Changes in peripheral vegetation of the Peel - Harvey Estuary 1994 - 1998

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COVER PHOTO
Aerial view looking north across Creery Island toward Mandurah on 7 Dec 1999.

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ABSTRACT

A series of studies were set up along the eastern shore of the Peel - Harvey estuary and the lower Harvey River to follow vegetation change in the five years following the opening of the Dawesville Channel. The results of these studies confirm the dynamic nature of estuarine samphire systems, the lack of any substantial pre opening data being a significant impediment to interpretation of trends in samphire dynamics. The freshwater wetland systems in Austin Bay have not been impacted by the changes of tidal regime within the estuary. On the eastern side of the estuary no decline of fringing vegetation was recorded, except as a result of fire. A significant decline in tree health was recorded for the riverine systems of the lower Harvey River, while the understorey composition showed little change. The significant decline in tree health in the lower Harvey River and the recent death of fringing vegetation on the western side of the Harvey estuary are likely to have been caused by changes in the salinity regime within the estuary brought about by the opening of the Channel. It is not clear why a similar response has not yet been seen on the eastern side of the estuary. Further changes in the fringing vegetation of the Harvey Estuary and the lower Harvey River can be expected.

INTRODUCTION

Following the opening of the Dawesville Channel in April 1994 a series of studies was set up to monitor changes in the peripheral vegetation around the Peel-Harvey estuary. These studies included 12 transects through saltmarsh vegetation on the east side of the estuary, two transects in low lying freshwater wetland important for protection of rare aquatic sedge, and studies of riverine vegetation, tree health and *Typha* patches dynamics on the lower Harvey River. This work was not commenced until after the Dawesville Channel was opened and this is a major limitation in interpretation of any change recorded. Gibson (1997) reported on changes recorded during the initial stages of this study.

The aim of the present work is to report on the first five years of this monitoring program.

METHODS

Samphire study

Two transects were established at each of six locations along the east side of the Peel Harvey estuary (Figure 1, Appendix 1). The transects referred to as Austin Bay A and B and Carrabungup A and B were located in the Austin Bay Nature Reserve (↑4990), transects referred to as Creery A and B were located on Creery Island Nature Reserve (↑8185), transects referred to as Mealup A and B were located in the McLarty Nature Reserve (↑24739), and transects referred to as North Kooljerrenup A and B and South Kooljerrenup A and B were located in Kooljerrenup Nature Reserve (↑23756). All of these reserves are A class reserves vested in the NPNCA for the purpose of conservation of flora and fauna.

These transects varied in length from 36.7m to 189.2m in length and ran from the upland vegetation out across the samphires or sedgelands to the water edge. At 10cm intervals along these transects point intercepts were recorded for all vegetation layers (generally one to three layers were present). From these data percentage overlapping cover was calculated for each species. These transects were permanently marked with steel star bars, steel droppers and wooden surveyor's pegs. The first seaward 20m of each transect was levelled at 50cm intervals. This work was undertaken between October and December in 1994 through 1998 by staff of Murdoch University’s Marine and Freshwater Research Laboratory.

Freshwater wetland study

In Austin Bay Nature Reserve *Schoenus natans* occurs in a low-lying seasonal freshwater wetland close to the estuary. This species was listed as Declared Rare flora and protected under the Wildlife Conservation Act. This species was thought to be extinct until the early 1990’s, having not been collected since 1911. In 1994 it was known from six populations across the Swan Coastal Plain with the Austin Bay population being the largest (Gibson *et al.* 1994). It is an annual sedge of ephemeral freshwater claypans. Two transects of 80 and 90m length and separated by c. 200m were established across the wetland where this species occurs. These transects were levelled and point intercept data collected at 5cm intervals, except for 1998 when 10cm intervals were used. These transects were established in November 1994 and rescored in November 1995, November 1996, November 1997 and November 1998.

Standard and inverse classifications were undertaken on yearly cover data using Bray-Curtis association measure. This allowed sorted two-way tables to be produced for both transects. Additionally the year data were ordinated using semi-strong hybrid non-metric multidimensional scaling ordination for each transect. The resultant ordinations were subject to Procrustal rotations to align common gradients. All analyses were undertaken using the PATN package (Belbin 1995).

Riverine vegetation study - lower Harvey River

In order to see if there were any changes to the riverine vegetation of the lower Harvey River, in response to expected increased penetration of salt water following the opening of the Dawesville Channel, 10 transects were established on the eastern bank of the river from the river mouth to 4 km upstream at approximately 500m intervals (Figure 2). The locations of these transects are given in Appendix 1.These transects were established in Reserve (↑36126), which is a narrow riverine reserve vested with the Minister for Water Resources for the purpose of drainage and conservation of flora and fauna. This reserve abuts Kooljerrenup Nature Reserve (↑23756), an A class reserve vested with the NPNCA for the purpose of conservation of flora and fauna. These transects were generally 10 to 15m long and each end was marked with a steel star bar. Point intercept data was collected at 10cm intervals. Each transect was levelled at 50cm intervals. These transects were established in May 1995 and rescored in November 1995, November 1996 and November 1997.

Tree health study - lower Harvey River

Tree species appear to segregate along the lower Harvey River in response to salinity levels, with the most tolerant species such as *Melaleuca rhaphiophylla* and *Casuarina obesa* occurring in the lower reaches and *Eucalyptus rudis* appearing as dense stands at the 2 km mark and continuing well upstream. *C. obesa* is restricted to the area from the river mouth to 1.5 km mark, while *M. rhaphiophylla* shows the widest tolerance occurring along the length of the lower Harvey. It could be expected that these taxa may respond to increased salinity levels in the lower stretches of the river. To measure this, 30 individuals of each species were marked at the lower and upper ends of their range in the lower 4 km of the river. Each individual was marked with a steel tag and girth at breast height (GBH) was measured and condition of the tree was scored on a one to five scale (1 < 20% canopy alive, 5 > 80% canopy alive). All individuals were within 5m of the river edge. *Melaleuca rhaphiophylla* is a typical paperbark, which sheds in long strips every year, measurement of GBH was considered unreliable and basal diameter (BD) was measured instead. In addition it was noted that the canopy of *M. rhaphiophylla* at the river mouth was changing to yellow colour at the end of the 1994/95 summer (JAK Lane pers. comm.), subsequently canopy colour was also scored on a 1 (yellow) to 3 (healthy) scale. GBH measurements of *C. obesa* and *E. rudis* were undertaken November 1994 and in November 1995, 1996 and 1997. Condition was scored in November 1994, May 1995, and in November 1995, 1996 and 1997. Measurements of *M. rhaphiophylla* were undertaken in June 1995, and in November 1995, 1996 and 1997.

Typha study - lower Harvey River

The *Typha* patches in the lower Harvey River were noticed to be dying in late 1994 (JAK Lane pers. comm.). As this may have been a consequence of salinity changes, the dynamics of the *Typha* patches were monitored. This involved marking all patches in the lower 4 km of river and scoring each for size (estimated) and condition (1 < 20% alive to 5 > 80% alive). The patches were visited in November 1994, November 1995, May 1996 and November 1996.

Tree death on the western side of estuary

Tree death on the western side of the estuary was first noted and photographed in May 1988 and rephotographed in May 1999 (JAK Lane, pers. comm.). Further oblique aerial photography was taken in December 1999 and February 2000 to document the extent of the tree death on the western side of the estuary.

RESULTS

Samphire study

Results of samphire study show no consistent trend around the Peel-Harvey estuary (Tables 1 - 12, Figures 3 - 14). There also appeared to be no consistent trend between those transects established around the Peel Inlet compared to those transects around the Harvey Estuary.

The cover of algal mat at Transect A at Austin Bay was relatively stable over the time of the study except in 1995 where there was about a 10% decrease. In contrast the amount of bare ground increased almost 14% between 1994 and 1995 (Figure 3). This transect was dominated by *Halosarcia halocnemoides* and *Lolium rigidum.* Both of these species stayed relatively stable between 1994 and 1995, decreased about 5% in 1996, stabilised in 1997, and then dropped sharply in 1998 (Plates 1 – 5). The profile of the transect showed a deposition of around 30mm over most of the transect between 1994 and 1995 and between the 12m and 20m mark between 1997 and 1998 (Table 1, Figure 4). An aerial view of this transect is shown at plate 5.

Transect B at Austin Bay showed a rapid increase in cover of algal mat between 1994 and 1996 and increase in cover of *Halosarcia halocnemoides* in 1995, then a gradual decrease back to 1994 levels (Plate 7 - 10). The other samphire species *Sarcocornia quinqueflora* decreased from 11.6% cover to less than 2% by 1998. There was also a large decrease recorded between 1994 and 1995 in cover of *Cotula coronopifolia,* an annual taxon common in brackish and freshwater wetlands. Both the weedy grasses *Lolium rigidum* and *Polypogon monspeliensis* showed substantial decreases over the course of the study. The profile of this transect showed little change over the period of this study (Table 2, Figure 6 and 7). A view of this transect from the air is shown in plate 11.

The *J. kraussii* which dominated the transect at CarrabungupA, increased slightly between 1994 and 1995, before declining more than 13% over the following years (Figure 8 & 9, Table 3). The cover of the perennial *Melaleuca acerosa* declined more than 6% between 1994 and 1995, and then remained relatively stable between 1995 and 1998. *Hakea prostrata* showed a similar decrease from 7.7% in 1994 to less than 2% by 1998. The weedy annuals *Oxalis pes-caprae*, *Ursinia anthemoides* and the grass *Bromus diandrus* were the only other species to show a change in cover of more than 5%. *Oxalis pes-caprae* was not recorded in 1994 and had increased to 11.5% by 1998. *Ursinia anthemoides* showed the opposite trend decreasing from 10.7% in 1994 to less than 2% by 1996. *Bromus diandrus* showed an increase from less than 1% in 1994 to almost 10% in 1997 followed by a drop to 5.4% in 1998. The major samphire species (*Sarcocornia quinqueflora*) at this site showed little change in cover over the 5 years (stable at c. 22% cover). Between 1994 and 1996 the profile of the transect changed little (Plate 12 – 14). However, the profile fluctuated between 1997 and 1998 (Figure 9).

The transect at Carrabungup B was dominated by *Juncus kraussii, Sarcocoronia quinqueflora, Suaeda australis* and algal mat (Figure 10 and 11). The decline of the *S. quinqueflora* and *S. australis* between 1994 and 1996 of 9.7% and 12% respectively is seen in the plates 15 - 17. During the same period there was an increase in cover of the algal mat (13.12%) and *J. kraussii* (11.24%) with a slight increase in latter years. The profile of the transect remained stable except for between 1996 and 1997 when there was a deposition of sediment over the whole transect (Table 4, Figure 12).

At transect A on Creery Island the cover of the dominant samphire species (*Halosarcia halocnemoides*) remained stable over the five year period (31-35%), while the cover of *Triglochin mucronata* decreased over 16% between 1994 and 1995 then fluctuated around 10% cover over the next four years. The amount of bare ground increased almost 7% between 1994 and 1995 then continued to slowly increase by another 5% by 1998 (Figure 13). There was a tendency for a decrease in cover of most of the weedy annual grasses over the period of the study (eg *Briza maxima, Bromus diandrus, Cynodon dactylon, Paspalum vaginatum,* and *Polypogon monspeliensis*). During the latter years of the study (1996-1998) the cover of most species remained relatively stable, with the exception of the annual ryegrass, *Lolium rigidum*, where percentage cover almost doubled in 1997 and then halved in 1998 (Table 5, Figure 14, Plate 18 – 21). Aerial views of the two transects at Creery Island are shown at plate 22 and 23.

Bolboschoenus caldwellii decreased more than 5% between 1994 and 1995 at transect B at Creery Island, and then decreased a further 5% between 1995 and 1996 (Figure 15, Table 6). *Cyndon dactylon* also showed a reduction in cover in the first two years of the study (of 10%), and a further decrease of 5% between 1996 and 1997 before stabilising between 1997 and 1998. The cover of *J. kraussii* also decreased 5% between 1994 and 1995 and then remained stable in the remaining years of the study (Plate 24 and 25). In contrast the cover of *Cotula coronopifolia* and *Isolepis nodosa* increased by more than 11% and 9% respectively during this same time period, however, both species showed large drops in cover in the latter years of the study. All four samphire species showed little change in cover over the five years. The cover of *Triglochin mucronata* fluctuated by around 5% every year of the study (Table 6, Figure 15). The profiles of both transect A and B changed little over the five years of the study (Figure 16 & 17).

There was a progressive decrease in the amount of bare ground at the transect at Mealup A from 45.6% in 1994 to 6.7% in 1998 (Figure 18). This is matched by a progressive increase in cover of the dominant samphire *Sarcocornia quinqueflora* (from 14.3% to 37.7%) (Figure 19, Plates 26 – 30). The cover of the weedy grass *Cyndon dactylon* fluctuated annually over the time of the study, while *Isolepis nodosa* showed a steady increase and *Juncus kraussii* showed a substantial drop in cover in the first year and then remained relatively stable. There was a successive deposition of sediment over the transect between 1994 and 1997, before this sediment eroded away between 1997 and 1998 (Table 7, Figure 20).

The percentage cover of the dominant species at Mealup B, *J. kraussii,* dropped 7% in the first year then maintained relatively stable cover at around 4% over the next four years. The major samphire species at this transect *(S. quinqueflora),* showed a decrease in cover from 15-16% in 1994-1995 to less than 2% in 1998 (Plate 31 – 33, Figure 21). *C. dactylon, M. cuticularis* tended to fluctuate showing no clear trend. There was erosion of up to 50mm of sediment over the transect between 1994 and 1995. This was followed by further deposition of up to 100mm in the following year and then erosion over the next two years (Figure 22, Table 8). These changes were reflected in the pattern of cover of bare ground.

The cover of *Atriplex prostrata, Cotula coronopifolia, Juncus kraussii* and *Melaleuca cuticularis* at the North Kooljerrenup transect A all decreased between 4.5% and 9% over the five years of the study (Figure 23, Table 9). The cover of the major samphire species (S. *quinqueflora*) decreased by 20% over the first three years, but then almost doubled in the final two years. The amount of bare ground and algal mat increased between 1994 and 1995. The cover of the algal mat increased again between 1995 and 1996 and then the amount of the algal mat and the bare ground decreased over the final years of the study (Figure 24, Plates 34 – 37). The profile of transect A changed little over the five years of the study (Figure 25). An aerial view of the transect at North Kooljerrenup is shown at plate 38.

There was a large decrease in the cover of several species at transect B at North Kooljerrenup between 1994 and 1995 (*S. australis, M. cuticularis, J. kraussii* and *A. prostrata*) (Figure 26, Table 10). At the same time the amount of bare ground and dead *S. australis* increased. The cover of *J. kraussii* and then increased substantially again between 1995 and 1998. A similar, but less pronounced, trend is seen in *M. cuticularis.* The cover of the dominant samphire species (*S. quinqueflora*) also decreased slightly between 1994 and 1995 and then more than doubled (to over 80% cover) by 1998. The algal mat increased 13% between 1996 and 1997 and a further 10% between 1997 and 1998. Most of the profile of transect B remained stable, with the exception of the central part of the transect. There was erosion of sediment between four and six metre marks along the transect and deposition of sediment between six and nine metre marks after the 1994 measurement (Table 10, Figure 27). A fire burnt out the fringing vegetation between the 1994 and 1995 field visits (R. Segal, per. comm., Plates 39 – 42)

Transect A at South Kooljerrenup had a large decrease in the cover of the algal mat between 1994 and 1995 and a large increase in the cover of bare ground at the same time (Figure 28, Table 11). The percentage cover of algal mat then increased to more than 35% between 1995 and 1998 and at the same time bare ground decreased. *J. kraussii* showed a sustained decrease in cover over the study period while *Bolboschoenus caldwellii* showed an initial increase then a sustained decrease (Figure 29, Plates 43 & 44). The major samphire species (*S. quinqueflora*) fluctuated between 55-60% over the five years. The profile at transect A fluctuated over the five years of the study, with only the time period between 1996 and 1997 showing a consistent deposition of sediment over the whole transect (Figure 30, Table 11). An aerial view of the transect at South Kooljerrenup is shown at plate 45.

Transect B at South Kooljerrenup showed large changes in cover in the final years of the study (Figure 31, Table 12, Plate 46 – 49). Between 1996 and 1997 the cover of the algal mat and *B. caldwellii* decreased 13 and 8% respectively. At the same time the amount of bare ground increased 13%. Between 1997 and 1998 the algal mat increased 15% whilst the bare ground decreased 12% and the *B. caldwellii* decreased again by a further 18.6%. The cover of the dominant samphire species (*S. quinqueflora*) fluctuated between 63-77% over the five year study. Between 1994 and 1995 the cover of *A. prostrata* decreased almost 9%, this was followed by a slow decline in cover until this species was not recorded in 1998. There was little change in the profile of transect B, with the exception of 1998, where up to 25mm of sediment was deposited over the transect between the six and 20 metre marks (Table 12, Figure 32).

The comparisons of Murray *et al.* (1995b) predictions of the expected changes in the peripheral vegetation of the Peel Harvey following the opening of the Dawesville Channel and the responses of taxa recorded on the 12 permanent transects established in this study are presented in Table 13.

Freshwater wetland study

There was considerable variation in species cover for eight or more species along the transects through the freshwater wetland (Tables 14 & 15), but no evidence of any intrusion of salt water. The two way tables sorted species with similar responses over the five years close together. Inspection of these tables indicates that 1994 and 1995 had broadly similar species patterns, as did 1996, 1997 and 1998. It was interesting to note that both the predominantly annual flora and perennial taxa such as *Leptocarpus canus* showed similar variability from year to year.

Ordinations of the species cover by year data matrices showed remarkably similar patterns across both transects. These results were plotted to show how species patterns changed through time. Neither transect showed unidirectional shifts in species composition through time (Figure 33), these results are consistent with the interpretation that the pattern seen reflect seasonal variation with no evidence salt water intrusion.

Salinity of the wetland was followed over the spring of 1996 where it was found that wetland was essentially fresh early in spring with increasing salinity to 12ppt as the wetland was almost dry (Table 16). This is consistent with impervious clay based, rainfed, wetland with the major source of salt from salt spray being concentrated as the wetland dries. Small areas of salt crust were visible on the dried surface during summer. An aerial view of the wetlands where the transects were established are shown at plate 50.

Riverine vegetation study - lower Harvey River

Ten transects were established in the lower 4 km of the Harvey River (Figure 2, Plates 51 – 54) to monitor any change resulting from increase salinity due to an expected increased penetration of the salt water due to the opening of the Channel. These transects (10 - 12m long) were established at regular intervals of c. 500m. They were established in May 1995 after many of the annual and some of the perennial species had died back, consequently large changes in percentage cover are seen on all transects between May 1995 and November 1995 (Tables 16 - 25). Most of these changes appear to be related to a seasonality component and will not be referred to further.

The transect at the river mouth was dominated by *Bolboschoenus caldwellii*, which varied little in cover over the three years of the study (97.9-94.9%). The proportion of bare ground also varied little (1-3%). The profile showed little change over the years with the exception of the last 1m near the river, which was gradually eroded away in successive years (Table 17, Figure 34).

Bolboschoenus caldwellii was also common in the transect at 0.0km, where the percentage cover almost doubled between 1995 and 1996 (26.1- 42.8%), and then halved again between 1996 and 1997 (42.8-21.7%). *Juncus kraussii* was also dominant in the 0.0km transect, with its percentage cover progressively increasing over the time of the study. The profile of the transect changed little between the 0m and 7m marks over the years of the study. Between 7m and 19.5m there was erosion of sediment on the shallower sections of the profile between May 1995 and November 1997 (Table 18, Figure 35).

The perennial species, *Melaleuca rhaphiophylla and Casuarina obesa* dominated the transect at 0.5km (Table 19). The cover of *C. obesa* remained stable between November 1995 and November 1996 and then increased 8.3% in the final year. The percentage cover of *Melaleuca cuticularis* more than doubled from 15.1% to 41.7% between 1995 and 1996 and then increased a further 2% in the final year. *M. rhaphiophylla* decreased 10.6% in cover between 1995 and 1996, and then increased 4.5% between 1996 and 1997. The weedy grass *Lolium perenne* lost almost 10% of cover between the first years of the study, but then increased by 2% in the final year. The amount of litter increased yearly, increasing from 14.4% in the first year to 31.1% in the final year. The profile of this transect changed little over the study (Figure 36).

Atriplex prostrata was a dominant at the transect at 1.0km (Table 20). This species lost 18.2% in cover between 1995 and 1996, and then gained 35.5% cover between 1996 and 1997. *Bolboschoenus caldwellii* gained cover slightly between 1995 and 1996, and then decreased by 5.4% between 1996 and 1997. The weedy species *Rumex crispus* lost over 6% in cover between 1996 and 1997, and was not represented at the transect in 1997. The perennial species *M. rhaphiophylla* and *C. obesa* changed little in the three years, increasing 0.9% and 2.7% respectively. The profile of this transect did not change over the years of the study (Figure 37).

The transect at 1.5km is dominated by the perennial *M. uncinata* which increased 6.2% from 23.8% between 1995 and 1996 and then remained stable between 1996 and 1997 (Table 21). The weedy species *Watsonia meriana* decreased 2.8% in the first year before increasing 7.7% to 33.85% in the final year. The cover of *Cotula coronopifolia* decreased 30% between 1995 and 1996, this trend reversed in the next time period (1996 – 1997), where the cover increased by 24.6%. *Juncus kraussii* remained stable during the time of the study. *Lolium perenne* increased in cover over successive monitoring periods, gaining 13.1% between 1996 and 1997. The profile of this transect showed little change over the years between 0m and 12.5m. There was some erosion of the riverbank between 12.5m and 13.5m (Figure 38).

W. meriana dominated the transect at 2.0km, with the percentage cover remaining fairly stable between 1995 and 1997 (Table 22). The cover of *Eucalyptus rudis* decreased 12.2% between 1996 and 1997 and then remained fairly stable between 1996 and 1997 (43.9 – 44.7%). The profile of this transect did not change over the years of the study (Figure 39).

A large proportion of the transect at 2.5km was covered by litter which decreased by 45% to 15.7% in 1996 and then increased again in the final year to 49.3% (Table 23). *Melaleuca rhaphiophylla* dominated the transect, increasing slightly from 95% to 98.6% between the first years and then dropping back to 95% by the end of the study. The cover of *J. kraussii* increased only slightly in during the study, increasing from 10% to 11.4% in the first years and then increasing a further 0.7% between the final years. *Rumex crispus* was not found along the transect in 1995, however, by 1996 its cover was 17.1% and this increased again in 1997 to 20.7%. The profile of this transect changed little over the years of the study (Figure 40).

J. kraussii increased progressively over the time of the study at the transect at 3.0km (Table 24). There was a sharp drop in the cover of *Mentha pulegium* from 46.4% to 7.20% between 1995 and 1996, and then a slight increase to 9.6% between 1996 and 1997. *Ranunculus* sp. only appeared at the transect in 1996 where it had a cover of 8.8% and *Ranunculus muricatus* was only found at the transect in 1997 where it had a cover of 12.8%. The perennial tree species *E. rudis* and *M. rhaphiophylla* both increased in cover between 1995 and 1996 (10.4% and 8.8% respectively). The cover of *M. rhaphiophylla* continued to increase (another 3.2%) between 1996 and 1997, however, *E. rudis* decreased 4% during this time. The profile of this transect remained stable over the study period (Figure 41).

The weedy species *W. meriana* dominated the transect at 3.5km decreasing slightly from 100% to 97.5% between 1995 and 1996 and the increasing again to 100% by the final year of the study (Table 25) *Eucalyptus rudis* also had a large presence and increased from 37.7% to 61.4% between 1995 and 1996 and then decreased slightly by the final year of the study to 59%. The profile of the transect remained stable except for slight erosion near the riverbank (Figure 42).

Both *W. meriana* and *E. rudis* also dominated the transect at 4.0km (Table 26). The cover of *W. meriana* decreased 8.6% between 1995 and 1996 and then increased in the final year of the study by

13.7%. *E. rudis* increase progressively over the study period from 84.9% to 92.1%. The profile of the transect changed little over the period of the study with the exception of some slight erosion near the riverbank (Figure 43).

Table 27 presents the overall changes in percentage cover of several common species along the 10 river transects following the opening of the Dawesville Channel.

Tree health study - the lower Harvey River.
Of the three species of trees studied along the lower Harvey River *Melaleuca rhaphiophylla* has the widest range occurring from the river mouth up to the 4 km mark. *Casuarina obesa* forms stands from river mouth to 1.5 km mark while *Eucalyptus rudis* forms stands from the 2 km mark upstream to the 4 km mark.

C. obesa generally grew faster and retained a healthier canopy condition at its upstream locality than at its downstream locality (Tables 28 - 30). The downstream trees of *E. rudis* grew faster than the upstream trees (Table 29). Whilst the upstream stand of *E. rudis* maintained the healthiest vegetation condition, the downstream trees lost some condition (Table 30).

The girth measurement of *M. rhaphiophylla* was difficult to measure due to its habit of shedding large amounts of bark. In an attempt to minimise this difficulty basal measurements were made (Table 28 & 30). The downstream stand consistently recorded negative growth over the period, and lost condition (Tables 30 & 32). The upstream stands also lost condition, however, basal diameter increased at each measuring period. The upstream plants were consistently green, even at June 1995, after the long dry summer. In contrast colour of the downstream stand was fairly yellow in June 1995 after the summer, then recovered to a healthy green in November then yellowed again over November 1996 and 1997 (Table 32).

Typha study - lower Harvey River
Typha patches were noticed to be dying in late 1994 along the lower 4 km of the Harvey River. It was possible that this was due to increased salinity levels in the lower river resulting from the opening of the Channel. The number, size and condition of these patches has been monitored on four occasions (Figure 44). The number of patches decreased from 21 in Nov 1995 to a low of 11 May 1996, since then there has been the recruitment of 6 new patches. These new patches were spread along the length of river previously occupied by *Typha*. Average condition has remained roughly constant except for May 1996 when the annual winter dying back was recorded. Average patch size has shown a consistent decline since November 1995 (Figure 44).

Tree death on the western side of estuary
Oblique air photos showing the extent of the tree death (in December 1999 and February 2000) on the western shore of Harvey Estuary are shown in plate 55 - 65. Areas photographed are shown at Figure 45. More extensive aerial surveys suggest that the extent of the fringing vegetation death is more extensive than shown in Figure 45 (JAK Lane, pers. comm.).

DISCUSSION

Samphire study
The dynamic nature of the saltmarsh vegetation of the Peel - Harvey estuary has recently been demonstrated in a comprehensive analysis of aerial photos dating back to 1957 (Glasson *et al.* 1995). This analysis showed significant loss of saltmarsh between 1965 and 1994 of some 370 ha. This loss of saltmarsh was most rapid between 1965 and 1986. Not all areas of the estuary were equally affected and some areas such as the Harvey delta and Austin Bay showed the reverse trend of a steady increase since 1977. The mapping of the saltmarsh show the dynamic nature of the patches with “individual areas showing evidence of ephemeral changes and succession” (Glasson *et al.* 1995).

The two areas highlighted in Glasson *et al.* (1995) as showing a steady increase in saltmarsh vegetation since 1977 were the Harvey delta and Austin Bay. The transects data from Austin Bay showed mainly decreases in samphire species, with the exception of *Halosarcia indica* subsp. *bidens* which increased at both transects (Table 1 & 2). *Halosarcia halocnemoides* in particular declined quite considerably at transect A (14.9%), as did the *Sarcocornia quinqueflora* (7.5% at transect A, and 9.8% at transect B).

When the total cover (excluding algal mat, bare ground, litter & wood) for these two transects are compared over the years of the study there is decline in total plant cover at both transects (88.5% in 1994 compared to 81.8% in 1998 at transect A and 135.9% in 1994 compared to 97.4% at transect B) (Table 1 & 2).

The transects in the Harvey delta showed a decrease in *Sarcocornia* cover from 60.2% to 55.4% on transect A, whereas the *Sarcocornia* at transect B increased from 63.3% to 76.9% (Table 11 and 12). *Suaeda australis* increased slightly at both transects (0.52% to 0.63% at transect A, and 0% to 2.47% at transect B). The cover of *Bolboschoenus caldwellii* decreased at both transects (18.8% to 17.0% at transect A, and 56.55% to 31.8% at transect B). If total plant cover (excluding algal mat, bare ground, litter & wood) for these transects are compared over the years of the study there is decline in total cover at both transects (128.4% in 1994 compared to 99.0% in 1998 at transect A and 143.5% in 1994 compared to 129.0% at transect B). These data are not consistent with Glasson *et al.* (1995) findings as some samphire species in the Harvey Delta and Austin Bay are declining at the same time as others are increasing. These results do, however, illustrate the dynamic nature of the samphires.

Backshall and Bridgewater (1981) and Murray *et al.* (1995a) have described the peripheral vegetation of the Peel - Harvey estuary. These studies were based on a series of transects established around the estuary, both concluded that tidal influence was the primary determinate of the very clear vegetation zonation seen. None of Backshall and Bridgewater’s transects (established in 1977-78) were permanently marked so detailed study of temporal change since that time is not possible. The Murray *et al.* (1995a) transects were established in early 1994 before the Channel was open. These transects were permanently marked and three of these transects (transects 7, 9 and 10) were incorporated into the study reported here (Austin Bay B, North Kooljerrenup A and South Kooljerrenup A). However, as the Murray *et al.* (1995b) study involved a one off measurement of the vegetation, no detailed description of the dynamics of the system is available prior to the opening of the Dawesville Channel.

