VITAL CONNECTIONS

Pioneering a Community Science approach to surveying the Alyth Burn and its catchment

"Find your place on the planet. Dig in, and take responsibility from there"

Gary Snyder, poet and bioregionalist

Alyth River Keepers

Bioregioning Tayside

cateran ECO museum

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BACKGROUND & CONTEXT

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, the latest headline data[1] 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 predicted[2], and higher temperatures and more extreme weather events becoming a regular occurrence, 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 second 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 Tayside's river system 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]

The project aimed to test the waters and lay the foundations for longer term involvement by local people in understanding and monitoring landscape change in the Alyth Burn catchment and to begin to collect new data sets that will enable better adaptation to extreme weather and the regeneration of natural habitats.

[1] State of Nature 2023: stateofnature.org.uk
[2] Scotland's Climate Changing Faster Than Predicted, James Hutton Institute: hutton.ac.uk/news
[3] The first stage began in 2021 on the River Ericht, VITAL SIGNS: cateranecomuseum.co.uk
[4] Growing Bioregioning Through Community Science: storymaps.arcgis.com/

"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

The context for the project was the increasing number of flood events in the town of Alyth in eastern Perthshire. Following a number of near and actual flood events in 2020 and 2021, a group of volunteers from the town took the initiative to set up the Alyth River Keepers (ARK). This group monitors 18 'pinch points' along the water course in the Den 'O' Alyth, sites that have been chosen because they are either likely to collapse during extreme precipitation or allow the build-up of debris which, if unchecked, could cause water surges further down in the town. Currently the River Keepers take photographs of each of the pinch points after extreme weather events and store them digitally for record and analysis. Alerts are then sent to Perth & Kinross's Green Space team who are responsible for managing the Den.

Working with other locally based organisations and with support from the Perth & Kinross Community Led Local Development Fund, ARK designed a six-month surveying project from January to June 2023, which aimed to develop a broader understanding of the catchment, its natural and cultural heritage and its ecological processes. Around 15 people from Alyth and broader Tayside took part in a series of activities, collecting data on geomorphology, ecology and landscape history. This entailed:

- **A written summary of the geomorphology** of the Alyth Burn catchment, together with two guided walks by local glacial geomorphologist Dr Wishart Mitchell, explained its glacial past and how the catchments' steep topography and narrow channel contributed to the likelihood of flooding in the town centre, which was built on a former flood plain.

- **Environmental surveying** under the guidance of local ecologist Daniele Muir, the group, documented plants, trees and wildlife in the Den at different times of year.

- **Tree Planting** took place in one section of the Den 'O' Alyth. 15 Black Alder, (Alnus glutinosa) and 30 Common Hazel, (Corylus Avellana) were planted by the group near the water course adjacent to the Tullyfergus bridge.

- **Historical surveying**, under the guidance of local landscape historian Christopher Dingwall was undertaken by one of the volunteers, who searched through old maps and place names to try and identify land use changes over the last 400 years.

The aim was to lay foundations for more regular surveys extending across the whole of the Alyth Burn catchment, which would aim to add monitoring the impact of flooding on natural habitats as well as humans. Extreme flood events have a number of negative impacts on freshwater ecosystems. Floods increase surface run-off, exacerbating erosion and introducing more soil, organic matter and pollutants into water courses, whilst erosion within the river channel is also increased. Plant biomass and the abundance of both vertebrates – such as fish – and invertebrates can be dramatically reduced by extreme floods.

The overall objective of more holistic and consistent surveying is to help develop community-led strategies, which can enable better flood adaption, increased ecosystem resilience and greater involvement by local people in the regeneration of their natural infrastructure on which their lives depend.

PARTNERS, FIELD EXPERTS AND VOLUNTEERS

Field Experts

Geomorphology,
Dr Wishart Mitchell

Environment,
Daniele Muir

Landscape History,
Christopher Dingwall

Volunteers

Richard & Janet Brinklow, Kevin Coe, Clare Cooper, Helen Dickinson, Pamela & Alasdair Dutton, David Gainsford, Miles Goodman, Ron McGill, Lorna Thorpe

Partners

The Alyth River Keepers are a group of volunteers from the town of Alyth, formed after near and actual flood events in 2020 and 2021, who monitor 18 'pinch points' along the water course in the Den 'O' Alyth. These sites have been chosen because they are either likely to collapse during extreme precipitation or allow the build-up of debris which, if unchecked, could cause water surges further down in the town. The group is now evolving to include monitoring the impact of flooding on the Alyth Burn's natural habitats.

