FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

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SUMMARY

During autumn 1992, 27 permanent lakes and swamps in Crown Land on the south coast (Cape Naturaliste to Albany) of Western Australia were surveyed for occurrence and abundance of fishes. The work was part of a biological survey of the wetlands by the WA Department of Conservation and Land Management with funding from Australian National Parks and Wildlife Service. It was the first intensive survey of fishes in permanent lakes and swamps throughout the south coast area, using a variety of methods.

Data on presence/absence and relative abundances of fishes were obtained by dab-netting, spot-lighting, trapping and poisoning with Rotenone. Broadly similar procedures were followed at each wetland.

Twelve native fish species were recorded: these comprised nine principle species being all those expected to occur plus one (*Galaxias maculatus*) new to the study area, and three secondary species. One exotic species *Gambusia affinis* was recorded.

The most widespread species were *Edelia vittata* and *Bostockia porosa*. The poorly known Balston's pygmy perch *Nannatherina balstoni* was relatively widespread, usually occurring in wetlands with tall sedges. *Galaxiella* species were rarely recorded; they were associated with extensive shallows and were found only between Northcliffe and Denmark. *Lepidogalaxias salamandroides* was found only in seasonal parts of Doggerup Lake. *Tandanus bostocki* was found only at Lake Wilson in cavities in tussock root mounds. The secondary species *Atherinosoma wallacei* and *Favonogobius suppositus* generally were in wetlands connected to the sea.

The occurrence of species was not strongly influenced by salinity of surface water but may be influenced by wetland area and number of `fish habitats' present.

No species were recorded at five wetlands, most of which were isolated from other wetlands by high dunes.

In terms of relative abundance, *Edelia vittata* was dominant at the majority of wetlands.

Most of the 12 native species appear to be widespread and abundant in Crown Land wetlands of the study area and/or adjacent parts of south-western Australia; none are currently endangered.

Owingup Swamp and Lake Jasper probably are the most important wetlands for fishes. In addition they are highly distinctive in terms of presence and relative abundance of fishes (cluster analysis: Raabe's Co-efficient). They are included in a representative set of ten protected wetlands that include all of the native principle fishes of the south coast.

Owingup Swamp is potentially threatened by deterioration of water quality due to inappropriate land-use practices in its unprotected catchment (Kent River). Lake Jasper is potentially threatened by water contamination from possible mining of mineral sands in its catchment.

Further introductions of the exotic *Gambusia* on the south coast should be prevented, particularly in the ten representative wetlands.

1. INTRODUCTION

1.1 Background

In 1991-2, the Australian National Parks and Wildlife Service provided $36 000 under the States Co-operative Assistance Program, to enable the Department of Conservation and Land Management (CALM) to conduct wetland inventory work on the south coast of Western Australia. This work was to include surveys of flora (by C. Robinson), invertebrate fauna and water chemistry (by D. Edward) and other fauna (waterbirds, frogs and fishes). Surveys of the fishes were done by the author under contract to CALM and are the subject of this report.

The inventory work was needed because CALM lacked comprehensive baseline biological data that would enable the conservation significance of the subject wetlands to be determined and against which potential impacts on the wetlands and their biota could be assessed. Potential impacts include possible future demands on water resources, proposed exploration and possible mining for mineral sands and increasing recreational use of the wetlands.

CALM did not have data on fishes obtained from systematic surveys of all the subject wetlands. Work done by Christensen (1982), Pusey and Edward (1990) and Allen and Berra (1989) included few or none of the subject wetlands. Edward *et al.* (in prep.) recorded fishes obtained by dab-netting while surveying for invertebrates; this was not an extensive survey of the fishes in all of the subject wetlands.

This report addresses the deficiency: it includes the results of systematic, intensive fish surveys conducted by the author during the autumn of 1992, raw and summary data for each wetland and discussion on the relationships between fish occurrence/abundance and habitat, the relative importance of each wetland for fishes and management issues.

1.2 Study Area and Wetlands to be Surveyed

The study area was the south coast of Western Australia from Cape Naturaliste to Albany, within 20 km of the coast (Fig. 1).

The wetlands to be surveyed for fishes in autumn 1992 were the same 27 surveyed for waterbirds in summer 1991-2 by the author (Jaensch 1992); they are listed in Table 1. All except Warren River Oxbow were surveyed for vegetation and floristics in 1991 and 1992 by Robinson (1992) and 23 were surveyed for invertebrates, fishes and water chemistry in (mainly) winter and spring 1991 by Edward *et al.* (in prep.).

Maximum commonality of wetlands surveyed for fishes, vegetation and water chemistry was desirable to facilitate examination of relationships between fish occurrence and habitat.

The wetlands to be surveyed provided a comprehensive representation of the types of permanent lakes and swamps occurring in the study area, varying greatly in area (< 1.0 ha to > 300 ha), maximum depth (< 1.0 m to > 10.0 m), and extent of vegetation subject to inundation (fringing to throughout the wetland). Most were fresh (total soluble salts < 1.0 parts per thousand), but a few were brackish (t.s.s. from 1.0 to <3.0 p.p.t.); many were acidic but a few were alkaline with pH ranging from 4.3 to 8.8 (Robinson 1992).

All of the wetlands are on Crown Land, most of it vested in the Western Australian National Parks and Nature Conservation Authority (NPNCA) and managed by CALM.

The distribution of these wetlands within the study area is shown in Figure 1: four are between Capes Naturaliste and Leeuwin, 14 are between Cape Leeuwin and Point Nuyts and nine are between Point Nuyts and Albany.

Figure 1. The study area and wetlands surveyed.

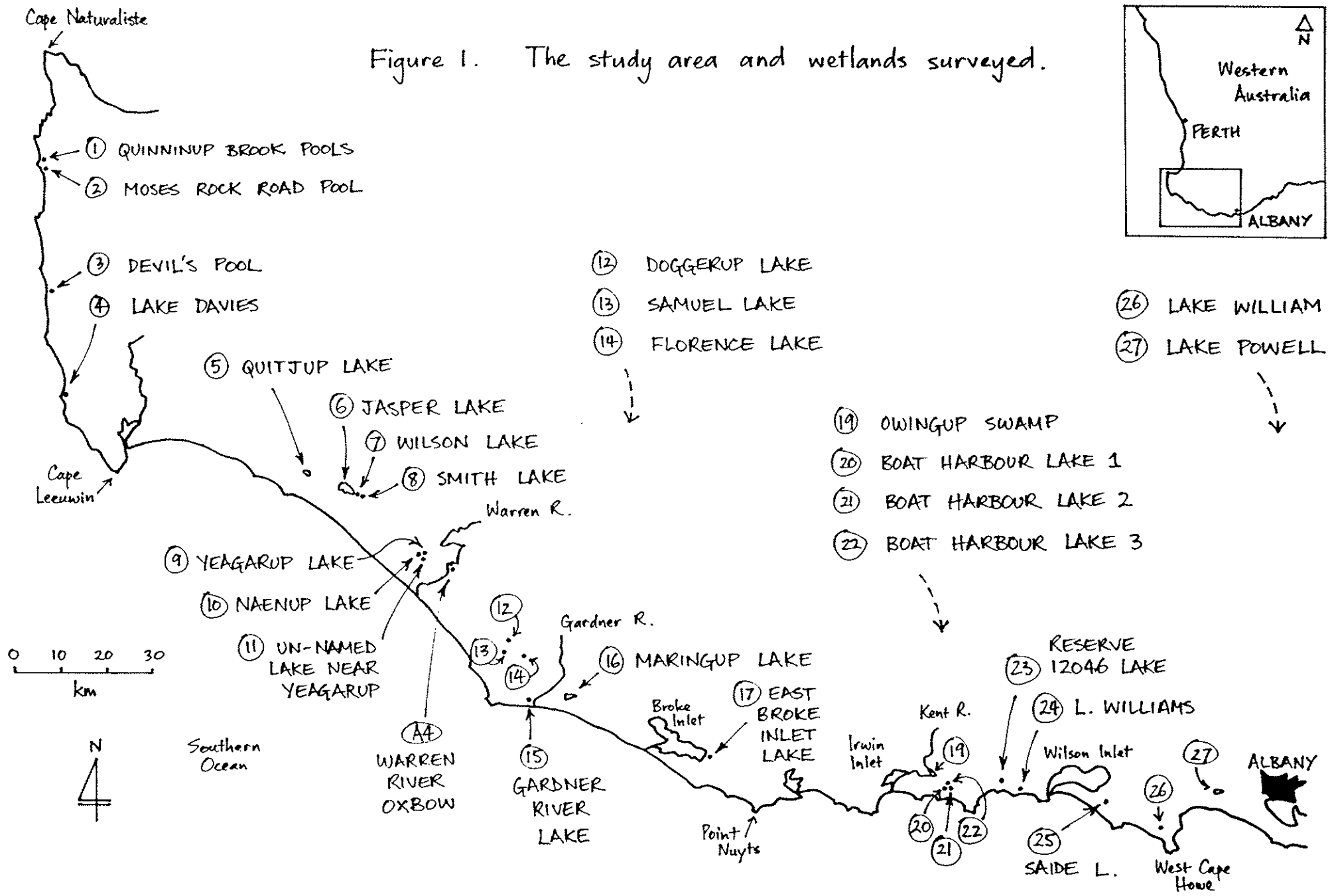


Table 1. The wetlands surveyed and dates of surveys.