The two major vegetation patterns described by Murray *et al.* (1995a) were: a bare ground ⇒ *Sarcocornia* ⇒ *Juncus* sequence; and a bare ground ⇒ *Sarcocornia* ⇒ *Halosarcia* sequence. The *Sarcocornia* zone was typical of frequently inundated low marsh areas and the *Halosarcia* zone typical of rare inundated high marsh areas. Given the increased height of tidal inundation, the higher frequency of inundation and the shorter period of inundation expected with the opening of the Channel, they predicted that there would be an increase in low marsh areas and a decrease of the high marsh vegetation (Murray *et al.* 1995b). In general terms the results from this study were not consistent with Murray *et al*. (1995b) predictions (Table 13). It may be that any trends may develop over a longer time period than that of this study.

Despite Murray *et al.* (1995b) prediction that low marsh areas (those areas where *Sarcocornia* was common) would increase in size, they also predicted that there would be a reduction in germination of *Sarcocornia quinqueflora* resulting from the increased saline conditions of the estuary in August post-Dawesville Channel. This species showed some dramatic changes in cover over the five years, in the Peel Estuary. Of those transects where the species was common, it showed a decrease in cover of between 7 to 10% (Table 1 – 13). In the Harvey Estuary four transects showed increases of between 8 and 44% (Table 7, 9, 10 and 12) while two transects showed decrease cover of between 5 and 14 % (Table 8 and 11). Transects at Mealup B and South Kooljerrenup A were, however, in close proximity with transects showing substantial declines in cover. These changes do not appear to be the result of large changes in the transect profile as there appears to be little correlation between big changes in percentage cover and changes in transect profile. These outcomes highlight the dynamic nature of the estuarine vegetation and suggest that the impact of the Dawesville Channel will be difficult to assess due to the lack of substantial pre-Channel monitoring of the dynamics of the system.

The percentage cover for both *Halosarcia indica* subsp *leiostachya* and *Halosarcia halocnemoides* have generally shown a small decrease (generally less than 3%) over the five year study in all transects where these species occurred, the exception being Austin Bay A where the decrease in cover has been of the order of 15% (Table 1 - 13). *Halosarcia* species were predicted to become less dominant due to an invasion of other species into the same niche as salinity reduces over the spring and summer months. They were also predicted to decrease in density because of the increased height of tidal inundation, higher frequency of inundation and shorter period of inundation expected with the opening of the Channel (Murray *et al.* 1995a). It was, however, predicted that *Halosarcia indica* subsp. *bidens* may increase in cover due to the predicted reduction in the salinity during its autumn germination. In the four transects where this subspecies was represented, a small increase in cover (less than 3%) occurred over the time of the study (Table 1, 2, 5 and 6). It was also suggested that the change in salinity may result in the *Halosarcia* species becoming denser and taller (Murray *et al.* 1995a). This may have occurred for the *Halosarcia indica* subsp. *bidens*, as shown by the increased percentage cover, but did not occur for *Halosarcia indica* subsp *leiostachya* and *Halosarcia halocnemoides* where the percentage cover declined.

An increase in cover of *Suaeda australis* was recorded at the transects at Austin Bay A, Carrabungup A, Mealup A and South Kooljerrenup A and B (Table 1, 3, 7, 11 and 13). Cover of this species decreased at Austin Bay B, Carrabungup B, Mealup B and North Kooljerrenup A and B (Table 2, 4, 8, 9 and 10). The prediction of Murray *et al*. (1995b) was that in the long term *S. australis* may fail to germinate in the higher saline conditions of the post-Dawesville Channel estuary and greater tidal scouring may inhibit vegetative reproduction. This prediction does not fit the results shown in this study. Interestingly this species has increased at transects adjacent to other transects where the species has decreased.

Another common component of the samphire flats was *Juncus kraussii*, which generally showed decreased cover over the five years where it was a common element of the vegetation (range 1 to 25% decrease). The exception was Carrabungup B which showed a 5% increase in cover (Table 4) while the adjacent transect showed an 11% decrease (Table 3). Murray *et al*. (1995b) predicted that *J. kraussii* would be able to cope with any increases in salinity after the opening in the Dawesville Channel and quickly re-establish areas that have been eroded. It is difficult to attribute changes in this species cover to erosion, as there appears to be little correlation with changes in transect profile. If changes in salinity were affecting the species we would expect to see a consistent pattern to the changes, which is not the case.

Frankenia pauciflora showed a fairly consistent decline in percentage cover over the years of the study at both the Creery Island transects (from 6 to 4% on transect A, and from 11 to 8% on transect B) (Table 5, 6 and 13). At the only other transect where *F. pauciflora* was found it was found in low density (0.07%) in only one year (Table 1). It was predicted that this species would decline, as it was unlikely to be able to cope with the changing tidal regimes (Murray *et al.* 1995a). The two Creery Island transects are the closest transects to the new opening where the changing tidal patterns would have a large effect.

The annual grass *Cyndon dactylon* showed a decline in all transects where it was found (Table 1, 3-9 and 13). This is opposite to the predictions of Murray *et al.* (1995b), who predicted that annual grasses would increase due to better seed dispersal through changed tidal regimes and better niche availability due to death of the perennial species from the change tidal regimes. Another annual grass, *Polygon monspeliensis*, declined in three transects (Austin Bay B, Creery Island B and South Kooljerrenup B) (Table 2, 6 and 12), remained stable in two transects (Creery Island A and North Kooljerrenup A) (Table 5 and 9) and increased at Austin Bay A (Table 1). There appears to be no general trend to the response of annual grass species to changes in species composition, or tidal fluctuations after the opening of the Dawesville Channel.

Other annual weeds, such as *Cotula coronopifolia*, also showed no overall trend of decline or increase around the estuaries. Transects at Austin Bay A, North Kooljerrenup B and South Kooljerrenup A all showed an increase of this species (Table 1, 10 and 11). The transect at Mealup A (Table 7) remained stable and transects at Austin Bay B, Creery Island A and B, North Kooljerrenup A and South Kooljerrenup B (Table 2, 5, 6, 9 and 12) all showed a decline in the cover of *C. coronopifolia*. These trends cannot be attributed to changes in perennial species density, as in most cases the cover of perennial species has increased, not decreased, and the annuals have responded in different ways in the same transect.

The cover of the sedge *Bolboschoenus caldwellii* has decreased in three transects (Creery Island B and South Kooljerrenup A and B) (Table 6, 11 and 12) and remained stable in two other transects (Creery Island A and North Kooljerrenup A) (Table 5 and 9). This is one of the responses that Murray *et al*. (1995b) predicted (Table 13). They suggested that this species may decrease in density due to higher winter salinity, or increase due the increased frequency and depth of inundation and reduced salinity in summer and autumn.

Perennial species were predicted to decline after the Dawesville Channel was opened due to changes in salinity (Murray *et al.* 1995b). However, as with the species discussed above there was no clear pattern of decline or increase. With the exception of *Melaleuca acerosa* at Carrabungup A and *M. cuticularis* at North Kooljerrenup B, all of these fluctuations were no more than 5% and may be attributed to changes in the shapes of plants year to year (ie the plant not touching the transect in as many places because a branch dies) rather than any large changes in density. *M. acerosa* at Carrabungup A and *M. cuticularis* at North Kooljerrenup B declined 6.6% and 7.8% respectively (Table 3 and 10). The decline of *M. acerosa* at Carrabungup A is due to the death of plants around the 45m mark. It is difficult to speculate on the reasons for this death, however as it has occurred so soon after the Dawesville Channel was opened, it may be due to changes in conditions caused by the Channel. The decline in *M. cuticularis* at North Kooljerrenup B was accompanied by a similar decline of 4.5% in the *M. cuticularis* at North Kooljerrenup between 1994 and 1995. This decline can be attributed to a fire that burned through the area in spring 1995 (R. Segal, pers. comm.). Subsequent regeneration after the fire at transect B can be seen in the increase of cover of *M. cuticularis* at the 1996 measurements.

Another common species found along the samphire transects is *Lolium rigidum* (Annual Rye Grass). This species was introduced from the Mediterranean and is now considered a weed of coastal sands, islands, disturbed areas and road verges (Hussey *et al.* 1997). The percentage cover of this species increased, slightly, at only three transects (Carrabungup A, Creery Island B and Mealup B) (Table 3, 6 and 8). It remained stable (Table 4, 7 and 11) or declined at all other transects where it was found (Table 1, 2 and 5). It is difficult to attribute these declines or increases to changes in transect profile as these appears to be no relationship between stability of the profile and changes in percentage cover of *L. rigidum*.

The annual herb *Triglochin mucronata*, was common along many of the transects. It is a species that is known to occur in winter wet depressions, and along watercourses, often in saline soils (Marchant *et al*. 1987). At six of the nine transects where this species was found it increased in cover (Table 2, 3, 4, 9, 10 and 12) and at two other transects it remained stable (Table 1 and 6). Only at Creery Island (Transect A) (Table 5) was there a considerable decline in the percentage cover. Any changes that have occurred in the Peel-Harvey Estuary after opening of the Dawesville Channel have not appeared to have had any discernible effect on the distribution and abundance of *T. mucronata* during this five year study.

Isolepis nodosa, a perennial herb, is known to occur on sand dunes close to the coast and in sandy areas along rivers (Marchant *et al*. 1987). The percentage cover of this species increased at four of the six transects where it was found (Table 6, 7, 8 and 9) and remained stable at two transects (Table 3 and 5). Several of these increases in percentage cover were quite large, indicating that any changes in soil salinity or shoreline profile have been favourable for this species during the five year study period.

Our results are consistent with the reported dynamic and variable nature of these saltmarsh systems, however they only partially supported the predicted species responses by Murray *et al*. (1995b) (Table 13). No clear trend can yet be seen in the data and it may take several more years for any general trend to become apparent.

Freshwater wetland study
The freshwater wetland vegetation showed appreciable seasonal variation in percentage cover. The transects were sampled in the week that the water disappeared from the wetland, this allowed scoring of both the aquatic species and the emergent herbs. There was a two week difference in the drying of the wetland between 1994 and 1995. About three quarters of the species on both transects showed little or no change over the sampling period (Tables 13 & 14). Of the species that did show substantial changes in cover (>5%) *Triglochin calcitrapa, Centrolepis glabrata Glossostigma diandrum* and *Schoenus natans* showed consistent trends between transects which were c. 200m apart. *Centrolepis aristata* was generally absent or present a very low cover values on both transects except in 1995 when it reached cover values of 20% on transect 2.

This variability in these annual herblands is not related to any increase in salinity (since many of the aquatic species are restricted to fresh or near fresh water environments) and seasonal variation in the time for the wetland to dry, mean temperature and rainfall patterns are the most likely cause. The ordination of yearly variation in species cover values is consistent with this interpretation showing similar non-directional trends for both transects across the ordination space over the 5 years of the study(Figure 33). This very close correlation between the two ordinations across the years indicates the causal factors are operating at the scale of the entire wetland rather than local factors impacting on individual transects.

Riverine vegetation study – lower Harvey River

The riverine transects showed the effects of massive weed invasion along most of its length (Tables 17 - 26). This invasion is likely to stem from river dredging that occurred in 1977 (JAK Lane, pers. comm.) prior to the reserve (↑36126) having the dual purposes of drainage and conservation of flora and fauna. Weeds now comprise the major understorey species on most of the 10 transects along the lower Harvey. Little change was recorded in cover between November 1995 and November 1997 (Table 27). *Watsonia meriana* which generally dominated the understorey of transect upstream of the 1.5 km mark was stable except for a increase of slightly more than 5% at the 4 km transect. Cover of *Rumex crispus* was stable at the lower two transects increased on the next two, decreased on transects at 2.5 and 3.0 km marks and decreased on the transect furthest upstream. This pattern is not consistent with changes to river salinity profiles. The only change in weed cover that is correlated to increases in down stream section is *Lolium perenne* (Table 27).

The river is fringed in some sections by *Juncus kraussii* and *Bolboschoenus caldwellii*, it could be expected that changes in the salinity levels in the river may be reflected in changes in cover of these species. This was not found to be the case our data shows no consistent evidence of a substantial change in cover of these species. *Juncus kraussii* showed increases on transect at the 0.0 km and 3.0 km transects and no significant change elsewhere. The cover of *Bolboschoenus caldwellii* was stable over the study on the lower transects on which it occurred.

The overstorey species did show some consistent trends over the study period. *Eucalyptus rudis* showed a decrease in cover at its downstream limit while increasing cover upstream. This is consistent with the results of the tree health study which showed a decrease in canopy condition at its down stream limit. *Melaleuca rhaphiophylla* showed a similar pattern with stable or decreasing cover values near the river mouth and with increasing or no change in cover further up stream. This is also consistent with decrease in health of this species closer to the river mouth. *Casuarina obesa* showed either no change or an increase in cover over the study. More detailed work on responses found for these three species in the tree health study are discussed below.

There was very little change in the transect profiles along the river transects with the exception of the transect at 0.0km where there was some deposition and removal of sediments between years (Figure 35). Profiles of transects at the river mouth, 1.5km, 3.5km and 4km (Figure 34, 38, 42 and 43) also showed some minor removal of sediment, but only at the riverbank. It appears that there has been little effect on the profile of the Harvey riverbank from any changes in tidal levels after the opening of the Dawesville Channel.

Tree health study – the lower Harvey River

Tree health study showed some unexpected results with the maximum growth of *E. rudis* occurring at the downstream population (Table 28). The canopy condition of the downstream stand is however, gradually degrading, whilst the upstream stand remained at the healthiest condition rating, suggesting that there may be a salinity effect on the downstream trees (Table 31).

The minimal growth of the *Casuarina obesa* at the downstream stand compared to the upstream stand, coupled with a condition rating that is gradually worsening at the downstream stand would suggest that this species is under severe stress at the river mouth (Table 28, 29 and 31). The upstream trees of *Casuarina obesa* are also losing condition, indicating increased stress on the trees 1.5km along the Harvey River from the river mouth.

The river mouth populations of *Melaleuca rhaphiophylla* are obviously under stress as shown by the yellowing of the canopy and decline in condition over successive years (Table 31 and 32). An initial yellowing of the canopy in June 1995 may be attributed to summer drought, as the condition at the same time was the maximum health category and this colour recovered to a healthier green by the November recording. Trees at the downstream stand also showed successive reductions in the basal diameter, whilst trees at the upstream stand gained basal diameter (Table 28 and 30). The consistent reductions in basal diameter of the downstream stand in conjunction with lose of condition and yellowing of the canopy suggests that there is a general decline in the health of the downstream trees. The upstream population is also showing a gradual decline in canopy health over the latter part of the study, 4km from the river mouth (Table 28 and 30).

While no causal relationship between tree decline and increased salinity has been demonstrated, the period of decline of all three species coincides exactly with the opening of the Channel.

Typha study – lower Harvey River

Typha orientalis is known to be a major invasive species of waterways and wetlands in southwest Western Australia. Watkins and McNee (1985) provide a detailed account of the invasion of this species into Forrestdale Lake. *Typha orientalis* can grow in fresh or brackish water up to 1000 parts per million dissolved salt, *Typha* is quite sensitive to changes in nutrient level and more so to temperature, with the optimum for *T. orientalis* is about 25^{o} C (Parsons & Cuthbertson 1992). Research in NSW suggests that salt tolerant ecotypes of *T. domingensis* may develop in salt affected areas.

The dynamics of the *Typha* patches along the lower Harvey River did not appear to be consistent with decline due to increased salinity levels. There was a general decline in number and size of patches from Nov 1994 to May 1996 however this was followed by an increase in number to Nov 1996, however size showed a consistent gradual decline. The new individuals recruited were scattered along the length of the original populations and not concentrated at the upstream section.

Tree death on the western side of estuary

Over the last few years it has become obvious that fringing shrubs and trees along the western margin of the Harvey Estuary were dying (Plate 55 to 62). These areas were photographed in December 1999 and February 2000. There seems little doubt that the death of the fringing vegetation is a direct result of the changes to the tidal regime brought about by the opening of the Dawesville Channel. All of the permanent monitoring transects have been established on the north and east side of the Peel – Harvey Estuaries. No detailed transects were established on the western shore as none of this land is within conservation reserves. It is not clear why significant death to the fringing vegetation is seen on the western shore and not the eastern side. The most parsimonious explanation appears to be the much steeper contours on the western shore and the lack of any broad samphire flats. The final extent of the area of fringing vegetation impacted by changed conditions of the estuaries is not likely to be known for some years as rare combinations of high tides and storm surges are likely to impact areas not yet showing any adverse effects. Indeed that there has been no large scale deaths of fringing shrubs and trees on the eastern shore to date provides no surety that such impacts will not be seen in the future.

The opening of the Dawesville Channel has impacted significant areas of fringing shrubs and trees. However, in terms of total area of impact, by far the most significant change to the fringing vegetation of the Peel - Harvey system over the last five years has been the recent development of the new marina to the north of Creery Island. In terms of total area of vegetation destroyed this development has had the largest impact on the estuary ecosystem (Plate 66 and 67).

Concluding remarks

The studies reported here confirm the dynamic nature of estuarine samphire systems although the influence of the opening of the Dawesville Channel is not clear due to lack of pre opening data. The death of the fringing trees and shrubs on the western side of the Harvey Estuary and the decline of tree health in the lower Harvey River occurred in the period immediately following the opening of the Channel. Further changes to the to the fringing vegetation and the riverine vegetation of the lower Harvey River can be expected. It is recommended that monitoring of the sites set up in this study continue at five yearly intervals.

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Table 1: Austin Bay Transect A (length 135.4m) - Change in species cover 1994 – 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**32.13**	**23.78**	**33.68**	**32.50**	**36.41**
Bare ground	**0.44**	**14.41**	**13.95**	**6.20**	**5.61**
Litter				0.22	0.96
Apium annuum		0.22	2.51	5.02	9.60
Atriplex hyloleuca				0.07	0.37
** Atriplex prostrata*	1.85	0.66	0.37	3.10	2.66
** Bromus hordeaceus*	4.87	0.30			
Casuarina obesa	5.10	4.95	5.54	5.39	4.14
Dead *Casuarina obesa*					1.55
** Cerastium glomeratum*		1.18	2.58	0.15	0.15
** Cotula coronopifolia*	3.10	3.32	4.80	3.91	6.35
** Cynodon dactylon*	5.02				
** Erharta longiflora*				0.15	
Frankenia pauciflora				0.07	
Grass sp13				0.37	0.30
** Hainardia cylindrica*					0.22
Halosarcia halocnemoides	**26.96**	**25.70**	**20.01**	**23.71**	**12.04**
Dead *Halosarcia halocnemoides*			**6.20**	**3.77**	**16.47**
Halosarcia indica ssp *bidens*	1.77	2.29	1.70	4.36	4.43
Dead *Halosarcia indica* ssp *bidens*			0.37		0.30
** Homeria flaccida*	2.22	1.77	3.62	3.40	2.58
**Isolepis marginata*		1.25	1.62		
** Juncus bufonius*		0.52	1.55		0.59
**** Lolium rigidum***	**26.59**	**26.22**	**21.86**	**21.42**	**10.56**
**** Polypogon monspeliensis***		**9.23**		**2.58**	**1.18**
** Romulea rosea*					0.07
Sarcocornia quinqueflora	**10.93**	**10.86**	**3.99**	**6.57**	**3.47**
Dead *Sarcocornia quinqueflora*			2.36	1.48	2.29
Sporobolus virginicus			0.15		
Suaeda australis	**0.07**			**5.02**	**1.18**
Dead *Suaeda australis*				1.03	1.33
Triglochin mucronata		0.22	0.30		
Wahlenbergia preissii		0.07			
** Watsonia meriana*		0.22	0.44		

Table 2. Austin bay transect B (length 115.9m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**13.80**	**24.24**	**33.82**	**33.13**	**28.64**
Bare ground	**0.60**		**1.90**	**2.93**	**8.46**
Litter				0.09	
Acacia saligna	1.38	1.29			
Apium annum	1.29	2.50	4.49	2.07	3.11
** Atriplex prostrata*	2.68		0.34	0.69	1.04
** Bromus hordeaceus*	1.90	1.81			
Casuarina obesa	6.21	8.28	9.23	9.58	10.44
** Cerastium glomeratum*	3.80	4.92	3.88	2.59	
Comesperma integerrimum	3.11	3.36	2.76	3.88	2.50
**** Cotula coronopifolia***	**28.04**	**11.30**	**13.2**	**11.48**	**8.97**
** Ehrharta longiflora*				0.26	1.12
Gahnia trifida	9.92	6.64	7.76	8.28	7.16
** Hainardia cylindrica*		2.07		4.31	4.06
Halosarcia halocnemoides	**29.77**	**35.46**	**31.15**	**27.95**	**27.96**
dead *Halosarcia halocnemoides*	0.09		0.78	0.78	2.33
Halosarcia indica ssp *bidens*	2.50	2.85	2.93	3.45	3.54
Halosarcia indica ssp *leiostachya*	1.21	1.12	1.29	0.78	0.52
** Homeria flaccida*			0.43		
** Hordeum leporinum*		0.09		1.21	
**Isolepis marginata*		0.34	3.62	0.60	1.04
** Juncus bufonius*	1.29	0.60		0.17	
Juncus kraussii	0.34	1.12	0.69	0.09	0.34
**** Lolium rigidum***	**8.89**	**7.68**	**1.55**	**5.87**	**3.19**
Melaleuca lateriflora			0.52		
Melaleuca uncinata	1.98	1.81	1.90	2.16	2.85
Melaleuca viminea	0.26	0.43	2.85	3.71	3.36
** Melilotus indica*	0.17				
Mitrasacme paradoxa				0.26	
** Oxalis pes-caprae*					0.09
**** Polypogon monspeliensis***	**16.57**	**8.89**	**7.33**	**3.45**	**0.69**
** Samolus repens*			0.26	0.52	0.52
Sarcocornia quinqueflora	**11.56**	**8.20**	**4.31**	**4.74**	**1.81**
dead *Sarcocornia quinqueflora*	0.60		1.03	0.34	0.17
Sporobolus virginicus			0.52		0.17
Suaeda australis	0.52				0.17
Triglochin mucronata		**4.74**	**11.82**	**6.82**	**8.89**
** Watsonia meriana*	1.81	1.81	4.57	3.19	1.38

Table 3. Carrabungup transect A (length 57.6m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	0.51	0.87	5.21	4.69	
Bare ground	3.75	5.04	4.51	5.38	8.16
Litter	0.17	1.74	5.72	1.74	2.08
Apium annum			1.39		0.17
Apium prostratum	4.09	2.43	0.87	3.99	4.34
Arctotheca calendula					0.69
Atriplex hypoleuca	0.85	2.43	3.30	4.51	3.65
* *Atriplex prostrata*	0.85		1.74		0.17
* *Avena barbata*	2.04				
* *Briza maxima*				0.52	1.56
* *Briza minor*				1.22	
**** Bromus diandrus***	**0.68**	**1.39**	**4.69**	**9.55**	**5.38**
Cakile maritima			0.52	1.56	
Calandrinia corrigioloides			0.52	0.17	
* *Carpobrotus edulis*	2.38	0.52			0.69
Casurina obesa			0.52	0.52	
* *Cynodon dactylon*			0.35	0.87	
* *Ehrharta longiflora*	4.94	5.04	2.08	2.95	7.64
Gahnia trifida		0.35	0.52	0.52	2.26
Grass sp13				1.74	
* *Hainardia cylindrica*		1.04		0.17	
Hakea prostrata	**7.67**	**3.99**	**1.39**	**1.22**	**1.74**
Isolepis nodosa			1.91		
Juncus kraussii	**61.84**	**64.06**	**56.25**	**58.68**	**50.00**
* *Lolium rigidum*	1.70	3.12	3.99	4.51	2.60
Macrozamia riedlei	3.92	6.42	4.34	6.42	4.34
Melaleuca acerosa	**16.69**	**10.42**	**9.90**	**10.07**	**10.07**
Dead *Melaleuca acerosa*			0.35		0.69
Melaleuca cuticularis	8.18	7.99	9.03	9.20	8.33
Microlaena stipoides		4.17	1.56		
**** Oxalis pes-caprae***		**0.87**	**7.46**	**9.38**	**11.46**
* *Petrorhagia velutina*		1.04		0.69	0.52
* *Rumex brownii*			0.69	0.69	0.17
* *Samolus repens*	1.70	2.08	3.47	2.78	2.08
Sarcocornia quinqueflora	22.49	25.00	22.74	21.70	22.40
Dead *Sarcocornia quinqueflora*				1.74	0.52
* *Silene gallica*			0.35	1.04	
* *Solanum nigrum*			1.39	0.87	
Sporobolus virginicus					0.35
Suaeda australia	2.73	4.69	1.39	4.69	5.21
Tetragonia decumbens	1.53			0.52	0.52
Thysanotus arenarius			0.35	0.52	0.87
Triglochin mucronata					0.52
* *Urospermum picroides*			0.52	1.39	1.91
**** Ursinia anthemoides***	**10.73**	**8.16**		**1.04**	**1.39**
* *Vulpia myuros*			1.74		
Wahlenberg capensis			1.91	0.17	0.17
* *Watsonia meriana*	2.73	4.69	0.17		

Table 4. Carrabungup transect B (length 58.7m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**25.04**	**30.32**	**38.16**	**38.16**	**34.41**
Bare ground		2.56		0.17	
Litter			0.68	0.17	0.17
* *Anagallis arvensis* var. *caerulea*			1.36	1.19	0.85
Apium prostratum	3.41				
* *Atriplex prostrata*		0.51			
* *Avena barbata*	4.60	0.51	0.34	1.02	
* *Briza maxima*	0.34	1.19	1.02	1.53	3.07
* *Briza minor*			0.17	1.36	0.68
Bromus diandrus				1.36	0.34
* *Cardamine hirsuta*	2.04			0.17	0.17
Casuarina obesa	17.55	17.89	15.33	18.40	17.89
* *Cynodon dactylon*	2.73		0.34	0.34	0.68
* *Ehrharta longiflora*	2.04	0.85	0.34	3.07	4.60
Gahnia trifida			0.17	0.68	0.68
Hakea prostrata		0.17	0.34	0.34	0.85
Dead *Hakea prostrata*				0.51	0.51
* *Hainardia cylindrica*		2.90			
Juncus kraussii	**27.09**	**31.86**	**38.33**	**36.29**	**32.88**
* *Lolium rigidum*		0.34		0.68	
Macrozamia riedlei	1.53	0.34	0.51	0.34	0.34
Melaleuca acerosa	1.36	1.19	1.02		1.36
Melaleuca cuticularis	2.22	2.04	2.38	2.56	3.07
Microlaena stipoides			2.04		
* *Samolus repens*	2.38	1.87	3.58	3.58	2.73
Sarcocornia quinqueflora	**41.74**	**41.23**	**32.03**	**35.78**	**33.39**
Dead *Sarcocornia quinqueflora*				0.17	0.51
* *Silene gallica*		0.34		0.34	
Suaeda australis	**15.67**	**10.90**	**3.58**	**5.96**	**6.30**
Dead *Suaeda australis*			0.51		2.73
Thysanotus arenarius	0.17	0.68		0.34	
Trachymene pilosa			1.87	0.85	0.17
Triglochin mucronata				2.90	2.56
* *Ursinia anthemoides*	0.85	1.87			
* *Watsonia meriana*	0.85	0.85	0.17	0.34	

Table 5. Creery island transect A (length 189.2m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	0.32	0.58	0.37	0.21	0.21
Bare ground	**5.60**	**12.52**	**15.49**	**15.91**	**17.18**
Litter		1.85	3.33	4.80	6.55
Apium annuum		1.69	0.05	0.21	0.85
* *Atriplex prostrata*	0.16		0.05		
* *Avena barbata*	2.54	1.22	0.16	0.10	
Bolboschoenus caldwellii			0.05		
* *Briza maxima*	4.33	1.96	0.05	0.21	0.06
**** Bromus diandrus***	**8.19**	**3.91**	**2.01**	**0.58**	**0.79**
* *Carpobrotus edulis*	1.27	1.48	1.74	1.06	0.85
Casuarina obesa	8.72	10.10	8.72	8.93	8.83
* *Cerastium glomeratum*		0.05		0.21	0.16
* *Cotula coronopifolia*	1.80	1.53		0.74	0.26
**** Cynodon dactylon***	**23.84**	**19.87**	**16.91**	**14.27**	**15.59**
* dead *Cynodon dactylon*			2.06		
* *Ehrharta longiflora*	1.27	3.17	0.32	3.86	3.01
Frankenia pauciflora	5.92	5.44	3.38	3.75	3.59
Dead *Frankenia pauciflora*			0.79	0.63	0.69
* *Hainardia cylindrica*	1.32	0.95	0.05	0.42	0.53
Halosarcia halocnemoides	32.29	35.52	33.72	33.35	31.71
Dead *Halosarcia halocnemoides*			4.02	3.06	6.45
Halosarcia indica ssp *bidens*	4.12	4.76	4.60	4.07	4.39
Halosarcia indica ssp *leiostachya*	6.13	6.24	6.34	5.50	4.81
Dead *Halosarcia indica* ssp *leiostachya*					0.26
Isolepis nodosa		0.95	0.05	0.16	
Dead *Isolepis nodosa*			0.16		
Juncus kraussii	1.59				0.26
**** Lolium rigidum***	**10.04**	**12.26**	**7.98**	**14.06**	**7.72**
* *Paspalum vaginatum*		4.76		0.21	
* *Polypogon monspeliensis*		0.79		0.10	
* *Romulea rosea*	2.22		0.11	0.16	
* *Samolus repens*			0.16	0.11	0.05
Sarcocornia quinqueflora	0.16	0.10	0.16		0.05
Siloxerus humifusus				0.32	0.48
Sporobolus virginicus		1.22	4.28	5.39	4.44
Dead *Sporobolus virginicus*			2.54		
Suaeda australis				0.42	
Triglochin mucronata	**28.12**	**11.58**	**9.20**	**14.01**	**7.45**
* *Urospermum picroides*		0.21	0.05	0.10	0.05
* *Vulpia myuros*		0.10			
* *Watsonia meriana*	0.26				

