
Monitoring Plan

A plan for assessing the impacts of a free living beaver population on the River Otter

Science and Evidence Forum
River Otter Beaver Trial
October 2017



Version : 3

Revised by Science and Evidence Forum in October 2017



In October 2015 Hugh Graham began a PhD at the University of Exeter investigating the impacts of the beavers on the physical geographical and associated ecological impacts of the beavers on the catchment. Detailed mapping of beaver field signs will be an important part of this.

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The River Otter Beaver Trial is led by Devon Wildlife Trust working in partnership with The University of Exeter, the Derek Gow Consultancy, and Clinton Devon Estates.

Expert independent advice is also provided by the Royal Zoological Society of Scotland, Professor John Gurnell, and Gerhard Schwab, an international beaver expert based in Bavaria.

In addition to the generous support of DWT members and others who have donated to our appeal, the trial is also funded by The Royal Society of Wildlife Trusts (RSWT). The ongoing complementary research work at the enclosed beaver trial near Okehampton is funded by Westland Countryside Stewards.

1. Background and purpose of Monitoring Plan

On 2nd February 2015, Devon Wildlife Trust (DWT) on behalf of the River Otter Beaver Trial (ROBT) partners, was granted a licence by Natural England under the Wildlife and Countryside Act 1981, to release Eurasian beavers, (*Castor fiber*), into the River Otter catchment in east Devon.

The beavers had been living wild for a number of years, but were shown to be breeding in 2014, resulting in the Department for Environment, Food and Rural Affairs (Defra) proposing their removal. The subsequent licence application followed a campaign by local people and DWT for the beavers to remain if they were shown to be healthy. It was argued that although this was not how re-introductions should take place, the presence of the beavers was an ideal opportunity to study their impacts in a productive lowland English landscape.

The Natural England licence to release the beavers was granted in the context of a 5 year trial running between March 2015 and March 2020. In February and March 2015, Defra trapped and tested some of the beavers, and DWT then released them back into the river at the end of March under this licence.



Beaver being released back into the river as part of the River Otter Beaver Trial (Photo Nick Upton / Naturepl.com)

A Monitoring Framework was submitted to Natural England as part of the licence application process. The River Otter Beaver Trial Management Group have established a Science and Evidence Forum who are now responsible for refining this Monitoring Framework and developing it into this detailed programme of work.

This document now sets out an ambitious set of Research Objectives that the partners have identified as being pertinent to the understanding of the impacts of the beavers on the river Otter and their colonisation of the catchment. It is important to note that this is a trial, and the ability to monitor different aspects of their behaviour and impacts is part of the trial. For that reason we would not expect all of these research objectives to be investigated in great detail. These objectives will be reported on individually either via direct research or by indirect research with recourse to existing literature and expert knowledge.

The different areas of work have been prioritised and some may only become possible as resources or technology become available.

The Objectives have been developed in consultation with national experts in various fields including a session at the National Mammal Society Symposium in October 2015, and taking into account comments made by the ROBT Fisheries Forum.

The Science and Evidence Forum will regularly review these objectives and progress against them as different things become more relevant than others. It will become clear as the project progresses that there will be some objectives that will become more important to answer in detail, while others may be less important or impossible to answer within this 5 year trial.

2. River Otter Beaver Trial Objectives

The objectives of the ROBT were outlined in the licence application and were to:

1. **Identify and assess impacts of beavers on habitats, wildlife, built infrastructure and local communities.** In particular this will concentrate on recording any impacts on farmers, wildlife, fish populations, water management infrastructure, roads, paths and the people that live and work in the valley.
2. **Identify wider public benefits associated with beaver activity in the landscape.** This includes the potential benefits of beaver dams storing floodwater, reducing pollution, which will be the subject of a PhD with Exeter University. This objective also includes other benefits such as economic benefits for local tourism businesses.
3. **Develop an effective management process for a free living beaver population.** Protecting important trees and structures, and trialling “beaver deceivers” in any dams will form the basis of mitigation measures. These techniques and the decision making steps are all outlined in the “Beaver Management Strategy” published in January 2016.
4. **Understand the ecology, behaviour and population dynamics of a beaver population in a lowland productive agricultural landscape.** Research will seek to understand how the beavers colonise the catchment and utilise the resources within it, and will enable the carrying capacity for the catchment to be calculated. Monitoring the population of the beavers and how they form territories will be a key aspect of this.
5. **Increase knowledge and awareness with local communities and other key stakeholders of beavers and their interactions in the landscape.** Public engagement and local education work will seek to explain the ecology and behaviour of beavers to local people, and ensure decisions about their future are based on factual information, rather than myths.
6. **Provide data and evidence to augment national knowledge base re beaver re-introduction.** The knowledge gained as part of the ROBT will be disseminated to various national and international audiences. There are numerous projects around Britain seeking to restore beavers to wetlands, and advice and experience will be provided to these where appropriate.

