

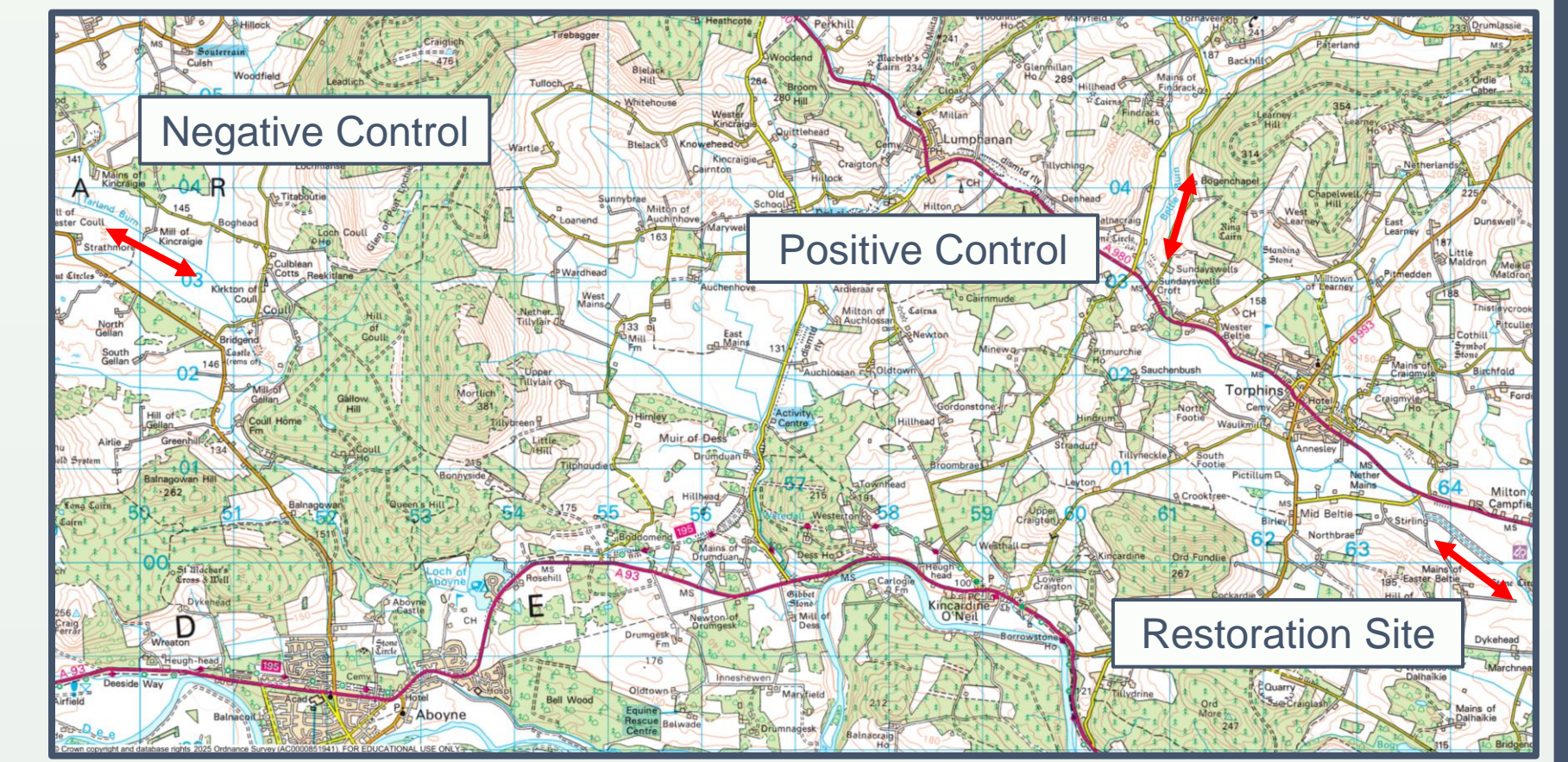
## Background

The Easter Beltie River Restoration research project has been **underway since 2017**, and the **main restoration event happened in Autumn 2020**. One component of the research is to investigate the **response of the macroinvertebrate fauna to habitat changes** within the river channel.