Table 6. Creery Island transect B (length 114.0m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat			3.77	0.61	4.21
Bare ground	1.40	3.07	4.39	6.76	2.64
Litter			2.81	0.26	4.82
Apium annuum		1.49	0.09	0.18	1.84
Atriplex protrata			0.26		
* *Avena barbata*	3.51	0.09			
Bolboschoenus caldwellii	**11.32**	**5.79**	**0.70**	**2.28**	**0.35**
Dead *Bolboschoenus caldwellii*			0.70	0.26	0.35
* *Briza maxima*	4.04	0.70	0.26	0.61	0.35
* *Bromus diandrus*	1.58	0.18	1.14	0.96	2.02
Cakile maritima			0.26		
* *Carpobrotus edulis*	2.72	2.63	2.72	2.02	2.19
* Dead *Carpobrotus edulis*					0.09
Cassytha racemosa				0.18	0.53
Casuarina obesa	0.09	0.26			0.09
* *Cerastium glomeratum*		2.81	0.17	1.75	2.72
Comesperma interregnum	0.17				
**** Cotula coronopifolia***	**2.19**	**11.67**		**1.93**	**0.61**
**** Cynodon dactylon***	**30.71**	**19.65**	**10.53**	**5.79**	**6.14**
* dead *Cynodon dactylon*			0.17		
* *Ehrharta longiflora*	1.84	2.63	0.26	0.96	2.02
Frankenia pauciflora	10.53	10.35	10.26	9.12	7.89
Dead *Frankenia pauciflora*			0.35	1.67	1.75
Hainardia cylindrica			0.09	1.05	1.93
Halosarcia halocnemoides	15.96	15.70	11.58	12.98	13.60
Dead *Halosarcia halocnemoides*			2.34	0.79	3.86
Halosarcia indica ssp *bidens*	10.88	15.96	14.12	14.12	13.51
Dead *Halosarcia indica* ssp *bidens*			0.35	0.35	2.46
Halosarcia indica ssp *leiostachya*	9.04	8.77	8.25	9.65	6.14
Dead *Halosarcia indica* ssp *leiostachya*			0.70		0.70
* *Hordeum leporinum*	1.75	2.28			
Isolepis marginata				0.61	
Isolepis nodosa		**9.04**	**6.40**	**6.23**	**1.75**
Juncus kraussii	**27.98**	**22.98**	**19.56**	**20.96**	**20.88**
Dead *Juncus kraussii*			1.75		0.53
* *Lolium rigidum*	6.40	9.56	7.98	8.33	8.51
* *Paspalum vaginatum*		2.81	3.24	2.89	1.58
Poa poiformis		0.35	0.09		0.18
* *Polypogon monspeliensis*	0.26	1.23		0.26	
Sarcocornia quinqueflora	0.61	2.02	1.75	2.02	1.58
Dead *Sarcocornia quinqueflora*			0.09		
Siloxerus humifusus			1.75	5.72	6.23
Sporobolus virginicus		1.58	0.26	0.18	0.44
Dead *Sporobolus virginicus*			0.17		
Triglochin mucronata	**15.00**	**10.96**	**16.05**	**19.74**	**15.00**
* *Ursinia anthemoides*	0.96	2.02	0.44	0.17	
* *Watsonia meriana*	0.17	0.17	0.09	0.09	

Table 7. Mealup transect A (length 39.0m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat		**0.77**	**6.92**	**12.82**	**13.08**
Bare ground	**45.64**	**43.08**	**30.26**	**20.26**	**6.67**
Litter		**1.54**	**10.26**	**2.05**	**6.92**
Acacia saligna	**8.20**				
Dead *Acacia saligna*		**5.64**	**3.33**	**0.77**	**1.03**
Arctotheca calendula					3.85
Atriplex hyloleuca					0.26
* *Atriplex prostrata*	3.33	1.28	4.62	0.77	1.80
* *Avena barbarta*				0.51	
* *Briza minor*					0.26
* *Bromus diandrus*	2.82			0.26	1.03
* *Cerastium glomeratum*				0.51	1.54
* *Cotula coronopifolia*		0.26			
Crassula natans					0.77
***** *Cynodon dactylon***	**33.85**	**20.26**	**11.54**	**20.51**	**18.97**
* *Ehrharta longiflora*	1.03			0.51	0.51
Grass sp13				1.03	0.26
Isolepis marginata		1.02	1.03		
Isolepis nodosa		**8.20**	**10.51**	**11.80**	**12.05**
Juncus kraussii	**17.44**	**10.00**	**13.59**	**13.08**	**12.56**
* *Lolium rigidum*			0.26	2.56	
Ornithopus compressus				0.77	
* *Paspalum vaginatum*		3.33	4.10	4.10	4.36
**Rumex brownii*			0.26	1.80	0.77
Sarcocornia quinqueflora	**14.36**	**21.54**	**21.80**	**30.00**	**37.69**
Suaeda australis	0.77	0.51	0.26	1.28	4.36
* *Urospermum picroides*				0.26	
* *Watsonia meriana*	0.51	1.03	0.26		

Table 8. Mealup transect B (length 36.7m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat			4.63	1.09	1.36
Bare ground	**37.87**	**38.69**	**54.22**	**48.23**	**49.59**
Litter	0.27		1.63		
Wood		2.18			3.00
* *Aira cupaniana*	3.27			0.54	1.36
Asteraceae sp.			0.27		
* *Atriplex prostrata*	5.18	2.18	0.54		
**Briza minor*				0.27	
* *Bromus diandrus*					0.27
* *Carpobrotus edulis*	0.54	1.09	1.36	3.27	2.72
* *Cerastium glomeratum*				0.27	
***** ***Cynodon dactylon***	**7.63**	**6.81**	**2.45**	**5.45**	**1.36**
* *Ehrharta longiflora*		0.54		3.54	0.82
Grass sp13				0.27	
Isolepis nodosa			**0.54**	**6.54**	**0.54**
Ixiolaena viscosa	0.27				0.23
Juncus kraussii	**52.04**	**46.32**	**47.41**	**46.32**	**45.23**
* *Lolium rigidum*					0.23
Melaleuca cuticularis	4.63	5.72	4.36	6.81	7.36
Regelia inops	1.91	0.54			
dead *Regelia inops*		1.09	1.36	0.82	0.27
Sarcocornia quinqueflora	**15.53**	**16.35**	**6.53**	**1.36**	**1.09**
Suaeda australis	0.82				
Trachymene pilosa			1.91	1.63	0.82
* *Urosperum picroides*			0.27		
* *Watsonia meriana*	1.36	0.82			

Table 9. North Kooljerrenup transect A (length 57.8m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**7.44**	**20.59**	**45.16**	**44.64**	**29.41**
Bare ground	**9.17**	**31.67**	**11.42**	**4.67**	**4.67**
Litter	0.52	2.59	0.35		1.56
* *Anagallis arvensis* var. *arvensis*				0.69	
* *Anagallis arvensis* var. *caerlea*		0.35	1.04		0.35
Astartea fascicularis	0.69				
Dead *Astartea fascicularis*			0.17		0.52
Atriplex hypoleuca		0.17	0.52	1.04	0.52
***** *Atriplex prostrata***	**9.17**	**6.40**	**0.17**	**0.17**	
Bolboschoenus caldwellii		0.35	0.17		
Centrolepis alepyroides				0.34	0.52
* *Cerastium glomeratum*		0.52	1.56	1.90	
* *Conyza* sp.			0.17	0.17	
***** *Cotula coronopifolia***	**9.00**	**8.82**	**10.03**	**9.00**	**1.90**
* *Cynodon dactylon*	2.94		1.90	3.98	2.60
Grass sp13				0.35	
* *Hainardia cylindrica*		3.11	1.73	2.08	0.35
Isolepis marginata		2.77	1.38	1.38	0.69
Isolepis nodosa			0.86	3.29	3.29
* *Juncus bufonius*			0.17		0.17
Juncus kraussii	**21.11**	**7.27**	**11.42**	**11.25**	**13.15**
Burnt *Juncus kraussii*		2.08			
Lobelia alata				0.17	0.17
* *Lythrum hyssopifolia*		0.17			
Melaleuca cuticularis	**4.50**				
Dead *Melaleuca cuticularis*			1.90	1.73	2.25
Melaleuca lateriflora				0.69	1.56
Melaleuca viminea	1.38				
* *Melilotus indica*		0.35			
* *Polypogon monspeliensis*		0.52	0.17		
Regelia inops	2.94				
Sarcocornia quinqueflora	**42.04**	**30.62**	**22.84**	**36.68**	**50.00**
dead *Sarcocornia quinqueflora*	1.21		1.38		0.17
Suaeda australis	1.56	2.94	3.63	4.84	1.38
dead *Suaeda australis*	6.40		2.42		1.04
Trachymene pilosa				0.17	0.17
Triglochin mucronata				0.35	0.17
* *Ursinia anthemoides*	0.69				
* *Watsonia meriana*	0.17				

Table 10. North Kooljerrenup transect B (length 57.6m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**0.35**	**1.39**	**0.69**	**13.89**	**23.44**
Bare ground	**0.52**	**16.32**	**16.49**		**0.87**
Litter		5.04			1.04
Apium annuum	0.35				
Astartea fascicularis	1.74		0.17	1.04	0.87
dead *Astartea fascicularis*	1.91				
Atriplex prostrata	**14.24**	**1.56**			
Centrolepis alepyroides				3.30	
* *Cerastium glomeratum*		0.87	0.35	0.35	
* *Cotula coronopifolia*	1.56	1.04	0.87	4.86	2.95
* *Cyndon* sp.				0.69	0.35
Drosera sp.		0.52			
Grass sp13				0.17	
* *Hainardia cylindrica*			0.17		
Isolepis oldfieldiana					
Isolepis marginata		1.21	3.65	2.26	0.17
Isolepis stellata			0.17		
* *Juncus bufonius*		0.17	1.56	1.22	
Juncus kraussii	**21.18**	**5.21**	**11.63**	**17.36**	**16.84**
Lobelia alata	3.99				0.17
Melaleuca cuticularis	**14.24**	**1.91**	**6.08**	**5.56**	**6.42**
Dead *Melaleuca cuticularis*				1.39	2.78
Melaleuca lateriflora				0.52	0.69
Sarcocornia quinqueflora	**37.33**	**34.20**	**49.13**	**73.26**	**80.73**
dead *Sarcocornia quinqueflora*	2.26	5.73	4.17	0.52	
Suaeda australis	**20.83**	**5.90**	**5.90**	**3.65**	**2.60**
Dead *Suaeda australis*	**10.07**	**29.51**	**14.76**	**0.52**	**0.17**
Thysanotus arenarius				0.17	
Triglochin mucronata			0.52	0.35	0.52
Wahlenbergia preissii			0.35		
* *Watsonia meriana*	0.17		0.17		

Table 11. South Kooljerrenup transect A (length 95.8m) - Change in cover 1994 – 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**14.61**	**0.73**	**5.64**	**25.99**	**36.33**
Bare ground	**0.31**	**17.22**	**16.70**	**2.92**	**0.83**
Litter			1.04	2.09	1.88
Apium annum					0.42
Astartea fascicularis	0.73	1.04	0.52	1.46	0.63
* *Atriplex prostrata*	2.50	0.84			
Bolboschoenus caldwellii	**18.89**	**24.95**	**23.38**	**22.13**	**17.02**
* *Cotula coronopifolia*				0.10	0.42
Juncus kraussii	**41.44**	**34.97**	**24.11**	**19.21**	**15.97**
Dead *Juncus kraussii*			0.94		
**Lolium rigidum*				0.10	
* *Lythrum hyssopifolia*			0.31		
Melaleuca cuticularis					0.42
Melaleuca lateriflora	1.67	0.73	1.77	0.42	0.42
Dead *Melaleuca lateriflora*				1.67	
Melaleuca viminea	1.36	1.88	1.98	2.82	4.49
* *Samolus repens*		1.04	0.21	2.40	1.57
Sarcocornia quinqueflora	**60.23**	**61.80**	**54.91**	**53.24**	**55.43**
Dead *Sarcocornia quinqueflora*			0.63	0.10	
Suaeda australis	0.52	0.10			0.63
* *Watsonia meriana*	1.04	3.44	3.13	3.86	1.57

Table 12. South Kooljerrenup transect B (length 133.5m) - Change in cover 1994 - 1998. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1994	Percentage 1995	Percentage 1996	Percentage 1997	Percentage 1998
Algal mat	**17.00**	**20.22**	**17.75**	**4.12**	**19.18**
Bare ground		**0.37**	**0.07**	**13.03**	**0.75**
Litter			2.02	0.07	0.82
Apium annum				0.07	
Atriplex hypoleuca					0.08
*** Atriplex prostrata***	**9.59**	**0.82**	**0.15**	**0.22**	
Bolboschoenus caldwellii	**56.55**	**53.11**	**58.50**	**50.49**	**31.84**
Casuarina obesa	1.95	2.40	2.10	5.17	3.37
* *Cotula coronopifolia*	2.10	1.95	2.70	0.60	0.08
Isolepis marginata		0.97	1.80	3.15	1.80
Dead *Juncus kraussii*				0.30	
Juncus kraussii	7.86	7.27	6.97	6.89	7.12
Melaleuca cuticularis		1.12	3.00	3.45	2.70
* *Polypogon monspeliensis*	1.57	0.52			
* *Samolus repens*	0.60	0.90	2.17	3.37	2.47
Sarcocornia quinqueflora	**63.30**	**71.31**	**66.14**	**74.38**	**76.93**
Dead *Sarcocornia quinqueflora*					0.08
Suaeda australis		0.82	1.12	3.52	2.47
Triglochin mucronata			0.22		0.08

Table 13. Predictions of Murray *et al.* (1995b) of changes (increase=↑, decrease= ↓ or stable= -) in species density around the Peel-Harvey Estuary after the opening of the Dawesville Cut, compared to changes measured in this study.

Species	Prediction	Actual response											
		AA	AB	CaA	CaB	CrA	CrB	MA	MB	NKA	NKB	SKA	SKB
Bolboschoenus caldwellii	↑↓					-	↓		-		↓	↓	
Juncus kraussii	↑		-	↓	↑	↓	↓	↓	↓	↓	↓	↓	↓
* *Cotula coronopifolia*	↑	↑	↓			↓	↓	-		↓	↑	↑	↓
* *Cynodon dactylon*	↑	↓		-	↓	↓	↓		↓	↓			
* *Polypogon monspeliensis*	↑	↑	↓			-	↓			-			↓
Halosarcia halocnemoides	↓	↓	↓			↓	↓						
Halosarcia indica ssp *bidens*	↑	↑	↑			↑	↑						
Halosarcia indica ssp *leiostachya*	↓		↓			↓	↓						
Frankenia pauciflora	↓	-				↓	↓						
Sarcocornia quinqueflora	↓	↓	↓	↓	↓	↓	↑	↑	↓	↑	↑	↓	↑
Suaeda australis	↓	↑	↓	↑	↓	-		↑	↓	↓	↓	↑	↑
Casurina obesa	↓	↓	↑	-	↑	↑	-						↑
Melaleuca acerosa	↓			↓	-								
Melaleuca cuticularis	↓			↑	↑				↑	↓	↓	↑	↑
Melaleuca lateriflora	↓		-							↑	↑	↓	
Melaleuca uncinata	↓		↑										
Melaleuca viminea	↓		↑							↓		↑	

AA= Austin Bay A, AB= Austin bay B, CaA = Carrabungup A, CaB= Carrabungup B, CrA= Creery Island A, CrB= Creery Island B, MA= Mealup A, MB= Mealup B, NKA= North Kooljerrenup A, NKB= North Kooljerrenup B, SKA= South Kooljerrenup A, SKB= South Kooljerrenup B.

Table 14. Sorted two way table of freshwater wetland transect 1, detailing cover changes between 1/11/94 - 11/11/98. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1/11/94	Percentage 14/11/95	Percentage 5/11/96	Percentage 3/10/97	Percentage 11/11/98
Bare	**17.71**	**35.71**	**64.22**	**68.00**	**57.56**
Glossostigma diandrum	**12.11**	**18.3**	**49.44**	**37.44**	**29.12**
Leptocarpus canus	**12.44**	**14.51**	**24.62**	**22.44**	**7.22**
Schoenus natans	**19.17**	**10.6**	**10.22**	**21.89**	**36.44**
Triglochin calcitrapa	**15.58**	**8.15**	**14.11**	**9.56**	**24.00**
Centrolepis glabra	**6.17**	**0.11**		**14.78**	**1.34**
Litter			**6.11**	**12.77**	**5.12**
Dead *Leptocarpus canus*			4.88	5.22	4.67
Melaleuca viminea			4.00	2.22	4.44
Centrolepis alepyroides	1.46	1.45	5.00	4.44	0.66
Triglochin procera	**4.26**	**0.67**	**10.22**	**2.00**	**3.78**
Villarsia submersa	5.72	7.14	4.00	2.78	3.12
Centrolepis mutica			**7.78**		
Villarsia capitata	**0.56**	**0.22**	**6.56**		**0.44**
Halosarcia halocnemoides	0.11		1.00	1.67	4.00
Isolepis marginata		0.11	1.11	0.78	2.66
Pogonolepis stricta	2.13	0.67	0.67	1.44	2.88
Melaleuca uncinata					2.88
Astartea fascicularis		0.56		1.44	
Casuarina obesa		0.11		0.11	
Gnephosis tenuissima		0.22		0.11	0.22
Brachyscome bellildoides			0.22		
Goodenia sp.			0.11		
Drosera stolonifera			1.44		
Isolepis cernua			0.44		
Philydrella drummondii	0.22		0.44		0.22
Samolus junceus	0.34	0.22	0.56		0.22
Cotula coronopifolia	0.11		0.78	0.44	1.12
Marsilea drummondii	0.11		0.44	0.33	0.88
Cyperus tenellus	0.34				0.44
Halosarcia indica	0.11	0.22	0.11		0.66
Polypogon tenellus					0.66
Blennospora drummondii	0.22				
Gratiola peruviana	0.11				
Juncus bufonius	0.11				
Microtis sp.	0.11				
Schoenus odontocarpus	0.11			0.22	
Centrolepis aristata	0.45	0.11			

Table 15. Sorted two way table of freshwater wetland transect 2, detailing cover changes between 1/11/94 - 11/11/98. Changes of more than ± 5% between two years are shown in bold.

Species	Percentage 1/11/94	Percentage 16/11/95	Percentage 5/11/96	Percentage 3/10/97	Percentage 11/11/98
Bare	**18.34**	**40.65**	**72.12**	**54.62**	**51.76**
Centrolepis glabra	**9.92**	**0.63**		**30.38**	**10.24**
Glossostigma diandrum	**9.17**	**16.31**	**46.00**	**33.25**	**20.76**
Leptocarpus canus	**14.83**	**13.68**	**24.62**	**26.50**	**9.62**
Schoenus natans	**7.29**	**3.51**	**15.75**	**19.75**	**27.76**
Triglochin calcitrapa	**17.71**	**9.79**	**13.62**	**14.38**	**38.76**
Litter		1.13	5.50	4.26	2.24
Dead *Leptocarpus canus*		1.50	4.88	2.50	3.62
Pogonolepis stricta	4.02	1.00	3.12	3.75	2.50
Melaleuca uncinata		1.25	1.12	2.25	2.50
Centrolepis alepyroides	**2.26**	**3.89**	**9.75**	**11.75**	**7.24**
Melaleuca cuticularis	**0.38**	**1.00**	**8.00**	**7.38**	**9.00**
Villarsia submersa	8.04	3.89	1.25	2.50	1.50
Centrolepis mutica			**7.00**		
Triglochin procera	1.76		3.88	0.50	0.24
Centrolepis aristata	**1.38**	**21.51**	**1.00**	**1.00**	**0.24**
Aphelia cyperoides	0.13	0.38		0.25	
Tribonanthes violacea	0.13	0.13		0.50	0.24
Utricularia menziesii	0.13			1.00	
Baumea juncea	0.63	0.75		0.25	1.00
Gnephosis tenuissima	0.88	0.38		0.88	1.50
Briza minor				0.25	1.24
Halosarcia halocnemoides	0.13	0.13	0.5	0.38	1.76
Isolepis marginata	0.13		0.75	0.88	1.24
Schoenus sp.	0.13	0.13	0.25		0.76
Brachycome iberidifolia	0.38			2.25	1.00
Philydrella drummondii	0.76	0.13	0.50	2.25	1.00
Polypogon tenellus				1.50	0.76
Schoenus odontocarpus	0.13			1.75	0.24
Blennospora drummondii	0.50				
Cyperus tenellus	0.25				0.24
Hydrocotyle sp.				0.25	
Juncus bufonius				0.12	
Stylidium sp.				0.12	
Millotia tenuifolia		0.13			
Brachycome bellildoides			1.12		
Brizula sp.			0.62		
Polypompholyx multifida			0.38		
Calaandrinia sp.			0.25		
Grass sp.			0.25		
Lepidosperma sp.			0.25		
Drosera stolonifera	0.13		0.25	0.12	
Halosarcia indica			0.25	0.25	0.24

Table 16. Salinity measurements in freshwater wetland from September to November 1995.

Date	Salinity (ppt)
6 Sept 1995	1.41
3 Oct 1995	5.93
1 Nov 1995	11.79

Table 17. River transect - river mouth - Change in species cover 3/5/95- 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground		2.04	1.02	3.06
Litter	22.45			
Aster subulatus	10.20			
** Atriplex prostrata*	4.10			
Bolboschoenus caldwellii	82.65	97.96	97.96	94.90
Juncus kraussii	6.12			

Table 18. River transect 0.0 km - Change in species cover 24/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes between May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	1.67	4.44	0.56	5.56
Litter	**12.78**	2.78	**6.67**	**5.00**
Agrostis sp.				3.89
Apium prostratum		**2.22**	**3.33**	**9.44**
Atriplex hypoleuca	2.78	6.67	8.33	7.78
****Atriplex prostrata***	**23.89**	**6.67**	**8.33**	**1.11**
Bolboschoenus caldwellii	**5.56**	**26.11**	**42.78**	**21.67**
**Cotula coronopifolia*			2.22	0.56
**Chenopodium* sp.			0.56	
Grass sp.		1.11	2.78	
Halosarcia indica	17.78	18.33	22.22	20.56
Juncus kraussii	**38.33**	**39.44**	**44.44**	**51.11**
****Lolium perenne***		**10.00**	**7.22**	**2.78**
Melaleuca rhaphiophylla	17.22	17.78	17.22	19.44
**Polypogon monspeliensis*			0.56	0.56
**Rumex crispus*		1.11	3.89	3.33
**Watsonia meriana*				1.67

Table 19. River transect 0.5 km - Change in species cover 24/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Litter	**45.45**	**17.42**	**27.27**	**31.06**
Atriplex prostrata	**17.42**	**25.00**	**27.27**	**12.12**
Casuarina obesa	**39.39**	**52.27**	**52.27**	**60.61**
dead *Casurina obesa*	1.52			
**Chenopodium* sp.	0.75			
Juncus kraussii	15.91	12.88	10.61	12.88
Lolium perenne	**25.76**	**49.24**	**39.39**	**41.67**
Melaleuca cuticularis	**15.15**	**15.09**	**41.67**	**43.18**
Melaleuca rhaphiophylla	**25.00**	**30.30**	**19.70**	**24.24**
**Raphanus raphanistrum*				0.76
**Rumex crispus*		0.76	5.30	2.27
**Rumex* sp.		0.76		

Table 20. River transect 1.0 km - Change in species cover 26/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	**6.36**	**8.18**		**12.73**
Litter	**32.73**	**18.18**	**40.00**	**24.54**
Atriplex hypoleuca		**6.36**		
Atriplex prostrata	**57.27**	**25.45**	**7.27**	**42.73**
Bolboschoenus caldwellii		**33.64**	**35.45**	**30.00**
Casuarina obesa	20.00	33.64	36.36	36.36
**Cotula coronopifolia*				0.91
Grass sp.		3.64		
**Lolium perenne*		0.91	0.91	
Melaleuca rhaphiophylla	51.82	57.27	56.36	58.18
**Polypogon monspeliensis*				0.91
Rumex crispus	**0.91**	**5.45**	**6.36**	

Table 21. River transect 1.5 km - Change in species cover 24/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	**15.38**	**1.54**	**9.23**	**0.77**
Litter	45.38	1.54	2.31	1.54
Alternanthera nodiflora		0.77		
**Agrostis* sp				0.77
Atriplex prostrata		**2.31**	**11.54**	
Bolboschoenus caldwellii			3.85	0.77
Cotula coronopifolia		**36.92**	**6.92**	**31.54**
Grass sp.	**14.62**	**7.69**		
Herb			3.07	
**Hordeum leporinum*				4.61
Isolepis cernua			**6.15**	
**Isolepis marginata*	0.77			
Juncus kraussii	10.77	13.08	13.08	13.08
Lolium perenne		**15.38**	**19.23**	**32.31**
**Lythrum hyssopifolia*		9.23	4.62	4.62
Melaleuca rhaphiophylla			1.54	3.08
Melaleuca uncinata	**30.00**	**23.85**	**30.00**	**30.77**
**Mentha pulegium*		2.31	0.77	
**Polypogon monspeliensis*				4.62
Rumex crispus	**2.31**	**6.92**	**13.85**	**3.08**
***Rumex* sp.**		**12.31**		
Watsonia meriana	**21.54**	**29.33**	**26.15**	**33.85**

Table 22. River transect 2.0 km - Change in species cover 24/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 24/4/95	Percentage 20/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	0.81			
Litter	13.01	2.44		
Eucalyptus rudis	**48.78**	**56.10**	**43.90**	**44.72**
Juncus kraussii	4.88	5.69	8.13	8.13
**Watsonia meriana*	81.30	93.50	92.68	94.31

Table 23. River transect 2.5 km - Change in species cover 26/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 26/4/95	Percentage 22/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	**15.00**	**16.43**	**8.57**	**2.86**
Litter	**71.43**	**60.71**	**15.71**	**49.29**
Alternanthera nodiflora		5.00	3.57	3.57
Astartea sp.			**5.00**	
Astartea fascicularis	**5.00**	**4.28**		**6.43**
Eucalyptus rudis			1.43	
Juncus kraussii	10.71	10.00	11.43	12.14
Melaleuca rhaphiophylla	91.43	95.00	98.57	95.00
**Mentha pulegium*		1.43	0.71	0.71
Polygonum hydropiper		0.71		1.43
**Polypogon monspeliensis*			2.14	
Rumex crispus	**0.71**		**17.14**	**20.71**
Rumex sp.		**8.57**		
**Watsonia meriana*				0.71

Table 24. River transect 3.0 km - Change in species cover 26/4/95 - 26/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 26/4/95	Percentage 22/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	**36.80**	**16.00**	**11.20**	**3.20**
Litter	28.00	4.00	4.80	3.20
Alternanthera nodiflora			**8.80**	**12.80**
Carex sp.			0.80	
Eucalyptus rudis	**30.40**	**26.40**	**36.80**	**32.80**
Juncus kraussii	**3.20**	**14.40**	**16.80**	**25.60**
Melaleuca rhaphiophylla		**0.80**	**9.60**	**12.80**
****Mentha pulegium***	**14.40**	**46.40**	**7.20**	**9.60**
Polygonum hydropiper		0.80		
**Polypogon monspeliensis*			3.20	
****Ranunculus muricatus***				**12.80**
****Ranunculus* sp.**			**8.80**	
****Rumex crispus***		**1.60**	**8.00**	**16.00**
**Rumex* sp.		1.60		
**Watsonia meriana*	18.40	26.40	26.40	28.80

Table 25. River transect 3.5 km - Change in species cover 26/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 26/4/95	Percentage 22/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	3.28			
Litter	59.02		1.64	
Eucalyptus rudis	**37.70**	**37.70**	**61.48**	**59.02**
Juncus kraussii	3.28			
**Watsonia meriana*	37.70	100.00	97.54	100.00

Table 26. River transect 4.0 km - Change in species cover 26/4/95 - 6/11/97. Changes of more than ±5% between two years are shown in bold (excluding changes betwee May 1995 and Nov 1995).

Species	Percentage 26/4/95	Percentage 22/11/95	Percentage 14/11/96	Percentage 6/11/97
Bare ground	4.32	4.32		0.72
Litter	**48.92**	**12.23**	**20.14**	**11.51**
Alternanthera nodiflora				0.72
Eucalyptus rudis	**82.73**	**84.89**	**90.65**	**92.09**
Juncus kraussii	7.19	10.79	11.51	11.51
**Rumex crispus*		5.75	4.32	0.72
**Rumex* sp.		1.44		
****Watsonia meriana***	**38.85**	**71.94**	**63.31**	**76.98**

Table 27. Changes in species cover of more than 5% between 1995 and 1997 along 10 transects along the Harvey River after the opening of the Dawesville Cut (increase=↑, decrease= ↓ or stable= -) (changes do not include April 1995 data). Transects were measured at the river mouth (RM and 0.0 km) and then at each 0.5 km up the river to 4 km.

