

Survey of Tumut Grevillea (*Grevillea wilkinsonii*) After Record Flood Heights in 2012

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Summary

- *Grevillea wilkinsonii* is a perennial shrub largely restricted to riparian vegetation of the Goobarragandra River. Record flood levels in March 2012 caused extensive damage to the river banks and resulted in the need to reassess the status of this threatened species.
- The 2012 survey found a total of 870 *Grevillea wilkinsonii* in 12 colonies (natural and planted) of the 17 colonies surveyed along a 4km stretch of the Goobarragandra River.
- All known colonies surveyed in 2008 were visited apart from those downstream of Kells Lane for which permission was not granted. However in the last survey these plants comprised only 1% of the population so the final figures would not be greatly affected by this omission.
- The 2012 total of 870 *G.wilkinsonii* was made up of 175 seedlings, 328 mid-size and 365 adult plants. This total is only slightly (3%) lower than the total of 900 plants found in 2011.
- However of the areas where *G.wilkinsonii* was found in 1998 the total number of plants had declined from 644 to 514 in 2008, 399 in 2011, and down to 210 in 2012. This represents a two-thirds reduction in the population at the naturally-occurring colonies, spread fairly evenly across the size classes. The majority of these sites are located within the flood zone and were adversely affected by extreme flood events in 2010 and then again 2012.
- The overall population has increased since 1998 and has been able to maintain population levels despite the floods only because of the establishment of new colonies at sites above the flood zone.
- In particular the Swing Bridge site which originated from a few plantings in 1993, now hosts more than half (53%) of the population. The TSR plantings comprise 11% of the population and Site 2 plantings 12%.
- A number of small colonies appear to have been lost. No plants were found at 3b, c, d, 3new or 7.
- Threats such as stock grazing, competition from weeds and native shrubs, spraying, and clearing for maintenance of roads and fences are ever-present threats and need to be continually managed.
- Establishment of new sites by planting of tubestock is proving a viable option to promote the conservation of this species, and new opportunities could be explored.



Tumut Grevillea flowers attract butterflies such as this Red spotted Jezebel (Photo: N.Taws)

Introduction

The Tumut Grevillea, *Grevillea wilkinsonii*, is a threatened species found only along a 20 km length of the Goobarragandra River near Tumut, NSW, and in one small population of seven individuals near Gundagai (NPWS 2001). A series of flood events beginning in September 2010 and culminating in record flood heights in March 2012 were experienced along the Goobarragandra River, causing alteration to the river bank morphology and obliteration of much of the riparian vegetation within the distribution of *G.wilkinsonii*. A survey in early 2011 found a 22% reduction in the naturally-occurring colonies due primarily to damage from floodwaters and debris. In late December 2012 Greening Australia Capital Region was commissioned to re-survey the Goobarragandra River population of *Grevillea wilkinsonii*. The primary objective of the survey was to assess and document the extent of flood damage to the *G.wilkinsonii* population.

Methods

The survey was carried out in December 2012. All sites identified and mapped by Hunter and Taws (2009) between the most upstream site at the Swing Bridge downstream to Graham's Reserve (see Figure 1) were visited. Permission was not granted to access sites downstream of Kells Lane (Percival and 'new sites'). The plantings at Sheldon's were not revisited.

Consistent with the methods used in previous surveys, all plants were recorded as being in one of three size classes:

1. Seedling, 0.1-0.2 metre
2. Mid-size, 0.2-1 metre
3. Adult, >1 metre

The mid-size class mostly includes those plants that are a few years old but are not yet reproductively mature, ie. aren't producing flowering or fruiting material. It also includes some plants that would be considered adult by their age but which have been damaged in some way (branches or foliage removed) and are not bearing flowers or fruit at the time of survey. Therefore the adult class can be considered to be the number of reproductive individuals.

A GPS recording was taken for the location of each plant or cluster of plants. At each site notes were made and photographs taken of the extent of any flood damage or other threats to the plants or the site in general. Some photo points first taken in 1998 were re-taken.

Results

A total of 870 *G.wilkinsonii* were recorded at all surveyed sites, made up of 175 seedlings, 328 mid-size and 365 adult plants (Table 1, Figure 2). In the last survey (2011) the plants at sites downstream of Kell's Lane comprised only 1% of the population so the final figures are not expected to be greatly affected by the omission of these sites.

This total of 870 is only slightly (3%) lower than the total of 900 plants found in 2011 and an increase of 8% on the number counted in 2008. However in the areas where *G.wilkinsonii* was found in 1998 the total number of plants had declined from 644 to 514 in 2008, 399 in 2011, and down to 210 in 2012 (Table 1, Figure 3). This represents a two-thirds reduction in the population at the naturally-occurring colonies, spread fairly evenly across the size classes. The majority of these sites are located within the flood zone and were adversely affected by extreme flood events in 2010 and then again 2012.

The overall population has increased since 1998 and has been able to maintain population levels despite the floods only because of the establishment of new colonies at sites above the flood zone. In particular the Swing Bridge site which now hosts more than half (53%) of the population, and to a lesser extent, the TSR plantings (11%) and Site 2 plantings (12%).

Details of changes to the population and descriptions of flood damage at each site are given in the following section.

