KABAY
rehabilitation environmental and biological
CONSULTANTS Pty Ltd
ACN 085 315 546
252 French Street
Tuart Hill
WA 6060
Phone 61-08 9349 0401
FAX 61-08-9349 0401
Email dkabay@iinet.net.au
Mobile 0417 950 508

ABN 20 085 315 546

Salinity Action Plan

Wetland Vegetation Monitoring

2001/2002

Report

July 2002

ED Kabay

Contents

Introduction 7

Methods 7

Data Collection 8
Invitro soil salinity 8
Digital Photographs 11
Retagging 12
GPS Measurements 12
Data analysis 12

Lake View (Blue Gum Swamp) 13

Description 13
Transects 13
Results 13
Population Structure and Tree Vigour 13
Changes in understorey composition 15
Soil Characteristics 17
Summary 17

Maisey's Wetland 1 19

Description 19
Transects 19
Results 19
Population Structure and Tree Vigour 19
Changes in understorey composition 22
Soil Characteristics 24
Summary 24

Maisey's Wetland 2 25

Description 25
Transects 25
Results 25
Population Structure and Tree Vigour 25
Changes in understorey composition 26
Soil Characteristics 27
Summary 27

Lake Logue 29

Description 29

Transects *29*

Results *29*
Population Structure and Tree Vigour 29
Changes in understorey composition 31
Soil Characteristics 31

Summary *32*

Walyormouring Lake **33**

Description *33*

Transects *33*

Results *33*
Population Structure and Tree Vigour 33
Changes in understorey composition 34
Soil Characteristics 35

Summary *35*

Lake Eganu **37**

Description *37*

Transects *37*

Results *37*
Population Structure and Tree Vigour 37
Changes in understorey composition 39
Soil Characteristics 41

Summary *41*

Ardath Lake **43**

Description *43*

Transects *43*

Results *43*
Population Structure and Tree Vigour 43
Changes in understorey composition 44
Soil Characteristics 47

Summary *47*

Lake Campion **49**

Description *49*

Transects *49*

Results *49*
Population Structure and Tree Vigour 49
Changes in understorey composition 55
Soil Characteristics 61

Summary *62*

Paperbark Swamp **64**

Description *64*

Transects *64*

Results *64*
Population Structure and Tree Vigour 64
Changes in understorey composition 67
Soil Characteristics 69

Summary *69*

Goonaping Swamp **71**

Description *71*

Transects *71*

Results *71*
Population Structure and Tree Vigour 71
Changes in understorey composition 74
Soil Characteristics 78

Summary *78*

References **80**

List of Figures

Figure 1 Size Class Distributions for *Casuarina obesa, Eucalyptus rudis* and *Melaleuca strobophylla* at Lake View. 15
Figure 2 Species Distribution along Lake View Transect 2 in 1998 and 2002 16
Figure 3. Size Class Distributions for *Casuarina obesa, Eucalyptus loxophleba, Eucalyptus salmonophloia* and *Melaleuca strobophylla* for Maisey's Wetland 1 21
Figure 4. Species Distribution along Maisey's Wetland 1 Transect 1 in 1998 and 2002 22
Figure 5. Species Distribution along Maisey's Wetland 1 Transect 2 in 1998 and 2002 23
Figure 6. Size Class Distributions for *Melaleuca strobophylla* Maisey's Wetland 2. 26
Figure 7. Species Distribution along Maisey's Wetland 2 Transect 2 in 1998 and 2002 27
Figure 8. Size Class Distributions for *Casuarina obesa* and *Melaleuca strobophylla* at Lake Logue 30
Figure 9. Species Distribution along Lake Logue Transect 2 in 1997 and 2000 31
Figure 10. Size Class Distributions for *Casuarina obesa* for Walyormouring Lake 34
Figure 11. Species Distribution along Walyormouring Lake Transect 1 in 1998 and 2002 34
Figure 12. Species Distribution along Walyormouring Lake Transect 2 in 1998 and 2002 35
Figure 13. Size Class Distributions for *Casuarina obesa, Eucalyptus loxophleba,* and *Melaleuca strobophylla* at Lake Eganu 39
Figure 14. Species Distribution along Lake Eganu Transect 1 in 1998 and 2002 40
Figure 15. Species Distribution along Lake Eganu Transect 2 in 1998 and 2002 40
Figure 16. Species Distribution along Lake Eganu Transect 3 in 1998 and 2002 40
Figure 17. Size Class Distributions for *Casuarina obesa* and *Eucalyptus yilgarnensis* at Ardath. 44
Figure 18. Species Distribution along Ardath Lake Transect 1 in 1998 and 2002 45
Figure 19. Species Distribution along Ardath Lake Transect 2 in 1998 and 2002 46
Figure 20. Size Class Distributions for *Acacia acuminata, A? prainii, Acacia sp, Alyxia buxifolia, Bossiaea ?rufa, Callitris glaucophylla, Dodonaea filifolia, Eremophila oppositifolia angustifolia, Eucalyptus yilgarnensis Melaleuca uncinata* and *M pauperiflora* at Lake Campion 55
Figure 21. Species Distribution along Lake Campion Transect 1 in 1998 and 2002 56

Figure 22. Species Distribution along Lake Campion Transect 2 in 1998 and 2002 57
Figure 23. Species Distribution along Lake Campion Transect 3 in 1998 and 2002 58
Figure 24. Species Distribution along Lake Campion Transect 4 in 1998 and 2002 59
Figure 25. Size Class Distributions for *Eucalyptus loxophleba, Eucalyptus yilgarnensis, Melaleuca lateriflora,* and *Melaleuca strobophylla* at Paperbark Swamp 67
Figure 26. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002 68
Figure 27. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002 68
Figure 28. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002 68
Figure 29. Size Class Distributions for *Eucalyptus wandoo, Eucalyptus rudis, Eucalyptus marginata* and *Melaleuca preissiana* at Goonaping Swamp 73
Figure 30. Species Distribution along Goonaping Swamp Transect 1 in 1997 and 2000 74
Figure 31. Species Distribution along Goonaping Swamp Transect 2 in 1998 and 2002 75
Figure 32. Species Distribution along Goonaping Swamp Transect 3 in 1998 and 2002 76

List of Tables

Table 1 In vitro soil salinities of selected location within a transect. (see Methods for definition of "Dist along" and "Dist out" 9
Table 2. Summary of Tree Data for Lake View 15
Table 3 Summary of understorey species distribution in all Transects at Lake View 16
Table 4 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake View over the two sampling periods 17
Table 5 Summary of Lake View Data 17
Table 6. Summary of Tree Data for Maisey's Wetland 1 22
Table 7 Summary of understorey species distribution in all Transects at Maisey's Wetland 1 23
Table 8 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Maizeys over the 3 year period 24
Table 9 Summary of data for Maizey 1 24
Table 10. Summary of Tree Data for Maisey's Wetland 2 26
Table 11 Summary Of Understorey Species Distribution In All Transects At Maisey's Wetland 2 ... 27
Table 12 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Maizeys 2 over the two Sampling Periods 27
Table 13 Summary of Data for Lake Maisey 2 28
Table 14. Summary of Tree Data for Lake Logue 31
Table 15 Summary Of Understorey Species Distribution In All Transects At Lake Logue 31
Table 16 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Logue over the Two Sampling Periods 31
Table 17 Summary of data from Lake Logue 32
Table 18. Summary of Tree Data for Walyormouring Lake 34
Table 19 Summary Of Understorey Species Distribution In All Transects At Walyormouring Lake 35
Table 20 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Walyormouring over the Two Sampling Periods. 35
Table 21 Summary of data for Lake Walymorouring 36
Table 22. Summary of Tree Data for Lake Eganu 39
Table 23 Summary Of Understorey Species Distribution In All Transects At Lake Eganu 40
Table 24 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Eganu over the Two Sampling Periods 41
Table 25 Summary of data for Lake Eagnu 42
Table 26. Summary of Tree Data for Ardath Lake 44
Table 27 Summary Of Understorey Species Distribution In All Transects At Ardath Lake 46

Table 28 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Ardath over the Two Sampling Periods. 47
Table 29 Summary of data for Lake Ardath 47
Table 30. Summary of Tree Data for Lake Campion 55
Table 31 Summary Of Understorey Species Distribution In All Transects At Lake Campion 59
Table 32 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Campion over the Two Sampling Periods. 62
Table 33 Summary of data for Lake Campion 62
Table 34. Summary of Tree Data for Paperbark Swamp 67
Table 35 Summary Of Understorey Species Distribution In All Transects At Paperbark Swamp 69
Table 36 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Paperbark Swamp over the Two Sampling Periods. 69
Table 37 Summary of data for Paperbark Swamp 70
Table 38. Summary of Tree Data for Goonaping Swamp 74
Table 39 Summary Of Understorey Species Distribution In All Transects At Goonaping Swamp 77
Table 40 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Goonapping Swamp over the Two Sampling Periods. 78
Table 41 Summary of data for Goonapping Swamp 78

Introduction

This report represents the results of the second monitoring period of a subset of lakes of the vegetation component of a project designed to provide on-going monitoring of wetland salinity and biological resources in wetlands of the agricultural zone of south-west Western Australia. Maintenance of wetland biological diversity in the agricultural zone is one of the major objectives of the Salinity Action Plan. Due to their low position in the landscape, wetlands are the habitat most affected by salinisation

The wetland monitoring project has four specific objectives, only one of which is relevant to this report:

1) Analyze and report trends in salinity and depth of agricultural zone wetlands monitored by CALM since 1978.
2) Monitor salinity, depth and nutrient status of a broad range of wetlands.
3) Monitor water birds, fish, frogs and aquatic invertebrates in a sub-set of wetlands to measure any changes in fauna of the wetlands.
4) **Monitor floristic composition and tree health in the same sub-set of wetlands to measure any changes in flora occurring in, and around the wetlands.**

Work presented in this document is an integral part of the overall project and will specifically address the fourth objective. Information from other components of the project that address the remaining objectives, will be used to interpret change in the vegetation and the impact this may have on fauna.

The objective, scope and approach of the study are outlined in the first report for this set of lakes (R. Gurner, R. Froend and G. Ogden 1999).

During 2001/02, vegetation was re-assessed at 9 wetlands, which had been initially measured in 1998/99 namely:

Site	Category
Logue	Fresh
Eganu	2° saline
Lake View	Declining
Walyormouring	2° saline
Dowerin	Fresh
Campion	1° saline
Goonaping	Fresh
Ardath Lake	1° saline
Paperbark	Fresh

Methods

The same methods as outlined in R. Gurner, R. Froend and G. Ogden (1999) were used in the second monitoring program for these lakes except for the following. Where the exact method could not be clearly understood the following were used.

Seedling: This was defined as small plants usually less than 2mm (but could bee larger) in Diameter at Breast Height but did not have their Mean Crown Score (MCS)measured. Rather their crown was defined as being healthy, stressed, slightly stressed or very stressed. The "seedling" data referred to in

Tables that document "Summary of Trees Data...." for the various lakes refers to these "seedlings". The MCS then refers to only "trees" and a "tree" is defined as having its Crown Scored.

The data for the histogram referred only to trees and seedlings that had their DBH measured. The data in the Table above and the histogram may not co inside regards to "Seedlings" and" Numbers <2cm"

Data Collection

The lakes were visited between late spring 2001 and late summer 2002. Some lakes had to the re visited or delayed being surveyed because access to some transects were limited by the presence of lake water.

Invitro soil salinity

As the salinities (EM38 measurements both in the vertical -deep 1.5m salinities- and the horizontal-shallow salinities modes) of the various locations within a transects were being made, soil samples were collected from the top 10cm in the area where the soil conductivities with the EM38 meter were being carried out. These were stored in labeled plastic bags and taken back to the laboratory (Murdock University)

"Dist (Distance) out" is the distance from the datum peg (left hand side facing lake at which the GPS reading was taken) along the base of the transect. It can be left hand side=0m, middle=10m or Right hand side or boundary of the transect =20m from the datum peg. "Dist (Distance) Along" is the distance from the 20m side of the transect along the transect towards the lake (see GPS Readings following)

Electrical conductivity of soil solution was determined using a 1:5 (w/v) soil water extract. Samples were prepared as per Rayment and Higginson (1992) with the following modifications.

Soil samples were air-dried and sieved where necessary to remove course particles (>2mm). 50 ml of deionised water was added to 10±0.05 g of soil in a centrifuge vial.

The samples were shaken in a rotary mechanical shaker for 60 minutes and centrifuged for 10 minutes at 4000 rpm before electrical conductivity of supernatant liquid was measured with a Hanna HI 8733 electrical conductivity meter

The data is tabulated in Table 1. The code is as follows

Code	Lake
Al	Ardath Lake
CAMP	Campion
GOO	Goonaping
LE	Eganu
LOG	Logue
PB	Paperbark

Code	Lake
LV	Lake View
LW	Walyormouring
MAI (1)	Dowerin 1
MAI (2)	Dowerin 2

Table 1 In vitro soil salinities of selected location within a transect. (see Methods for definition of "Dist along" and "Dist out"

Lake	Transect	Dist along	Dist out	mS/m
AL	T1	0	0	823
AL	T1	8	20	1916
AL	T1	8	10	1008
AL	T1	16	0	1687
AL	T1	20	20	1181
AL	T1	24	10	1029
AL	T1	32	20	409
AL	T1	36	10	641
AL	T1	36	0	767
AL	T2	0	0	50.7
AL	T2	4	20	315
AL	T2	8	10	148.8
AL	T2	16	0	528
AL	T2	20	10	559
AL	T2	24	20	835
AL	T2	32	0	1181
AL	T2	36	10	681
AL	T2	40	20	987
CAMP	T1	0	20	36.2
CAMP	T1	4	0	45.2
CAMP	T1	8	10	22.2
CAMP	T1	16	20	39.6
CAMP	T1	20	0	108.2
CAMP	T1	24	10	77.4
CAMP	T1	28	20	3.27
CAMP	T1	32	0	3.86
CAMP	T1	36	10	9.56
CAMP	T1	40	20	8.6
CAMP	T2	0	0	10.47
CAMP	T2	0	20	4.2
CAMP	T2	4	10	34
CAMP	T2	12	20	3.18
CAMP	T2	16	0	2.74
CAMP	T2	20	10	1.83
CAMP	T2	28	20	1.22
CAMP	T2	28	0	1.82
CAMP	T2	36	10	12.83
CAMP	T2	40	0	7.98
CAMP	T2	44	20	5.17
CAMP	T2	52	0	849
CAMP	T2	56	10	9.9
CAMP	T2	60	20	42.2
CAMP	T3	0	10	2.4
CAMP	T3	4	20	17.4
CAMP	T3	4	0	15.66
CAMP	T3	12	10	36.4
CAMP	T3	20	0	10.82
CAMP	T3	20	20	9.77
CAMP	T3	28	10	53.4
CAMP	T3	32	0	10.99
CAMP	T3	36	20	1.09
CAMP	T3	44	10	3
CAMP	T3	48	0	17.08
CAMP	T3	50	10	58.6
CAMP	T3	52	20	2.98
CAMP	T3	60	0	228
CAMP	T4	0	0	5.02
CAMP	T4	4	10	2.89
CAMP	T4	12	20	3.65
CAMP	T4	20	0	23.5
CAMP	T4	24	10	97
CAMP	T4	28	20	14.1
CAMP	T4	36	10	540
CAMP	T4	40	0	301
GOO	T1	0	10	4.26
GOO	T1	4	0	7.24
GOO	T1	12	20	3.67
GOO	T1	16	10	5.44
GOO	T1	24	0	4.23
GOO	T1	32	20	3.12
GOO	T1	36	10	6.71
GOO	T1	44	0	4.19
GOO	T1	48	20	4.86
GOO	T1	52	10	6.99
GOO	T1	60	0	5.58
GOO	T2	0	0	2.78
GOO	T2	4	10	2.74
GOO	T2	12	20	3.85
GOO	T2	20	0	11.95
GOO	T2	24	10	7.86
GOO	T2	32	20	30.1
GOO	T2	36	0	7.88
GOO	T2	36	0	3.19
GOO	T2	40	10	15.74
GOO	T2	48	20	31.2
GOO	T2	48	0	12.03
GOO	T2	56	10	16.57
GOO	T2	60	0	3.94
GOO	T2	60	20	19.47
GOO	T3	0	0	1.35
GOO	T3	8	20	1.75
GOO	T3	20	0	3.14

Lake	Transect	Dist along	Dist out	mS/m
GOO	T3	24	20	2.28
GOO	T3	28	10	1.98
GOO	T3	36	0	6.59
GOO	T3	40	10	17.12
GOO	T3	44	20	3.3
GOO	T3	52	0	2.41
GOO	T3	56	10	3.45
GOO	T3	60	20	2.56
LE	T1	0	10	5
LE	T1	0	0	264
LE	T1	4	20	8.43
LE	T1	4	0	7.29
LE	T1	12	10	35.6
LE	T1	20	0	152.8
LE	T1	24	10	34.1
LE	T1	36	10	22.5
LE	T1	40	20	46
LE	T1	40	20	3.36
LE	T1	40	0	12.95
LE	T1	48	10	2.97
LE	T1	52	0	1.63
LE	T1	56	20	21.7
LE	T1	60	10	5.33
LE	T2	0	10	71.1
LE	T2	0	20	48.5
LE	T2	12	10	56.1
LE	T2	16	0	53.8
LE	T2	20	20	54
LE	T2	28	10	23.9
LE	T2	36	0	94.5
LE	T2	36	20	15.4
LE	T2	40	10	14.38
LE	T2	52	20	50.9
LE	T2	56	0	112.9
LE	T2	56	10	210
LE	T2	60	10	88.6
LE	T3	0	0	6.51
LE	T3	4	10	6.15
LE	T3	12	20	2.81
LE	T3	16	10	15.62
LE	T3	20	0	13.58
LE	T3	24	20	6.97
LE	T3	32	10	17.32
LE	T3	40	0	8.05
LE	T3	40	20	3.96
LOG	T1	0	0	93.7
LOG	T1	4	10	72.2
LOG	T1	8	20	65.7
LOG	T1	16	0	67.9

Lake	Transect	Dist along	Dist out	mS/m
LOG	T1	20	10	88.1
LOG	T1	24	20	67.2
LOG	T1	28	0	87.6
LOG	T1	32	10	114.4
LOG	T2	20	0	85
LOG	T2	20	4	67.8
LOG	T3	0	20	49
LOG	T3	0	0	21.3
LOG	T3	4	20	20.1
LOG	T3	12	10	57.8
LOG	T3	24	20	71.4
LOG	T3	32	10	56.4
LOG	T3	36	20	90.4
LOG	T3	40	0	87.7
LOG	T3	52	10	56.4
LOG	T3	56	20	102.9
LOG	T3	60	0	57.7
LV	T1	0	0	3.22
LV	T1	0	20	2.7
LV	T1	8	10	60.7
LV	T1	12	20	149.8
LV	T1	16	0	16.63
LV	T1	20	10	112
LV	T1	28	20	699
LV	T1	30	0	712
LV	T1	36	10	117
LV	T1	40	20	330
LV	T2	0	20	26.1
LV	T2	4	0	20.6
LV	T2	4	10	24.5
LV	T2	12	20	8.1
LV	T2	16	0	102.9
LV	T2	16	10	120.8
LV	T2	24	20	658
LV	T2	28	10	389
LV	T2	28	0	144.8
LV	T2	36	30	299
LV	T2	40	10	259
LV	T2	40	0	59.9
LW	T1	0	0	364
LW	T1	4	20	991
LW	T1	8	20	795
LW	T1	16	0	503
LW	T1	20	20	748
LW	T1	24	20	925
LW	T1	24	10	1999
LW	T1	32	0	1509
LW	T1	40	10	1290
LW	T1	40	20	1488

Lake	Transect	Dist along	Dist out	mS/m
LW	T1	48	0	1125
LW	T1	56	20	1910
LW	T1	60	10	1106
LW	T1	60	20	1414
LW	T2	0	0	600
LW	T2	4	10	682
LW	T2	16	10	1111
LW	T2	16	0	738
LW	T2	28	10	1284
LW	T2	30	20	1255
LW	T2	32	0	1162
MAI(1)	T1	0	0	16.42
MAI(1)	T1	4	10	7.1
MAI(1)	T1	12	20	17.96
MAI(1)	T1	20	0	18.18
MAI(1)	T1	24	10	19.02
MAI(1)	T1	32	20	30.2
MAI(1)	T1	36	10	44.8
MAI(1)	T1	40	0	64.7
MAI(1)	T2	0	0	7.04
MAI(1)	T2	4	10	9.32
MAI(1)	T2	12	20	17.05
MAI(1)	T2	20	0	12.16
MAI(1)	T2	24	10	28.7
MAI(1)	T2	32	20	36
MAI(1)	T2	36	10	64.1
MAI(1)	T2	40	0	75.5
MAI(2)	T1	0	0	23
MAI(2)	T1	4	10	12.06
MAI(2)	T1	8	20	7.44
MAI(2)	T1	16	0	76.7
MAI(2)	T1	20	10	67
MAI(2)	T1	24	20	44
MAI(2)	T1	30	0	103
MAI(2)	T2	0	0	17.7
MAI(2)	T2	4	10	16.61
MAI(2)	T2	8	20	25.4
MAI(2)	T2	16	20	7.81

Lake	Transect	Dist along	Dist out	mS/m
MAI(2)	T2	20	10	33.8
MAI(2)	T2	20	0	29.3
PB	T1	0	0	7.33
PB	T1	4	10	31.7
PB	T1	12	20	8.38
PB	T1	16	0	7.29
PB	T1	20	10	15.53
PB	T1	28	20	20.7
PB	T1	36	10	15.74
PB	T1	44	10	20.8
PB	T1	44	20	3.03
PB	T1	52	0	26.9
PB	T1	56	10	4.23
PB	T1	60	20	10.85
PB	T2	0	0	5.79
PB	T2	4	10	6.95
PB	T2	8	20	4.46
PB	T2	16	0	6.92
PB	T2	20	10	5.4
PB	T2	24	20	4.77
PB	T2	32	10	3.52
PB	T2	36	0	7.86
PB	T2	40	20	4.25
PB	T3	0	0	26.7
PB	T3	8	10	5.29
PB	T3	12	20	3.73
PB	T3	16	0	16.99
PB	T3	24	10	9.13
PB	T3	28	20	7.84
PB	T3	36	0	17.4
PB	T3	40	10	15.04
PB	T3	48	20	8.2
PB	T3	52	0	11.18
PB	T3	60	0	6.13

Digital Photographs

A digital camera was used and six photographs was taken of each transects Three photographs of the transect were taken on the right, middle and left of the transect facing the water i.e. photographs of the end of the transect furthest from the lake The second group of 3 photographs were taken facing away from the lake on the right , middle and left of the transects i.e. photographs of the end of the transect closest to the lake.

Retagging

Where retagging was required a 30mm square 1mm thick numbered Aluminium plate with a 3mm hole in the middle nailed with either a 50mm long 2.8 diameter flat top galvanized nail or 1mm thick galvanized wire was used to nail or attach the tag to the tree or shrub. Where the numbering was similar to that previously used in the transect, similar numbers are differentiated by the either being rectangular i.e. nnn(R) (1998/99 numbering tags) or square nnn(S) (2001/02 numbering tags). The original roofing nail was left in the tree to aid in identifying the location future re-measuring site for the particular tree.

GPS Measurements

As the original GPS readings for the location of the transect were not accurate because of USA government policy, these readings were repeated using a Garmin etrex GPS unit. The left hand corner of the transect facing the lake (i.e. the edge of the transect away from the lake) was designated the location of the transect, 0/0 for soil salinity determination and the location of whether the understorey plots were on the left or right hand side of the transect.

Data analysis

In this report the results of the second monitoring program for these lakes were compared and analyzed with those of the first in the following ways.

1. Changes in the soil salinities (conductivities both vertically and horizontal) with sections (0m 10m and 20m Section Means) of each transect (for understorey changes) and within the whole transect (Transect Means) for overstorey changes.
2. Changes in the number of trees and seedlings and crown condition (Mean Crown Score) for each species for the whole lake (transects combined).
3. Changes in the size distribution of the overstorey for the whole lake (transects combined).
4. Changes in the distribution of understorey species within each transect.

Lake View (Blue Gum Swamp)

Description

R. Gurner et al (1999) reports that Blue Gum Swamp is a small ephemeral wetland situated in a narrow band of remnant vegetation on private farmland 10km North West of Moora (30°35' S, 115°58' E). The Swamp lies in a cleared catchment adjacent to a large chain of seasonal wetlands which receive inflow from the northern waters of the Moore River. The bulk of the water supply for Blue Gum Swamp comes from direct precipitation and runoff. Although there is no direct hydrological interaction between Blue Gum Swamp and the surrounding chain of wetlands, during high rainfall years Blue Gum Swamp interconnects with the series of wetlands via channels and flats forming part of the larger system. This flooding event occurs approximately every 10 years with the latest event occurring in March 1999. Blue Gum Swamp has also been recognised as an important refuge for waterbirds. Grazing history within the surrounding vegetation and on the lakebed itself is unknown, but it seems likely that grazing has occurred.

Transects

Two 40 metre transects were established around the main lake area starting from the terrestrial vegetation extending on to the lakebed.

The first monitoring was undertaken in February 1999 and the second in early October 2001. At this time the lake was dry. Some re nailing of tags was carried out.

Transect 1: (GPS: 50 401319 / 6615173) lies directly on the southern bank of the lake, 30 metres east of the main track where the relief is moderate.
Transect 2: (GPS: 50 401380 / 6615359) is located on northeastern side of the lake south of the inflow drain on slight to moderate relief.