Bioregioning Tayside is a new platform bringing together people in Tayside to build community resilience and respond to the planetary crises we face. Bioregioning re-invigorates and restores how we humans think about our presence on this planet and how we act because it challenges us to see a geographic area – **our place** – first and foremost through its natural infrastructure instead of the infrastructure humans have designed – turning shires and cities into biomes and watersheds. Changing the frame in this way offers us the opportunity to perceive our interdependence with the natural world in new ways and take the urgent action needed to bring human and biotic communities back into a healthy, balanced co-existence with each other.

The Cateran Ecomuseum is a museum without walls set across 1,000 sq km of east Perthshire and west Angus – 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 pre- history to the present day. Set in specific landscapes, ecomuseums 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 and a focus for community empowerment and regenerative tourism.

WHAT IS COMMUNITY SCIENCE AND WHY IS IT RELEVANT TODAY?

The group intentionally chose to work through a Community Science[5] 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.

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.

[5] Community science: A typology and its implications for governance of social-ecological systems: researchgate.net/publication

"The most important work we can do today is weave the weft of community into the warp of these times"

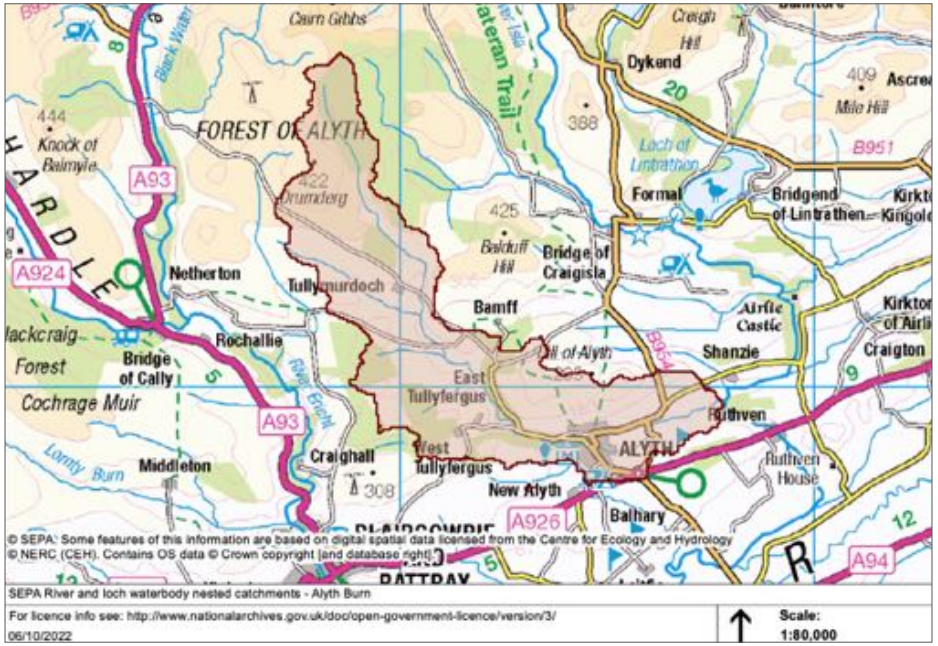
Writer and Activist, Alastair McIntosh

WHAT DID WE FIND OUT?

Geomorphology

Dr Wishart Mitchell undertook a short study of the geomorphology[6] of the Alyth Burn Catchment for the project. The catchment size is calculated by SEPA as 36.28 sq km to its confluence with the River Isla.

