Appendix 3

Beaver Ecology and Key Factors Informing Future Management

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Introduction

The Eurasian beaver (*Castor fiber*) is native to Britain and would once have dramatically shaped most of the rivers, streams and wetlands, and associated riparian land throughout the country. Beavers have the capacity to recolonise the majority of our river catchments and wetlands once again.

The countryside we know today has however been transformed by intensive human activity. This is magnified in the riparian zone where previously complex multi-channel ('braided') wetlands have often been dredged and simplified into single river channels which cut their way deeply through the landscape.

We have engineered rivers and wetlands to function unnaturally and impacted them indirectly through land management practices. This includes land-drainage and farming in floodplains, abstracting and impounding water, and through built development. Conversely, some areas of wetland habitat have been abandoned and, in the absence of dynamic natural processes, are not reaching their ecological potential.

The presence of beavers represents an opportunity to restore more naturally functioning wetland systems and, in so doing, help to deliver key elements of the Government's 25-year Environment Plan (Figure 3.1).

Figure 3.1 – Extract from 'A Green Future: Our 25 Year Plan to Improve the Environment.'

"In order to help leave the environment in a better condition for the next generation, we need to restore and create areas of wetland, woodland, grassland and coastal habitat, to provide the greatest opportunity for wildlife to flourish and to promote the wider economic and social benefits that healthy habitats offer. Taking this approach will help us improve the overall status of threatened species, such as hen harrier and curlew, and will help prevent extinction, as well as providing opportunities for reintroduction of species such as beavers.

…We have still lost many formerly native species from England - such as the white-tailed eagle, the orange-spotted emerald dragonfly and the beaver. As well as lost species, others, such as the pine martin, fen orchid or hen harrier, are found in only a few sites within their former range. Their reintroduction, when carefully planned and managed, can enrich our natural environment and provide wider benefits for people.

…We will also provide opportunities for species recovery and reintroduction as we develop our Nature Recovery Network. Natural England will continue to work with partners and local communities on species reintroduction and recovery projects that support nature conservation and help towards meeting economic and social goals."

A semi-aquatic highly territorial rodent

Beavers have very specific zoological and ecological traits. An understanding of these traits, associated behaviours and impacts within the riparian zone needs to be reflected in all proposed management interventions.

Beavers are a semi-aquatic rodent. This means they are restricted to wetlands and watercourse networks, rarely straying far from the safety of deeper water where they can quickly escape if threatened. They are powerful swimmers and superbly adapted to the aquatic environment. They are highly mobile, and will travel great distances, often surmounting considerable obstacles (e.g. major roads and grilled culverts), to find suitable habitats and other beavers.

Beavers are a social and highly territorial species which live in family groups, often comprising three generations. A single family may occupy, depending on habitat quality, three or more kilometres of watercourse. They patrol and defend their territories, often ferociously; territorial disputes range from posturing to highly aggressive behaviour which can result in fatal wounds being inflicted on other beavers.

It is crucial to understand the territorial behaviour of the species and their population dynamics, to fully account for how management activity can interfere with or destabilise an established equilibrium. If family groups are destabilised, inward or outward migration from the territory is likely. This can lead to new territorial disputes resulting in harm to displaced individuals and those with whom the come into contact.

Beavers – a keystone species

Beavers' capacity to engineer wetlands through damming activity and coppicing of woody vegetation can exert a transformational impact on the ecology and visual appearance of riparian land. This disproportionately positive impact, relative to the abundance of beavers, means beavers are regarded as the archetypal wetland 'keystone' species. Their loss from Britain has had profoundly negative impacts on the health of our watercourses and wetlands and the species which depend on healthy aquatic ecosystems. In many areas, where habitats are already suitable and water is deeper, the visual impacts of their presence are often very subtle and may only be observed by the trained eye. However, beavers are highly industrious and adaptable, able to transform less optimal areas into perfect beaver habitat. Their engineering abilities allow them to build dams, excavate channels and create the deeper water that they need for their security. The early phases of beaver colonisation can be visually very dramatic as terrestrial habitats are transformed into dynamic wetlands.

However, in many areas these beaver engineered wetlands and beaver activity is likely to conflict to varying degrees with existing landuses and may present localised risks to residential areas, key infrastructure or more widely to maintaining productivity of farmland.

Management of beavers and the wetlands they influence will therefore be essential to ensure the overwhelming benefits they can bring are maximised whilst any negative effects are either avoided or efficiently and effectively mitigated.

