

A study of tree disease on St Helena

Amy J Webster, Mojgan Rabiey, Megan C McDonald, Norbert Maczey, Rebecca Cairns-Wicks, Philip Taylor, Robert Reeder, Robert W Jackson

UNIVERSITY OF BIRMINGHAM

BIFOR
BIRMINGHAM INSTITUTE OF FOREST RESEARCH



Introduction

St Helena is a volcanic island with an endemic cloud forest along its central ridge¹. The forest provides water, CO₂ sequestration and tourism income¹. An unknown disease-causing agent coupled with climatic changes, threatens the forest resilience³.

Aims

- Understand the pathosystem on the island to improve disease prevention and safeguard the cloud forest.
- Improve the islanders ability to cope with the disease beyond the time of the project.

Methods

- Monitoring health of 12 *Melanodendron integrifolium* (black cabbage) trees (Figure 1).
- Survey of microbiota through isolations.
- Multi-loci phylogenetic analysis of candidate pathogenic *Phytophthora* spp. Carried out using the ITS1, ITS2, cox-spacer and YPT1 loci.

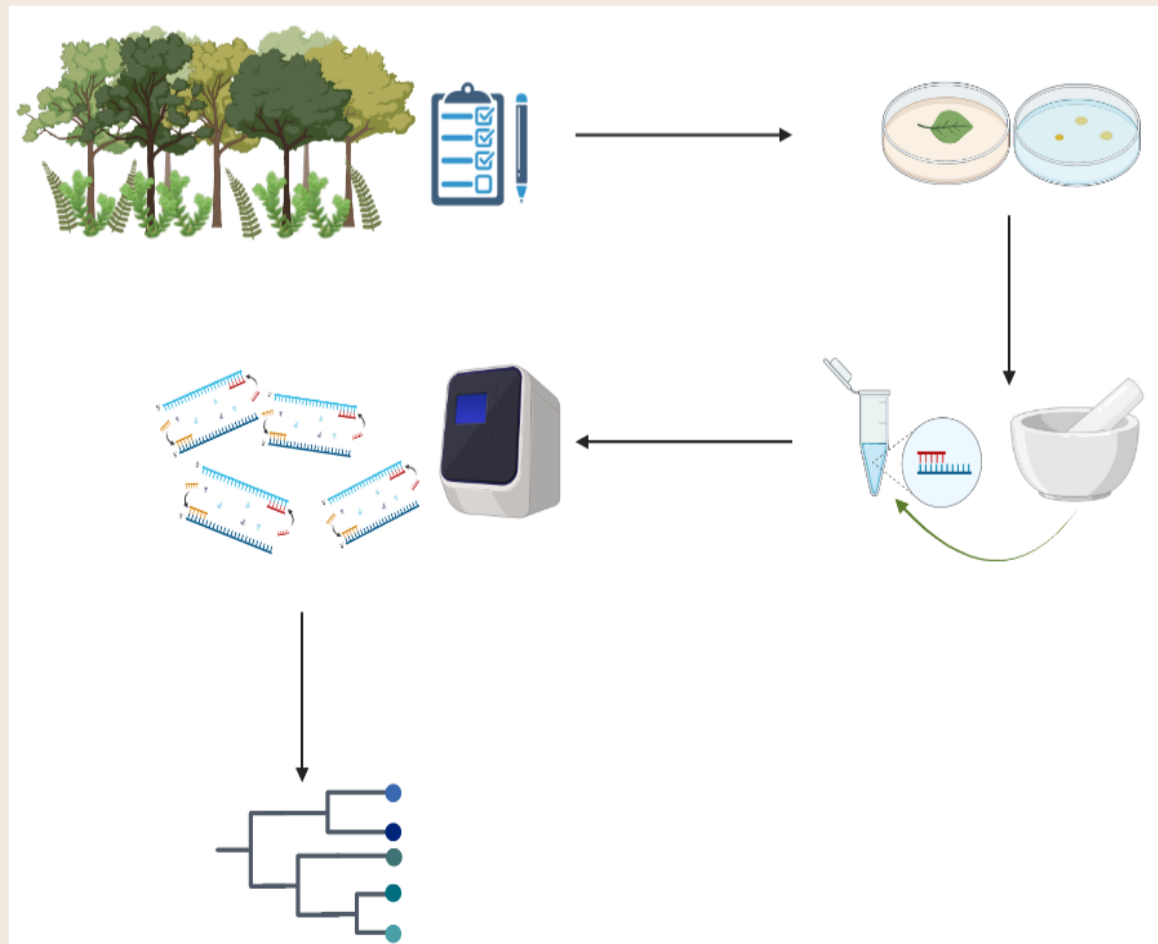


Figure 1: Initial method used to survey, isolate and identify candidate pathogens.

