



Western Port Seagrass Partnership

Mangrove Restoration at Grantville, 2020–21



June 2021

Cover Photo: Planting mangroves at Grantville, February 2021 (Photo Neil Daly)

Mangrove restoration at Grantville, 2020-21.

Gregory D. Parry

June 2021

Western Port Seagrass Partnership

PO Box 2590

Mt Waverley, Victoria 3149

Preferred way to cite:

Parry G.D. (2021). Mangrove Restoration at Grantville, 2020-21, 10 pp. Western Port Seagrass Partnership, PO Box 2590, Mt Waverley, Victoria, Australia 3149.

Executive Summary

Western Port Seagrass Partnership, in conjunction with many volunteers, commenced planting mangrove seedlings in 2005 to reduce coastal erosion. This report describes survival of mangrove seeds and seedlings planted in 2020-21 at Grantville. Mangroves were removed from this site, probably in the 1800s, and now this coastline is retreating, causing loss of coastal vegetation and threatening nearby housing.

This study had two main objectives: (1) to compare the survival and growth of seeds and seedlings; and (2) to determine whether their survival was affected by how far offshore they were planted. In addition to the above primary objectives, the effect of protective tubes on survival of mangrove seeds was also investigated.

The key findings were that

- (1) Seeds planted in January 2020 had similar rates of survival to seedlings planted in November 2020 and February 2021. These results suggest that planting seeds is a more efficient method of mangrove restoration at Grantville than is planting seedlings. Seedlings require a specialised nursery which makes seedlings more costly than seeds. Seeds can be harvested and planted at near zero cost. However, seeds planted in January 2021 had much lower survival. This lower survival could have been due to poorer quality seeds or, more likely, these seeds were planted with less care.
- (2) Seedlings and seeds planted 30- 40 m from shore usually had lower survival than those planted 40-75 m offshore. But, much of the variation in survival of both seeds and seedlings remains unexplained.
- (3) Protection of plants with 90 mm PVC tubes provided ambiguous results. At one plot seedlings had higher survival when protected by tubes, at another seeds had higher survival when unprotected, and at the third site protected and unprotected seeds had similar rates of survival. Collectively these results suggest that protecting small mangroves with tubes does not usually improve survival and, as it involves much greater cost and effort to install tubes, it is not recommended at sites similar to Grantville.

Table of Contents

Executive Summary	i
Introduction	1
Materials and Methods	2
Study site	2
Effect of distance offshore on survival of seedlings.....	2
Effect of protection by tubes on survival of seeds and seedlings	2
Results and Discussion	4
Effect of distance offshore and growth on seed and seedling survival	4
Effect of tubes on seedling survival.....	5
Acknowledgments	8
References	8
Appendices	9

List of Figures

Figure 1. Location of mangrove planting area near Colbert Reserve, Grantville.....	2
Figure 2. Location of all plots planted at Grantville 2020-21. Plots planted at the same time are shown in the same colour. Plots marked with red dots were planted with seeds, while plots planted with seedlings are marked with green dots.	3
Figure 3. Plot of annual survival of different plantings against distance offshore.	4
Figure 4. Plot of annual survival of different plantings against mean height of mangroves on each plot....	5
Figure 5. Comparison of survival on plots where rows were not protected or protected with short and long tubes (Plot X6), or not protected and protected with short tubes. Arrows indicate when tubes were removed. * On Plot X6 in Dec 2020, there were 7 live + 8 prostrate plants, some of the latter survived.....	6
Figure 6. Erosion beneath and surrounding protective tubes on Plot X1.....	7
Figure 7. Plots of survivorship on all mangrove plots planted on different dates. A Planted January 2020, B. November 2020, C. Seedlings January 2021, D. Seeds January 2021. Plots for seedlings planted in May 2020 are shown in Figure 5 (Plot X6).....	9

List of Tables

Table 1. Mean height of mangroves in May 2021 on different plots and with different treatments	7
Table 2. Mean length of mangroves on each plot in May 2020 and May 2021.	10

Introduction

Western Port Seagrass Partnership, in conjunction with many volunteers, commenced planting mangrove seedlings in 2005 to reduce coastal erosion, a major source of sediment entering Western Port. This report considers mangroves planted in 2020-21 at Grantville, a site where mangroves were found when Western Port was surveyed in 1835 (Smythe 1842), but where only a few remain. The loss of mangroves from the Grantville coastline has contributed to increased coastal erosion causing loss of coastal vegetation and threatening nearby housing.