Non-intervention presents unacceptable risks to the future of beavers and human interests in river catchments.

It is important to recognise that beavers have been absent from the British Isles for over 400 years. Their activities and influences on riparian land are therefore alien to impacted stakeholders and wider society.

Widespread modern land-use practices, a lack of beaver awareness and understanding coupled with misinformation and myths regarding the species will, if left unmanaged, lead to unnecessary anxiety and concern with potential impacts on local livelihoods and infrastructure. Education and awareness raising therefore represents one of the cornerstones of this Management Strategy.

Initial colonisation of the River Otter

Evidence and accounts from members of the public and landowners reveal that beavers have been living on the River Otter since 2008, with initial breeding occurring prior to the death of a founding adult male in April 2012. New kits were also confirmed in 2013 and 2014 prior to the beginning of the Trial.

In February 2015 a detailed survey undertaken by the Animal and Plant Health Agency (APHA) estimated the population to comprise nine individual beavers living in two family groups, including four adults and five sub-adults. In March 2018, the population had grown to an estimated 27 animals living in eight family groups, and by the end of the Trial period in February 2020 we predict that there could be 15 family groups of beavers distributed throughout the catchment.

Phases of beaver colonisation of the River Otter catchment

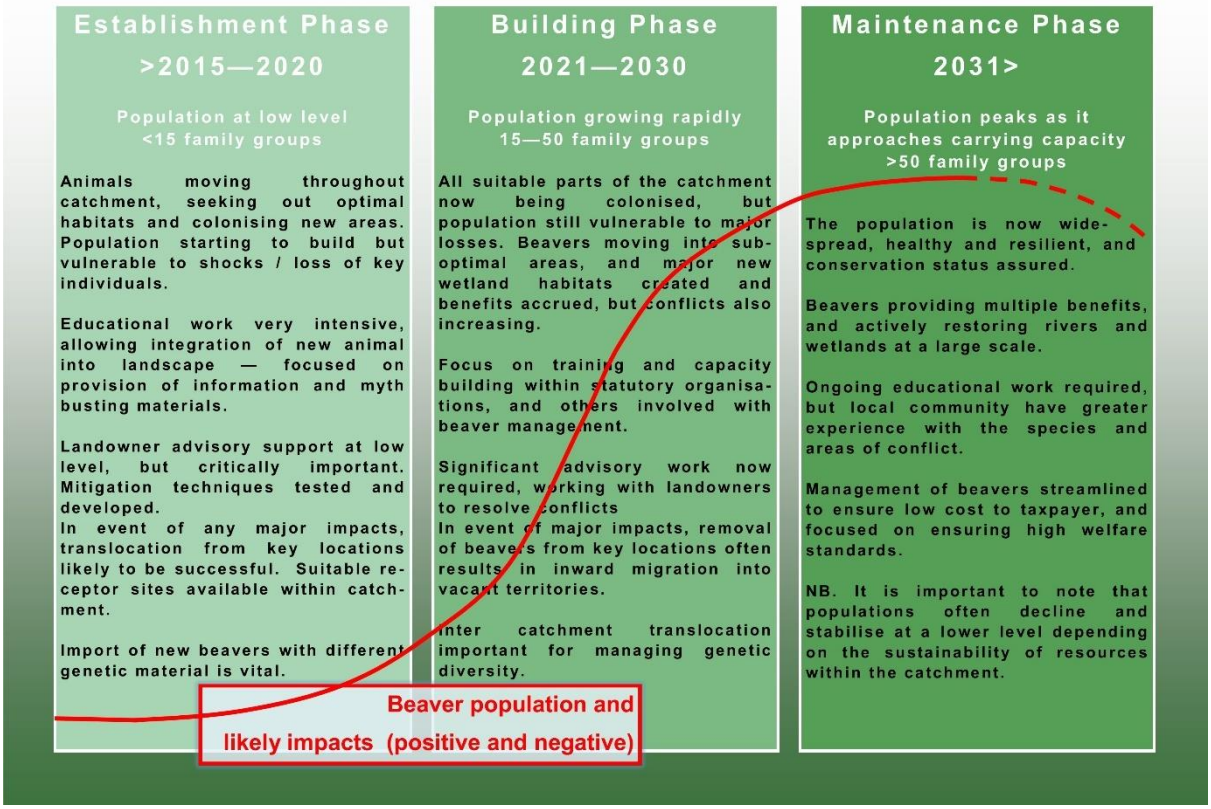
Beavers are highly mobile animals, and in the early stages of colonisation, will explore extensively across a catchment. In March 2017 a one-year old female beaver was trapped and tagged near Otterton village which is located just a few kilometres from the estuary and given distinctive orange ear tags. Two months later this same individual was filmed by a local resident 46km upstream at Otterhead lakes, at the source of the catchment, where she has subsequently established a territory with a male. In May 2018 she gave birth to at least one kit. This is a significant journey for a young animal, but highlights how mobile beavers are, particularly during the initial colonisation of the catchment where territories are more diffuse.

