Wilson Inlet Foreshore Flora Survey

March 2011

Acknowledgments

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Department of Water
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Table of Contents

Summary

- The Wilson Inlet foreshore vegetation survey is one of numerous parameters being monitored to analyse the effect, if any, that the timing of bar openings is having on the surrounding environment and local community.

- The Wilson Inlet is by nature a fluctuating system, with the foreshore vegetation in a zone of transition in which death and recruitment of certain flora species is an annual occurrence. The question is whether or not the timing of the bar opening is creating water levels and periods of inundation of such extremes that the fringing vegetation is being stressed past their tolerance levels.

- The period of inundation for foreshore vegetation of the Wilson Inlet has been relatively consistent in the past, until recent history, with the bar opened artificially every year until 2007. The bar was not opened in 2007 and 2010 which has increased the length of time and height of water inundation in those given years. The effects, if any, on the fringing native vegetation in the past have not been regularly monitored.

- For this survey low lying areas prone to seasonal inundation were targeted as these would incur the greatest impact from varying water levels. As this is the first year of the monitoring, the data collected will form the baseline data from which future comparisons and trends can be made.

- At the time of surveying all sites showed some level (or recent evidence) of water inundation inland of present foreshore fringing vegetation with depths of up to 80cm recorded at the shoreline end markers.

- Bushland Condition over the transect sites ranged from “Degraded” to “Very Good”. Generally the greatest level of disturbance to vegetation occurred at the shoreline end of the transects and areas in and near water inundation.

- Cover Abundance over the transect sites varied greatly both over the transects and within transect sites, ranging from values of 1 to 7 with no apparent correlation with water inundation or distance from shoreline.

- Seventy flora species were recorded over the twelve transects, including eleven invasive species. The dominant invasive flora species over all the transects was the introduced *Paspalum spp.*(Couch) and to a lesser extent *Chenopodium spp.* (Goosefoot).

- *Juncus krausii* and *Sarcocornia blackiana* (samphire) dominated the native understorey along the shoreline section of the transects with the upperstorey cover of *Melaleuca species.* The flora species towards the inland marker of the transect varied more from site to site (see Raw data excel spreadsheet for species details).

- At a number of transect sites; stressed or dead *Melaleuca* species, predominately *M. densa* were observed in areas near or on the shoreline. The actual timeline for their deaths can not be accurately dated due to lack of previous permanent monitoring sites along the fringing foreshore vegetation, highlighting the need for such monitoring in the future. Some deaths appear older then others, with some trees without leaves and fruits, while others still had leaves and fruits attached to branches. Other notable vegetative deaths included a large number of *Banksia occidentalis* at site WINI1 and numerous unidentified native sedge species (most likely *Juncus krausii*) at WIPR1.

- The most probable causes of the stressed and dead species could be; salt water intrusion into the tap roots from extended and prolonged exposure to saline water, roots immersed in fresh water for a prolonged period of time, high nutrient levels or direct human and vehicle impact (or a combination of these factors).

- Annual monitoring of the twelve permanent transects over at least 5 years is recommended to identify any patterns or trends for; new deaths or increased stress on presently healthy trees; recruitment of young plants and their survival rate.

- Water quality monitoring near identified areas of stressed species should be undertaken and analysed in combination with flora survey results to determine whether salt and nutrient levels in the water are contributing factors to the stress or deaths of foreshore vegetation.

- Establishing an indicator group of species from susceptible common species, for targeted monitoring would be useful in more efficient data monitoring and collation in the future. From this baseline study it would appear that *Melaleuca densa* may be one of several suitable indicator species.

- Data collected in future years will require careful interpretation as there are numerous factors which can affect and impact foreshore vegetation condition.

1.0 Introduction

1.1 Aim

The aim of this survey was to monitor water level, flora species; diversity, abundance (or percentage cover), structure and bushland condition of vegetation along the Wilson Inlet foreshore to be used as a measure of one of the key parameters for determining the effects if any, of the bar opening timing and placement on the Wilson Inlet environment. This survey intends to provide the first year of baseline data to allow future monitoring comparisons.

1.2 Study area

The Wilson Inlet is an estuary on the south coast of Western Australia, adjacent to the township of Denmark. The Wilson Inlet catchment covers an area of 2379 km^2, with the inlet itself covering 48km^2. Five major rivers; the Denmark, Hay, Sleeman and Little Rivers and the Cuppup Creek, drain into the inlet with the river systems exhibiting a discharge pattern which reflects the seasonal rainfall: strong flows over winter/spring period and moderate to negligible flows over summer/autumn period (Waterways Commission, 1995). Studies over the past decades have revealed that Wilson Inlet is showing signs of eutrophication; symptoms include excessive accumulation of plant material and organic ooze.

At the mouth of the estuary there is a seasonally formed sandbar. The stream flow from winter rains raises the inlet water level and the sandbar is artificially breached to prevent flooding of low-lying areas around the inlet and as a potential means for marine water exchange to “flush out” nutrient enriched water. In most years the bar is opened in July or August although, as was the case in 2010, the bar is not opened when there has been unseasonably low winter rainfall and reduced stream flow from the rivers draining into the inlet.

When the bar is opened, the channel formed normally remains open for a number of months, during which there is exchange between the inlet and the ocean. As stream flow decreases over summer the channel eventually closes and the inlet is again isolated from the ocean.

Over the years there has been a shift in the rationale behind the timing and placement of the bar opening. The current guidelines are set out to address and consider a combination of environmental and community values.

1.3 Foreshore Vegetation

Vegetation communities in fringing riparian habitats are temporally and spatially dynamic as a result of fluvial disturbance. Plant species exhibit a diversity of morphological, physiological and life history adaptations which enable them to persist in this variable and dynamic habitat.

The vegetation itself plays a number important role in the natural function of the Wilson Inlet;

- providing valuable habitat for water birds and other fauna,
- acting as a filter for nutrients and pollutants draining from surrounding land
- and helping to stabilize the inlet and surrounding waterways banks.

The Wilson Inlet lies in the South West Botanical Province, Darling Botanical District, Warren sub district. Remnant vegetation within the Wilson Inlet Foreshore Reserves contains flora of regional importance. It has also been identified as having significant local value and assists in maintaining water quality. The vegetation along the Denmark Foreshore can be grouped into the following main vegetation associations:
_ Foreshore fringing vegetation – rushes and sedges, mainly *Juncus krausii* and *Ficinia nodosa,* and paperbarks *Melaleuca densa* and *M. cuticularis* along the edge of the Inlet. Above the high water mark, over storey species include *Taxandria juniperina*, *M. raphiophylla* and *Callistachys lanceolata* with under storey rushes *Lepidosperma* species.
_ Swamp heathland – seasonally inundated heathland dominated by *Beaufortia sparsa*.
_ Swamp woodland – occurrence of stands of *M. preissiana* (paperbark).
_ Sclerophyll woodland – areas of *Eucalyptus cornuta* (Yate) and *Banksia* species.
_ Sclerophyll forest – dominated by *E. marginata* (Jarrah), *Corymbia callophylla* (Marri), *E. patens* (Blackbutt) with *Agonis* species.
_ Sclerophyll tall forest – stands of *E. diversicolor* (Karri). (Wilson Inlet Foreshore Reserves Management Plan, 2008).

Along the foreshore there can be found Priority 1 *Selliera radicans;* a small herbaceous plant that grows in saline mud in places around the Inlet shore. A definition of priority one is; **Priority One – Poorly Known:** taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc.,
or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on
protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2.0 Methodology:

2.1 Monitoring Transects: Twelve transects, of a standard 20m by 2m were monitored along the Wilson Inlet foreshore (see Map 1). The size of transect may differ according to the actual/in field situations where topography has gentler slope gradient and requires greater length of transect to encompass the fringing vegetation.

Each transect was placed so that one end is in line with the junction of the fringing riparian vegetation and aquatic vegetation, unless there is a long section of uniform riparian vegetation in which case, the transect may start further inshore. This included any semi/submerged riparian vegetation. The other transect end was then a general standard of 20m inshore.

All twelve transects were demarked with metal droppers at the midline of each end (at 1m point of the 2m), with an identifier tag on the shore end. (The identifier tag at site near Poddyshot for example marked PS.01.) The ID tag included the information of; date, transect ID and survey project officers' initials.

The twelve quadrats were chosen with the purpose of covering all foreshore vegetation types along the Wilson Inlet and targeting areas of gentle gradient which would be most affected by higher water levels as well as areas where changes to the vegetation had been noted by local community.