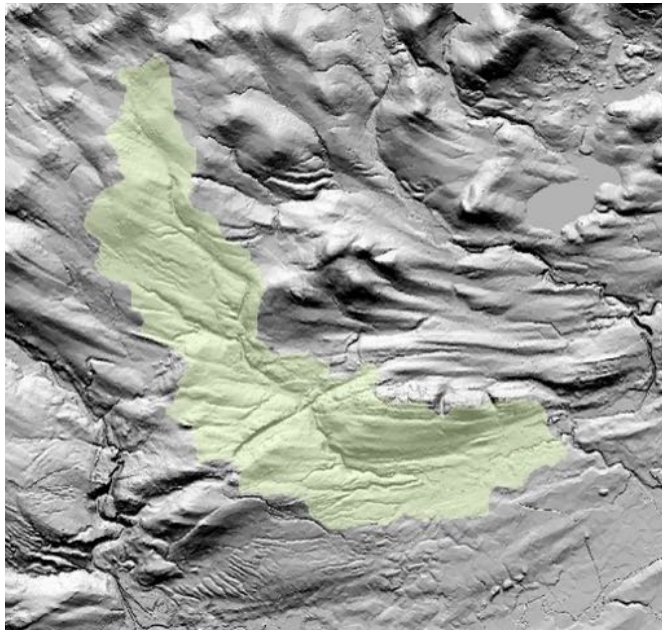
It is a small catchment constrained between the more extensive catchments drained by the River Ericht to the west and the River Isla to the east, of which it is a tributary. The landscape of this part of Tayside can be described as a dissected plateau with gently sloping upland areas that are incised by valleys eroded first by rivers and since modified further by glacial ice and meltwater during the multiple climatic changes that mark the current Quaternary Period, which began 2.58 million years ago with a particular emphasis on the impact of glaciation and deglaciation during the last 30 thousand years.



[6] The full study can be read here: bioregioningtayside.scot

The catchment is notably narrow in its upper part, being about 1km in breadth in its upper reaches. A series of tributaries, occupying former meltwater channels come together to flow across the Highland Boundary Fault through the Den 'O' Alyth gorge, a major bedrock channel. The geological structure of the catchment, with its volcanic and sedimentary rock types has created a steep catchment, prone to 'flashiness', with waterflow rising and falling quickly. As the number of extreme precipitation events increase with global heating, the town of Alyth, built on the floodplain at the bottom of the catchment, will inevitably suffer increased flooding. As Dr Wishart Mitchell, author of the geomorphology report said: "If you started from scratch today, you would not necessarily put Alyth where it is".

Perth & Kinross Council are currently undertaking a Natural Flood Management Study for the town to ascertain what new adaptations might be possible to help manage the increased flooding events. Separately, Bamff Wildland have funding for a nature connectivity project focussed, in part, on the upper catchment, which will investigate designing a series of interventions that would enable some channels to re-access their natural floodplains, slow the flow of water off the land, by 're-wiggling', and by putting large woody debris (including whole, mature trees) directly into the water course. It is hoped that further funding will be found to enable ARK to contribute further to both these initiatives.



Environmental Survey

The Den is one of a series of wooded gorges in eastern Perth & Kinross important for its diversity of flora and fauna and cited by NatureScot (NS) as a Site of Special Scientific Interest (SSSI.)

The SSSI is mostly semi-natural mixed woodland with several plants which are locally uncommon, including lily of the valley and birds-nest orchid. The tree species within the woodland vary across the site depending on soil conditions. On the richer soils at the base and sides of the Den, ash-birch woodland has developed and covers about a quarter of the site, although ash die back is very visible. Sycamore is also present in the canopy here. Hazel can be common in the understorey, especially on the field edges to the south and the ground flora is rich in species such as dog's mercury and herb bennet among others.

Beech is a major component of the non-native tree species composition, and its impact is most critical to the local ecology. Beech regeneration is considered the main cause of the unfavourable condition of the SSSI; it casts a heavy shade over much of the year and produces a thick and persistent leaf litter. There are few native species which can survive in these conditions, so where the beech is dense, the ground is often virtually devoid of vegetation. Sycamore is another species present in parts of the site, and both the beech and sycamore are regenerating. Expansion of these species leads to a loss of the semi-natural communities and the special qualities of the Den. As a result of the significant presence of both these tree species, the condition of the woodland is considered to be unfavourable.

Other tree species are present, including oak, with some possibly ‘veteran’ examples of sweet chestnut on the road side. Hazel on the field edges still showed signs of coppicing from earlier times.

Of particular concern to the group was the lack of past riparian planting on the banks, which was leading to increasing bank erosion, with the remaining mature trees – mostly beech – regularly falling during extreme weather events and tearing away huge chunks of the banks leaving them vulnerable to even more erosion. A small number of Black Alder and Common Hazel were planted near the water course close to the Tullyfergus Bridge as part of this project in order to begin mitigating this issue. However, the drought in the late Spring of 2023 meant that many of these young trees died.