The gradual improvement in planting methods used by WPSP between 2005 and 2019 is documented in Parry (2019). Improving mangrove establishment is a slow process. Mangroves in Western Port grow slowly as they are close to the southern margin of their distribution. Seeds are also only available for propagation for a few weeks each summer. Evaluation of each new growing method requires a minimum of 12 months to measure the survival of plants. There also remain many environmental factors that may influence the survival of mangroves, including wave action, sediment type, sediment movement, salinity of ground water, distance offshore, proximity of other mangroves, nutrient availability and barnacle settlement. Consequently, the best method of establishment is likely to vary between locations, further complicating the evaluation of methods.

This study had two main objectives: to compare the survival and growth of seeds and seedlings and to determine whether their survival was affected by how far offshore they were planted. The former is important to determine whether the extra cost of establishing seedlings in a specialised nursery is worthwhile. While the latter should ensure mangroves are planted where they are most likely to survive.

In addition to the above primary objectives, the effect of protective tubes on survival of mangrove seeds was also investigated. Parry (2019) showed that protective tubes can improve initial seed and seedling survival. But these conclusions were based on comparisons between plots with and without protection. Previous studies also showed that there are often large differences in survival between plots (whether protected or not) so further studies of the effect of protection were undertaken within plots.

Materials and Methods

Study site

All mangroves were planted near Colbert Reserve, Grantville (Figure 1). Mangroves were planted in plots that usually contained 100 seeds or seedlings. On each plot 100 mangroves were planted 1 m apart in a 4 × 25 m matrix. Plots were marked with wooden stakes with numbered sheep ear tags.



Figure 1. Location of mangrove planting area near Colbert Reserve, Grantville.

Mangrove seeds were planted in January 2020 (Plots P9, X1, X2 & X3), seedlings were planted in May 2020 (Plot X6) and November 2020 (Plots C, P8, X7, X9 & X10), and both seeds (Plots R1, R2, R3, R4) and seedlings (Plots G1, G2, G3, G4, & R11) were planted in February 2021 (Figure 2).

Seeds were planted using a technique developed by John Eddy, where seeds are attached to a bamboo stake with a rubber band and the stake pushed into the sediment so that approximately one third of the seed is buried (Parry 2019). Rubber bands were cut with scissors after 1 month, as previous observations suggested that <20% of rubber bands perish in this time, and seedling growth is inhibited when seedlings remain attached to stakes for too long.

Seeds can only be planted in January-February when they are ripe, while seedlings were planted

in May (5 months old), November (9 months old) and in February (12 months old). One plot (Plot G4) was planted with 2 year old seedlings, but these were shorter, but had more leaves, than 12 month old seedlings planted at the same time.

The number of survivors on each plot (and treatments within plots X1, X6 and P9) was counted every 4-12 weeks, and the height of a sample of 20 plants from each plot was measured in May 2020 and May 2021.

There were no clear seasonal differences in survival so survivorship on all plots was standardised by estimating annual survival from all counts of survivors on each plot. Annual survival was estimated from the gradient of $\text{Log}_e(\text{No. of Survivors})$ vs time regressions, and subsequently shown as % annual survival.

Effect of distance offshore on survival of seedlings

Plots planted with seeds and seedlings were interspersed and located at a range of similar distances offshore (33 m – 76 m) to test whether survival of both seeds and seedlings were affected by distance offshore (Figure 2). Distance offshore of each plot was measured using Arcview® software, and was measured from the boundary between near shore white sand and the muddy peat layer visible in Figure 2.

