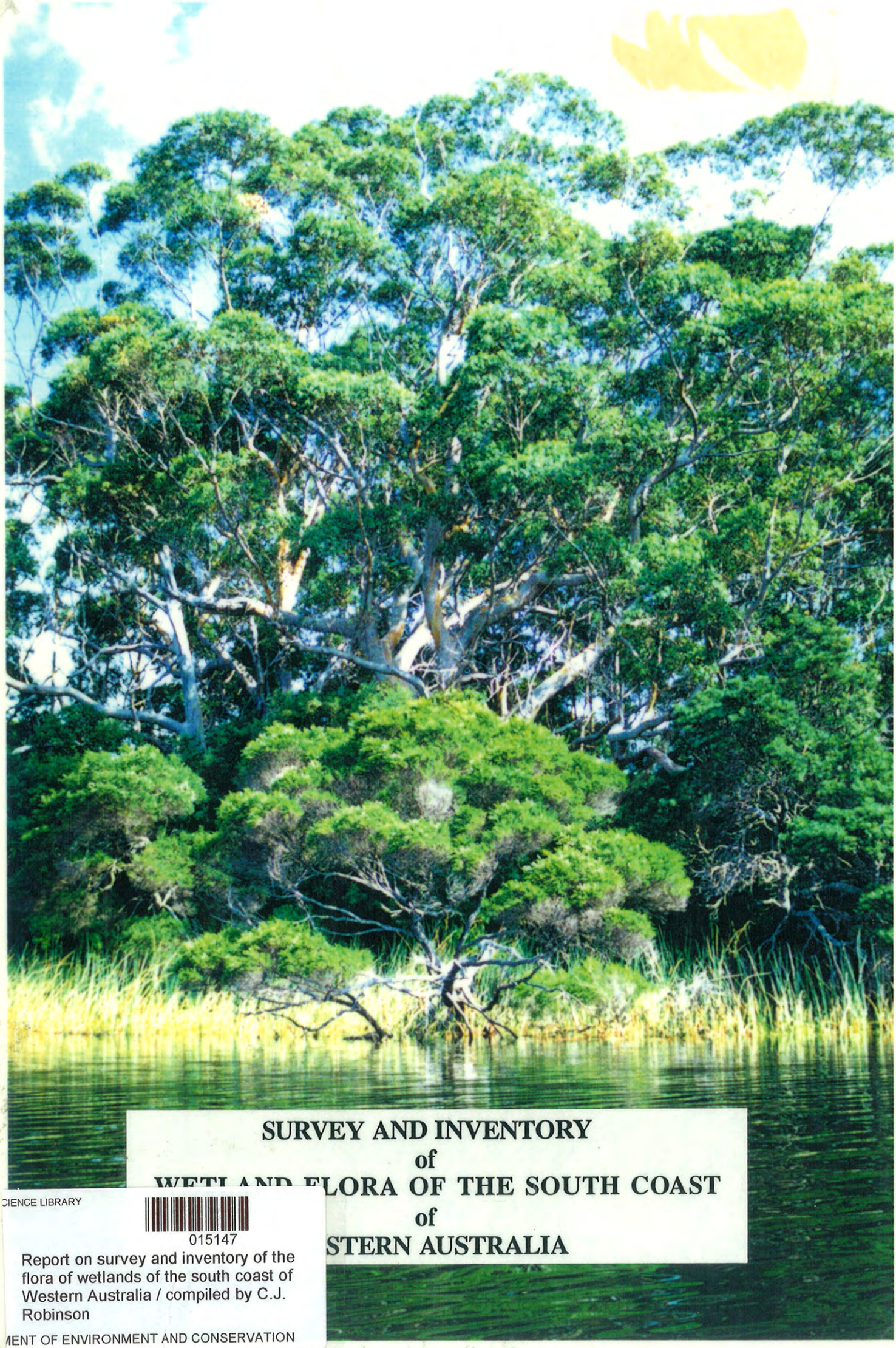

SURVEY AND INVENTORY
of
WETLAND FLORA OF THE SOUTH COAST
of
WESTERN AUSTRALIA

REPORT
on

SURVEY AND INVENTORY OF THE FLORA OF WETLANDS OF THE SOUTH COAST OF WESTERN AUSTRALIA

Report to:

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June 1992

Front Cover: Lake Maringup

ACKNOWLEDGEMENTS

Funding for this project was provided to CALM by the Australian National Parks and Wildlife Service (Wetlands Conservation and Management Programme) through the States Cooperative Assistance Programme. Mr Jim Lane (CALM), Project Supervisor, defined the project's objectives, liaised with ANPWS and provided continued logistic support. Dr Neil Gibson (CALM) facilitated the floristic analysis and provided extremely useful comments on the draft report. Dr Jacob John (Curtin University) identified algae speciments and Dr Linda Moore (Water Authority) identified the 'algal biscuits'. Dr Andrew Burbidge (CALM) provided useful information about the oblong tortoise and identified scutes. Mr Alex Kern (Mines Department) provided geological background on lake formation. Dr Barbara Rye (CALM, WA Herbarium) assisted in identification of the Cyperaceae. Mr Kim Phillips-Jones (CALM, Manjimup) provided access to Inventory aerial photography and the Agriculture Dept. (Busselton) analysed water samples.

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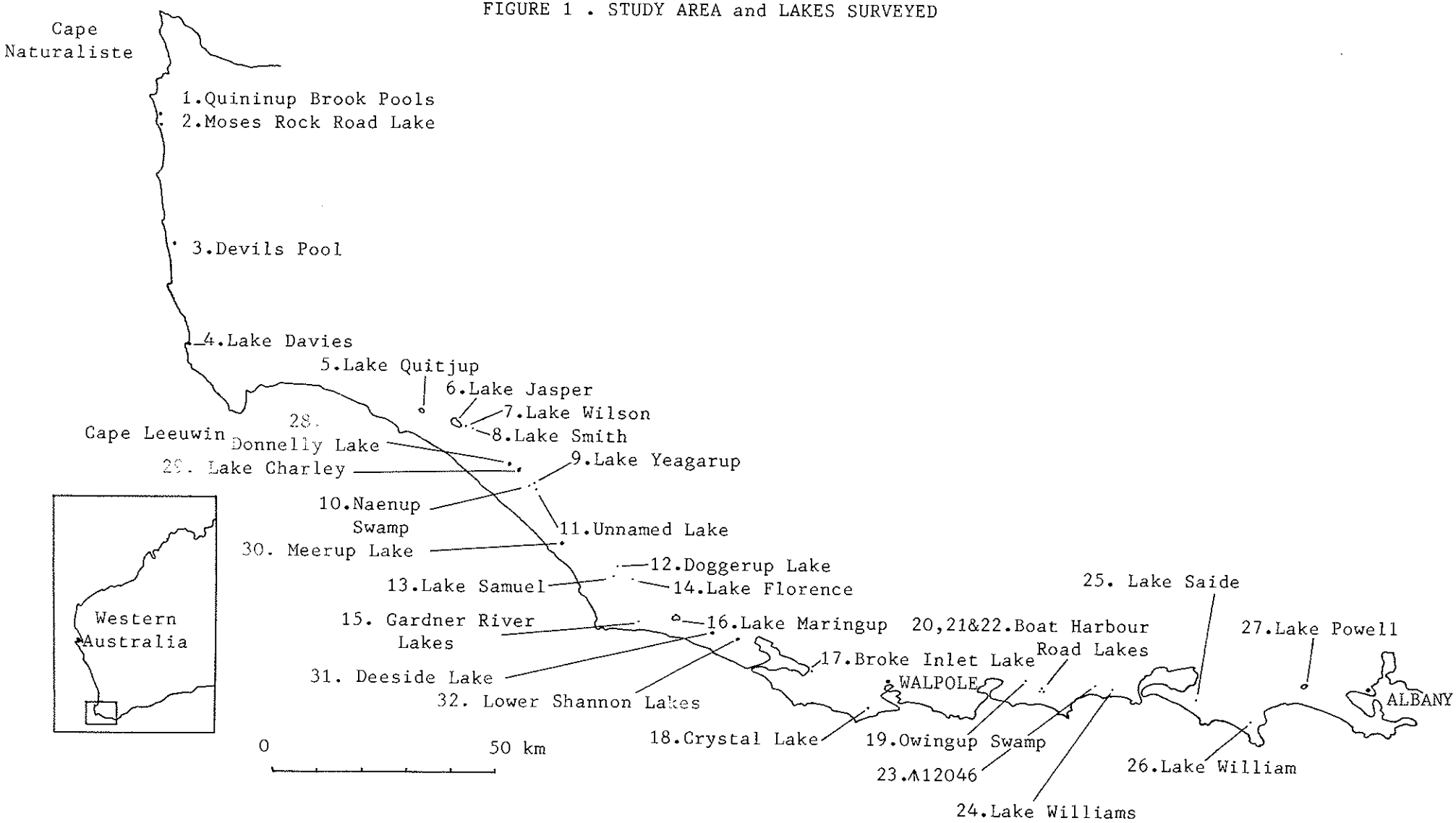
INTRODUCTION

As part of a process in recognition and documentation of the conservation significance of CALM lands on the South Coast of Western Australia, this study was initiated specifically to survey the vegetation associated with permanent freshwater lakes (and swamps). The inventory compiled of the vegetation and other features for each lake will provide a reference to determine which lakes (wetlands) have particular or special conservation values. The information and data collected will also provide useful input for general management of each lake and surrounding reserves. It was considered more important to survey as many lakes as possible (in moderate detail) across the geographic range than to study a few in great detail.

STUDY AREA

The study area extends from Cape Naturaliste to Albany, within 20km of the coast on land administered by CALM, within the Warren Botanical sub-district (Beard, 1981). Maps produced by CALM and DOLA (scale 1:50,000) were used to establish a preliminary list of reasonably accessible lakes or swamps to be visited. Initially, 27 areas were surveyed in 1991 and another five in 1992 (Figure 1). Lake Saide, in its non-pristine surroundings is not in the CALM estate but was surveyed to provide comparative opportunity.

FIGURE 1 . STUDY AREA and LAKES SURVEYED



GEOLOGICAL FORMATION

Hydrogeological classification of a representative list of lakes surveyed was provided by the Department of Mines, Geological Survey (Table 1). A more precise explanation to the timing of formation of many of the lakes has resulted from archaeological research carried out by the Western Australian Museum at Lake Jasper since April 1988 (W.A. Museum Information Sheet, undated). Archaeologist divers discovered ancient tree trunks on the bed in the deepest parts of the lake. These were carbon dated to 3750-4000 years old, indicating that the trees died there as the lake waters began to rise. Further information provided by Alex Kern (Geological Survey, pers.comm.) explains that post-glacial sea levels peaked approximately 6000 years ago, followed by a drop of around 2m. This drop exposed the sandy sea bed which was blown inland to form mobile dunes which blocked stream valleys resulting in lakes formed by a damming effect, 4000-5000 years ago. The mobile dunes (except Yeagarup and Meerup) have become stabilised by vegetation, but are still obvious features of the landscape on the south-west (prevailing windward) side of many lakes such as Jasper, Quitjup, Doggerup, Maringup, William, 12046 and Owingup.

Lakes such as Powell, Saide, Samuel and Florence are surface expressions of the water table in depressions left in flat, low lying Pliocene estuarine deposits. Lake Davies is also a surface expression of the water table, but within

TABLE 1

HYDROGEOLOGY OF COASTAL LAKES BETWEEN CAPE NATURALISTE AND ALBANY

LAKE	GEOMORPHIC UNIT	TECTONIC UNIT	LOCAL GEOLOGY	REMARKS
Devils Pool	Coastal Belt	Leeuwin Complex	Quaternary Tamala limestone	)
Lake Davies	Coastal Belt	Leeuwin Complex	Quaternary Tamala limestone	)
Lake Quitjup	Estuarine Deposits	Perth Basin	Tertiary estuarine and lacustrine deposits	) Surface expression
Lake Jasper	Estuarine Deposits	Perth Basin	Tertiary estuarine and lacustrine deposits	)
Lake Smith	Estuarine Deposits	Perth Basin	Tertiary estuarine and lacustrine deposits	) of
Lake Wilson	Estuarine Deposits	Perth Basin	Tertiary estuarine and lacustrine deposits	)
Yeagarup Lake	Coastal Belt	Perth Basin	Quaternary quartz sand with basalt outcrops	) water table
Naenup Swamp	Coastal Belt	Perth Basin	Quaternary quartz and calcareous quartz sand	)
Lake Florence	Estuarine Deposits	Albany-Fraser Orogen	Tertiary alluvial and lacustrine deposits	)
Doggerup Lake	Estuarine Deposits	Albany-Fraser Orogen	Tertiary alluvial and lacustrine deposits	)
Lake Samuel	Estuarine Deposits	Albany-Fraser Orogen	Tertiary alluvial and lacustrine deposits	)
Lake Maringup	Coastal Belt	Albany-Fraser Orogen	Quaternary quartz sand with granitoid outcrops	)
Crystal Lake	Coastal Belt	Albany-Fraser Orogen	Tertiary ferriginous soil with granitoid outcrops	Perched lake
Boggy Lake	Coastal Belt	Albany-Fraser Orogen	Quaternary quartz sand with granitoid outcrops	Perched lake
Owingup Swamp	Estuarine Deposits	Albany-Fraser Orogen	Quaternary estuarine and lagoonal deposits	) Surface expression
unnamed	Coastal Belt	Albany-Fraser Orogen	Quaternary quartz sand with granitoid outcrops	) of
Lake Sadie	Estuarine Deposits	Albany-Fraser Orogen	Quaternary estuarine and lagoonal deposits	) water table
Lake William	Coastal Belt	Albany-Fraser Orogen	Quaternary colluvium and quartz sand	Perched lake
Lake Powell	Estuarine Deposits	Albany-Fraser Orogen	Quaternary estuarine and lagoonal deposits	Surface expression of water table

GE800WRV240,25

the Coastal (dunes) Belt. Moses Rock Road Pool has formed in the coastal dunes by the blocking of a stream. The formation of Devils Pool in Boodjidup Brook is unclear but may be due to erosion of softer sedimentary rock in the stream bed to form a lake. Crystal Lake is unique in this survey, being at higher elevation and perched on a granitoid outcrop.

Vegetation associations are based mostly on quartz sands and peaty sandy soils from the early Tertiary (Pliocine estuarine, lagoonal and lacustrine deposits) in which many lakes are bedded or Quaternary (Pleistocene) quartz or calcareous sands (Wilde and Walker, 1984) in stable dunes which support associations generally beyond the immediate lake fringe (except in Leeuwin-Naturaliste Ridge). These same soils of Pliocine or Pleistocene origin are considered potentially prospective for heavy mineral sands eroded from inland rocks and deposited along the old shorelines associated with higher sea levels of those periods (Martinick et al. 1989).

METHOD

Each lake to be surveyed was located on the relevant map (scale 1:50,000) to determine best access to the general area. District CALM staff were consulted when access was not clear, when the possibility of plant disease risk existed or the area was remote and an element of risk to personal safety was involved. Aerial photography (CALM

Inventory, Manjimup) was used for extra access information and to provide preliminary outlines of vegetation associations to be mapped. Quality photocopies of aerial photographs were used in the field and in preparation of vegetation maps.

Twenty-seven lakes were surveyed in 1991. All were resurveyed again (except Crystal Lake) in 1992 and five new lakes (considered too remote or inaccessible for the 1991 survey) were included.

When possible, a canoe was used to survey the immediate fringe of vegetation (usually Tall Sedges, often inundated up to 1m) and to provide movement around the lake to other vegetation associations. The canoe often had to be carried in from the nearest vehicle access. The dense nature of fringing vegetation frequently meant that paddling was often restricted.

The fringing sedges were sampled and recorded exhaustively. The structural and cover-dominant species (mainly) were recorded for the other surrounding vegetation associations to facilitate classification of vegetation within the topography associated with the immediate catchment of each lake. The fringing sedges are generally poorly collected (and presently poorly curated at the W.A. Herbarium). They were targeted specifically to improve the collection data base and to determine if particular species may be used to indicate specific lacustrine conditions. Voucher specimens were collected for all species. Multiple

collections were made of the *Baumea* species; these will be mounted and labelled for immediate incorporation into the W.A. Herbarium. All identifications were verified where possible from collections at the W.A. Herbarium. The vegetation associations (following Muir, 1977) were recorded for each site (Table 2) and a species list was compiled for the Tall Sedges association at each lake (Table 3). A complete list of species in each vegetation association at each lake is provided in Appendix A.

Maximum depth recordings, pH and Total Soluble Salts (TSS) levels from samples taken at each lake are presented in Table 4. Depth was recorded using a weighted tape measure dropped from a canoe. pH was determined using a TPS Ionode pH meter which measures the potential developed between the sample solution and a stable reference solution of fixed pH. TSS levels (mg l^{-1}) were calibrated from conductivity measurements (mSm^{-1}) provided by the Agriculture Department (Busselton).

General description notes, Semeniuk Classification (Semeniuk, 1987 and Semeniuk et al., 1990), water flow and visual quality, fauna observed, access details, inspection dates, Reserve and Location photographic record are all presented for each lake in Appendix A.

Floristic analysis was conducted for the Tall Sedges and Aquatics Associations using the computer programme PATN (Belbin, 1989). This programme uses the Bray-Curtis Dissimilarity Measure to produce dendograms of sites grouped

according to species and species according to sites by UPGMA (flexible) Agglomerative Heiraclial fusion Technique (β = -0.1; to slightly spread spacing). A Two-Way Table was then produced after defining the number of groups from inspection of each dendogram.

An ordination of sites was produced using the Semi-Strong-Hybrid Multi-dimensional scaling technique of Belbin (1989).

Relative Conservation Values for this group of 32 lakes were generated from the sum of the scores for 13 selected evaluation criteria (Table 7). Criteria 1-6 (Primary Criteria) were allocated a score between 0 and 10. Maximum score of 10 for Criterion 1 (No. of Aquatic Species) was given to those lakes with 8 species (i.e. the maximum number recorded for any lake). Similarly a score of 5 was given where 4 aquatic species were recorded. For Criterion 2 (No. of Sedge Species) a maximum score was given to these lakes recording 16 species within the Tall Sedges Association. A score of 5 was allocated to Criterion 3 (Rare Species) if one species recorded at a lake was regarded as rare or significant in the context of this survey. A score of 10 was allocated if there were two or more significant species or one species (e.g. *Eleocharis sphacelata*, Lake 30) was of extreme significance. Criterion 4 (Habitat) was scored (0-10) depending on estimate of vegetation associated with each lake in terms of suitability for fauna habitat. Scoring of this criteria is based upon the premise that natural

undisturbed vegetation will provide good habitat for animals. The maximum number of weeds recorded at any lake was 10 which was given a score of 0 for Criterion 5; conversely a lake site with no weeds scored 10. Criterion 6 (Community Rarity) scores are derived from Table 5 (Floristic Analysis). Community type 1 sites (lakes) were assigned a maximum score of 10, 5 for types 5 and 4 and 0 for community types 2 (modified lakes) and 3 (lake 2 which is species poor).

Criteria 7-13 were considered to be secondary in determination of conservation values and were assigned a possible score of 0-5. Criteria 7 (Modification) relates to clearing in the catchment, drains and other man-made disturbances considered likely to have an impact upon the natural systems within a lake. Lakes with little or no modification scored highest. Criterion 8 (Size) allocated values 1-5 based upon size (maximum axis) classes 0-100m, 100-500m, 500-1000m, 1000-2000m and 2000m or more (score 5). Criterion 9 (Reserve Size) was similarly scored 1-5 based upon distance to the nearest reserve boundary (0-100m, 100-500m, 500-1000m, 1000-2000m and 2000m or more a maximum score of 5). Criterion 10 (Inaccessibility) scored an inaccessible lake highly at 5 and a lake with vehicle tracks to its edge as 1. Criterion 11 (Wilderness) assigns the highest score of 5 to those lakes which are considered to be most natural or pristine. Criterion 12 recognises that human recreation is not necessarily compatible with

conservation and consequently those lakes currently most used for recreation are scored lowest.

RESULTS AND DISCUSSION

Twenty Vegetation Associations were identified (Table 2) not including aquatic plants. Some associations (e.g. Karri forest) detected in aerial photography and from ground observation were not visited due to lack of time or inaccessibility (i.e. distance from lake). They were mapped as they do form a significant and obvious part of the vegetation in the immediate catchment around the lake, but may not be important in determining the conservation significance of the lake.

The Tall Sedges Fringing Association was in all cases investigated thoroughly. Frequently the association numbered under 10 species (Table 3) a function of variable environmental conditions (where water levels vary dramatically between seasons and years).

The most frequently encountered species of fringing Tall Sedges belonged to the genus *Baumea* with seven species collected. Most species are generally easily recognisable but may vary in size depending on location (*B. vaginalis* in particular). A leaf of *B. articulata* at Lake Maringup was measured at 4m tall; 1.5m above water, 2.5m below and possible another 0.3m into the mud to the rhizome. All *Baumea* specimens collected were examined by W.A. Herbarium

TABLE 2

Vegetation Associations Recorded at each Lake

	LAKES																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Karri Forest									+				+	+	+	+		+					+			+				+		
Bullich Woodland			+	+		+	+	+				+				+									+			+		+	
Jarrah Woodland					+	+	+	+	+	+	+	+	+						+				+					+	+	+		+
Marri Woodland			+												+			+													
Banksia Woodland										+	+						+														
Paperbark Low Forest					+	+	+	+		+			+	+	+	+	+		+			+	+	+	+		+			+	
Cedar Dense Low Forest					+							+									+					+			+		
Agonis linearifolia Thicket					+																											
Kunzea Thicket					+	+													+		+										
Callistachys Thicket			+		+	+					+								+												
Astartea Dense Thicket																																
Heath Coastal	+	+	+																												
Heath Wet					+	+	+	+	+		+	+	+	+	+		+	+	+				+	+		+				+	+	+
Heath Dry						+							+	+	+			+													
Granite Heath																								+								
Agonis floribunda Heath					+	+	+	+							+															+	+
Scrub over Tall Sedges			+																													
Tall Sedges	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Low Sedges						+			+	+			+																			
Herbs				+																												

TABLE 3. Species composition of TALL SEDGES ASSOCIATION at each lake.

Species	LAKE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Apium prostratum	r	r																														
Aster subulatus*	r		r																													
Baumea arthrophylla				r		r			r		r					r	r	r	r	r	r	r			r							
B. articulata			i		d	c	r	c	c	c	c				i	c			d	r	i	c	d	c	i		i	c	c	r		
B. juncea	r		r	i		r			r	r	r	r	r		r	r		r	r	r	r	r	r	r	r	r				r		
B. preissii	r		r		r	r	r				r	c	c			r			r	r				r				r				
B. riparia					r		r	r	r		r	r	r					r		r			r			r		r	r	r		
B. vaginalis			r		r	r	r	r	r		r	r	r	i	r	r	d	r		i	r	r	r	r		r		r	r	r	r	r
B. sp.						r										r				r							r					
Bulboschoenus caldwellii																									r							
Carex appressa																r				r				r								
Cassytha sp.							r						r	r			r														r	
Centella asiatica	r		r	r						r															r				r	r		
Cyperus congestus*	r		r																						r							
Eleocharis sphacelata																														i		
Epilobium billardierianum										r																						
Gratiola peruviana					r																				r	r				r	r	
Gahnia trifida																				c	i	r										
Isolepis nodosa	r																						r		r	r	r					
I. prolifer*	r																										i					
Hainardia cylindrica*			r	r																												
Haloragis brownii											r	r																				
Juncus kraussii	r		r	c																					r		r					
J. microcephalus*									r																		r					
J. pallidus																			r				r		r		r					
J. planifolius											r																					
Lepidosperma effusum		r														r		r		r												
L. gladiatum	r																															
L. striatum																										r						
Leptocarpus coangustatus							r						c	r	r	r														i	c	
L. scariosus						r	r	i	r	r		i	c	r			c	d	r	r			r	r					r		r		
Lobelia alata	r		r																										r			
Paspalum vaginatum*	r		r																						r		r					
Pennisetum clandestinum*																											c					
Polypompholyx multifida						r																										
Samolus repens	r			r																												
S. valerandi*	r																															
Schoenoplectus vallidus			r																													
Schoenus cruentus													r													r						
S. nitens				r																												
S. sp. CJR 634													r																			
Selliera radicans																									r							
Stenotaphrum secundatum				i																												
Triglochin procera					r	r	r	r	r	r	r	r	r	r	r	r			r	r	r	r	r		r	r	r			r	r	r
T. striata				r																												
Typha orientalis*		d	i						r							r			r	r	d	r		r	c		c					
Villarsia albiflora															r							r										
V. lasiosperma					r	r	r					r		r			r							r	r			r		r		
Xyris lacera					r	r	r	r				r		r			r								r					r		
Zantedeschia aethiopica*	r																										r					
Total	15	3	13	9	8	11	10	6	9	6	9	9	6	9	7	11	7	6	8	13	7	8	8	7	16	9	12	4	6	8	8	3

* introduced
Estimated cover (after Muir 1977)
d:70-100% dense
c: 30-70% mid-dense
i: 10-30% sparse
r: 0-10% very sparse

TABLE 3A. AQUATIC PLANTS RECORDED AT EACH LAKE

SPECIES	LAKES																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Chara sp.		+		+		+			+		+					+			+	+	+	+			+						
Callitriche stagnalis*			+							+	+								+				+								
Haloragis brownii																			+						+		+				
Lemna disperma				+															+			+	+		+						
Myriophyllum salsugineum						+													+						+		+				
M. tillaeoides																+									+						
Najas marina																			+											+	
Potamogeton drummondii			+			+										+															
P. ochreatus			+													+			+						+						
P. pectinatus																			+						+						
P. tricarinatus											+														+						
Ruppia sp.																															
Rorippa aquaticum*		+																											+		
Spirogyra	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+						
Triglochin procera			+			+				+	+														+	+	+	+	+	+	+	+
Utricularia australis											+																		+		+	+
Villarsia lasiosperma																										+						

*introduced

TABLE 4

DEPTH (metres), pH and TOTAL SOLUBLE SALTS (mg/l) Recorded at each LAKE

		LAKES																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	31
DEPTH	(	0.7	2.2	4.3	4.1	1.7	8.2	1.9	1.3	104	2.1	2.6	3.0	1.3	0.9	2.2	4.5	0.9	-	2.1	1.5	0.9	1.2	5.7	2.5	1.1	2.1	0.5	3.8	6.2	3.7	1.1	1.0
	(	-	2.2	3.1	4.6	2.1	8.9	1.3	1.3		1.6	3.3	2.4	1.3	0.7	1.7	3.9	0.2		0.7	0.9	0.4	0.7	4.6	2.1	0.4	1.4	0.7	3.1	5.7	3.0	0.4	0.4
pH	(	8.2	7.6	6.7	8.8	6.3	6.6	5.6	4.6	6.4	7.0	7.1	6.5	4.3	4.5	5.6	7.1	4.5	5.0	6.1	7.5	7.7	7.4	6.9	5.6	7.1	4.3	6.4	6.6	6.6	5.0	4.8	4.4
	(	8.2	8.2	7.8	8.7	5.8		4.7	4.4	6.6	6.5	7.0	5.2	4.8	4.0	5.7	8.2	4.5		7.5	8.1	8.1	7.6	6.5	5.4	7.9	4.5	7.7					
TSS	(	1133	446	999	2733	528	391	325	325	220	231	303	99	116	143	182	220	143	171	165	512	864	330	259	286	401	149	242	126	163	135	145	145

NOTE : see Appendix A for dates of sampling .

staff (B.L. Rye, who is currently working on the *Cyperaceae*), who agreed with general species groupings, including *Baumea sp.* (CJR Nos.603, 650, 753 and 762) which did not match any material in the collection. This species appears very similar to *B. articulata* and frequently grows with it. It is however smaller in stature, has a similarly shaped but smaller inflorescence, slightly flattened leaves and stem which, although articulated, are not as conspicuously or as consistently articulated as those of *B. articulata*. The collection of this genus requires curation and revision with reference to type material to establish firm species characteristics. The differences between *B. preissii* and *B. laxa*, *B. arthrophylla* and *B. rubiginosa* are currently unclear.

Two species of sedges found at only one lake each were of significance being unusual in the context of this study and in the Warren botanical sub-district (Beard, 1981). *Schoenoplectus vallidus* was found only at Devils Pool where it forms a major part of the Tall Sedges Association. This lake is quite dissimilar from even the other lakes in the Leeuwin-Naturaliste Ridge, being situated on a fast-flowing winter stream, with variable salinity and pH and a largely cleared catchment. *Eleocharis spacelata* was discovered at Meerup Lake covering broad areas of the shallower margins close to the steep mobile dune face. This lake was quite similar to several others (e.g. Lakes 10 and 11) in its floristics and situation (i.e. before a high mobile dune),

but has a much lower pH (and slightly lower TSS). This species has an unusual distribution, having been collected in the far north of Western Australia, around Perth and one collection from near Esperance. The collection from Meerup Lake is very significant in the distribution pattern of this species.

Floristic Analysis of the Tall Sedges Association is presented in Table 5, the Two-Way Table which was derived from both dendograms (see Methods) being divided at the five group level. Further division did not result in more ecologically coherent groups.

Community type 1 is found associated with those lakes on the Leeuwin Naturaliste Ridge and is typified by species group A (including *Samolus repens*, *Centella asiatica* and *Juncus kraussii*) and *Baumea juncea* of group C. These lakes had the highest pH and TSS levels (see Table 4) and were situated in calcareous dunes or limestone in close proximity to the ocean.

Community type 2 is found surrounding all lakes which have relatively narrow vegetated margins and whose catchments have been largely cleared for agriculture. The introduced weeds of species group B (and the presence of *Typha orientalis*) largely defines this community type and are a reflection of the degree of disturbance in their

TABLE 5. TWO - WAY TABLE : TALL SEDGES ASSOCIATION

SPECIES GROUPS		COMMUNITY TYPE	1	2	3	4	5
			000	122	0	0000121313	0131122111221222
			134	957	2	5786294172	9103863051260 48
	A	Apium prostratum	+		+		
		Samolus repens	+ +				
		Aster subulatus*	++				
		Lobelia alata	++				+
		Sonchus oleraceus*	+				+
		Polygonum salicifolium	+				+
		Centella asiatica	+++	+		+	+ +
		Cyperus congestus*	++	+			
		Juncus kraussii	+++	++			
		Paspalum vaginatum*	+	++			
		Hainardia cylindrica*	++				
	B	Atriplex prostrata*		+++			
		Chenopodium macrospermum*		+++			+
		Juncus pallidus		+++			+
		Isolepis nodosa	+	++			++
		Solanum nigrum*		+			+
		Gratiola peruviana		+		+ +	+ +
		Isolepis prolifer*	+	+			
		Zantedeschia aethiopica*	+	+			
		Juncus microcephalus*		+			+
		Haloragis brownii				+	+ +
	C	Baumea articulata	+	+++		++++ +	+++ +++++++++
		B.vaginalis	+			++++++++++	+++++++ +++++++
		Triglochin procera		+++		+++++ ++ +	++++ ++++++++
		Baumea juncea	+++	++		++	++++++++++++++
		Leptocarpus scariosus		+		++++++++	+ +++++ + +
		Baumea riparia				+++ ++	+++++++ +
		B. preissii	++	+		++ ++	+ + ++++
		Cassytha spp.				+ +++	+
		Leptocarpus coangustatus				+ ++++	+ +
		Villarsia lasiosperma		+		++ ++++++	+
		Xyris lacera		+		+++++ +++	
	D	Baumea arthrophylla	+	++		+ +	++ + ++++
		Typha orientalis*	+	+++	+		+ +++++
		Gahnia trifida					++ +
		Baumea sp.		+		+	++ +
		Carex appressa					+++
		Lepidosperma effusum			+		+ ++
		Villarsia albiflora					+ +
	E	Epilobium billardierianum					+ +
		Schoenus cruentus				+	+

* introduced.

environments. pH levels are consistently 7-8 and TSS levels quite fresh (165-400mg l^{-1}).