2.2 Data Collected: For each transect the date, names of data collectors, transect ID, size of the transect, GPS location (Decimal degrees) of each end of the transect as well as soil type details of colour and texture (sand/loam or clay) were recorded on the Monitoring Data Collection sheets (see Appendix 1 for data sheets template).

Water level: The Department of Water, Wilson Inlet water level monitoring point measurement was recorded on the Monitoring Collection sheet on the day of data collection.

At each transect a photo was taken from the shoreline end metal dropper looking up (inland) the transect line for future reference and comparison.

Each transect was divided into 1m by 2m plot sections on the Monitoring Collection Data sheet, on which the following data was collected:

- Cover Abundance: The Cover Abundance Scale is utilised to estimate percentage of overall vegetation cover within each sub-plot. Canopy cover from middle and upper story flora is included as cover.

Cover Abundance Scale (A)	
Cover Abundance Value	**Description**
1	one-a few individuals
2	uncommon and < 5 % cover
3	common and < 5 % cover
4	very abundant and 5 % or 5-20 % cover
5	20 - 50 %
6	50 - 75 %
7	75 - 100 %

- Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate degree of disturbance within each plot.

Bushland Condition Scale (B)	
Bushland Condition Value	**Description**
Very Good - Excellent (VG) (4)	80-100% Native Flora Composition. Vegetation structure intact or nearly so. Cover/abundance of weeds less than 5%. No or minimal signs of disturbance
Fair - Good (G) (3)	50-80% Native Flora Composition. Vegetation structure modified or nearly so. Cover/abundance of weeds 5-20% any number of individuals. Minor signs of disturbance.
Poor (P) (2)	20-50% Native Flora Composition. Vegetation structure completely modified. Cover/abundance of weeds 20-60% any number of individuals. Disturbance incidence high.
Degraded (D) (1)	0-20% Native Flora Composition. Vegetation structure disappeared. Cover/abundance of weeds 60-100% any number of individuals. Disturbance incidence very high.

- Water level was recorded at each 1m interval along the transect using a 1m measuring stick starting from: 1m to 20m.

- The name and number of each species of flora was recorded (for greater accuracy) within 1m by 1m sub-plots along the 20m transect. Where species were clumping types (i.e. rushes and sedges) percentage cover rather than numbers was used.

- Dead plants are not included in the species count; however they were noted in the comments section.

2.3 Data Collation: The monitoring data collected was collated onto an excel spreadsheet and the transect sites recorded onto a GIS map. Hard and electronic copies of report have been sent to Department of Water.

3.0 Results

Note: Graphs for Bushland Condition; scale converted to numbers for graphing purposes; Degraded = 1, Poor = 2, Good = 3, Very Good = 4 and not applicable = 0.

Raw data is compiled on a separate excel spreadsheet titled Appendix 2: Raw data for Wilson Inlet Foreshore Vegetation Survey 2011.

3.1 Prawn Rock Channel

The transect line was brought inland of the actual shoreline due to the uniform nature of the fringing vegetation and water depth inside of the actual shoreline (see Photo 1.1).

Water inundation: The entire length of transect line was inundated, with water depth ranging from 10cm to 55cm deep. The middle/latter section; plots 10 – 18 recorded the deepest levels, with the transect line running across a swale. Water levels for this section were between 40cm – 55cm.

Bushland Condition: Overall the Bushland Condition was generally "Poor" or "Degraded", with incursion of introduced *Paspalum spp.* (Couch) and *Pennisetum clandestinum* (Kikuyu) grasses throughout the area. Only the last 2 inland meters of the transect line (plot 19 and 20) showed improvement to "Good" condition (see figure 1.1). This coincided with proximity to/reduction in water level.

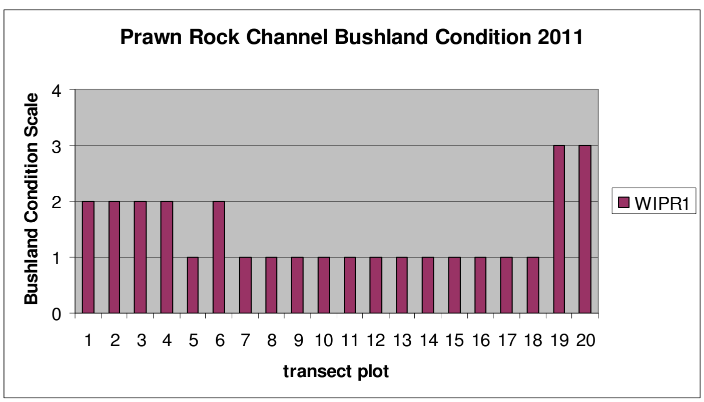


Figure 1.1 Prawn Rock Channel Bushland Condition

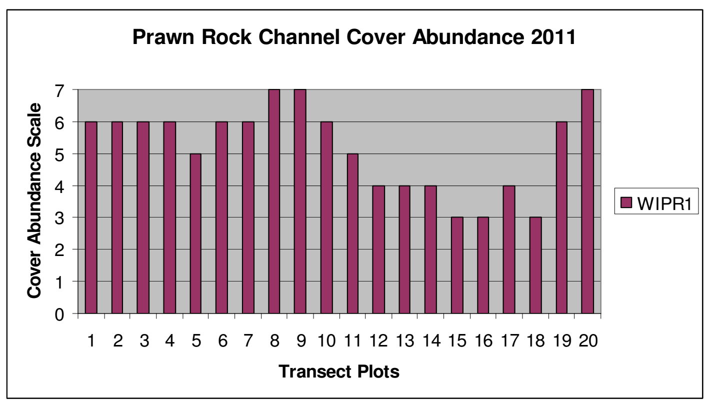


Figure 1.2 Prawn Rock Channel Cover Abundance

Cover Abundance: Ranged from 3 to 7 cover along the transect line (see figure 1.2). There appeared to be no correlation between the Cover Abundance values and water levels as any one Cover Abundance value varied considerably over differing inundation levels.

Flora species: Dominant native species along the transect line was the sedge *Juncus krausii*, although it was patchy to absent in the middle swale section (plot 10 – 18) where the water levels ranged between 40cm - 55cm. In general, when water levels exceeded 40cm, native flora species were absent, while couch and kikuyu were still present. The exceptions to this were in subplot 16.1, 17.1 and 17.2 where 1 - 3 *Baumea juncea* plants were present and sub-plot 14.2 in which no vegetation was found.

Towards the latter inland section of the transect, the native sedge *Baumea juncea* and one *Melaleuca cuticularis* tree were also present. Further inland past the 20m marker on less inundated land, the native sedge *Ficinia nodosa* was observed.

It was noted that along and around the transect, particularly in deeper water sections, there were a number of dead clumps of a native sedge species (see Photo 1.2), which the couch was growing over. This may be why the couch could survive in the deeper water sections of the transect. A number of dead *Melaleuca* species were also seen in the vicinity; however these deaths occurred over a number of years ago due to drainage/road works nearby (pers. comm. Shire of Denmark).

Photo 1.1 Prawn Rock Channel transect line

Photo 1.2 Prawn Rock Channel; example of dead sedge clumps and couch invasion

3.2 Poddyshot

Water inundation: Along the Poddyshot transect water inundation was recorded at plots 1, 2 and 11 (water level 9cm, 3cm and 2cm respectively). Plots 3 – 10 were only just above the water line with soil moist.

Bushland Condition: The Poddyshot transect varied greatly, ranging from "Degraded" to "Very Good" (see figure 2.1). "Very Good" condition was only recorded along the latter, inland section of the transect; plots 16 – 19. "Good" condition was recorded throughout the transect with no general trend i.e. plots 1, 2, 7, 8, 14 and 20. "Poor" and "Degraded" conditions were similarly distributed. The lower condition grades were mainly due to incursion from the invasive grass species, *Paspalum spp.* (Couch) and *Pennisetum clandestinum* (Kikuyu). There was also a smaller population of other invasive weeds including *Chenopodium spp.* (Goosefoot).

