

Monitoring native regeneration after frilling of macrocarpa plantations at Waipuna Bush, Banks Peninsula, 2017-2022

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Background

Starting in 2016, we have been steadily killing off several unwanted macrocarpa plantations near our Waipuna Bush Covenant. The covenant is located at the head of Western Valley between Little River and Port Levy, Banks Peninsula. The macrocarpa trees were planted in the late 1990s but were never managed for forestry. Most of the trees had canker or other deformities. Most trees were probably 10-15 m tall at the time we began this exercise, with trunks 15-30 cm in diameter.

These plantations are set within an upper valley where most of the land is protected by reserve or conservation covenant, and native species predominate. This upper valley includes some mature upper cool-temperate forests dominated by totara, tree fuchsia, and broadleaf, along with younger forests and native shrublands progressing along a path of natural regeneration. The intention has been to gradually eliminate these exotic macrocarpa plantations before they reach an unmanageable size, and to enable regeneration of native species for which an abundant seed source already exists in the surrounding land.

Killing the macrocarpas has been achieved by making a continuous frill around the trunk of each tree with downward blows of a sharp hatchet, cutting through the bark and into the cambium layer of the tree. This has been followed immediately by spraying the cut with the herbicide Glyphosate 360 (360 g/l glyphosate as the isopropylamine salt) at a concentration of 1 part herbicide to 4 parts water, or more recently, 2 parts herbicide to 3 parts water. This method has proved very effective on these young trees, with leaves on the extremities showing signs of dying within 3 weeks during the growing period, or up to a few months after treatment in winter.

Monitoring methods

We established monitoring to record the impact of this macrocarpa killing exercise on native regeneration. Monitoring began in February 2017, immediately after the area of macrocarpa trees had been frilled. In one of the plantations eight macrocarpa trees were permanently marked 1 m above ground level with plastic tags nailed to the tree. Two of these marker trees were in control areas in which the macrocarpas were allowed to continue growing, while the remaining six trees were in locations where all trees in the area had been frilled between December 2016 and January 2017 (Fig. 1, p. 32). A photo of each site was taken looking up to each marked tree from 2.5 m downslope, and additional photos of the nearby area were taken from the marked tree looking across the slope in either direction.

The species and height of every tree seedling greater than 15 cm tall and rooted within a 1 m radius of each marked macrocarpa tree was recorded. The measurements and photos were repeated in January or February every year since establishment in 2017, with the most recent measurement being in February 2022, approximately 5 years since the trees were frilled.