3. Objective Outcomes from Research work

This Monitoring Plan sets out the actions that will be carried out to deliver 8 core Research Objective that were detailed in the Monitoring Framework included within the licence application submitted by DWT on behalf of the ROBT partners to Natural England in 2014.

The Science and Evidence Forum will now oversee the delivery of this Monitoring Plan. Fundamental to the delivery of this research work will be the scientific objectivity of the findings. It is one of the key roles of the Science and Evidence Forum to guarantee that rigorous scientific methods are employed throughout. The Forum is chaired by Professor Richard Brazier from University of Exeter and includes a majority from academic institutions including other representatives from the Universities of Exeter and Southampton. Other organisations including the Environment Agency are also represented.

Throughout the trial period, key research findings will be published in the peer reviewed scientific literature. Much of the work will also be included within a number of PhD theses that will have been published during the lifetime of the Trial.

In 2019/20 the Forum will publish a final report that will collate the series of End of Project Reports as detailed in this Plan. This report will comprise an executive summary of the key findings and recommendations, with links to any research reports and papers published in the academic literature and elsewhere.

	Key to colour coding of tables:	
	This area of work has now been completed	
	This work is ongoing, or not yet due to start	
	This has not started and no clear way forward has been developed	

4. Research Objectives

1. Economic and land-use impacts - Assess and quantify the associated costs and benefits of beavers in a productive English landscape including impacts on agriculture and forestry and infrastructure.

1a. To characterise the land use, agricultural and forestry activities within the catchment and monitor any changes that can be attributed to beaver activity.

1b. To qualify and quantify any impacts on farmers, foresters, and other landowners taking into account costs and benefits of mitigation measures

1c. To identify and map infrastructure at risk of beaver activity, and quantify any impacts and associated costs.

END OF PROJECT REPORT: Comprehensive net cost assessment to farming, forestry and infrastructure management sectors.

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
1a	Carry out land use analysis alongside watercourses within the catchment to identify potential conflict areas.	DBRC carried out an analysis of land use within 30m of all main rivers (124kms) in the catchment in 2015.
1a & 8b	Identify best dataset of riverside woody vegetation to inform BRAT model, and catchment carrying capacity work.	UoE obtaining CEH Landcover 2015 data. UoE producing vegetation Index as part of BRAT model. Additional work may need to be carried out (poss using Aerial Photo Interpretation) to obtain sufficient data to allow catchment carrying capacity to be determined.
1a & 1b	Conduct annual winter walkover survey of parts of the catchment where beavers are active. Produce Site Impact Reports for key sites or where complaints have been received.	Annual systematic survey work carried out. Site Impact Reports also produced for some sites. There have now been 2 sites where beaver dams have impacted on agricultural land, and where mitigation has successfully resolved conflicts.
1c	EA / DWT to identify and monitor key water management infrastructure, including fish passes, and quantify in detail any detected impacts, and costs of management solutions.	Key EA infrastructure identified and surveyed frequently by ROBT staff. Any impacts noted, and would be quantified if appropriate. There have been no impacts on EA infrastructure, although feeding and other signs nearby have been identified.
1c	Monitor for and quantify any impacts on infrastructure including roads, rights of way, electricity and telecommunications	Any reports or complaints about impacts on rights of way and other infrastructure would be followed up. No reports or complaints have been made to date
1b & 1c	Maintain a record of visits made to individual sites to quantify resources needed	Visits database held and updated
1a & 1b	Investigate areas of at-risk commercial forestry and monitor and record any impacts	Poplar plantation at Dotton identified as at risk, and frequently monitored. UoE also developing model that quantifies this. No impacts detected to date
all	Quantify accurately agricultural impacts, drawing on skills of land agents / agricultural economists.	This would be carried out as part of a socio-economic PhD, the proposal for which is being developed and funding sought - proposed to start in Jan 2018.
all	Publish End of Project Report, including identifying high risk areas and issues	For 2019/20

2. Economic and land-use impacts - Further economic benefits of beaver re-introduction will be determined, such as through eco-tourism, fisheries and education.

2a. To characterise the local eco-tourism industry and quantify any benefits of 'beaver tourism' for local businesses.