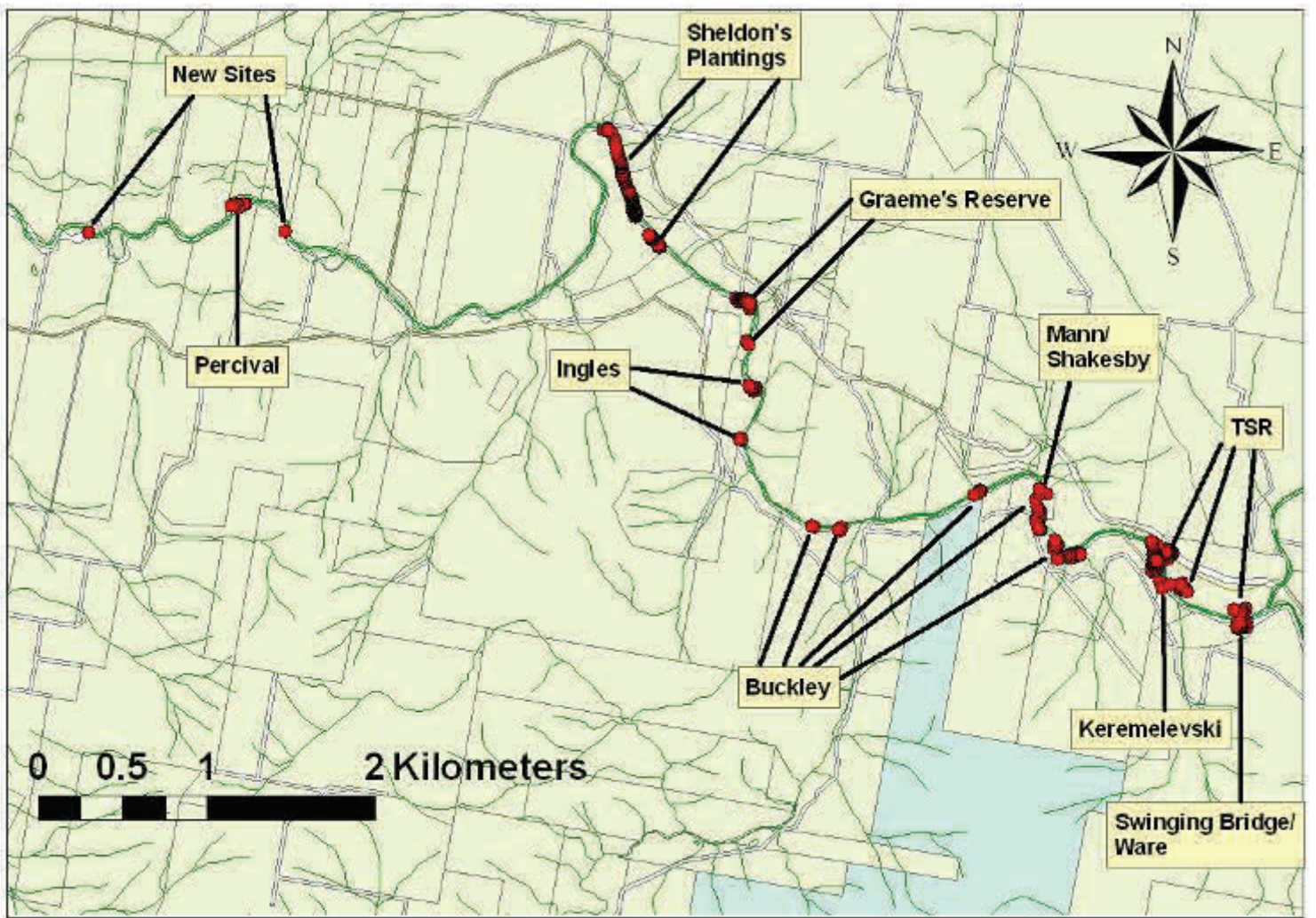


Figure 1 Location of *Grevillea wilkinsonii* sites (natural and planted) along the Goobarragandra River (map reproduced from Hunter and Taws 2009).

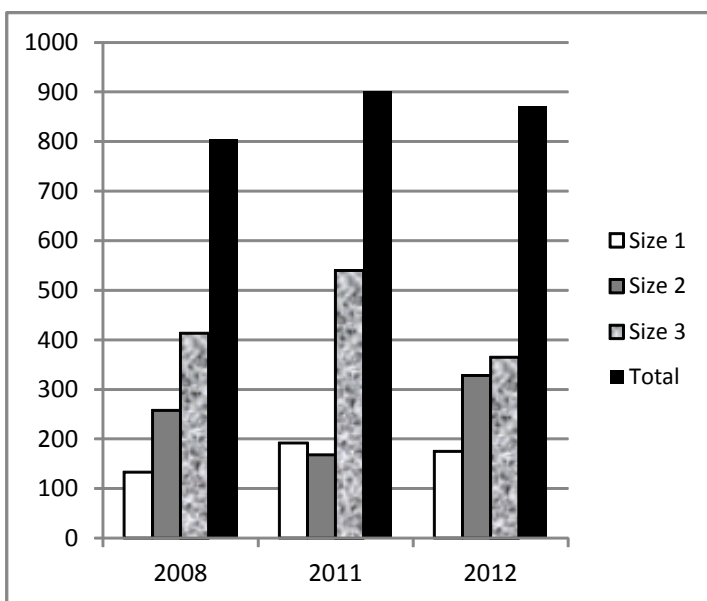


Figure 2. Total number of *G.wilkinsonii* in three size classes at all sites surveyed in 2008, 2011 and 2012

