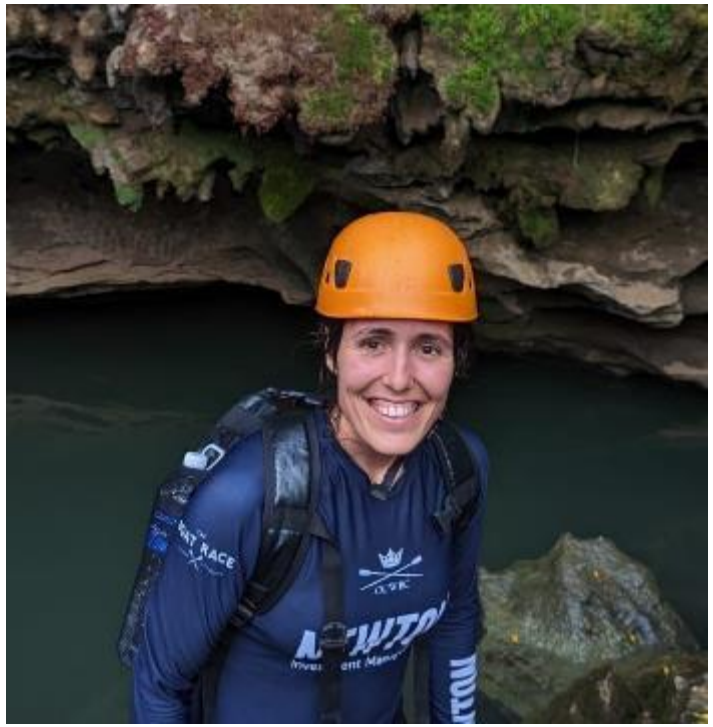
Dr Karina Marsden



Tilly Edwards

Prof Andy Smith

Project Team

Karina Marsden – Teaching and Research Lecturer in Soil and Environmental Science, expertise in GHG quantification and mitigation

Tilly Edwards – NERC funded Envision PhD student determining the role of epiphytes in C and N cycling in temperate rainforests

Andy Smith – Professor of Forest Ecology, expertise in forest ecology, biogeochemistry, plant-soil interactions and ecosystem function

