Management of Beaver Impacts

Evidence Summary

March 2025

Credit: Maria Thompson.

Context and objectives

Beavers are ecosystem engineers that modify the environment, affecting both humans and other wildlife. They are native to Britain, but humans hunted them to extinction around 400 years ago. In the last three decades, Eurasian beavers have returned to Britain. Some stakeholders celebrate this due to beavers' ecological benefits. But others are concerned about how potential negative beaver impacts will be managed, and whether management techniques are effective.

This review assesses the evidence on beaver management, appraises the strength of the evidence, and shows areas where further research is required.

Research aims

We conducted a rapid evidence assessment to answer the following questions:

- How effective are interventions for managing negative beaver impacts?
- What ecological mitigation and compensation measures exist for beavers and how effective are they in the context of development?

Preamble

The following sections summarise the key findings of the rapid evidence assessment. Complete details of the methods and results are provided in the Full Report.

Caveats

This evidence summary provides an objective overview of the evidence review on beaver management. It does not provide advice or guidance of any kind.

Readers in England should note that beavers are a European Protected Species. As such, the conclusions made below should therefore be considered within the legislative context in England. Furthermore, some management actions require additional environmental permits from the relevant risk management authority. More information can be found here: [Protection and management of beavers in England - GOV.UK (www.gov.uk).](https://www.gov.uk)

Readers should also note that this evidence review focuses solely published scientific literature and published or unpublished grey literature. There is extensive knowledge around the efficacy of different beaver management techniques held in practitioner experience. However, the systematic process of producing evidence reviews is not designed to capture these types of evidence; it is only designed to capture documented evidence.

Efficacy summary

This report reviews the scientific evidence on beaver management.

Monitoring and education detect and pre-empt challenges and conflict between humans and beavers. Education also corrects misinformation and teaches landowners about the benefits and disbenefits of beavers, which improves human-beaver co-existence. Given that education and monitoring are the first step in Natural England's Beaver Management Framework and have a minimal impact on beaver welfare, most land landowners' will be able to incorporate these methods into their beaver management strategy.

If monitoring reveals that beavers are causing undesirable impacts, such as tree damage, blocked culverts, and increased water levels, land/water managers can use various techniques to manage beavers' population. The review found that flow devices, odour and textural repellent, tree guards, exclusion fencing, culvert fencing, and beaver-proof culvert ends (e.g., T-culverts) each reduce beaver-related impacts. Dam removal is successful in some scenarios, but beavers often rebuild removed dams.

If the former methods fail to resolve conflict between humans and beavers, trapping and culling can be used to manage beavers. However, these methods have limited success as beavers often repopulate trapped and culled areas. There are also restrictions on the use of these interventions in England and Natural England's licensing regime recommends that they are only used as a last resort.

The review also identified several interventions that had no effect – or at best a short-term effect – on beaver foraging behaviour. These include repellents (other than odour or texture repellents), electric shock devices, and scarer devices.

Some interventions were potentially effective but lack extensive scientific evidence to support their use. These include tree buffers, embankment protection with steel mesh mats, lodge removal and infilling burrows, and ecological compensation measures.

Most of the management interventions identified in this review would benefit from further research. As already mentioned, some interventions lacked extensive evidence on their efficacy, while others had been researched extensively but were supported by weak evidence (Figure 1)[1]. In areas where there is either a lack of scientific evidence or a lack of robust evidence, further well-designed studies would aid decision making in the future.

Figure 1 illustrates the efficacy of each intervention examined by this review. Figure 2 provides a graphical summary of the efficacy of the different interventions.

[1] See full report for more detail on strength of evidence for different interventions.