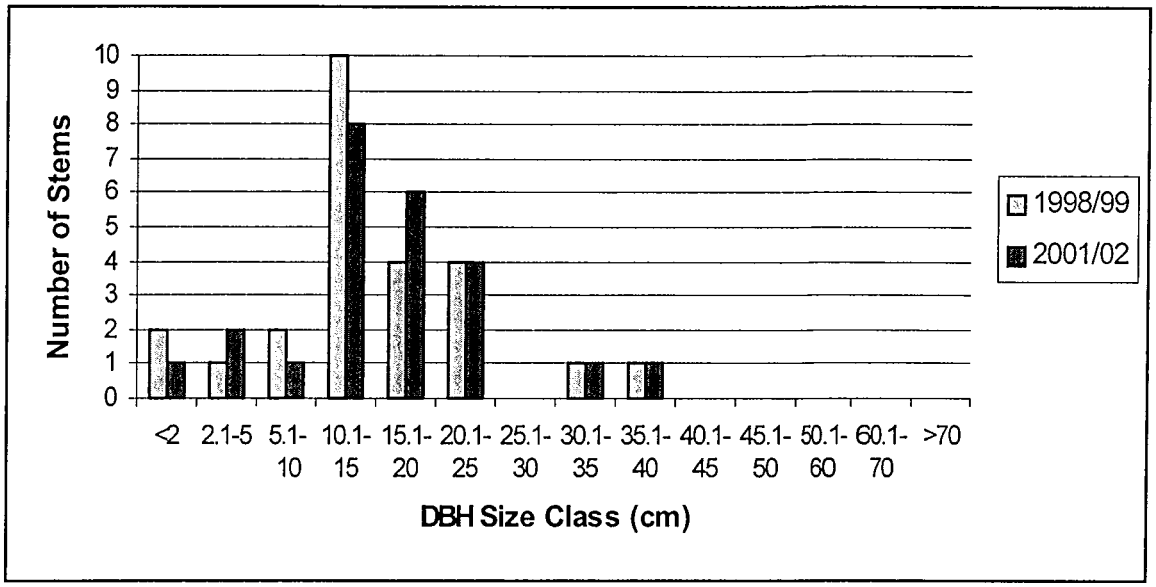
The plant communities around the lake are as described by R. Gurner *et al* (1999)

Results

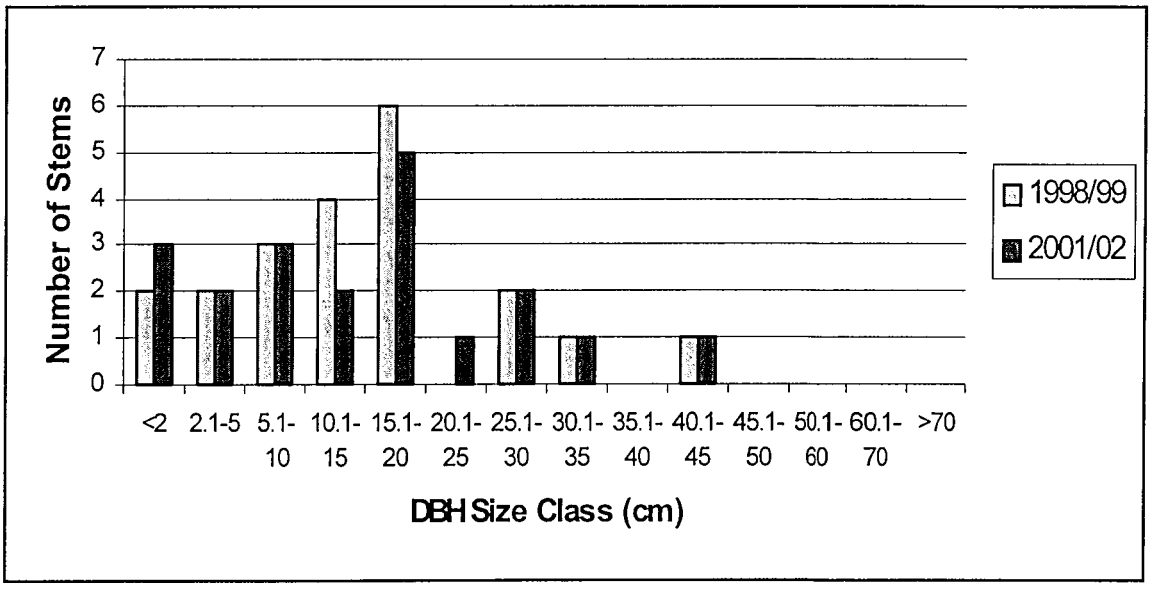
Population Structure and Tree Vigour

There has been very little change in the population structure over the last year at this lake (Figure 1 and Table 2). Crown condition of a number of species has deteriorated (*Casuarina* spp and *Melaleuca* spp) but not significantly.

Casuarina obesa



Eucalyptus rudis



Melaleuca strobophylla

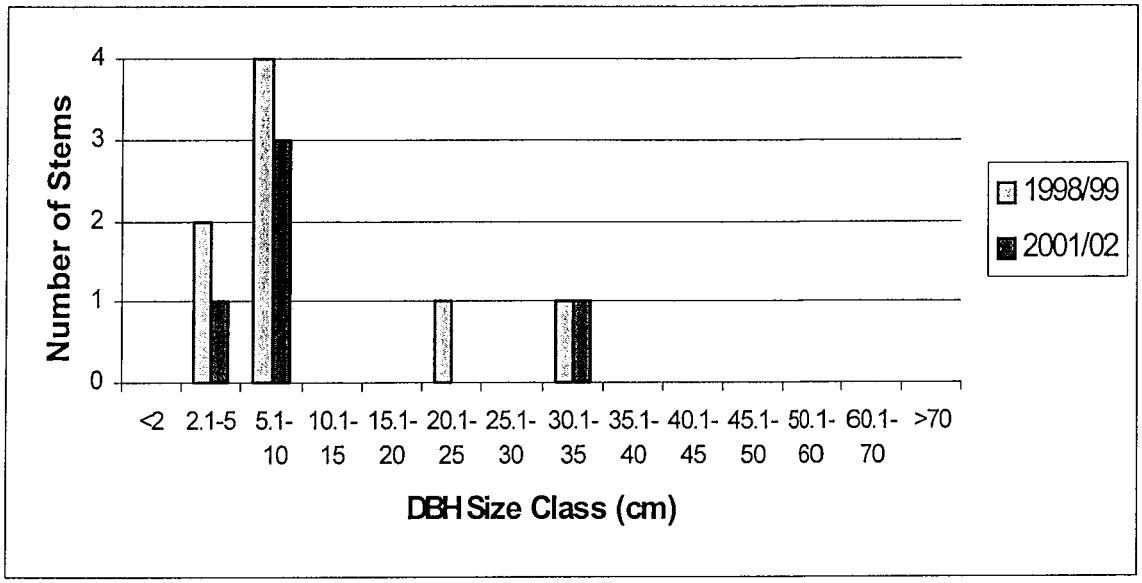


Figure 1 Size Class Distributions for *Casuarina obesa, Eucalyptus rudis* and *Melaleuca strobophylla* at Lake View.

Table 2. Summary of Tree Data for Lake View

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Casuarina obesa	25	24	0	0	15.0 (2.5)	13.0 (4.5)
Eucalyptus rudis	21	21	0	0	9.3 (3.9)	13.5 (5.9)
Melaleuca strobophylla	8	5	0	0	14.5 (2.6)	12.8 (1.6)
Melaleuca teretifolia	2	2	1	0	19.5 (6.4)	7 (0)
Melaleuca viminea	9	3	0	0	11.9 (2.5)	9.3 (4.0)

Changes in understorey composition

The salt tolerant species *Halosarcia* sp, *Atriplex lindleyi* and *Wilsonia rotundifolia* have appeared in the transects in addition to seedlings of *Melaleuca* spp. The distribution of the other understorey species has not changed dramatically (Figure 2 and 3 and Table 3)

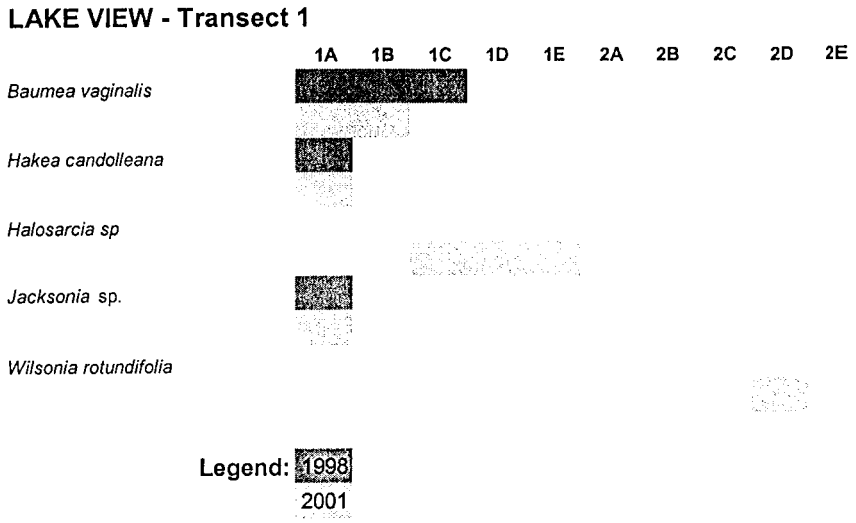


Figure 2 Species Distribution along Lake View Transect 1 in 1998 and 2002

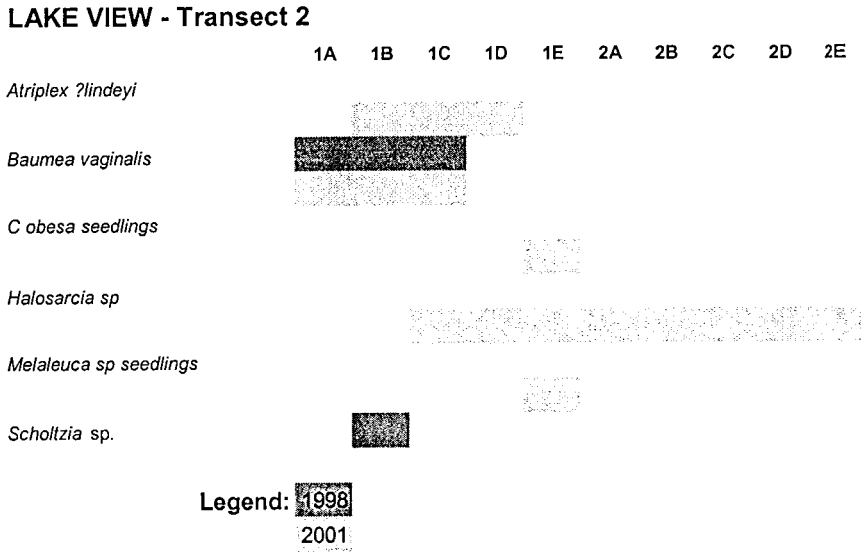


Figure 2 Species Distribution along Lake View Transect 2 in 1998 and 2002

Table 3 Summary of understorey species distribution in all Transects at Lake View

LAKE VIEW - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Halosarcia sp	*yes*				
Wilsonia rotundifolia	*yes*				
Baumea vaginalis				*yes*	
Hakea candolleana					*yes*
Jacksonia sp.					*yes*

LAKE VIEW - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Atriplex ?lindleyi	*yes*				
C obesa seedlings	*yes*				
Halosarcia sp	*yes*				

LAKE VIEW - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Melaleuca sp seedlings	*yes*				
Scholtzia sp.			*yes*		
Baumea vaginalis					*yes*

Soil Characteristics

Table 4 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 13% in the vertical and 23% in the horizontal EM38 measurements over the three year period.

Table 4 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake View over the two sampling periods

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	367	**505**	326	**502**	414	**515**	403	**527**	463	**463**	491	**487**
Transect Mean	415	**494**	406	**505**								
T2												
Section Mean	447	**387**	359	**366**	442	**464**	362	**431**	446	**589**	375	**532**
Transect Mean	445	**480**	365	**443**								

Summary

Table 5 summarizes all the data for Lake View transects. With the increase in soil salinities there has been a decrease in tree condition, a decrease in salt sensitive understorey species and an increase in the more salt tolerant species.

Table 5 Summary of Lake View Data

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	yes		
Crown Condition (all transects MCS)	*Eucalyptus rudis*	*Casuarina obesa* *Melaleuca strobophylla* *Melaleuca teretifolia* *Melaleuca viminea*	
Count of Overstorey Individuals *(Species increasing /decreasing /No Change in Counts)*		*Casuarina obesa* *Melaleuca strobophylla* *Melaleuca teretifolia* *Melaleuca viminea*	*Eucalyptus rudis*

Condition	Increase	Decrease	No Change
Understorey Species *(Species increasing /decreasing/No Change)*	*Atriplex ?lindleyi* *Baumea vaginalis* *C obesa* seedlings *Halosarcia sp* *Melaleuca sp seedlings* *Wilsonia rotundifolia*	*Baumea vaginalis* *Scholtzia* sp	*Hakea candolleana* *Jacksonia* sp.

Maisey's Wetland 1

Description

R. Gurner *et al.* (1999) reports that Maisey's wetland is a moderately small ephemeral wetland situated on privately owned farm land (Peter Maisey) east of Lake Dowerin (31°15'S, 117°04'E) and approximately 10km south east of the Dowerin town site. The wetland lies within cleared paddocks apart from a thin band of remnant vegetation remaining on the outer lake perimeter. The wetland is characterised by a short steep bank which moderates on the eastern and northern sides. The wetland historically has been used for grazing, particularly the northern section where grazing was undertaken until 1993. A number of smaller and lower topographical wetlands surround the main Maisey's lake with scattered dead *Eucalyptus loxophleba* and *Melaleuca strobophylla* presumably from waterlogging (pers. Com. Peter Maisey, 1999). Maisey's wetland is classified as fresh with the majority of the lake water supply coming from direct precipitation and runoff with little hydrological interaction with the adjacent saline Lake Dowerin.

Transects

Two 40 metre transects were established on Maisey's wetland to sample the outer fringing terrestrial vegetation, littoral wetland vegetation and lakebed.

The first monitoring was undertaken in March 1999 and the second in mid January 2002. The lake was dry at the time of sampling.

Transect 1: (GPS: 50 506799 / 6542543) lies centrally on the western side of the lake off the main track.
Transect 2: (GPS: 50 507269 / 6542467) lies on the eastern side of the lake approximately 75 metres south of the inflow channel. Both transects start on the top ridge of the wetland and finish on the lakebed.

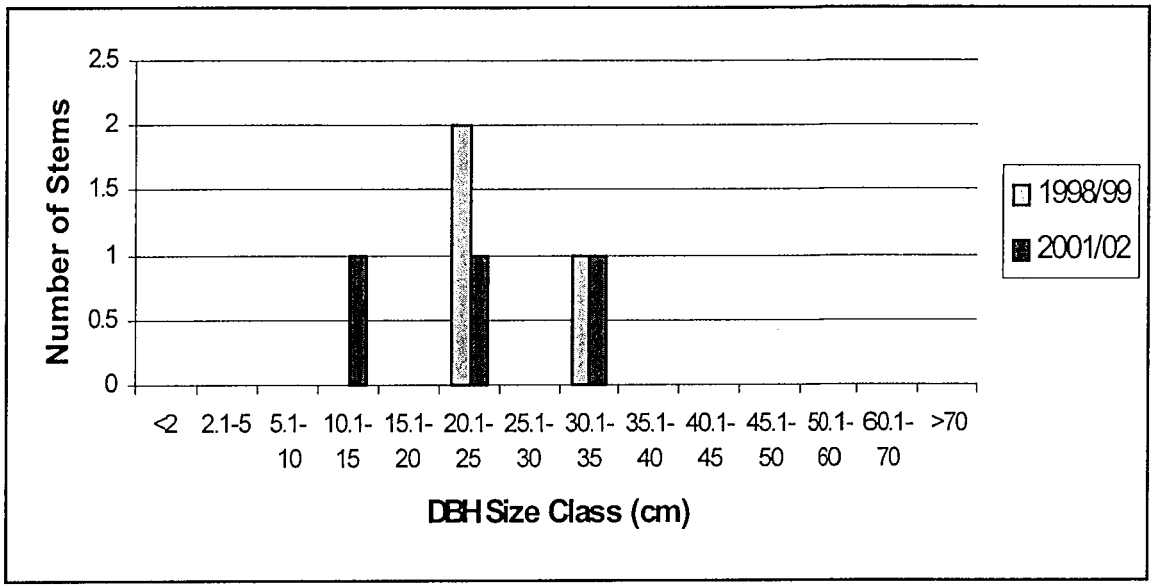
The plant communities around the lake are as described by R. Gurner *et al* (1999)

Results

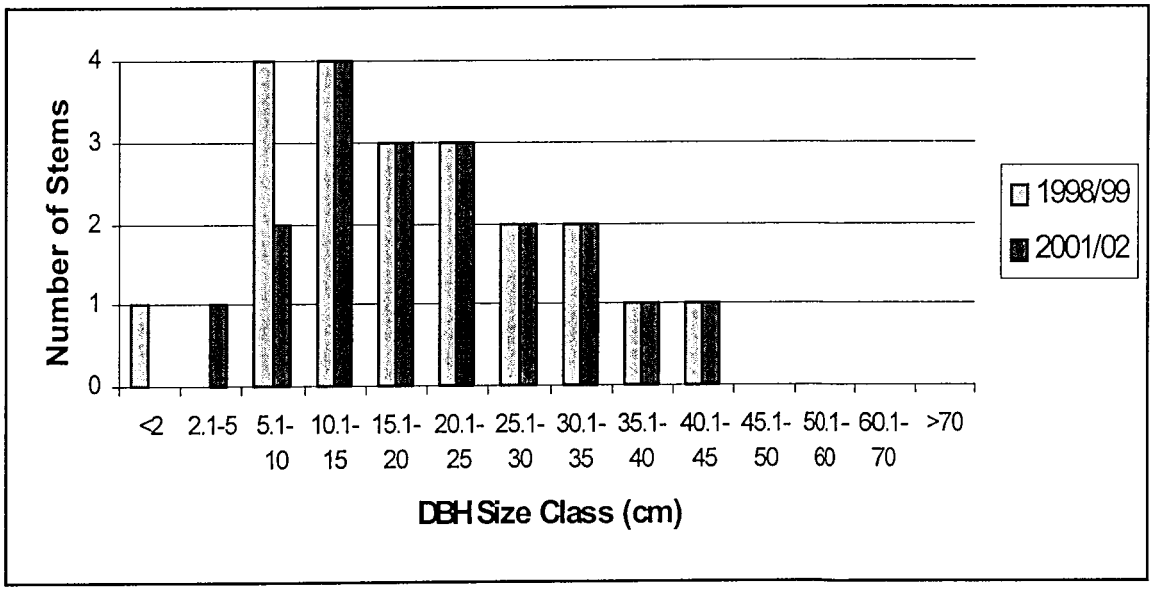
Population Structure and Tree Vigour

Figure 4 indicates that there has been a slight recruitment of saplings of *Eucalyptus loxophleba* with a slight improvement in crown health in all tree species except *E loxophleba* and *E salmonophloia* (Table 4)

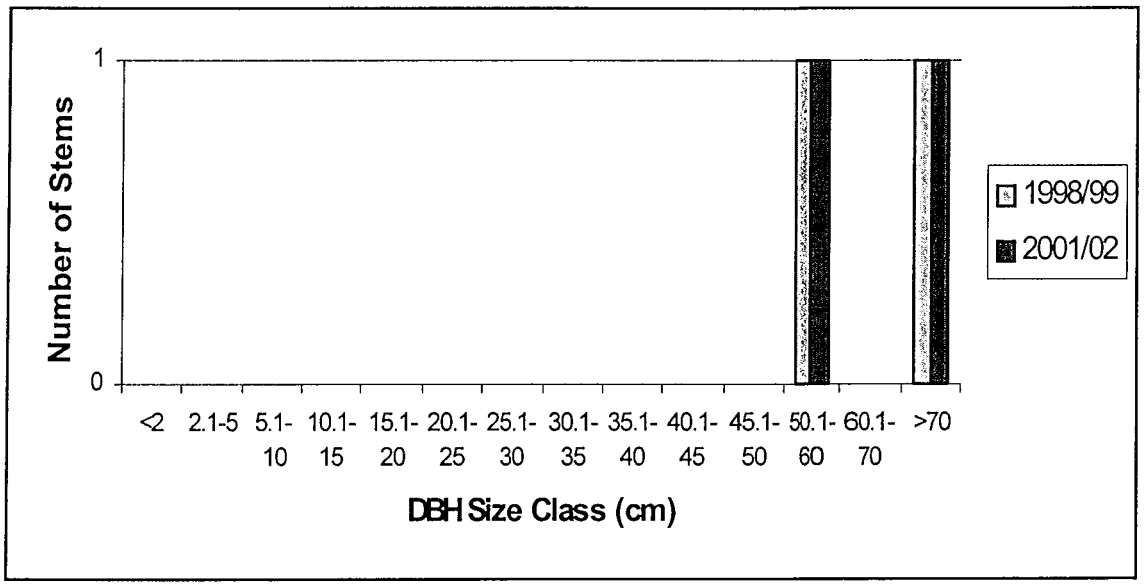
Casuarina obesa



Eucalyptus loxophleba



Eucalyptus salmonophloia



Melaleuca strobophylla

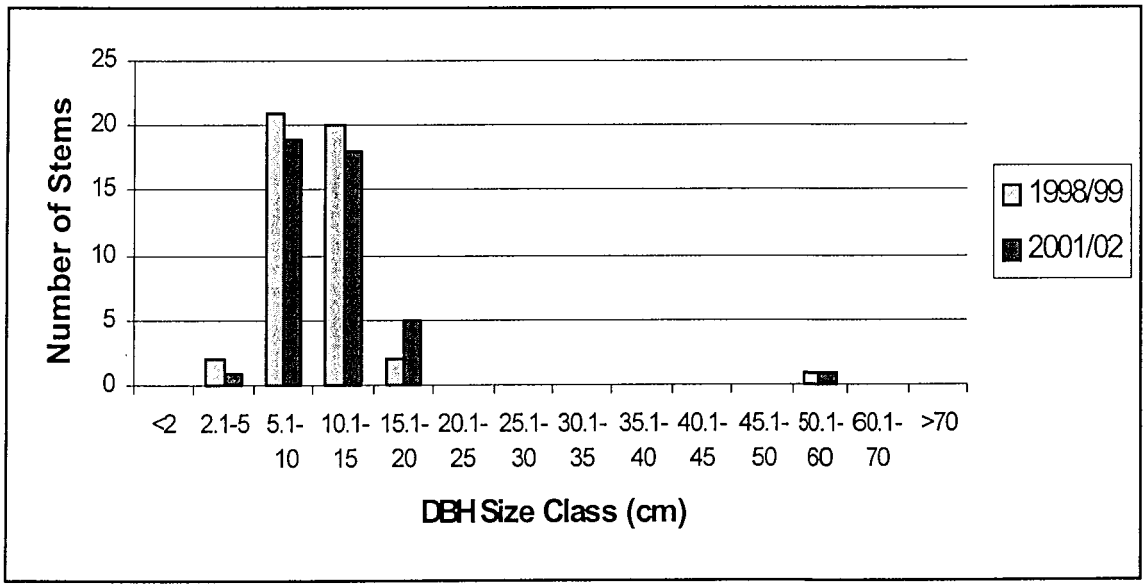


Figure 3. Size Class Distributions for *Casuarina obesa, Eucalyptus loxophleba, Eucalyptus salmonophloia* and *Melaleuca strobophylla* for Maisey's Wetland 1

Table 6. Summary of Tree Data for Maisey's Wetland 1

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Casuarina obesa	3	3	0	0.0	11.7 (5.5)	13.7 (1.2)
Eucalyptus loxophleba	21	20	0	0.0	12.5 (2.9)	11.2 (3.0)
Eucalyptus salmonophloia	2	2	0	0.0	22.0 (1.4)	15.0 (0)
Melaleuca strobophylla	46	44	0	0.0	12.5 (2.2(	13.2 (1.5)

Changes in understorey composition

Figures 5 and 6 indicate that there has been a expansion of the less salt tolerant understorey species such as *Austrostipa elegantissima, Enchylaena tomentosa* and *Melaleuca* sp seedlings with a decrease in the more salt tolerant species such as *Chenopodium* sp , *Halosarcia* and *Sclerolaena* spp over the monitoring sampling period. Because the specific identity of the other species was not known in 1998 changes in the distribution of the other species is unknown.

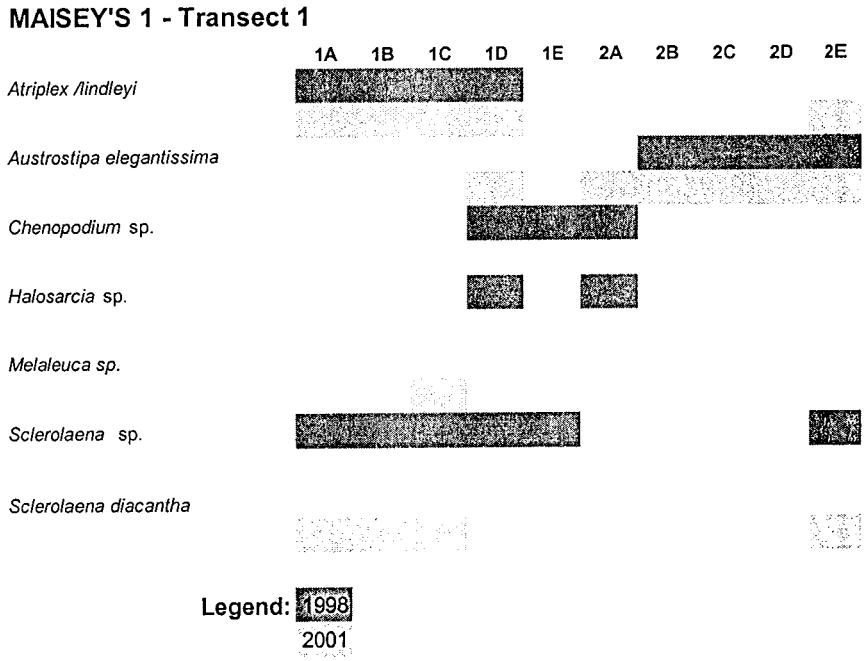


Figure 4. Species Distribution along Maisey's Wetland 1 Transect 1 in 1998 and 2002

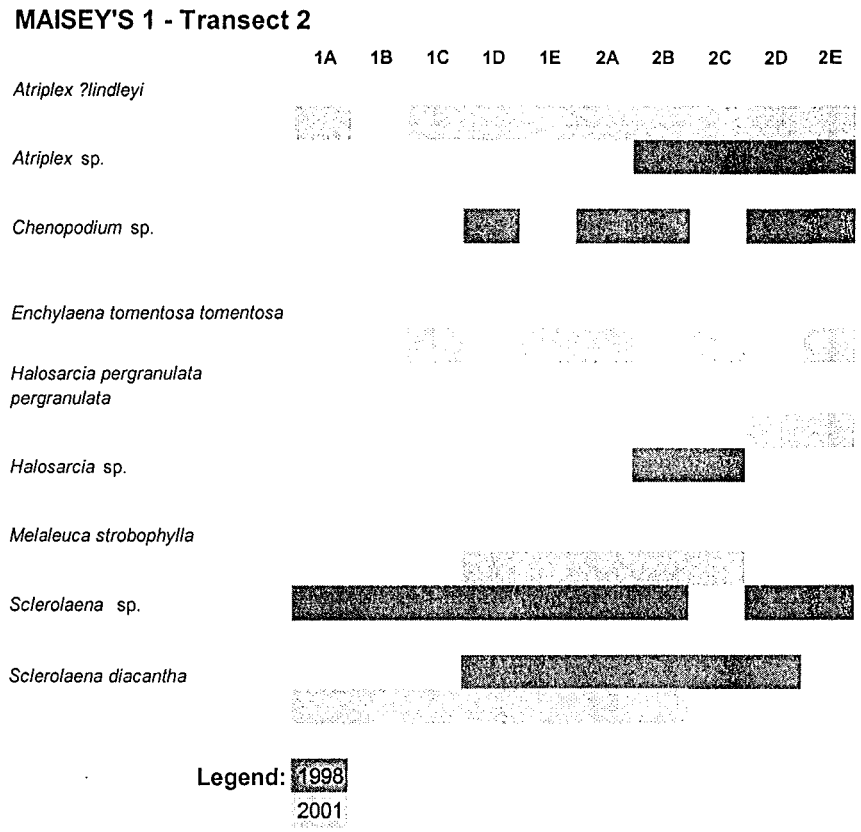


Figure 5. Species Distribution along Maisey's Wetland 1 Transect 2 in 1998 and 2002

Table 7 Summary of understorey species distribution in all Transects at Maisey's Wetland 1

MAISEY'S 1 - Transect 1	New Recruit	Expansion	Extinction	Contraction
Melaleuca sp.	*yes*			
Sclerolaena diacantha	*yes*			
Atriplex /lindleyi		*yes*		
Austrostipa elegantissima		*yes*		
Chenopodium sp.			*yes*	
Halosarcia sp.			*yes*	
Sclerolaena sp.			*yes*	

MAISEY'S 1 - Transect 2	New Recruit	Expansion	Extinction	Contraction
Atriplex ?lindleyi	*yes*			
Enchylaena tomentosa tomentosa	*yes*			
Halosarcia pergranulata pergranulata	*yes*			
Melaleuca strobophylla	*yes*			
Sclerolaena diacantha		*To areas Away from Lake*		*From Areas Close to lake*
Atriplex sp.			*yes*	
Chenopodium sp.			*yes*	
Halosarcia sp.			*yes*	
Sclerolaena sp.			*yes*	

Soil Characteristics

Table 7 tabulates the mean soil salinities for all the transects over the two sampling periods. There was decrease of 23% in the vertical and decrease of 27% in the horizontal EM38 measurements over the period.

