

Grassy Head Post-Fire Vegetation Monitoring Study

Report prepared for the Macleay Landcare Network Inc
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SUMMARY OF FINDINGS

- **Increased native vegetation**

All sites demonstrated an increase in both diversity and abundance of native plant species over the survey period. The absence of any pre-fire species records in the plots means that it is not possible to say if there has been a full recovery of native plant diversity in the 5 years since the 2009 fire.

- **Decreased bare ground**

There has been a decrease in the recorded occurrence of bare ground at all sites over the survey period, indicating the progressive return of vegetation to areas burnt in 2009.

- **Reduced re-sprouting of native tree/shrub species but increased native shrub/tree seedlings**

Records from the 2013 survey showed several plots with burnt coastal banksia (*Banksia integrifolia*) and dogwood (*Jacksonia scaporia*) re-sprouting. The 2014 survey revealed that most of the re-sprouting plants had died over the year. However, the 2014 survey did record seedlings of coastal banksia (*Banksia integrifolia*), geebung (*Persoonia* sp.), and coastal wattle (*Acacia longifolia subsp. sophorae*) in the Plots.

- **Increased kangaroo grass cover**

There has been a general increase in grass cover at all sites since 2009. Most sites show an increase in kangaroo grass (*Themeda australis*) cover. The data from Plot 5 showed that between 2013 and 2014 the cover of kangaroo grass increased as other grass species such as prickly couch (*Zoysia macrantha*) and several annual weed species decreased. Clearly, kangaroo grass is a strong competitor in this environment.

- **Decreased weed presence and abundance**

Most plots demonstrated a decrease in weed presence and abundance between 2013 and 2014. The exception was Plot 1 which recorded a single individual in 2014 after having no weed species recorded in the previous years. A decrease in the occurrence and abundance of annuals was the most significant change observed. This is most likely related to the decrease in bare ground at all plots over the survey period and the increased cover and density of kangaroo grass (*Themeda australis*) and other dense native species such as lomandra (*Lomandra longifolia*).

Introduction

In July 2013, GECO Environmental was contracted by the Macleay Landcare Network Inc to undertake a small-scale study of the post fire recovery of Themeda grassland communities occurring on Grassy Head headland. The study had been commenced the previous year by the then Landcare coordinator, Lyndel Wilson.

The main intent of the study was to document the response of the Themeda grassland community to being burnt, in particular any effects in terms of weed encroachment that may be related to the post fire vegetation recovery.

Description of Grassy Head study area.

Grassy Head headland is located approximately 10 km north of the Macleay River entrance at South West Rocks, on the mid north coast of New South Wales. The whole of the headland is Crown reserve. No plan of management exists for the headland or for adjacent areas of Crown reserve.

The geology of the headland is mapped as part of the Kempsey Beds which are variously composed of lithic sandstone, mudstone, siltstone, and pebbly sandstone with minor conglomerate. Soils have been described as imperfectly drained, moderately deep, Mottled Yellow Kurosols (Yellow Podzolic Soils and Soloths), with shallow Leptic Tenosols (Lithosols and Black Headland Soils) and exposed rock faces on steep slopes (Diamond Head Soil Landscape as per Eddie, 2014).

The headland has two potential Endangered Ecological Communities (EEC) occurring. Extensive areas of kangaroo grass (*Themeda australis*) cover the more exposed northern and eastern slopes and are likely to be consistent with the *Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC. Small pockets of littoral rainforest also occur which are considered candidate Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions EEC.

Aerial photograph images are provided for comparison in Figures 1 and 2 below. Figure 1 shows the headland in 1942 while Figure 2 is an image from 2012. The following points are of interest:

- There has been significant regeneration of vegetation to the south of the headland. This area was the old river mouth until the river broke a new entrance near South West Rocks in 1893, and was the subject of a large scale soil conservation project during the 1970s and 1980s. The area is currently maintained by community volunteers with the assistance of the Grassy Head Nursery Reserve Trust.
- It would appear that there has been some loss of potential littoral rainforest or coastal banksia heath from the north-western extent of the headland at the very south of Grassy Head beach (area denoted by dotted line).
- A small pocket of littoral rainforest has persisted at the location indicated by the arrow, despite regular burning in the early half of the 20th century (see below)
- *Themeda* grasslands are extensive in both photos

