



THE RIVER DETECTIVES

Pioneering a community science approach to understanding landscape change in the Howe of Strathmore during the Industrial Revolution of the 18th and 19th centuries.

"Landscapes provide a living history of Scotland's past and inspiration for many aspects of our culture. They underpin our national economy and offer a wide range of social and health benefits. We must look after our landscapes as a unique and irreplaceable resource for current and future generations."

NatureScot

cateran
ECC@
MUSEUM



Bioregioning
Tayside

The Cateran Ecomuseum



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Credits

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Marl Mania

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With grateful thanks to Dr Richard Tipping and Christopher Dingwall for leading the drafting of this documentation.

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The CATERAN Ecomuseum

“Museums are physical manifestations of civilisations’ collective memories, inventories of the traces left in us by the past. They are also vital stories of change: in our behaviour, culture, economy and technology. And, by showing us how much we have changed before, museums remind us of our ability to change now and help us learn the lessons of the past to illuminate the paths ahead. They are more important now than ever as we face a challenge unprecedented in scale and speed to prevent the loss of the climate and biosphere which give civilisation a home.” Andrew Simms

THE CATERAN ECOMUSEUM is a museum without walls – all our sites are outside. Designed to reveal the hidden history of CATERAN Country by the community who live here, it tells the story of its people, places and landscapes, from prehistory to the present day.

Originating in France in the 1970s, Ecomuseums focus on the identity of a place with the term “éco” being a shortened form for “écologie”.

Still a relatively new concept, there are around 300 worldwide, mostly in Europe, but there is only one other in Scotland, on Skye.

Set in specific landscapes, they offer:

- an opportunity for local people to share the unique heritage of where they live in a way that is meaningful to them and which preserves the objects, sites and cultural practices they value

- a holistic nature and culture frame for the interpretation of cultural heritage, quite different to traditional museums’ focus on the specific items and objects of their collections, sited inside a building
- a focus for community empowerment and regenerative tourism

Since 2019, the Ecomuseum has focused its work on revealing how the story of our past can help guide the story of our future through its Museum of Rapid Transition programme. Activities and events have been designed to offer heritage-based experiences that inspire local people and visitors to take rapid climate action and transition to more sustainable ways of living.



The confluence of the River Ericht and the River Isla



The River Erich at Blairgowrie

CONTEXT

“Scotland is rich with passion, endeavour and concern for our natural world and, as we work tirelessly to tackle the nature-climate emergency, it is clear that ambition for landscape-scale, collaborative conservation efforts has never been so vital.”

Professor Colin Galbraith, Chair of NatureScot

Climate and Biodiversity crisis

OUR PLANET HOME is in crisis. In just a few decades, a large part of the world’s biological diversity the result of tens of millions of years of evolution – has disappeared. What is being described as a sixth mass extinction event – driven by our destruction of habitats – is underway. Added to this, our ever-increasing greenhouse gas emissions are rapidly heating up our climate – putting additional stress on the already severely damaged flora and fauna.

The Global Climate Emergency and the Nature Emergency are twin reinforcing crises. Not only is climate change pushing many species and ecosystems to the brink, but biodiversity loss is accelerating climate change.

Here in Scotland, one of the most nature-depleted countries in the world, the latest headline data¹ shows a 19% decline in species abundance (territorial & freshwater) since 1970, a 54% decline in the distribution of flowering plants and bryophytes (mosses) and 16% of species identified as under threat of extinction. This decline has largely been driven by the intensive use of land for agriculture

and forestry, overgrazing and over-fishing and is exacerbated by global heating, pollution, invasive non-native species and unsustainable development. With Scotland’s climate changing faster than predicted², and higher temperatures and more extreme weather events becoming a regular occurrence, these trends are likely to accelerate.

these trends are likely to accelerate

In response to this ‘polycrisis’, individuals, communities, organisations and governments around the world are mobilising to rapidly reduce carbon emissions and prevent, halt and reverse the degradation of ecosystems.

This project is part of Scotland’s response to that global mobilisation. It is the third stage of a programme of work being undertaken in Tayside by a group of organisations, which aims to generate greater engagement with and stewardship of the Tay Bioregion’s land and water scapes by local people and visitors.³ It is also part of a larger Bioregioning Tayside pilot project studying how communities can get more involved in helping to monitor landscape change.⁴

1 [State of Nature 2023](#)

2 [Scotland’s Climate Changing Faster Than Predicted](#)

3 The first stage began in 2021 on the [River Ericht](#) and the second on the [Alyth Burn](#)

4 [Growing Bioregioning Food Community Science](#)

Community Science and why it is relevant today

FOR THE RIVER DETECTIVES PROJECT, the Ecomuseum intentionally chose to work through a Community Science⁵ approach. Community science is defined as scientific research and monitoring, based on scientific modes of inquiry, which are (i) community-driven and community-controlled, (ii) characterized by place-based knowledge and social learning, collective action and empowerment, and (iii) with the normative aim to negotiate, improve and/or transform governance for stewardship and social-ecological sustainability.

There is an increasing recognition globally of the role to be played by this form of knowledge generation, particularly in relation to supporting social-ecological system transformation, and helping to achieve a better 'fit' between ecological systems and human governance, at local and higher levels of decision making.



The River Detectives at one of the field sites

More than natural science

It is important to note that in community science, the word 'science' (and 'scientific research') is used to include systematic collection and analysis of *any* form of information using a scientific mode of inquiry. This can include not only natural science 'data', but other information that may be classified within social science and humanities.

Different from Citizen Science

It is useful to note the difference between community science with the more commonly used concept, citizen science. Citizen science is typically instituted not by a community but by a researcher or team of researchers outside the community – i.e., it is driven by scientific professionals and experts. In contrast, community science is *led by the community*, which chooses whether or not to engage with any given scientific experts, whether internal or external. Further, the context in which community science emerges is strongly associated with the social-ecological system in which a community is embedded, including a set of shared beliefs, a strong connection to place and the self-organising properties of the community from which iterative social learning arises.

The River Detectives project emerged through this community-driven and community-controlled process. It was conceived and led by the Cateran Ecomuseum, a place-based, community-led heritage organisation, with palaeoenvironmental experts chosen for their local knowledge and their previous work with the Ecomuseum and its leaders and the River Detectives themselves were recruited from local communities.

5 Community science: A typology and its implications for governance of social-ecological systems



River Detectives at a Marl Mania meeting

Background to The River Detectives

THE FOCUS for the River Detectives was on the last period of rapid transition in the region, the agricultural and industrial revolutions of the 18th – 19th centuries, and how everything changed: sometimes for the better; sometimes for the worse.

Each of the four projects, **Flax and Flood**: an environmental history of the Blairgowrie Mills, **Flood and Flow**: reconstructing flood histories for the River Isla, **Marl Mania**: exploring the basis for the 18th century agricultural revolution in Strathmore and **Peat and Productivity**: discovering a lost landscape around Meigle, related to water and how it was harnessed in diverse rural and urban settings. The projects also looked at how the landscape was transformed and continues to be transformed, exploring their environmental and social

impacts of these changes and their ongoing legacies.

The findings from all four projects have been documented and interpreted in ways that aim to help the communities of Strathmore and other stakeholders mitigate and adapt to the climate crisis and restore biodiversity.

This is important. Surviving the 21st century will be about making the right choices. We have made some wrong choices about how we manage our landscapes and environments in the past. Learning from past mistakes means understanding them at all scales from the local to the global and this is why environmental history needs to be taken much more seriously. The key to the future is the past – from where we have all come.

Surviving the 21st century will be about making the right choices.

Peat & Productivity

What the project was about

IN THIS PROJECT, the River Detectives set about reconstructing local biodiversity loss as a result of peat extraction in the early stages of the Industrial Revolution. Old maps show that peat bogs were abundant around Meigle, on the south side of Strathmore, even as late as the 1780s, where now there are almost none.

Peat bogs have unique ecosystems and great diversity of flora and fauna. They can also regulate atmospheric pollutants, improve water quality and reduce flooding. Very importantly they also store vast quantities of carbon and where peat remains undisturbed and/or continues to form this helps to offset the effects of human activities, such as fossil fuel burning, that are raising CO₂ levels in the atmosphere, leading to climate change.

What the River Detectives did

For Peat & Productivity, the Detectives set themselves a series of research tasks to try and uncover the story of how the great Meigle Mosses, the name for an extensive area of peat, came to be lost. They sought to find out:

- how old the peat bogs were; how far back they could be traced
- how big they might have been
- how fast and why they shrank over time

First of all, they looked for the one small area of peat discovered by soil surveyors in the 1950s, to radiocarbon date when it formed. Then they down-loaded maps of the soils around Meigle, focusing on those that were once wet enough to have supported peat bogs.

Those maps were then layered with a compilation of archaeological sites and ancient villages, from prehistoric to Medieval, figuring that people didn't live, farm or build monuments where the peat bog was: so where people weren't, the peat might have been.



Painstakingly, the Detectives then translated from 'old Scots' the 15th and 16th century records of Coupar Angus Abbey, who owned much of the area. The monks rented out farms, and some farms paid rents in peat. Most farm-names are still there, which made it easier to know where most were. Part of the puzzle was to work out which farms paid rent from their own peat bogs and which farms didn't pay rent in peat, possibly because they had none, or none left and record those changes over time.

Alongside this work, they chased down every reference, every fleeting glimpse of the landscape described by writers over the centuries.

Then they compared old maps, from the 1670s to the 1860s, to understand the timing and rate of peat loss and explored what the 18th century agricultural revolution meant for the natural world in Strathmore and who the agricultural 'improvers' were, their 'mind-set', plans, practices and ambitions.

Finally, they began to piece together what they had found to explain the loss of peat, framing their analysis with a series of questions: was it because of an energy crisis when there were no more trees to burn? Was it because landowners and farmers wanted to use the soil beneath the peat? Was it to get at the marl they hoped was under the peat? (marl is a powdery lime-rich deposit, which can be used as a fertiliser to increase crop yields.)