Annual systematic mapping of beaver feeding signs throughout the catchment as part of the ROBT, and the lack of any evidence of migration outside of the River Otter catchment, suggests that, at the current population levels at least, the beavers are using the entire catchment, but are not dispersing away from it.

For the above reasons, we are recommending that the colonisation and the management of beavers in River Otter is considered at the **catchment scale**. At that scale the use of a standard Gompertz Function graph is an appropriate way to characterise the colonisation of the catchment (see Figure 3.2). This outlines three distinct phases and the nature and intensity of management interventions that would be appropriate in each phase. Following

the initial colonisation of a river catchment, there is often a 'lag phase' of slow growth. This **establishment** phase is characterised by low population resilience; the death of a breeding female, for example, could seriously impact population resilience and mark the start of population decline which may lead to local extinction. When several healthy breeding family groups are well established, there follows a period of more rapid population growth where beavers expand into most of the readily accessible areas of suitable habitat (**building** phase). Population growth then levels off as it approaches 'carrying capacity' (**Maintenance** phase).

Figure 3.2 - It is suggested that the restoration and management of beavers in each catchment is best considered in these three phases.



This Management Strategy is relevant to the Building Phase (approximately 2020 – 2030). The conservation status of the beavers during the first years of this phase will remain vulnerable to loss of key breeding animals. If this were to occur additional genetically diverse animals would need to be reintroduced. Additional animals will also be required to be introduced to ensure the best future genetic health for a founding population. The vulnerability of the population to any loss during this phase would need to be fully recognised in any supporting beaver management guidance. The conservation status of the species during the building phase will be a key consideration influencing choice of management interventions.

If the colonisation of the River Otter follows patterns seen in catchments elsewhere in Europe, we expect to observe a decrease in the rate of expansion as the population approaches the ecological carrying capacity. During this phase the conservation status of the beaver population will become more robust. A new management paradigm will begin where detailed assessments of the impacts of individual interventions on the beaver population will not be required. However, there will a need for management interventions and the cumulative impact of these would still need to be understood and any actions clearly justified and fully consider beaver welfare.

As with all wildlife, beaver population density varies considerably in time and space and will be strongly influenced by habitat quality and availability. Beaver density is also significantly influenced by their territorial behaviour, with average territory size decreasing as habitat quality increases. As populations move into the maintenance phase, a decrease in territory size is often observed as a result of population pressure and competition for resources. At this point, the availability of habitat becomes a major limiting factor, and territorial disputes become more prevalent. Mortality rates increase directly through in-fighting and indirectly through the stresses of living in smaller territories that need to be defended more vigorously. These dynamics can become physically evident by a decrease in breeding rates and delayed dispersal.

While a developing beaver population with abundant habitats can display growth rates of 15-20% per annum, populations will level off once readily available habitat has been occupied. The evidence from elsewhere suggests that this peak population level will decline as the beavers impact on the available food resources within the catchment. This equilibrium represents the ecological carrying capacity.

The level at which this occurs is difficult to determine accurately, but modelling work is ongoing with the University of Exeter to estimate the maximum number of territories that the catchment might support.

Population Management

It is likely that before the ecological carrying capacity is reached, the socially acceptable population size for those living and working in the catchment would have been exceeded. This Management Strategy Framework is designed to facilitate the process of striking a balance between the ecological and social carrying capacities in a scientifically and democratically inclusive and acceptable manner.

An important beaver management tool for populations maintained at the social carrying capacity level is to trap and translocate beavers to locations where populations are in establishment phases. This option would only be available should their wider re-introduction into England be permitted. This approach enables the management of conflicts and significantly delays the need for lethal control to be considered. However, based on experiences from the experience elsewhere in Europe, it is likely that lethal control will also be required in time as part of any long-term management strategy.