Community type 3 was found around only Lake 2. This community was the most dissimilar encountered. The lake was very small, relatively deep, steep-sided and geologically very young. The lack of much shoreline has prevented establishment of a greater number of typical components of the Tall Sedges Associatiron. The main component of this community type was *Typha orientalis*, an aggressive introduced species.

Community types 4 and 5 are defined by species group C, and the almost total lack of species from groups A and B. Community type 4 differs from community type 5 by the presence of *Villarsia lasiosperma* and *Xyris lacera* and to a lesser extent by *Cassytha spp.* and *Leptocarpus coangustatus.* Community type 5 is partially differentiated from type 4 by the species group D.

The division between community types may be attributable to a difference in pH. Type 4 has an average pH of 5.2 (see Table 4) and type 5 an average of 6.3. Community type 5 has a slightly higher average TSS level of 281mg l^{-1} compared with 202mg l^{-1} of type 4. It is difficult to attach any importance to this difference as one site in type 5 (Lake 26 - 864mg l^{-1}) greatly influences this average.

Maximum depth recordings (Table 4) are not considered to affect the Tall Sedges Association. Many lakes are deep

only in small sections, rising quickly to more shallow depths over the majority of the lake bed. Average depths recorded for community types 4 and 5 are 2.6m and 2.8m respectively.

The ordination of the Tall Sedges Association (Figure 2) shows good separation of these five community types along axes 1 and 3, where axis 3 appears to be highly correlated with pH. The species-poor community type 2 is seen as an outliner.

The Floristic Analysis of the Aquatics Association (Table 6) shows a separation between community types based largley upon species richness. This pattern appears to be a function of pH and TSS (Table 4). The species recorded as *Algae sp.* was (at the time of analysis) undetermined and may not be an algae. Therefore community types 1 and 2 are considered together. Their average pH is 5.1, TSS 210mg 1^{-1} and represent (with the exception of site 1) the 'blackwater' lakes. Lakes 32 and 31 (both pH 4.8), included in community type 4, would also have been included in this blackwater sub-group, except for the occurrence of *Triglochin procera* in open water. This species does however occur at most lakes in community types 1 and 2 within the Tall Sedges Association. Average pH for community types 3, 5 and 6 are 7.8, 7.05 and 7.03 and TSS averages 1193, 430 and 262mg 1^{-1}.

FIGURE 2. ORDINATION of TALL SEDGES ASSOCIATION

OUTLINED GROUPINGS ACCORDING TO TABLE 5.

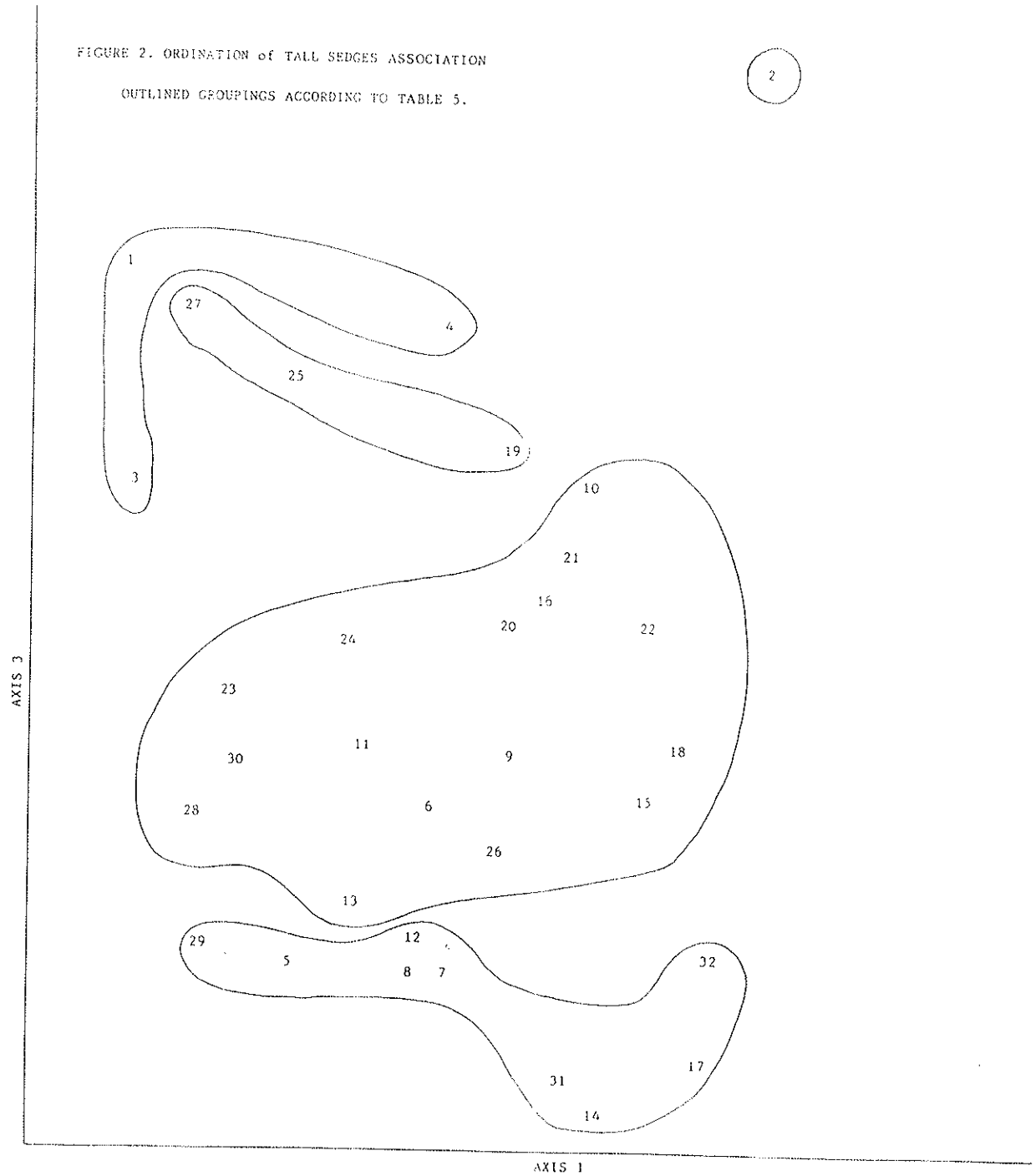


TABLE 6. TWO - WAY TABLE : AQUATICS

SPECIES GROUPS		COMMUNITY TYPE :	1	2	3	4	5	6
			001112223	00111	00220	0233	011222	112
			183784680	57245	29014	6921	301237	695
	A	Algae sp.		+++++				
		Callitriche stagnalis*					+	+
		Myriophyllum tillaeoides				+		+
		Haloragis brownii					++++++	+++
	B	Lemna disperma					+	++
		Potamogeton drummondii					+	+++
		P. ochreatus					+	++
		Chara sp.			+++++	+	++	+++
	C	Spirogyra	+++++++++	+++++	+++++	++++	++++++	+++
		Triglochin procera						
	D	Myriophyllum salsugineum			+			+ +
		Najas marina				+		+
		Average pH.		5.1	7.8	5.5	7.1	7.0
		Average TSS.(mg/1)		210	1193	211	430	262

*introduced

Many schemes have been developed for evaluating natural areas (Smith and Theberge, 1986), and assessing nature conservation values of wetlands (Winning, 1990 and Le Provost et al. 1987, Table 10). All techniques are subjective to varying degrees and are based on intuitive preference in selection of evaluation criteria. An attempt has been made here to assess the relative conservation values of the 32 lakes in this survey (Table 7).

This technique is based upon a simple procedure of allocating a score for each lake for each of the selected criteria. Lakes with higher total scores are considered (by this process) to be of greater conservation value. The method is subjective as selection of criteria and assignment of weighting (maximum scores of either 5 or 10) and individual scoring is partially an arbitrary and intuitive process. The resultant ranking (Table 8) should only be used in management decisions when the selected criteria are seen to be an adequate reflection of management objectives.

A sub-total for Criteria 1-11 is provided in Table 7 as these are attributes considered to be objectively scored. Criterion 12 (Wilderness) and 13 (Scenic Beauty) are human values and may be considered separately due to their subjectiveness. Inclusion of Criteria 12 and 13 does however result in only minor reordering of ranking (Table 8).

Lake Maringup was identified as the lake with the highest conservation value as a result of consistently high

TABLE 7. ASSESSMENT of CONSERVATION VALUES of LAKES

		LAKES																														
	CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	No. of Aquatics	1	3	6	4	1	5	1	1	3	4	5	1	1	1	1	8	1	1	10	3	3	4	4	1	9	1	4	1	3	1	4	3
2	No. of Sedges	9	2	8	4	5	7	6	4	6	3	6	4	6	4	4	7	4	4	5	8	4	5	5	4	10	6	8	3	4	5	5	2
3	Rare Species	0	0	5	0	0	5	0	0	0	0	10	0	0	0	0	5	0	0	0	5	0	0	0	0	5	0	5	5	0	10	0	0
4	Habitat	1	1	5	3	8	10	5	5	8	6	6	6	7	6	7	10	6	6	9	8	7	8	5	5	3	6	3	8	8	8	7	7
5	Weeds	0	7	4	6	10	9	10	10	9	10	10	10	10	10	10	9	10	10	5	9	8	8	3	8	5	10	0	10	10	10	9	10
6	Community	10	0	10	10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	5	5	5	0	5	0	5	5	5	5	5
7	Modification	3	4	3	3	5	4	5	5	4	5	5	5	5	5	5	5	5	5	3	5	5	5	3	4	2	5	1	5	5	5	4	5
8	Size of Lake	1	1	2	2	3	5	2	2	3	3	3	2	2	2	2	4	1	1	4	3	2	2	2	1	2	2	3	2	2	2	1	1
9	Size of Reserve	3	3	1	3	5	5	5	5	5	5	5	3	5	5	5	5	5	5	3	4	4	4	1	3	1	4	1	5	5	5	5	5
10	Inaccessibility	2	2	3	1	4	1	1	1	1	3	3	4	3	4	3	3	5	5	4	2	4	3	1	2	1	3	1	5	4	5	5	5
11	Recreation	4	5	4	3	5	0	4	4	3	5	4	4	4	5	4	4	5	5	5	5	5	5	4	4	5	4	5	5	4	4	5	5
Sub Total		34	28	51	39	51	56	44	42	47	48	62	44	48	47	46	65	47	47	48	57	47	49	33	37	43	46	31	54	50	60	50	48
12	Wilderness	3	3	3	2	5	4	4	4	4	4	4	4	4	4	4	5	5	4	4	3	3	3	3	4	2	4	2	5	4	5	5	5
13	Scenic Beauty	1	3	3	3	4	5	3	3	4	4	5	4	4	4	4	5	4	5	3	3	3	3	3	4	1	4	1	4	4	5	4	4
	TOTAL	38	34	57	44	60	65	51	49	55	56	71	52	56	55	54	75	56	57	55	63	53	55	39	45	46	54	34	63	58	70	59	57

TABLE 8. RANKING of LAKES according to CONSERVATION VALUE

1. Lake Maringup
2. Unnamed Lake Yeagarup
3. Meerup Lake
4. Lake Jasper
5. Lake 1 Boat Harbour
6. Donnelly Lake
7. Lake Quitjup
8. Deeside Lake
9. Lake Charley
10. Crystal Lake
11. Lower Shannon
12. Devils Pool
13. Lake Samuel
14. Naenup Swamp
15. Broke Inlet
16. Lake Yeagarup
17. Lake Florence
18. Owingup Swamp
19. Lake 3 Boat Harbour
20. Lake William
21. Gardner River Lakes
22. Lake 2 Boat Harbour
23. Doggerup Lake
24. Lake Wilson
25. Lake Smith
26. Lake Saide
27. Lake Williams
28. Lake Davies
29. ↑12046
30. Quininup Brook
31. Lake Powell
32. Moses Rock Pool

scores in all criteria. The unnamed lake at the Yeagarup Dunes also had a high total score. This was partly influenced by the high score for Criterion 3 (Rare or Significant Species) given due to the occurrence of *Utricularia australia* and *Potamogeton tricarinatus* which did not occur at any other lake and covered relatively large areas at this lake. Similarly Meerup Lake scored highly due to a high score for Criteria 3 (i.e. rare species *Eleocharis sphacelata*). Lake Jasper was ranked highly, but its conservation value was lessened by its high degree of accessibility and recreational use. The lakes in the Leeuwin-Naturaliste Ridge were generally lowly ranked. this possibly reflects an inadequacy in the selection criteria to evaluate their relatively different geological situation and the scarcity of water bodies within their immediate CALM estate (i.e. Leeuwin-Naturaliste National Park).

Dr John (Environmental Biologist, Curtin University), examined samples of algae on dead wood (Lake 6) and organic 'sludge' (Lakes 16, 20 and 21), and revealed the presence of large numbers of unicellular algae (mainly blue green and diatoms). The sample from Lake Maringup had particularly high numbers of inidividuals and high species diversity which according to Dr John revealed a pollution-free environment. He indicated that species numbers and

diversity of unicellular algae can be used as an accurate indicator of pH and TSS.

An interesting and significant discovery at Owingup Swamp were the 'algal biscuits' (concentrically laminated brown rock-like discs, 20mm diameter) located on the north-eastern shore. These structures are one form of microbialite which are "organosedimentary structures produced by growth and metabolic activity of benthic microbial communities" (L.S. Moore, Background Pamphlet). They are rare and previously known in Western Australia only from alluvial deposits in the Scott River area. This discovery increases the significance of Owingup Swamp which is not reflected in Table 7 as no criteria was selected to evaluate such a feature.

Tortise scutes found in late autumn in several very shallow (300-400mm) lakes (i.e. 31 and 32) revealed that these lakes possibly play an important role in the local survival of the oblong tortise *(Chelodina oblonga)*. These animals, like the surrounding vegetation, occur in a flat region which is seasonally inundated up to 1m. It is speculated that in winter, spring and early summer the tortises forage far out from the lake but return as the waters recede. This species of tortise has a much higher

dessication rate and lower critical thermal maximum than other southern Western Australian species (A.A. Burbidge, pers. comm.). Consequently the shallow, blackwater lakes (with low predator visibility), are critical to the survival of the tortise away from larger bodies of permanent water. The presence of *Chelodina oblonga* was recorded at 15 lakes by casual observation; six by the discovery of predated carapaces. Predation (presumed by foxes) may be the greatest survival threat currently facing the oblong tortise.

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APPENDIX A

LAKES 1 - 32

General Description
Semeniuk Classification
Reserve
Location
Water
Fauna
Access
Inspection Date
Species List
Vegetation Map
Photographs

NO. 1 QUINNINUP BROOK POOLS

GENERAL DESCRIPTION

Outcropping of basement granite to form bars under eroded limestone across the Quinninup Brook has resulted in a series of low waterfalls (to 5m high) each with a permanent pool at its base. In the context of this study, these pools are very small, but were considered worthy of survey due to the scarcity of water bodies within the Leeuwin-Naturaliste National Park. Although no foot track leads directly to these pools, they are easily located 300m in from the beach, north of the Moses Rock carpark (1.6km) and are frequently visited.

The creekbed above the falls was heavily infested by Arum lilies *(Zantedeschia aethiopica)*, choking out native sedges and shrubs. True wetland vegetation associations were restricted to the edges of the pools (and were heavily infested with weeds) and immediately surrounded by coastal heath on high calcareous dunes. A vegetation map was not prepared due to the small scale of these pools. Most of the catchment for the Brook is cleared; the nutrient-rich runoff may be responsible for the blooms of filamentous green algae in the lower pools.

SEMENIUK CLASSIFICATION

LEPTOSCALE BACATAFORM SEDGELAND-HEATH IRREGULAR SUBHALINE POOL

RESERVE: Leeuwin-Naturaliste National Park

LOCATION: Lat: 33°45' Long: 115°00'

WATER:

Colour: clear

pH: 8.2

Depth: 0.7m (bottom pool), 1.3m (top pool)

Movement: year round flow in Quinninup Brook

TSS: 1133mg l^{-1}

FAUNA: None observed

ACCESS: From Moses Rock carpark, north along coast to Quininup Brook and then 300m in from beach to pools.

INSPECTION: 28.3.91; 9.3.92

QUININUP BROOK

VEGETATION COMMUNITIES

SPECIES	1	2
Apium prostratum	r	
Aster subulatus*	r	
Baumea juncea	r	
B. preissii	r	
Centella asiatica	r	
Cyperus congestus*	r	
Isolepis nodosa	r	
I. prolifer*	r	
Juncus kraussii	r	
Lepidosperma gladiatum	r	
Lobelia alata	r	
Paspalum dilatum*	r	
P. vaginatum*	r	
Plantago lanceolata*	r	
Polygonum salicifolium	r	
Samolus repens	r	
S. valanderi*	r	
Sonchus oleraceus*	r	
Epilobium billardi.	r	
Rumex crispus*	r	
Zantedeschia aeth.	r	
Melaleuca heugelii		i
Acanthocarpus preissii		r
Agonis flexuosa		r
Acacia cyclops		r
A. littorea		r
A. saligna		r
Avena fatua*		r
Boronia alata		r
Chorilaena quercifolia		r
Lagurus ovatus*		r
Meuhlenbeckia adpressa		r
Olearia axillaris		r
Pelargonium capitatum*		r
Scaevola crassifolia		r
Spyridium globulosum		r
Leucopogon parvifolius		r
Templetonia retusa		r

Estimated Cover (after Muir)

i: 10-30%

r: 0-10%

*introduced species

Community 1- Tall Sedges

2- Heath Coastal

NO. 2 MOSES ROCK ROAD POOL

GENERAL DESCRIPTION

This small (20m across) lake or pool is perched on limestone just inland of a high calcareous coastal dune (a few hundred metres from the ocean) and below a craggy limestone cliff. Halfway between the cliff top (and cave) and the pool a small stream emerges from under limestone rubble and runs down a thickly vegetated gully into the pool. There was no outflow creek; drainage is presumed to be by seepage under the dunes toward the ocean. There was little variation in water level between seasonal visits (i.e. August 1991 and March 1992). The broad western edge of the roughly triangular pool was a sloped sandy shore, whilst the other sides were formed by a solid limestone bank. The bed of the pool was sandy or covered with silty lime deposits over which in the shallower margins, a slime of filamentous green algae *(Spirogyra sp.)* had developed. In the deeper parts of the pool masses of *Chara* sp, green algae proliferated. Large floating masses of filamentous green algae had developed on the surface when inspected in late summer (9.3.92). These masses often supported cress *(Rorripa aquaticum)* seedlings.

The pool was fringed on two sides by *Typha orcentalis* and some swordsedge *(L.effusum)*. Watercress *(Rorippa nasturtium-aquaticum)* was growing on the pool edges. Beyond the fringes the pool was surrounded by coastal heath typical

for the calcareous soils of this region. Unlike many coastal streams in this region the gully was not yet choked out by Arum lilies *(Zantedeschia aethiopica)*.

The pool is occasionally visited as are the cliffs and cave above; however as it is not visible from any of the tracks and is tucked away behind the dunes it is thus protected from greater foot traffic.

RESERVE: Leeuwin-Naturaliste National Park

LOCATION: Lat: 33°46' Long: 114°59'

WATER:

- Colour: clear
- pH: 7.6, 8.2
- Depth: 2.2m (to top of Characeae Algae)
- Movement: stream fed from east; seepage to ocean
- TSS: 446mg l^{-1}

FAUNA: None observed

ACCESS: Foot access only over sand dunes from vehicle track heading south from Moses Rock Road along beach front.

INSPECTION DATE: 20.8.91; 9.3.92

MOSES ROCK POOL

VEGETATION COMMUNITIES

SPECIES	1	2	3
Chara ?vulgaris	c		
Apium prostratum		r	
Lepidosperma effusum		r	
Typha orientalis*		d	
Acanthcarpus preissii			r
Ammophila arenaria*			r
Acacia cyclops			r
Acacia littorea			r
Boronia alata			r
Chorilaena quercifolia			r
Asphodelus fistulosus*			r
Cassytha glabella			r
Hibbertia cuneiformis			r
Leucopogon parviflorus			r
Lepidosperma gladiatum			r
Melaleuca huegelii			r
Olearia axillaris			r
Pimelea ferruginea			r
Rhagodia baccata			r
Senecio sp.			r
Scaevola crassifolia			r
Spyridium globulosum			r
Solanum symonii			r
Templetonia retusa			r
Tetragonia decumbens			r
Threkeldia diffusa			r
Rorripa aquaticum*	r		

Community 1-Aquatics
2-Tall Sedges
3-Heath Coastal

*introduced species

Estimated Cover (after Muir 1977)
d-70-100%
c-30-70%
r-0-10%

MOSES ROCK ROAD POOL

NO. 3 DEVILS POOL

GENERAL DESCRIPTION

Devils Pool is situated on Boodjidup Brook within the Leeuwin-Naturaliste National Park, in a steep-sided gully eroded through limestone and calcareous stabilized dunes. It may have originated as the base of an old cave system or resulted from a damming effect of a harder limestone bar or limestone rubble across the Brook. A limestone cliff face, shallow cave and scree slope heads a feeder creek valley 100m north of the Pool, providing a year round flow into the pool. Boodjidup Brook which arises in mostly cleared farmland does not flow during late summer. A small alluvial fan exists at the entry point of Boodjidup Brook. Although in a popular tourist region, there is no direct access from the National Park and Devils Pool is infrequently visited despite its spectacular scenery. A private land boundary comes within 20m of the eastern end of the lake and some recreational use is made of the lake by residents and their visitors. A roughly slashed walk track runs from the private property to the western end of Devils Pool. The water of Devils Pool (which is relatively deep (see Table 4) is not clear, appears greenish from suspended algae which may be a result of increased nutrients leached from cleared farmland in its catchment. The bottom is covered to an unknown depth with black mud.

Most of the lake is fringed by tall sedges *(B.articulata, Schoenoplectus vallidus, T.orientalis)* surrounded by associations of *Astartea* thickets, scrub over sedges, Peppermint low forest, coastal heath and Marri woodland. Weeds, particularly concentrated around the inflow and outflow of Boodjidup Brook were Figs *(Ficus carica)*, Pennyroyal *(M.pulegium)*, Nightshade *(S.nigrum)*, Blackberry *(Ribis sp.)*, Arum lily *(Zantedeschia aethopica)* and Clovers.

SEMENIUK CLASSIFICATION

MICROSCALE BACATAFORM SEDGELAND-THICKET-WOODLAND-HEATH SUBMALINE OVAL LAKE

RESERVE: Leeuwin-Naturaliste National Park

LOCATION: Lat: 34°01' Long: 115°01'

WATER:

Colour: greenish

pH: 7.8, 6.7, 7.5

Depth: 3.1m, 4.3m, 3.1m

Movement: inflow only from cave slope to north; outflow to coast via Brook (2.4.91, 4.3.91); inflow from both Boodjidup Brook and cave; outflow via Brook (25.6.91)

FAUNA: Long-necked tortise, mussels, coots, black ducks

ACCESS: Walk track from Location 1378 (private) or through thick scrub from bush track 500m north in National Park.

INSPECTION DATE: 2.4.91; 25.6.91; 4.3.92

DEVILS POOL

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7
Haloragis brownii	r	r	r				
Potamogeton drummondii	r						
Aster subulatus		r	r				
Baumea articulata		i					
B.juncea		r					
B.preissii		r					
B.vaginalis		r	r				
Centella asiatica		r					
Cyperus congestus*		r					
Lobelia alata		r					
Paspalum vaginatum*		r					
Schoenoplectus vallidus		i					
Typha orientalis*		i					
Astartea fascicularis			d				
Agonis linearifolia			i				
Carex appressa			r				
Juncus pallidus			r				
Zantedeschia aethiopica			r				
Callistachys lanceolatum				r			
Lepidosperma effusum				c			
Phebalium anceps				i			
Pteridium esculentum				r	r		r
Agonis flexuosa					i	r	i
Hydrocotyle plebia					r		
Muehlenbeckia adpressa					r		
Pteris vittata					r		
Rhagodia baccata					r		
Spyridium globulosum					r	r	
Templetonia retusa					r	r	
Acacia cochlearis						r	
A.littorea						r	
Olearia axillaris						r	
Melaleuca thymoides						r	
Pimelea argentea						r	
Banksia grandis							r
Eucalyptus calophylla							i
Trymalium floribundum							r
Leucopogon australis							r
Triglochin procera	r						
Potamogeton ochreatus	r						

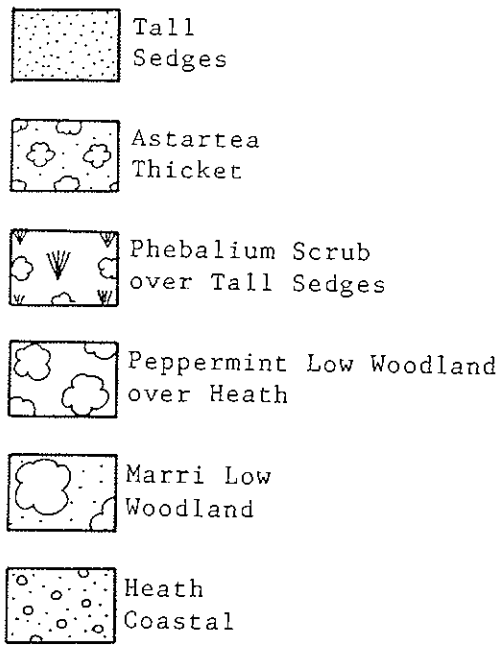
Community 1-Aquatics
2-Tall Sedges
3-Astartea Thicket
4-Phebalium Scrub Over TallSedges
5-Peppermint Low Woodland overHeath
6-Marri Low Woodland
7-Heath Coastal

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

*introduced species

Late additions: Juncus kraussii 2r
Hainardia cylindrica* 2r

3 DEVILS POOL



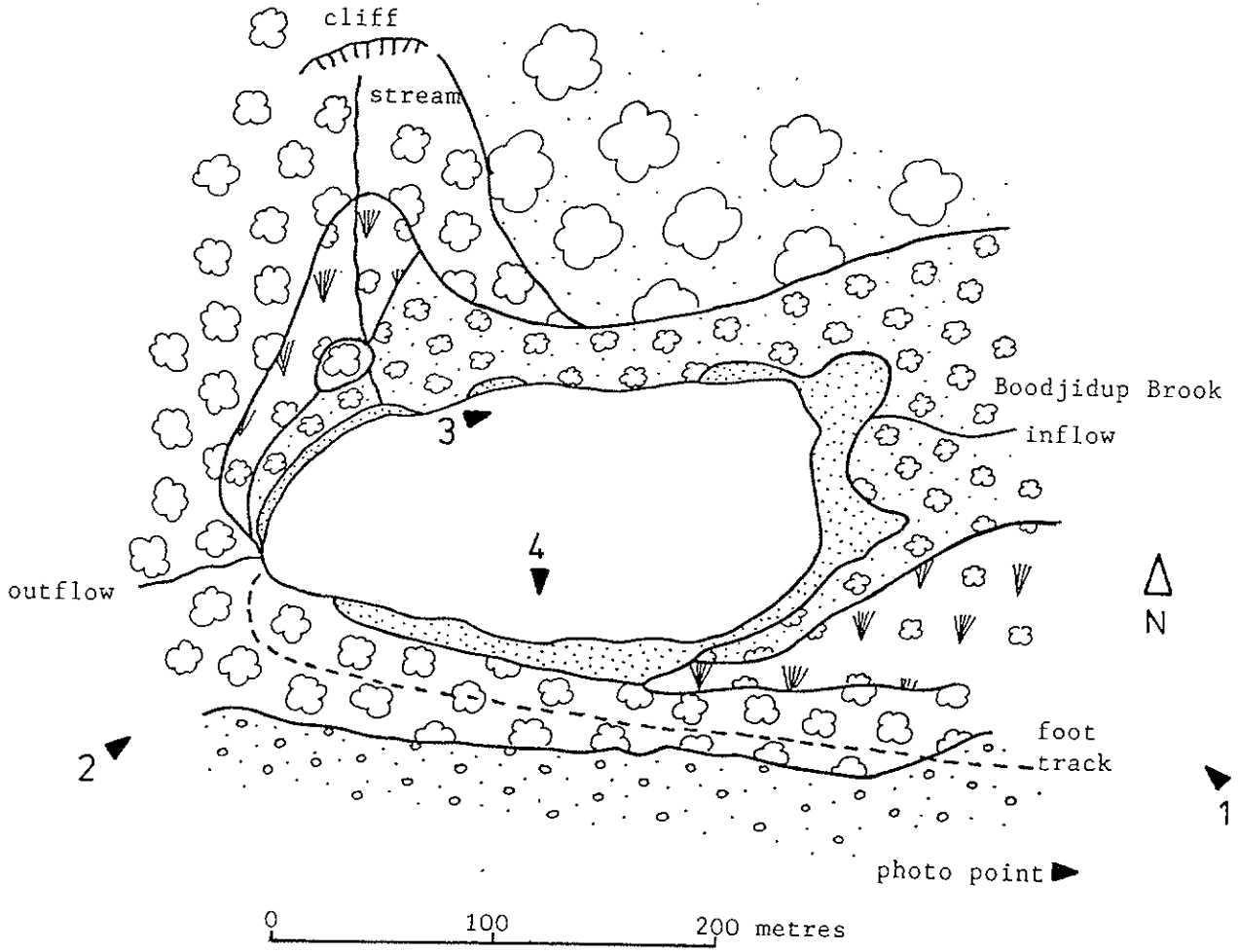


photo 1. DEVILS POOL-Aerial View from South East

photo 2. Aerial View from South Western end

photo 3-Schoenoplectus vallidus fringing Tall Sedges

photo 4-Fringing Tall Sedges with Peppermint Woodland and Coastal Heath behind.

NO. 4 LAKE DAVIES

GENERAL DESCRIPTION

Lake Davies is an oval shaped open lake 80m by 170m, situated less than 10m above sea level and 600m inland from Hamelin Bay within the Leeuwin-Naturaliste National Park. Positioned in the swale between calcareous dunes, this discrete lake is not stream-fed and is presumed to be an exposure of the water table (or possibly spring fed). The shore is fringed with rushes, behind which is a narrow herb field surrounded by Peppermint forest on consolidated dunes.