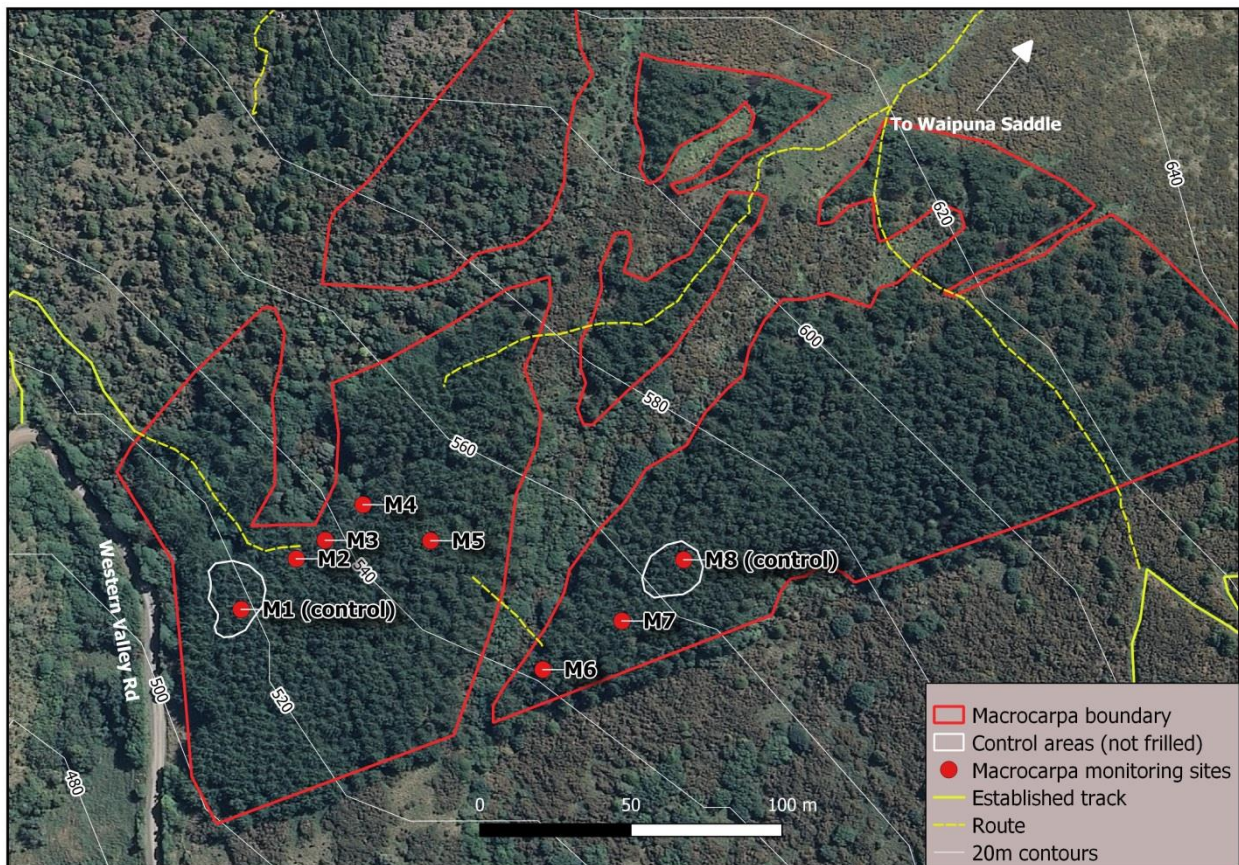


Figure 1. Location of the eight monitoring sites (M1-M8) within the macrocarpa plantations.

Results

Over the 5 years since frilling, dramatic native regeneration has occurred at sites M2 to M7, while there has been negligible change at control sites M1 and M8 where the macrocarpa trees had not been killed (Fig. 2, p. 33).

The dominant regenerating tree species have been tree fuchsia (*Fuchsia excorticata*), māhoe (*Melicytus ramiflorus*), wineberry (*Aristotelia serrata*), marbleleaf (*Carpodetus serratus*), and *Coprosma rotundifolia*. Species composition varies from site to site. While māhoe has become the dominant species by 2022 at M2, tree fuchsia dominates at M5, while wineberry is more common at M6 (Fig. 3, p. 34).

The progression in plant frequency since killing of the macrocarpas has not been linear. The number of regenerating plants showed little movement for the first year, but then steadily increased year by year (Fig. 4, p. 34) until reaching a peak of 199 plants combined over the eight sites in 2021, four years after the trees were frilled. Since then, there has been a reduction in stem frequency, down to 145 in 2022.

Tree heights have tended to increase steadily over the five years with no decline in 2022 (Fig. 5, p. 35). This emerging canopy, along with a rapid increase in non-tree understorey species, such as ferns, may have contributed to the pattern of tree stem frequency decline over the last year.

A density of 145 tree stems over the eight measured sites (including the two control sites), equates to a density of 58,000 stems/ha. No doubt this density will decrease over time as dominant trees shade out competition.



M1 (control) 2017



M1 (control) 2022



M2 2017



M2 2022



M3 2017



M3 2022



M4 2017



M4 2022

Figure 2. Natural regeneration occurring between 2017 (the time of frilling) and 2022 as exemplified in photos taken looking up the slope at monitoring site M1 (control tree, not frilled) and sites M2-M4 (trees frilled).

