Report on the suspected invasiveness of the grass *Chloris gayana* on Kilto & Wooramel Stations in WA.

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Terms of Reference: *Investigate whether the exotic grass Chloris gayana presently being grown as a fodder crop on Kilto Station (Broome) and Wooramel Station (Carnarvon) has managed to escape and establish itself outside cultivation in natural areas of these stations.*

Background

Chloris gayana is a well known grass, introduced to Australia from South Africa as fodder grass (Moore, Sanford & Wiley, 2006; Loch, Rethman, & van Niekerk, 2003; Tropical Forages Database, 2008). It has variously been reported as being invasive or potentially invasive and is as such listed by various agencies as an invasive or potentially invasive plant (Batianoff & Butler, 2002; Hussey, Keighery, Cousens, Dodd & Lloyd, 2007; Keighery & Longman, 2004; Lonsdale, 1994; Randall, 2002).

Constraints

These Kilto and Wooramel Station surveys were both conducted at the end of October 2010, a particularly dry year in WA and drought conditions will have influenced results as far as species composition, densities and possibly the absence of the target species.

Kilto Station

This a very large pastoral lease station some 50 km ENE of Broome (Figure 1). *Chloris gayana* has been grown as a fodder grass on a pivot system for the better part of nine years. The grass is cut, baled and then transported along a haul road to a feedlot and barn near the homestead. Stock is not allowed to graze on the grass in areas of cultivation. Water is obtained from several bores. Permanent surface water exists in the area as a few natural clay pans, small man-made impoundments and spillage from bores.

Long term average rainfall is about 770 mm per year. Kilto Station received 596mm rainfall in the 12 months preceding the survey date (BOM site 2010), which is significantly below the long term average with the station recording 54.6 mm in the two weeks preceding the study.

Soils are mainly grey or whitish alluvial sands with sections of colluvial sandy loams and clays over sandstone and laterite.