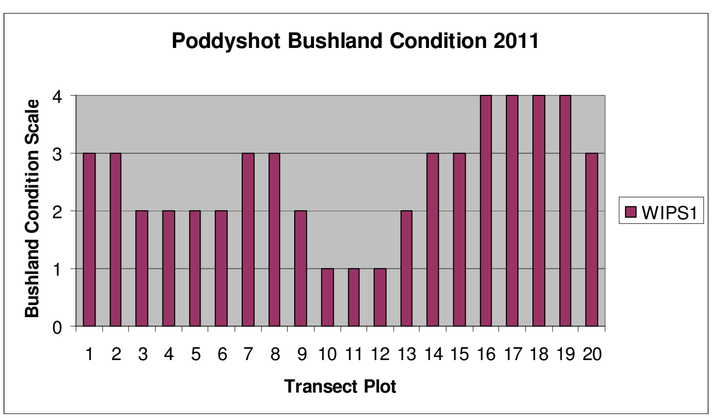


Figure 2.1 Poddyshot Bushland Condition

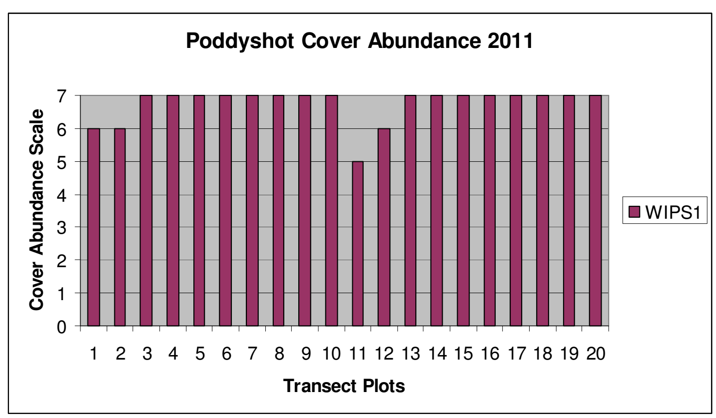


Figure 2.2 Poddyshot Cover Abundance

Cover Abundance: Fairly uniform along the transect line from 5 to 7, with the majority of plots recording 7 (75-100% cover) (see figure 2.2). The plots that recorded 5 and 6 Cover Abundance coincided with the only recordings of water inundation (0.5cm to 9cm). Upperstorey cover began at plot 13 with stands of *Melaleuca cuticularis* and still supported understorey cover of 45% - 100%.

Flora species: *Juncus krausii* and *Ficinia nodosa* were the dominant under storey native species, while the upperstorey consisted of *Melaleuca cuticularis* from plot 13 to 20. There was evidence of young *Melaleuca spp.* death in area within the inundation zone (see photo 2.2).

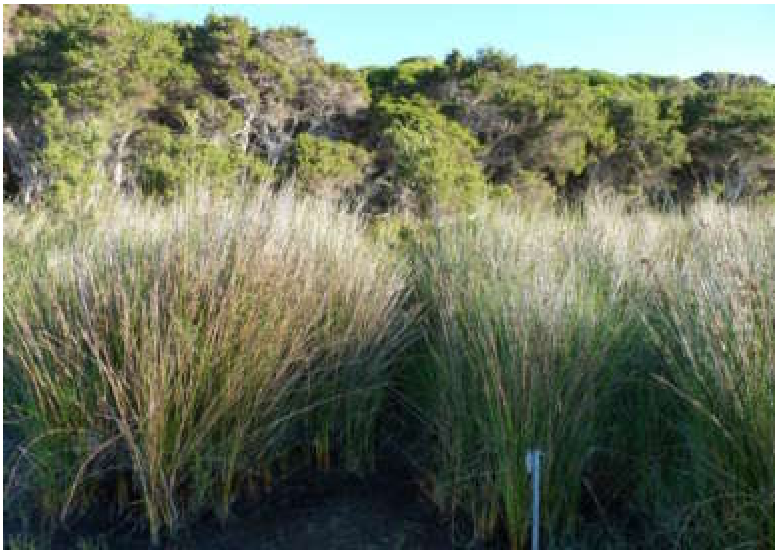


Photo 2.1 Poddyshot transect (note original photo was lost, displayed photo taken mid March 2011. At time of survey water level was 9cm at shoreline marker.

Photo 2.2 Poddyshot, dead *Melaleuca spp.* (note; was taken mid March 2011. At time of survey Melaleuca was partially under water).

3.3 Yacht Club Reserve

Water inundation: The water line reached plot 4 of the transect line with signs of being even higher recently. Water depth for plots 1, 2 and 3 were 23cm, 18cm and 10cm respectively. Where the water line had recently receded (plots 4 - 10), there was little native understorey and some areas of opportunistic weed incursion.

Bushland Condition: Generally “Poor” to “Degraded” along the length of the transect (see figure 3.1). Exceptions were plots 20, 16, 14 and 13 which were graded “Good”, “Good”, “Very Good” and “Good”, respectively. As mentioned previously, where there had been recent and current inundation there was little understorey and a number of weeds evidence leading to Bushland Condition generally graded as “Degraded” (plot 1 – 10), with the exception of plot 8 with a grade of “Poor”.

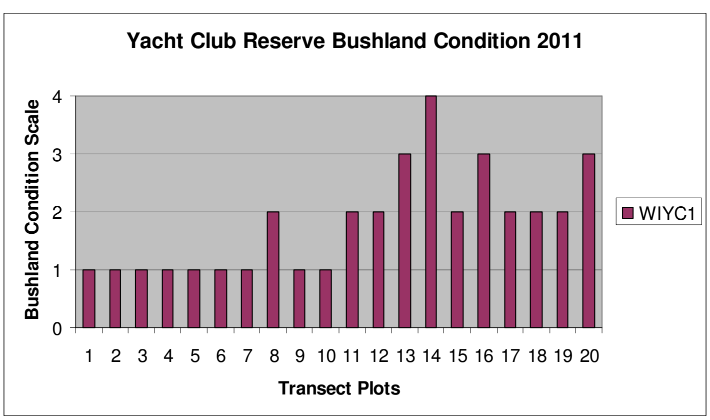


Figure 3.1 Yacht Club reserve Bushland Condition

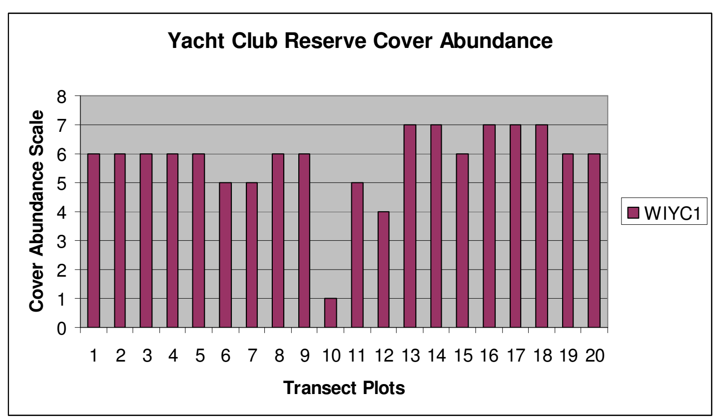


Figure 3.2 Yacht Club Reserve Cover Abundance

Cover Abundance: Plots 1 to 9 recorded a value of "6" (see figure 3.2), primarily from upperstorey cover by *Melaleuca cuticularis* and *Melaleuca raphiophylla.* The understorey for these plots was generally negligible (less than 5% cover) except for plot 7 and 8 where weed incursion including *Chenopodium spp.* (Goosefoot) and *Sonchus spp.* (Sowthistle) had occurred. Further inland (plots 11 to 20) along the transect, the under storey cover increased to 20% - 100%. Plots 13 – 20 all recorded abundance cover of 7 with the exception of plot 15 which recorded a cover of 6. Plots 10, 11 and 12 recorded covers of 1, 5 and 4 respectively. In these plots there were gaps in the upperstorey and <5% to 50% understorey cover.

Photo 3.1 Yacht Club Reserve transect line

Flora species: The primary weeds recorded along the transect were; *Chenopodium spp.* (Goosefoot) and *Paspalum spp.* (Couch), with Couch present from plot 6 to 20.

Plots 1- 10 upperstorey cover consisted of *Melaleuca cuticularis* and *M. raphiophylla.* Sub-plot 2.2 recorded a dead mature *M. cuticularis* as well as a couple of other dead *M.* species present in the surrounding area. While the approximate date of the death could not be determined it was noted that dead leaves and fruits were still on the tree for future reference. While the understorey along this section of the transect was minimal, the Priority 1 native species, *Selliera radicans* was present in the plots 6, 7, 8 and 14.