Species	Distance along Harvey River (Km)									
	RM	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Fringing rushes & sedges										
Bolboschoenus caldwellii	-	-		-	-					
Juncus kraussii		↑	-			-	-	↑		-
Weed species										
Atriplex prostrata		↓	↓	↑	-					
Cotula coronopifolia		↑-		↑-	↓					
Lolium perenne	↓	↓	-	↑						
Mentha pulegium					↓-		↓-	↓		
Polypogon monspeliensis		↑-		↑-	↑-		-	↑-		
Rumex crispus		↑-	↑-	↓	↓		↑	↑		↓
Watsonia meriana		↑-			↑-	↑-	↑-	↑-	↑-	↑
Native understorey										
Alternanthera nodiflora					-		-	↑		-
Canopy species										
Casaurina obesa		↑	-							
Eucalyptus rudis						↓	-	↑	↑	↑
Melaleuca cuticularis			↑							
Melaleuca rhaphiophylla		-	↓	↑	-		-			
Melaleuca uncinata					↑					

Table 28. Average tree diameter at breast height (DBH) in two stands of *Casuarina obesa* and *Eucalyptus rudis* and average tree diameter at basal diameter (BD) in two stands of *Melaleuca rhaphiophylla* from November 1994 to November 1997.

	DBH (mm) Nov 94	DBH (mm) Nov 95	DBH (mm) Jun 96	DBH (mm) Nov 97
Casuarina obesa				
0.5 km	211.39	215.12	213.54	213.67
1.5 km	362.34	362.82	368.02	373.50
Eucalyptus rudis				
2.0 km	236.72	245.42	258.51	274.53
4.0 km	256.72	259.42	272.10	277.78
	BD (mm) Jun 95	**BD (mm) Nov 95**	**BD (mm) Jun 96**	**BD (mm) Nov 97**
Melaleuca rhaphiophylla				
0.5 km	259.95	256.66	256.11	243.04
4.0 km	217.51	229.02	229.24	226.30

Table 29. Average change in tree diameter (at breast height) (± standard deviation) of two stands of *Casuarina obesa* and *Eucalyptus rudis* between November 1994 and November 1998.

	Change DBH (mm) Nov 1994 – Nov 1995	Change DBH (mm) Nov 1995 – Nov 1996	Change DBH (mm) Nov 1996 – Nov 1997
Casuarina obesa			
0.5 km	+3.73 ± 6.69	-1.58 ± 7.94	+0.13 ± 3.12
1.5 km	+1.15 ± 6.99	-3.30 ± 10.77	+5.48 ± 14.10
Eucalyptus rudis			
2.0 km	+8.70 ± 8.10	+13.09 ± 11.76	+14.17 ± 19.53
4.0 km	+2.70 ± 9.98	+12.68 ± 13.33	+5.68 ± 14.06

Table 30. Average vegetation condition (1 poor to 5 excellent) (± standard deviation) of two stands of *Melaleuca rhaphiophylla, Casuarina obesa* and *Eucalyptus rudis* between November 1994 and November 1997.

	Condition Nov 94	Condition May 95	Condition Nov 95	Condition Nov 96	Condition Nov 97
Casuarina obesa					
0.5 km	4.97 ± 0.18	4.93 ± 0.25	4.63 ± 0.72	4.17 ± 1.20	4.10 ± 1.35
1.5 km	4.97 ± 0.18	4.93 ± 0.36	4.97 ± 0.18	4.70 ± 0.70	4.58 ± 0.52
Eucalyptus rudis					
2.0 km	4.97 ± 0.18	5.00 ± 0.00	5.00 ± 0.00	4.90 ± 0.30	4.83 ± 0.38
4.0 km	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00	5.00 ± 0.00
Melaleuca rhaphiophylla					
0.5 km	-	5.00 ± 0.00	4.43 ± 0.86	3.93 ± 1.20	3.14 ± 1.06
4.0 km	-	5.00 ± 0.00	5.00 ± 0.00	4.70 ± 0.47	4.27 ± 0.78

Table 31. Average change in basal diameter (± standard deviation) of two stands of *Melaleuca rhaphiophylla* between May 1995 and November 1998.

	Change DBH (mm) May 1995 – Nov 1995	**Change DBH (mm) Nov 1995 – Nov 1996**	**Change DBH (mm) Nov 1996 – Nov 1997**
Melaleuca rhaphiophylla			
0.5 km	-3.29 ± 15.25	-0.55 ± 14.03	-1.70 ± 11.78
4.0 km	+3.79 ± 13.45	+5.60 ± 15.18	+0.83 ± 22.27

Table 32. Average change in canopy colour (1 yellow to 3 green) of two stands of *Melaleuca rhaphiophylla* between June 1995 and November 1997.

	Colour Jun 95	**Colour Nov 95**	**Colour Nov 96**	**Colour Nov 97**
Melaleuca rhaphiophylla				
0.5 km	1.43 ± 0.50	2.97 ± 0.18	2.83 ± 0.38	1.82 ± 0.65
4.0 km	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00	3.00 ± 0.00

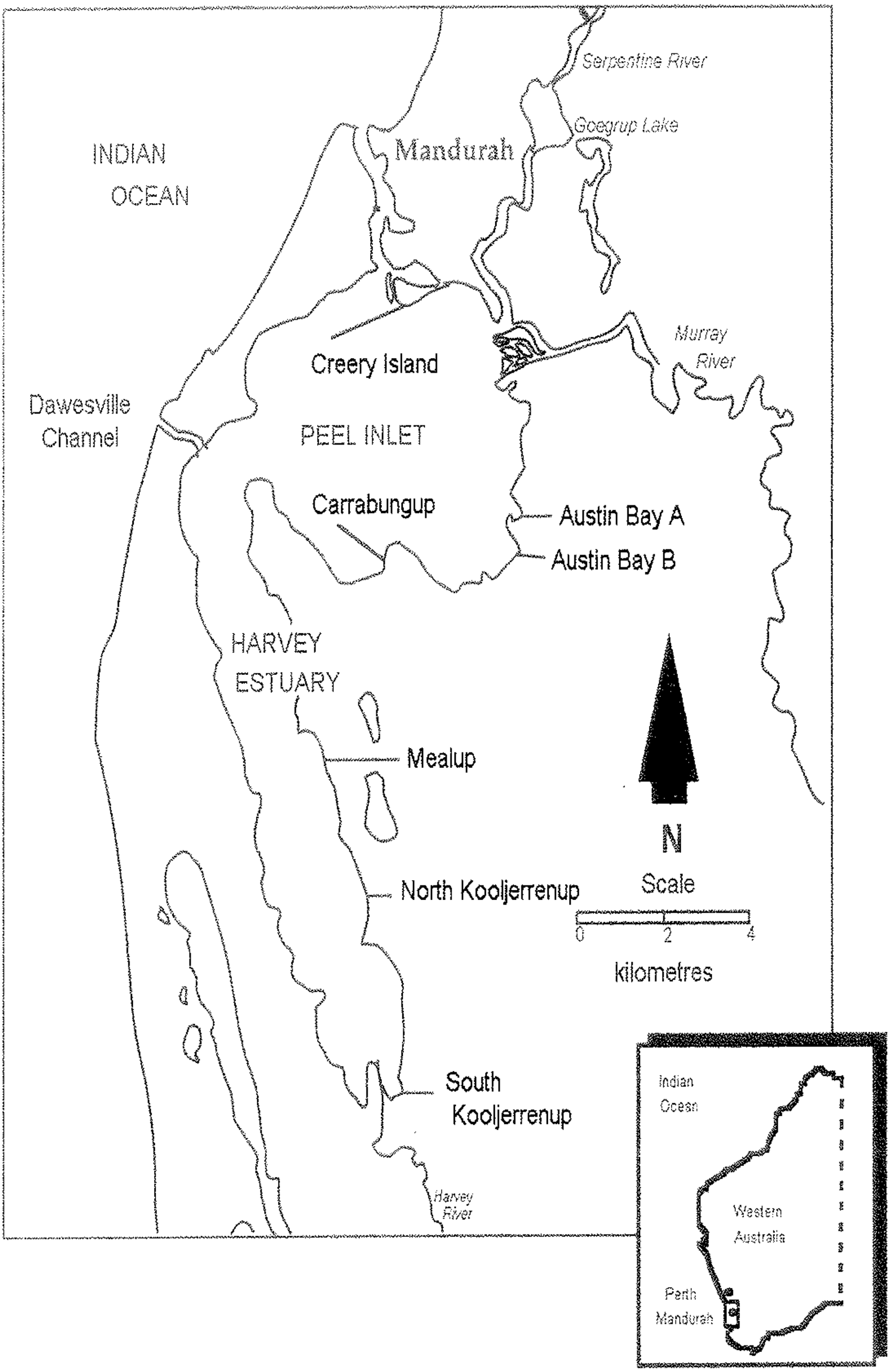

Figure 1. The location of samphire study sites within the Peel-Harvey Estuarine System.

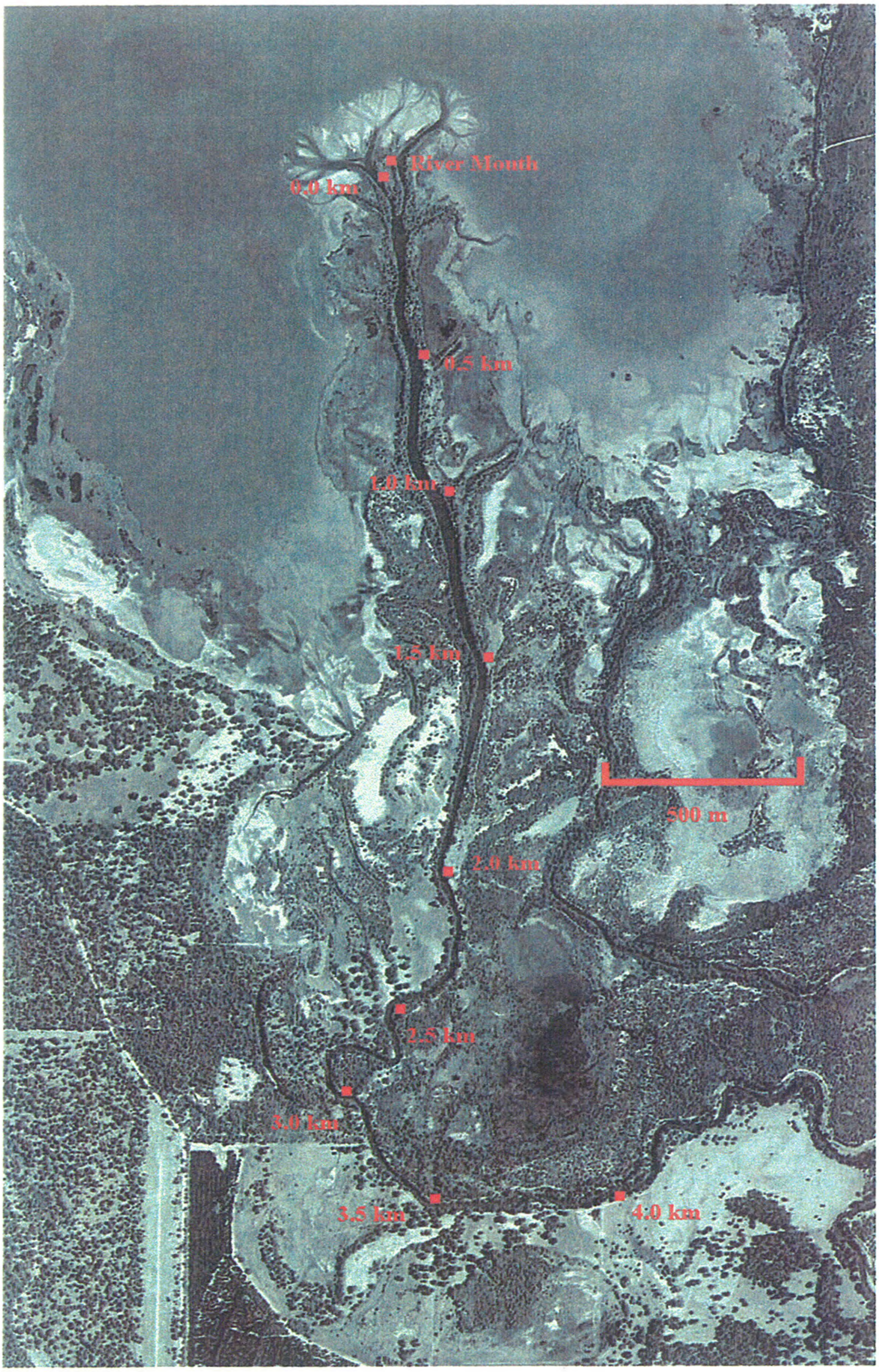

Figure 2. Locations of the Riverine Transects along the Harvey River.

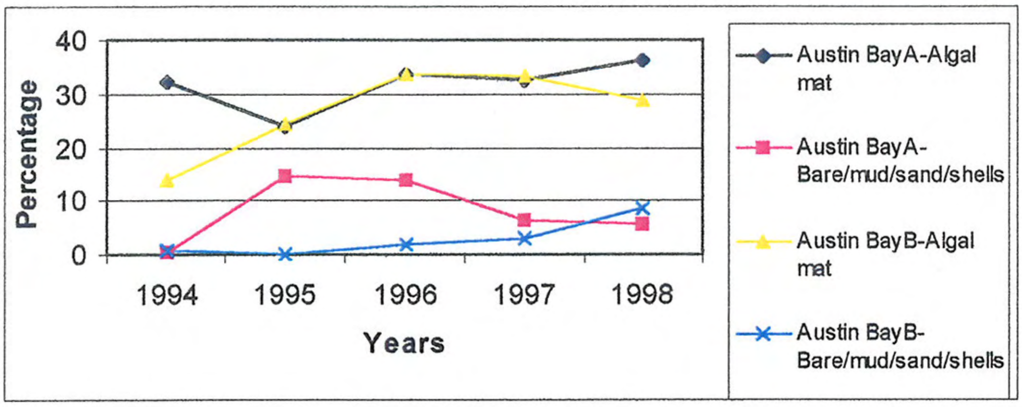

Figure 3. Percentage change in the cover of algal mat and bare ground at Austin Bay transects A and B between 1994 and 1998.

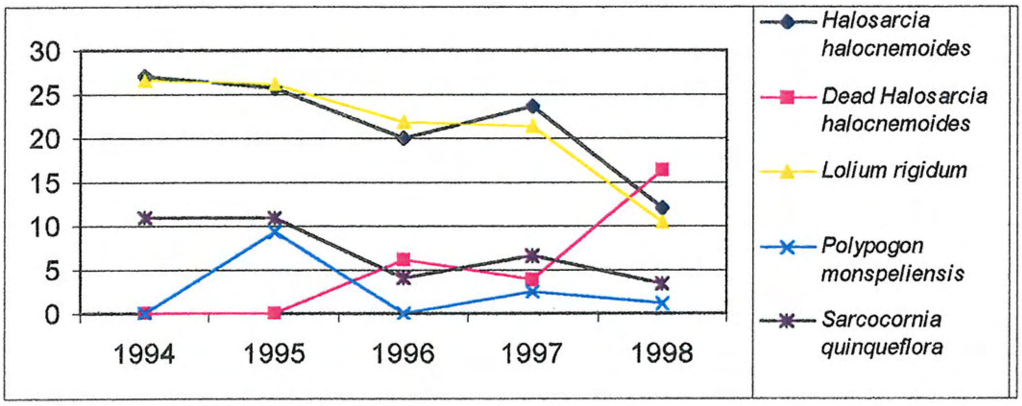

Figure 4. Percentage change in cover of the dominant species at Austin Bay transect A between 1994 and 1998.

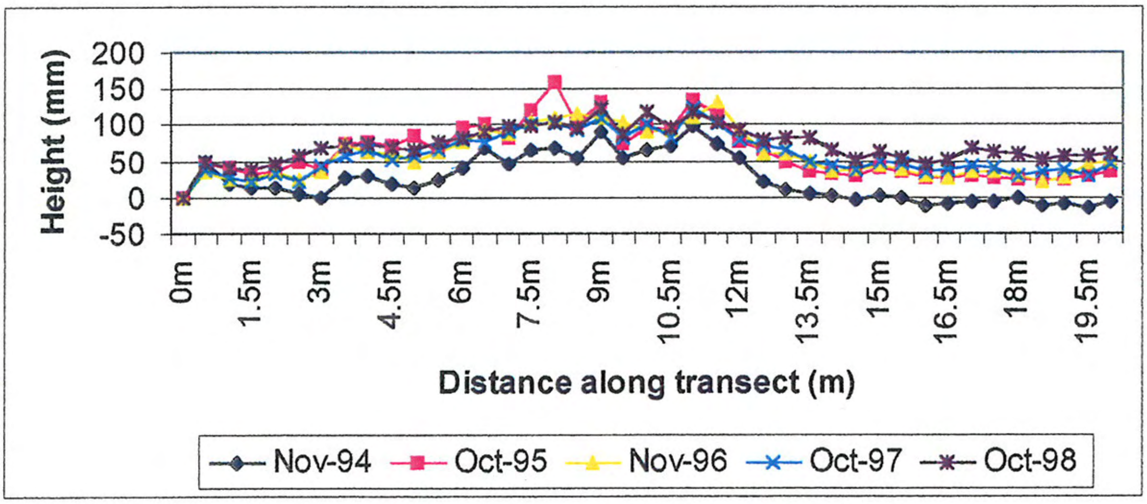

Figure 5. Level profile of Austin Bay transect A between 1994 and 1998.

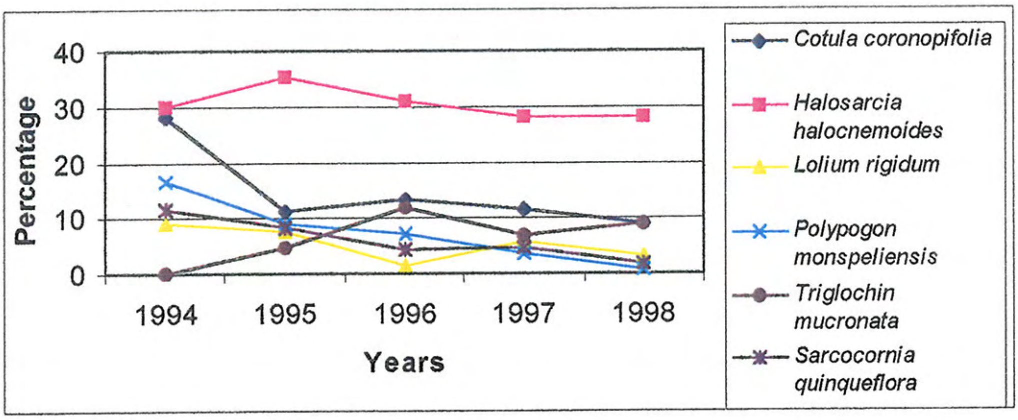

Figure 6. Percentage change in cover of the dominant species at Austin Bay transect B between 1994 and 1998.

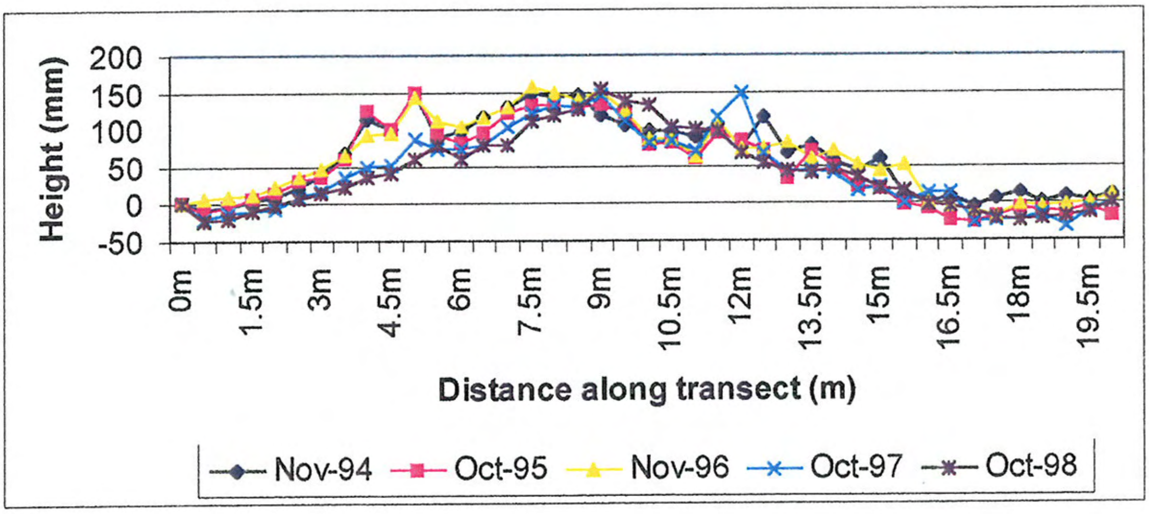

Figure 7. Level profile of Austin Bay transect B between 1994 and 1998.

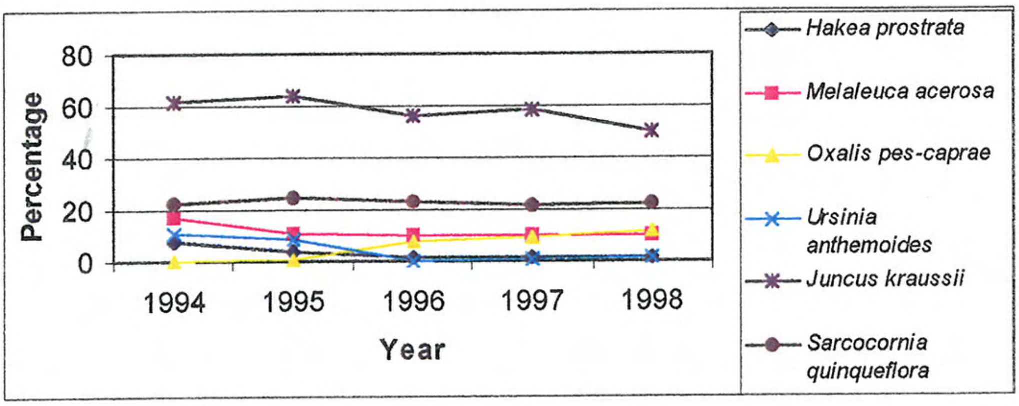

Figure 8. Percentage change in cover of the dominant species at Carrabungup transect A between 1994 and 1998.

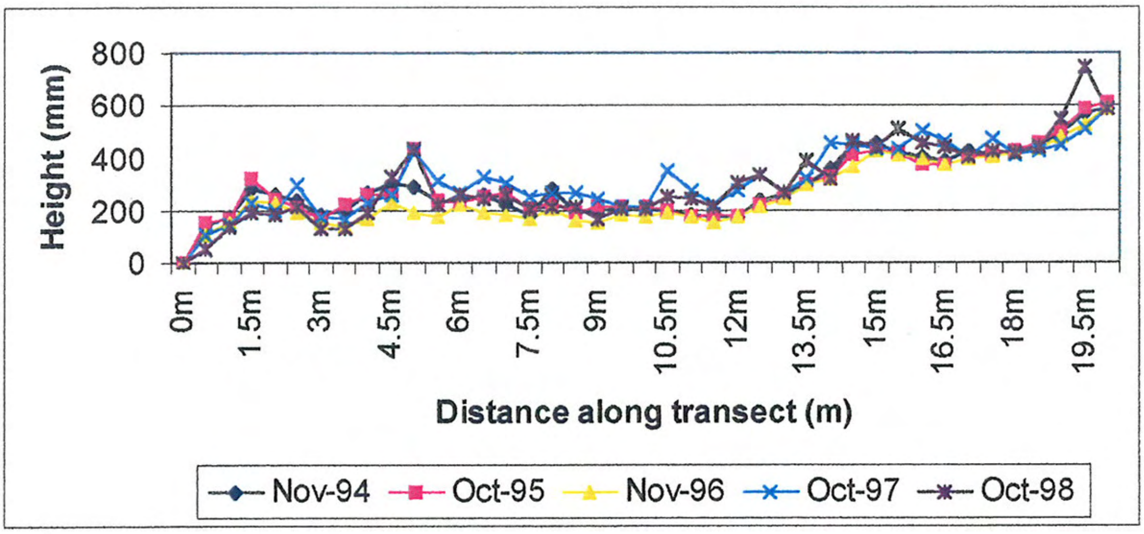

Figure 9. Level profile of Carrabungup transect A between 1994 and 1998.

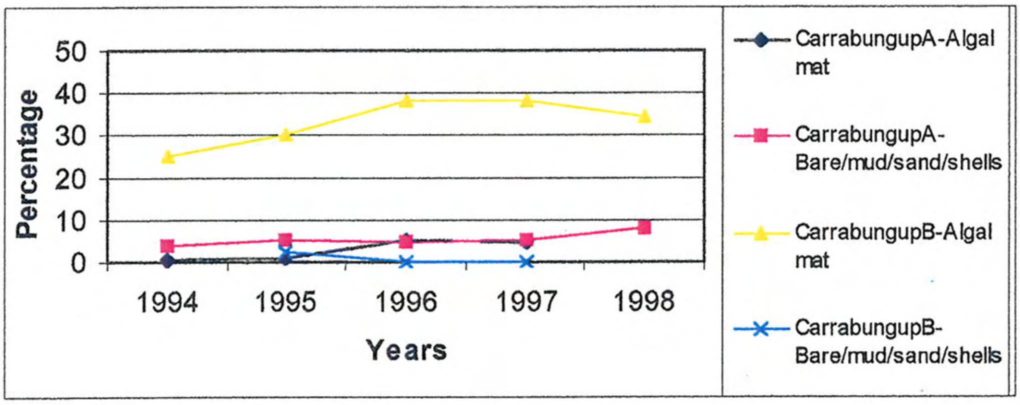

Figure 10. Percentage change in the cover of algal mat and bare ground at Carrabungup transects A and B between 1994 and 1998.

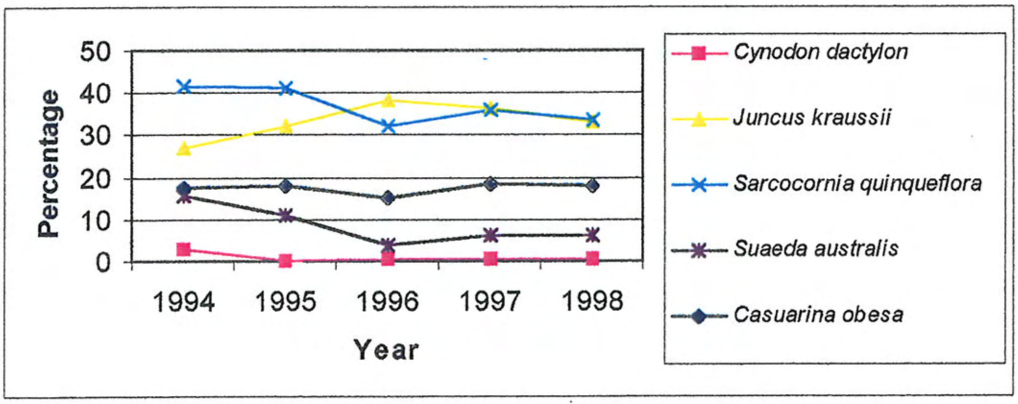

Figure 11. Percentage change in cover of the dominant species at Carrabungup transect B between 1994 and 1998.

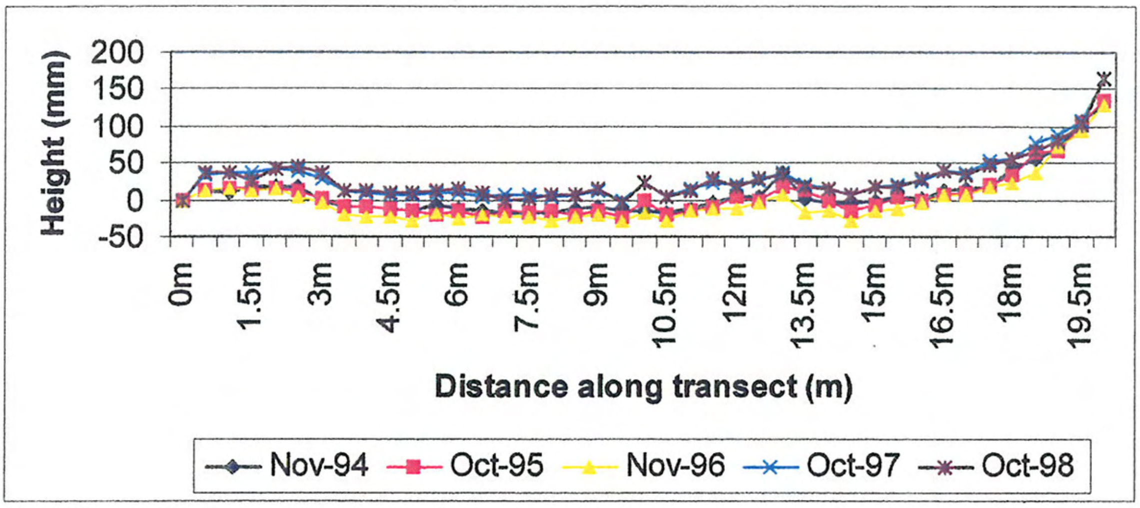

Figure 12. Level profile of Carrabungup transect B between 1994 and 1998.