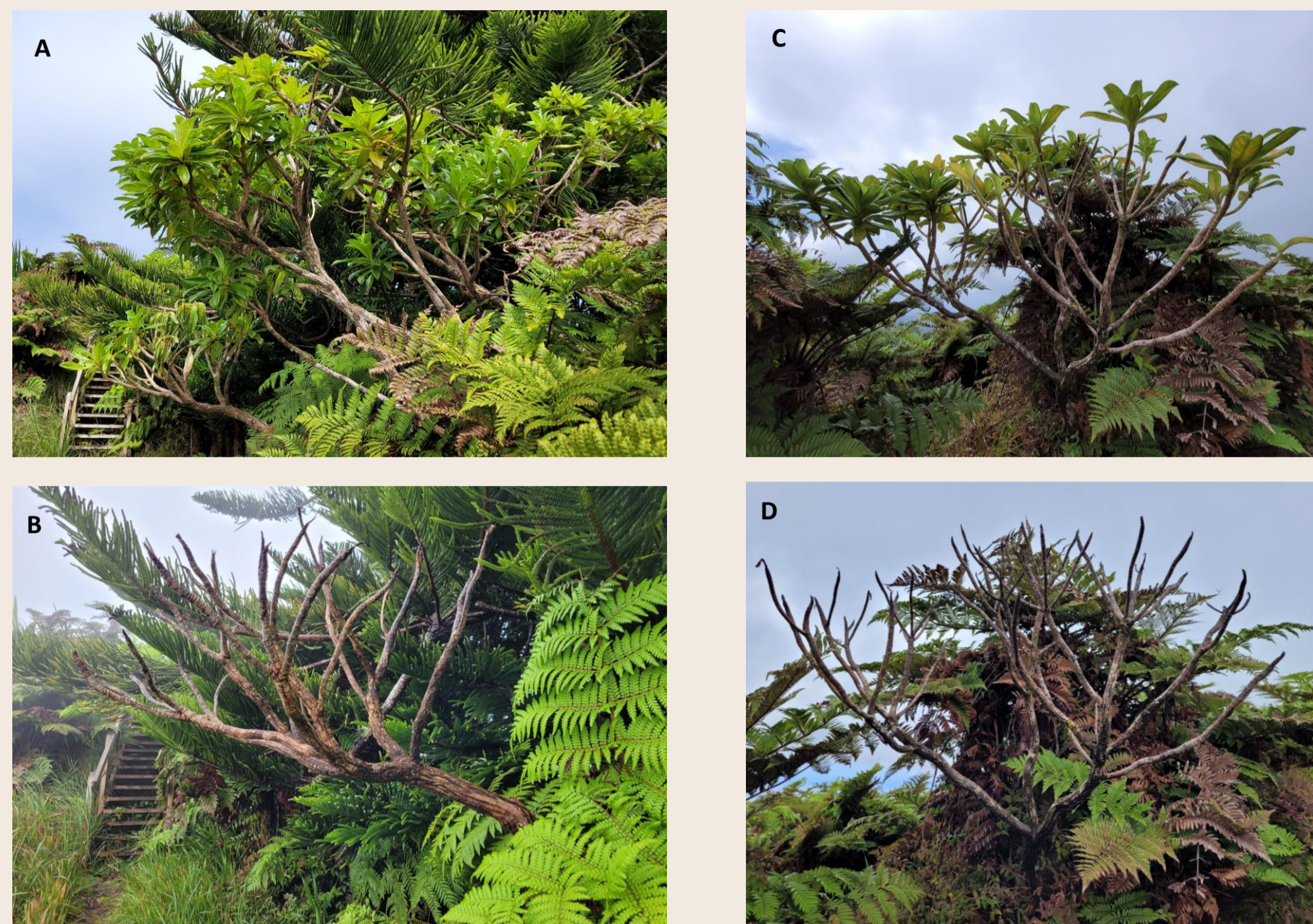


Figure 2: Black cabbage tree 9 and 7 killed during monthly monitoring on the island. Tree 9 shown in June 2022 (A) and November 2023 (B). Tree 7 shown in June 2022 (C) and September 2022 (D).