Figure 1
Grassy Head headland 1942

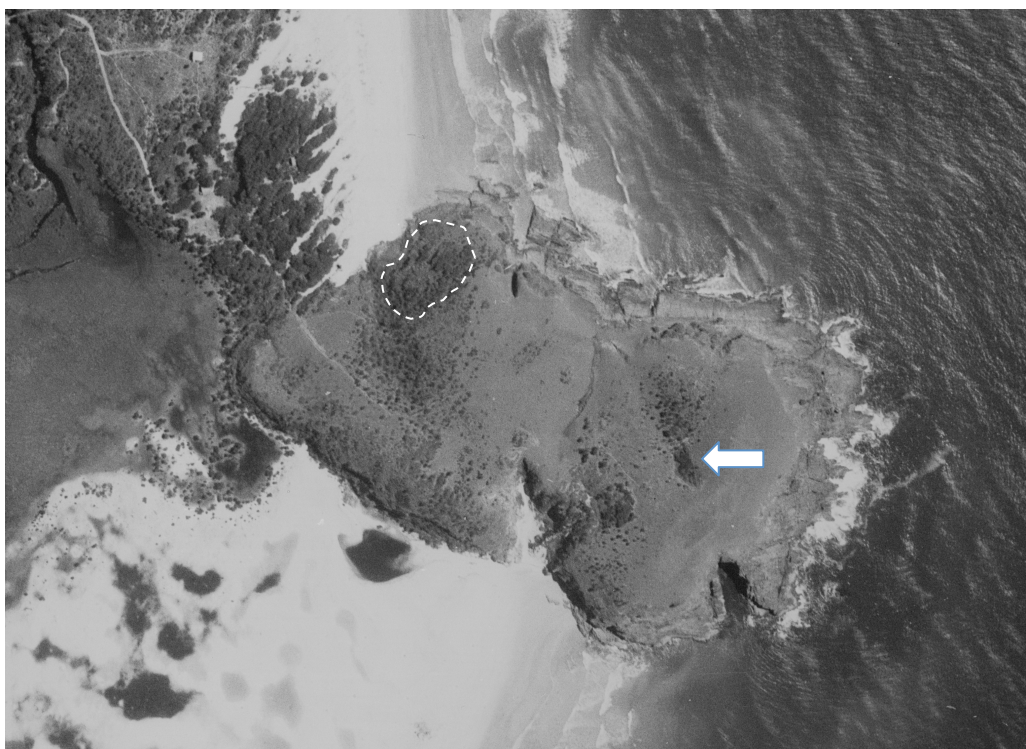


Figure 2
Grassy Head headland 2012



Basemap source: Six Viewer, Land & Property Information, NSW Government

Grassy Head Past Fire History

There are few records available indicating the fire history for the headland. Anecdotal evidence from long-term residents of the district suggest that prior to the mid 1940's, the headland was regularly burnt by the unofficial caretaker of the headland area, Jimmy Jones. It is thought that a large bushfire in 1947, which burned an area from Taylors Arm through to the coast, was likely to have also burned the headland. Regular burning ceased when the management of the land was transferred to a trust of banana growers in the late 1940s and then later to the Kempsey Shire Council (Darren Rogers, pers.comm. October 2014). NSW Rural Fires Service only has records for approximately the last 10 years for the area (Belinda Devine, pers.comm. November 2014)

The most recent fires occurred in 2009 and then in 2012 (Eric Rogers, Stuarts Point Rural Fire Service). Of these the largest occurred on 8 October 2009, having started between the 4WD access track to the south of the headland and the caravan park. This fire burnt approximately 80% of the headland (see Figure 3). The second fire, on 15 August 2012, started in the southern corner on the north side of the headland and burnt only a small way up the hill. An area of littoral rainforest in the hind dune was also damaged by this fire.

Figure 3
Approximate area of burning 2009



Basemap source: Six Viewer, Land & Property Information, NSW Government
Approximate area of burning provided by Lyndel Wilson, 2014

