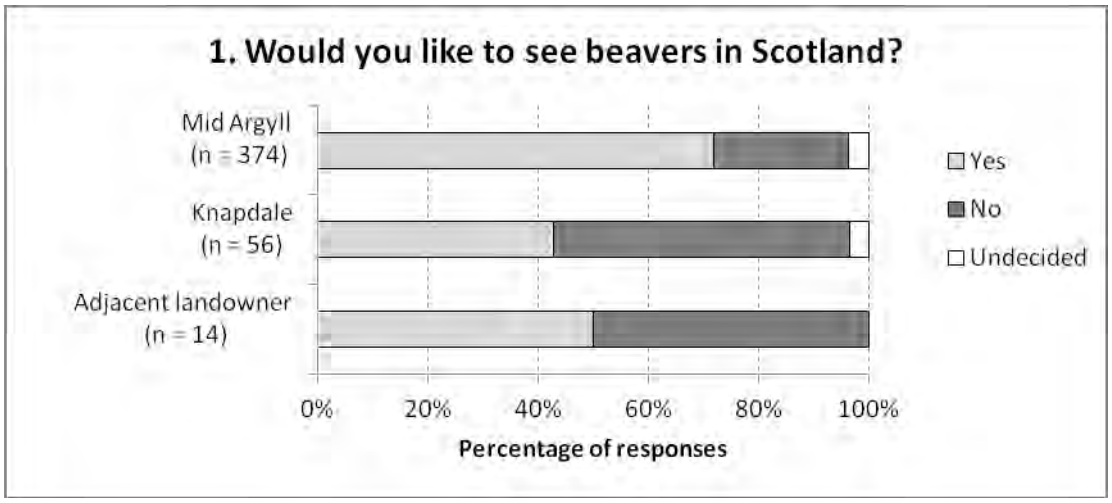


Image 102: Mid-Argyll and sub-group responses to question 1, 2007.

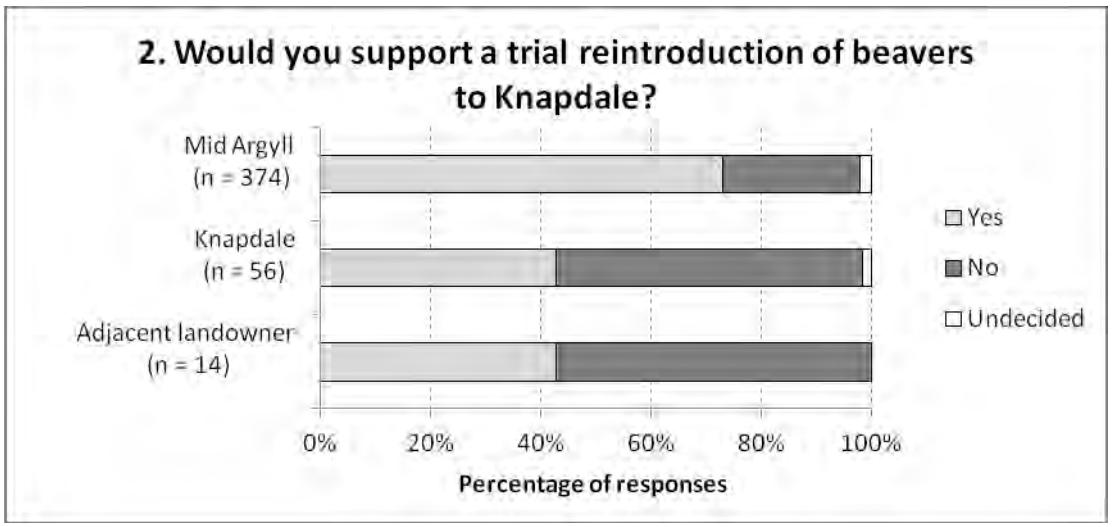


Image 103: Mid-Argyll and sub-group responses to question 2, 2007.

Of the 466 responses submitted by post or online, 374 were received from Mid-Argyll and 92 from outwith the area. Of the Mid-Argyll responses, 72% were in favour of beavers returning to Scotland, and 73% were in favour of beavers returning to Knapdale Forest.

The strongest opposition to (or concern about) the Trial came from those living within Knapdale itself (Tayvallich, Achnamara, Crinan, Bellanoch and Cairnbaan): 31 negative responses were received, including 20% of adjacent landowners. Seven (9%) of the national/local stakeholder organisations contacted raised 'key concerns' and objections. A report on the local consultation exercise was prepared by the Scottish Wildlife Trust communications team in early December 2007.

The majority of comments from those in favour of the Trial related to the benefits to biodiversity and wildlife tourism, and a desire to see the reinstatement of a keystone species to Scotland. Comments from those against the Trial covered a wide range of concerns and perceptions, including detrimental environmental and socio-economic impacts, public-health and containment issues, the length of the Trial, historical evidence of previous range, questions about the consultation process, issues of insurance and compensation, the presence of non-native species such as mink, and the best use of resources.

The overall results reaffirmed the conclusions of the previous consultations led by Scottish Natural Heritage (SNH) that, despite some concern and opposition, there was widespread local support for a

trial reintroduction of beavers in Knapdale. This led to the Scottish Beaver Trial partnership taking the next step of making an application to the Scottish Government for a licence to run such a Trial.

A full report on the 2007 consultation process and results can be found in Appendix 11.

2014 public consultation

The second public consultation led by the SBT partners ran for a two-month period over February and March 2014 and had a different aim from the 2007 exercise. Specifically, the consultation aimed to identify any changes in levels of support or opposition to the reintroduction of beavers and the Trial process as a whole, as well as gauging the perceived impact (positive or negative) that the beavers had on the local area and beyond. The 2014 consultation employed different methods to try to answer these questions, using a combination of web-based surveys, public drop-in sessions, individual stakeholder meetings and public surveys at local community points in and around the Lochgilphead area (see image 104). The web-based consultations consisted of a Survey Monkey[3] survey and a commissioned YouGov[4] poll.

The 2014 public consultation had eight questions, with an opportunity to provide comments at the end. Questions relating to attitude or belief had Likert Scale[5]-type answers (plus a 'prefer not to comment') that varied with the question.

A total of 997 responses were received, of which 315 were on paper and 682 were submitted online. 140 (14%) of respondents identified themselves as coming from Mid-Argyll. Of those, 83.6% were in favour of wild beavers living in Mid-Argyll.

The results illustrate the continued level of support among the majority of respondents for beavers in Knapdale and Scotland. They also show that the strongest levels of opposition against beaver reintroduction are found in the local area of the Trial.

The full results of the 2014 consultation process can be found in Appendix 12.

[3] www.surveymonkey.com
[4] www.yougov.co.uk
[5] 'A scale used to represent people's attitudes to a topic' – *Oxford English Dictionary*.

Image 104: Poster advertising beaver talk and consultation, January 2014 (© Kilmartin House Museum).

11.2 Educational programmes

The Trial has education clearly identified as one of its main aims:

'To explore the environmental education opportunities that may arise from the Trial itself and the scope for a wider programme should the Trial be successful.'

In the application to the Scottish Government, the SBT partners outlined how the Trial would provide an opportunity for local and national education programmes majoring on the beaver, which could also help to promote a greater understanding and promotion of Scotland's natural heritage, encouraging the restoration of degraded wetland habitats. In August 2008, an Education and Interpretation Working Group was established to lead on the planning and delivery of education and interpretation outputs associated with the Trial, and resources were allocated to assist in the delivery of these outputs. The group comprised Royal Zoological Society of Scotland (RZSS) and Scottish Wildlife Trust education and

interpretation staff and advisers, as well as local and specialist interpretation staff from Forestry Commission Scotland (FCS) (see Appendix 6).

The term 'formal education' is used here to cover learning activities with schools, nurseries, colleges and universities, while 'informal education' refers to learning activities with the public and other special-interest groups, including academic audiences. As well educational activities provided for academic institutions, special-interest groups and the wider public, an important element of the educational outputs of the Trial was the extensive use of volunteers to deliver many aspects of the project, including field work and education. Not only did volunteers assist with project tasks, but also they gained new skills and expertise. Particular priority was given to working with schools in the Argyll area, especially those close to the Trial. The closest school, Ashfield Primary in the nearby village of Achnamara, had a total of 10 engagements with educational staff from the Trial between 2009 and 2014.

SBT Education Plan

In August 2009, the Education and Interpretation Working Group developed an Education Plan for the Trial, with the following objectives:

i. Develop a formal education programme and educational resources for the Scottish Beaver Trial which engages with the national curriculum and promotes environmental awareness and responsibility.
ii. Develop an informal education programme for the Scottish Beaver Trial to enable wider participation and involvement in learning, which focuses upon the natural environment and biodiversity and which promotes environmental awareness and responsibility.
iii. Develop the role of the Scottish Beaver Trial partners in providing learning opportunities to the wider community in Scotland and beyond.
iv. Engage with diverse communities and audiences in promoting an informed discussion about, and an understanding of, the role of keystone species in ecosystems.
v. Engage with diverse communities and audiences in promoting an informed discussion about, and an understanding of, the role of humans in environmental management and conservation of biodiversity.
vi. Continuously develop educational activities and opportunities that arise throughout the duration of the Trial, with particular emphasis upon utilising feedback from participants and audiences.
vii. Provide a model of educational practice that can be utilised in future environmental education projects after the conclusion of the Trial.

In the first two years of the Trial, educational work was carried out by specialist RZSS and Scottish Wildlife Trust educational staff based in Edinburgh, with support from the project staff. However, due to the high level of demand for guided walks, talks and events, it was decided to recruit a part-time Education Ranger in April 2012. The role has continued beyond the end of the monitoring phase.

Between May 2009 and May 2014, the project delivered the following headline educational outputs:

- 31,100 people engaged in SBT walks, talks, events and education sessions, including:
- 5,343 children and 2,092 adults engaged in the formal education programme, and:
- over 200 schools and colleges visited by SBT partner education staff (nursery, primary, secondary, tertiary and continued education).

Within these figures, key outputs included:

Formal education:

- Two curriculum-linked outreach lessons – 'Beavers are Back' (2012) and 'Beavers at Home' (2013) were developed for both lower and upper-level primary-school pupils and delivered at over 70 primary schools across Scotland.
- Continuing Professional Development beaver workshop developed for schoolteachers and provided to 110 teachers.
- Development and publishing of curriculum-linked 'Scottish Beaver Trial Education Pack', which was sent to every primary and secondary school in Scotland (2,569) in 2011 and launched at Lochgilphead Joint Campus by Mike Russell MSP, Cabinet Secretary for Education. The pack focused on the upper primary/lower secondary level and included hard copies and a DVD containing lesson plans for teachers, a film of the beaver release for younger audiences and a poster of a beaver.

Image 105: SBT Education Pack cover, 2011.

Image 106: Bruce the Beaver makes some new friends at the launch of the SBT Education Pack, 2011.



Images 107 and 108: Local Argyll teachers taking part in an SBT Continuing Professional Development Day, 18 November 2011.


Image 109: Castlehill Primary schoolchildren from Campbeltown build an arch to learn about 'keystone species', 2014.

Image 110: ‘Beavers are Back’ interactive panorama, Castlehill Primary School, Campbeltown, 2014.

Image 111: Testing dam-building skills at Barcaldine Primary School, 2013.

Online education:

- A 'Learning Zone' was created on the SBT website in 2012, which allowed the download of educational resources.
- Two online live educational events took place using the online community portal for Scottish schools, 'GLOW'.[6] These were 'Interview the Expert' (broadcast 2012) and 'The Schools Beaver Film Project' (broadcast 2014), both for primary-level students. Two schools joined these broadcasts live, with 54 views from different schools at later dates.

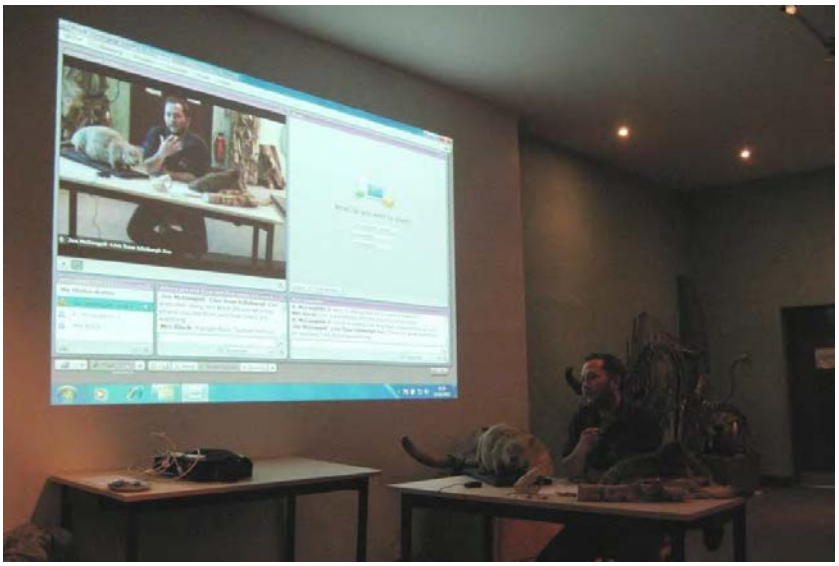


Image 112: SBT Field Officer Rob Needham being remotely interviewed by schoolchildren using the GLOW network 27 April 2012 (Photo: RZSS).

Informal education:

- A series of activities were created for public events, including: interactive feely boxes, beaver-habitat creation panorama and a GPS Beaver Trail.
- Geocaching – three Geocache boxes were hidden in well-visited parts of the Trial site, and 'travel bugs' were placed in two of the boxes, with a mission set to move them between every European country where beavers are currently found.

Image 113: Geocaching travel bugs – 'Bonnie and Bruce' posing for photos before they set off on their journey.

[6] http://www.educationscotland.gov.uk/usingglowandict/glow/whatis/index.asp

Image 114: 'Beavers at Home' flyer, 2013.


Image 115: Bruce the Beaver visits the Best of the West Festival, Inveraray Castle, 2013.

- Springtime events were coordinated with the Europe-wide 'Beaver Spring' (*Printemps des Castors*) programme, which celebrated beaver populations across seven European countries (see image 116 below).
- Over 100 talks and presentations were given by SBT project and partner staff to a combined audience of over 4,000 people between 2009 and 2014. These covered a wide range of specialist topics – from the project itself, to beaver ecology, animal welfare, species reintroduction, business opportunities and educational methods.

Image 116: Beaver Spring logo – *Printemps des Castors* (© PDC).

International seminars

On 15 December 2009, the SBT partners hosted the first 'UK Beaver Seminar' at Edinburgh Zoo. The seminar attracted over 80 delegates from all over the UK to listen, learn and debate beaver reintroductions from a host of speakers, including experts from Germany and Norway.

SBT partners and SNH staff also gave presentations on the Trial to a large number of European, Russian and North American delegates at both the 5th International Beaver Symposium in Lithuania (September 2009) and the 6th International Beaver Symposium in Croatia (September 2012). SBT staff also presented at several other seminars and conferences, including the 11th International Mammalogy Congress in Belfast (August 2013) and the Veterinary and Comparative Pathology Seminar Series at the Roslin Institute (March 2012).

Image 117: SBT Project Manager Simon Jones delivers a talk at the UK Beaver Seminar.

Image 118: Sixth International Beaver Symposium presentation title slide, Croatia, 2012.

11.3 Interpretation and visitor management

The interpretation and visitor-management methods employed for the purposes of the Trial were the result of careful forward planning and implementation, combined with considered adaptation to visitor and beaver behaviours over the course of the Trial. The forward planning of the interpretation and Visitor Management Plans created was covered in the Memorandum of Agreement between the Trial partners and the hosts, FCS, in order to ensure that these areas were carefully managed and resourced throughout the period of the Trial. The use of effective interpretation as a method of providing public information on the Trial was also viewed as a method for delivering some of the educational programme objectives listed in section 11.2.

Prior to the creation of the SBT Education Plan, local FCS staff quickly identified the need to develop a strategic document to guide the visitor management and interpretation for the FCS-owned Trial site in Knapdale. Led by the FCS Interpretation Officer, the SBT Interpretation Plan was produced in September 2008. The plan has the following objectives for interpretation on the site.

1. Learning objectives

Visitors (on and off-site) will understand:

- why the Scottish Beaver Trial is taking place;
- that beavers can have a positive impact on biodiversity;
- that Knapdale Forest is a rich and valuable habitat for wildlife;
- that the Scottish Wildlife Trust and RZSS are managing the Trial in an FCS forest;
- that the Trial is being resourced by the project partners and external funders, and that they can support the Trial on an individual basis.

2. Emotional objectives

Visitors (on and off-site) will feel that:

- the Scottish Beaver Trial is an exciting and well-managed scientific project;
- the Scottish Beaver Trial is worthy of support;
- a visit to Knapdale is worthwhile and enjoyable.

3. Behavioural objectives

On-site visitors will:

- interact with the interpretation provided;
- minimise disturbance to beavers and other wildlife by keeping to designated paths and following the Scottish Outdoor Access Code.

SBT leaflets

Over the period of the project, six different leaflets were produced in relation to the Trial by the SBT partners. Examples of these leaflets can be found in Appendix 13.

During the October to November 2007 Local Consultation on the Trial proposal, a leaflet was produced as part of the consultation process. This was mailed to every postcode in the Mid-Argyll area. In June 2008, both the Scottish Wildlife Trust and RZSS ran separate membership appeals in order to fundraise for the project once the licence had been secured from the Scottish Government. Each organisation produced a separate leaflet to support these appeals.

In November 2009, a general information leaflet was produced for the Trial, and in 2013 this leaflet was reviewed and updated to focus on the Dubh Loch site, which by this time had become established as the main area of significant beaver activity and visitor interest. Visitor leaflets were provided at the Barnluasgan Information Centre and via a contracted leaflet-distribution service and made available to as many local businesses and tourist hotspots as possible. Leaflets were also distributed among members of the Heart of Argyll Tourism Alliance.

On-site interpretation and visitor facilities

Condition 30 of the Scottish Government licence for the Trial required a Visitor Management Plan to be prepared and agreed prior to release of the beavers:

'A Visitor Management Plan must be agreed and implemented prior to the release of beaver and during the lifetime of the project (addressing issues such as signage, interpretative information in existing buildings, provision for self-guided and guided walks, etc.). This plan and the design of associated facilities must be discussed and agreed with SNH.'

The creation of a Visitor Management Plan was also covered in the Memorandum of Agreement between the Trial partners and FCS hosts. The SBT Visitor Management Plan was prepared by the SBT project team and produced by the FCS West Argyll District in May 2009 to complement the SBT Interpretation Plan and guide the on-site visitor management and interpretation actions for the Trial.

This plan identified a number of priority actions required to adequately prepare the public visitor facilities at Knapdale ahead of the release of the beavers, based upon the presumption that the interest generated by the Trial would result in increased numbers of visitors to the Trial area. The need to protect the sensitive, designated habitats of the Trial area, as well as preventing excessive disturbance to the beavers themselves, meant that the proactive management of these visitors was an important consideration and duty of the Trial partners and particularly the landowners, FCS.

The Trial area and wider forest has a relatively good spread of visitor facilities, which are all managed by FCS; and it was decided that, as most visitors come to the Barnluasgan car park and information centre, this site and the nearby Loch Coille-Bharr car park would become the focal points for visitor information, interpretation and infrastructure improvements. Between November 2008 and April 2009, a programme of works saw the upgrading of car-parking facilities, signage and the information centre at Barnluasgan, along with the provision of new interpretation panels and waymarker posts at Loch Coille-Bharr to create the 'Beaver Detective Trail'.

The consultant designers, Imagemakers, were employed to design and produce the interpretation panels and a life-sized wooden beaver, while a local woodcarver produced wooden bench seating and a funder plinth. The new facilities were opened by Roseanna Cunningham MSP, Minister for the Environment, on 29 May 2009 immediately after the release of the third family of beavers.

The upgrading of the Knapdale visitor facilities associated with the SBT placed an additional workload on FCS and SBT staff and required additional funding. However, this provision was seen as an essential element to the public face of the Trial; and subsequent feedback from the visitor comments book placed in the Barnluasgan centre suggested that the facility and the information were well received. Some of the panels installed in May 2009 delaminated in the first year and were replaced in 2013.

As the Trial progressed, feedback from project staff indicated that visitor numbers appeared to increase, and visitor use of the site focused on the Dubh Loch area, where beaver effects were most noticeable. Most visitors parked at Barnluasgan and then walked the relatively short distance to the Dubh Loch and back again, with some visitors venturing further around the Loch Coille-Bharr 'Beaver Detective Trail'. Following the natural relocation of the beaver family released into Loch Coille-Bharr to the Dubh Loch in the summer of 2009, the appearance of a sizeable dam led to the creation of an area of flooded forest and the submerging of over 100 metres of relatively well-used forest road along the eastern side of Loch Coille-Bharr (see image 119).

Image 119: Flooded track near Dubh Loch, 2009 (© Laurie Campbell).

