Briefing Paper

Reintroducing Beavers into the UK

The European beaver (*Castor fiber*) was once widespread across Eurasia. However, by the beginning of the twentieth century, over-hunting had resulted in its elimination throughout most of its original range (including the UK), leaving just eight remnant populations. These populations later gained legal protection, and the first reintroduction scheme took place in 1922. To date, over 19 countries across Europe have reintroduced beavers. The only countries within the beaver's natural range now without surviving or reintroduced beaver populations are Britain, Portugal, Italy and some south Balkan countries (Halley and Rosell, 2002). As a result of this long history of reintroductions, a wealth of expertise and experience exists.

Beavers are highly territorial rodents, living in family groups of typically 3-5 individuals. They are crepuscular (active at dawn and dusk) vegetarians, feeding predominately on herbs, semi-aquatic plants and bark. Unlike many rodents, beavers only mate once a year, and have a typical litter size of 2-3 offspring. Juveniles leave the family territory in their second spring, to acquire their own territory. The territory size typically ranges from 1 to 7 km; depending on availability of food.

Beavers are variously described as 'ecosystem engineers' which modify the structure of ecosystems (Jones *et al*., 1994) and as 'keystone' riparian species (Collen and Gibson, 2001) which, through their presence and activities, increase biodiversity and modify the surrounding ecosystem. Beavers alter their environment by building dams, lodges, food caches and bank-side burrows, by felling trees and by altering the hydrology of catchments and floodplains.

The EU Habitats Directive requires member states to consider the desirability of reintroducing certain species, among them the beaver, due to its great ecological importance. Beavers are believed to be an important component of healthy, functioning rivers, wetlands and riparian woodlands. However, they have been absent in England since the 12th Century (Macdonald *et al*., 1995) and in Scotland since the 16th Century (Gaywood, 2001), significantly longer than most of other European countries. Changes to our landscape, flora and fauna during this time may have reduced the suitability of beaver occupation to the UK, and it is certain that many human activities (floodplain forestry, riparian built infrastructure and land use, etc.) would be significantly affected by the activities or established populations of beavers.

Potential Ecosystem Benefits of Beavers
Beavers could provide potential ecosystem benefits via;

Felling trees, which:

- Thins and opens up patches of riparian forest, allowing more light to reach the woodland floor, and thus encouraging a more diverse range of ground flora and fauna (O'Grady, 1993)
- Increases coarse particulate and dissolved organic matter entering rivers, which increases invertebrate densities by providing additional food through fungal and microbial pathways (Naiman *et al*., 1984).
- Increases nesting opportunities, in standing and fallen woody debris, for species of birds and bats (Collen and Gibson, 2001).

Damming, which produces beaver ponds which can:

- Stabilise water flows, migitaging the negative effects of extreme flow conditions by storing water in the wetlands areas that are created, and also reducing erosion in runoff events (Parker, 1986; Burns and McDonnel, 1998).
- Raise groundwater levels, creating new valuable wetland habitat (Gurnell, 1998) and potentially contributing to catchment water storage and the smoothing of low flows.
- Increase allochthonous (external carbon) sources entering the watercourse, thus increasing nutrient levels (France, 1997), which provides better feeding opportunities for birds, fish and mammals.
- Ameliorate stream acidity, improving water quality for fish (Cirmo and Driscoll, 1993).
- Reduce bank erosion and bed scouring (Parker *et al.,* 1985).
- Increase sediment removal from the water (Naiman *et al*., 1988).
- Increase pollutant and nutrient removal from the water (Cirmo and Driscoll, 1993).
- Encourage sorting of bed sediment (Gurnell, 1998).

Excavation of lodges and burrows provides:

- Shelter for otters, water voles and water shrews (Schwab, *pers. comm.*).
- Habitat mosaics by diversifying river bank structure (Naiman *et al*., 1988).

Potential Benefits to Fisheries

Beaver ponds can increase densities and species richness of trout and coarse fish by providing refugia from low flow and enriched feeding opportunities (Schlosser, 1998; Snodgrass and Meffe, 1999). Research has shown this increase in lentic habitat can benefit both juvenile trout, which have a strong affinity with pool environments, and large migrating adult salmonids and resident trout, as the ponds offer important refugia (Collen and Gibson, 2001).

The felling of trees by beavers can also increases woody debris, leading to increased invertebrate diversity and biomass, which could subsequently lead to better fish growth rates. The debris cover, provided by the lodge and food cache, has also been shown to attract some fish species including salmonids and percids (Collen and Gibson, 2001).