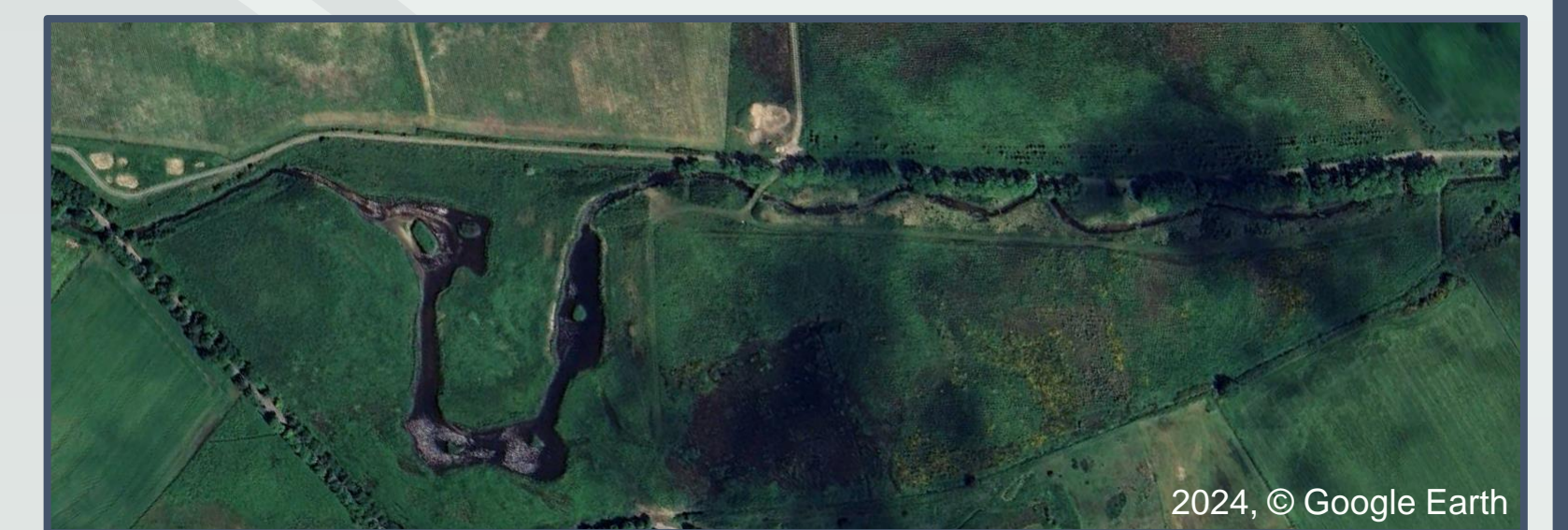
Previous research has shown a **highly variable response of the macroinvertebrate fauna to river restoration**. Some reviews and opinion pieces have linked some of this variability to inadequate experimental design, notably a poor Before-After-Control-Impact (BACI) type approaches.

Some of these challenges are difficult to overcome, for example, the collection of *Before* (baseline) information is extremely challenging due to the **short-notice nature of the funding** for these projects, other challenges can be addressed. Specifically, **appropriate field Controls** and **minimising/eliminating sources of subjectivity in the data collection**, can reduce the non-experimental noise in the collected data.