This unforeseeable negative impact provided a management challenge for FCS and the Trial partners. Following consultation with SNH, it was decided to re-route the trail around the newly-created beaver pond to maintain access and allow visitors to see the beaver dam in action. A new trail was constructed by FCS contractors along the wooded ridge between the two waterbodies, but the site of the dam itself created a greater obstacle. A bridge structure being undesirable close to the dam, a solution was found in the construction of a floating pontoon walkway, anchored to the loch shore and running parallel to the shore and the beaver dam. The pontoon was constructed by contractors using similar methods to those used in nearby commercial fish farms. Construction took place during late 2010, with the walkway opened in early 2011.

Image 120: Floating pontoon walkway on Loch Coille-Bharr, Knapdale, February 2011.

In order to assess visitor numbers, FCS installed electronic, remote people-counters at various points in the Trial area in February 2009 before the Trial began. These included on the forest road to Loch Coille-Bharr, at the field gate opposite Barnluasgan car park and on the trail around Loch Barnluasgan. In September 2011, a people-counter was installed on the newly built track to the Dubh Loch dam, with a counter being placed near to the Dubh Loch viewpoint area in March 2012. This counter disappeared (presumed stolen) in June 2012 and was replaced in February 2013. A vehicle-counter was installed across the entrance to the Barnluasgan car park between April 2012 and September 2013 in order to assess the number of vehicles using the facility. Despite their installation, problems with people-counter reliability and frequency of reading meant that the data collected had a large degree of uncertainty associated with it, making estimates of detailed visitor numbers difficult to calculate.

However, the perceived increase in visitor numbers led to the focusing of resources on the Barnluasgan and Dubh Loch areas, and in 2012 the car park at Barnluasgan was upgraded to create more spaces, while interpretative fingerposts (see image 124) were installed along the track to the Dubh Loch. A decision was also taken to follow through aspirations from the earlier Visitor Management Plan and construct a timber viewing platform overlooking the Dubh Loch, allowing visitors to better experience the flooded forest landscape and providing seating and a focal point from which to try to view the beavers in the wild. This platform was constructed in sustainable Scottish timber by contractors in late 2013 and opened to the public in spring 2014, being part-funded by the SBT partners.

Image 121: View across to the upgraded information centre at Barnluasgan, 2009.

Image 122: Upgraded signage and interpretation at Barnluasgan, 2009.

Image 123: Life-sized wooden beaver produced by Imagemakers, 2009.


Image 124: Interpretative fingerpost on 'Beaver Detective Trail', spring 2009.

Image 125: Dubh Loch beaver-pond viewing platform under construction in Knapdale, 2013.

Image 126: Dubh Loch beaver-pond viewing platform, Knapdale, 2013.

11.4 Media, communications and marketing

Considerable effort and resources were put into the planning and implementation of public relations, media and marketing for the purposes of the SBT; and this effort was rewarded with a great deal of media coverage, which reached many millions of people both in the UK and abroad and is summarised in image 127 below.

Image 127: Infographic showing engagement with people.

From the time that the first local-area consultation exercise was planned by the Scottish Wildlife Trust and RZSS in the late summer of 2007, through to the capture, quarantine and release of the first animals in May 2009 and the conclusion of the field monitoring programme in 2014, the PR and media staff from the Scottish Wildlife Trust, RZSS, FCS and SNH, as well as SBT staff, had an ongoing workload associated with supporting the external communications for the Trial. The project was considered to have good PR potential by the staff and organisations involved; and the national coverage it generated was a result of the 'story' itself – the return of the beaver to Scotland – combined with an effective media campaign run chiefly by SBT partners. Various detailed media strategies and protocols were developed by the PR and Communications Working Group to deliver all elements required for external communications. In turn, these strategies and protocols led to the creation of several project leaflets (see Appendix 13), a dedicated website, a weekly blog, a Facebook page and a Twitter feed. The tone of external communications focused on portraying the facts about beaver ecology and the aims and process of the Trial.

The Trial was a culmination of many years of effort from a wide variety of individuals and organisations both in Scotland and further afield, and this – combined with the large-scale third-party funding associated with the Trial – meant that there was a large crowd present at most of the releases, and more still at the Ministerial launch. Although this meant that the animal-release process and launch were enjoyed and experienced by many people (both at the site and through subsequent media coverage), it did result in some significant logistical problems for those organising the events, and concerns were raised regarding the potential negative impact of relatively large numbers of people upon the stress levels of the animals themselves.

Image 128: Original beaver release at Loch Coille-Bharr.

The story of the SBT beaver release was picked up by a wide variety of local, national and international media outputs. It has been estimated that this reached over 10 million people on Friday 29 May 2009. Newspaper circulation figures alone reached 4,633,253 people, while figures for the following day were calculated at 6,502,411. It proved more difficult to measure viewing figures for broadcast news and websites, although BBC, STV and Sky News all ran the item in their news broadcasts and contained features on their websites. The first release was also covered on national BBC radio stations and a few local stations, with the majority of the coverage being balanced in tone. Subsequent opinion pieces were either completely positive or negative, as were the associated letters submitted to newspapers. Interviews were divided between all the project partners as equally as possible to ensure fair representation. The Trial also commissioned film footage that was used by all the broadcasters and was featured in online video news reports. The still images captured were also used by several newspapers and online sites. It was therefore concluded that coverage was not compromised by the decision to exclude broadcasters and photographers on site during the actual release process.

Image 129: Screenshot of Scottish Beaver Trial website, 2014.

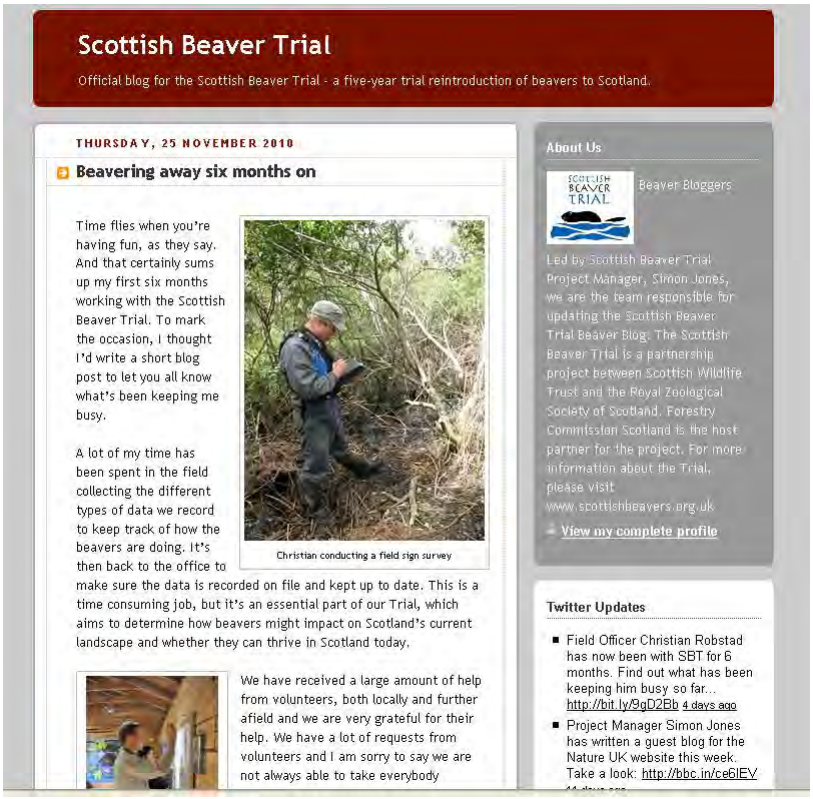


Image 130: Blog for the Scottish Beaver Trial, November 2010.

Spikes in public interest in the project were often directly associated with popular television shows featuring the Trial. Of particular note were the appearances on BBC's *Springwatch* show in 2011 and

2014, BBC's *The One Show* in 2009, 2012 and 2013, BBC's *Chris Packham's Animals' Guide to Britain* in 2011 and ITV's *Ray Mears' Wild Britain* in 2013.

Image 131: Advertisement for *The Animal's Guide to Britain*, 2011 (© BBC).
Image 132: Ray Mears and SBT Field Officer, Rob Needham, prepare to film beavers in Knapdale, 2012.

Image 133: London 2012 gold medal-winning GB Olympian, Tim Baillie, filming BBC's *The One Show* in Knapdale, 2012.

Image 134: Róisín Campbell-Palmer, SBT Field Operations Manager, explains a predator-scent experiment to a BBC *Springwatch* cameraman, 2014.

Along with external television coverage, the project partners also commissioned filming for the purposes of marketing the Trial. A documentary-style short film of the capture, quarantine and release process, entitled *Return of the Native*, was commissioned by the SBT partners in 2008 to provide a record of this historic event, along with a supply of good-quality images which could be used by the media. The film was produced by Otter Films, based locally in the Knapdale area. The SBT partners also commissioned Otter Films to capture footage of the kits born in the Trial in the spring of 2010. In early 2014, a five-minute video was created by RZSS's Digital Manager to capture the visual highlights of the project for use in the end-of-project celebratory events. This video included aerial images taken in the autumn of 2013 from a remotely controlled quadcopter flying above parts of the Trial area (see images 135 and 136 below) and was embedded on the SBT website in May 2014. The website also contained a series of short video vignettes outlining different elements of beaver ecology and field work, along with a virtual guided tour of the main visitor attractions.

Image 135: Quadcopter fitted with high-resolution camera (© Upper Cut Productions).

Image 136: Dubh Loch beaver site seen from the air looking south-west, 2013.

The marketing focus of the Trial was aimed at promoting several different elements of the project: the species, the Trial process itself, the local area and the partner organisations involved. This approach underpinned all marketing and media activities and resulted in the planning and successful delivery of many public and stakeholder events, the production and sale of retail merchandise (see image 139 below) and the running of several public competitions. A particular focus was working in partnership with the local business community. In the spring and summer of 2012, a short-term post of Marketing Coordinator was created in order to liaise with businesses, develop a 'beaver brand' for the local area and produce materials (guides and factsheets) that those involved in the tourism industry could give to their guests and customers. The Trial partners developed a close relationship with the Heart of Argyll

Tourism Alliance (HoATA), both as a member of the alliance and as a supporter at tourism events including a 'Beaver Tourism Experience' day for local tourism operators and the VisitScotland Tourism Expo, both held in 2013.

Image 137: Flyer for 'Beaver Tourism Experience', February 2013.

Image 138: Darren Dobson, owner of the Cairnbaan Hotel, talking to 'Beaver Tourism Experience' delegates, February 2013.

Image 139: Scottish Beaver Trial merchandise flyer.

Image 140: Making beaver cakes – see the recipe at our blog!

One product of the Trial marketing strategy was the creation of a 'Bruce the Beaver' mascot, which proved very popular at public events. The original version was handmade for a Scottish Wildlife Trust beaver reintroduction campaign in 2004, with a new, custom-made costume created for joint use by the Trial partners and HoATA in 2013.

Image 141: Bruce the Beaver (Mark I) celebrates 'winning' the Ryder Cup at the Scottish Trade and Travel Fair, April 2013 (© Heart of Argyll).

Image 142: Bruce the Beaver (Mark II) and runner at the Commonwealth Games Queen's Baton Relay, Lochgilphead, 15 July 2014.

During the five-year Trial period, several public competitions were run to raise awareness and participation in the project. These included two 'Name the Beaver' competitions, with local children helping to choose the names of kits that had been born in Knapdale. The beaver names – 'Barney' and 'Woody' – are the result of these competitions.

Project events such as guided walks programmes, talks and local consultation meetings were advertised in the local press; and news items were always supplied to the local press in the first instance.

The public interest in and media profile of the Trial resulted in the collection of three awards for the project between 2011 and 2013. In 2011, the Trial was awarded the 'Lonely Planet Wildlife Comeback Award', and in 2013 it was highly commended in the 'Nature of Scotland Awards' before being voted 'Best Conservation Project' in the UK by readers of the BBC's *Countryfile* magazine.

Image 143: Team Beaver (l–r: Simon Jones, Róisín Campbell-Palmer, Robert Needham and Olwen Hemmings) at Nature of Scotland Awards, Edinburgh, 2013.

Image 144: SBT Project Manager Simon Jones with BBC *Countryfile* magazine's award for 'UK's Best Conservation Project, 2013'.

The last major milestone of the Trial was the 'Celebrating the Scottish Beaver Trial' event, which took place on 14 May 2014 just prior to the cessation of the five-year monitoring period. Hosted and introduced by Mike Mackenzie MSP, the event gathered together many of the people and organisations involved in the planning and delivery of the Trial, and featured speeches from Professor Colin Galbraith, Chair of the SBT Steering Group, and Paul Wheelhouse MSP, Minister for the Environment and Climate Change.

Image 145: Paul Wheelhouse MSP, Minister for the Environment and Climate Change, at 'Celebrating the Scottish Beaver Trial' event, Scottish Parliament, 14 May 2014 (Photo: Phil Hannah).


Image 146: Former and current Scottish Government Environment Ministers with 'Bruce', Roseanna Cunningham MSP, Michael Russell MSP and Paul Wheelhouse MSP (Photo: Phil Hannah).

Image 147: Scottish Beaver Trial staff and volunteers at the Scottish Parliament, May 2014 (Photo: Phil Hannah).

11.5 Recommendations

1. The early establishment of good internal and external communication links between those planning such a reintroduction project and other partners and local people and other stakeholders is vital to success. Sufficient lead-in time is needed to develop detailed project proposals, allowing input into these from all interested parties regardless of their views on the reintroduction. Time is also required to build trust between new external parties; and this must be done in an atmosphere of openness and transparency.
2. The creation of a Local Stakeholders' Forum is considered essential to project success. An independent chair is preferred in order to allow all sides equally to air their views, concerns and ideas. This group should begin meeting while the project is still in the planning phase to allow input to this process. It should also be recognised that feedback from local stakeholders can help to improve the effectiveness of communications and to inform an adaptive style of project management.
3. Local consultation exercises should be an integral part of projects of this nature, in line with best practice and complying with IUCN and SNH guidance on species translocations and reintroductions.
4. The development of a dedicated education pack was seen as a useful hook to interest school and special-interest groups, but there should be efforts to make this resource web-based rather than solely hard copy, and sufficient funding should be allocated to promote it to target audiences.
5. The development and roll-out of 'beaver lessons' was very successful. They should be 'scalable' across school age-ranges to allow flexibility of use and to ensure they match national curriculums.
6. It is important that educational data is subject to the same scrutiny as any other scientific data, and that set protocols should be developed to ensure that data is collected and used in a consistent manner.
7. Beaver costumes and remote camera traps can be very useful for related educational activities.

8. A dedicated educational staffing resource should be built into projects of this nature at the design stage.
9. High-profile projects of this nature need to budget for a sustained period of marketing and communications activity, in order to develop the potential of the project as well as to meet the ongoing media and public demand for information. This may mean the provision of dedicated staff resource for this purpose. Such work is considered vital to the potential success of the Scottish Beaver Trial and also a vital requirement for funders. Complex, multi-partner projects such as this, which involve organisations that rely on recognition and support to raise profile and funds, require clear protocols for primary and secondary branding. Without this, there can be a lower public and stakeholder recognition of partner involvement and/or conflicting messages.
10. Likewise, a clear media protocol is required to identify who the key audiences are (i.e. the media, the public, stakeholders) and any key responsibilities of the different partners.

12

Resources

12. Resources

12.1 Organisational structures and staffing

An organogram showing the organisational structure of the Scottish Beaver Trial (SBT) is illustrated in Appendix 6. The terms of reference of the separate groups within the structure are found in Appendix 7.

As a partnership project, the Trial was directed at a strategic level by a Steering Group formed in the autumn of 2007 by the chief executives of the Scottish Wildlife Trust and the Royal Scottish Zoological Society (RZSS). The Steering Group comprised representatives of each of the partner organisations, including Forestry Commission Scotland (FCS), along with external expert advisors and representatives of major funders. To avoid bias as independent monitors, Scottish Natural Heritage (SNH) sat on the group as observers.

This group in turn had an overview of the work of the SBT Project Team, whose members were responsible for much of the on-the-ground decision-making and implementation of the Trial. The group was made up of operational staff from the Scottish Wildlife Trust, RZSS, FCS and SNH, the majority of whom were based locally in Mid-Argyll. The Project Team was advised and assisted by four working groups which covered (i) Fundraising, (ii) Data, (iii) Education and Interpretation and (iv) Marketing and Communications. In January 2011, the Scottish Wildlife Trust and RZSS also formed an SBT Management Team comprising the lead staff members from each of the SBT working groups along with key project staff. This group was created in order to share and disseminate updates from various work areas from the project and to identify progress and actions required to move the project forward.

The structure also included two independent groups. The Research and Monitoring Coordination Group was chaired by SNH and comprised SNH staff, SBT observers and representatives of all the Independent Monitoring Partners. This group guided the independent monitoring process and authorised research projects directly associated with the Trial. The Research and Monitoring Coordination Group fed directly, via a scientific review system, to the Scottish Government.

A separate Local Stakeholders' Forum was also established prior to the first beaver releases to provide a clear, transparent line of communication between the project partners and local stakeholders, and to allow local stakeholders' views to be fed into the decision-making process for the Trial. While complex in nature and occasionally a challenge to efficient communications, the organisational structure of the Trial was a reflection of the number and variety of parties involved in the project.

At the start of the Trial, dedicated project staffing consisted of two full-time equivalent posts – a full-time Field Officer and a full-time Project Manager – with the additional full-time support of the Beaver Project Leader from RZSS. However, the need for additional staff capacity to ensure completion of all field tasks soon became apparent, and an Assistant Field Officer role was created in August 2010. In October 2010, the role of Field Operations Manager evolved from the RZSS Beaver Project Leader role to oversee operations in Knapdale, with the Project Manager concentrating on strategic planning and overall delivery.

With the arrival of the Field Operations Manager and an increase in longer-term student placements, the need for an Assistant Field Officer ceased, and this post ended as staff moved on. A short-term SBT Marketing Coordinator intern position was recruited in 2012 to develop and produce an SBT marketing toolkit for local businesses over the spring and summer months.

The final member of the project staff team to come on board was the part-time Education Ranger, arriving in spring 2012 to meet the demand for educational events and public guided walks. By the end of the field monitoring phase in 2014, the project employed 3.5 full-time equivalent posts, but relied on up to 14 support staff from the partner and host organisations to ensure that the project ran smoothly. Between 2009 and 2014, the Field Officer post-holder changed three times as individuals moved on from the project and replacements were recruited. All project staff posts ceased on 30 May 2014, with the exception of the Education Ranger, who remained in place to monitor beaver activity and continue educational engagement in the period leading up to a Scottish Government decision on the future of the beaver population in Knapdale.

From the beginning of the Trial, the project staff were assisted by a number of volunteers and student placements who helped with the full range of field work and educational activities. These volunteers were from a range of backgrounds and included local residents, overseas volunteers and students from secondary and higher-level education. Over the five years of the field monitoring phase, 61 volunteers from six European countries contributed over 11,000 hours of work to the project. This assistance was invaluable in terms of project delivery and certainly prevented the need to employ more staff to ensure that all field and educational work was carried out to a good standard. Of particular note were the eight long-term student placements who, at various times, worked full-time for up to 10 months, building up the required skills and experience to perform in a similar capacity to field staff. Some of the long-term placements also carried out small-scale research projects where this work did not impact upon the independent monitoring process (see section 10.1). It is worth noting that the experience of the Trial was that it is easier for project staff to manage and support small numbers (one to three) of volunteers at any one time than managing large groups, which can be more logistically challenging to work with.

12.2 Budgets and fundraising

Note: the budgetary figures contained in this report do not include all associated costs of the SBT borne by FCS or SNH.

At the time of application to the Scottish Government in December 2007, the cost for the Scottish Beaver Trial had been estimated by the partners at approximately £850,000. This figure comprised costs associated with legal fees, site preparation, animals, staffing, equipment and office space, monitoring and research, interpretation and communications, management and contingencies. SNH committed £275,000 to the Independent Monitoring Programme for the project over the period of the Trial. The financial scale of the project meant that neither the Scottish Wildlife Trust nor RZSS had sufficient financial capacity to fund the project directly, therefore there was a requirement to raise new external funds in order to deliver the entire project successfully. In March 2008, a Fundraising Working Group was established by the Scottish Wildlife Trust and RZSS in order to prepare a fundraising strategy for the Trial. This strategy focused on the targeting of (i) grant-making bodies and charitable trusts, (ii) appeals to members of the Scottish Wildlife Trust and RZSS, and (iii) corporate and business support. At this point, the outline Trial budget was more accurately costed out, rising to an estimated £1.37 million, with the change largely a result of increases in staffing, research project costs and interpretation costs.

Following the granting of the Scottish Government licence in May 2008, the Fundraising Working Group was faced with a major challenge as the project was given the go-ahead somewhat later than hoped, but with a timetable for release set for spring 2009. Notwithstanding an early promise of significant third-party funding from the People's Trust for Endangered Species (PTES, formerly the Mammals Trust), this meant that over £1 million had to be raised in less than 12 months in order for the Trial to begin.

The fundraising effort gained a massive boost in October 2008 when the Scottish Wildlife Trust was successful in securing an unprecedented award of £1 million from Biffa Award (which awards grants to community and environmental projects across the UK using funds from landfill tax credits donated by Biffa Waste Services). This foundation grant, combined with other grants and successful membership appeals (to Scottish Wildlife Trust members in June 2008 and to RZSS members in September 2008), meant that the majority of funding for the Trial was confirmed by Christmas 2008.

