Enhancing Riparian Restoration Through Improved Monitoring and Collaboration

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Key Points

- Effective stakeholder engagement is crucial for the success of riparian restoration projects, fostering collaboration and alignment of objectives among diverse stakeholders.
- The integration of robust monitoring protocols, such as the Restoration Outcomes Monitoring Protocol (ROMP), provides valuable insights into restoration effectiveness and informs adaptive management strategies.
- Stratified site selection, encompassing both public and private land, allows for a comprehensive assessment of restoration outcomes across diverse tenure and management contexts.
- Challenges such as persistent weed growth, fauna browsing, inadequate stock exclusion measures, and inefficient communication between assessors and stakeholders underscore the importance of proactive mitigation strategies and continual monitoring to address evolving restoration obstacles.

Abstract

Melbourne Water invests substantial resources each year to improve the health and amenity of waterways in the Port Phillip and Westernport Catchment in the greater Melbourne region. The organisation has a responsibility to maximise the ecological and social benefits of that investment, and riparian revegetation activities are a fundamental way of improving waterway health, biodiversity benefits and amenity. The Restoration Outcomes Monitoring Protocol (ROMP) is a long-term revegetation monitoring program designed to track pre-establishment, establishment (1-3 years) and post-establishment (>3-20 years) phases. The protocol considers a range of plant attributes (e.g., weediness, ground layer attributes, native species richness and abundance, vegetation structure, recruitment and canopy presence) in revegetated areas, and compares these to remnant sites with similar target vegetation communities. Revegetation success or failure is then related back to original establishment techniques and subsequent maintenance to identify what approaches worked most efficiently. Here we discuss some of the considerations of initiating a landscape-scale restoration program, including negotiating with multiple landholders and project managers and aligning monitoring with planting prior to and during works. We also discuss the many factors that influence plant establishment and survival, and the drivers of revegetation success or failure. This work aims to develop knowledge in best practice revegetation techniques to restore structurally and functionally diverse landscapes across many different riparian areas. With targeted monitoring we can understand what approaches deliver the greatest revegetation success and these efficiencies will improve confidence in investment and environmental outcomes.

Keywords

Restoration, revegetation, intervention management, collaboration

Introduction

Riparian areas, critical for the health and amenity of waterways, face numerous anthropogenic pressures, including land clearing, urbanisation, and invasive species, which have led to the degradation of numerous stream ecosystems (Naiman et al., 1993). Melbourne Water, recognising the importance of waterway health, invests substantial resources each year to enhance the ecological and social value of riparian areas. Central to these efforts is riparian revegetation, which play a pivotal role in mitigating anthropogenic pressures and improving waterway health. Effective stakeholder engagement is essential to ensure the success of these interventions, as it fosters collaboration, aligns objectives, and can maximise the impact of restoration initiatives.

An earlier investigation into restoration practices compared remnant sites and those revegetated 10 – 15 years prior to assessment (Foley-Congdon et al., 2024). While the findings suggested similarities in species richness and tree cover across revegetated and remnant areas, the study also noted distinct differences. Specifically, sites subject to revegetation exhibited a deficiency in natural recruitment and an increased prevalence of weed species. An identified limitation of this study was the challenge in discerning the original planting species and site management practices, owing to the absence of consistent monitoring methods applied before and after planting.

In the past, many revegetation programs have lacked robust documentation of the monitoring and assessment of restoration effectiveness, including the influence of weather, anthropogenic, or environmental factors on the restoration outcomes (Foley-Congdon et al., 2014, González et al., 2015). Similarly, lack of robust databases meant that planting and site maintenance information may have been lost over time. Thus, there has been a tendency to allocate additional resources to sites without sufficiently addressing and learning from past mistakes. Consequently, there is a pressing need to improve revegetation outcomes by maintaining documentation about the planning and planting of revegetated areas, and to develop monitoring programs that assess short and long-term planting outcomes across multiple sites in comparison to target habitats.