Potential advantages flowing from the presence of beavers within a catchment for salmonids include:

- The deeper water in beaver ponds provides important juvenile rearing habitat (Scruton *et al*., 1998), as well as important habitat for adults during the winter (Cunjak, 1996) and in times of drought (Duncan, 1984)
- The presence of dams reduces siltation of spawning gravels below the impoundment (Macdonald *et al*., 1995).
- Greater food availability has been found to increase growth rates of juvenile life stages (Murphy *et al*., 1989).

Potential Conflicts with Fisheries

The reintroduction of beavers also has the potential to cause a number of conflicts with the UK's native fisheries, including:

- Disruption to upstream and downstream migration of fish, including salmonids. Research on the closely-related North American beaver (*Castor canadensis*) has shown that some dams can temporarily limit adult and juvenile fish migration, particularly during low water flow (Alexander, 1998; Cunjak and Therrien, 1998). In Lithuania, rapid population growth has lead to increased beavers dams, resulting in increased disturbance to fish migration (Ratkus, 2006). 'Trapped' fish may also become more vulnerable to predation and/or poaching.
- The formation of dams reduces stream velocity and increases silting upstream of the dams, which can reduce available spawning habitat (Knudsen, 1962: Halley and Lamberg, 2001) and alter the distribution of riffles and runs, the salmonids' preferred habitat (Mitchell and Cunjak, 2007), resulting in reproductive disruption to anadromous salmonids. Selective felling may also reduce the species composition of

leaf litter entering streams, which could alter insect fauna and, consequently, the nutritional base for juvenile fish (Collen and Gibson, 2001).

- Changes in the temperature regime may also perturb salmonid populations. Increased temperatures found above and below the impoundments may be suboptimal for salmonids, and are likely to reduce dissolved oxygen levels (Avery, 1983). The reduction of bankside vegetation and the associated shade can also result in increasing water temperatures, which could be damaging to salmonid populations, particularly in light of climate change.

However, some evidence from our European counterparts suggests anglers have little concern with the effect of established beaver populations on migratory fish. In Norway, beavers share the same watersheds with some salmon and trout fisheries. Here, populations of hatchling salmon have been recorded above a series of beaver dams up to 1.6m high and over 600 metres in length, suggesting the passage of adult fish (Halley and Lamberg 2001). Other studies have shown juvenile salmonids are able to pass over or through dams to continue their downstream migration (Bryant, 1964; Swanston, 1991; Alexander, 1998) and adults use side channels created by the diverted flow to bypass dams.

Parker and Ronning, (2007) believed that, due to the low frequency, small size and short life-span of the beaver dams on spawning tributaries in Norway, their effect on upstream and downstream migration of salmonids was negligible, and should have little impact on the reproductive success of salmonids in the long term. This is supported by Pacific and Atlantic salmon experiences in North America (Collen and Gibson, 2001).

The problems associated with dams are not always permanent; for example, the removal of the dam will result in the sediment being scoured away again. Also, research suggests that not all beaver families build dams; for example, in 2003, on the Numedalslaget River system in Norway, beavers in only 5 out of 15 territories built dams (Parker and Ronning, 2007). This is because, when available and unoccupied, beavers strongly prefer slow and wide habitats which do not require energy being expended on dam construction (Halley and Rosell, 2002). Great Britain, particularly to the east and south, lacks the steep topographies and also dense riparian tree cover of Nordic countries, and may therefore promote non dam-building life habitats in established beavers. Beavers are also highly territorial, and so densities are controlled and few dams are functional at any one time (Cook, 1940).

Research suggests the view that beaver dams are routinely impassable for anadromous species is now untenable. The interference of dams on fish movements are site specific and complex, depending on dam formation, size and location as well as river flow and season (Halley and Lamberg, 2001;Rosell *et al*., 2005).

Other Problems with Beaver Reintroduction

Ninety-eight percent of all beaver conflicts are within a 20 metre zone around the watercourse (Schwab, *pers. comm*.). Other common beaver-human conflicts include (Richard, 1985):

- Agricultural: beavers feeding on cultivated crops; farm machinery falling down excavated burrows and lodges; and debris blocking culverts and drains.
- Forestry; the felling of valuable trees.
- Water Management: damming of watercourses leading to flooding; tree felling in navigational and recreational watercourses; and the excavation of the banks of reservoirs, dams or dikes. The wash-out of a beaver dam in storm conditions could also result in a potentially damaging flood/sediment pulse moving downstream.
- Reduced public access to water bodies due to fallen wood debris and excavated ground.