Table 8 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Maizeys over the 3 year period

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	384	210	262	125	343	189	225	108	346	213	233	128
Transect Mean	358	204	240	120								
T2												
Section Mean	304	289	180	173	297	308	179	198	317	321	196	201
Transect Mean	306	306	185	191								

Summary

Table 9 summarises all the data for Maizey 1. Though soil salinity has decreased, there has been a deterioration in the condition and number of Eucalypt species and an increase in the condition of the more salt tolerant *Casuarina* and *Melaleuca* tree species which could be due to the long drought conditions which have been experienced between the sampling period. This suggestion that changes are due to drought rather than salinity is supported by the increase in normal understorey species and a decrease of salt tolerant species.

Table 9 Summary of data for Maizey 1

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*		yes	
Crown Condition (all transects MCS)	*Casuarina obesa* *Melaleuca strobophylla*	*Eucalyptus loxophleba* *Eucalyptus salmonophloia*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Casuarina obesa* *Melaleuca strobophylla*	*Eucalyptus loxophleba*	*Eucalyptus salmonophloia*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Atriplex ?lindleyi* *Austrostipa elegantissima* *Chenopodium* sp. *Enchylaena tomentosa tomentosa* *Halosarcia pergranulata pergranulata* *Melaleuca sp.* *Melaleuca strobophylla* *Sclerolaena diacantha*	*Atriplex* sp. *Chenopodium* sp.. *Halosarcia* sp. *Sclerolaena* sp.	

Maisey's Wetland 2

Description

R. Gurner *et al.* (1999) reports that a second, smaller ephemeral wetland to the north west (approximately 100 m) (31°14' S, 117°03' E) was sampled and has been referred to as Maisey's Wetland 2. Unlike Maisey's wetland (first lake) the surrounding vegetation has been entirely cleared leaving approximately 20 mature *Melaleuca strobophylla* individuals on the lakebed. The shallow banks of the wetland now contain dense stands of seedlings and saplings. The saplings are reported to have germinated following an unusually high rainfall period between 1989 - 1991 (pers. Com. Peter Maisey, 1999). Also noticeable was a number of seedlings which have germinated since this mass recruitment event. The wetland has been fenced since the original germination event effectively precluding grazing. Similarly to the main wetland, Maisey's wetland 2 is fresh with the majority of the lakes water supply coming from direct precipitation and runoff with little hydrological interaction between other wetlands in the vicinity.

Transects

Two transects (32 m and 20 m in length) were established on Maisey's Wetland 2 to include a sample of the thick dense regeneration on the fringe of the wetland and the remnant mature trees located on the lake bed.

The first sampling was undertaken in March 1999 while the second was carried out in mid January 2002 At this time the lake was dry.

Transect 1: (GPS: 50 506265 / 6542911) is situated on the south west corner of the wetland in front of the mature stand of *Melaleuca strobophylla.*
Transect 2: (GPS:50506541 / 6543036) is situated on the eastern side of the wetland within the very dense stand of *Melaleuca strobophylla* saplings. Transect 2 lies approximately 50 metres directly in from the fence.

The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

Population Structure and Tree Vigour

Data was too limited to say what changes had occurred in the overstorey structure at the wetland though the crown condition analysis indicated a slight deterioration in tree health between the two monitoring periods.

Melaleuca strobophylla

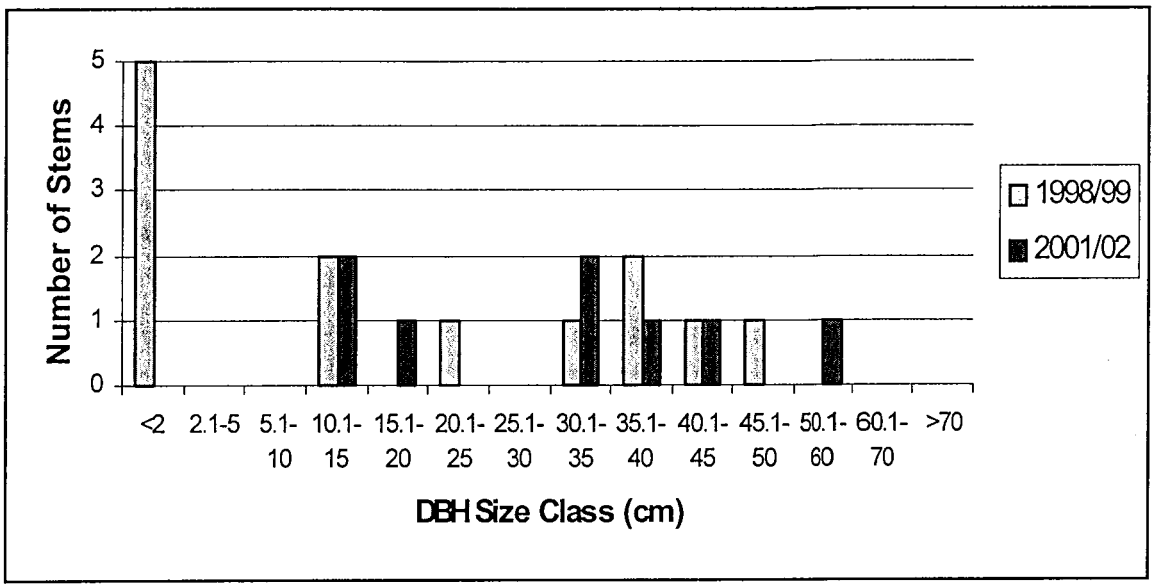


Figure 6. Size Class Distributions for *Melaleuca strobophylla* Maisey's Wetland 2.

Table 10. Summary of Tree Data for Maisey's Wetland 2

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Melaleuca strobophylla	8	8	608	586.0	16.5 (2.8)	12.5 (5.1)

Changes in understorey composition

Figures 8 and 9 indicate that there has been a recruitment of the more salt tolerant species and a contraction of salt sensitive species eg *Austrostipa elegantissima.*

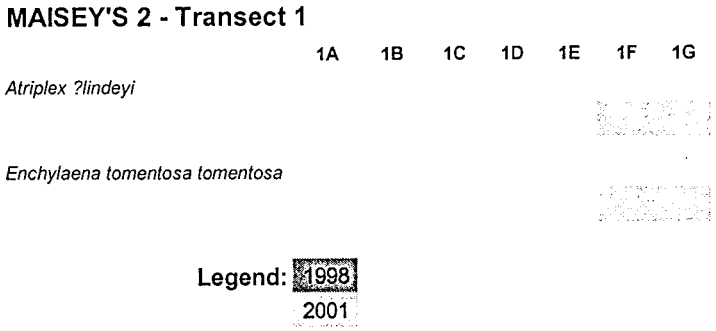


Figure 8. Species Distribution along Maisey's Wetland 2 Transect 1 in 1998 and 2002

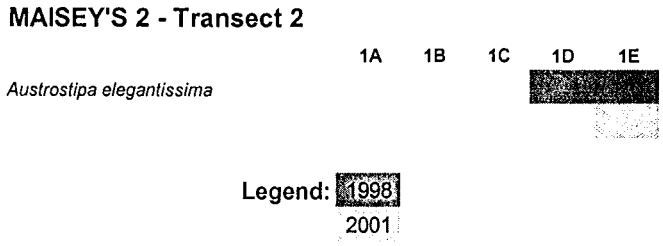


Figure 7. Species Distribution along Maisey's Wetland 2 Transect 2 in 1998 and 2002

Table 11 Summary Of Understorey Species Distribution In All Transects At Maisey's Wetland 2

MAISEY'S 2 - Transect 1	New Recruit	Expansion	Extinction	Contraction
Atriplex ?lindeyi	*Yes*			
Enchylaena tomentosa tomentosa	*Yes*			

MAISEY'S 2 - Transect 2	New Recruit	Expansion	Extinction	Contraction
Austrostipa elegantissima				*Yes*

Soil Characteristics

Table 10 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 18% in the vertical and 23% in the horizontal EM38 measurements over the three year period.

Table 12 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Maizeys 2 over the two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	180	**185**	106	**110**	177	**188**	105	**127**	167	**168**	101	**102**
Transect Mean	175	**180**	104	**113**								
T2												
Section Mean	217	**283**	133	**180**	210	**275**	131	**179**	207	**271**	128	**171**
Transect Mean	211	**276**	131	**177**								

Summary

Table 13 summarises all the data for Lake Maiseys 2 . With the increase in soil salinities there has been a decrease in crown health of the trees and a move towards more salt tolerant understorey plants.

Table 13 Summary of Data for Lake Maisey 2

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	Yes		
Crown Condition (all transects MCS)		*Melaleuca strobophylla*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*			*Melaleuca strobophylla*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Atriplex ?lindeyi* *Enchylaena tomentosa tomentosa*	*Austrostipa elegantissima*	

Lake Logue

Description

R. Gurner *et al.* (1999) reports that Lake Logue is a large, fresh seasonal lake situated 12 km southwest of Eneabba in the Lake Logue Nature Reserve (29073, Class C) (29°51' S, 115°08' E). The total lake area is 424.8 hectares with 74% consisting of open water and 25% vegetation (Halse, Pearson and Patrick, 1993). Lake Logue and nearby Lake Indoon are the largest components of a northerly trending chain of ephemeral wetlands which sit upon extensive aeolian sands. Lake Logue is a broad shallow claypan (composed of grey soils, heavy bluish-grey clays and silty clays) surrounded by dunes of coarse white sand which rise to 5m (Australian Nature Conservation Agency, 1996). Logue is bounded by a white sandy beach except in the west where there is a low limestone cliff. Water is supplied to Lake Logue by direct precipitation, surface runoff and discharges from ephemeral drainages, notably Eneabba Creek from the east (Australian Nature Conservation Agency, 1996). Lake Logue and nearby Lake Indoon are linked by groundwater with flow moving in a northwest direction. Lake Logue consists of seasonally waterlogged flats and micro scale creeks (Australian Nature Conservation Agency, 1996). The Logue/Indoon area acts as a major feeding stopover, staging area for dispersal and drought refuge for waterbirds. A population of the declared vulnerable plant *Eremophila microtheca* occurs on seasonally waterlogged flats. Also *Phytophthora cinnamomi* and *Phytophthora citricola* is present at Lake Logue (Australian Nature Conservation Agency, 1996). Wild horses have been identified as a disturbance to the Lake Logue Nature Reserve.

Transects

One 60 metre transect and three 40 metre transects were established on Lake Logue to sample the outer fringing wetland vegetation on the lakebed.

The first monitoring was undertaken in March 1999 after which the lake extensively flooded and the second in late January and late February 2002. Water was still in the lake after the 1999 floods. The water level was such that a large number of tags ,especially those secured by galvanised wire were missing. Extensive retagging of the plants occurred in all transects.

Transect 1: (GPS: 50 319602 / 6695680) is situated on the south west section of the Lake, left off the main access track running from the road in front of the mature stand of *Melaleuca strobophylla* on the lake bed.
Transect 2: (GPS:50 319595 / 6697539) is situated on the far northwestern side of the Lake in direct line of the major access track around the lake bed (same used to located transect 1). Plot leads into open water.
Transect 3: (GPS: 50 318825 / 6696607) is situated on the middle west side of the lake directly north of the low limestone cliff.
Transect 4: (GPS:50 320126 / 6695274) is situated on the south western side of the wetland near inflow drain.
All transects are situated on the lake bed. The major access track on the lake bed was used to located all transects. Plot leads into open water.

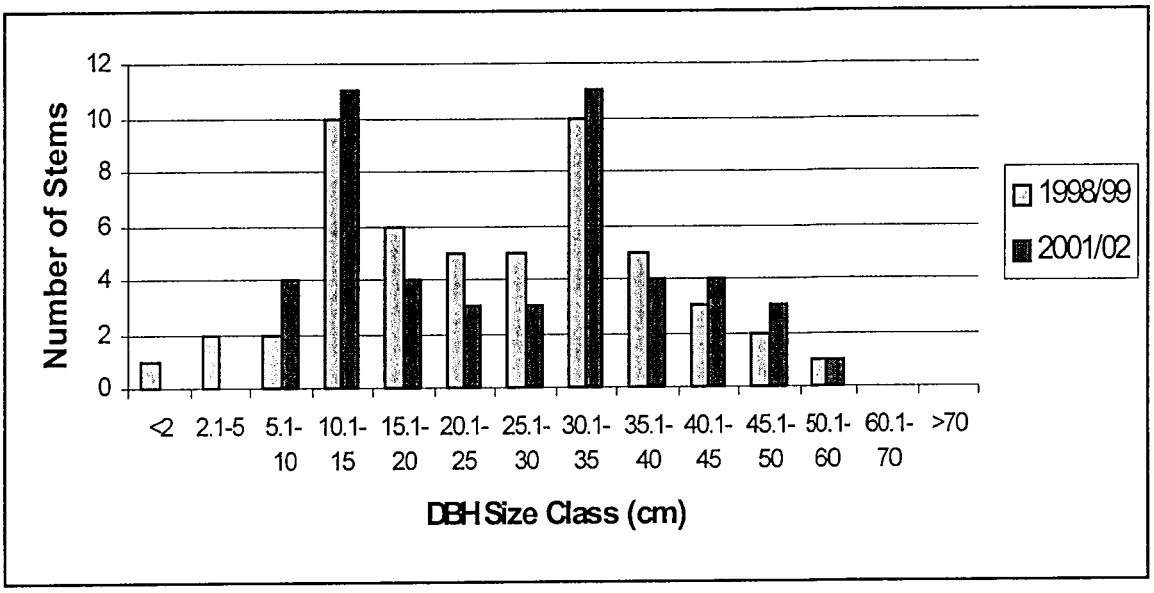
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

Population Structure and Tree Vigour

Though Figure 10 does not indicate any recruitment it does suggest that growth has occurred with individuals moving to the higher size class between the monitoring periods. That there has been a deterioration in crown health indicates that the time between the monitoring periods has been stressful.

Casuarina obesa



Melaleuca strobophylla

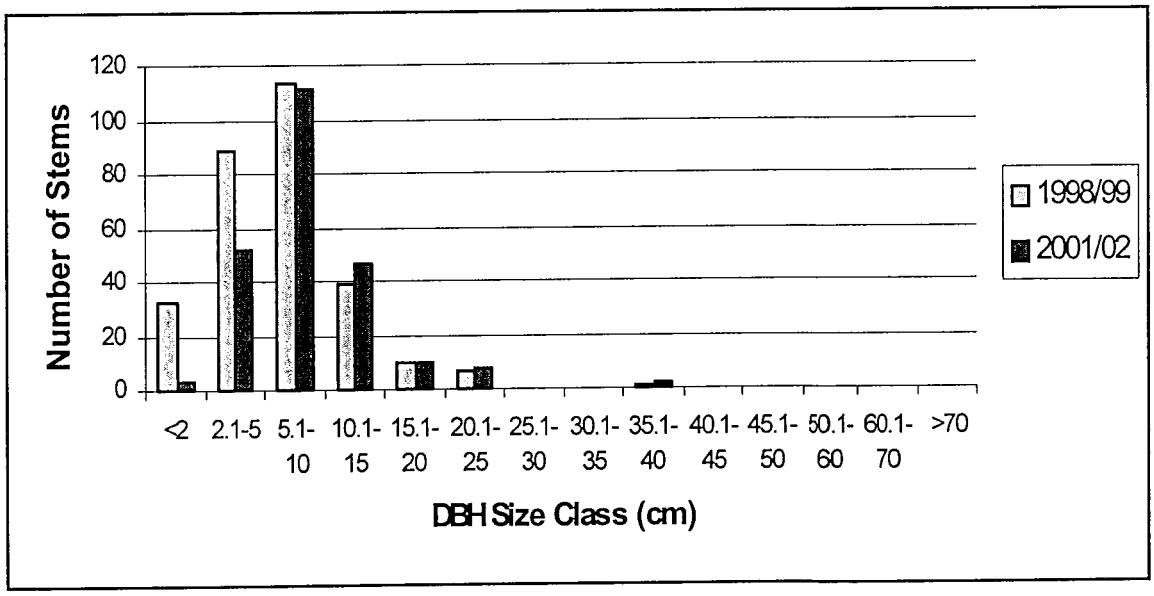


Figure 8. Size Class Distributions for *Casuarina obesa* and *Melaleuca strobophylla* at Lake Logue

Table 14. Summary of Tree Data for Lake Logue

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Casuarina obesa	51	45	1	0.0	13.0 (2.8)	11.6 (2.4)
Melaleuca strobophylla	292	231	0	0.0	14.5 (2.7)	13.8 (1.6)

Changes in understorey composition

The three years of flooding has eliminated any understorey at lake Logue.

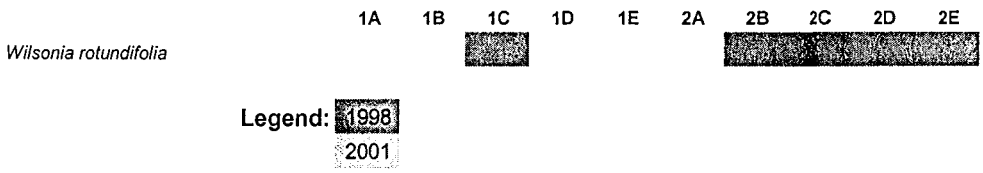


Figure 9. Species Distribution along Lake Logue Transect 2 in 1997 and 2000

Table 15 Summary Of Understorey Species Distribution In All Transects At Lake Logue

LOGUE - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Wilsonia rotundifolia			*Yes*		

Soil Characteristics

Table 13 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 71% in the vertical and 37% in the horizontal EM38 measurements over the period.

Table 16 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Logue over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002
T1												
Section Mean	52	227	58	209	63	209	71	192	58	225	67	205
Transect Mean	58	221	65	202								
T2												
Section Mean	80		80		91		99		93	227	101	267
Transect Mean	88		93									
T3												
Section Mean	51	118	49	85	56	130	53	94	53	112	54	81

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002	Vertical 1998	Vertical 2002	Horizontal 1998	Horizontal 2002
Transect Mean	53	120	52	87								
T4												
Water												

Summary

Waters are beginning to recede from Lake Logue and soil salinities are beginning to increase. The extensive flooding has lead to tree deaths and a deterioration in tree health. The understorey has not yet recovered.

Table 17 Summary of data from Lake Logue

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*			
Crown Condition (all transects MCS)		*Casuarina obesa* *Melaleuca strobophylla*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*		*Casuarina obesa* *Melaleuca strobophylla*	
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*		*Wilsonia rotundifolia*	

Walyormouring Lake

Description

R. Gurner et al (1999) reports that Walyormouring Lake is a large saline seasonal lake situated approximately 25 km northwest of Goomalling in the Walyormouring Nature Reserve (17186) (31°08' S, 116°51' E). The total lake area is 1010.0 hectares with 80% consisting of open water and 19% vegetation (Halse, Pearson and Patrick, 1993). The lake lies upon flat to undulating topography with moderately steep short banks common around the outer lake perimeter, particularly on the southwestern side. The lake has a main inflow channel at the northwestern end which may also act as an outflow channel after periods of flooding. The lake can overfill during flooding events but will retain water for extended periods after flooding. Halse, Pearson and Patrick (1993) suggest it is during these periods that the few live saplings of *Casuarina obesa* germinating each year die. The lake is located in a relatively cleared catchment surrounded by farmland with evidence suggesting that areas of the reserve have previously been used for grazing. Walyormouring Lake has had a long history of salinisation and water logging.

Transects

One 60 metre plot and one 40 metre plot were established on Walyormouring Lake to sample the mature and regeneration stands of *Casuarina obesa* woodland on the northern section of the lake bed.

Monitoring was undertaken in March 1999 while the second occurred in early October 2001 Due to the windy conditions on this lake causing extensive wear on the tags, a large number of tags were re nailed or re wired.

Transect 1: (GPS: 50 488589 / 6554294) is situated on the north side of the Lake, located by the west access track running from the road in front of the Nature Reserve sign.
Transect 2: (GPS:50 488727 / 6554095) is situated approximately 200 metres south east of transect 1 in a dense regeneration stand.

The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

Population Structure and Tree Vigour

Again there is evidence that though there has been some recruitment, crown health has deteriorated during the period.

Casuarina obesa

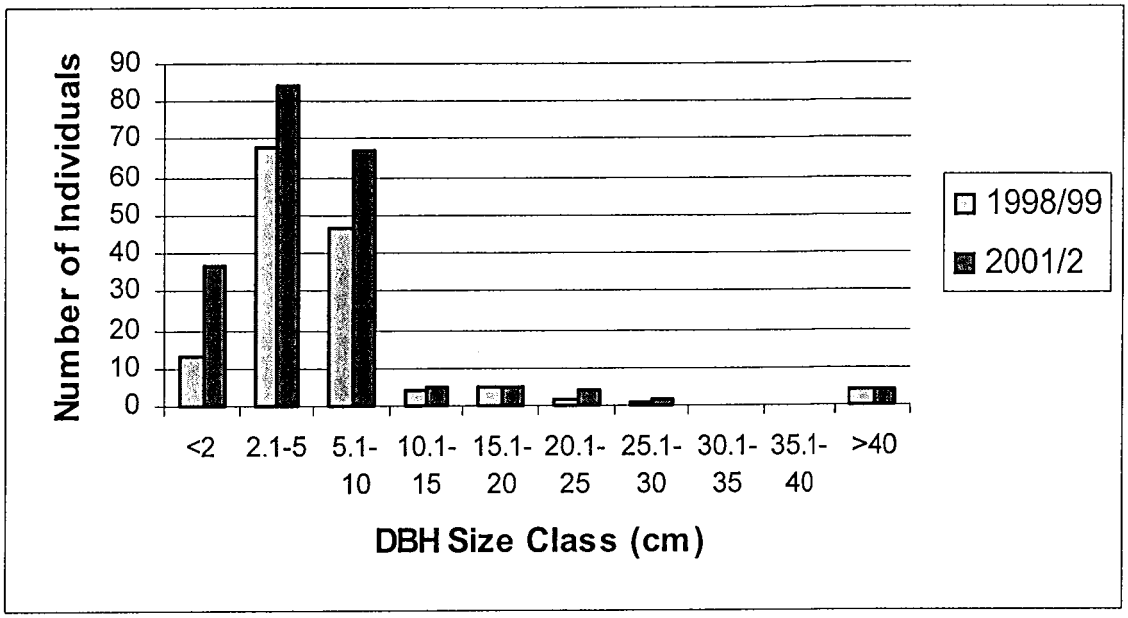


Figure 10. Size Class Distributions for *Casuarina obesa* for Walyormouring Lake

Table 18. Summary of Tree Data for Walyormouring Lake

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Casuarina obesa	217	183	165	36	9.2 (3.2)	6.8 (2.5)
Melaleuca strobophylla	1	1	0	0	8 (?)	6 (?)

Changes in understorey composition

Though it is difficult to determine changes in the distribution of the major understorey species at this lake due to the general occurrence of *Halosarcia* sp through out the plots, there has been a recruitment of *Wilsonia rotundifolia* in transect 1.

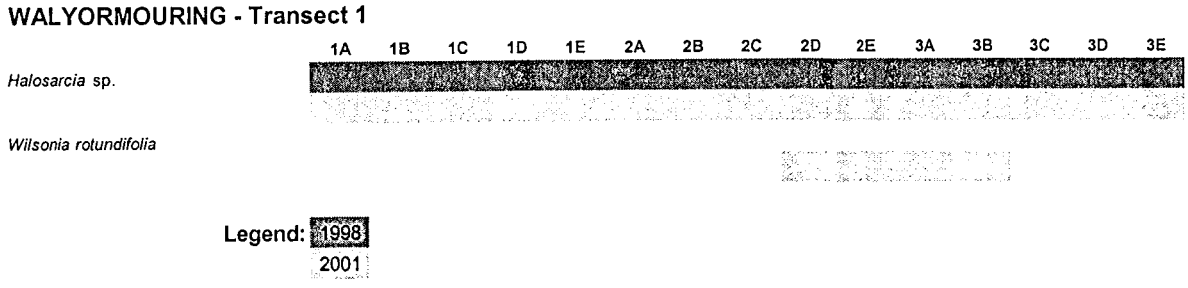


Figure 11. Species Distribution along Walyormouring Lake Transect 1 in 1998 and 2002

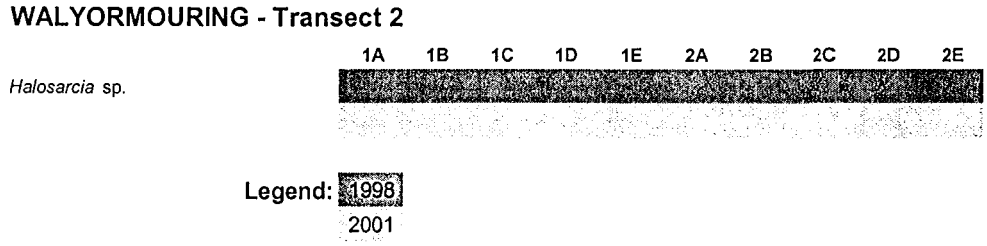


Figure 12. Species Distribution along Walyormouring Lake Transect 2 in 1998 and 2002

Table 19 Summary Of Understorey Species Distribution In All Transects At Walyormouring Lake

WALYORMOURING - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Wilsonia rotundifolia	*yes*				
Halosarcia sp.					*yes*

WALYORMOURING - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Halosarcia sp.					*yes*

Soil Characteristics

Table 16 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 69% in the vertical and 248% in the horizontal EM38 measurements over the three year period.

Table 20 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Walyormouring over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	140	326	103	602	143	322	107	604	151	349	126	569
Transect Mean	145	332	112	592								
T2												
Section Mean	383	507	294	773	384	546	283	740	274	438	209	611
Transect Mean	347	497	262	708								

Summary

Table 21 summaries all the data for Lake Walymorouring. Soil salinities have increased and this has effected the condition of the salt tolerant tree species. A new salt tolerant species has colonized the area.

Table 21 Summary of data for Lake Walymorouring

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	yes		
Crown Condition (all transects MCS)		*Casuarina obesa* *Melaleuca strobophylla*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Casuarina obesa*		*Melaleuca strobophylla*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Wilsonia rotundifolia*		*Halosarcia* sp.

Lake Eganu

Description

R. Gurner *et al.* (1999) reports that Lake Eganu is a large semi-permanent saline lake situated approximately 40 km south of Carnamah in the Pinjarrega Nature Reserve (25210) (30°00' S, 115°53' E). The total lake area is 82.2 hectares with 23 % consisting of open water and 76 % vegetation (Halse, Pearson and Patrick, 1993). Lake Eganu is part of a larger system which includes a series of permanent and seasonal swamps with numerous inlet channels and outflow drains. The hydrology of this chain of wetlands is unknown, but the direction of the flow appears to be in a northwest direction. The surrounding area is a gently undulating lowland of aeolian quartz sands (Australian Nature Conservation Agency, 1996). Lake Eganu has a long history of water gauging/study and is a major refuge for water birds. Lake Eganu has a long history of salinisation and has declined since the early 1970's.

Transects

Three transects were established on Lake Eganu, two 60 metre plots and one 40 metre plot which sampled the upper littoral zone down to the lakebed. The first monitoring was undertaken in March 1999 while the second occurred in mid October 2001 (for overstorey and soil conductivity for T1 and T2) and late January 2002 (for all of T3 and understorey for T1 and T2.) Water was still in this lake in October but not in January. Some re nailing of tags occurred in this lake.