Grassy Headland Post fire vegetation survey

The survey

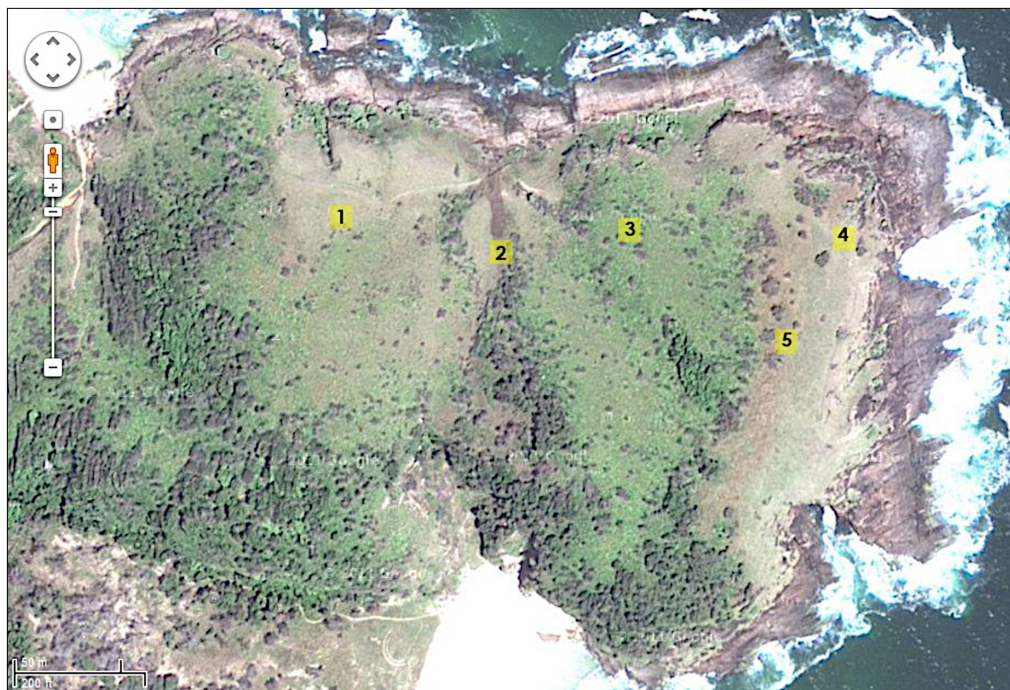
The results presented are based on data collected during surveys undertaken in September 2013 and September 2014. The assistance of Mark Robinson, currently of Coffs Harbour Local Land Services, with plant identification and field survey is gratefully acknowledged.

Plot selection

Five (5) survey plots were selected by the Landcare Coordinator prior to the commencement of the project. The sites were adopted without change as they appeared to broadly cover the variability of the study area being that area burnt by the 2009 wildfire.

Each plot represents an area of 100m² being 10m by 10m square. A wooden survey peg was located in the northwest corner of each plot to allow the quadrats to be easily relocated for subsequent surveys. The location of the pegs was recorded by GPS to allow the corner of each quadrat to be relocated should a fire or vandalism result in the loss of the peg. The northern boundary of each plot is found by extending due east from this point for 10m. Figure 4 shows the location of survey plots on the headland. The GPS coordinates for the north-west corner of each plot are provided in Table 1.

Figure 4
Location of survey plots



Basemap source: Six Viewer, Land & Property Information, NSW Government

Table 1
GPS coordinates of the north-west corner of each of the survey plots,
Grassy Head headland, NSW.

Plot	GPS Coordinates	
	S	E
1	30.79392	153.00027
2	30.79423	153.00108
3	30.79394	153.00179
4	30.79418	153.00252
5	30.79473	153.00226

Survey method

The survey methodology was designed to allow a coarse determination of changes to the relative abundance of introduced species and native species in the plots over the period of survey.

All species within each of 5 plots were identified, counted (or numbers estimated where greater than 50 specimens were present), and a cover class assigned. *Table 2* shows the cover classes used. The proportion of coverage (%) of both introduced and native species was estimated within each 10m x 10m quadrat as well as the percentage of bare ground at time of survey.

Table 2
Cover classes assigned to recorded species in survey plots, Grassy Head, NSW.

Cover Class	Code
< 1% Trace	T
1 – 5%	1
5 – 25%	2
25 – 50%	3
50 - 75%	4
75 – 95%	5
95 – 100%	6

Survey Results

Table 3 shows the results of the surveys undertaken under the project, including the results of the initial year's survey which was undertaken by the Macleay Landcare Network Inc. coordinator, Lyndel Wilson, in 2012.

A total of 55 native species and 17 introduced species were identified (see Appendix 1: Species List). Three weeds of National Significance were identified: Lantana

(*Lantana camara*), Bitou Bush (*Chrysanthemoides monilifera*) and Fireweed (*Senecio madagascariensis*).