Here we examine a project aimed at enhancing riparian management interventions, through leveraging existing knowledge to maximise success and minimise resource expenditure. By understanding the processes and stakeholders involved in implementing a landscape scale revegetation program we can better optimise resource allocation (Ruiz-Jaen & Aide, 2005). This can be done by leverage monitoring protocols such as the Restoration Outcomes Monitoring Protocol (ROMP) (Jellinek et al., 2022) to better understand what drives restoration outcomes and adaptively manage these into the future. This project seeks to not only enhance ecological resilience, but also improve the cost-effectiveness of restoration efforts, thus ensuring the long-term sustainability of waterway ecosystems and potentially take into account the detrimental impacts of climate change.

Background

The Restoration Outcomes Monitoring Protocol (ROMP) is a structured monitoring approach that was developed to assess the effectiveness of management interventions such as revegetation, weed control and pest animal management in the Port Phillip and Westernport region, and to track how restored areas change into the future in comparison to target remnant areas (Jellinek et al., 2022).

ROMP is designed to be undertaken as a Before After Reference Intervention design, where possible. This means that monitoring should take place before and shortly after interventions, and then at pre-defined periods, with restored sites paired with target (remnant or reference) habitats if appropriate sites are available. The ROMP method breaks monitoring down into three phases. These phases include:

1. Pre-establishment phase: undertaken 1 to 2 weeks prior to site preparation being undertaken.
2. Establishment phase (0 to 3 years): monitoring areas within 1 to 2 weeks after management interventions, then every spring for 3 years. Undertaken at intervention and target sites.
3. Post-establishment phase (5 to 20+ years): monitoring the longer-term changes at the site in spring (intervention and target sites) every 5 years since establishment.

In the pre-establishment phase, baseline information is collected prior to revegetation being undertaken. Where possible, this work should involve discussions with on-ground staff to identify exactly where and when management interventions will be undertaken.

Monitoring Methods

Study Sites

The study was undertaken in the greater Melbourne area in Victoria, Australia and began in Autumn 2022. Fifteen sites were selected where restoration activities were planned to be undertaken by Melbourne Water regional waterway managers. The site selection process was critical to ensure the stratification of survey sites across important environmental gradients (e.g. stream size, climate, soil type and landscape context). This stratification would ideally show how revegetation survives and grows in different areas, and what factors, such as contextual (e.g., climate) and site modifiers (e.g., site preparation and land-use history), etc., are likely to influence intervention outcomes. Among these sites, some were located on public land while others were on private land, reflecting the diverse tenure and management contexts within the region.

Revegetation intervention sites were matched to nearby (within 10 km) remnant sites of similar vegetation type (as judged by Ecological Vegetation Class). Ten remnant sites were selected. In subsequent years, ten more new revegetation sites and five remnant sites were added each year. As of Autumn 2024, 35 revegetation and 9 remnant sites have been monitored for the program (Figure 1).

