

Beavers are back in the UK and they will reshape the land

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It has been 400 years since Britain was home to beavers. Now they have returned, and they are rapidly proving their worth

With only GPS coordinates and my phone as a guide, I arrived at my bucolic destination: an unnamed road in the middle of Devon in southwest England, lined with thick hedges, low-hanging trees and open pastureland for miles around.

On a June morning with a thin cover of cloud above, I was here to meet Richard Brazier, an environmental scientist from University of Exeter, and his post-doctoral colleague Alan Puttock. They are running a one-of-a-kind outdoor experiment.

After a short walk through fields and hopping over rusty gates, we came across the 3-hectare plot of land, contained behind a 12-volt electrified fence.

The electric fence put up to keep the beavers in (Credit: Alex Riley)



Five years ago, tall trees such as birch, aspen, and the occasional oak filled this small space, all lining the trickle of a highland stream. The thick canopy cast a shadow on the plants below, sapping the life from their leaves.

The biodiversity is booming

Today, things have changed. The undergrowth is overgrown. Lopsided willow trees dominate, sending hundreds of shoots and stems into the air, each pining for the light above. A thick blanket of green foliage erupts from the peaty soil.

Flora is blossoming, fauna flourishing. With their long cascade of pink bells, foxgloves rise high from the purple moor grass below. Butterflies and bees flutter from flower to flower.

"The biodiversity is booming," Brazier tells me as we approach the wire fence through a field of coarse grass and rushes. "It's alive."



Behind this fence, every species – plant and animal – depends on the behaviour of just one: the Eurasian beaver. Since their introduction in March 2011, a breeding pair of these large rodents has been as busy as, well, beavers.



To walk through this maze of low-hanging willow is to walk back through time
They have raised a family. They have built a lodge to live in and gouged deep
canals through the land for getting out and about. And, of course, they have chopped

down trees and built a series of 13 dams from sticks and mud. The woodland stream has been, and is being, transmogrified into wetland.

It is easy to see why beaver are known as "ecosystem engineers". But it is Brazier and Puttock's task to find out what these large rodents are engineering exactly.

Although small in size, this site has huge importance. What the pair concludes from their studies here may help decide the fate of the charismatic beaver across the UK.

To walk through this maze of low-hanging willow is to walk back through time. A few centuries ago, beavers were bountiful across all of Europe and parts of Asia, numbering up to 400 million individuals.

"When this animal existed in the tens of millions in Western Europe and Eurasia, it was a dominant landscape force, in the way that wind and water and fire are," says Derek Gow, a beaver and water vole consultant from Devon.

These beaver populations are still far from wild

Then they were trapped and killed for their luxurious pelts and their castoreum; waterproofing oil they secrete from two sacs near their genitals. Catholics even ate beaver as a replacement for fish.

Localised – but extensive – extinction followed. British beavers were the first collective casualty. The last beaver on the islands was shot in 1526 in Scotland.

Centuries passed, the beaver's influence on the land washed away. Then the species that caused their demise decided to aid in their recovery. Starting in 1899, moratoriums were established. Three decades later, individuals from the eight surviving populations – in France, Belarus, Germany, Mongolia, Norway, Russia, and China – were reintroduced into new areas and into beaver-less countries nearby, planting the species in fresh lands like sown seeds.

The remnant population in Norway, for example, grew from a precariously low 100 or so individuals in 1880 to 7,000 by the 1930s; not only providing ample numbers to spread across the country, but also for reintroductions into neighbouring Sweden and nearby Finland.



Across Europe and Asia beaver populations took root and grew, bolstering the species as a whole. And over the last decade – over 400 years after the last of the UK's native beavers vanished – the species was reintroduced into catchment sites in Scotland and in Devon. Both trials are ongoing, and have returned parts of Britain to a state that otherwise exists only in distant memory.

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Although these reintroduction efforts are considered a form of landscape "rewilding", these beaver populations are still far from wild.

Before they could be accepted back into the country, every individual had to be checked for the rare tapeworm *Echinococcus*. If passed on to a dog, then a human, this intestinal parasite could make someone very ill, or even kill them.

And even though tuberculosis actually afflicts badgers, the beavers were checked for the disease, Brazier tells me. "Beavers. Badgers. In some people's minds it's the same animal or it will represent the same risk to their livestock."

All medicals were, as expected, negative.