Table 3 shows that there has been:

- an increase in both the diversity and abundance of native plant species in all plots;
- a decrease in abundance and cover of weed species over the survey period in all plots except Plot 1, which showed a increase from nil to one weed species present in 2014; and,
- a decrease in the percentage of bare ground in all plots over the survey period, indicating the progressive return of vegetation to areas burnt in 2009.

The absence of any pre-fire species records in the plots means that it is not possible to say if there has been a full recovery of native plant diversity in the 5 years since the 2009 fire.

However, interestingly, a comparison of the aerial images from both 1942 and 2012 (Figures 1 and 2) to Figure 4 on page 5 (early 2009 image) shows that the headland had a much more extensive but patchy shrub layer (*Banksia integrifolia*, *Casuarina glauca*, *Jacksonia scaparia*, *Persoonia sp.*) before the 2009 fire. This would tend to support the anecdotal evidence of the fire history of the headland, with the regular fires in the pre 1940s era promoting the grassland and the long absence of fire from the post 1950 era allowing the slow establishment of coastal heath scrub over a broad area.

Table 3
Proportion of native to weed species in plots over the survey period.

		Total Species Recorded	Number Native Species	Number Weed Species	% Native Cover	% Weed Cover	% Bare Ground	% Cover Grassland	% Cover Shrub/Tree
2012*	Plot 1	11	11	-	62	-	38	60	2
	Plot 2	20	14	6	60	20	20	60	10
	Plot 3	7	7	-	52	-	48	50	2
	Plot 4	13	13	-	70	-	30	65	5
	Plot 5	14	12	2	45	1	55	40	5
2013	Plot 1	13	13	-	80	-	20	78	2
	Plot 2	44	34	10	93	7	<1	95	5
	Plot 3	21	20	1	90	<1	10	88	2
	Plot 4	15	15	-	90	-	10	89	1
	Plot 5	16	12	4	99	1	<1	99	1
2014	Plot 1	16	15	1	99	<1	1	95	5
	Plot 2	42	35	7	93	7	-	95	5
	Plot 3	24	23	1	89	1	10	85	5
	Plot 4	15	15	-	96	-	5	90	5
	Plot 5	18	16	2	99	1	-	99	1

* 2012 survey undertaken by Lyndel Wilson, Macleay Landcare Network Inc.

Table 4 shows the changes in recorded presence, cover class (using the cover classes described above) and abundance (individuals counted, shown in brackets) of weed species recorded over the survey period. Cells shaded orange indicate marginally increased abundance over the survey period. Cells shaded green indicated reduced abundance over the period.

Table 4
Recorded presence, cover class, and abundance (in brackets) of weed species in each plot over the survey period

		Lantana	Bitou bush	Groundsel	Cape berry	Fireweed	Carpet grass	Thistles	Fleabane	Verbana	Stinking Roger	Scarlet pimpernel	Milkweed		
Plot 1	2012					-									
	2013					-									
	2014					T (1)									
Plot 2 [#]	2012	T(4)	T(2)	-	-	-	T	-	-	T(20)	T(3)	-			
	2013	T(8)	T(2)	T(2)	T(3)	T(12)	2(nr)	T(2)	T(1)	T(1)	0	T(4)			
	2014	T(3) [#]	0 [#]	T(1)	0	T(7)	1(nr)	0	0	T(1)	0	0			
Plot 3	2012	-													
	2013	T(2)													
	2014	T(2)													
Plot 4	2012	No weeds were recorded over the survey period in Plot 4													
	2013														
	2014														
Plot 5	2012	T(40) ¹				-			T(nr)			-			-
	2013	T(1)				T(4)			T(5)			-			T(1)
	2014	0				T(3)			0			T(10)			0

Notes:

(nr) = no record available of actual number of individuals available

Cells shaded green indicate reduced abundance over the survey period

Cells shaded orange indicate marginally increased abundance over the survey period.

* 2012 survey undertaken by Lyndel Wilson, Macleay Landcare Network Inc.

[#] this plot potentially sprayed by a weed control contractor in mid-2014

¹ recorded as seedlings in 2012

Table 4 shows that;

- Plot 2 had the most weed species recorded, most likely reflecting the more favourable characteristics of the site in terms of shelter, moisture, and soils. By 2014 only lantana, groundsel, fireweed, verbena, and carpet grass were persistent.
- Weeds were not a persistent management issue in any of the other plots, with either only very small numbers of individuals recorded or marked decreases in abundance over the survey period.