In the latter inland section (plots 11 – 20) of the transect the dominant understorey native species included *Centella cordifolium, Lobelia alata and Lepidosperma longitudinale* while the middle and upperstorey were *Agonis flexuosa, Callistachys lanceolata* and *Eucalyptus cornuta.*

3.4 Mokare Trail

Water inundation: Plots 1 - 5 had water inundation levels of 1cm – 5cm, with plots 6 – 14 (except for the built up trail section) on fairly flat land which contained moist soil just above the current water level.

Bushland Condition: Fairly consistent over the transect line with "Good" - "Very Good" condition in all except three plots (9, 10 and 11) (see figure 4.1). Mokare Trail intersected the transect on plots 9 and 10 and half of plot 11, hence the "Degraded" Bushland Condition score for plots 9 and 10 and "Poor" for plot 11. Minimal weed incursion by *Paspalum spp.*(Couch) occurred primarily at the foreshore bank edge and a small number of E*ragrostis curvula* (African Lovegrass) and *Chenopodium spp.* (Goosefoot), occurred near the Mokare trail edge (plot 11).

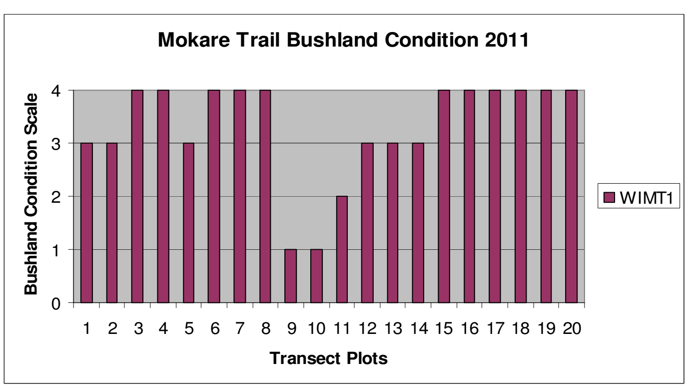


Figure 4.1 Mokare Trail Bushland Condition

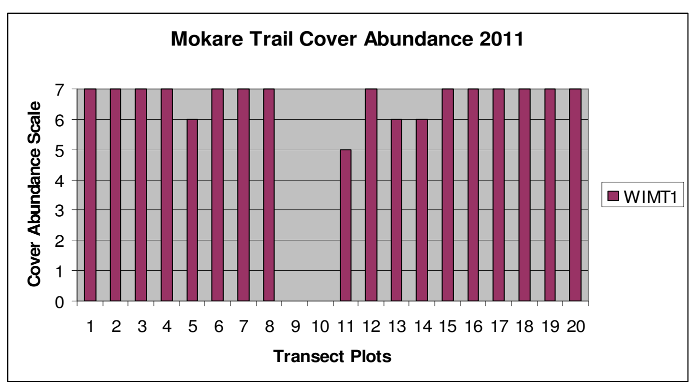


Figure 4.2 Mokare Trail Cover Abundance

Photo 4.1 Mokare Trail transect line

Cover Abundance: Was also fairly uniform with grades of 6 and 7 along the transect, excluding where the Mokare trail intercepted the transect (see figure 4.2). Plot 11 recorded a value of 5 and plots 9 and 10 were “not applicable”. The cover was made up thick under storey and open upper canopy.

Flora species: Dominant native flora species in the wetter areas of the transect near the shoreline end, included *Juncus krausii* and *Centella cordifolium.* Following the transect line away from the shoreline *J. krausii* transitioned to *Ficinia nodosa* and *Baumea juncea,* while *C. cordifolium* remained present until plot 15. Understorey cover from plots 15 - 19 was almost 100% *B. juncea.* Middle and upperstorey cover in the latter section (plots 17 – 20) included *Callystachys lanceolatum* and *Taxandria juniperina.*

3.5 LakeView Place

Water Inundation: Was recorded only at plot 1 with a depth of 40cm.

Bushland Condition: Ranged from “Degraded” to “Very Good” (see figure 5.1). From the shoreline end, (plots 1 – 9), the condition was “Degraded” - “Poor” with invasion by *Paspalum spp.* (Couch), *Chenopodium spp.* (Goosefoot) and *Conyza spp.* (Fleabane). From plot 10 Bushland Condition improved with plots 10 and 11 recording “Good” and 12 – 20 “Very Good”.

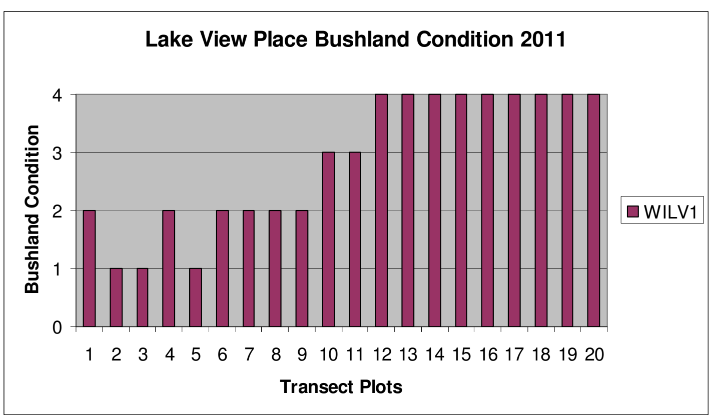


Figure 5.1 Lake View Place Bushland Condition

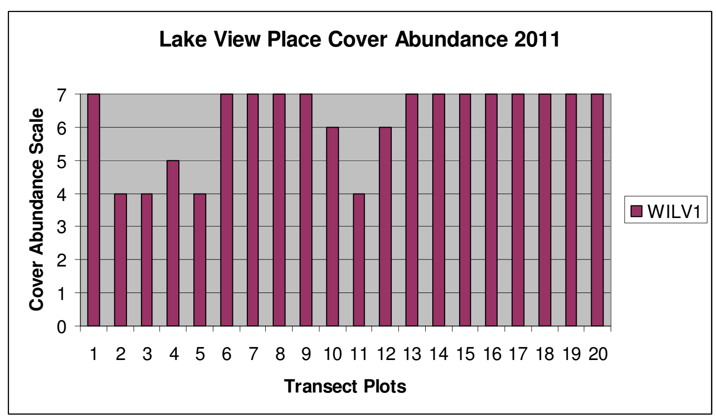


Figure 5.2 Lake View Place Cover Abundance

Cover Abundance: Was generally high with 15 out of the 20 plots recording cover of 6 and 7 (see figure 5.2). Plots 2, 3, 5 and 11 recorded cover of 4 and plot 4 recorded cover of 5. A high percentage of the cover for shoreline end plots was from invasive flora species as described above in Bushland Condition section.

There was minimal middle and upper storey cover until the latter section of the transect (plot 12 - 20) in which *Callystachys lanceolatum* and *Taxandria juniperina* dominated.

Flora species: In the shoreline section of the transect (plots 1 – 5) *Juncus krausii and Apium prostratum* dominated the native species. Plots 6 – 13's dominant native species transitioned to *Ficinia nodosa and Centella cortifolium. Baumea juncea* became more prevalent along with *Dampiera hederacea, Tarax grossa* and *Gahnia trifida* from plot 14 to 17. From plot 17 - 20 *B. juncea* phased out and native species *Empodisma gracillium* became prevalent.

The Priority 1 native species, *Selleria radicans,* was identified in sub-plot 6.1.

It was also noted that there were a number of dead sedges in and around some of the shoreline end plots (see Photo 5.2).

Photo 5.1 Lakeview Place transect line

Photo 5.2 Example of dead sedges and other vegetative matter

3.6 Crusoe Beach

There were a number of exposed granite rocks at plots 5, 6 and 7 with an underlying granite sheet running out into the inlet. Due to the rock shelf protruding into the water past the shoreline, the shoreline end transect marker had to be brought in slightly until enough soil was present to hold the marker.

Water inundation: There was visual evidence of recent water inundation at plots 1 and 2 but no water inundation along the transect line at the date of surveying.

Cover Abundance: Ranged along the entire Cover Abundance scale over the length of the transect (see figure 6.2). Plots 1 – 5 recorded values of 5 - 7, while plots 6 – 15 recorded values of 1 – 4. Plots 16 – 20 recorded cover values of 5 – 7. The higher cover along the shoreline section is in the main part from a *Melaleuca cuticularis* tree at plot 3.

It should be noted that the area is frequented by the public with signs of an informal track intersecting the transect line. Depth of soil along the transect also varied greatly depending on the underlying granite rock shelf which would have some impact on the vegetation.

