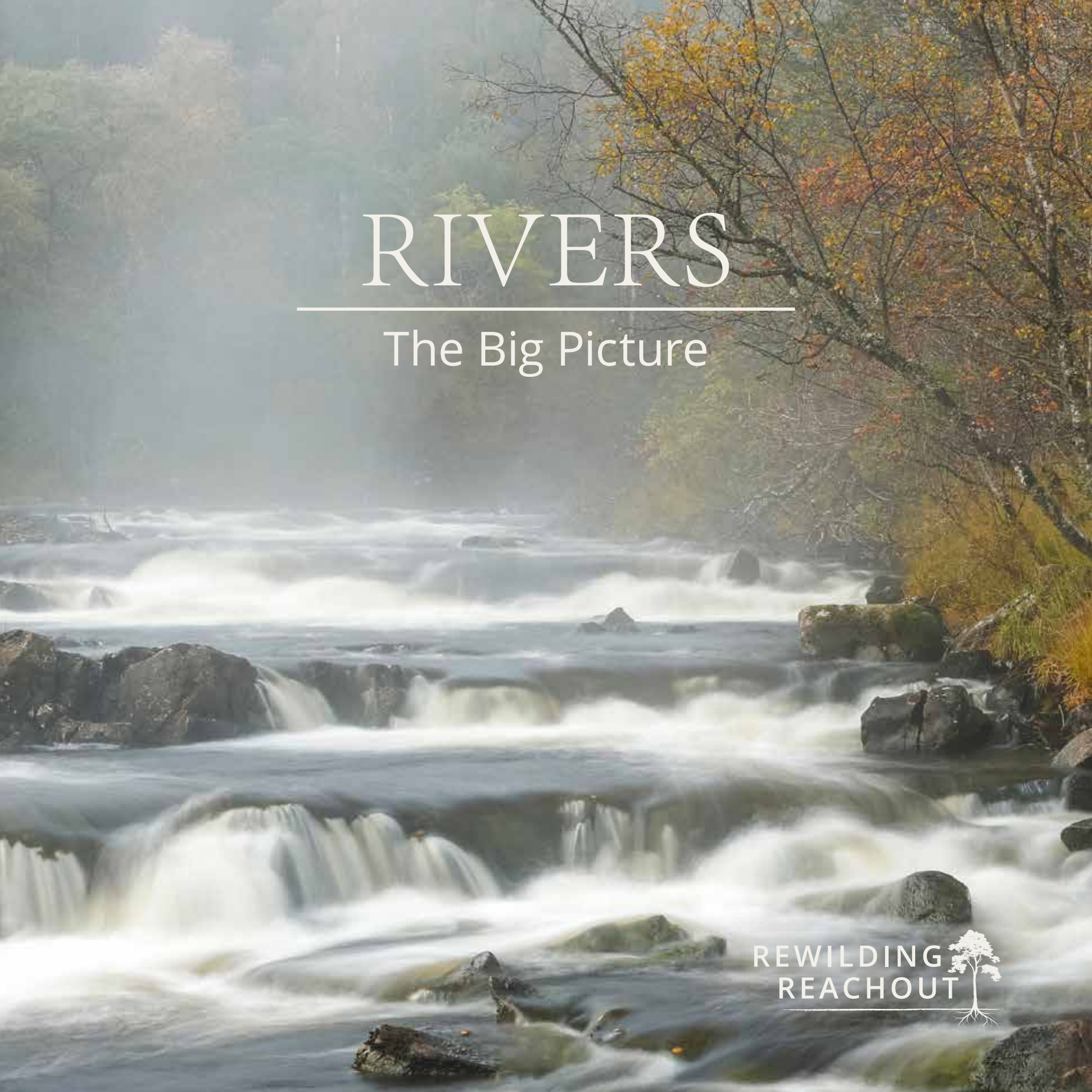

RIVERS

The Big Picture

REWILDING
REACHOUT









SCOTLAND: The Big Picture works to drive the recovery of nature across Scotland through rewilding, in response to the growing climate and biodiversity crises.

We believe that restoring the natural living systems on which all life depends is the responsibility of everyone, and that young people's voices should be heard and valued.

Rewilding Reachout is a series of booklets, films and stories shaped by our #NextGen rewilders, a team of inspirational young people who aim to inform and inspire fresh thinking among young Scots around the potential of a rewilded Scotland.