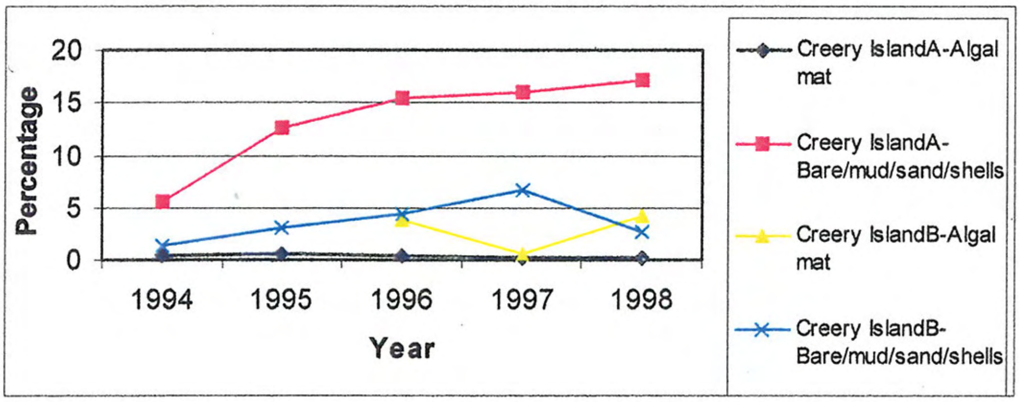

Figure 13. Percentage change in the cover of algal mat and bare ground at Creery Island transects A and B between 1994 and 1998.

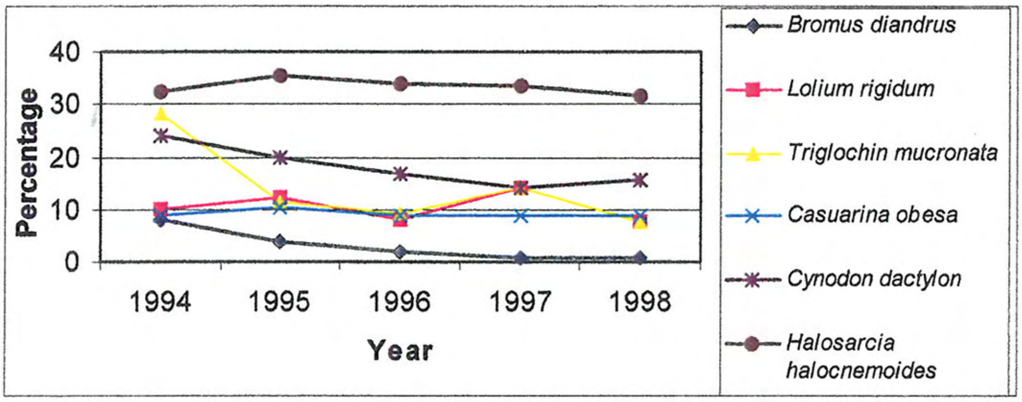

Figure 14. Percentage change in cover of the dominant species at Creery Island transect A between 1994 and 1998.

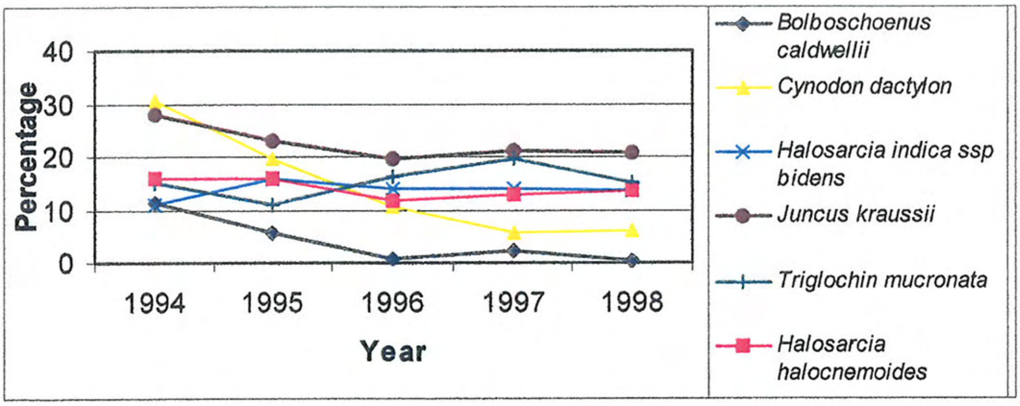

Figure 15. Percentage change in cover of the dominant species at Creery island transect B between 1994 and 1998.

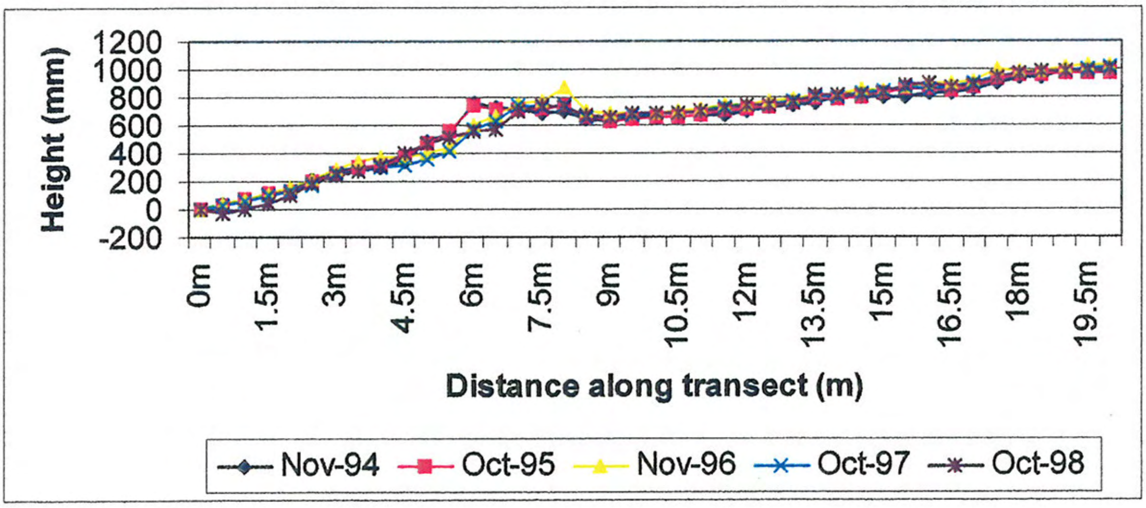

Figure 16. Level profile of Creery Island transect A between 1994 and 1998.

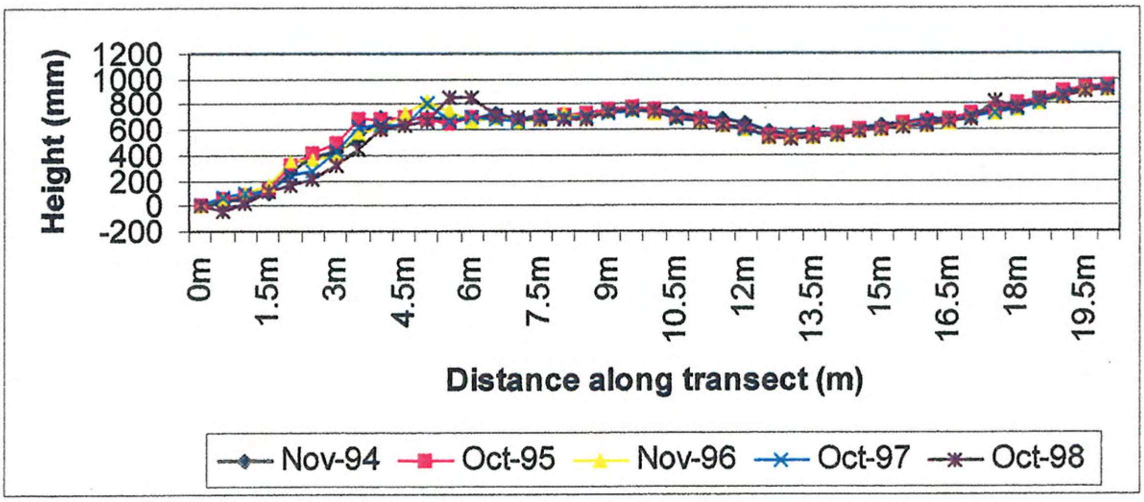

Figure 17. Level profile of Creery Island transect B between 1994 and 1998.

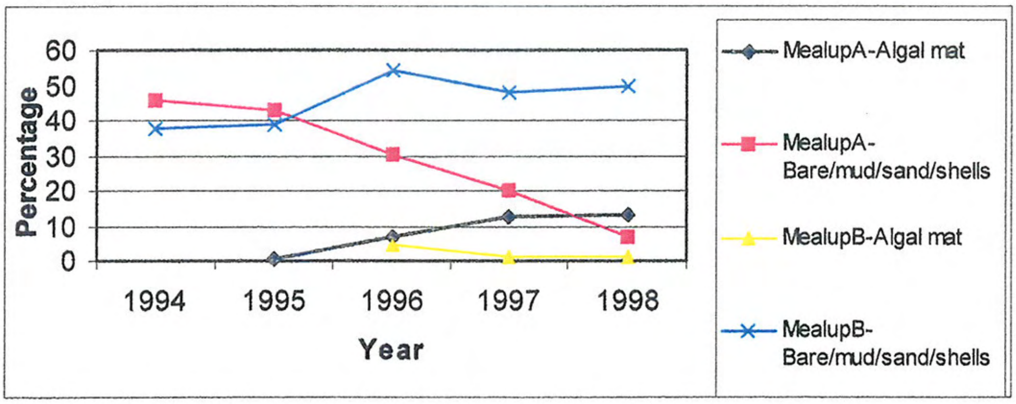

Figure 18. Percentage change in the cover of algal mat and bare ground at Mealup transects A and B between 1994 and 1998.

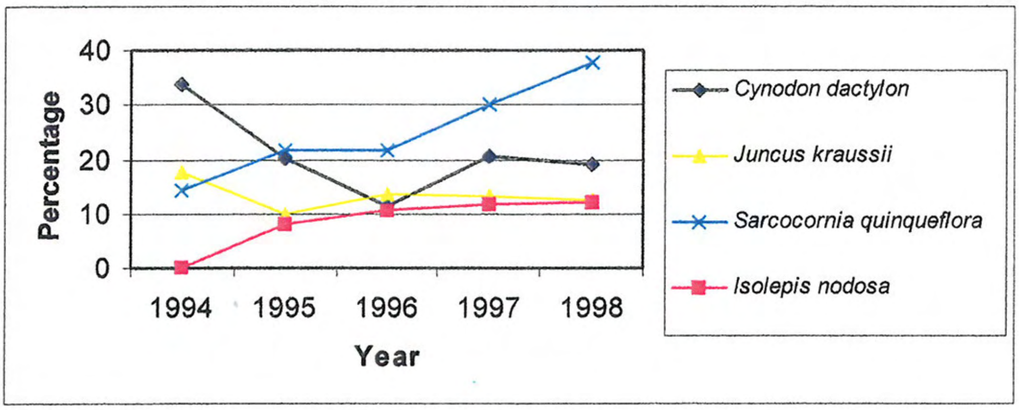

Figure 19. Percentage change in cover of the dominant species at Mealup transect A between 1994 and 1998.

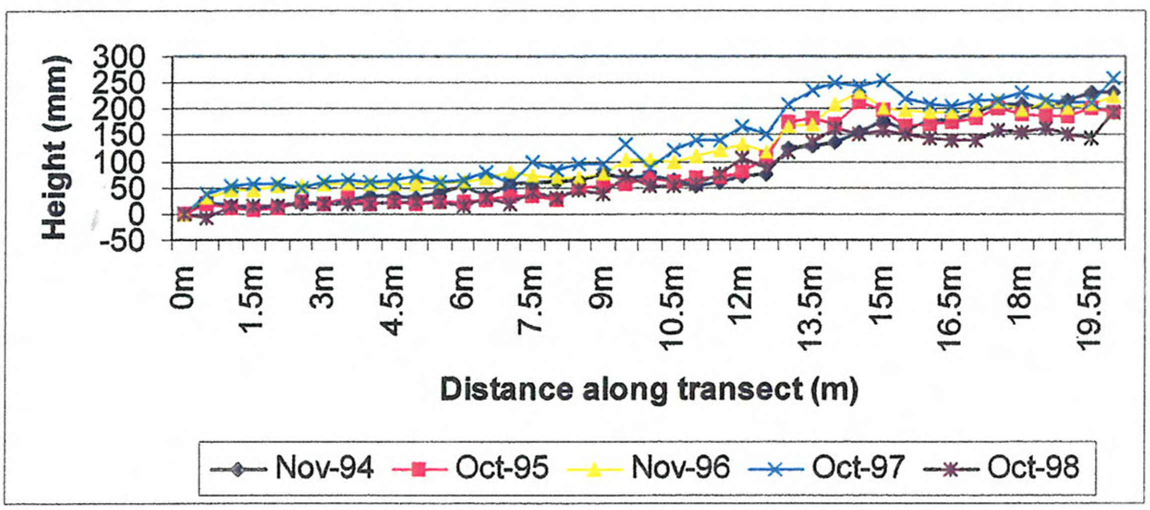

Figure 20. Level profile of Mealup transect A between 1994 and 1998.

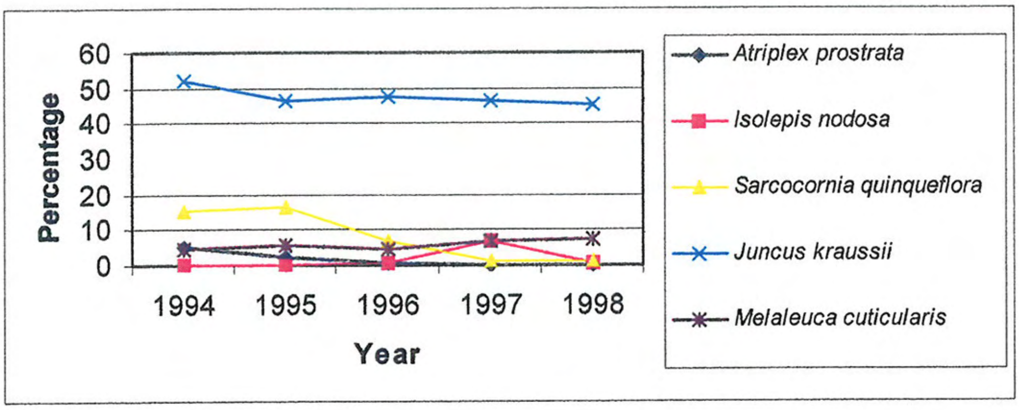

Figure 21. Percentage change in cover of the dominant species at Mealup transect B between 1994 and 1998.

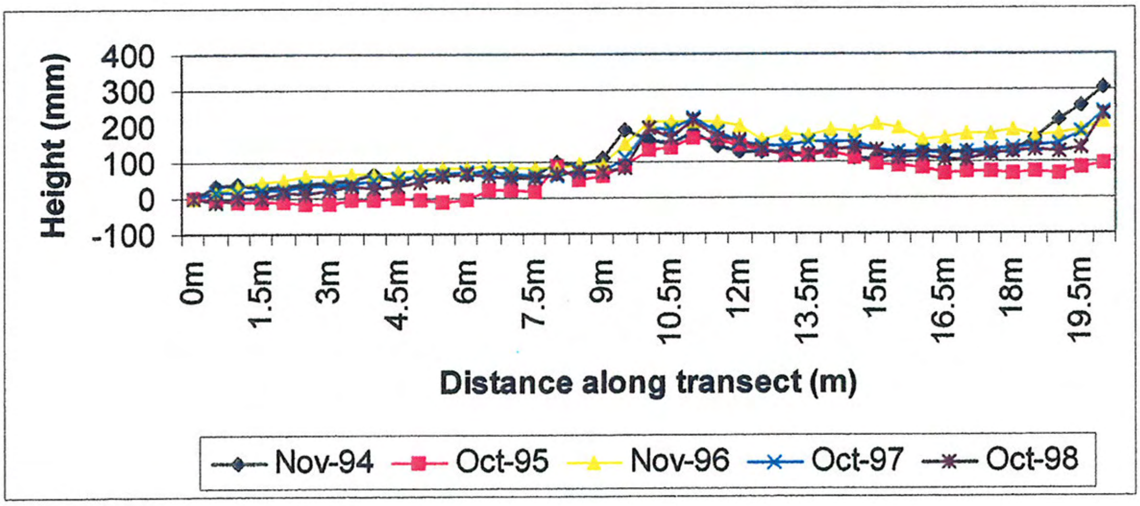

Figure 22. Level profile of Mealup transect B between 1994 and 1998.

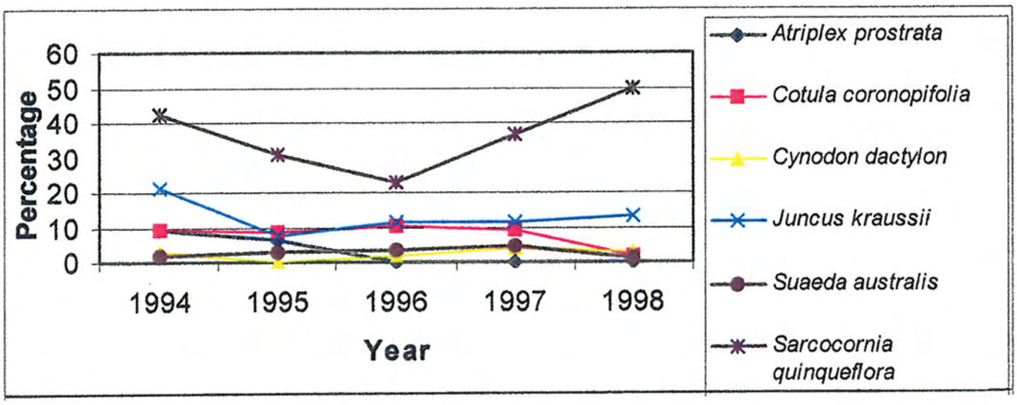

Figure 23. Percentage change in cover of the dominant species at North Kooljerrenup transect A between 1994 and 1998.

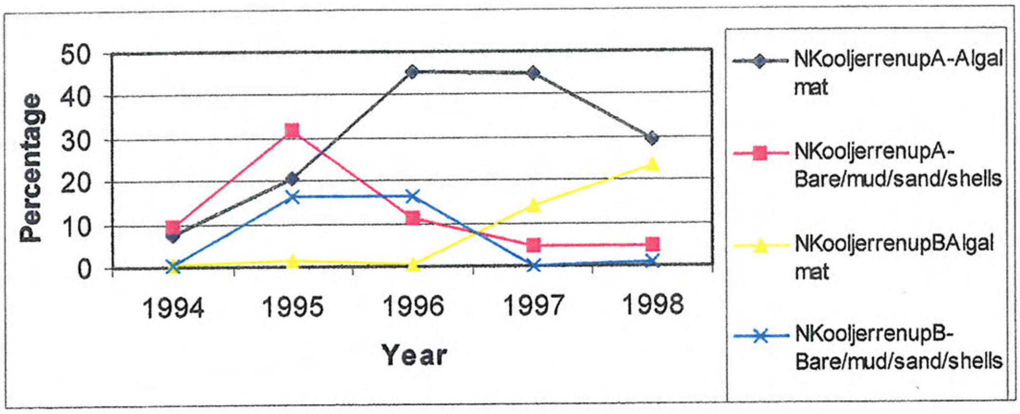

Figure 24. Percentage change in the cover of algal mat and bare ground at North Kooljerrenup transects A and B between 1994 and 1998.

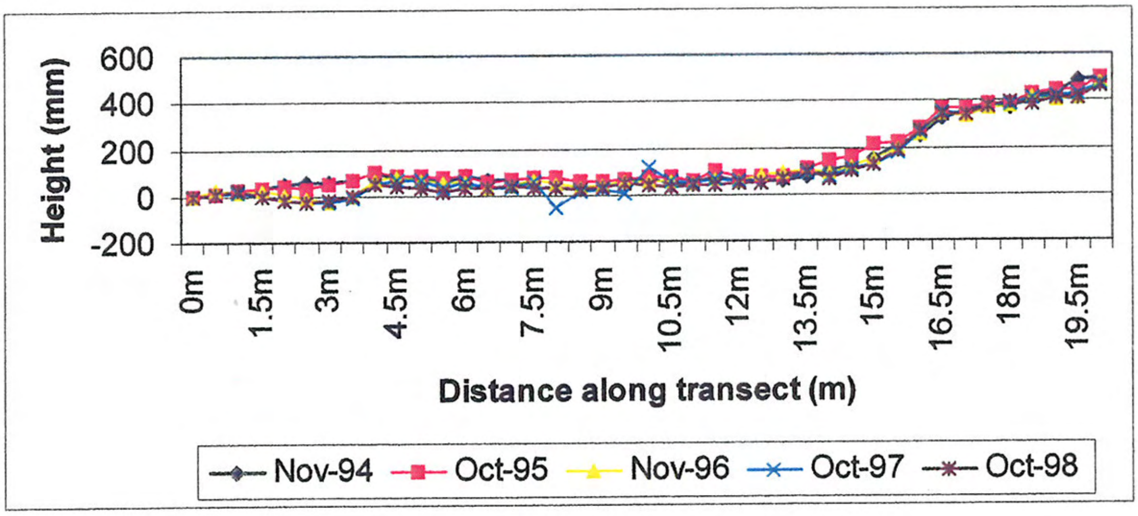

Figure 25. Level profile of North Kooljerrenup transect A between 1994 and 1998.

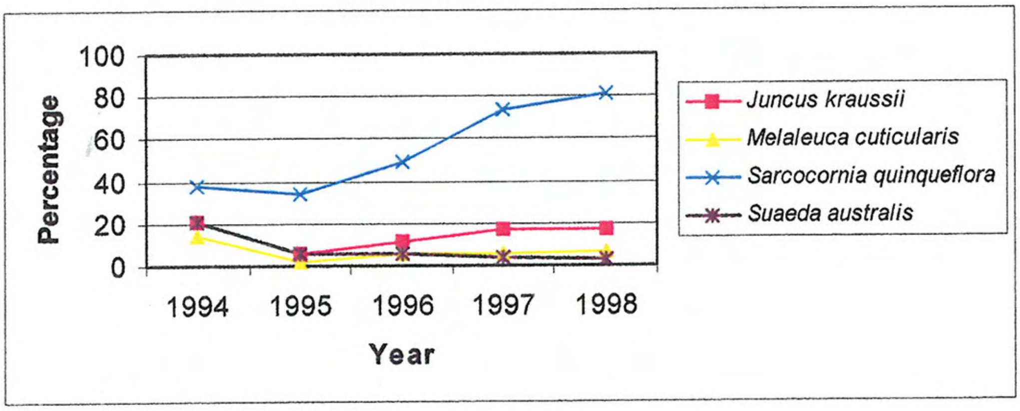

Figure 26. Percentage change in cover of the dominant species at North Kooljerrenup transect B between 1994 and 1998.

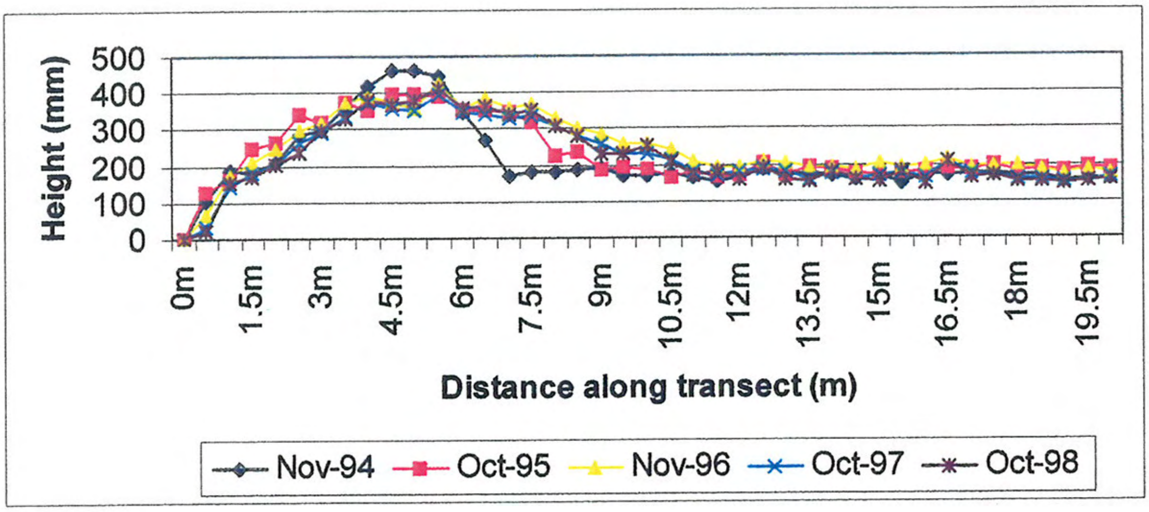

Figure 27. Level profile of North Kooljerrenup transect B between 1994 and 1998.

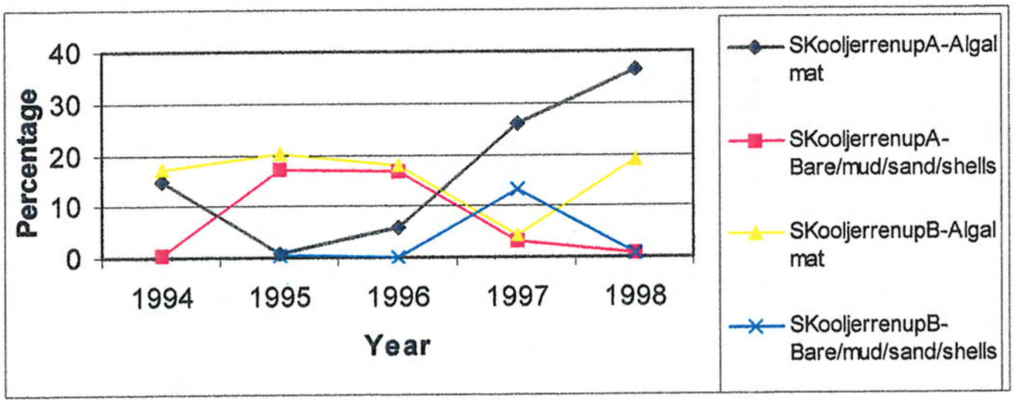

Figure 28. Percentage change in the cover of algal mat and bare ground at South Kooljerrenup transects A and B between 1994 and 1998.

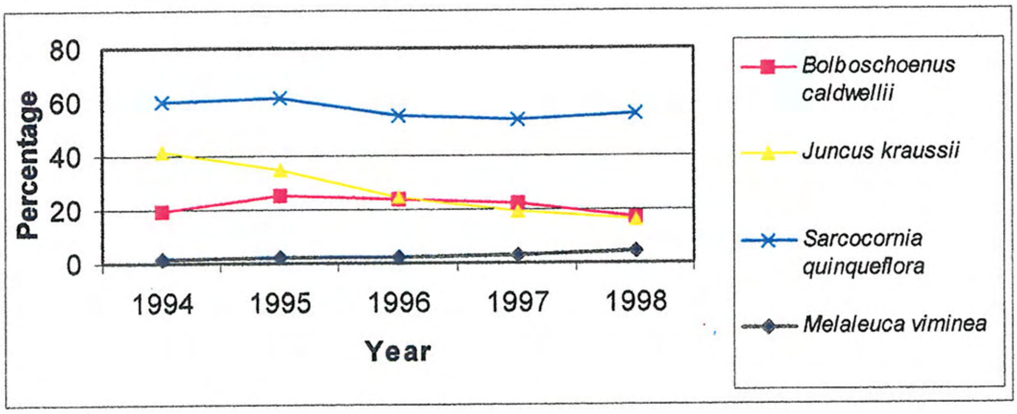

Figure 29. Percentage change in cover of the dominant species at South Kooljerrenup transect A between 1994 and 1998.

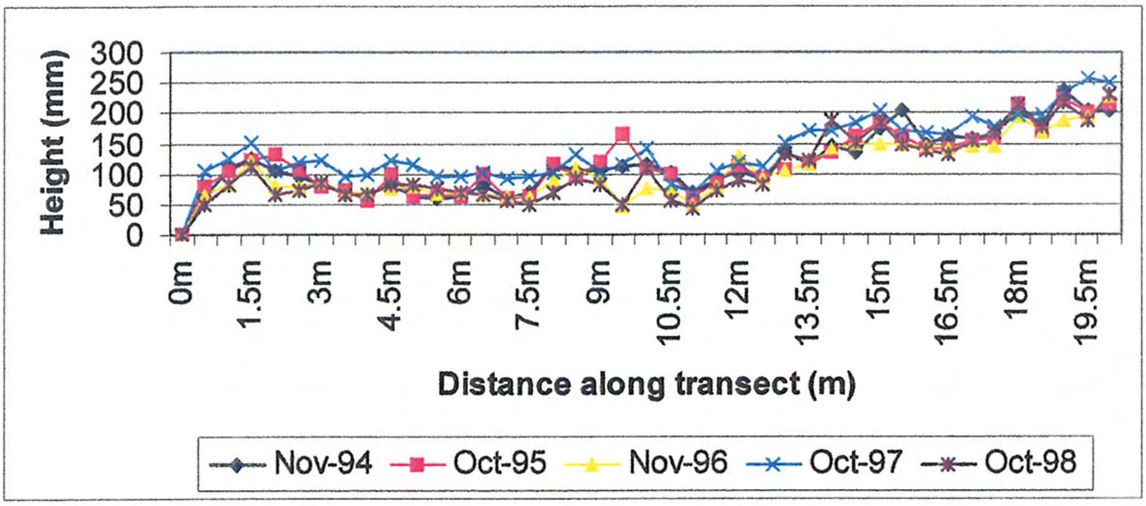

Figure 30. Level profile of South Kooljerrenup transect A in 1994 and 1995.