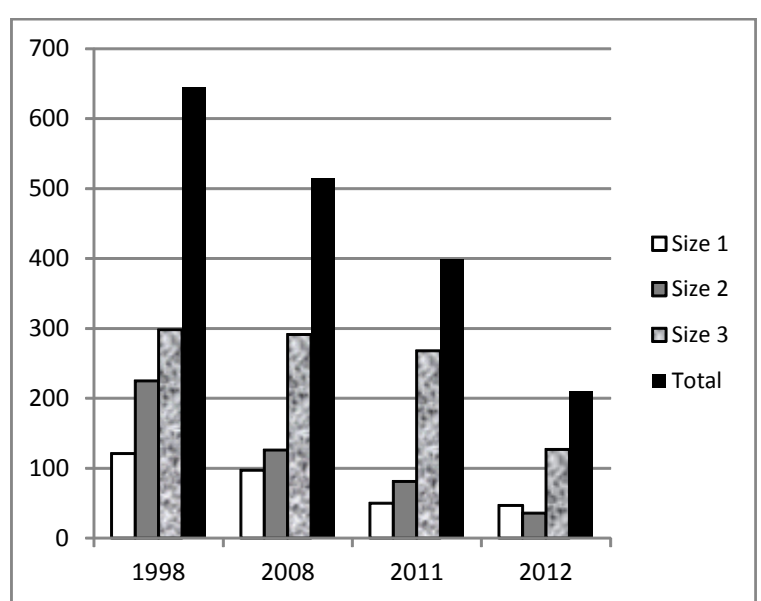


Figure 3 Total number of *G.wilkinsonii* in three size classes at the natural colonies surveyed in 1998, 2008, 2011 and 2012

Table 1 Number of *G. wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012

| Properties | Site | 2012 Survey | | | 2011 survey | | | 2008 Survey | | | 1998 Survey | | | 2012 | | | | | | | |
|---------------|---------------------------------|-------------|---------|----------|-------------|--------|---------|-------------|-------|--------|-------------|----------|-------|--------|---------|----------|-------|-----------------|------------------|-----|-----|
| | | Size I | Size II | Size III | total | Size I | Size II | Size III | total | Size I | Size II | Size III | total | Size I | Size II | Size III | total | prop-erty total | % of popu-lation | | |
| TSR | Swing Bridge | 115 | 211 | 135 | 461 | 117 | 59 | 108 | 284 | 21 | 94 | 13 | 128 | | | | | 461 | 53.0 | | |
| TSR | TSR Planting | 2 | 38 | 55 | 95 | 4 | 12 | 61 | 77 | 12 | 12 | 35 | 59 | | | | | 95 | 10.9 | | |
| TSR | Site 1 (TSR) | 8 | 17 | 44 | 69 | 23 | 20 | 58 | 101 | 24 | 28 | 45 | 97 | | | | | 69 | 7.9 | | |
| Keremelevski | Site 2 | 0 | 3 | 6 | 9 | 0 | 0 | 8 | 8 | 0 | 0 | 9 | 9 | | | | | 9 | 1.0 | | |
| Keremelevski | Site 2 planting | 11 | 43 | 48 | 102 | 17 | 14 | 65 | 96 | 0 | 16 | 48 | 64 | | | | | 102 | 11.7 | | |
| Buckley | Site 3a | 2 | 9 | 33 | 44 | 4 | 13 | 43 | 60 | 15 | 37 | 29 | 81 | | | | | 8 | 26 | 56 | 90 |
| Buckley | Site 3b | 0 | 0 | 0 | 0 | 2 | 20 | 5 | 27 | 13 | 8 | 4 | 25 | | | | | 3 | 18 | 2 | 23 |
| Buckley | Site 3new | 0 | 0 | 0 | 0 | 4 | 1 | 22 | 27 | 3 | 9 | 12 | 24 | | | | | | | | |
| Buckley | Site 3c | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | | | | 0 | 0 | 3 | 3 |
| Buckley | Site 3d | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 3 | 4 | | | | | 0 | 0 | 4 | 4 |
| Buckley | Site 5 | 21 | 4 | 3 | 28 | 10 | 11 | 15 | 36 | 11 | 9 | 14 | 34 | | | | | 4 | 32 | 24 | 60 |
| Buckley | Site 6 | 15 | 0 | 1 | 16 | 4 | 6 | 3 | 13 | 3 | 4 | 4 | 11 | | | | | 9 | 7 | 10 | 26 |
| Buckley | Site 7 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 0 | 2 | 2 | 4 | | | | | 0 | 0 | 7 | 7 |
| Mann/Shakesby | Site 4 | 1 | 0 | 13 | 14 | 5 | 2 | 32 | 39 | 1 | 4 | 32 | 37 | | | | | 41 | 48 | 33 | 122 |
| Ingles | Site 8a | 0 | 0 | 10 | 10 | 1 | 3 | 43 | 47 | 1 | 3 | 50 | 54 | | | | | 7 | 18 | 82 | 107 |
| Ingles | Site 8b | 0 | 0 | 6 | 6 | 0 | 2 | 8 | 10 | 0 | 2 | 10 | 12 | | | | | 0 | 1 | 11 | 12 |
| Graeme 's Re- | Site 9 | 0 | 3 | 11 | 14 | 1 | 3 | 49 | 53 | 28 | 29 | 88 | 145 | | | | | 45 | 69 | 24 | 138 |
| Graeme 's Re- | Site 9new | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | | | | | | | | |
| New Site 1 | New Site 1 | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | | | | | | | | |
| Percival | LB | | | | | 0 | 1 | 12 | 13 | 0 | 0 | 11 | 11 | | | | | | | | |
| New Site 2 | New Site 2 | | | | | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | | | | | | | | |
| | Totals (areas surveyed in 1998) | 47 | 36 | 127 | 210 | 50 | 81 | 268 | 399 | 97 | 126 | 291 | 514 | | | | | 121 | 225 | 298 | 644 |
| | Totals | 175 | 328 | 365 | 870 | 192 | 168 | 540 | 900 | 133 | 258 | 414 | 805 | | | | | -61 | -84 | -57 | 67 |
| | | | | | | | | | | | | | | | | | | 8 | | | |