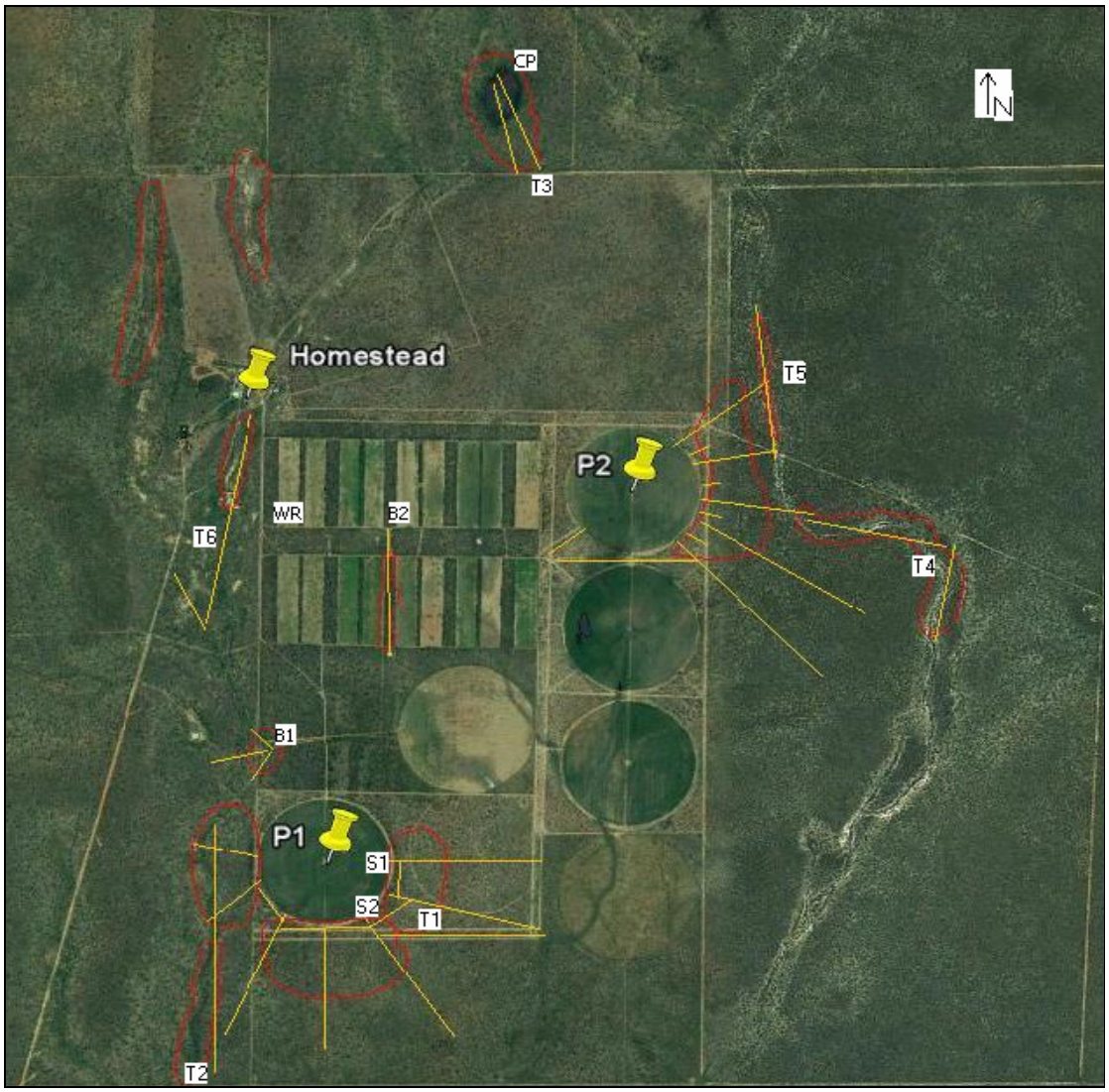

Figure 1: **Kilto Station— red polygons indicate areas targeted for detailed investigation as well as targeted survey polygons; yellow lines indicate planned band-transects executed (Scale: 5 mm = 150 m).**

Vegetation Description

The natural vegetation is described by Beard (1991) and is typical Pindan Woodland of the Dampier Peninsula and considered to be a part of the Kimberley region. This is a low tree woodland of mainly *Acacia* species and a few emergent (*c*. 8 m) *Corymbia* tree species. The study area is bounded by several small annual drainage systems flanked by emergent *Melaleuca* species. Grasses, mainly *Chrysopogon fallax* and the invasive *Cenchrus* species, are common and heavily grazed by stock. Vegetation density varies from dense to moderately dense.

The detailed agricultural aspects of the cultivation of *C. gayana* on Kilto Station is adequately described in the report by Ham (2010).

Methodology

Desk- top review: A review of literature, herbarium specimen records and anecdotal evidence for the presence of *C. gayana* was initiated and completed before physically investigating the target site. Several well known field botanists were approached to provide anecdotal evidence for the presence of *C. gayana* in the Kimberley as a whole (Acknowledgements). Herbarium records were obtained from Flora Base and specimens were physically inspected at the WA herbarium in Perth.

Planning of surveys: It was decided that several radial bearing, band-transects originating from the pivots would be done. Further transects would be done along water-courses, a nearby clay pan and along all haul roads. Further transects and spot checks would also be made along watercourses and potential establishment sites downstream from Kilto Station. A plant species list would also be compiled as part of the results for each survey point and transect and wherever *C. gayana* was found in natural areas, a standard cover & abundance quadrat (Barbour, Burke & Pitts, 1987; Shimwell, 1971; Weaver & Clements , 1938) would be made.

As many desk top band transects as possible were planned and as on site information became available it was decided which to do. The survey comprised a half a day site familiarisation and planning of field surveys, and two days for completion of the field surveys. The investigation was started on the 25th of October and completed on 27th of October 2010.

On Site Planning: A review of the site during the planning stage, together with information obtained from the Station owner and local Department of Agriculture extension officer lead to the final decision to concentrate on Pivot 1 & Pivot 2 for the survey. Pivot 1 represented the oldest continuing presence of cultivated *C. gayana* and also had the greatest soil diversity surrounding it. Pivot 2 represented a particular instance where a previous survey (Ham, 2010) had found *C. gayana* about 30 m away from the pivot circles edge. It is also the closest to a relatively large ephemeral stream bed (Figure 1). Pivots 1 and 2 were considered representative and provided possibly the best opportunities for excursion and establishment of *C. gayana* outside the irrigated areas.

Figure 1 indicates transect position and the general direction surveyed as well as the location of targeted, serendipitous survey polygons.

Band Transect Execution: Two Botanists walked each transect in the direction of a previously determined way point away from the pivot perimeter. Species composition, presence of *C. gayana* and general cover being recorded every 10 m, 30 m, 50 m , 100 m, 150 m and every 50 meters thereafter as necessary (detailed waypoints and digital images are available for each of these sites and are not included in this report). This was repeated on the return back or a general search of the area was made back towards the site of the transect origin.

Targeted serendipitous surveys: These surveys were carried out along main roads and in the town of Broome and included site four (S4) where the main drainage system from Kilto crosses the Great Northern Highway under the Deep creek bridge. These areas were selected as they were considered to provide good opportunity for exposure to, and establishment of *C. gayana*. During these serendipitous surveys the target grass was actively searched for.