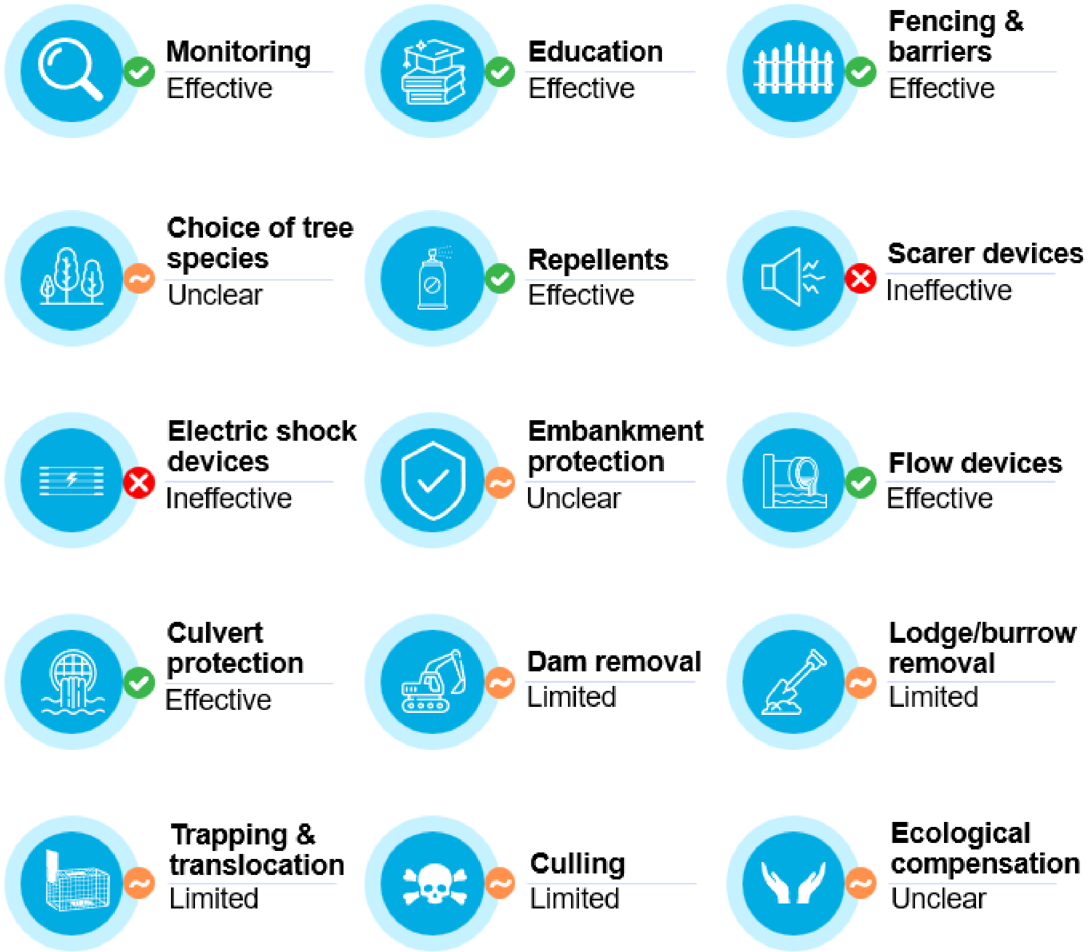


Figure 1: Visual summary of the efficacy of interventions identified in the evidence review