## Maps



Pre-restoration

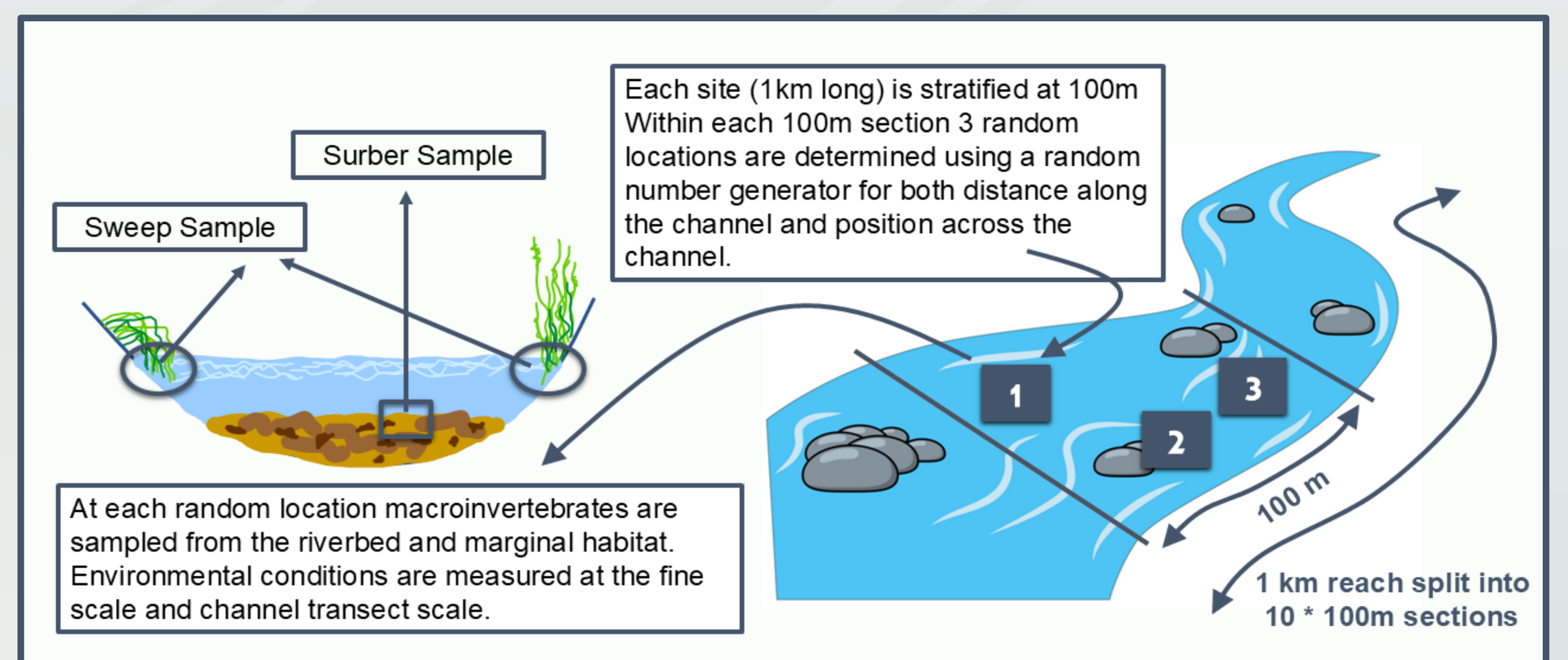


Post-restoration

## Monitoring Approach

To address some of the common issues, the following monitoring approach was adopted:

- Bias in sample location → **stratified random sampling**
- Effort → **fully quantitative & semi-quantitative** data collection
- Seasonality → **highly constrained sampling period** (April)
- BACI **Before** (2017, 2018, 2019) | **After** (2021, 2022, 2023, 2025)  
**Control** (Positive “natural” & Negative “straightened”)  
**Impact** (Easter Beltie, Restoration)
- Macroinvertebrates identified to a high a taxonomic resolution, generally species for most groups, but lower classifications for others (e.g. Diptera, Oligochaeta)



By adopting an approach, where human judgement has been removed to a level which is practical, the data collection for the project has addressed concerns which have been raised by multiple scientific reviews, and our own experience.