Site Code	Wetland Name	Lat.(S)	Long.(E)	Date Surveyed
1	Quinninup Brook Pools	33°45'	115°00'	9 May 1992
2	Moses Rock Road Pool	33°46'	114°59'	4 May 1992
3	Devil's Pool	34°01'	115°01'	5 May 1992
4	Lake Davies	34°13'	115°02'	5 May 1992
5	Quitjup Lake	34°23'	115°35'	24-25 April 1992
6	Lake Jasper	34°24'	115°41'	23-24 April 1992
7	Lake Wilson	34°26'	115°43'	22-23 April 1992
8	Lake Smith	34°26'	115°43'	22-23 April 1992
9	Yeagarup Lake	34°32'	115°53'	6-7 May 1992
10	Naenup Swamp	34°32'	115°52'	6-7 May 1992
11	Un-named Lake (Near 9)	34°33'	115°52'	6-7 May 1992
A4	Warren River Oxbow	34°34'	115°55'	7 May 1992
12	Doggerup Lake	34°43'	116°04'	7-8 May 1992
13	Lake Samuel	34°44'	116°04'	8 May 1992
14	Lake Florence	34°44'	116°06'	7-8 May 1992
15	Gardner River Lake	34°50'	116°06'	3-4 April 1992
16	Maringup Lake	34°50'	116°12'	2-3 April 1992
17	Lake East of Broke Inlet	34°57'	116°32'	2 April 1992
19	Owingup Swamp	35°00'	117°04'	20 March 1992
20	Boat Harbour Lake 1	35°01'	117°05'	30-31 March - 1 April 1992
21	Boat Harbour Lake 2	35°01'	117°06'	30-31 March 1992
22	Boat Harbour Lake 3	35°01'	117°06'	31 March - 1 April 1992
23	Reserve 12046 Lake	35°00'	117°13'	18-19 March 1992
24	Lake Williams	35°01'	117°16'	19 March 1992
25	Lake Saide	35°03'	117°28'	17 & 19 March 1992
26	Lake William	35°05'	117°36'	18 March 1992
27	Lake Powell	35°01'	117°44'	17 & 21 March 1992

1.3 Objectives

Objectives of the research were:

(1) to test and use a variety of methods for assessing the occurrence and abundance of fishes in south coast wetlands; and

(2) to examine relationships between fish occurrence and habitat, the relative importance of each wetland for fishes and management issues.

2. METHODS

2.1 Survey Effort and Sampling Sites

The fish surveys were conducted within the period 17 March to 9 May 1992. They were done in autumn to capitalise on the seasonal concentration of fish in minimum areas of water and thereby improve chances of finding all species present. Dates of surveys at each wetland are given in Table 1.

In general, the survey strategy at each wetland was kept similar to permit an assessment of the relative importance of the wetlands for fishes. It entailed several hours of intensive catching effort, with extra effort made at some larger wetlands (e.g. Lake Jasper) that had a greater diversity of `fish habitat' (see below) and less effort at smaller, simpler sites, e.g. Quinninup Brook Pools. In addition, catching was done at night where it seemed likely that that effort would produce additional species.

At each wetland one or more sampling sites were chosen and usually three methods (see below) were used to obtain fish. Each sampling site was representative of a major fish habitat or association of habitats observed in the wetland at that time. At most wetlands one or two sampling sites were sufficient to include all the habitats.

Substrate and water depth generally determined the location of the sampling site if the particular fish habitat (e.g. fringing tall sedges) was extensive. A boat was sometimes used to gain access to sampling sites but where boat access was not possible and wading therefore required, a site with firm substrate and water less than 50 cm deep was chosen.

Location over sandy or other pale coloured substrate was also advantageous for sighting of fish if the water was dark coloured.

2.2 Catching Methods

Up to four recognised catching methods were used at each wetland: dab-netting, spot-lighting, baited fish traps and poisoning with Rotenone. Each method was trialled at the start of the project to gain familiarity with its potential and limitations.

Dab-netting involved using a fine-meshed net (triangular-mouthed 250 micron plankton net, D-mouthed 1 x 1 mm invertebrate net or 3 x 3 mm prawning net) on a 1.0-1.5 m handle to sweep randomly through the water, plunge in front of the moving operator, push through the thin layer of lake-bed litter or probe around sedges. Edward *et al.* (in prep.) also used dab nets.

Spot-lighting was done by night at wetlands where sandy beaches were present (Maringup, Yeagarup, Jasper) and it was thought that additional species might be recorded. It involved shining a strong torchlight into the water and dab-netting fish attracted to or revealed by the light.

Collapsable fish traps, advertised as `bait traps', were obtained from a retail store. Each trap was a 40 x 25 x 25 cm rectangular volume enclosed in 2 mm nylon mesh, with two funnel entrances giving fish access to a baited pouch (Fig. 2). A handful of dry cat food (chicken and liver variety) was wrapped in stocking and placed in the pouch and used several times over 4-6 days. A minimum water depth of 12 cm was needed to allow surface-swimming fish to enter the trap (Fig. 3).

Natural fish poisons such as the alkaloid Rotenone found in six genera (e.g. *Derris*) of Leguminosae, have long been used by subsistence and hunter-gatherer human communities including Australian Aborigines (Randall 1963, Low 1991). Rotenone causes the death of

Figure 2. Overhead view of baited fish trap. Note the two funnel entrances, pouch for bait (short zip) and long zip (open) for retrieval of fish. Trap length is 40 cm.

Figure 3. Fish trap set in water about 20 cm deep; seasonal swamp part of Doggerup Lake, 8/5/92.

Figures 4 and 5. Retrieval of fish poisoned by Rotenone; Boat Harbour Lake 1, 1/4/92.

fishes by vasoconstriction of the capillaries of the gills (Randall 1963). Powdered Rotenone without additives has relatively little effect on most invertebrates and undergoes decomposition when exposed to light and air (Randall 1963, Low 1991).

Use of Rotenone fish poison in this project generally followed procedures recommended by G. Allen (WA Museum) with modifications arising from field trials at Lake Powell. The trials showed that mixing of approximately 200 g of Rotenone marketed as `Barbasco Root' (untreated, powdered plant matter, imported from Peru) in 10-12 litres of water produced an acceptable result when poured in a thin line 8-12 m long in water less than 50 cm deep. That is, a large proportion of the fish visible in that area were killed within 1.0 hours, few if any fish were killed in the following hour, none were found freshly dead 24 hours later, significant numbers remained alive and apparently healthy in the test area 24 hours later, and although some fish were netted while escaping the treated area or found dead within about 5.0 m of the area (having floated away), none were found farther afield.

Due to the fineness of the dry Rotenone powder it was necessary to transport it in sealed plastic bags, mix it with water while wearing a particulate-excluding respirator mask and avoid inhaling while spreading the mixture.

With practice the preparation and spreading of Rotenone in one site could be effected within 5-10 minutes. Typically, the first affected fish, which were the smallest specimens, were sighted swimming jerkily near the water surface within 10-15 minutes. It was necessary to busily patrol the area of treatment and nearby areas to scoop up the struggling and escaping fish before they died and sank to the lake bed (Figs. 4 & 5), though dead and dying galaxiids sometimes floated for a while.

Usually the Rotenone mixture was spread beside or within fish shelter, parallel to the shoreline. The proportion of wetland `shore' treated with Rotenone was usually 1.0-5.0 per cent (median ca. 2.0 %). Small embayments or windward corners of the lake were often targetted to prevent or limit the spread and dilution of poison by wind or water movement. Where some spread inevitably occurred the total fish catch was greatly reduced.

Rotenone was not used at three wetlands (Quininnup Brook Pools, Moses Rock Road Pool and Lake East of Broke Inlet) because of small wetland area and/or shallowness and therefore potential for excessive fish kill. Baited traps were not set in Lake Saide (too shallow) and Lake Williams (traps in use elsewhere) and dab-netting was not tried at seven wetlands.

2.3 Specimen Collections

During the first surveys, all fish were retained as preserved specimens for confirmation of identifications by referral to the WA Museum. Several species overlooked in the field were recognised on closer examination in the laboratory.

Subsequently, all fish caught live were released at point of capture once identified and counted, except where a representative specimen of a species was needed for that wetland. All poisoned fish were retained as preserved specimens.

Specimens were preserved by placement in 10 per cent formalin solution soon after capture and transferred to 70 per cent alcohol solution within seven days.

The principal references for identification of fishes were the guide by Allen (1982) and recent papers, e.g. Berra and Allen (1989).

A representative reference collection of fish species obtained from each wetland is housed at the WA Museum. Specimen registration numbers are given in Appendix 2.

2.4 Fish Habitats

In addition to the species and numbers obtained of each species, the following data also were recorded at each wetland: salinity (surface water samples taken and measured in the laboratory with a TPS LC80 conductivity kit), location and extent of sampling sites (on maps) and potential habitats for fish at the date of survey. `Fish habitats' were those components of the wetland vegetation or topography, observed during the survey, that were wholly or partly covered in water and potentially provided shelter or feeding areas for fish. These were classified as follows:

* sedges or rush (e.g. *Baumea* spp.) standing in water;
* thickets of shrubs (e.g. *Agonis* spp.) standing in water;
* logs that were partly or fully submerged;
* steep banks or tussock root mounds (usually with holes) that were covered by water;
* submerged aquatic weed, e.g. *Myriophyllum* spp.;
* shallow water (< 50 cm deep); and
* deep water (50 cm or deeper).

Several of these habitats commonly occurred in the same area, e.g. sedges, shallows and logs. Examples of some habitats are depicted in Figures 6 and 7.

Summary datasheets for each wetland surveyed are included in Appendix 1.

2.5 Analysis of Data

Cluster analysis by two algorithms (Sorensen's, Raabe's) was applied to the data using the Average Linkage Method (CLUSTERS3 rev 3.10 by Walker) in order to identify wetlands with similar fish faunas. Exotic species were included. Due to the program's limit of 20 sites, it was necessary to exclude two wetlands from the set of 22 that supported fish. Devil's Pool and Lake Davies were omitted because they were the only wetlands that supported secondary species but no principle species and because they are located in a landform unit found only in the far west of the study area: the Leeuwin-Naturaliste low coastal range.

Figure 6. Fish habitats: tall sedges and shallow water; Owingup Swamp, 20/3/92.

Figure 7. Fish habitats: logs/stumps and deep water; Maringup Lake, 3/4/92.

3. RESULTS & DISCUSSION

3.1 Wetland Depths and Salinities

The normal climate on the south coast is a wet cool winter followed by a dry hot summer with less than 20 mm of rain in both January and February.

Consequently, most of the wetlands were shallower in autumn 1992 than in the preceding summer; this was manifest in less fringing vegetation (and other fish habitats) being inundated (cf. wetland maps in Jaensch 1992). At Lake Jasper the fall in water depth over four months was 63 cm and extensive adjoining swamps were dry in autumn despite having been fully flooded in December. Exceptionally, several of the stream-fed wetlands surveyed in May, notably Doggerup Lake, had begun to refill due to resumption of stream flow with onset of the rainy season; fish therefore had renewed access to parts of those wetlands.

In general however, it could be assumed that fish were relatively concentrated rather than widely dispersed within each wetland surveyed in autumn 1992.