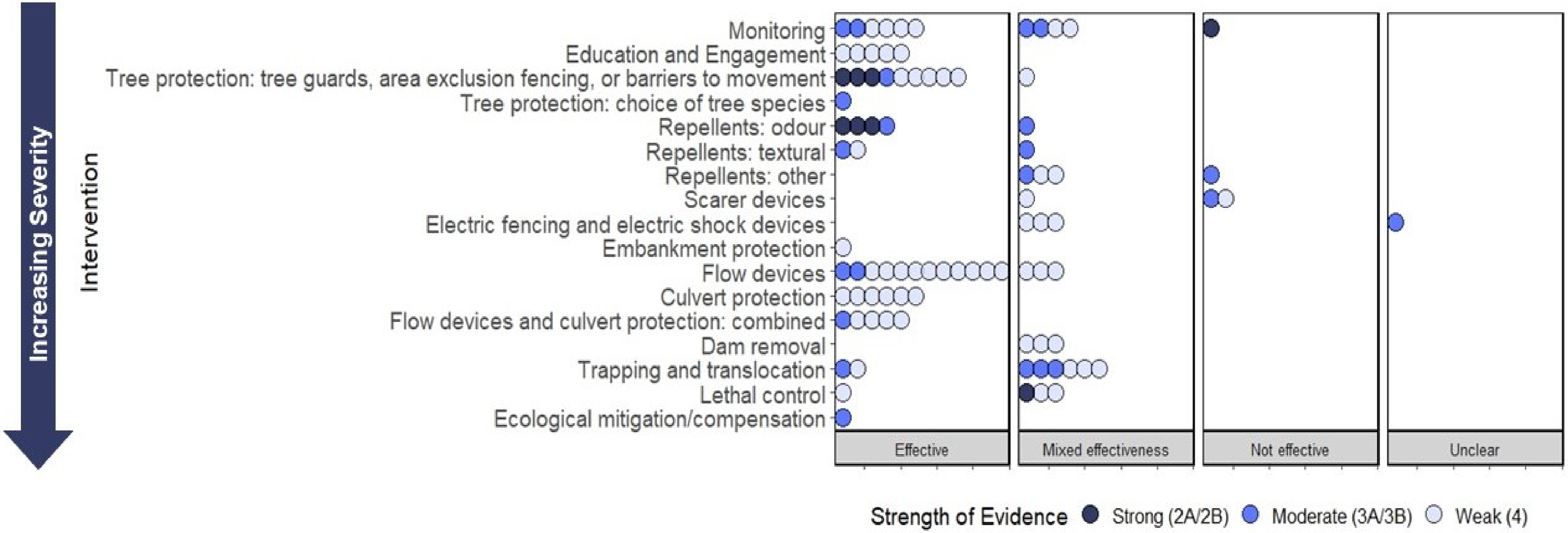


Figure 2: Dot plot summarising the strength and direction of studies reporting on different interventions.
The graph represents each study as a single dot. The direction of evidence for each study has been organised into four categories: effective, mixed effectiveness, not effective, and unclear. Studies classified as 'mixed effectiveness' either had no clear direction of effect or had two or more pieces of evidence pointing different ways. Studies are further subcategorised by their strength of evidence; strong studies had more robust methods than moderate or weak studies and are therefore more trustworthy.