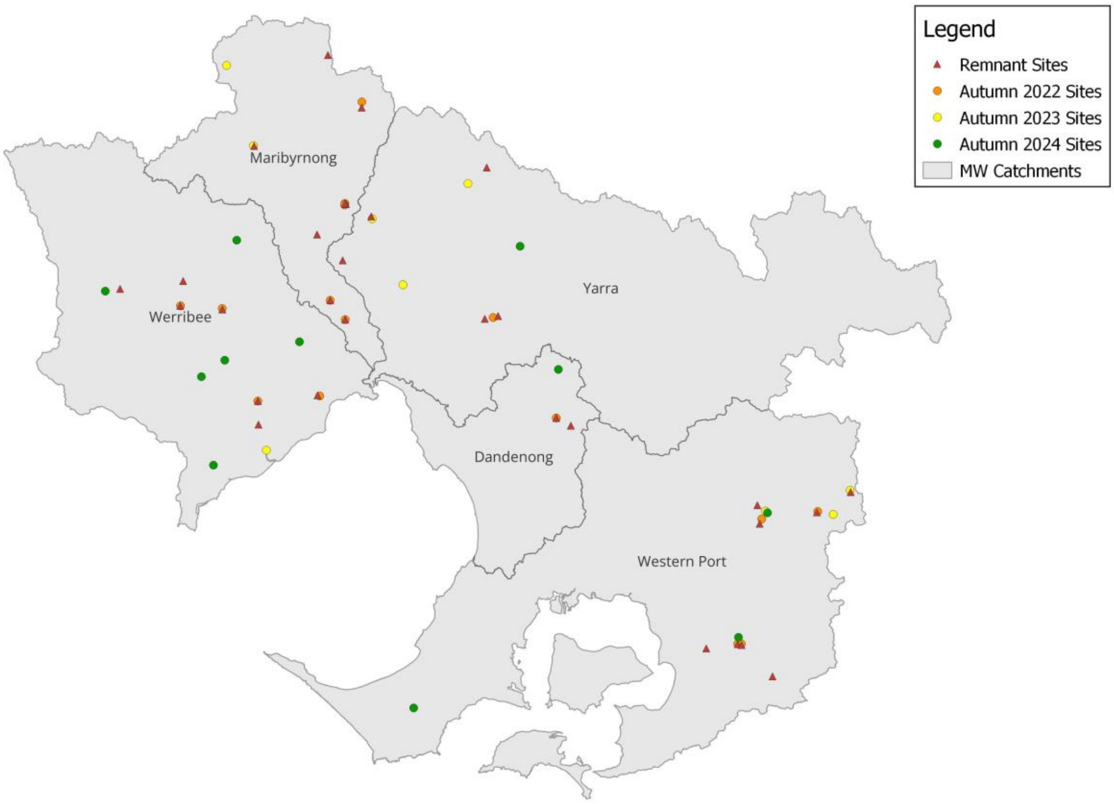

Figure 1 Survey sites in the greater Melbourne area, across the five major catchments. Circles represent revegetation sites of different years and triangles represent remnant sites.

Field Surveys

The ROMP method was used to assess the vegetation composition and structure within a 250 m stream reach at each site. For detailed guidelines of the ROMP method, refer to Jellinek et al. (2022). Belt transects, measuring 20 x 4 m, were placed at least 30 m apart along the stream reach (Figure 2). Within these transects, every native and exotic tree and shrub species present were identified and counted, with their recruitment status and height recorded. Ground layer attributes were assessed through the establishment of five 1 m x 1 m quadrats along each transect, capturing various ground cover types and the presence of browsing animal scats.

Vegetation structure was evaluated using a 2 m structure pole placed at 5 m intervals, categorising plants into height classes and lifeforms. Canopy cover for tree species was assessed, distinguishing between native and exotic species. Additionally, extensive photographic documentation was conducted during the baseline assessment to aid in future site relocation and comparison of changes over time.