Following the capture of the beavers in Norway in the autumn of 2008, it was necessary to revise the budget again towards the £2 million level as a result of increased costs involved in this operation (see section 5). The various Independent Monitoring Partners also made substantial in-kind contributions towards the costs of implementing the monitoring programme; and in-kind contributions from the support of FCS staff also enhanced the resources put towards the project. From 2008 until the end of the five-year field monitoring period in May 2014, the budget for the Trial remained in the region of £1.5 to £2 million.

A summary of budgeted expenditure and income sources is illustrated in images 148 and 149.

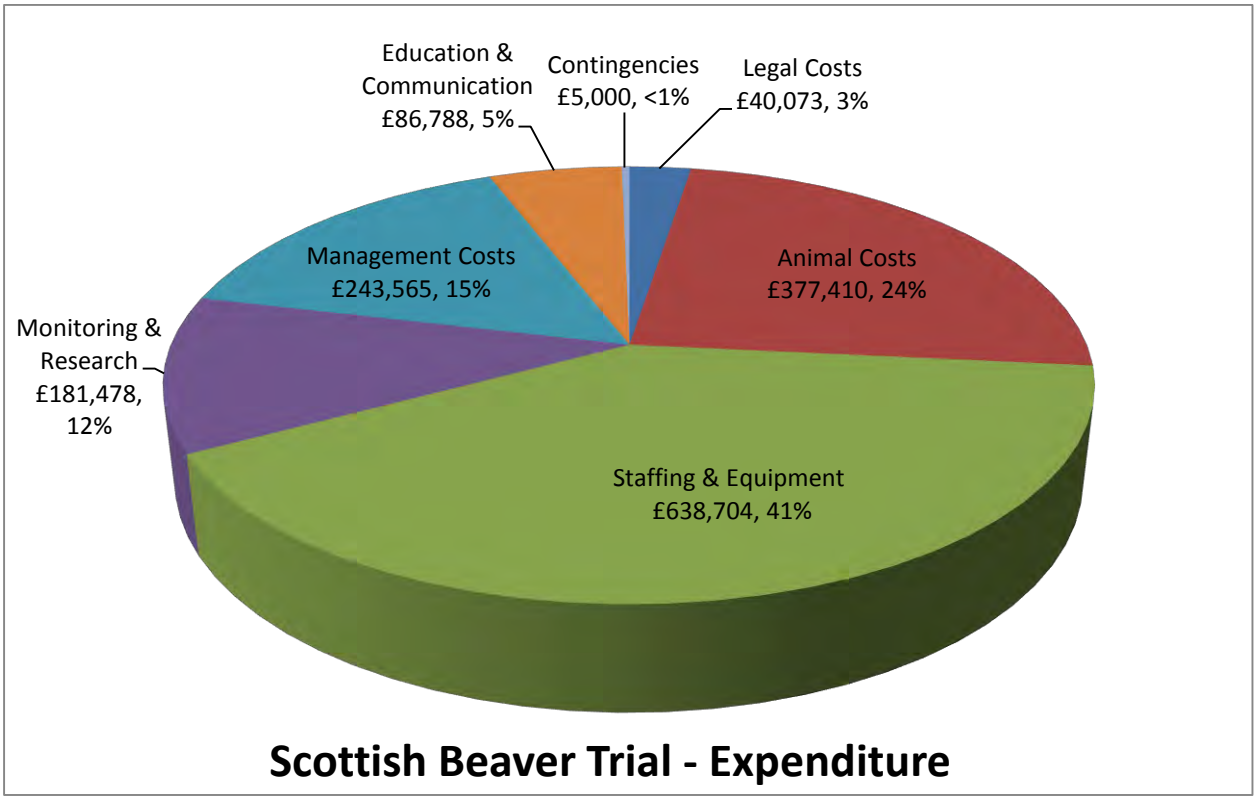


Image 148: Scottish Beaver Trial expenditure.

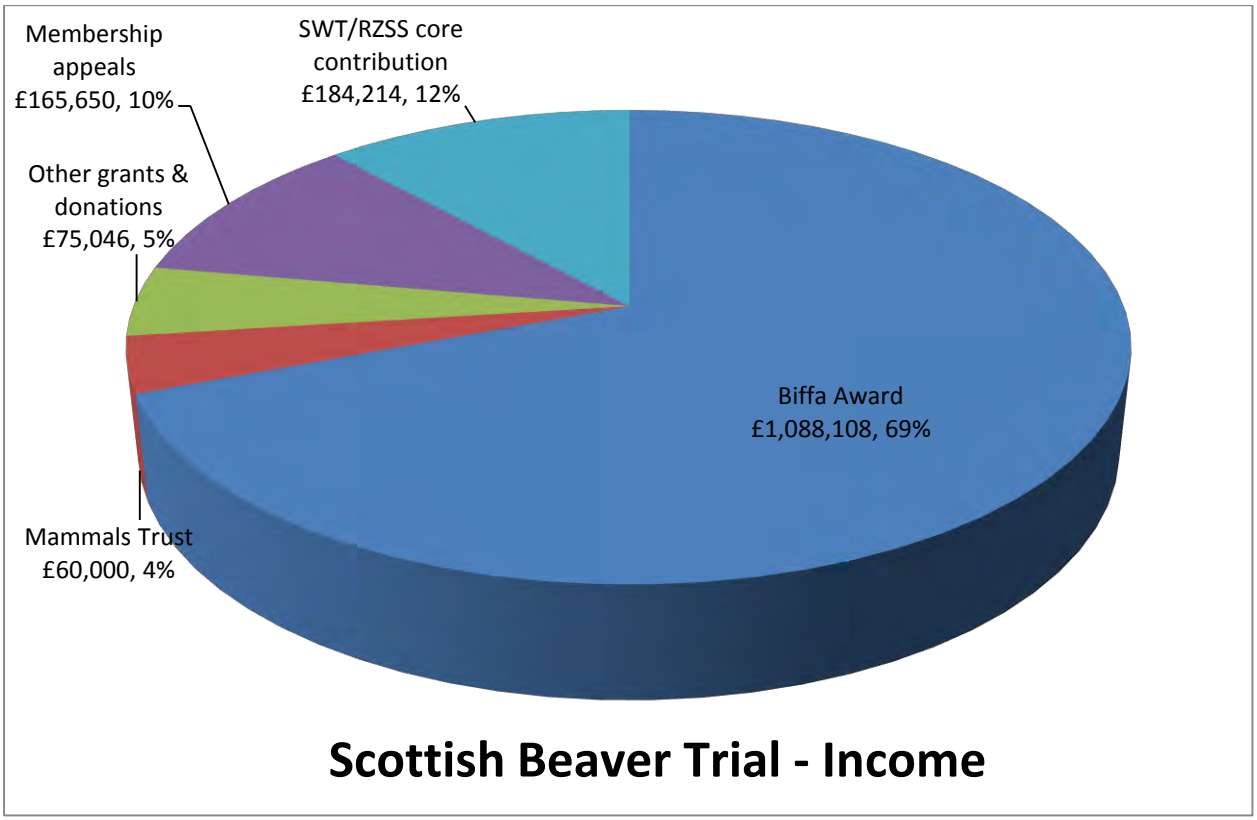


Image 149: Scottish Beaver Trial income.

12.3 Recommendations

1. Our experience suggests that accurately forecasting an outline budget for such a project can be a challenge, and it should be recognised that significant contingencies and flexibility should be built in from the start to adapt to changing circumstances, particularly with regard to animal costs. As with all major project budgets, sufficient lead-in time is required to cost out detailed tasks and capital items.
2. A simple yet key point to make when considering the budget and fundraising for such a nationally important, groundbreaking initiative is that scientifically monitored trial projects cannot be done on the cheap and need to be well resourced and very carefully costed to ensure the best chances of success.
3. Fundraising generally requires a lead-in time of at least three to 12 months (depending upon sources), and is easier for projects which have not yet started, but (particularly for grants) eligible expenditure cannot precede approval. As such, project planning should incorporate sufficient lead-in time for fundraising.

13

Conclusions

84%
of Mid-Argyll residents support wild beavers living in Knapdale. 11% disagree

74%
of Scottish adults aware of the Trial support beaver reintroduction, according to a YouGov poll. 6% disagree

80%
of local people believe that beavers will help tourism and the area's economy. 4% disagree

13. Conclusions

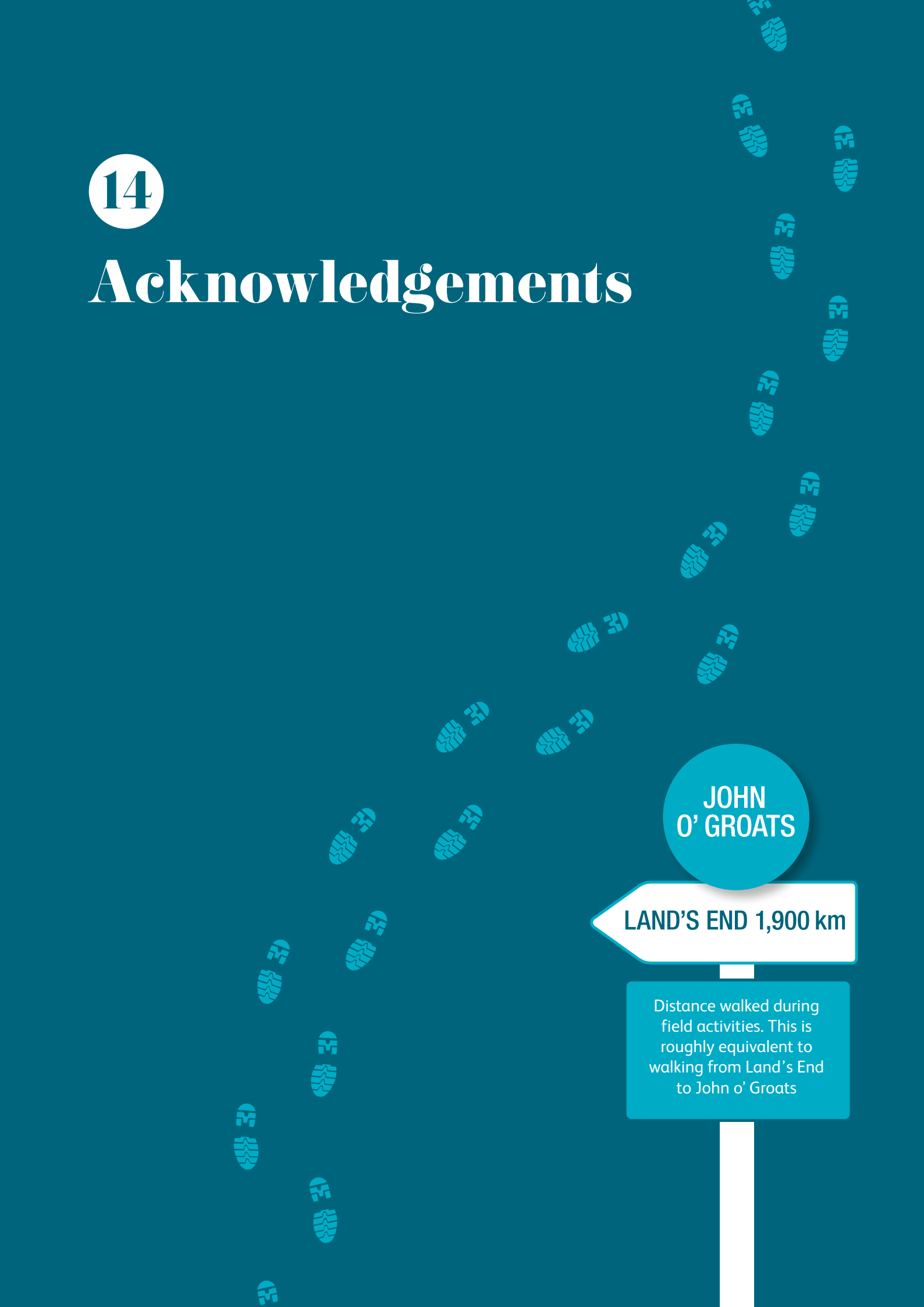
The last two days of May 2009 finally saw the realisation of a project that was over 10 years in the making – a true milestone in UK conservation history – as the first ever formal mammal reintroduction began. The release of the first three families of Eurasian beavers into the lochs of Knapdale Forest took the combined efforts of over 40 people from 10 organisations across three countries – all this in just 12 months leading up to the first release. The five years that followed saw the successful delivery of a complex Independent Monitoring Programme in field conditions that were often demanding for the project staff, volunteers and external scientists involved. New animal-management techniques and study methods were tried and tested in the field, and the lessons learned from the results of this work had led to advances in our understanding of this keystone species and how a reintroduction project of this nature can be built upon should there be further releases of beavers in Scotland in the future. Along with this work, the research partnerships that were stimulated by the start of the Trial went on to publish a series of peer-reviewed papers and associated publications that have expanded our knowledge base of beavers. We must now await the results of the Independent Monitoring Programme to fully assess the results of the Trial, and after it the synthesis report of Scottish Natural Heritage (SNH) to the Scottish Government.

Alongside the science was an educational programme that grew from a modest start but which continues at the time of writing to be innovative and popular with young and old alike. The pioneering nature of the Trial, and the arrival of a once extinct species capable of changing landscapes, meant that the press and media were quick to respond, and the project has reached millions of people through television, social media and the press.

The authors of this report, along with many others across Scotland, Wales and England, look forward to the coming months when a decision on the future of beavers in Scotland will be made. Perhaps one day we shall see the widespread return of this native species to our lochs, rivers and burns.

14

Acknowledgements



14. Acknowledgements

We would like to thank all of the staff and volunteers from numerous organisations who have worked – some for many years – on the development and implementation of the Scottish Beaver Trial, in particular the members of the Scottish Beaver Trial Steering Group, Project Team and Working Groups. Thanks go to Professor Frank Rosell and colleagues at Telemark University College, not only for providing our beavers but also for the great deal of advice. To the Trial hosts, Forestry Commission Scotland, we are grateful for your huge team effort and professionalism throughout. To all those from Scottish Natural Heritage, we are grateful for all your groundbreaking work prior to 2008, without which the Trial could never have happened. And, to our third-party funders of the Trial, notably Biffa Award, we say many thanks for helping the project proposal to become a reality.

In particular, many thanks go to the following people:

Advisers – Derek Gow, Duncan Halley, Gerhard Schwab.

Biffa Award staff – particularly Gillian French and Irene Greenwood.

Dalriada Veterinary Surgery – Justine Armstrong, Alison Barr, Fiona Campbell.

Forestry Commission Scotland – David Jardine, Margaret MacCallum, Ian McKee, Philippa McKee, Kevin McKillop, Nick Purdy, John Taylor, Helen Watt.

Mattilsynet – Jan Egil Aronsen, Pia Paulsen.

Royal (Dick) Vet, University of Edinburgh – Jorge del Pozo, Gidona Goodman, Anna Meredith.

Royal Zoological Society of Scotland – Donna Brown, Georgina Cook, George Corr, Amy Cox, Nick Dowling, Richard Duncan, Jo Elliot, Simon Girling, Rachel Goddard, Donald Gow, Maxine Gow, Claire Gresswell, Darren McGarry, Jamie Ormiston, Jon-Paul Orsi, Polly Phillipot, Romain Pizzi, Ross Poulter, Douglas Richardson, Sarah Robinson, Rob Thomas, Iain Valentine, David Windmill.

Scottish Beaver Trial Education Ranger – Olwen Hemmings.

Scottish Beaver Trial Field Officers – Nathan Dove, Jenny Holden, Robert Needham, Christian Robstad.

Scottish Beaver Trial volunteers – David Angel, Tasmin Batey, Pat Batty, Steve Benham, Vanessa Berrie, Michael Burford, Sophie Carpenter, Donna Causer, Pete Creech, Sue Creech, Colin Davies, Rob Davis, Bostjan Debersek, Karen Dixon, Helen Downie, Lorna Dykes, John Evans, Hannah Farley, Samantha Gate, Jenny Gatwood, Milou Geven, Harry Gray, Jenna Griffiths, Lindsey Grimshaw, Kate Harvey, Phil Hemmings, Sam Hempenstall, Philippa Hughes, Francesca Jaroszynska, Mark Johnston, Jamie Lamb, Helena Letailleur, Nadine Little, Pauline Lynch, Fraser MacNicol, Jim Malcolm, Donald Malone, Clare McCartan, James McCready, Sophie Morrill, Katie Murphy, Scott Murray, Charlie Nash, Victoria Pinion, Shayl Renyard, Megan Robertson, Sara Schloemer, Charlie Self, Matthew Sharpe, David Stewart, Jennifer Stollery, Hazel Templeton, Mollie Thomas, Allison Tubbesing, Rowan Turner, Jacob van der Ploeg, Priscilla Vlaming, Charlotte Wagner, Alister Walker, Sophie Watts, Polly Willis, Carys Young, Jonathan Young.

Scottish Natural Heritage – Ndurie Abah, Dave Batty, Martin Gaywood, Stan Phillips, Karen Taylor, Angus Tree.

Scottish Wildlife Trust – Allan Bantick, Lyndsay Barmforth, Oliver Davies, Catherine Douglas, Gill Dowse, Steve Gardner, Ryan Gavan, Clara Govier, Lucy Graham, Karlene Hill, Jonny Hughes, Michael Lennon, Ian Mackenzie, Donna Mathieson, Nicola McGovern, Simon Milne, Ivor Normand, Jo Pike, Paul Ritchie, Jess Ryder, Alexa Seagrave, Greg Tinker, Debbie Tribak, Nick Wright.

SEPA staff, Lochgilphead.

Telemark University College, Norway – Frode Bergan, Frid Berge, Bjornar Hovde, Tone Jøran Oredalen, Howard Parker, Frank Rosell.

All our volunteers, students, supporters and stakeholders.

15

References

Winner
Lonely Planet
'Wildlife Comeback Award'

Runner-up and highly commended
RSPB Nature of Scotland
'Innovation Award'

Winner
BBC *Countryfile* Magazine Award
for 'Best Conservation Project'

15. References

Campbell R, Dutton A, Hughes J (2007) *Economic impacts of the beaver*. Report published by Wildlife Conservation Research Unit, University of Oxford.

Campbell-Palmer R, Girling S, Pizzi R, Hamnes I, Øines Ø, Del-Pozo J (2013) *Stichorchis subtriquetrus* in a free-living beaver in Scotland. *Veterinary Record*, doi:10.1136/vr.101591.

Campbell-Palmer R, Girling S, Rosell F, Paulsen P, Goodman G (2012) *Echinococcus* risk from imported beavers. *Veterinary Record*, 170: 235.

Campbell-Palmer R, Rosell F (2010) Conservation of the Eurasian beaver *Castor fiber*: an olfactory perspective. *Mammal Review*, 40 no. 4: 293–312.

Campbell-Palmer R, Rosell F (2011) The importance of chemical communication studies to mammalian conservation biology: A review. *Biological Conservation*, 144: 1,919–30.

Campbell-Palmer R, Rosell F (eds) (2013) *Captive Management Guidelines for Eurasian Beaver, Castor fiber.* Royal Zoological Society of Scotland publication.

Cross H, Campbell-Palmer R, Girling S, Rosell F (2012) The Eurasian beaver (*Castor fiber*) is apparently not a host to blood parasites. *Veterinary Parasitology*, 190: 246–8.

Davic RD (2003) Linking keystone species and functional groups: a new operational definition of the keystone species concept. *Conservation Ecology*, 7, r11.

Directive 92/43/EEC Conservation of Natural Habitats and Wild Flora and Fauna (the Habitats Directive) Article 2.

Duff AG, Campbell-Palmer R, Needham R (2013). The beaver beetle *Platypsyllus castoris* Ritsema (Leiodidae: Platypsyllinae) apparently established on reintroduced beavers in Scotland, new to Britain. *The Colepterist*, 22: 9–19.

Goodman G, Girling S, Pizzi R, Rosell F, Campbell-Palmer R (2012) Establishment of a health surveillance program for the reintroduction of the Eurasian beaver (*Castor fiber*) into Scotland. *Journal of Wildlife Disease*, 48: 971–8.

Gottstein B, Frey CF, Campbell-Palmer R, Pizzi R, Barlow A, Hentrich B, Posautz A, Ryser-Degiorgis M-P (2014) Immunoblotting for the serodiagnosis of alveolar echinococcosis in alive and dead Eurasian beavers (*Castor fiber*). *Veterinary Parasitology*, doi:10.1016/j.vetpar.2014.06.017.

Gurnell J, Gurnell AM, Demeritt D, Lurz PWW, Shirley MDF, Rushton SP, Faulkes CG, Norbert S, Hare EJ (2008) *The feasibility and acceptability of reintroducing the European beaver to England*. Report prepared for Natural England and the People's Trust for Endangered Species.

Hardman B, Moro D (2006) Optimising reintroduction success by delayed dispersal: Is the release protocol important for hare-wallabies? *Biological Conservation*, 128: 403–11.

Heidecke D (1986) Erste Ergebnisse der Biberumsiedlungen in der DDR. *Zoologische Abhandlungen*, 41: 137–42.