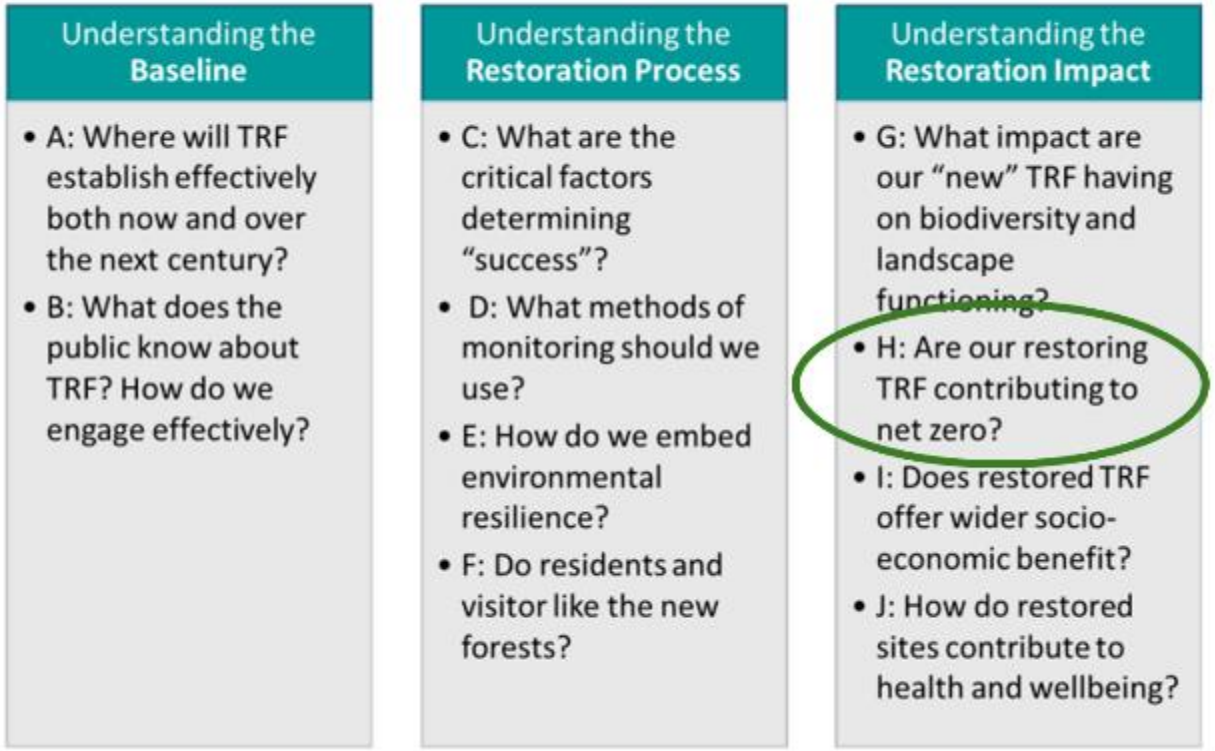
Cryptogamic covers

- Diverse assemblages of mosses, lichens, cyanobacteria and algae
- Lack specialised tissues shown in “higher plants”
  - No true vascular system
  - Reproduce via spores
- Cover diverse substrates and surfaces
  - rock, soil, decaying wood, on other plants (= epiphytic)
- Contribute to biogeochemical and hydrological processes

Overarching Aims

- Establish source-sink dynamics of greenhouse gases (CO_2, CH_4 and N_2O) from cryptogamic covers
- Quantify their overall importance in the carbon balance of temperate rainforests

Figure 1: Research Priorities and underlying themes of interest in the Aviva Temperate Rainforest Research Programme.



Non-CO_2 greenhouse gases (GHG) and trees?

nature

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Article | Open access | Published: 24 July 2024

Global atmospheric methane uptake by upland tree woody surfaces

Vincent Gauci ✉, Sunitha Rao Pangala, Alexander Shenkin, Josep Barba, David Bastviken, Viviane Figueiredo, Carla Gomez, Alex Enrich-Prast, Emma Sayer, Tainá Stauffer, Bertie Welch, Dafydd Elias, Niall McNamara, Myles Allen & Yadvinder Malhi

Nature **631**, 796–800 (2024) | Cite this article

- Tropical, temperate and boreal forests
- CH_4 uptake via methanotrophy (bacteria on and in tree surfaces)
- Height of tree surface (> 2 m) found to be important

Non-CO_2 GHG sources and sinks from cryptogams?

Article | Open access | Published: 16 October 2017

Cryptogamic stem covers may contribute to nitrous oxide consumption by mature beech trees

Katerina Machacova, Martin Maier, Katerina Svobodova, Friederike Lang & Otmar Urban

Scientific Reports **7**, Article number: 13243 (2017) | Cite this article

- Absorbed N_2O by cryptogamic covers may constitute an additional N source
- If consumption > (re)emission then negative fluxes can occur
- N_2O consumption found to increase under **wet conditions**
- Likely to be N_2O conversion to N_2 by complete denitrifiers but mechanism not been established

- Importance of N_2O and CH_4 uptake in temperate rainforest unknown

Research Questions

1. Do cryptogamic covers act as sinks for greenhouse gases in temperate rainforests?
2. How do the source-sink dynamics change with contrasting communities and substrates?
3. Do the source-sink dynamics change with height above the forest floor?
4. Do the source-sink dynamics change temporally (diurnally and seasonally)?
5. Do the source-sink dynamics change across temperate rainforest restoration age?
6. What is the magnitude of importance of cryptogamic covers in the carbon balance of temperate rainforests?

Study Sites - Chronosequence

Young, medium and old restoration age

- Coed Hendre Ddu
  - Privately owned
  - Cwm Pennant (Garndolbenmaen)
- Gwaith Powdr (Wildlife Trusts; Penrhyndeudraeth)
- Coed Crafnant (Wildlife Trusts; near Harlech)

Spatial GHG flux measurements

- Laser-based instruments CO_2, N_2O and CH_4 to be determined
- Contrasting substrates
  - Rocks
  - Soil
  - Dead wood
  - Tree surfaces
  - Tree bows
- Height above forest floor

- Focus on the “pristine” temperate rainforest (i.e. **impact** of restoration)

Photo credit: Tilly Edwards

Temporal GHG flux measurements

- Spatial campaign to inform the temporal campaign – but likely to focus on tree stems (at contrasting heights)
- All sites to be monitored across four seasons
- Daily and nocturnal flux measurements to be determined
- Metadata will also be collected

- Upscaling of the results to quantify the contribution of cryptogamic covers on the overall C budget of temperate rainforest

