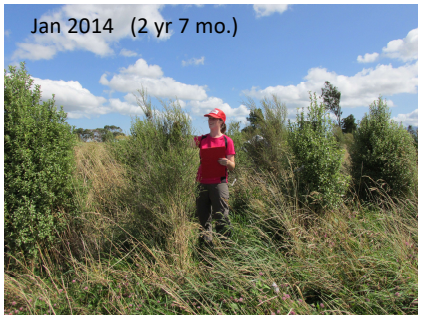
Tree survival, growth, sequestration and natural regeneration of a Wairarapa swamp forest restoration project.

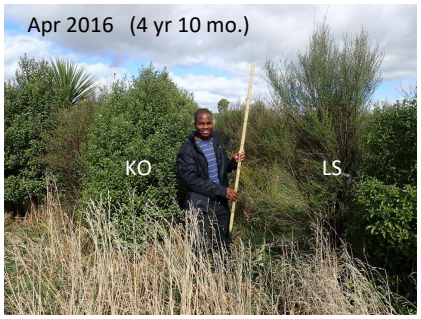
Stephen Hartley[1], Benoit Magat[2], Aurore Fanal[3], Manon Hulley[2]

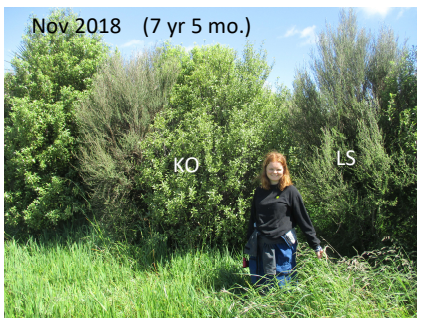
1. Centre for Biodiversity and Restoration Ecology, Victoria University of Wellington, NZ. 2. AgroSUP, Dijon, France. 3. Gembloux Agro-Bio Tech, Belgium

INTRODUCTION

Natural, restored and reconstructed wetlands can enhance biodiversity and many ecosystem services, including carbon sequestration (Tomscha et al. 2019). However, there is a lack of documented data on native tree species' survival, growth rates and sequestration trajectories in such projects. Here we report the results of eight years of monitoring at the Wairio Wetland Restoration site.







IMAGES ↑ Growth of kohuhu (KO) and mānuka (LS) trees.

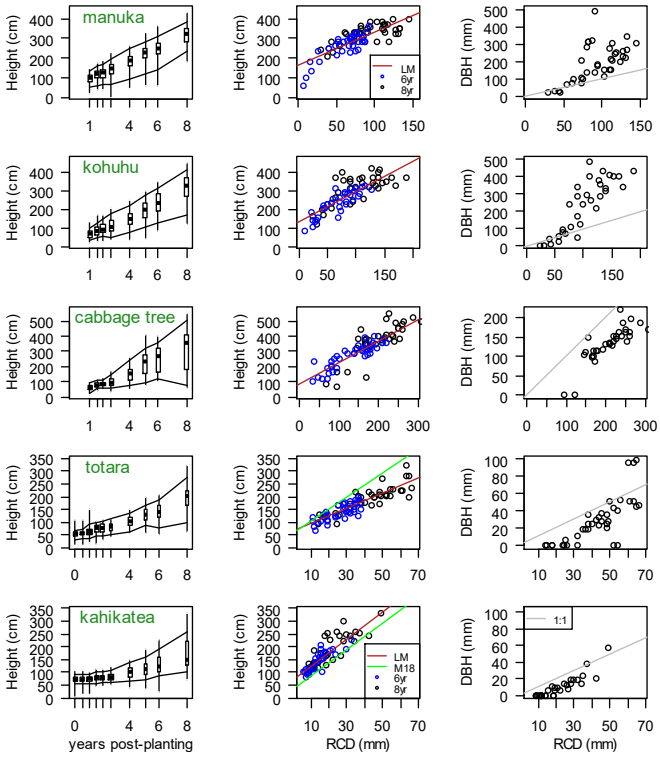
RIGHT → Tōtara seedling under kohuhu and manuka

METHODS

Over 2000 trees of 8 species were planted in experimental plots in a retired paddock at Wairio wetland (near Lake Wairarapa). **Survival** and **height** (H) were measured at annual intervals, and from 2017, diameter at breast height (**DBH**) at 1.35m and root collar diameter (**RCD**) at 10cm were recorded from a subsample of each species.
Linear models (**LM**) were fitted to the relationship between height and RCD, and compared to relationships recorded by Marden et al. 2018 (**M18**) for tōtara and kahikatea. The ratio of DBH to RCD was examined by species.
Total carbon content was estimated following the methods of Bergin et al. (2011) using the equation **Carbon**(kg) = $0.0186(\mathbf{RCD}(cm)^2\mathbf{H}(m))^{0.976}$, except for cabbage trees for which we developed our own volumetric equation.

RESULTS

After eight years, mānuka (LS) and cabbage trees (CA) had the highest survival rates (52-56%), the podocarps, kahikatea (DD) and tōtara (PT), had survival rates of 41-48%. Cabbage trees grew tallest, *Pittosporum tenuifolium* (KO) and *Olearia virgata* (OV) sequestered the most carbon over the eight years (7.4 and 5.1 kg per tree, respectively) and kahikatea and tōtara the least (0.1 to 0.8 kg per tree).



Species	% Survival after 8 years	Average carbon (kg) per tree
Leptospermum scoparium (LS)	**55.9**	**4.67**
Pittosporum tenuifolium (KO)	**48.1**	**7.38**
Coprosma propinqua (CP)	34.1	1.62
Coprosma robusta (CR)	15.4	3.32
Olearia virgata (OV)	42.9	**5.10**
Cordyline australis (CA)	**52.3**	**4.64**
Podocarpus totara (PT)	41.1	0.81
Dacrycarpus dacrydioides (DD)	**47.7**	0.12

CONCLUSION

At initial planting densities of 4440 trees per hectare (1.5m spacing), similar planting projects bordering ephemeral wetlands in the lower North Island using the same species mix may expect to sequester 33 tonnes of CO_2 per hectare in the first eight years.

More importantly, the eight year old mānuka and *P. tenuifolium* have shaded out tall fescue grass and created conditions in which natural regeneration of kahikatea and tōtara can begin. Podocarps have slow growth initially, but ultimately these will be the most massive trees of a restored swamp forest.

REFERENCES

Bergin et al. (2011) Technical Bulletin *Tane's Tree Trust* Sect. 10.5 & pers. comm.
Marden et al. (2018) *NZJ Forestry Science* 48:9.
Tomscha et al. (2019) *Ecosphere* 10:10.
See also, https://www.wgtn.ac.nz/sbs/…/wetlands-for-people-and-place

ACKNOWLEDGEMENTS

The Wairio Wetland Restoration Trust, Ducks Unlimited, Greater Wellington Regional Council, Department of Conservation, Fish & Game, Ngati Kahungunu, Bridget Johnson, Aprille Gillon, Tapuwa Mapara and Florence Wellington.