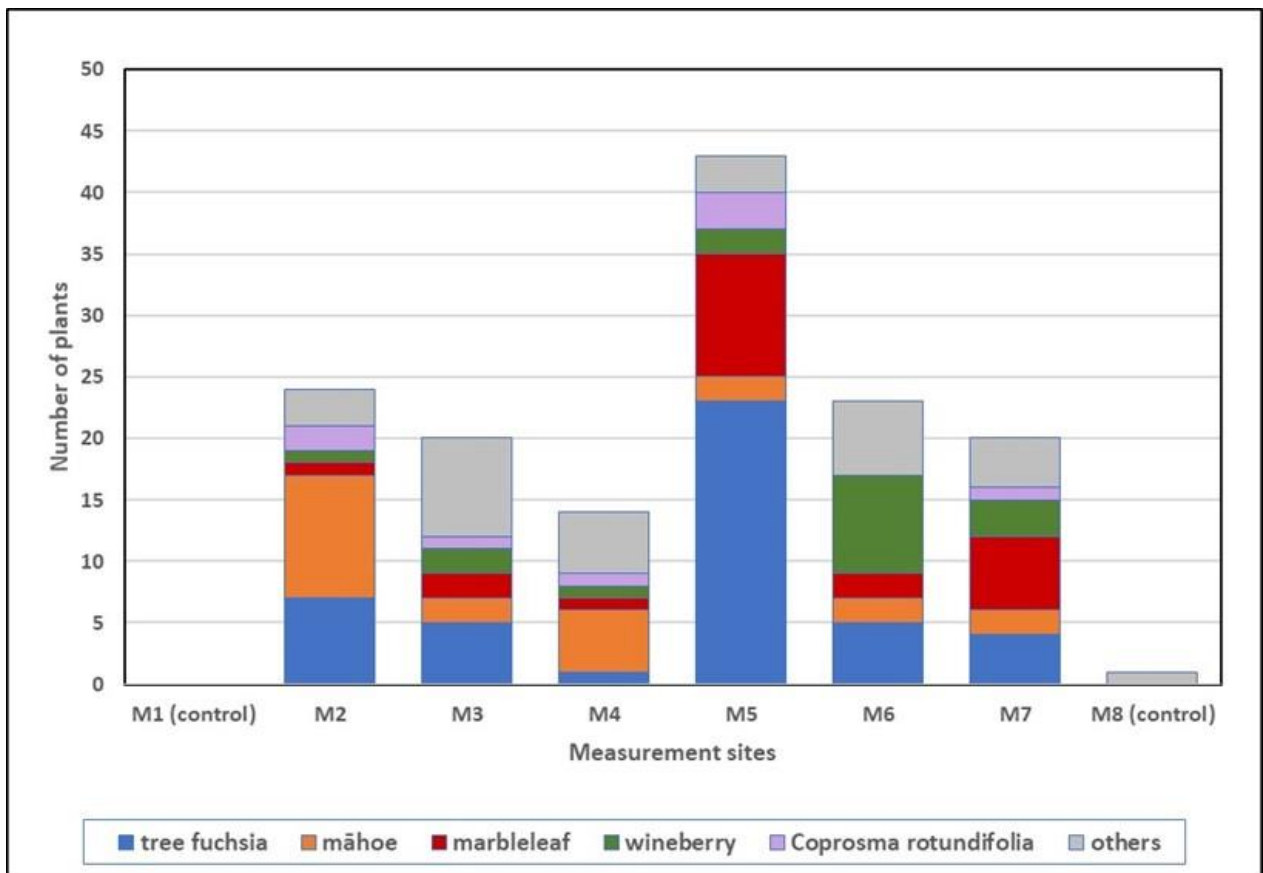


Figure 3. Species composition for the five most abundant colonising species at each monitoring site in 2022, five years after frilling.