The lake is surprisingy deep (4.2m), reasonably clear and does contain some introduced debris (old boards, posts, some pipe and bottles and cans). The lease boundary for Hamelin Bay Caravan Park joins the lake shore in the south-western quadrant. Mowed introduced grasses abut the fringing rushes at this end, and a small section of rushes have been removed to provide access for recreational pursuits such as swimming and canoeing. Marron have been introduced (P.C. Warrilow, local fisherman - pers.comm.), and discarded baits were evident in the surrounding vegetation. One live marron was found in a trap. Several small marron were disturbed from the inundated fringing sedges.

No water is directly drawn from the lake, although both CALM and the Caravan Park have done so in the past. CALM now have a bore 30m due east of the lake to supply water to

an overhead tank by the temporary Ranger's depot situated further back under the Peppermints. The Caravan Park also has a bore within its lease. It is not known whether these bores have any draw down effect on the lake surface. It is also unknown if there is any nutrient leaching from the various activities of the Caravan Park. Current level of total soluble salts is double that suitable for human consumption.

Current access is from Hamelin Bay Road (sealed) 15m from the southern shore either through the eastern end of the Caravan Park or via the CALM Ranger's hut. The Leeuwin-Naturaliste National Park Management Plan 1989-1999 proposes (Table 4, p. 30), the road be realigned to the north side of Lake Davies to provide general beach access and the existing road be retained for Caravan Park access only. This would effectively excise the lake from the National Park and construction of the road (as per Figure 12, Draft Management Plan) may result in erosion of the steep dunes, vegetation loss, possible silting of the lake and excessive run-off. Such a road construction may be in contravention of item 14.1.5, Leeuwin-Naturaliste Management Plan (p. 47), but is supported (A.1.3, p. 67) in its ability to enhance the view to Lake Davies.

The area around Lake Davies and no doubt the lake itself have long been used by Europeans. The original Hamelin Bay townsite which serviced the timber exporting port of the nineteenth and early twentieth centuries was

located in the Peppermints around and inland of the lake. It is likely that the lake was used as a general water supply. In July 1900, a severe gale which sank three ships in Hamelin Bay, blew sheets of salt water from the ocean into the lake making it too salty to drink ('Giants of the South', V.G. Fall, 1974, unpublished thesis).

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-HERBLAND-HEATH OVAL SUBHALINE LAKE

RESERVE: Leeuwin-Naturaliste National Park

LOCATION: Lat: 34°13' Long: 115°02'

WATER:

Colour: greenish clear

pH: 8.8, 8.7

Depth: 4.1m (4.4.91), [4.6m (12.6.91)], 4.2m (9.3.92)

Movement: none discernible

TSS: 2734mg l^{-1}

FAUNA: Black ducks, grebes, coots, marron, fish and shrimps

ACCESS: Hamelin Bay Road

INSPECTION DATE: 4.4.91; 12.6.91; 25.6.91; 9.3.92

LAKE DAVIES

VEGETATION COMMUNITIES

SPECIES	1	2	3	4
Chara ?vulgaris	i			
Myriophyllum salsugineum	r			
Baumea arthrophylla		r	r	
B.juncea		i	i	
Centella asiatica		r	r	
Juncus kraussii		c		
Lobelia alata		r	r	
Hainardia cylindrica*		r	r	
Samolus repens		r	r	
Schoenus nitens		r		
Stenotaphrum secundatum*		i	c	
Triglochin striata		r		
Thysanotus tenellus			r	
Muehlenbeckia adpressa			r	
Microtis uniflora			r	
Sporobolus indicus*			r	
Romulea rosea*			r	
Acacia cyclops			r**	r
A.saligna **			r**	r
Agonis flexuosa			r**	c
Boronia alata				r
Acacia littorea				r
Olearia axillaris				r
Scaevola crassifolia				r
Spyridium globulosum				r

Community 1-Aquatics
2-Tall Sedges
3-Herbs
4-Peppermint Open Low Woodland over Coastal Heath

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

*introduced species
**invading seedlings

4 LAKE DAVIES

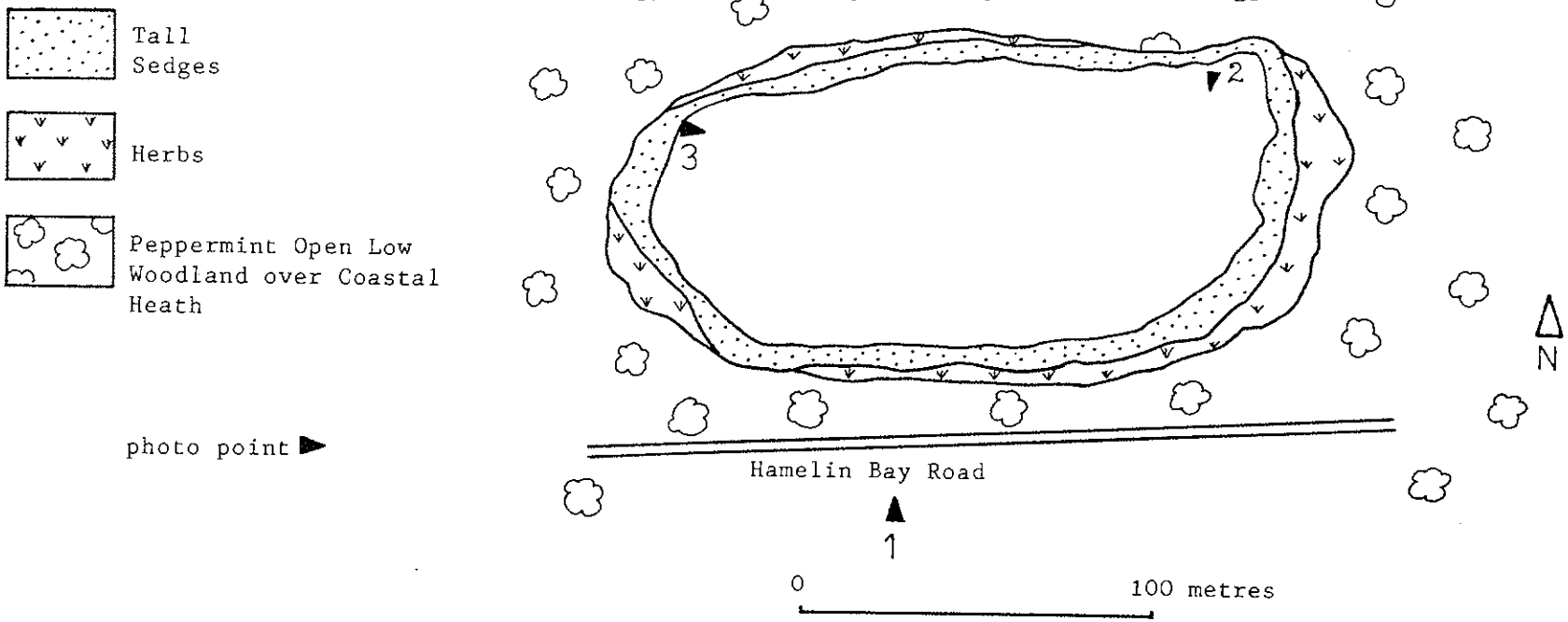


photo 3. Panorama of Lake Davies from western end.

photo 1. Aerial view of Lake Davies from the south.

photo 2. Myriophyllum salsugineum and Chara sp.

NO. 5 LAKE QUITJUP

GENERAL DESCRIPTION

An almost pristine lake, 1.3km by 0.7km of open water situated 6.5km north-east of Black Point in D'Entrecasteaux National Park. It is bordered on its south-western side by a high ridge of silicious sand, supporting Jarrah forest which slopes steeply to the lake. The rest of the lake is bordered (behind a low bank) by densely vegetated palusplain and floodplain (Semeniuk, 1987) which form part of the extensive wetland mosaic from Gingilup Swamp to the Donnelly watershed. The winter water level of the lake may be continuous with the water level of the floodplain.

The lake is bordered on most sides (except the south-western) by a low natural levee bank. Within the levee the wetland can be considered a discrete basin; the vegetation consisting of a fringe of rushes (partly emergent) up to 10m wide, with *B.articulata* the structural and cover dominant. Beyond the lake basin the surrounding vegetation is Jarrah woodland and wetland communities of *Callistachys lanceolatum* thicket, *A.juniperina* low forest, *M.raphiophylla* low forest, *Agonis-Leptocarpus* heath over tall sedges, *A.linearifolia* thicket, *Kunzea* heath and *Beaufortia* heath.

The lake is relatively shallow with much of the bottom covered to an unknown depth with a thick black organic sludge (? *Baumea* peat). Sections of the northern and southern shores are sandy but the majority of the shoreline

is indistinct due to dense stands of *Baumea articulata* over the black sludge. The condition of the lake and surrounds is natural with limited human activity (and rubbish) resulting from occasional marroning.

Cleared land, cattle and buildings are visible 2.5km to the north on location 12895. This location is the main site of the Jangardup Heavy Minerals Mine proposed by Cable Sands. The ERMP prepared for this mine claims "the adjoining D'Entrecasteaux National Park will not be affected by the operations" (p. 60). Lake Quitjup is not mentioned in the ERMP even though it is only 3km from the main ore body.

SEMENIUK CLASSIFICATION

MESOSCALE PERIFORM SEDGELAND-HEATH-THICKET-WOODLAND IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°23' Long: 116°35'

WATER:

Colour: dark brown clear

pH: 6.3, 5.8

Depth: 1.7m, 2.1m

Movement: none obviously discernible

TSS: 528mg l^{-1}

FAUNA: Marron, black swans, black duck, black cormorant, swamp hen. Dunnart *(Sminthopsis gilbertii)* - found dead in Beaufortia Heath.

ACCESS: Only one track (6.2km), emanating from Black Point Road provides direct access and is guarded by a CALM barrier. Recently (1991), a rough 4-WD track (approximately 500m) has been driven through scrub to the southern corner of the lake from an old graded track to the east. Its progress is marked by beer cans and its terminus by marron carapaces.

INSPECTION: 22.4.91 to 24.4.91; 30.4.92

LAKE QUITJUP

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7	8	9
Baumea articulata	d		r	r	i	r			
B.preissii	r								
B.riparia	r								
B.vaginalis	r		i	r	r				
Leptocarpus scariosus	r	r	r	r	i	r	r		
Triglochin procera	r		r		r				
Villarsia lasiosperma	r								
Callistachys lancelatum		c	r			r			
Gahnia decomposita		i				r			
Lepidosperma effusum		r							
Agonis linearifolia		r				c	r		
A.parviceps		r					r		r
A.juniperina		r	d						
Eucalyptus megacarpa		r						r	
Ampera volubilis			r	r	r				
Melaleuca raphiophylla			r	d					
M.polygaloides			r	r					
Gonocarpus hexandrus			i						
Melaleuca laterita			r	r					
Agonis floribunda			r	r	c				
Pimelea hispida					r				
Xyris lacera	r	r							
X.laxiflora					r	r	r	r	
Astartea fascicularis					r	r		r	
Homalospermum firmum						r		r	
Acacia hastulata						r	r		
Empodisma gracillimum						r			
Sphenotoma gracile						r		r	
Kunzea ericifolia							d	r	
Pericalymma ellipticum							r		
Calothamnus lateralis							r		
Melaleuca preissiana							r		
Anarthria gracilis							r	r	
Beaufortia sparsa								c	
Evandra aristata								i	
Hypocalymma ericifolium								r	
Persoonia teretifolia								r	
Adenanthos obovatus								r	
Agonis flexuosa									r
Anarthria scabra									r
Boronia crenulata									r
Eucalyptus marginata									i
Hibbertia cuneiformis									r
Leucopogon capitellatus									r
Macrozamia reidlei									r
Pteridium esculentum									r

Community 1-Tall Sedges
2-Callistachys Thicket
3-Cedar Dense Low Forest
4-Paperbark Low Forest
5-Agonis floribunda Heath over Tall Sedges
6-Agonis linearifolia Thicket
7-Kunzea Dense Thicket
8-Beaufortia Heath
9-Jarrah Low Woodland over Low Heath

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

5 LAKE QUITJUP

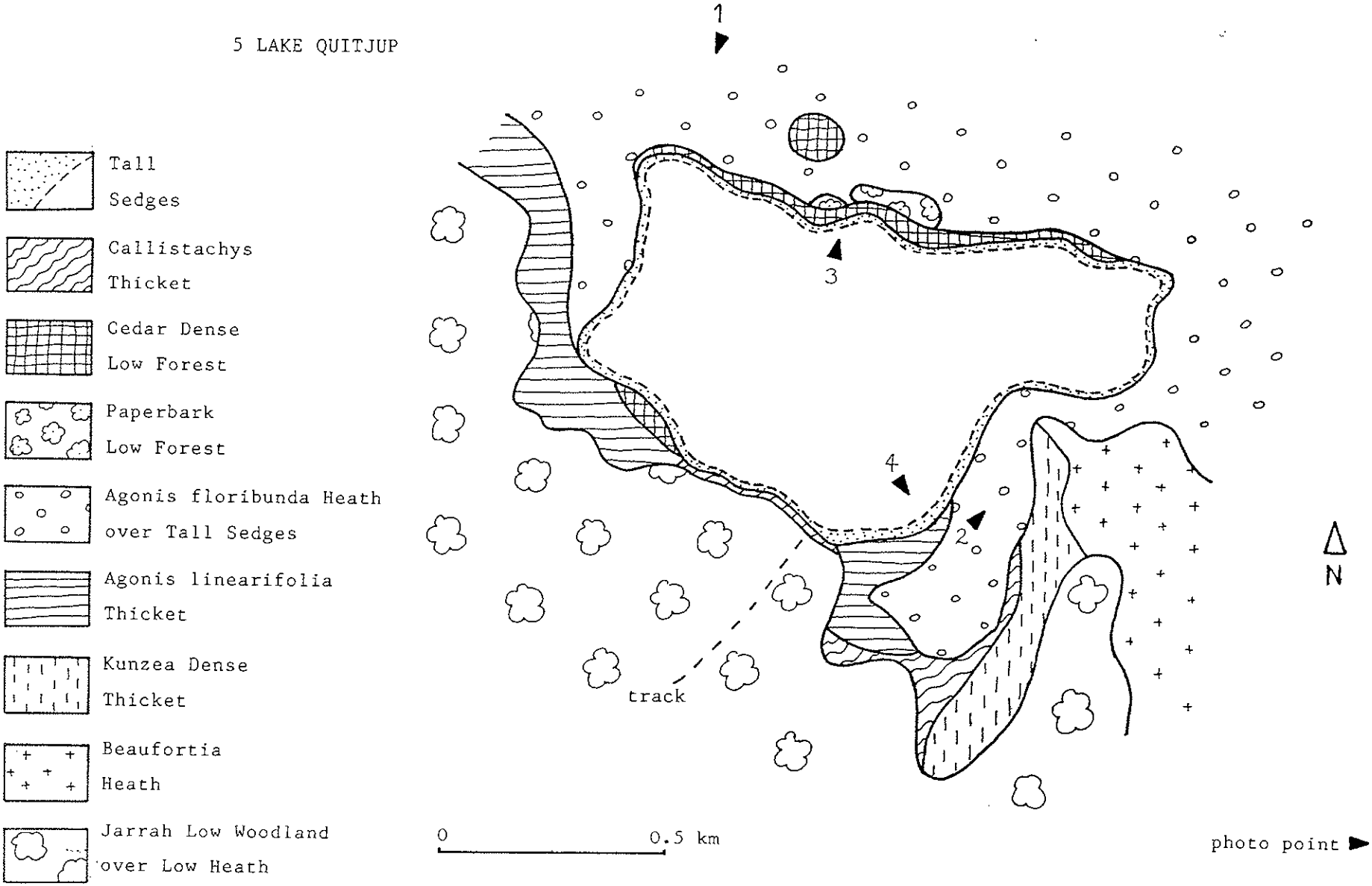


photo 1. Western end of Lake Quitjup, viewed aerially from the north east.

photo 2. Agonis floribunda heath over tall sedges.

photo 3. Cedar Dense Low Forest behind Baumea articulata.

photo 4. Agonis linearifolia Thicket behind Baumea articulata.

NO. 6 LAKE JASPER

GENERAL DESCRIPTION

Lake Jasper is the largest freshwater lake in south-western Australia, being 3.75km long by 1.75km wide, and is spectacular with its broad expanses of clean open water (up to 10m deep) and broad white sandy beaches. Similar to Lake Quitjup, it is bordered on the south and south-western sides by relatively high silicious sand dunes, with the other shores being surrounded by the broad 'blackwater' flats of palus plain and floodplain which extend from Gingelup Swamp to the Donnelly watershed. The dunes support woodland of Bullich and Peppermint which give way to Jarrah forest toward the east. The blackwater wetlands are comprised of a mosaic of vegetation communities, some of which are easily defineable such as low Cedar *(Agonis juniperina)* forest or broad Sedgefields.

The majority of these wetlands were simply mapped as a complex communities comprised of elements of tall sedges, *Beaufortia* heath, *Agonis floribunda* heath over sedges, Jarrah woodland and Paperbark forest. On the scale at which the vegetation fringing Lake Jasper was mapped it was not practical to define every area of each association.

The fringing sedges, dominated by species of *Baumea* (and *B.articulata* in particular) have been mapped as occurring on the south-west shores of Lake Jasper. They do in fact occur right around the lake, but apart from the area

mapped (where they may be up to 10m wide), their distribution is very patchy, and do not form dense stands.

The lake bed is generally very clear and sandy. Parts of the shallows on the eastern margins are covered with smooth silicious stones up to 75mm. Large clumps of the algae *Chara* sp. occurred at the northern end.

The lagoon located in the south west corner provided a marked contrast to the open waters of Lake Jasper. At the time of inspection (19.3.92) there was approximately 600mm of water above a loose suspension of organic sludge greater than 2m (i.e. canoe paddle depth). The pH level of 8.9 is more basic than the open lake waters. Several large clumps of the aquatic plant *Najas marina* (not present in the lake) grew in the middle of the lagoon. The surrounds were burnt-out Cedar *(A. juniperina)* stands and sedges on solid peat banks. The lagoon supported a relatively large number of water birds of 10 different species and long necked tortises. A spotless crake was observed feeding on small fish or shrimps.

Recent archealogical research has revealed numerous stone artefacts and old tree trunks on the lake bed up to 9m below current surface levels. These trees died as the lake water was beginning to accumulate which carbon dating of the stumps has revealed was between 3750 and 4000 years ago. The estimated age of some of the stone artefacts at not more than 4000 to 5000 years further supports this theory. Geological opinion (Alex Kern, Department of Mines,

pers.comm.) also supports the possible age of Lake Jasper at around 4000 to 5000 years. Post-glacial sea levels reached their peak about 6000 years B.P. and have subsequently dropped 2-3m. The exposed sea bed then gave rise to the wind-blown mobile sand dunes such as those which caused the damming of Lake Jasper. The geological explanation which applies to Lake Jasper has shed light on the formation on many other lakes in this survey which occupy a similar position in their surrounding landforms.

Lake Jasper has for many years been used for recreation (camping, boating, marron fishing), particularly by people of the hinterland around Pemberton and Manjimup. The area is now subject to the 10 year management plan for D'Entrecasteaux National Park which has reserved certain areas of the Lake for skiing and power boating and permits camping in a specified area on the southern shore. Boat launching, picnic and toilet facilities are provided, and access from the Vasse Highway has been upgraded to all-weather 4-wheel drive. The road improvement, coupled with the blocking of many minor tracks through the Blackwater wetlands will restrict the spread of dieback disease. Lake Jasper will become more popular as a summer recreation area, however human impact will largely be confined to those areas currently developed. Rubbish did not appear to be a large problem, but several piles of bottles, cans and polystyrene floats (from marron nets) were found discarded in the heath vegetation over the low banks in the south-east corner.

Behind the main sandy swimming beach, upon which illegal camping was observed in January, numerous toilet pits had been dug. Apart from the south east corner where most recreation is confined, the rest of the lake surrounds are quite pristine.

SEMENIUK CLASSIFICATION

MACROSCALE BACATAFORM SEDGELAND-HEATH-THICKET-WOODLAND OVOID FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°25' Long: 115°40'

WATER:

Colour: clear

pH: 6.6 (open water), 8.9 (lagoon)

Depth: 8.2m (1.5.91), 8.9m (22.8.91)

Movement: none discerned

TSS: 391mg l^{-1}

FAUNA: Marron, cobbler fish, long-necked tortise, grebe, musk duck, black duck, swan, coot, swamp hen, spotless crake, white faced heron, white egret, sea eagle, darter, little black cormorant, mountain duck (chestnut shell duck)

ACCESS: All-weather 4-WD from Vasse Highway to camping and boat launching facilities.

INSPECTION DATE: 26.1.91; 1-3.5.91; 22.8.91; 19.3.92

LAKE JASPER
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7	8	9	10
Chara sp.	r									
Baumea arthrophylla		r	r	r						
B.articulata		c	r	i						
B.juncea		r								
B.vaginalis		r	c	r	r					
B.sp.CJR 753		r								
Leptocarpus scariosus		r		r						
Polypompholyx multifida		r								
Villarsia lasiosperma		r		r	r					
Xyris lacera		r								
Banksia littoralis			r							
Agonis juniperina			r		d	i	r			
Gahnia trifida			r							
Triglochin procera			r							
Agonis floribunda				c						
Hakea ceratophylla				r						
Melaleuca preissiana				r	r	c				
Restio applanatus				r			r			
Callistachys lancelatum					r	i	r	c		
Boronia stricta					r		r			
Lepidosperma effusum					r	r				
Anigozanthos flavidus						r		r		r
Centella asiatica						r				
Opercularia hispidula						r				
Beaufortia sparsa							i			
Acacia hastulata							r	r		
Homalosperma firmum							r			
Phebalium anceps							r			
Cassytha glabella							r			
Astartea fascicularis							r			
Acacia myrtifolia							r			
Evandra aristata							r			
Restio ?crassus							r			
Stylidium scandens							r	r		
Adenanthos obovatus							r			
Agonis parviceps							r	c		
Gymnoschoenus anceps							r			
Agonis linearifolia							r			
Pultenaea reticulata								r		
Kunzea ericifolium								r		
Pteridium esculentum								r		r
Hypolaena exsulca								r		
Boronia crenulata								r		
Tremandra diffusa								r		
Macrozamia reidlei								r		r
Eucalyptus megacarpa								r	i	c
Hibbertia cuneiformis								r		
Banksia attenuata									r	
Anarthria prolifera									r	
A.scabra									r	
Acacia extensa									r	
A.pulchella									r	
Agonis flexuosa									r	i
Jacksonia horrida									r	r
Loxocarya flexuosa									r	r
Melaleuca thymoides									r	
Phlebocarya ciliata									r	
Pimelea rosea										

LAKE JASPER-VEGETATION COMMUNITIES cont.

Species	1	2	3	4	5	6	7	8	9	10
Hakea oleifolia										r
Hibbertia grossularifolia										r
Hakea prostrata										r
Rhagodia baccata										r
Pimelea clavata										r
Melaleuca thymoides						r				
Baumea preissii		r								
Triglochin procera		r								
Najas marina	r									

Community 1-Aquatics
2-Tall Sedges
3-Low Sedges
4-Agonis floribunda Heath over tall sedges
5-Cedar Dense Low Forest
6-Paperbark Low Forest
7-Beaufortia Heath
8-Callistachys Thicket
9-Heath Dry
10-Bullich Low Woodland over Heath Dry

Estimated Cover (after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

6 LAKE JASPER

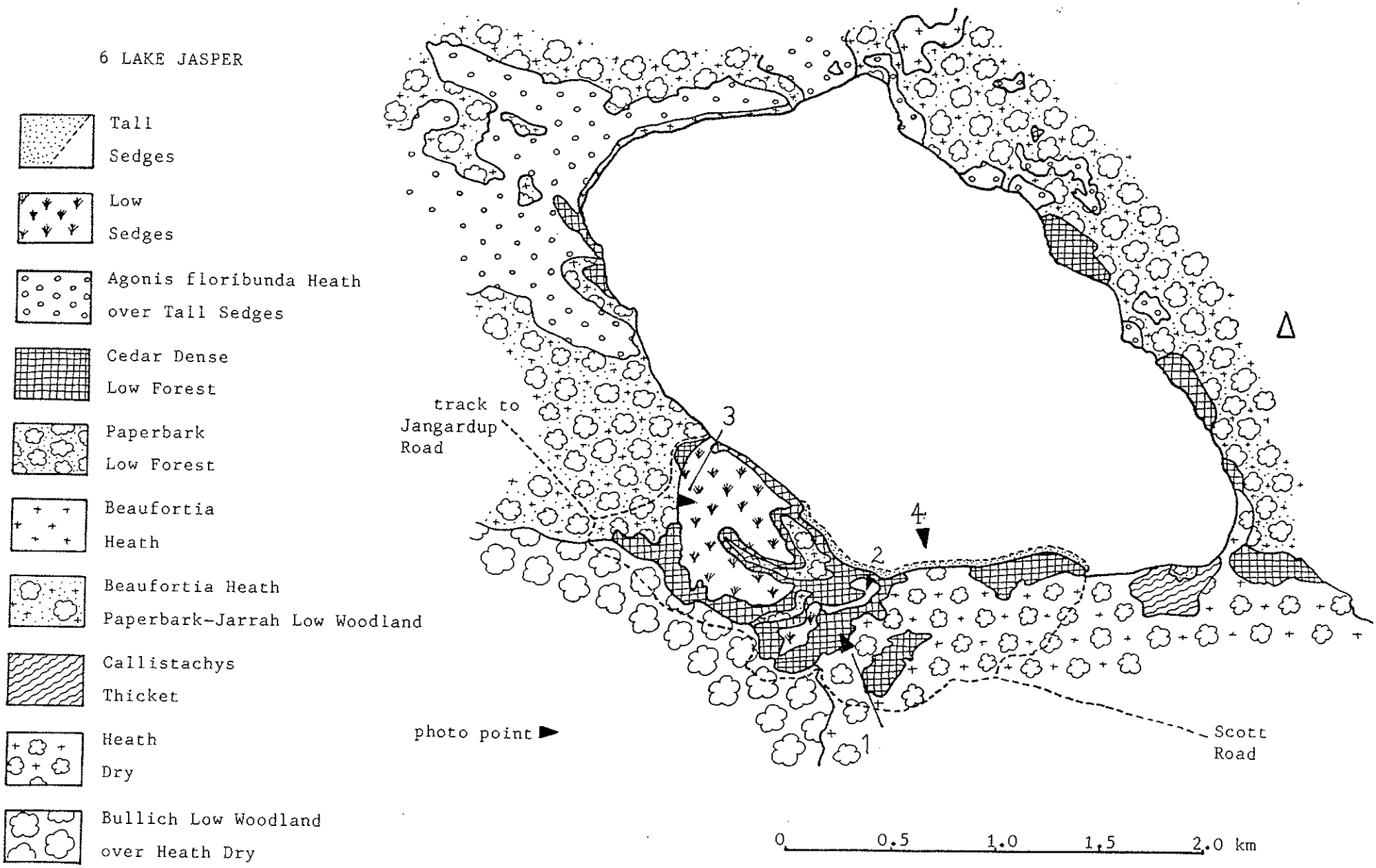


photo 1. Aerial view of lagoon in south western corner.

photo 2. Najas marina growing the lagoon.

photo 3-Banksia littoralis,Melaleuca preissiana and Agonis juniperina over Low Sedges of Gahnia trifida and Baumea vaginalis.

photo 4-Fringing Tall Sedges before Bullich Low Woodland over Dry Heath.

NOS. 7 AND 8 LAKE WILSON AND LAKE SMITH

GENERAL DESCRIPTION

Lakes Wilson and Smith have formed in the same broad, flat expanse of Blackwater wetlands (palusplain and floodplain) that surround Lake Jasper. The vegetation associations are continuous from Lake Jasper, and on a larger scale all three lakes could be mapped together. An almost continuous band of Cedar *(Agonis juniperina)* from the south-east corner of Lake Jasper, at the base of the sand ridge, joins the three lakes.

Lake Wilson is peculiar in this group with its curiously sculptered peat shores supporting clumps of *Leptocarpus scariosus*. The south-western shore, along the base of the sand ridge (supporting Bullich woodland) was fringed with *Baumea articulata*. The association of *Agonis floribunda* heath over sedgeland behind the fringing sedges is continuous from west of Lake Wilson to east of Lake Smith. Lake Smith is completely fringed with an often broad and dense stand of *Baumea articulata*. The sand ridge formation supporting Bullich woodland peters out toward the south between the two lakes and is replaced by Jarrah woodland.

The bed of Lake Wilson is generally shallow with peaty sludge over sand. Lake Smith is also shallow with a sandy bed.

Both lakes are easily accessible by short tracks from Scott Road, but do not appear to be used frequently for recreation apart from seasonal marroning. Marron were freed from illegal traps left set at Lake Wilson. Most visitors to the region may stop briefly but continue on to the more spectacular Lake Jasper.

SEMENIUK CLASSIFICATION

MESOSCALE ZONIFORM SEDGELAND-SEDGELAND HEATH-HEATH-WOODLAND IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°26' Long: 115°43'

WATER:

Colour: Lake Wilson - clear brown
Lake Smith - clear brown

pH: Lake Wilson - 5.5 (3.5.91) and 4.7 (19.3.92)
Lake Smith - 4.6 (3.5.91) and 4.4 (19.3.92)

Depth: Lake Wilson - 1.9, 1.3
Lake Smith - 1.3, 1.3

Movement: non-discernible

TSS: Lake Wilson - 391mg l^{-1}
Lake Smith - 325mg l^{-1}

FAUNA: Long-necked tortise, marron (Lake Wilson)

ACCESS: Direct from Scott Road.