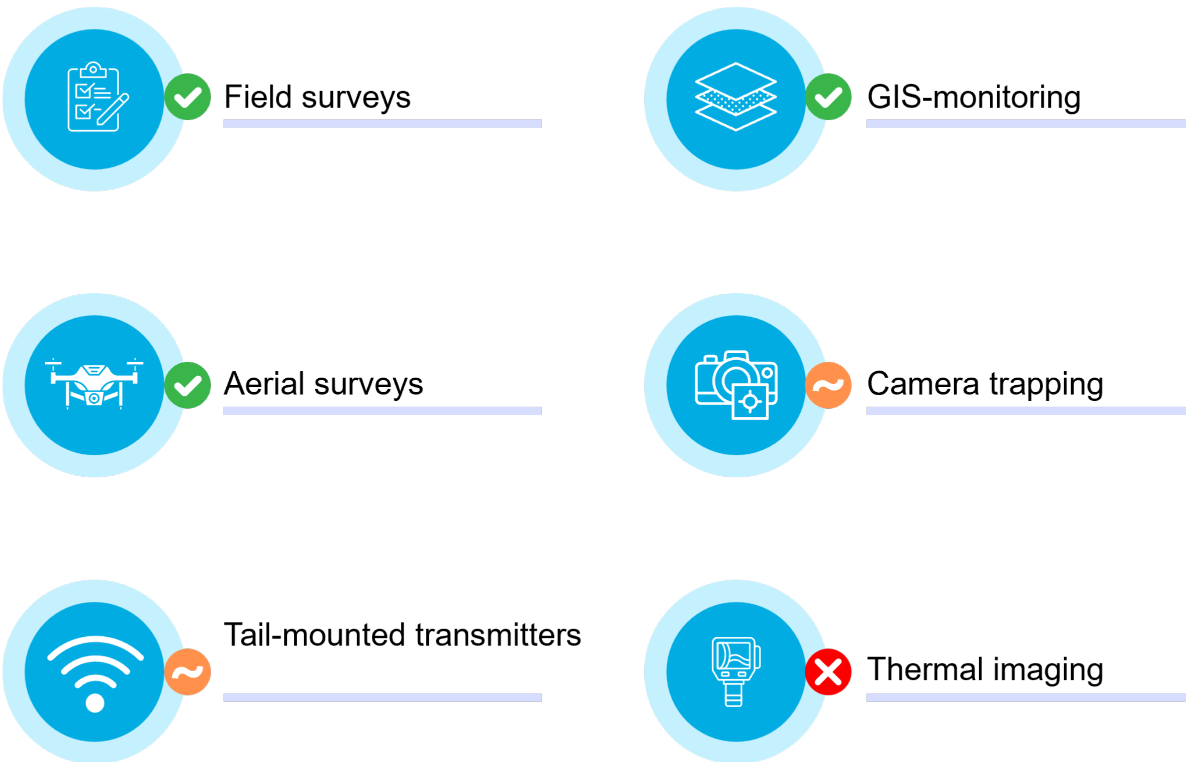
Monitoring beavers

Monitoring is the first step in Natural England's Beaver Management Framework (1). It can be a valuable tool to assess and manage beaver activity.

Evidence suggests that monitoring allows identification of potential sources of human-beaver conflict to be identified before they occurred (2-6). This allows pre-emptive measures to be put in place to prevent conflicts arising.

Field surveys (foot and canoe), GIS-based monitoring, and remote sensing (e.g., aerial surveys) allow successful identification of beaver distribution, beaver territory location, and potential management issues (2-6). However, there are some limitations to these methods. Field surveys are time intensive (5) and remote-sensing imagery had difficulty determining whether lodges were occupied or abandoned (6).

Some monitoring methods were less effective. Camera trapping can be used to track beaver activity, but it had limited success in published studies (7, 8). Thermal imaging was only successful at identifying active beaver lodges under a niche set of conditions (9). Tail-mounted transmitters had poor retention rates and caused negative impacts on beavers' health (10-12).



Education and stakeholder engagement

It has been 400 years since beavers went extinct in Britain, and most people today lack understanding or experience of living alongside them. This evidence review found that engagement between wildlife managers and stakeholders, and education on how to live alongside beavers, helps to resolve human-beaver conflicts. Education and stakeholder engagement improves stakeholder knowledge, promotes successful management techniques, and facilitates better communication and more collaborative decision-making (13-16). This leads to more peaceful human-beaver coexistence. However, education and stakeholder engagement is resource intensive and requires ongoing commitment (14, 17).

Alongside monitoring, education and stakeholder engagement form the first stage in Natural England's Beaver Management Framework. The evidence found here suggests that they are effective management techniques, with few barriers to their use.

Education

Engagement

Management of damage to individual trees

Beavers forage plants, including trees and shrubs, feeding on the leaves and bark. Beavers sometimes fell trees to access foliage on higher branches or use tree parts for dam and lodge construction (18). Human-beaver conflict can arise if beavers damage commercially or culturally important trees, ornamental trees, or rare tree species (18, 19). There are, however, a number of interventions, including tree guards and repellents, that can reduce beavers' impact on individual trees.

Tree guards can protect valuable trees. Scientific evidence suggests that tree guards prevent beavers from foraging bark, felling, or otherwise damaging trees (Figure 3) (20-22). Landowners generally support these findings, reporting that tree guards are satisfactory in most scenarios (23, 24). Installing tree guards according to manufacturer guidelines is important to success, and trees with incorrectly installed guards are more easily damaged (21). Efficacy is also better when using heavyweight materials, such as high-density textile tubes or wire mesh/chain link mesh, compared with lighter materials (20, 21). However, lightweight materials, such as elastic mesh, are often less expensive than their heavyweight counterparts, such as plastic or textile tubes. Lightweight materials may therefore be useful in cost-prohibitive scenarios, whereas heavyweight materials may be more appropriate when beavers threaten particularly valuable trees (20). Overall, tree guards offer a useful tool for preventing damage to individual trees.