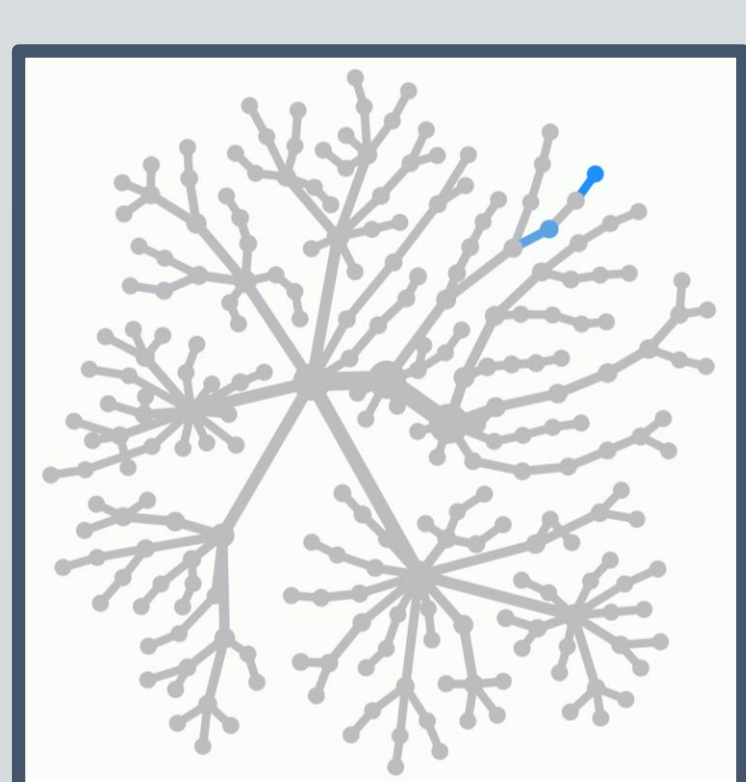
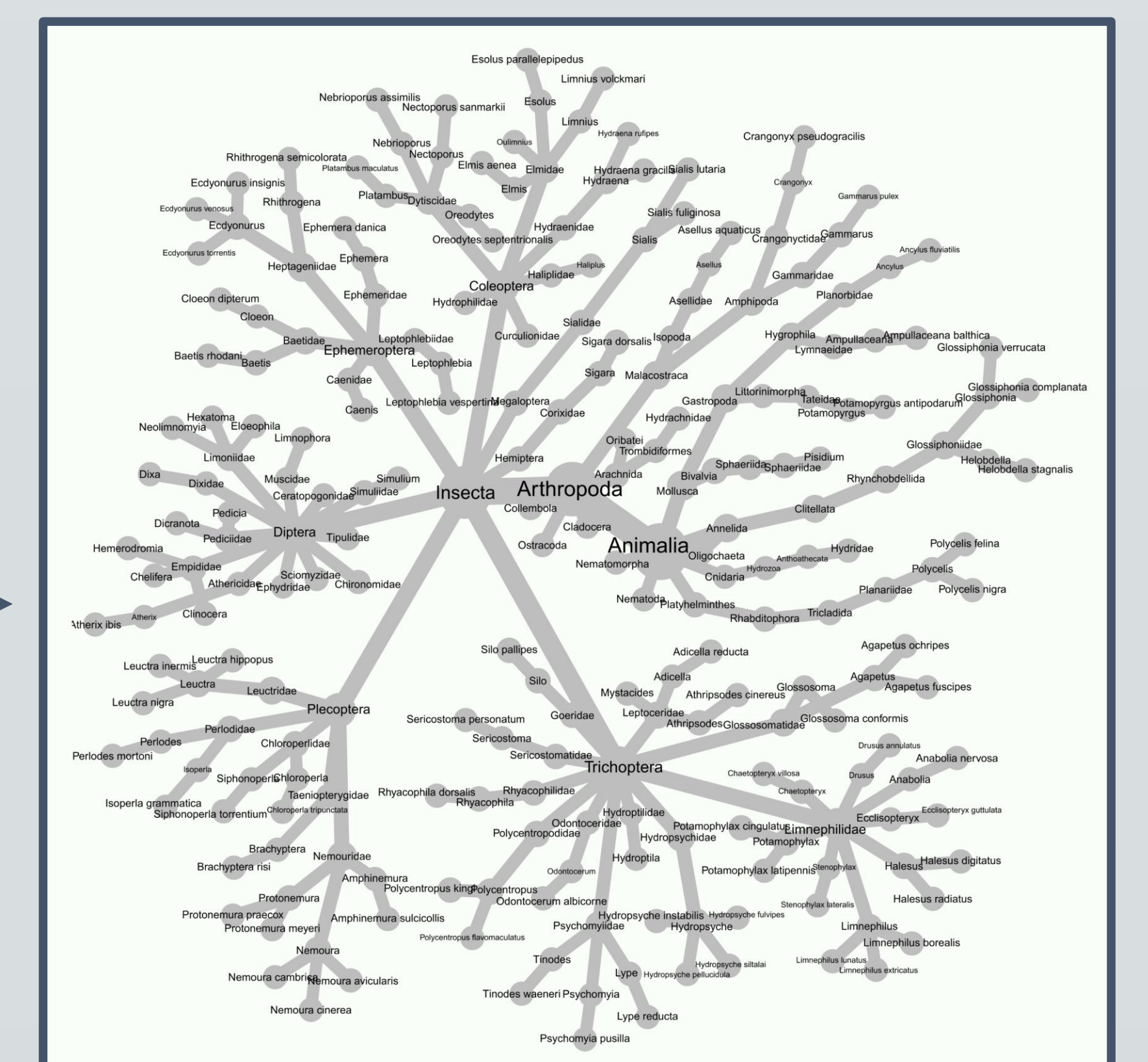
## Early Results