Findings

1. Cycles of recovery from dieback during wetter months, followed by death (Figure 2).
2. Clustering of dead black cabbage trees around deceased trees 9 and 7 (Figure 3 & 4).
3. *Phytophthora* spp. isolated from several endemic trees however not from black cabbage.
4. *Phytophthora* isolate falls within *P. cryptogea* complex clustering with "*P. kelmiana*" (Figure 4).
5. *Ilyonectria* spp. isolated from black cabbage trees and saplings.

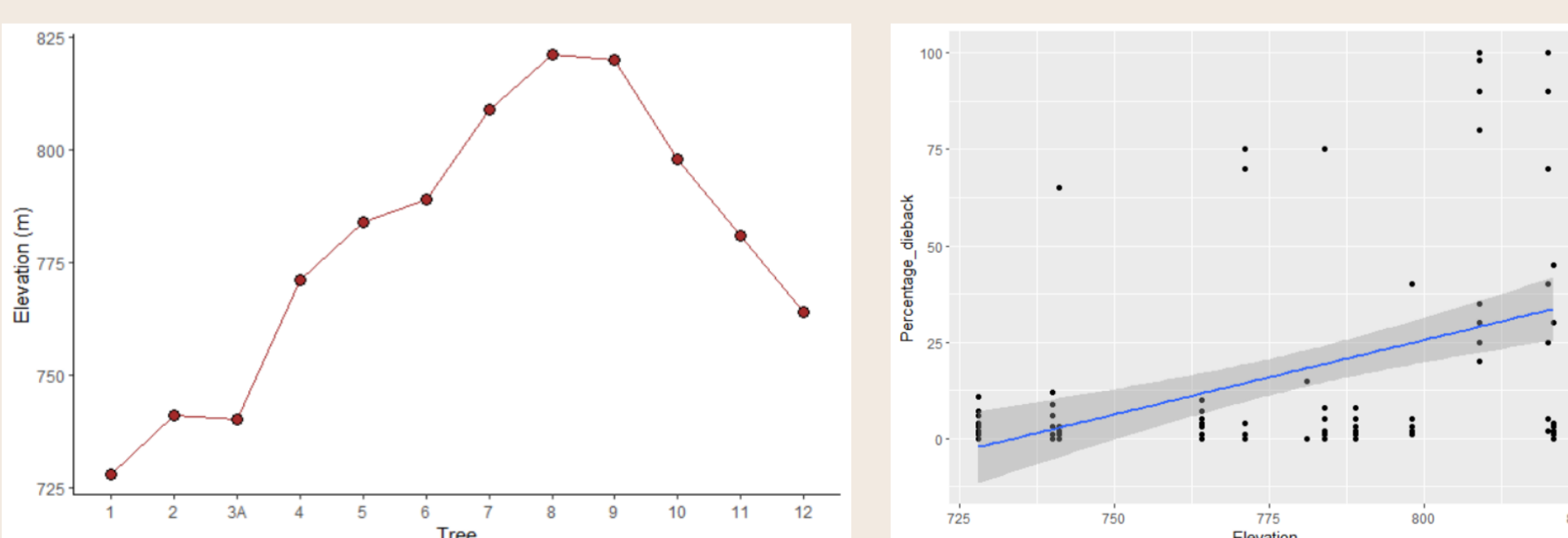


Figure 3: Distribution of 12 focal black cabbage trees across the peaks (left) and a linear mixed model of correlation between dieback and elevation ($r^2 = 0.4$).