#SBPNextGen

Thanks to National Lottery players

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Many a mickle makes a muckle

Scotland's greatest rivers are the sum of a thousand smaller streams. Like any ecosystem, a river is made up of different habitats, from clear, fast-flowing mountain streams to wide and sluggish lowland rivers. But up and down our rivers, life has been disappearing.

Freshwater species are going extinct more rapidly than any other species and, in Scotland, declining salmon numbers are a sign that all is not well beneath the water's surface.

Litter and in this case, discarded fishing lines, can have a devastating effect on a river's wildlife.

Scotland's rivers might be subject to fewer pressures than many other European waters, but they are suffering from a daunting combination of problems. Our rivers have been straightened, dredged, polluted, invaded by alien species and over-exploited to meet growing domestic and agricultural demand for water. No ecosystem can resist such relentless assaults but, in many ways, rivers are especially vulnerable: a single pollution incident, for instance, can poison miles of river downstream.

In 2021, Scotland's rivers, lochs and burns were judged to be in the worst state ever recorded, with more than 400 water bodies damaged by pollution and other problems, including stretches of Scotland's longest river, the Tay. The same assessment revealed the poor state of many of Scotland's iconic lochs, including Loch Awe, Loch Doon, Loch Katrine and Loch Leven.

How did we get into this situation?

Seeking the source

A Highland stream, tumbling endlessly down a rocky hillside, appears as something of a miracle. No mechanical pump moves water back up to the source; no human-engineered system of pipes and hydraulics works to keep the water flowing. The water just keeps coming. So, where does it all come from?

Nearly all rivers flow from a source high in the hills, travelling downhill to the sea, although not every river will complete its journey. In the US, the famous Colorado River no longer reaches the sea, with its lower stretches having dried up entirely thanks to a series of enormous dams. Perhaps only one in three of the world's longest rivers can still be described as free flowing, remaining clear of dams and other man-made obstructions and diversions. Wild water is getting rarer.

Rivers are born in the mountains because that’s where most rain falls. When air reaches a mountain, it is forced upwards, and as air rises, it cools. This cooler air is unable to carry as much moisture, and so the surplus falls as rain or snow. Soon, some of the water begins trickling downhill, while some soaks into the ground, topping up ground water or emerging under pressure from freshwater springs.

Rivulets gather into small burns, which feed larger streams, collecting more and more water to deliver into the main river stem. Eventually, the river grows wider, its flow becomes slower and it becomes a gentle, tranquil thing. However, after heavy rain, a glassy river can quickly become a raging, foaming flood.

It never rains, but it pours...

Here in Scotland, we are used to rain. Indeed, with freshwater an increasingly precious global resource, perhaps we should be grateful for our wet climate. However, climate change is making flooding more common. All the carbon dioxide we have been releasing – driving cars, heating our homes and powering industry – has enhanced the greenhouse effect. Our warming atmosphere now holds more water than it used to, and so, when it rains, it falls in increasingly intense downpours.

Scotland's abundant rainfall feeds a unique rich woodland, aptly known as 'rainforest'.

Nowhere to go

In cities, our paved streets, tarmac drives and plastic lawns leave few places for water to escape. With drains sometimes blocked by “fatbergs” (made up of cooking grease, wet wipes and other things that people thoughtlessly wash down the plug or flush down the loo), water levels can rise quickly after heavy rain.

In the countryside, problems are created when water runs off the land too quickly, causing rivers to burst their banks. This is made worse when we drain wetlands that otherwise act like a sponge, compact soils so that they absorb less water (compressing ground with heavy machinery or too many grazing livestock) or use heavy rollers to flatten out natural dips and hollows, undermining all the natural mechanisms that help slow the flow of water off the hills.