Observations and Findings

Desk- top review: None of the botanists contacted, could confirm the presence of *C. gayana* in the wild in the Kimberley region and none had actually ever encountered it outside cultivation in the Kimberley. The herbarium record search produced a single record for *C. gayana* from Dampierland and indeed from Kilto Station itself and it was collected directly adjacent to the cultivated fields.

Band Transect: The results of the Kilto band transect survey are presented in Table 1 (Appendix A). Transects are divided into two sections (1&2). One (1) being the first 50m which would usually have been in an un-grazed area within the perimeter fence surrounding the pivot and two (2) the section outside the pivot perimeter fence and subject to grazing.

An investigation done earlier in the year and just after the rainy season (Ham, 2010) found several "excursions" of *Chloris gayana* around pivots one & two - interestingly this investigation found much

the same as in that report with the following exceptions: there was a decrease in the number of "excursions" observed and it was clear that seedlings mentioned by Ham (2010) at his point "Excursion I" (Image 11) was in fact the grass *Digitaria bicornis*.

During this study *C. gayana* was not found on any of the radial transects walked or on any serendipitous targeted surveys outside the direct influence of agricultural practices.

Chloris gayana was found on the following sites:

a. *Bore One (B1) (Figures 1 & 2):* This site is a disturbed area with permanent water from the bore. A few *C. gayana* plants were found growing amongst the dominant sward of *Chloris virgata*. *Chloris gayana* tended to occur on exposed areas where mechanical disturbance and high levels of moisture favoured its establishment. It seemed unable to compete with other grasses in the surroundings and downstream on the bore drainage line where no mechanical disturbance was present. In essence this site should not be described as a natural area and is actually a high impact site of large scale mechanical disturbance where haul vehicles and harvesters are washed. Cover abundance was less than 5% of the area, with the majority of grasses consisting of *C. virgata* with about 70% cover.

Figure 2:Bore One (B1). *Chloris gayana* in the foreground

Figure 3: Downstream from B1 with *C. gayana* now absent from natural areas.

b. *Homestead (Figure 1):* The homestead is the central point where all harvesting vehicles and bales of harvested fodder are stored and deployed from. *Chloris gayana* was here found only to be present along the edge of a permanent water source and apparently only on the water side of the source. Once again high levels of mechanical disturbance and permanent water was available. Outside this niche it was again displaced by *C. virgata* and other grasses. This

whole area is also actively irrigated. Under these conditions a cover abundance of about 1% was attained by *C. gayana*.

c. *WR (Figure 1):* This is a windrow along the haul road between the pivots and the homestead. A few small/young plants of *C. gayana* were found here close to a permanent pool of water. This particular spot is somewhat troubling as it is excluded from grazing, does not receive permanent irrigation but does occur on disturbance. Its presence there can probably be ascribed to the fact that it is on the haul road. It does however indicate that caution should be observed as to the potential presence of *C. gayana* away from the homestead and pivots when and where it is not grazed. The station had also received substantial rain in the preceding weeks and germination of other grasses was also evident. As this was essentially on the main haul road and the greater area had no vegetative cover it can be estimated that the area covered by Rhodes grass was less than 0.05%.

d. *Site 1 (S1 (Figure 1)):* Is a site within 15 m of the pivot perimeter, heavily disturbed and in essence still within reach of the pivot. It should thus not be considered to be part of a natural area. A detailed survey quadrat failed to establish any significant cover abundance for *C. gayana* (less than 1%) and the quadrats western border was in fact the pivot's perimeter.

e. *Site 2 (S2) (Figure 1 &4):* Is a site between two transect lines at pivot one. The S2 occurrence site is approximately 20 m from the pivot perimeter and heavily disturbed. A detailed cover abundance analysis failed to give any significant cover abundance for *C. gayana* (less than 0.5%) and the site was heavily infested with other weedy taxa and several decomposing loose bales of discarded *C. gayana* fodder was lying about. The site is thus not considered as being in a natural state away from the direct influence of the pivot.

Figure 4: Site 2 (S2). *Chloris gayana* in the foreground

Forty four transects from the desk top target was walked, totalling some 18.5 km in length and some 50+ m wide. Only five occurrences for "escaped" *C. gayana* were found, all within the direct influence of water from either the pivots, irrigation at the homestead or within the direct influence

of permanent water from a bore (Appendix A). No C. gayana was observed within any natural areas or any other disturbed areas without permanent water.

A very clear edge effect could be observed between the cultivated fields of *C. gayana* and the surrounding natural vegetation and fallow fields not being irrigated (Figure 1).

Conclusions

The survey described above is considered adequate to provide a general investigation of the invasiveness of *C. gayana*, given the potential limitation of the preceding relatively low rainfall conditions.