What challenges the River Detectives faced

The big challenge was to imagine what these peat bogs once looked like, when they are no longer there. The Detectives had to find examples that have survived in order to imagine them in their full glory, for example Dun Moss and the Forest of Alyth Mires.

The Meikle peat bogs were very probably raised mosses, given where they were in the landscape. The few left in Scotland, such as Flanders Moss, are giant teardrop-shaped domes of peat, each many hundreds of metres across and several metres thick, spreading and coalescing over time to merge with neighbours, to form one continuous sheet.

Translating 'old Scots' was testing because monastic scribes used a variety of spellings for different places and objects. The Detectives worked through Abbey rentals,

which were complex with details of highly divided farm/townships. Directions on land management and tree planting by the Abbey were also included.

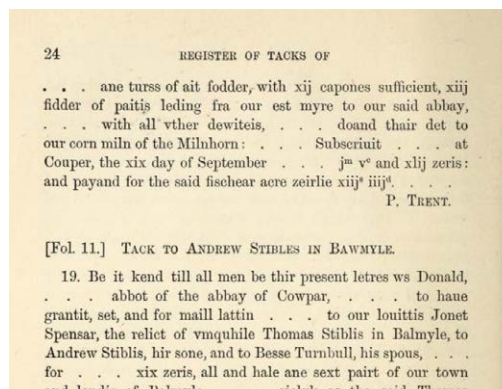
The hypotheses the Detectives were testing

One of the ideas being tested, simply put, was that because trees had become scarce, people turned to peat bogs for their fuel. It's very hard to understand from documents how scarce

woodland was, but two pollen diagrams from around Blairgowrie both indicate lots of trees until the 1770s. Then trees were lost, quickly cut down, but for firewood or to increase farmland?

18th century 'improving' landowners hated peat; it made no money.

Strathmore was full of 'improving' landowners, and they 'improved' peat either by draining it or trying to grow crops on it after burning



Some of 'Old Scots' language used in the Coupar Angus Abbey record books

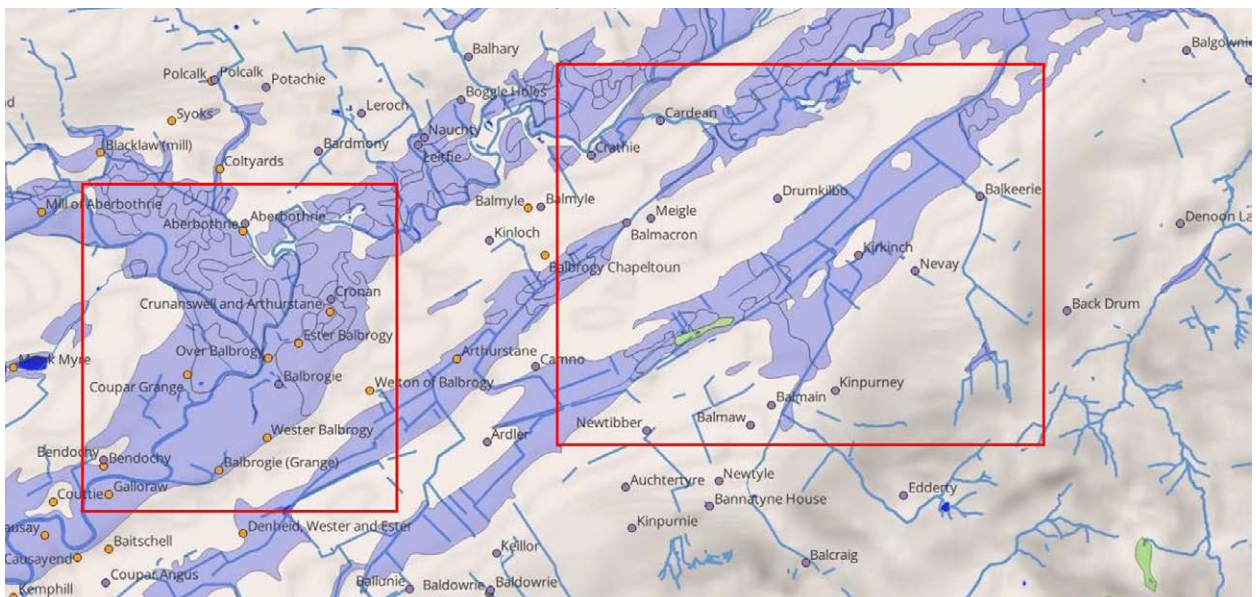
the surface. Both these happened but to what extent?

Marl mania in Strathmore meant an obsessive search for this magic manure. Marl was found under one peat bog east of Meigle, and instructions issued to use it, but "*tenants have none of them as yet obeyed the above order relating to the marling of their lands, I do desire that the strictest attention may be had thereto, and that they be compelled to do it*" complained one landowner in 1763: was this a case of 'old dogs not wanting to learn new tricks', or the tenants resistance to being bullied? In 1795, however, this bog was still described as "*a level and marshy tract, some ... cultivated; the rest ... indifferent pasture*", suggesting that marl had not been the subject of manic extraction.

Project findings

The Detectives found one small remaining patch of peat, still there though now dug to make duck ponds. There was no marl beneath it, just glacial lake clay. Currently being radiocarbon-dated, it is likely to be nearly 12,000 years old.

The map below shows how the distribution of old settlements can be used to identify wetlands where people didn't live or farm. The dark shades are hills; the blue lines rivers and streams; the green splashes are areas of peat:



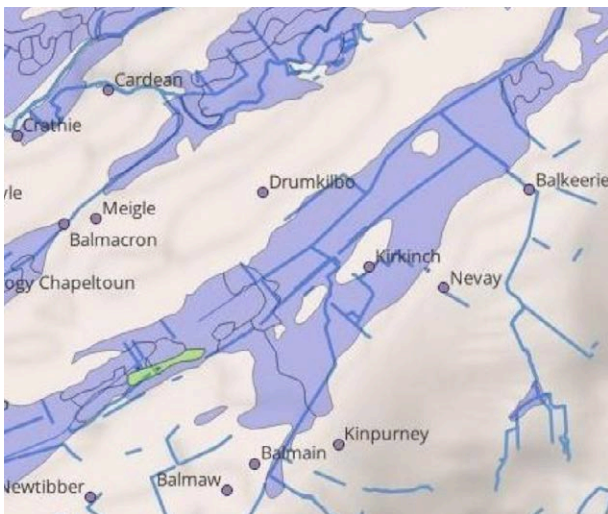
Is this the last remaining fragment of the Meigle Mosses?



This aerial photograph shows what's left of the once-huge Meigle Mosses, in a corner of a field on Donald Clerk's organic farm at Fullerton. It is still a flourishing wetland. The peat makes an easily-excavated pond but it still survives in situ around the pond. Under the peat is a lake clay, which makes an impermeable substrate on which peat formed. The peat is now less than a metre thick because people have cut its surface over hundreds of years.

the one almost in the centre is that around Donald Clerk's duck pond (see inset on previous page). The blue shading is the distribution of wetland soils. They occur on floodplains as in the north west along the Rivers Isla and Ericht, and along shallow valleys in the south east. The named places are villages that have Pictish and Gaelic names, named in the 8th-10th centuries AD. The places could be older than this. We can focus on two areas which show different patterns of colonisation of wetland soils.

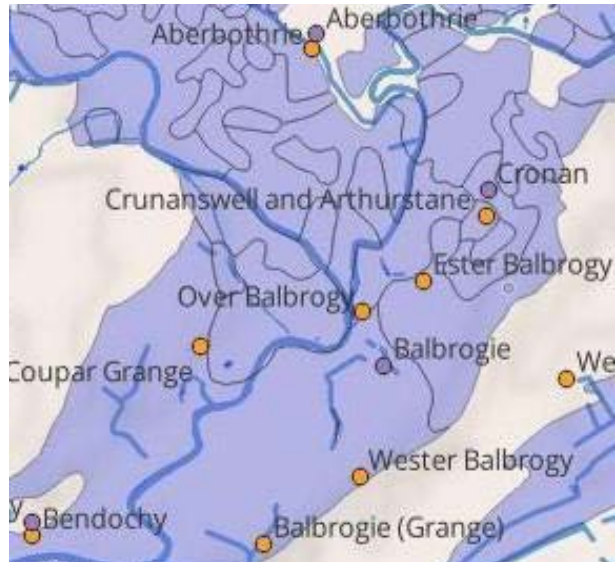
The map below shows in blue the wetland soils south east of Meigle. Here they represent in outline, former lakes. The villages and farms avoid the wetland soil. They lie on stream-lined ridges of glacial till, like Drumkilbo or on the valley side. Kirkinch in the centre is the site of an old church (Kirk). Inch means an island. In this case the island is of glacial sediment that was surrounded by the peat bog.



The distribution of old settlements around Meigle

By contrast, the map above right, shows the confluence of the Rivers Ericht and Isla. There are 8th-10th century villages and farms directly on wetland soils. These soils, though, are floodplain soils, originally wet but by this time dry enough to be colonised and farmed. Many of these places were later to be monastic farms.

The oldest map to clearly depict the Meigle Mosses is by John Adair in 1683 (right). His drawing of the River Isla and the Dean Water is simplistic; his depiction of the Sidlaw Hills even more so.



The confluence of the River Ericht and the River Isla

But 'Meigle Moss' is named. By 1683 the western edge was at Camno. It had shrunk some 7.5km from its prehistoric maximum: we don't know why but one village near Coupar Angus paid rent in peat to the Abbey in the 16th century.

To the east, Kirkinch (Maire K.) is still surrounded by peat, which stretches 3km beyond Kirkinch. Adair has also tried to map two types of peat, we assume: speckles and dashes. We don't know what the symbols mean because Adair didn't give a key to the map.