Measured autumn salinities of the 27 wetlands varied from 2.11 parts per thousand (p.p.t., total soluble salts) at Boat Harbour Lake 2, to 0.09 p.p.t. at Lake Samuel. In autumn, seven lakes were brackish (1.0-3.0 p.p.t.) and the rest fresh (< 1.0 p.p.t.) whereas only three were brackish in summer (Jaensch 1992). In autumn, salinity at 15 wetlands had not changed markedly (cf. summer salinities), salinity at nine wetlands had increased by 60-80 per cent and salinity at three wetlands had increased by more than 100 per cent (notably a five-fold increase at Lake East of Broke Inlet, which was drying out).

3.2 Species Recorded

The fish species recorded at each of the 27 wetlands surveyed in autumn 1992 are shown in Table 2. Some are illustrated in Figures 8-17.

The 13 species recorded comprise ten *principle* species (Allen 1982), that are generally confined to inland (non-tidal) waters, and three *secondary* species (a recently described hardyhead *Atherinosoma wallacei*, the bigmouth goby *Favonogobius suppositus* and the Swan River goby *Pseudogobius olorum*), that frequently occur in estuarine as well as inland situations. (Note that Pavlov *et al.* (1988) placed *Atherinosoma wallacei* in their new genus *Leptatherina wallacei* but this is not followed here.)

Eight native principle species were previously known to occur in the study area and all were recorded in the autumn 1992 surveys.

A ninth, the spotted minnow (= common jollytail) *Galaxias maculatus*, was recorded for the first time in the study area during the autumn 1992 surveys, in Boat Harbour Lake 3 on 31 March or 1 April 1992 (Fig 10). This represents an extension of known range about 80 km westwards from the Albany-Esperance area. *Galaxias maculatus* also occurs in south-eastern Australia, New Zealand and South America (Allen 1982). Though the species generally spawns in estuaries it can also adapt to landlocked situations where it may spawn in feeder streams (Pollard 1971). No marine connection or feeder stream is apparent at Boat Harbour Lake 3 though there is a short feeder drain from an adjacent swamp.

The tenth principle species recorded was an exotic, the mosquitofish *Gambusia affinis* (= *Gambusia holbrooki*). Several other exotics, notably rainbow trout *Salmo gairdneri*, brown trout *Salmo trutta* and redfin perch *Perca fluviatilis*, have been introduced to parts of south-western Australia but none were recorded in the lakes surveyed in autumn 1992. The

Table 2. Fish species recorded at each of the 27 wetlands surveyed in autumn 1992.

Species	Wetland (refer to Table 1 for wetland names and locations and dates of surveys)																											Number of wetlands in which recorded
	1	2	3	4	5	6	7	8	9	10	11	A4	12	13	14	15	16	17	19	20	21	22	23	24	25	26	27	
Galaxiella munda														*														1
Galaxiella nigrostriata													*[a]			*[b]		*	*									4[b]
Galaxias maculatus																						*						1
Galaxias occidentalis						*			*		*		*				*	*	*	*		*						9
Lepidogalaxias salamandroides													*[a]															1[a]
Tandanus bostocki							*																					1
Bostockia porosa					*	*	*	*	*			*	*	*	*	*	*	*	*	*		*	*	*				17
Edelia vittata					*	*	*	*	*		*	*	*	*	*	*	*	*	*	*		*	*	*	*[c]			19
Nannatherina balstoni					*			*					*		*	*	*	*	*	*								9
Atherinosoma wallacei			*														*		*								*	4
Favonogobius suppositus			*			*													*									3
Pseudogobius olorum			*	*		*											*		*	*		*	*		*		*	10
Gambusia affinis[d]									*			*													*		*	4
Total no. of species recorded	0	0	3	1	3	5	3	3	4	0	2	3	6	3	3	4	6	5	8	5	0	5	3	2	3	0	3	

[a]. Recorded only in adjoining shallow swamp, i.e. a few metres by water from the permanent (lake) part of the wetland.
[b]. *Galaxiella* sp. captured but not identified to species before it escaped.
[c]. Recorded only in the outflow drain, a few metres from the lake edge.
[d]. Exotic species.

Figure 8. Hardyheads *Atherinosoma wallacei* obtained from Maringup Lake, 2/4/92 (preserved specimens). Note the silvery lateral line and prominent scales. (Top fish standard length (SL) = 65 mm)

Figure 9. Bigmouth gobies *Favonogobius suppositus* obtained from Devil's Pool, 5/5/92 (preserved specimens). Note the disc-like pelvic fin. (Top fish SL = 68 mm)

Figure 10. Western minnow *Galaxias occidentalis* (top) and spotted minnow *Galaxias maculatus* (bottom), obtained from Boat Harbour Lake 3, 31/3/92 (preserved specimens). Note differences in head and markings. (*G. maculatus* SL = 67 mm)

Figure 11. Freshwater cobbler *Tandanus bostocki* obtained from L Wilson, 23/4/92 (preserved specimens). (Top fish SL = 94 mm)

Figure 12. Balston's pygmy perch *Nannatherina balstoni* (top 3) and western pygmy perch *Edelia vittata* (bottom) freshly obtained from the Lake East of Broke Inlet, 2/4/92. Note the much smaller mouth of *Edelia*.

Figure 13. *Nannatherina balstoni* obtained by Rotenone poisoning at Quitjup Lake, 25/4/92. (Top fish SL = 55 mm)

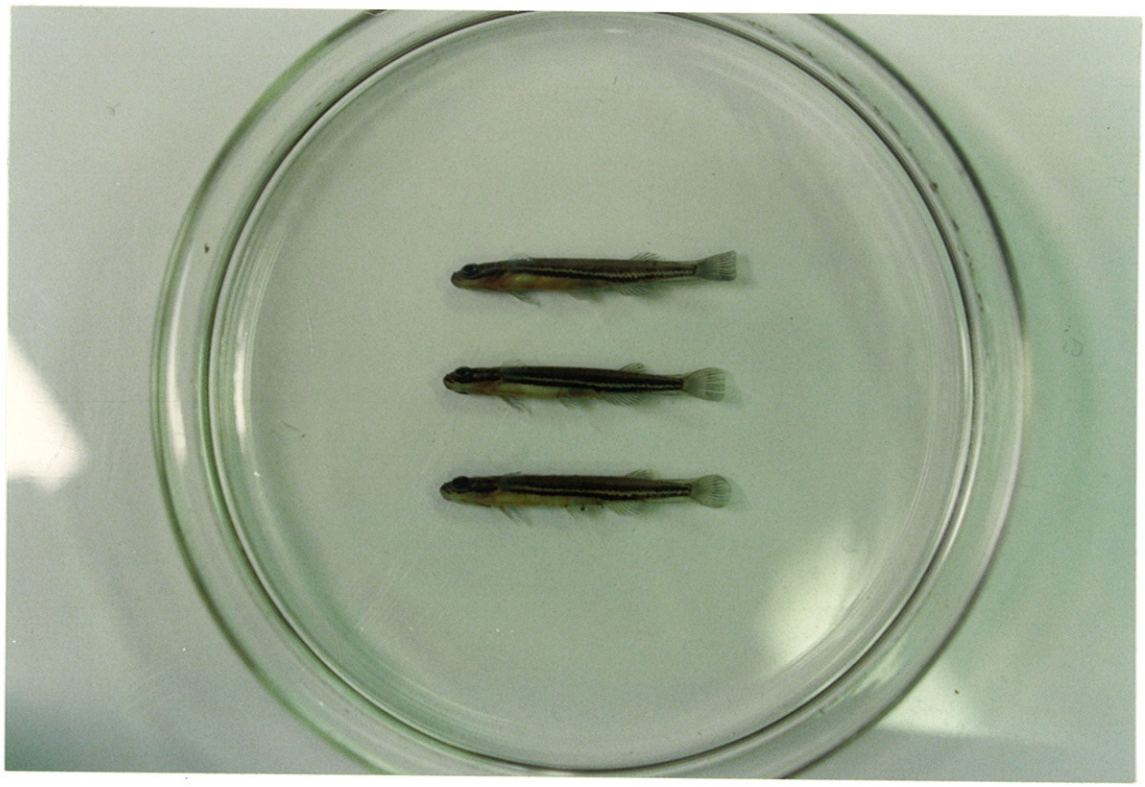


Figure 14. Black-stripe minnows *Galaxiella nigrostriata* obtained from Doggerup Lake, 8/5/92 (preserved specimens). (Top fish SL = 28 mm)

Figure 15. Nightfish *Bostockia porosa* obtained from poisoning at Maringup Lake, 2/4/92 (preserved specimens). (Top fish SL = 80 mm)

Figure 16. Variation in size and shape of *Edelia vittata* from Owingup Swamp, 20/3/92. (Largest fish SL = 54 mm)