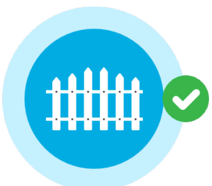
Figure 3: Wire mesh tree guards wrapped around mature trees, preventing damage by beavers. Credit: Kate Gamez.

Repellents can protect trees by leveraging mechanisms that are unpleasant to beavers.

Odour deterrents that mimic the scent of predators are particularly effective at reducing damage to trees (25, 26). Evidence from US- and Europe-based trials suggests river otter odour is the most effective, but other predator odours are also successful, including red fox, lynx, wolf, brown bear, and human odour (25, 26). Commercial repellents are also effective. Big game repellent liquid/powder, which mimics the scent of predator urine, is the most successful at reducing tree damage (27, 28). Plantskydd, which acts through a similar mechanism, also reduces tree damage but to a lesser extent (27, 28). Note that most studies on odour repellents (commercial or otherwise) were conducted in the USA, and results may differ in Britain, where predators are different.

Textural repellents (sand and paint mixture) reduces beaver foraging on trees, although there are concerns with the toxicity of the sand and paint mixture for beavers (29, 30). Soaking palatable tree species (e.g., aspen) with extract from less palatable trees (e.g., maple) has been trialled but is, so far, ineffective (31).

Repellents



Tree guards

Readers in England should note that while tree guards can be used by anyone, most of the studies on repellents were from the US. As such, the substances used may not be legal in England. More information can be found [Check your product is regulated as a biocidal product - Biocides - HSE. English audiences should also be mindful of the use of pollutants near a watercourse, as per the government guidance: Flood risk activities: environmental permits.

Management of damage to groups of trees

While tree guards and repellents reduce or prevent damage to trees, using these interventions over large areas may prove impractical. There are, however, other options for protecting large groups of trees, including exclusion fencing, buffer zones, and scarer devices.

Exclusion fencing can be constructed around areas of valuable trees (Figure 4). Scientific studies suggest that properly constructed exclusion fencing can completely protect trees from beavers (30, 32). Furthermore, landowners report that exclusion fencing is an acceptable method for management of tree-related impacts (23, 24). Exclusion fencing, therefore, offers an effective method of preventing damage to groups of trees.

Figure 4: Enclosure fencing preventing passage of animals between areas. Credit: Giles Wagstaff.

Buffer zones consisting of tree species palatable to beavers (e.g., willow) can be used as a barrier between beavers and commercially valuable trees (e.g., oak) (Figure 5). There is limited evidence for buffer zones, but preliminary findings suggest that creating a buffer of highly palatable softwoods, such as willow, reduces beaver penetration into commercial hardwood plantations (33). More evidence is needed on this to confirm the efficacy of buffer zones.