Transect 1: (GPS: 50 391616 / 6680908) is positioned on the middle east side of the Lake, located by the north western sand track approximately 200 metres west of the bridge off Green Head road.
Transect 2: (GPS: 50 391480 / 6680396) is situated approximately 250 metres south of transect 1starting in a live Casuarina obesa woodland and finishing on the lake bed, 30 metres from the water mark.
Transect 3: (GPS: 50 393589 / 6683507) is located in the northern series of wetlands. The access track which leads directly to the plot is located 50 metres before the bridge, heading north.

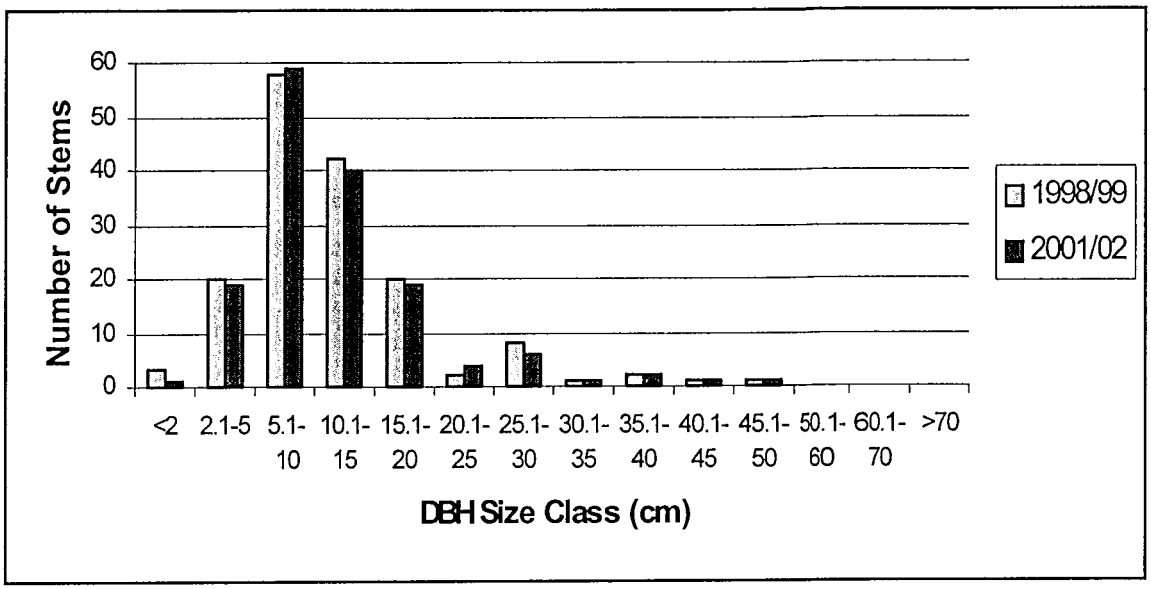
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

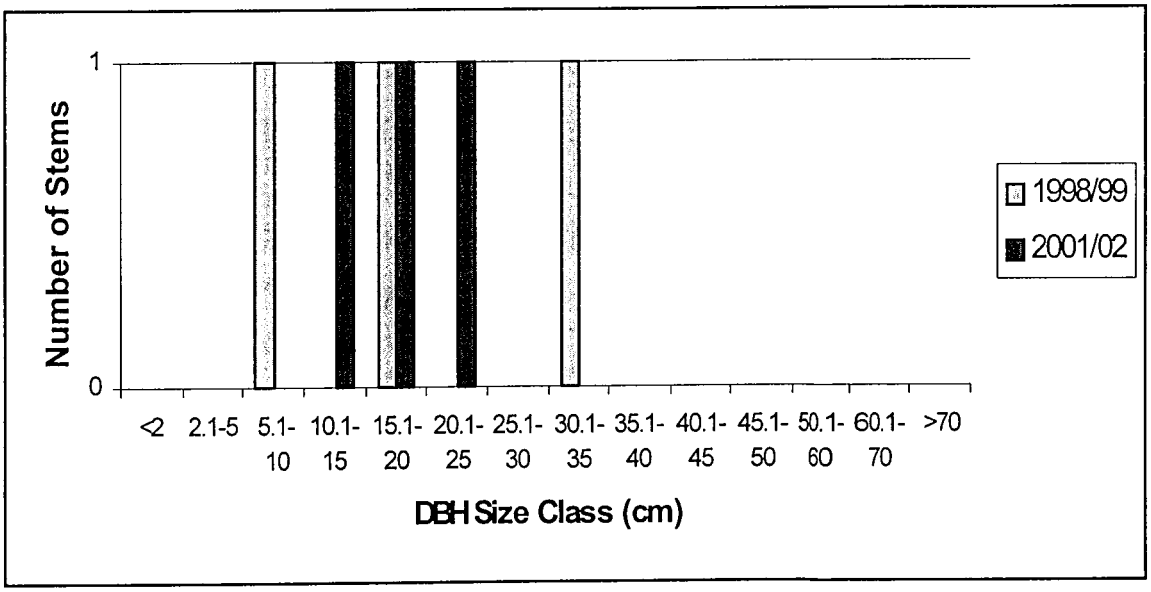
Population Structure and Tree Vigour

The data in Figure 15 indicate that there has been little recruitment or tree growth at this lake though there has been a slight improvement in the crown health of the major species *Casuarina obesa.*

Casuarina obesa



Eucalyptus loxophleba



Melaleuca strobophylla

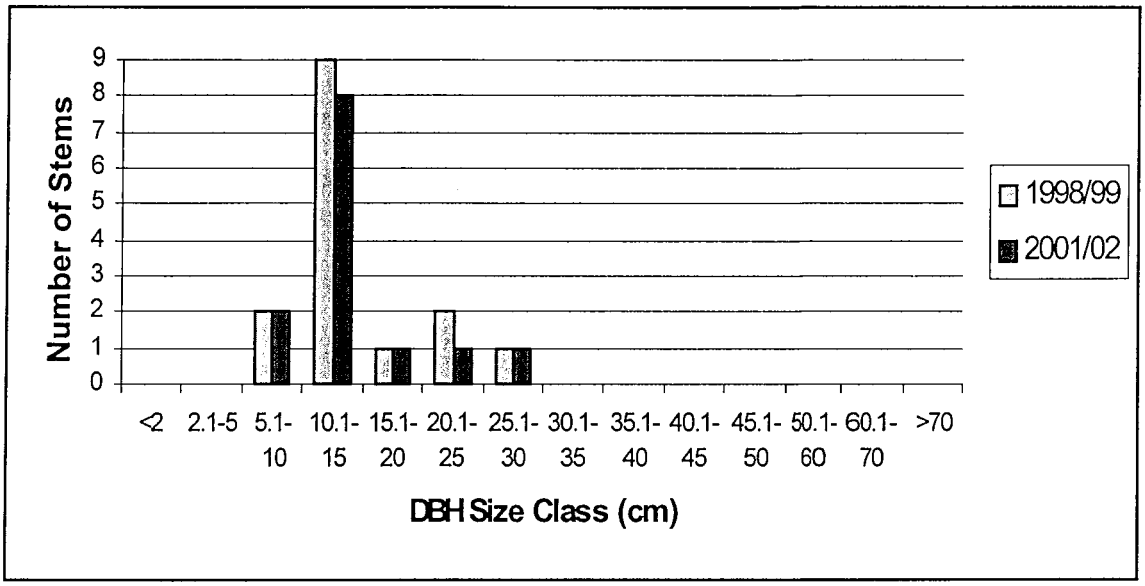


Figure 13. Size Class Distributions for *Casuarina obesa, Eucalyptus loxophleba,* and *Melaleuca strobophylla* at Lake Eganu

Table 22. Summary of Tree Data for Lake Eganu

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Acacia sp.	0	0	2	2.0		
Casuarina obesa	157	153	1	0.0	9.9 (4.3)	12.2 (2.4)
Eucalyptus loxophleba	3	3	0	0.0	14.3 (2.5)	14.7 (6.8)
Hakea recurva. recurva	0	0	5	4.0		
Melaleuca lateriflora	0	0	1	1.0		
Melaleuca strobophylla	15	13	0	0.0	15.5 (1.9)	11.2 (3.5)
Melaleuca viminea	0	0	3	3.0		
Scholtzia sp.	0	0	4	0.0		

Changes in understorey composition

There has been a reduction of the distribution of *Baumea vaginalis* and *Sclerolaena parviflora* and an elimination of *Chenopodium* sp and *Hakea recurva* from the transects with a recruitment of *Rhagodia drummondii* and expansion of *Halosarcia* and *Enchylaena* spp

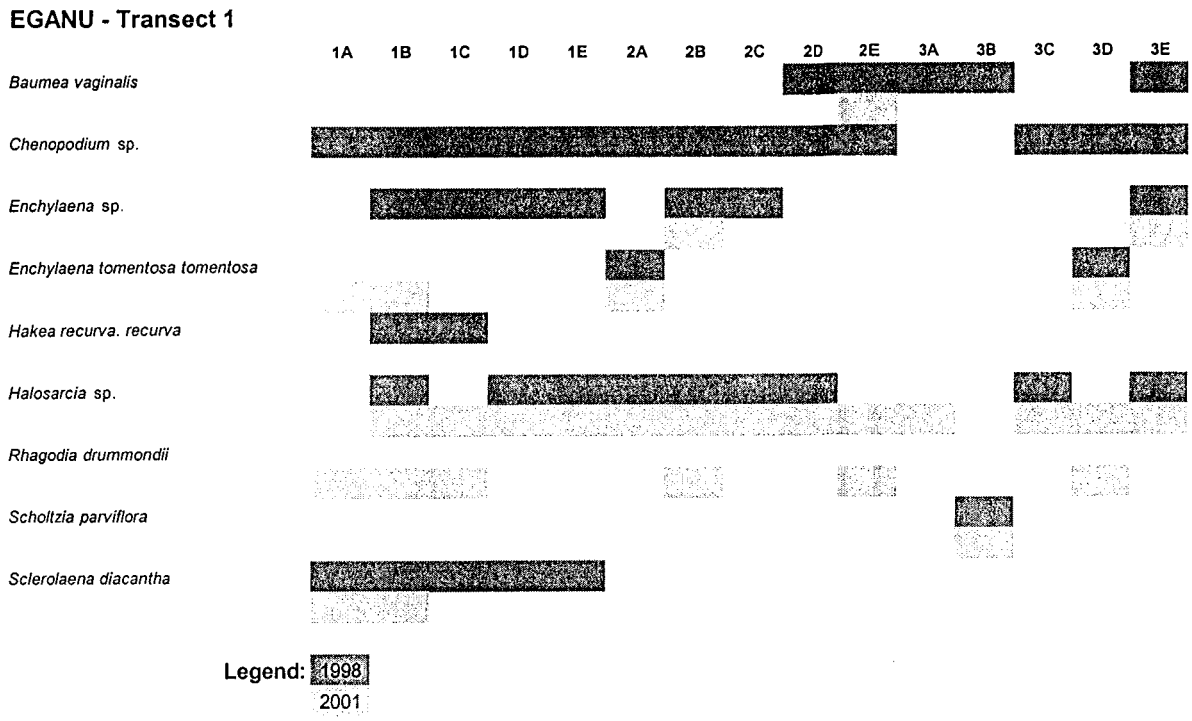


Figure 14. Species Distribution along Lake Eganu Transect 1 in 1998 and 2002

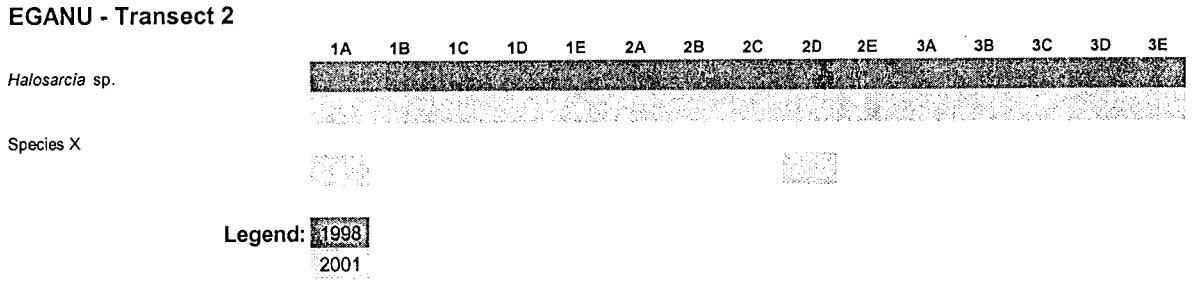


Figure 15. Species Distribution along Lake Eganu Transect 2 in 1998 and 2002

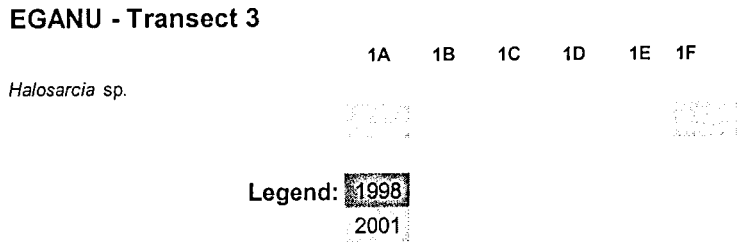


Figure 16. Species Distribution along Lake Eganu Transect 3 in 1998 and 2002

Table 23 Summary Of Understorey Species Distribution In All Transects At Lake Eganu

EGANU - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Rhagodia drummondii	*yes*				
Enchylaena sp.		*yes*			

EGANU - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Halosarcia sp.		*yes*			
Chenopodium sp.			*yes*		
Hakea recurva. recurva			*yes*		
Baumea vaginalis				*yes*	
Enchylaena tomentosa tomentosa				*yes*	
Sclerolaena diacantha				*yes*	
Scholtzia parviflora					*yes*

EGANU - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Enchylaena sp	*yes*				
Halosarcia sp.					*yes*

EGANU - Transect 3	New Recruit	Expansion	Extinction	Contraction	No Change
Halosarcia sp.	*yes*				

Soil Characteristics

Table 19 tabulates the mean soil salinities for the transects over the two sampling periods. There was a decrease of 19% in the vertical and 25% in the horizontal EM38 measurements over the three year period.

Table 24 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Eganu over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	422	330	291	218	401	319	271	211	387	302	262	195
Transect Mean	403	317	275	208								
T2												
Section Mean	557	523	402	353	650	588	485	431	662	606	533	472
Transect Mean	623	572	473	419								
T3												
Section Mean	320	223	264	154	328	193	273	137	317	180	265	133
Transect Mean	322	199	267	141								

Summary

Table 25 summaries all the data for Lake Eagnu. There has been a reduction in soil salinities over the period and this has been reflected in an increase in the condition of salt sensitive trees. However closer to the lake there has been a reduction in the number of the salt tolerant trees and the understorey has become more dominated by salt tolerant species without the elimination of the salt sensitive species.

Table 25 Summary of data for Lake Eagnu

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*		yes	
Crown Condition (all transects MCS)	*Casuarina obesa* *Eucalyptus loxophleba*	*Melaleuca strobophylla*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*		*Casuarina obesa* *Hakea recurva. Recurva* *Melaleuca strobophylla* *Scholtzia* sp.	*Acacia* sp *Eucalyptus loxophleba* *Melaleuca lateriflora* *Melaleuca viminea*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Enchylaena* sp. *Halosarcia* sp. *Rhagodia drummondii*	*Baumea vaginalis* *Chenopodium* sp. *Enchylaena tomentosa tomentosa* *Hakea recurva. recurva* *Sclerolaena diacantha*	*Scholtzia parviflora* *Halosarcia sp*

Ardath Lake

Description

R. Gurner *et al.* (1999) reports that Ardath Lake (32°05' S, 118°09' E) lies in a large block of remnant vegetation vested in the Shire of Bruce Rock. Along with other low-lying areas in the surrounding landscape, much of the vegetation of the lake is severely salt affected. Inflow and outflow appears to occur through the channel at the south western end of the lake. A low drainage bund has been constructed across a second channel which lies directly north of the main channel. The bund appears to direct flow into the lake through the main channel and may block outflow into the second channel. These modifications to the drainage may be intended to maintain water levels for recreation (i.e. skiing).

Transects

Two 40 metre transects were established on this lake:
Transect 1: (GPS: 50 608866 / 6448308) is positioned on the western side of the lake, located by the main access track off the sealed rod.
Transect 2: (GPS: 50 609112 / 6448112) is situated on the eastern side of the lake, located by the main access track. Transect 2 finishes in the water. **Note:** the rear of this transect crosses the access track and has no rear right star picket.

The second sampling program for this lake occurred in early December 2001

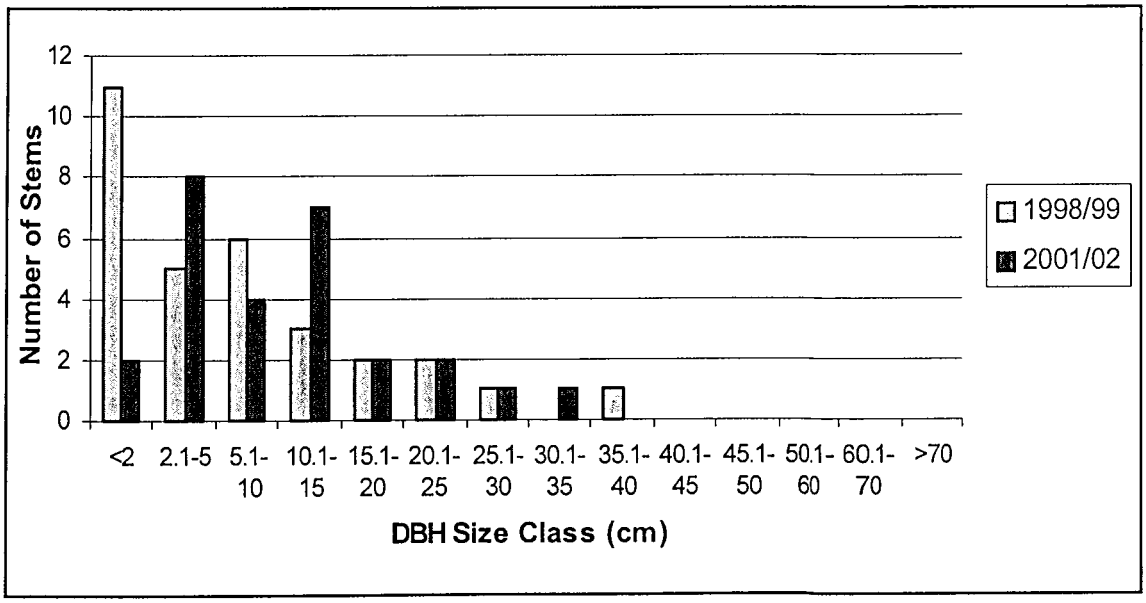
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

Population Structure and Tree Vigour

The limited data for this lake that the trees have mostly survived but that *Eucalyptus yilgarnensis* has not fared as well as the more salt tolerant *Casuarina obesa*.

Casuarina obesa



Eucalyptus yilgarnensis

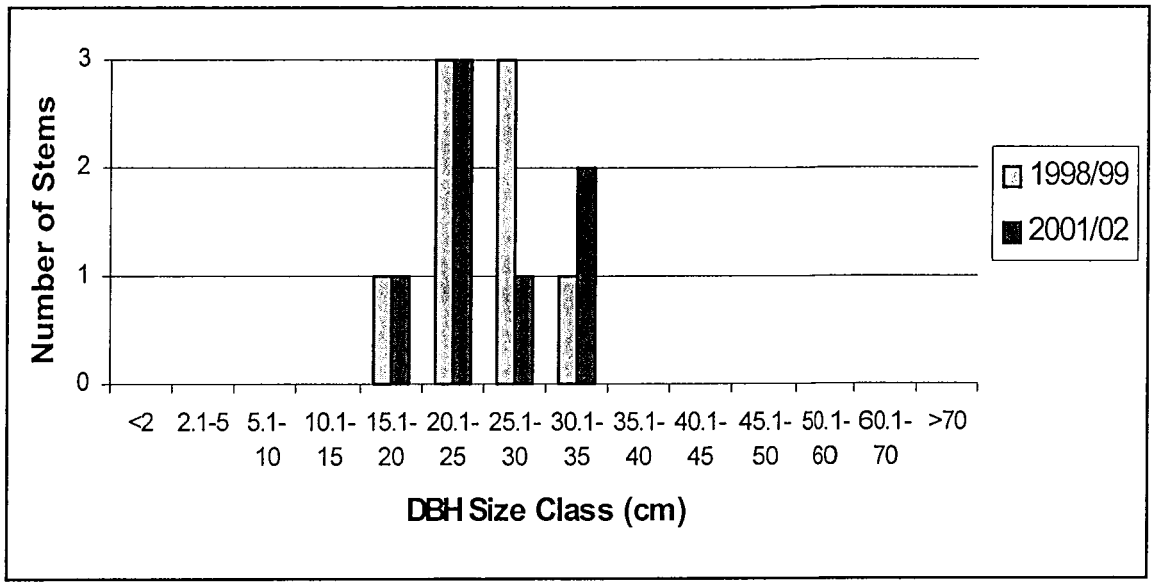


Figure 17. Size Class Distributions for *Casuarina obesa* and *Eucalyptus yilgarnensis* at Ardath.

Table 26. Summary of Tree Data for Ardath Lake

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Casuarina obesa	25	16	6	13	13.9 (2.7)	14.4 (2.2)
Eucalyptus yilgarnensis	7	6	0	0	10.7 (3.0)	8.8 (2.1)
Melaleuca lateriflora	0	0	9	2	N/a	n/a
Melaleuca thyoides	0	0	21	18	n/a	n/a
Scaevola spinescens	0	0	0	2	n/a	n/a
Acacia ?rostellifera	0	0	1	2	n/a	n/a

Changes in understorey composition

There is a difference between the two transects. In Transect 1 there has been an elimination of a number of species including *Enchylaena tomentosa, Mesembryanthemum nodiflorum, Chenopodium* sp. *Acacia* sp and *Alyxia buxifolia.* In Transect 2 there has been a recruitment or expansion of *Melaleuca thyoides, Darwinia halophila, Sclerolaena diacantha, Dianella revoluta, Daviesia argillacea* and *Scaevola spinescens* and a decrease or elimination of *Grevillea acuaria, Acacia rostellifera* and *Olearia pimeleoides*

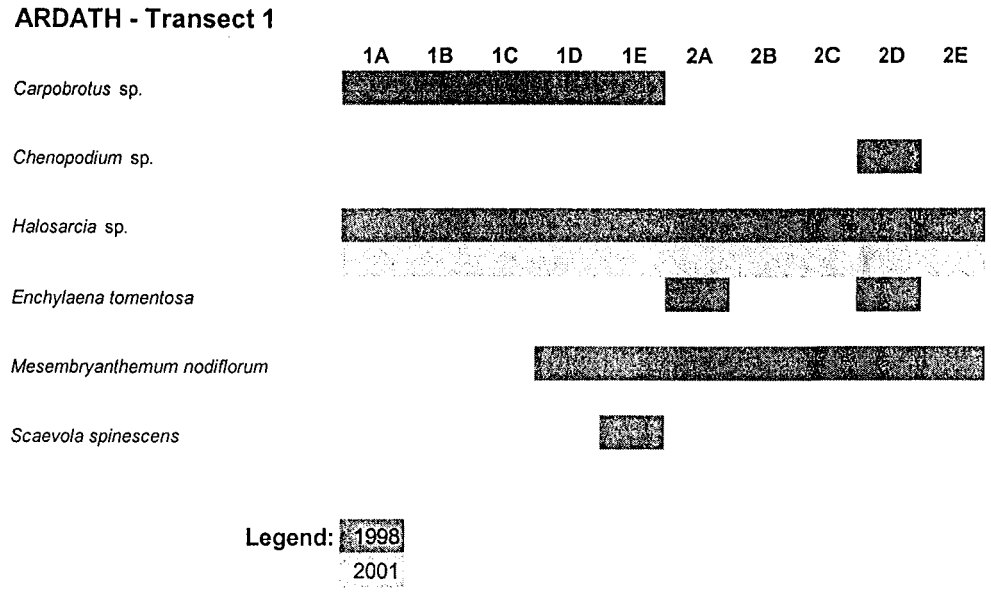


Figure 18. Species Distribution along Ardath Lake Transect 1 in 1998 and 2002

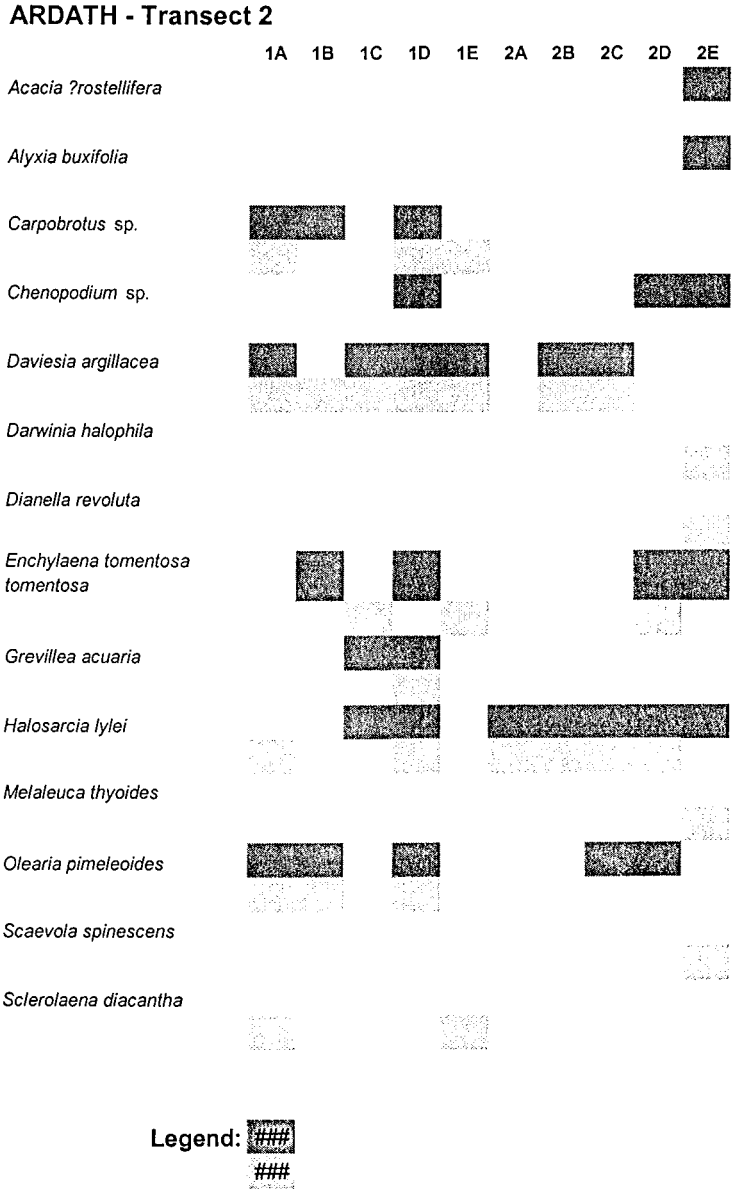


Figure 19. Species Distribution along Ardath Lake Transect 2 in 1998 and 2002

Table 27 Summary Of Understorey Species Distribution In All Transects At Ardath Lake

ARDATH - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Carpobrotus sp.			*yes*		
Chenopodium sp.			*yes*		
Enchylaena tomentosa			*yes*		
Mesembryanthemum nodiflorum			*yes*		
Scaevola spinescens			*yes*		
Halosarcia sp.					*yes*

ARDATH - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Darwinia halophila	*yes*				
Melaleuca thyoides	*yes*				
Scaevola spinescens	*yes*				
Sclerolaena diacantha	*yes*				
Dianella revoluta	*yes*				
Daviesia argillacea		*yes*			
Enchylaena tomentosa tomentosa		*yes*		*yes*	
Halosarcia lylei		*yes*			
Acacia ?rostellifera			*yes*		
Alyxia buxifolia			*yes*		
Chenopodium sp.			*yes*		
Grevillea acuaria				*yes*	
Olearia pimeleoides				*yes*	
Carpobrotus sp.					*yes*

Soil Characteristics

Table 22 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 18% in the vertical and 18% in the horizontal EM38 measurements over the three year period.