INSPECTION: 3.5.91; 22.8.91; 19.3.92

LAKES WILSON and SMITH - VEGETATION COMMUNITIES

SPECIES	1W	1S	2	3	4	5	6	7
Baumea articulata	i	c	r					
B. riparia	r	r						
B. vaginalis	r	r	r					
B. preissii	r							
Cassytha glabella	r							
Leptocarpus coangustatus	c							
L. scariosus	c	i						
Triglochin procera	r	r						
Xyris lacera	r	r	r					
Agonis floribunda			c	r				
Astartea fascicularis			i					
Cyathochaete clandestina			r					
Villarsia lasiosperma			r					
Eucalyptus megacarpa					r			r
Melaleuca preissiana					c			
Acacia hastulata						r		
Leucopogon interruptus						r	r	
Beaufortia sparsa						i		
Bossiaea rufa						r		
Evandra aristata						r		
Gahnia decomposita						r		
Gymnoschoenus anceps						r		
Homalospermum firmum						r		
Persoonia teretifolia						r		
Sphenotoma gracile						r		
Agonis parviceps						c	i	
Anarthria scabra						i	i	r
A. prolifera							r	
Boronia crenulata							r	
Banksia attenuata							r	
B. ilicifolia							r	
Eucalyptus marginata							i	
Hypocalymma robustum							r	
Jacksonia horrida							r	
Melaleuca thymoides							r	
Pteridium esculentum							r	i
Xanthorrhoea preissii							r	r
Acacia extensa								r
Agonis flexuosa								r
Dampiera sp.								r
Kunzea ericifolium								r
Leucopogon capitellatus								r
Persoonia longifolia								r
Platytheca galioides								r
Macrozamia reidlei								i

W- LAKE WILSON
S- LAKE SMITH

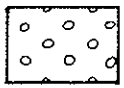
Community 1-Tall Sedges
2-Agonis floribunda Heath over Tall Sedges
3-Cedar Dense Low Forest
4-Paperbark Low Woodland
5-Beaufortia Heath
6-Jarrah Low Woodland
7-Bullich Low Woodland

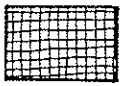
Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

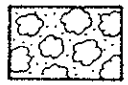
7 LAKE WILSON

8 LAKE SMITH


Tall
Sedges


Agonis floribunda Heath
over Tall Sedges


Cedar Dense
Low Forest


Paperbark
Low Woodland


Beaufortia
Heath


Beaufortia Heath
Paperbark–Jarrah Low Woodland


Jarrah Low Woodland
over Heath


Bullich Low Woodland
over Heath

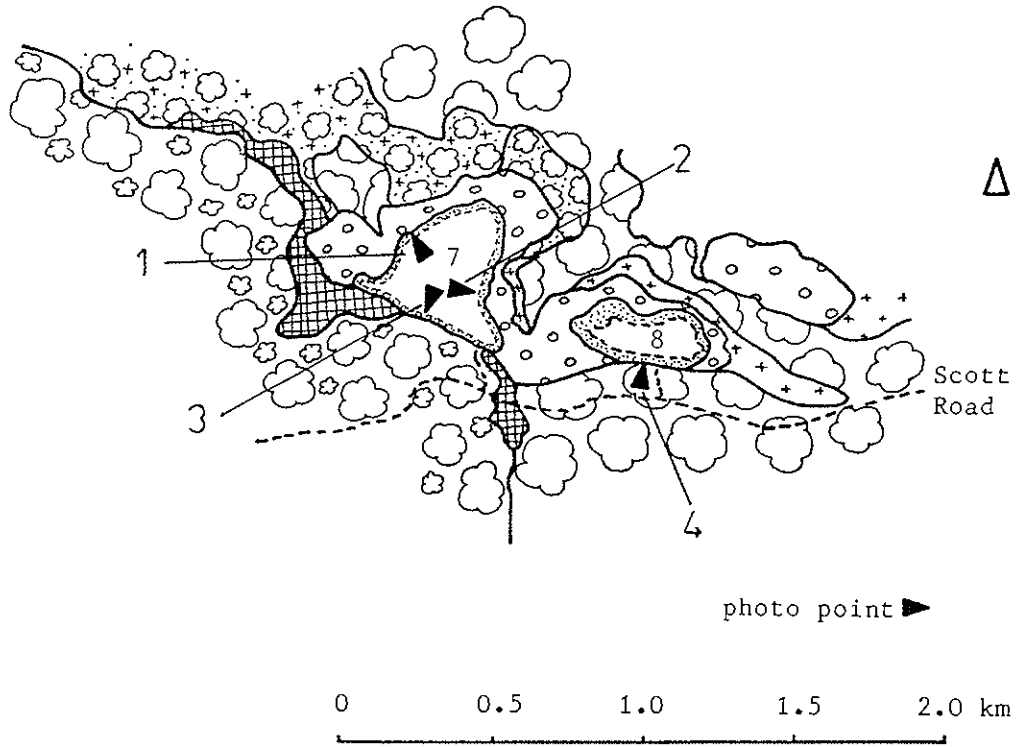


photo 1-Lake Wilson;Leptocarpus scariosus clumps
on sculptered peat.

photo 2-Lake Wilson;Leptocarpus scariosus on peat over sand
with Beaufortia Heath and Jarrah Low Woodland behind.

photo 3-Lake Wilson;fringing Tall Sedges before
Bullich Woodland.

photo 4-Lake Smith;Beaufortia Heath foreground with
broad expanse of fringing Tall Sedges(Baumea articulata)
in background.

NOS. 9, 10 AND 11 YEAGARUP LAKES

GENERAL DESCRIPTION

Three lakes; Yeagarup Lake, Naenup Swamp, and an unnamed lake, are dealt with together as they are each components of a local wetland system. Naenup Swamp and the unnamed lake are situated against the inland (north-eastern) edge of the Yeagarup Dunes and both are being invaded by the dunes. Aeolian deposition from the encroaching dunes is resulting in changes in the vegetation particularly evident about 300 to 500m from the dune face. The lakes are deepest close to the dune face as dune 'shadow' protects this open water from sand being blown off the top. The inland end of Naenup Swamp appears to be drying quickest as broad areas of *Baumea articulata* could be crossed (dry) by foot in August. Generally *B.articulata* stands are inundated well in excess of 1m by mid-winter. The sandy shores of Naenup Swamp were being invaded by shrubs, particularly *Banksia littoralis*, whereas *B.littoralis* and *Agonis juniperina* higher on the older banks were dying as a result of a suspected changing water table. Similarly the broad areas of *B.articulata* which stretched inland toward Yeagarup Lake from the unnamed lake are being invaded by *B.littoralis*, *Banksia seminuda*, *Hakea oleifolia*, *Phebalium anceps* and some *A.juniperina*. It is reasonable to speculate that both Naenup Swamp and the unnamed lake were once much deeper (like Yeagarup Lake) with broad expanses of open water. Initially as the dunes

encroached, the lake bed was invaded by rushes *(B.articulata)* from the fringe which are now in turn being invaded by shrubs and small trees as the dunes encroach further. An attempt has been made to stabilize the dunes by planting Marram grass *(Ammophila arenaria)*. This has partly been successful in stabilizing the leading face of the dune, but vast areas behind are still subject to erosion by prevailing winds.

The Banksia Woodland, between the open dunes and Naenup Swamp featured many fine old examples of River Banksia *(B. seminuda)*. Some dense stands of younger individuals formed an almost monospecific community not unlike an exotic pine forest in general appearance.

The unnamed lake was notable for the abundance of aquatic plants, particularly in the south-west corner where *Utricularia australis*, *Chara sp.* and *Potamogeton tricarinatus* form very dense masses. Most of the bottom of the unnamed lake was covered with organic deposits whereas Naenup Swamp was more sandy, possibly due to aeolian deposits over organic mud.

Yeagarup Lake being about 1km from the dunes, appears unaffected by aeolian deposition. It is surprisingly deep (10.4m) at the north-western corner where a high woodland ridge slopes steeply into the lake without an intermediate shore. Rushes fringe the eastern half, while the southern sector is immediately bordered by wet heath on peat banks. A broad sedge field is located behind the rush fringe on the

south-eastern side. Yeagarup Lake is very picturesque with the backdrop of the dunes to the west and tall Karri forest to the south. It is easily accessed by two-wheel drive and picnic facilities are provided. Numerous campsites exist off the track toward the dunes and were probably created by marroners, but have not impacted greatly on the general natural appearance of the lake and its surrounding vegetation. Rubbish discarded at the campsites is however beginning to accumulate.

SEMENIUK CLASSIFICATION

MACROSCALE ZONIFORM (YEAGARUP) - HETEROFORM (NAENUP AND UNNAMED) SEDGELAND-HEATH-WOODLAND-FOREST OVOID (YEAGARUP)-IRREGULAR (NAENUP AND UNNAMED) FRESH LAKE

RESERVE: Charley Block (State Forest)

LOCATION: Lat: $34^{o}32'$ Long: $115^{o}52'$

WATER:

Colour: clear

pH: Yeagarup - 6.4, 6.6
Naenup - 7.0, 6.5
Unnamed - 7.10, 7.0

Depth: Yeagarup - 10.4m
Naenup - 1.5m
Unnamed - 3.3m

Movement: none discerned

TSS: Yeagarup - 220mg l^{-1}
Naenup - 231mg l^{-1}
Unnamed - 303mg l^{-1}

FAUNA: Coot, mussels, marron (Yeagarup), musk duck (Naenup), tortise, marron, black swan (unnamed lake)

ACCESS: Yeagarup Lake is accessible by two-wheel drive from Ritter Road. Naenup Swamp and the unnamed lake were reached on foot from the 4-WD track over the Yeagarup Dunes.

INSPECTION: 13.5.91; 23.7.91; 12-13.3.92

YEAGARUP LAKE
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	
Baumea arthrophylla	r	r				
B.articulata	c		r	r		
B.juncea	r					
B.riparia	r	r				
B.vaginalis	r	r				
Juncus microcephalus*	r					
Leptocarpus scariosus	r	i				
Triglochin procera	r					
Astartea fascicularis		r	r			
Baumea acuta		r				
Cassytha glabella		r				
Lepyrodia muirii		r				
Schoenus sp. aff sublaxus		r				
Selaginella gracillima		r				
Xyris lacera		i				
Triglochin procera		r				
Acacia hastulata			r			
Agonis linearifolia			r	r		
A.parviceps			r		r	
Beaufortia soarsa			r			
Banksia littoralis			r			
Drosera platypoda			r			
Empodisma gracillima			r	r		
Gahnia decomposita			r			
Lepidosperma effusum			r			
Leucopogon australis			r			
L.hirsutus			r			
Callistachys lanceolatum			r	r		
Phebalium anceps			r			
Sphaerolobium sp.			r	r		
Sphenotoma gracile			r			
Sporodanthus rivularis			r			
Agonis juniperina				c		
Acacia divergens				r		
Lepidosperma tetraquetrum				r		
Allocasuarina fraseriana					r	
Agonis flexuosa					r	
Acacia myrtifolia					r	
Boronia crenulata					r	
Anigozanthos flavidus					r	
Anarthria prolifera					r	
Eucalyptus calophylla					r	
E.marginata					i	
Leucopogon capitellatus					r	
Macrozamia reidlei					r	
Chara sp.						r
Villarsia lasiosperma		r				
Baumea riparia			r			
Cosmelia rubra			r			
Hibbertia perfoliata			r			
Sphaerolobium sp.			r			
Schoenus rodwayanus			r			

Communities 1-Tall Sedges
2-Low Sedges
3-Beaufortia Heath
4-Cedar Dense Low Forest
5-Jarrah Low Woodland
6-Aquatics

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-30%

NAENUP SWAMP
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6
Haloragis brownii	r					
Baumea articulata		d	r	r		
B.juncea		r	i			
Centella asiatica		r				
Leptocarpus scariosus		r		r		
Triglochin procera		r				
Typha orientalis*		r				
Agonis juniperina			d	i	i	
Banksia littoralis				r	i	r
Eutaxia obovatus				r		r
Kunzea ericifolium				r		
Melaleuca preissiana				c		
Persoonia longifolia				r		
Pultenaea reticulata				r		
Agonis flexuosa					r	r
A.parviceps					r	
Acacia cyclops					r	
Astartea fascicularis					r	
Banksia seminuda					i	
Boronia crenulata					r	
Eucalyptus marginata					r	
Lepidosperma longitudinale					r	c
Thomasia purpurea					r	
Tremandra stelligera					r	
Acacia pulchella						r
Anigozanthos flavidus						i
Hibbertia cuneiformis						r
H.racemosa						r
Olearia axillaris						r
Olax phyllanthi						r
Sollya heterophylla						r
Triglochin procera	r					
Epilobium billardiera.		r				
Agonis juniperina			i			
Acacia myrtifolia					r	
Allocasuarina fraserana					r	
Eutaxia obovatus					r	
Leucopogon australis					r	
Loxocarya flexuosa					r	
Sollya heterophylla					r	
Trymalium spathulatum					r	

Community 1-Aquatics
2-Tall Sedges
3-Cedar Low Dense Forest
4-Paperbark Low Woodland
5-Banksia Low Woodland
6-Low Sedges

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

UNNAMED LAKE-YEAGARUP
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6
Potamogeton tricarinatus	r					
Utricularia australis	r					
Baumea articulata		c				
B.juncea		r				
B.preissii		r				
B.riparia		r				
B.vaginalis		r				
Juncus planifolius		r				
Triglochin procera	r	r				
Agonis juniperina			r	r		
Banksia littoralis			r			
Callistachys lanceolatum			i			
Lepidosperma effusum			i			
Phebalium anceps			i			
Hakea oleifolia			r	r		
Acacia myrtifolia				r		
Agonis flexuosa				r		r
Anarthria prolifera				r		
Anarthria scabra				r		r
Banksia attenuata				i		i
B.ilicifolia				r		i
Conostylis aculeata				r		
Hibbertia cuneiformis				r		
Lepidosperma effusum				r		
Leucopogon capitellatus				r		
Lobelia alata				r		
Xanthorrhoea preissii				r		r
Acacia littoralis					r	
A.cyclops					r	
Ammophila arenaria					r	
Dryandra sessilis					r	
Exocarpus odoratus					r	
Helichrysum cordatum					r	
Isolepis nodosus					r	
Pimelea clavata					r	
Olearia axillaris					r	
Olax phyllanthi					r	
Spyridium globulosum					r	
Acacia pulchella						r
Agonis parviceps						r
Allocasuarina fraseriana						r
Banksia grandis						r
Boronia crenulata						r
Bossiaea linophylla						r
Eucalyptus marginata						i
Eutaxia obovata						r
Leucopogon capitellatus						r
Macrozamia reidlei						r
Pultenaea reticulata						r
Pteridium esculentum						r
Tremandra stelligera						r
Baumea arthrophylla		r				
Haloragis brownii		r				
Chara sp.	r					

Community 1-Aquatics
2-TallSedges
3-Wet Heath
4-Banksia Low Woodland
5-Heath Coastal
6-Jarrah Low Woodland

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

9 LAKE YEAGARUP
10 NAENUP SWAMP
11 UNNAMED LAKE

Tall Sedges

Low Sedges

Beaufortia Heath

Cedar Dense Low Forest

Paperbark Low Woodland

Banksia Low Woodland

Heath Coastal

Jarrah Low Woodland over Heath

Karri Forest

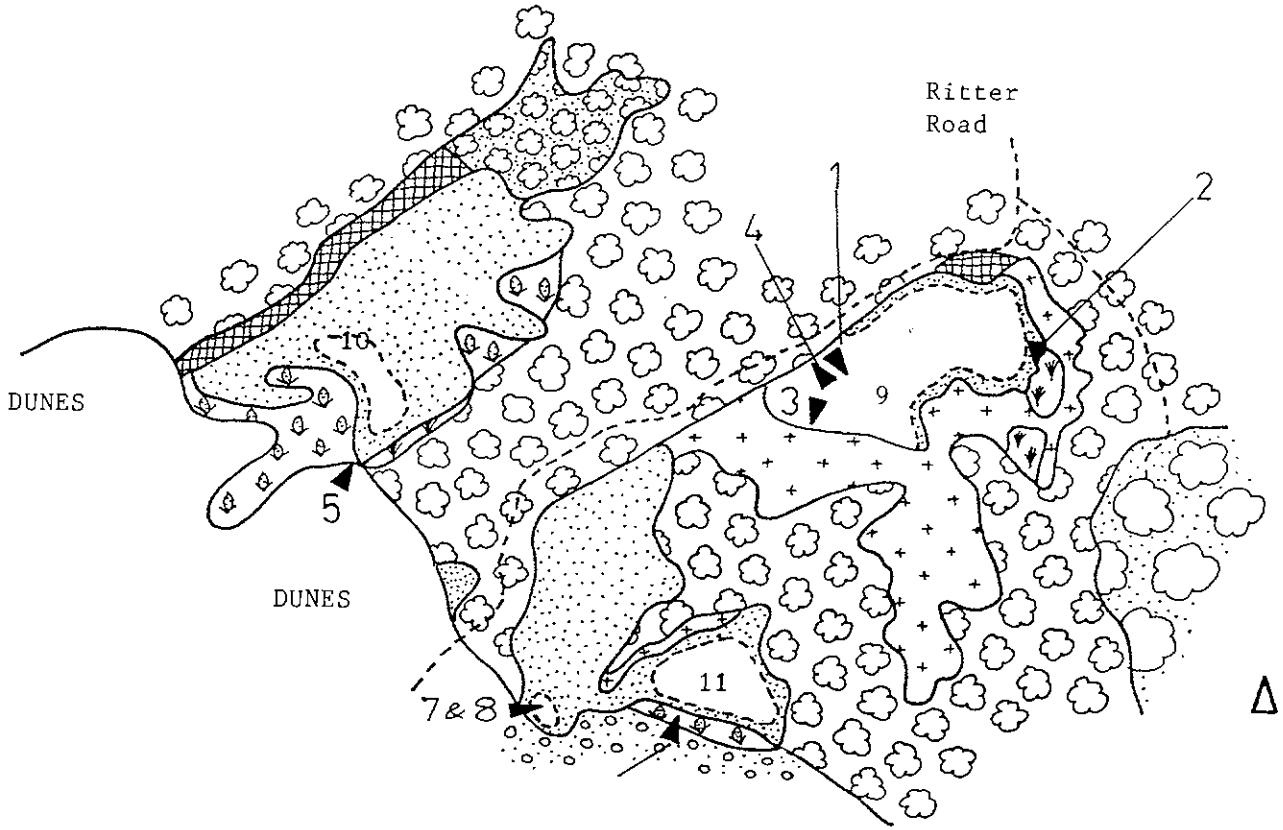


photo 1-Yeagarup Lake Viewed toward the north east.

photo 3-Beaufortia Heath at southern end of Yeagarup Lake.

photo 2-Broad expanse of Low Sedges,east side of Yeagarup Lake.

photo 4-Sporodanthus rivularis and Empodisma gracillima under Cedars;north western side of Yeagarup Lake.

photo 5. (Above) Panorama of Naenup Swamp

photo 6. (Below) Panorama of unnamed lake; Yeagarup.

photo 7. Utricularia australis and Potamogeton tricarinatus.

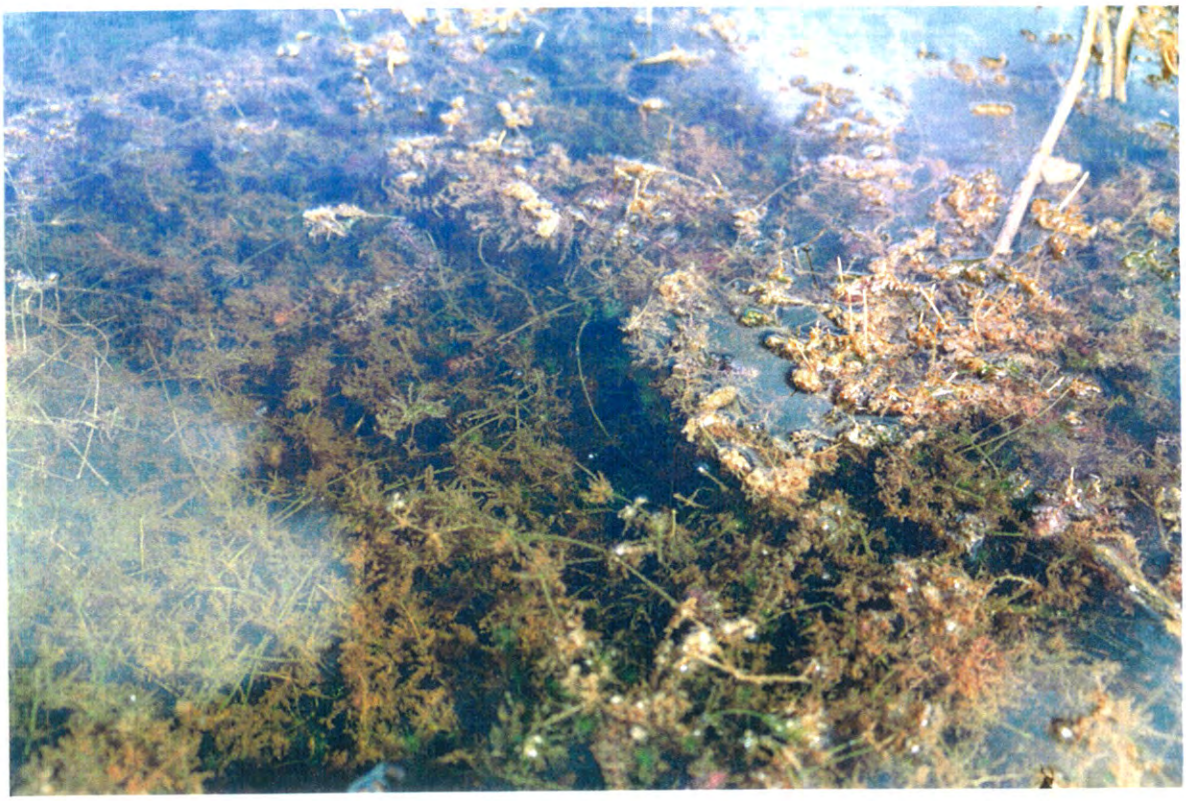


photo 8. Utricularia australis and Chara sp.

NO. 12 DOGGERUP LAKE

GENERAL DESCRIPTION

Doggerup Lake is nestled at the base of a high dune of silicious sand (stable) which has encroached on the broad flats of the Doggerup watershed. The dune supports a Peppermint woodland over Heath and the flats *Beaufortia* heath and *Agonis linearifolia* thicket. The narrow sedge fringe is comprised mainly of *Baumea* species and *Lepto-carpus*.

The lake bed is sandy (and in places quartz gritty) although some areas have accumulated organic sludge. This lake is quite difficult to access due to the rough track which is flooded in winter and does not appear to be heavily used for recreation. Discarded polystyrene floats indicate that some marroning is attempted. There was also some evidence of cutting Velvet Rush *(L.scariosius)* but was probably opportunistic. The condition of the lake and surrounds (apart from a large burnt area to the north) was quite natural.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-HEATH-THICKET IRREGULAR ELONGATE FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°43' Long: 116°04'

WATER:

Colour: pale brown

pH: 6.5, 5.2

Depth: 3.0m, 2.4m

Movement: several creeks flowing in; outflow possible to south, but not obvious

TSS: 99mg 1^{-1}

FAUNA: Musk duck

ACCESS: The rough sand track off Malimup Track in July was covered in many places by pools and running water. Frequent use could make it very boggy. Late summer access is good.

INSPECTION: 18.6.91; 25.3.92

DOGGERUP LAKE

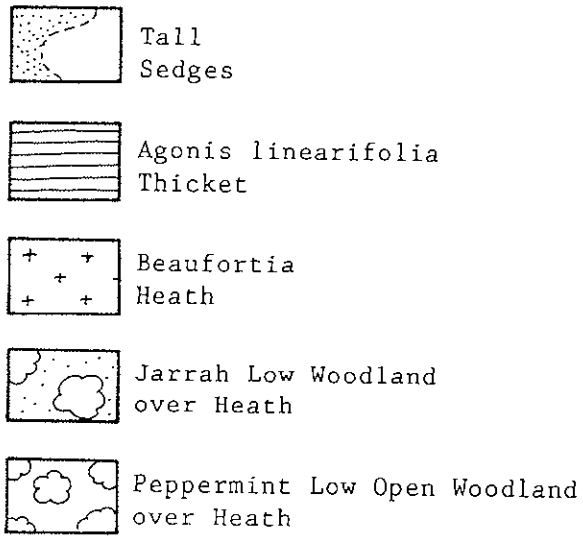
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Baumea juncea	r				
B.preissii	c	r			
B.riparia	r	r			
B.vaginalis	r				
Leptocarpus scariosus	i	r	r		
Triglochin procera	r				
Xyris lacera	r				
Acacia hastulata		r	r		
Agonis linearifolia		i			
Aotus gracillima		r			
Astartea fascicularis		r	r		
Boronia stricta		r	r		
Empodisma gracillimum		i			
Homalospermum firmum		i	c		
Sporodanthus rivularis		i			i
Stylidium scandens		r	r		
Acacia myrtifolia			i	i	r
Agonis parviceps			i	i	
Beaufortia sparsa			i		
Drosera spp.			r		
Evandra aristata			i	r	
Anarthria prolifera			r	r	
A.scabra			r	r	r
Gymnoschoenus anceps			r		
Persoonia teretifolia			r		
Sphenotoma gracile			r		
Xanthorrhoea preissii			r	r	
Eucalyptus marginata				i	
Kunzea ericifolium				r	
Adenanthos obovatus				r	
Agonis flexuosa					c
Boronia crenulata					r
Eucalyptus patens					r
E.diversicolor					r
Jacksonia horrida					r
Leucopogon interruptus					r
L.parviflorus					r
Loxocarya flexuosa					r
Macrozamia reidlei					r
Persoonia longifolia					r
Pteridium esculentum					r
Tremandra stelligera					r
Villarsia lasiosperma	r				
Callistachys lanceolata		r			
Phebalium anceps			r		
Schoenus cruentus			r		
Schoenus rodwayanus			r		

Community 1-Tall Sedges
2-Agonis linearifolia Thicket
3-Beaufortia Heath
4-Jarrah Low Woodland Over Heath
5-Peppermint Low Open Woodland over Heath

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

12 DOGGERUP LAKE



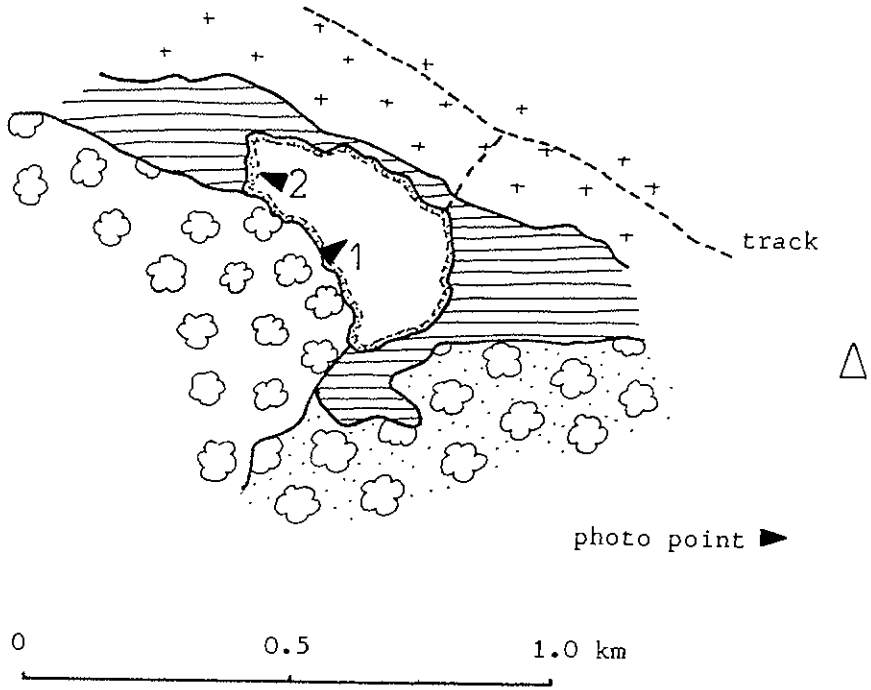


photo 1. Doggerup Lake viewed to the south east.

photo 2. Baumea preissii (broad stems) and B. riparia.

NO. 13 LAKE SAMUEL

GENERAL DESCRIPTION

Lake Samuel is formed as a widening of Doggerup Creek in a broad flat subject to inundation. The inflow is shrouded by dense Cedars *(Agonis juniperina)* and *Agonis linearifolia*, but forms an open waterway (up to 5m wide) about 100m upstream. The outflow is also navigable for a short distance. At the time of July inspection water was flooding from the lake into broad areas of low sedges to the south and east. Dense stands of *Baumea* species fringed the entire lake, the bed of which is mostly covered with an unknown depth of black organic sludge.

The Malimup Track passes close to the north and a rough track heads to the lake edge. One local sails his surfcat here (pers.comm.), and fishing for marron in the lake and Doggerup Creek also occurs. Similar to Lake Florence, the stands of Cedar and Karri (in the distance) make this lake quite beautiful.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-LOW FOREST-HEATH-WOODLAND IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°01' Long: 116°03'

WATER:

Colour: pale brown clear

pH: 4.3, 4.8

Depth: 1.3m, 0.7m (outflow creek deeper by 0.3m)

Movement: positive flow in and out via Doggerup Creek

TSS: 116mg 1^{-1}

FAUNA: None observed

ACCESS: Off Malimup Track from Windy Harbour Road. This track has been upgraded to all-weather 4-WD.

INSPECTION: 19.6.91; , 25.3.92

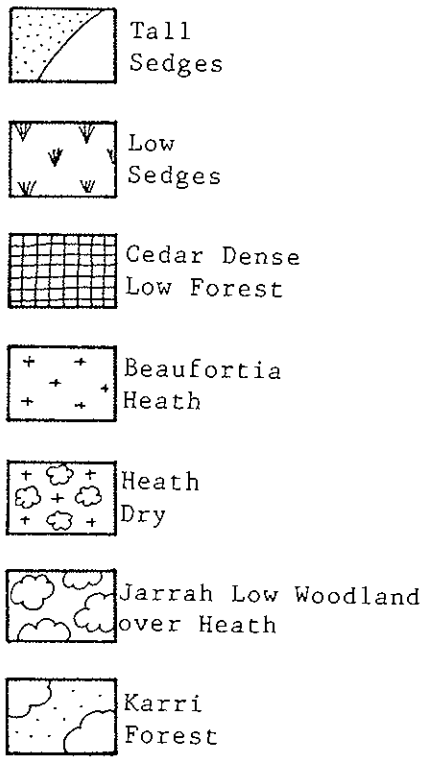
LAKE SAMUEL-VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Baumea juncea	r	r			
B. preissii	c				
B. vaginalis	r		r		
B. riparia	c				
Triglochin procera	r				
Leptocarpus scariosus	r	c	i		
L. tenax		r			
Astartea fascicularis		r	r	i	
Restio applanatus		i			
Schoenus cruentus		r		r	
S. sp.		i		r	
Xyris lacera		r			
Villarsia lasiosperma		r			
Agonis juniperina			c	r	
A. linearifolia			r	r	
Psuedoloxocarya grossa			i		
Beaufortia sparsa		r		i	r
Boronia stricta				r	
Homalospermum firmum				r	
Sphenotoma gracile				r	
S. squarrosa				r	
Stylidium scandens				r	
Agonis floribunda				r	
Cassytha glabella	r			r	
Schoenus rodwayanus		r		r	
Agonis parviceps					i
Acacia pulchella					r
Anarthria prolifera					r
A. scabra					r
Evandra aristata					r
Kunzea ericifolia					r
Pultenaea reticulata					r
Hypocalymma strictum					r
Hypolaena exsulca					r
Xanthorrhoea preissii					r
Persoonia longifolia					r
Jacksonia horrida					r
Macrozamia reidlei					r
Adenanthos obovatus					r
Dasypogon bromellifolius					r

Community 1-Tall Sedges
2-Low Sedges
3-Beaufortia Heath
4-Heath Dry
5-Jarrah Low Woodland-not sampled
6-Karri Forest-not sampled

Estimated Cover (after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

13 LAKE SAMUEL



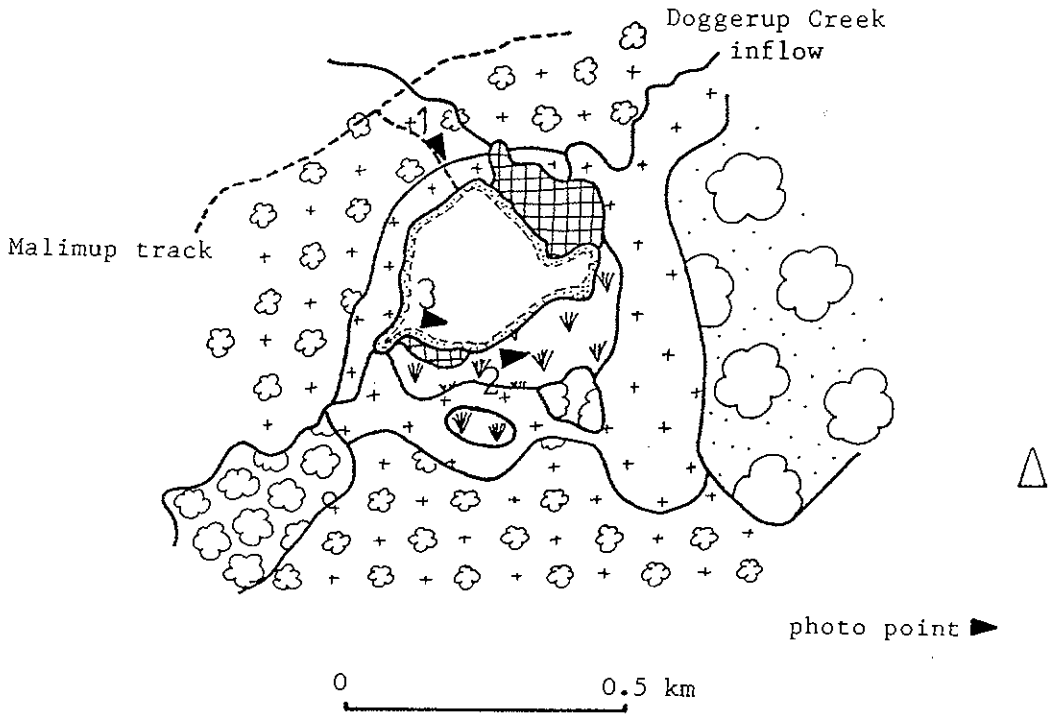


photo 1-Lake Samuel viewed from north over Agonis parviceps
Dry Heath toward Jarrah Woodland in distance.
Cedars mark inflow of Doggerup Creek.

photo 2-Broad expanse of Low Sedges;south and east
of Lake Samuel.

photo 3-Baumea preissii in fringing Tall Sedges;
Karri Forest background.