Adair maps no peat on the floodplains of the rivers; Meigle Mosses were alone.



John Adair Map (1682) of the Meigle Area

One of the glories of Scottish cartography is the map by General Roy, between 1747-1755, though called only a 'sketch' by Roy himself. The map (see next page) was made just before both the agricultural 'improvements' and industrial

marl extraction. This extract is of the same area as Adair's map 60 years earlier. It shows little change but now you can almost feel the peat and the wetlands and the lochans.

On the west the mosses are now isolated patches. Country estates with enclosed gardens lie jeek-by-jowl with wetlands. 'Improving' landowners lived in the country houses, but farmland around the mosses is not indicated. In the east the mosses are still unbroken. Furthest east is a large lake draining to the Dean Water.

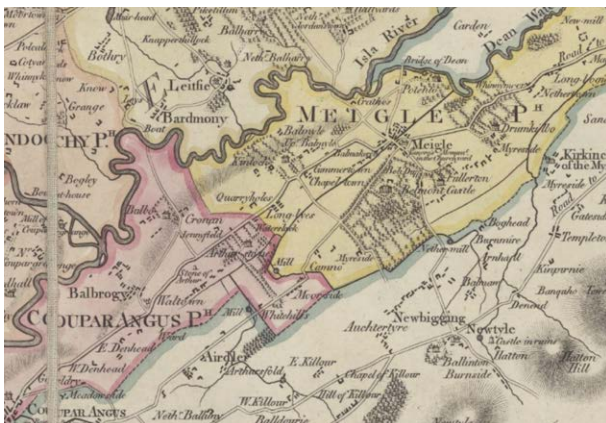
"Here and there appear, just above ground, the huts of the inhabitants, which they call towns, built of and covered with turf, and among them, at great distances, the gentlemen's houses, with enclosures and a few trees round them."

Thomas Gray at Glamis 1765.



General Roy's map of the Meigle area

On James Stobie's 1783 map (below) there is no peat anywhere around Meigle. Had it gone? Or did Stobie not record peat? His map of the Flanders Mosses, which were still huge in the



James Stobie map (1783) of the Meigle area

1780s, names them but the mosses themselves are not depicted.

And as we have seen, the valley east of Meigle was largely "a level and marshy tract" in 1795; "marshy places toward the north" could be glimpsed in 1792 from Newtyle; of Meigle, the pro-'improvement' Church minister would only say "The lower class are indifferently supplied with peat or turf from mosses in the vicinity", but there were still mosses.

Elsewhere in Strathmore, peat was denied before 1800 to most people through enclosure, draining and attempts to grow crops on them, or peat-cutting had reached the groundwater table, making them "difficult of access, except in a very dry summer."

Surprising research findings

Wetland soils and the distribution maps, suggest that the peat bogs at their largest probably formed a huge continuous sheet from west of Coupar Angus to near Glamis in the east, over 18km. They were narrow, though, maybe a few hundred metres across lying in elongated valleys formed in the last glaciation. People as late as the 1750s probably found it easier to go round than across them.

When the Detectives looked at the Medieval farms owned by Coupar Angus Abbey, it became clear that the peat wasn't only around Meigle. Farms that dug their own peat were often out on the floodplains of the Rivers Isla and Ericht. Floodplains are nowadays swept clean of peat by floods, but we think that this wasn't so centuries back.

Many early-mid 18th century documents give no indication that peat cut to burn was scarce, yet by 1800 it was almost universally described this way. We don't understand this. If true, population growth after 1750 must have been prodigious: a 28% increase has been calculated. But it might be that ordinary people weren't allowed to cut the peat bogs they had traditionally used: agricultural 'improvement' meant the loss of common land; peat was "restricted to the tenants of the ground."



Scottish Hand Loom Weaver

In 1772 the big landowner around Meigle, James Stuart Mackenzie (also very big in Government) denied handloom weavers access to peat as fuel. Why only weavers? Being self-employed and owning a few acres of land, maybe they couldn't be bullied as easily as tenants, so they were cleared from the land using this rather underhand tactic. But weavers, through their independence, were also politically active at times of food shortages; was Mackenzie teaching them a lesson?

New knowledge discovered

The Meigle Mosses have never had their story told. They have never featured in histories of the agricultural revolution in Scotland. But their loss is significant because causal factors in their disappearance are more complex than in better-studied examples.

No-one to our knowledge has tried to use distributions of archaeological sites and Pictish villages to explain gaps in settlement patterns. Absence of such evidence is, of course, not

evidence for absence, but cumulatively the patterns, combined with maps of wetland soils, are convincing reconstructions of wetland extent.

Focusing on monastic records, we have described in detail a critical part of the late Medieval rural economy ignored by others.

We have shown how recent the destruction of the mosses was around Meigle.



Cardean Bridge, near Meigle

More detective work that could be done

Whilst this stage of research is now complete, (2024) more work could be done to uncover the lost mosses of Meigle.

It would be exciting to find more remnants of the mosses; less than a metre survives where the Detectives sampled for radiocarbon dating. More radiocarbon dates would be good to define rates of peat growth. Scientific investigations of the plants making up the mosses would tell us what the peat was made of and whether these really were raised mosses.

More exploration of the idea of resource sustainability in Medieval peat-cutting could be done. Coupar Angus Abbey defined the numbers of cartloads of peat demanded as rent by each tenant each year. What we don't know

is how the Abbey calculated the number of cartloads per year they demanded. If we knew that, we could get close to seeing whether people understood that peat bogs were finite resources, or whether they thought they were in some way boundless.

Some historians think agricultural 'improvement' was a top-down process inspired by landowners, others that ambitious tenant farmers led the movement and landowners took the plaudits. Strathmore is a key place to understand this.

Only rarely do we directly understand the beliefs and motivations of improving landowners. In Strathmore their instructions to farm managers are known in some detail, so we know how farms were to be 'improved', but not why.





Flooding on the River Isla in 2022

Flood & Flow

What the project was about

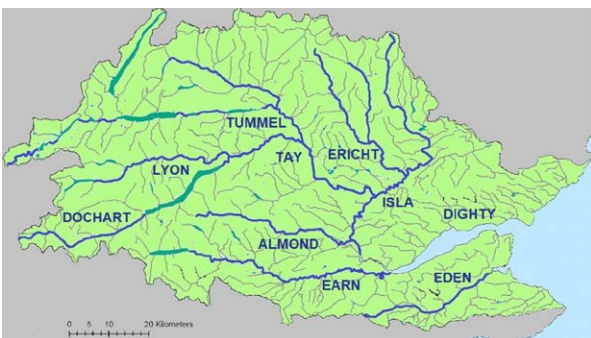
FLOOD & FLOW WAS ABOUT making a chronology of riverine floods for Strathmore. As the climate heats up today, flooding is a major factor in people's environmental concerns in the valley. Floods in July 2015 in Alyth made national news, for instance. We wanted to understand the long-term context of the recent floods, analyse the interplay of river and agriculture in the agricultural revolution, and help to predict what might happen next.



Alyth Burn flooding in 2015

What we already knew.

In 2006, Lindsey McEwen published a chronology of floods for the catchment of the River Tay.



The Tay Catchment

Around 100 events were reported from 1760 to 1950, but only from around 1880 were sources reliable. There are almost no details provided of individual events. McEwen related her chronology to seasonality, particular triggers,

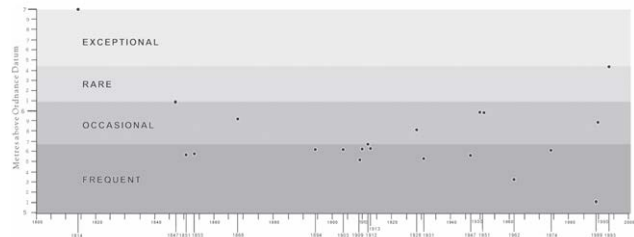
and types of weather. She identified flood-rich periods on presence-absence of events.

The Perth flood of January 1993 prompted Smith (1995) to list the top 20 floods measured from flood-marks on Smeaton's Bridge in the city from 1814.



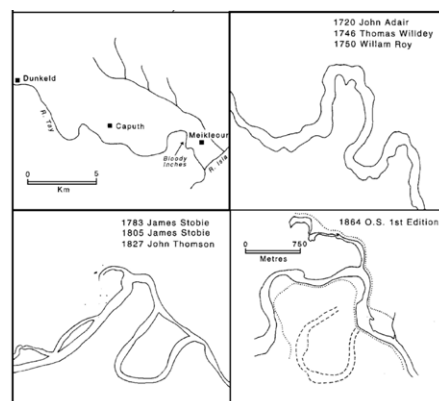
Smeaton's Bridge flood marks

Bowler (2012) used these to estimate different scales of impact.



David Bowler recorded floods for Perth 1814-1993.

In 2006 a team of scientists from Dundee University published a record of Tay floods back to around 1780 from a river sediment record at an oxbow lake (an abandoned channel), called the Bloody Inches, near Caputh. The idea here is that sediment in floods will flow across a



Alan Werritty map of recorded Lower River Tay floods

floodplain and into such channels where they will be trapped, piling up layers of sediment recording each flood.

What the River Detectives did

The Detectives set out to make a flood chronology for Strathmore. They focused on the River Isla catchment, the major eastern tributary of the Tay, and the lower Tay itself downstream of Caputh, just above the confluence with the Isla.