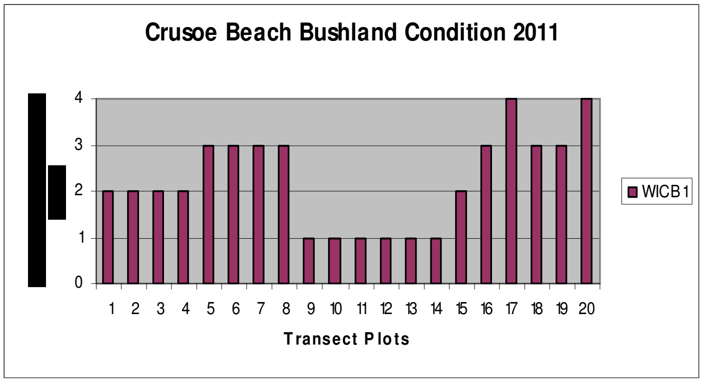


Figure 6.1 Crusoe Beach Bushland Condition

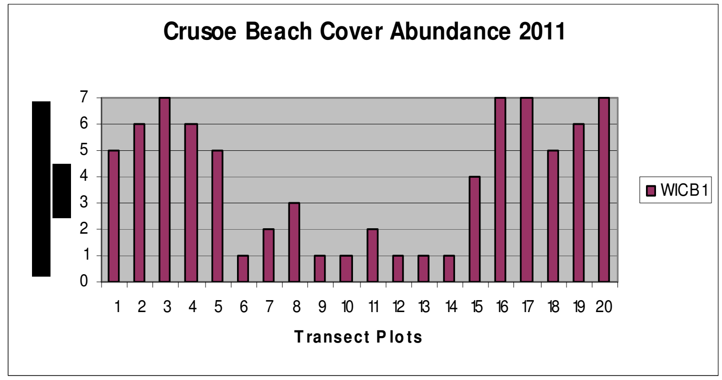


Figure 6.2 Crusoe Beach Cover Abundance

Photo 6.1 Crusoe Beach transect line

Bushland Condition: Varied greatly over the transect, ranging from “Degraded” to “Very Good” (see figure 6.2). Plots 2,9,10,11,12,13 and 14 recorded “Degraded” condition. Plots 11 – 13 were bare sand except for 2 plants on plot 12. Plots 1, 3, 4 and 15 recorded “Poor” condition with *Paspalum spp.* (Couch) and a small number of other invasive flora species present. Plots 5, 6, 7, 8, 16, 18 and 19 recorded “Good” condition and plots 17 and 20 recorded “Very Good” condition.

Flora species: Primary invasive species present were *Paspalum spp.*(Couch) and *Chenopodium spp.* (Goosefoot) and also included *Hypochaeris glabra* (Flat weed).

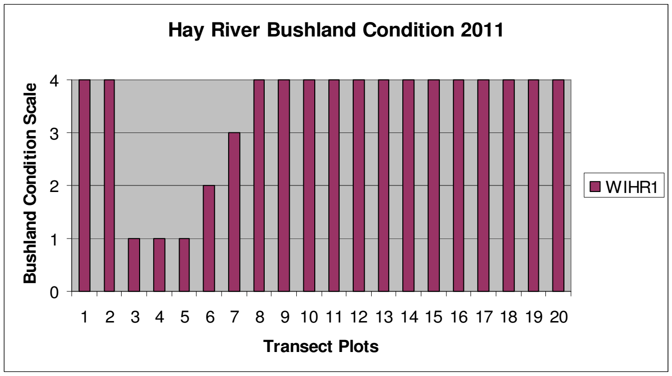
The shoreline end (plots 1 – 10) upperstorey consisted of *Melaleuca cuticularis* and understorey was dominated by *Juncus krausii, Sarcocornia blackiana* (Samphire) and Priority 1 species, *Selleria radicans.* Further inland (plots 15 – 20) the upper storey species transitioned to *Melaleuca densa* and the understorey was dominated by *Desmocladus spp*. and *Ficinia nodosa.*

3.7 Hay River

Water inundation: The shoreline end of the transect was inundated with water up to plot 5 with depth of 30cm at plot 1 and then a rise in land resulting in a depth of only 5cm at plots 2, 3 and 4.

Bushland Condition: Generally “Very Good” with only plots 3, 4, 5, 6 and 7 graded “Degraded”, “Degraded”, “Degraded”, “Poor” and “Good” respectively (see figure 7.1). There was minimal weed incursion in the “Degraded” and “Poor” conditioned plots, however a vehicle track ran through plots 3, 4 and 5 which caused a high level of disturbance and changes to vegetation structure.

Cover Abundance: Was fairly uniform along the transect with plots 8 – 20 recording 7 (see figure 7.2). The dense cover was primarily made up of *Melaleuca cuticularis and M. densa* with very little under storey.



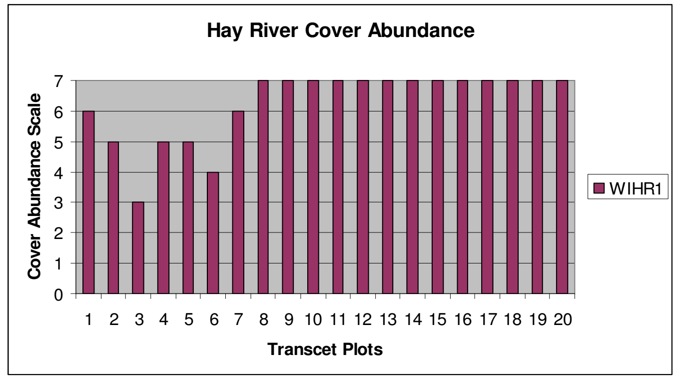


Figure 7.1 Hay River Bushland Condition

Figure 7.2 Hay River Cover Abundance

The shoreline transect end plots 1 – 7 recorded cover of 3 – 6. Plots 1 – 5 contained little upperstorey and the native under storey vegetation was composed of *Sarcocornia blackiana* (Samphire) and *Juncus krausii*.

Photo 7.1 Hay River transect line

Flora species: As mentioned before, dense upperstorey of *M. cuticularis and M. densa* dominated the latter section of the transect line with little under storey, while along the shoreline section of the transect understorey species, *Sarcocornia blackiana* (samphire) and *Juncus krausii,* dominated with only a few of the upperstorey species present. It was noted that there were a number of dead younger *Melaleuca densa* at the transition zone.

3.8 Morley Beach

Water inundation: From plots 1 to plot 3 the water inundation was a uniform 3cm. Due to the gentle slope of the land at Morley beach a number of the plots inland of plot 3, while above the shore line, showed recent water inundation with dead vegetative matter evident and moist soil.

Cover Abundance: Was generally high, with 6 - 7 cover for all plots except for plot 1, 3 and 15 which recorded 4, 5 and 5 respectively (see figure 8.2).

Bushland Condition: Both ends (shoreline and inland ends) were “Poor” (plots 1, 19 and 20) with all remaining plots in either “Good” or “Very Good” condition (see figure 8.1). There was a small amount of *Chenopodium spp.* (Goosefoot) incursion in the area as well as evidence of disturbance to the shoreline fringing vegetation from vehicles accessing and driving along the beach.