On the plots with protection (P9, X1 & X6) only survival rates of unprotected mangroves were included in the analysis of the effects of distance offshore on mangrove survival

Effect of protection by tubes on survival of seeds and seedlings

Parry (2019) showed that 'long' 90 mm diameter PVC tubes interfere with growth of lateral roots and often cause plants to become prostrate when they are removed. At one plot (X6) seedlings were planted with three treatments applied in alternating rows of 4 plants. The three treatments were: no protection; protection by 'long' tubes; and protection by 'short' tubes. Long tubes are inserted ~100 mm into the sediment, while 'short' tubes are inserted only 25 mm into the sediment

and are held in place by bamboo stakes and cable ties (Parry 2019).

At two plots (Plots X1 & P9) seeds were planted with two treatments applied in alternating rows of 4 plants. The two treatments were: no protection; and protection by 'short' tubes. Seeds were planted in January 2020 on plots X1 & P9, but to prevent tubes shading small seedlings tubes were not deployed on these plots till May 2020.

Tubes were inserted on all plots (X1, P9 & X6) in May 2020, when seedlings were planted on plot X6. Tubes were removed from all plots in March 2021 to avoid tall seedlings being ringbarked by the sharp tube edges (Parry 2019).

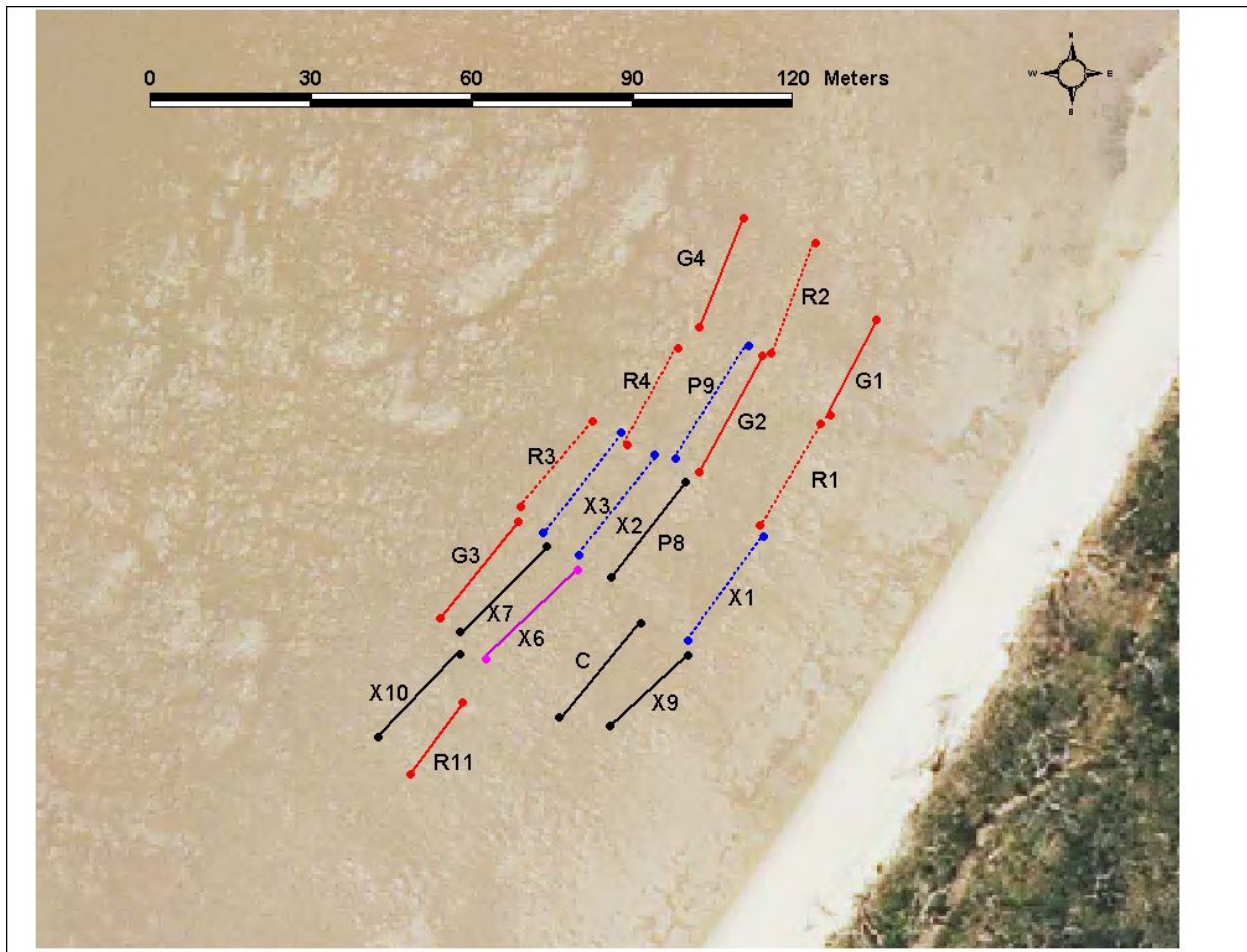


Figure 2. Location of all plots planted at Grantville 2020-21. Plots planted at the same time are shown in the same colour. Plots marked with broken lines were planted with seeds, while plots planted with seedlings are marked with solid lines.

Results and Discussion

Effect of distance offshore and growth on seed and seedling survival

Rates of survival of seeds planted in January 2020 were similar to those of seedlings planted in November 2020 and February 2021. But survival of seedlings planted in May 2020 and seeds planted in February 2021 were much lower (Figure 3, Appendix - Figure 7).

The reason for much lower survival of seeds planted in February 2021 is uncertain. There may have been differences in seed quality between

years, or those planted in 2021 may have been planted less carefully than those in 2020. This suggests that more attention needs to be paid to both seed quality and supervision when volunteers are planting seeds. Survival of seedlings appears less sensitive to the care with which they are planted.

Plots showed that survival was not strongly affected by distance offshore, although plots closer than 40 m from shore usually had the lowest survival in each planting (Figure 3). As plantings prior to 2020 had all been in this zone it may account for the lower survival of these earlier plantings.