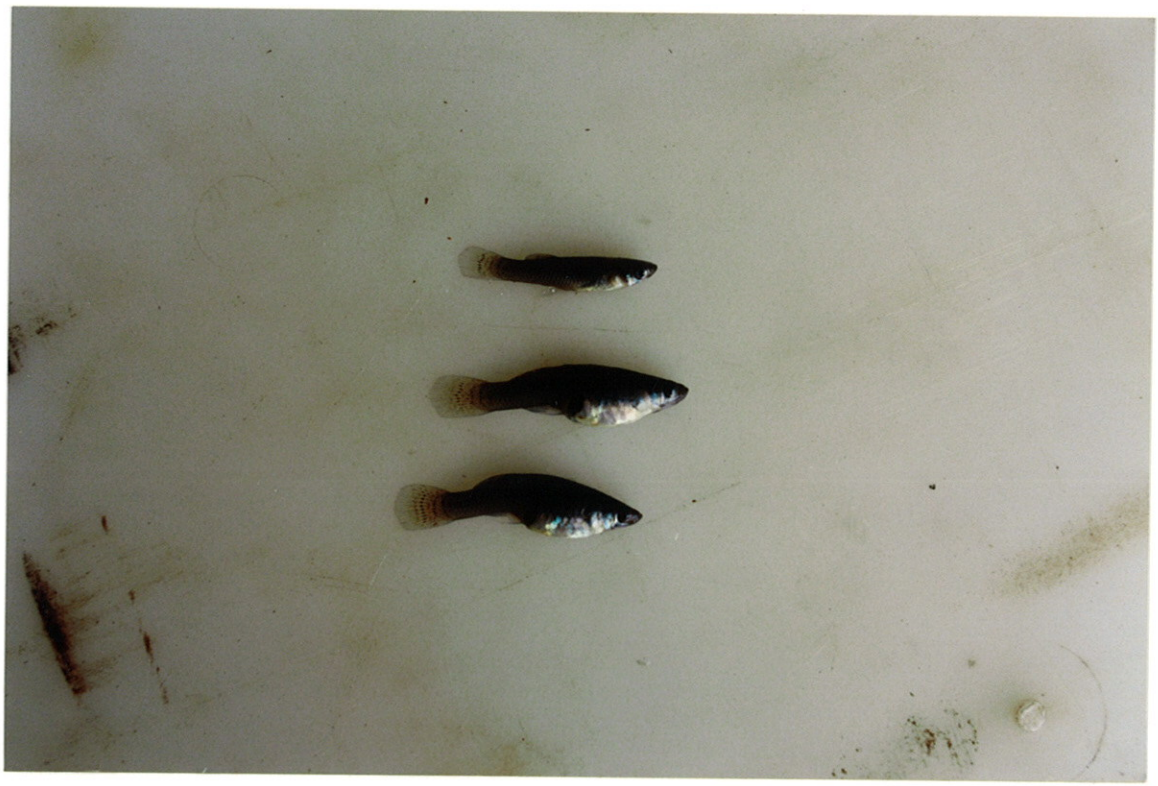


Figure 17. Mosquitofish *Gambusia affinis* (male at top, females at middle and bottom) obtained from Lake Powell, 21/3/92. (Middle fish SL = ca. 35 mm)

Murray cod *Maccullochella peeli* was introduced to Lake Powell near 1900 but has probably died out (Allen 1982).

Secondary species not recorded in autumn 1992 but which may occur in inland waters of south-western Australia include the pouched lamprey *Geotria australis*, Perth herring *Nematalosa vlaminghi* and mullets *Aldrichetta forsteri* and *Mugil cephalus* (Allen 1982).

The freshwater cobbler *Tandanus bostocki* was not recorded at Lake Jasper by the author but is known to occur there: C. Robinson found a beach-washed specimen on 19 March 1992 and children told the author they found cobblers in burrows on certain beaches in late April 1992.

Six of the 13 species recorded in autumn 1992 (*Galaxias maculatus*, the salamanderfish *Lepidogalaxias salamandroides*, *Tandanus bostocki*, Balston's pygmy perch *Nannatherina balstoni*, *Atherinosoma wallacei* and *Favonogobius suppositus*) were not recorded by Edward *et al.* (in prep.).

Of the 83 records of species at the 27 wetlands (the entries in Table 2), 32 were also obtained by Edward *et al.* (in prep.). Six records were obtained by Edward but not in the current study: the mud minnow *Galaxiella munda* at Lakes Jasper and Florence, the black-stripe minnow *Galaxiella nigrostriata* at Lake Smith, the western minnow *Galaxias occidentalis* at Quitjup Lake and Lake Samuel and the western pygmy perch *Edelia vittata* at Lake Powell. (Presence of galaxiids at Lakes Smith and Florence in autumn 1992 was suspected - fast movement of fish at the water surface - but not confirmed.)

Christensen (1982) surveyed 120 wetlands, few of which were lakes, in summer 1978 and 1979 using the dab-netting method. At Yeagarup Lake(s), the only wetland common to that and the present survey, he recorded three of the four species obtained by the author: *Galaxias occidentalis*, the nightfish *Bostockia porosa* and *Edelia vittata*, but not *Gambusia affinis*.

3.3 Distribution of Species

Fish species were not recorded at five of the 27 wetlands surveyed in autumn 1992: Quinninup Brook Pools, Moses Rock Road Pool, Naenup Swamp, Boat Harbour Lake 2 and Lake William. Edward *et al.* (in prep.) also found no fishes at Moses Rock Road Pool and Naenup Swamp but did not survey for fish at the other three wetlands.

The most widespread species were *Edelia vittata* (at 19 wetlands) and *Bostockia porosa* (at 17: Table 2). The least widespread species were *Galaxiella munda* (only at Lake Samuel), *Galaxias maculatus* (only at Boat Harbour Lake 3), *Lepidogalaxias salamandroides* (only at Doggerup Lake) and *Tandanus bostocki* (only at Lake Wilson, but see above).

Several researchers (Christensen 1982, Coy *et al.* 1992, Luke Pen pers. comm.) have suggested or implied that *Nannatherina balstoni* may be only sparsely distributed within its entire range (which more or less coincides with the study area) and therefore possibly vulnerable. However, in autumn 1992, it was found in nine of the 22 wetlands that had fish (equal fourth most widespread species). Eight of these nine wetlands were in three geographical clusters: the Quitjup-Smith group of lakes, the Doggerup-Maringup group and the Owingup-Boat Harbour group (Fig. 1). The species was absent from the five easternmost wetlands. Pusey and Edward (1990) found the species in each of the nine wetlands that they surveyed in the Northcliffe to Broke Inlet area.

Of the nine species each found in three or more wetlands, most occurred in the east, centre and west of the study area. However, *Galaxiella nigrostriata* was found only in the centre (between Northcliffe and Denmark) and *Gambusia affinis* was found in only two areas: near the Warren River and in the far east.

Pseudogobius olorum, though widespread, was absent from 10 lakes between Lake Jasper and Maringup Lake. This and the other two secondary species (*Atherinosoma wallacei, Favonogobius suppositus*) were the only fishes recorded from the four wetlands between Capes Leeuwin and Naturaliste (Fig. 1).

The distribution of some species appeared to be closely linked to occurrence of a particular fish habitat. *Galaxiella nigrostriata* was found only where there was an extensive area of water less than 30 cm deep. *Tandanus bostocki* was found (at Lake Wilson) where there were numerous root mounds of the sedge *Leptocarpus* sp. containing abundant cavities still under water. *Nannatherina balstoni* was invariably in or beside beds of tall sedge. (Even at Lake East of Broke Inlet where there were only two small clumps of sedge *Baumea vaginalis* still in water, each clump was sheltering one or two *N. balstoni* which composed the total catch of this species at that wetland.) *Atherinosoma wallacei* was only at lakes with known or suspected connections to marine habitats (at Maringup Lake there is probably an existing or ancient connection to Gardner River). *Favonogobius suppositus* was at lakes with marine connections, but also at Lake Jasper which is not marine-connected.

Lepidogalaxias salamandroides was not recorded in any areas of permanent water in the autumn 1992 surveys, a result consistent with previous work (Pusey and Edward 1990, Edward *et al.* in prep.) which has suggested that this species primarily occurs in seasonal swamps and survives by aestivation when the swamps dry out (Allen and Berra 1989). At Doggerup Lake, *Lepidogalaxias salamandroides* was not found in the area of permanent water but in adjoining seasonal wetland connected by a few metres of waterway that had recently reflooded (see datasheet and map in Appendix 1). *Galaxiella nigrostriata* is also thought to be capable of aestivation (Pusey and Edward 1990) and at Doggerup it also was confined to the attached seasonal wetland; here specimens exhibited the bold markings and reddish colour typical for early in the wet season, whereas specimens from other lakes (not yet re-flooded at time of survey) were plain.

3.4 Relative Abundances of Species

The relative abundances of species at each wetland as determined by the autumn 1992 surveys are presented in Table 3.

Edelia vittata was the dominant species at 14 of the 22 wetlands that had fish and at 14 of the 19 wetlands that had *Edelia*. It contributed more than two thirds at 11 wetlands. It was also the dominant species in permanent wetlands studied by Pusey and Edward (1990).

Pseudogobius olorum was dominant at three wetlands (Devil's, Davies, Reserve 12046), *Bostockia porosa* at two (East of Broke, Williams) and *Galaxias occidentalis* at one (Jasper). The exotic *Gambusia affinis* was overwhelmingly dominant at Lakes Saide and Powell and contributed at least 24 per cent of total catch at two other wetlands. *Atherinosoma wallacei* and *Favonogobius suppositus* made appreciable contributions (20+ %) at Devil's Pool and *Atherinosoma wallacei* likewise at Owingup Swamp.

The grand total catch of fish from the 27 wetlands in autumn 1992 was 4969 individuals (Table 3). Species obtained in highest numbers were *Edelia vittata* (65 % of grand total catch), *Gambusia affinis* (10 %) and *Galaxias occidentalis* (8 %).

3.5 Relative Importance of Wetlands

Rankings of wetlands by number of native fish species recorded in autumn 1992 are presented in Table 4.

Table 3. Relative abundances of fish obtained at each wetland.

For each wetland, the contribution that each species made to the total catch for that wetland is expressed as a percentage of the total catch. The sum of total catches is the "grand total catch" (individuals). Exotic species are marked (*).

Species	Wetland (refer to Table 1 for wetland names and locations and dates of surveys)																											Total Catch (individuals)
	1	2	3	4	5	6	7	8	9	10	11	A4	12	13	14	15	16	17	19	20	21	22	23	24	25	26	27	
Galaxiella munda														2														1
Galaxiella nigrostriata													4			1		7	<1									15
Galaxias maculatus																						<1						1
Galaxias occidentalis						49			3		11		3				1	2	2	7		13						385
Lepidogalaxias salamandroides													3															9
Tandanus bostocki							4																					8
Bostockia porosa					21	2	43	9	8			5	1	2	10	6	4	44	6	<1		1	8	93				294
Edelia vittata					73	47	53	90	58		89	71	85	96	80	90	91	40	60	90		85	31	7	1			3240
Nannatherina balstoni					6			1					4		10	3	2	7	2	1								63
Atherinosoma wallacei			34														<1		25								<1	97
Favonogobius suppositus			22			<1													2									19
Pseudogobius olorum			44	100		2											1		3	1		1	61		4		21	351
*Gambusia affinis**									31			24													95		79	486
Total Catch (Individuals)	0	0	50	79	86	489	215	163	36	0	64	62	274	64	20	108	1068	45	304	525	0	535	175	42	95	0	470	4969

The three most important wetlands in terms of species richness were Owingup Swamp (8 species), Doggerup Lake (6) and Maringup Lake (6: Table 4). Owingup Swamp and Doggerup Lake and probably also Maringup Lake are similar in that they are connected to the sea, each through different drainage systems (Kent River, Doggerup Creek and Gardner River respectively). However they differ in terms of salinity of surface water in autumn, varying (in 1992) from less than 0.30 p.p.t. at Maringup and Doggerup Lakes to more than 1.00 p.p.t. at Owingup Swamp.