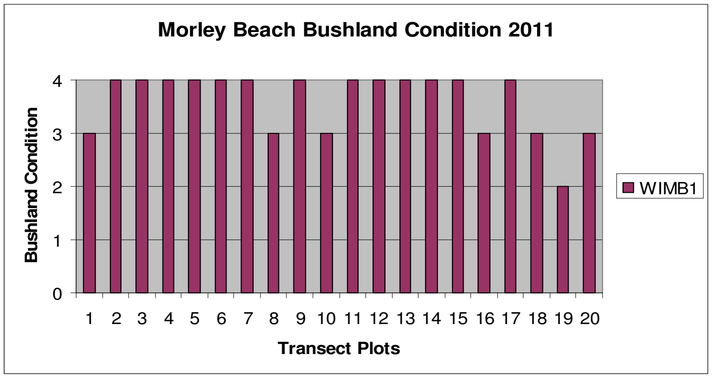


Figure 8.1 Morley Beach Bushland Condition

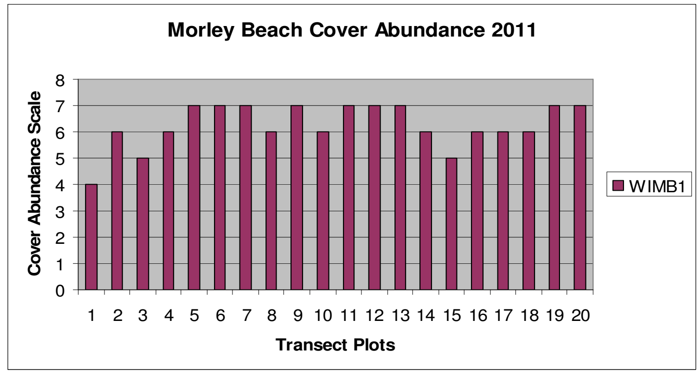


Figure 8.2 Morley Beach Cover Abundance

Flora species: At the shoreline end and over most of the transect the dominant vegetation species was *Sarcocornia blackiana* (Samphire). *Juncus krausii* was more prevalent at the shoreline end until plot 8 and within the middle transect section (plots 10 – 14) *Bolboschoenus spp.* made up to 65% of cover. In the latter, inland end the native rushes and sedges *Juncus pallidus, Ficinia nodosa and Baumea juncea* became more prevalent. The upperstorey species *Melaleuca cuticularis* was almost completely absent along the transect line until plot 18, with only *M. cuticularis* present at sub-plot 4.1.

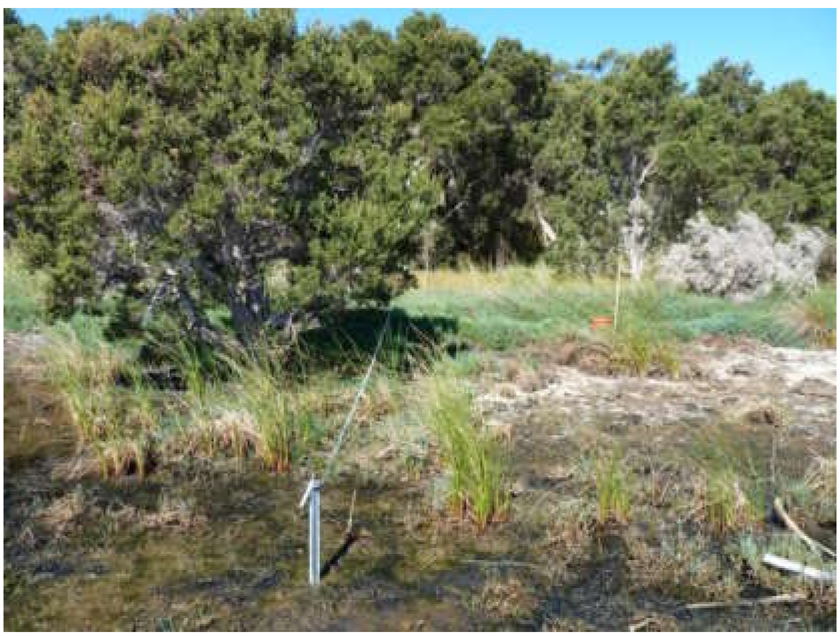


Photo 8.1 Morley Beach transect line

It is worth noting that unlike other sites along the Wilson Inlet, the couch species found at Morley beach (plots 7 – 18 with <5% - 5% cover) was the native *Sporobolus virginicus* (Marine Couch). Also, a dead annual grass species was present in the latter section of the transect which, if alive, would have made up to 25% cover in some sub-plots.

3.9 Youngs Lake

Water inundation: Occurred up to plot 4, with water level at plot 1; 35cm, plot 2; 25cm plot 3; 5cm and plot 4 at water line. Plots 5 – 7 showed evidence of recent inundation with the soil still waterlogged.

Bushland Condition: Was “Very Good” (plots 9 -20) in the latter inland section of the transect (see figure 9.1). Plots 1 and 2 recorded no vegetation and were underwater, hence, “not applicable” was recorded. Further along the transect plots 3 – 8 recorded “Poor” condition with little vegetative matter.

Cover Abundance: Showed a general trend of increasing Cover Abundance values from shoreline to inland (see figure 9.2). Plots 1 and 2 recorded no vegetation but a number of granite rocks, so “not applicable” was recorded. Plots 3 – 8 ranged from 1 to 7 and plots 9 – 20 all recorded 7.

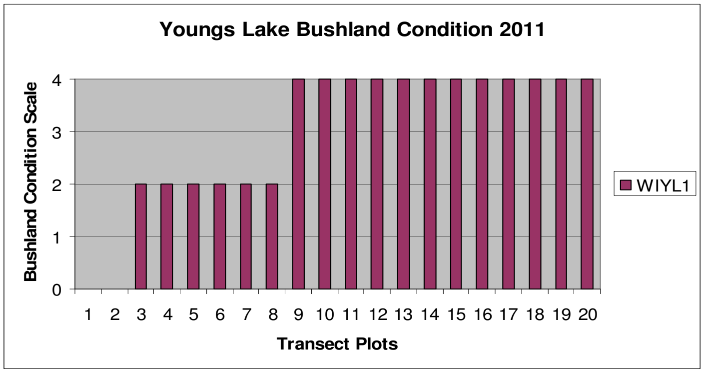


Figure 9.1 Youngs Lake Bushland Condition

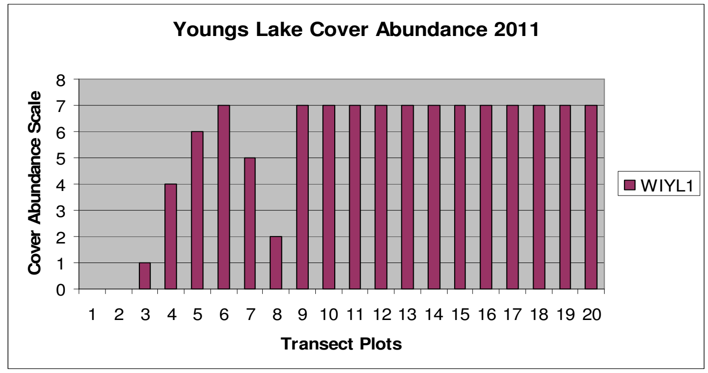


Figure 9.2 Youngs Lake Cover Abundance

Flora species: The dominant native species at the shoreline end was *Sarcocornia blackiana* (Samphire) and further inland, stands of *Melaleuca cuticularis and M. densa* dominated with little understorey. There were some signs that *M. densa* closer to the shoreline were stressed (see photo 7.1) but overall the vegetation looked healthy and unlike a number of other transect sites, the introduced *Paspalum spp.* (Couch) and *Chenopodium spp.* (Goosefoot) species were almost absent.

Photo 9.1 Youngs Lake transect line

3.10 Nenamup Inlet

Water inundation: The water line reached plot 14, with water depths of 20cm to 30cm from plot 1 - 9 and then a decline in water depth to plot 14.

Bushland Condition: Was "Very Good" except for the two plots (plots 1 and 2) closest to the shoreline transect end (see figure 10.1). Plot 1 recorded "not applicable" due to no vegetation and complete water inundation. Plot 2 recorded a "Poor" bushland condition with 3 *Juncus krausii* plants in the plot.

Cover Abundance: Was reasonably uniform, particularly at the inland end where plots 14 – 20 all recorded 7 (see figure 10.2). The lowest Cover Abundance values were recorded at plot 2 with a grading of 1. Plot 1, due to no vegetation and underwater, was "not applicable". Between plots 3 – 13 the abundance cover ranged from 5 to 7 with no correlation to water depth, i.e., plots 3 – 5 recorded 7, plots 6 – 8 recorded 5 and plots 9 – 13 recorded 6.