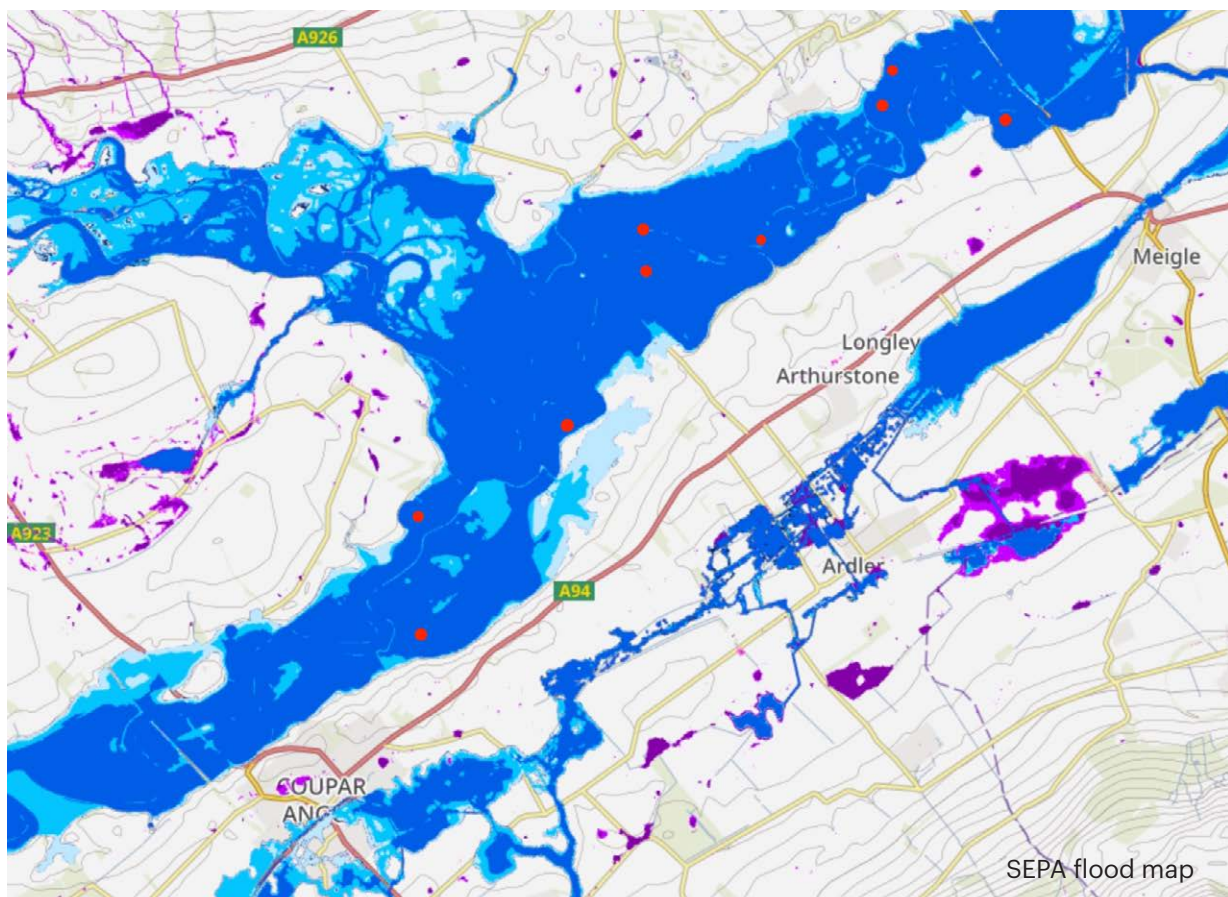
Their aim was to try and understand how flooding affected people, and vice versa, in the agricultural revolution, and in Blairgowrie during the time of the development of the mills, and how this knowledge might be relevant to people living in Strathmore today.

They pursued both the documentary approach, using local and regional newspaper accounts together with other contemporary descriptions, and the sedimentological approach of Werrity *et al* (2006).

They used the invaluable on-line resource of the British Newspaper Archive. To be a flood, reports had to describe the floodplain under water.

In total the Detectives searched eleven newspapers. Paper copies of the *Blairgowrie Advertiser* were searched between 1946 and 1962 when on-line newspapers are few. We also used quantitative SEPA (Scottish Environmental Protection Agency) data on flood heights measured at Balbrogie on the River Isla and Wester Cardean on the Dean Water between 1997 and 2023. From these we collected data on season, causal factors, impacts, and tried to assess the relative magnitude of floods.

For sedimentological analyses, they identified from analysis of old maps, eight oxbow lakes (abandoned meanders) between the Crathie and Couttie Bridges, cored three with lightweight peat gouges and quickly focused on one, at Netherton Farm near Crathie Bridge. The Detectives then sampled this, sent some sediment for dating by lead isotopes and some for grain-size analysis.



What the challenges were

On-line newspaper searches revealed many powerfully written, dramatic reports of floods, but after 1953 these became rare, and our record falls away in the most recent times, until the 1990s.

The Perthshire Advertiser Report of flooding on 14th October 1847

BLAIRGOWRIE

Here the effects of the extraordinary flooding were disastrous. It commenced to rain on Tuesday evening between seven and eight o'clock and continued to pour heavily without intermission until Thursday morning. On that morning the river swelled to a fearful extent. By nine o'clock it had attained a height greater than had been ever seen by any living inhabitant of Blairgowrie or Rattray and was still continuing on the increase. The greatest consternation prevailed among the spectators who were witnessing the mighty torrent, dashing and thundering along its devastating career, tossing on its gigantic bosom numberless trees of all sizes, many of which had been torn from their roots, bodies

of sheep, and fragments of all moveable things which had come within its merciless range. At about half-past nine it was evident that the Bridge between Blairgowrie and Rattray could not much longer withstand the furious beatings of the cataract; and, at the request of Baillie Mitchell, constables were stationed at each end, to prevent as much as possible people from standing or crossing. This precaution had not been long in operation when the Bridge was struck by a large tree with so much violence as to make it shake to its centre, and shortly afterwards the base of one of the pillars gave way, and more than the half of two arches tumbled into the stream.



Flooded Road just before Couttie Bridge, Spring 2024



A flooded Strathmore from Alyth Hill, Spring 2024

Probably the detective's greatest challenge was starting the fieldwork in October 2023 when the River Isla was hit by four big storm events in what turned out to be the wettest winter on record; not good when you're working on floodplains.

Trying to make sense of some sediment records was nigh-on impossible. These were oxbow lakes protected from floods by embankments. They began to realise that these sediment sequences reflected events when embankments were breached, and thick wedges of sand ripped up the sediment record; spectacular but uninformative.



And coring oxbows were tricky, as at Netherton in November 2023 (above).



Flooded Bardmony Bridge, autumn 2023

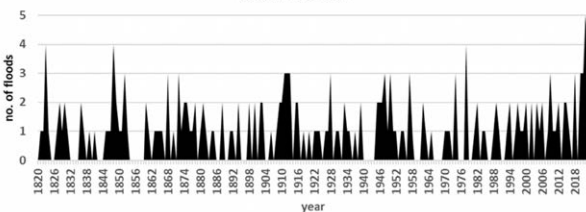
Project findings

Records of flooding

Researching documentary records, we found 202 flood events reported from the upper Dee, just over the watershed with the Ericht, from the Isla catchment, and from the lower Tay (including Perth) between 1820 and the end of 2023. We think the record is comprehensive from around 1845 when newspaper reporting matured.

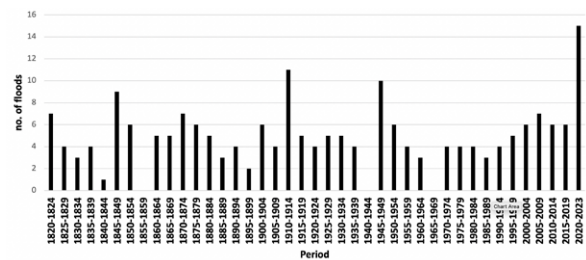
There were 78 years (39%) when no floods were reported, 68 (34%) when one flood was reported, 35 (17%) with two floods, 15 (8%) with three, four years (1%; 1823, 1848, 1978, 2023) with four and only one year, 2022, with five floods reported.

Flood frequency looks like this:



River Detectives map of flood records from 1820-2023.

Grouping events in 5 year periods gives a clearer signal of flood-rich periods.



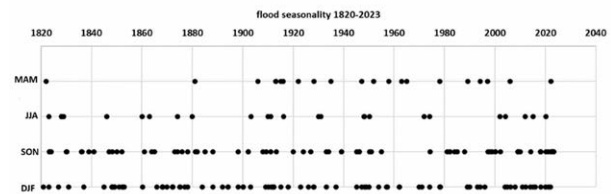
River Detectives map of flood records in 5 year intervals

Events before c. 1845 are probably under-reported. After 1845 there were flood-rich periods, with more than six floods, in 1845-1854, 1870-1879, 1900-1904, 1910-1914, 1945-1949, 2005-2009 and the three years 2020-2023.

We think the absence of floods 1854-59 and 1940-44 was real, despite in the latter, reports from WW II over-shadowing everything else. From 1972 we draw on SEPA data, which are

different to newspaper accounts. From 1996 floods have occurred in every year bar six (2001, 2003, 2007, 2013, 2017 and 2019), and in 14 of these years there have been more than one flood. From 2020 the flood record has been exceptional, with three floods per year in 2020 and 2021, four in 2023 and an unprecedented five in 2022.

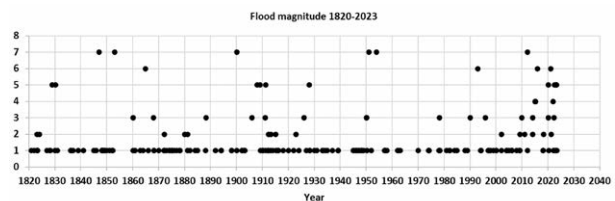
Flood seasonality looks like this (MAM = March-April-May (spring); JJA = June-July-August (summer); SON = September-October-November (autumn); DJF = December-January-February (winter):



River Detectives map of flood seasonality

Floods have been overwhelmingly autumn and winter events. Summer floods have been more clustered, in the early 1860s, between 1903 and 1916 and after 2002. After 1910 they occurred in pairs of events in 1910-11, 1930-31, 1948 and 1950, 1972 and 1974 and 2002 and 2004. Spring floods were very rare before 1906. Clusters of spring floods were experienced 1913-1916 and 1958-1965.