2b. To monitor and understand the changes in access to the river Otter, including to the rights of way, and other areas.

2c. To characterise the socio-economic value of the river Otter fishery, and any impacts of beavers on this.

END OF PROJECT REPORT: Quantitative and qualitative assessment of the socio-economic value of beavers in the river

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
2a	Conduct on-line questionnaire for local businesses to quantify impacts on their activity.	This would be carried out as part of a socio-economic PhD, the proposal for which is being developed and funding sought - proposed to start in Jan 2018.
2a	Carry out follow-up detailed interviews with smaller number of businesses.	This would be carried out as part of a socio-economic PhD, the proposal for which is being developed and funding sought - proposed to start in Jan 2018.
2a & 2b	Monitor footpath counters to understand changes in useage of Rights of Way.	ongoing by ED AONB
2a & 2b	Conduct questionnaires on footpath users, in areas throughout the catchment, including in control areas where beavers are not active - in 2017 and 2019	This would be carried out as part of a socio-economic PhD, the proposal for which is being developed and funding sought - proposed to start in Jan 2018.
2a & 2b	Quantify potential benefits on local tourism businesses by analysing data from questionnaires in 2019/20	This would be carried out as part of a socio-economic PhD, the proposal for which is being developed and funding sought - proposed to start in Jan 2018.
2c	Produce a short summary of the use and economics of the River Otter fishery, including the CDE land, Deer Park and other syndicates.	No progress as yet. Could be led by Fisheries Forum. Funding is not currently identified.
all	Produce cost:benefit socio-economic report in 2019/20	For 2019/20

3. Biodiversity - Habitats and Species - Determine the impact of beaver activity on vegetation communities, in particular semi-natural habitats. Studies should determine changes in both the nature of and extent of the habitats.

3a. To characterise the ecological value of the river Otter and monitor any changes that can be attributed to beaver activity.

3b. To understand whether beaver activity has a significant impact on vegetation structure, including changes in canopy and key (and non-native) plant communities.

3c. To characterise and quantify changes to channel plan form and quantify whether beaver activity has any impacts on long term rates of change, and sediment transport.

3d. In the event that beavers are recorded in designated sites, to determine their impacts, if any, on the designated interest features of the site.

3e. To map any new wetland habitats created by beaver activity, including standing open water

3f. To understand the rate of dead wood entering watercourses, and quantify proportion related to beaver activity. Monitor for any impacts associated with this and investigate it as a method for beaver surveys.

NB. The End of Project Report for this section would be integrated into the single Biodiversity report outlines in Section 4 below.

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
3a	Based on the land-use assessment, designated sites, WFD status and species records summarise ecological character of River Otter catchment.	Background information collected. Include this in final report in 2019/20
3a & 3d	Monitor for any beaver impacts on designated sites, and their interest features.	Otter Estuary SSSI baseline bird data collected in 2016. Clyst William Cross (Danescroft) CWS being studied for a range of ecological and hydrological impacts.
3b	Monitor canopy structure in some areas of beaver activity using UAV technology.	UAV monitoring work has already begun at Danes Mill and will continue throughout the lifetime of the trial.
3b	Carry out research projects into any impacts of beavers on Japanese knotweed and Himalayan balsam.	Lower priority - offer as student projects. Two students have carried out work on Himalayan Balsam in the catchment.
3b	Monitor in-channel aquatic macrophytes and other riparian plant communities for any detectable beaver related impacts	Lower priority - offer as student projects. One student has collected macrophyte data at Danescroft
3c	Characterise channel plan form changes and assess whether beaver burrows have changed long term rates of change.	This is a GIS exercise that should be undertaken later in the trial to avoid missing any potential geomorphic impacts. (Jake / Hugh / DBRC ?)
3b & 3c & 3f	Assess rates of woody debris entering watercourse - differentiating between background rates and those due to beaver activity.	Beaver sticks are recorded as part of annual systematic surveys. No clear methodology has been developed for this. May just consist of anecdotal evidence.
3e	Map in detail the extent and development of new wetland habitats created by beavers.	Carried out as part of annual survey and where necessary through the use of UAV imagery.

4. Biodiversity - Habitats and Species - Determine the impact of beaver activity on key fauna populations. The monitoring will focus on impacts on fish populations, but will also include amphibians, and invertebrates (aquatic and terrestrial) and birds

4a. To characterise fish populations in the river Otter, and in the event of any beaver damming or other significant changes, to investigate their impacts on fish populations, including passage and recruitment.