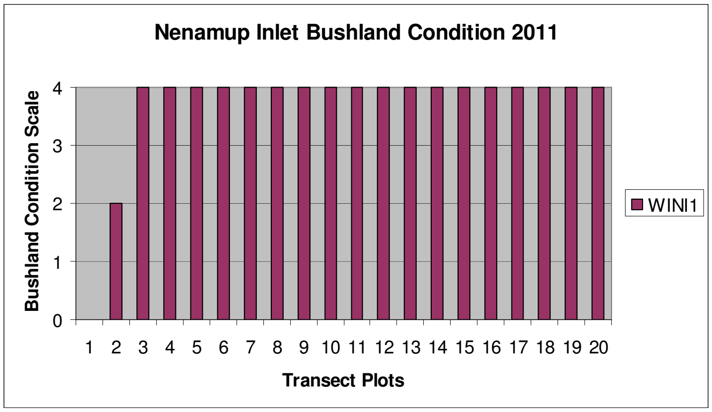


Figure 10.1 Nenamup Inlet Bushland Condition

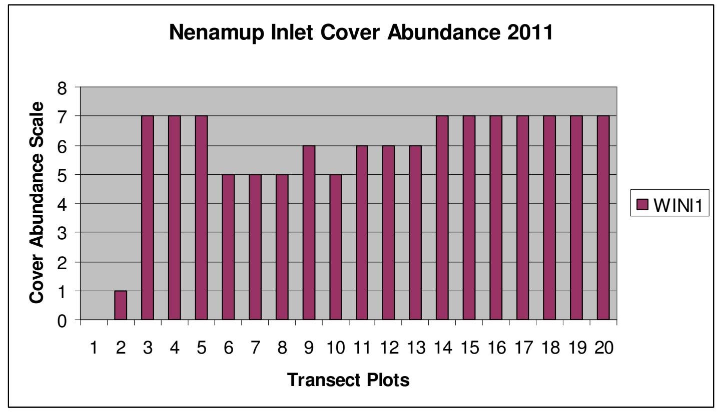


Figure 10.2 Nenamup Inlet Cover Abundancec

Flora species: Weed invasion was minimal with only a small number of *Chenopodium spp.* (Goosefoot) recorded in plots 13 and 14. The vegetation was dominated by *Melaleuca densa* with numerous young plants (up to 32 within subplot 11.1) recorded along the transect. There was patchy undergrowth dominated by *Juncus krausii* closer to the shore end and *Meeboldina denmarkia* was recorded further inland.

It was noted that there were a large number of dead *Banksia occidentalis* further inland towards the 20m mark. Prior surveys of the area by Mark Parre have found numerous *Cyperus eragrostis* (an introduced species) growing around the fringes of Nenamup which now appear totally absent.

Photo 10.1 Nenamup Inlet transect line

Photo 10.2 Nenamup Inlet foreshore view with marker

3.11 Nullaki Gate

Water inundation: High level of water inundation along the transect from plots 1 – 7; starting at 55cm and steadily decreasing.

Bushland Condition: The transect was fairly degraded, with plots 1 – 17 recording “Degraded” condition (except for plot 16) and plots 18 – 20 recording “Poor” (see figure 11.1). The site showed a large infestation of *Paspalum spp.* (Couch) and little to no native vegetation. It was noted that the site showed evidence of past informal camping which may be contributing to the high level of disturbance to the area along with other factors.

With the exception of one *Baumea juncea* plant in subplot 6.2 and five *Juncus krausii* plants within the plots 11 and 12, Couch was the only vegetation present within plots 1 – 12.

Cover Abundance: Was uniformly high, with only plot 4 (cover value of 5) recording a value less than 6 (see figure 11.2). As mentioned before, cover for plots 1 – 12, except for 5 plants, was only made up of the introduced Couch grass species. There was little upperstorey cover with a large number of dead trees.

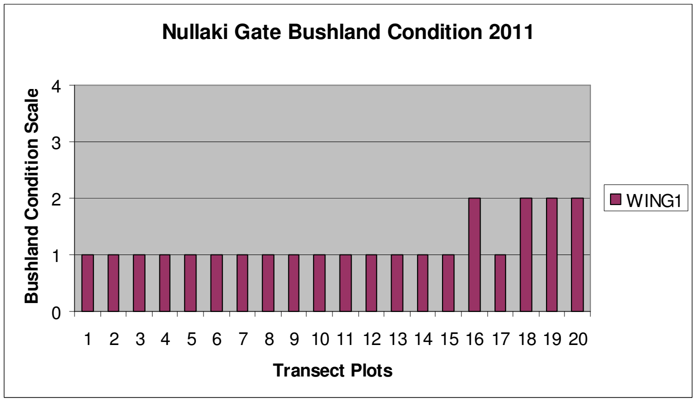


Figure 11.1 Nullaki Gate Bushland Condition

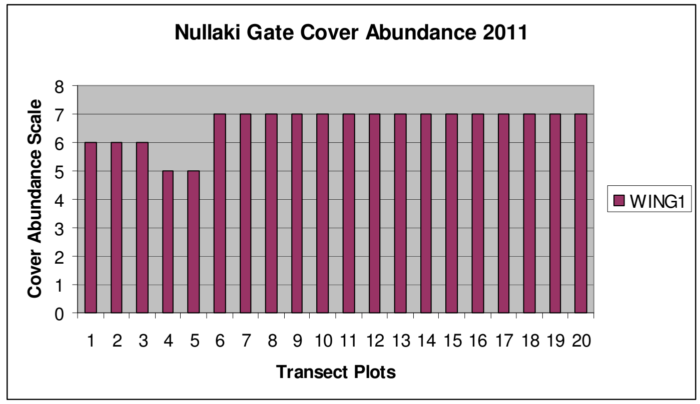


Figure 11.2 Nullaki Gate Cover Abundance

Flora species: Understorey species *Juncus krausii* and *Rhagodia baccata* became more prevalent in the latter inland section of the transect (plots 13 – 20).Of the upperstorey there were none recorded along the actual transect; however there were a large number of tree deaths within the inundation area, (approximately 50% as a guideline). Dead species included *Melaleuca densa* and one *Agonis flexuosa.* All *M. densa* within 8 meters from the shoreline were dead. The dead trees appear to have died over 12 months ago as all the leaves are missing from them. Other *A. flexuosa* are also showing signs of stress (area between shoreline and Eden Road).

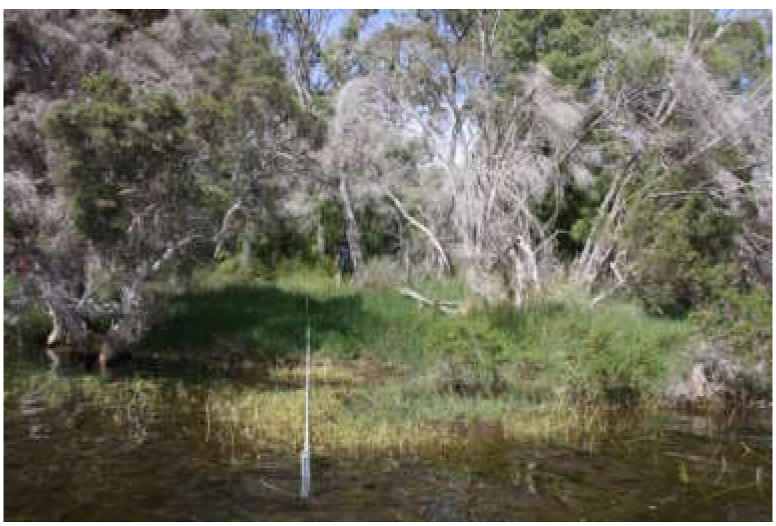


Photo 11.1 Nullaki Gate transect line

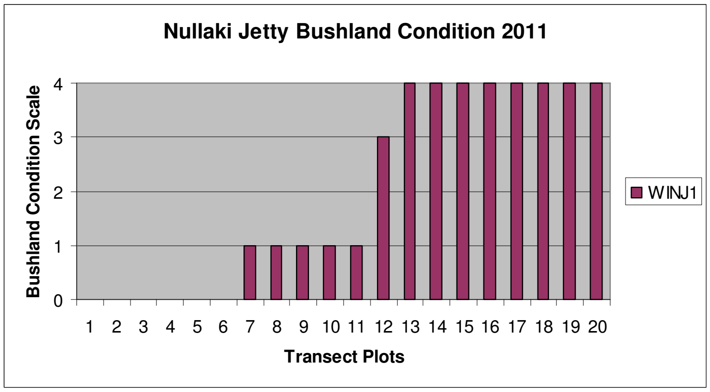
Photo 11.2 Nullaki foreshore looking east from transect

3.12 Nullaki Jetty

Water inundation: There was a high level of water inundation from plots 1 – 10. Depths of up to 80cm (plot 1) were recorded. For plots 1 – 6 water depth was 80cm to 50cm and no vegetation was recorded, hence Bushland Condition and Cover Abundance were “not applicable”.

Bushland Condition: Improved traveling away from the shoreline transect end (see figure 12.1). Plots 1 -6 were “not applicable” due to being underwater and having no vegetation. Plots 7 – 11 were “Degraded”, plot 12 “Good” and plots 13 – 20 “Very Good”. The main invasive species along the “Poor” section of the transect were *Paspalum spp.* (Couch) and *Chenopodium spp.* (Goosefoot).