It is apparent that active weed management and control is not undertaken in the observed operation. The sward is also allowed to go to flowering and fruiting without being harvested in many cases although the operator is aware that nutritive value is greatest when harvested just before flowering.

The results of the survey indicate that *C. gayana* has not substantially established or proliferated beyond the irrigated pivot area, and suggest that it is unlikely to become a vigorous or invasive weed in this environment.

Wooramel Station

Wooramel Station is a very large and old pastoral lease station approximately 70 km south of Carnarvon, with the homestead situated directly next to the Wooramel River. *Chloris gayana* has been grown with varying degrees of success under pivot irrigation for less than two years. Livestock was actively allowed to graze on the grass in a "wagon-wheel" shaped system of enclosures. Other crops such as Lucerne were also cultivated and livestock was allowed to alternate between grazing camps. The pivot ceased operating in June 2010 and was unused until the last week of October 2010 when irrigation was resumed again. The area under the pivot was allowed to become fallow in this time and has not been re-seeded since the initial sowing of seed.

The pivot is some 40 km north of the homestead. This is also the site of the main bore that supplies water to the pivot. The bore was historically artesian and free flowing with water draining in the direction of Shark Bay. Currently water is piped to two or more watering points along the historic bore drain (BD1 & BD2).

Prior to this, a small scale experiment was established at the Wooramel homestead to investigate *C. gayana* and other grasses for their ability to withstand the somewhat saline irrigation water available on this station.

The area is essentially an arid landscape on the eastern apron of Shark Bay and rainfall averages about 250 mm per year and is described as semi-arid and Mediterranean by Beard (1990).

Soils are mainly alkaline, red sands and red sandy loams with extensive areas of salt flats, all overlaying sedimentary rocks of the Carnarvon Basin (Beard, 1990).

Vegetation Description – The natural vegetation is described by Beard (1991) and comprises of two types. At the Wooramel homestead and along the Wooramel River, the vegetation is dominated by emergent riparian *Eucalyptus camaldulensis* a sparse under storey of *Alectryon oleifolius*, *Acacia tetragonophylla* , *Acacia wiseana & Acacia victoriae*. Grasses and shrubs are heavily grazed and reportedly consist mainly of Kangaroo Grass (*Themeda triandra*). The vegetation around the active pivot is significantly different and consists of Chenopod Scrub (with emergent *Hakea recurva* as shrubs or small trees) of *Alectryon oleifolius* and *Acacia xiphophylla*. Members of the Amaranthaceae and Chenopodiaceae made up much of the scrub layer and the grass layer reportedly consists of mainly Kangaroo Grass. This vegetation type is intermittently interwoven with Halophytic Chenopodaceous scrub dominated by *Tecticornia pruinosa* and *Rhagodia eremea* on small rises.

Figure 5: Wooramel Station – locations of River Transects (RT) and the Homestead (HS) (Scale: 5 mm = 50 m)

Methodology

Advance knowledge of the study area was sketchy but did not influence the methodology. The methodology was similar to that used at Kilto Station but on a smaller scale and the investigation was carried out on 8 & 9 November 2010.

It was decided to first investigate the area around the homestead and along the Wooramel River for escaped *C. gayana* (Figure 5). This decision was made so as to maximise the chance of encountering *C. gayana,* based on the fact that this area was historically the oldest site of *C. gayana* cultivation on the station and water is reasonably readily available for the chance establishment of grass and other weeds. Three band transects were walked along the Wooramel River and included both banks (RT). Here any visible grass was investigated and notes were made of the rest of the vegetation. The area around the historical test plot was also surveyed as well as all areas around the homestead.

Targeted observations were also made along a short road perpendicular to the two parallel river transects and on the main road between Wooramel and Carnarvon.

At the pivot (Figure 6), four radial band transects up to 500 m long were walked away from the pivot edge and in the direction of the prevailing wind and drainage. Species composition, presence of *C. gayana* and general cover being recorded every 10 m, 30 m, 50 m , 100 m, 150 m and every 50 meters thereafter as necessary. The area around the bore and between the two watering points on the historical bore drain was also surveyed by driving or walking in sections.

Figure 6: Pivot area- yellow lines indicate transects walked (Scale: 5 mm = 80 m).

Results

A desktop review and search of herbarium records failed to find any mention or recent collections of *C. gayana* in the Carnarvon area. Anecdotal evidence pointed to the fact that the whole area had in earlier times been heavily overgrazed before the bore was capped and small stock units dramatically decreased (Brain Scott, *pers. comm.*)

The investigative transect results for Wooramel Station are presented in Table 2 (Appendix A).

No *C. gayana* were found in any of the areas surveyed outside cultivation on Wooramel Station.

