Effect of Salix spp. in Styx Mill Conservation Reserve

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Executive summary

Styx Mill Conservation Reserve is a wetland area that holds cultural, social, and ecological value. Invasive willows can threaten the ecological health of wetlands and are present within Styx Mill Conservation Reserve.

Willow removal techniques are labour and cost intensive. Is willow removal worthwhile to restore the natural environment?

Our research question is: What are the impacts of willow tree presence on native plant regeneration at Styx Mill Conservation Reserve?

Quantitative data collection method was used to compare native regeneration between three site categories: native

Introduction

Restoration ecology is becoming increasingly important as anthropogenic stressors increase at an unprecedented rate, causing severe degradation and alteration to the natural environment (Suding, 2011). Severe habitat loss, increased fragmentation, and an influx of invasive species has resulted in a dramatic loss of native species. (NZ) unique geological background, landscape, and climate; there is a vast amount of endemism*. This concept could be applied to Styx Mill. However, the benefits of nurse plants on species richness may be exclusively correlated with harsh environments (Callaway, Brooker, Choler, Zaal, & et al., 2002).

How invasive mammals impact native regeneration

Brushtail possums ( ), European rabbits ( ), and two rat species (,) are small invasive mammals consume native vegetation at Styx Mill (The Styx, 2020). There is limited information on the interaction between invasive mammals and willows, and how this impacts native plant regeneration (Wilson, 2003).

Possums and rats consume large quantities of native plant material such as seeds, flowers, fruits, and leaves, and in the absence of ungulates consume seedlings (King & Forsyth, 2021; Wilson, 2003; Clayton, 2008). At high densities can alter the recruitment and composition of native plant communities (Allen, Lee, & Rance, 1994, Wilson, 2003). In native forests adjacent to pasture, damage caused to native plant seedlings was likely due to rabbits. Further away from pasture into the forest, seedling damage is reduced, as rabbits were less common (Gillman & Ogden, 2003).

The physiology of willow trees, invasive traits, and removal techniques

Willows tend to grow in well-watered environments or around damp/swampy areas (Weih et al., 2006). Their invasive traits enable them to survive in the water tract of highly disturbed sites with low native vegetation. The growth patterns of willows are the leading cause for invasive tendencies in willows as their access to waterways enables them to spread on large scales. Invasive tendencies include high dispersal rates through breakable branches dropping into waterways (Lewerentz et al., 2019). Researchers also found complex root systems and higher growth rates in juveniles than natives, also contribute to invasive growth trends (Lewerentz et al., 2019).

Due to these invasive traits' willows require extensive removal techniques to target growth and reinvasion. Through a before-after control-impact experiment the application of drilling glyphosate into roots significantly reduced willow cover and reinvasion rates. This method is desirable for willow control as it provides accurate results with low collateral damage in non-targeted vegetation (Burge et al., 2017). Overall, results showed willows treated with glyphosate allow for increased native regeneration.

The effects of willow trees on native fauna biodiversity

The effects of willows on native biodiversity are varied. Willows in waterways positively effect native benthic invertebrates* and had no effect on native fish (Glova & Sagar, 1994).

Negative trends were also observed in terrestrial biodiversity. Native arthropod abundance and diversity decreased with the presence of invasive plants (Litt et al., 2014). Native beetle abundance and diversity decreased with grey willow presence (Watts et al., 2012).

Avian biodiversity peaked in areas of native vegetation, decreased with willow presence and was lowest in sites with no vegetation (Holland-Clift et al., 2011). This highlights the importance of strategic removal plan