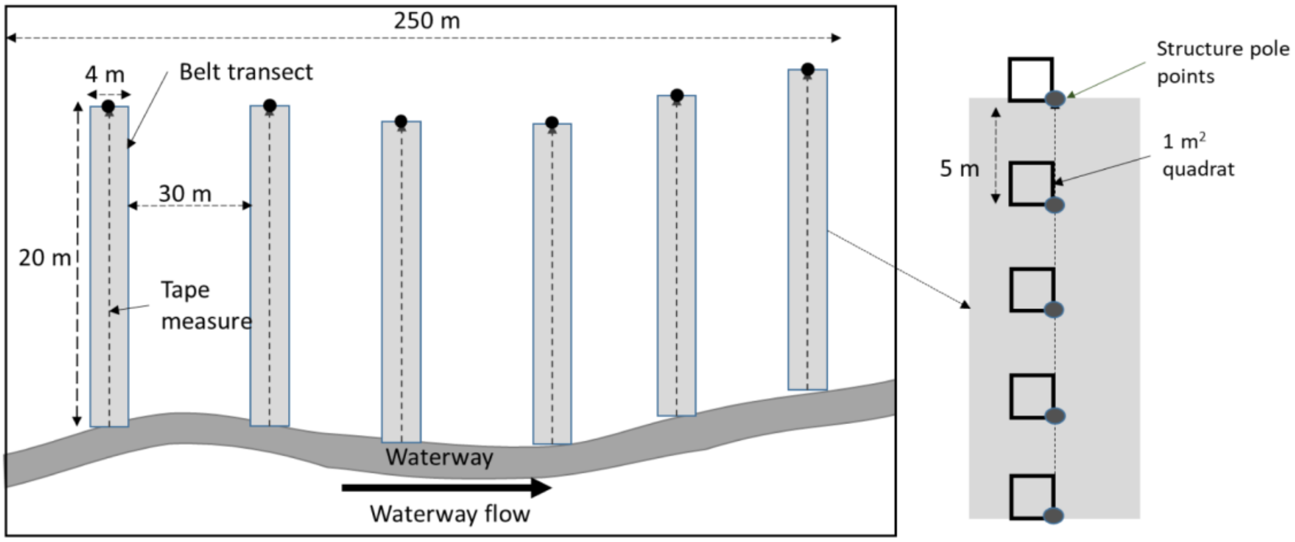

Figure 2 Diagram of the ROMP survey design undertaken at revegetated and remnant sites. Not to scale.

Preliminary Outcomes

The ROMP program commenced in 2022 and up to three site visits for certain locations have been completed. Given that the program has only been run over three planting seasons, the available data does not yet permit comprehensive analysis of revegetation outcomes. Nonetheless, some preliminary observations suggest notable changes have occurred (Figure 3).

Figure 3 Current monitoring activities at the Monbulk Creek restoration site

Improving Collaboration and Monitoring

Liaising with Melbourne Water Project Managers

A significant challenge for the project arises from variability in the planning and operational approaches of various Melbourne Water project managers overseeing the multiple survey sites. Each manager employs their unique management style, resulting in diverse site setups and approaches to defining revegetation zones. Some managers present precise Geographical Information Systems (GIS) polygons outlining revegetation areas, while others disperse polygons across potential revegetation zones. This variability complicates the organisation and coordination of site pre-establishment and establishment surveys, making it challenging to establish consistent procedures and rigorously fulfil the ROMP protocol. For instance, there have been instances where plantings did not align with the placement of pre-establishment monitoring transects, potentially impacting the accuracy of results and providing an incomplete picture of restoration outcomes. Each management region also has a different procedure for ordering native plant species for revegetation and for site management before and after planting, meaning that there is variability in site management and species type, health and size.

This can be managed by promoting communication with project managers and landholders to foster better collaboration and alignment of objectives. Implementing structured communication channels and regular meetings can facilitate the exchange of information and ensure all stakeholders are actively involved in the decision-making processes, ultimately enhancing the effectiveness of restoration initiatives.

Landholder limitations

Landholders may alter their plans over time, resulting in challenges to monitoring of vegetation in certain areas. Additionally, insufficient width and length allocated by landholders for planting can impede the establishment of a substantial revegetation area (the required setback from waterways is meant to be 20 m according to Melbourne Water policy), thereby complicating the assessment of ecological changes compared to more intact remnant sites.

This can be addressed by improving communication between Melbourne Water and landholders by documenting future plans in the works agreement signed by both parties prior to the commencement of works. For Crown land, these plans can also be incorporated into a Riparian Management Licence for the use of Crown Land.

Severe Weather Events

Severe weather events, such as floods or bushfires, pose a significant risk to the long-term monitoring program as they can and have resulted in the destruction of plants, plant guards, and fences installed as part of the restoration efforts. In such instances, Melbourne Water may be required to reinvest in acquiring the same supplies, thereby increasing resource expenditure and potentially delaying project progress.

In October 2022, 15 sites had already been planted and were ready for post-establishment ROMP assessments. Unfortunately, floods occurred at the majority of these sites, resulting in the loss of plants, drowning, and damage to plant guards and stock fences. This setback caused a delay in the assessments and necessitated the resetting of many sites. As a result, Melbourne Water incurred additional expenses due to the need to reorder plants and guards, as well as the process of replanting, thereby increasing overall project expenditures.

Continuous monitoring of the revegetation efforts in comparison with remnant sites provides valuable insights into the factors contributing to success or failure. Through this ongoing assessment, it becomes possible to identify instances of failure during extreme weather events, enabling the development of strategies for adaptive management. For example, selective planting of species able to withstand floods or investing in higher-quality plant/tree guards to deter browsers may prove to be more cost-effective in the long run, as it reduces the need for replanting or frequent maintenance. Another important measure to improve restoration efforts affected by severe weather events is to continue and ensure the allocation contingency funding.