Relative abundances of native fishes were included in an assessment of relative importance of wetlands by calculating Simpson's Index of Diversity (Table 5). Two wetlands (Devil's, East of Broke) were grouped at the top of the table, followed by Owingup Swamp, Lake Jasper, Lake Wilson and Reserve 12046 Lake in a second-ranked group.

Wetlands that were highly ranked in both assessments (i.e. supporting five or more species and in one of the top two groups in terms of diversity) were Lake East of Broke Inlet, Owingup Swamp and Lake Jasper.

If the record of *Tandanus bostocki* from Lake Jasper obtained by Robinson during the survey period (see above) is included the number of species at Lake Jasper becomes six. This would increase Lake Jasper's rank to equal second by number of species (Table 4; but no change in position in the list), but would not alter its rank by diversity (Table 5).

3.6 Wetlands with Similar Fish Faunas

Cluster analysis by Sørensen's Co-efficient (using presence/absence data only) revealed a major grouping at the 52 per cent level of similarity comprising all wetlands other than Lakes Saide and Powell (which formed a group at 67 %) and Un-named Lake (Fig. 18). The most similar wetlands were Boat Harbour Lake 1 and Maringup Lake (a group at 91 %), Doggerup Lake and Lake East of Broke Inlet (at 91 %) and Quitjup, Smith and Florence Lakes (at 100 %, i.e. identical species).

Analysis by Raabe's Co-efficient (using relative abundances, Table 3) revealed the following groups (Fig. 19) at levels of similarity greater than 80 per cent:

Group A: Saide, Powell (83%);
Group B: Wilson, East of Broke (83%);
Group C: Yeagarup, Warren (87%);
Group D: Smith, Un-named, Doggerup, Samuel, Gardner, Maringup, Boat Harbour Lakes 1 & 3 (88%);
Group E: Quitjup, Florence (89%).

The most similar wetlands were Gardner River Lake and Lake Smith which formed a sub-group at the 97 per cent level.

Unallocated at the >80 per cent level were: Lake Williams, the Lake in Reserve 12046 and Lake Jasper (which were not similar to other wetlands above the 50 per cent level) and Owingup Swamp which was similar to other wetlands (Groups D & E) only at the 66 per cent level. These four wetlands may therefore be regarded as having relatively distinctive fish faunas.

3.7 Factors that may Influence Occurrence and Relative Abundance of Fishes

It was not the purpose of this study to rigorously examine factors that influence the occurrence and relative abundance (and consequently diversity) of fishes in the 27 wetlands. However, it is possible to make some observations that may point to possible research hypotheses.

Table 4. Ranking of wetlands by number of native fish species recorded in Autumn 1992.

Rank	Wetland	No. of native species[a]
1	Owingup	8
= 2	Doggerup	6
= 2	Maringup	6
= 4	Jasper	5
= 4	East of Broke	5
= 4	Boat Harbour 1	5
= 4	Boat Harbour 3	5
8	Gardner	4
= 9	Devil's	3
= 9	Quitjup	3
= 9	Wilson	3
= 9	Smith	3
= 9	Yeagarup	3
= 9	Samuel	3
= 9	Florence	3
= 9	Reserve 12046	3
= 17	Un-named	2
= 17	Warren	2
= 17	Williams	2
= 17	Saide	2
= 17	Powell	2
22	Davies	1
= 23	Quinninup	0
= 23	Moses	0
= 23	Naenup	0
= 23	Boat Harbour 2	0
= 23	William	0

[a]Includes fish identified only to genus, e.g. *Galaxiella sp.*

Table 5. Ranking of wetlands by Simpson's Index of Diversity.

Simpson's Index of Diversity is the inverse of the sum of Pi^2 where Pi here is the proportion that the ith species contributes to the total catch for the wetland (Table 3). Exotic species were not included in calculations. Wetlands with no species are excluded.

Rank	Wetland	Index of Diversity
1	Devil's	2.796
2	East of Broke	2.725
3	Owingup	2.346
4	Jasper	2.152
5	Wilson	2.129
6	Reserve 12046	2.103
7	Quitjup	1.713
8	Florence	1.515
9	Saide	1.471
10	Yeagarup	1.386
11	Doggerup	1.362
12	Boat Harbour 3	1.350
13	Un-named	1.242
14	Boat Harbour 1	1.239
15	Gardner	1.233
16	Smith	1.218
17	Maringup	1.206
18	Williams	1.153
19	Warren	1.136
20	Samuel	1.065
21	Powell	1.020
22	Davies	1.000