Huntly N (1995) How important are consumer species to ecosystem functioning? In CG Jones and JH Lawton (eds), *Linking Species and Ecosystems* (New York: Chapman & Hall), pp. 72–83.

IUCN/SSC Guidelines for Reintroductions. Prepared by the SSC Reintroduction Specialist Group. Approved by the 41st Meeting of the IUCN Council, Gland, Switzerland, May 1995.

Jones S, Gow D, Lloyd Jones A, Campbell-Palmer R (2013) The battle for British beavers. *British Wildlife*, 24: 381–92.

Kitchener AC, Lynch JM (2000) A morphometric comparison of the skulls of fossil beavers and extant European beavers, *Castor fiber*. Report to *Scottish Natural Heritage Review* no. 127.

McEwing R, Frosch C, Rosell F, Campbell-Palmer R (2014) A DNA assay for rapid discrimination between beaver species as a tool for alien species management. *European Journal of Wildlife Research*, doi10.1007/s10344-014-0803-6.

Molony SE, Dowding CV, Baker PJ, Cuthill IC, Harris S (2006) The effect of translocation and temporary captivity on wildlife rehabilitation success: An experimental study using European hedgehogs (*Erinaceus europaeus*). *Biological Conservation*, 130: 530–7.

Parker M (1986) Beaver, water quality and riparian systems. *Proceedings of the Wyoming Water and Streamside Zone Conference. Wyoming Water Research Centre, University of Wyoming, Laramie*, 1: 88–94.

Rosell F, Bozsér O, Collen P, Parker H (2005) Ecological impact of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. *Mammal Review*, 35 nos 3–4: 248–76.

Rosell F, Campbell-Palmer R, Parker H (2011) More genetic data are needed before populations are mixed: response to 'Sourcing Eurasian beaver *Castor fiber* stock for reintroductions in Great Britain and Western Europe'. *Mammal Review*, 42: 319–24.

Rosell F, Hovde B (2001) Methods of aquatic and terrestrial netting to capture Eurasian beavers. *Wildlife Society Bulletin* 29: 269–74. Available online at: http://hdl.handle.net/2282/795

Royal Zoological Society of Scotland and Scottish Wildlife Trust (2007) Application to Scottish Government by the Royal Zoological Society of Scotland and Scottish Wildlife Trust for a Licence under Section 16(4) of the Wildlife and Countryside Act 1981, as amended, to release European beaver, *Castor fiber*, for a Trial Reintroduction in Knapdale, Argyll. 21 December 2007.

Rushton S, South A, Lurz P (2002) *Predicting the outcome of a proposed re-introduction of the European beaver* Castor fiber *at Knapdale, Argyll.* SNH Commissioned Report F022AC327, Battleby.

Scottish Beaver Trial (2007) *Trial reintroduction of the European beaver to Knapdale, Mid-Argyll.* Local consultation report: 1 October to 30 November 2007.

Scottish Natural Heritage (1998) *Scott Porter Research & Marketing, 1998. Reintroduction of European beaver to Scotland: results of a public consultation.* SNH Research, Survey and Monitoring 121, Battleby.

Scottish Natural Heritage (2001) *Appendix 2: Proposed trial reintroductions of beaver to Knapdale: Report on local consultation* (Edinburgh: Scottish Natural Heritage).

Scottish Natural Heritage (2014) *Best Practice Guidelines for Conservation Translocations in Scotland* (Inverness: Scottish Natural Heritage).

Scottish Natural Heritage (2007) *Species Action Framework. A Five-Year Action Framework: Making a Difference for Scotland's Species* (Edinburgh: Scottish Natural Heritage).

Senn H, Ogden R, Cezard T, Gharbi K, Iqbal Z, Johnston E, Kamps-Hughes N, Rosell F, McEwing R (2013) Reference-free SNP discovery for the Eurasian beaver from restriction site-associated DNA paired-end data. *Molecular Ecology*, 22: 3,141–50.

Tattersall FH, Macdonald DW (1996) *A preliminary review of the direct and indirect costs of re-introducing the European beaver* Castor fiber *to Scotland.* Confidential report to SNH.

Teixeira C, Schetini de Azevedo C, Mendl M, Cipreste CF, Young RJ (2007) *Revisiting translocation and reintroduction programmes*.

Woodford M H (2000) *Quarantine and health-screening protocols for wildlife prior to translocation and release into the wild*. Published jointly by the International Union for Conservation of Nature, Gland, Switzerland, OIE, Paris, France, Care for the Wild Horsham UK, and European Association of Zoo and Wildlife Veterinarians, 86pp.

Zurowski W, Kasperczyk B (1988) Effects of reintroduction of European beaver in the lowlands in the Vistula basin. *Acta Theriologica*, 33: 325–38.

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Appendices

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countries recorded in the Knapdale visitor book

16. Appendices

Appendix 1

Scottish Government Licence and Conditions for the Scottish Beaver Trial

Minister for Environment
Michael Russell MSP

T: 0845 774 1741
E: scottish.ministers@scotland.gsi.gov.uk

The Scottish Government

Simon Milne
Scottish Wildlife Trust
Cramond House
Kirk Cramond
Cramond Glebe Road
Edinburgh
EH4 6NS

30th May 2008

Dear Simon,

BEAVER REINTRODUCTION PROJECT

I refer to your application submitted to the Scottish Government on 21 December 2007 for a licence under section 16(4) of the Wildlife and Countryside Act 1981, to release European beaver for a trial reintroduction in Knapdale, Argyll.

I am pleased to be able to tell you that we have decided to grant a licence for the project as set out in your application.

The licence allows the Scottish Wildlife Trust and Royal Zoological Society of Scotland to release up to four families of beavers (each family to comprise not more than two adults and their kits) within the Knapdale release site as defined in the application. The release of the beavers will not take place until 2009. There will then a period of five years to assess the viability of the reintroduction. Any further releases of beavers at the end of the trial or in relation to any other trial will require a further licence from the Scottish Government. The decision on whether to grant any further licence is a matter for the Scottish Government.

The licence is subject to a number of conditions set out in the attached annex. These relate to the management of the project, the potential impact on the protected areas and species within the release site and the arrangements for post release monitoring.

We have received a number of letters from individuals and national organisations expressing serious concern about the potential impacts on their properties and businesses. I recognise that many of their concerns may only be assessed in the context of an actual trial taking

I wish the beaver reintroduction project every success, and I look forward to the opportunity to see these charismatic animals at home in the Scottish countryside

Yours sincerely

Victoria Quay, Edinburgh EH6 6QQ
www.scotland.gov.uk

ANNEX

BEAVER REINTRODUCTION PROJECT

Licence Conditions

1) The licence allows the Scottish Wildlife Trust and Royal Zoological Society of Scotland to release up to four families of beavers (each family to comprise not more than two adults and their kits) into the wild at the Knapdale release site as defined in the application.

2) The release of the beavers will not take place until 2009.

SNH Role

3) SNH to coordinate a monitoring programme in collaboration with the project partners through an appropriate group, and involving SNH's Scientific Advisory Committee. The group, chaired by SNH, will maintain a suitable level of scientific independence from the other project groups.

SNH, in collaboration with the group, will:

- Collate information on behalf of the Scottish Government (SG).
- Assess and approve all research, survey and monitoring projects associated with the project (including those projects which SNH will not necessarily lead on, e.g. public health), thereby ensuring limited resources are directed at addressing the core objectives of the trial.
- Coordinate research, survey and monitoring projects to ensure collaborative opportunities are identified, data is collated in compatible formats, disturbance to beavers minimised and detrimental effects to nature conservation interests avoided (e.g. SAC, SPA, species etc.) .
- Ensure all data and information collated during the trial has joint ownership and is made publicly available.
- Produce a pre-release monitoring programme and a post-release monitoring programme by the year of the release, both plans to be submitted to the SG

SNH will also lead, in collaboration with other partners where appropriate, on specific projects relating to the monitoring and modelling of the beaver population, and the monitoring of the effects of beaver.

4) SNH to report to the SG on whether the conditions of any licence are being fully addressed on the ground.

Beaver management

5) We would recommend the collection and quarantine of a fourth family as a useful back-up, in case of any mortality during the quarantine period. Beaver mortality during quarantine is not uncommon.

6) We would strongly recommend that all animals are 'soft released', with all precautions taken to limit the risk of individuals dispersing away from the trial area, and details to be agreed with SNH.

7) We would strongly recommend one simultaneous release of all the animals at the start of the trial, rather than a series of phased releases. This will help to ensure that the animals have the opportunity to establish territories at the same time, and it reduces the risk of animals dispersing away from the trial area.

8) Consideration should be given as to whether all animals which move outwith the proposed trial area should be removed, or just those where the land owners request it.

9) Localised mink control should be considered during the initial establishment of the population to protect beaver kits. The details of any mink trapping must be agreed with SNH to take account of SAC qualifying interests and European Protected Species

Project management

10) The European beaver is included within the Species Action Framework (SAF). All species identified on the SAF have an implementation plan which sets out objectives, actions and tasks which need to be undertaken. It identifies also lead partners for each task and sets out resourcing issues. The European beaver is the only one of the 32 SAF species for which a plan has not yet been drafted because a project has not yet been approved. SWT/RZSS to draw up an implementation plan with its partners and SNH, and the plan must be made publicly available (e.g. on the SAF web pages).

11) SNH should be represented on the "Beaver Steering Group" and a "Beaver Project Team" as observers.

12) The licence applicants should ensure they have in place a forum to allow the views of the local community, including local businesses and property-owners, to be fed into the decision-making processes for the project.

13) The length of the collection and quarantine element of the project is one year, and the fieldwork element of the project is five years. The applicants need to plan for work extending into year seven to allow time for all monitoring work to be completed, and analysed.

14) Once the beavers are released, the licence applicants must be able to ensure that they can implement the key elements of the trial, as set out in their application, and address any conditions set by the SG. If resourcing is insufficient to continue the trial as agreed, then the exit strategy will need to be implemented.

15) The role of the Field Officer should include regular monitoring of 'sensitive' areas to ensure potential problems are avoided. This to be discussed and agreed with relevant adjacent land owners and relevant public bodies (including British Waterways, Historic Scotland, FCS, and SNH).

16) A training event should be held in the Knapdale area immediately prior to the release of animals. This will ensure relevant project staff and local people are fully aware of, and prepared for, practical beaver management issues which may arise during the project.

17) Discussions, involving the project group members and SNH, to be held with the local FES District to ensure future management of woodland takes into account beaver issues.

18) Arrangements must be put in place by the licence applicants to ensure that local businesses and properties have a clear route to pursue compensation claims for damage caused by the beavers during the period of the trial.

19) The exit strategy must be implemented at any time if this is considered necessary by the SG. The SG will consult with the licence applicants and with the monitoring team led by SNH before deciding that the exit strategy should be implemented.

Research, Survey and Monitoring

20) A suite of tracking methodologies should be employed, rather than relying too heavily on radio-tracking techniques, which may have a number of practical and animal welfare limitations. This will be addressed through the monitoring programme to be led by SNH.

21) Argyll and Bute Council to lead on public health monitoring (in discussion with Scottish Water), with relevant veterinary advice from RZSS. SNH's role would be to ensure that any monitoring

is effectively and efficiently coordinated with other elements of the overall monitoring programme.

22) SNH to discuss with the licence applicants the potential role of the full-time Field Officer in collating data for some aspects of the scientific monitoring work.

Mitigation of impact on protected sites and species

23) Beaver dam construction on burns to be carefully monitored and SNH to be informed immediately once new dams are created. An assessment will then be made by SNH on a case by case basis and, if judged necessary, management of the dam will be required.

24) Beaver dam construction on loch outflows to be carefully monitored and SNH to be informed immediately once new dams are created. If beaver dams are constructed on the outflows of oligo-mesotrophic lochs within the SAC, then the natural water levels of the lochs must be maintained, either through the use of beaver-specific devices which can be incorporated to manage water flow, or through removing the dam. The details to be discussed and agreed with SNH.

25) No dam building by beavers in outflow burns of Loch Clachaig to be permitted during the period April to July inclusive. Any dams being built during that period should be removed without disturbance to the divers.

26) Outflow burns of Loch Clachaig to be checked for beaver activity annually in March before the return of divers; if a dam is present consult SNH to determine whether it needs to be removed

27) Stands of hazel, which hold significant communities of 'typical species' of lichens, should be protected where necessary using appropriate methods and following discussion and agreement with SNH.

28) The methods, and the location, design and construction of structures, required for the 'soft release' of beavers (e.g. artificial lodges and fencing) must take into account local otter activity. The same applies to the erection of fencing for any other purpose during the trial (e.g. the exclusion of beavers from sensitive areas). This must be discussed and agreed with SNH.

29) If divers are breeding on Loch Clachaig in any year then checking for beavers must be carried out without any disturbance to the breeding birds. Black-throated diver is listed on Schedule 1 of the Wildlife & Countryside Act 1981, as amended, therefore, prior to any survey work, relevant project staff must apply for a licence from SNH.

30) A visitor management plan must be agreed and implemented prior to the release of beaver and during the lifetime of the project (addressing issues such as signage, interpretive information in existing buildings, provision for self-guided and guided walks etc.). This plan and the design of associated facilities must be discussed with and agreed with SNH.

31) *Brachytron pratense* to be monitored within the SSSI and the trial site as a whole. *Calopteryx virgo* should be monitored along specific sections of enclosed and open burns. This can be done through the monitoring programme for the project.

Landscape and Habitats Division
Scottish Government
May 2008

Appendix 2

SG licence amendment for replacement beavers – 10th June 2010

Rural & Environment Directorate
Natural Resources Division

Mr Simon Jones
Scottish Beaver Trial Project Manager
Scottish Wildlife Trust
Units 5-7 Napier Way
Wardpark North
Cumbernauld
G68 0EH

10 June 2010

Dear Mr Jones

BEAVER REINTRODUCTION PROJECT

Thank you for your letter of 14 May to Hugh Dignon requesting a variation in your licence to conduct the Scottish Beaver Trial in order to introduce further replacement animals.

I am writing to notify you that, following consultation with SNH, Scottish Government is content to permit the release of replacement animals within the first two years of the trial i.e. up to 29 May 2011.

The conditions attached to the original licence will apply. Additional conditions relating to the replacement animals are listed in the attached Annex.

You state that the options for animals that cannot be returned to the trial would be euthanasia or return to captivity. Given the value of this resource, we consider the only option for healthy animals to be return to captivity. The option to euthanase animals on welfare grounds due to illness or injury would of course remain.

Finally, although two animals are still missing from the original release at Creagmhor, I understand that an animal was seen outside the trial area in autumn 2009 and one was seen in the last few weeks. We would expect the SBT to continue their efforts to relocate these animals.

Yours sincerely

ANDREW L TAYLOR

BEAVER REINTRODUCTION PROJECT: VARIATION TO LICENCE CONDITIONS

1. Replacement animals will only be used to replace dead or missing adult beavers in a pair.

2. Replacement animals will only be released within the trial site up to 29 May 2011.

3. Before any replacement animals are used agreement must be obtained from SNH.

4. Replacement animals will only be used in two circumstances; firstly in case of proven death of an adult, and secondly if an adult has been missing and no evidence seen for a period of six months. If the death was related to the trial then replacement animal would only be used if that factor or risk was satisfactorily removed or mitigated.

5. There should be a presumption that replacement animals should come from the remaining animals from the November 2008 import. Only if no suitable animal is available should other animals be considered.

6. The release arrangements, including the need for any fencing, should be discussed and agreed with SNH.

7. Released animals should have ear tags.

8. SNH should attend any release as observers.

Natural Resources Division
June 2010

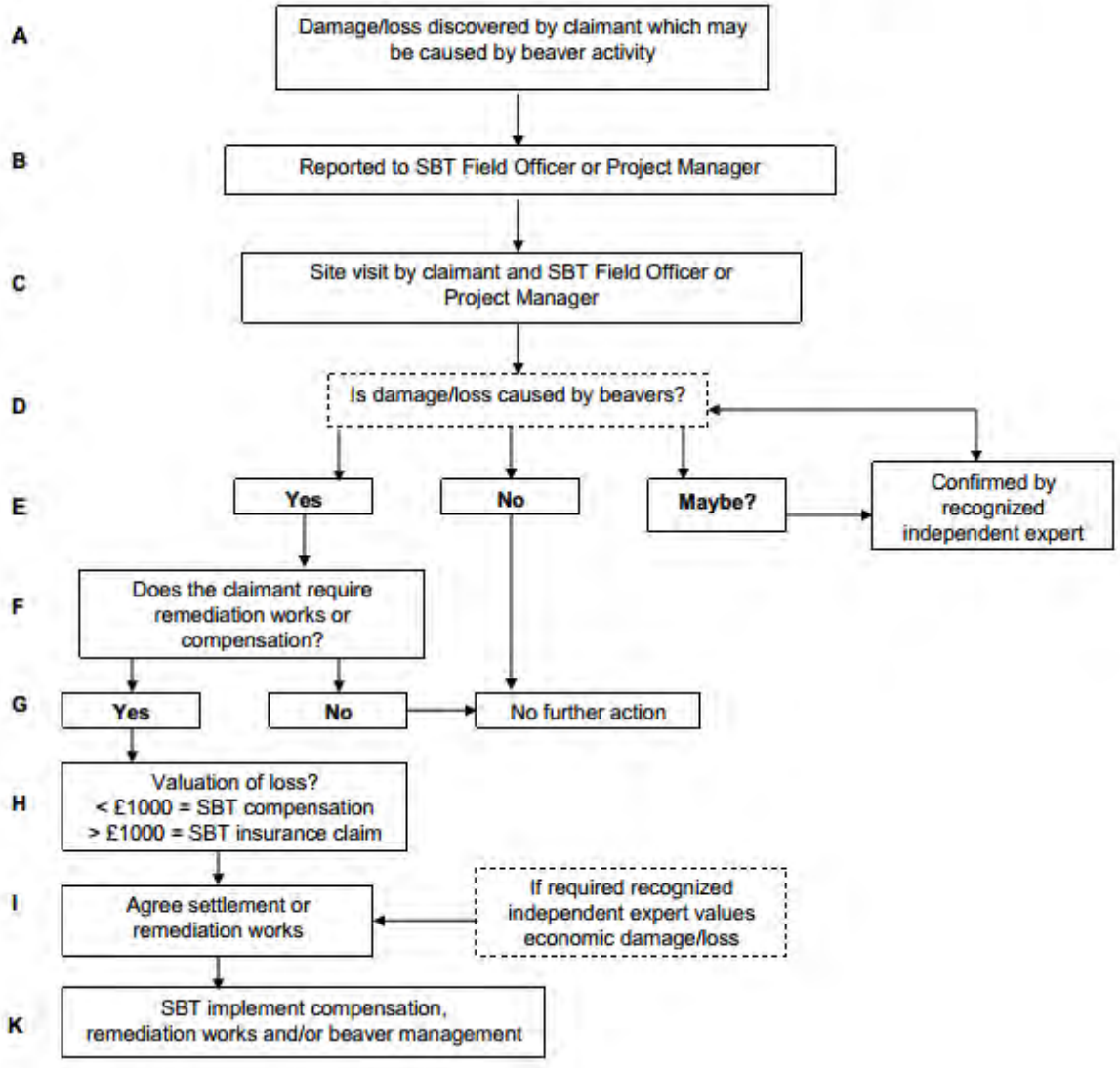
Appendix 3

Scottish Beaver Trial compensation procedure

Scottish Beaver Trial – compensation procedure

IMPORTANT POINTS:

1. This procedure only covers the period of the Scottish Beaver Trial (2009 – 2014).
2. The Scottish Beaver Trial (SBT) partners will at all times have an ongoing dialogue with local stakeholders and landowners regarding the beavers, their effects and any management required as a result of the trial.
3. Wherever possible, the SBT partners with the agreement of local stakeholders and landowners, will attempt to use pro-active preventative measures to mitigate against any economic loss or damage caused by the beavers.