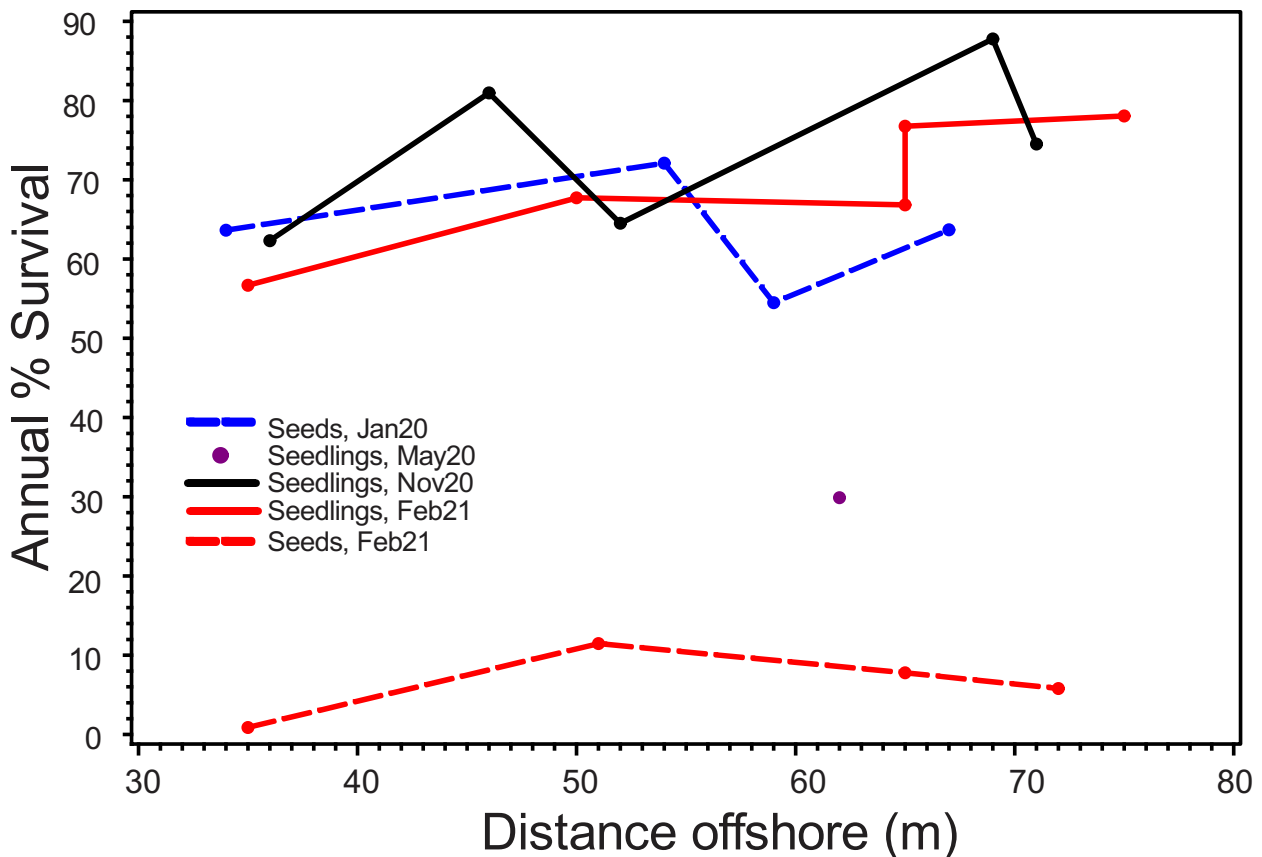


Figure 3. Plot of annual survival of different plantings against distance offshore.

Mangroves larger than 70 cm have higher survival rates than smaller mangroves (Parry

2019). But there was no evidence that survivorship and growth of mangroves smaller

than 30 cm were closely linked (Figure 4, Appendix Table 2). Mangroves on all plots in Figure 4 were the same age in May 2021 (5 months), except at plot G4, where 2 yo seedlings

were planted in February 2021, and seeds planted in 2021, which were only 5 months old and therefore much smaller.