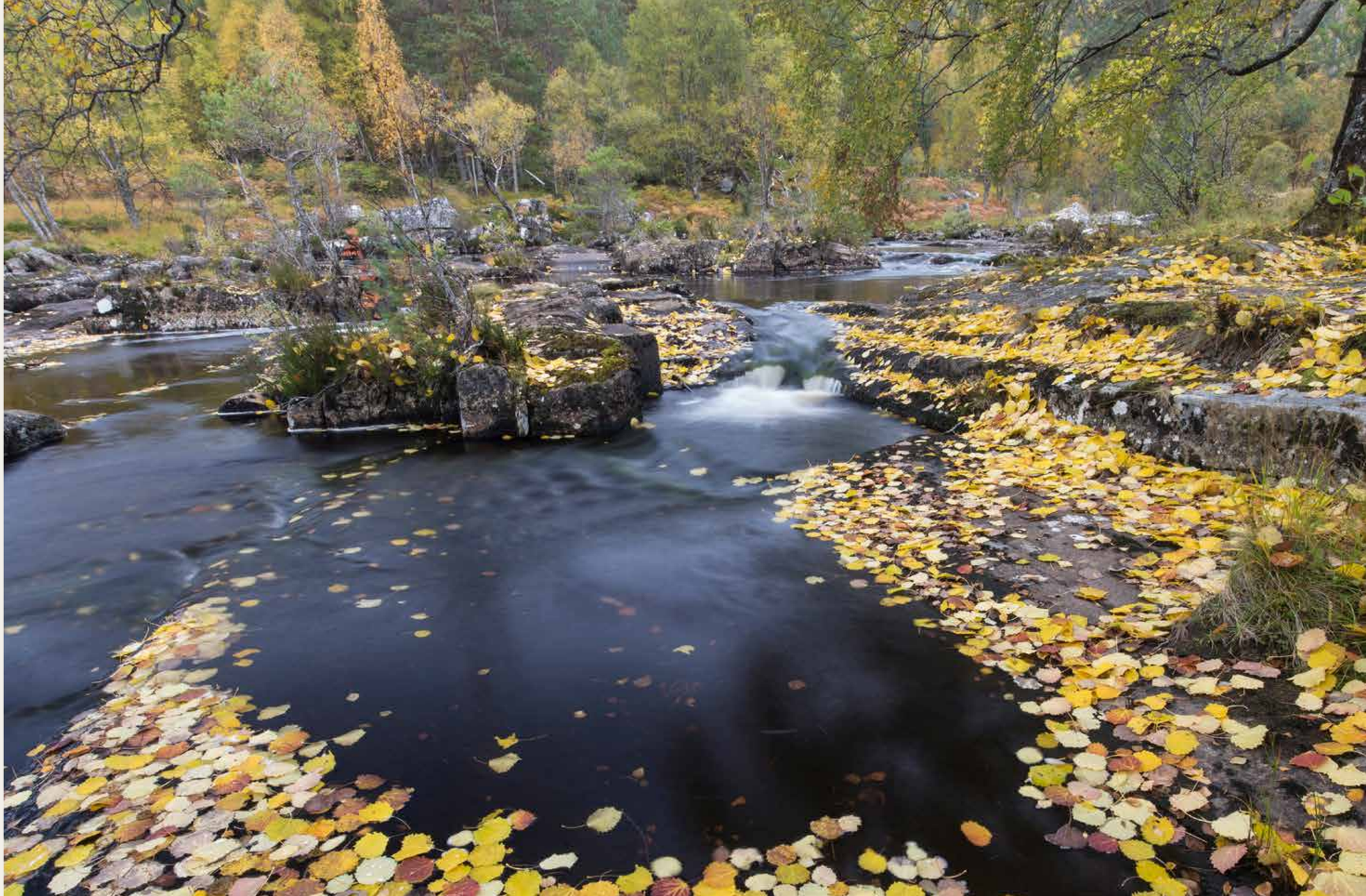
In a hurry to get water off their land, some landowners have dredged and straightened rivers. Others have dug drainage ditches, filled in ponds or mowed and sprayed old rushy pastures, drying out wet ground so that it can be more easily farmed, but also degrading the land’s natural capacity to store water. Just as bad, when we farm in ways that expose bare soil on our hillsides, earth is washed away by heavy rain, leaving the farm poorer, the land degraded, and rivers choked by silt.

Of course, we need farms and we need food. But all this re-engineering of the landscape has come at a cost – a cost to our wildlife and a cost to ourselves. Inevitably, our narrowly confined, over-burdened rivers eventually push back. All the water funnelled into our rivers has to go somewhere. And for some communities, that somewhere ends up being their town, their street or their living room.

Fresh thinking

When it comes to tackling flooding, trees might not be the first thing you think of, but they can help in lots of ways. First, trees absorb carbon, making them a great ally in the fight against climate change. But trees help in other ways too. Raindrops that land on leaves often evaporate back into the air, meaning less water reaches the ground to flood our rivers.

The roots of a tree also create little passages in the soil, allowing rain to soak into the ground rather than flowing straight into the river. And tree roots help anchor soil in place, stopping soil washing into our rivers where sediments choke freshwater life and reduce how much water a river can hold.