River Transects (RT) (Figure 7): No presence of *C. gayana* could be found along the river banks. The dominant grass was Buffels Grass with intermittent *Leptochloa digitata* in shaded areas.

Figure 7: River transect on the Wooramel showing typical dominant *Eucalyptus camaldulensis* and dry sandy river bed and grass sward composed of *Cenchrus ciliaris* and *Leptochloa digitata*.

Homestead and historical grass test site (HS): The old test plot for *C. gayana* and other grasses (at HS) is illustrated in Figure 8 - this has been allowed to become fallow and has not succeeded in regenerating again. The dominant grass with about 80% cover was Buffels Grass (*Cenchrus ciliaris*).

Figure 8: Grass test plot after being abandoned, now dominated by Buffels Grass, the only grass that managed to survive.

Pivot: Chloris gayana could only be found as a regenerating sward directly under the pivot (Figure 9). Interestingly, even the central area of the pivot (Figure 10) which did not receive irrigation was devoid of the surrounding Rhodes grass but nevertheless the grass *Cynodon dactylon* abounded and grew well (Figure 11).

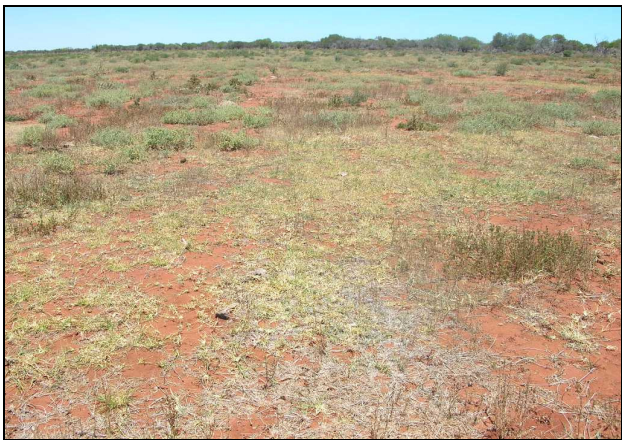

Figure 9: Regenerating Rhodes grass under the Wooramel pivot.

Figure 10: Central – un-irrigated area of the Wooramel pivot.

Figure 11: Healthy growth of *Cynodon dactylon* at the centre of the pivot.

Bore drain, Bore, BD1 & BD2: No presence of *C. gayana* could be found in this area. The area has been heavily grazed but there was still a presence of Buffels Grass (*C. ciliaris*) (Figure 12).

Figure 12: Site BD2 with Chenopod shrubs and *Cencrus ciliaris*.

Transect lines (T1, T2, T3 & T4): Very few grasses with the exception of *C. ciliaris* (Buffels Grass) could be found. Anecdotal reports indicate that the sward would also contain Kangaroo Grass (*T. triandra*). The area had been heavily grazed and most of the palatable vegetation had not as yet regenerated. There was no indication that *C. gayana* had moved from the pivot into these areas containing natural vegetation.

Conclusion

A total band transect length of 8 km was investigated at Wooramel Station. This operation is much smaller than that at Kilto Station and also much drier. The total area surveyed and the habitat niches investigated was adequate to determine whether *C. gayana* had escaped from cultivation.

As can be seen from the attached plant species list, weeds are not actively controlled on Wooramel Station and there is a profusion of weedy species that have invaded most disturbed areas.

Chloris gayana does not occur outside cultivation in the areas surveyed at Wooramel under environmental conditions as present during the study period. At the initial experimental site at Wooramel homestead *C. gayana* was unable to persist after watering was stopped and has completely died out with the sward now being dominated by Buffels Grass. This was also apparent at the pivot where *C. gayana* appeared stressed in areas not recently watered and clearly absent from areas that had dried out.

It appears highly unlikely that *C. gayana* could persist in this dry landscape without the irrigation system in place.

Discussion

Chloris gayana does not appear to be able to survive outside the direct influence of irrigation/cultivation on both Kilto & Wooramel Station. It appears as if at least two factors are simultaneously needed for *C. gayana* to establish and survive; that is mechanical disturbance and a ready source of water. Casual observations indicated that it is also possibly a very weak competitor with other grasses and broadleaved plants in the sward. These observations are in line with those of Moore (undated). Being a decreaser grass and based on casual observation it is doubtful that *C. gayana* would survive heavy grazing and this may also be a factor that contributed to its absence outside the perimeter fence at Kilto Station and outside the pivot area at Wooramel.

It was apparent from the pivot at Wooramel that *C. gayana* acts very much the same as a typical lawn grass in that it survives light cropping or grazing by lateral growth and stolon formation. It is also drought resistant once a substantial stolon thatch is established, as it has survived four months on natural rainfall only at the pivot on Wooramel Station, rebounding when irrigation recommenced.