NO. 14 LAKE FLORENCE

GENERAL DESCRIPTION

Lake Florence is a shallow blackwater (acidic) lake with a sandy bottom surrounded by a sedge fringe of *Leptocarpus* on eroding peat beds. *B.vaginalis* clumps in the sedge fringe grew from the sandy bed, not the eroding peat. The surrounding topography is flat, although the map (CALM 1:50,000) shows this lake on the boundary between the Gardner River and Doggerup Creek watersheds. There was a surprisingly small variation in water depth over the period of survey. Although close to Windy Harbour Road and flanked by a rough track/firebreak, it is not frequently visited. A CALM barrier on the track and winter inundation make it appear inaccessible. Some marroning activity does occur as marked by discarded newspaper (dated 26.1.91), beer cans and bottles, and polystyrene marron net floats. Much older bottles and rusted cans on a track to the north-eastern shore indicate visits over a long period of time, but possibly only by a small group of local people. The Cedar *(Agonis juniperina)* stands and Karri *(Eucalyptus diversicolor)* forest (in the distance) make this lake quite picturesque.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-LOW FOREST-HEATH ROUND FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°44' Long: 116°06'

WATER:

Colour: dark brown

pH: 4.5, 4.0

Depth 0.9m, 0.7m (25mm peat deposit)

Movement: none observed; although the track crossed a shallow drainage line heading south-east away from the lake

TSS: 143mg l^{-1}

FAUNA: Tortise carapace, pigmy perch

ACCESS: Barrier-guarded track running east from Windy Harbour Road to the south side of the lake. Track is firm peaty sand; some sections are more deeply inundated and peaty and have the potential to become very boggy.

INSPECTION: 19.6.91; 25.3.92

LAKE FLORENCE
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Baumea vaginalis	i				
Cassytha racemosa	r		r		
Leptocarpus coangustatus	c	r			
L.scariosus	c	r			
Schoenus cruentus	r				
S.sp.CJR634	r	r			
Triglochin procera	r				
Villarsia lasiosperma	r				
Xyris lacera	r	r			
Agonis juniperina		c			
A.floribunda		r			
Ampera volubilis		r			
Homalospermum firmum		r		i	
Acacia myrtifolia			i		
A.hastulata			r		
Actinotus laxus			r		
Adenanthos obovatus			r	r	
Agonis parviceps			i	i	
Aotus aff.genistoides			r		
A.gracillima			r		
Beaufortia sparsa			i	i	
Banksia quercifolia			r		
Boronia stricta			r		
Eucalyptus megacarpa			r		
Gymnoschoenus anceps			r		
Kunzea ericifolium			r	r	
Sphenotoma gracile			r		
Anarthria prolifera				r	
A.scabra				r	
Evandra aristata				i	
Kunzea recurva				r	
Boronia stricta			r		
Hypocalymma stricta			r		
Cosmelia rubra			r		
Pultenaea reticulata			r		
Persoonia teretifolia			r		
Restio applanatus			r		
Jacksonia horrida			r		
Melaleuca thymoides			r		

Community 1-Tall Sedges
2-Cedar Dense Low Forest
3-Beaufortia Heath
4-Heath Dry
5-Karri Forest-not sampled

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-10-30%

14 LAKE FLORENCE

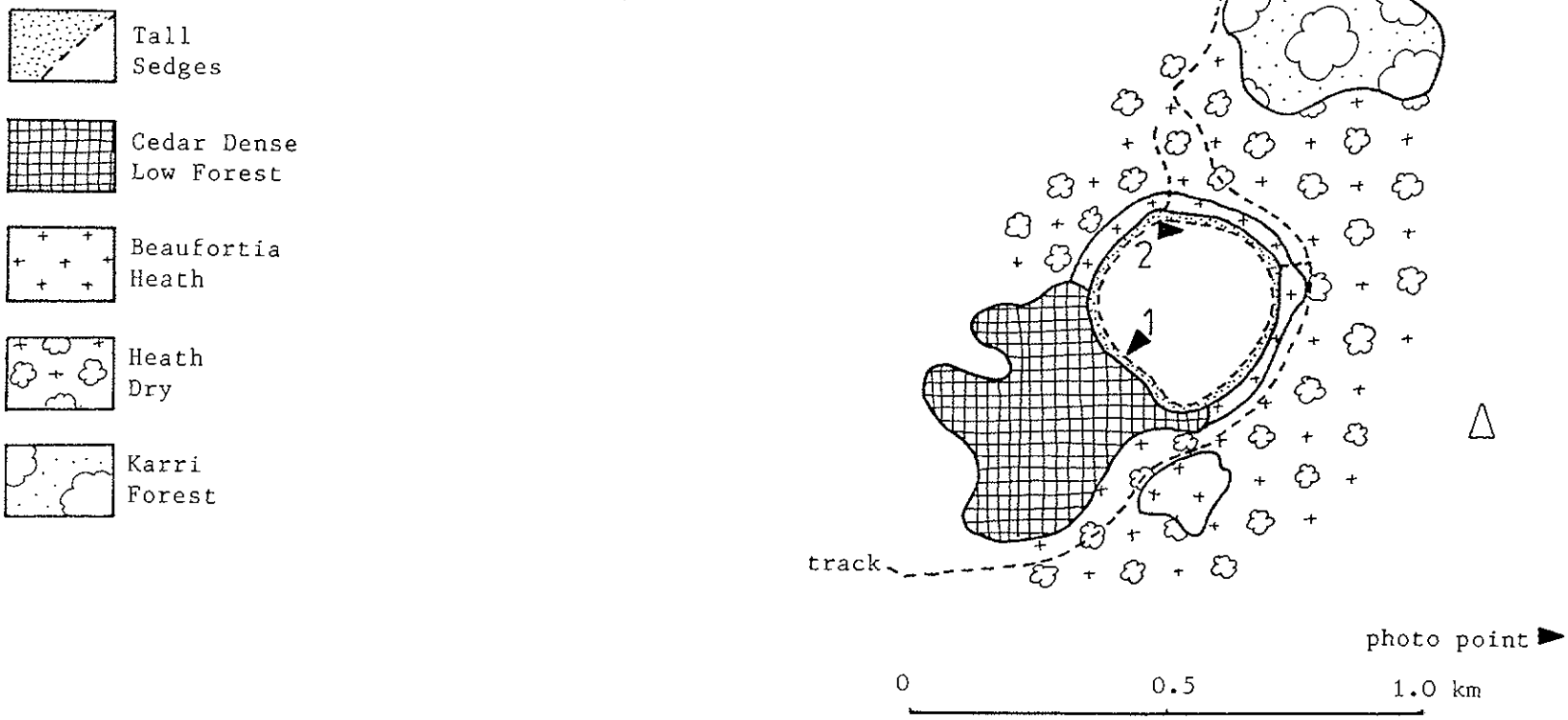


photo 1-Leptocarpus clumps on eroding peat in dark tannin stained acidic waters.

photo 2-Lake Florence viewed from the northern end looking east.

NO. 15 GARDNER RIVER LAKES

GENERAL DESCRIPTION

This lake, or series of lagoons, are formed where silicious coastal dunes meet the flats (subject to inundation) of the hinterland and are flanked by a pocket of exposed granite and Karri forest. A positive flow (obvious in the more narrow channels) towards the east, indicate that these lakes flow on into the Gardner River. In late summer when the surrounding watershed of the Gardner River dries out, lake flow diminishes significantly.

The contrast of dry heath (dominated by *Banksia ilicifolia*) south and Marri-Karri forest to the west and north, combined with adjacent exposed granite outcrops make this place interesting and picturesque.

Although the nearby mouth of the Gardner River is used for recreation (several permanent huts have been established), the area is probably only used by locals (from Northcliffe or Pemberton) and visits to these lakes are infrequent. A rough track does provide access from Tragedy Track, and some rubbish and campfire ashes remain.

Few people navigate the narrow waterway, as indicated by a colony of about 10 black cormorants nesting (with eggs) in an overhanging Paperbark. The bottom was mostly sandy, or rocky.

Baumea vaginalis was the most common fringing sedge, except in the eastern lagoon, where *B.articulata* formed more

extensive colonies. Thickets of Cedar *(A.juniperina)* with occasional Paperbark *(M.raphiophylla)* were almost ubiquitous behind the fringing reeds.

SEMENIUK CLASSIFICATION

MESOSCALE ZONIFORM SEDGELAND-LOW HEATH-LOW FOREST-TALL FOREST ELONGATE IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°50' Long: 116°06'

WATER:

Colour: pale brown, clear

pH: 5.6, 5.7

Depth: 2.3m, 1.7m

Movement: positive west to east

TSS: 182mg l^{-1}

Algae: none discernible

FAUNA: Nesting black cormorants, tortise carapace, mussels

ACCESS: Tragedy Track from the Windy Harbour Road provides dry summertime only 4-WD access. A narrow track running through the consoidated dunes, parrallel to and approximately 200m from the coast, emanating from the Windy Harbour rubbish tip, provides year-round dry 4-WD access to the mouth of the Gardner River. The dry eastern end of Tragedy Track can then be used to travel north-west to the lakes. A rough track runs off Tragedy Track to the eastern end of the western lagoon.

INSPECTION: 1.7.91; 25.3.92

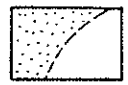
GARDNER RIVER LAKES
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7
Baumea articulata	i		r	r			
B.vaginalis	c	i	i	r			
B.juncea	r			r			
Leptocarpus coangustatus	r	r	r	r			
L.scariosus	r	r	r	r			
Villarsia albiflora	r	r					
Astartea fascicularis		r		i			
Agonis juniperina		c					
A.linearifolia		r		i			
Melaleuca polygaloides		r					
M.raphiophylla		r					
Agonis floribunda			c	r			
Acacia hastulata				r			
Cyathochaeta clandestina				r			r
Beaufortia sparsa				r			
Drosera pulchella				r			
Gonocarpus benthamii				r			
Lepidosperma longitudinale				r			
Loxocarya sp.				r			
Phebalium anceps				r			
Schoenus cruentus				r			
Evandra aristata				r			
Boronia crenulata				r			
Calothamnus lateralis				r			
Gymnoschoenus anceps				r			
Hakea varia				r			
Astartea sp.				r			
Melaleuca basicephala				r			
Macrozamia reidlei				r			
Pultenaea reticulata				r	r		
Xanthorrhoea preissii				r	r		r
Agonis parviceps					i		
A.flexuosa					i		i
Banksia ilicifolia					c		
Anarthria prolifera					r		
Jacksonia horrida					r		
Pteridium esculentum					r		
Melaleuca thymoides					r		
Eucalyptus calophylla						r	i
E.diversicolor							c
E.cornuta							r
Acacia browniana							r
A.myrtifolia							r
A.extensa							r
Chorilaena quercifolia							r
Eutaxia obovatus							r
Dodonaea ceratocarpa							r
Leucopogon capitellatus							r
Lhotskya ericoides							r
Tremandra stelligera							r
Triglochin procera	r						

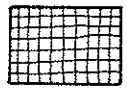
Community 1-Tall Sedges
2-Cedar.Dense Low Forest
3-Agonis floribunda Heath overSedges
4-Beaufortia Heath
5-Heath Dry
6-Marri Low Woodland
7-Karri Forest

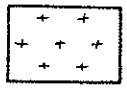
Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

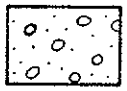
15 GARDNER RIVER LAKES


Tall
Sedges


Agonis floribunda Heath
over Tall Sedges


Cedar Dense
Low Forest


Beaufortia
Heath


Heath
Dry


Marri Low
Woodland


Karri
Forest

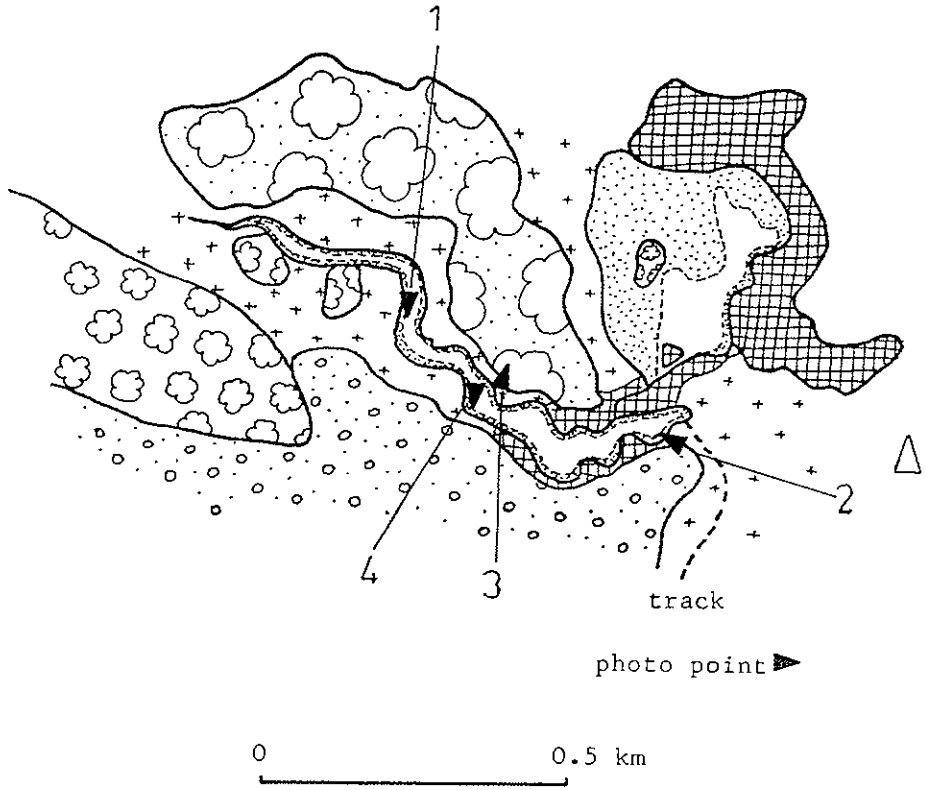


photo 1-Cormorant nests.

photo 2-View toward west from access track.

photo 3-Granite outcrop between Karri Forest and lake.

photo 4-View toward the south over fringing Tall Sedges to Dry Heath.

NO. 16 LAKE MARINGUP

GENERAL DESCRIPTION

Lake Maringup is one of the most strikingly beautiful wetlands on the south coast, with a backdrop of majestic Karri *(E. diversicolor)* forest and tall even stands of Cedars *(Agonis juniperina)*. It is surrounded by pristine catchment except for Location 5606 to the south, which has been modified by grazing and fire. Exposed rocks (granite) are evident in parts of the lake bottom, and some parts are characterized by sandy shores and sand bottoms. Much of the lake bed, particularly the shallower bays extending off the main body of water, are covered to an unknown depth with organic sediments. A canoe paddle plunged into the sludge could be pushed down easily three-quarters of its length (2m). During late summer as water levels drop, some of these areas are exposed as flats (Neil Gibson, pers.comm.). These flats are fringed with dense *B.articulata* growing considerable distances from the shores out into the sludge. Much of the bottom, particularly over the organic sludge, was covered with simple algae, which appeared greenish brown and gave the appearance that the bottom was solid. Dr Jacob John (Environmental Biologist, Curtin University) examined the sludge and determined that it was composed mostly of blue-green algae with high numbers of individuals and species of desmids and diatoms. The high numbers and species diversity indicate a pollution-free environment.

Massive tree stumps, some rising from 3m deep, reach the surface in the eastern half of the lake. Their size indicates they could be Karri *(E. diversicolor)* and may be as old as the lake itself. Lake Maringup probably began to form 4-5,000 years ago when sand drifts blocked streams draining towards Gardner Beach.

The surrounding topography is largely undulating silicious grey sands. Although accessible from Moore's Track and a summertime track from the north, the lake does not appear to be heavily used for recreation. Discarded rubbish was minimal, although some chopped firewood indicates that some occasional camping takes place.

SEMENIUK CLASSIFICATION

MACROSCALE ZONIFORM SEDGELAND-LOW FOREST-TALL FOREST IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°50' Long: 116°11.6'

WATER:

Colour: clear

pH: 7.1, 8.2

Depth: 4.5m (visibility to +3m), 3.9m

Movement: none discernible

TSS: 220mg l^{-1}

FAUNA: Swans, musk ducks, little grebe

ACCESS: Moore's Track from Chesapeake Road is an all-weather two-wheel drive to hut on Location 5240; then a

sandy 4-WD track (all weather) to the north-west; this track although negotiable, is closed to normal traffic.

INSPECTION: 30.6.91; 24.3.92

LAKE MARINGUP

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Chara sp.	r				
Myriophyllum salsugineum	r				
Najas marina	r				
Potamogeton drummondii	r				
Baumea arthrophylla		r			
B.articulata		c			
B.juncea		r	r		
B.preissii		r			
B.vaginalis		i	i		
B.sp.CJR 650		r			
Leptocarpus coangustatus		r			
Lepidosperma effusum		r			
Triglochin procera		r			
Typha orientalis*		r			
Agonis juniperina			c		
Ampera volubilis			r		
Bossiaea rufa			r		
Melaleuca raphiophylla			r		
Phebalium anceps			r		
Banksia littoralis			r		
Callistachys lanceolatum			r		
Agonis flexuosa				c	r
Anigozanthos flavidus				r	r
Bossiaea linophylla				r	
Eucalyptus cornuta				i	r
Hakea oleifolia				r	
Helichrysum cordatum				r	
Jacksonia horrida				r	
Leucopogon capitellatus				r	
Loxocarya flexuosa				r	
Macrozamia reidlei				r	
Olearia axillaris				r	
Rhagodia baccata				r	
Eucalyptus diversicolor					c
Hardenbergia comptoniana					r
Hibbertia cuneiformis					r
Pimelea clavata					r
Pteridium esculentum					r
Opercularia hispidula					r
Trymalium floribundum					r
Haloragis brownii	r				
Carex appressa		r			
Banksia seminuda			r		
Juncus planifolius			r		

Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Peppermint Low Woodland over Heath
5-Karri Forest

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

16 LAKE MARINGUP

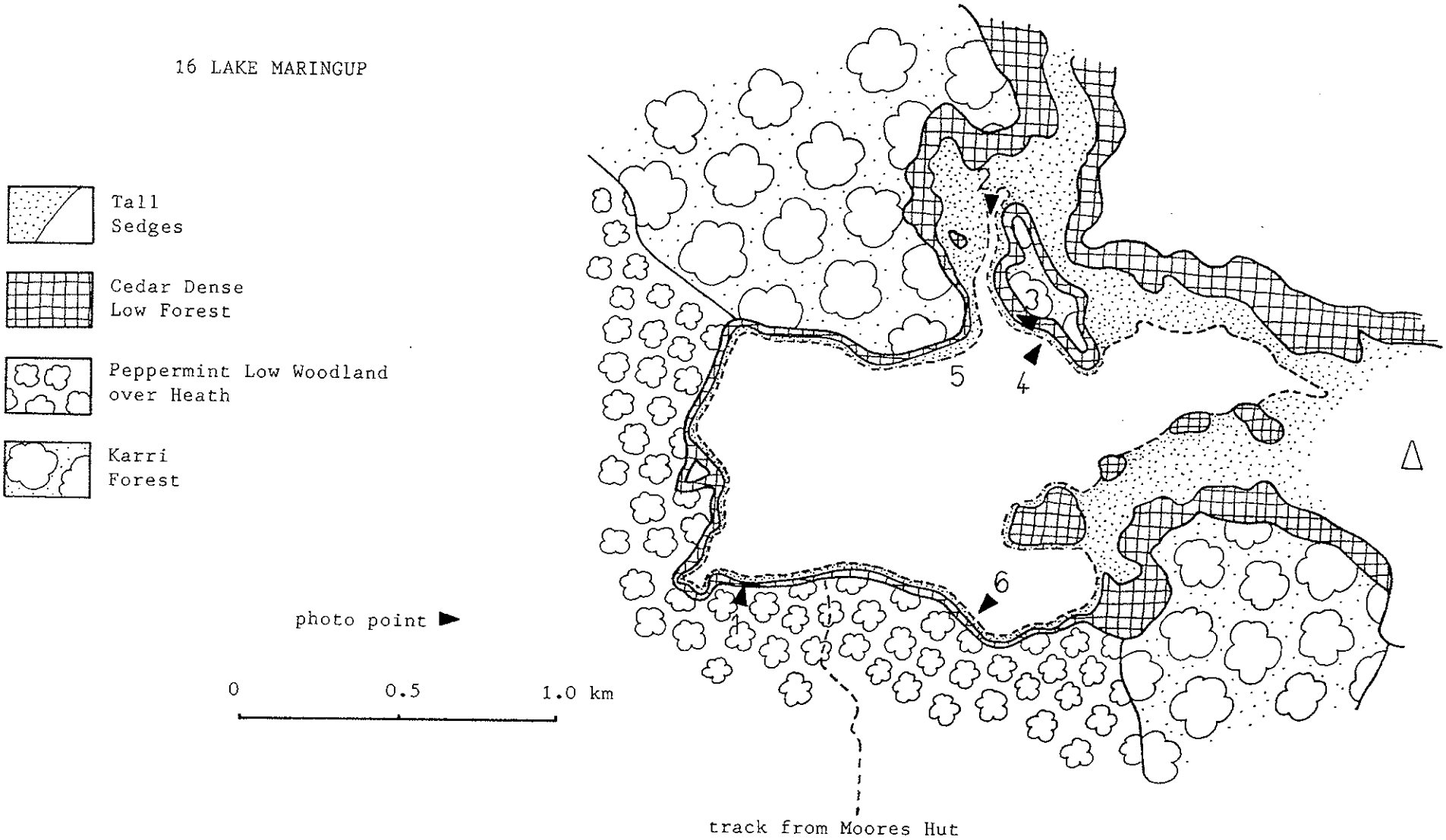


photo 1-View toward north shore showing tallKarri Forest behind Cedar stands.

photo 2-View toward the south;shallow water over organic sludge,fringed by Tall Sedges with Cedars behind.

photo 3. Cedars over Baumea vaginalis.

photo 4. Karri forest above Cedar dense low forest (including Banksia littoralis) behind fringing Baumea arthrophylla.

photo 5. Baumea arthrophylla growing from the organic sludge of blue-green algae.

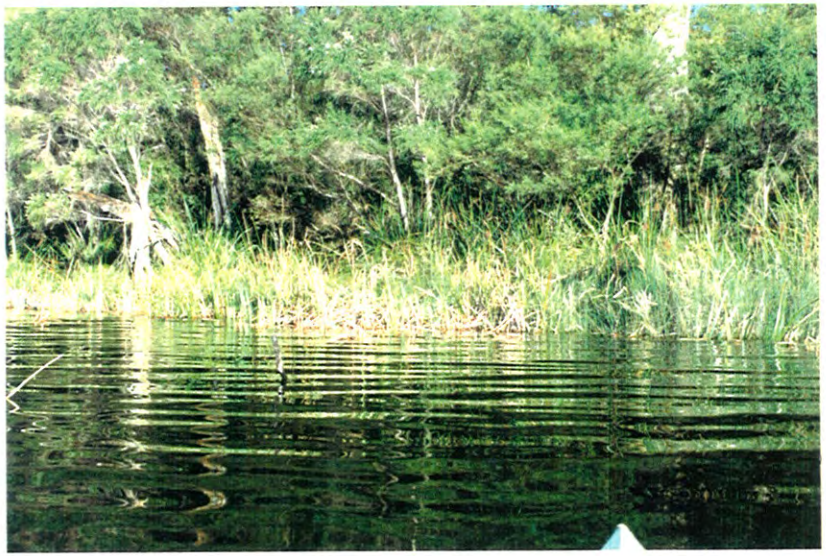


photo 6. Typha orientalis.

NO. 17 BROKE INLET LAKE

GENERAL DESCRIPTION

This lake is one of a series visible from the Woolbale Hills and is located about 500m inland from the eastern end of Broke Inlet. Access was particularly difficult at the time of August inspection as Inlet and Woolbale Roads were subjected to severe inundation and/or overgrown with vegetation. Access was eventually gained by canoe from Camfield. Summer access was gained via Inlet Road.

The lake was partially surrounded by tall Cedars and an unusually tall and dense stand of *Banksia quercifolia* beyond which was a broad expanse of wet heath punctuated by the occasional Paperbark *(M.pressiana)* or *B.littoralis*.

Due to the dense surrounding vegetation a canoe was not carried to the lake and no accurate depth measurement was recorded in August. It was 750mm deep at the edge of the fringing rushes and dropped off slightly towards the middle, from the rushes. In March it was practical to wade to the middle. The bed was sandy with a thin deposit of peat.

This lake would be rarely (if ever) visited. The local Ranger (from Crystal Springs) has visited another smaller lake to the north-east (1.1km) to check for the presence of marron (he found none). The presence of scutes (carapace scales) indicated that this lake is probably the dry season refuge of the oblong tortise *(Chelodina oblonga)*.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-DENSE LOW FOREST-HEATH ROUND FRESH LAKE

RESERVE: Inlet Forest Block/D'Entrecasteaux National Park

LOCATION: Lat: 34°57' Long: 116°32'

WATER:

Colour: clear brown (but murky when very shallow in autumn due to save action on peat deposits)

pH: 4.5

Depth: 900mm (winter estimate), 150mm (actual autumn level)

Movement: none discerned

TSS: 143mg l^{-1}

FAUNA: Tortise scutes, pygmy perch

ACCESS: Inlet road, summertime only; winter access off Broke Inlet.

INSPECTION: 16.8.91; 24.3.92

BROKE INLET LAKE

VEGETATION COMMUNITIES

SPECIES	1	2	3	4
Baumea vaginalis	d	r		
Cassytha glabella	r			r
Leptocarpus scariosus	c	r		r
Agonis juniperina		d	r	r
Baumea riparia		r		
Sphenotoma squarrosa		r		
Agonis parviceps			i	r
Allocasuarina fraseriana			r	
Banksia quercifolia			d	
Melaleuca preissiana			r	r
Pultenaea reticulata			r	
Kunzea recurva			r	
Acacia myrtifolia				r
Astartea sp.				r
Beaufortia sparsa				i
Banksia littoralis				r
Calothamnus lateralis				r
Evandra aristata				r
Hakea varia				r
Homalospermum firmum				r
Melaleuca basicephala				r
Baumea arthrophylla	r			
Leptocarpus coangustatus	r			
Villarsia lasiosperma	r			
Xyris lacera	r			
Agonis floribunda				r
Aotus villosa				r
Xyris laxiflora				r
Schoenus sp.				r
Cosmelia rubra				r
Gymnoschoenus anceps				r

Community 1-Tall Sedges
2-Cedar Dense Low Forest
3-Banksia Low Woodland
4-Beaufortia Heath

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

17 BROKE INLET LAKE

photo 1. Panorama of Broke Inlet Lake from south west.

NO. 18 CRYSTAL LAKE

GENERAL DESCRIPTION

Crystal Lake is a beautiful small pristine perched lake situated high in the Nuyts Wilderness, and is one of the most inaccessible covered in this project. There is no obvious track to the lake but it is reached by crossing Peppermint-Jacksonia heath from the walk track (across the Deep River from Shedley Drive). The route from the walk track passes a spectacular gorge at the head of Crystal Brook which supports Karris in excess of 20m, the crowns of which just rise above the Peppermints of the surrounding heath. The lake is surrounded by vegetated silicious sand ridges and stream-fed from the south-east; numerous outcrops of granite occur in the vicinity (including Mount Hopkins), and it is probable that the lake is perched on granite. Human visits are infrequent and restricted to enthusiastic bush walkers only.

SEMENIUK CLASSIFICATION

MICROSCALE PERIFORM SEDGELAND-HEATH-LOW FOREST OVOID FRESH LAKE

RESERVE: Nuyts Wilderness, Walpole-Nornalup National Park

LOCATION: Lat: 35°02' Long: 116°39'

WATER:

Colour: clear brown

pH: 5.02

Depth: unrecorded

Movement: stream fed from south-east, no outflow discerned

TSS: 171mg l^{-1}

FAUNA: None recorded

ACCESS: From Nuyts Wilderness Walk Track.