4b. In the event of significant beaver impacts on the river Otter, to understand in detail the changes to macro-invertebrate assemblages at a reach-scale.

4c. In the event of significant beaver activity, investigate the impacts on riparian and floodplain bird populations at a reach-scale.

4d. To understand any impacts of the beavers on otters, water voles and bats within the valley where interactions and impacts are likely.

4e. In the event of the creation of suitable new wetland areas, to monitor the impacts on amphibian communities.

END OF PROJECT REPORT: A single Biodiversity report summarising all effects on habitats, fish and other species.

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
4a	Gather baseline fisheries data and characterise fish populations in the River Otter, (incl eels, lamprey, bullheads, other course fish and salmonids)	Baseline data collected by UoS at Deer Park in 2015 and Danescroft in 2016
4a	In the event that beaver dams are built in the river or streams, carry out detailed monitoring of impacts on fish populations and migration	Initial survey at Danescroft was in response to dam in River Tale.
4b	Characterise invertebrate assemblages based on existing EA datasets, and additional sampling.	Historical invertebrate data collected and analysed. All EA sampling sites have been sampled in Spring 2016 - and could hopefully be resurveyed in 2019?
4b	Intensively monitor changes in macro-invertebrate communities in areas of intensive beaver activity. Identify community changes up and downstream of Beaver activity (damming)	Currently taking place and will continue for the duration of the trial as part of UoE PhD. Given the extent of damming the localised effects have been prioritised
4c	In the event of significant beaver activity, carry out detailed bird monitoring of key species	Baseline breeding bird surveys carried out at Danescroft and Lower Otter Estuary. Repeat survey at Danescroft required in 2019.
4d	Collect anecdotal information about beaver / otter interactions	Anecdotal information being collected
4d	In the event of beaver activity in Tale catchment, carry out water vole monitoring work	Baseline water vole survey carried out in 2016 and 2017. Repeat survey at Danescroft required in 2019.
4d	Consider deploying anabat technology in areas where significant beaver activity occurs or is predicted	Low Priority and no progress - lack of baseline data would reduce validity of any findings. Could be opportunity for DMG.
4e	Carry out eDNA surveys for amphibians at key pond sites	eNDA surveys undertaken at Danescroft
4b	Other species surveys as suitable opportunities arise – eg Odonata etc	Odonata larvae at Danescroft included in PhD invertebrate monitoring. Adult odonata could be surveyed by volunteers / BDS
all	End of Project Report	For 2019/20

5. Ecosystem Services - Water Resources - Quantify the impact of beaver activity on water resources regulation at a range of scales in the Otter catchment.

5a. To quantify impacts on channel flow / discharge using existing data collected.

5b. In the event that beaver dams are constructed, to quantify impacts of dams on water storage and flood attenuation, and drought amelioration benefits. These impacts would also be expressed in the context of WFD status.

END OF PROJECT REPORT: Final report on ecosystem services; part 1 – hydrology including potential impacts on flood risks and low flows.

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
5a	Compile and analyse existing datasets provided by EA to characterise baseline discharge conditions	Completed
5b	Wherever practical, install additional hydrometric monitoring equipment where beaver damming is predicted or occurring.	Currently taking place and will continue for the duration of the trial
5b	Continue work at enclosed beaver site in West Devon to monitor impacts of dams on peak and base flows	Work ongoing and being published
5b	Modelling localised impacts in enclosure on flows at catchment scale	No progress on this so far although this is key long term goal. Further work is needed before this modelling can go ahead - and may not be possible before 2020.
all	End of Project Report	For 2019/20. Impacts need to be expressed in context of WFD status.

6. Ecosystem Services - Water Quality - Quantify the impact of beaver activity on water quality including sediment, and macronutrients (Nitrogen, Phosphorus, Carbon) retention at a range of scales in the Otter catchment

6a. To investigate whether water chemistry more or less variable than natural annual variability in the presence of beaver activity, using existing datasets.

6b. In the event that beaver dams are constructed, to investigate any reach-scale impacts on water quality, including sediment transport, and impacts on gravel beds.

6c. To investigate impacts on ecological status, as defined by macro-invertebrates using existing data collected, and through additional sampling.

END OF PROJECT REPORT: Final report on ecosystem services; part 2 – impacts on water quality, including potential of beavers to contribute to improving WFD status of watercourses.