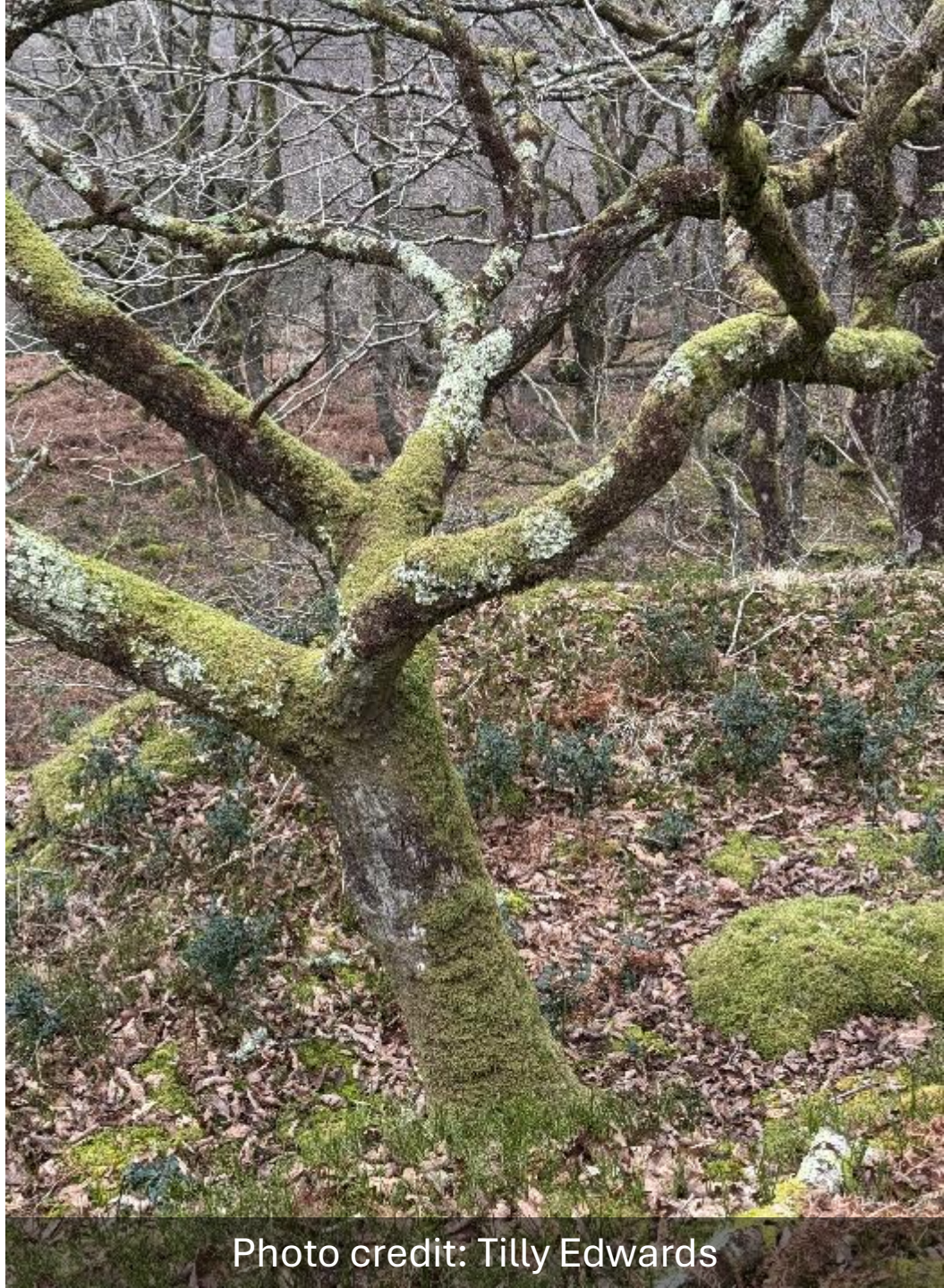

Photo credit: Tilly Edwards

Deliverables

Open access datasets of GHG fluxes and controlling variables (e.g. temperature, humidity, PAR)

2 scientific publications one focusing on spatial aspect and one on the temporal aspect

Non-technical summary for stakeholders

Stakeholder workshop and virtual tours of the forests (VR experience and web-browser based 360-degree imagery)

Summary

- Temperate rainforest restoration is set to expand in the UK
- Detailed understanding of whether restored temperate rainforest is contributing to net zero is required
- Previous studies have demonstrated CH_4 and N_2O uptake on tree surfaces
- Quantifying this in temperate rainforests important for establishing C budgets / C credits

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The Wildlife Trusts

AVIVA