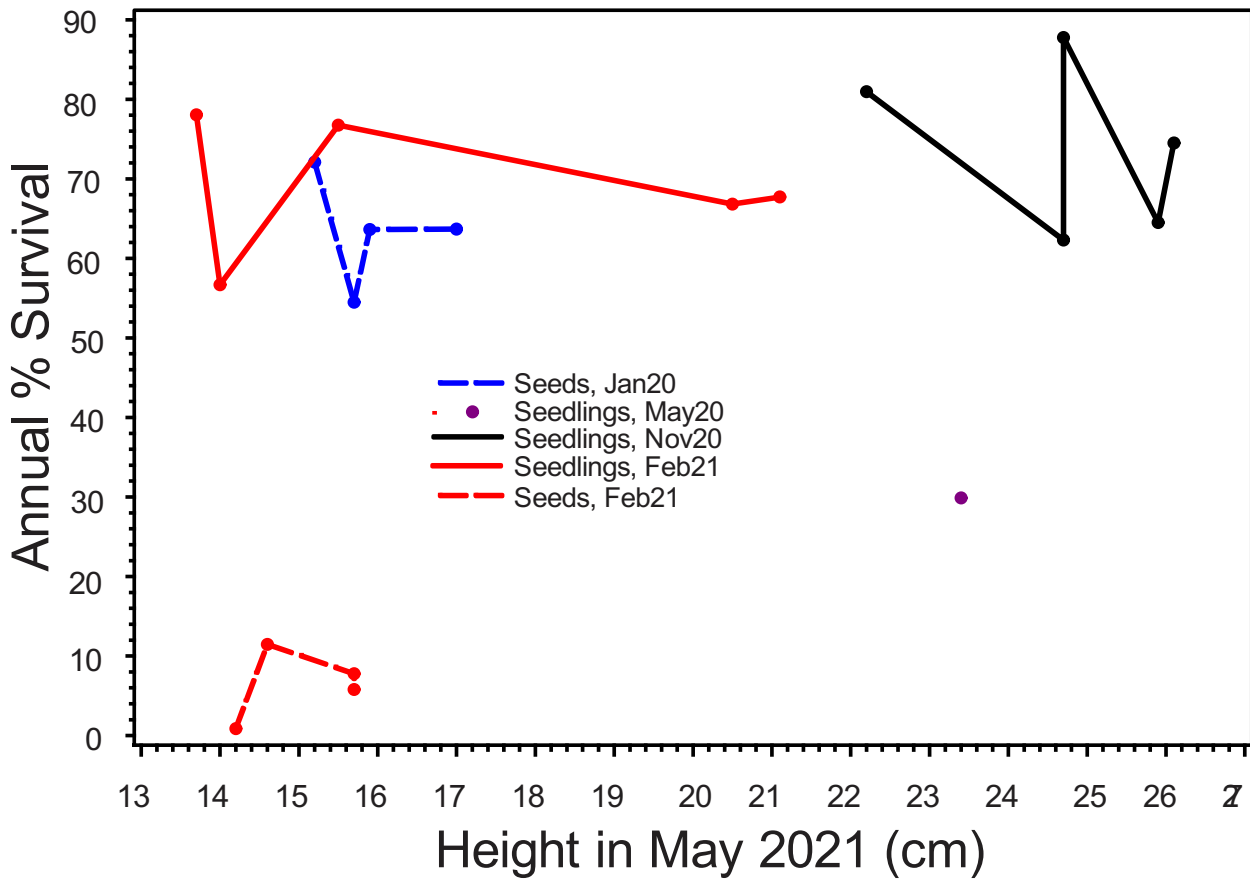


Figure 4. Plot of annual survival of different plantings against mean height of mangroves on each plot.

Effect of tubes on seedling survival

On Plot X6 survival was higher in short and long tubes than for unprotected seedlings. While on Plot X1 survival was higher for unprotected seeds than for those protected by short tubes. At plot P9 survival of protected and unprotected

seeds was similar. The low survival of mangroves at Plot X1 appears to be the result of increased erosion within and near tubes, which created shallow pools at low tide within and around the tubes (Figure 5). This erosion only occurred at this inshore plot where the underlying peat layer was covered by a much thinner layer of sandy mud (0-2 cm).