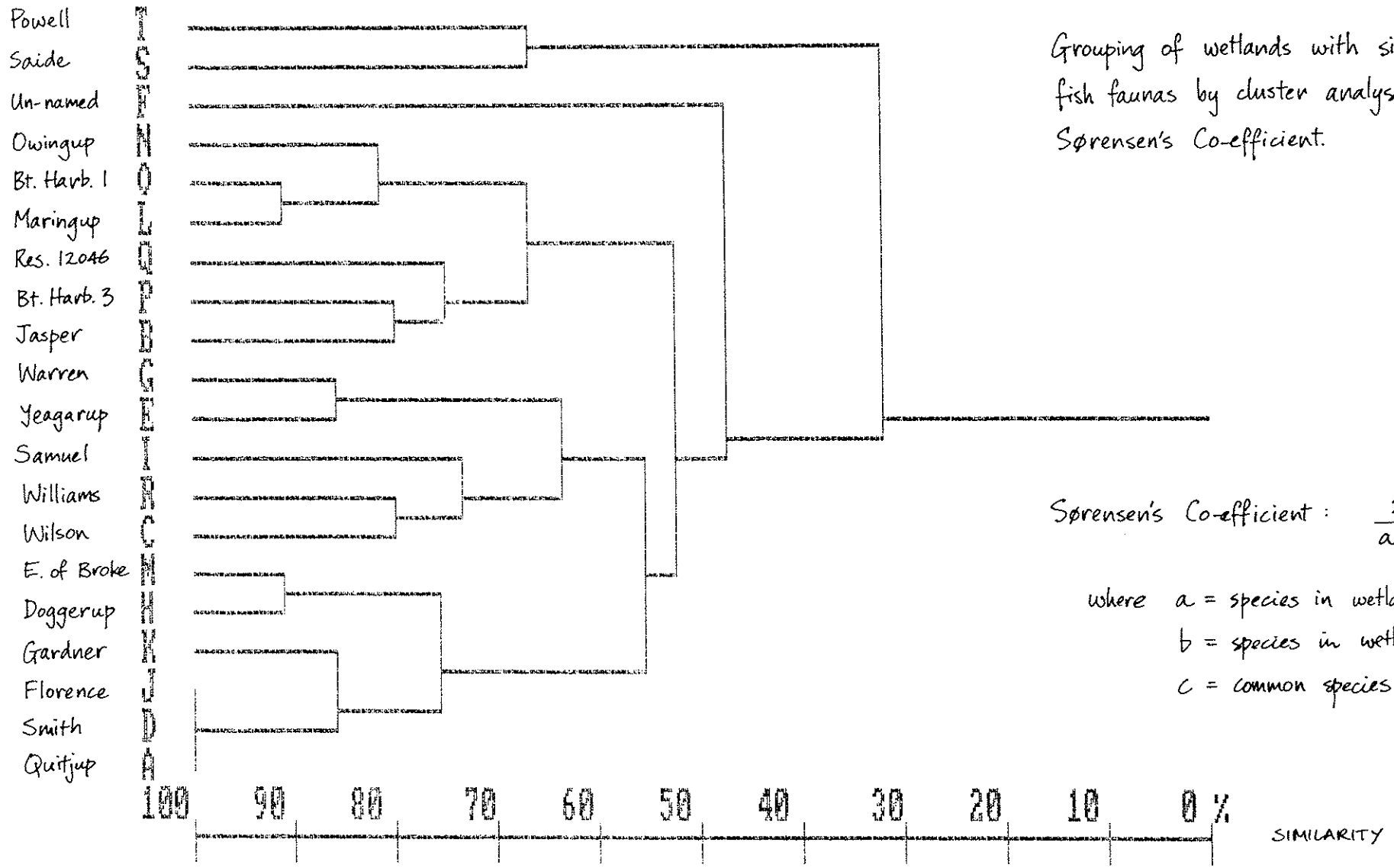


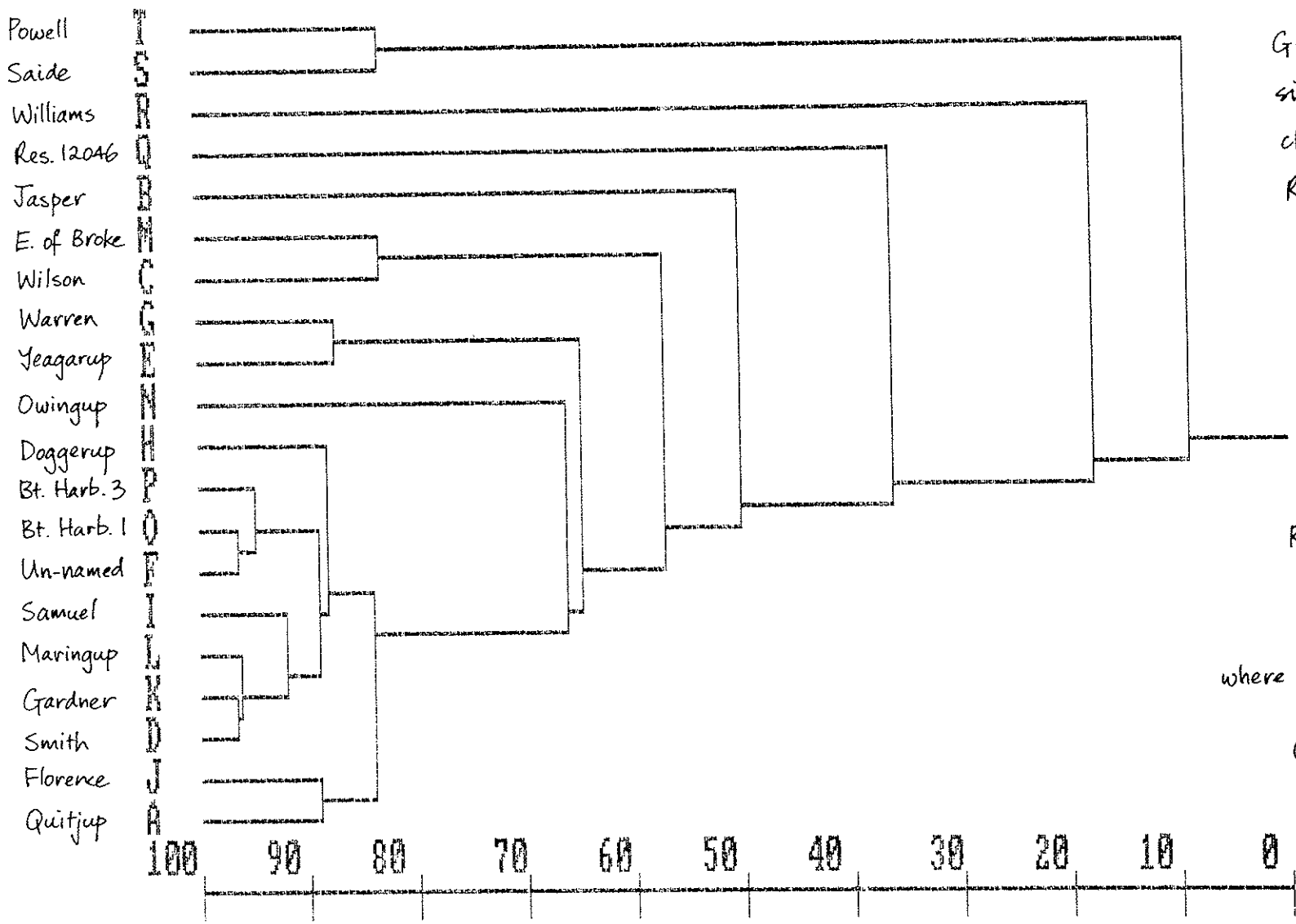
Figure 18.

Grouping of wetlands with similar fish faunas by cluster analysis: Sørensen's Co-efficient.

Sørensen's Co-efficient : $\frac{2c}{a+b}$

where a = species in wetland X,
b = species in wetland Y,
c = common species.

Figure 19.



Grouping of wetlands with similar fish faunas by cluster analysis: Raabe's Co-efficient.

Raabe's Co-efficient:

$$\Sigma \min (A, B, C \ldots N)$$

where A.....N = lesser abundances of common species (converted to percentages).

Wetland Area Five of the top seven wetlands ranked by species (Table 4) are either large or medium in size; none of the wetlands without fish are large. However, Lake East of Broke Inlet, which is ranked equal fourth in terms of number of species, is a small wetland.

Four of the top six wetlands ranked by diversity (Table 5) are small wetlands. Wetlands with low rank by diversity include some that are small and some that are large.

Variety of Habitats An inspection of the lists of fish habitats at each wetland in autumn 1992 (datasheets, Appendix 1) shows that eight wetlands each had five or six fish habitats (none had the maximum 7). Four of those wetlands (e.g. Jasper) were in the top seven and three were equal ninth in ranking by species (Table 4), while the other (Moses) had no fish. Only two of the wetlands were in the top six in ranking by diversity (Table 5).

Salinity Wetlands that were brackish (> 1.0 p.p.t.: datasheets, Appendix 1) and wetlands that were highly fresh (< 0.3 p.p.t.) in autumn 1992 were scattered throughout the rankings by species (Table 4) and by diversity (Table 5).

Nutrient Richness Data on nutrients were not collected during the autumn surveys. However, earlier work has shown that Lakes Powell and Saide are particularly enriched with nutrients (Edward *et al.* in prep.) probably due to catchments being in agricultural areas, unlike the catchments of most of the other 25 wetlands. Neither wetland was highly ranked in terms of number of native species (Table 4) but Powell ranked ninth in terms of diversity. Both wetlands supported large numbers of the exotic *Gambusia*.

Exotic Fishes Where *Gambusia* was recorded in this study the number of native species varied from three at Yeagarup Lake to two at each of the other three wetlands (Table 2).

Presence of abundant exotic species may cause the reduction or local extinction of native species. This has been shown as probably occurring in the Murray River (W.A.) in regard to exotic *Perca fluviatilis* and native *Edelia vittata* (Hutchinson 1991) but, despite some evidence of exclusion of native fishes in Perth wetlands (Allen 1982), has not been conclusively demonstrated for exotic *Gambusia* and native species in W.A.

Isolation Three of the five wetlands without fish (Moses, Naenup, William) are isolated from other wetlands and the ocean by high sand dunes. Boat Harbour Lake 2, also fish-less, appeared to be isolated by dunes though Robinson (pers. comm.) believed there was a connection to nearby lakes.

Lake William and Boat Harbour Lake 2 are shallow and may have lost their fish faunas during recent periods of drought. Indeed, Closs (1990) suggests that fish-less wetlands, which are common in south-eastern Australia, result from drying out in summer and lack of connection to rivers. This is also a common phenomenom on the Swan Coastal Plain, south-western Australia (A. Storey pers. comm.).

Only two of the fish-supporting lakes are isolated by sand dunes but both are close to low sea coast: Lake Davies (one species, a secondary fish) and Lake Williams (two species, both principle fish).

Interestingly, the four fish-less wetlands mentioned above were visibly richer in large invertebrates such as Odonata and Notonectidae and in large tadpoles than

fish-supporting lakes. This was not assessed systematically but is a common phenomenom in fish-less wetlands (Closs 1990, pp. 90-91).

The fifth fish-less wetland, Quininnup Brook Pools, is connected to the ocean but some of the pools are isolated by waterfalls that presumably act as barriers to fish movement.

4. CONCLUSIONS

4.1 Limitations

Timing Conduct of the surveys in autumn, mostly before onset of the 1992 rainy period, meant that shallow seasonally inundated parts of some wetlands were dry whereas in winter and spring those parts may have supported an abundance of *Galaxiella* species and *Lepidogalaxias salamandroides* (cf. total of only 6 records of these 3 species in autumn). However, in other respects autumn was ideal because the fishes were concentrated and access to wetland edges was generally straightforward (many sites would have been less accessible in winter-spring).

Blackwater Many of the wetlands held dark, tannin-stained (?) water (`blackwater') in which it was difficult to sight live, struggling or dead fish (especially on the lake bed) even in the shallows. The problem was exacerbated where sediments became disturbed during surveys. However, by allowing disturbed sediments to settle it was possible to locate and recover most of the sunken fish and with practice and still conditions, many of the escaping fish could be detected from slight ripples.

Catching methods: deepwater Usually it was not possible to survey deep water effectively because access difficulties prevented use of a boat at many wetlands. Even where wetlands were boatable, Rotenone proved ineffective in deep water and traps were unproductive. This meant that some larger species such as *Tandanus bostocki* or others that may inhabit deep water may have been missed. However, it is likely that most of the fish species and individuals occurred in the shallowest parts and these were intensively sampled.

Catching methods: traps Baited traps were left in water overnight wherever possible because sometimes this strategy yielded records of species not obtained by any other method at that wetland, e.g. the *Nannatherina balstoni* recorded at Lake Florence. At several lakes that had an abundance of fish, baited traps left overnight caught marron or gilgies *Cherax* spp. but no fish; presumably the crustaceans either ate any fish in the traps or deterred them from entering. Usually traps were effective in catching fish (but not crustaceans) also by day; therefore failed overnight attempts were followed up with daytime attempts.

Catching methods: galaxiids The three galaxiids that are widespread in the study area were each obtained at least once with Rotenone. However, at some lakes (e.g. Smith) fast moving fish, presumably galaxiids, were seen at the water surface but not secured by Rotenone or other catching methods. Probably galaxiids would be more effectively caught using a seine net but Rotenone may be more effective if used when galaxiids were more abundant (winter-spring?).

Relative Abundance Randall (1963) cautioned against using data obtained from use of Rotenone poison for quantitative expressions of species composition and abundance, because of the varied susceptibility of species and individuals to the poison and varied strategies for escape. However, because similar procedure was used at each wetland (see section 2.2), therefore the catch data were considered appropriate for analysis of relative abundance.

4.2 Conservation of Fish Species

Results of this study suggest that the following native fish species are secure within Crown Land on the south coast because they are widespread and abundant: *Galaxias occidentalis, Bostockia porosa, Edelia vittata* and *Pseudogobius olorum.*

Nannatherina balstoni also seems secure though less abundant (63 recorded: about one for every 50 *Edelia*). Pusey and Edward (1990) found about one *Nannatherina* for every nine *Edelia* in a different set of wetlands, mostly temporary (seasonal) water bodies, in D'Entrecasteaux National Park (their study: 189 individuals). It would be useful to extend surveys to the east of Albany (at least to near Pallinup River) in order to complete an assessment of the status of this species at lakes on Crown Land within its entire range.

Galaxias maculatus and *Tandanus bostocki* are known to be widespread and abundant outside the study area in adjoining parts of south-western Australia (Allen 1982) and therefore should be secure in the region even though only a few were found in the present study. *Atherinosoma wallacei* and *Favonogobius suppositus*, though not widespread or abundant in the wetlands surveyed, are known to occur widely in streams and estuaries of the region and therefore presumably are also relatively secure (Allen 1982).

The three other native species, *Galaxiella munda, Galaxiella nigrostriata* and *Lepidogalaxias salamandroides*, were not found to be widespread or abundant in the present study or in earlier work by Edward *et al.* (in prep.) at the same wetlands. However, they are known to be relatively abundant at least in some parts of the study area (streams, temporary wetlands) including the eastern part of D'Entrecasteaux National Park (Christensen 1982, Pusey and Edward 1990).

4.3 Factors Influencing Occurrence and Relative Abundance of Fishes

Observations from the present study (section 3.7) point to the conclusion that the number of fish species in a wetland may be influenced by wetland area and variety of habitats. Occurrence and relative abundance of fishes do not appear to be strongly or consistently influenced by salinity in the 27 wetlands surveyed. The influence of exotic fish (*Gambusia)* on occurrence and relative abundances of native fishes is not clear from the present study. Wetlands that are highly isolated are likely to be devoid of fishes.