Swing Bridge

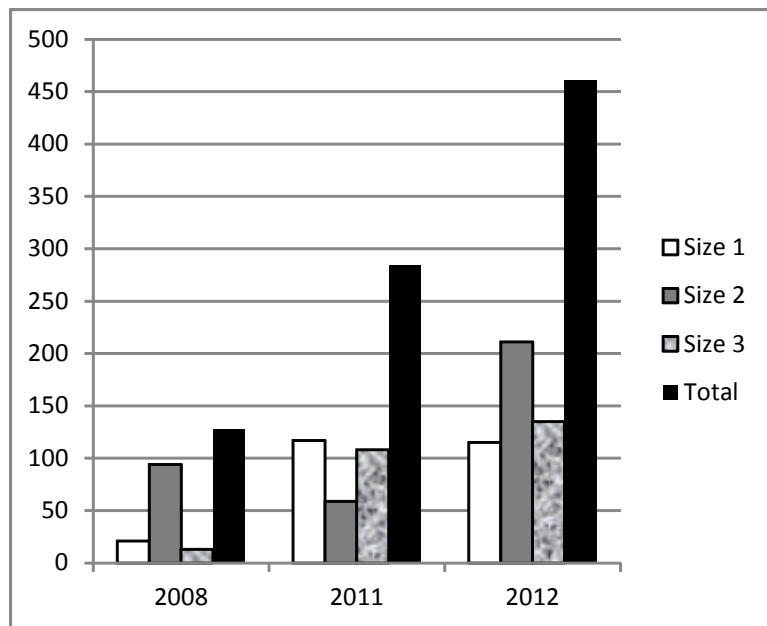


Figure 4 Swing Bridge site: numbers of *G.wilkinsonii* in three size classes in 2008, 2011 and 2012.

The Swing Bridge site was established in 1993 when a few individuals were planted on the southern side of the river across the swing bridge from the TSR. The site was not assessed in 1998 as planted sites were excluded from that survey.

Since the first count at this site in 2008, numbers have increased almost four-fold to 461 plants and this site now holds more than 50% of the population surveyed in 2012 (Table 1, Figure 4). In addition there were many new germinants (<0.1 metre tall) which were not included in the count. This site has spread more than 100 metres across the hill slope new plants continue to be found higher up the slope.

Flood damage at the Swing Bridge site was minimal with the majority of the plants above even the highest flood mark. Those plants which had been inundated sustained some damage but most were recovering (Photo 1).

The main threat to the plants at this site is potential encroachment by the large thicket of Blackberry on the eastern edge.

TSR Plantings

Both sets of plantings in the TSR, those near the swing bridge and those in the fenced enclosure were above the 2012 flood height.

Total numbers continue to increase, particularly in the mid-size class (Table 1, Figure 5). Few seedlings were evident in 2012 possibly due to the thick tea-tree (*Leptospermum brevipes*) and grass cover in the TSR inhibiting the same high level of recruitment as observed just across the river at Swing Bridge site.

It appears that current stock grazing in the TSR is infrequent or light, as the larger plants nearer the swing bridge showed no evidence of being browsed even though they are open to grazing.

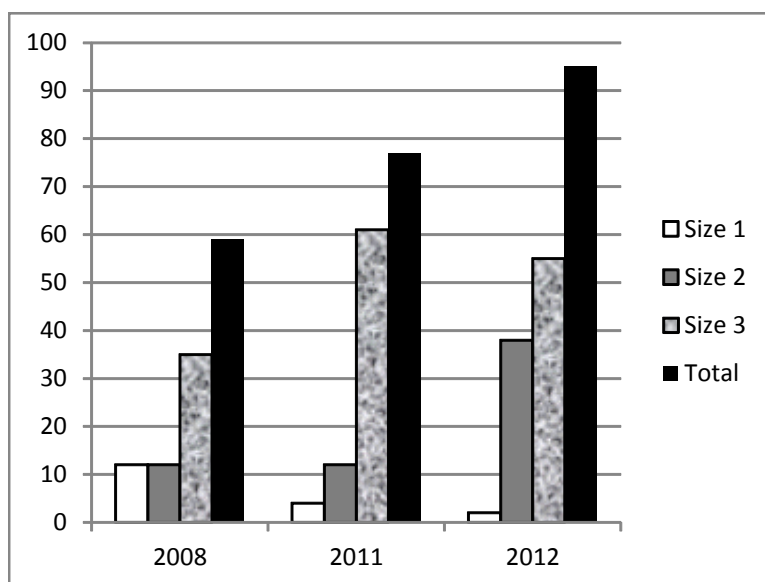


Figure 5 TSR plantings: numbers of *G.wilkinsonii* in three size classes in 2008, 2011 and 2012

Site 1 (TSR)

Site 1 comprises the fenced portion of the TSR between the Goobarragandra Road and the river, and the verge on the opposite side of the road. The naturally-occurring colony in the fenced section was supplemented with some plantings in 1993 and these are now included as part of Site 1.

Plant numbers had dropped at this site, down from 101 in 2011 to 69. The majority of plants at Site 1 were above flood height so flood damage was minor. Plants in the northern part of the fenced section were the most affected with the loss of some individuals and obvious branch and foliage damage to others (see Photos 2 & 3).

In previous surveys, most of the recruitment has occurred on the unfenced eastern verge of the road where the bare earth and open canopy associated with the road drain and the fenceline provided better opportunities for seedling establishment than the dense shrub and grass growth in the fenced section. However fewer recruits were found in this area, possibly due to disturbance from road maintenance works or the thickening canopy of *Leptospermum*.

The main threats to plants at this site are:

- competition from native shrubs (primarily *Leptospermum brevipes* and *Pomaderris angustifolia*) and weeds, principally Blackberry.
- necessary roadworks such as clearing the table drain and maintaining clearways
- erosion of the gully in the fenced section which increased during the floods,

Site 2

Natural colony

A small colony of naturally-occurring *G. wilkinsonii* is found at Site 2 on the rocky bluff between the house and the river. Four plants were counted below the bluff in 1998 and two had persisted until 2011 but had been completely removed in 2012 (see Photos 4 & 5). Encouragingly three mid-sized plants were found on the bluff.