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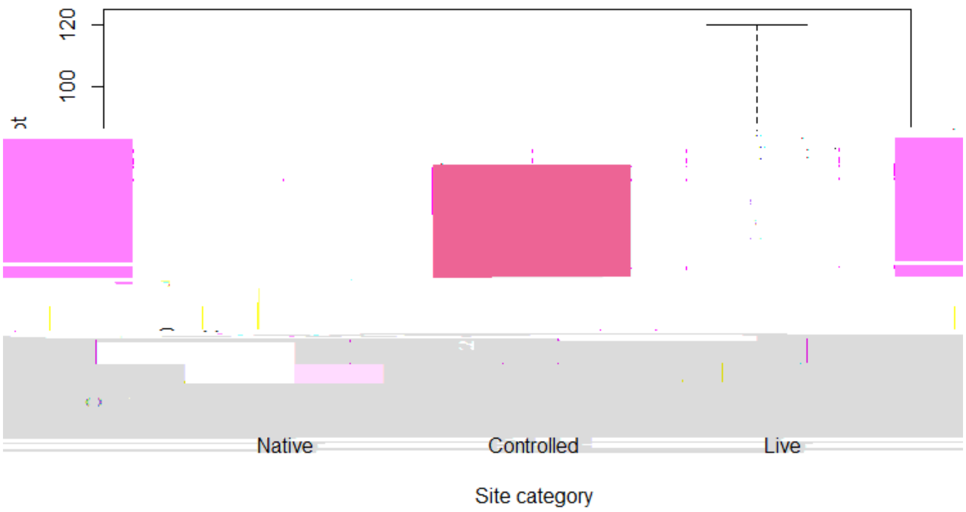
Analysis of deviance table from a multi-factor quasi-Poisson run testing the response variable of native plant density against predictor variables; site category, willow abundance, level of herbivory and distance from stream.



Boxplot showing density of native plants (stem count) between different site categories; native vegetation, controlled willows and live willows.

Boxplot showing density of native plants (stem count) between plots with varying amounts of willows; none, few, some and lots of willows.

Boxplot showing density of native plants (stem count) between plots with varying levels of herbivory; none, small and some herbivory. No sites had large amounts of herbivory.

Boxplot showing density of native plants (stem count) between plots found at varying distances from the stream; near (<2m), medium (2-7m) and far (>7m).

The relationship between willow abundance and native regeneration is likely to be more apparent as the native trees mature. This is because as plants mature, they need higher levels of light and nutrients. Willows will compete with natives for resources and prevent them from reaching full maturity (J. W. Griffiths & McAlpine, 2017). Over the next 10 to 20 years the competitive relationship between willows and natives at Styx Mill can be observed in more detail.

Willow size

Sites with high abundance of willows tended to have smaller willow birds. When looking at instream diversity, willows had a positive impact on native benthic

Recommendations to New Zealand Conservation Trust

We recommend that the current management of willows at Styx Mill continues. Although our study found that native plant regeneration was not affected by willow presence, the literature tells us that there are other crucial factors that should be considered. Wider biodiversity of animals is negatively impacted by invasive plants including willows (Schirmel et al., 2015; Holland-Clift et al., 2010)) Aspects of bank stability are important to consider as it differs with stream velocity. The Styx River is slow flowing through Styx Mill, and in areas with willows present it is known to encroach and push the water up over the banks. This is common with willows on the banks of slow flowing rivers (Marttila et al., 2018) This influences our recommendations, as we suggest prioritising control of willows near the river to avoid encroachment.

We also recommend maintaining the removal strategy that is occurring at Styx Mill currently which avoids clear-felling. Native biodiversity of animals, especially native birds, responds poorly to areas with no vegetation (Holland-Clift et al., 2010). Thus, drilling glyphosate into the base of the trunk and keeping the controlled willow trunk provides habitat for birds, invertebrates and keeps some shelter for native regeneration.

In addition to the continued management of willows, we also recommend the continued planting of natives. While this was not something we tested for, we found that native seedlings within sites had mature versions of those species close by. This suggests that seed source plays a significant role in native regeneration. This suggestion is corroborated by a study from Cordell et al., (2009) that also recommends management of non-natives and planting of natives to incentivise native regeneration.

A native species that has been shown to be capable of regeneration following willow control is kahikatea. (Griffiths & McAlpine, 2017). We would recommend planting more kahikatea to promote native regeneration growth reflecting similar elements from the historic wetland of Canterbury.

Future plans for native plant regeneration within Styx Mill sh we recommend that treatment of willows with glyp

Appendix B.

Data collection sheet used at each sample site.

			LW DW N
Sunny/ Overcast Raining Windy Other:			
<2m <7m		none small some lots	

>7m

0-5cm 5-

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