We tried to classify the scale of floods since 1820, not easy to do because newspaper reports are subjective, but our assessment of flood magnitude looks like this:



River Detectives map of flood magnitude

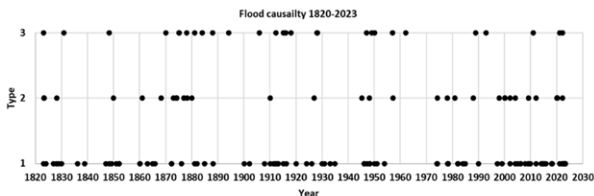
There are four relative magnitudes up the right hand side: 1 = common; 3 = uncommon; 5 = rare; 7 = exceptional; even numbers on this scale are intergrades.

The exceptional floods reported by newspapers were:

- November 1847 when the Brig O' Blair came down (see newspaper on page 20);
- January 1854 when floodwater on the Isla reached nearly the same height;
- 1900 when 1.45" [37mm] of rain fell on Strathmore on 2nd January;
- 1951 when 1.53 inches [39mm] of rain on November 4th;
- December 1954 when at one house at Aberbothrie "only the roof ... was showing above the vast expanse of water".

It is not easy to compare these accounts with the measurements of floods undertaken since 1997 by SEPA, but there is no doubt that very large floods have become all-too-frequent.

The causal factors of these are threefold, long duration heavy rainfall over 24+ hours, violent storms <24 hours and snowmelt:



River Detectives map of flood causality

Type 1 rainfall caused 60% of the events. There are clusters of Type 1 events at the end of the 1820s, spanning the years around 1850, the 1910s, the early 1930s, the late 1940s and from 1998. Type 2 rainfall caused 20% of the events, with clusters in the 1870s and from 1998-2002.



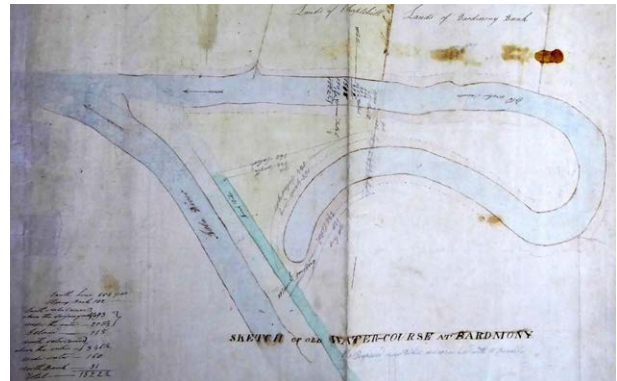
Aberbothrie Road flooding, winter 2024

Snowmelt events (Type 3) were common from 1870 to 1888, 1912-1918 and in the late 1940s.

Records of Flooding Control

Controlling somehow the frequency and scale of flooding on the River Isla has been a dream for centuries. Farmers planted their best crops on the extensive floodplains because these were the best soils, ironically rejuvenated with nutrients every time there was a flood.

Landowners and farmers straightened the course of the Isla, making abandoned meanders. Many of the oxbows we looked at were made around 1800.



This 1839 estate plan of Bardmony, discovered at Balhary House by Carol Pudsey, shows an old meander abandoned as the river was straightened



Aerial view of oxbow lake at Nethernton

Straitjackets in the form of embankments were built after "terrible" floods in harvest 1789 and successive years. But their subsequent construction along the river was more piecemeal and their effectiveness thus greatly weakened, reactions to damaging floods at different times.

Even well-constructed embankments built "on the most scientific principles" (implying some



Aerial view of repaired embankments built in 2024 on the River Isla at Bendochy

weren't) were breached, surprisingly frequently. When this happened, neighbours blamed neighbours; litigation followed.

One church minister opined in 1845 that "We hope never more to witness the dreadful devastations which an autumnal flood was wont to cause". This year marked the onset of a decade rich in floods.

In 1875 around 20% of the Isla catchment was re-directed to Dundee; floods on the Isla did not stop, although after 1874 they became fewer for a time, even though rainfall totals in eastern Scotland were high.

Analysis of Flood sediments

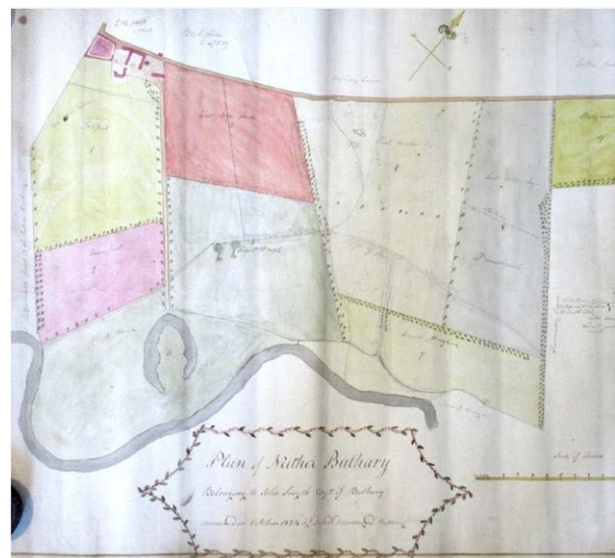
We quickly realised that our best record was in an oxbow at Netherton, near Leithie. This was the active channel in 1783 (above right). They had become abandoned meanders in 1824 (right).

We have, roughly, 220 years of flood sediment in just over 2m of sediment, meaning that floods added an average of 1cm of sediment every year.

The sediments are mostly banded, especially in the lowest metre, meaning that we can record



This map by James Stobie in 1783 shows the channel of the River Isla. Just south of Nether Balharry are two wiggly meanders; the one to the right (east) is Netherton 1



Plan of Nether Balharry in 1824

most of the floods affecting the Isla, much more convincingly than on the Tay at Bloody Inches.



A coring sample

Now (June 2024) we're waiting for different laboratories to tell us when the events we're recording occurred, by developing a sediment-based chronology, and the size of each flood from its grain-size (silt, sand etc.).

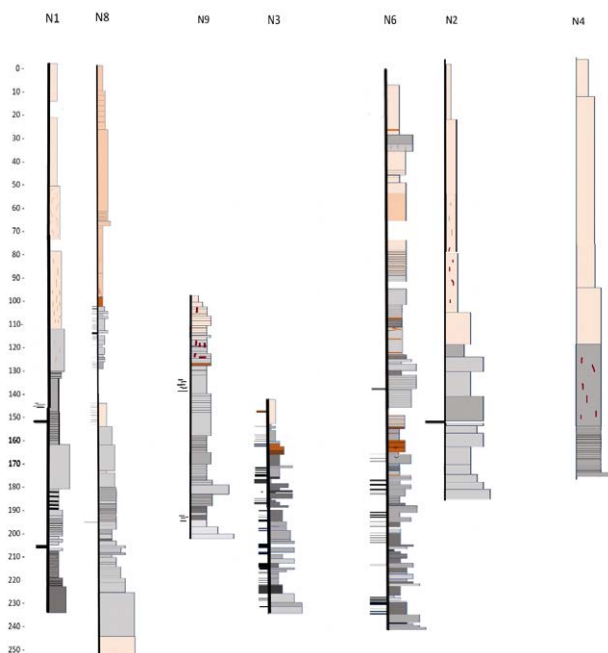


Diagram of a sediment stratigraphy of seven cores at Netherton

New knowledge discovered

The project gained two sets of new data. The search for documentary records delivered very rich material and for the River Isla, the Detectives have created the most detailed chronology of flood events in Scotland, with the sediment record for Netherton truly astounding.

Combining the two sets of records, independent of each other, will tell us enormous amounts about climate change in the last 200 years, and about the near-future.

More detective work that could be done

Although we will have astonishingly well-resolved sediment and documentary records of flooding in the Isla, we are a long way from explaining what drove the changes. We have assumed that changing climate was important, but yet the flood records do not match rainfall records. In this critical 200-year period there were major changes in land use, in the uplands as well as the lowlands where floods occurred, but our understanding of the timing and scale of these changes is very limited. It will be possible to use our newly-acquired skills in asking new questions: what happened to our rivers before 1800, in the 'little ice age'? and further back still?



A Woman Spinning Flax by Francois Bonvin

Flax & Flood

What the project was about

Flax & Flood was all about understanding the way the River Ericht affected Blairgowrie's 19th century textile mills and how the mills affected the river.



Keithbank Mill in the 1950's

Blairgowrie's textile mills represent the local flourishing of the Industrial Revolution, when factories driven by water-power replaced home-based spinners and weavers of locally-grown and imported flax to make linen cloths, and later in the middle of the 18th century, Jute.



The interior of one of the mills in Blairgowrie

Technological, economic and social histories of the textile industry are common, but not environmental histories.

What we already knew

The River Ericht had the advantage in stream-power in being the longest river of those near

Dundee, where imported flax was shipped; it has the largest catchment; it has the highest discharge (stream-flow).

The Ericht was long the focus of traditional mills. These, though, were on low-gradient reaches of the river or on tributaries because they didn't need much energy.

Above the Brig O' Blair the Ericht is much steeper: this was where the industrial mills had to be because they needed much more energy.

Meikle Mill was constructed first, in 1798 on the right bank just above the Brig O' Blair.



The Meikle Mill, furthest right in this postcard, was accompanied by the Ericht Linen Works, nearest the camera, in 1868

Lornty Mill, on the Lornty Burn, was converted from a tobacco mill in 1814. Oakbank, the first mill in Scotland to spin jute successfully, and, opposite it, Old Keathbank, were built in 1830.



Oakbank Mill today

Then four more were built in the same decade, and Brooklinn, below Lornty on the Lornty Burn, was built in 1843.



Oakbank Mill's Water Wheel

Two pairs of mills shared weirs: Oakbank and Old Keathbank in 1830; Ashbank and Bramblebank in 1836.