Well wooded waterways benefit from the shade that trees provide plus the nutrients that fall into the river from autumn leaves and the insects that live on those leaves.

Slowing the flow

Rather than doing everything possible to hasten the flow of water off our hills, it is wiser to seek ways to reduce peak flows and maintain water levels in periods of drought. One way to do this is by modifying how we use land, but nature stands ready to help us out too.

Beavers bring variety to our river systems – they can be natural allies in improving the health of rivers. Beaver dams trap sediments and agricultural pollutants such as insecticides and fertilisers that otherwise threaten a river's life. Their woody dams also slow the river's flow, holding back water during flood events, while retaining standing water during droughts. Beaver dams even lock up carbon in waterlogged ground, helping to reduce the threat of climate change.

But beavers are more than just helpful aquatic engineers. They are what ecologists call a **keystone species**, which means their activity has profound effects on a whole ecosystem. Beavers' relentless gnawing opens up the tree canopy, creating opportunities for different plants to grow into the light. These new plants support more insects, which in turn attract a wider mix of bird species, adding to overall biodiversity – the variety of living things.

Beavers also increase the abundance of dead wood, felling trees and storing leafy branches in underwater larders. This creates food and habitat for a wide range of freshwater invertebrates, which feed fish such as salmon and brown trout. And so, bringing back beavers means more fish, more birds and more insects.

Beavers mean cleaner water, less flooding, more carbon locked away and more life!

"A river doesn't just carry water,
it carries life"

Amit Kalantri

A classic study

Ecologist Robert Paine established the keystone species hypothesis in 1969, following a novel experiment in tidal rock pools in Washington State, US. Paine removed the ochre sea star (a type of starfish) from some pools while leaving other pools undisturbed, seeking to investigate the role of these mini predators in regulating their micro-worlds.

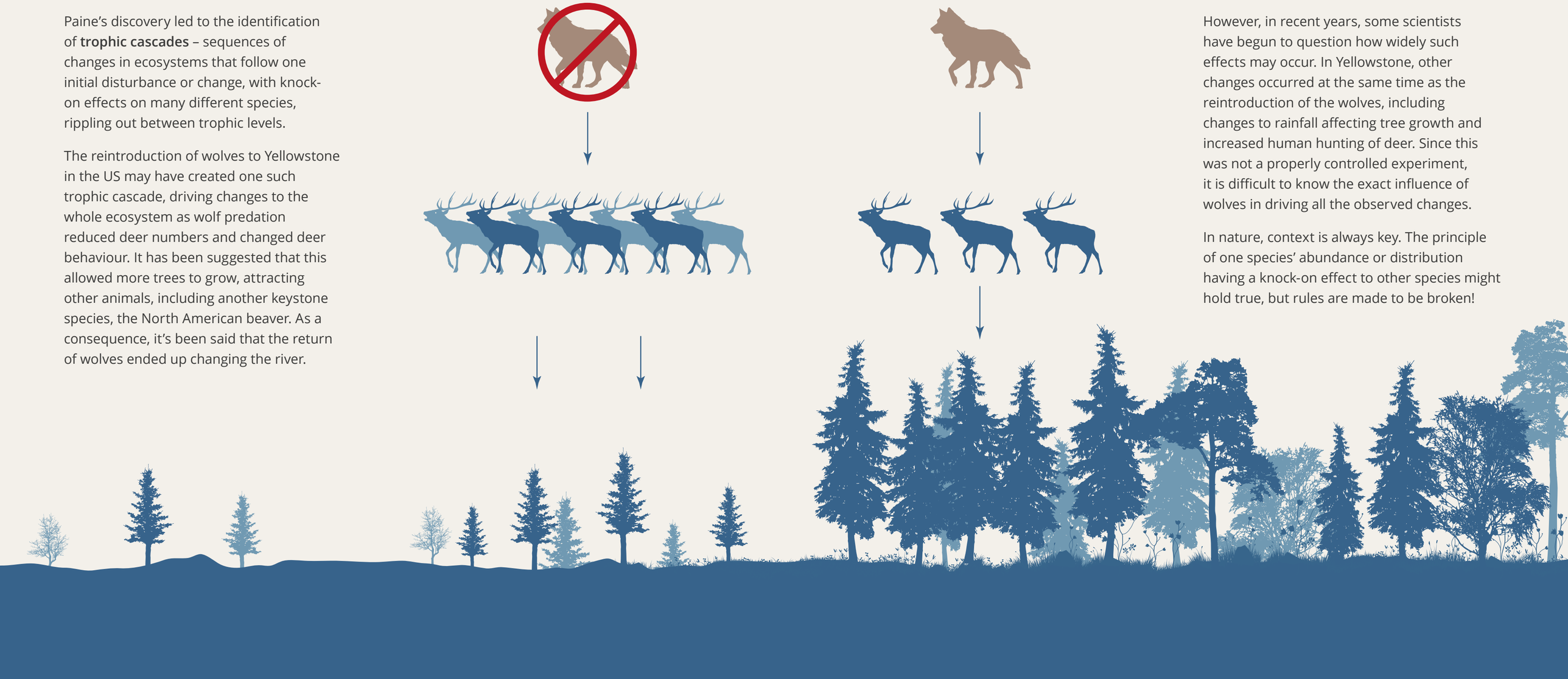
Sea stars normally eat mussels. Where Paine removed all the sea stars, the mussel population was "released" from predation, and mussel numbers quickly increased. In fact, mussels quickly overran these sites, crowding out most other species.