Dispersal into adjacent catchments

The ROBT licence requires any beaver signs in adjacent catchments to be investigated. While there have been several reports during the ROBT term, all have been followed up and no evidence of any beaver activity has been identified. Otters appear to be thriving in this part of Devon, and sightings are becoming more frequent and these are often confused with beavers.

As the beaver population increases, we expect to observe more frequent dispersal of animals into the headwater streams. There are a small number of headwaters where the catchment boundaries are very diffuse to beavers owing to the presence of permeable semi-natural wetland habitats spanning catchments.

The adjacent catchment to the west is the River Exe (including the River Culm tributary) and based on the geography, this appears to be a possible inland dispersal route out of the Otter catchment. Access into the Sid to the east would appear much less likely due to the presence of plateaus (without watercourses) separating the catchments. The River Axe, also to the east, is a much larger river with numerous headwater streams, and there are a small number of potential crossing points.

To the north, the River Otter rises in the Blackdown Hills where the stream gradients are much steeper, and dispersal via this route represents a greater obstacle. To the north of the Blackdown Hills lies the River Tone and the Somerset Levels, where the mitigation of beaver conflicts would be complicated by the very flat, heavily drained, floodplain landform.

Another possible route for dispersal is via the coast. Some animals may explore the Otter estuary and coastline and access the Exe estuary to the west, or the River Sid to the east. In both Knapdale in Scotland, and in Kent, observations of beavers moving along the coast have been reported.

An assessment of different intensities of management interventions

As beaver populations colonise new areas, they will first choose optimum habitats where water is deepest and there are sufficient food resources available. As such, their impacts tend to be initially confined to small numbers of stakeholders who own or manage land bordering rivers, generally in rural areas. As population density increases and unoccupied reaches are colonised, less optimum beaver habitat will be impacted. At this stage the impacts, both real and perceived, will become more prominent and the novelty of their presence may be replaced by hostility from specific sectors. Access to high quality information, advice, financial support and robust management solutions will help to mitigate this potential conflict.

Successful beaver management is well practiced throughout Europe (where beavers receive European Protected Species status) and North America, where a range of tried and tested mitigation techniques directly applicable in a British context are employed. A range of regimes exist from state supported resourcing of compensatory systems through to licenced culling and hunting quota systems. All successful management regimes are commonly characterised by acceptance that management is essential, the ease of access to high quality information and advice, and where appropriate financial support, coupled with a rapid

response from appointed officers and/or volunteers who are expert in directly assisting with managing conflicts.

Many of these techniques have been developed in response to a general lack of societal support for unregulated lethal or highly invasive wildlife management and where beavers are afforded legal protection (for example European Protected Species status).

It is clear from all geographies where beavers have been reintroduced that extremes of beaver management, from immediate, invasive and high impact action through to non-intervention, are unacceptable to society as a whole. This is reflected in the views of the participants of the public perception survey carried out by the University of Exeter. (Please refer to Figure 3.3)

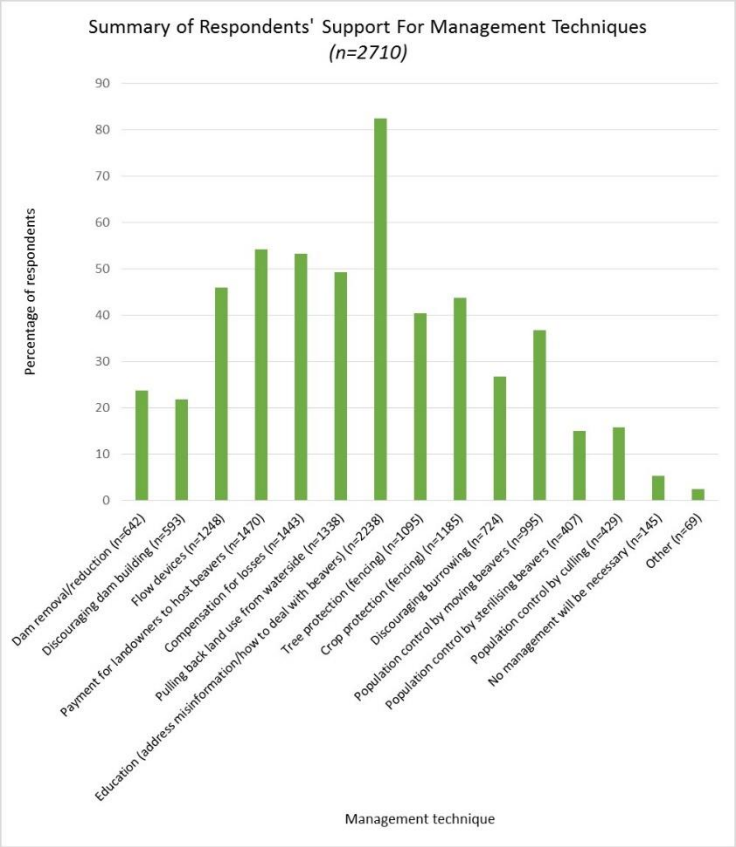


Figure 3.3 – Support for different management techniques among participants of perception survey.