Westfield Mill, Brooklyn Mill & Keithbank Mill.
General oblique aerial view

Below the Brig O' Blair on the left bank, one huge lade fed Erichside (1820), Eastmill (1834), Westmill (1845) and Ashgrove (1864).



Ashgrove Lade in the 1950's

What the River Detectives did

In this project, the River Detectives set out to reconstruct what the River Ericht looked like to early mill-owners to understand decisions they made about where to build. They researched more about the mills, the mill-owners and the town from new sources and tried to develop a record of weather events that affected the river and the mills.

They also sought to trace how the river and the mills changed each other from paintings and postcards, explored how traditional users of the river (farmers, millers, fishermen) coped with the water demands of the mills and used the history of salmon in the river as an indicator of the health of the river.

Research included investigating LiDAR mapping to produce a new description of the river, gathering material from on-line copies of local and regional newspapers and other published material and collating and analysing estate plans and old maps.

The Detectives then created the first detailed chronology of weather events affecting Strathmore from the later 18th century, from newspaper accounts and the *Transactions of the Highland and Agricultural Society of Scotland*, to see how they might have affected an industry dependent on one highly variable power source: water. They also gathered data from many sources about salmon, and commercial and sporting salmon-fishing.

What the challenges were

The Detectives found early on that there is very little known or published about the changing year-by-year economic fortunes of the mills, so that they could not relate these to the weather events recorded.

They also hoped to find statistics on yearly salmon catches following the forming of Blairgowrie's Angling Club in 1830, but were unable to retrieve these.

Blairgowrie had its own school of painters in the 19th century, the 'Blairgowrie Boys', led by William Geddes, but although he was fond of painting

fish, these rarely included the landscape and as a result, this novel approach to landscape reconstruction had to be abandoned.

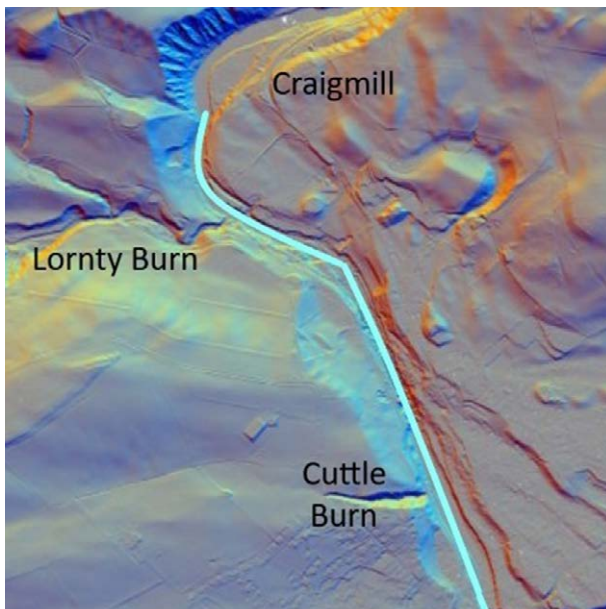


William Geddes, *Two Salmon*

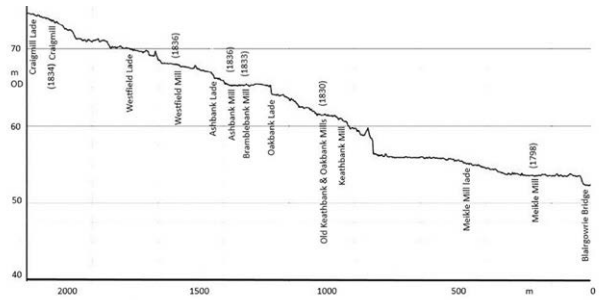
Project findings

We reconstructed in detail from LiDAR imagery the gradient of the Ericht from Craighall to the Brig O' Blair. Because the Ericht is a bedrock-lined channel, it looks now as it did when the earliest mill was planned. This is what the mill-owners saw.

The Meikle Mill was built on a reach with no gradient: why? This makes no engineering or economic sense when it could have been



A LiDAR image along the Ericht, which strips out all the vegetation and human structures built anywhere. It needed a 250m-long lade to generate sufficient stream-power (called the fall).



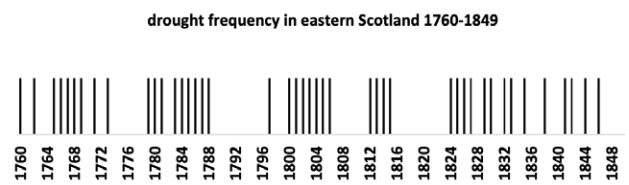
The gradient of the river traced from the pale blue line in the top image, with the names and dates of mills.

Why was there a 32-year gap (1798-1830) between mills on the Ericht (Lornty was on the Lornty Burn). Here's one explanation:



The Ericht at the Cuttle Croy, serving Meikle Mill: before c.1930

There had been no prolonged droughts for almost 20 years when Meikle Mill was built: after 1798 they occurred each year from 1800 to



A new chronology the Detectives made of prolonged droughts (lasting >10 weeks)

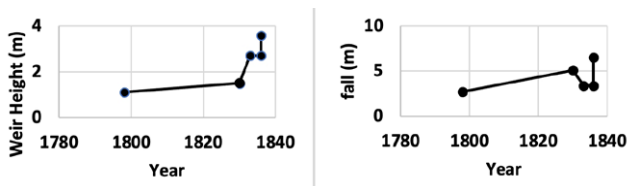
1806 and from 1812 to 1815. The 1810s were also the coldest decade in the last 500 years due to the final phase of the 'little ice age'; frosts have similar impacts on stream-flow to droughts; no water. A new chronology of floods from 1820 made by the Detectives also showed that there were few between 1823 and 1845.

Millers couldn't trust the weather and in response, mills built in later years gravitated to

the steepest gradient reaches with the highest stream powers, above the rapids called the Keith. It made economic sense to do this to ensure sufficient water power and by 1836 there were five mills on a 500m length of river on both banks above the Keith.

The Detectives also re-discovered the heights of weirs of these mills from local newspapers in 1884: these control the fall of a mill.

Weirs got higher over time. This reflects the overcrowding of mills, each trying to increase



A diagram showing the heights of the weirs

their fall. But Bramblebank and Ashbank Mills in 1836 lost out because higher weirs meant water backing-up and interfering with mills upstream.

This density of mills on other British rivers led



Oakbank weir, a modest 1.5m high weir. Bramblebank is in the background, the still-water formed by Oakbank's weir almost affecting Bramblebank

to "vexatious lawsuits": this did not happen on the Ericht: why not? Why did mills share weirs? Costs were halved but so was stream-power; weirs perpendicular to the river (which they had to be to share stream-power) were more susceptible to costly collapse. One explanation is that co-operation was necessary to cope with water shortages. "what emerged in this economy in the eighteenth century was a mixed

system in which competition and cooperation worked together, odd as it may sound."

Mokyr, J. 2009 The Enlightened Economy. Britain and the Industrial Revolution 1700-1850, p338.

The later 19th century was no drier. Only the 1870s saw a reliable water supply.

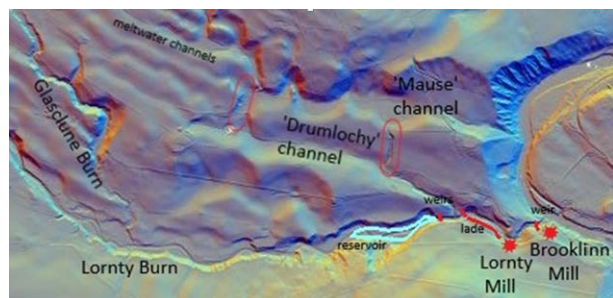
One way to manage water shortages was to turn to steam. Of the mills above Brig O' Blair, Westfield had steam in 1835 but the others were



Drought frequency in Scotland 1850-1900

still water-powered in 1845; this was not seen as a way out here or on other Perthshire mills; 22% only were steam-powered as late as 1862.

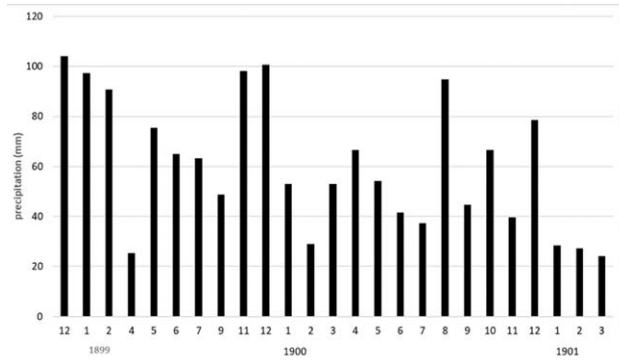
The second way was to build reservoirs. This didn't happen at all on the Ericht. Lornty and Brooklinn Mills on the Lornty Burn were especially vulnerable, but estate plans show that 1863 was the earliest date the Lornty Dam can be demonstrated. However, the LiDAR image shows below that no effort was made to



LiDAR image of the Lornty Burn joining the River Ericht

maximise efficiency of the dam. The reservoir is in pale blue on the floor of the Lornty Burn. The image picks out the many parallel glacial meltwater channels; two are named. Both could have been diverted easily enough to increase capacity of the reservoir, but they weren't.

In 1868 the Parochial Board of Blairgowrie, the town council, sought to tap the Lornty Burn for an improved supply to the town: Agreement was reached but local droughts, almost every season from January 1899, led in 1904 to friction and legal action by Grimond of Lornty: he lost.



Falling rainfall amounts at Coupar Angus 1899-1901

The later 19th century was no less turbulent for the mills: previously unreported were very damaging fires at Erichside (1865 and 1885), Oakbank (1872), Ashbank (1880), Bramblebank (1881), Ashgrove (1890) and Westfield (1901). Lay-offs, short-time working, reduced wages, short-lived strikes impacted in sustained economic depressions 1867-1873 and 1888-1880.