Table 28 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Ardath over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	696	861	727	883	704	846	764	920	686	835	744	812
Transect Mean	695	847	745	872								
T2												
Section Mean	472	528	374	441	484	550	373	458	545	615	479	557
Transect Mean	500	564	409	485								

Summary

Table 29 summaries all the data for Lake Ardath. With the increase in soil salinities there has been a decrease in the health of salt sensitive trees and a reduction in the salt sensitive understorey. Salt tolerant trees and understorey plants have increased in condition and proportion in the understorey population respectively.

Table 29 Summary of data for Lake Ardath

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	yes		
Crown Condition (all transects MCS)	*Casuarina obesa*	*Eucalyptus yilgarnensis*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Acacia ?rostellifera* *Scaevola spinescens*	*Casuarina obesa* *Eucalyptus yilgarnensis* *Melaleuca lateriflora* *Melaleuca thyoides*	
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Darwinia halophila* *Enchylaena tomentosa tomentosa* *Grevillea halophila* *Halosarcia lylei* *Melaleuca thyoides* *Scaevola spinescens* *Sclerolaena diacantha* *Daviesia argillacea*	*Acacia ?rostellifera* *Alyxia buxifolia* *Carpobrotus* sp. *Chenopodium* sp.. *Dianella revoluta* *Enchylaena tomentosa* *Grevillea acuaria* *Mesembryanthemum nodiflorum* *Olearia pimeleoides* *Scaevola spinescens*	*Halosarcia sp.* *Carpobrotus sp*

Lake Campion

Description

R. Gurner *et al.* (1999) reports that Lake Campion is a very large seasonal hypersaline lake situated approximately 40 km north of the Merredin town site in the Campion Nature Reserve (24789) (31°09' S, 118°21' E). The total lake area is 611.2 hectares with 100 % consisting of open water (Halse, Pearson and Patrick, 1993). A series of saline depressions occur in the remnant vegetation to the east and south of the lake along with several small creeks which flow into the lake. A narrow band of remnant vegetation separates the lake from adjoining pasture to the north. The saline nature of the lake has lead to the death of the majority of the littoral vegetation. The lake is used for skiing when water level permits.

Transects

Four transects were established on Lake Campion. The plots sampled the upland wetland vegetation through to the *Halosarcia* species on the lakebed.

The first monitoring was undertaken in November 1998 while the second occurred in early December 2001 (T1, T2 and T3) when there was water in the lake and late January 2001 for T4. By January the lake had dried up allowing access to T4.

Transect 1: (GPS: 50 628395 / 6555055) is situated approximately half way along the western peninsula that crosses Stock Road.
Transect 2: (GPS:50 628208 / 6554632) is located approximately half way along the northwestern side of the southern section of the lake.
Transect 3: (GPS: 50 628169 / 6553366) is positioned in the middle of the bay to the south east of the car park/boat ramp.
Transect 4: (GPS:50 629289 / 6554488) is situated approximately half way along the second bay on the south west side of the main lake body.

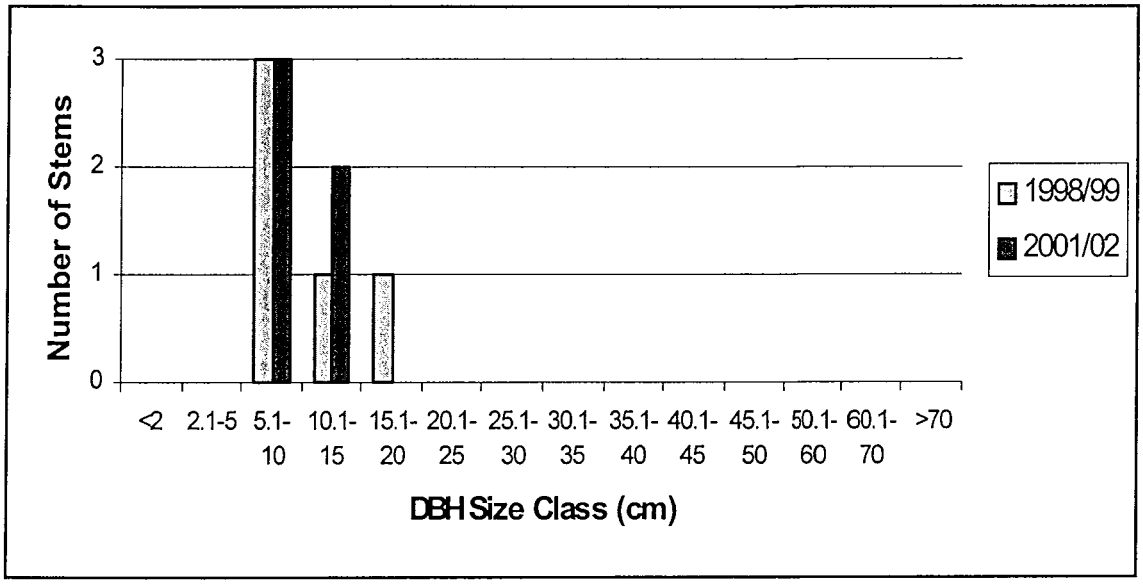
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

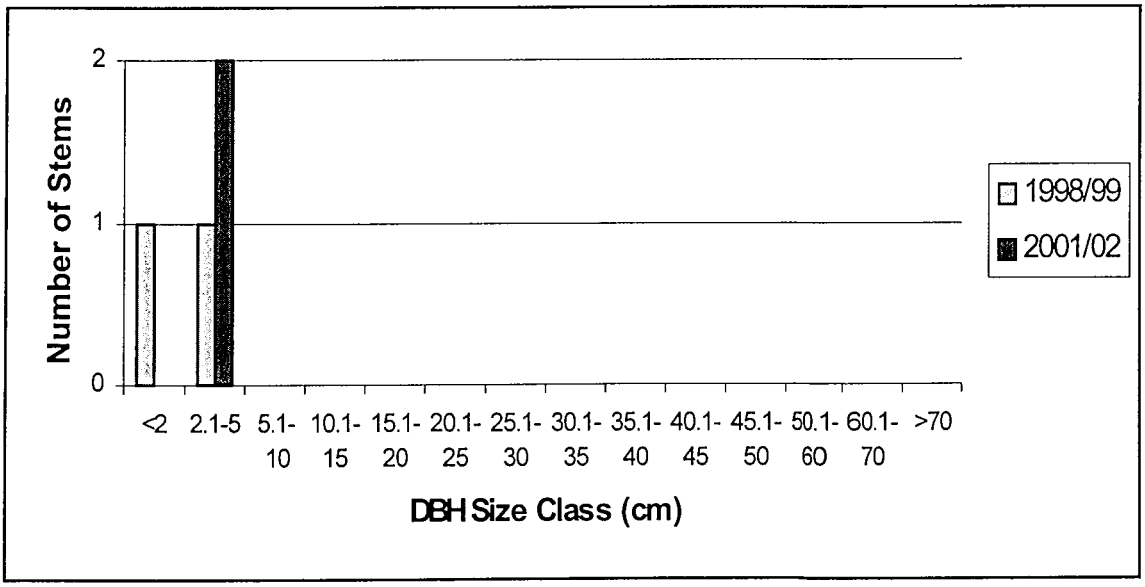
Population Structure and Tree Vigour

Though there has been some mortality amongst the trees at this lake, crown health has not deteriorated to any degree.

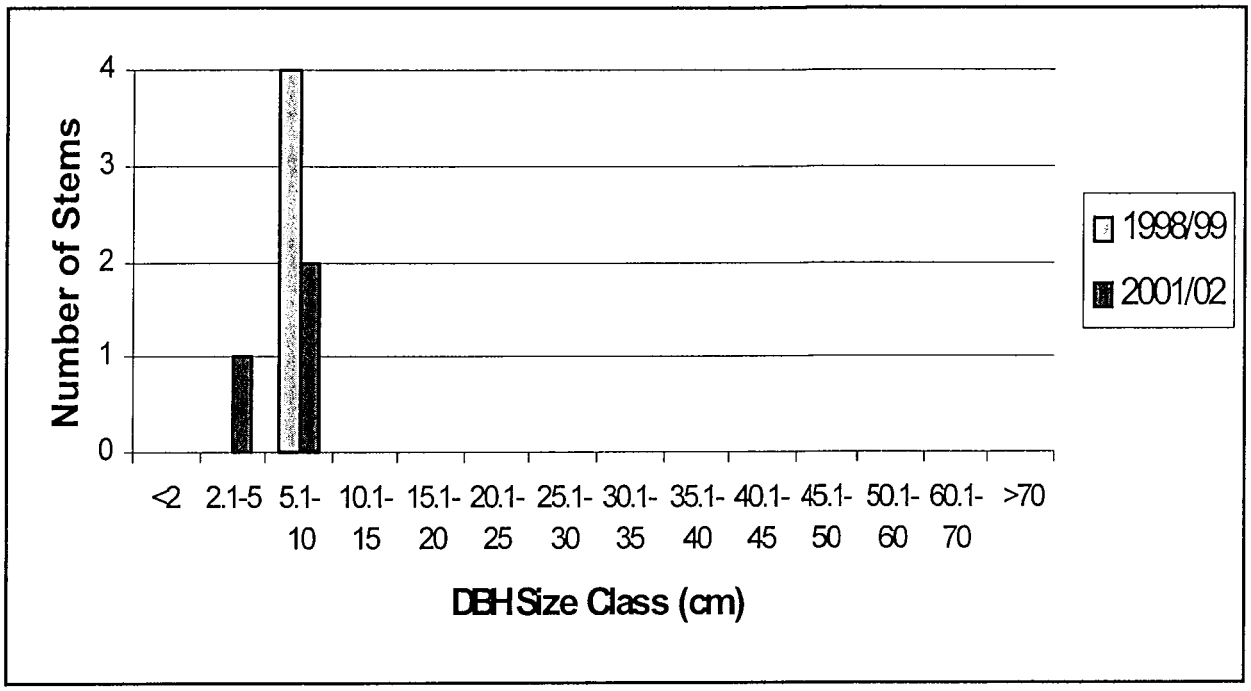
Acacia ?prainii



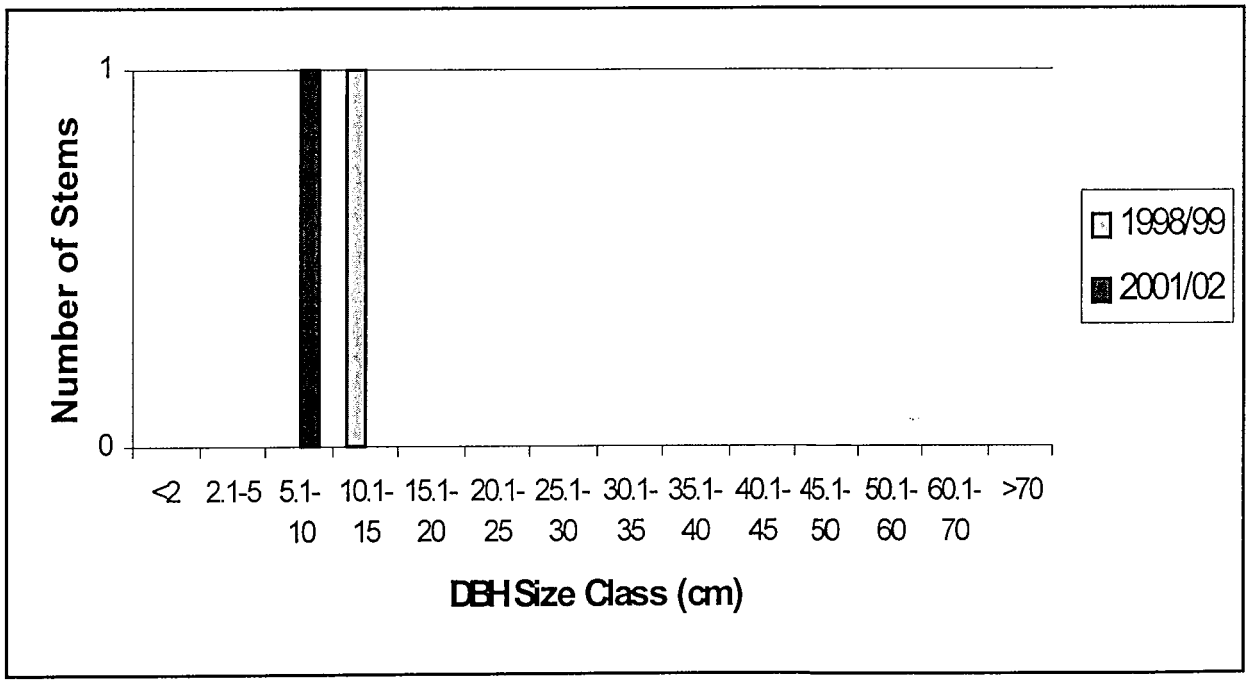
Acacia acuminata



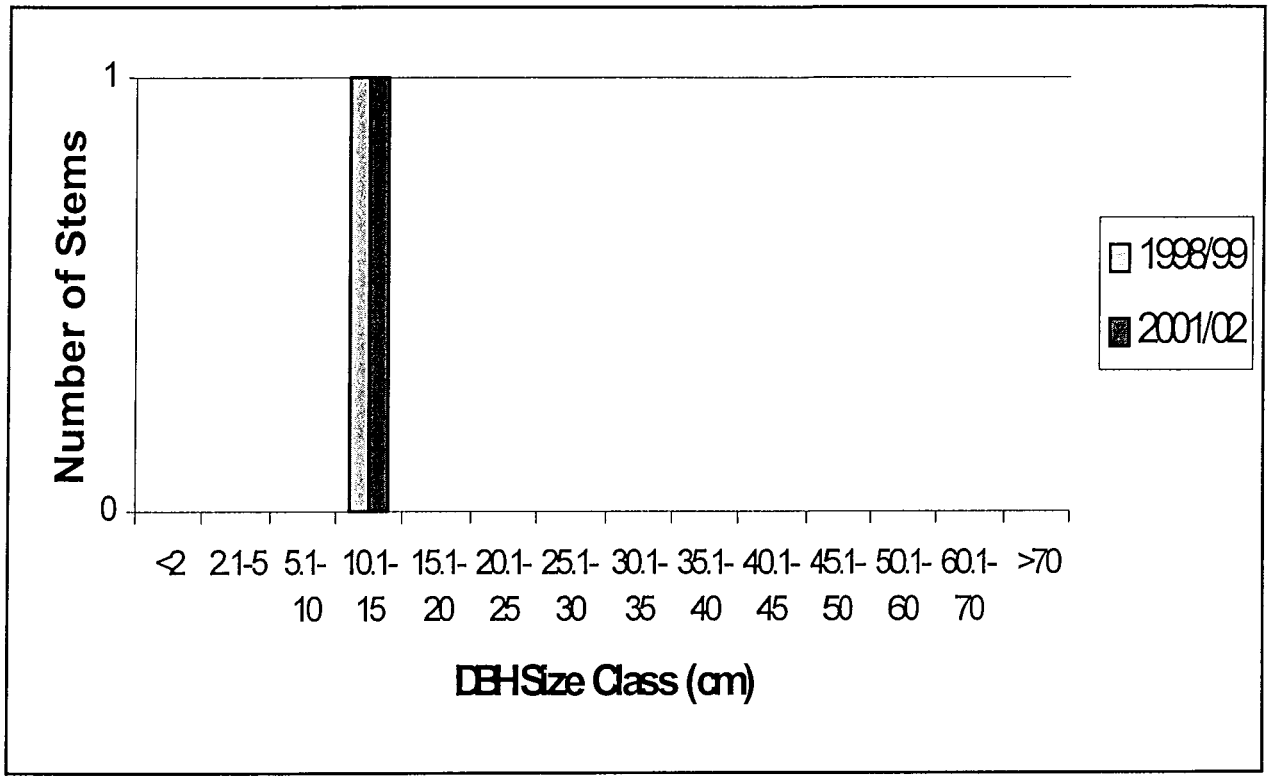
Acacia sp.