Presented here is the **change in the macroinvertebrate community at the restoration site**. The results are from the Surber samples and represent the change in density and identity of individuals associated with the riverbed. The data are presented as **taxonomic maps, which retain the hierarchical relationships** between the community fauna. Analysing community data using this approach allows all levels of identification resolution to be included, avoiding the rather frustrating situation where information is lost when individuals have not been identified to the same taxonomic level.

The chart to the right depicts the whole community which has been recorded from the Easter Beltie between 2018 and 2023.

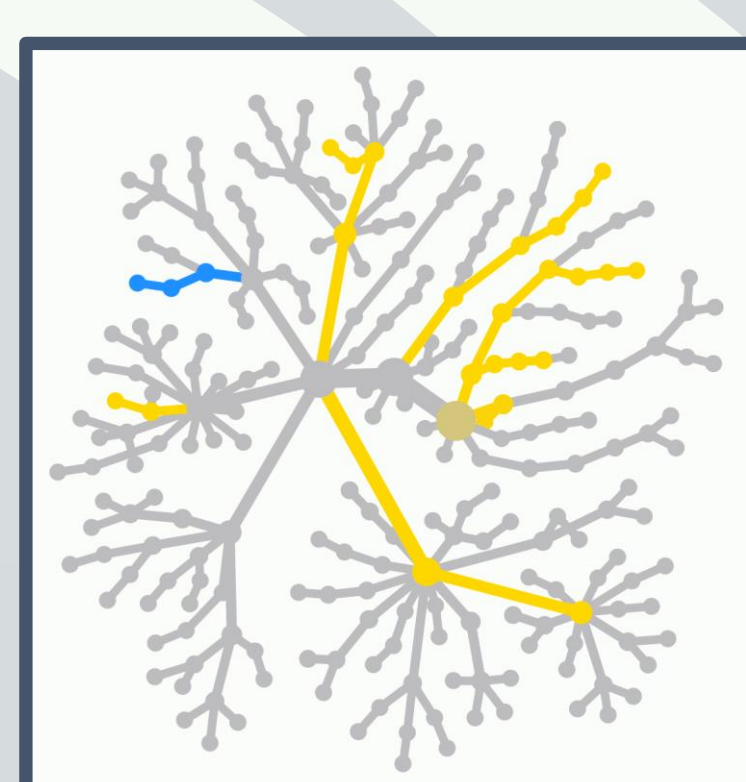
The charts below depict **timeseries pairwise differences** between the macroinvertebrate community starting with 2018 and ending with 2023. **Blue** highlight indicates a statistically **greater density** in the later year and **yellow** indicates a **lower density**.

For example, in the **pre-restoration** years (2018 cf. 2019) there is **little difference** between the paired years, while in the comparison between 2019 cf. 2021, representing the difference in the year **following restoration**, there is a significant disturbance to the community indicated by a **reduction in density** in multiple taxonomic groups.