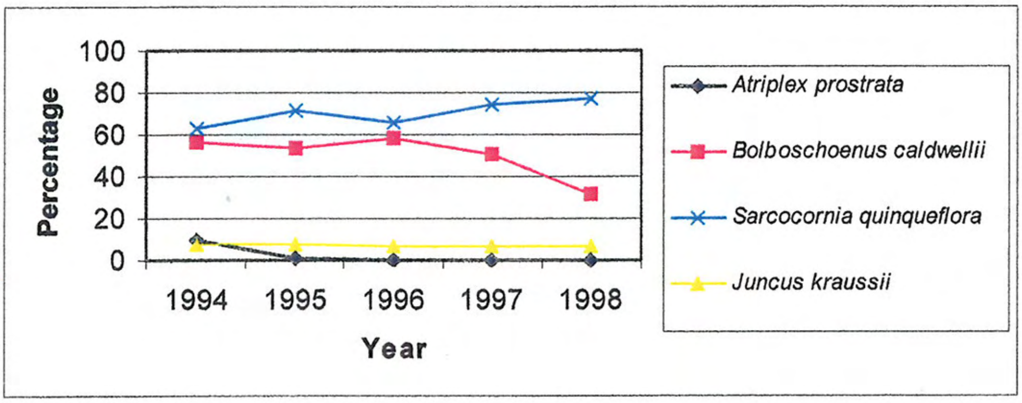

Figure 31. Percentage change in cover of the dominant species at South Kooljerrenup transect B between 1994 and 1998.

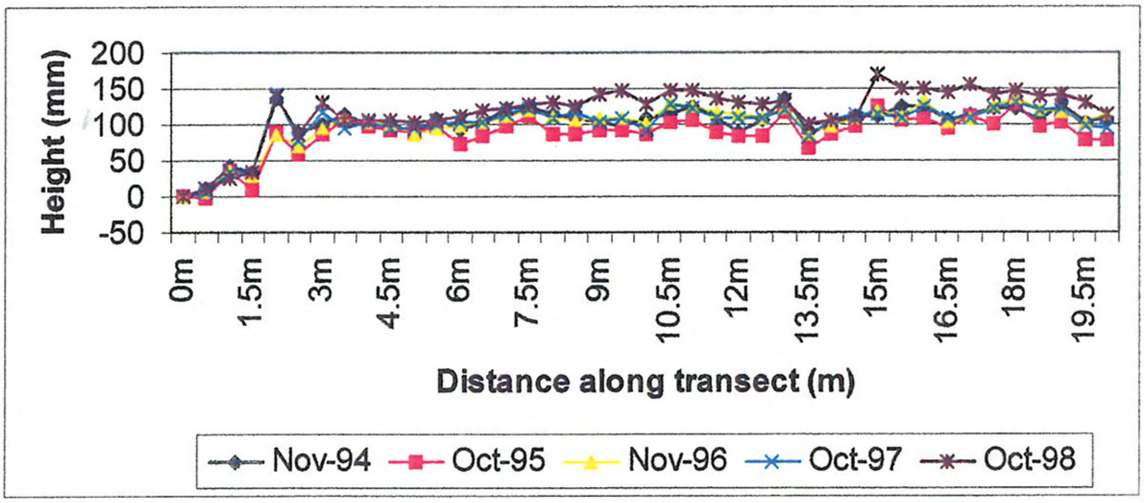

Figure 32. Level profile of South Kooljerrenup transect B in 1994 and 1995.

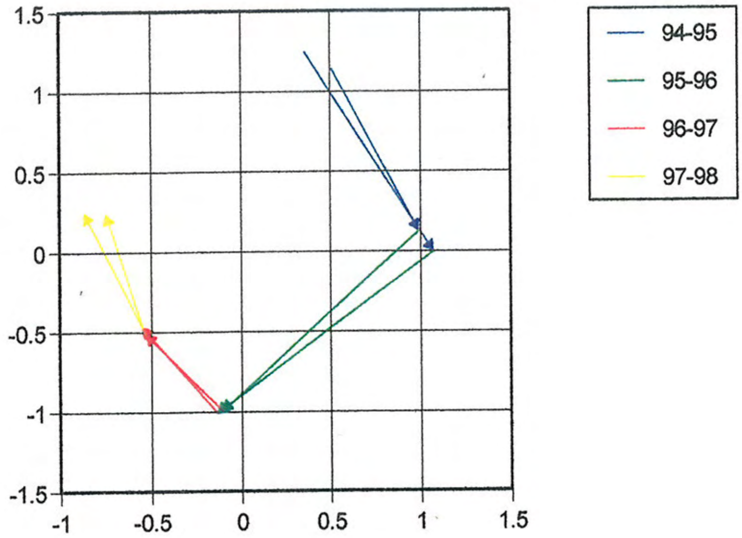

Figure 33. Ordinations of Freshwater Transects 1 and 2 showing seasonal patterns in changes in species cover over the 5 year study.

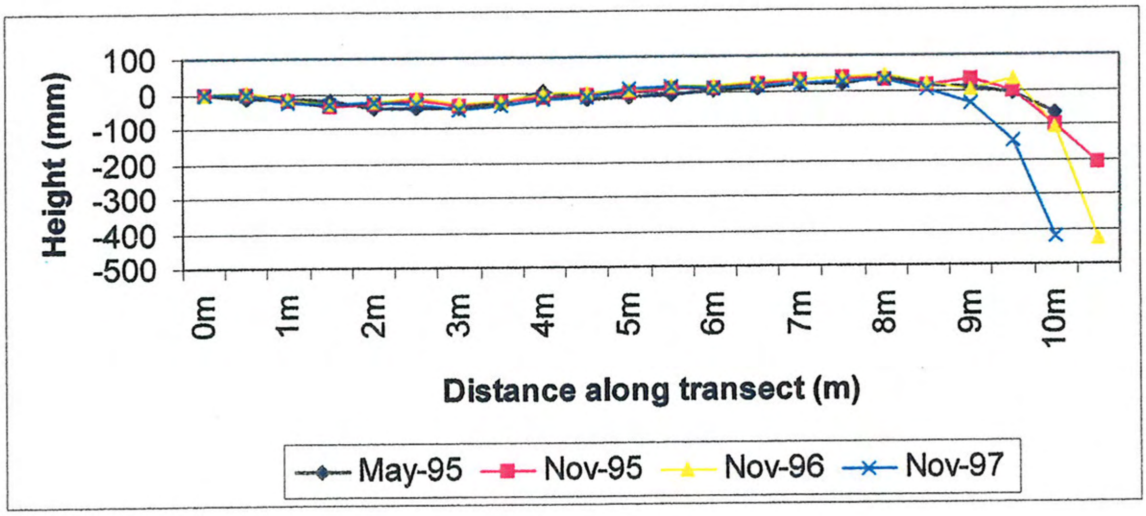

Figure 34. Level profile of transect at river mouth of Harvey River in 1994 -1997.

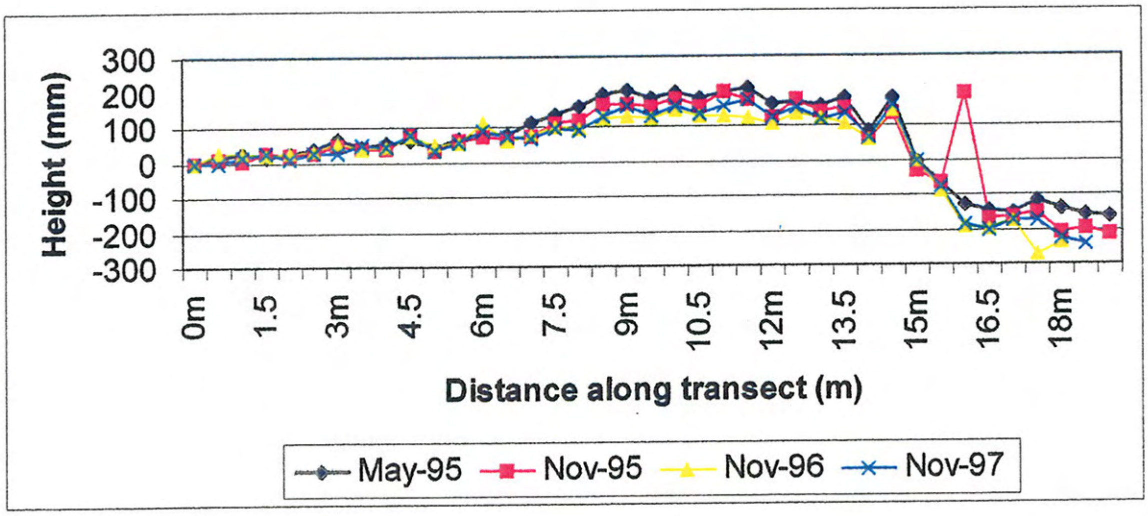

Figure 35. Level profile of transect at 0.0km along the Harvey River in 1994 -1997.

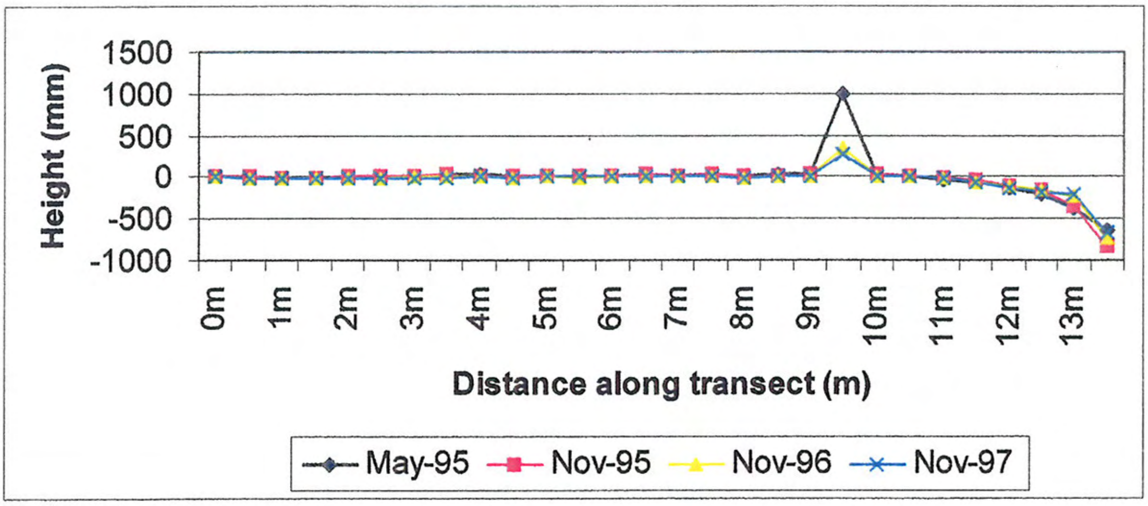

Figure 36. Level profile of transect at 0.5km along the Harvey River in 1994 -1997.

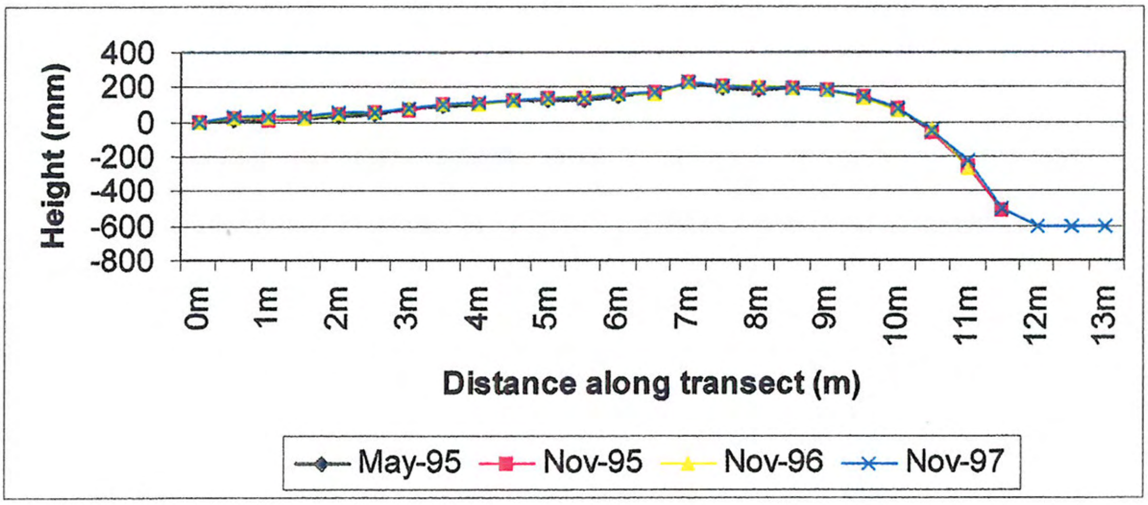

Figure 37. Level profile of transect at 1.0km along the Harvey River in 1994 -1997.

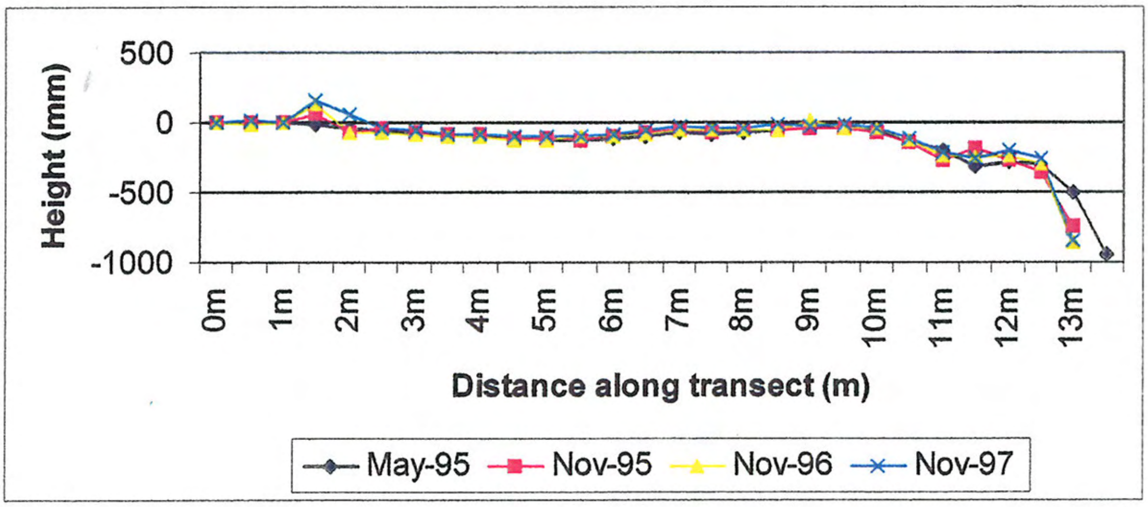

Figure 38. Level profile of transect at 1.5km along the Harvey River in 1994 -1997.

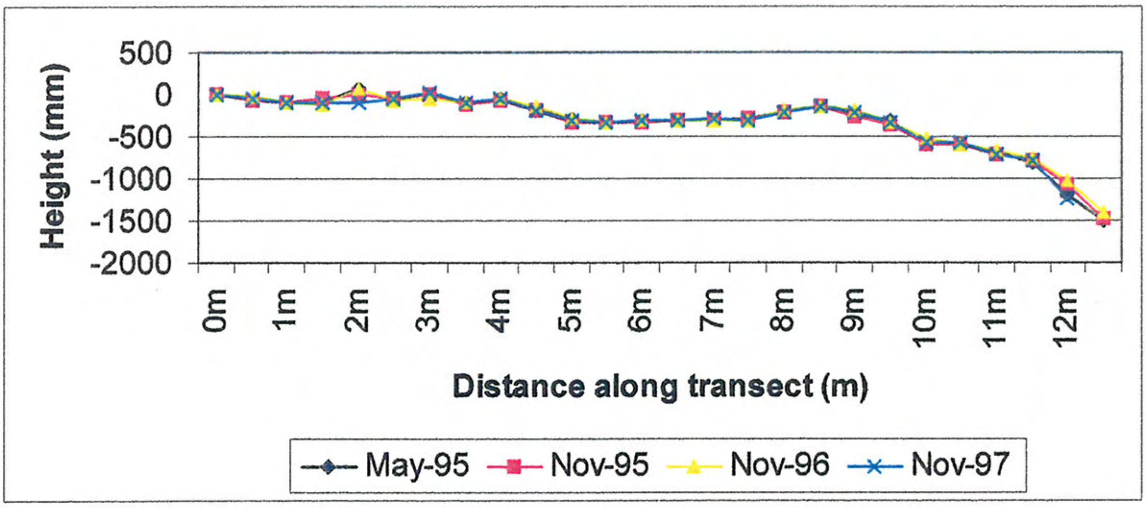

Figure 39. Level profile of transect at 2.0km along the Harvey River in 1994 -1997.

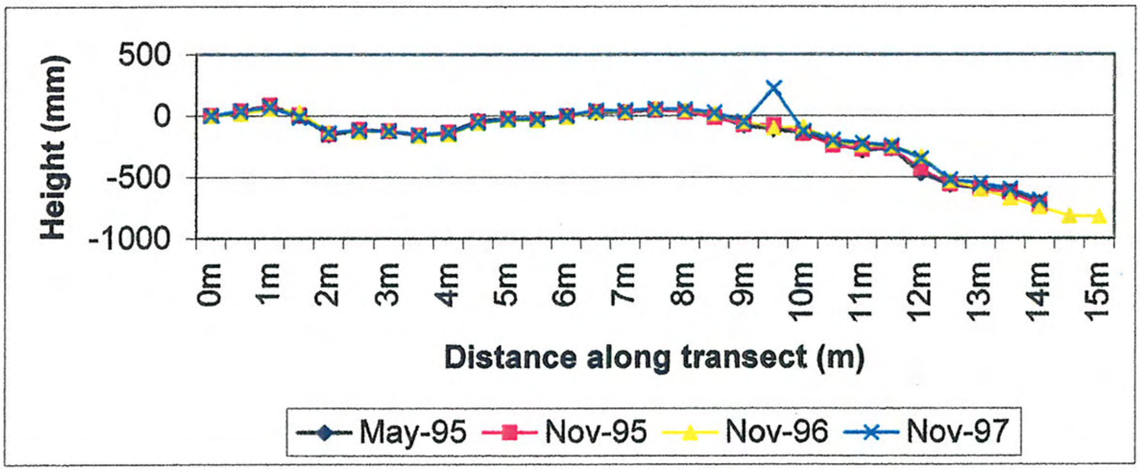

Figure 40. Level profile of transect at 2.5km along the Harvey River in 1994 -1997.

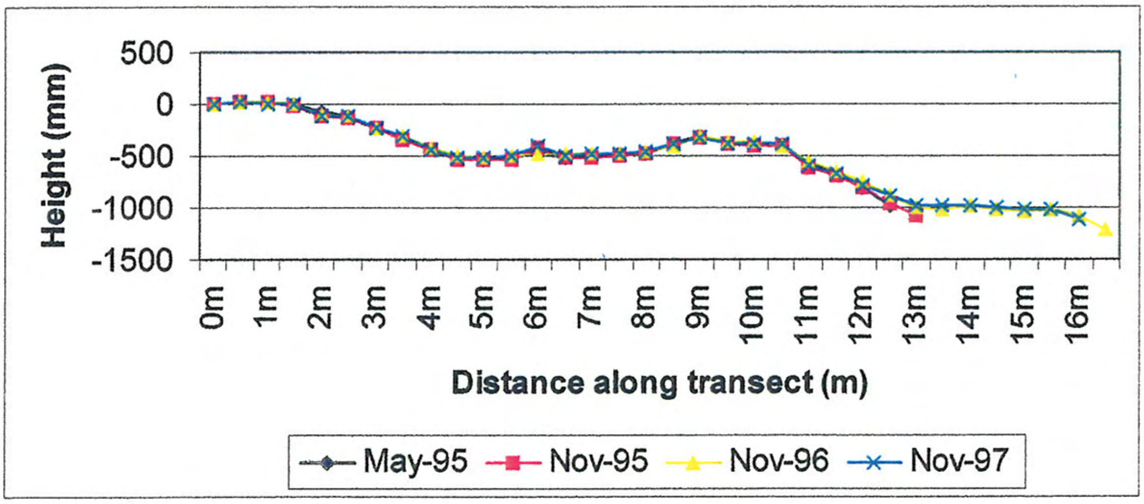

Figure 41. Level profile of transect at 3.0km along the Harvey River in 1994 -1997.

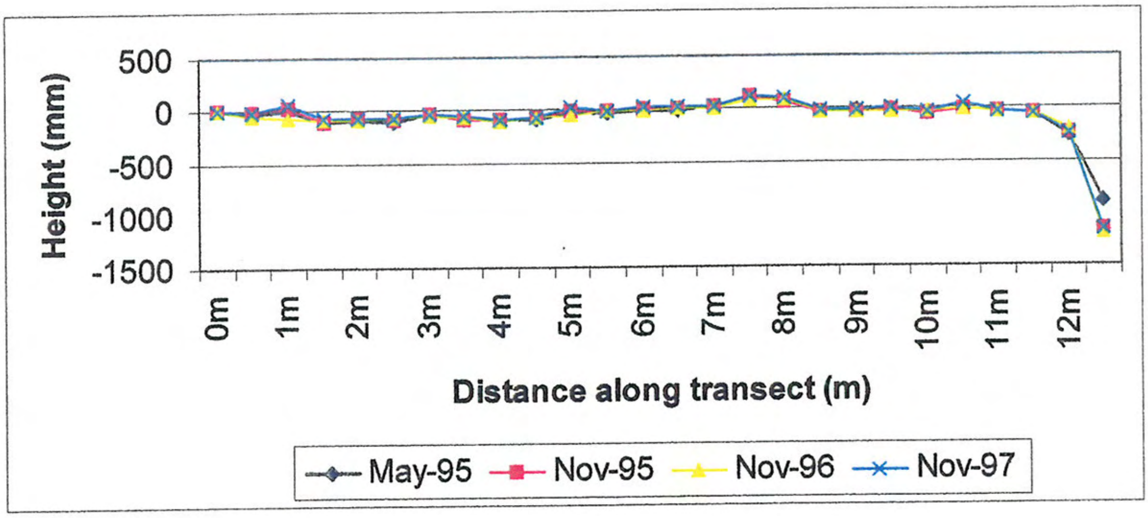

Figure 42. Level profile of transect at 3.5km along the Harvey River in 1994 -1997.

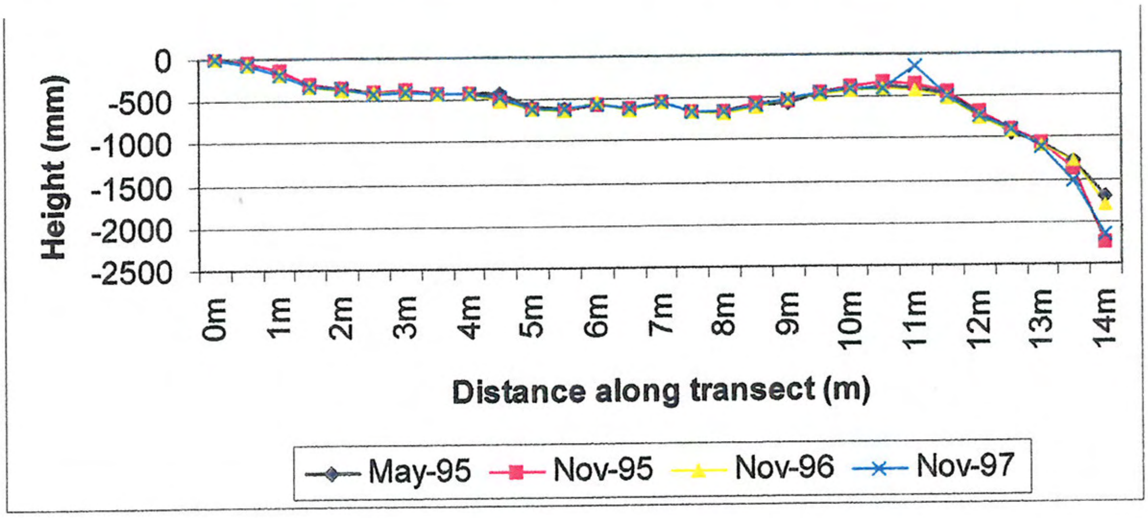

Figure 43. Level profile of transect at 4.0km along the Harvey River in 1994 -1997.

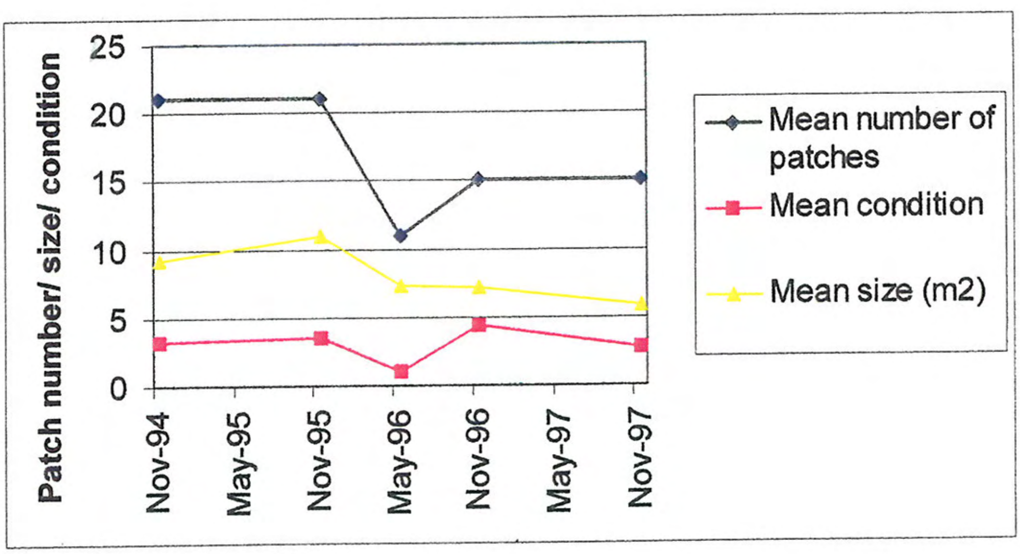

Figure 44. Changes in *Typha* patch number, patch size and patch condition from 1994 to 1996.

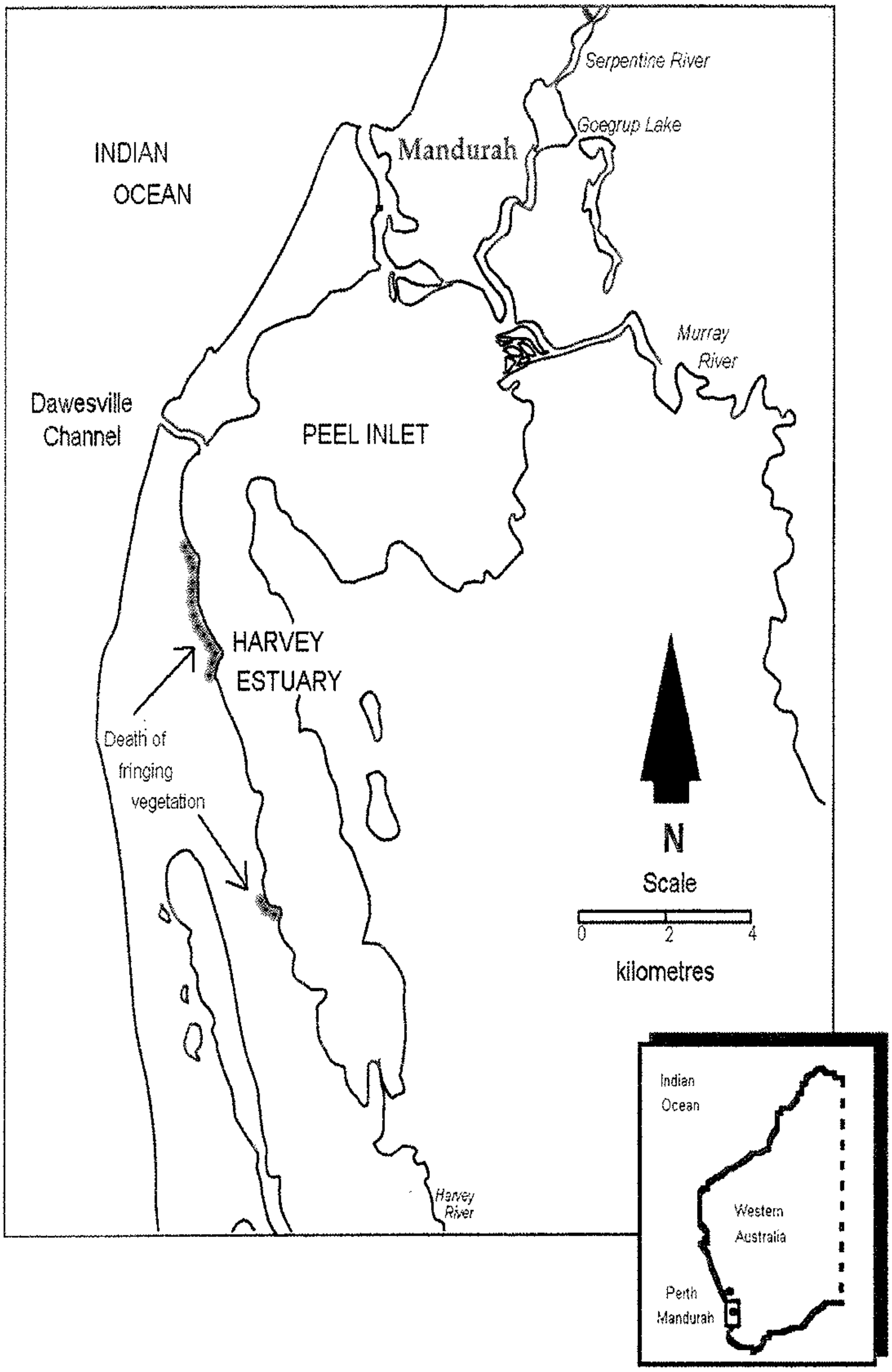

Figure 45. Map of the Peel-Harvey Estuary showing areas of dying fringing vegetation, Dec 1999 - Feb 2000.