Although a valuable test of public acceptance, these large-scale trials – covering huge swathes of land – are hard to monitor. That is where Brazier's experiment, supported by the Devon Wildlife Trust, comes in. This is no trial, but a carefully controlled experiment. It is both a field site and a test tube.

"Elsewhere around the world, you just haven't had the level of control that we've got here," Brazier tells me. "That's good for the science. It means that the results you come up with are absolutely related to what the beavers have done, and then you can start to extrapolate from that."

These things are so strong that they just become part of the topography

Although they are fenced in, there have been no recorded attempts of a great escape by the resident rodents. "It could be argued that a lot of money was spent on this for no reason," Brazier tells me as he kneels down next to the fence.

The homebody beavers are instead content to gnaw on willow trees from dusk until dawn, within the confines they have been allocated. By coppicing these trees, beavers promote new shoots to form on old trees.

It is an old relationship. Humans have been coppicing willow for 8,000 years in the UK, but beavers have been doing it for around 10 million years (<http://www.bbc.co.uk/earth/story/20160727-extinct-giant-beavers-made-stone-corkscrews-instead-of-dams>).

Not only does the willow get a new lease of life, but beavers benefit too. When placed within their dams, willow shoots continue to grow, creating a natural and self-reinforcing building material.

"These things are so strong that they just become part of the topography," Brazier tells me as we stand on one of the largest dams at the site. "It just becomes part of the landscape."



Within each pond, thin-stalked rushes, water lilies, and sphagnum moss provide shelter for a menagerie of invertebrates under the slowly moving surface. And although I did not see them, larger animals have started to return also.

Kingfishers have been spotted. Before beavers were introduced, only five clutches of frogspawn were recorded. Last year's surveys revealed over 550. That is good news for herons. The birds are often seen wading through the shallows, plucking frogspawn from the water's surface.

You can even see it on your phone if you want to check whether it's raining and whether it's flowing at this site

The biological benefits are as obvious as the tooth marks that dent the surrounding stumps and branches. Brazier's interests, however, lie beneath our feet. How do beavers, and their dams, impact a once free-flowing stream?

For this, he and Puttock have help from an array of high-tech gadgets. At the top of the stream, above the beaver dams, a large piece of plastic with a V-shaped hole sits in the stream. This allows the amount of water flow to be measured accurately and, importantly, compared to another V-notch 590ft (180m) downstream, below the beaver dams.

"Flow in, flow out," Brazier says like an ecological mantra throughout the day. By comparing these two volumes during heavy rainfall, the researchers can assess the movement of water through the experimental site.

And they do not have to get wet to do so. The data – rainfall, flow in, flow out – is automatically beamed to their offices at the University of Exeter using an on-site satellite and 3G connection, all powered by a small solar panel.

"You can even see it on your phone if you want to check whether it's raining and whether it's flowing at this site," Brazier says.



When the system was first installed in 2011, the readings that came back were very unusual. Without a drop of rain, the water levels had steadily increased over a matter of hours. Was the rainfall meter – a vertical post that catches water just like a small bucket – broken?

Not quite. With the sound of trickling water over the V-notched channel, the beavers' innate behaviour had taken over. They had dammed the equipment, raising the water levels overnight.

Beavers dampen any hydrological extremes, reducing the peak flow of water and making it stay longer in the area

It was a simple fix. Although adept at climbing onto felled trees, beavers struggle with a metre-high mesh fence. Without such impediments, the water and the data has flowed in for the past five years.

As one would expect, beaver dams slow the flow of water dramatically. "Where water would travel 180m in tens of seconds at maximum velocities, now you've got a

situation where that water's taking hours if not days to move through this site," says Brazier. "And it can only be attributed to these dams."

Beavers dampen any hydrological extremes, reducing the peak flow of water and making it stay longer in the area. In contrast, the drainage ditches that line the surrounding fields sweep rainfall downstream in a flash.

Flooding occurs. Water from headwaters accumulates quickly when the land levels off, not only breaking the banks of rivers but also the bank accounts of many homeowners. The infamous UK floods of 2007, for instance, caused an estimated £6 billion of damage.



British rivers like the Thames are prone to flooding (Credit: Martyn Goddard/Alamy)

Beaver can help, Brazier says. By slowing the flow – while storing 650,000 litres of water on the site – these mammals are a natural method of flood prevention, before the flood has even started. They can protect our homes, by building their own.