Bavarian Case Study

The Bavarian beaver population was reintroduced between 1966 and the early 1980s and, by 2007, had grown to 12,000 beavers. The increasing population has lead to growing numbers of beavers settling in areas heavily used by humans. Bavaria now employs a site-specific beaver management programme to minimise conflicts. This involves measures to change land use, compensate for damages, and permits to remove obstructive dams or problem beavers (Schwab and Schmidbauer, 2001). The establishment of a 20 metre wide natural vegetation zone along waterways is recommended, where possible, to prevent problems with beaver feeding damage (Nolet and Rosell, 1998). This 'buffer zoning' of riparian habitat will have its own associated sets of environmental benefits. In addition, wire meshing or sand painting is applied locally to protect individual trees (Richard, 1985). Trapped beavers are exported for reintroduction programmes, or to zoos and wildlife parks. However, as this reintroduction has been very successful, most of the ca.500 animals trapped per year are now killed after trapping.

Management of Beaver Reintroduction

The reintroduction of beavers into some catchments in the UK is strongly supported by other conservation organisations, and could greatly benefit our river ecosystems. However, reintroducing beavers into areas with a high human population density or into managed landscapes would require specific management. Experience suggests that containing beaver populations between catchments is relatively easy and achievable, but containing populations within one part of a catchment is much harder (Halley and Rosell, 2002).

This leads us to conclude that controlled research is a priority, with the full cooperation and involvement of fisheries and other potentially affected societal interests, to assess the overall effects of beavers on significant salmonid rivers. This is consistent with the Precautionary Principle.

If potential adverse affects are found, the S&TA would when support limited trial reintroductions into non-significant salmonid catchments. We feel that the trials should be targeted at catchments with water quality/quantity issues, where the benefits of beavers are likely to be the greatest and their impact could be properly monitored and assessed. Riparian owners must not only be in agreement with the trial reintroductions, but also be active partners in the programmes with ongoing engagement in the process and its evaluation.

It is of paramount importance that a comprehensive management strategy, with stakeholder engagement, be put into place before any trial reintroduction. The strategy must include:

- Measures for beaver removal/culling if the animals spread beyond the agreed area or if adverse impacts, including jeopardy to fisheries, are found during the trial.
- Measures for dam regulation or removal; many UK Rivers have large parts of their catchment constrained by reservoirs to moderate spate events. Therefore, unlike rivers with natural flow regimes, which may have high flows and velocity during spate events, many UK Rivers may not have sufficient power to remove beaver dams.
- Rigorous and consensual success criteria established by all stakeholders well in advance of the trial reintroduction'
- Mechanisms to remove all beavers at the end of the trial if the trial is deemed unsuccessful. If trial is success, measures put in place to control dispersal and abundance.
- Identified long-term funding resources and personal to successfully manage trial reintroduction. Ongoing management will be required, as removed dams are likely to be rebuilt and juvenile beavers when migrating to a new territory may go outside the agreed area.
- Identified funds to regularly monitor and assess the impacts of beavers. This monitoring may be most successfully achieved via a PhD project; assessing the impacts of beavers reintroduction, specific to the UK's intensively managed countryside.
- A commitment to adaptive management to respond to unforeseen events, emerging knowledge, changing public opinion or policy drivers during the lifetime of the project.
- Public awareness campaigns to notify the general public that the trial reintroduction is to assess the function and suitability of beavers in the UK, and reintroduction will only take place under a comprehensive management strategy. The strategy will include a culling programme to control number of beavers if it is deemed necessary. This is important as the beavers no longer have any natural predators in the UK.

Conclusions

Beavers have the potential, in certain areas, to bring benefits to the ecology of our watercourses. They can have positive impacts on geomorphology, nutrients, sediment, biodiversity, and could help offer flood protection. The reintroduction of beavers has the ability to achieve many targets under current political drivers such as WFD and the Habitat Directive.

Conversely, beavers could adversely affect some environmental issues important to fisheries and the functioning of river ecosystems, and impair migration routes to and from spawning and juvenile habitats for salmonids and other migratory species. The Atlantic salmon is already protected under European legislation, and it is our obligation to help restore and conserve our native populations. Further questions arise as to the feasibility of reintroducing beavers into our heavily managed and densely populated landscapes.

The practicality and benefits of reintroducing beavers will depend on the location and topography of the local area. We therefore believe that trial reintroduction should only be considered on a catchment basis, and in conjunction with a comprehensive management plan and funding stream. The trial should weigh up the environmental benefits provided by beavers against the potential damages, which may span fisheries, forestry, agriculture. These parameters, together with the associated costs of beaver management, must be determined before any further introductions are implemented.

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