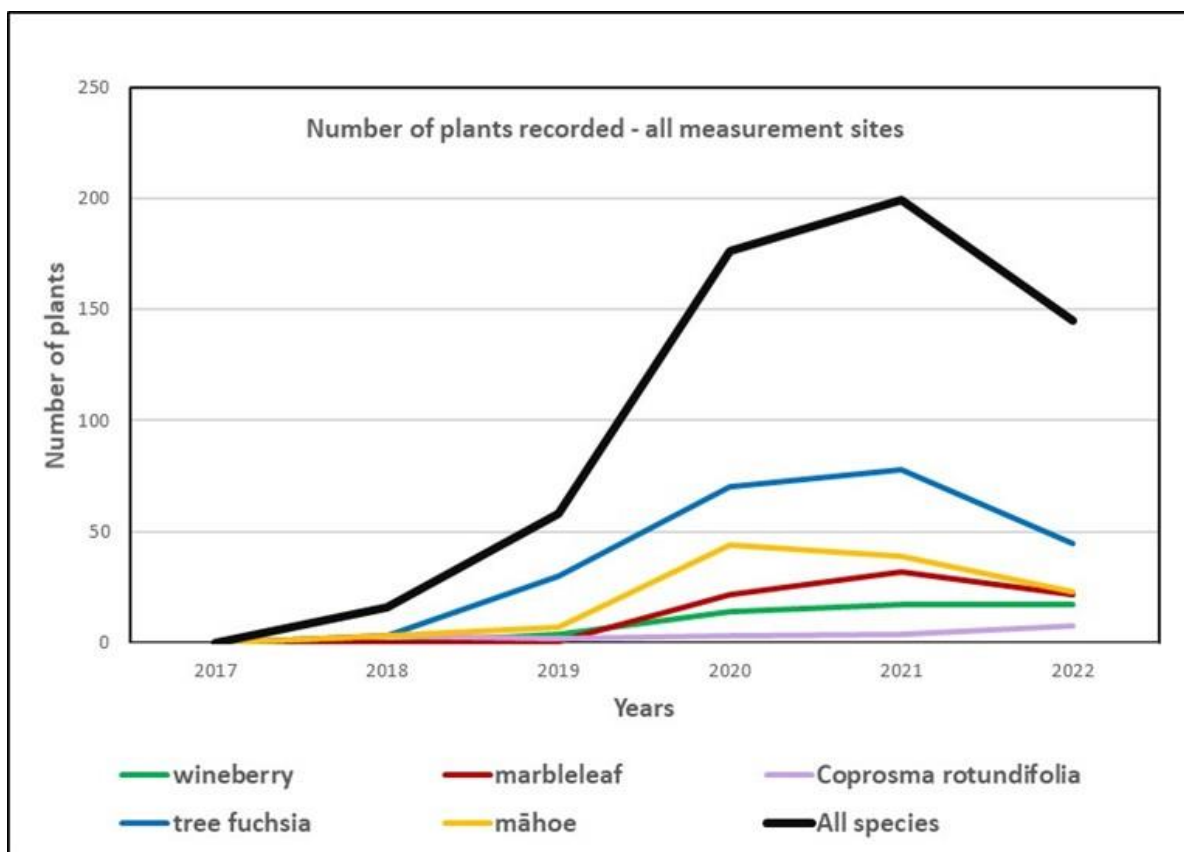


Figure 4. The total number of plants of the main colonising species across all monitoring sites between 2017 and 2022.

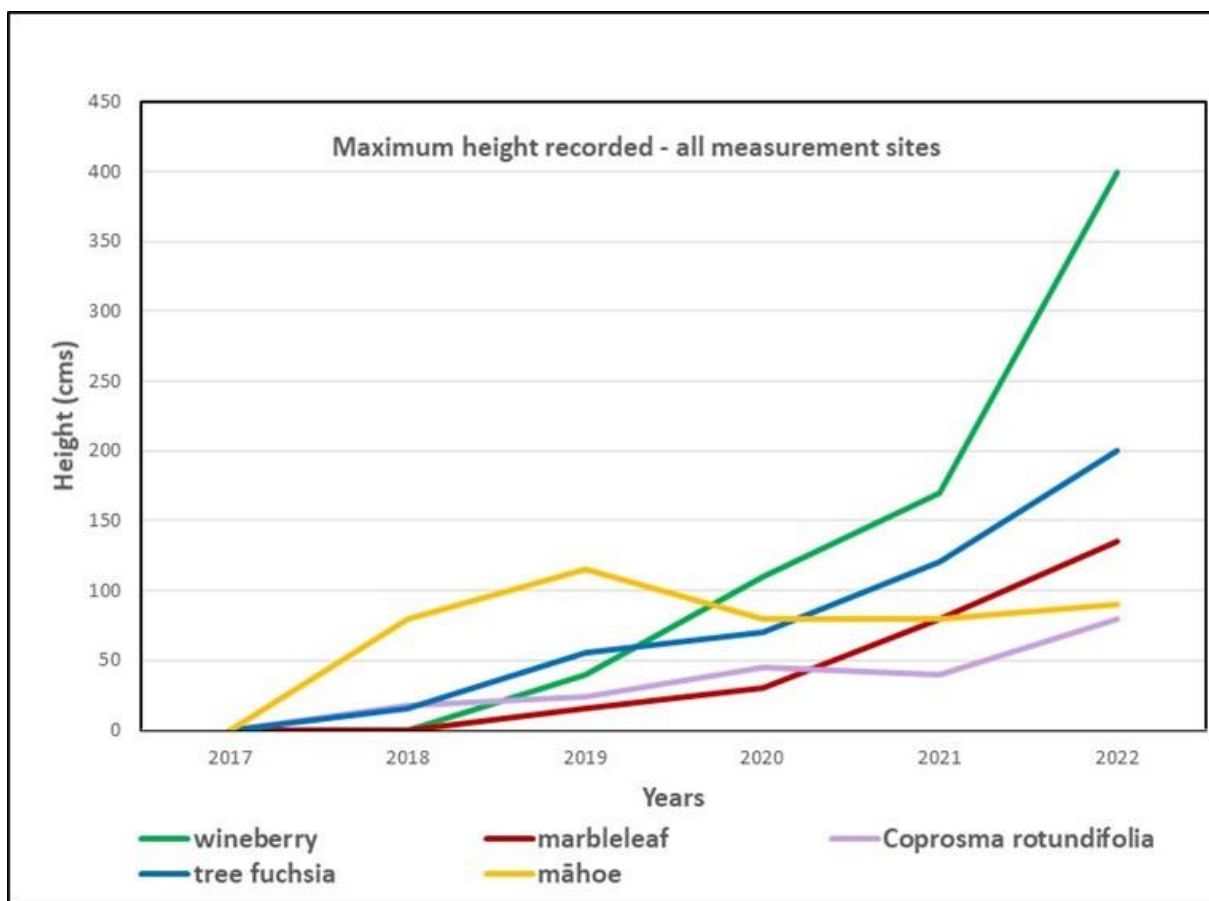


Figure 5. Height of the tallest seedling of the main colonising species across all monitoring sites between 2017 and 2022.