Historical records show the river as containing Atlantic salmon (Salmo salar) and brown trout (Salmo trutta), of which brown trout, at least, are still present. Water Invertebrate sampling by the group showed good numbers of Caddis Fly larvae, Mayfly nymphs and freshwater shrimps.

A diversity of birdlife was recorded during the project. Dippers are a common sight as are Grey Herons, Buzzards, Mallard Ducks, Wood Pigeons, Jays, Magpies, Bullfinches, Pheasants, Blackbirds, Tits and Robins. Camera Traps showed an abundance of Pine Marten, Brown Hare, Red, Roe and Fallow deer, Foxes, Badgers and Red Squirrels. No Grey Squirrels were seen. Beavers, common in the north of the catchment at Bamff Wildland, were spotted at the Tullyfergus Bridge. Stoats were frequently captured on the camera traps as were Field Mice and Rats. Otters were also recorded.

One survey documented on one transect in the early spring evidenced over 30 species of woodland and freshwater plants.

Historical Survey[7]

The landscapes of Strathmore, including the Alyth Burn Catchment landscapes have been moulded and managed by humans for centuries. Different kinds of land-use over that period have affected the natural flow of water courses, influenced human settlement and, as we are now beginning to understand, reduced the biodiversity, essential for the processes that support all life on earth, including humans. Bringing this historical perspective into this project was an important aspect of the project, given the impact of land-use on landscape change.

Before the 18th century, there are few maps showing how land-use in the Alyth Burn catchment has evolved over time. Even after that point, it is difficult to give more than a broad-brush impression of how land-use has changed, although significant large-scale trends can be identified from a survey of historical maps, particularly in the later 19th century. From the 12th to the 16th centuries the catchment area north of the town was part of the Royal Forest of Alyth. In the Middle Ages a foresta in Latin meant a hunting reserve, an area where the holder controlled the vert (the vegetation) and the venison (the game). This enabled the lord, the holder of these forest rights, to control wood-cutting, ploughing, the growing of crops, grazing of cattle and sheep and access through the forest since all these activities could damage the habitat of the deer.

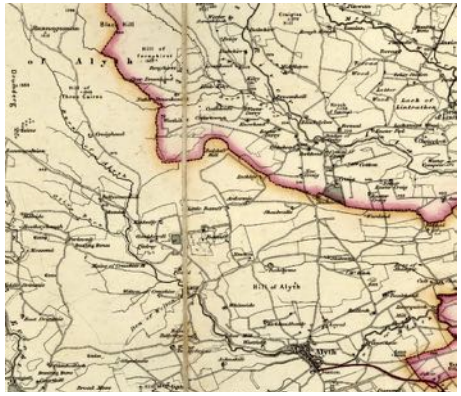
In practice he usually permitted these activities on the payment of a fine or a fee. Hunting deer and boar was, however, more strictly controlled, though poaching must have been fairly common. So forests were not recognisable features in the landscape. They were simply a set of rights or rules imposed over an area of land held by its lord who could be a king, baron, bishop or abbot. Woods often survived better in forests and so gradually by the 16thc in Scotland the word came to mean a wooded area as it does today.

[7] The full Historical Survey can be read here: bioregioningtayside.scot

By the 18th century the Roy and Stobie maps indicate many settlements in the area, suggesting fairly intensive arable farming with the Stobie map also recording at least four mills along the course of the Burn, confirming its importance as a source of power for agricultural and industrial activities. From the 19th century, the Ordinance Survey maps and Name Books, which listed place-names and land use for nearly all fields and enclosures in a parish, show major transformations beginning to happen in settlement distribution and land-use. The maps and the Name Books together present a snapshot of the landscape as it was in the middle of the 19th century, which can be compared with Stobie's map of the late-18th century and satellite imagery of the present day to show the evolution of land-use in the Alyth Burn catchment over the last 200 or more years.

The two most significant changes are the disappearance of most of the dozens of small settlements or steadings that once dotted the valley upstream from Alyth, leaving only ruins or no trace at all; and the massive shift in land-use from arable to pasture and forestry.