Non-intervention does not account for beavers' capacity to cause negative impacts such as localised flooding of infrastructure, farmland or residential areas. The result of such negative interactions with a species, which could have been foreseen and mitigated, have been observed in Bavaria and Scotland to cause heightened anxiety and hostility from key stakeholders. Conversely excessive management, where a mitigation hierarchy is not adhered to and invasive interventions are the first (not last) choice, will not maximise natural capital and wildlife rewards from beavers. It will also exert social ramifications where large sectors of the community will feel alienated, and unhelpfully establish a divide between those taking management action and those who oppose it.

A balance therefore needs to be struck where a broad tolerance of beaver colonisation is developed whilst recognising that there is a genuine tension which needs to be addressed, between those who directly incur costs and reap fewer benefits, and others who benefit at no cost. In so doing tolerance levels are likely to increase, creating a foundation of acceptance of beaver activity alongside the understanding that there is a need for management.

One of the key lessons learnt from Europe is that management is essential and should be based on a good understanding of beaver ecology and behaviour. Hasty and repeated actions that occur too early and without regard to beaver behaviour can be counter-productive, establishing populations which are harder to manage, less predictable and which can cause higher risk to economic and social interests. This is confirmed by frequently reported observations that when beavers first colonise a new area, their impacts are often more pronounced. The expression 'better the beaver you know' is a pertinent description used by some landowners and managers in other EU countries.

Our relationship with beavers will change over time as we begin to learn to live alongside the species, understand their behaviours, and successfully manage their impacts. Any future management strategy should therefore adopt a pragmatic approach, which is flexible and open to review and revision. However, poorly handled reviews can magnify tensions and drive further division between groups. The strategy which is developed from the outset therefore needs to be 'fit for purpose' and have buy-in and build consensus from a diverse range of stakeholders.

Limitations of beaver management and tolerance zones

The family group structure and territorial nature of beavers has a major bearing on how impacts can be managed successfully. When population density is high, beavers removed from high quality habitat will be replaced, often rapidly, by dispersing beavers from neighbouring territories or prospecting individuals. The pressure exerted will be greatest where adjacent territories are closer and connected by high quality, permeable habitats. Conversely, if a beaver family can be tolerated – through management if necessary - their presence will deter other beavers from entering the territory.

Beavers move throughout their territories and explore unoccupied areas freely, mostly during the hours of darkness and, other than leaving a few tell-tale gnawing marks on riverside trees, go largely undetected. Preventing this low-level beaver presence at a *sub*-catchment scale is not practical.

As the population approaches carrying capacity in a particular area, the removal of beavers from a location is likely to result in recolonisation, and thus the need to repeat action in perpetuity. Tolerating the beavers and managing the impacts, is likely to be a more sustainable and effective solution in all but the most vulnerable and high-risk locations.

If beavers are present within a catchment, but specific areas are zoned as 'low tolerance zones,' reacting quickly in the event of unacceptable behaviours (e.g. damming or burrowing) is a more realistic proposition. The use of this zoning to identify certain low tolerance locations is considered in appendix 7.

If the decision is made that beavers are not to be tolerated within an *entire* catchment then disrupting their overland dispersal and tracking and trapping beavers as they first colonise is the most cost-effective and humane way of achieving this outcome. However, this would require a long-term commitment of resources which should not be underestimated.

Regular Review of BMSF

We recommend that the Beaver Management Strategy Framework is subject to internal annual review by the proposed BMG. In addition, it is also recommended that full formal review occurs every five years (and at a point when population data indicates a movement from **Building** to **Maintenance** phases) to involve a wider group of stakeholders and community representatives. This period where we relearn to live with beavers is likely to be characterised by changing social attitudes toward beavers, which will occur in conjunction with new techniques trailed and honed for managing their impacts, which would need to be reflected in the strategy.