However, similar, but more natural conditions were found on both stations outside the areas of cultivation; that is the several creek lines investigated at Kilto; the banks of the Wooramel River and;

the bore drain at Wooramel. The absence of *C. gayana* from these systems seems to indicate an inability to establish and persist under these dynamic natural conditions. The reasons for this are currently speculative but may have to do with seed viability, dispersal mechanisms (Gardener, McIvor & Jansen, 1993; Lonsdale, 1994; Moore, undated) or the fact that it is unable to compete with the rest of the sward under natural conditions and grazing on these two stations under prevailing environmental conditions.

Acknowledgements

The following persons kindly participated in the anecdotal survey; Ken Kenneally, Russell Barrett, Andrew Mitchell & Tim Willing.

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Appendix A

TABLE 1: Kilto Plant Species List:

Terestrial plant taxa.	P1		P2		CP	B1	B2	BP	HS	WR	S1	S2	S3	S4	T1	T2	T3	T4	T5	T6
	a	b	a	b																
Aizoaceae Martinov																				
Trianthema pilosa F.Muell.	■																		■	■
Amaranthaceae Juss.																				
Achyranthes aspera L.										■										■
**Amaranthus viridis* L.	■		■			■				■					■					
**Gomphrena celosioides*	■		■			■	■			■					■					
Gomphrena cucullata J.Palmer Mart.										■			■							■
Ptilotus polystachyus (Gaudich.) F.Muell.	■		■			■	■			■						■	■		■	
Apocynaceae Juss.																				
Carissa lanceolata R.Br.		■	■	■												■	■	■	■	
Asteraceae Bercht. & J. Presl																				
**Verbesina encelioides* (Cav.) A.Gray	■																			
Pterocaulon sp. A Kimberley Flora (B.J. Carter 599)	■	■		■				■	■							■		■	■	
**Xanthium strumarium* L.	■		■												■					
Bignoniaceae Juss.																				
Dolichandrone heterophylla (R.Br.) F.Muell.	■	■	■	■				■	■							■		■	■	
Bixaceae Kunth																				
Cochlospermum fraseri Planch.		■		■											■	■		■		
Boraginaceae Juss.																				
Ehretia saligna R.Br. var. *saligna*	■	■	■	■											■	■	■	■	■	■
Heliotropium curassavicum L.	■	■		■												■				
Heliotropium diversifolium Benth.	■		■			■		■	■							■			■	■
Heliotropium foliatum R.Br.	■	■														■				
Heliotropium leptaleum Craven	■			■												■				
Trichodesma zeylanicum var. *latisepalum* F.Muell.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Brassicaceae Burnett																				
**Raphanus raphanistrum* L.	■																			
Chenopodiaceae Vent.																				
Salsola tragus L.	■						■							■						
Cleomaceae Bercht. & J.Presl																				
Cleome viscosa L.													■							■
Combretaceae R. Br.*osa* L.																				
Terminalia cf. *hadleyana* W.Fitzg.																		■		
Convolvulaceae Juss.																				
**Cuscuta campestris* Yunck.	■	■	■									■								
Evolvulus alsinoides var. *decumbens* (R.Br.) Ooststr.	■		■	■			■									■		■	■	
**Merremia dissecta* (Jacq.) Hallier f.	■		■																	
Polymeria ambigua R.Br.	■	■		■												■		■	■	
Cucurbitaceae Juss.																				
**Citrullus lanatus* (Thunb.) Matsum. & Nakai	■	■	■			■	■	■	■	■	■	■		■	■	■	■		■	■
**Cucumis anguria* L. var. *anguria*	■																			

TABLE 1: Kilto Plant Species List:

Cyperaceae Juss.
**Cyperus compressus* L.
Cyperus cf. *javanicus* Houtt.
**Cyperus polystachyos* Rottb.
Droseraceae Salisb.
Drosera derbyensis Lowrie
Euphorbiaceae Juss.
Euphorbia australis Boiss.
**Jatropha gossypiifolia* L.
Fabaceae Lindl.
Acacia colei Maslin & L.Thomson var. *colei*
Acacia eriopoda Maiden & Blakely
Acacia hippuroides Benth.
Acacia holosericea G.Don
Acacia platycarpa F.Muell.
Acacia tumida Benth. var. *tumida*
**Alysicarpus ovalifolius* (Schumach.) J.Leonard
Bauhinia cunninghamii (Benth.) Benth.
Cajanus marmoratus (Benth.) F.Muell.
**Centrosema pascuorum* Benth.
Crotalaria cunninghamii R.Br. subsp. *cunninghamii*
Cullen corallum J.W.Grimes
**Desmodium tortuosum* (Sw.) DC.
Erythrina vespertilio Benth.
Erythrophleum chlorostachys (F.Muell.) Baill.
Glycine tomentella Hayata
Neptunia dimorphantha Domin
Senna notabilis (F.Muell.) Randell
Sesbania cannabina (Retz.) Pers.
**Stylosanthes hamata* (L.) Taub.
Tephrosia rosea Benth. var. *rosea*
**Trifolium cernuum* Brot.
Goodeniaceae R. Br.
Goodenia armitiana F.Muell.
Goodenia sp. Dampier Peninsula (B.J. Carter 675)
Velleia panduriformis Benth.
Haemodoraceae R. Br.
Haemodorum gracile T.Macfarlane P4
Lamiaceae Martinov
Clerodendrum floribundum var. *coriaceum* (R.Br.) Moldenke
Clerodendrum tomentosum (Vent.) R.Br. var. *tomentosum*
**Hyptis suaveolens* (L.) Poit.
**Ocimum basilicum* L.

TABLE 1: Kilto Plant Species List:

Lecythidaceae A. Rich.																				
Planchonia careya (F.Muell.) R.Knuth																				
Loranthaceae Juss.																				
Amyema miquelii (Miq.) Tiegh.																				
Malvaceae Juss.																				
Abutilon otocarpum F.Muell.																				
Brachychiton diversifolius R.Br. subsp. *diversifolius*																				
**Corchorus olitorius* L.																				
Corchorus sp.																				
Gossypium australe F.Muell.																				
**Malvastrum coromandelianum* (L.) Garcke																				
Sida hackettiana W.Fitzg.																				
Sida rohlenae subsp. *occidentalis* R.M.Barker																				
Sida spinosa L.																				
**Triumfetta pentandra* A.Rich.																				
Waltheria indica L.																				
Marsileaceae Mirb.																				
Marsilea hirsuta R.Br.																				
Menispermaceae Juss.																				
Tinospora smilacina Benth.																				
Moraceae Gaudich.																				
Ficus opposita Miq.																				
Myrtaceae Juss.																				
Corymbia flavescens K.D.Hill & L.A.S.Johnson																				
Corymbia zygophylla (Blakely) K.D.Hill & L.A.S.Johnson																				
Melaleuca leucadendra (L.) L.																				
Melaleuca nervosa (Lindl.) Cheel																				
Nyctaginaceae Juss.																				
Boerhavia coccinea Mill.																				
Oleaceae Hoffmanns. & Link																				
Jasminum didymum subsp. *lineare* (R.Br.) P.S.Green																				
Passifloraceae Roussel																				
**Passiflora foetida* var. *hispida* (Triana & Planch.) Killip																				
Phyllanthaceae Martinov																				
Flueggea virosa (Willd.) Voigt																				
Phyllanthus reticulatus Poir.																				
Poaceae Barnhart & Barnh.																				
Aristida holathera var. *latifolia* (B.K.Simon) B.K.Simon																				
Aristida inaequiglumis Domin																				
**Cenchrus ciliaris* L.																				
**Cenchrus echinatus* L.																				
**Chloris gayana* Kunth						B1			HS	WR	S1	S2								
**Chloris virgata* Sw.																				
Chrysopogon fallax S.T.Blake																				

TABLE 1: Kilto Plant Species List:

**Cynodon dactylon* (L.) Pers.
Dactyloctenium radulans (R.Br.) P.Beauv.
Digitaria bicornis (Lam.) Roem. & Schult.
**Digitaria ciliaris* (Retz.) Koeler
**Echinochloa colona* (L.) Link
Ectrosia danesii Domin
Eragrostis eriopoda Benth.
Eragrostis falcata (Gaudich.) Steud.
Eragrostis speciosa (Roem. & Schult.) Steud.
Eriachne benthamii Hartley
Heteropogon contortus (L.) Roem. & Schult.
Ischaemum australe R.Br. var. *australe*
**Lolium perenne* L.
Paraneurachne muelleri (Hack.) S.T.Blake
Perotis rara R.Br.
Sorghum plumosum (R.Br.) P.Beauv.
Tragus australianus S.T.Blake
Triodia sp. In det.
**Urochloa mutica* (Forssk.) T.Q.Nguyen
Xerochloa barbata R.Br.
Portulacaceae Juss
Calandrinia strophiolata (F.Muell.) Ewart, B.Rees & B.Wood
Portulaca filifolia F.Muell.
**Portulaca oleracea* L.
Proteaceae Juss.
Grevillea pyramidalis R.Br.
Hakea arborescens R.Br.
Persoonia falcata R.Br.
Rubiaceae Juss.
Gardenia pyriformis subsp. *keartlandii* (Tate) Puttock
Nauclea orientalis (L.) L. (Cultivated)
Oldenlandia corymbosa L. var. *corymbosa*
Oldenlandia mitrasacmoides (F.Muell.) F.Muell.
Psydrax attenuata var. *tenella* S.T.Reynolds & R.J.F.Hend.
Timonius timon (Spreng.) Merr.
Santalaceae R. Br.
Santalum lanceolatum R.Br.
Sapindaceae Juss.
Atalaya hemiglauca (F.Muell.) Benth.
Distichostemon hispidulus var. *aridus* S.T.Reynolds
Scrophulariaceae Juss.
Myoporum montanum R.Br.
Solanaceae Juss.
Solanum dioicum W.Fitzg.