Though it wasn't the end for the mills, (the last working mill shut down in 1979) as the market began to change and technology evolved, a sense of fin de siècle was building by the turn of the century. In an extraordinary Perthshire Advertiser editorial in July 1900: *"it is Perthshire that is bidding fair to become the fruit garden of Scotland ... steam factories were erected on the banks of the Ericht. They in turn have had their innings, and Blairgowrie has now become a popular summer resort ... [with] unrivalled scenery around Craighall ... fishing in river and loch, and sport with the gun on Highland hills"*.

Salmon and the mills

The first notice of the Ericht and its salmon fishings is contained in a Charter dated 1326, granted by Robert the Bruce to the monks of

Coupar Angus Abbey, translated as follows: *"Charter of Robert 1st, King through God, to the Holy Mary . . . We, of our special favour, have given permission to the same monks of fishing for and taking salmon in times, prohibited by our statutes, whenever they wish, in their fisheries of the Waters of the Tay, the Isla, the Ericht . . . to their own proper uses, and for the soup of the aforesaid convent."*

The Keith fishings, with the rocky gorge immediately below the waterfall, was a favourite scene of salmon netting and can be traced to 1620. This was commercial fishing: a keith was a *'bar across a river ... to prevent salmon from [moving] further, a kind of dam'*. It may have been erected around 1700; it may have been the subject of a court-case in 1750. Parishes above Craighall bitterly complained at the end of the 18th century of the impact of the Keith on their fishing.

From 1740 to 1830 the Ericht was known to be very fine stream for rod-fishing, although the salmon taken were never large. The heaviest ever known to have been captured in it weighed 24 lb.

By 1836 *"The salmon no longer ascend the Ericht ... which they once did in great quantities, because of the numerous Spinning-mills now upon it."*, and by 1845, the fishery was *"much decreased in value"*.

We cannot quantify the reductions in salmon numbers or factors like overfishing on the Tay and Isla, or poisoning from chemical processes in the mills, but these and other problems may account for not one fish being reported below the Keith in 1851.

In 1870, when Frank Buckland and Young inspected the salmon rivers of Scotland, they found the Ericht at Blairgowrie, which had once been a famous salmon river, entirely blocked up by impassable dams, of which there were no fewer than six in the course of about 2 miles of water. The uppermost was not an insurmountable barrier, but the

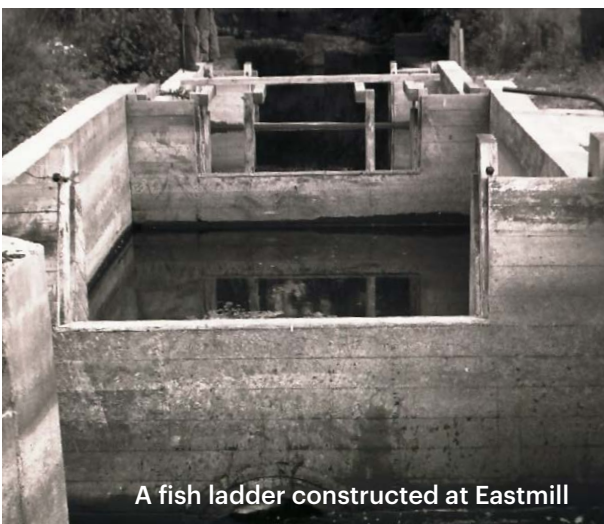


The Lade Gate at the Brig O' Blair today

second at Westfield's was entirely impassable, being twelve feet (3.6m) in height, and quite perpendicular.

Equally impactful was the 12 ft wide, 4 ft deep lade intake just above Brig O' Blair to the left-bank mills, which "*absorbs and carries off the larger proportion of the river in the dry season*", leaving the river dry. The lade gate at this point on the river is still causing issues today.

In the summer of 1884, the Tay Board (today known as the Tay District Salmon Fisheries Board), brought over a Colonel Macdonald from the United States (who had successfully resolved similar issues on the Potomac) to look into the problem and improvements were made, including the construction of fishways which were placed on the inaccessible weirs at Ashbank and Westfield. "*These being the first fishways of the kind ever placed on absolutely insuperable obstacles in a salmon river in Scotland.*"



A fish ladder constructed at Eastmill

Around 1960, another impediment to fish passage, Craighall Linn, a small fall just north of Blairgowrie, was blasted. This helped increase salmon numbers and for a time, until the 1990's, the Ericht was known as a very productive salmon river.

New knowledge discovered

This research builds on **previous work** – '*Vital Signs*' – undertaken by the Ceteran Ecomuseum. Both projects aim to lay the foundations for a new environmental history of the River Ericht, one that can help us take better care of it in the future. In this project, the River Detectives created the first detailed chronology of weather events affecting Strathmore from the later 18th century and showed how the unreliable water supply affected decisions about where the mills were built. They brought LiDAR imagery into play to help create new descriptions of how humans had changed the watercourse over time and began to uncover the impact of the mills on the Atlantic Salmon, now categorised as an endangered species, with some of those impacts still being felt today.

More detective work that could be done

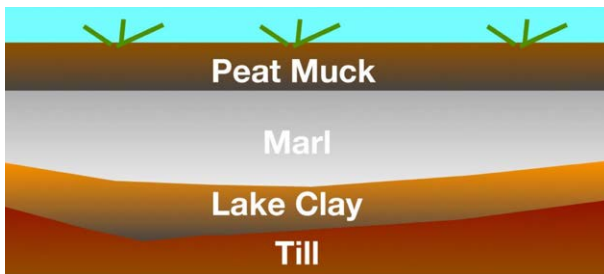
This first stage of work on the Ericht has opened tantalising doors into the potential for further research on past climate change in the area and how it stimulated technological and social transformation. More work could be done on how current biodiversity relates to the past, including the effects of past land management and how future ecosystem management practices can take these into account. The health of Strathmore's Sites of Special Scientific Interest (SSSI) could help shape a new understanding of these important protected landscapes and analysing river sediments for micro plastics could provide a depressing but important glimpse into the legacy of our modern lifestyles.

Marl Mania

What the project was about

PRIOR TO 1700 the landscape of Strathmore, stretching from Forfar in the east to Dunkeld in the west, was peppered with lochs and peat bogs left at the end of the last Ice Age. It was around 1700 AD that Scottish farmers discovered that shell marl, a powdery lime-rich deposit associated with these lochs and bogs, could be used as a fertiliser to increase crop yields.

Between c.1730 and c.1830 huge quantities of shell marl were extracted from below peat bogs or dredged from the bottoms of the lochs. Yet prior to this River Detectives project little was known about what became a major industry, and such things as the finding of the marl, how it was extracted and used, or who was employed.



Typical sequence of deposits where marl is found

What the River Detectives Did

In Marl Mania, the primary purpose was to build up a picture of how shell marl was extracted, processed and used as a fertiliser. Also, to identify those estates in Strathmore which were involved in the marl industry, and how they were able to benefit from this. The intention was to get a better understanding of the part played by marl in the agricultural revolution in Strathmore in the 18th and 19th centuries, by charting its rise and decline.

Under the guidance of Dr. Richard Tipping and Christopher Dingwall, the River Detectives set out to assemble information from a variety of sources to tell this story. They did this

through a careful study of historical maps, both manuscript and printed, drawn up between c.1600 and the present day, by identifying those places and place-names associated with the marl industry and consulting a range of printed sources published between the 18th and 20th centuries.

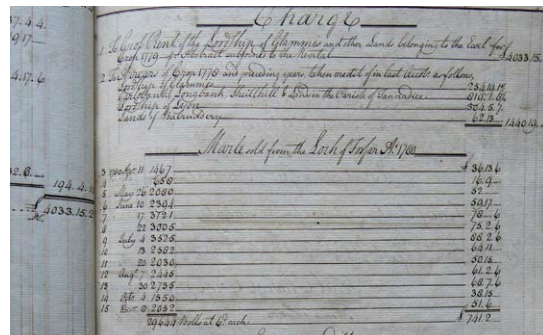
They also located and analysed old estate records, some of them dating back the early 18th century and by visiting sites where marl was extracted, they looked see what if any traces of the marl industry can be found in today's landscape.



An estate record from Dunnichen

What the challenges were

Tracking down private estate records was not easy, given that much material is held privately, or can only be viewed at the National Records of Scotland and National Library of Scotland in Edinburgh by special arrangement. Even where the team was granted access to the material, the physical business of opening and transcribing and/or photographing individual items was often time-consuming.



Accounts from the Glamis Estate, 1780

Additionally, many of the Detectives were unfamiliar with older styles of writing or obsolete vocabulary and needed some

guidance when reading original manuscripts, some of which were up to 300 years old.

The hypotheses the Detectives were testing

Given how little was known about the marl industry in Strathmore, there were many avenues to investigate. Four principal themes were prioritised.

First was the idea that shell marl was an economically viable source of lime fertiliser when compared to that obtained by burning limestone in limekilns and transporting it from a distance.

Research was also undertaken on the human resource needed for such a huge enterprise. The marl industry was labour intensive, with the consequence that a large number of people in Perthshire and Angus were employed in the marl industry in its heyday.

A third area the Detectives looked into was whether those estates with large deposits of marl, more than required for their own use, were able to sell marl for profit.