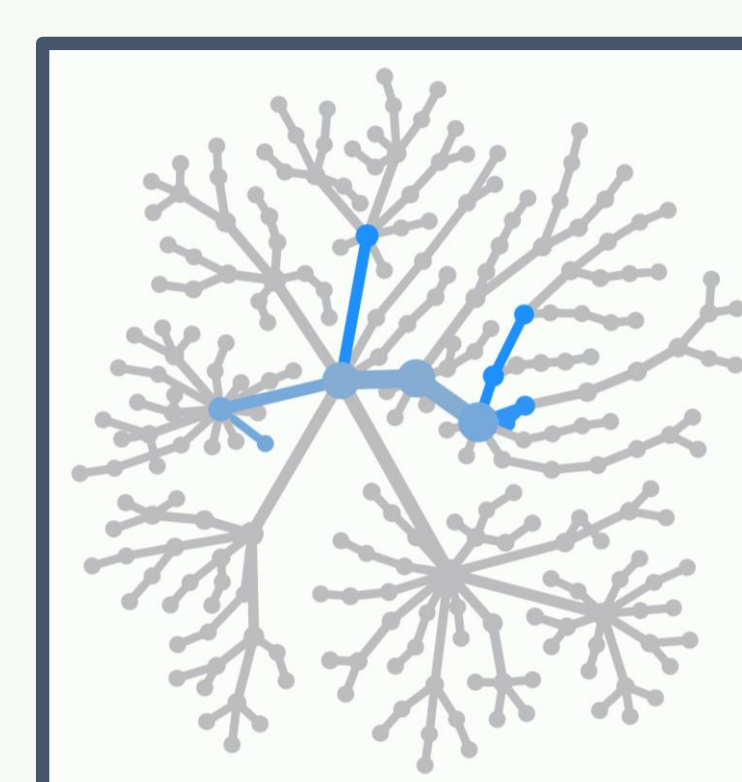
2018 cf. 2019

Pre-restoration fauna differences between 2018 & 2019  
*Gammarus pulex/fossarum* only showing any difference between the two years



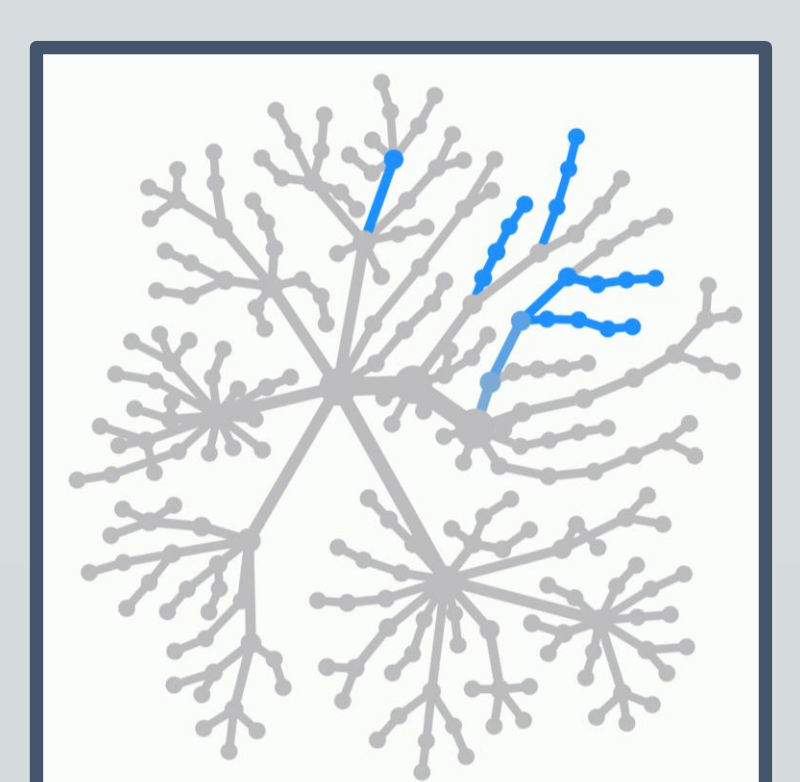
2019 cf. 2021

The restoration has caused a significant decrease in the density of a number of groups, e.g. Coleoptera, Mollusca, Trichoptera and a significant increase in density of *Baetis rhodani/atlanticus*



2021 cf. 2022

In the years following the restoration, there has been an increase in the density of some of the groups that were initially disrupted.



2022 cf. 2023