Although there were just a few sea stars in each pool, Paine realised they were having a huge effect in keeping their ecosystem in balance. Observing the crucial role of such special species in maintaining the integrity of whole ecosystems, Paine invented the term "keystone species", referring to the central stone of an arch that holds the whole thing together and stops it tumbling down.

Domino effects

Paine's discovery led to the identification of **trophic cascades** – sequences of changes in ecosystems that follow one initial disturbance or change, with knock-on effects on many different species, rippling out between trophic levels.

The reintroduction of wolves to Yellowstone in the US may have created one such trophic cascade, driving changes to the whole ecosystem as wolf predation reduced deer numbers and changed deer behaviour. It has been suggested that this allowed more trees to grow, attracting other animals, including another keystone species, the North American beaver. As a consequence, it's been said that the return of wolves ended up changing the river.



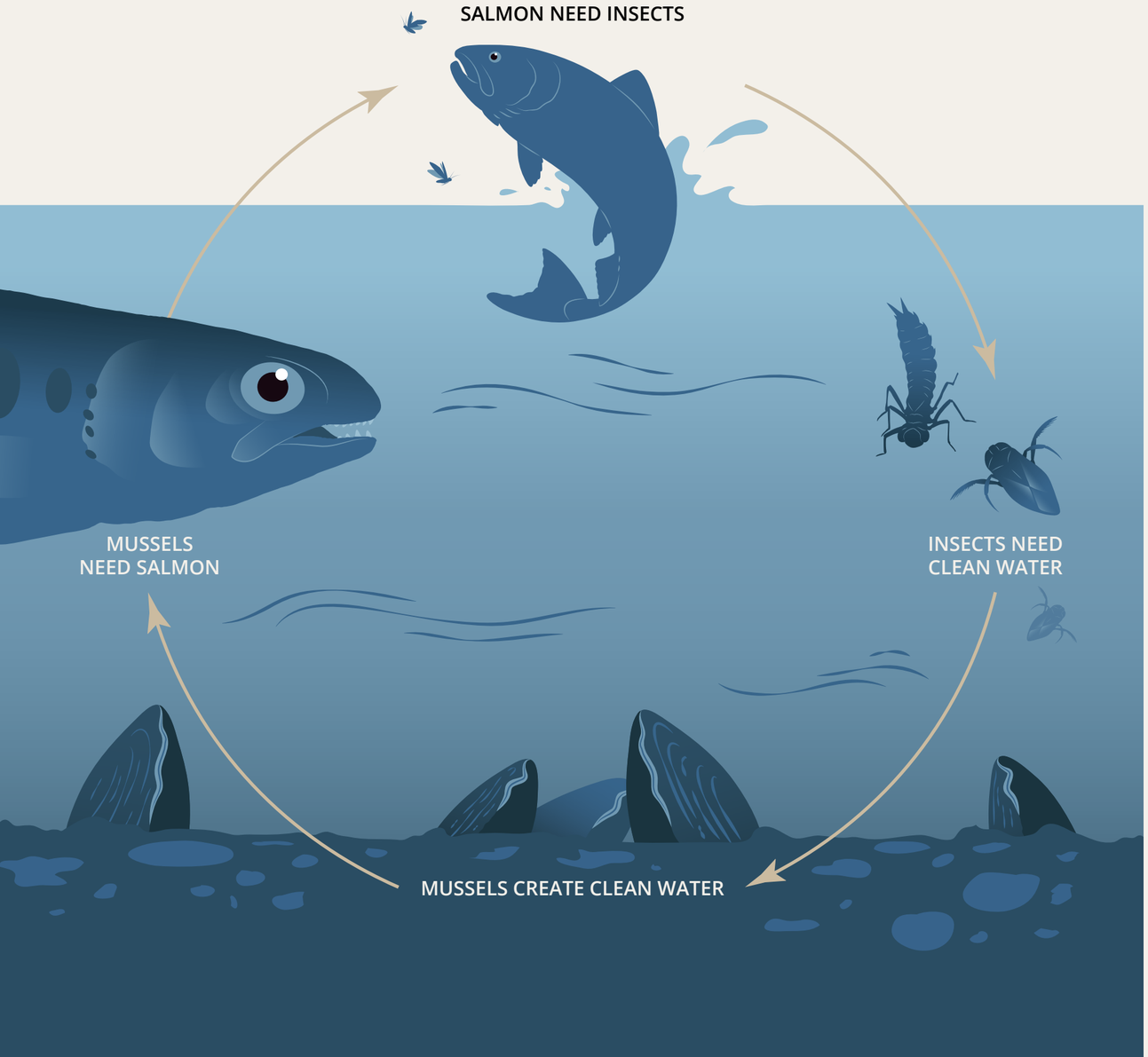
However, in recent years, some scientists have begun to question how widely such effects may occur. In Yellowstone, other changes occurred at the same time as the reintroduction of the wolves, including changes to rainfall affecting tree growth and increased human hunting of deer. Since this was not a properly controlled experiment, it is difficult to know the exact influence of wolves in driving all the observed changes.