And by mastering the art of imperfect engineering, beavers also stem downstream droughts. The dams are not watertight. Water is slowed and stored, yes, but it is not stationary and made stagnant. "It's so slow," says Brazier, as he points out how each pond is a metre lower than the one before. "It's like a big escalator staircase with water gently moving through."

As the water slowly filters through each mesh of willow branches, rush reeds, and mud it is also, well, filtered

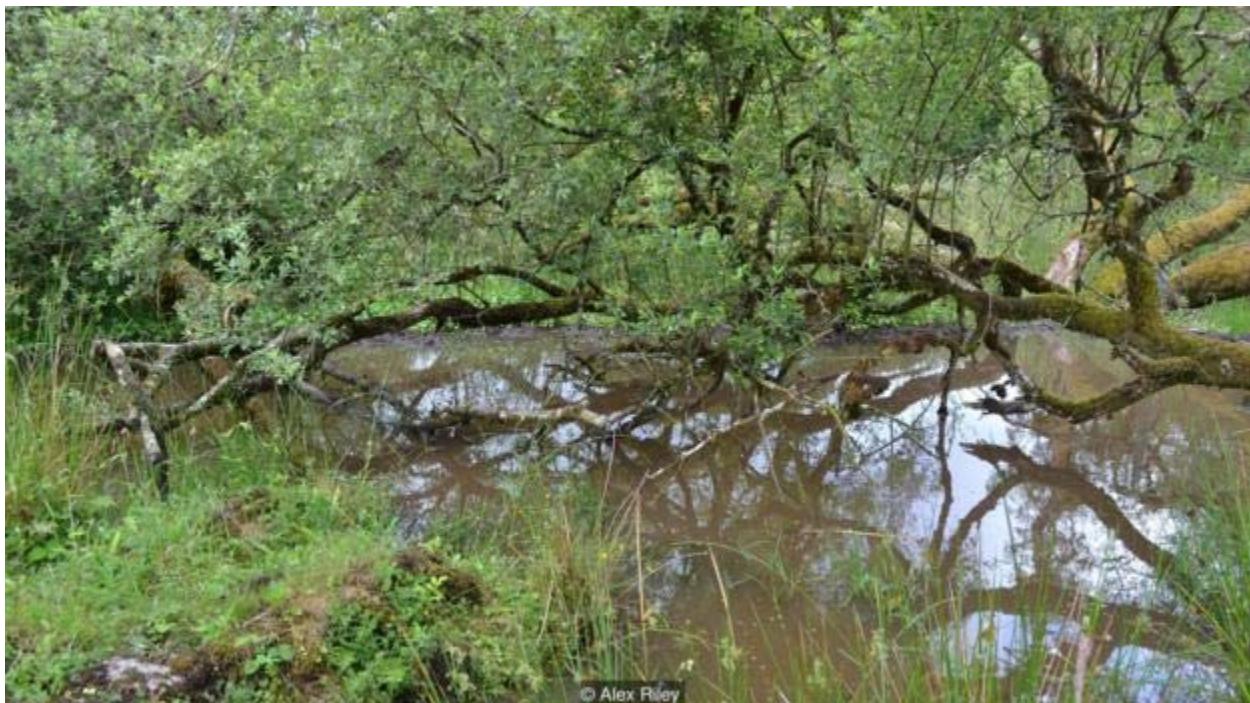
"The way I see it," Puttock adds, "if we were put in here with all the tools we like to engineer the site to this level, or to store this much water, or to slow down water this much... I don't think we could do it."

Next to the V-notch channel, Puttock shows me a tool he uses on site. It is a cream-coloured water pump that looks like a small compost bin. When a pressure gauge detects a 1cm increase in water level, water is siphoned up from the stream through a

reinforced tube (because beavers) and stored for analysis in 1-litre bottles that sit on a rotating wheel at the pump's base.

Unlike the rainfall and flow data, these water bottles have to be collected by hand and by van. After driving back to the lab at Exeter University, Puttock has been testing the water for certain agricultural pollutants – nitrates, ammonia, phosphorus – as well as the amount of sediment within each sample.

The results have revealed something extraordinary: what goes in does not come out. As the water slowly filters through each mesh of willow branches, rush reeds, and mud it is also, well, filtered.



"The landscapes [beavers] make are like kidneys," says Gow, who was not involved in the research. "If you've got a landscape that's polluted, that's full of nitrates, silts, and other toxic runoffs, then they stop this rubbish going into the drinking water supplies and out to sea."