Appendix 4

Scottish Beaver Trial risk assessment

Beaver effect/impact	What/where at risk?	Mitigation measures/controls	Action by	Risk rating (high, med, low)
Flooding				
1. Detrimental flooding caused by damming	(i) Crinan Canal – feeder burns (ii) Neighbouring private property (iii) FCS estate infrastructure	• Active field monitoring of beaver locations and activity by project field staff. • Removal of dams if location considered to have potential negative impact. • If required, fencing of key points to prevent beaver access/egress. • Recapture and relocation of animals if beaver activity considered to potentially have negative impact. • Insurance cover in place.	Field Officer Field Officer Field Officer Field Officer Steering/Local Management Groups	(i) Low (ii) Low (iii) Med
2. Detrimental flooding caused by burrowing	(i) Crinan Canal (ii) Neighbouring private property (iii) FCS estate infrastructure	• Active field monitoring of beaver locations and activity by project field staff. • If required, fencing of key points to prevent beaver access/egress. • Recapture and relocation of animals if beaver activity considered to potentially have negative impact. • Insurance cover in place.	Field Officer Field Officer Field Officer Steering/Local Management Groups	(i) Med (ii) Low (iii) Low
3. Potential bank collapse caused by burrowing	(i) Crinan Canal (ii) BW feeder lochs	• Active field monitoring of beaver locations and activity by project field staff. • If required, fencing of key points to prevent beaver access/egress. • Recapture and relocation of animals if beaver activity considered to potentially have negative impact. • Insurance cover in place.	Field Officer Field Officer Field Officer Steering/Local Management Groups	(i) Med (ii) Med

Public health						
4. Spread of water borne pathogens in drinking water supply (e.g. *Giardia*, *Cryptosporidium*).	(i) (ii)	Public water supply: Kilduskland reservoir Private water supplies (11): Oakbank Farm, Scotnish Farm, Scotnish Lodge, Dounans, Leac na Ban, Seafield Farm, Gallachoile, Barnluasgan, Craglin, Gartnagrenach & Tigh-na-grian	• Public health monitoring of water supplies by Argyll & Bute Council Public Protection Services. • Screening of beavers in quarantine and post release • Active field monitoring of beaver locations and activity by project field staff. • If required, fencing of key points to prevent beaver access/egress. • Recapture and relocation of animals if beaver activity considered to potentially have negative impact.	A & B Council RZSS/Field Officer Field Officer Field Officer Field Officer	(i) (ii)	Low Low
Forestry and agriculture						
5. Damage to notable trees	(i) (ii)	FCS estate Neighbouring private forestry interests	• Fencing of key points to prevent beaver access/egress. • If required, fencing of key points to prevent beaver access/egress. • Insurance cover in place.	Field Officer & FCS Field Officer Steering/Local Management Groups	(i) (ii)	Low Low
6. Damage to forestry	(i) (ii)	FCS estate Neighbouring private forestry interests	• Active field monitoring of beaver locations and activity by project field staff. • Insurance cover in place.	Field Officer & FCS Steering/Local Management Groups	(i) (ii)	Low Low
7. Damage to crops	(i)	Neighbouring private property – crops	• Active field monitoring of beaver locations and activity by project field staff. • If required, fencing of key points to prevent beaver access/egress. • Insurance cover in place.	Field Officer Field Officer Steering/Local Management Groups	(i)	Low

Fish						
8. Migrating fish impeded by damming	(i) (ii)	Efferent/afferent burns from west side of Loch Coille Bharr and efferent burn from Loch Linne Outwith trial area: River Add – upstream & tributaries (salmon & sea trout)	• Active field monitoring of beaver locations and activity by project field staff. • If required, fencing of key points to prevent beaver access/egress.	Field Officer & AFT Field Officer	(i) (ii)	Low Low
9. Salmonid spawning area(s) impacted by damming and flooding	(i)	Outwith trial area: River Add – upstream & tributaries (salmon & sea trout)	• Active field monitoring of beaver locations and activity by project field staff. • Insurance cover in place.	Field Officer & AFT Steering/Local Management Groups	(i)	Low
Designated features						
10. Significant detrimental impact upon designated features of SAC/SSSI	(i) (ii)	Taynish and Knapdale Woods SAC (marsh fritillary butterfly, western acidic oak woodland, otter, lochs with aquatic vegetation). Knapdale Woods SSSI (breeding birds, bryophytes, dragonflies, lichens, loch trophic range, upland oak wood).	• 'Appropriate Assessment' monitoring of features by SNH. • Active field monitoring of beaver locations and activity by project field staff. • Removal of animals if beaver activity considered to have significant negative impact.	SNH Field Officer	(i) (ii)	Low-Med Low-Med
11. Significant detrimental impact upon Scheduled Ancient Monuments (SAMs)	(i) (ii)	13 SAMs within trial area (1 at Loch Coille Bharr). 124 Unscheduled SAMs within trial area.	• Active field monitoring of beaver locations and activity by project field staff. • Monitoring of SAMs by Field Officer, FCS and Historic Scotland, as part of agreed SAM Management Plans. • Protection of features if considered practicable and a high risk of negative impact. • Removal of animals if beaver activity considered to have significant negative impact.	Field Officer Field Officer, FCS & Historic Scotland	(i) (ii)	Low Low

People				
12. Significant detrimental impact on trial due to marked increase in visitor numbers to trial area.	(i) Beavers (ii) Designated site features	• Information and media campaign to manage visitors. • Interpretation, recreation and access management plan development and implementation. • Monitoring of visitor numbers.	Steering/Local Management Groups FCS FCS	(i) Low (ii) Low
13. Significant detrimental impact on local area infrastructure due to marked increase in visitor numbers to trial area.	(i) Road and car parking capacity and condition.	• Information and media campaign to manage visitors. • Interpretation, recreation and access management plan development and implementation. • Monitoring of visitor numbers.	Steering/Local Management Groups FCS FCS	(i) Low-Med
Beavers				
14. Road traffic accidents and near misses due to beaver activity near roads.	Injury to general public or beavers. (i) B8025 Bellanoch – Tayvallich Road. (ii) Barnluasgan – Achnamara Road. (iii) B841 Cairnbaan – Crinan Road.	• Active field monitoring of beaver locations and activity by project field staff. • If required, road signage to alert drivers of beaver presence. • If required, fencing of key points to prevent beaver access/egress. • Insurance cover in place.	Field Officer Field Officer and A&B Council Field Officer & FCS Steering/Local Management Groups	(i) Low - Med (ii) Low - Med (iii) Low
15. Beaver related human injuries	(i) Bites from poorly handled animals. (ii) Fall/trip resulting from contact with animal (iii) Immersion in water resulting from monitoring activity	• Only trained personnel to handle animals as required. • All necessary PPE, first aid and required equipment with personnel. • Minimum of two personnel when handling animals. • All work in or close to water requires buoyancy aids and training	RZSS & Field Officer RZSS/SWT RZSS & Field Officer RZSS/SWT	(i) Low (ii) Low-Med (iii) Low- Med
16. Loss of/damage to radio tag transmitters, leading to loss of individual beavers.	(i) Beavers within and outwith trial area.	• Active field monitoring of beaver locations and activity by project field staff. • Regular inspection of radio tags and operation, and replacement if necessary. • Recapture and relocation of animals if beaver activity considered to potentially have negative impact.	Field Officer Field Officer Field Officer	(i) Low - Med

17. Beaver mortality/injury	Disease, nutrition, predation, accident, unauthorised persecution. (i) Beavers in quarantine. (ii) Beavers within and outwith trial area.	• Regular observation and inspection of animals by veterinary/skilled personnel during quarantine and trial periods. • Suitable management intervention *if necessary* for sick, injured, malnutrioned animals, in post release phase. • Unauthorised persecution – liaison with Strathclyde Police Wildlife Liaison Officers.	RZSS & Field Officer RZSS & Field Officer Field Officer	(i) Low -Med (ii) Low - Med

Key

FCS = Forestry Commission Scotland, AFT = Argyll Fisheries Trust, RZSS = Royal Zoological Society of Scotland, SWT = Scottish Wildlife Trust, A&B Co = Argyll & Bute Council

Actions required/reminders (if any):_____ Action by (date):_____

Risk rating (guide only)

	LIKELY	PROBABLE	REMOTE	IMPROBABLE
SERIOUS	High	High	Low	Low
CONSIDERABLE	Medium	Medium	Low	Low
MINOR	Low	Low	Low	Low
NEGLIGBLE	Low	Low	Low	Low

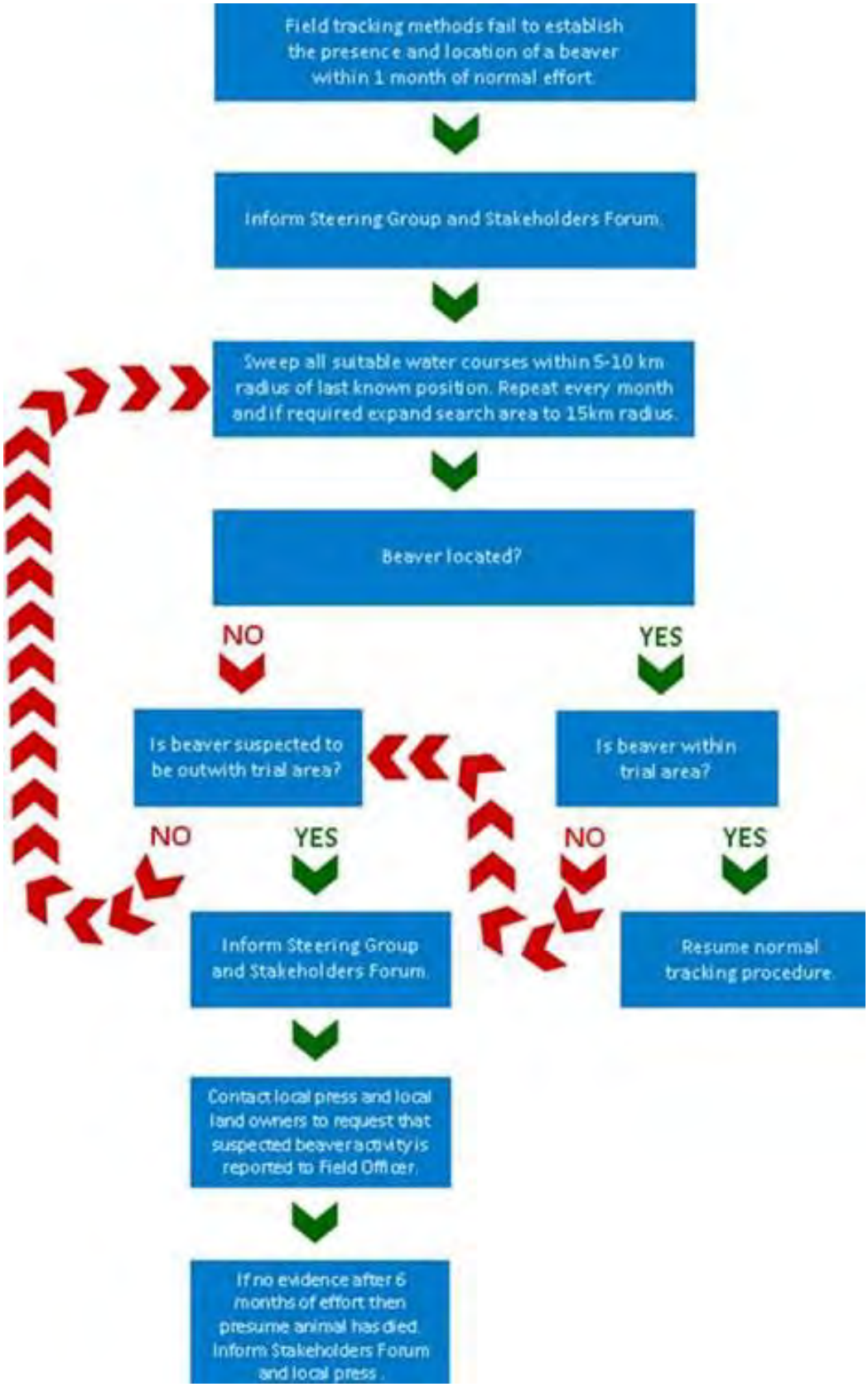
LIKELY	Happens repeatedly, expected
PROBABLE	Will happen several times
REMOTE	Unlikely though conceivable
IMPROBABLE	Highly unlikely

Risk assessment prepared by: Simon Jones, SBT Project Manager Date: August 2008

Signature: _____ Review date: _____

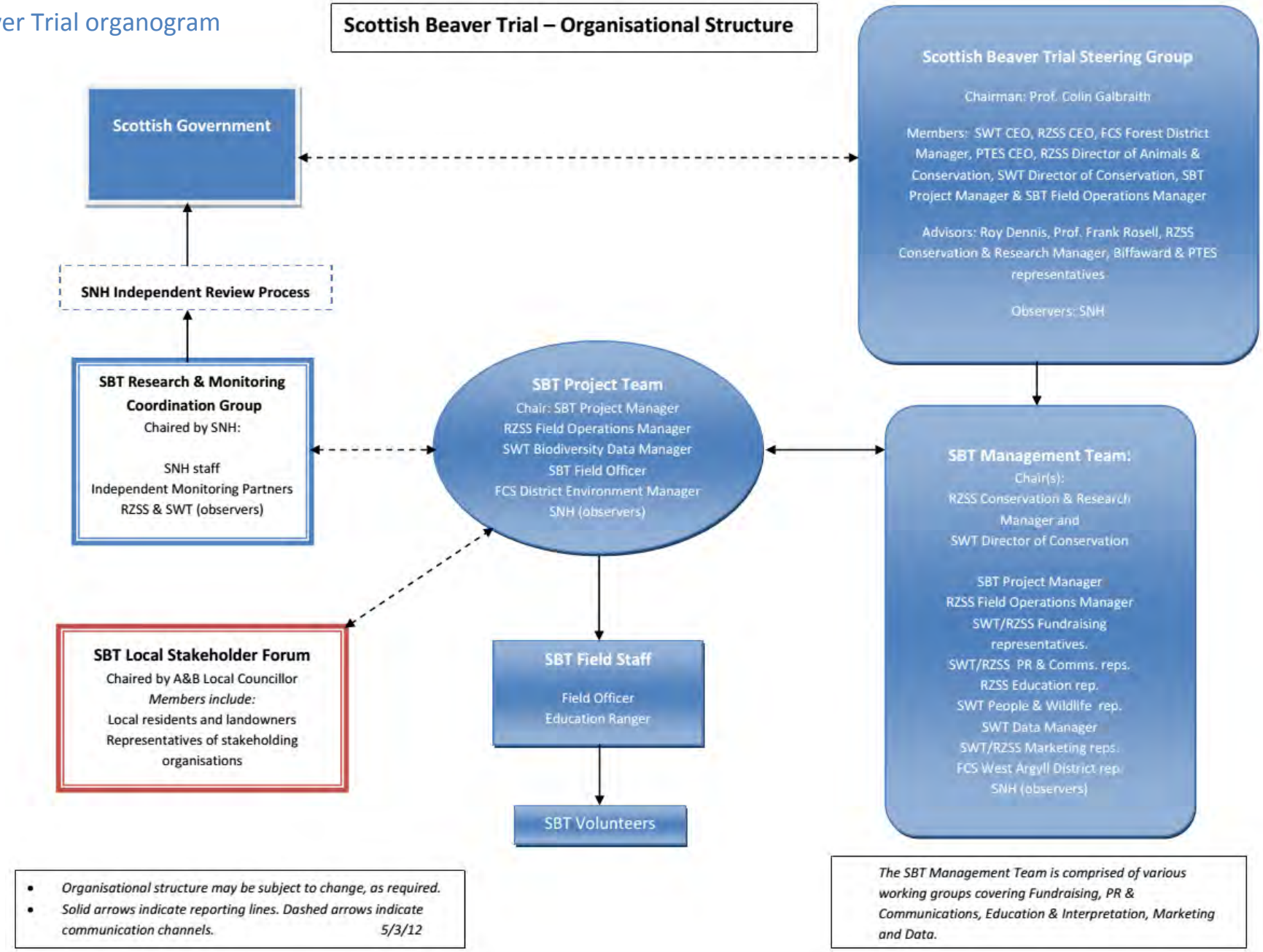
Appendix 5

Scottish Beaver Trial – missing beaver protocol



Appendix 6

Scottish Beaver Trial organogram



Appendix 7

Scottish Beaver Trial organisational terms of reference

Partners

The Scottish Beaver Trial is a partnership project between the Royal Zoological Society of Scotland, the Scottish Wildlife Trust and the host, Forestry Commission Scotland, to undertake a time-limited trial reintroduction of the Eurasian beaver to Knapdale, Mid-Argyll.

The Scottish Wildlife Trust is a registered charity. It is the largest voluntary body working for all the wildlife of Scotland, representing more than 35,000 members who care for wildlife and the environment. The Scottish Wildlife Trust seeks to raise public awareness of threatened habitats and species, and manages over 120 wildlife reserves Scotland-wide.

The Royal Zoological Society of Scotland (RZSS) owns Edinburgh Zoo and the Highland Wildlife Park and is a registered charity, number SC004064. RZSS was founded by visionary lawyer Thomas Gillespie. The Society was set up 'to promote, facilitate and encourage the study of zoology and kindred subjects and to foster and develop among the people an interest in and knowledge of animal life'. RZSS has been involved in several successful species reintroduction programmes in the past. These include native species, such as the Canna mouse, as well as global initiatives including reintroducing the Socorro dove back to the Socorro Islands, off the Mexican coast.

Hosts

Forestry Commission Scotland (FCS) manages the Trial site of Knapdale Forest as part of the national forest estate. FCS serves as the Scottish Government's forestry directorate and is responsible for the protection and expansion of Scotland's forests and woodlands. FCS manages the national forest estate for a range of public benefits – economic, social and environmental. It works closely with a range of national and local stakeholders and partners to deliver the Scottish Government's goals vested in the Scottish Forestry Strategy. In relation to the beaver trial, FCS will host the Trial on their land and will lead on on-site visitor management and interpretation.

The role of Scottish Natural Heritage

Scottish Natural Heritage (SNH) advises the Scottish Government and works to secure the conservation and enhancement of Scotland's natural heritage, foster understanding and facilitate enjoyment of it and encourage its sustainable use. In relation to the Scottish Beaver Trial, the role of SNH, as laid out in the Scottish Government licence conditions (3 and 4), is to:

Licence condition 3 – Coordinate a monitoring programme in collaboration with the project partners through an appropriate group, and involving SNH's Scientific Advisory Committee. The group, chaired by SNH, will maintain a suitable level of scientific independence from the other project groups.

SNH, in collaboration with the group, will:

- Collate information on behalf of the Scottish Government.
- Assess and approve all research, survey and monitoring projects associated with the project (including those projects which SNH will not necessarily lead on, e.g. public health), thereby ensuring limited resources are directed at addressing the core objectives of the Trial.

- Coordinate research, survey and monitoring projects to ensure collaborative opportunities are identified, data is collated in compatible formats, disturbance to beavers minimised and detrimental effects to nature conservation interests avoided (e.g. SAC, SPA, species etc.).
- Ensure all data and information collated during the Trial has joint ownership and is made publicly available.
- Produce a pre-release monitoring programme and a post-release monitoring programme by the year of the release, both plans to be submitted to the Scottish Government.

SNH will also lead, in collaboration with other partners where appropriate, on specific projects relating to the monitoring and modelling of the beaver population, and the monitoring of the effects of beaver.

Licence condition 4 – SNH to report to the Scottish Government on whether the conditions of any licence are being fully addressed on the ground. SNH are directly involved in a significant number of these licence conditions.

Independent monitoring partners

- Beaver ecology – Oxford University Wildlife Conservation Research Unit (WildCru)
- Beaver veterinary health monitoring – Royal (Dick) School of Veterinary Studies
- Woodland vegetation – Macaulay Land Use Research Institute
- Aquatic macrophytes, river habitat and hydrology – University of Stirling
- Water chemistry – Scottish Environmental Protection Agency (SEPA)
- Odonata – British Dragonfly Society
- Fish communities – Argyll Fisheries Trust
- Public health – Argyll & Bute Council Environmental Health Department
- Scheduled ancient monuments – Historic Scotland

From time to time, a range of other Independent Monitoring Partners (public and non-public) may be involved in the monitoring of the Scottish Beaver Trial. See the SBT website for further details.

Scottish Beaver Trial Steering Group

- To actively promote the aims of the Scottish Beaver Trial.
- To design the framework for the project.
- To direct the Project Team through the Project Manager.
- To maintain a channel of communication with the Scottish Government for the exchange of information and for the resolution of issues that may arise.
- To receive and respond to feedback from all groups written into the organisational structure of the Scottish Beaver Trial via the Project Manager.

Scottish Beaver Trial Project Team

- To be responsible for the detailed planning, implementation and reporting of the Knapdale Beaver Trial.

Research and monitoring Coordination Group

An independent group, reporting to the Scottish Government, chaired and coordinated by SNH. Remit as laid out in Scottish Government licence conditions:

- Collate information on behalf of the Scottish Government.
- Assess and approve all research, survey and monitoring projects associated with the project (including those projects which SNH will not necessarily lead on, e.g. public health), thereby ensuring limited resources are directed at addressing the core objectives of the Trial.
- Coordinate research, survey and monitoring projects to ensure collaborative opportunities are identified, data is collated in compatible formats, disturbance to beavers minimised and detrimental effects to nature conservation interests avoided (e.g. SAC, SPA, species etc.).
- Ensure all data and information collated during the Trial has joint ownership and is made publicly available.
- Produce a pre-release monitoring programme and a post-release monitoring programme by the year of the release, both plans to be submitted to the Scottish Government.
- See the SBT website for further details.

Fundraising Working Group

- To coordinate and implement the procurement of external funds required for the Knapdale Beaver Trial.

Education and interpretation Working Group

- To oversee and implement the educational, interpretation and visitor-management aspects of the Knapdale Beaver Trial.

PR and communications Working Group

- To coordinate and manage PR and media issues and enquiries at a national level.
- To advise the project team on local PR and communications matters.

Local Stakeholder Forum

- To provide a clear, transparent line of communication between the project partners and local stakeholders.
- To allow local stakeholders' views to be fed into the decision-making process for the Trial.

Knapdale beaver volunteers

- To allow volunteers to become actively involved in the implementation of the Knapdale Beaver Trial.