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
6a	Compile and analyse existing datasets provided by EA to characterise baseline water chemistry across the catchment	Complete. Additional water quality sampling has been ruled out as invertebrate sampling provides a more useful metric for environmental change in the context of the trial and is significantly less costly.
6b	Wherever practical, install water quality monitoring equipment where beaver damming is predicted or occurring.	Sedimentation impacts of dams included in research
6c	Compile and analyse existing datasets provided by EA, and collect additional samples to characterise macro-invertebrate communities and assess them against specialist indices.	Currently taking place and will continue for the duration of the trial
6b & 6c	Monitor water quality indicator species wherever significant beaver impacts are predicted, including where damming occurs if possible.	Currently taking place and will continue for the duration of the trial
all	Continue work at enclosed beaver site in West Devon to monitor impacts of dams on water quality / sedimentation	Work ongoing and being published
all	End of Project Report	For 2019/20

7. Social Impact - Provide a qualitative analysis regarding community interaction with this controversial issue. The study would consider the involvement and perception of the project by the general public and other stakeholders.

7a. To understand how stakeholders develop perceptions of introduced wildlife populations, including their potential risks and benefits.

7b. To understand how social attitudes towards beavers change over the course of the trial.

END OF PROJECT REPORT: Final report on social impacts of beavers on the river Otter and any changes to societal attitudes in the valley

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
7a	Undertaken research to understand how stakeholders develop perceptions of introduced wildlife populations, including their potential risks and benefits.	Research conducted by Sarah Crowley, and papers being published.
7b	Carry out initial questionnaires and focus groups to understand social attitudes towards beavers by a cross section of the local population	Large scale perception survey conducted in 2017 by Roger Auster at UoE. Papers being published on findings.
7a & 7b	Repeat surveys in 2019 using same methodology, to see if perceptions towards beavers have changed.	For 2018/19
all	End of Project Report	For 2019 / 20

8. Beaver Health, behaviour and population change - Monitor the health of the beavers before and after release and their behaviour and population demography through time.

8a. To understand the baseline health of the beaver population living wild on the river Otter and to assess their health through the trial period, including understanding any mortality.

8b. To understand the population size and distribution throughout the trial period, and to map and understand their use of the river Otter resources.

8c. To develop a detailed understanding of beaver damming stimuli, and scenarios for the location of dam building in the catchment over time.

END OF PROJECT REPORT: A summary of the health status of the River Otter beaver population

END OF PROJECT REPORT: The population dynamics, dispersal and future carrying capacity of the River Otter

Contributes. to:	Activity (updated Oct 2017)	Progress and comments (Oct 2017)
8a	Carry out health screening of wild-living beavers to assess health status of adult animals living wild on the river at the start of the trial.	Adult animals captured by APHA in 2015 and health screened by RZSS.
8a	Health screen additional animals released into the river during the trial, or other wild-living beavers captured during the course of the trial.	Additional pair released in 2016 were health screened by RZSS. Other animals captured in 2017 were also health screened
8a	Capture and health screen a sample of animals at the end of the trial to compare health status with baseline data.	To be conducted in 2019
8a	Recover any dead beavers wherever possible, and carry out detailed post-mortem to identify cause of death and condition.	No mortality reported to date
8b	Map historical records of beavers and pre-2015 beaver field signs to develop understanding of early colonisation of the river.	Data being collected. To be included in final reports.
8a & 8b	Using observations and camera traps, monitor active beaver burrows and other areas of focused activity to identify individuals where possible, monitor health and understand family structure.	Ongoing camera trapping, sightings collated, winter systematic surveys of field signs undertaken. This is allowing rough territories to be mapped.
8a & 8b	Monitor additional released animals using camera traps, and detailed surveys. If practical consider radio transmitters.	Ongoing video recording and camera trapping work at Danescroft. Volunteers interpreting high definition cameras
8a & 8b	Collect DNA samples at any opportunity to understand inter-relatedness and family structure	DNA analysis of initial 5 beavers carried out. DNA often collected where animals are captured, to be analysed in more detail when the markers have been developed by RZSS.
8b	Map all field signs systematically, at least annually, to understand colonisation of the river, seasonal behaviour and use of territories.	Annual winter systematic surveys of field signs conducted.
8b	Map beaver food resources and compare with beavers' use of the river and territory size. Assess available resources to understand carrying capacity of different habitat types and entire catchment.	Options being investigated / possibly by adding further detail into the BRAT model
8c.	Compare known ecological requirements of beavers with hydrological characteristics of River Otter catchment to understand where beavers may dam, and whether flooding may determine their distribution in the catchment	Currently being undertaken as part of the dam capacity modelling work.
all	End of Project Reports	For 2019/20