TABLE 1: Kilto Plant Species List:

Violaceae Batsch																			
Hybanthus enneaspermus (L.) F.Muell. subsp. *enneaspermus*																			
Zygophyllaceae R. Br.																			
**Tribulus terrestris* L.																			

Table 2. Wooramel Species List

Taxon	RT	HS	T1	T2	T3	T4	T5	T6	B1	BD1	BD2	FL	Piv
Aizoaceae Martinov													
**Mesembryanthemum crystallinum* L.													
Tetragonia cristata A.M.Prescott													
Trianthema pilosa F.Muell.													
Amaranthaceae Juss.													
Ptilotus divaricatus (Gaudich.) F.Muell. var. *divaricatus*													
Ptilotus polakii F.Muell.													
Arecaceae Bercht. & J.Presl													
**Phoenix dactylifera* L.													
Asteraceae Bercht. & J. Presl													
Calocephalus francisii (F.Muell.) Benth.													
Cephalipterum drummondii A.Gray													
Chrysocephalum apiculatum (Labill.) Steetz													
**Conyza bonariensis* (L.) Cronquist													
Gnephosis tenuissima Cass.													
Pluchea dentex Benth.													
Bignoniaceae Juss.													
**Tecoma stans* (L.) Kunth													
Boraginaceae Juss.													
**Echium plantagineum* L													
Brassicaceae Burnett													
**Sisymbrium orientale* L.													
Campanulaceae Juss.													
Wahlenbergia gracilenta Lothian													
Chenopodiaceae Vent.													
Atriplex amnicola Paul G.Wilson													
Atriplex codonocarpa Paul G.Wilson													
Atriplex semilunaris Aellen													
**Chenopodium murale* L.													
Enchylaena tomentosa R.Br. var. *tomentosa*													
Maireana carnosa (Moq.) Paul G.Wilson													
Maireana platycarpa Paul G.Wilson													
Maireana trichoptera (J.M.Black) Paul G.Wilson													
Rhagodia eremaea Paul G.Wilson													
Salsola tragus L. subsp. *tragus*													
Sclerolaena costata (R.H.Anderson) A.J.Scott													
Sclerolaena tridens (F.Muell.) Domin													

Sclerolaena sp.													
Tecticornia pruinosa (Paulsen) K.A.Sheph. & Paul G.Wilson													
Cucurbitaceae Juss.													
**Citrullus cf. lanatus* (Thunb.) Matsum. & Nakai													
Fabaceae Lindl.													
Acacia tetragonophylla F.Muell.													
Acacia victoriae Benth.													
Acacia wiseana C.A.Gardner													
Acacia xiphophylla E.Pritz.													
**Vachellia farnesiana* (L.) Wight & Arn.													
Goodeniaceae R. Br.													
Goodenia sp.													
Myrtaceae Juss.													
Eucalyptus camaldulensis Dehnh.													
Nyctaginaceae Juss.													
Commicarpus australis Meikle													
Plantaginaceae Juss.													
Stemodia viscosa Roxb.													
Poaceae Barnhart & Barnh.													
**Cenchrus ciliaris* L.													
**Cynodon dactylon* (L.) Pers.													
Chloris													
Eleusine indica (L.) Gaertn.													
Leptochloa digitata (R.Br.) Domin													
Themeda triandra Forssk.													
Polygonaceae Juss.													
**Emex australis* Steinh.													
Portulacaceae Juss.													
Calandrinia sp.													
Proteaceae Juss.													
Hakea recurva Meisn.													
Sapindaceae Juss													
Alectryon oleifolius (Desf.) S.T.Reynolds subsp. *oleifolius*													
Scrophulariaceae Juss.													
Eremophila maitlandii Benth													
Solanaceae Juss.													
**Solanum nigrum* L.													
Solanum orbiculatum Poir. subsp. *orbiculatum*													
Tamaricaceae Link													
**Tamarix aphylla* (L.) H.Karst.													