It's like a big escalator staircase with water gently moving through

Instead, the pollutants remain within the wetland habitat, where they fertilise the plants within the ponds and surrounding soil. Further, with less sediment seeping downstream, beaver activity creates unclogged streams, perfect conditions for fish spawning and for one of the most endangered aquatic species in the UK and Europe – the freshwater pearl mussel.

"The more you look at beavers, the more you understand the other species that exist in the habitats they create," adds Gow. "Beavers are basically the generators of life."

"The story so far has been massively positive," says Brazier about his exclusive plot. Elsewhere in the UK, however, not everyone holds the same view.

Without the necessary management plans, landowners and farmers are often hesitant to accept the idea of an animal that can cause localised bogginess and standing water. The situation can get nasty. Earlier this year, at least 23 beavers (some

pregnant, others with young kits) were shot and killed by landowners in Tayside, Scotland.

Beavers are basically the generators of life

Meanwhile, fishermen believe that beaver dams impede fish stocks, reducing their catch.

In 2012, Paul Kemp from the University of Southampton investigated this issue further. Poring over 108 studies from 1930 to 2011, he found 184 benefits and 119 costs of beaver dams. "It's certainly not straightforward, it's complex," Kemp says. "It's ecology and everything in ecology is always complex."

Out of those negatives, the most common and most logical was the blockage of migrating fish by beaver dams. Scrutinising further, however, Kemp found nearly 71% of total drawbacks were not backed by quantitative data. They were based on speculation, not hard stats.

Where evidence is available, the benefits greatly outnumber the negatives.



"In many cases, what you have is an increase in the heterogeneity – the diversity, of habitat," Kemp adds. "Then you can get increased abundance of fish in those areas. And when the rains come, [the dams] are quite passable under the high flow."

He nearly fell off the river bank laughing at the idea that beavers were a bad thing for game fishing

Kemp's words are backed by a study published in July 2016 in the journal Scientific Reports (<http://www.nature.com/articles/srep28581>). After surveying steelhead salmon in 20 miles (32km) of Bridge Creek catchment in the US, Nicolaas Bouwes from Utah State University and his colleagues found no evidence that the building of beaver dams blocked the fish's upstream migration routes.

As they wrote, "several spawners were documented as having passed more than 200 dams or simulated beaver dams [made from wood posts and weaved willow] during their migrations."

After asking one of the researchers from Bridge Creek whether fish stocks had been reduced, Gow recalls a memorable response from a few years back. "He nearly fell off the river bank laughing at the idea that beavers were a bad thing for game fishing. He said it was completely the opposite."

As Brazier tells me, the problem is often built on ignorance.

Why would you bother by law restricting this native species?

When news broke of beavers inhabiting the River Otter in Devon in 2009, one local landowner was worried that they would eat all the fish. "Of course, they're herbivores," says Brazier.

He thinks C.S. Lewis's *The Lion, The Witch and the Wardrobe* helped convince people otherwise. "[But] it's a fairy tale. You've also got a lion that speaks and a white witch."

"[Lewis] has a lot to answer for," adds Puttock.



When it comes to their work, Brazier and Puttock are not interested in such debates.

"Whatever our personal views, we're trying to be objective here," says Brazier. "And then people can take that evidence and hope make some better decisions."

"But if the data we've seen here are representative of the wider story, i.e. benefits are basically all positive, why would you keep the fence up?" he adds. "Why would you bother by law restricting this native species? It doesn't make any sense really."

A beaver is not just an animal. It is an ecosystem

On my visit in June, I did come across one con. It is not only beavers that like wetlands: so do biting insects such as horse flies. Still, it seems a small – and localised – price to pay for cleaner water and flood prevention.

As noon approached, Brazier, Puttock and I made our return trip back along the electrified fence, in silence. If we were quiet, Brazier told me, we might be able to see the resident rodents. Hushed, with only the sound of our boots on coarsely-cut grass and the swish of waterproof trousers, we walked slowly towards their lodge.

Nothing. They were hidden underneath their mass of logs, sleeping in darkness as the Sun shone brightly above.

But, in a way, we had seen the beavers. Their presence extends far from their furry bodies and sharp, orange-coloured teeth and into the ecosystems they create and continually nourish. The coppiced willow, the beds of rushes, and the insects all around are all dependent on this one species, this keystone of ecology.

A beaver is not just an animal. It is an ecosystem.

Before I left, Brazier gave me a souvenir: a small stick of willow, chewed at both ends by a beaver. In the future, people across the UK may be able to collect their own.