Weed and Fauna Management

One of the primary challenges encountered during the monitoring of revegetation is the persistent growth of weeds and the browsing activity of native and exotic fauna. While tree guards provide some protection against browsing, they are not entirely effective, particularly against larger animals like deer and kangaroos. In certain areas, the use of larger steel mesh tree guards has proven to be more effective, albeit at a higher cost. However, the long-term benefits of this investment may outweigh the initial expense, as evidenced by improved plant survival rates.

Regular monitoring allows for the documentation of vegetation progress and browsing patterns, providing valuable insights into site vulnerability. By identifying areas prone to browsing damage, proactive measures can be taken to mitigate risks and enhance restoration outcomes.

Moreover, sites located adjacent to paddocks are equipped with stock exclusion fences to prevent stock damage to revegetation efforts. Despite these measures, observations from current monitoring efforts reveal signs of tree and shrub browsing near these fences. While this may be attributed to inadequate buffer space provided by landholders, it underscores the importance of strategic planning and investment in effective mitigation strategies.

Strategic planning and proactive measures are essential for addressing issues related to stock exclusion fences. Planting further away from fence lines and investing in larger steel tree guards can help minimise browsing damage and ensure the success of restoration efforts.

Method Limitations

Along with external limitations to the monitoring, there were also technical limitations when it came to the actual methods. One limitation is that a 250 metre riparian reach may not be possible for some sites, due to urbanisation or other land uses, leading to a less comprehensive understanding of habitats, vegetation types, and ecological interactions present along the watercourse. This could result in incomplete data collection and potentially skew the assessment results, leading to less accurate conclusions about the health and functioning of the ecosystem. Another predicted limitation is the difficulty in recording all ongoing management actions (e.g., pest plant or animal control, tree guard maintenance) that will influence restoration effectiveness over the longer term.

Improving communication and collaboration between assessors and stakeholders can help address these issues. Regular liaisons with Melbourne Water project managers for updates on management actions, combined with thorough record-keeping by the project team, will be essential in this effort.

Conclusion

This study highlights the challenges encountered in ecological restoration efforts, ranging from logistical hurdles in liaising with stakeholders to environmental risks such as severe weather events and variable landholder practices. Despite these challenges, the use of robust monitoring protocols such as the Restoration Outcomes Monitoring Protocol (ROMP) provides valuable insights into the effectiveness of management interventions. By identifying limitations and proposing solutions, such as comprehensive documentation of site variables and establishment, and long-term monitoring, this research contributes to the ongoing refinement of restoration practices. Moving forward, addressing these challenges in a systematic manner will be essential to ensure the long-term success and sustainability of riparian restoration projects.

Acknowledgments

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References

Foley-Congdon, E., Jellinek S., Chee, Y.E., & Greet J. (2024) Revegetated riparian areas are dominated by weeds, and lack structural diversity and natural recruitment: lessons for restoration practice. *Restoration Ecology* 1, 1-11. https://doi.org/10.1111/rec.14098

González, E., Sher, A.A., Tabacchi, E., Masip, A., Poulin, M. (2015) Restoration of riparian vegetation: A global review of implementation and evaluation approaches in the international, peer-reviewed literature. *Journal of Environmental Management* 158, 85-94. http://dx.doi.org/10.1016/j.jenvman.2015.04.033

Jellinek, S., Chee, Y.E., Greet, J. (2022) Guidelines for undertaking the restoration outcomes monitoring protocol (ROMP). *University of Melbourne, Melbourne, Australia.* https://mwrpp.org/wp-content/uploads/sites/8/2023/02/22.1-Restoration-outcomes-monitoring-propocol-method_100123.pdf

Naiman, R.J., Decamps, H., Pollock, M. (1993) The role of riparian corridors in maintaining regional biodiversity. *Ecological Applications* 3. 209–212. https://doi.org/10.2307/1941822

Ruiz-Jaen, R.C., & Aide, M.T. (2005) Restoration success: how is it being measured? *Restoration Ecology* 13, 569–577. https://doi.org/10.1111/j.1526-100X.2005.00072.x