4.4 Potential Threats to Fishes

Mineral Sand Exploration and Mining The potential impact of possible sand-mining near Quitjup, Jasper, Yeagarup and Maringup Lakes on waterbirds was addressed by Jaensch (1992). The main concern for fishes would be possible contamination of lake water by effluent from processing of mineral sands, especially at Maringup and Jasper Lakes since they are highly important for fishes (section 3.5) and since Maringup is intended to be managed as a biological reference area (Dept CALM 1987, section 9.8, Prescription 1.). However, the precise tolerances of the various native species to contaminants probably is not well known.

Pollution Pollution from sewage effluent and/or agricultural chemicals probably has caused some nutrient enrichment at Owingup Swamp, Lake 12046, Lake Saide and Lake Powell because parts of the catchments of those lakes are outside the reserve system. Limited nutrient enrichment, at least in the short term, may cause some organisms eaten by fish and thereby the fish to proliferate, but long term and substantial enrichment is likely to radically alter wetland ecology to the detriment of the native fishes. Fortunately, most of the other wetlands are currently isolated from pollution sources because their catchments are entirely within conservation reserves.

Exotic Fishes It may be significant that the two most widespread native species (*Bostockia porosa, Edelia vittata*) were not recorded in autumn 1992 at Lake Powell where the exotic *Gambusia* was abundant. It has been shown that *Gambusia* consume grazer invertebrates (e.g. *Daphnia*) that control the growth of algae (McComb and Lake

1988, p. 139). Therefore an abundance of *Gambusia* may indirectly result in toxic algal blooms that affect populations of native fishes.

Salmo species feed on the fry of native fishes (Allen 1982). They were not recorded in the lakes surveyed, probably because most of the lakes are not connected to well oxygenated streams which are apparently important for trout survival (Coy 1979); therefore they may not be a threat to native fish in most lakes. However, the redfin perch *Perca fluviatilis* probably would threaten native perches (*Bostockia, Edelia, Nannatherina*) if it became established in the lakes.

4.5 Important Wetlands and their Protection

The ten wetlands ranked highly by species richness (Table 4) or diversity (Table 5), which may therefore be considered the most important for fishes (section 3.5), are as follows (listed from west to east):

Devil's Pool
Lake Jasper
Lake Wilson
Doggerup Lake
Maringup Lake
Lake East of Broke Inlet
Owingup Swamp
Boat Harbour Lake 1
Boat Harbour Lake 3
Reserve 12046 Lake

These ten wetlands support 11 of the 12 native fishes or all 12 if the record of *Galaxiella munda* obtained by Edward *et al.* (in prep.) at Lake Jasper is included. They also include five of the wetlands in which *Nannatherina balstoni* was recorded in autumn 1992.

Lake Jasper, Lake East of Broke Inlet and Owingup Swamp, were highly ranked both by species and diversity and therefore are particularly important. They support eight of the 12 native fishes recorded in the study. The distinctiveness of Lake Jasper and Owingup Swamp is further illustrated by their relatively low levels of similarity with other wetlands (Fig. 19).

Lake Jasper and Lake East of Broke Inlet and their catchments lie within D'Entrecasteaux National Park and therefore are well protected (provided mining does not occur in the Park). Owingup Swamp is protected by Quarram Nature Reserve but its catchment (the Kent River basin) lies outside the reserve and appropriate land management practices should be undertaken to protect that catchment from threats to fishes.

A wetland from Group E (Quitjup or Florence: Fig. 19) should be added to the ten listed above (which include wetlands from Groups B and D) if a set of wetlands representative of the fish fauna of the south coast is to be identified. Groups A and C are not represented in the ten but are characterised by dominance of exotic *Gambusia*.

5. RECOMMENDATIONS

1. The water quality of Owingup Swamp (a particularly important wetland for fishes) and its major inflow (principally Kent River) should be monitored and land management that will minimise or prevent deterioration of water quality should be promoted and practised in the Kent River catchment.

2. Deterioration in the water quality of Lake Jasper (a particularly important wetland for fishes) as a direct or indirect consequence of possible sand mining should be prevented.

3. Further surveys should be conducted at Boat Harbour Lake 3 and other lakes in Quarram Nature Reserve to clarify the abundance and life cycle requirements of the isolated population of *Galaxias maculatus* in that area.

4. CALM should prevent further introductions of *Gambusia affinis* in south coast wetlands, particularly the permanent lakes in conservation reserves (which are important for conservation of endemic native fishes), and should investigate the possibility of eradicating *Gambusia* where it currently occurs.

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APPENDIX 1

Datasheets, maps and photographs for each wetland surveyed in autumn 1992

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Quinninup Brook Pools Lat: 33°45' S, Long: 115°00' E

Land Status: within Leeuwin-Naturaliste National Park

CALM Region/District: Central Forest / Busselton Shire: Busselton

Forestry Map (1:50 000): Busselton

Date of Survey: 9/5/92 Duration: overnight/~~half day~~/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) _____, thickets (t) _____,
logs (l) _____, banks (b) ✓ ledge, weed (w) ✓,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.62 (surface water)

% of Wetland ~~Shore~~/Area Surveyed: 20 Boat used? _____

Capture Methods Used: baited traps ✓x3, dab-netting ✓, spotlighting _____,
Rotenone poison _____

Species Recorded * = exotic species	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
nil					
Totals nil species			nil.		

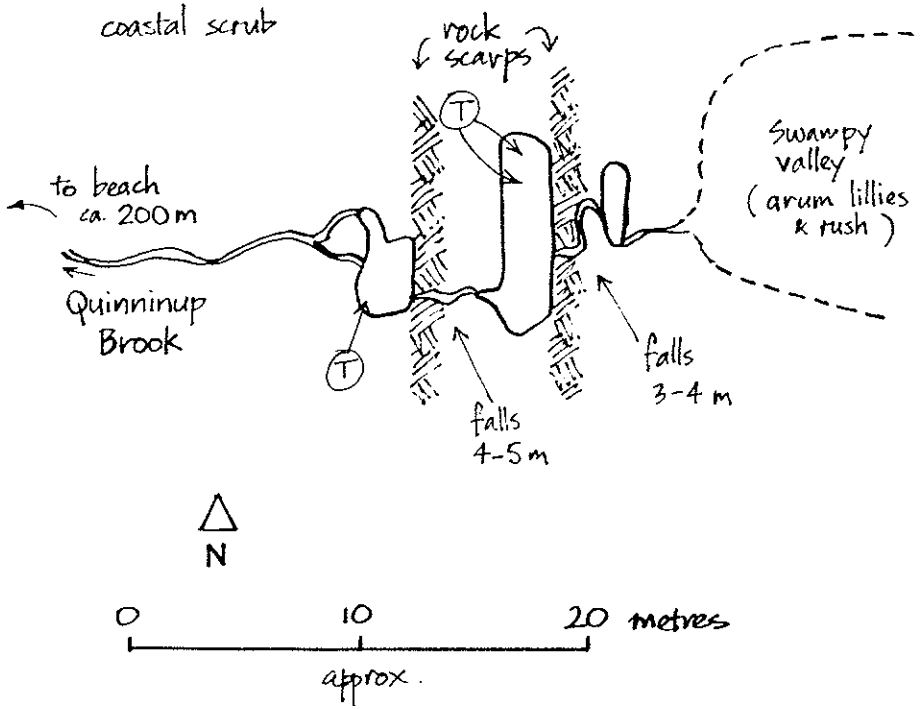
Comments (conditions/other fauna/management):

· tadpoles and large invertebrates were visibly plentiful in the pools.

1. QUINNINUP BROOK POOLS (9/5/92)

: stream flowing steadily.

: (T) = fish trap sites; water 40-100 cm deep.



: dab-netting in the larger pools and in stream above and below the falls yielded no fish.

: traps yielded no fish.

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FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Moses Rock Rd. Pool Lat: 33° 46' S, Long: 114° 59' E
Land Status: within Leeuwin-Naturaliste National Park
CALM Region/District: Central Forest / Busselton Shire: Busselton
Forestry Map (1:50 000): Busselton

Date of Survey: 4/5/92 Duration: overnight/half day/full day.
Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) _____, banks (b) ✓ ledge, weed (w) ✓,
water <50 cm (s) ✓, water >50 cm (d) ✓.
Wetland Salinity (ppt): 0·41 (surface water)
% of Wetland Shore/~~Area~~ Surveyed: <10 Boat used? _____
Capture Methods Used: baited traps ✓×6, dab-netting ✓, spotlighting _____,
Rotenone poison _____

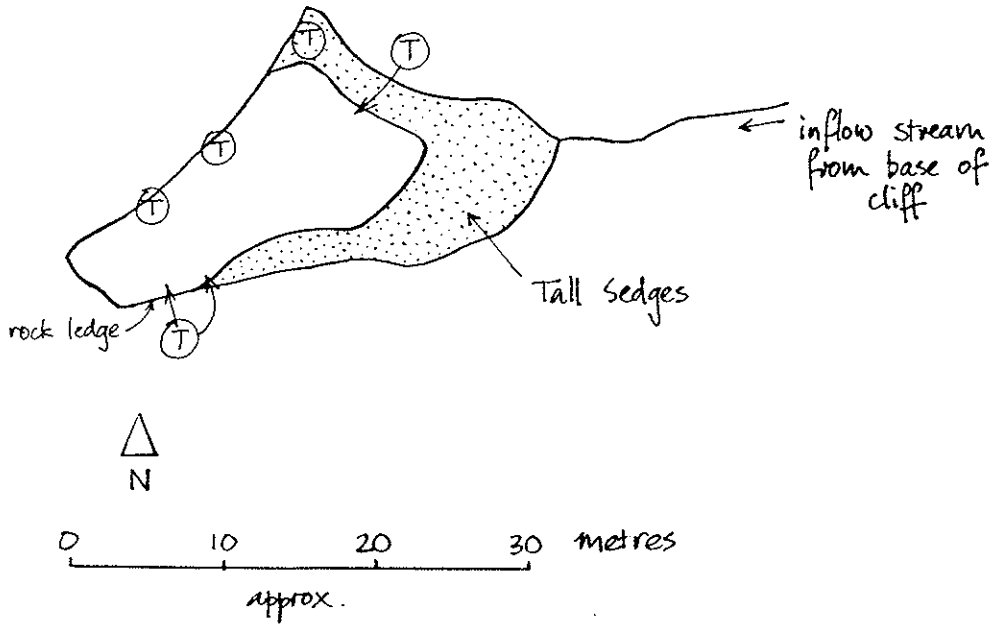
Species Recorded * = exotic species	Number obtained: caught live	Rotenone	total catch	Habitats found in (above)	Water Depths found in (cm)
nil					
Totals nil species			nil.		