Plantings

Plantings of *G. wilkinsonii* on the ridge and river flats north of the house were started in 2000. Most planted individuals have survived to be large profusely-flowering adults, and seedlings were found around plants on the ridge (Table 1, Figure 7). Flood damage to a number of adult plants on the river flat was evident.

Apart from flooding at this site the other main threat is competition from weeds, particularly Blackberry, and native shrubs. Recruitment from adult plants on the river flat is unlikely due to the dense cover of grasses such as *Paspalum dilatatum*, however on higher ground where native grasses such as *Themeda australis* are more prevalent, natural recruitment is already occurring.

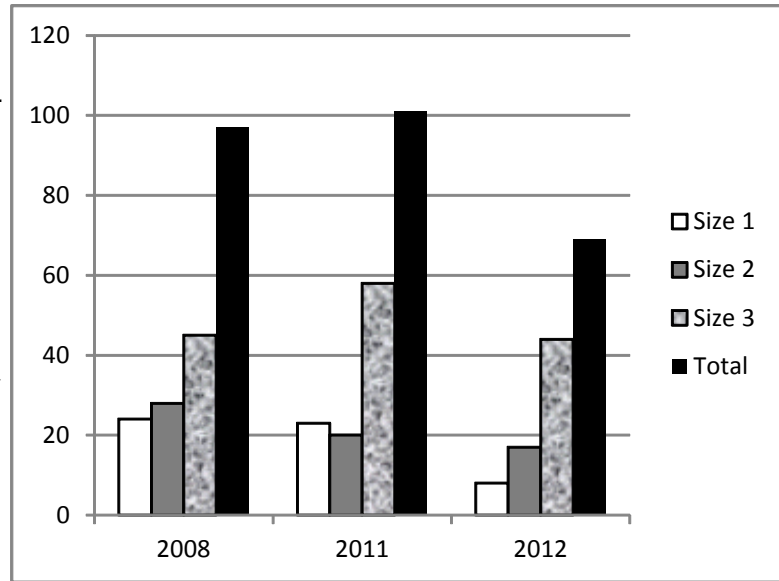


Figure 6 Site 1: numbers of *G. wilkinsonii* in three size classes in 2008, 2011 and 2012.

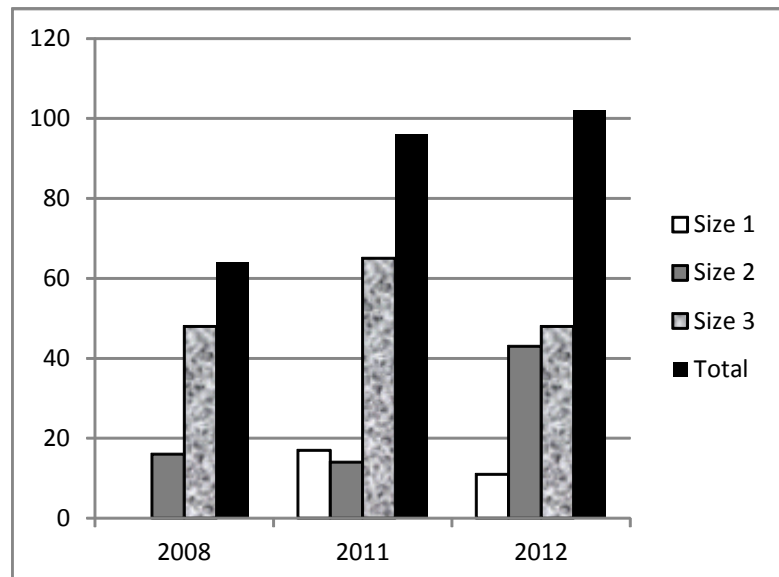


Figure 7 Site 2 plantings: numbers of *G. wilkinsonii* in three size classes in 2008, 2011 and 2012



Photo 1 Damage to adult plant within the flood zone at the Swing Bridge site, with new shoots arising from the lower branches . (Photo N. Taws)



Photos 2 & 3 Site 1, Plant #15 on October 1998 (left) and December 2012 (right). The plant was still alive with just a few new shoots from the rootstock. In 2012 this plant was counted in the mid-size class as it was non-reproductive, whereas in 1998 it was counted as an adult. (Photos N. Taws)

Site 3

Site 3 comprises five separate colonies on the property “Federal Park”.

3a

Site 3a occupies the steep riverbank above “The Big Hole”. Part of the site around the pump is fenced from stock. Since 1998 the total number of plants has steadily declined to 44, half the 1998 total. (Table 1, Figure 9). There was no evidence of any *Grevillea* surviving in the flood zone. The majority of adult plants were found in the fenced section although recruitment was lacking probably due to dense shrub and Blackberry growth. Plants in the unfenced section of the site were affected by cattle browsing, and soil erosion of the steep slope.

3b

Site 3b occupies a low-lying shingle bank of rocks, pebbles and sand adjacent to the river. The site is unfenced from the adjacent grazing land, and there has been evidence of damage to the *G. wilkinsonii* from cattle browsing in each of the previous surveys. The site was completely inundated in March 2012 and there was no evidence of any *Grevillea* surviving the flood. Any shrubs of other species that had survived appeared to have been browsed.

3c

Site 3c in 1998 was a clump of three adult *G. wilkinsonii* threatened by smothering from clearing debris heaped next to it, and dense *Leptospermum* and Blackberry growth. In 2008 only one plant could be found, and in 2011 this plant could not be relocated amongst the dense shrub and weed growth, so it appears that no *G. wilkinsonii* exist at this site any more.

3d

Site 3d is right next to the river. Four plants were recorded in 1998 and 2008 but only two of these could be relocated in 2011 and none were found in 2012, most likely removed by the flood.