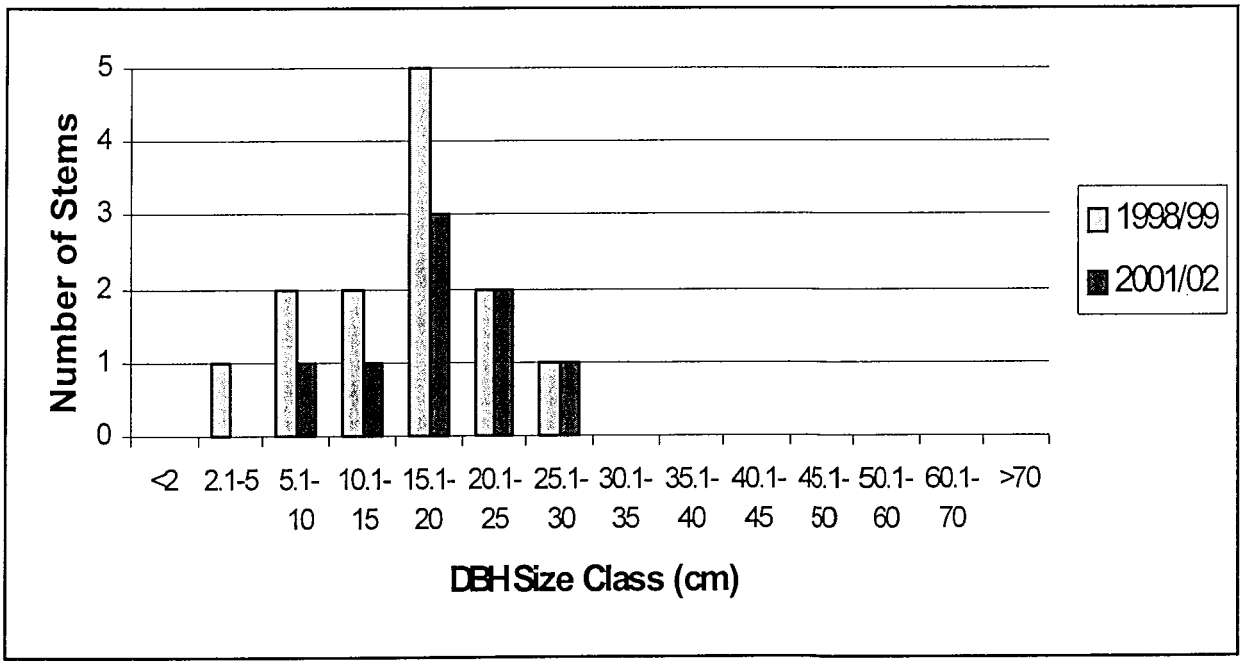
Alyxia buxifolia



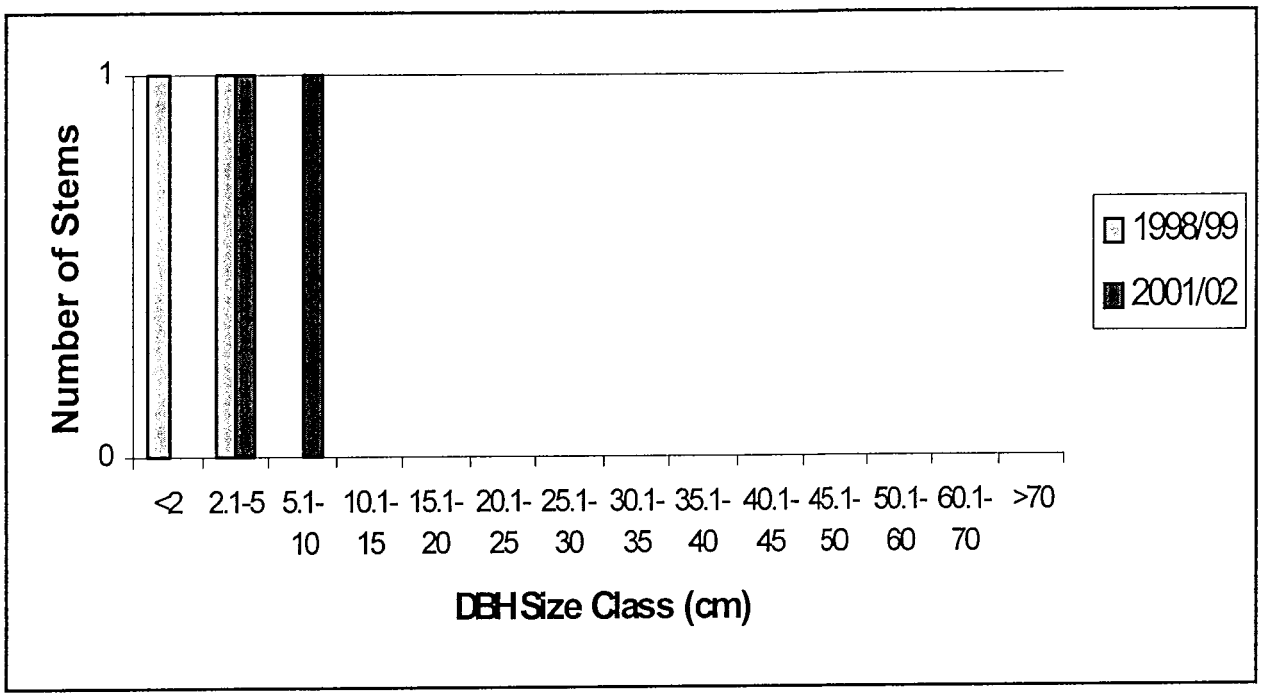
Bossiaea ?rufa



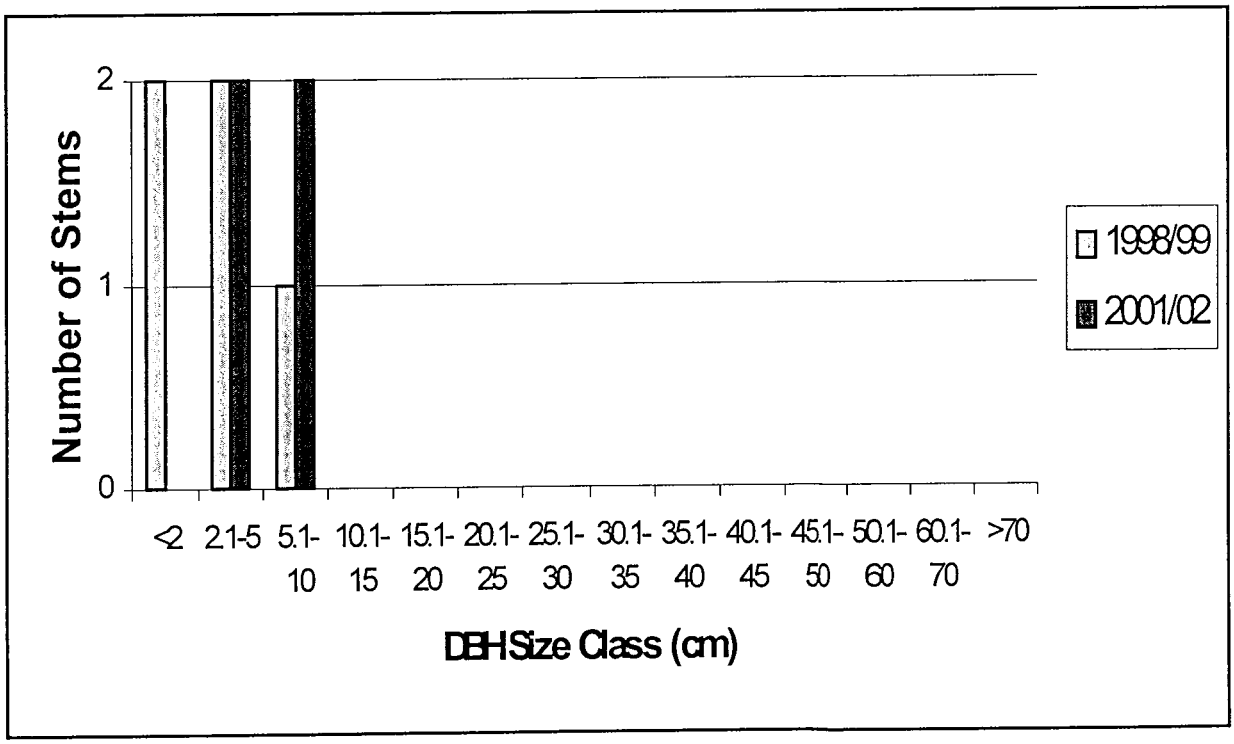
Callitris glaucophylla



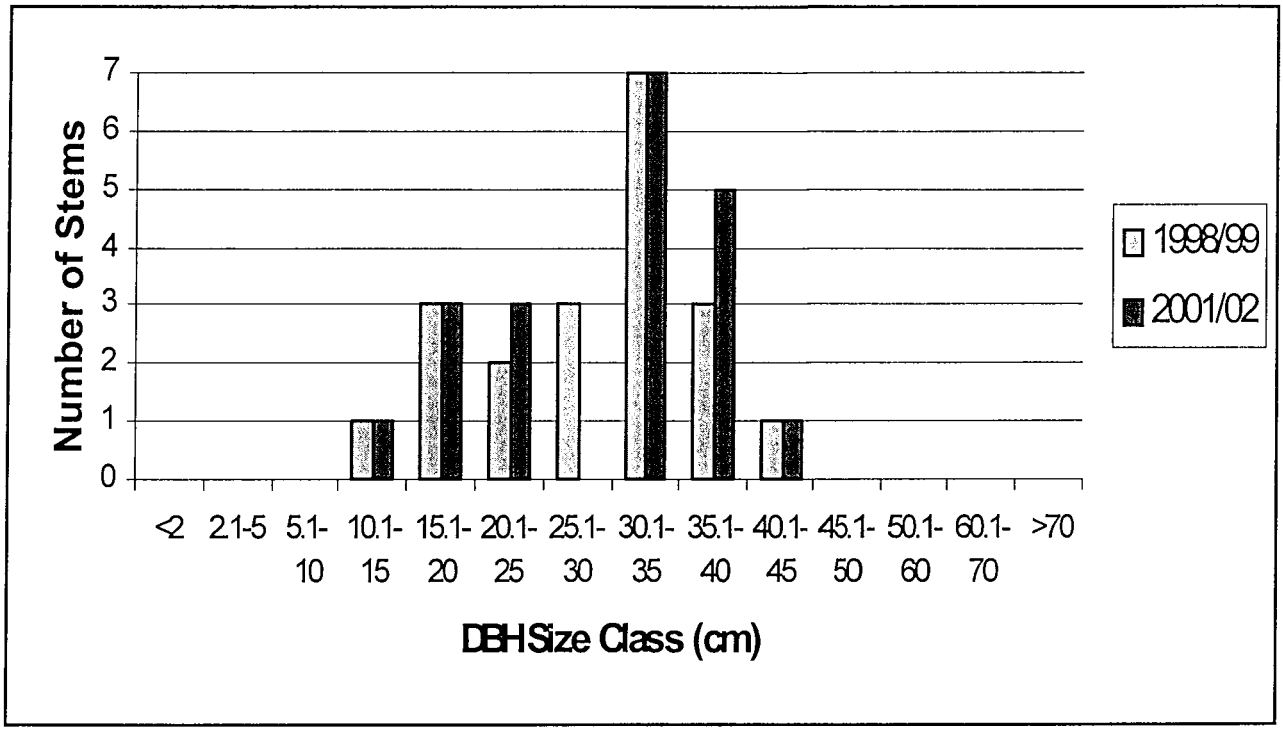
Dodonaea filifolia



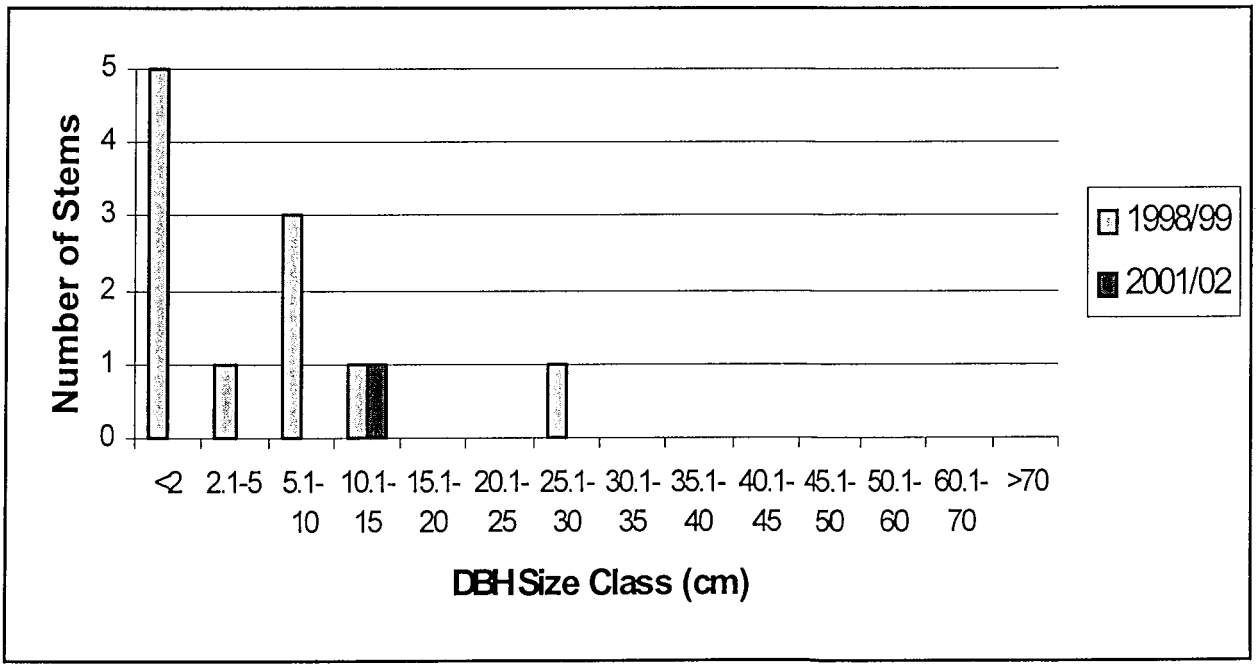
Eremophila oppositifolia angustifolia



Eucalyptus yilgarnensis



Melaleuca pauperiflora



Melaleuca uncinata

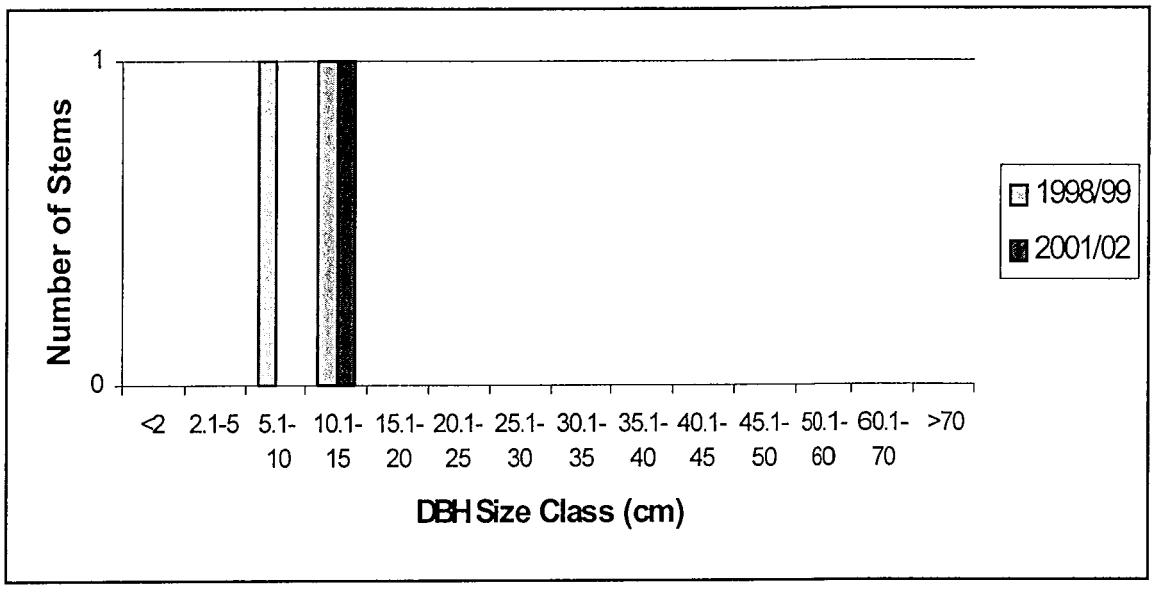


Figure 20. Size Class Distributions for *Acacia acuminata, A? prainii, Acacia sp, Alyxia buxifolia, Bossiaea ?rufa, Callitris glaucophylla, Dodonaea filifolia, Eremophila oppositifolia angustifolia, Eucalyptus yilgarnensis Melaleuca uncinata* and *M pauperiflora* at Lake Campion

Table 30. Summary of Tree Data for Lake Campion

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Acacia ?prainii	5	5	2	0.0	11.0 (2.4)	<9.0
Acacia acuminata	2	2	0	0.0	14.0 (0.7)	-
Acacia sp.	4	2	5	2	11.5 (3.4)	13.0 (2.8)
Alyxia buxifolia	1	1	1	0.0	13	12.0
Bossiaea? rufa	2	1	7	0.0	11.0	12.0
Callitris glaucophylla	13	6	0	1.0	15.2 (3.6)	15.5 (1.5)
Dodonaea filifolia	1	21	19	5.0	11.0	11.0
Eremophila oppositifolia. angustifolia	4	4	3	4.0	15.5 (2.5)	17.0
Eucalyptus yilgarnensis	20	20	0	0.0	13.8 (4.6)	12.4 (2.8)
Hakea recurva	0	0	6	6.0		
Melaleuca pauperiflora	7	1	7	0.0	11.9 (4.5)	14.0
Melaleuca uncinata	2	1	237	181.0	16.0 (1.4)	9.0

Changes in understorey composition

Species diversity is quite high at Campion. There has been a number of changes in the distribution of species along the transects. These have included the elimination and recruitment of some species specially in the areas of the transects closest to the lake. Those area closest to the lake have had salt sensitive species eliminated while salt tolerant species have increased.

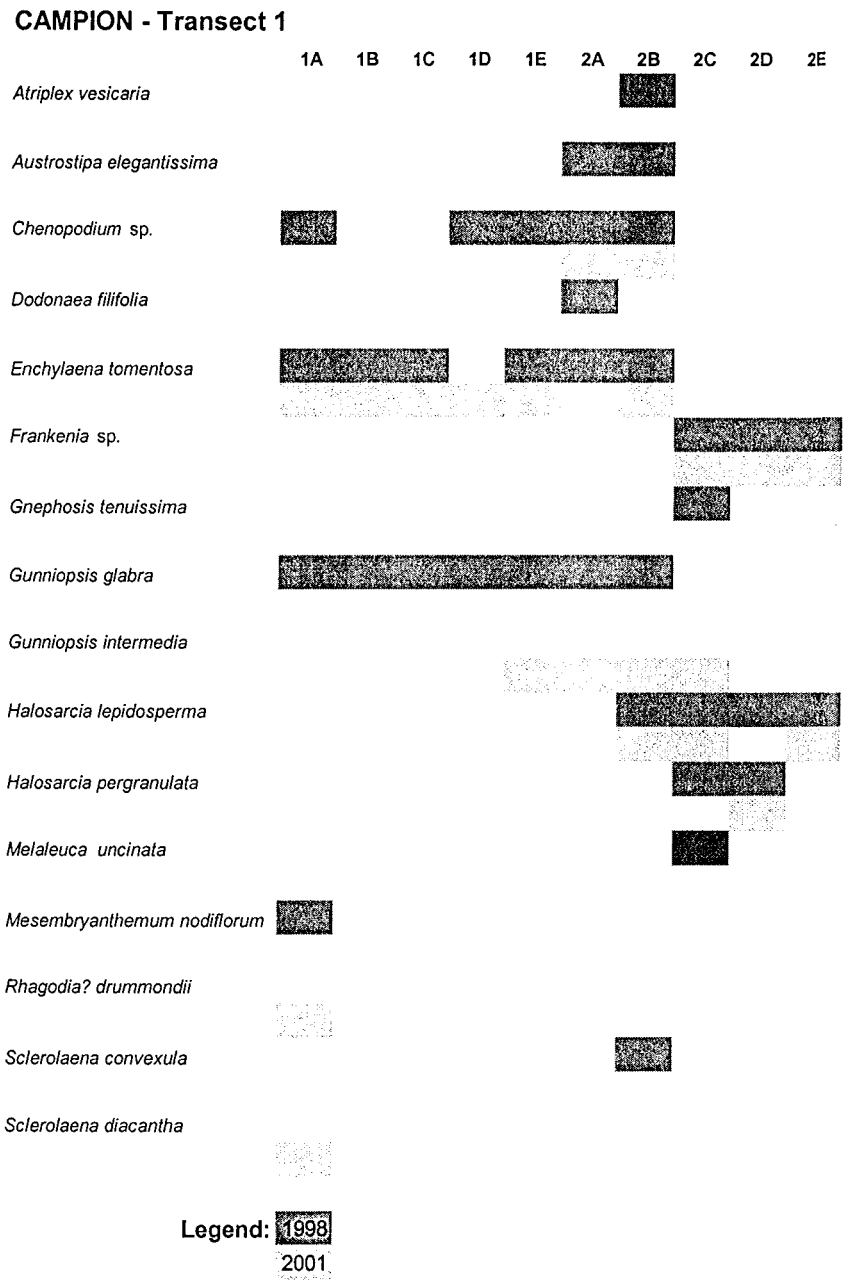


Figure 21. Species Distribution along Lake Campion Transect 1 in 1998 and 2002

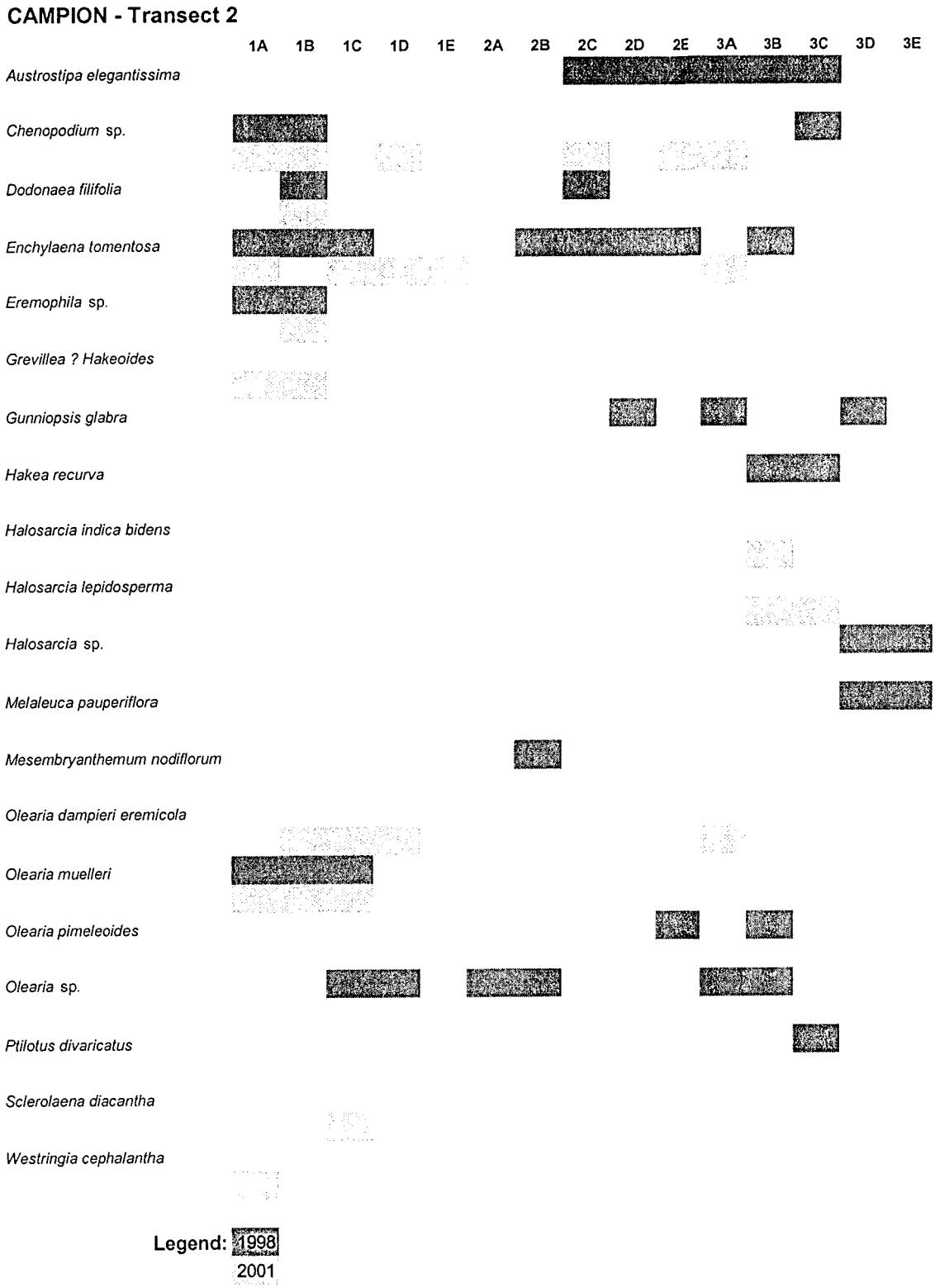


Figure 22. Species Distribution along Lake Campion Transect 2 in 1998 and 2002

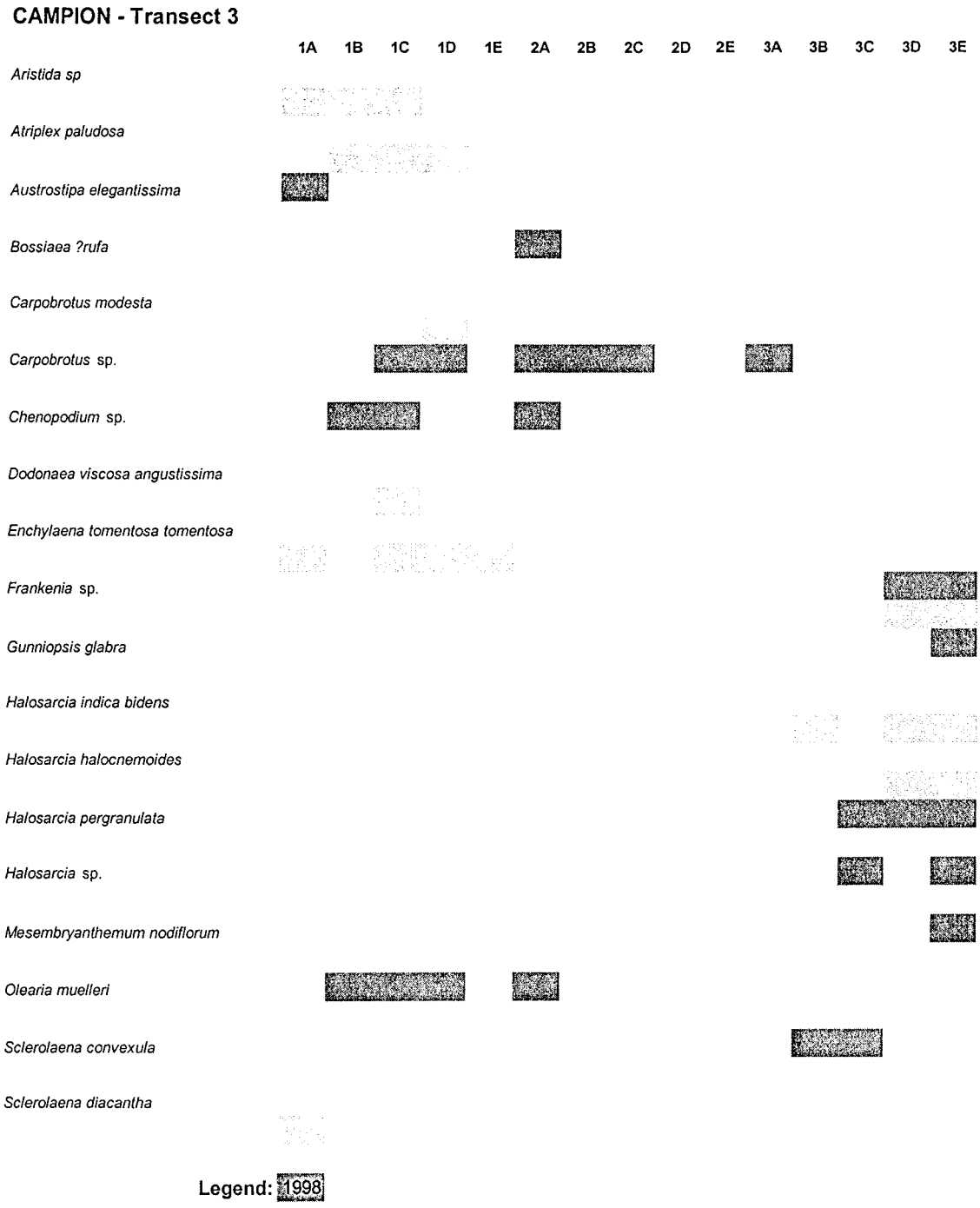


Figure 23. Species Distribution along Lake Campion Transect 3 in 1998 and 2002

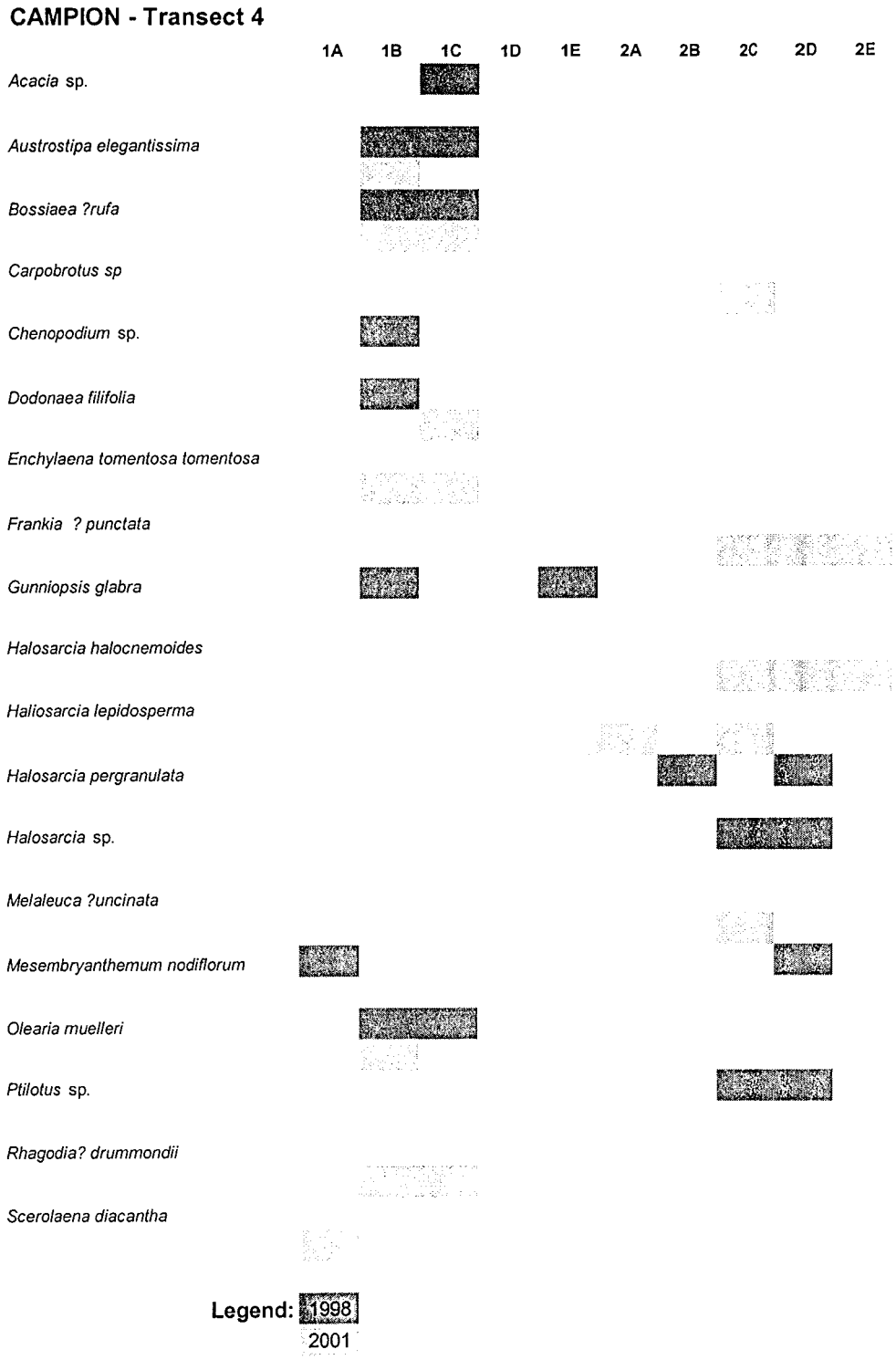


Figure 24. Species Distribution along Lake Campion Transect 4 in 1998 and 2002

Table 31 Summary Of Understorey Species Distribution In All Transects At Lake Campion

CAMPION - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Gunniopsis intermedia	*yes*				
Rhagodia? drummondii	*yes*				
Sclerolaena diacantha	*yes*				

CAMPION - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Atriplex vesicaria			*yes*		
Austrostipa elegantissima			*yes*		
Gnephosis tenuissima			*yes*		
Gunniopsis glabra			*yes*		
Dodonaea filifolia			*yes*		
Melaleuca uncinata			*yes*		
Mesembryanthemum nodiflorum			*yes*		
Sclerolaena convexula			*yes*		
Chenopodium sp.				*yes*	
Halosarcia lepidosperma				*yes*	
Halosarcia pergranulata				*yes*	
Enchylaena tomentosa					*yes*
Frankenia sp.					*yes*

CAMPION - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Grevillea ? Hakeoides	*yes*				
Halosarcia indica bidens	*yes*				
Halosarcia lepidosperma	*yes*				
Olearia dampieri eremicola	*yes*				
Sclerolaena diacantha	*yes*				
Westringia cephalantha	*yes*				
Chenopodium sp.		*yes*			
Enchylaena tomentosa		*yes*		*yes*	
Austrostipa elegantissima			*yes*		
Gunniopsis glabra			*yes*		
Hakea recurva			*yes*		
Halosarcia sp.			*yes*		
Melaleuca pauperiflora			*yes*		
Mesembryanthemum nodiflorum			*yes*		
Olearia pimeleoides			*yes*		
Olearia sp.			*yes*		
Ptilotus divaricatus			*yes*		
Dodonaea filifolia				*yes*	
Eremophila sp.				*yes*	
Olearia muelleri					*yes*

CAMPION - Transect 3	New Recruit	Expansion	Extinction	Contraction	No Change
Aristida sp	*yes*				
Atriplex paludosa	*yes*				
Carpobrotus modesta	*yes*				
Dodonaea viscosa angustissima	*yes*				
Enchylaena tomentosa tomentosa	*yes*				
Halosarcia indica bidens	*yes*				
Halosarcia halocnemoides	*yes*				
Sclerolaena convexula	*yes*				
Austrostipa elegantissima			*yes*		

CAMPION - Transect 3	New Recruit	Expansion	Extinction	Contraction	No Change
Bossiaea ?rufa			*yes*		
Carpobrotus sp.			*yes*		
Chenopodium sp.			*yes*		
Gunniopsis glabra			*yes*		
Halosarcia pergranulata			*yes*		
Halosarcia sp.			*yes*		
Mesembryanthemum nodiflorum			*yes*		
Olearia muelleri			*yes*		
Sclerolaena diacantha			*yes*		
Frankenia sp.					*yes*

CAMPION - Transect 4	New Recruit	Expansion	Extinction	Contraction	No Change
Carpobrotus sp	*yes*				
Enchylaena tomentosa tomentosa	*yes*				
Frankia ? punctata	*yes*				
Halosarcia lepidosperma	*yes*				
Halosarcia halocnemoides	*yes*				
Melaleuca ?uncinata	*yes*				
Rhagodia? drummondii	*yes*				
Sclerolaena diacantha	*yes*				
Dodonaea filifolia		**To lake**		**From lake**	
Acacia sp.			*yes*		
Chenopodium sp.			*yes*		
Gunniopsis glabra			*yes*		
Halosarcia pergranulata			*yes*		
Halosarcia sp.			*yes*		
Mesembryanthemum nodiflorum			*yes*		
Ptilotus sp.			*yes*		
Austrostipa elegantissima				*yes*	
Olearia muelleri				*yes*	
Bossiaea ?rufa					*yes*

Soil Characteristics

Table 25 tabulates the mean soil salinities for the transects over the two sampling periods. There was only a slight change (increase of 3% in the vertical and decrease of 1% in the horizonal EM38 measurements) in soil salinities over the three year period.

Table 32 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Lake Campion over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	506	479	414	326	507	497	348	336	485	510	340	353
Transect Mean	499	495	368	338								
T2												
Section Mean	331	326	290	235	331	318	293	224	292	390	211	337
Transect Mean	318	345	265	265								
T3												
Section Mean	286	299	191	198	291	294	181	190	282	308	173	188
Transect Mean	286	300	182	192								
T4												
Section Mean	460	483	350	338	421	411	247	302	454	451	338	302
Transect Mean	445	448	312	314								

Summary

Table 33 summaries all the data for Lake Campion. There has been no changes in the soil salinities and this is reflected in the little changes that have occurred in the transects. Changes that have occurred include the decrease in some salt tolerant understorey and an increase in a number of salt sensitive understorey species.