- Generally speaking, the decrease in the occurrence and abundance of annuals (eg. fireweed, thistles, fleabane, stinking roger and milkweed) was the most significant change observed. This is most likely related to the decrease in bare ground at all plots over the survey period and the increased cover and density of kangaroo grass (*Themeda australis*) and other dense native species such as lomandra (*Lomandra longifolia*).

No listed threatened or endangered plants (listed under the *NSW Threatened Species Act 2005* or the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999*) were recorded during the survey.

However, one species of vine (*Glycine* sp.) and a species of orchid (*Diuris* sp.) were recorded but not identified to species level. As a species of *Glycine* found on the coastal headland at Scotts Head (approximately 5km to the north) has been recently listed as an endangered population under the TSC Act (*Glycine cladestina* (broad-leaved form)), it is recommended that the *Glycine* sp. found on Grassy Head be further investigated.

Similarly, *Diuris* sp. aff. *Chrysantha* is a species of orchid listed as threatened under the TSC Act and known to occur within the Themeda Grasslands EEC. As the *Diuris* species recorded on Grassy Head headland has not been positively identified beyond its genus it is recommended that it also be further investigated.

Conclusion

This study has been targeted towards assessing the post-fire weed response on the headland. The data reveals an interesting dynamic in terms of native species recovery and weed invasion and persistence. To date, the headland is mostly recovering well in terms of the re-establishment of natives with relatively minor weed issues. However, the findings of this study are preliminary and ideally regular surveying would continue to determine longer-term trends.

The study has revealed other interesting questions about post-fire vegetation responses on headlands. For instance, the vegetation of the headland is markedly different in its structure post 2009 with far fewer shrubs. Many banksia were killed in the fire and where surviving specimens resprouted they were often not persistent. There is also an extensive coverage of *Lomandra longifolia* on the headland and the dynamics between this species and the Themeda community is interesting: Are the areas of *Lomandra* increased after fire? Further, some species that may have been expected to be found do not occur, for example *Pultanea maritima*...is this due to the very frequent burning regime in the early half of the 20th century, the very infrequent burning in the 2nd half of the 20th century, or for other reasons.

In essence the most important question is what is the best burning regime to maintain both the Themeda grasslands and the littoral rainforests on the headland? This is certainly an issue to address should a management plan be developed for the headland and the adjacent crown reserves.

References

Eddie M.W. (2014), Soil Landscapes of the Wingham and Camden Haven 1:100,000 Sheets, Draft report, Office of Environment and Heritage.

Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing.
<http://www.environment.nsw.gov.au/determinations/LittoralRainforestEndSpListing.htm>

Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing.
<http://www.environment.nsw.gov.au/determinations/ThemedaGrasslandSeacliffsEndSpListing.htm>