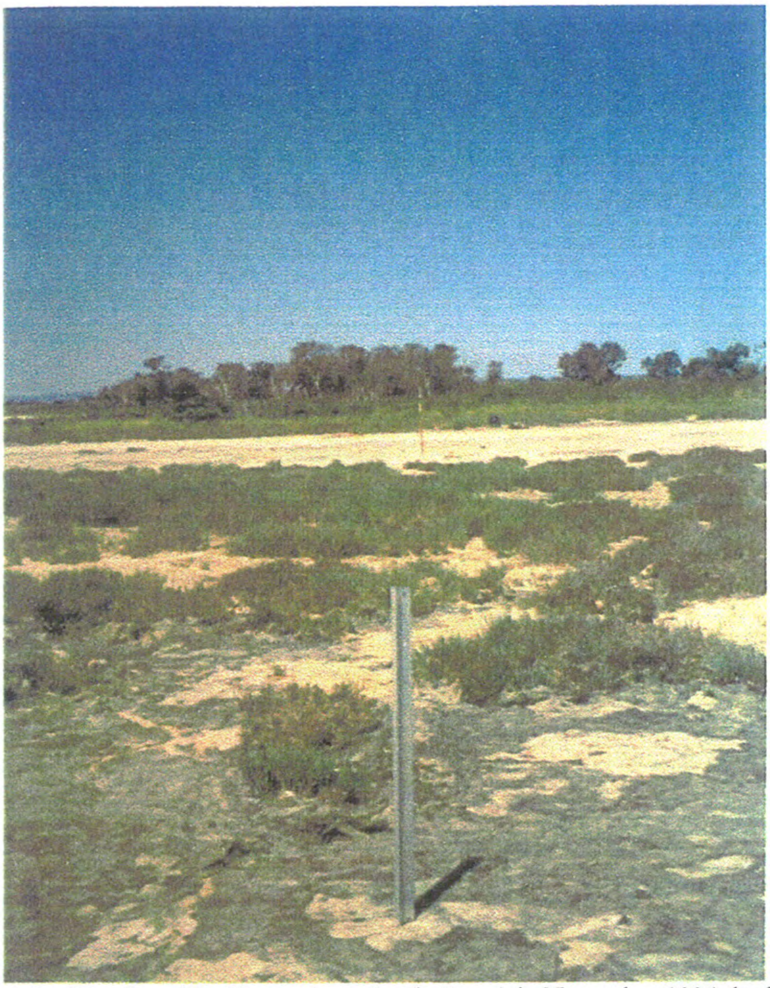

Plate 1. Transect A of the Samphire Transects at Austin Bay A in November 1994, looking east from the 0 meter mark at the waters edge to the 140 metre mark inland.

Plate 2. Transect A of the Samphire Transects at Austin Bay in November 1996, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

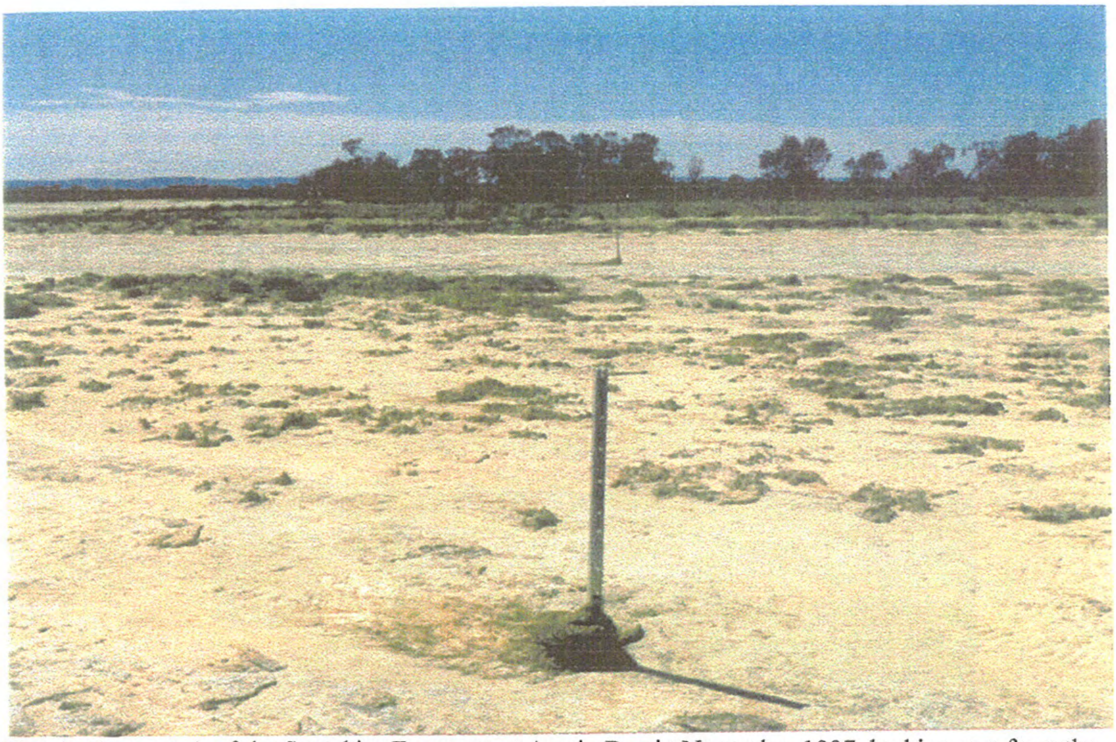

Plate 3. Transect A of the Samphire Transects at Austin Bay in November 1997, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

Plate 4. Transect A of the Samphire Transects at Austin Bay A in November 1998 looking east from the 10 metre mark at the waters edge to the 140 metre mark inland.

Plate 5. Aerial view, looking east, of the samphire transect at Austin Bay A on 7 Dec 1999.

Plate 6. An aerial view, looking east, of the samphire transect at Austin Bay A on 16 Feb 2000. Note much higher tide than seen in previous plate.

Plate 7. Transect B of the Samphire Transects at Austin Bay in Nov 1994, looking south from the 0 metre mark at the waters edge to the 120 metre mark inland.

Plate 8. Transect B of the Samphire Transects at Austin Bay, in Nov 1996, looking from the 0 metre mark at the waters edge to the 120 metre mark inland.

Plate 9. Transect B of the Samphire Transects at Austin Bay in Nov 1997, looking south from the 10 metre mark at the waters edge to the 20 metre mark inland.

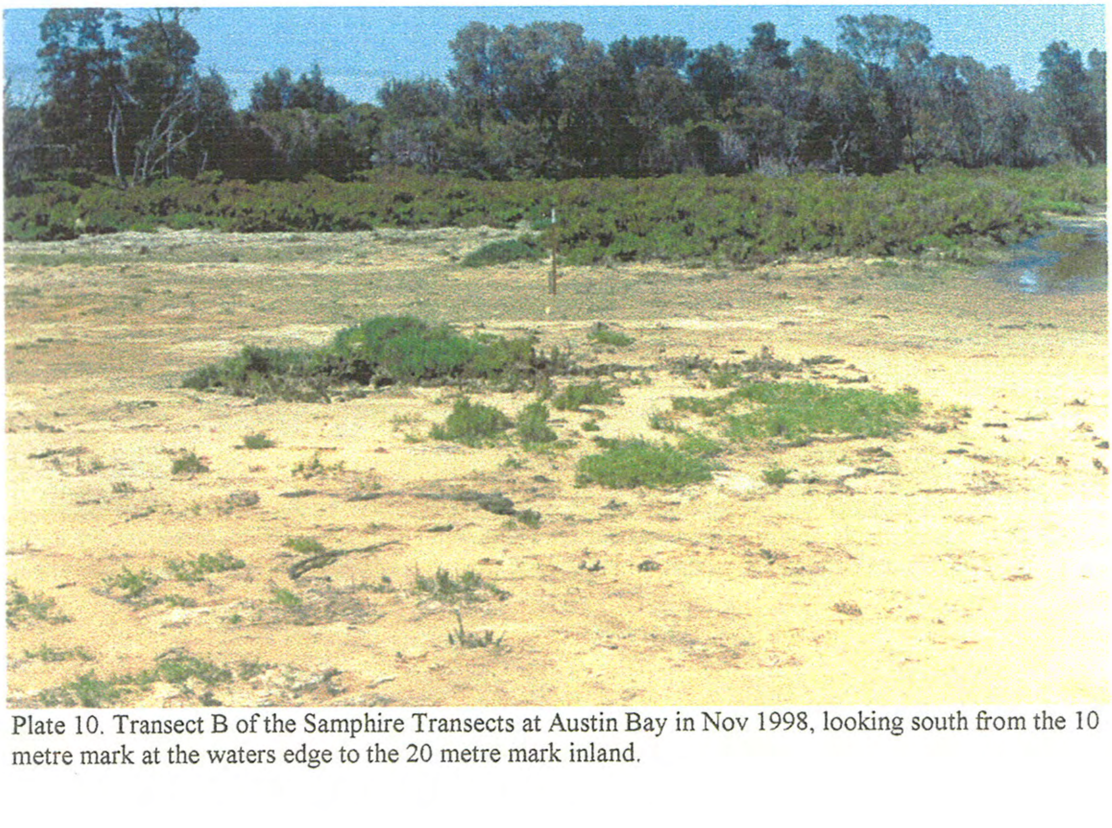

Plate 10. Transect B of the Samphire Transects at Austin Bay in Nov 1998, looking south from the 10 metre mark at the waters edge to the 20 metre mark inland.

Plate 11. Aerial view, looking east, of the Samphire transect Austin Bay B on 7 Dec 1999.

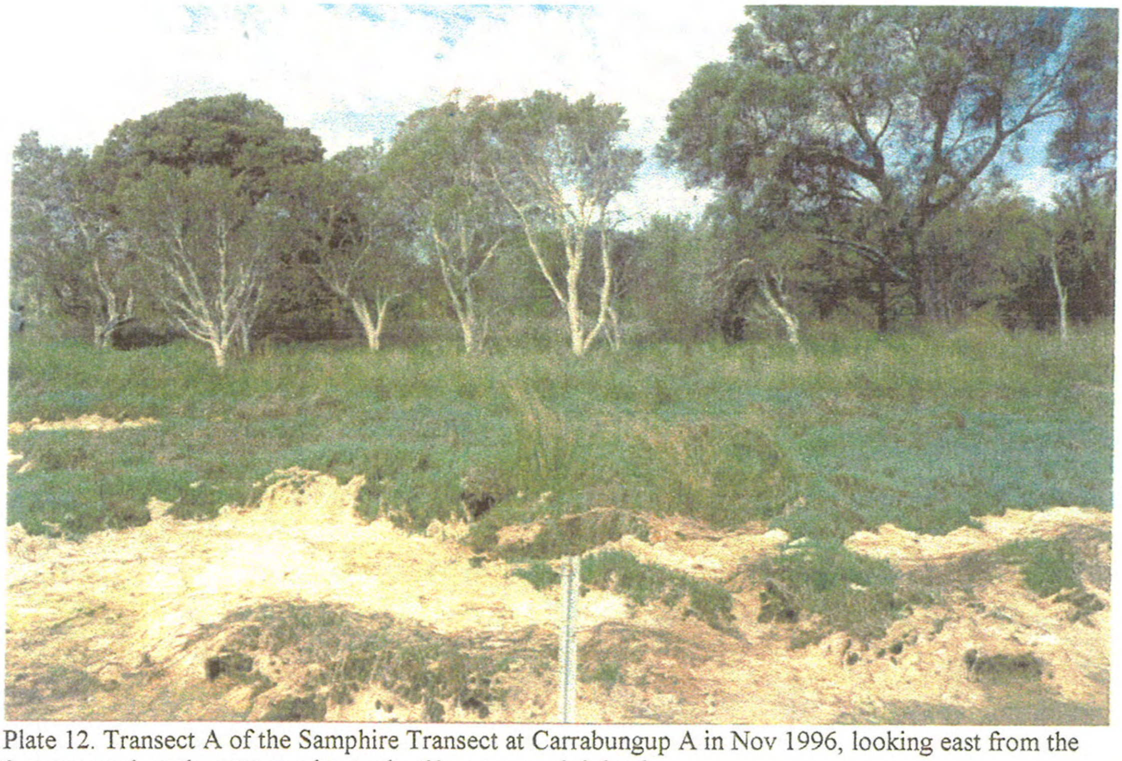

Plate 12. Transect A of the Samphire Transect at Carrabungup A in Nov 1996, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 13. Transect A of the Samphire Transects at Carrabungup in Nov 1997, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 14. Transect A of the Samphire Transects at Carrabungup in Nov 1998, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 15. Transect B of the Samphire Transects at Carrabungup in Nov 1994, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate16. Transect B of the Samphire Transects at Carrabungup in Nov 1996, looking east from the 0 metre mark to the 60 metre mark inland.

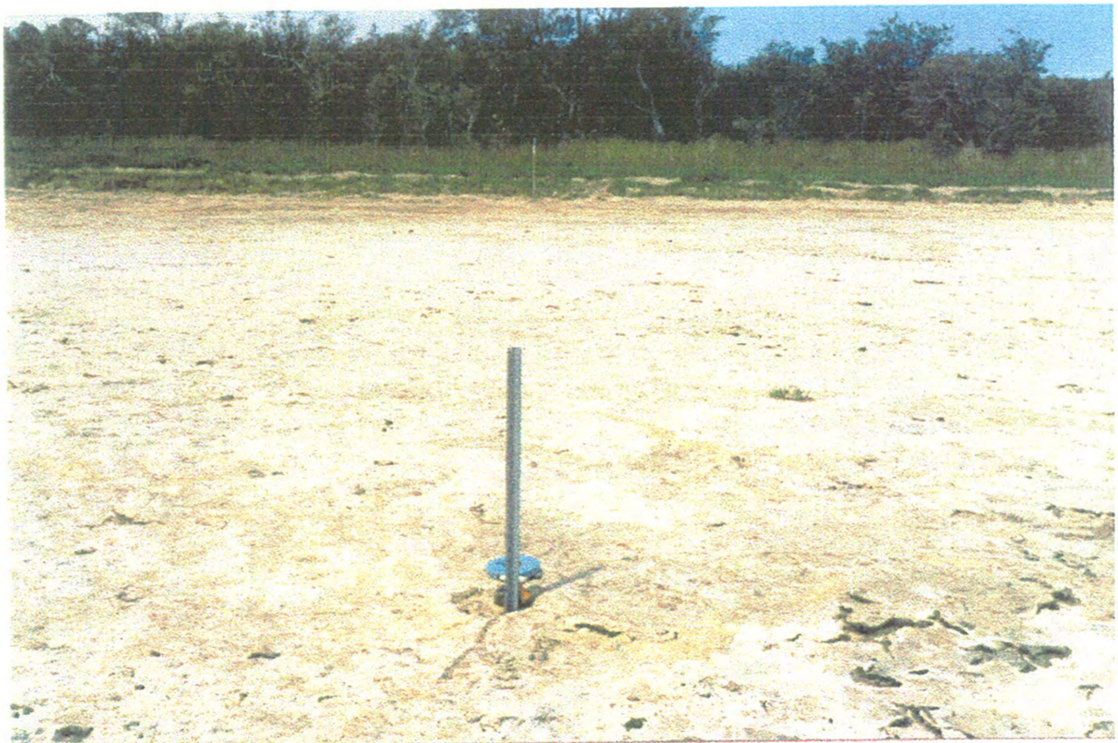

Plate 17. Transect B of the Samphire Transects at Carrabungup in Nov 1997, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 18. Transect A of the Samphire Transects at Creery Island in Nov 1994, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

Plate 19. Transect A of the Samphire Transects at Creery Island in Nov 1996, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

Plate 20. Transect A at the Samphire Transects at Creery Island in Nov 1997, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

Plate 21. Transect A of the Samphire Transects at Creery Island in Nov 1998, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

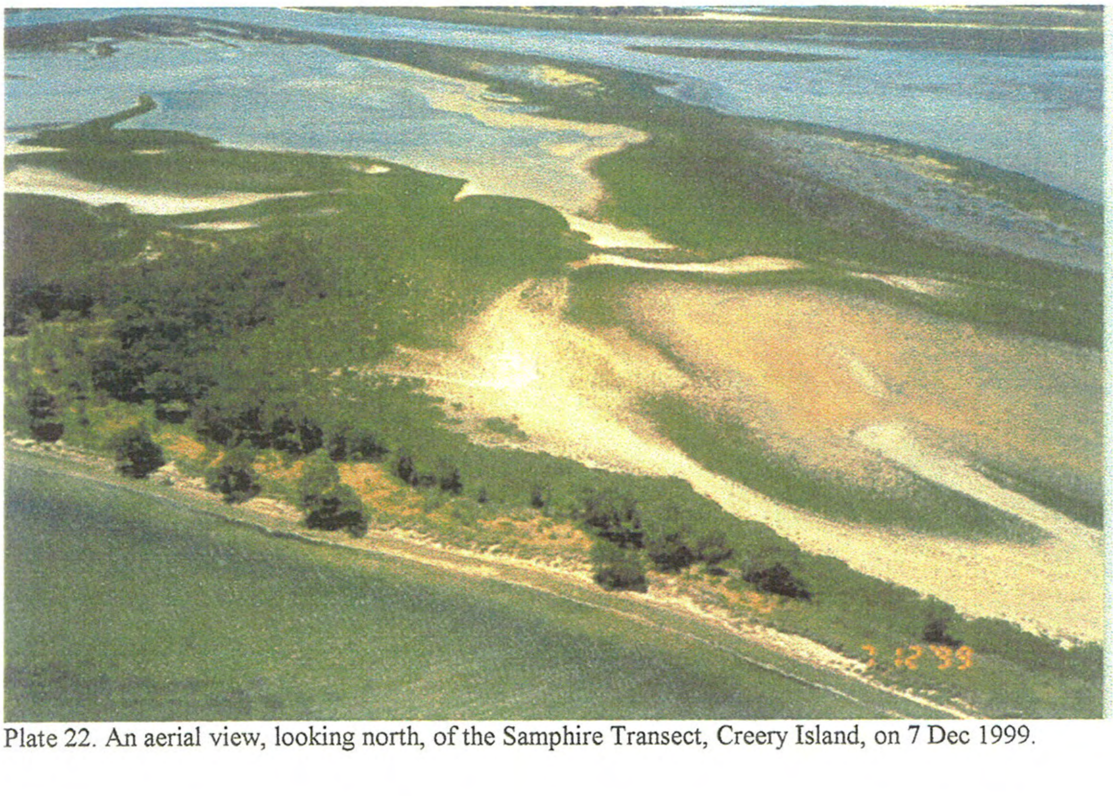

Plate 22. An aerial view, looking north, of the Samphire Transect, Creery Island, on 7 Dec 1999.

Plate 23. Aerial view looking north of the Samphire Transects at Creery Island on 7 Dec 1999.

Plate 24. Transect B of the Samphire Transects at Creery Island in Nov 1996, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

Plate 25. Transect B of the Samphire Transects at Creery Island in Nov 1997, looking north from the 0 metre mark at the waters edge to the 20 metre mark inland.

Plate 26. Transect A of the Samphire Transects at Mealup in Nov 1994, looking north-east from the 0 metre mark at the waters edge to the 40 metre mark inland.

Plate 27. Transect A of the Samphire Transects at Mealup in Nov 1996 looking north-east from the 0 metre mark at the waters edge to the 40 metre mark inland.

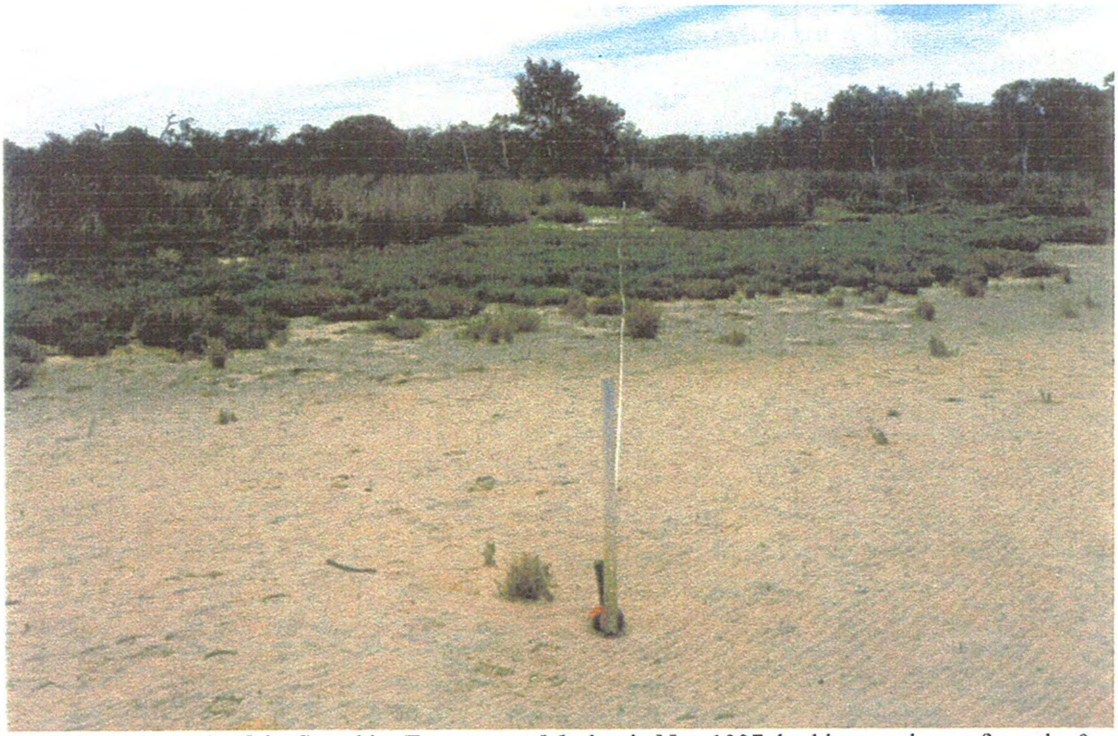

Plate 28. Transect A of the Samphire Transects at Mealup in Nov 1997, looking north-east from the 0 metre mark at the waters edge to the 40 metre mark inland.

Plate 29. Transect A of the Samphire Transect at Mealup in Nov 1998, looking north-east from the 0 metre mark at the waters edge to the 10 metre mark inland.

Plate 30. Transect A of the Samphire Transect at Mealup in Nov 1998, looking north-east from the 10 metre mark near the waters edge to the 20 metre mark inland.

Plate 31. Transect B of the Samphire transect at Mealup in Nov 1994, looking east from the 0 metre mark at the waters edge to the 40 metre mark inland.

Plate 32. Transect B of the Samphire Transects at Mealup in Nov 1996, looking east from the 0 metre mark at the waters edge to the 40 metre mark inland.

Plate 33. Transect B of the Samphire Transect Mealup in Nov 1997, looking east from the 0 metre mark at the waters edge to the 40 metre mark inland.

Plate 34. Transect A of the Samphire Transects at North Kooljerrenup in Nov 1994, looking east from the 0 metre mark at the waters edge to the 60 metre inland mark.

Plate 35. Transect A of the Samphire Transects at North Kooljerrenup in Nov 1996, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 36. Transect A of the Samphire Transects at North Kooljerrenup in Nov 1997, looking east from the 10 metre mark to the 60 metre mark inland.

Plate 37. Transect A of the Samphire Transects at North Kooljerrenup in Nov 1998, looking east from the 10 metre mark to the 60 metre mark inland.

Plate 38. Aerial view, looking east, of the Samphire Transects at North Kooljerrenup on 16 Feb 2000.

Plate 39. Transect B of the Samphire Transects at North Kooljerrenup in Nov 1994, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

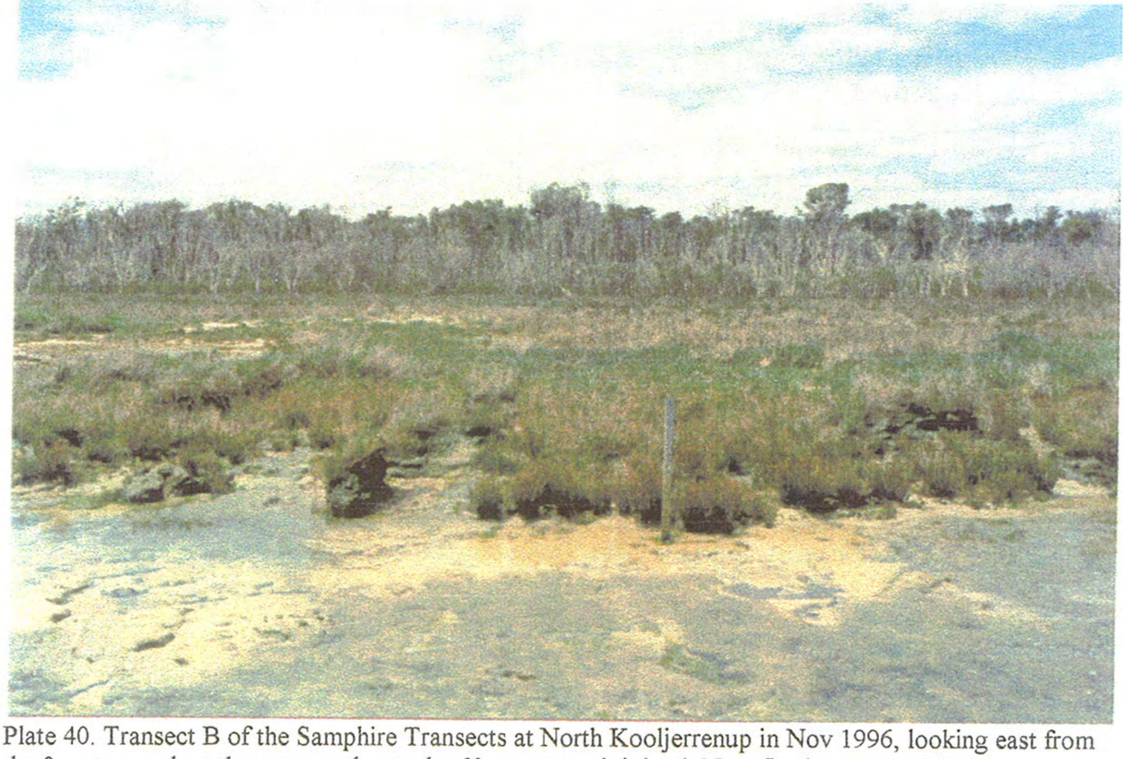

Plate 40. Transect B of the Samphire Transects at North Kooljerrenup in Nov 1996, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland. Note fire impact on fringing vegetation.

Plate 41. Transect B of the Samphire Transects at North Kooljerrenup B in Nov 1997, looking east from the 0 metre mark at the waters edge to the 60 metre mark inland.

Plate 42. Transect B of the Samphire Transects at North Kooljerrenup in Nov 1998, looking east from the 10 metre mark near the waters edge to the 20 metre mark inland.

Plate 43. Transect A of the Samphire Transects at South Kooljerrenup in Nov 1997, looking east from the 20 metre mark near the waters edge to the 100 metre mark inland.

Plate 44. Transect A of the Samphire Transects at South Kooljerrenup in Nov 1998, looking east from the 20 metre mark near the waters edge to the 60 metre mark inland.

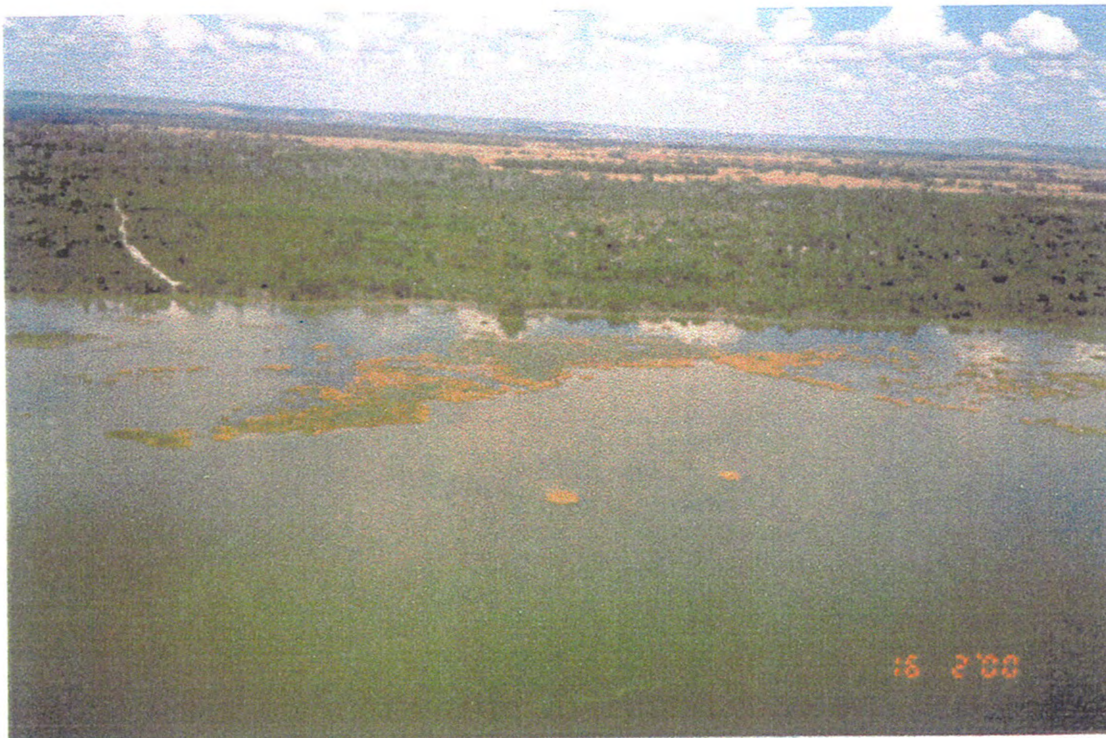

Plate 45. Aerial view, looking east, of the Samphire Transect at South Kooljerrenup A on 16 Feb 2000.