In nature, context is always key. The principle of one species' abundance or distribution having a knock-on effect to other species might hold true, but rules are made to be broken!

Umbrella species

We can often protect whole ecosystems by focusing on just one high-profile **umbrella species** (sometimes called flagship species) because protecting them also protects many other less-well-known species with which they share space. Save the whale and you help everything else in the sea. Save the tiger and you protect everything else in the forest.

In Scotland, Atlantic salmon serve as an ideal umbrella species for our degraded rivers. If we can make our rivers healthier for salmon, by improving the health of entire river catchments, we will benefit all the other species that live in and around our rivers.



Indicator species

Atlantic salmon are one useful measure of a river's health, but there are other species that provide signs of water quality and system health. We call these organisms **indicator species** – because they indicate the health of an ecosystem – and freshwater pearl mussels offer us one excellent example.

Freshwater pearl mussels look a lot like common marine mussels but grow much larger and live far longer, growing as large as your hand and living for more than 100 years. Freshwater pearl mussels live in clean, fast-flowing rivers, filtering out tiny particles of organic matter to feed. An adult freshwater pearl mussel can filter more water in a day than an average person uses to shower. Very occasionally, they grow a pearl.

Sadly, these mussels are now critically endangered. Over-exploitation (for food and pearls) is the primary reason for the massive decline in their numbers and range, but as filter feeders, freshwater pearl mussels are also extremely vulnerable to water pollution and engineering work in rivers. The signs couldn't be clearer: everything indicates we need to clean up our rivers. And fast.

Rewilding

Rewilding offers a way to breathe life back into our diminished rivers by restoring native woodlands alongside water courses, reconnecting rivers with their natural floodplains, recreating lost wetlands and returning missing species such as beavers. Rivers are natural connectors, joining communities, transporting nutrients and channelling migrations – corridors of life that flow throughout our land.

But rewilding our rivers will require more than just a narrow focus on the river itself. We need to expand our horizons beyond the riverbank, rethinking how we live in and work the landscape across our rivers' catchments, and reassessing how we value, use and manage water in our daily lives.

Rewilded rivers, shaded again by trees, home to busy beavers and free-swimming salmon, offer hope that the damage we have done to our rivers may yet be undone, while rewilded catchments could reduce flood risk, enrich our landscape and inspire us with their beauty.

What can you do for Scotland's rivers?

- **Save water** – rivers and their wildlife are threatened by over-extraction, plus purifying domestic water supplies requires energy and chemical inputs, so although water might be free, it's best to fix leaks, avoid letting taps run, avoid products with a large water footprint, and if it's yellow, let it mellow! (Search water saving tips.)