3new

In the 2008 survey a new colony was located on the river’s edge between sites 3b and 3c. Despite the 2010 floods covering this site more plants were recorded in 2011 (Table 1). However after the flood in 2012 the site was buried under rock, sand and debris smothering all *G. wilkinsonii*. No living plants were found at this colony.

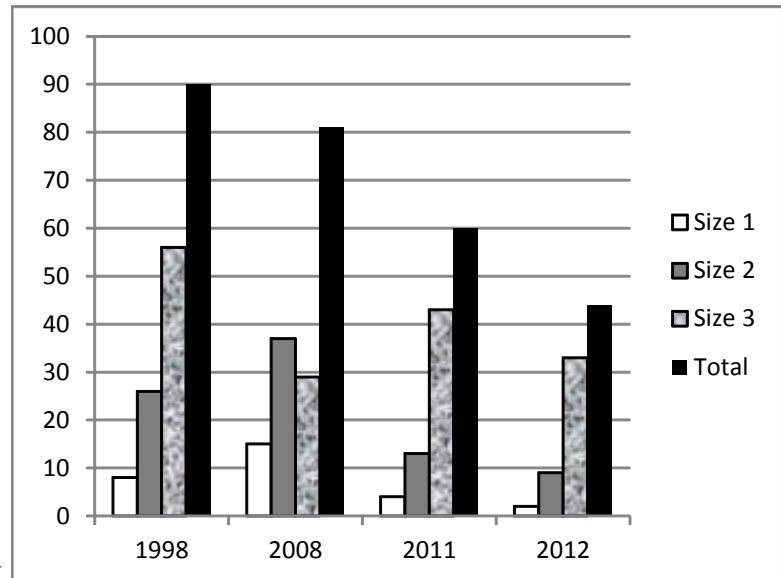


Figure 8 Site 3a: numbers of *G. wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012



Photos 4 & 5 (above) Site 2. The upstream-most plant in the natural population below the Bluff, October 1998 (above left) and the same place in December 2012 (above right). This area bore the full force of the floodwaters in March 2012 and no evidence of any *Grevilleas* remains.
(Photos: N. Taws)

Photo 6. Site 3new. Dead *Grevillea* plants were found under mountains of sand, rocks and debris, but no living plants were found at this site.
(Photo: N. Taws)

Site 4

Site 4 has been counted accurately in four surveys since 1993 (Table 1, Figure 9). The number of adult plants remained stable in the low 30s between 1998 and 2011 although the number of sub-adult plants decreased markedly after 1998.

The 2010 floods impacted on this site causing death of at least one large adult and damage to others. However the 2012 flood was much more damaging and killed more than half of the adult plants (Photos 8 & 9), leaving only 10 in the flood zone and the three planted individuals above the flood zone. Only one seedling was found at the site. No recruitment has been found around the planted individuals.

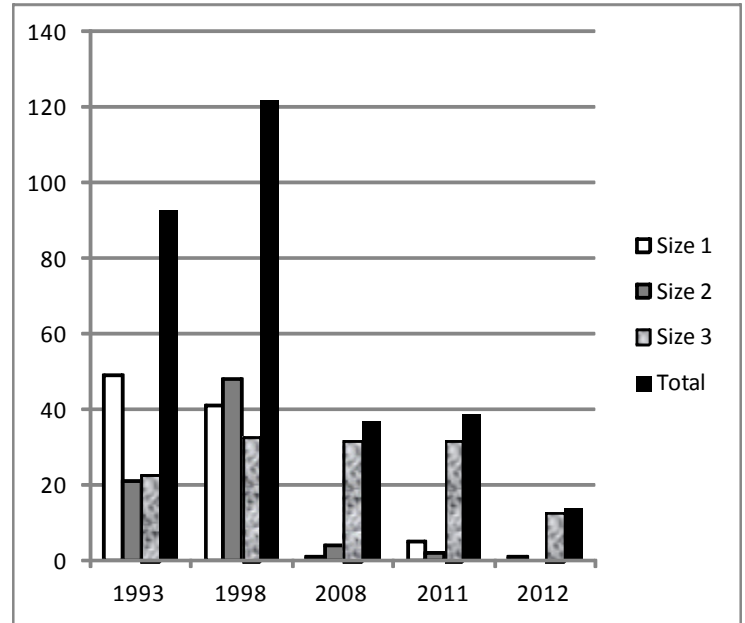


Figure 9 Site 4: numbers of *G. wilkinsonii* in three size classes in 1993, 1998, 2008, 2011 and 2012

Site 5

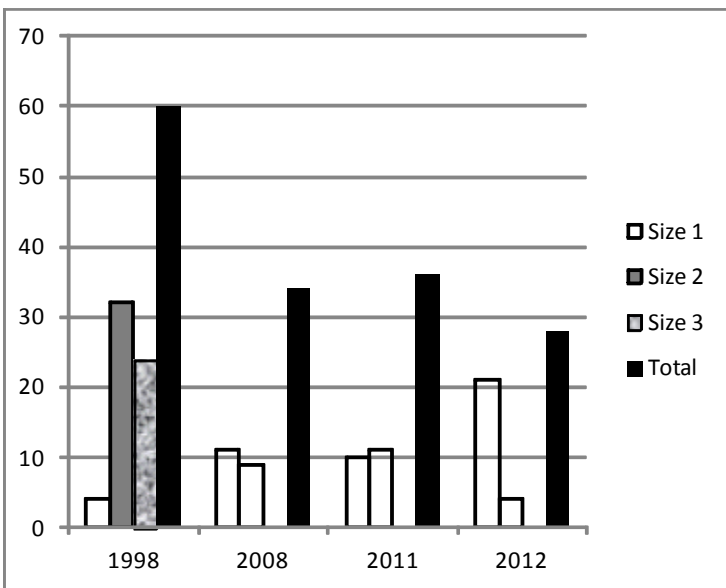


Figure 10 Site 5: numbers of *G. wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012

Site 5 occurs on “Federal Park” on a steep slope with native vegetation and little weed growth. All plants grow close to the river and were inundated in all the floods. Damage after the 2010 floods was minimal but the 2012 event killed most of the adults at the site (Table 1, Figure 10), leaving only three, down from 24 in 1998.