Plate 46. Transect B of the Samphire Transects at South Kooljerrenup in Nov 1994, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

Plate 47. Transect B of the Samphire Transects at South Kooljerrenup in Nov 1996, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

Plate 48. Transect B of the Samphire Transects at South Kooljerrenup, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

Plate 49. Transect B of the Samphire Transects at South Kooljerrenup in Nov 1998, looking east from the 0 metre mark at the waters edge to the 140 metre mark inland.

Plate 50. An aerial view, looking east, of the wetlands at Austin Bay where the wetland transects were located. Photo taken on 7 Dec 1999.

Plate 51. An aerial view, looking east, of the mouth of the Harvey River where some of the Riverine Transects were located. Photo taken on 7 Dec 1999.

Plate 52. An aerial view, looking north, of the mouth of the Harvey River where some of the Riverine Transects are located. Photo taken on 7 Dec 1999.

Plate 53. An aerial view, looking north-east, of the Harvey River where some of the Riverine Transects were located. Photo taken 7 Dec 1999.

Plate 54. An aerial view, looking north-east, of the Harvey River where some of the Riverine Transects were located. Photo taken 7 Dec 1999.

Plate 55. Tree death along the western side of the Harvey Estuary. Aerial photo taken of bay north of point (AMG 50- 376000 6377500) shown in plate 56. Photo taken 7 Dec 1999.

Plate 56. Tree death along the western side of the Harvey Estuary. Aerial photo, looking south over point on western side of the estuary (AMG 50- 376000 6377500), west-north-west of Herron Point. Photo taken 7 Dec 1999.

Plate 57. Tree death along the western shore of the Harvey Estuary, near White Hill Road. Photo taken 7 Dec 1999.

Plate 58. Aerial view of the western shore of the Harvey Estuary looking north towards Point Morfitt along the Park Ridge Reserve. Photo taken 7 Dec 1999.

Plate 59. Tree death along the western shore of the Harvey Estuary, looking north toward the southern Bay of Point Morfitt. Photo taken 7 Dec 1999.

Plate 60. Tree death near the boardwalk at Warrungup Spring along the western shore of the Harvey Estuary. Aerial photo taken 7 Dec 1999.

Plate 61. Boardwalk near Warrungup Spring, looking west towards the western shore of the Harvey Estuary and showing the tree death along the shoreline. Photo taken 16 Feb 2000.

Plate 62. Just south of Plate 61, looking west towards the western shore of the Harvey Estuary and showing the tree death along the shoreline. Photo taken 16 Feb 2000.

Plate 63. Just south of Plate 62, looking west towards the western shore of the Harvey Estuary and showing the tree death along the shoreline. Photo taken 16 Feb 2000.

Plate 64. View of tree death along the western shore of the Harvey Estuary near Dawesville. Photo taken 16 Feb 2000.

Plate 65. Tree death along the western shore of the Harvey Estuary near Dawesville. Photo taken 16 Feb 2000.

Plate 66. Aerial view, looking east, of the early stages of the marina and housing development near the RAMSAR listed Creery Island Wetlands. Photo taken 7 Dec 1999.

Plate 67. Aerial view, looking south, of the marina and housing development near the RAMSAR listed Creery Island Wetlands. Photo taken 16 Feb 2000.

Appendix 1
Locations of Samphire and Riverine transects.

Approximate locations of the Samphire Transects.

Austin Bay A and B:	32° 38'	115° 45'
Carrabungup A and B:	32° 33'	115° 43'
Creery Island A and B:	32° 38'	115° 43'
Mealup A and B:	32° 41'	115° 42'
North Kooljerrenup A and B:	32° 44'	115° 43'
South Kooljerrenup A and B:	32° 46'	115° 43'

GPS fixes of the locations of the Riverine Transects.

River Mouth:	32° 46' 23"	115° 42' 48"
O.0km:	32° 46' 25"	115° 42' 45"
0.5km:	32° 46' 41"	115° 42' 51"
1.0km:	32° 46' 55"	115° 42' 53"
1.5km:	32° 47' 12"	115° 42' 55"
2.0km:	32° 47' 28"	115° 42' 53"
2.5km:	32° 47' 42"	115° 42' 48"
3.0km:	32° 47' 48"	115° 42' 42"
3.5km:	32° 47' 59"	115° 42' 52"
4.0km:	32° 47' 58"	115° 43' 14"

Appendix 2
Plate index

Descriptions of plates (arranged in ascending plate number). Images of all the plates are located as jpg files on the attached CD. Photos are indexed by plate number, folder name and file name. Images should not be copied or reproduced without the permission of the copyright holders. Copyright for all photos contained within the Samphire 1994-1998 folder is held by Marine and Freshwater Laboratory, School of Environmental Science, Murdoch University (except Plate 5, 6, 11, 22, 23, 38 & 45). Copyright for all other photos, including Plate 5, 6, 11, 22, 23, 38 & 45 is held by the Department of Conservation and Land Management. Plates 68 - 79 are not reproduced or discussed in the report.

Plate number	Folder name	File name	Description of plate
Plate 1.	Samphire 1994-1998	AustinBayA_1994_0to140m	Transect A Austin Bay: 1994: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 2.	Samphire 1994-1998	AustinBayA_1996_0to140m	Transect A Austin Bay: 1996: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 3.	Samphire 1994-1998	AustinBayA_1997_0to20m	Transect A Austin Bay: 1997: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 4.	Samphire 1994-1998	AustinBayA_1998_0to10m	Transect A Austin Bay: 1998: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 5.	Samphire 1994-1998	AerialviewAustinBayADec99	An aerial view looking east of the samphire transect at Austin Bay transect A on 7 Dec 1999.
Plate 6	Samphire 1994-1998	AerialviewAustinBayAFeb00	An aerial view looking east of the samphire transect at Austin Bay transect A on 16 Feb 2000. Note higher tide than seen in previous plate.
Plate 7.	Samphire 1994-1998	AustinBayB_1994_0to120m	Transect B Austin Bay: 1994: looking south from the 0 metre mark at the waters edge to the 120 metre mark inland.
Plate 8.	Samphire 1994-1998	AustinBayB_1996_0to120m	Transect B Austin Bay: 1996: looking south from the 0 metre mark at the waters edge to the 120 metre mark inland.
Plate 9.	Samphire 1994-1998	AustinBayB_1997_10to20m	Transect B Austin Bay: 1997: looking south from the 10 metre mark near the waters edge to the 20 metre mark inland.
Plate 10.	Samphire 1994-1998	AustinBayB_1998_10to20m	Transect B Austin Bay: 1998: looking south from the 10 metre mark near the waters edge to the 20 metre mark inland.
Plate 11.	Samphire 1994-1998	AerialviewAustinBayB2	An aerial view looking east of Austin Bay transect B
Plate 12.	Samphire	CarraburmupA_1996_0to60m	Transect A Carraburmup: 1996: looking east from the 0 metre mark at

	1994-1998		the waters edge to the 60m metre mark inland.
Plate 13.	Samphire 1994-1998	CarraburmupA_1997_0to20m	Transect A Carraburmup: 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 14.	Samphire 1994-1998	CarraburmupA_1998_0to20m	Transect A Carraburmup: 1998: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 15.	Samphire 1994-1998	CarraburmupB_1994_0to60m	Transect B Carraburmup: 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 16.	Samphire 1994-1998	CarraburmupB_1996_0to60m	Transect B Carraburmup: 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 17.	Samphire 1994-1998	CarraburmupB_1997_0to40m	Transect B Carraburmup: 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 18.	Samphire 1994-1998	CreeryIslandA_1994_0to20m	Transect A Creery Island 1994: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 19.	Samphire 1994-1998	CreeryIslandA_1996_0to20m	Transect A Creery Island 1996: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 20.	Samphire 1994-1998	CreeryIslandA_1997_0to20m	Transect A Creery Island 1997: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 21.	Samphire 1994-1998	CreeryIslandA_1998_10to20m	Transect A Creery Island 1998: looking north from the 0 metre mark near the waters edge to the 20m metre mark inland.
Plate 22.	Samphire 1994-1998	AerialviewCreeryIslandB1	An aerial view looking north of the samphire transect, Creery Island, on 7 Dec 1999.
Plate 23.	Samphire 1994-1998	AerialviewCreeryIslandB2	An aerial view looking north of the samphire transect, Creery Island, on 7 Dec 1999.
Plate 24.	Samphire 1994-1998	CreeryIslandB_1996_0to20m	Transect B Creery Island 1996: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 25.	Samphire 1994-1998	CreeryIslandB_1997_0to20m	Transect B Creery Island 1997: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 26.	Samphire 1994-1998	MealupA_1994_0to40m	Transect A Mealup 1994: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 27.	Samphire 1994-1998	MealupA_1996_0to40m	Transect A Mealup 1996: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 28.	Samphire 1994-1998	MealupA_1997_0to40m	Transect A Mealup 1997: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 29.	Samphire 1994-1998	MealupA_1998_0to10m	Transect A Mealup 1998: looking north-east from the 0 metre mark at the waters edge to the 10m metre mark inland.

Plate 30.	Samphire 1994-1998	MealupA_1998_10to20m	Transect A Mealup 1998: looking north-east from the 10 metre mark near the waters edge to the 20m metre mark inland.
Plate 31.	Samphire 1994-1998	MealupB_1994_0to40m	Transect B Mealup 1994: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 32.	Samphire 1994-1998	MealupB_1996_0to40m	Transect B Mealup 1996: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 33.	Samphire 1994-1998	MealupB_1997_0to40m	Transect B Mealup 1997: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 34.	Samphire 1994-1998	NorthKooljerrenupA_1994_0to60m	Transect A North Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 35.	Samphire 1994-1998	NorthKooljerrenupA_1996_0to60m	Transect A North Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 36.	Samphire 1994-1998	NorthKooljerrenupA_1997_10to60m	Transect A North Kooljerrenup 1997: looking east from the 10 metre mark to the 60m metre mark inland.
Plate 37.	Samphire 1994-1998	NorthKooljerrenupA_1998_10to20m	Transect A North Kooljerrenup 1998: looking east from the 10 metre mark the 60m metre mark inland.
Plate 38.	Samphire 1994-1998	AerialviewNorthKooljerrenupA	Aerial view, looking east, of the Samphire Transects at North Kooljerrenup on 16 Feb 2000.
Plate 39.	Samphire 1994-1998	NorthKooljerrenupB_1994_0to60m	Transect B North Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 40.	Samphire 1994-1998	NorthKooljerrenupB_1996_0to60m	Transect B North Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland. Note fire impact on fringing vegetation.
Plate 41.	Samphire 1994-1998	NorthKooljerrenupB_1997_0to60m	Transect B North Kooljerrenup 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 42.	Samphire 1994-1998	NorthKooljerrenupB_1998_10to20m	Transect B North Kooljerrenup 1998: looking east from the 10 metre mark near the waters edge to the 20m metre mark inland.
Plate 43.	Samphire 1994-1998	SouthKooljerrenupA_1997_20to100m	Transect A South Kooljerrenup 1997: looking east from the 20 metre mark near the waters edge to the 100m metre mark inland.
Plate 44.	Samphire 1994-1998	SouthKooljerrenupA_1998_20to60m	Transect A South Kooljerrenup 1998: looking east from the 20 metre mark near the waters edge to the 60m metre mark inland
Plate 45.	Samphire 1994-1998	AerialviewSouthKooljerrenupA	An aerial view of South Kooljerrenup transect A
Plate 46.	Samphire 1994-1998	SouthKooljerrenupB_1994_0to140m	Transect B South Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.

Plate 47.	Samphire 1994-1998	SouthKooljerrenupB_1996_0to140m	Transect B South Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 48.	Samphire 1994-1998	SouthKooljerrenupB_1997_0to140m	Transect B South Kooljerrenup 1997: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 49.	Samphire 1994-1998	SouthKooljerrenupB_1998_0to140m	Transect B South Kooljerrenup 1998: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 50.	Wetland	Aerialview_WetlandTransects	An aerial view, looking east, of the wetlands at Austin Bay where the wetland transect were located. Photo taken on 7 Dec 1999.
Plate 51.	Riverine 1995-1997	Aerialview_HarveyRiverMouth1	An aerial view looking east of the mouth of the Harvey River where the riverine transects were monitored. Photo taken 7 Dec 1999.
Plate 52.	Riverine 1995-1997	Aerialview_HarveyRiverMouth2	An aerial view looking north west of the mouth of the Harvey River where the riverine transects were monitored. Photo taken 7 Dec 1999.
Plate 53.	Riverine 1995-1997	Aerialview_HarveyRiver1	An aerial view looking north east of the Harvey River where the riverine transects were monitored. Photo taken 7 Dec 1999.
Plate 54.	Riverine 1995-1997	Aerialview_HarveyRiver2	An aerial view of the Harvey River where the riverine transects were monitored. Photo taken 7 Dec 1999.
Plate 55.	Tree Death	Treedeath2	Tree death on the western side of the Harvey estuary. Aerial photo taken of bay north od point (AMG 50- 376000 6377500) shown in plate 56. Photo taken 7 Dec 1999.
Plate 56.	Tree Death	Treedeath1	Tree death on the western side of the Harvey estuary. Aerial photo, looking south over point on western side of estuary (AMG 50- 376000 6377500), west-north-west of Herron Point. Photo taken 7 Dec 1999.
Plate 57.	Tree Death	Treedeath10	Tree death on the western shore of Harvey estuary, near White Hill Road. Photo taken 7 Dec 1999.
Plate 58.	Tree Death	Treedeath11	Aerial view of western shore of the Harvey estuary looking north towards Point Morfitt along the Park Ridge Reserve. Photo taken 7 Dec 1999.
Plate 59.	Tree Death	Treedeath5	Tree death along the western shore of the Harvey estuary, looknig north toward the southern bay of Point Morfitt. Photo taken 7 Dec 1999.
Plate 60.	Tree Death	Treedeath8	Tree death near boadrwalk at Warrungup Spring along the western shore of the Harvey estuary. Photo taken 7 Dec 1999.
Plate 61.	Tree Death	Treedeath4	Boardwalk at Warrungup Spring, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.

Plate 62.	Tree Death	Treedeath6	Just south of plate 61, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.
Plate 63.	Tree Death	Treedeath7	Just south of plate 62, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.
Plate 64.	Tree Death	Treedeath9	View of tree death along western shore of the Harvey estuary near Dawesville. Photo taken 16 Feb 2000.
Plate 65.	Tree Death	Treedeath3	Tree death along western shore of the Harvey estuary near Dawesville. Photo taken 16 Feb 2000.
Plate 66.	Development	Marinadevelopment1	An aerial view, looking east, of the urban and marina development adjacent to the RAMSAR listed Creery Island wetlands. Photo taken 7 Dec 1999.
Plate 67.	Development	Marinadevelopment2	An aerial view, looking south, of the urban and marina development adjacent to the RAMSAR listed Creery Island wetlands. Photo taken 16 Feb 2000.
Plate 68.	Samphire 1994-1998	AustinBayA_1996_40to140m	Transect A Austin Bay: 1996: 40-140m
Plate 69.	Samphire 1994-1998	CarraburmupB_1996_20to60m	Transect B Carraburmup: 1996: 20-60 m
Plate 70.	Samphire 1994-1998	CarraburmupB_1997_20to40m	Transect B Carraburmup: 1997: 20-40 m
Plate 71.	Samphire 1994-1998	CarraburmupB_1998_20to40m	Transect B Carraburmup: 1998: 20-40 m
Plate 72.	Samphire 1994-1998	CarraburmupB_1997_20to40m	Transect B Carraburmup: 1997: 20-40 m
Plate 73.	Samphire 1994-1998	CarraburmupB_1998_20to40m	Transect B Carraburmup: 1998: 20-40 m
Plate 74.	Samphire 1994-1998	CreeryIslandA_1997_60to200m	Transect A Creery Island 1997: 60 - 200 m
Plate 75.	Samphire 1994-1998	CreeryIslandA_1998_70to200m	Transect A Creery Island 1998: 70 - 200 m
Plate 76.	Samphire 1994-1998	NorthKooljerrenupA_1996_20to60m	Transect A North Kooljerrenup 1996: 20 - 60 m
Plate 77.	Samphire	NorthKooljerrenupA_1997_20to60m	Transect A North Kooljerrenup 1997: 20 - 60 m

	1994-1998		
Plate 78.	Samphire 1994-1998	NorthKooljerrenupA_1998_20to60 m	Transect A North Kooljerrenup 1998: 20 - 60 m
Plate 79.	Samphire 1994-1998	SouthKooljerrenupA_1996_10to60m	Transect A South Kooljerrenup 1996: 10 - 60 m

Appendix 3

Plate index

Descriptions of plates (arranged in transect order). Images of all the plates are located as jpg files on the attached CD. Photos are indexed by plate number, folder name and file name. Images should not be copied or reproduced without the permission of the copyright holders. Copyright for all photos contained within the Samphire 1994-1998 folder is held by Marine and Freshwater Laboratory, School of Environmental Science, Murdoch University (except Plate 5, 6, 11, 22, 23, 38 & 45). Copyright for all other photos, including Plate 5, 6, 11, 22, 23, 38 & 45, is held by the Department of Conservation and Land Management.

Plate number	**Folder name**	**File name**	**Description of plate**
Plate 1.	Samphire 1994-1998	AustinBayA_1994_0to140m	Transect A Austin Bay: 1994: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 2.	Samphire 1994-1998	AustinBayA_1996_0to140m	Transect A Austin Bay: 1996: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 68.	Samphire 1994-1998	AustinBayA_1996_40to140m	Transect A Austin Bay: 1996: 40-140m
Plate 3.	Samphire 1994-1998	AustinBayA_1997_0to20m	Transect A Austin Bay: 1997: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 4.	Samphire 1994-1998	AustinBayA_1998_0to10m	Transect A Austin Bay: 1998: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 5.	Samphire 1994-1998	AerialviewAustinBayADec99	An aerial view looking east of the samphire transect at Austin Bay transect A on 7 Dec 1999.
Plate 7.	Samphire 1994-1998	AustinBayB_1994_0to120m	Transect B Austin Bay: 1994: looking south from the 0 metre mark at the waters edge to the 120 metre mark inland.
Plate 8.	Samphire 1994-1998	AustinBayB_1996_0to120m	Transect B Austin Bay: 1996: looking south from the 0 metre mark at the waters edge to the 120 metre mark inland.
Plate 9.	Samphire 1994-1998	AustinBayB_1997_10to20m	Transect B Austin Bay: 1997: looking south from the 10 metre mark near the waters edge to the 20 metre mark inland.
Plate 10.	Samphire 1994-1998	AustinBayB_1998_10to20m	Transect B Austin Bay: 1998: looking south from the 10 metre mark near the waters edge to the 20 metre mark inland.
Plate 11.	Samphire 1994-1998	AerialviewAustinBayB2	An aerial view looking east of Austin Bay transect B
Plate 12.	Samphire 1994-1998	CarraburmupA_1996_0to60m	Transect A Carraburmup: 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.

Plate 13.	Samphire 1994-1998	CarraburmupA_1997_0to20m	Transect A Carraburmup: 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 14.	Samphire 1994-1998	CarraburmupA_1998_0to20m	Transect A Carraburmup: 1998: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 15.	Samphire 1994-1998	CarraburmupB_1994_0to60m	Transect B Carraburmup: 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 16.	Samphire 1994-1998	CarraburmupB_1996_0to60m	Transect B Carraburmup: 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 17.	Samphire 1994-1998	CarraburmupB_1997_0to40m	Transect B Carraburmup: 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 72.	Samphire 1994-1998	CarraburmupB_1997_20to40m	Transect B Carraburmup: 1997: 20-40 m
Plate 69.	Samphire 1994-1998	CarraburmupB_1996_20to60m	Transect B Carraburmup: 1996: 20-60 m
Plate 70.	Samphire 1994-1998	CarraburmupB_1997_20to40m	Transect B Carraburmup: 1997: 20-40 m
Plate 71.	Samphire 1994-1998	CarraburmupB_1998_20to40m	Transect B Carraburmup: 1998: 20-40 m
Plate 73.	Samphire 1994-1998	CarraburmupB_1998_20to40m	Transect B Carraburmup: 1998: 20-40 m
Plate 18.	Samphire 1994-1998	CreeryIslandA_1994_0to20m	Transect A Creery Island 1994: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 19.	Samphire 1994-1998	CreeryIslandA_1996_0to20m	Transect A Creery Island 1996: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 20.	Samphire 1994-1998	CreeryIslandA_1997_0to20m	Transect A Creery Island 1997: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 74.	Samphire 1994-1998	CreeryIslandA_1997_60to200m	Transect A Creery Island 1997: 60 - 200 m
Plate 21.	Samphire 1994-1998	CreeryIslandA_1998_10to20m	Transect A Creery Island 1998: looking north from the 0 metre mark near the waters edge to the 20m metre mark inland.
Plate 75.	Samphire 1994-1998	CreeryIslandA_1998_70to200m	Transect A Creery Island 1998: 70 - 200 m
Plate 22.	Samphire 1994-1998	AerialviewCreeryIslandB1	An aerial view looking north of the samphire transect, Creery Island, on 7 Dec 1999.
Plate 23.	Samphire	AerialviewCreeryIslandB2	An aerial view looking north of the samphire transect, Creery Island,

	1994-1998		on 7 Dec 1999.
Plate 24.	Samphire 1994-1998	CreeryIslandB_1996_0to20m	Transect B Creery Island 1996: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 25.	Samphire 1994-1998	CreeryIslandB_1997_0to20m	Transect B Creery Island 1997: looking north from the 0 metre mark at the waters edge to the 20m metre mark inland.
Plate 66.	Development	Marinadevelopment1	An aerial view, looking east, of the urban and marina development adjacent to the RAMSAR listed Creery Island wetlands. Photo taken 7 Dec 1999.
Plate 67.	Development	Marinadevelopment2	An aerial view, looking south, of the urban and marina development adjacent to the RAMSAR listed Creery Island wetlands. Photo taken 16 Feb 2000.
Plate 26.	Samphire 1994-1998	MealupA_1994_0to40m	Transect A Mealup 1994: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 27.	Samphire 1994-1998	MealupA_1996_0to40m	Transect A Mealup 1996: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 28.	Samphire 1994-1998	MealupA_1997_0to40m	Transect A Mealup 1997: looking north-east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 30.	Samphire 1994-1998	MealupA_1998_10to20m	Transect A Mealup 1998: looking north-east from the 10 metre mark near the waters edge to the 20m metre mark inland.
Plate 31.	Samphire 1994-1998	MealupB_1994_0to40m	Transect B Mealup 1994: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 32.	Samphire 1994-1998	MealupB_1996_0to40m	Transect B Mealup 1996: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 33.	Samphire 1994-1998	MealupB_1997_0to40m	Transect B Mealup 1997: looking east from the 0 metre mark at the waters edge to the 40m metre mark inland.
Plate 34.	Samphire 1994-1998	NorthKooljerrenupA_1994_0to60m	Transect A North Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 35.	Samphire 1994-1998	NorthKooljerrenupA_1996_0to60m	Transect A North Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 76.	Samphire 1994-1998	NorthKooljerrenupA_1996_20to60m	Transect A North Kooljerrenup 1996: 20 - 60 m
Plate 36.	Samphire 1994-1998	NorthKooljerrenupA_1997_10to60m	Transect A North Kooljerrenup 1997: looking east from the 10 metre mark to the 60m metre mark inland.
Plate 37.	Samphire 1994-1998	NorthKooljerrenupA_1998_10to20m	Transect A North Kooljerrenup 1998: looking east from the 10 metre mark the 60m metre mark inland.

Plate 38.	Samphire 1994-1998	AerialviewNorthKooljerrenupA	Aerial view, looking east, of the Samphire Transects at North Kooljerrenup on 16 Feb 2000.
Plate 39.	Samphire 1994-1998	NorthKooljerrenupB_1994_0to60m	Transect B North Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 40.	Samphire 1994-1998	NorthKooljerrenupB_1996_0to60m	Transect B North Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland. Note fire impact on fringing vegetation.
Plate 41.	Samphire 1994-1998	NorthKooljerrenupB_1997_0to60m	Transect B North Kooljerrenup 1997: looking east from the 0 metre mark at the waters edge to the 60m metre mark inland.
Plate 42.	Samphire 1994-1998	NorthKooljerrenupB_1998_10to20m	Transect B North Kooljerrenup 1998: looking east from the 10 metre mark near the waters edge to the 20m metre mark inland.
Plate 43.	Samphire 1994-1998	SouthKooljerrenupA_1997_20to100m	Transect A South Kooljerrenup 1997: looking east from the 20 metre mark near the waters edge to the 100m metre mark inland.
Plate 44.	Samphire 1994-1998	SouthKooljerrenupA_1998_20to60m	Transect A South Kooljerrenup 1998: looking east from the 20 metre mark near the waters edge to the 60m metre mark inland
Plate 45.	Samphire 1994-1998	AerialviewSouthKooljerrenupA	An aerial view of South Kooljerrenup transect A
Plate 79.	Samphire 1994-1998	SouthKooljerrenupA_1996_10to60m	Transect A South Kooljerrenup 1996: 10 - 60 m
Plate 46.	Samphire 1994-1998	SouthKooljerrenupB_1994_0to140m	Transect B South Kooljerrenup 1994: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 47.	Samphire 1994-1998	SouthKooljerrenupB_1996_0to140m	Transect B South Kooljerrenup 1996: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 48.	Samphire 1994-1998	SouthKooljerrenupB_1997_0to140m	Transect B South Kooljerrenup 1997: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 49.	Samphire 1994-1998	SouthKooljerrenupB_1998_0to140m	Transect B South Kooljerrenup 1998: looking east from the 0 metre mark at the waters edge to the 140m metre mark inland.
Plate 50.	Wetland	Aerialview_WetlandTransects	An aerial view of the wetland transects looking east from the waters edge over the wetlands
Plate 51.	Riverine 1995-1997	Aerialview_HarveyRiverMouth1	An aerial view looking east of the mouth of the Harvey River where the riverine transects were monitored
Plate 52.	Riverine 1995-1997	Aerialview_HarveyRiverMouth2	An aerial view looking north west of the mouth of the Harvey River where the riverine transects were monitored
Plate 53.	Riverine 1995-1997	Aerialview_HarveyRiver1	An aerial view looking north east of the Harvey River where the riverine transects were monitored

Plate 54.	Riverine 1995-1997	Aerialview_HarveyRiver2	An aerial view of the Harvey River where the riverine transects were monitored
Plate 55.	Tree Death	Treedeath2	Tree death on the western side of the Harvey estuary. Aerial photo taken of bay north od point (AMG 50- 376000 6377500) shown in plate 56. Photo taken 7 Dec 1999.
Plate 56.	Tree Death	Treedeath1	Tree death on the western side of the Harvey estuary. Aerial photo, looking south over point on western side of estuary (AMG 50- 376000 6377500), west-north-west of Herron Point. Photo taken 7 Dec 1999.
Plate 57.	Tree Death	Treedeath10	Tree death on the western shore of Harvey estuary, near White Hill Road. Photo taken 7 Dec 1999.
Plate 58.	Tree Death	Treedeath11	Aerial view of western shore of the Harvey estuary looking north towards Point Morfitt along the Park Ridge Reserve. Photo taken 7 Dec 1999.
Plate 59.	Tree Death	Treedeath5	Tree death along the western shore of the Harvey estuary, looknig north toward the southern bay of Point Morfitt. Photo taken 7 Dec 1999.
Plate 60.	Tree Death	Treedeath8	Tree death near boadrwalk at Warrungup Spring along the western shore of the Harvey estuary. Photo taken 7 Dec 1999.
Plate 61.	Tree Death	Treedeath4	Boardwalk at Warrungup Spring, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.
Plate 62.	Tree Death	Treedeath6	Just south of plate 61, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.
Plate 63.	Tree Death	Treedeath7	Just south of plate 62, looking west toward the western shore of the Harvey estuary and showing tree death along shoreline. Photo taken 16 Feb 2000.
Plate 64.	Tree Death	Treedeath9	View of tree death along western shore of the Harvey estuary near Dawesville. Photo taken 16 Feb 2000.
Plate 65.	Tree Death	Treedeath3	Tree death along western shore of the Harvey estuary near Dawesville. Photo taken 16 Feb 2000.