Appendix 8

Publication abstracts from Scottish Beaver Trial partner research collaborations

Campbell-Palmer R, Rosell F (2010) Conservation of the Eurasian beaver *Castor fiber*: an olfactory perspective. *Mammal Review*, 40: 293–312. Chemical communication in mammals includes an array of specific behaviours that are often ignored in terms of their potential relevance to conservation. Often used during territorial or social interactions between animals, chemical communication can also be used as a tool in reintroduction programmes. Reintroductions still exhibit high failure rates and methods to improve success should be investigated. The Eurasian beaver *Castor fiber* has been widely reintroduced across Europe after its near-extinction in the 19th century. Using olfactory studies in the beaver, we aim to demonstrate how scent transfers a range of information about the sender which can be used to monitor social and territorial behaviour along with general well-being. Scent manipulation can be used to reduce human–beaver conflicts, and aid reintroduction success through reducing stress and territorial conflicts, and by influencing dispersal and settlement. Two species of beavers, the Eurasian and the North American beavers Castor Canadensis, occupy freshwater habitats throughout North America, parts of South America, most of Europe and parts of Asia. Most of the reviewed literature concerns the wild Eurasian beavers, its chemical communication and conservation; however, captive studies and those addressing North American beavers are also included. Chemical communication is advanced and has been well documented in this highly territorial species. However, few studies directly link olfaction with conservation practices. Olfactory studies in beavers can provide non-invasive methods to monitor translocated animals and indicators of health. We conclude that chemical analysis, olfactory studies and behavioural manipulations involving semiochemicals have important impacts on conservation and can generate practical solutions to conservation problems including aiding animal capture, captive stress reduction, breeding pair formation and release site fidelity.

Rosell F, Campbell-Palmer R, Parker H (2011) More genetic data are needed before populations are mixed: response to 'Sourcing Eurasian beaver *Castor fiber* stock for reintroductions in Great Britain and Western Europe'. *Mammal Review*, 42: 319–24. In a review recently published in *Mammal Review*, Halley (2010) discussed the sourcing of Eurasian beavers (*Castor fiber*) for potential reintroduction programmes in Britain and Western Europe. Eurasian beavers have recently been the subject of a controlled reintroduction to Scotland as part of a five-year scientific trial, the outcome of which will be presented to the Scottish Government who will then decide on future full-scale reintroductions. Feasibility studies have recently been published for England and Wales (Gurnell *et al*. 2008, Halley *et al*. 2009), where there is strong interest in beaver reintroduction within conservation circles. Therefore, the subject of Halley's paper is interesting, relevant and will be the focus of an important discussion for future sourcing of reintroduction stocks. The purpose of this response is not to contest the conclusions of Halley (2010), but to expand on certain points and advocate further research on the consequences of intentional mixing of beaver populations in order to source reintroductions. Careful consideration of all evidence presented should receive serious attention by those involved in captive breeding and reintroduction programmes. In our opinion a more comprehensive review should include discussion of the points raised in this paper.

Campbell-Palmer R, Rosell F (2011) The importance of chemical communication studies to mammalian conservation biology: A review. *Biological Conservation*, 144: 1,919–30. The relevance of chemical communication to mammalian conservation is not often the focus of scientific investigation. Our review identifies and discusses 10 key areas in which the study of chemical communication aids conservation behaviour. Articles (n = 140) were revealed; most were concerned with population monitoring (22.50%), reducing human–wildlife conflicts (18.93), influencing habitat selection (18.57%), increasing welfare of captive animals (12.86%), encouraging captive breeding (12.86%), reducing predation (5.71%), and increasing the success of release programmes (5.00%). Few articles (<4%) were found relating olfactory

studies to health status of wild populations, reducing hybridisation or as indication of pollution. A growing number of articles are addressing how olfactory studies may aid conservation, but more rigorous experimental testing and manipulations are required. The vast majority of studies linking olfaction with conservation involved the population monitoring of wild carnivores. We suggest that animal behavioural studies and manipulations of chemical communication can have significant impacts on conservation in these areas, which should be further developed to generate practical applications. Areas of future study include chemical communication of aquatic mammalian species, the transfer of olfactory cues under water, and the identification of genetic markers that may link 'personality' with olfactory responses. Linking olfactory studies to fitness, either on an individual or population scale, particularly in a wider ecological context is more likely to increase conservation value. Animal translocations and reintroduction programmes may offer a means to do this and could be an important area to direct future studies.

Cross H, Campbell-Palmer R, Girling S, Rosell F (2012) The Eurasian beaver (*Castor fiber*) is apparently not a host to blood parasites. *Veterinary Parasitology*, 190: 246–8. Parasites can alter the physiology and behaviour of host species and negatively impact on their fitness thus affecting population densities. This is the first investigation into the presence of blood parasites in the Eurasian beaver (*Castor fiber*), a species that has been the subject of many translocation and reintroduction programmes. Two hundred and seventy blood slides prepared from the blood of 27 beavers from southern Norway were microscopically analysed for the presence of blood parasites. This study reports an absence of blood parasites in the Norwegian Eurasian beavers sampled. At present, there is no single 'gold standard' test for this parasite in live beavers.

Campbell-Palmer R, Girling S, Rosell F, Paulsen P, Goodman G (2012) *Echinococcus* risk from imported beavers. *Veterinary Record*, 170: 235. Reintroduction is a valuable conservation tool in the restoration of species, though imported mammal from Europe undergo a statutory rabies quarantine other zoonotic diseases may go undetected unless owners of captive collections voluntarily submit samples for health screening. There is a potential risk that non-native zoonotic pathogens such as *Echinococcus* could have been present in imported beavers but this currently remains an unknown, other risk is probably low. We would encourage greater regulation of wildlife imports supported by stronger veterinary legislation with the implementation of a standard health screening protocol. A balance must be struck between the health and welfare of these individuals and a responsible disease screening programme that ensures that non-native zoonotic diseases are not going undiagnosed and unchecked. A large part of this will be met by the responsible sourcing and screening of beavers, preferably from *Echinococcus*-free regions of Europe. The IUCN guidelines are there to encourage that these are managed correctly and do not jeopardise the animals being reintroduced, other wildlife and ecosystems, or people who are to live with that species.

Goodman G, Girling S, Pizzi R, Rosell F, Campbell-Palmer R (2012) Establishment of a health surveillance program for the reintroduction of the Eurasian beaver (*Castor fiber*) into Scotland. *Journal of Wildlife Disease*, 48: 971–8. In 2009 and 2010, 16 Norwegian Eurasian beavers (*Castor fiber*) were reintroduced to Knapdale, Scotland as part of a five-year reintroduction trial (Scottish Beaver Trial). Despite numerous reintroduction programs throughout Europe there is no published information concerning recommended health surveillance during beaver reintroduction and only one publication describing causes of mortality. We describe the establishment of a health surveillance program based on International Union of Conservation of Nature (IUCN) and governmental guidelines, and report preliminary results based on the faecal and blood samples following the completion of the first stage of reintroduction. Animals underwent at least one general anaesthetic to allow collection of faecal and blood samples and a thorough clinical examination. No bacterial enteric pathogens such as Salmonella spp., *Campylobacter* spp., or *Yersinia pseudotuberculosis* were isolated, nor were *Giardia* spp. or *Cryptosporidium* spp. However, numerous helminths including *Travassosius rufus* and *Stichorchis subtriquetrus* were detected. Five animals were positive for *Leptospira* antibodies. This included

Leptospira saxkoebing, *Leptospira canicola*, *Leptospira copenhageni*, *Leptospira icterohaemorrhagiae*, *Leptospira autumnalis*, and *Leptospira javanica*. The highest loss of animals (20%) was during the statutory 6-mo rabies quarantine period. No common cause of death was determined. The rabies quarantine conditions were waived for four remaining animals, three of which were introduced to the wild successfully. The authors recommend the shortest possible quarantine period when introducing beavers, but allowing for the minimum recommended IUCN 35 days to allow for implementation of the initial stage of the health surveillance program, examination of animals, sample collection, and processing.

Duff AG, Campbell-Palmer R, Needham R (2013). The beaver beetle *Platypsyllus castoris* Ritsema (Leiodidae: Platypsyllinae) apparently established on reintroduced beavers in Scotland, new to Britain. *The Colepterist*, 22: 9–19. The beaver beetle *Platypsyllus castoris* Ritsema is an obligate commensal of the two extant species of beaver (Mammalia: Castoridae). The Eurasian beaver *Castor fiber* can now be found over much of its former native range from central and northern Europe discontinuously across Russia as far east as Mongolia, while its counterpart in the Nearctic region, the North American or Canadian beaver *Castor canadensis*, occurs widely across North America and as an introduction in Tierra del Fuego (south Argentina), northeast Europe and northwest Russia (Müller-Schwarze and Sun 2003; Halley *et al.* 2012). Many European populations of Eurasian beaver have been successfully re-established during the past century as a result of conservation measures including hunting bans and reintroduction programmes (Halley and Rosell 2002), following their near-extinction in the late 19th century. This paper details the discovery of the beaver beetle on a wild-born female Eurasian beaver kit trapped at a trial reintroduction site in Scotland, thereby establishing the presence of the beaver beetle in the British insect fauna.

Campbell-Palmer R, Girling S, Pizzi R, Hamnes I, Øines Ø, Del-Pozo J (2013) *Stichorchis subtriquetrus* in a free-living beaver in Scotland. *Veterinary Record*, doi:10.1136/vr.101591. The Eurasian beaver, *Castor fiber*, once threatened with extinction, has now largely recovered across much of its former range through various conservation measures (Nolet and Rosell 1998). Eurasian beavers were removed from Scotland by the 16th century, through hunting (Kitchener and Lynch 2000). During December 2010, a female beaver (~ one year old) was trapped in the Tayside region and taken into captivity at Edinburgh Zoo where it died shortly afterwards. A gross and histological post-mortem examination was conducted to elucidate the cause of death at the veterinary pathology unit of the Royal Dick Veterinary School (Edinburgh, UK). During this examination, three adult trematode parasites, *Stichorchis subtriquetrus*, were noted in the caecum of the beaver, with no associated pathological changes. The presence of this trematode constitutes the first documentation of this parasite species in free-living beavers born in Scotland/Britain. *S. subtriquetrus* occurs widely across Europe. *S subtriquetrus* is the most frequently found parasite reported in beavers (Koubkova and others 2002, Drozdz and others 2004, Vengušt and others 2009). As *S. subtriquetrus* is a strictly specialised parasite of the genus, *Castor*, its recorded presence in Britain is not perceived as a threat to other wildlife or humans (Koubkova *et al*. 2002).

Campbell-Palmer R, Rosell F (eds) (2013) Captive Management Guidelines for Eurasian Beaver, *Castor fiber.* Royal Zoological Society of Scotland publication. Practical guidelines on enclosure design, nutritional and veterinary care requirements of captive beavers. This European collaboration incorporates lessons learnt by a range of organisations with numerous years' experience of captive beaver management. Ecological background for this species is provided along with recommendations for reintroduction processes and population management.

Senn H, Ogden R, Cezard T, Gharbi K, Iqbal Z, Johnston E, Kamps-Hughes N, Rosell F, McEwing R (2013) Reference-free SNP discovery for the Eurasian beaver from restriction site-associated DNA paired-end data. *Molecular Ecology*, 22: 3,141–50. Many conservation projects are hampered by the lack of genetic resources for the target species. In this study, we used (restriction site associated DNA) RAD sequencing

to discover SNP markers suitable for population genetic and parentage analysis with the aim of using them for monitoring the reintroduction of the Eurasian beaver (*Castor fiber*) into Scotland. In the absence of a reference genome for beaver, we built contigs and discovered SNPs within them using paired-end RAD data, so as to have sufficient flanking region around the SNPs to conduct marker design. To do this, we used a simple pipeline which catalogued the Read 1 data in STACKS and then used the assembler CORTEX_VAR to conduct *de novo* assembly and genotyping of multiple samples using the Read 2 data. The analysis of around 1.1 billion short reads of sequence data was reduced to a set of 2,579 high-quality candidate SNP markers that were polymorphic in Norwegian and Bavarian beaver. Both laboratory validation of a subset of the SNPs (1.25% error) and internal validation by confirming patterns of Mendelian inheritance in a family group (0.9% error) confirmed the success of this approach.

Jones S, Gow D, Lloyd Jones A, Campbell-Palmer R (2013) The battle for British beavers. *British Wildlife*, 24: 381–92. This article presents an overview of the current situation regarding the status of beavers in Britain and explores some of the key arguments which may decide their future. It is clear from the activity of the past 10 years that the total number of sites with beavers in Britain is growing. It is probable that we are entering a critical period concerning the longer-term future of this species as several interacting events and process converge. Over a relatively short time, we have seen the first use of beavers as habitat-management tools, the first formal trial reintroduction and the appearance of unlicensed wild beavers in several locations. Therefore the big questions regarding beaver reintroduction are not going away. There is increasing impetus and significant grounds for potential co-operation among stakeholders, but significant barriers in terms of evidence, practicalities and perception still remain.

McEwing R., Frosch, C., Rosell, F., Campbell-Palmer, R. (2014). A DNA assay for rapid discrimination between beaver species as a tool alien species management. European Journal of Wildlife Research. doi10.1007/s10344-014-0803-6. The confirmed presence of alien North American beavers in some regions of Eurasia may compete with and hinder the successful recolonisation of the native Eurasian species back to its former range. Distinguishing the two species in the field can be problematic, time-consuming and expensive, thereby potentially limiting appropriate conservation actions. Here, a rapid and inexpensive genetic SNP assay is described that can separate the two species from either non-invasively collected samples or samples taken directly from restrained individuals. We applied these new genetic assays to free-living beavers of unknown origin sampled in Scotland.

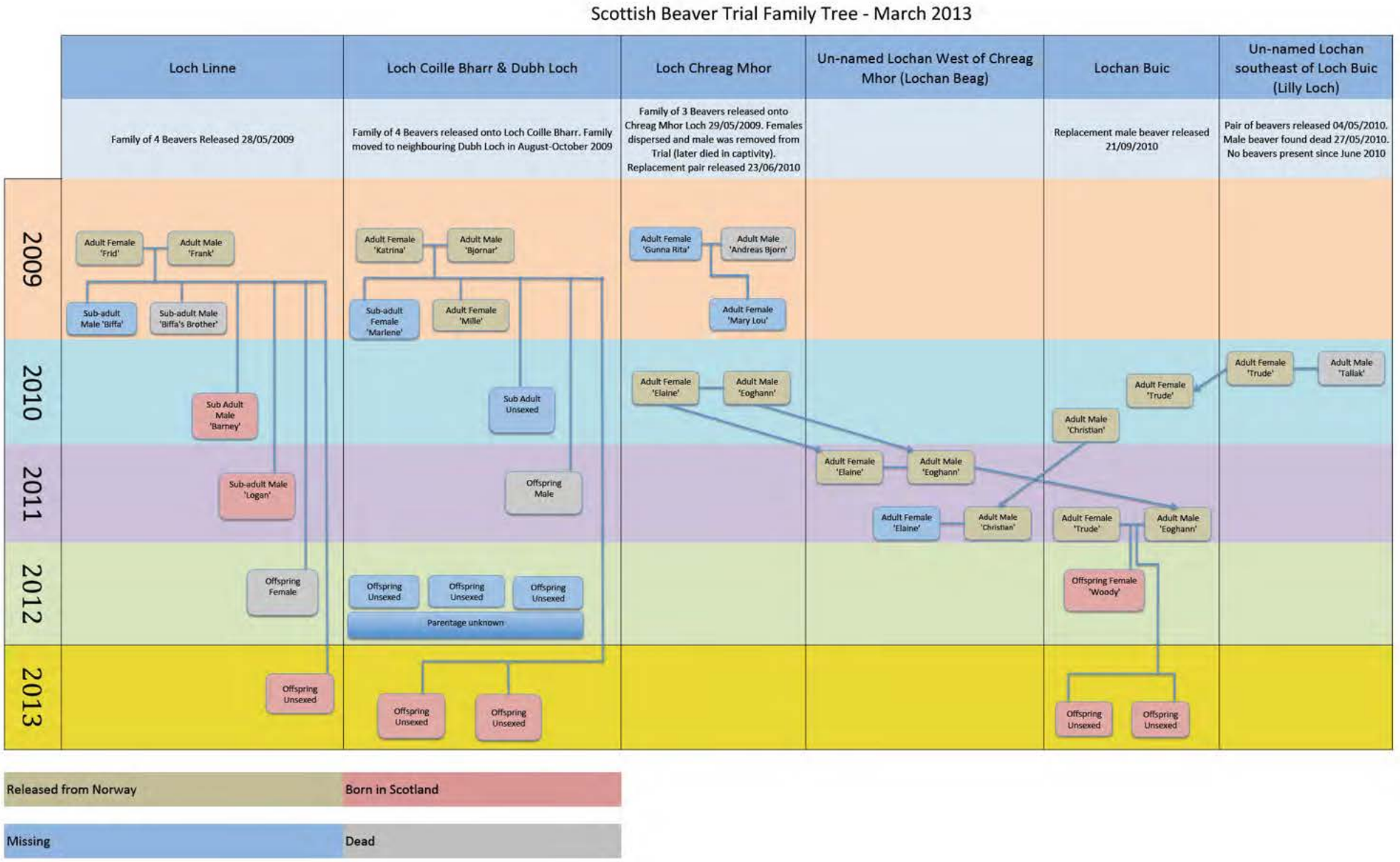
Senn, H., Ogden, R., Frosch, C., Syrůčková, A., Campbell-Palmer, R., Munclinger, P., Durka, W., Kraus, R.H.S., Saveljev, A.P., Nowak, C., Stubbe, A., Stubbe, M., Michaux, J., Lavrov, V., Samiya, R., Ulevicius, A., Rosell, F. (2014) Nuclear and mitochondrial genetic structure in the Eurasian beaver (*Castor fiber*) – implications for future reintroductions. *Evolutionary Applications*, 7: 645–62. Many reintroduction projects for conservation fail, and there are a large number of factors that may contribute to failure. Genetic analysis can be used to help stack the odds of a reintroduction in favour of success, by conducting assessment of source populations to evaluate the possibility of inbreeding and outbreeding depression and by conducting post-release monitoring. In this study, we use a panel of 306 SNP (single nucleotide polymorphism) markers and 487–9 base pairs of mitochondrial DNA control region sequence data to examine 321 individuals from possible source populations of the Eurasian beaver for a reintroduction to Scotland. We use this information to reassess the phylogenetic history of the Eurasian beavers, to examine the genetic legacy of past reintroductions on the Eurasian landmass and to assess the future power of the genetic markers to conduct ongoing monitoring via parentage analysis and individual identification. We demonstrate the capacity of medium density genetic data (hundreds of SNPs) to provide information suitable for applied conservation and discuss the difficulty of balancing the need for high genetic diversity against phylogenetic best fit when choosing source population(s) for reintroduction.

Gottstein, B., Frey, C.F., Campbell-Palmer, R., Pizzi, R., Barlow, A., Hentrich, B., Posautz, A., Ryser-Degiorgis, M.-P. (2014) Immunoblotting for the serodiagnosis of alveolar echinococcosis in alive and dead Eurasian beavers (*Castor fiber*). *Veterinary Parasitology*, doi:10.1016/j.vetpar.2014.06.017. A novel species-specific anti-beaver-IgG-alkaline-phosphatase conjugate was synthesised for the development of a new serological test for echinococcosis in beavers. Two different ELISAs conventionally used for human *Echinococcus multilocularis* serology (Em18-ELISAand Em2-ELISA) yielded diagnostic sensitivities of 0% and 46%, respectively. In contrast, the subsequently developed immunoblotting assay gave an 85% diagnostic sensitivity (11 out of 13 beavers with alveolar echinococcosis were immunoblotting-positive, i.e. showed reactivity with a specific 21 Mr band), and maximal specificity. In conclusion, this immunoblotting assay should be the method of choice for use in serological studies on *E.multilocularis* in Eurasian beavers, and the test proved suitable to investigate both animals alive and post-mortem.

Appendix 9

Scottish Beaver Trial – beaver family tree (May 2014)

As of October 2014, no further changes in the family tree have been recorded.



Appendix 10

Beaver body-condition scoring system

Standard rodent body-condition scoring systems can be used to determine body condition in beavers. Particular attention should be paid to the pelvic region, backbone and tail. Beavers in poorer body condition have a prominent backbone and pelvis. These will also be more visible when a beaver is on land, with the pelvis more 'M'-shaped. Tails are also more concave on both sides of the mid-vein. Lack of proper grooming may also be seen in poorer body condition (with fur looking 'scruffy' or unkempt). Taken from Campbell-Palmer and Rosell (2013), *Captive Management Guidelines for Eurasian beaver (Castor fiber)*.

Body Condition Score 1

Beaver is emaciated: skeletal structure extremely prominent, little flesh cover. Vertebrae distinctly segmented. Tail arch very prominent, with tail sunken either side of midline, owing to low fat reserves.

Body Condition Score 2

Beaver is in poor condition: segmentation of vertebral column evident. Dorsal pelvic bones are readily palpated. Tail arch prominent, tail sunken, low fat reserves.