Surprisingly, 21 seedlings were found in 2012, the largest number recorded at this site. It was not clear whether they were new recruits after the most recent flood or whether they had germinated after the 2011 flowering season and survived the 2012 flood (Photo 7).



Photo 7 Site 5 seedling recruitment after flood events on steep rocky banks within the flood zone (Photo: N.Taws)



Photos 8 & 9 Site 4 in October 1998 (left) and from the same point in December 2012 (right)

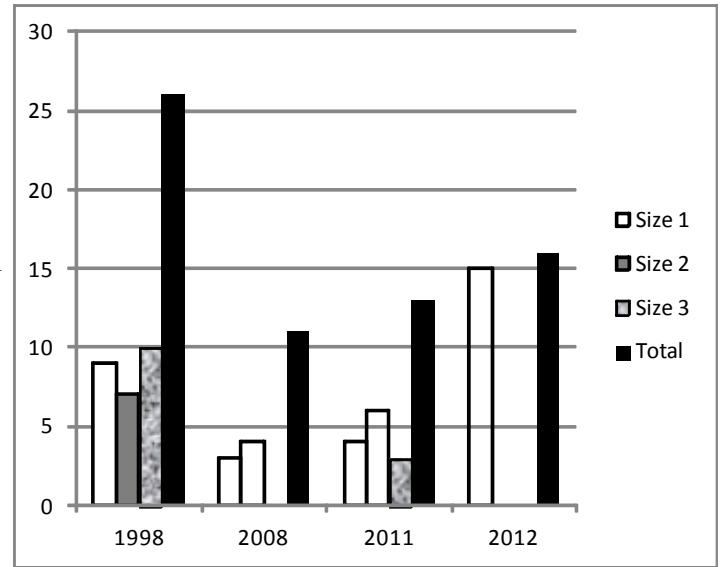


Site 6

Site 6 is also on “Federal Park”, downstream from Walls Creek, on a steep and densely shrubby slope. Similarly to Sites 5 and 4, plant numbers showed a big decline from 1998 to 2008 but remained fairly stable to 2011 despite the 2010 floods (Table 1, Figure 11). However the 2012 flood killed all but one of the adults at the site.

Again, as at Site 5, there were a surprising number of seedlings (15) which now comprise the majority of the colony.

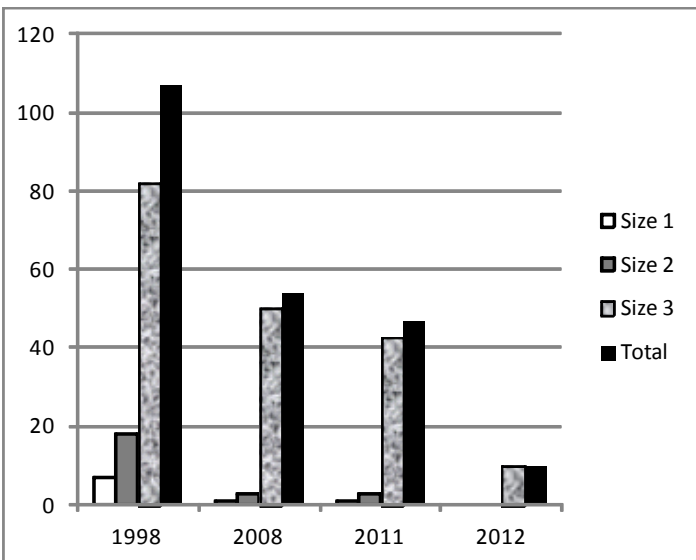
Figure 11 Site 6: numbers of *G.wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012



Site 7

Site 7 is the most downstream site on “Federal Park” and all within the flood zone. The maximum number of plants was seven adults in 1998 and there has been a steady decline in each of the surveys since (Table 1). Some flood-damaged plants remained after the 2010 events but after the 2012 flood there was no evidence of *G. wilkinsonii* at this site.

Site 8

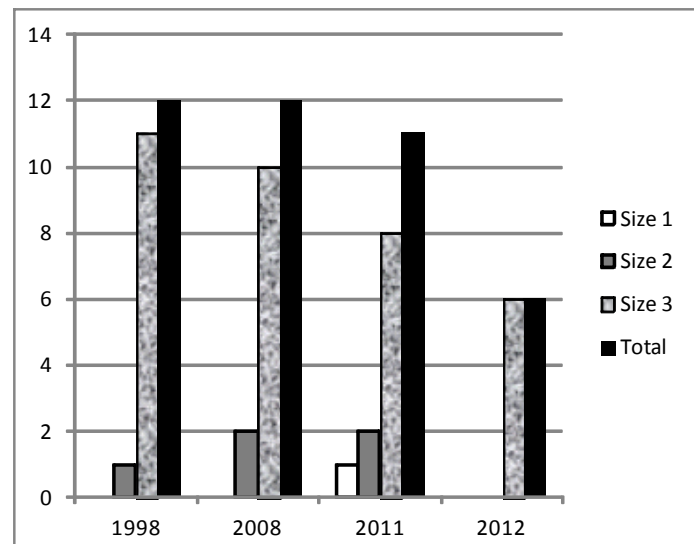


8a

Site 8a occupies a small sandy beach and the adjacent riverbank on the property “Freshford”. The flood events, particularly 2012, have had a major impact on this colony (Table 1, Figure 12). Ten adults were found in the 2012 survey, down from 82 in 1998. The remaining adults were all up on the bank above flood height. No recruitment was observed.