Table 33 Summary of data for Lake Campion

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*			yes
Crown Condition (all transects MCS)	*Acacia* sp *Callitris glaucophylla* *Eremophila oppositifolia angustifolia*	*Acacia ?prainii* *Eucalyptus yilgarnensis*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Dodonaea filifolia*	*Acacia* sp. *Bossiaea? rufa* *Callitris glaucophylla* *Melaleuca pauperiflora* *Melaleuca uncinata*	*Acacia ?prainii* *Acacia acuminata* *Alyxia buxifolia* *Eremophila oppositifolia angustifolia* *Eucalyptus yilgarnensis* *Hakea recurva*

Condition	Increase	Decrease	No Change
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Aristida sp* *Atriplex paludosa* *Carpobrotus modesta* *Carpobrotus sp* *Chenopodium* sp. *Dodonaea filifolia* *Dodonaea viscosa angustissima* *Enchylaena tomentosa tomentosa* *Frankia ? punctata* *Grevillea ? Hakeoides* *Gunniopsis intermedia* *Halosarcia halocnemoides* *Halosarcia indica bidens* *Halosarcia lepidosperma* *Melaleuca ?uncinata* *Olearia dampieri eremicola* *Rhagodia? drummondii* *Sclerolaena convexula* *Sclerolaena diacantha* *Westringia cephalantha*	*Acacia* sp. *Atriplex vesicaria* *Austrostipa elegantissima* *Bossiaea ?rufa* *Carpobrotus* sp. *Chenopodium* sp. *Dodonaea filifolia* *Eremophila* sp. *Frankenia* sp. *Gnephosis tenuissima* *Gunniopsis glabra* *Hakea recurva* *Halosarcia lepidosperma* *Halosarcia pergranulata* *Halosarcia* sp. *Melaleuca uncinata* *Melaleuca pauperiflora* *Mesembryanthemum nodiflorum* *Olearia muelleri* *Olearia pimeleoides* *Olearia* sp. *Ptilotus divaricatus* *Ptilotus* sp. *Sclerolaena convexula* *Sclerolaena diacantha*	*Bossiaea ?rufa* *Enchylaena tomentosa* *Frankenia* sp. *Frankenia* sp. *Olearia muelleri*

Paperbark Swamp

Description

R. Gurner *et al.* (1999) reports that Paperbark Swamp is a small fresh seasonal wetland which is located approximately 30 km south west of Corrigin in the Paperbark Nature Reserve (Reserve Number) (32°24' S, 118°, 06' E). The wetland lies within cleared paddocks apart from the vegetation remaining in the reserve. The wetland is characterised by gentle to flat sloping banks near the perimeter to sharp rolling topography toward the centre which is comprised of interconnected depressions, mounds and creeks. A large drainage inlet has been constructed within the southern section of the reserve opposite a paddock with evidence of water logging and erosion. Modification to the drainage of the lake may be causing the vegetation stress noted within the southern portion of the Swamp. Grazing history within the Paperbark Swamp is unknown, but it seems likely that grazing has occurred within the southern sections of the nature reserve.

Transects

Three 60 metre transects were established in Paperbark Swamp. Transects 1 and 2 sampled the terrestrial vegetation of the reserve and transect 3 sampled the community of *Melaleuca strobophylla* and *Melaleuca pholidophylla* in the centre of the swamp.

The second sampling occurred in early December 2001 when the lake was dry.

Transect 1: (GPS: 50 603590 / 6413029) is situated 50 metres in from the dogleg in the main access track near the property boundary.
Transect 2: (GPS:50 603693 / 6412780) is located approximately 200 metres south from the dogleg in the main track. SSE of transect 1.
Transect 3: (GPS: 50 603243 / 6413123) is positioned approximately 100 metres ENE of the corner drain inlet at the southern end of the reserve. Located in a stand of mature *Melaleuca strobophylla.*

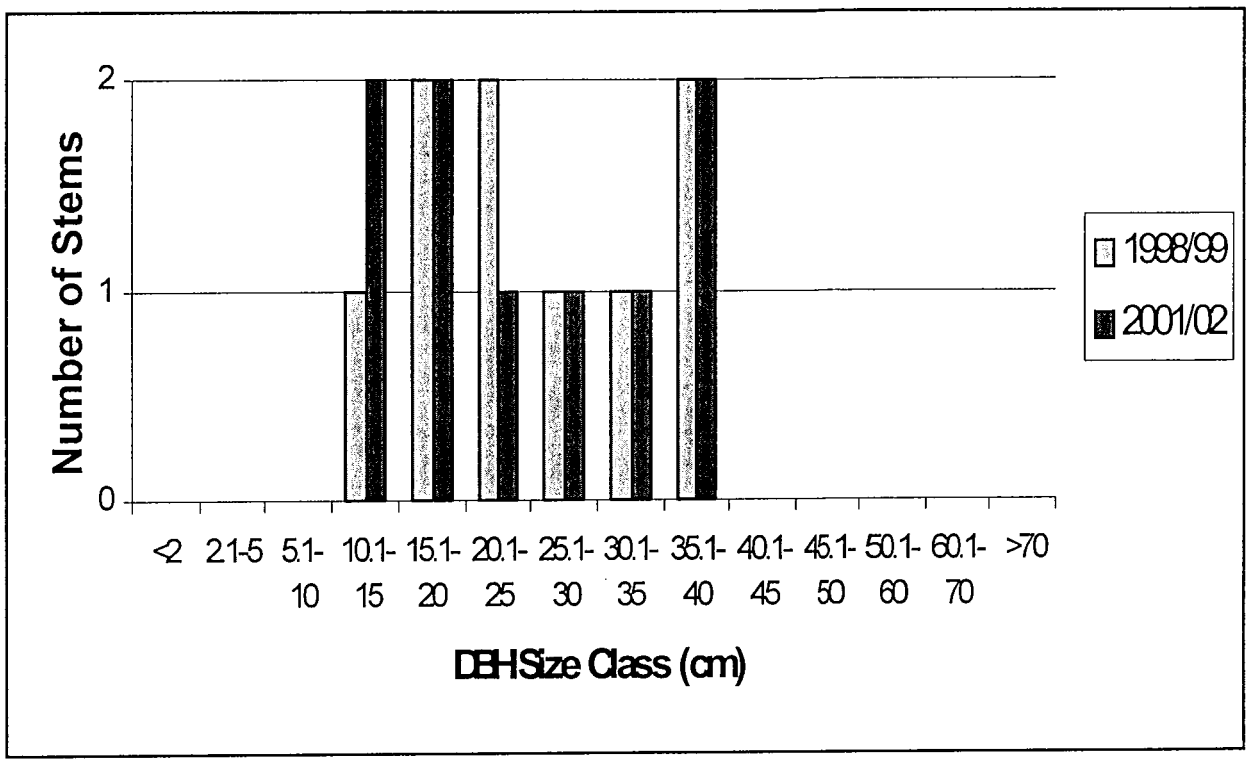
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

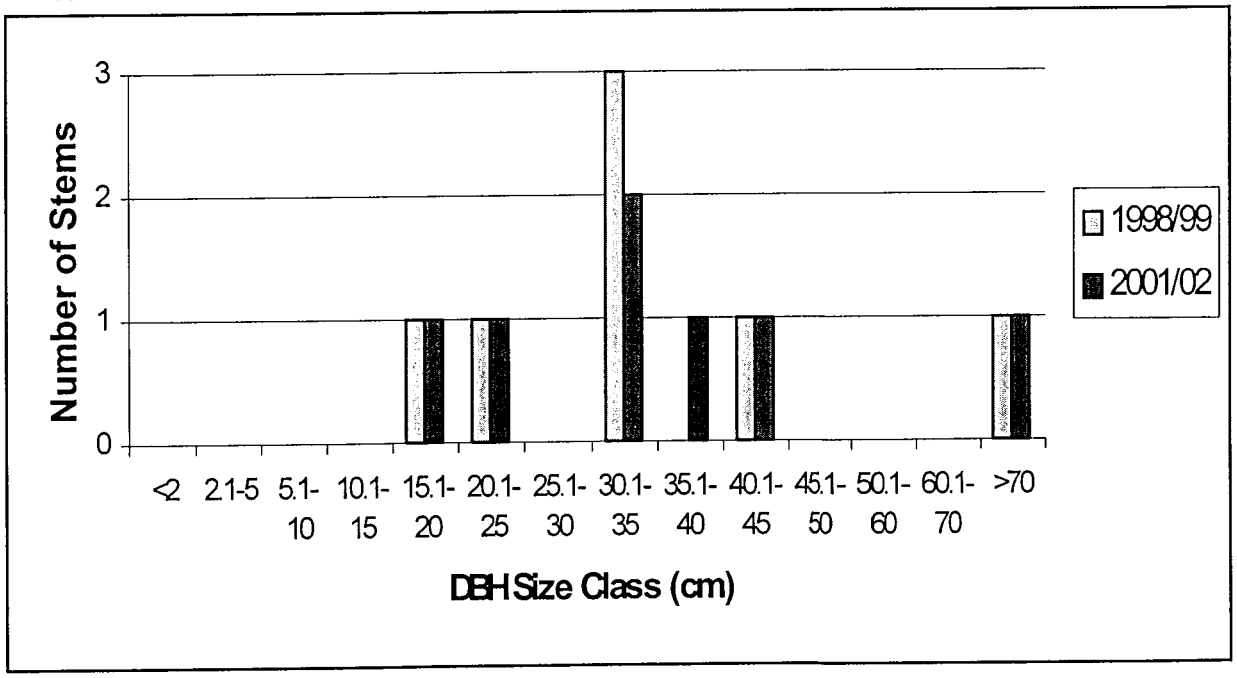
Population Structure and Tree Vigour

There has not been much change in population structure or tree vigor between the sampling periods (Figure 27 Table 10)

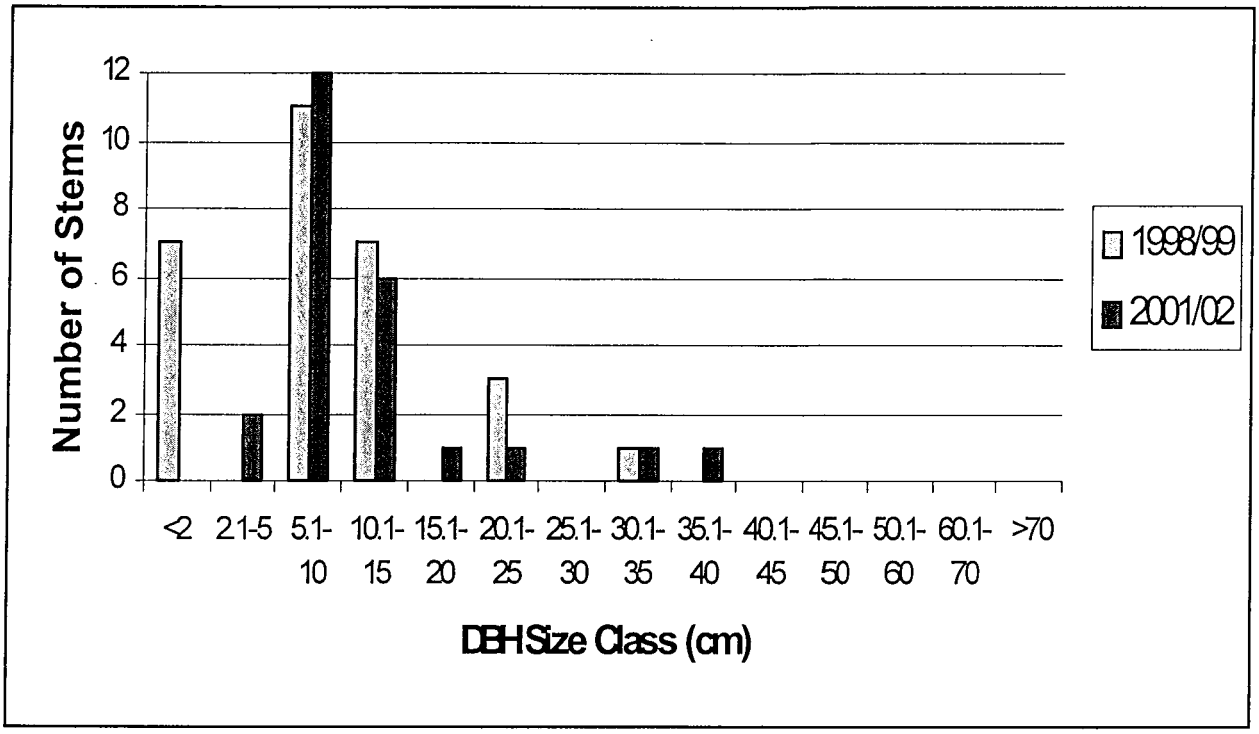
Eucalyptus loxophleba



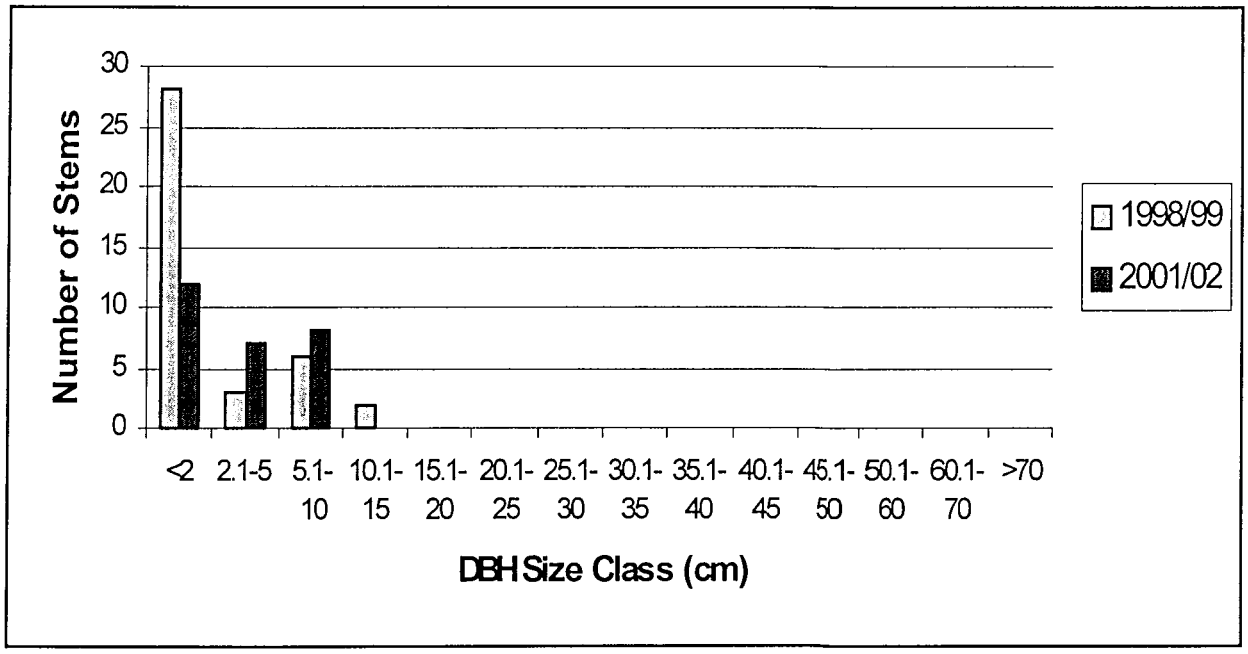
Eucalyptus yilgarnensis



Melaleuca lateriflora



Melaleuca pholidophylla



Melaleuca strobophylla

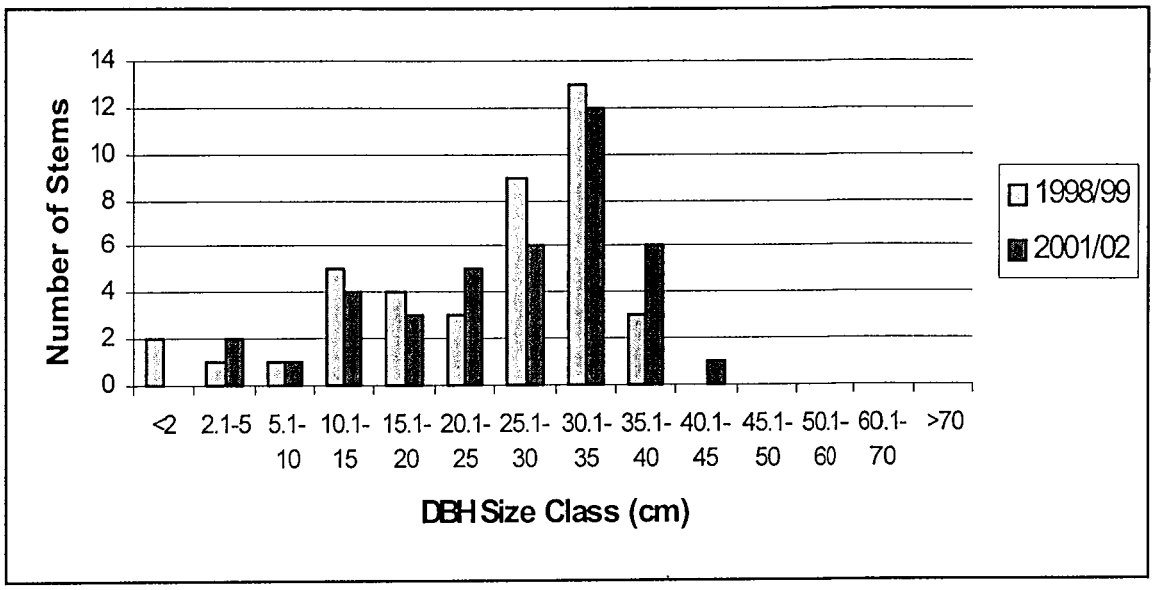


Figure 25. Size Class Distributions for *Eucalyptus loxophleba, Eucalyptus yilgarnensis, Melaleuca lateriflora,* and *Melaleuca strobophylla* at Paperbark Swamp

Table 34. Summary of Tree Data for Paperbark Swamp

Species	Trees 1999	Trees 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Bossiaea ?rufa	1	1	0	0		
Eucalyptus loxophleba	9	9	0	0	9.0 (3.7)	9.4 (3.9)
Eucalyptus yilgarnensis	7	7	0	0	12.9 (4.0)	12.6 (2.8)
Hakea recurva	1	0	0	0		
Melaleuca lateriflora	24	22	127	89		13.8 (1.7)
Melaleuca pholidophylla	29	26	121	116		14.2 (1.0)
Melaleuca strobophylla	40	40	1	1	13.7 (2.4)	13.2 (1.7)
Scaevola spinescens	0	4	0	0		

Changes in understorey composition

The lack of change in the overstorey is also reflected in the understorey with little change in species distribution along the transect.

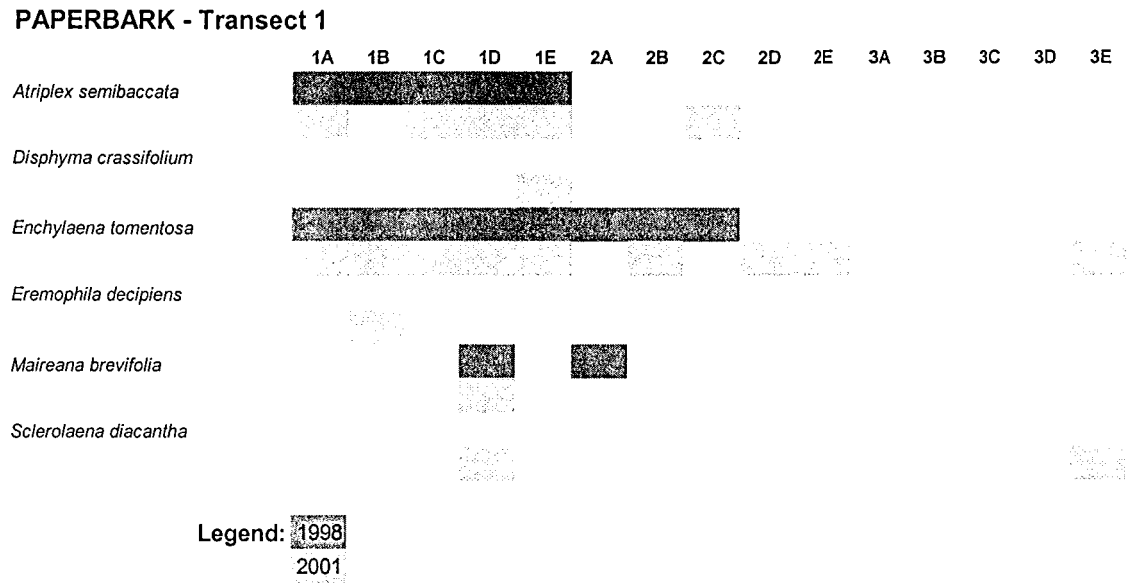


Figure 26. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002

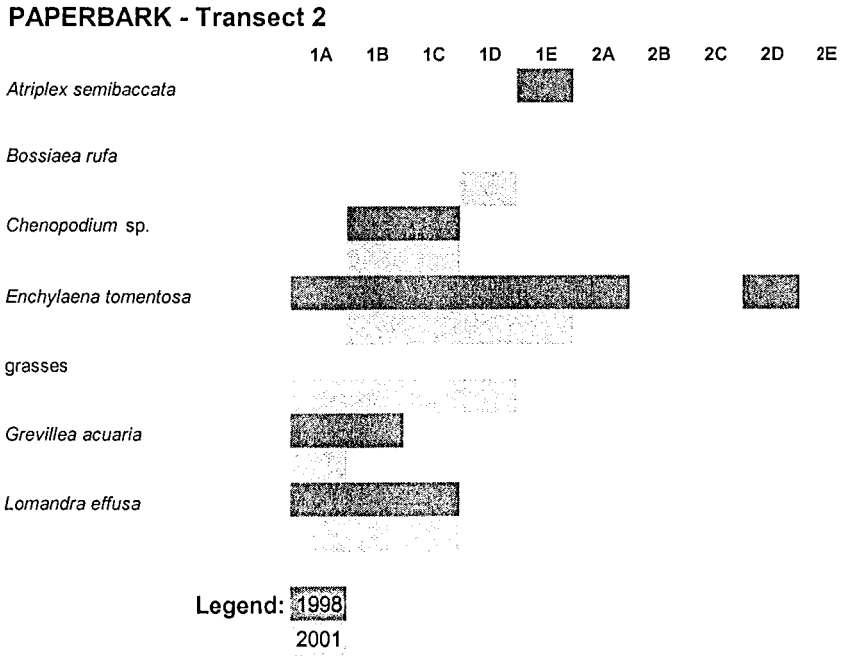


Figure 27. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002

Figure 28. Species Distribution along Paperbark Swamp Transect 1 in 1998 and 2002

Table 35 Summary Of Understorey Species Distribution In All Transects At Paperbark Swamp

PAPERBARK - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Disphyma crassifolium	*yes*				
Eremophila decipiens	*yes*				
Sclerolaena diacantha	*yes*				
Atriplex semibaccata		*yes*			
Enchylaena tomentosa		*yes*			
Maireana brevifolia				*yes*	

PAPERBARK - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
Bossiaea rufa	*yes*				
grasses	*yes*				
Atriplex semibaccata			*yes*		
Enchylaena tomentosa				*yes*	
Grevillea acuaria				*yes*	
Chenopodium sp.					*yes*
Lomandra effusa					*yes*

Soil Characteristics

Table 28 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 79% in the vertical and 103% in the horizontal EM38 measurements over the three year period.

Table 36 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Paperbark Swamp over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	88	131	49	71	87	135	48	74	102	151	58	82
Transect Mean	92	139	52	76								
T2												
Section Mean	105	227	59	150	109	232	61	157	126	267	70	185
Transect Mean	113	242	63	164								
T3												
Section Mean	76	129	34	64	80	129	37	69	79	119	37	64
Transect Mean	78	125	36	66								

Summary

Table 37 summaries all the data for Paperbark Swamp. There has been an increase in the soil salinities of the swamp though from low levels and this has caused the death of individuals of some tree species and a decrease in some salt sensitive understorey species.

Table 37 Summary of data for Paperbark Swamp

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	yes		
Crown Condition (all transects MCS)	*Eucalyptus loxophleba*	*Eucalyptus yilgarnensis* *Melaleuca strobophylla*	
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Scaevola spinescens*	*Hakea recurva* *Melaleuca lateriflora* *Melaleuca pholidophylla*	*Bossiaea ?rufa* *Eucalyptus loxophleba* *Eucalyptus yilgarnensi:* *Melaleuca strobophylla*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*Atriplex semibaccata* *Atriplex semibaccata* *Bossiaea rufa* *Disphyma crassifolium* *Enchylaena tomentosa* *Eremophila decipiens* grasses *Sclerolaena diacantha*	*Enchylaena tomentosa* *Grevillea acuaria* *Maireana brevifolia*	*Chenopodium sp.* *Lomandra effusa*

Goonaping Swamp

Description

R. Gurner *et al.* (1999) reports that Goonaping Swamp is a small fresh seasonal wetland which is located approximately 50 km south west of York in the Wandoo Conservation area (32°09' S, 116°, 35' E). The wetland lies within a forest catchment with cleared paddocks adjacent to the north and west of the reserve. The bulk of the water supply for Goonaping Swamp comes from direct precipitation and runoff with inflow occurring in two drains located on the northern and southwestern edges of the swamp. Outflow is restricted to the southwestern drain. The Swamp is characterised by moderately steep slopes with a broad shallow lakebed depression. The wetland slopes are comprised of laterite scree and clayey soils primarily supporting *Eucalyptus wandoo* woodlands with scattered *Eucalyptus marginata* and pockets of *Banksia* species occurring on deep sands. The lower slopes and littoral zone consist of sandy to clayey loams of alluvial origin supporting *Melaleuca preissiana* and *Eucalyptus rudis* with wetland communities of *Melaleuca viminea* occurring further down slope (Capill, 1984).

Transects

Three 60 metre transects were established on Goonaping Swamp sampling the elevated terrestrial vegetation down into the littoral zone.

The first monitoring was undertaken in February 1999 while the second occurred in late December 2001 and early and mid January 2002 Transect 3 had been nearly completely burnt in a 2000 fire. A number of trees had been destroyed and the understorey completely burnt

Transect 1: (GPS: 50 461770 / 6442420) is situated on the southeastern side of the swamp approximately 100 metres from the main inflow outflow drain.
Transect 2: (GPS:50 462303 / 6443446) is located on the northwestern side of the lake where the elevation is higher. Transect 2 is positioned near the stand of large mature *Eucalyptus rudis*.
Transect 3: (GPS: 50 462432 / 6443223) is positioned on the middle east side of the Swamp approximately 200 metres around from transect 2. Transect 3 can be accessed through the inflow drain near the cleared paddocks off the main track.