Body Condition Score 3

Beaver is in normal condition: vertebrae and dorsal pelvis not prominent, but palpated with slight pressure. Tail arch is visible but tail is thick with good healthy fat reserves.

Body Condition Score 4

Beaver is overweight: spine is a continuous column. Vertebrae palpated only with firm pressure. Tail arch not really visible, tail thick and more rounded.

Body Condition Score 5

Beaver is obese: body is bulky. Bones disappear under flesh and subcutaneous fat layer. Tail is thick and rounded.

Appendix 11

Scottish Beaver Trial public consultation 2007 (pp. 11–15)

4. Summary of feedback

4.1 Overview

The project partners (SWT and RZSS) received an encouraging response to the consultation and the associated events. Out of 466 responses submitted by post or online, 374 were received from the Mid-Argyll area and 92 outwith Mid-Argyll. An additional eight responses were declared void due to duplication or incomplete information. Fifty-six confirmed they were either a member of SWT or RZSS. The number of responses was seven times higher than the previous local consultation.

4.1.1 Public

4.1.1.1 Event attendance

Public events on 18 and 20 October

	Date	Location	Attendance
Members Centre event (7.30 – 9pm)	18 October	Oban	100
Public drop in day (10am – 5pm)	20 October	Cairnbaan	75 (estimated)

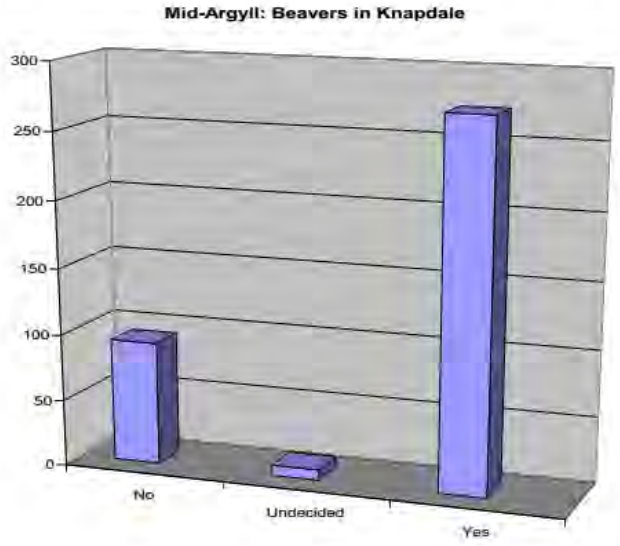
At the events, the project team was available to answer questions and discuss the project. People were encouraged to complete the consultation forms which were available. At both events support for the project outweighed objections; a trend that was reflected in the overall responses received formally (see details on the next page).

4.1.1.2 Mid-Argyll responses

Table 2: Would you like to see beavers in Scotland?

	Number of response	% of local responses
For	269	72.1%
Against	91	24.4%
Undecided	14	3.8%
Total	374	

Table 3: Would you support a trial reintroduction of beavers to Knapdale?



	Number of response	% of local responses
For	273	73.2%
Against	93	24.9%
Undecided	8	2.1%
Total	374	

4.1.1.3 Knapdale residents

Fifty-six residents living in Tayvallich, Achnamara, Crinan, Bellanoch and Cairnbaan responded to the consultation. This represents 8% of the population in the area (Census 2001).

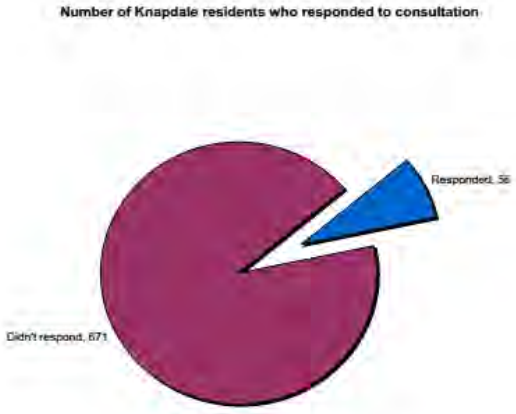
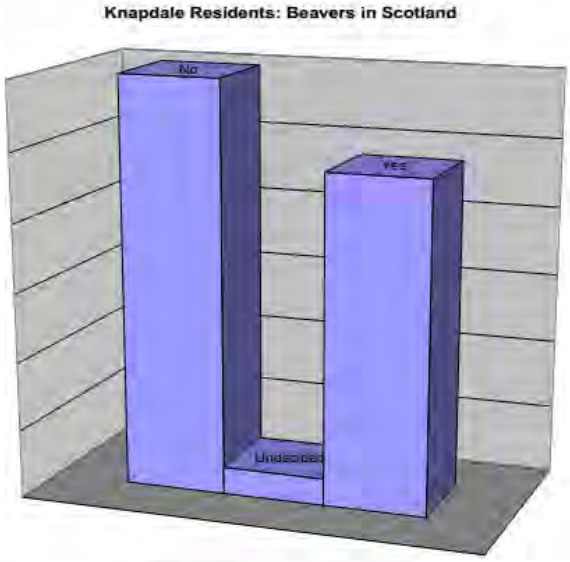
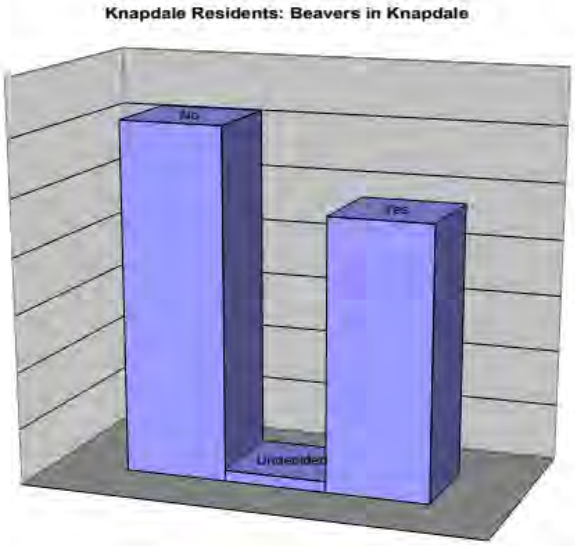


Table 4: Would you like to see beavers in Scotland?



	Number of response	% of Knapdale resident's responses
For	24	44.4%
Against	30	53.6%
Undecided	2	3.6%
Total	56	

Table 5: Would you support a trial reintroduction of beavers to Knapdale?



	Number of response	% of Knapdale resident's responses
For	24	44.4%
Against	31	57.4%
Undecided	1	1.9%
Total	56	

4.1.1.4 Neighbouring landowners or residents to the proposed trial site

Of the 39 neighbouring landowners contacted only 14 (36%) responded to the consultation. All neighbours received a letter inviting them to speak directly to the Project Manager about the trial (see Appendix F).

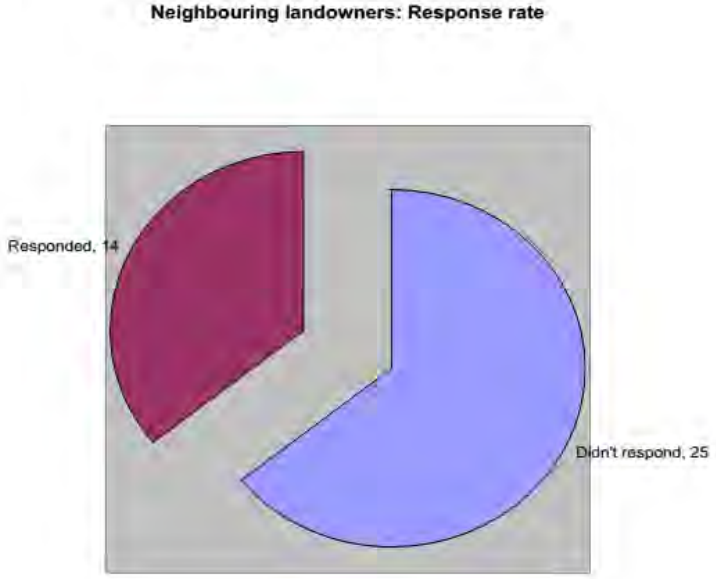
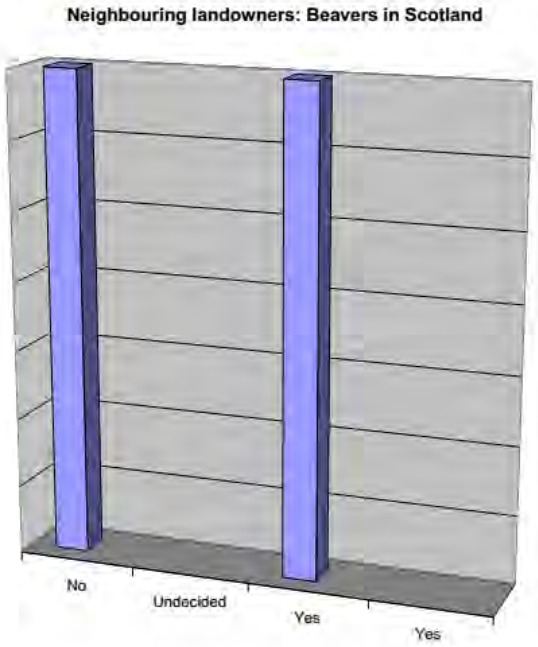
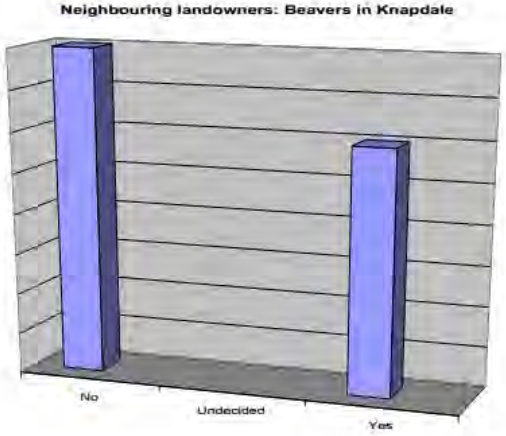


Table 6: Would you like to see beavers in Scotland?



	Number of response	% of neighbour responses
For	7	50%
Against	7	50%
Undecided	0	0%
Total	14	

Table 7: Would you support a trial reintroduction of beavers to Knapdale?



	Number of response	% of neighbour responses
For	6	42.9%
Against	8	57.1%
Undecided	0	0%
Total	14	

Appendix 12

Scottish Beaver Trial public consultation 2014

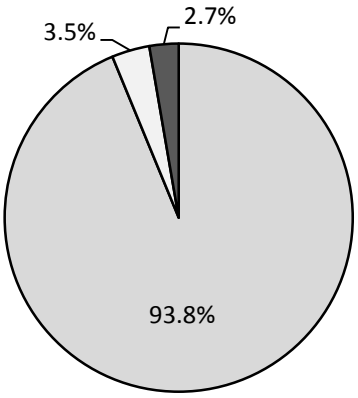
2014 Consultation format

- 8 questions (1 location question) + comments section
- Focus on beaver trial support and impact of beaver reintroductions
- Paper and online (Survey Monkey)
- Distributed at talks and events, local public hotspots, stakeholder forums (by SBT representatives)
- Late January to late March 2014

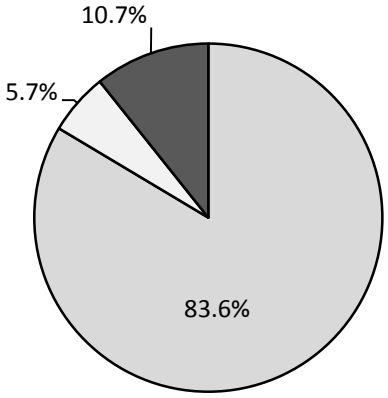
2014 Consultation summary charts

1a. What is your level of support for wild beavers living in Mid-Argyll?

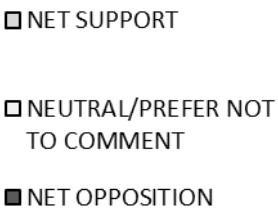
All respondents (*n* = 997)



Mid-Argyll (*n* =140)

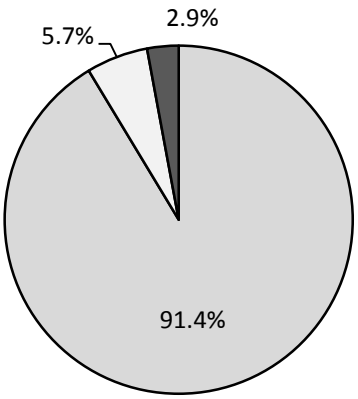


Legend

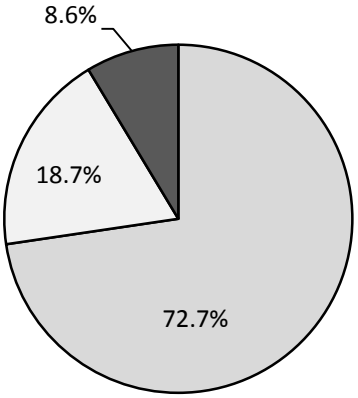


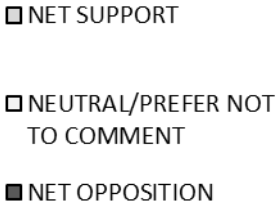
1b. What is your level of support for wild beavers living elsewhere in Scotland?

All respondents (*n* = 995)



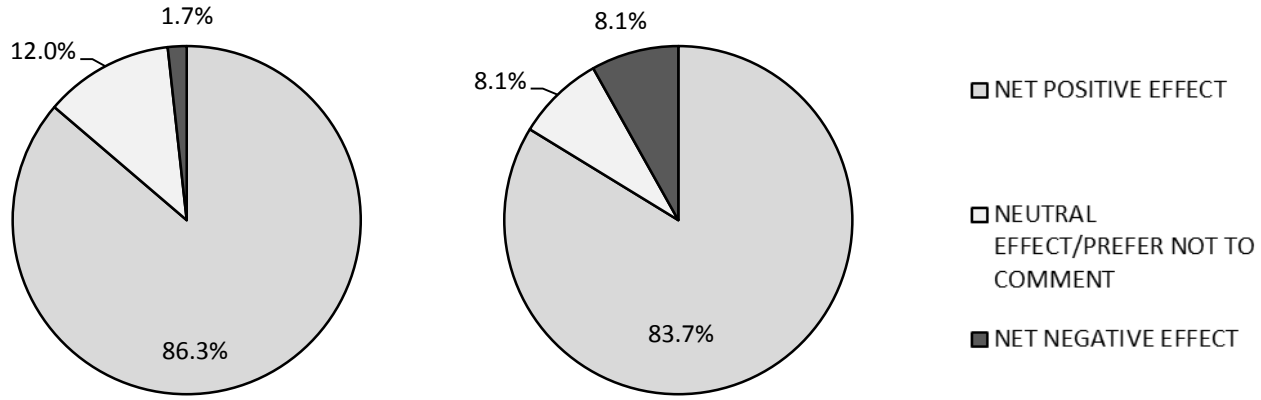
Mid Argyll (*n* = 139)





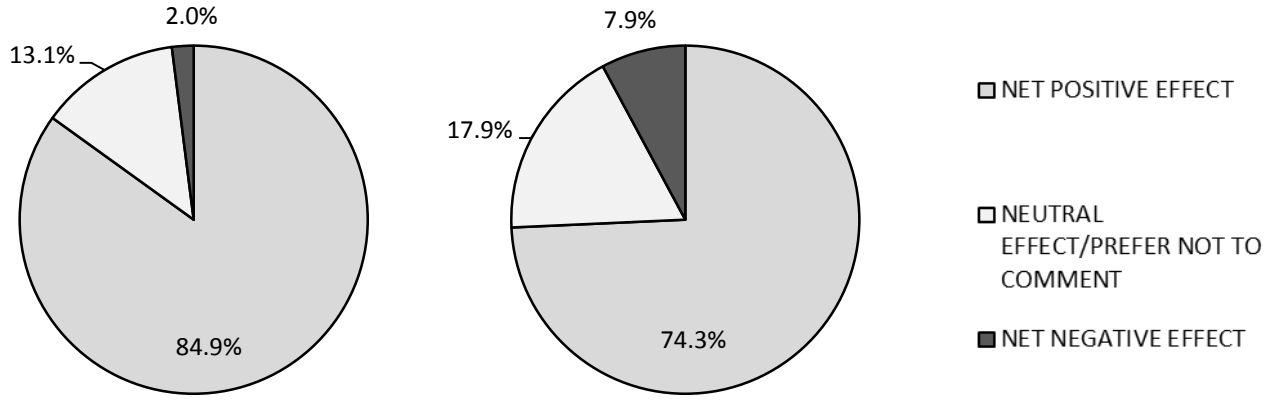
2a. What effect do you think the Trial has had in Mid-Argyll?

All respondents = 975 n = 123



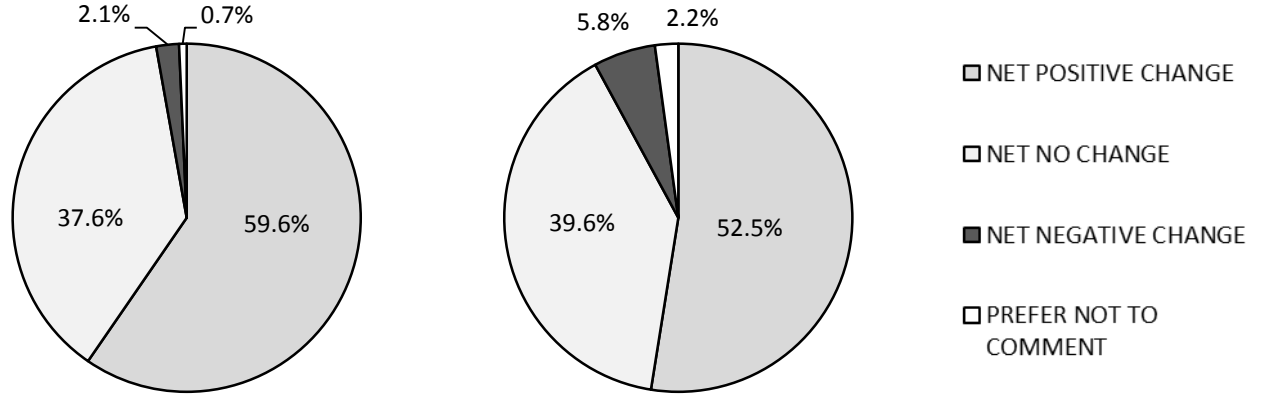
2b. What effect do you think that the Trial has had in Scotland?

n = 996 *n* = 140



3. How have your views on beavers changed in the last 5 years?

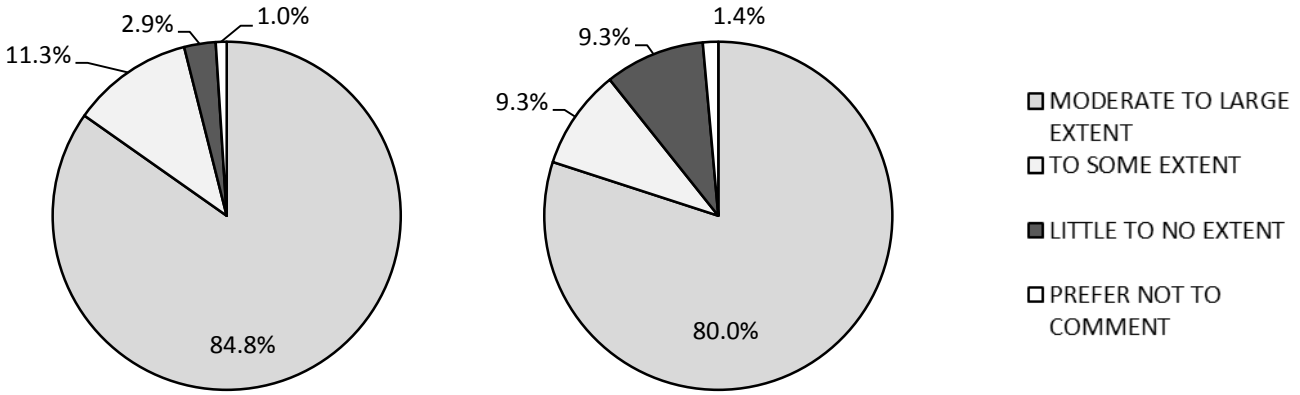
n = 995 *n* = 139



Of those who reported no change in their views (*n* = 374), what was their level of support for beavers in Mid-Argyll ?