Weeds and dense native shrub growth have been an ongoing issue at this site, and may flourish in the wake of the floods to the detriment of *Grevillea* recruitment.

Figure 12 Site 8a: numbers of *G.wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012



8b

Site 8b is a small colony on “Freshford” on the property boundary with “Federal Park”. The 2012 floods removed any plants in the flood zone and the six remaining adults grow up high on the bank (Table 1, Figure 13). This site is prone to erosion, and although recruitment has been observed on the bare eroding banks the plants have usually not been found in the next survey. Dense *Leptospermum* growth at the top of the bank inhibits recruitment around the plants further away from the eroding cliff face.

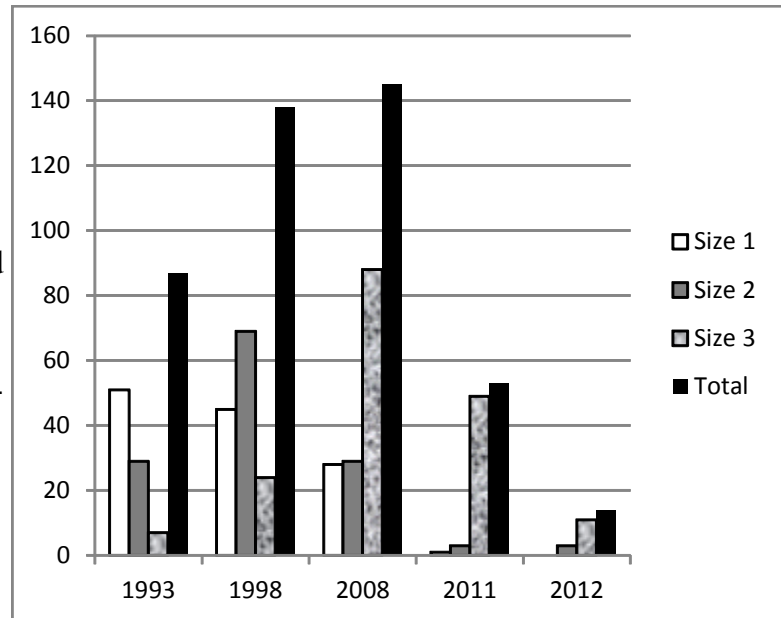
Figure 13 Site 8b: numbers of *G.wilkinsonii* in three size classes in 1998, 2008, 2011 and 2012

Site 9

Site 9 is located on public land (Graeme's Reserve) on a shingle bank and the adjacent riverbank, in a very similar topographic location to Site 8a. The colony suffered a very similar fate to that at 8a and in 2012 the number of plants had declined to just 14, 10% of the total counted in 2008 (Table 1, Figure 14).

It may be that the shingle banks such as those at Sites 8a and 9 provide good conditions for recruitment of the *Grevillea* but provide a less solid root-hold than the rocky banks when flooding occurs.

Figure 14 Site 9: numbers of *G.wilkinsonii* in three size classes in 1993, 1998, 2008, 2011 and 2012



Site 9new

Site 9new was a cluster of three plants 200 metres upstream from Site 9. One large adult plant was above the 2012 flood, one was below flood height and damaged but surviving, and the third lower down had been killed by floodwaters.

Photos 8 & 9 Site 9 in October 1998 (top) and the same place in December 2012 (below). Photos: N. Taws

Discussion

The 59% reduction since 2008 in the *G.wilkinsonii* population at the naturally-occurring colonies can be almost all attributed to the recent floods, but in particular the extreme 2012 event. The 2010 floods had greatest impact on sub-adults, with 35% fewer mid-size plants and 48% fewer seedlings in the 2011 survey but adult plants still at 93% of the 2008 numbers. However after the 2012 flood adult numbers had dropped to 43% of the 2008 numbers.

Several small sites—3b, 3c, 3d, 3new and 7- contained no *G.wilkinsonii*. Of these sites 3b provides the best conditions for recruitment on the shingle bank but until stock grazing is excluded from this area there is little prospect that new plants will grow to adulthood.

The floods have also created new opportunities for recruitment of *G.wilkinsonii* by removing competing vegetation, creating bare earth and depositing sand and soil. However the loss of so many adult plants may decrease the chances of recruitment at some sites, particularly if weeds or other native shrubs take advantage of the open conditions.

The success of recruitment at the planted sites at the Swing Bridge, TSR and Site 2 demonstrates that planting tubestock is a viable option to establish new sites and help provide an insurance against any one threat or event impacting on all the sites .

Possible new sites to consider for plantings include other parts of the TSR, Site 4 above the flood zone, Site 9 above the flood zone, or additional sites at “Sheldon’s”.

In addition, planting within the flood zone is not entirely a lost cause. The 2011 survey found that many of the older planted tubestock at Site 2 and Sheldon’s were able to withstand the 2010 floods which were considered to be major flood events. It was only the most extreme event in 2012, a flood greater than any previously recorded in the valley, that was so damaging to many of the adult plants. Other threats to *G.wilkinsonii* such as stock browsing, competition and smothering from weeds and native shrubs are ongoing and need to be continually managed.

Recommendations

As a result of the survey the following recommendations are made:

- Continue to undertake plantings of *G.wilkinsonii*, to replace losses at existing planting sites, and to establish new colonies where appropriate sites can be identified. Possibilities include other parts of the TSR, Site 4 and Site 9, and the property of Sheldon’s.
- Continue to manage the ongoing threats to *G.wilkinsonii*, including preventing stock access to sites, and controlling or removing weeds and native plants competition to promote natural recruitment at the sites.
- Undertake another survey in 3-5 years time to determine the status of the population.

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