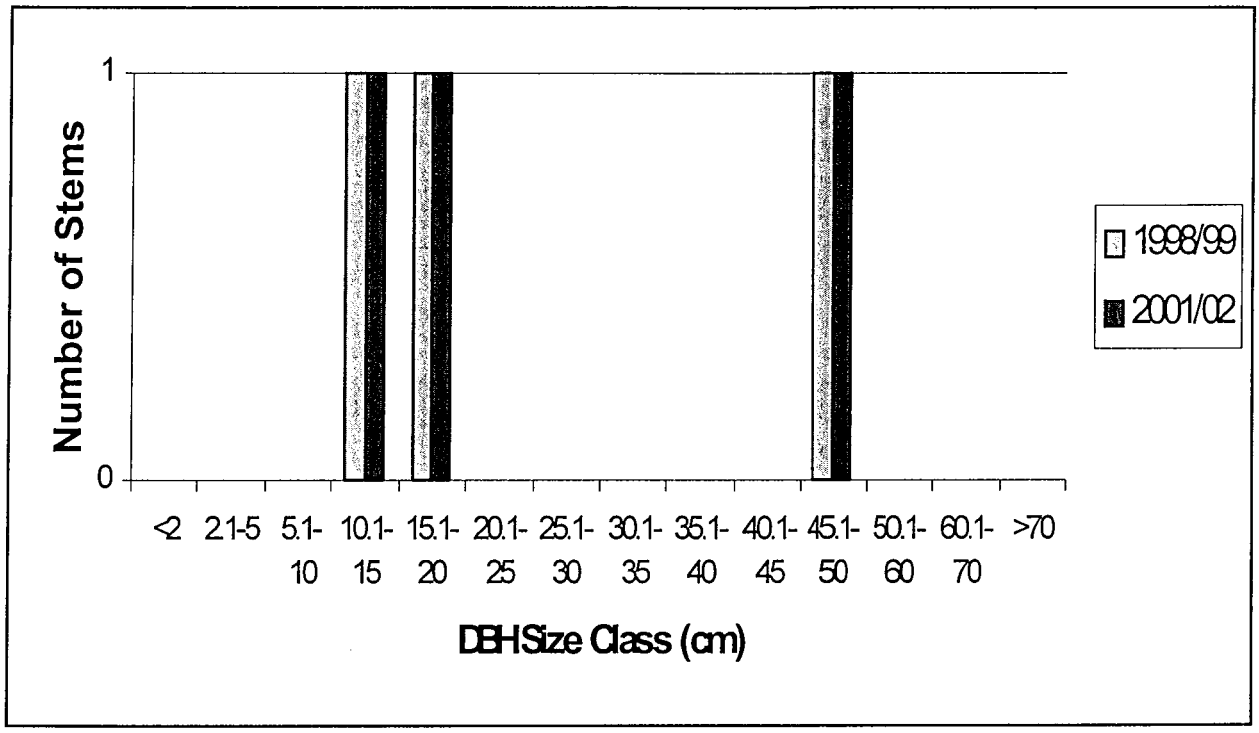
The plant communities around the lake are as described by R. Gurner *et al.* (1999)

Results

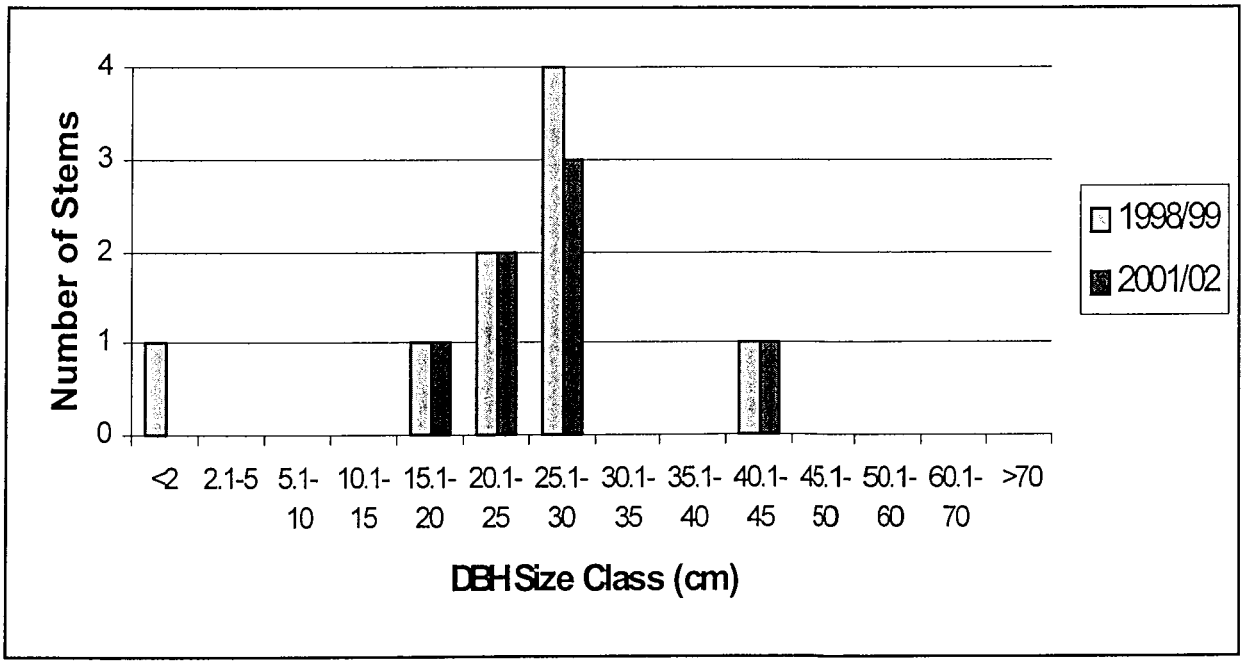
Population Structure and Tree Vigour

This lake is very similar to Paperbark Swamp in that very little change has occurred in the overstorey component with the increase in crown vigor indication slightly improved conditions during the period. A fire has effected part of the swamp killing a number of mature *Melaleuca* trees.

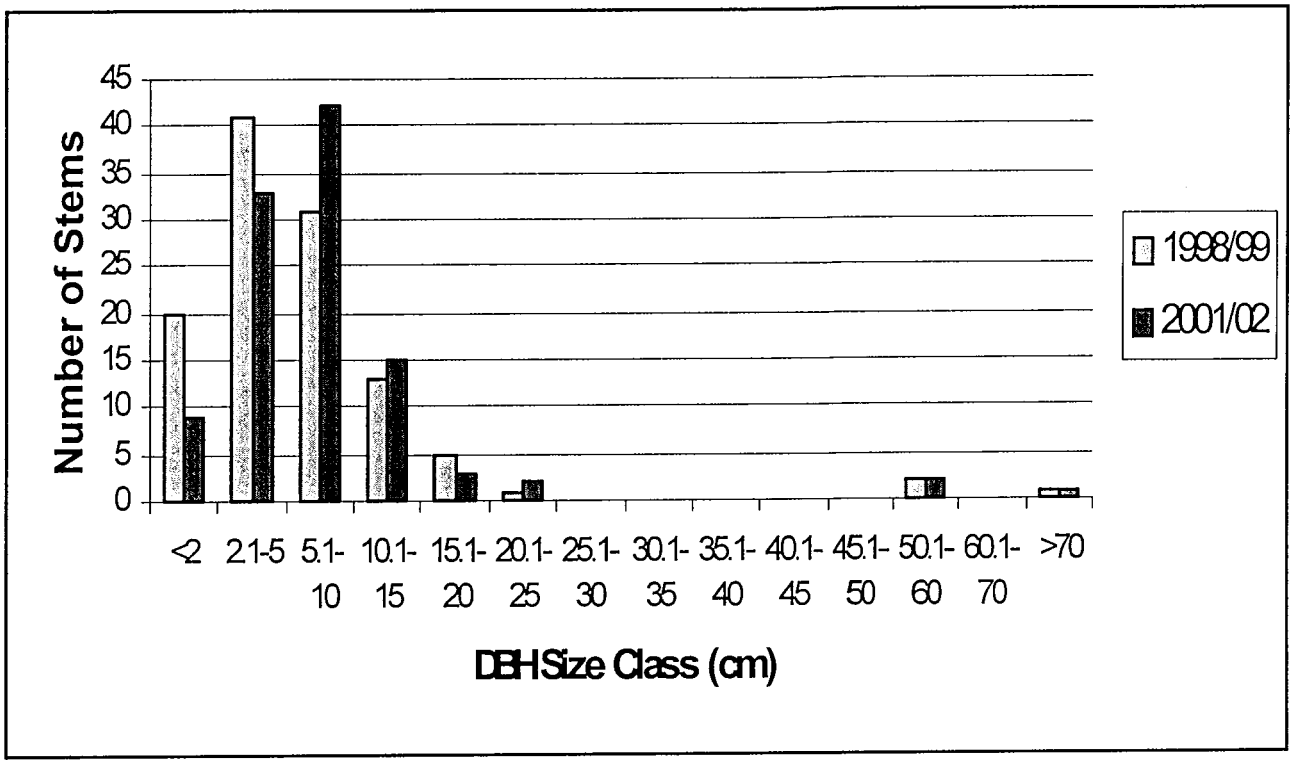
Eucalyptus marginata



Eucalyptus rudis



Eucalyptus wandoo



Melaleuca preissiana

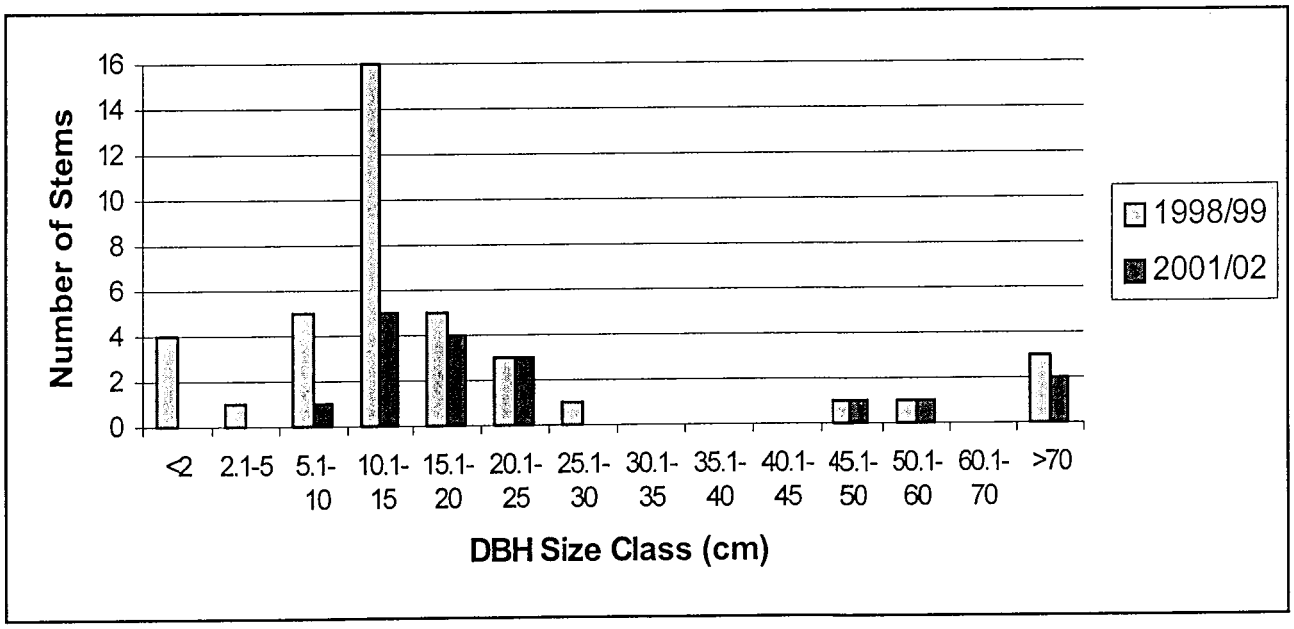


Figure 29. Size Class Distributions for *Eucalyptus wandoo, Eucalyptus rudis*, ***Eucalyptus marginata*** and *Melaleuca preissiana* at Goonaping Swamp

Table 38. Summary of Tree Data for Goonaping Swamp

Species	Trees/Plants 1999	Trees/Plants 2002	Seedlings 1999	Seedlings 2002	MCS (SD) 1999	MCS (SD) 2002
Acacia saligna	1	1	-	-	-	-
Banksia menziesii	0	0	5	4.0	-	-
Eucalyptus marginata	3	3	0	0.0	14.3 (4.5)	17.7 (2.3)
Eucalyptus rudis	7	7	1	0.0	14.9 (2.4)	12.5 (1.3)
Eucalyptus wandoo	114	100	87	130.0	(13.7 (3.5)	17.9 (2.3)
Hakea prostrata	1	2	0	0.0		
Hakea varia	34	34	-	-	-	-
Jacksonia sp.	3	4				
Kunzea ericifolia	166	193				
Macrozamia riedlei	1	5				
Melaleuca preissiana	33	13	0	0.0	11.6 (2.9)	14.2 (1.6)
Melaleuca viminea	472	474				
Regelia ciliata	20	8				
Xanthorrhoea preissii	58	97				

Changes in understorey composition

The understorey of this lake is very diverse.

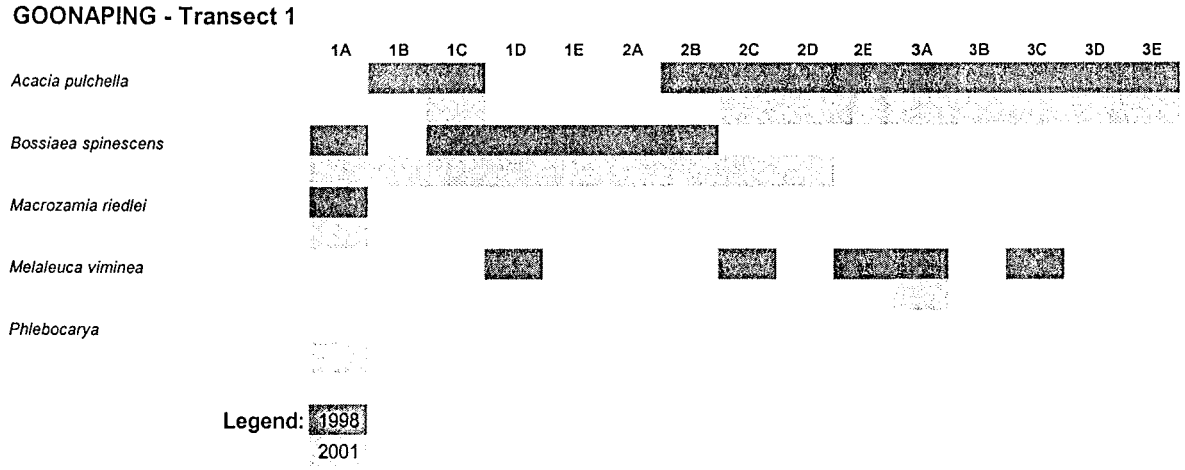


Figure 30. Species Distribution along Goonaping Swamp Transect 1 in 1997 and 2000

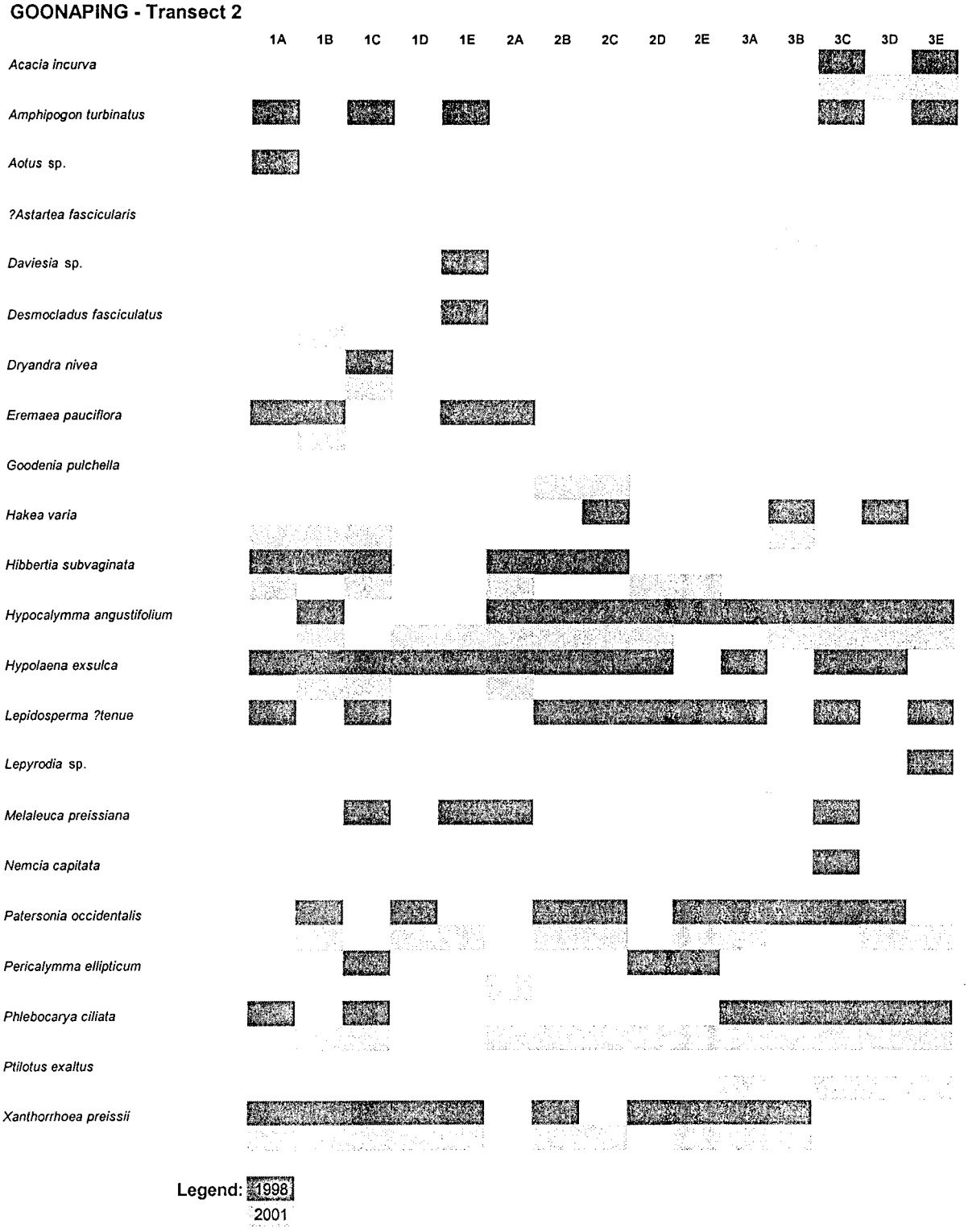


Figure 31. Species Distribution along Goonaping Swamp Transect 2 in 1998 and 2002

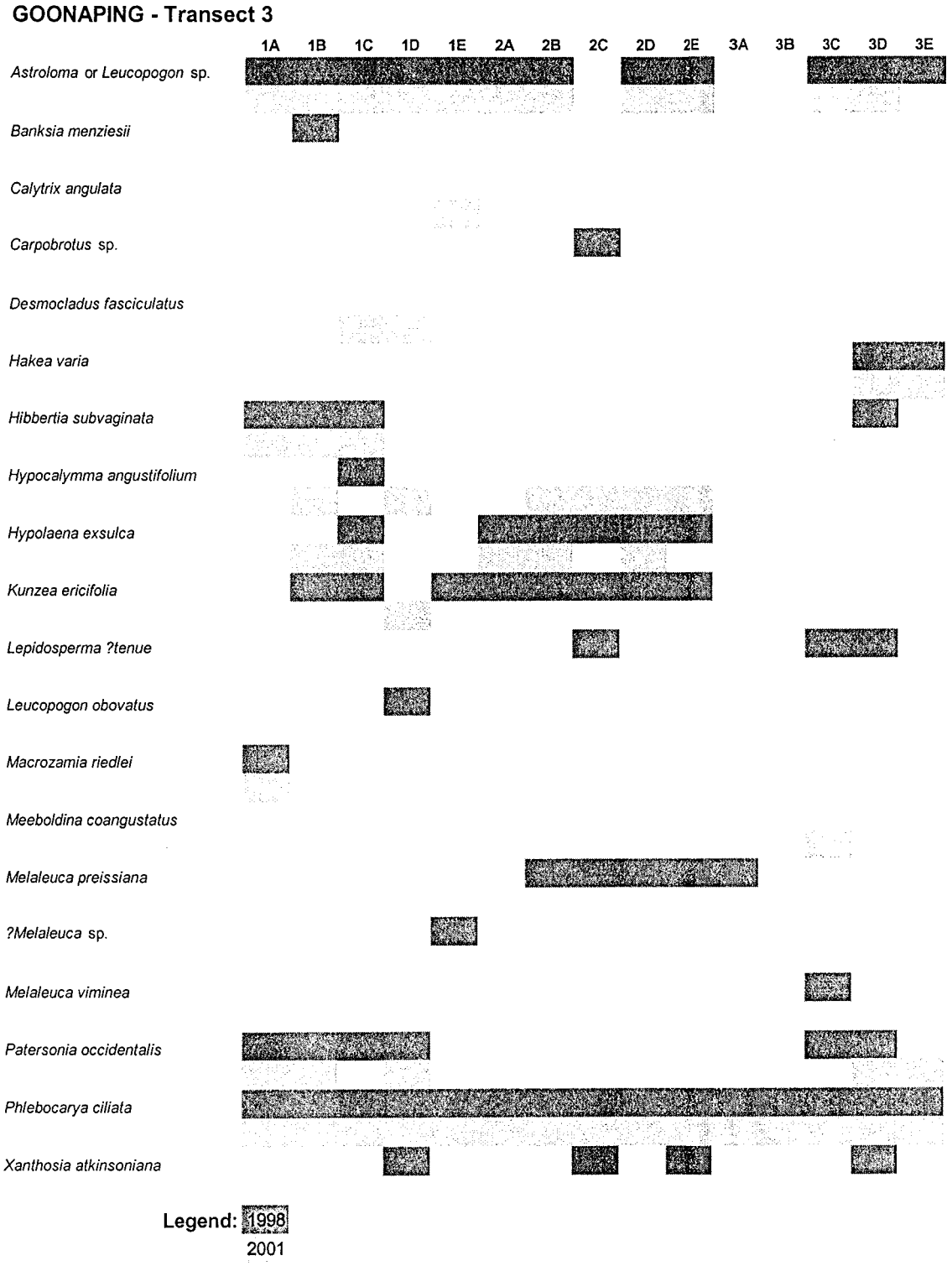


Figure 32. Species Distribution along Goonaping Swamp Transect 3 in 1998 and 2002

Table 39 Summary Of Understorey Species Distribution In All Transects At Goonaping Swamp

GOONAPING - Transect 1	New Recruit	Expansion	Extinction	Contraction	No Change
Phlebocarya	*yes*				
Bossiaea spinescens		*yes*			
Acacia pulchella				*yes*	
Melaleuca viminea				*yes*	
Macrozamia riedlei					*yes*

GOONAPING - Transect 2	New Recruit	Expansion	Extinction	Contraction	No Change
?Astartea fascicularis	*yes*				
Goodenia pulchella	*yes*				
Ptilotus exaltus	*yes*				
Acacia incurva		*yes*			
Hibbertia subvaginata		*yes*			
Phlebocarya ciliata		*yes*			
Hakea varia		*From lake*			
Patersonia occidentalis		*To lake*			
Desmocladus fasciculatus		*From lake*		*From Lake*	
Amphipogon turbinatus			*yes*		
Aotus sp.			*yes*		
Daviesia sp.			*yes*		
Lepidosperma ?tenue			*yes*		
Lepyrodia sp.			*yes*		
Melaleuca preissiana			*yes*		
Nemcia capitata			*yes*		
Eremaea pauciflora				*yes*	
Hypolaena exsulca				*yes*	
Pericalymma ellipticum				*yes*	
Dryandra nivea					*yes*
Hypocalymma angustifolium					*yes*
Xanthorrhoea preissii					*yes*

GOONAPING - Transect 3	New Recruit	Expansion	Extinction	Contraction	No Change
Calytrix angulata	*yes*				
Meeboldina coangustatus	*yes*				
Desmocladus fasciculatus	*yes*				
Hypocalymma angustifolium		*yes*			
Patersonia occidentalis		*To lake*			
Hypolaena exsulca		*From lake*		*From lake*	
Banksia menziesii			*yes*		
Carpobrotus sp.			*yes*		
Lepidosperma ?tenue			*yes*		
Leucopogon obovatus			*yes*		
Melaleuca preissiana			*yes*		
?Melaleuca sp.			*yes*		
Melaleuca viminea			*yes*		
Xanthosia atkinsoniana			*yes*		
Astroloma or *Leucopogon* sp.				*yes*	

GOONAPING - Transect 3	New Recruit	Expansion	Extinction	Contraction	No Change
Hibbertia subvaginata				*yes*	
Kunzea ericifolia				*yes*	
Hakea varia					*yes*
Macrozamia riedlei					*yes*
Phlebocarya ciliata					*yes*

Soil Characteristics

Table 31 tabulates the mean soil salinities for the transects over the two sampling periods. There was an increase of 177% in the vertical and 973% in the horizontal EM38 measurements over the three year period.

Table 40 Comparison of Mean Section and Transect soil salinities (mS/m) for all Transects at Goonapping Swamp over the Two Sampling Periods.

	Distance Across (m)											
	0 m				10 m				20 m			
Distance (m)	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02	Vertical 1998/99	Vertical 2001/02	Horizontal 1998/99	Horizontal 2001/02
T1												
Section Mean	28	56	10	35	22	53	8	34	29	57	11	36
Transect Mean	26	55	10	35								
T2												
Section Mean	27	74	3	45	28	79	5	47	44	94	14	56
Transect Mean	33	82	8	49								
T3												
Section Mean	12	45	-2	30	3	39	-8	29	-2	33	-11	21
Transect Mean	4	39	-7	27								

Summary

Table 41 summaries all the data for Goonapping Swamp. Soil salinities have increased but this has more to do with decreased in soil moistures over the last 3 dry years rather than an inflow of saline waters or a rise in ground waters. Changes have occurred due to a recent fire in one of the transects and the development of the understorey composition and tree health in the other transects since the last fire.

Table 41 Summary of data for Goonapping Swamp

Condition	Increase	Decrease	No Change
Soil Salinity *(Mean salinity change over all Transects)*	Yes		
Crown Condition (All Transect MCS)	*Eucalyptus marginata* *Eucalyptus wandoo* *Melaleuca preissiana*	*Eucalyptus rudis*	

Condition	Increase	Decrease	No Change
Count of Overstorey Individuals *(All transects. Species increasing /decreasing /No Change in Counts)*	*Hakea prostrata* *Jacksonia* sp. *Kunzea ericifolia* *Macrozamia riedlei* *Melaleuca viminea* *Xanthorrhoea preissii*	*Eucalyptus wandoo* *Melaleuca preissiana* *Regelia ciliata*	*Acacia saligna* *Banksia menziesii* *Eucalyptus marginata* *Eucalyptus rudis* *Hakea varia*
Understorey Species *(All Transects. Species increasing /decreasing/No Change)*	*?Astartea fascicularis* *Acacia incurva* *Bossiaea spinescens* *Calytrix angulata* *Desmocladus fasciculatus* *Goodenia pulchella* *Hakea varia* *Hibbertia subvaginata* *Hypocalymma angustifolium* *Hypolaena exsulca* *Meeboldina coangustatus* *Patersonia occidentalis* *Patersonia occidentalis* *Phlebocarya ciliata* *Ptilotus exaltus*	*Acacia pulchella* *Amphipogon turbinatus* *Aotus* sp. *Astroloma* or *Leucopogon* sp. *Banksia menziesii* *Carpobrotus* sp. *Daviesia* sp. *Desmocladus fasciculatus* *Eremaea pauciflora* *Hibbertia subvaginata* *Hypolaena exsulca* *Kunzea ericifolia* *Lepidosperma ?tenue* *Lepyrodia* sp. *Leucopogon obovatus* *?Melaleuca* sp. *Melaleuca preissiana* *Melaleuca viminea* *Nemcia capitata* *Pericalymma ellipticum* *Xanthosia atkinsoniana*	*Dryandra nivea* *Hakea varia* *Hypocalymma angustifolium* *Macrozamia riedlei* *Phlebocarya ciliata* *Xanthorrhoea preissii*

References

Australian Nature Conservation Agency (1996). *A Directory of Important Wetlands in Australia. Second Edition.* ANCA, Canberra.

Capill, L.G. (1984). *Wandoo Woodland Conservation. A Proposal for a System of Ecological Reserves in the Woodlands of Southwestern Australia.*

Gurner R, R. Froend and G. Ogden (1999) Salinity Action PlanWetland Vegetation Monitoring1998/1999

Halse SA, Pearson GB and Patrick S, (1993) Vegetation of depth gauged wetlands in nature reserves of south-west Western Australia. CALM Technical Report No. 30.

EN.REFLIST