In the Drumderg/Tullymurdoch upland sector, over the last 150 years or so, the amount of arable land has declined by more than 90%, and that of pasture by more than 50%. The spread of forestry during the 20th century accounts for most of this change, with the area planted to commercial monocultural non-native trees expanding more than 10-fold from under 200 acres to well over 2000 acres. In addition, windfarms now occupy dozens of acres of this area.



James Stobie map, 1783

Modern aerial view of the Alyth Burn Catchment

In the upper-central Bamff/Tullyfergus sector, land-use changes since the mid-19th century differ from those further upstream: arable land has declined by more than 80%, but pasture has increased by almost 20% while commercial forestry has increased from just over 100 acres to around 1000 acres today. Another windfarm now occupies much of the southwest portion of the area. On the threshold of the lowlands in the Alyth Hill/Johnshill sector, trends from upstream are replicated, with arable land down 60% and pasture up by 50%. Commercial forestry cover has also increased, especially on the western and southwestern slopes of Alyth Hill.

Down in the valley floor, in the Alyth town/Pitcrocknie sector, urbanisation has proliferated over the last 150 years, with some 350 acres of former agricultural land gone to the expansion of the town, and especially the new Pitcrocknie satellite village to the east. The OS maps of around 1860 show a corn mill at Millhaugh, a 'plash' mill (part of the textile works on the southern bank near the Pack Bridge), and a woollen mill on Mill Street all relying on the Burn as a source of power. Today, all three mills plus a gas works next to the woollen mill have long since disappeared.

Across the Town/Pitcrocknie sector as a whole, the area of arable land is down 50% from its mid-19th century figure, while pasture land has increased by more than 200%, echoing trends seen in the upstream sectors. The expansion of the town along with the construction of the railway and sewage works have contributed to a 90% fall in the area of woodland and heath in this sector.

Most noticeably, the course of the Burn itself through this sector has seen major changes. Between Springbank, on the south-eastern edge of Alyth, and the Pitcrocknie steading, a sequence of meanders has been eliminated and the Burn has been canalised for around three quarters of a mile, apparently to facilitate the construction of the railway line into Alyth (opened in 1861).

CONCLUSION AND NEXT STEPS

Landscapes contribute to several aspects of our lives. Not only do they provide the 'natural infrastructure' - water, land to grow food, and climate - on which all life, including ours, depends, they are the bedrock of key parts of our economy such as food production and tourism, a source of our own and our national identity and they play an important role in our health, wellbeing and sense of place.

Growing people's awareness of, and interaction with their landscapes is essential to addressing the climate, biodiversity and health crises. Projects like this one offer new ways to connect people to the landscapes on their doorstep and offer the potential to create new structures which will encourage them to take a leadership role in how they are managed in the future.

The partners and volunteers involved were keen to take a catchment-scale approach to the project and to take into account how historical human behaviours had changed the landscape of the catchment, how this had contributed to present-day flooding impact and biodiversity decline and what lessons could be learned that could enable better management of the catchment in the future.

In the past, management of the water environment has fallen to Government, to private companies and to landowners, often operating in isolation. However, a catchment-scale approach embeds collaborative working at a river-catchment scale, enabling attention to be paid to all the issues that enable a healthy river system – including how geomorphology, land-use and catchment management affects the hydromorphological processes and addressing critical issues such as diffuse agricultural pollution, water abstraction and barriers to lateral and longitudinal connectivity.

The project evidenced that people enjoy getting together i.e. benefiting from the social aspect beyond the specific activities they are engaged with and that they have skills and knowledge to bring to projects like this one that could be better shared to build capacity and agency within communities and develop larger, more consistent groups who could act as new stewards of our landscapes. Crucial to building on what the group achieved during the short period of this project is more consistent funding that pays for organisation and expertise. This would enable a more tailored approach to the different interests and skills of the volunteers and allow for more targeted engagement strategies for particular groups, such as school children, young people and those who are often harder to reach. It would also enable a much more comprehensive quantitative and qualitative data collection strategy which could store data in such a way as to make it more easily accessible by communities, local authorities and agencies and more useful in building local community adaptation and resilience strategies via e.g. Local Place Plans.

A new governance strategy for streamlining data collection methodologies and enabling similar projects across the Tay Bioregion to connect could provide valuable insights for community-led mitigation and adaptation strategies across the whole River Tay catchment system.

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CLLD Community-Led Local Development

NatureScot
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