INSPECTION: 24.7.91

CRYSTAL LAKE

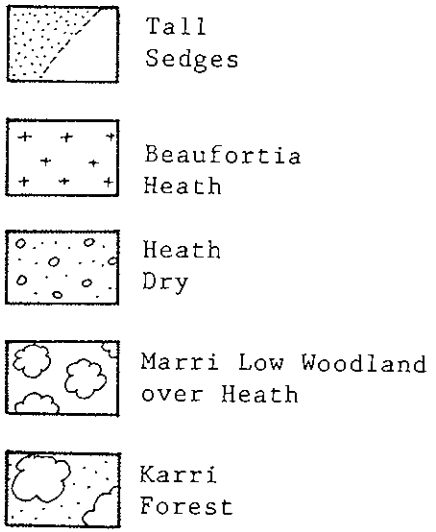
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
B					
Baumea arthrophylla	r				
B.juncea	r				
B.riparia	r				
B.vaginalis	r				
Leptocarpus scariosus	d				
Lepidosperma effusum	r				
Agonis parviceps				r	
Adenanthos obovatus		i	i	r	
Astartea fascicularis		r			
Boronia graciliceps		i			
B.stricta		r		r	
Banksia seminuda		r			
Callistachys lanceolatum		r			
Dampiera hederacea		r			
Empodisma gracillima		r		r	
Evandra aristata		r			
Gymnoschoenus anceps		r			
Agonis flexuosa			i		
Anarthria scabra			r		
Astroloma sp.			r		
Bossiaea linophylla			r		
Dryandra sesslis			r		
Leucopogon parviflorus			r		
Jacksonia horrida			r		
Monotoca tamariscina			r		
Pultenaea reticulata			r	r	
Xanthorrhoea preissii			r		
Acacia divergens			r	r	
A.pentadenia				r	
Chorilaena quercifolia				r	
Eucalyptus calophylla				r	
Lasiopetalum sp.				c	
Persoonia elliptica				r	
Pteridium esculentum				r	
Eucalyptus diversicolor				r	
					c

Community 1-Tall Sedges
2-Beaufortia Heath
3-Heath Dry
4-Marri Low Woodland over Heath
5-Karri Forest-not surveyed

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

18 CRYSTAL LAKE



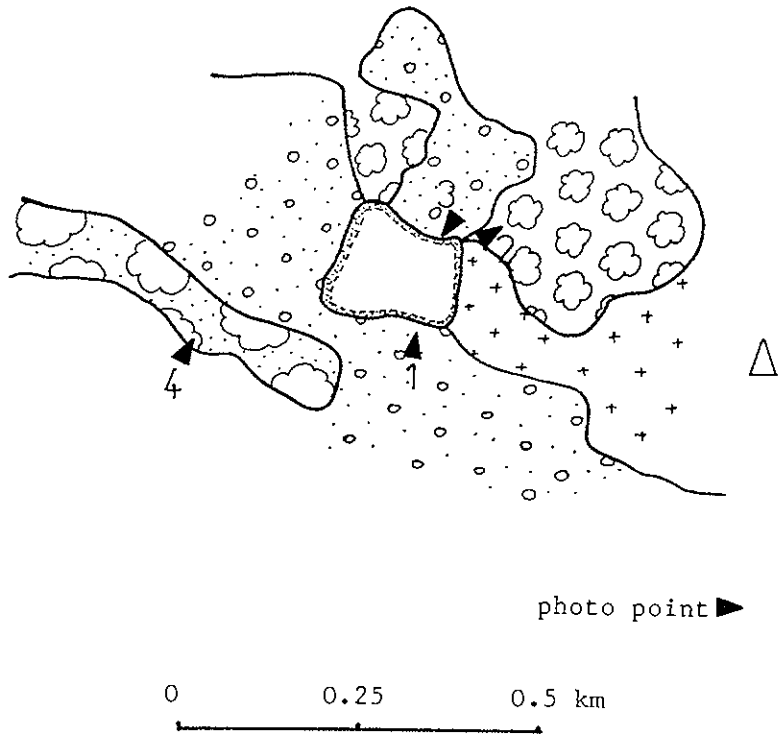


photo 1-Eastern end of Crystal Lake.

photo 3-Veiw toward south western corner of Crystal Lake.

photo 2-Marri Low Woodland over Heath.

photo 4-Karri Forest in Crystal Brook valley.

photo 1-Eastern end of Crystal Lake.

photo 3-Veiw toward south western corner of Crystal Lake.

photo 2-Marri Low Woodland over Heath.

photo 4-Karri Forest in Crystal Brook valley.

NO. 19 OWINGUP SWAMP

GENERAL DESCRIPTION

Owingup Swamp is a large body of open water fed by the Kent River. In winter the lake floods over its low banks to the south-west into a broad Cedar forest *(Agonis juniperinis)* from which the Kent River apparently rises again and flows out to the Irwin Inlet. Apart from the extensive Cedar stands, the most significant vegetation associations are the broad expanses of *Baumea articulata* which in parts (especially the north-eastern corner) are impenetrable. A small population of *Typha* was established at the southern end.

The water appeared relatively dirty, which is probably due to the lower Kent catchment being cleared. Several uprooted aquatic plants were collected in the lake but may have originated upstream in the river. The lake bottom was sandy, as was the wooded rise to the north-east.

Although Owingup Swamp is largely surrounded by cleared and occupied farmland, it is accessible by only one small track and does not appear to be frequently used for recreational purposes.

Survey in April revealed a much different lake from that visited in July. It was now possible, due to a drop in water level of 1.3m to drive out via access track onto the broad sandy dry lake bed or shores. Granite outcrops now quite obvious in the centre of the water body and at the

southern end were previously undetected. The shallow water allowed survey for aquatic plants to be more effective with species of Potamogeton *(P. drummondii)* and *Chara sp.* being found. The exposed sandy bed supported a seasonal association of annuals (both introduced and native) comprised of *Chenopodium macrospermum*, *Atriplex prostratum*, *A. hortens*, *Cotula coronopifolia*, *Polygonum prostratum*, *Myriophyllum tillaeoides*, *Centipedia cunninghamii* and *Alternanthera nodiflora*. A bed of small (10-20mm diameter) algae biscuits (related in formation to stromatalites) were discovered on the north east shore. These formations are uncommon (Linda Moore, Water Authority Scientist, pers. comm.).

SEMENIUK CLASSIFICATION

MACROSCALE ZONIFORM SEDGELAND-LOW FOREST-WOODLAND IRREGULAR FRESH LAKE

RESERVE: Quarram Nature Reserve

LOCATION: Lat: 35°00' Long: 117°04'

WATER:

Colour: dirty pale brown

pH: 6.12, 7.5

Depth: 2.1m, 0.7m

Movement: Kent River flows in; outflow into Cedar thicket

TSS: $165mgl^{-1}$

FAUNA: Swans, musk ducks, little grebe, black ducks

ACCESS: Narrow 4-WD track from Boat Harbour Road opposite Location 2433.

INSPECTION: 25.7.91; 6.4.92

OWINGUP SWAMP

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7
Callitriche stagnalis	r						
Gratiola peruviana*	r						
Haloragis brownii	r						
Lemna disperma	r						
Potamogeton ochreatus	r						
Baumea arthrophylla		r					
B.articulata		d					
B.juncea		r					
B.vaginalis		r	r				
Juncus pallidus		r					
Leptocarpus scariosus		r		r			
Triglochin procera		r					
Typha orientalis		r					
Agonis juniperina			d	i		r	
Villarsia			r				
Astartea fascicularis				r		r	
Agonis linearifolia				r			
Acacia hastulata				r			
Adenanthos obovatus				r			
Banksia littoralis				r			
Beaufortia sparsa				r			
Boronia denticulata				r			
Chaetanthus leptocarpoides				r			
Callistachys lanceolatum				r	c	r	
Kunzea recurva				r			r
Hakea varia				r			
Melaleuca leptoclada				r			
Bossiaea rufa						r	
Gahnia trifida						r	
Lepidosperma effusum						r	
Melaleuca preissiana						i	
M.raphiophylla						c	
Acacia pulchella							r
Allocasuarina fraseriana							r
Agonis parviceps							r
Eucalyptus calophylla							i
E.marginata							i
Leucopogon capitellatus							r
Macrozamia reidlei							r
Pultenaea reticulata							r
Pteridium esculentum							r
Xanthorrhoea preissii							r

Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Beaufortia Heath
5-Callistachys Thicket-not surveyed
6-Paperbark Low Woodland
7-Jarrah-Marri Low Woodland over Heath

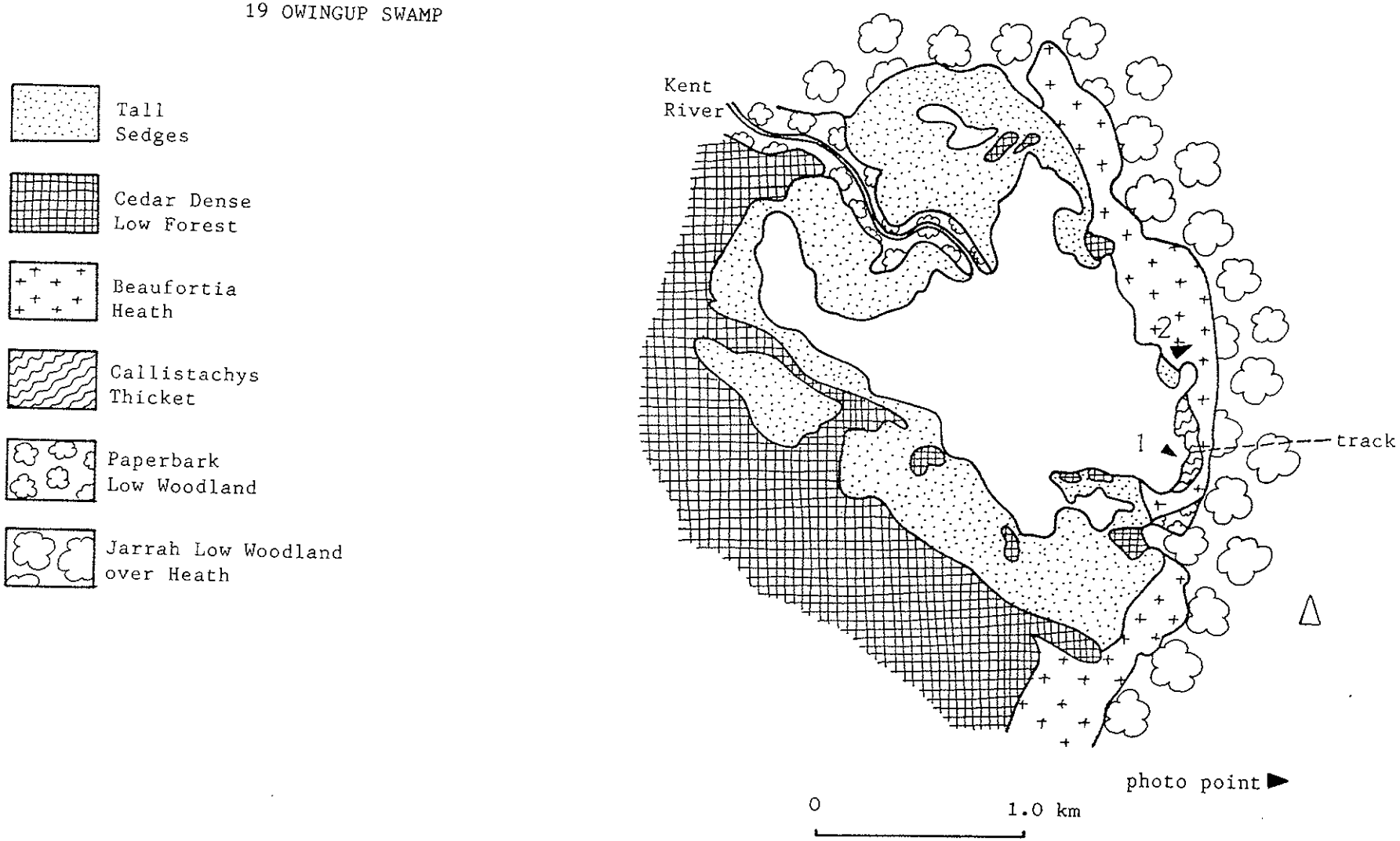
Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-30%

OWINGUP SWAMP - VEGETATION COMMUNITIES cont.

	1	2	3	4	5	6	7	8
Chara sp.	r							
Potamogeton drummondii	r							
Phebalium anceps			r					
Leptocarpus coangustatus			r					
Melaleuca raphiophylla		r						
Bossiaea rufa			r	r				
Pericalymma ellipticum				r				
Melaleuca polygaloides			r					
Lepidosperma effusum			r					
Baumea riparia		r						
Agonis floribunda				r				
Villarsia lasiosperma				r				
Atriplex hortens*								r
A. prostratum								r
Chenopodium macrospermum*								r
Cotula coronopifolia								r
Alternanthera nodiflora								r
Polygonum salicifolium								r
Centipeda cunninghamii								r
Myriophyllum tillaeoides								r
Aster subulatus*								r

Community 8 - Dry Lake Bed.

19 OWINGUP SWAMP



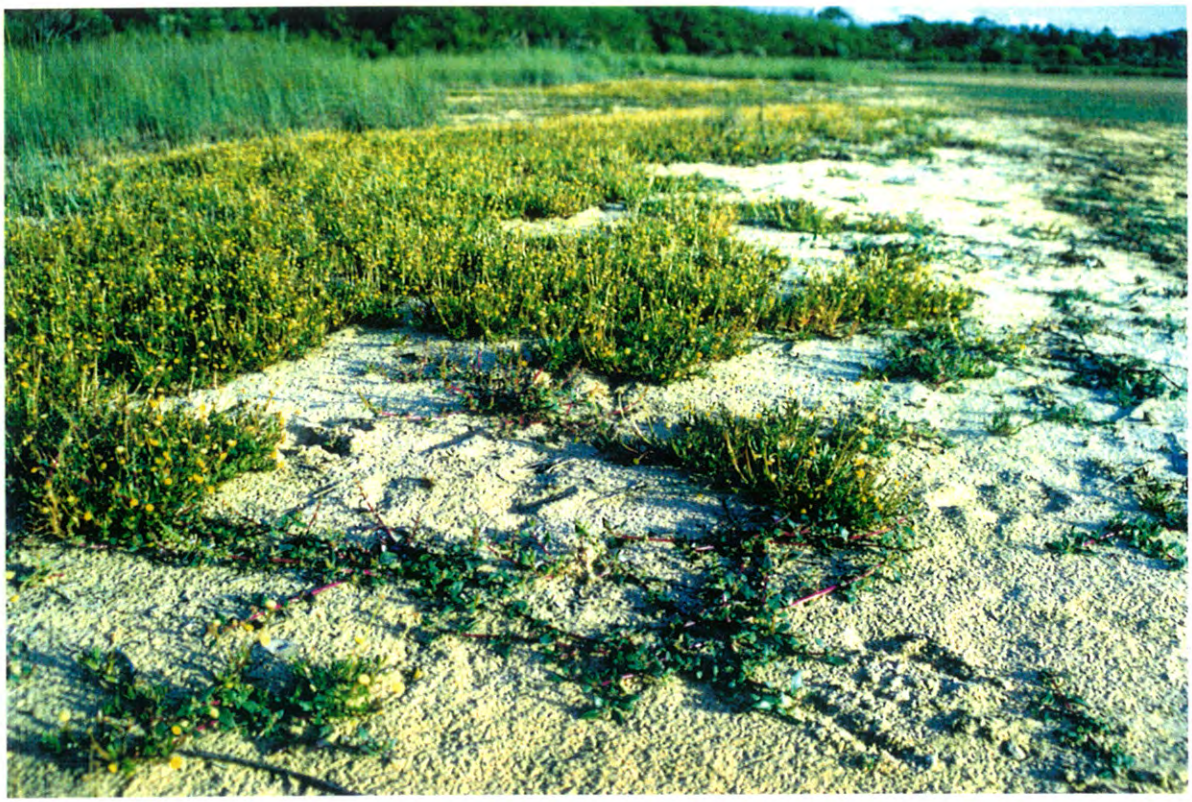


photo 1. Strand plants on lake bed, late autumn.

photo 2. Beaufortia Heath inundated up to 1 metre.

NOS. 20, 21 AND 22 BOAT HARBOUR ROAD LAKES

GENERAL DESCRIPTION

This group of lakes is mapped (Denmark Sheet, CALM) as four separate water bodies, but in reality the two north-eastern lakes form one water body in winter and can be continuously navigated by canoe. The south-eastern lake (dealt with here as No.2) is drained by a creek into the north-western lake (No.1) which is also fed by outflow from the north-eastern lake (No.3).

Lake 2 is particularly picturesque, set at the base of a high coastal ridge with steeply sloped lower ridges extending north-east along both shores. The south-western end supports a broad sedgefield of *Baumea ssp.* and *Gahnia trifida*, but has been invaded by *Typha orientalis*. A horse trail runs down to the lake on the eastern side and is responsible for introducing numerous pasture weeds (Sow Thistle, Phalaris, Sheep Sorrel and Clovers). The origins of the horse trail were obscure and unlikely to be used by walkers. The bed of the south eastside of this lake was mostly sandy, but an indeterminate depth of organic gelatinous sludge has accumulated at the northern end toward the outflow creek and the western side. A nesting swamp hen was observed in the *Typha* and a tortise carapace was found on the shore. In April the lake was very shallow with only approximately 150mm water over the organic sludge in many

areas. Maximum depth was only 350mm and toward the outflow the sludge bed was exposed.

Lake 3, which in summer appears as two separate water bodies is fringed by rushes, wet heath and Cedar thickets, and is surrounded by low ridges of silicious sand. A nesting swan with one cygnet was observed. The bed is slightly muddy and littered with sticks. A small population of *Typha* was observed in the northern end. When surveyed in April the water levels had dropped dividing the area into three water bodies linked by waterlogged muddy areas. Many old tree stumps were exposed as were wide sandy shores on the northern sides of the two larger water bodies.

Lake 1, the largest in this group, is flanked to the north and west by a very broad sedgefield with an immediate fringe composed mainly of *Gahnia trifida*, behind which is a range of channels through a mixture of *Gahnia* and *Baumea spp.* and a few scattered *Banksia* and *Melaleuca*. A population of *Typha* had established in the eastern corner near the inflow and out toward the lake centre. The bed of this lake was covered with a gelatinous organic sludge (like Lake 2), which has a greenish orange surface, appears like gravel or small rocks, but totally disintegrates when stirred by paddle. The depth of this sludge is well over 1.3m (paddle depth). Apart from horse riders, this area appears little used for recreation.

April survey found broad expanses of Lake 1 to be comprised of organic sludge with clumps of dead or dying

Chara sp. on top. Like at Lake 2, many wading birds were taking advantage of the low water levels.

The organic sludges from Lake 1 and Lake 2 were examined under microscope by Dr Jacob John (Environmental Biologist, Curtin University). He determined that the organic sludge was a mass (living and dead) of diatoms, blue green algae, various invertebrates (especially ostracods and copepods) combined with invertebrate fecal pellets. The gelatinous nature of the sludge was due to a mucopolysaccharide gel secreted by the unicellular algae. The food chain within this sludge-producing community is based upon the macrophytic algae *(Chara sp.)* which exudes solutions high in nitrogen and phosphorous (Dr John, pers. comm.).

SEMENIUK CLASSIFICATION

LAKE 1: MESOSCALE ZONIFORM SEDGELAND-HEATH OVOID FRESH LAKE

LAKE 2: MESOSCALE ZONIFORM SEDGELAND-THICKET-HEATH ELONGATE FRESH LAKE

LAKE 3: MESOSCALE ZONIFORM SEDGELAND-DENSE LOW FOREST-HEATH IRREGULAR FRESH LAKE

RESERVE: Quarram Nature Reserve

LOCATION: Lat: 35°01' Long: 117°05'

WATER:

Colour: clear

pH: Lake 1 - 7.54, 8.1
Lake 2 - 7.70, 8.1
Lake 3 - 7.40, 7.6

Depth: Lake 1 - 1.5m, 0.85m

Lake 2 - unrecorded, 350mm
Lake 3 - 1.2m, 0.7m

Movement: outflow via creeks from Lake 2 and Lake 3, into Lake 1; no outflow from Lake 1

TSS: Lake 1 - 512mg l^{-1}
Lake 2 - 864mg l^{-1}
Lake 3 - 330mg l^{-1}

FAUNA: Tortise, swans (nesting), swamp hen (nesting), musk duck

ACCESS: Lakes 1 and 3 very close to and accessible from Boat Harbour Road. Lake 2 found by picking up horse trail from Boat Harbour Road, 500m from bend.

INSPECTION: 12.8.91 to 14.8.91; 6.4.92

VEGETATION COMMUNITIES–LAKE 1

SPECIES	1	2	3	4
Ghara sp.	r			
Baumea arthrophylla		r		
B.articulata		r		
B.juncea		r		
B.preissii		r		
B.riparia		r		
B.vaginalis		i		
Garex appressa		r		
Banksia littoralis		r		r
Gahnia trifida		c		
Lepidosperma effusum		r		r
Leptocarpus scariosus		r		
Phebalium anceps		r		
Schoenus sp.CJR 717		r		
Triglochin procera		r		
Typha orientalis*		r		
Albizia lophantha				r
Acacia littorea				i
Agonis flexuosa				i
Muehlenbeckia adpressa				r
Pimelea clavata				r
Scaevola crassifolia				i
Baumea sp.	r			
Opercularia volubilis				r
Bossiaea linophylla				r
Isolepis nodosa				r
Rhagodia baccata				r
Leucopogon parviflorus				r

Community 1–Aquatics
2–Tall Sedges
3–Beaufortia Heath–not surveyed
see Lake 2 & 3
4–Heath Coastal

Estimated Cover(after Muir)
d–70–100%
c–30–70%
i–10–30%
r–0–10%

VEGETATION COMMUNITIES–LAKE 2

SPECIES	1	2	3
Baumea arthrophylla	r		
B.articulata	i		
B.juncea	r		
B.vaginalis	r		
Gahnia trifida	i		
Triglochin procera	r		
Typha orientalis*	d		
Albizia lophantha		i	
Callistachys lanceolatum		i	
Cassytha glabella		r	
Banksia littoralis		r	
Epilobium billardierianum		r	
Gonocarpus hexandrus		r	
Haloragis brownii		r	
Lepidosperma effusum		i	
Muehlenbeckia adpressa		r	
Phebalium anceps		i	
Opercularia volubilis		r	
Agonis flexuosa			i
Acacia littorea			r
Exocarpus odoratus			r
Lepidosperma gladiatum			r
Leucopogon parviflorus			r
Logania vaginalis			r
Olearia axillaris			r
Phyllanthus calycinus			r
Rhagodia baccata			r
Scaevola crassifolia			r
Spyridium globulosum			r
Chara sp.	r		

Community 1–Tall Sedges
2–Callistachys Thicket
3–Heath Coastal
4–Heath Dry–see Lake 3

Estimated Cover (after Muir)
d–70–100%
c–30–70%
i–10–30%
r–0–10%

VEGETATION COMMUNITIES-LAKE 3

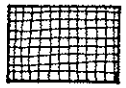
SPECIES	1	2	3	4	5
Gratiola peruviana*	r				
Haloragis brownii	r				
Baumea arthrophylla		r			
B.articulata		c			
B.juncea		r			
B.vaginalis		r			
Gahnia trifida		r			
Leptocarpus scariosus		r			
Triglochin procera		r			
Typha orientalis*		r			
Acacia hastulata			r	r	
Agonis juniperina			d		
Cassytha glabella			r		
Adenanthos obovatus				r	r
Anigozanthos flavidus				r	
Astartea fascicularis				i	
Banksia quercifolia				i	
Beaufortia sparsa				i	
Banksia littoralis				r	
Evandra aristata				i	
Kunzea recurva				r	r
Pultenaea reticulata				r	
Sphenotoma gracile				r	
Acacia myrtifolia					r
A.pulchella					r
Agonis parviceps					r
Allocasuarina fraseriana					r
Anarthria prolifera					r
A.scabra					r
Andersonia caerulea					r
Banksia ilicifolia					r
Boronia crenulata					r
Daviesia flexuosa					r
Eucalyptus marginata					r
Jacksonia horrida					r
Lysinema ciliatum					r
Melaleuca thymoides					r
Pultenaea reticulata					r
Chara spp.	r				
Lepidosperma effusum			r		
Callistachys lanceolatum			r		
Xyris lacera		r			
Villarsia albiflora		r			

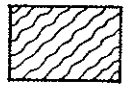
Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Beaufortia Heath
5-Heath Dry

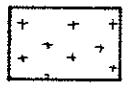
Estimated Cover (after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

BOAT HARBOUR ROAD LAKES
20 LAKE 1
21 LAKE 2
22 LAKE 3

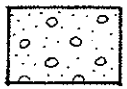

Tall
Sedges


Cedar Dense
Low Forest


Callistachys
Thicket


Beaufortia
Heath


Heath
Dry


Heath
Coastal

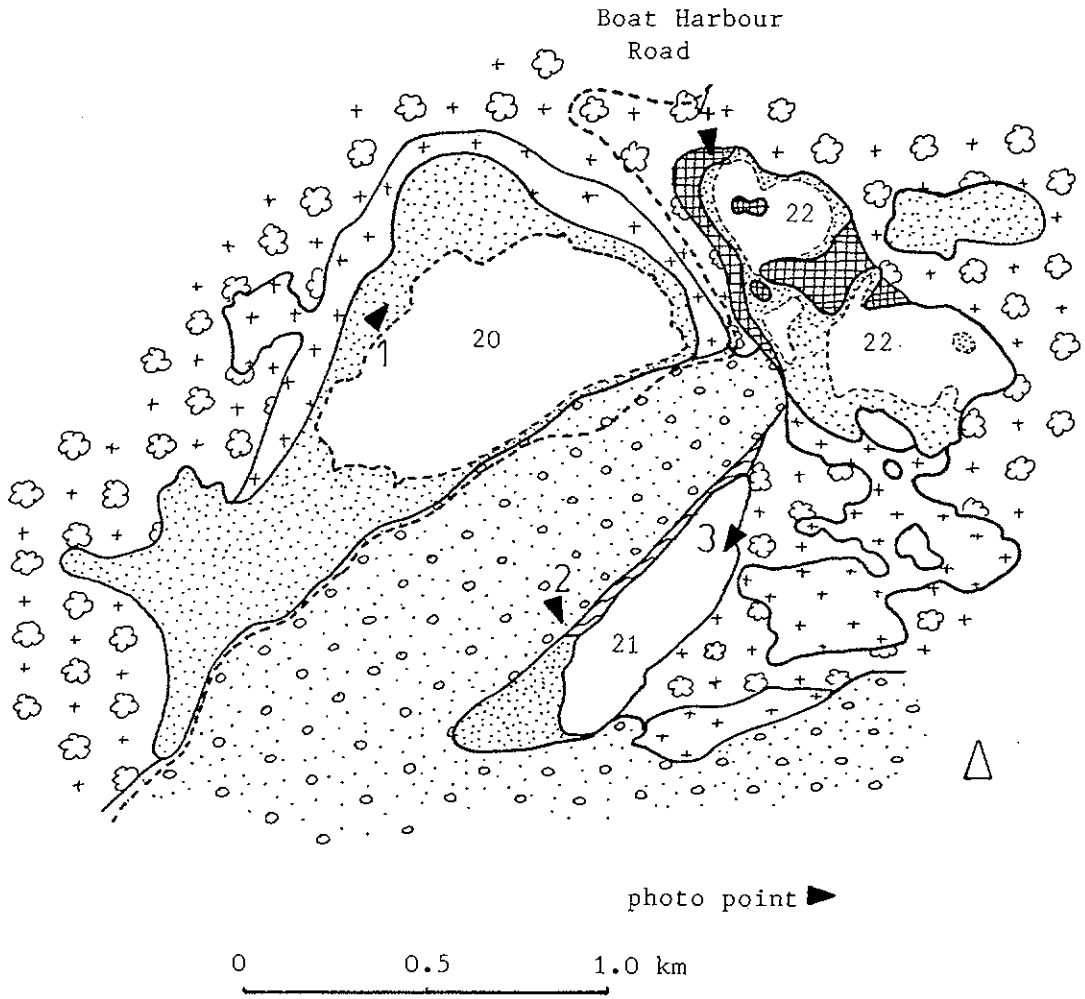


photo 1-Lake 1,dense field of Gahnia trifida.

photo 3-Lake 2,south east shore.

photo 2-Lake 2,southern end;dense Typha orientalis.

photo 4-Lake 3;Cedars behind the fringing Tall Sedges.

NO. 23 ↑12046 LAKE

GENERAL DESCRIPTION

Located on the northern edge of William Bay National Park and opposite the Ranger's office, the lake is surrounded by cleared land to the north and east, coastal dunes to the south and Karri forest to the west, and is within sight of the Petrified Forest. There are no extensive beds of fringing rushes, indeed the very dense Cedar *(Agonis juniperina)* stand on the north-eastern side has no understorey and is open to the lake surface without any intervening sedges. There is evidence of previously moderate stands of *Typha orientalis* on the southern edge but these appear to have been chemically controlled with herbicide. This southern shore is quite convoluted and several small bays run into shady grottos at the base of the sand ridge. The lake bed is sandy and relatively deep. A large polythene pipe runs from a slight excavation on the western side toward the Ranger's office. Recreational use is probably limited.

April survey found that the declining water level had exposed many tree stumps (some quite substantial), particularly at the western end. Sandy shores or lake bed also exposed on the southern and eastern end now supported a dense crop of weeds *(Atriplex prostratum, Psuedographalium luteo-album, Aster subulatus, Solanum nigrum, Sonchus*

oleraceus and *Gratiola peruviana)* and *Haloragis brownii* which becomes aquatic with inundation.

SEMENIUK CLASSIFICATION

MESOSCALE BACATAFORM SEDGELAND-DENSE LOW FOREST-HEATH-FOREST IRREGULAR FRESH LAKE

RESERVE: William Bay National Park

LOCATION: Lat: 35°00' Long: 117°14'

WATER:

Colour: pale brown, clear

pH: 6.9, 6.5

Depth: 5.7m, 4.6m

Movement: inflow from north-west and east; no outflow observed

TSS: 259mg l^{-1}

FAUNA: Long-necked tortise

ACCESS: Direct access to walkers from William Bay Road only 50m from lake.