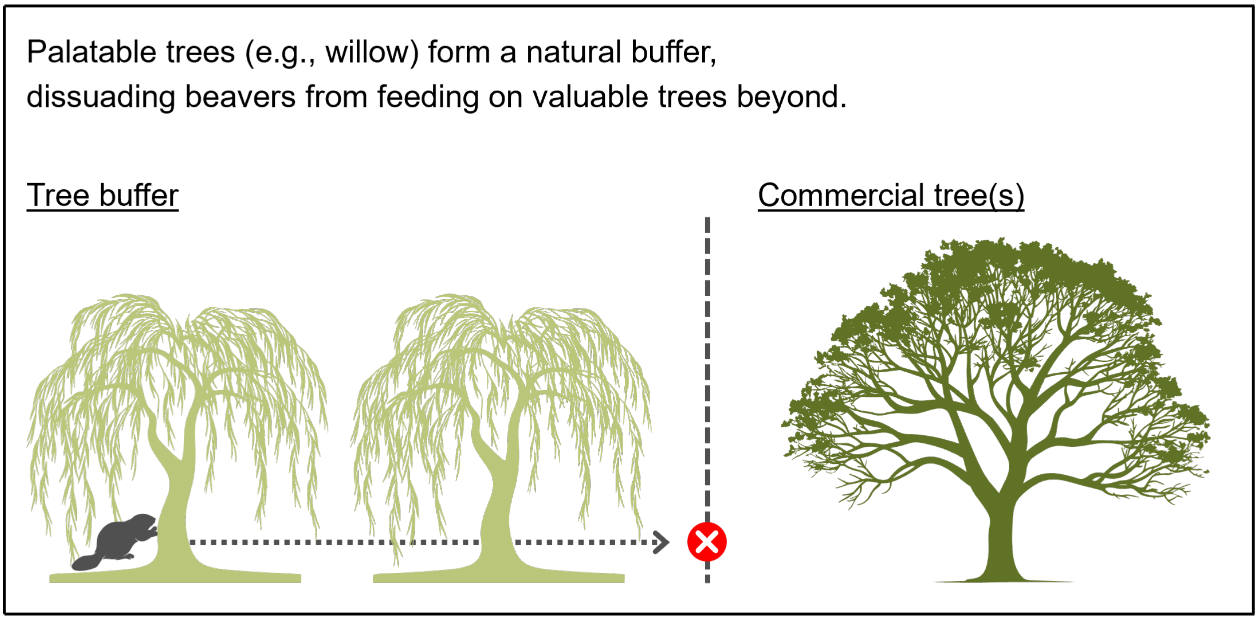


Figure 5: Illustration showing how buffers of palatable trees can attract beavers' attention, deterring them from felling valuable trees beyond the buffer.

Scarer devices that emit light, sound, or an electric shock offer an alternative method of management. However, experts report that most scarer devices do not work for more than a few days (34). Evidence, albeit limited, also suggests that light and sound scarer devices do not reduce damage to trees (30). Additionally, landowners report that frightening beavers unacceptable in most scenarios, although landowners that had experienced prior beaver impacts were more likely to find scarer devices acceptable (23). There is limited empirical evidence on electric fencing. Anecdotal evidence and expert opinion suggests that electric fencing is harmful, and often lethal, to beavers and other wildlife (35). It can also be impractical, due to the need for daily maintenance (35).

Evidence suggests that beaver-related damage to areas of trees can be reduced using exclusion fencing, and possibly buffer zones. In England, both management techniques can be implemented by stakeholders without a licence.

Scarer devices do not prevent damage to trees for more than a few days, nor are they recommended for long term use by Natural England due to their harmful effects on wildlife. For more information on the use of scarer devices, including electric fencing, in England, please see: [Beavers: how to manage them and when you need a licence](#).

Management of damage to embankments

Burrowing beavers can cause damage to embankments alongside waterways or human infrastructure (e.g., railway tracks) (36). This can cause conflict with humans if it results in flooding or unstable or damaged infrastructure. The review identified limited evidence on embankment protection, but initial findings suggest that steel mesh with geomat protects against beaver-related damage to embankments (36). Overall, it is difficult to make conclusions about the effectiveness of this management technique based on limited evidence. More information can be found on the permittance of embankment protection is available at [Flood risk activities: environmental permits](#).

Management of flooding

Where water depths are insufficient for beavers to dive away from predators or build underwater entrances to their lodges and burrows, beavers will create dams to raise the water level. This can cause conflict with humans if it results in flooding of human infrastructure or farmland.

Flow devices (also known as pond levellers) can maintain water levels at a desired level at dammed streams or beaver ponds, without negatively affecting beavers' activity (Figure 6). This finding is supported by a large body of academic research, and reports from landowners, who generally indicate they are satisfied with the performance of flow devices (6, 17, 19, 23, 37-41). Landowners also reported that after the installation of flow devices, they were less likely to turn to more extreme management options (e.g., lethal control) (42). As well as being efficacious, cost-benefit analyses suggest that flow devices result in a net cost saving, as they prevent damage to infrastructure and buildings and reduced costs associated with beaver management (trapping, dam removal, etc) (37, 43).