Cover Abundance: The majority of plots that Cover Abundance was applicable to recorded 7 (see figure 12.2), with the exception of plots 7 and 8 which were graded 5 and 6 respectively and recorded water depths of 40cm and 20cm. Cover In plots 7, 8 and 9 was wholly made up of *Paspalum spp.* (Couch).



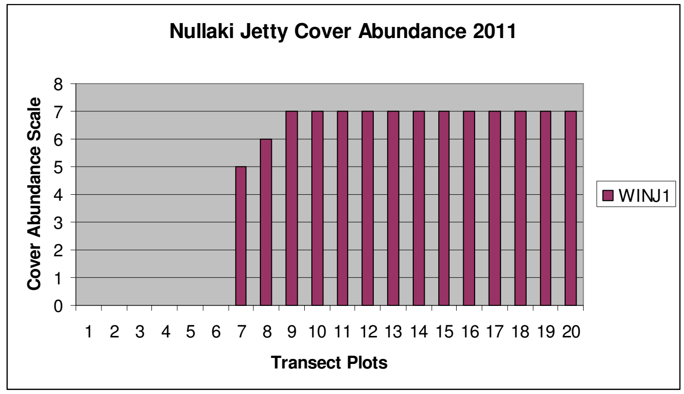


Figure 12.1 Nullaki Jetty Bushland Condition

Figure 12.2 Nullaki Jetty Cover Abundance

Flora species: The dominant native vegetation species was *Ficinia nodosa* and to a lesser extent *Juncus krausii* to plot 17 from which *Baumea juncea and Lepidosperma effusum* became more prevalent. Overstorey species became present at plot 16 onwards, comprising of *Rhagodia baccata and Templetonia retusa.*

It should be noted that a number of *Melaleuca densa* trees were dead in the adjacent area.

Photo 12.1 Nullaki Jetty transect line

4.0 Discussion

At the time of surveying all sites showed some level or recent evidence of water inundation inland of present foreshore fringing vegetation with depths of up to 80cm recorded at the shoreline end markers. Native species recorded past the water line included; *Melaleuca cuticularis, M. densa* and *Juncus krausii.* In plots where water depth (at time of surveying) was greater than 40cm no native vegetation was present/alive; however weed species; *Paspalum spp.*(Couch) growing over semi-submerged vegetative matter survived at deeper depths.

Generally, the greatest level of disturbance to vegetation occurred at the shoreline end of the transects, along areas in and near water inundation. In this zone 10 out of the 12 transects recorded opportunistic invasive species taking a hold in newly exposed soil or growing over dead semi-submerged matter. The main invasive flora species over all the transects was the introduced *Paspalum spp.*(Couch) and to a lesser extent *Chenopodium spp*. (Goosefoot).

At a number of transect sites dead *Melaleuca* species were observed, predominately *M. densa*. The actual timeline for their deaths can not be accurately dated, although evidence of young sapling death and numerous dead trees with leaves still present would suggest more recent deaths of some plants, when taking into account defoliation and decomposition time for vegetative matter. Older tree deaths of *Melaleuca species* (no leaves present on branches) were also present along the foreshore area including WIPR1 and WING1. With the exception of site WIPR1, where previous deaths of *Melaleuca spp.s* were noted when drainage and road works on adjacent Ocean Beach Road occurred (pers.comm. Shire of Denmark), lack of past monitoring means that an accurate date for their deaths can not be established. Other notable vegetative deaths included a large number of *Banksia occidentalis* at WING1 and numerous unidentified native sedge species (most likely *Juncus krausii*) at WIPR1.

A number of live *Melaleuca densa* also showed signs of stress at or in the vicinity of transects WINJ1, WING1, WIYL1 and WIPS1 as well as *Agonis flexuosa* at site WING1. Species including *Agonis flexuosa, Banksia occidentalis and Melaleuca densa* are less tolerant of salt water than *M. cuticularis* which, over the study area, had relatively low number of deaths noted. The most probable causes of the stressed and dead species could be; salt water intrusion into the tap roots from extended and prolonged exposure to water, roots immersed in fresh water for prolonged period of time, high nutrient levels or direct human and vehicle impact (or a combination of these factors).

While the death of some species is a natural part of estuarine systems, the deaths and stress of a number of tree and sedge species is of concern and warrants future monitoring. Annual monitoring of the twelve permanent transects over at least 5 years is recommended to identify any patterns or trends for; new deaths or increased stress on presently healthy trees; recruitment of young plants and their survival rate. Water quality monitoring near identified areas of stressed species should be undertaken and analysed in combination with flora survey results to determine whether salt and nutrient levels in the water are contributing factors to the stress or deaths of foreshore vegetation.

Establishing an indicator group of species from susceptible common species, for targeted monitoring would be useful in more efficient data monitoring and collation in the future. From this baseline study it would appear that *M. densa* may be one of several suitable indicator species.

There needs to be careful interpretation of data collected in future years due to the fluctuating nature of the foreshore riparian zone. with death and recruitment of flora a natural occurrence for a number of native species. Numerous factors need to be considered and examined when interpreting any changes to foreshore vegetation condition.

5.0 References

The condition of the Denmark and Hay River foreshores, Report No.60 (1995) Waterways Commission

Wilson Inlet Foreshore Reserves Management Plan (2008). Green skills.

Appendix 1: Monitoring Collection Data Sheets

Wilson Inlet Foreshore Fringing Vegetation Survey Template

Date: ______________ **Transect ID:** ______________ **Size:** 20m x 2m

Location: ____

Shore end Lat/Long: ______________________ **Inland end Lat/Long:** ______________________

______________________ ______________________

Soil Type: **Survey Project Officers:**

Colour: ______________________ ______________________

Texture (s/l/c): ______________________

(sand/loam/clay) ______________________

Cover Abundance Scale (A)	
Cover Abundance Value	**Description**
1	one-a few individuals
2	uncommon and < 5 % cover
3	common and < 5 % cover
4	very abundant and 5 % or 5-20 % cover
5	20 - 50 %
6	50 - 75 %
7	75 - 100 %

Bushland Condition Scale (B)	
Bushland Condition Value	**Description**
Very Good - Excellent (VG) (4)	80-100% Native Flora Composition. Vegetation structure intact or nearly so. Cover/abundance of weeds less than 5%. No or minimal signs of disturbance
Fair - Good (G) (3)	50-80% Native Flora Composition. Vegetation structure modified or nearly so. Cover/abundance of weeds 5-20% any number of individuals. Minor signs of disturbance.
Poor (P) (2)	20-50% Native Flora Composition. Vegetation structure completely modified. Cover/abundance of weeds 20-60% any number of individuals. Disturbance incidence high.
Degraded (D) (1)	0-20% Native Flora Composition. Vegetation structure disappeared. Cover/abundance of weeds 60-100% any number of individuals. Disturbance incidence very high.

Common vegetation species and their acronyms

Md	*Melaleuca densa*		Cl	*Callystachys lanceolatum*		La	*Lobelia alata*	
Mc	*Melaleuca cuticularis*		Af	*Anigothanthos flavidus*		Cc	*Centella cordifolium*	
Mr	*Melaleuca raphiophylla*		Fn	*Ficinia nodosa*		Le	*Lepidosperma effusum*	
Ec	*Eucalyptus cornuta*		Jk	*Juncus krausii*		Bh	*Billardiera fusiformis*	
Ho	*Hakea oleifolia*		Jp	*Juncus pallidus*		Df	*Desmocladys flexuosa*	

General Comments/observations: ____

Wilson Inlet Foreshore Fringing Vegetation Survey Transect Template

Transect ID: ___ **Date:** ______ **Survey Project Officers:** ______

SPECIES	Shoreline end	ABUNDANCE and BUSHLAND CONDITION		SPECIES	WATER LEVEL
	1 A= B=				
	2 A= B=				
	3 A= B=				
	4 A= B=				
	5 A= B=				
	6 A= B=				
	7 A= B=				
	8 A= B=				
	9 A= B=				
	10 A= B=				
	11 A= B=				
	12 A= B=				
	13 A= B=				
	14 A= B=				
	15 A= B=				
	16 A= B=				
	17 A= B=				
	18 A= B=				
	19 A= B=				
	20 A= B=				

Appendix 2: Wilson Inlet Foreshore Vegetation Survey Sites