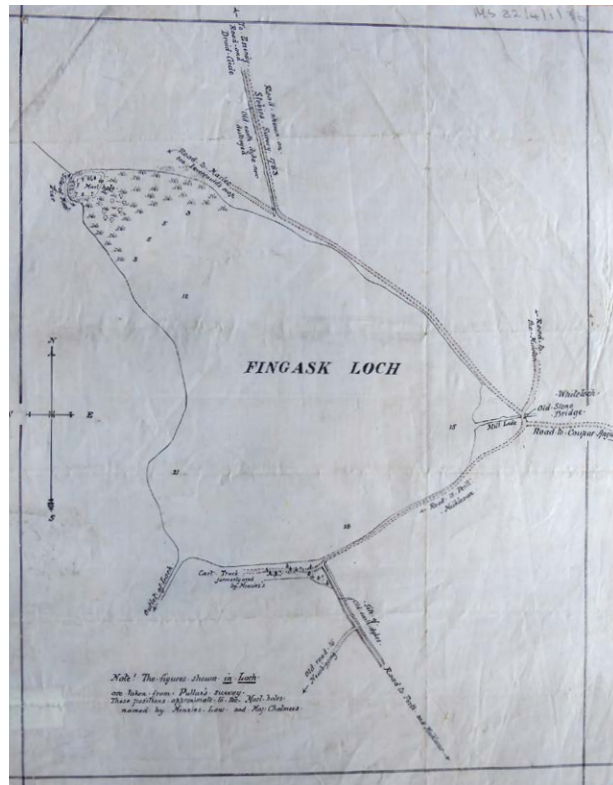
And finally, they explored the background to the decline of the marl industry as it became more difficult to quarry or dredge, and as the arrival of railways made alternative fertilisers cheaper and easier to obtain.

Project findings

The Detectives confirmed that occurrence of shell marl was closely related to the late-glacial and post-glacial topography of Strathmore.

Indeed, Strathmore had the largest deposits of shell marl to be found anywhere in Scotland, either buried from beneath peat, or on the bottom of lochs and as an unconsolidated and granular material, shell marl required little in the way of processing, so was easy for farmers to transport and spread on their land.

They also discovered that the use of marl as a fertiliser lasted for around a century, from the c.1730 to c.1830, peaking in the last decades



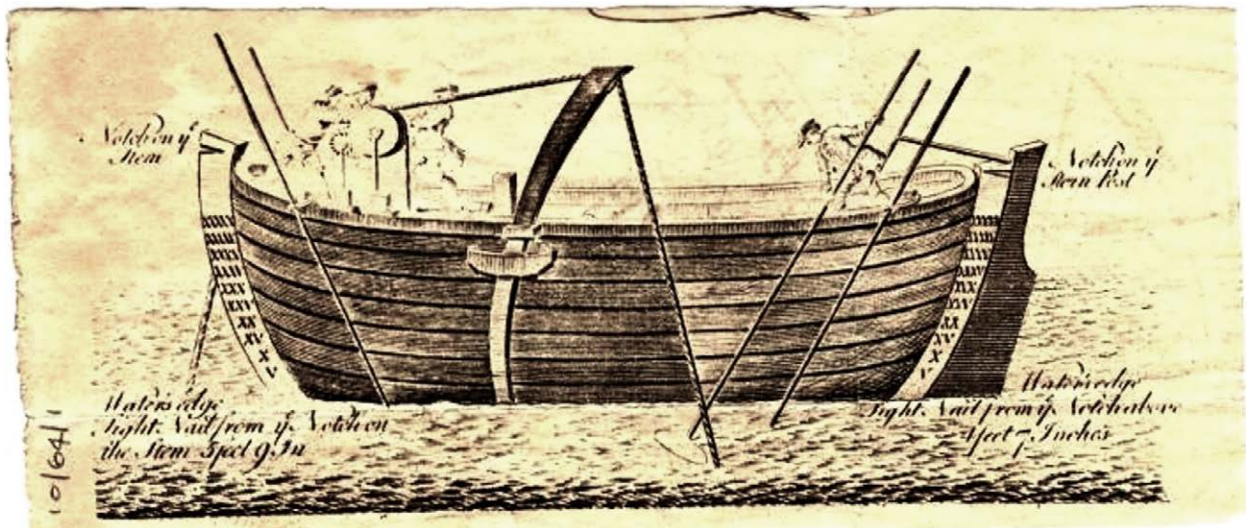
A map of Fingask Loch showing the marl excavation site in the north west corner



The same north west corner of Fingask Loch today

of the 18th century and playing a significant part in the 18th and 19th century agricultural improvements in Strathmore. Indeed, at its peak, the industry was highly profitable for those estates which had large deposits.

The Detectives also discovered that a number of landowners began used marl on an experimental basis in order to gauge its effectiveness and that, while moderate use of marl could boost crop yields, excessive use could result in the poisoning of land. This led



A drawing of a Marl Boat

to some landowners drawing up rules for their tenants on the use of the marl.

New knowledge discovered

This research undertaken for this project has been truly ground breaking, for in spite of marl having been a major industry in Strathmore for the best part of a century, little has been known or written about its existence until now. One particularly intriguing question that the work generated is whether the loss of the Meigle Mosses, investigated in Peat & Productivity above, were as a result of marl extraction.

More detective work that could be done

Much of the numerical data on the quantity of marl extracted, and on the number and type of people employed in the marl business, comes from two archives – those for the Strathmore Estate near Forfar held at Glamis Castle, and those for the Dunnichen Estate near Forfar

held at the Angus Archives at Restenneth, both of which recorded annual income and expenditure. It would be valuable to see if the marl story could be expanded by searching for other estate papers.

Archaeological traces of the marl industry could also continue to be investigated, along with an attempt to identify any historical artefacts which may have been used for the mining or dredging of marl.

Another idea that emerged was whether it could be possible to reconstruct a marl boat, using a drawing and measurements to be found in the Angus Archives at Restenneth, and in published descriptions of dredging.

The relevance of the findings to the climate and biodiversity crises we face today

Peat & Productivity

Biodiversity loss of precious wetland ecosystems on the scale that happened in Meigle is a graphic reminder of what people did, comparatively recently.

The totality of environmental change that occurred should make us think and the reasons why this happened should help us make better choices in the future about how we manage our landscapes. In and around Meigle, poor people, cutting peat to burn, had no choice: access to firewood was denied to them after 1750, access to peat was, too; and coal was too expensive. Landowners had little regard for the natural world and most historians think it didn't contribute to the economy.

As we begin to understand how our modern landscape came into being, and recognise the importance of large scale peat moss systems to the healthy hydrology of our landscapes and the regulation of carbon, we are in a better position to help regenerate them.

Flood & Flow

Investigating the flood history of the River Isla over the winter of 2023/24 made the link to our changing climate very real. Not only was fieldwork seriously affected by the constant floods, but now we can see those floods in a fascinating long-term context.

The Howe of Strathmore was far from a natural environment by the 8th – 10th centuries AD. By 1850, rivers had been caged, straightened, and hemmed in by embankments that attempted to protect floodplain soils, pushing the problems downstream. They didn't work then and those same embankments are not working now as flood events multiply due to climate change. The agricultural improvements of the agricultural revolution created a farming landscape that was thoroughly drained,

speeding water from fields to rivers and this is still the case today.

As the Scottish Government's ambitious climate change legislation comes in to play, particularly the Agriculture and Rural Communities Bill, land use in Strathmore will change again. Having drained our wetlands and straight-jacketed our rivers, this time it will need to find ways of putting back natural protections that enable greater capacity to absorb the extreme rainfall events we are now experiencing.

Flax & Flood

The investigations begun in Vital Signs and furthered through Flax & Flood underline the long term nature of the environmental degradation humans have caused along the River Ericht. Understanding this history is key to how we make better decisions about land use change in the future.

The research undertaken by the River Detectives in Flax & Flood has shown how climate conditions in the past caused unreliable water supplies on the Ericht, driving mill owners to crowd mills alongside particular parts of the river and invent engineering solutions that ensured the levels of water power they needed. But their decisions blocked the passage of the Atlantic Salmon back and forth to spawning grounds in the north of the catchment and the legacy of their industry is still negatively impacting the health of the salmon population a century and a half later.

The insights gained, and the questions raised will help those involved in leading nature restoration on the Ericht today, such as the new **River Ericht Catchment Restoration Initiative**, respond to the impacts of increasing floods and drought driven by climate change and take the urgent action needed to give our endangered salmon access to cold, clean water they need to survive.

Marl Mania

The shell marl of Strathmore, deposited by melting ice flows, give us a fascinating glimpse into deep time. The fact that there were glaciers in Strathmore as little as twelve thousand years ago at the end of the last Ice Age, reminds us that climate change, unconnected with and unaffected by human activity, has always been part of Earth's history, and that climate change will continue into the future on a geological time-scale. While we may be able to influence the rate of change we are causing as a species in the short term, humanity cannot override or reverse these long-term global trends.

Along with land drainage, the clearance of the peat mosses, and the fertilising of the land, marl contributed to the transformation of much of Strathmore into one of Scotland's most agriculturally fertile regions. However, the rise of the intensive land management practices that went with this 'age of improvement' resulted in a huge loss of natural habitats and a decrease in biodiversity.

Thankfully, we are beginning to understand that this loss can be reversed by adopting agricultural practices which are more sympathetic to wildlife and more protective of the natural infrastructure upon which all life, including ours depend.



A sample of Marl from Strathmore (2024)

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Page 9 Freshly cut peat frying, photo Clare Cooper

Page 10 Flanders Moss, photo courtesy of Visit Scotland

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Page 16/17 Flooding on the River Isla in 2022, photo Markus Stitz

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Page 21 A flooded Strathmore from Alyth Hill, photo Markus Stitz, the River Detectives coring at one of the sites, photo Clare Cooper, Flooded Bardmony Bridge, photo Markus Stitz

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Page 24 Aerial view of repaired embankments built in 2024 on the River Isla at Bendochy, photo Markus Stitz, James Stobie's 1783 map, image of plan of Nether Balhary, courtesy Balhary Estate

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Page 30 Drought frequency in Scotland 1850 - 1900 by the River Detectives, diagram showing the heights of the weirs by the River Detectives, Oakbank Weir, photo by Peter Dawson, a LiDAR image of the Lornty Burn joining the River Ericht from the National Library of Scotland's side by side georeferenced maps viewer

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Page 34 A map of Fingask Loch showing the marl excavation site in the north west corner, image courtesy of Perth & Kinross Archives, Fingask Loch today, photo Markus Stitz

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