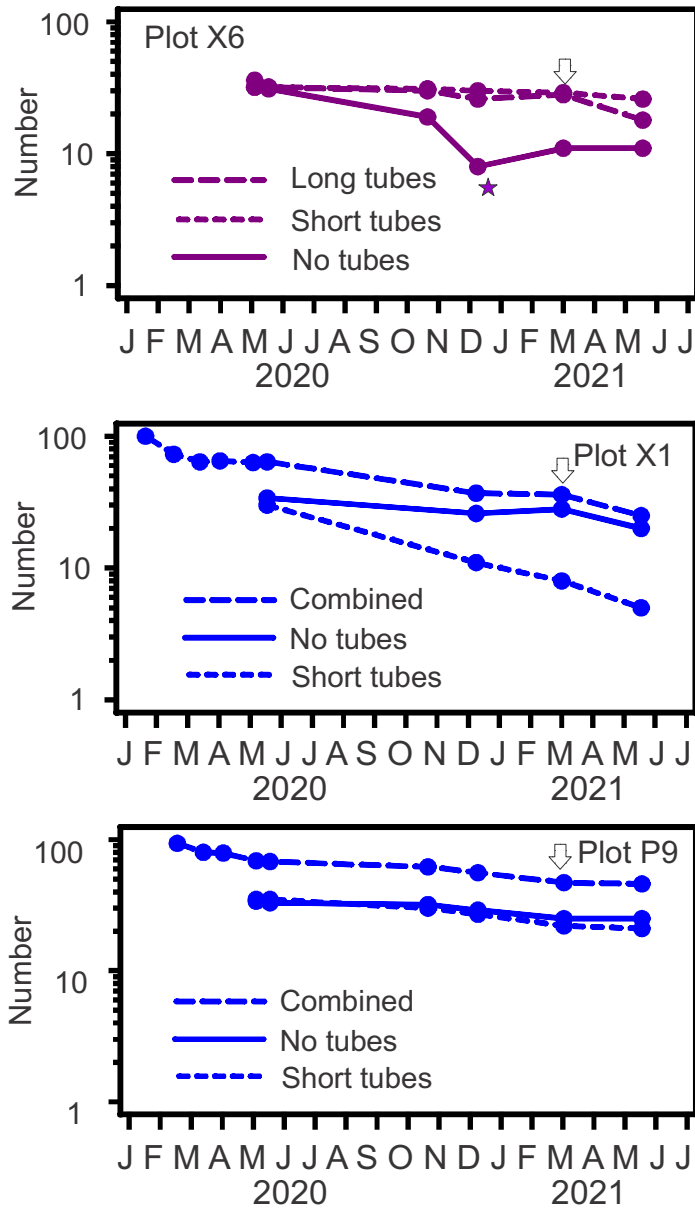


Figure 5. Comparison of survival on plots where rows were not protected or protected with short and long tubes (Plot X6), or not protected and protected with short tubes. Arrows indicate when tubes were removed. * On Plot X6 in Dec 2020, there were 7 live + 8 prostrate plants, some of the latter survived.



Figure 6. Erosion beneath and surrounding protective tubes on Plot X1.

The effect of tubes on seed and seedling survival was variable. Mangroves planted near shore, where the peat layer was barely covered, had higher survival when tubes were not used. Survival of mangroves planted further offshore was higher when protected by tubes on one plot,

but similar whether mangroves were protected on not on the other.

There was no clear pattern of differences in mean height of seeds or seedlings between treatments when the mean heights of survivors were measured in May 2021 (Table 1)

Table 1. Mean height of mangroves in May 2021 on different plots and with different treatments

Category	Date planted	Plot_no	Treatment	Mean height (cm)
Seeds	1 Jan 20	P9	No tubes	15.2
			Short tubes	15.3
		X1	No tubes	15.9
			Short tubes	16.2
Seedlings	May 20*	X6	Long tubes	25.2
			No tubes	23.4
			Short tubes	24.7

* Note that seedlings planted in May 20 were 17 months old when planted.

The absence of a clear improvement in survival from use of tubes suggests that the additional

effort and cost associated with their use is not justified at sites similar to Grantville.

Acknowledgments

This work was funded by a grant from Landcare (2020) and continues a series of mangrove plantings supported by grants from Coastcare (2014), Landcare (2015), and Port Phillip and Western Port Coastal Management Authority (2014 & 2016).

All WPSP board members contributed to this work, but those most actively engaged in the field program 2020-21 were Ian Stevenson and Dick Cox.

Many volunteers assisted with planting mangroves and monitoring their survival in 2020-21. Thanks to all those who contributed. The

following list contains many of those who assisted: DELWP, Working for Victoria, and Wareen Beek Rangers from Holmesglen TAFE

Grace Basham, Michael Buckley, Jack Dewhurst, Nick Durham, Bob Gray, Ian Gunn, Mandy Gunn, Georgia Harrison, Jessica Schubert Hoban, H. Kastritseas, Kim Locun, Aaron Moore, Colleen Munro, Angus Parker, Peter Rennick, Phil Ridway, Clint Schipper, Heather Shimmer, Miki Takahashi, J. Thomson, Phillip Wierzbowski.

References

Smythe, G.D. (Cartographer) (1842). Western Port maps.

Parry, G.D. (2019). Mangrove restoration in Western Port, 27pp. December 2019. Report from Western Port Seagrass Partnership, PO Box 2590, Mt Waverley, Victoria, Australia 3149.