Other tree and shrub species regenerating in the eight monitored sites but less abundant than those mentioned above were *Coprosma dumosa*, *C. robusta*, *Griselinia littoralis*, *Hebe salicifolia*, *Hedycarya arborea*, *Pennantia corymbosa*, *Pseudopanax arboreus*, *P. colensoi*, *P. crassifolius*, *Pseudowintera colorata*, *Senecio glomeratus*, and *Schefflera digitata*. Other regenerating native species noted under the dead macrocarpas include mountain holly (*Olearia ilicifolia*), *Coprosma rhamnoides*, *Uncinia uncinata*, *Muehlenbeckia australis*, stinging tree nettle / ongaonga (*Urtica ferox*), and bush lawyer (*Rubus cissoides*). Ferns are becoming quite prevalent including creek fern (*Blechnum fluviatile*), pig fern (*Hypolepis ambigua*), water fern (*Histopteris incisa*), and prickly shield fern (*Polystichum vestitum*). A number of thistles and other exotics have appeared, such as Scotch thistle (*Cirsium vulgare*) and foxglove (*Digitalis purpurea*), but these are now being swamped by taller native colonising species.

An extensive seed bank of gorse (*Ulex europaeus*) will exist across the area, as gorse was clearly present prior to the planting of the macrocarpas, evidenced by frequent rotting gorse stems and trunks under the dense shade of the macrocarpa canopy. With the increased light after macrocarpa frilling, gorse seedlings are now prevalent, but gorse is being outcompeted by an emerging canopy of native species.

Threats

Deer browsing is unfortunately common in the area, with māhoe seedlings being a particular target, and deer trails developing. Pigs would be another potential threat to this

regeneration, with pigs gradually spreading from an infestation in Prices and Kaituna valleys.

Weed pests could also be a problem. Plant threats observed at low frequency in the plantation include old man's beard (*Clematis vitalba*), Chilean flame creeper (*Tropaeolum speciosum*), and blackberry (*Rubus fruticosus*).

Future monitoring

The dense native regeneration is now proving quite difficult to move through in many places, and repeating the photographs is becoming of limited value as the original scenes are blotted out by rampant vegetation in front of the camera lens. Having recorded the trends over a five-year period, we propose not re-measuring the sites for another five years, by which time a shading canopy is likely to have established and the seedling density at eye level may have reduced.

The macrocarpas in the control areas are now getting quite tall, reaching 3 to 4 metres above the canopy of the surrounding dead trees. These areas, with open ground under the dense shade of the still living macrocarpas, also seem to harbour deer. We propose frilling the control areas in the near future.

Other methods of macrocarpa control

The frilling method has proved very effective at killing these macrocarpas. Combined, the plantations covered approximately 8 hectares and comprised 8,000-9,000 trees. However, it is a very labour intensive process, and these results could not have been achieved without a small dedicated group of volunteers. To successfully frill these two plantations has required 200 person-days of voluntary effort, over 65 days.

Alternatively, the trees could have been clear felled by chainsaw. However, leaving the dead trees standing has meant that birds still frequent the area and drop seed. Most of the bird species we find in the bush on our covenant still seem to frequent these dead macrocarpa plantations. Leaving the trees as standing dead has also provided just a gradual increase in sunlight, which seems to have favoured native reestablishment. Opening the area directly up to full sunlight would perhaps have favoured the re-emergence of light demanding gorse.

Other methods could be employed to kill such unwanted plantations. Aerial spraying would be efficient but costly, and would have killed the sparse but valuable old tree fuchsia and totara which were still just surviving under the emergent macrocarpa canopy.

Alternatively, the trees could have been killed by chainsaw frilling, or drill and filling. The hatchet frilling method offers the advantage of inexpensive equipment, lack of noise, and relative safety. The method is also reasonably economical with herbicide, eliminating between 100 and 200 trees per litre of Glyphosate 360.

Acknowledgements

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