INSPECTION: 14.8.91; 13.9.91; 7.4.92

↑ 12046 WILLIAM BAY ROAD

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7
Callitriche stagnalis*	r						
Gratiola peruviana*	r						
Haloragis brownii	r						
Baumea articulata		c					
B.juncea		r					
B.preissii		r					
B.vaginalis		r	r				
Carex appressa		r					
Typha orientalis*		r					
Agonis juniperina			d				
Baumea riparia			r		r		
Lepidosperma effusum			r				
Leptocarpus scarisus			r				
Phebalium anceps			r				
Agonis flexuosa				i			
Acacia littorea				i			
Chorilaena quercifolia				r		r	
Hibbertia cuneiformis				r			
Isolepis nodosus				r			
Lepidosperma gladiatum				r			
Loxocarya flexuosa				r			
Olax phyllanthi				r			
Acacia hastulata					r		
Adenanthos obovatus					r		
Agonis linearifolia					r		
A.parviceps					r		
Astartea fascicularis					r		
Boronia stricta					r		
Aotus gracillima					r		
Eucalyptus patens					i		
Evandra aristata					i		
Empodisma gracillima					i		
Gahnia decomposita					i		
Hibbertia furfuracea					r	r	
Monotoca tamariscina					r		
Spyridium globulosum					r		
Acacia pentadenia						i	
Boronia crenulata						r	
Bossiaea linophylla						i	
Eucalyptus diversicolor						c	
Trymalium floribundum						r	
Banksia littoralis			r				
Psuedognaphalium lut.alb.*							r
Aster subulatus*							r
Solanum nigrum*							r
Sonchus oleraceus*							r
Polygonum salicifolium							r
Chenopodium macrospermum*							r

Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Heath Coastal
5-Blackbutt Open Low Woodland over Beaufortia Heath
6-Karri Forest
7- Dry Lake Bed

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

23 ↑ 12046 WILLIAM BAY ROAD

Tall Sedges

Cedar Dense Low Forest

Heath Coastal

Blackbutt Open Low Woodland over Beaufortia Heath

Karri Forest

Jarrah Low Woodland over Low Heath

Pasture

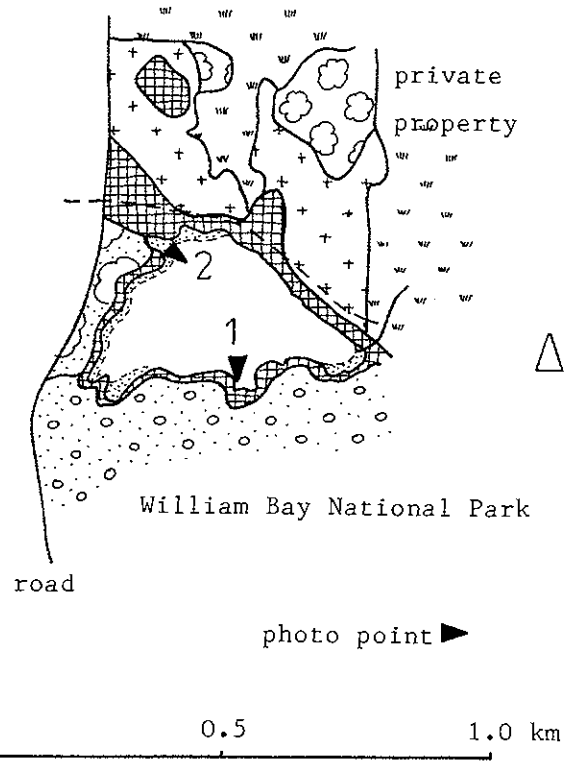


photo 1-Cedars and Lepidosperma effusum on southern shore.

photo 2-Baumea articulata foreground with Cedars and Coastal Heath in background.

NO. 24 LAKE WILLIAMS

GENERAL DESCRIPTION

Lake Williams is a pretty little lake located behind the high dunes of Lights Beach and notable for the granite outcrop which forms its eastern edge. A creek flows into its north-eastern corner through a *Callistachys* thicket and out to the south-west through a Cedar thicket. The west bank supports coastal heath on silicious sands. Lake Williams is easily accessible to walkers from both Madfish Bay Road and Lights Road along well established vehicle tracks. All vehicular access is now denied by barriers erected to control the spread of dieback. The lake bed is sand over granite. The sandy shores exposed by declining water level (April Survey) supported introduced weed species *Isolepis prolifera*, *Cyperus congestus*, *Psuedognaphalium luteo-album*, *Corrigiola litoralis* and *Chenopodium macrospermum*.

SEMENIUK CLASSIFICATION

MICROSCALE BACATAFORM SEDGELAND-THICKET-HEATH OVOID FRESH LAKE

RESERVE: William Bay National Park

LOCATION: Lat: 35°01' Long: 117°16'

WATER:

Colour: dark brown, clear

pH: 5.6, 5.4

Depth: 2.5m

Movement: inflow from north-east; outflow to south-west

TSS: 186mg l^{-1}

FAUNA: Black ducks

ACCESS: Walk tracks from Madfish Bay Road and Lights Road.

INSPECTION: 13.8.91; 7.4.92

LAKE WILLIAMS

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6	7
Baumea articulata	d						
B.juncea	r						
B.riparia	r						
B.vaginalis	r		i				
Juncus pallidus	r	r					
Leptocarpus scariosus	r	r	r				
Triglochin procera	r						
Acacaia hastulata		r					
Agonis juniperina		r	d				
Callistachys lanceolatum		d	r				
Cassytha glabella		r					
Isolepis nodosus		r					
Phebalium anceps		r					
Psuedoloxocarya grossa		r					
Lepidsperma effusum			r				
Villarsia sp.			r				
Agonis parviceps				i			
Astartea fascicularis				i			
Banksia quercifolia				r		r	
Beaufortia sparsa				i			
Evandra aristata				i			
Homalospermum firmum				r			
Sphenotoma squarrosa				r			
Agonis ciliatum					r		
Anthocersis viscosa					r		
Borya nitida					r		
Burchardia multiflora					r		
Eutaxia obovata					r		
Lepidosperma gladiatum					r		
Moss sp.					r		
Pelargonium capitatum					r		r
Stypandra sp.					r		
Acacia myrtifolia						r	
Adenanthos obovatus						r	
Agonis flexuosa						r	i
Allocasuarina humilis						r	
Anarthria prolifera						r	
A.scabra						r	
Darwinia vestita						r	
Dasypogon bromeliifolius						r	
Kunzea recurva						r	
Leucopogon parviflorus						r	
Melaleuca thymoides						r	
Nuytsia floribunda						r	
Pultenaea reticulata						r	
Acacia littorea							r
Hakea prostratum							r
Helichrysum cordatum							r
Hakea oleifolia							r
Olax phyllanthi							r
Olearia axillaris							r
Phyllanthus calycinus							r
Rhagodia baccata							r
Scaevola crassifolia							r
Spyridium globulosum							r

Community 1-Tall Sedges
2-Callistachys Thicket
3-Cedar Dense Low Forest
4-Beaufortia Heath
5-Granite Heath
6-Heath Dry
7-Heath Coastal

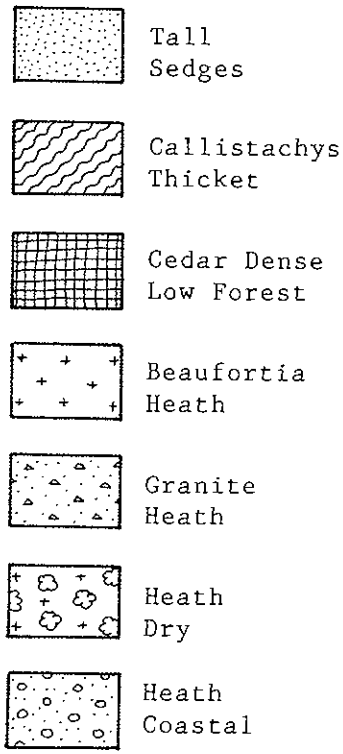
Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

LAKE WILLIAMS - Vegetation Communities cont.

SPECIES	1	2	3	4	5	6	7	8
Centella asiatica		r						
Anigozanthos flav.			r					
Juncus kraussii			r					
Pseudoloxocarya grossa			r					
Anarthria gracilis						r		
Hypocalymma strictum						r		
Andersonia caerulea						r		
Cyperus congestus *								r
Corrigiola littoralis*								r
Chenopodium macrospermum*								r
Isolepis prolifer*								r
Pseudognaphalium lut.alb.*								r

Community 8 - Dry Lake Bed.

24 LAKE WILLIAMS



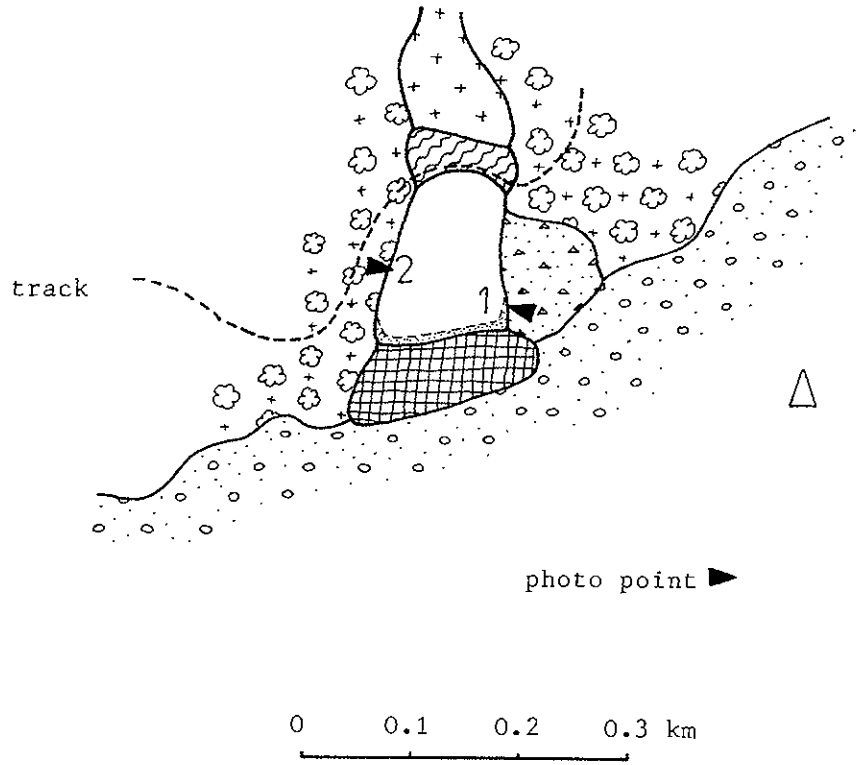


photo 1-Agonis ciliatum on granite.

photo 2-Baumea articulata foreground with granite outcrop background.

NO. 25 LAKE SAIDE

GENERAL DESCRIPTION

Lake Saide is an integral part of a drainage system for the agricultural flats which lie around it. At the time of inspection the potato fields along Brown's Road were draining via a constructed drain directly into the lake. The drain water was dirty and contained numerous aquatic invertebrates. The flooded potato fields were providing a broad feeding ground for many water birds (mainly swans and ducks). It is highly probable that the waters of Lake Saide are contaminated by agricultural chemicals and fertilizers, but the area generally supported more birds than any other lake visited in this survey.

Typha orientalis has formed very dense stands on most shores (except parts of the eastern side) and has choked out what native sedges may have been established. Water Couch *(Paspalum vaginatum)* has covered broad areas behind the *Typha* (near the potato fields) with a semi-floating mass, which when disturbed emits a foul odour from rotting vegetable matter below the surface. Cow trails run through the eastern side of the fringing vegetation resulting in invasion by pasture weeds.

The lake bed was of even depth, sandy to slightly muddy. There was no evidence of recreatironal use. A rubbish disposal site is situated lkm to the north-east and may leach into the drainage system.

Survey in April found the water level to have decreased significantly (from 1.1m to 0.4m) thus exposing broad areas of the lake bed as sandy or muddy shores. These exposed areas supported numerous wading birds and introduced plants. The lower water level made survey of aquatic plants easier and three species of *Potamogeton* not previously detected during spring survey were found. *Selliera radicans*, a prostrate creeping annual, was found on the banks of the outflow canal. The only other known location of this species in Western Australia is on the salty margins of Wilson's Inlet.

The bulk of the Water Couch *(Paspalum vaginatum)* which was almost completely inundated in August, had greened up and was growing vigorously on the damp shores in April.

SEMENIUK CLASSIFICATION

MACROSCALE ZONIFORM SEDGELAND-DENSE LOW FOREST-FOREST IRREGULAR FRESH LAKE

RESERVE: 10781 Common Shire of Albany and 17464 Camping and Recreation (not vested).

LOCATION: Lat: 35°03' Long: 117°28.5'

WATER:

Colour: dirty pale brown-green

pH: 7.1, 7.9

Depth: 1.1m, 0.4m

Movement: inflow from agricultural drains; outflow to Nenamup Inlet via drain

TSS: 401mg l^{-1}

FAUNA: Swans, musk duck, black duck, mountain duck, grebe, long-necked tortise

ACCESS: Up drain from Brown's Road.

INSPECTION: 15.8.91; 8.4.92

LAKE SAIDE

VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Chara sp.	r				
Gratiola peruviana*	r				
Haloragis brownii	r				
Myriophyllum salsugineum	r				
Rorippa nasturtium*	r				
Lemna disperma	r				
Baumea arthrophylla		r			
B.articulata		i			
B.juncea		r			
Gratiola peruviana*		r			
Juncus pallidus		r			
J.kraussii		r		r	
Isolepis nodosus		r			
Typha orientalis*		c		r	
Paspalum distichum*		c		c	
Villarsia sp.		r			
Agonis juniperina			d		
Callistachys lanceolatum			r		
Lepidospermum effusum			r		
Melaleuca polygaloides				i	
M.raphiophylla				i	
Acacia pentadenia					r
Agonis flexuosa					r
Eucalyptus calophylla					i
E.cornuta					i
Gastrolobium bilobum					r
Hakea oleifolia					r
Hibbertia cuneiformis					r
H.furfuracea					r
Loxocarya flexuosa					r
Macrozamia reidlei					r
Sollya heterophylla					r
Spyridium globulosum					r
Potamogeton drummondii	r				
P. ochreatus	r				
P. pectinatus	r				
Cyperus congestus*		r			
Bolboschoenus caldwellii		r			
Atriplex prostrata		r			
Chenopodium macrospermum*		r			
Polygonum salicifolium		r			
Triglochin procera		r			

Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Paperbark Low Forest
5-Marri-Yate Low Woodland over Heath

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
R-0-10%

25 LAKE SAIDE

Tall
Sedges

Cedar Dense
Low Thicket

Paperbark
Low Woodland

Marri-Yate Low Woodland
over Heath

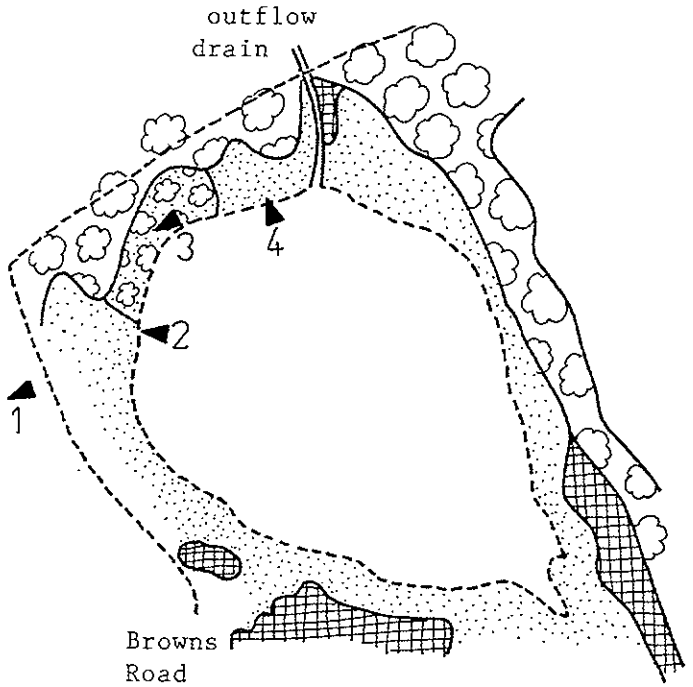


photo point ►

0 0.25 0.5 km

photo 1-Swans grazing on flooded potato fields.

photo 2-Typha orientalis.

photo 3-Semi floating mass of Paspalum vaginatum.

photo 4-Typha orientalis choking out native sedges.

NO. 26 LAKE WILLIAM

GENERAL DESCRIPTION

Lake William is relatively pristine, surrounded by National Park, with a grove of Karri and high coastal dunes to the south-west which provide a magnificent scenic backdrop. It was probably formed by the mobile dunes (now stabilized) blocking a stream which had originally flowed to the coast, forming the limestone cliffs to the south by erosion. There is no current outflow from the lake and excess water is presumed to seep away under the dunes.

The lake bed is sandy with, in most areas, a very narrow or absent sedge fringe. A pool at the south-eastern end which is connected to the main body of the lake by a narrow neck is surrounded by moderate stands of *B.vaginalis* and supports a broad expanse of *Villarsia*. A band of *Callistachys* thicket runs along the base of the high dunes at the lake's edge to the north and west. The water is clear but heavily stained with tannins.

The lakeside is easily accessible on foot via old vehicle tracks (now closed for dieback control), but does not appear to have suffered heavy recreational use. Very little rubbish was present.

SEMENIUK CLASSIFICATION

MESOSCALE BACATAFORM SEDGELAND-THICKET-HEATH IRREGULAR FRESH LAKE

RESERVE: West Cape Howe National Park

LOCATION: Lat: 35°05' Long: 117°36'

WATER:

Colour: dark brown, clear

pH: 4.3, 4.5

Depth: 2050mm, 1350mm

Movement: stream-fed from east; possible seepage out to west

TSS: 149mg l^{-1}

FAUNA: None observed

ACCESS: On foot via tracks through West Cape Howe National Park.

INSPECTION: 17.9.91; 8.4.92

LAKE WILLIAM
VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6
Baumea juncea	r					
B.riparia	r					
B.vaginalis	r					
Lepidosperma striatum	r					
Leptocarpus scariosus	r				r	
Schoenus cruentus	r					
Triglochin procera	r					
Villarsia lasiosperma	r					
Xyris lacera	r					
Agonis juniperina		i				
Anigozanthos flavidus		r				
Banksia littoralis		r				
Callistachys lanceolatum		c				i
Kunzea ericifolia		r				
Lepidosperma effusum		r		r		
Adenanthos obovatus			r		r	
Agonis parviceps			i			
Anarthria prolifera			r		r	
A.scabra			r			
Andersonia caerulea			r			
Astartea fascicularis			r		i	
Banksia ilicifolia			i			
B.quercifolia			r			
Bossiaea linophylla			i	r		i
Dasypogon bromeliifolius			r			
Eucalyptus marginata			i			
Jacksonia horrida			r			
Johnsonia lupulina			r			
Leucopogon glabellus			r		r	
L.unilateralis			r			
Melaleuca thymoides			r			
Petrophile longifolia			r			
Agonis flexuosa				c		i
Acacia pulchella				r		
A.littorea				i		
Dryandra sessilis				r		
Hakea oleifolia				r		
Hibbertia furfuracea				r		
Leucopogon capitellatus				r		
L.parviflorus				r		
Logania vaginalis				r		
Pimelea clavata				r		
Rhagodia baccata				r		
Acacia hastulata					r	
Agonis aff.linearifolia					i	
Beaufortia sparsa					i	
Cosmelia rubra					r	
Evandra aristata					c	
Gymnoschoenus anceps					i	
Homalospermum firmum					r	
Persoonia teretifolia					r	
Eucalyptus diversicolor						c
Tremandra stelligera						r
Pteridium esculentum						r

Community 1-Tall Sedges
2-Callistachys Thicket
3-Heath dry
4-Peppermint Open Woodland over Heath Coastal
5-Beaufortia Heath
6-Karri Forest

Estimated Cover(after Muir)
d-70-100%
c-30-70%
i-10-30%
r-0-10%

26 LAKE WILLIAM

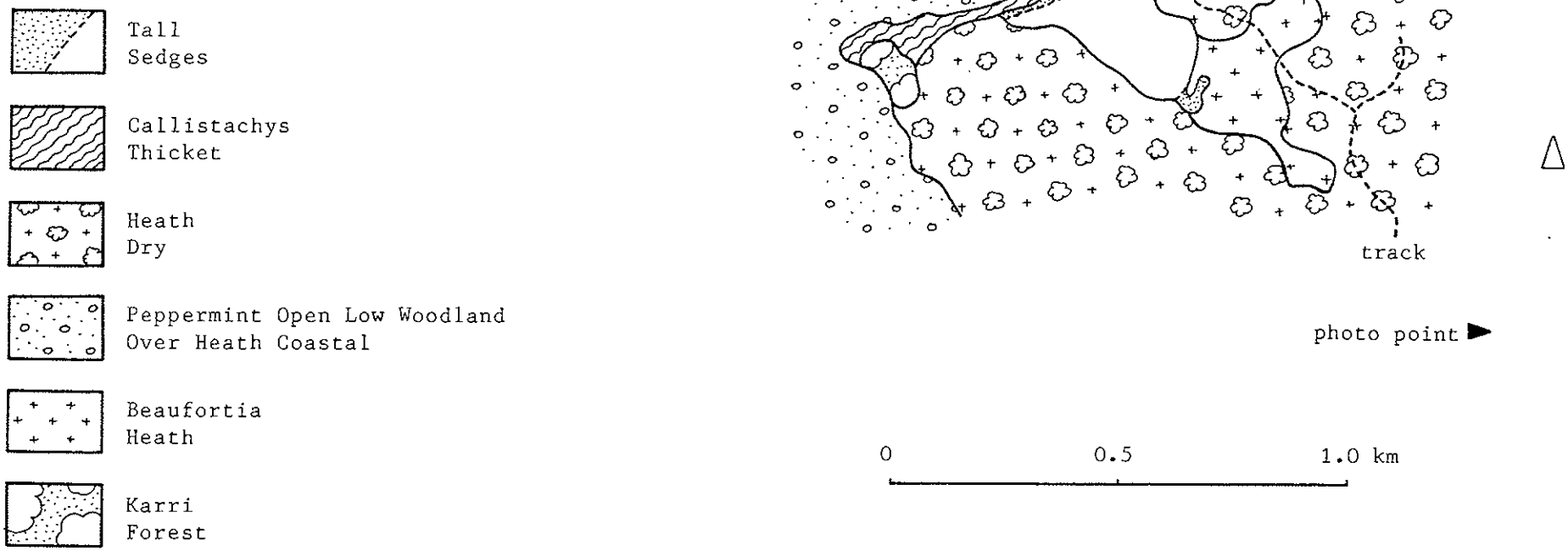


photo 1. Panorama of Lake William looking south; eastern half above and western half below.

NO. 27 LAKE POWELL

GENERAL DESCRIPTION

Lake Powell is originally likely to have been formed as an exposure of the water table, possibly fed by several minor creeks. It is now an integral part of a network of canals which drain a catchment of 2000km^2 (L. Emery, Torbay Waterways Protection Committee, pers.comm.). This catchment is largely cleared for agriculture (grazing and potato growing), and also includes the outflow from Timewell Road Treatment Plant. This plant is Albany's major sewerage treatment plant (primary treatment only), and discharges, amongst other things, 5 tonne per annum of phosphorous (L. Emery, pers.comm.). The lake is fed by a canal in the eastern corner and drained to the sea via Torbay Inlet to the west. The winter water level in Lake Powell is quite low (0.5m) due to constant drainage, however in periods of heavy rain it floods readily into Elleker townsite to the north due to the increased size of its catchment. The water is murky brown. The water level in April was higher (700mm), possibly due to the sand bar at the ocean being closed, and recent rains.

The shores are comprised mostly of soft, foul-smelling brown mud, which in some areas is covered with a thick deposit of white sand. When surveyed in April after recent rain, the water had the appearance (slightly milky) and smell of domestic drainage. The lake appears to act as a

settling pond for sediments carried in via the canal systems. Similar to Lake Saide, Lake Powell is fringed by introduced grass (Kikuyu and Water Couch) and Bullrushes *(T.orientalis)* which may be choking out the native sedges (e.g. *B.articulata*). The broad areas of water-logged Water Couch emitted a foul stench (of anaerobic decomposition) when disturbed.

The reserve around the lake is quite narrow and has been invaded by introduced trees (Pines and Acacias) and shrubs (Blue Broom). Although Lake Powell and the Nature Reserve are surrounded by relatively lightly populated rural land, there appears to be very little recreational use. One local resident said that dumping of rubbish and even carcasses occasionally occurred.

SEMENIUK CLASSIFICATION

MACROSCALE ZONIFORM HEATH-DENSE LOW FOREST-TALL SEDGES IRREGULAR FRESH LAKE

RESERVE: Lake Powell Nature Reserve

LOCATION: Lat: 35°01' Long: 117°45'

WATER:

Colour: murky brown

pH: 6.4 (19.9.91); 7.7 (8.4.92)

Depth: 0.5m (9.91); 0.7m (4.92)

Movement: artificial drain entering from east and draining out to the west

TSS: 242mg l^{-1}

FAUNA: Swamp hen, black cormorant, black duck

ACCESS: Direct from Lower Denmark Road or Elleker Grasmere Road.

INSPECTION: 18.9.91; 19.9.91; 8.4.92

LAKE POWELL

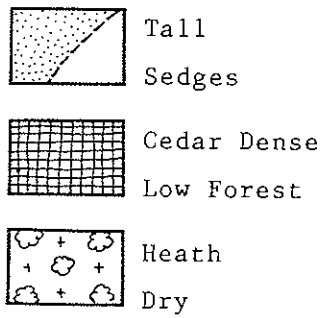
VEGETATION COMMUNITIES

SPECIES	1	2	3	4
Haloragis brownii	r			
Lemna disperma	r			
Baumea articulata		i		
B.sp CJR767		r		
Isolepis prolifera		i	i	
Juncus kraussii		r		
J.microcephalus*		r		
J.pallidus		r	r	
Pennisetum cladestinum *		i		
Paspalum distichum*		c		
Triglochin procera		r		
Typha orientalis*		c		
Zantedeschia aethiopica*		r	r	
Agonis juniperina			c	r
A.linearifolia			r	r
Astartea fascicularis			r	
Banksia occidentalis			r	r
Baumea juncea			r	
Callistachys lanceolatum			r	
Hakea linearis			r	
Leptocarpus scariosus			r	
Lepidosperma effusum			r	
Melaleuca polygaloides			r	
M.raphiophylla			i	
Phebalium anceps			r	
Psoralea pinnata*			r	
Schoenus brevifolius			r	
Villarsia sp.			r	
Acacia hastulata				r
A.pycnantha*				r
Adenanthos obovatus				r
Agonis flexuosa				r
Aotus intermedia				r
Anarthria prolifera				r
A.scabra				r
Anigozanthos flavidus				r
Banksia littoralis				r
Beaufortia sparsa				r
Bossiaea linophylla				r
Cyathochaeta clandestina				r
Dampiera leptoclada				r
Grevillea occidentalis				r
Hibbertia cuneiformis				r
Hypolaena exsulca				r
Isopogon axillaris				r
Hypocalymma cordifolium				r
Kunzea ericifolium				r
Leucopogon capitellatus				r
Pericalymma ellipticum				r
Pinus radiata*				r
Petropile squamata				r
Stirlingia tenuifolia				r
Atriplex prostratum.		r		
Chenopodium macrospermum*		r		
Solanum nigrum*		r		
Sonchus oleraceus*		r		

Community 1-Aquatics
2-Tall Sedges
3-Cedar Dense Low Forest
4-Heath Dry

Estimated Cover(after Muir)
d-70-100%
c-30-70%
I-10-30%
r-0-10%

27 LAKE POWELL



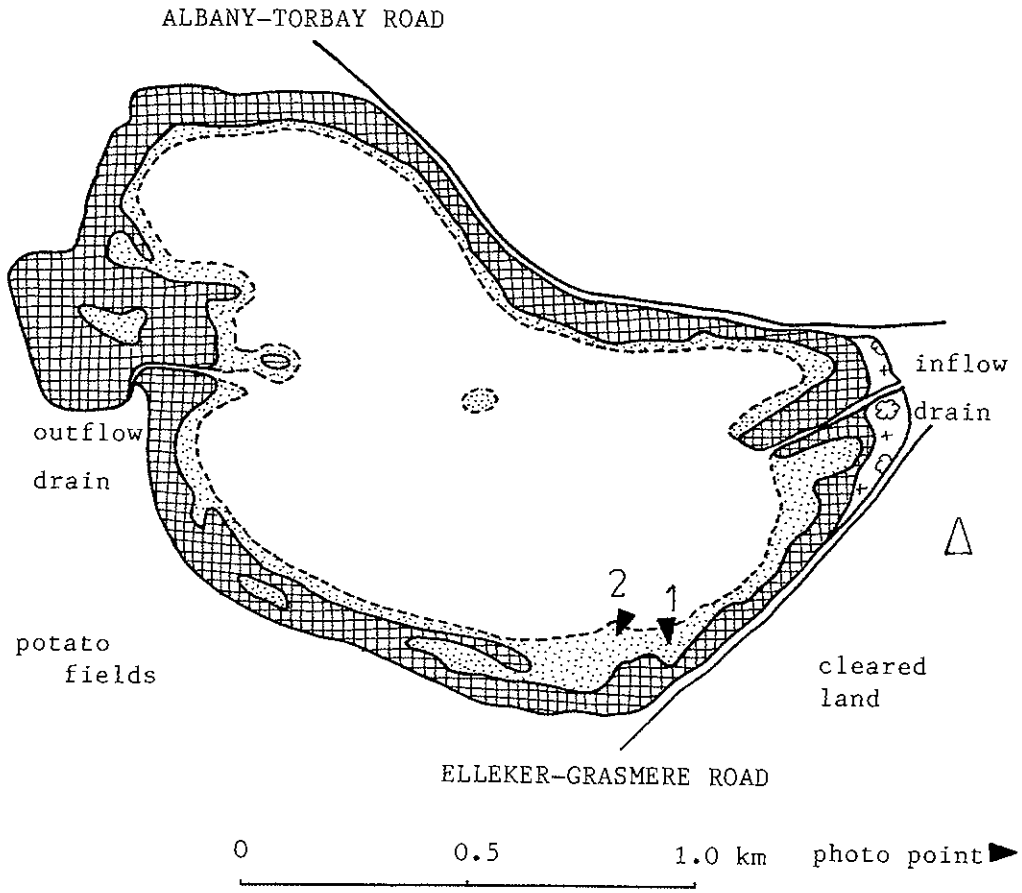


photo 1-Typha orientalis (background),Isolepis prolifera (middleground) and Paspalum vaginatum (foreground) choking out native sedges.

photo 2-Kikuyu grass invading fringing Baumea articulata.

NO. 28 DONNELLY LAKE

GENERAL DESCRIPTION

This lake is absolutely pristine in a region which is relatively inaccessible and consequently, rarely, if ever visited. Access was gained on foot (carrying a canoe) through dense vegetation from Charley Road. Due to quarantine restrictions Charley Road is closed to protect the diesease-free forest of Charley Block. A permit (issued by CALM) is required to enter this area only in dry soil conditions. Consequently, it is not surprising that there was no sign at all of human visitation or impact upon this lake.

Similar to many other lakes in this study, the south-western side of the lake was bordered by a high dune, consolidated by a eucalypt woodland. The balance was surrounded by a dense heath of *Agonis linearifolia* heath-thicket. This community was growing in peaty soils which formed a vertical vegetated bank at the lake's edge, with no shore. The fringe of sedges, growing from the lake bed was either narrow or absent. The dense colonies of the wirey sedge *(Empodisma gracillimum)* give the banks a picturesque appearance.

The band of *Beaufortia sparsa* heath community (on seasonally waterlogged soil) growing above the *Agonis linearifolia* heath (on seasonally inundated soil) was clearly highlighted by being in full flower at the time of

survey. The *Beaufortia* was very dense, up to 3m tall and appeared unburnt for a considerable period and was almost impenetrable. Access to the open water was achieved at the northern end where the higher, more open Eucalypt woodland comes close to a narrow band of *Agonis linearifolia* thicket and avoids the tall *Beaufortia*.