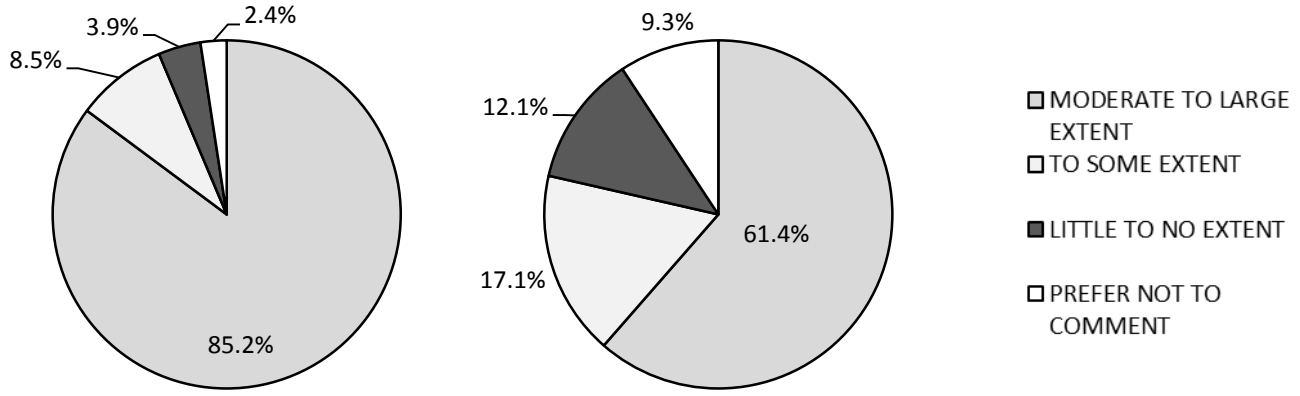
4. If beavers were to remain in Mid Argyll, how much do you think it could help with tourism and the local economy?

n = 991 *n* = 140



5. If beavers were to remain in the wild elsewhere in Scotland, how much do you think it could be beneficial to wildlife and our natural environment?

All respondents (n = 991) Mid Argyll (n =140)



SOME POINTS TO NOTE

- Respondents were consistent in their attitudes across the questions (a halo effect), i.e., if they answer in the positive on the first question, they were more likely to answer positively to all other attitudinal questions than change their view.

- The variations in responses were more likely to go from positive to a neutral/no comment answer. In one instance, the respondent supported the proposal of wild beavers in Scotland but believed that the Scottish Beaver Trial has had a negative impact. (The respondent also provided comments to support this.)

- Responses in the positive/supportive and negative/opposing were more likely to be at the extremities of the scale (a low central-tendency effect).

2014 YOUGOV POLL

- Five questions as part of the poll, three beaver trial related (2 Likert scale questions and 1 unprompted awareness question). The remaining two related to unprompted and prompted awareness of wildlife charities and organisations.

- More focused on awareness

- Detailed demographics collected: gender, age, social grade, Scottish Region* working status, marital status, children in household. (*NE Scotland, Highlands and Islands, South Scotland, West Scotland, Central, Mid-Scotland & Fife, Lothians and Glasgow).

- Restricted to Scotland and adults over 18 years of age

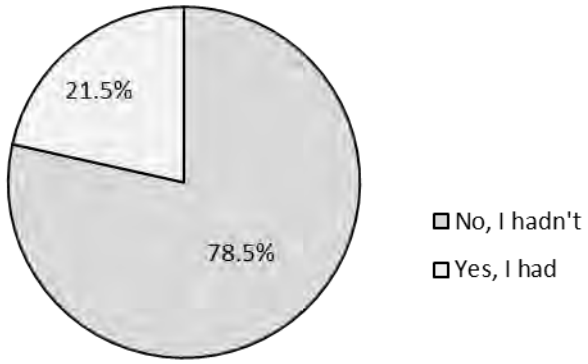
- National flavour (responses weighted). 1 response does not necessarily equal count of 1.

- 3 days: 19 - 21 March 2014

- 1652 adults (18+) in Scotland

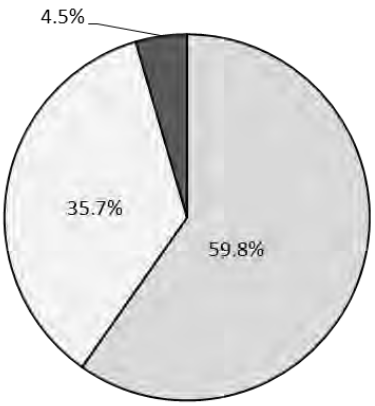
2014 YOUGOV SUMMARY CHARTS

1. Before taking this survey, had you heard of the Scottish Beaver Trial in Knapdale, Argyll?
(n = 1652)

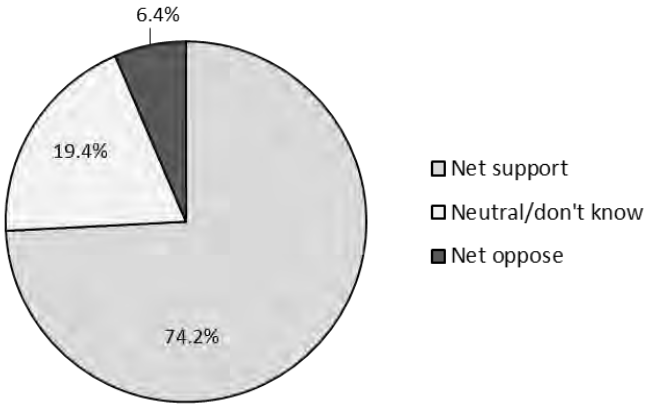


2. To what extent do you support or oppose the reintroduction of beavers to Scotland?

All respondents (n = 1652)

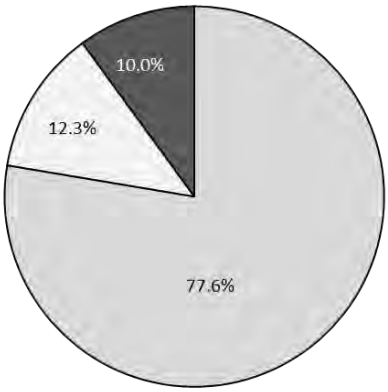


Those who had previously heard of the trial (n = 355)

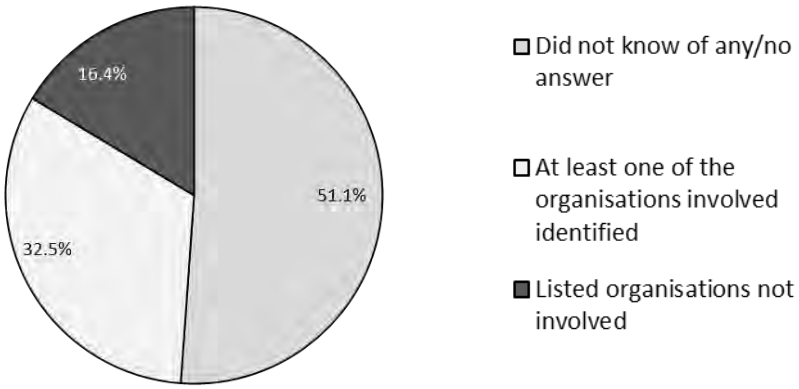


Q3. What organisations are you aware of that are involved in this project to reintroduce beavers to Scotland? (unprompted)

All responses (n = 1652)



Those who had previously heard of the trial (n = 355)



Total number of organisations correctly identified	# Responses (weighted)	% of total responses	Response with highest frequency
One	155	9.4	SNH (89)
Two	42	2.5	SWT & SNH (21)
Three	5.3	0.3	SWT, RZSS & FCS (4)
Four	0.36	0.02	
TOTAL	213		

Frequency of inclusion in a response – top 20

Over 50 different organisations were included in the responses and these were mostly government related (agencies or statutory bodies) or other charities involved in wildlife conservation, animal welfare or land management.

The number of times an organisation was mentioned in a response (frequency) is shown in the table below for the organisations with the top 20 frequencies. All four organisations involved in the Scottish Beaver Trial made it into the top ten. It should be noted that there were some responses that could have been construed as belonging to either Scottish Wildlife Trust or RZSS, for example, "Wildlife Trust (unspecified)", "Scottish Beaver Trial" or "Edinburgh Zoo"; these have been kept separate to illustrate possible brand confusion between connected organisations/groups.

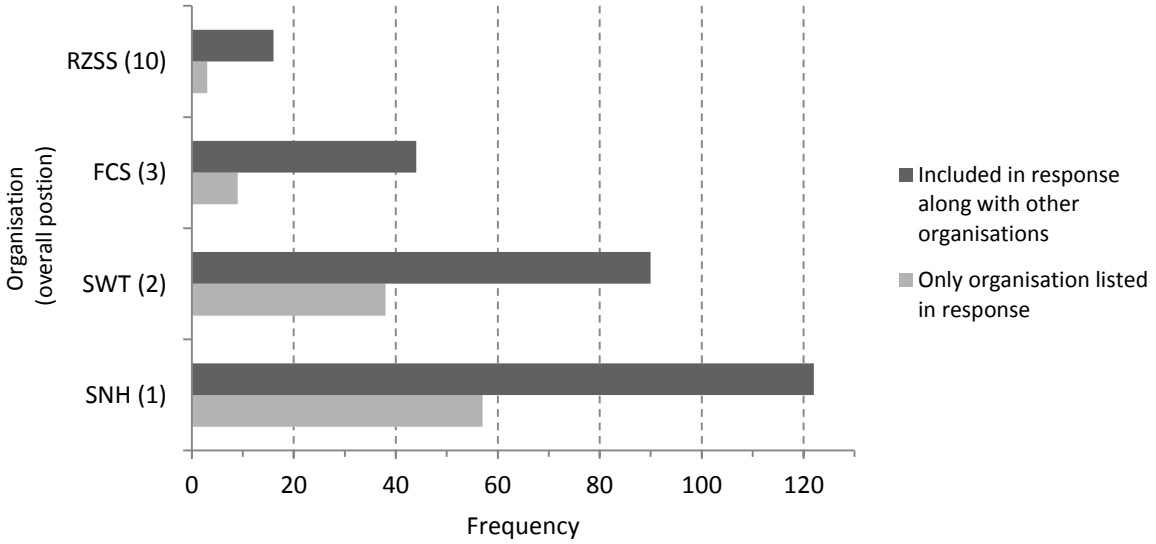
Position	Organisation	Frequency	Position	Organisation	Frequency
1	Scottish Natural Heritage*	122	11	RSPB	14
2	Scottish Wildlife Trust*	90	12	Local council/Argyll & Bute Council	10
3	Forestry Commission Scotland*	44	13	Visit Scotland	10
4	Scottish SPCA	43	14	Scottish Beaver Trial†	9
5	National Trust Scotland	37	15	Other beaver related organisations	8
6	WWF	29	16	Woodland Trust	7
7	Scottish Government	27	17	Edinburgh Zoo†	5
8	RSPCA	23	18	SEPA	5
9	Wildlife Trust (unspecified)†	18	19	Scottish Parliament	4
10	Royal Zoological Society of Scotland*	16	20	DEFRA	3

* Organisation involved in reintroduction

† Organisation connected to those involved

Comparison of frequencies across SNH, SWT, FCS and RZSS

Organisation (overall position across all responses)	# Included in response along with other organisations	# Only this organisation listed in response
SNH (1)	122	57
SWT (2)	90	38
FCS (3)	44	9
RZSS (10)	16	3

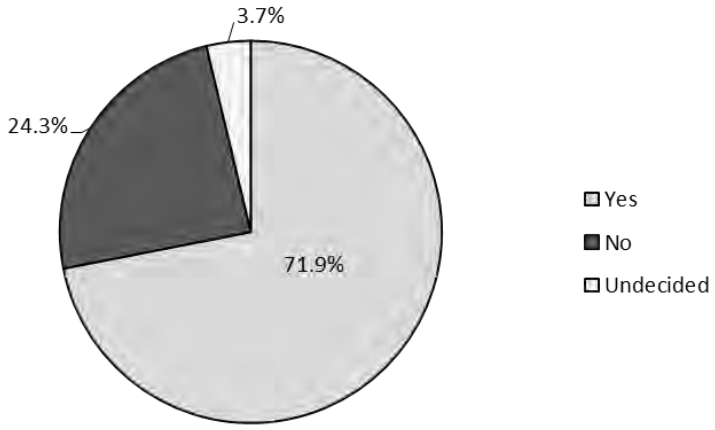


2007 Consultation results

- See 2007 consultation paper for full details (http://www.scottishbeavers.org.uk/docs/files/general/SBT2007_ConsultationReport_Dec07.pdf)

1. Would you like to see beavers in Scotland?

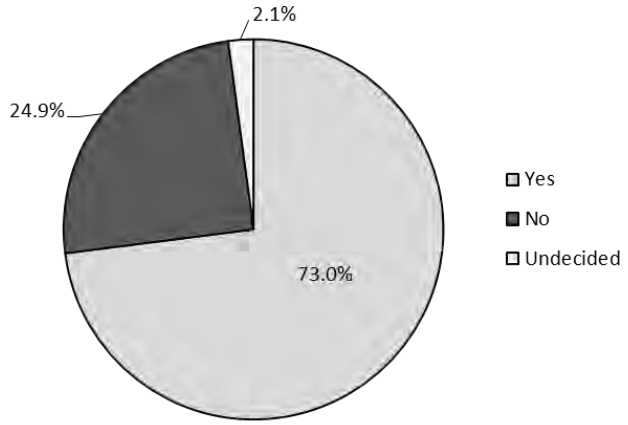
Mid-Argyll (*n* =374)



Would you like to see beavers in Scotland?	Mid Argyll responses
Yes	269
No	91
Undecided	14
Total	374

2. Would you support a trial reintroduction of beavers to Knapdale?

Mid Argyll responses (n = 374)



Would you support a trial reintroduction of beavers to Knapdale?	Mid Argyll responses
Yes	273
No	93
Undecided	8
Total	374

Appendix 13

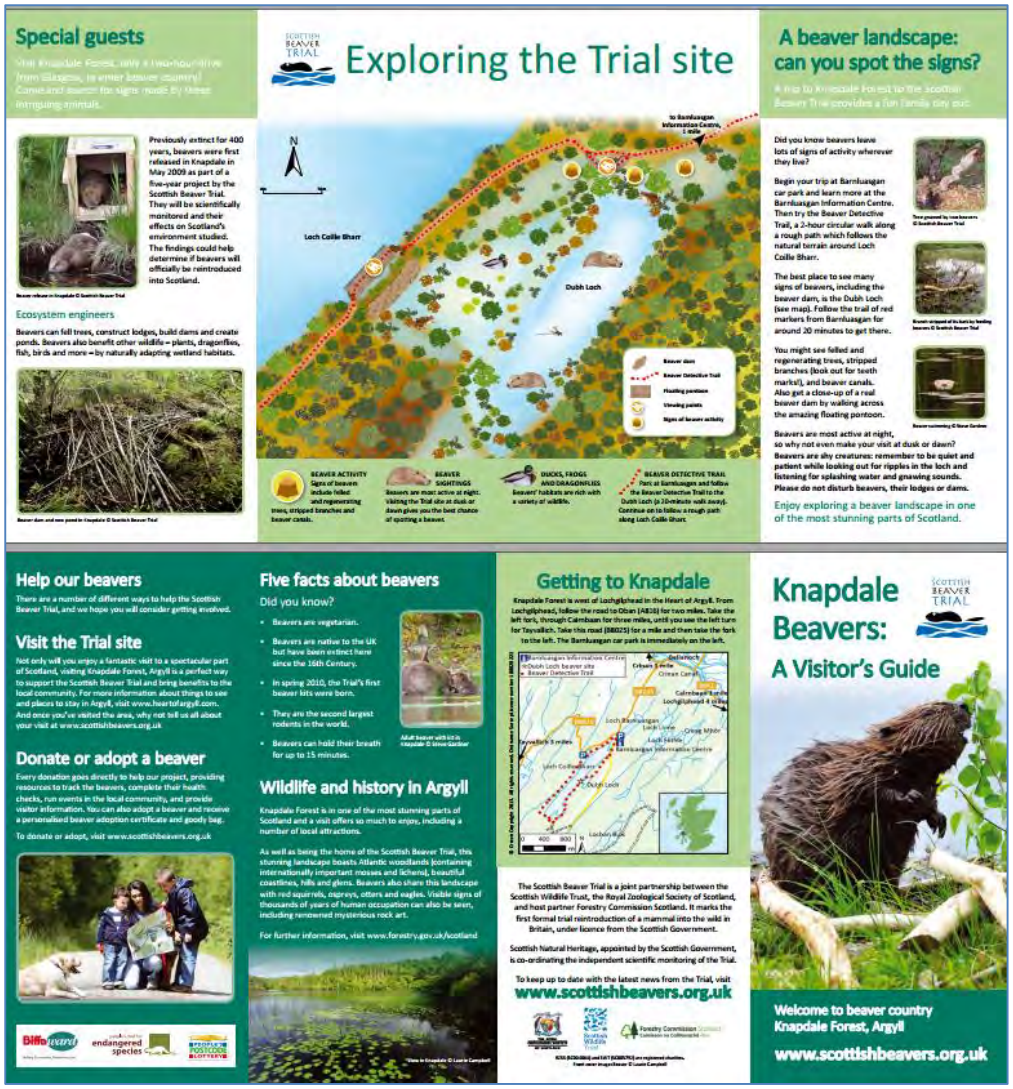
Scottish Beaver Trial leaflets

Return of the Beaver - proposed reintroduction leaflet, 2007 © SBT

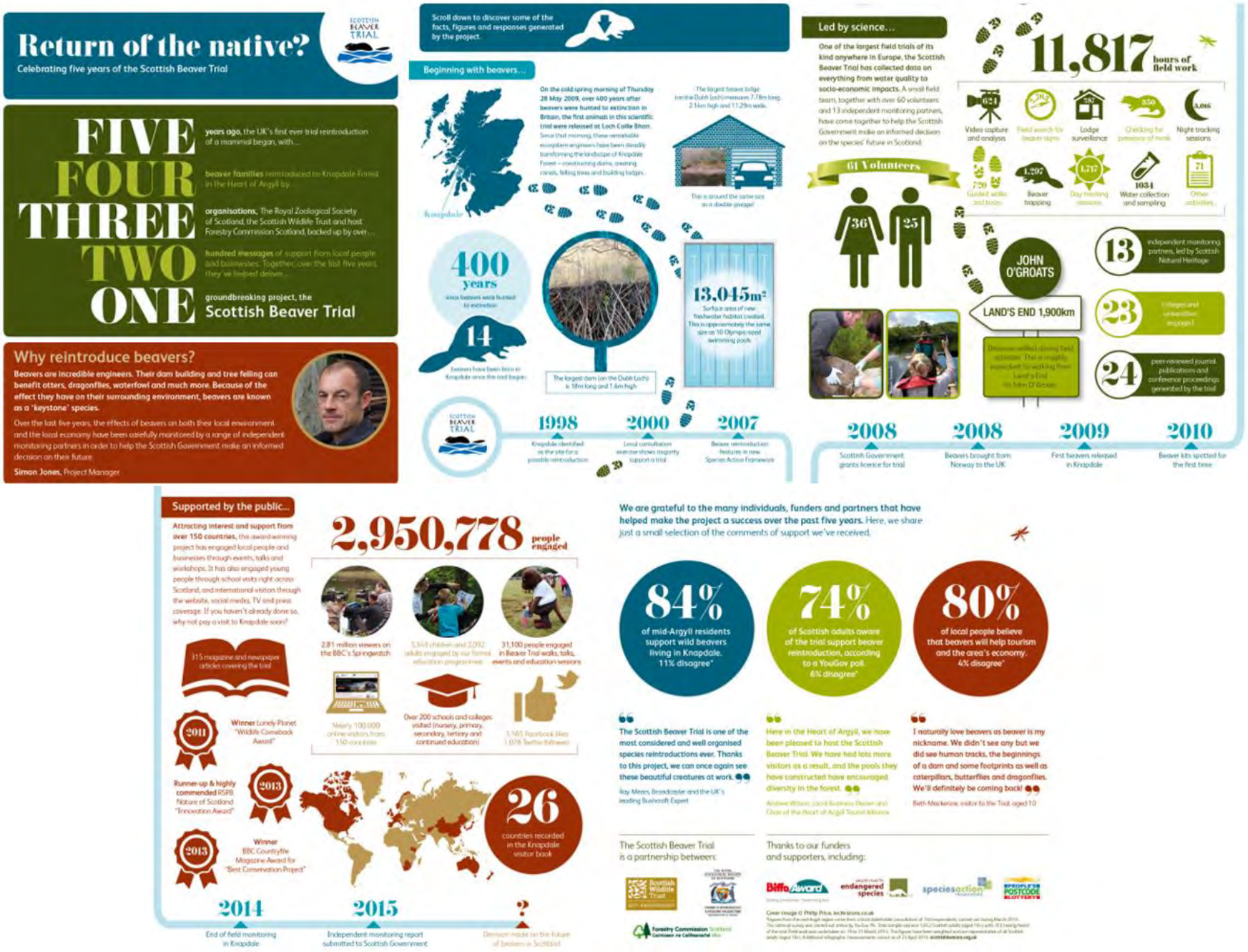
SBT leaflet produced for the Scottish Wildlife Trust appeal, 2008 © Scottish Wildlife Trust

SBT leaflet produced for the RZSS appeal, 2008 © RZSS

General information leaflet for SBT, 2009 © SBT



Knapdale Beavers: A Visitor's Guide leaflet, 2013



Scottish Beaver Trial infographic leaflet, May 2014

SCOTTISH BEAVER TRIAL

The Scottish Beaver Trial
is a partnership between:

Scottish Wildlife Trust
50TH ANNIVERSARY

THE ROYAL ZOOLOGICAL SOCIETY OF SCOTLAND
OWNERS OF EDINBURGH ZOO & HIGHLAND WILDLIFE PARK

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