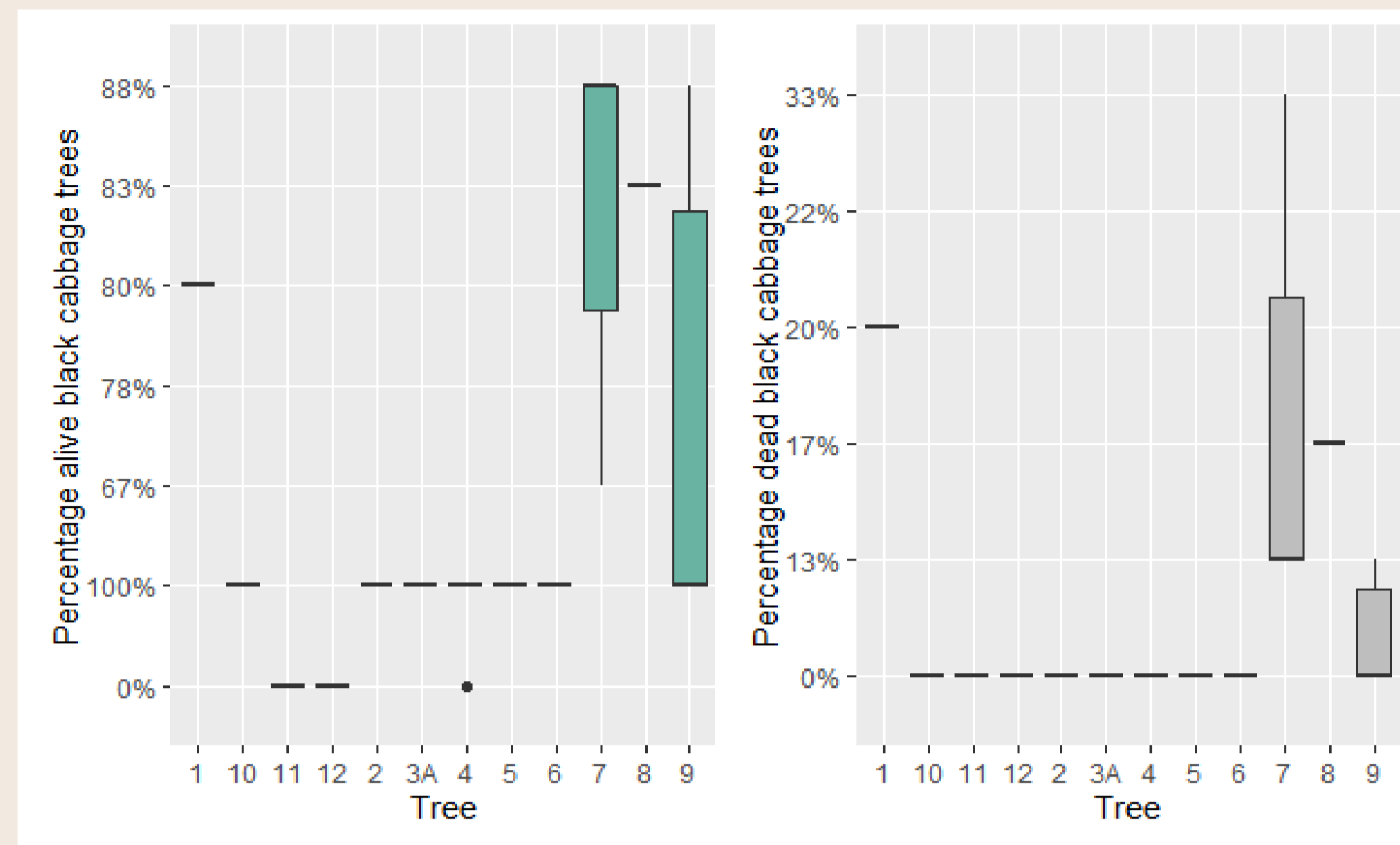


Figure 3: Percentage of alive (left) and dead (right) black cabbage trees found surrounding each of the 12 focal black cabbage trees monitored monthly from April 2022 – January 2023.



Key:
WW = Whitewood
SC = She Cabbage
BC = Black cabbage
RW = Redwood
P = Peaks
N = Peak's nursery
S = Scotland's nursery

Figure 4: Phylogenetic trees showing the clustering of several *Phytophthora* species and unidentified isolates from St Helena based on the cox-spacer (left) and YPT1 (right) loci. All sequences were aligned using Geneious alignment and the trees produced using RAxML with 100 bootstraps, and best fit maximum-likelihood.

Conclusions

- Wet seasons may increase soil inoculum leading to tree death.
- "*P. kelmiana*" has been associated with tree disease but better characterisation is necessary.
- *Ilyonectria* and *Phytophthora* have moved into nurseries.
- Heterogeneity between *Ilyonectria* isolates is host dependent

Future work

- Artificial inoculations to examine host range
- Build a reference genome for the *Phytophthora* and *Ilyonectria* on the island
- Population genetics study of candidate pathogens
- qPCR diagnostic tool development to monitor replanting sites

References
1. Lambdon, P. & Cronk, Q. 2020., *Frontiers in Ecology and Evolution*. 8.
2. Gray et al 2019., *Biodiversity and Conservation*, 28(6), pp.275-296.
3. Detheridge et al 2020., *Fungal Ecology*, 45.

Email: AJW118@student.bham.ac.uk

Twitter: @AmyJW31