The lake appears to be an end-point for local drainage and is disjunct from Charley Brook which flows into the Donnelly River. The lake is unnamed, but for the purposes of this study is called Donnelly Lake.

SEMENIUK CLASSIFICATION

MICROSCALE BACATAFORM SEDGELAND-THICKET-HEATH-FOREST IRREGULAR-OVOID FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°30' Long: 115°48.5'

WATER:

Colour: pale brown

pH: 6.6

Depth: 3.1m

Movement: creeks draining into lake from north and south; the northern creek still trickling at the time of survey

TSS: 126.5mg l^{-1}

FAUNA: Little pied cormorant

ACCESS: South- west through bushland from Charley Road.

INSPECTION: 11.3.92

DONNELLY LAKE - VEGETATION COMMUNITIES

SPEIES	1	2	3	4	5
Baumea articulata	c				
B. preissii	r				
B. sp.	r				
B. vaginalis	r				
Callistachys lanceolatum		i	r		
Phebalium anceps		r			
Agonis linearifolia		r	i		
A. juniperina			r		
A. parviceps			r	r	r
Acacia hastulata			r		
Actinotus laxus			r		
Banksia littoralis			r		
Boronia stricta			r	r	
Cassytha glabella			r		
Drosera platypoda			r		
Empodisma gracillimum			r		
Eucalyptus patens			r	r	
Gahnia decomposita			r		
Homalospermum firmum			r	r	
Lepidospermum effusum		r	r		
Pseudoloxocarya grossa			r		
Schoenus aff sublaxus			r		
S. rodwayanus			r		
Sphenotoma gracile			r	r	
Sphaerolobium sp.			r		
Sporodanthus rivularis			r		r
Stylidium scandens			r		
Xyris lacera			r		
X.laxiflora			r		
Beaufortia sparsa				i	
Persoonia teretifolia				r	
Pultenaea reticulata				r	r
Gymnoschoenus anceps				r	
Eucalyptus megacarpa					r
E. marginata					r
Agonis flexuosa					r
Anarthria scabra					r
Boronia crenulata					r
Leucopogon unilateralis					r
Banksia ilicifolia					r
Podocarpus drouynianus					r
Macrozamia reidlei					r
Pteridium esculentum					r
Xanthorrhoea preissii					r

Communities
1- Tall Sedges
2- Callistachys Thicket
3- Agonis linearifolia Thicket
4- Beaufortia Heath
5- Woodland

28 DONNELLY LAKE

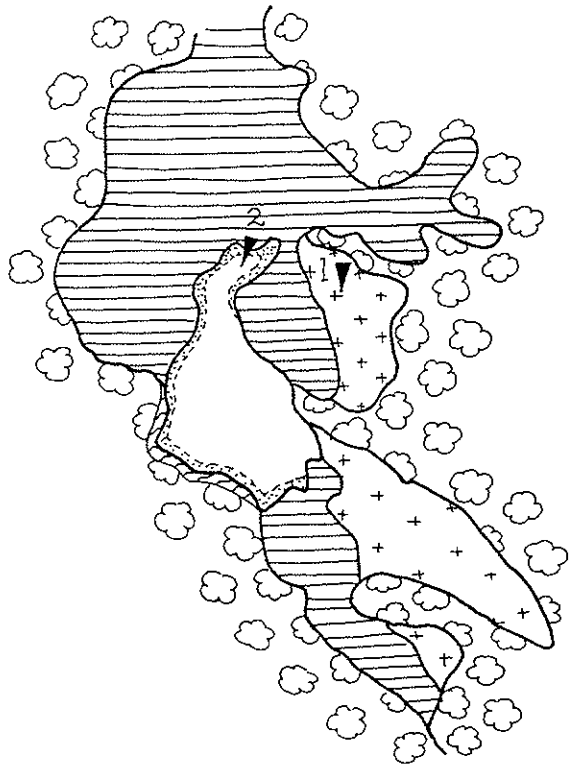


photo point

Tall
Sedges

Callistachys
Thicket

Agonis linearifolia
Thicket

Beaufortia
Heath

Jarrah Bullich
Low Woodland

0 0.5 1.0 km

photo 1. Beaufortia sparsa Heath; north eastern side of Donnelly Lake.

photo 2. North end of Donnelly Lake.

NO. 29 LAKE CHARLEY

GENERAL DESCRIPTION

Lake Charley is marked as a permanent water point on the CALM (Warren, 1:50,000) map and is consequently accessible to vehicles via reasonable tracks. However, as Charley Block is in dieback quarantine, access to the area is only with a CALM permit in dry soil conditions. Although evidence existed of several old campfires, the area is not often used by the general public for recreation, despite supporting marron (CALM Officer, Manjimup, pers. comm.).

Apart from the tracks, the lake and its surrounds are virtually pristine and very attractive. The lake is fed by a seasonal stream flowing into the eastern end. Beyond the narrow band of Tall Sedges and *Agonis linearifolia* thicket, the lake is surrounded by higher Jarrah *(E. marginata)* forest on soils varying from sandy dunes (to the south-west) and coarse gravels (to the north-east). The lake bed varied from deep organic sludge on the northern side to firm gravelly sands on the south. In the context of this survey, Lake Charley at 5.7m is quite deep. At the time of inspection there was a narrow exposed shoreline around most of the lake.

The thick vegetation around the lake supported abundant wildlife. Red eared firetail finches, New Holland honeyeaters and a western spinebill were observed in the *B. articulata* in the early morning. White tailed black

cockatoos were drinking from the lake in both early morning and evening. A mardo *(Antechinus flavipes)* was observed darting about in thick vegetation by the campsite.

A small stand of *Pultenaea pinifolia* (Reserve Flora, Priority Three) was discovered by the campsite, which constitutes a major known range extension. Previously this species was only known from sandy valleys between Busselton and Margaret River.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-THICKET-FOREST
IRREGULAR FRESH LAKE

RESERVE: Charley Block, State Forest

LOCATION: Lat: 34°30' Long: 116°49'

WATER:

Colour: brown

pH: 6.6

Depth: 5.7m

Movement: inflow from east

TSS: 163mg 1^{-1}

FAUNA; Red eared firetail finch, New Holland honeyeater, western spinebill, white tailed black cockatoo and mardo *(Antechinus flavipes)*

ACCESS: Via Charley Road off Boat Landing Road (by Quarantine Permit only).

INSPECTION: 12.3.92

LAKE CHARLEY - VEGETATION COMMUNITIES

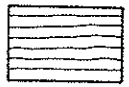
SPECIES	1	2	3	4	5
Ruppia sp.	r				
Triglochin procera	r				
Baumea articulata		c			
B. vaginalis		r	r		
Leptocarpus scariosus		r	r	r	
Villarsia lasiosperma		r			
Centella asiatica		r			
B. riparia		r	r		
Lepyrodia muirii			r		
Ampera volubilis			r		
Gonocarpus hexandrus			r		
Xyris lacera			r		
Agonis linearifolia				i	
A. parviceps				r	r
Leucopogon hirsutus				r	
Callistachys lanceolatum				r	
Cassytha glabella				r	
Beaufortia sparsa				r	
Boronia stricta				r	
Acacia hastulata				r	
Banksia littoralis				r	
Anigozanthos flavidus				r	
Astartea fascicularis				r	
Gahnia decomposita				r	
Phebalium anceps				r	
Stylidium scandens				r	
Sphenotoma squarrosum				r	
Acacia myrtifolia					r
Anarthria scabra					r
Banksia grandis					r
Eucalyptus calophylla					i
E. marginata					r
Lasiopeta;um floribundum					r
Hovea elliptica					r
Patersonia sp.					r
Persoonia longifolia					r
Podocarpus drouynianus					r
Xanthorrhoea preissii					r
Pteridium esculentum					r
Pultenaea pinifolia					r

Communities
1- Aquatics
2- Tall Sedges
3- Low Sedges
4- Agonis linearifolia Thicket
5- Jarrah Forest

29 LAKE CHARLEY

Tall
Sedges

Low
Sedges



Agonis linearifolia
Thicket

Jarrah Low
Woodland

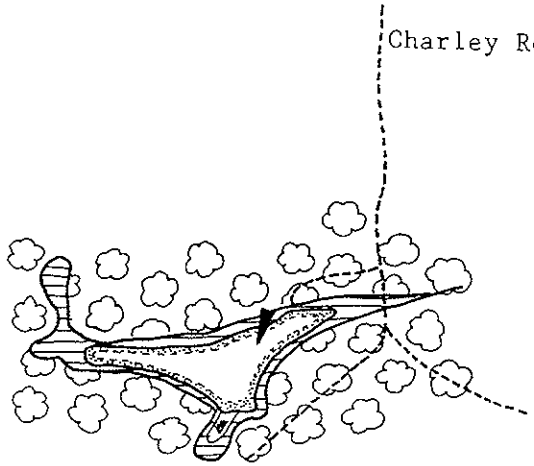


photo point

0 0.5 km

photo 1. Panorama of Lake Charley.

NO. 30 MEERUP LAKE

GENERAL DESCRIPTION

This lake is somewhat similar to two lakes at Yeagarup, as it is very slowly being filled by a high mobile sand dune moving toward the east. The only areas of open water are immediately at the foot of the dune. The complex of wetland vegetation associations further east in the valley may be in the process of drying out as aeolian deposition and hydrological changes take place before the advancing dune.

In the context of this study, the vegetation associations encountered were unremarkable, except that of the Tall Sedges. This community included *Eleocharis sphacelata* (comprising at least 10% of the cover) which has not been collected from any of the other 31 lakes. Its discovery in this location is very important in terms of the known distribution of this species. There are only seven collections currently housed in the W.A. Herbarium; two from locations in the north-west, one from Queensland, three from near Perth and one from near Esperance. Another population may occur near Lake Muir (J.A.K. Lane, pers. comm.). In the shallower margins of the north-west corner the *Eleocharis sphacelata* had been heavily grazed by kangaroos.

The lake and associated valley, surrounded by the mobile dune and consolidated dunes under Bullich woodland, forms quite spectacular scenery. Particularly appealing is

the narrow arm of open water in the south-west corner flanked by steep consolidated sandy slopes of Bullich woodland. The area is relatively remote and is only accessible on foot from the nearest road, 2km east. Consequently it is very infrequently visited. However a recently used campsite was found which contained considerable rubbish, including a 1992 newspaper. The route used was heavily marked by fresh flagging tape, which was removed. Judging from some of the rubbish left, the campers were probably seeking marron.

SEMENIUK CLASSIFICATION

MESOSCALE MACULIFORM SEDGELAND-THICKET-HEATH-WOODLAND IRREGULAR FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: $34^{o}38'$ Long: $115^{o}56'$

WATER:

Colour: dark brown

pH: 5.0

Depth: 3.0m (estimated)

Movement: slight flow south-west into long narrow arm

TSS: 135mg l^{-1}

FAUNA: Swamp hen; tracks of large dog, emu and kangaroo

ACCESS: Although a track from the end of Richardson Road is visible on the 1989 aerial photos, it is largely overgrown and cannot be followed on the ground. The lake was located

on foot approximately 2km due west of a northward bend in Richardson Road, through an old pine plot.

INSPECTION: 23.3.92

MEERUP LAKE - VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5	6
Baumea articulata	c		r			
B. juncea	r					
B. riparia	r					
B. vaginalis	r		r			
Centella asiatica	r	r	r			
Eleocharis sphacelata	i					
Gratiola peruviana	r					
Triglochin procera	r					
Agonis juniperina		c	r			
Astartea fascicularis		r	c	i		
Banksia seminuda		r				
Callistachys lanceolatum		r				
Leptocarpus scariosus		r	r			
Lobelia alata		r				
Agonis linearifolia			r			
Melaleuca preissiana			r			
Patersonia umbrosa			r			
Schoenus cruentus			r			
Xyris lacera			r			
Aotus villosa				r		
Beaufortia sparsa				r		
Boronia stricta				r		
Homalospermum firmum				r		
Schoenus rodwayanus				r		
Anarthria scabra					r	
Acacia extensa					r	
A. pulchella					r	
Anigozanthos flavidus					r	
Banksia ilicifolia					r	r
B. seminuda					r	r
Boronia crenulata					r	
Conostylis aculeata					r	
Eucalyptus megacarpa					i	r
E. patens					r	
E. marginata					r	c
Isolepis nodosa					r	
Jacksonia horrida					r	r
Kunzea recurva					r	
Leucopogon capitellatus					r	r
L, interruptus					r	
Lomandra hastilis					r	
Loxocarya flexuosa					r	
Sollya heterophylla					r	
Agonis flexuosa						r
A. parviceps						i
Macrozamia reidlei						r
Pultenaea reticulata				r		r
Persoonia longifolia						r
Xanthorrhoea preissii						r

Communities
1- Tall Sedges
2- Cedar Dense Low Forest
3- Astartea Heath
4- Homalospermum Heath
5- Bullich Woodland
6- Jarrah Woodland

30 MEERUP LAKE

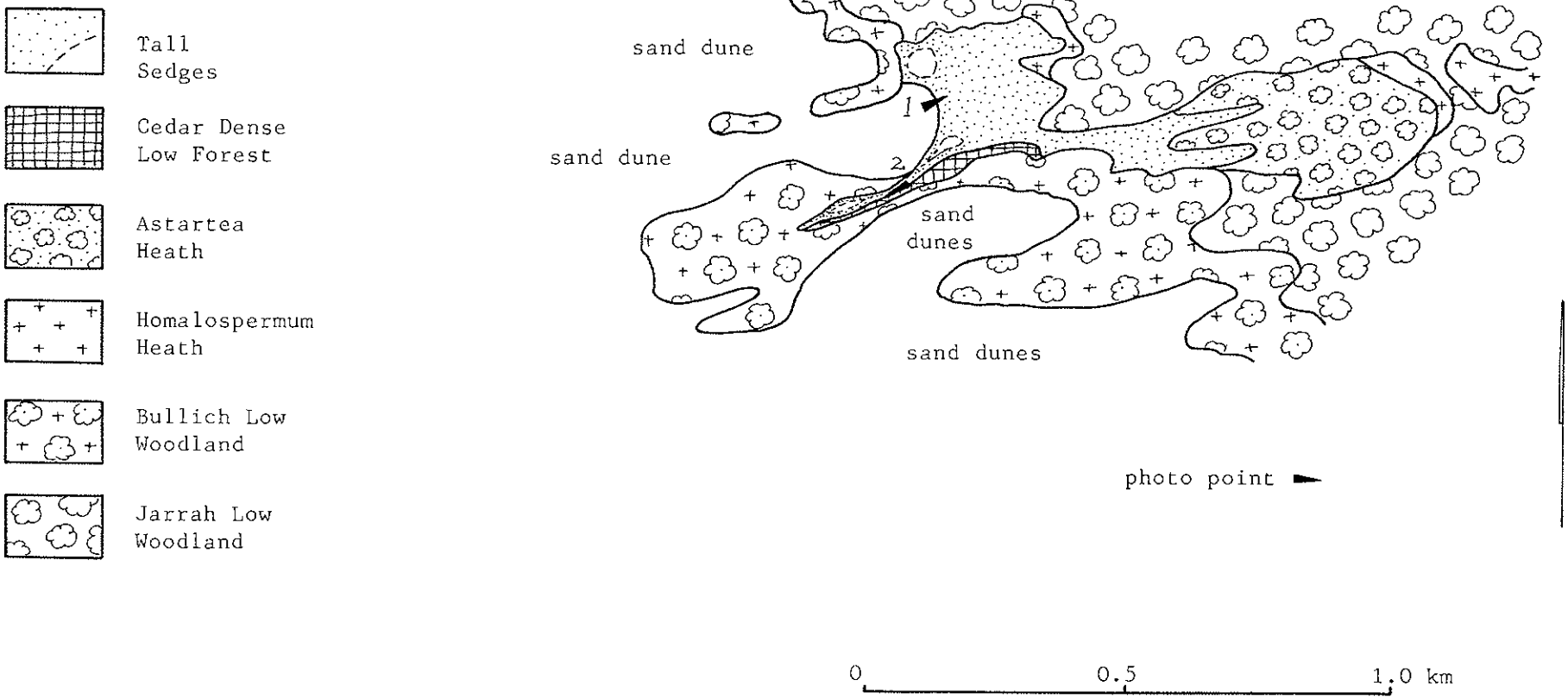


photo 1. Panorama of Meerup Lake looking east.

photo 2. Eleocharis sphacelata.

photo 3. South western arm of Meerup Lake.

NO. 31 DEESIDE LAKE

GENERAL DESCRIPTION

Deeside Lake is a shallow, white sandy shored lake in a broad heath flat (subject to seasonal waterlogging or inundation) in the catchment of Chesapeake Brook which flows into the lower Shannon River. The lake is not directly connected to the local drainage, but in periods of high water level (winter) the lake surface is expected to flow out into the surrounding heath. The lake bed was covered by a thick layer of dense peat, which could be walked upon. Using a calibrated net handle it was possible to measure the depth of peat (down to the solid sand bed) below the open water at the lake's centre.

Human visits are likely to be extremely infrequent, with no current evidence except two pieces of flagging tape at the southern end. Access was gained via an overgrown bulldozer line (visible on 1988 aerial photography) running south-east from Deeside Coast Road. The dry bed of Chesapeake Brook, just west of the lake was located from the bulldozer line, and followed to within 100m from the lake.

The lake is fringed by a narrow band of sedges, almost entirely composed of *Leptocarpus* species. Beyond the sedge fringe on the western side is a thicket of tall *Agonis linearifolia* which grades off into a *Beaufortia sparsa* heath. The northern and eastern side (behind the sedges)

are flanked by seasonally inundated *Agonis floribunda* heath over sedges.

Many carapace scales (scutes) from tortises were found on the shore and in the shallows. The number of scutes indicated the presence of a significant population of tortises (identified as long necks, *Chelodina oblonga*, by A.A. Burbidge); none were actually seen as the lake waters, although shallow, were almost black with tannins and peat. It is postulated that this lake represents a vital refuge for these amphibian reptiles during dry periods. It is presumed that when the surrounding flats are inundated during winter the tortises forage far out from the lake and return as the waters recede. The next nearest permanent water is 4.5km east in the Shannon River. Small fish were observed breaking the surface of the lake water. One was caught (a pygmy perch); these may provide a summer food source for the tortise population.

Many small frogs were observed around the clumps of *Leptocarpus* in moist sand. Fragments of predated crustaceans were present around the lake, but there were few burrows in the lake shores.

SEMENIUK CLASSIFICATION

MICROSCALE ZONIFORM SEDGELAND-HEATH-THICKET ROUND FRESH LAKE

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°51' Long: 115°18'

WATER:

Colour: very dark brown

pH: 4.8

Depth: 350mm (over 1100mm peat)

Movement: none

TSS: 259 mg 1^{-1}

FAUNA: Frog, fish, tortise (long necked or oblong)

ACCESS: South-east from Deeside Coast Road between Chesapeake Road and freehold (Location 5605) via old bulldozer line.

INSPECTION: 27.2.92

DEESIDE LAKE - VEGETATION COMMUNITIES

SPECIES	1	2	3	4	5
Myriophyllum tillaeoides	r				
Triglochin procera	r	r			
Baumea vaginalis		r			
Cassytha glabella		r			
Gratiola peruviana		r			
Leptocarous coangustatus		i			r
L. scariosus		r			r
Villarsia lasiosperma		r			r
Xyris lacera		r			r
Agonis linearifolia			i	r	
A. parviceps			r	r	
Acacia hastulata			r	r	
Adenanthos obovatus			r	r	
Boronia stricta			r		
Banksia quercifolia			r	r	
Beaufortia sparsa				r	
Dasypogon bromeliifolius			r	r	
Evandra aristata				r	
Gymnoschoenus anceps			r	r	
Homalospermum firmum				r	
Patersonia umbrosa				r	
Sphaerolobium sp.			r	r	
Stylidium scandens			r	r	
Agonis floribunda					r
Astartea fascicularis				r	r
Diaspasis filifolia					r
Cyathochaeta clandestina					r

Community 1- Aquatics
2- Tall Sedges
3- Agonis linearifolia Thicket
4- Beaufortia Heath
5- Agonis floribunda Heath

31 DEESIDE LAKE

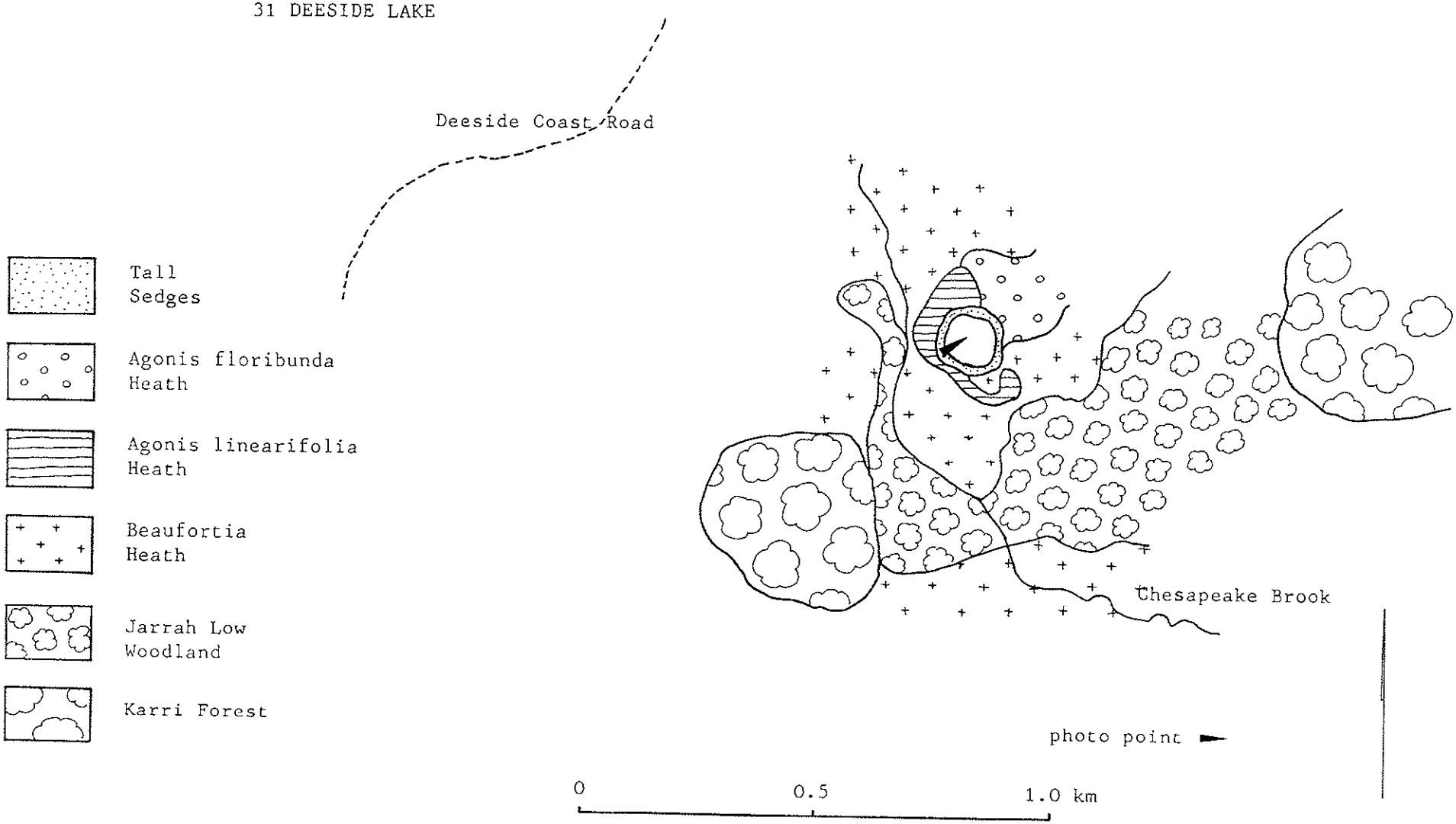


photo 1. Panorama of Deeside Lake; looking north east (above) and south east (below).

NO. 32 LOWER SHANNON LAKES

GENERAL DESCRIPTION

Three lakes form a close series in the seasonally inundated or waterlogged flats in the region south of the lower Shannon River, at the western end of Broke Inlet. The lakes are nestled against the south-western edge of a sandy ridge of Jarrah woodland. The ridge end of each lake is fringed by tall Cedars *(Agonis juniperina)* which peter out towards the broad flats surrounding the lakes and the sandy ridge. The flats are vegetated with *Beaufortia* heath and *Agonis floribunda* Heath, the latter association dominating behind the sedge fringe of the lakes indicating that in winter the lake surfaces flood out into the surrounding vegetation.

An extremely hot wild fire (possibly 12-18 months prior to this survey) had killed most of the Cedars *(A. juniperina)* and many of the *Agonis floribunda*. Judging from the size of the burnt out trunks of the *Agonis floribunda*, which appear to regenerate only by seed, they had been long unburnt. Most of the clumps of fringing *Leptocarpus* had been burnt down to hummocks of peat and were slowly regenerating. The remaining living clumps of *Leptocarpus* around the immediate lake edges frequently formed sculptured peat columns, similar to those seen at Lake Florence. *Beaufortia sparsa* and *Astartea fascicularis* were resprouting from lignotubers, whilst seedlings of *Agonis juniperina* and

A. floribunda were establishing. The number of species recorded in most vegetation communities is lower, due to the effects of the fire.

Similar to Deeside Lake (5km north-west), the sandy lake bed was covered with peat (to a recorded depth), however the shores were not clean white silicious sand but very soft and peaty. This may be resultant from above-normal deposits of organic matter and charcoal being washed into the lakes after the recent fire. The lake beds were softer and more difficult to walk over than Deeside Lake.

Tortise carapace scales (see Deeside Lake) were found in and between the lakes. No fish were caught in a brief scoop netting effort. The third and most easterly lake was not surveyed due to insufficient time.

SEMENIUK CLASSIFICATION

MICROSCALE BACATAFORM-ZONIFORM SEDGELAND-HEATH-FOREST ROUND FRESH LAKES

RESERVE: D'Entrecasteaux National Park

LOCATION: Lat: 34°52.5' Long: 116°21'

WATER:

Colour: dark brown (both)

pH: 4.4 (both)

Depth: western lake - 350mm (550mm peat)
middle lake - 300mm (700mm peat)

Movement: none

TSS: 404mg l^{-1} (western)
409mg l^{-1} (middle)

FAUNA: Tortise scales, crustacean carapace and claws (surrounding heath)

ACCESS: Barriered track from Chesapeake Road (1.5km west of Shannon River), approximately 4km south and then 800m south-west along firebreak.

INSPECTION: 27.2.92

LOWER SHANNON LAKES - VEGETATION COMMUNITIES.

SPECIES	1	2	3	4	5	6
Triglochin procera	r	r				
Baumea vaginalis***		r				
Leptocarpus coangustatua		c	r			
Agonis juniperina			c			
Ampera volubilis			r			
Astartes fascicularis			r	r	r	
Villarsia lasiosperma				r		
Agonis floribunda			r	c		
A. parviceps					r	r
Adenanthos obovatus					r	
Anarthria prolifera					r	
Banksia quercifolia					r	
Beaufortia sparsa					r	
Dasypogon bromeliifolius					r	
Evandra aristata					r	
Haemodorum spicatum					r	
Homalospermum firmum					r	
Kunzea recurva					r	
Pultenaea reticulata					r	
Xanthorrhoea preissii					r	r
Acacia myrtifolia						r
Eucalyptus marginata						i
E. patens				r		r
Anarthria scabra						r
Macrozamia reidlei						r
Persoonia longifolia						r
Pteridium esculentum						r
Patersonia occidentalis						r

*** middle lake only

Community 1- Aquatics
2- Tall Sedges
3- Cedar Dense Low Forest
4- Agonis floribunda Heath
5- Beaufortia sparsa Heath
6- Jarrah Low Woodland

32 LOWER SHANNON LAKES

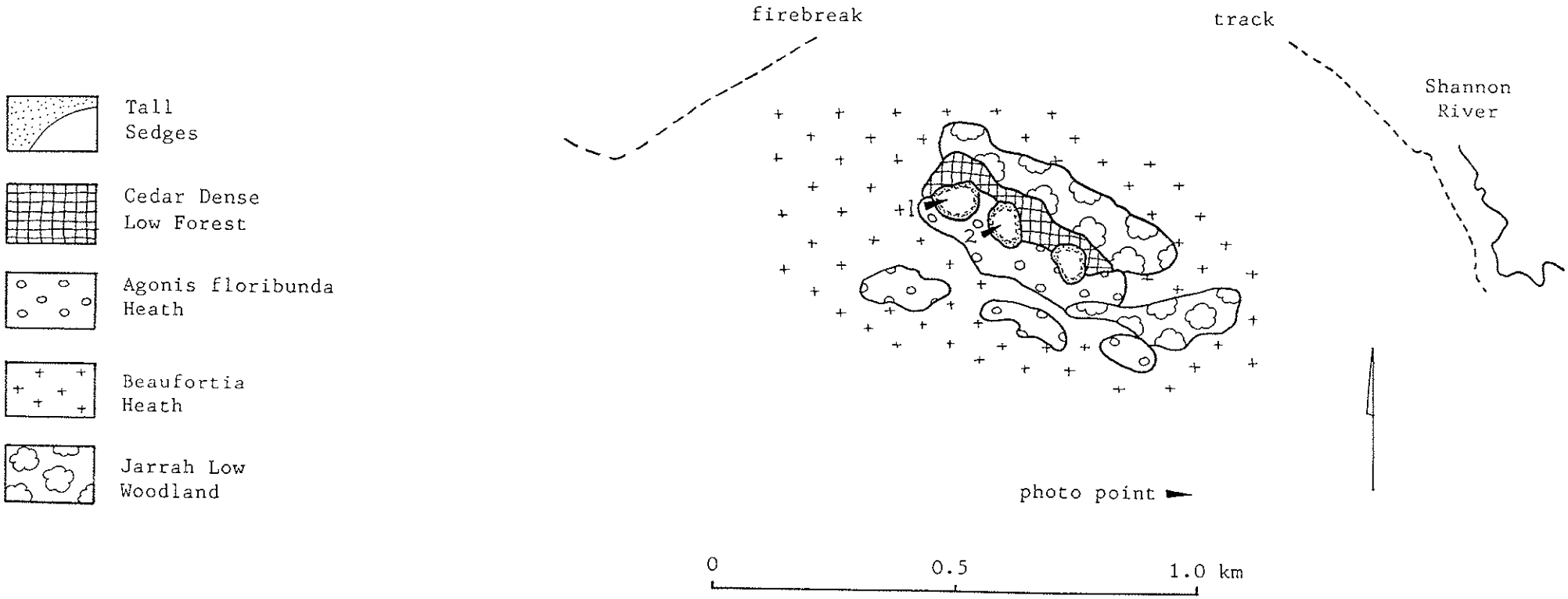


photo 1. Triglochin procera and regenerating Leptocarpus.
Western lake.

photo 2. Middle lake with Tall Sedges fringe.
Cedar low forest and Jarrah forest in background.