Flow devices occasionally fail. This is most often caused by beavers building secondary dams, which causes higher water levels at the outlet of the flow devices (44). Failures can also be caused by beavers blocking flow devices, insufficient pipe capacity, and lack of routine maintenance (34, 42, 44, 45). Where beavers block flow devices, this can often be resolved by removing the blockage and installing a cage over the tube inlet to protect it from beavers (6, 40). Overall, flow devices manage flooding well in most situations and results in a net cost saving over time.

Figure 6: Flow device with a cage at the inlet installed through a beaver dam to manage water levels. Credit: Giles Wagstaff.

Installing flow devices may be undesirable in some situations. For example, the reduction in water levels caused by flow devices may not be enough to resolve human-beaver conflicts or the presence of a dam may be intolerable to a land manager. In these instances, dam removal may be a suitable option. Scientific evidence suggests that dam removal can relieve beaver-related impacts (e.g., flooding) in the short term, but as beavers habitually rebuild dams, researchers often reported a recurrence of beaver impacts in the medium-to-long term (7, 38). To permanently remove a dam, practitioners must often destroy it several times until beavers stop rebuilding (7, 38). Accordingly, landowners have mixed perceptions of dam removal. They generally report that removing dams is unacceptable when beaver impacts were minor but more desirable as the severity of beaver impacts increased (23).

Dam notching may provide an alternative to dam removal. It allows water to flow through a gap in the dam and water levels to drop. However, notching is a short-term solution, as beavers will often repair the dam (8).

Both flow devices and dam removal play a role in management of flooding. Flow devices generally manage water levels well and are deemed more acceptable by landowners than dam removal. Therefore, installation of a flow device is the better first-line defence against flooding. If flow devices fail, dam removal may be a suitable alternative.

Flow devices

Dam removal

For guidance around the use of these interventions in England, readers should refer to: Protection and management of beavers in England, Flood risk activities, and Fisheries offences.

Management of culvert plugging

Beavers sometimes plug culverts, which can prevent the proper flow of water. The review identified a number of possible solutions to this problem, including installation of culvert fencing and T-culverts.

Culvert exclusion fences aim to prevent beavers from accessing culverts, while also covering a sufficient area to prevent beavers from perceiving movement of water through the culvert. Scientific evidence suggests that culvert exclusion fencing is generally successful at preventing beavers from blocking culverts (42, 44). These findings are supported by comments from experts (8, 43) and landowners (42). Of note, one study showed that cylindrical designs were less effective than trapezoidal ones, although further research is needed to confirm the finding (46).

Culvert fences occasionally fail, most often due to beavers damming the fences, but other causes include maintenance not being performed and vandalism (44). As with flow devices, results of cost-benefit analyses suggested that erecting culvert exclusion fencing resulted in a net cost saving, by reducing management costs associated with unblocking and repairing culverts and infrastructure (e.g., roads, etc) (37, 43).

T-culverts play a similar role to exclusion fencing: preventing beavers from accessing culverts and perceiving movement of water through culverts. T-culverts haven't been examined in any robust studies; however, case studies suggest that they prevent plugging of culverts by beavers (34, 47, 48). T-culverts required routine maintenance to prevent the intake/fencing from being blocked by debris (34).

Culvert fencing

T-culverts

For guidance around the use of these interventions in England, readers should refer to: [Protection and management of beavers in England](), [Flood risk activities](), and [Fisheries offences]().

Trapping, translocation, and lethal control

If land managers are unable to employ the management interventions described above, it may be necessary to use more drastic methods of management. These include trapping, translocation, and lethal control. In England, these activities can only be carried out by a specially trained and licensed person. They can only occur when there is no suitable alternative and they do not affect the favourable conservation status of beavers. English readers should note that all the studies the review identified on trapping came from the US, which use trapping methods not permitted in England. The only type of trap which is legal for beavers in England is the Bavarian beaver trap, for which the review found no studies.