Appendices

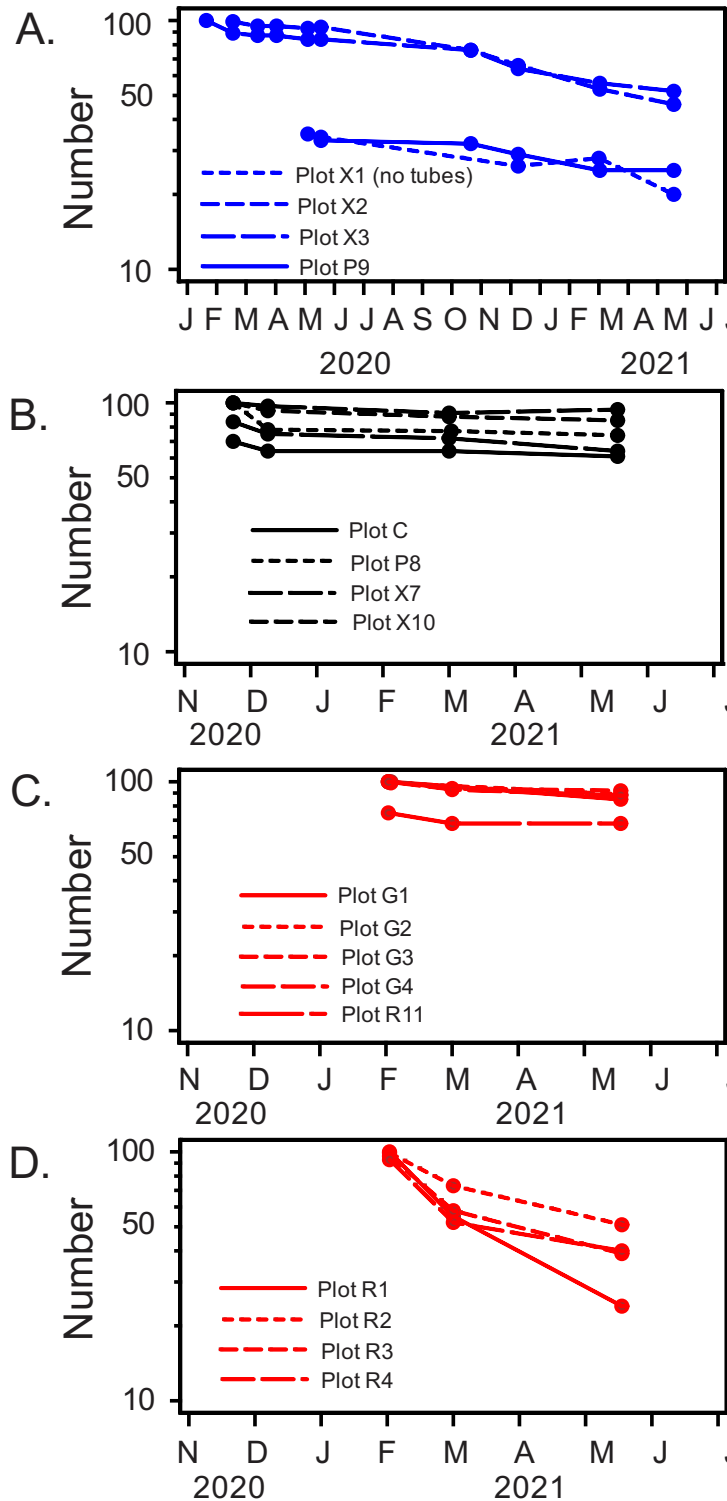


Figure 7. Plots of survivorship on all mangrove plots planted on different dates. A Planted January 2020, B. November 2020, C. Seedlings January 2021, D. Seeds January 2021. Plots for seedlings planted in May 2020 are shown in Figure 5 (Plot X6).

Table 2. Mean length of mangroves on each plot in May 2020 and May 2021.

Category	Date planted	Plot_no	Date	
			18-May-20	18-May-21
Seeds	Jan-20	P9	12.4	.
Seeds		P9 (no tubes)	.	15.2
		X1	9.75	.
		X1 (no tubes)	.	15.9
		X2	11.4	15.7
		X3	14.2	17
Seedlings	May-20	X6	18.7	.
		X6 (no tubes)	.	23.4
Seedlings	Nov-20	C	.	22.2
		P8	.	25.9
		X10	.	26.1
		X7	.	24.7
		X9	.	24.7
Seeds	Feb-21	R1	.	14.2
		R2	.	14.6
		R3	.	15.7
		R4	.	15.7
Seedlings	Feb-21	G1	.	14
		G2	.	21.1
		G3	.	13.7
		G4	.	20.5
		R11	.	15.5

Not for citation without permission