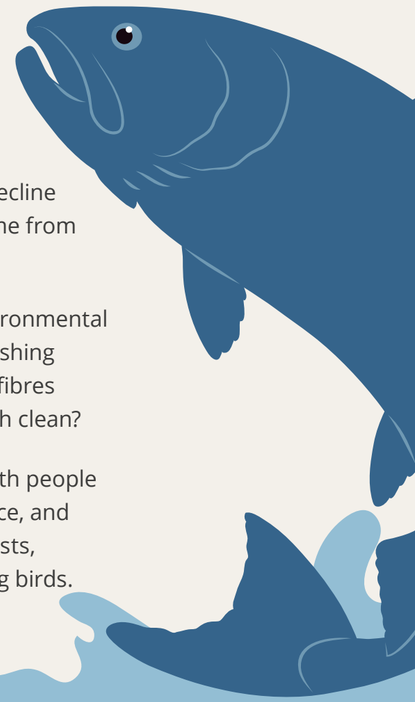
- **Bee safe** – anti-flea prophylactics such as spot on treatments and flea collars contain toxic chemicals that wash off dogs, polluting rivers, poisoning invertebrates and destroying food chains. Just one flea treatment can contain enough pesticide to kill 60 million bees! If your dog really needs flea prophylactics, chewable tablets are likely to be less harmful for the environment.

- **Love your drains** – never flush anything down the loo except what your body produces (and toilet paper). That means no wet wipes, no tampons, no cotton buds … nothing except toilet paper.

- **Think about what you eat** – Some farmed salmon is implicated in the decline in wild salmon stocks. If you choose to eat salmon, find out where it came from and learn about the environmental implications of fish farming at sea.

- **Go green** – use eco-friendly cleaning products to avoid the harmful environmental effects of bleach and powerful detergents (often used for laundry or washing up). You can also add microplastic catchers to your wash to stop plastic fibres polluting water, or why not join a riverbank litter pick or organise a beach clean?

- **Do not disturb** – our rivers, islands and waterways are getting busier with people out enjoying the water. However, lots of wildlife is sensitive to disturbance, and getting too close, even for a quick photo, can cause birds to abandon nests, separate seal pups from their mothers, or chase off exhausted migrating birds.



Glossary

Alien species – organisms introduced, deliberately or accidentally, into places where they do not naturally occur, often causing negative effects for native wildlife.

Catchment – a large area of land from which water drains into a river system, with many smaller streams and rivers feeding one main river.

Dredging – the process by which waterways are cleared of sediments, allowing water to move along the watercourse faster. However, dredging can increase flooding downstream, can destroy fish breeding habitats and erode riverbanks.

Flagship Species – a charismatic species selected to act as an ambassador for a selected habitat, campaign or environmental issue.

Freshwater – water containing less than 1,000 mg/l of dissolved solids, most often salt. Basically, water that isn't salty! Only 2.5% of the water in the world is freshwater, and nearly 70% of that is locked up in glaciers and the ice caps.

Ground water – water found in saturated zones beneath the land's surface.

Indicator species – organisms that signal environmental conditions where they occur.

Insecticides – chemicals used to kill invertebrates.

Invertebrates – animals without a backbone, including insects, molluscs (such as snails), and annelids (such as worms). They make up 95% of all animal species.

Keystone species – an organism with a profound and disproportionate effect on the ecosystem in which it occurs, without which the ecosystem would be significantly different.

Migration – seasonal movements of animals from one region or habitat to another in search of food, better conditions, or breeding opportunities.

Pasture – land used for grazing animals.

Peak flow – the amount of water flowing through a river at its maximum rate.

Reintroduction – the release of an organism into an area where it used to live but has become extinct, often due to human activity.

Rivulets – small streams.

Sediments – solid material that settles to the bottom of water, or that is moved and deposited in a new location by wind, water or glaciers.

Silt – fine sand, clay, or other material carried by running water before being deposited as a layer of sediment, especially in a channel or harbour.

Trophic cascades – indirect interactions between species, typically originating with predators, that spread through food webs. E.g. reintroduced wolves may alter deer behaviour (changing where deer feed or how much they eat), leading to changes in vegetation (height, structure, species mix) that in turn might influence insect or bird diversity and abundance.

Umbrella species – organisms whose conservation may confer protection on a large number of naturally co-occurring species.

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