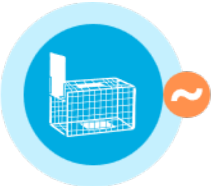
In the studies reviewed, live trapping was generally carried out using Hancock traps and/or snares. Scientific evidence suggests that both of these traps have a low capture rate (42, 44, 49). Experts report that trapping is only effective in the short term, as beavers will often repopulate trapped sites (34). Trapping also causes unintended mortality captured beavers at an approximate rate of 10% (50, 51). Despite this, landowners still found trapping an acceptable form of management in most scenarios (23, 24). Indeed, trapping uptake recently increased in Tayside, Scotland, partly as practitioners perceived that it was effective and partly due to a desire to reduce use of lethal control (8).

If beavers have been successfully trapped, they can be moved to a more suitable area. Transporting beavers can cause mortality, although the rate is relatively low at approximately 5% (50). Beavers are also at an increased risk of predation when they are moved to unfamiliar areas, and evidence suggests mortality rates can be high after translocation[2]. Surviving beavers often leave the designated target area, which means multiple beavers may need to be translocated for a pair to successfully establish at a desired location (50). Additionally, the translocation of kits and yearlings is generally unsuccessful – although this finding is based on limited evidence (50). Despite these challenges, beavers have been successfully translocated to target areas as part past relocation projects (50).

If beavers cannot be managed by any other method, the final option is to cull the beavers. Culling has limited success. Evidence from scientific studies suggests that beaver colonies can be successfully removed from sites, but if there is a local beaver population, beavers often re-establish at the culled site (52). Landowner opinion on the

[2] Most evidence on the mortality of beavers after translocation is from the USA, where there are more apex predators that hunt beavers (coyote, bears, etc) than in Britain. Post-translocation mortality may therefore be lower in the Britain than the USA.

efficacy and acceptability of culling is divided, with landowners reporting that culling generally resolves beaver-related impacts but is unacceptable in most scenarios (23, 24). Of note, initial evidence suggests that culling is not cost-effective compared with other forms of management, such as culvert protection and flow devices (52). This is likely because culling is a short-term solution and requires sustained efforts as beavers recolonise no tolerance sites.


Trapping


Translocation


Culling

Readers in England should note that trapping, translocation, and lethal control are strongly discouraged by Natural England's licensing regime and are considered a last resort.

Guidance on the use of these interventions can be found here: Protection and management of beavers in England.

Mitigation of the impacts of development on beavers

No evidence was found on how best to mitigate the impact of development on beavers, aside from one study that showed that exclusion fencing and stock guards can reduce fatalities of coypu on roads (53). This review can therefore make no conclusions about whether ecological mitigation and compensation measures work for beavers based on such limited evidence. This evidence gap should be addressed through future research.

Management of water systems

During beavers' absence from Britain, humans have made significant changes to natural waterways. Humans have drained areas of land below sea level, built on flood plains, and developed complex water infrastructure systems. As beavers are reintroduced or return to these highly modified landscapes, humans need to be able to continue to manage water at catchment scales. However, since modern systems of water management have not coexisted with beavers in Britain, the effects of these systems on beavers are unknown.

There are potential adjustments water managers can make to reduce the impacts on beavers. Evidence suggested that that the timing of water level fluctuations is crucial. Researchers recommend spreading water level changes out over a longer period of time to make changes less abrupt (54). Researchers also recommend timing water changes so that they did not exacerbate natural fluctuations. In addition, data on muskrats showed that where human alteration of water levels was unavoidable, riparian buffers significantly improved the chance of muskrat survival because it gave them land to escape to when water levels were raised (55). Beavers have similar behaviour to muskrats and riparian buffers could help reduce the impact of water fluctuations on beavers.

Summary

Overall, the evidence presented in this review improves our understanding of beaver management and highlights areas where evidence gaps remain. The findings of this review can be used alongside prior reviews on beavers and their impacts, as well as insights from practitioners, to inform future management decisions concerning beavers. Natural England hopes this will help to support successful co-existence between humans and beavers.

Further reading

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