Appendix 1 – Species List

Native Plant species recorded

Species Name	Common Name	Native/ Introduced	Form	Plot				
				1	2	3	4	5
<i>Acacia longifolia</i> subsp <i>sophorae</i>	Coastal wattle	N	S		x		x	x
<i>Banksia integrifolia</i>	Coastal banksia	N	T	x	x	x	x	x
<i>Breynia oblongifolia</i>	Coffee bush	N	S		x	x		x
<i>Caesia parviflora</i>	Pale grass lily	N	H			x		
<i>Carex breviculmis</i>	Short-stemmed sedge	N	Sedge	x	x	x	x	
<i>Casculata</i> sp.	Dodder	N	H		x			x
<i>Casuarina glauca</i>	Swamp oak	N	T	x				
<i>Centella asiatica</i>	Gotu kola	N	H	x	x		x	x
<i>Chorizima paviflora</i>	Eastern flame pea	N	H			x	x	
<i>Cupaniopsis anarcicoides</i>	Tuckeroo	N	T		x			
<i>Cynodon dactylon</i>	Green couch	N	G		x			
<i>Dianella</i> sp.	Blue flax lily	N	H				x	x
<i>Dicondra repens</i>	Kidney weed	N	H					x
<i>Diuris</i> sp.	Donkey orchid	N	H	x			x	
<i>Entolasia stricta</i>	wiry panic	N	G			x		
<i>Eragrostis brownii</i>	Brown love grass	N	G		x	x		
<i>Ficus fraseri</i>	White sandpaper fig	N	T		x			
<i>Gahnia aspera</i>	Rough saw sedge	N	Sedge		x			
<i>Geitonoplesium cymosum</i>	Scrambling lily	N	V		x			
<i>Glochidion fernandi</i>	Cheese tree	N	T		x			
<i>Glycine</i> sp.	-	N	V		x	x	x	x
<i>Hibbertia aspera</i>	Climbing guinea flower	N	S			x		
<i>Hibbertia linearis</i>	Showy guinea flower	N	S			x		
<i>Hydrocotyle</i> sp.	Pennywort	N	H					x
<i>Imperata cylindrica</i>	Bladey grass	N	G		x			
<i>Ischaemum australe</i>	-	N	G		x			
<i>Jacksonia scaparia</i>	dogwood	N	T			x		
<i>Juncus</i> spp.	-	N	Rush		x			
<i>Lobelia anceps</i>	Angled lobelia	N	H	x	x			
<i>Lomandra longifolia</i>	Lomandra	N	Rush	x	x	x	x	x
<i>Marsdenia rostrata</i>	Milkvine	N	V		x			
<i>Notelaea longifolia</i>	Mock olive	N	S		x			
<i>Oplismenus imbecillus</i>	Paddymelon grass	N	G		x			x
<i>Oxalis</i> sp.	-	N	H	x				
<i>Pandorea pandorana</i>	Wonga wonga vine	N	V			x		
<i>Paspalidium</i> sp.	-	N	G			x		
<i>Persoonia</i> sp.	a geebung	N	S	x		x		
<i>Pimelea linifolia</i> ssp. <i>linifolia</i>	Slender rice flower	N	S	x	x	x	x	
<i>Polymeria calycina</i>	Slender bindweed	N	V	x	x	x	x	x
<i>Poranthera microphylla</i>	Small poranthera	N	H			x	x	

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Species Name	Common Name	Native/ Introduced	Form	Plot				
				1	2	3	4	5
<i>Pratia purpurascens</i>	White root	N	H		x		x	x
<i>Pterostylis</i> spp.	Ground orchid	N	H			x		
<i>Pultenaea daphnoides</i>	Large leaved bush pea	N	S	x		x	x	
<i>Schoenus</i> sp.	-	N	Sedge	x	x	x	x	
<i>Smilax australis</i>	Barbwire vine	N	V		x			
<i>Smilax glycyphylla</i>	Sweet Sarsaparilla	N	V		x			
<i>Solanum americanum</i>	Nightshade	N	H		x			
<i>Stephania japonica</i>	Snake vine	N	V		x	x		x
<i>Themeda australis</i>	Kangaroo grass	N	G	x	x	x	x	x
<i>Thysanotus tuberosus</i>	Common fringe lily	N	H	x			x	
<i>Tricoryne elatior</i>	Yellow Autumn lily	N	H			x	x	
<i>Velleia spathulata</i>	Wild pansy	N	H	x		x	x	
<i>Viola hederacea</i>	Native violet	N	H		x			
<i>Xerochrysum bracteatum</i>	Paper daisy	N	H					x
<i>Zoysia macrantha</i>	Prickly couch	N	G					x

Introduced Plant Species Recorded

<i>Angallis arvensis</i>	Scarlet pimpernel	W	H		x			
<i>Axonopus fissifolius</i>	Carpet grass	W	G		x			
<i>Baccharis halimifolia</i>	Groundsel	W	S		x			
<i>Chrysanthemoides monilifera</i>	Bitou bush	W	S		x			
<i>Cirsium vulgare</i>	Spear thistle	W	H					
<i>Conyza</i> spp.	Fleabane	W	H		x			
<i>Cyperus congestus</i>	Dense flat sedge	W	Sedge		x			
<i>Erechtites valerianifolius</i>	Brazilian fireweed	W	H		x			
<i>Gomphocarpus fruticosus</i>	Mikweed	W	H					x
<i>Lantana camara</i>	Lantana	W	S		x	x		x
<i>Onopordum acanthium</i>	Scotch Thistle	W	H					x
<i>Paspalum longifolium</i>	Paspalum	W	G		x			
<i>Physalis peruviana</i>	Ground cherry	W	H	x				
<i>Senecio madagascariensis</i>	Madagascan fireweed	W	H	x	x			x
<i>Sonchus oleraceus</i>	Thistle	W	H		x			
<i>Tagetes minuta</i>	Stinking roger	W	H		x			
<i>Verbena rigida</i>	Slender vervain	W	H		x			x