Comments (conditions/other fauna/management):

- tadpoles, 'koonacs' and leeches were visibly plentiful (under torchlight).
- Birds: Little Pied Cormorant (1).

2. MOSES ROCK ROAD POOL (4/5/92)

: stream flowing steadily; waterline as shown (outer line).
: less algae on water surface than on 3/12/91.
: Typha was vigorous.



: (T) traps were in deep water on south side (~100 cm), but in shallows (~40 cm) on NW side.
: no fish were caught.
: considerable activity by 'koonacs', leeches and tadpoles — all visible in the clear water at night under torchlight.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Devil's Pool Lat: 34° 01′ S, Long: 115° 01′ E

Land Status: within Leeuwin-Naturaliste National Park

CALM Region/District: Central Forest / Busselton Shire: Augusta-Margaret R.

Forestry Map (1:50 000): Boranup

Date of Survey: 5/5/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) ✓, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.54 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: 4% all methods; Rotenone 2% Boat used? _____

Capture Methods Used: baited traps ✓x6, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Atherinosoma wallacei	17	0	17	s	<20
Favonogobius suppositus	9	2	11	s, r, b, d	40-50+
Pseudogobius olorum	17	5	22	r, b, s, d	<50
Totals 3 species	43	7	50		

Comments (conditions/other fauna/management):

- Atherinosoma were from a school in the mouth of the outflow stream (see map).
- Pseudogobius were visibly plentiful in sandy shallows near outflow — more could have been caught (by dab-netting), with little effort.
- outflow stream was flowing steadily.
- Birds: Aust. Grebe (4), Eur. Coot (1), Spotless Crake (2+).

3 DEVILS POOL (5/5/92)

TS Tall Sedges

Astartea Thicket

Phebalium Scrub over Tall Sedges

Peppermint Low Woodland over Heath

Marri Low Woodland

Heath Coastal

: outflow stream was flowing steadily.

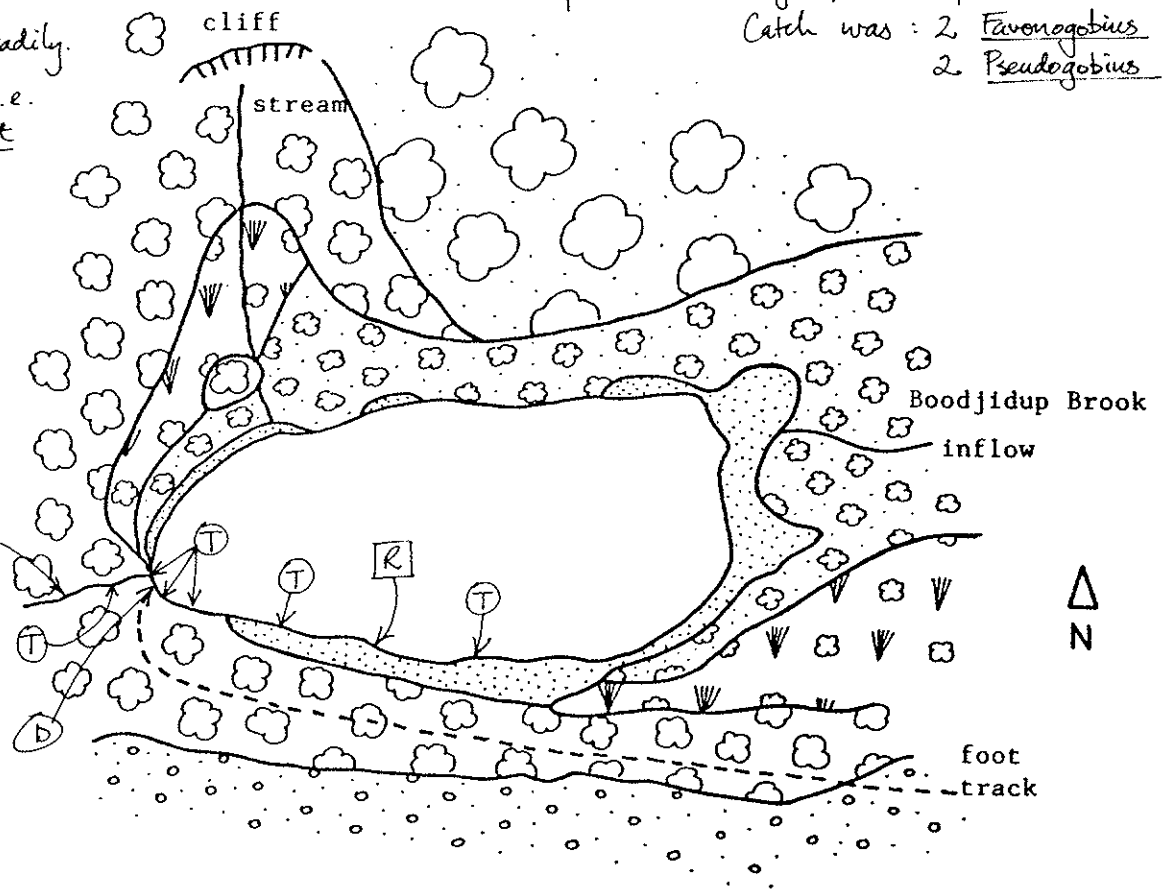
: waterline similar to 4/12/91, i.e. fringing vegetation was not extensively inundated.

: (T) = trapping site.

[R] = Rotenone site.

Rotenone on south shore ..... set in the narrow fringe of TS where water was mostly less than 50 cm deep but becoming deeper immediately offshore from that.

Catch was : 2 Favonogobius
2 Pseudogobius



Good stream banks here but flow took most of the Rotenone away; catch was small (3 Pseudogobius)
Depth of water: 30-50 cm.

Dab-netting at mouth of outflow stream yielded 17 small Atherinosoma from a school there. Pseudogobius were abundant in sandy shallows under shady large peppermint trees at "(D)".

Traps were in water 40-50 cm deep and yielded 9 Favonogobius (in the 4 'easternmost' traps).

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FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Davies Lat: 34° 13′ S, Long: 115° 02′ E

Land Status: within Leeuwin-Naturaliste National Park

CALM Region/District: Central Forest / Busselton Shire: Augusta-Margaret R.

Forestry Map (1:50 000): Boranup

Date of Survey: 5/5/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) _____, banks (b) _____, weed (w) ✓,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 1·43 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 7%. Rotenone = 4% Boat used? _____

Capture Methods Used: baited traps ✓×6, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Pseudogobius olorum	62	17	79	r, w, s, d	0–100
Totals 1 species	62	17	79		

Comments (conditions/other fauna/management):

- Pseudogobius were mostly very small sized. They were visibly plentiful in the sandy shallows and many more could have been dab-netted with little effort.
- Birds: Eur. Coot (5), Pacific Black Duck (2), Aust. Grebe (4).
- Water depth (as on gauge) was ·08 (= 4.08 m ?).
- Palaemonetes shrimps were abundant.
- possibly also some galaxiid fish present: evidence was fast movements near water surface giving ripples.

Rotenone was set in water 0–65cm deep but mostly < 30 cm deep. Some was spread over Myriophyllum weed in deeper water. Result: 17 Pseudogobius, only a small fraction of the number visible there.

4 LAKE DAVIES (5/5/92)

: depth at gauge = 4.08m

: TS inundated only as far as 0.5–1.0m from edge of open water.

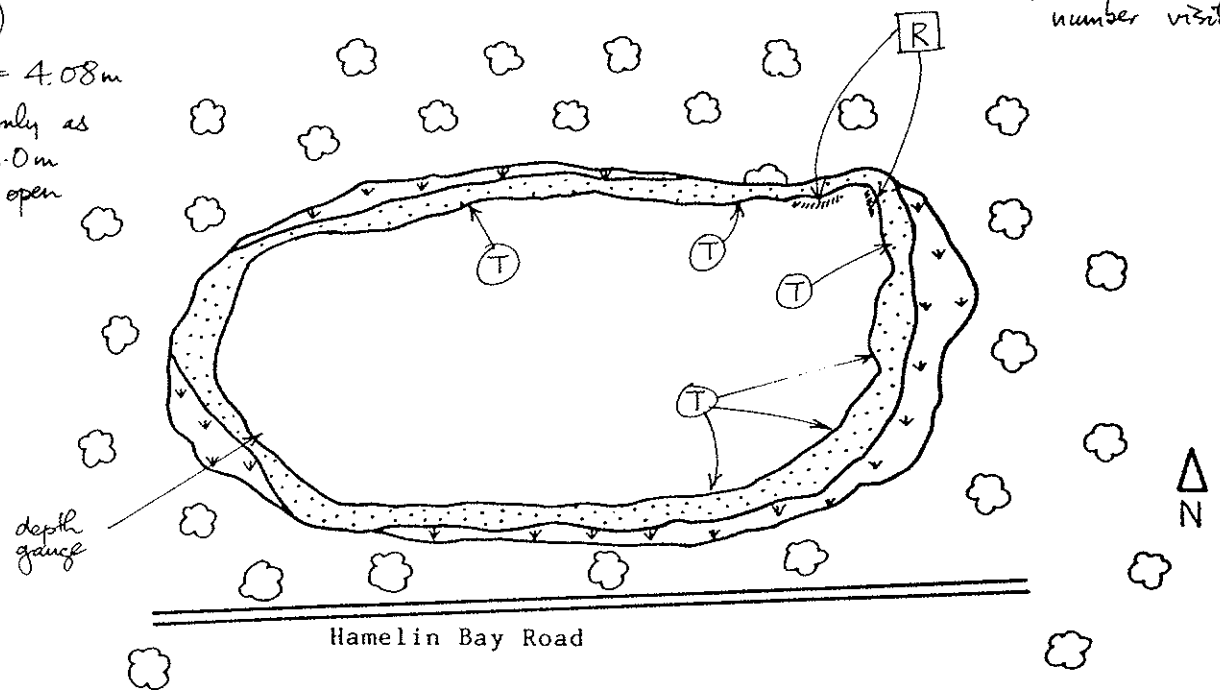
TS — Tall Sedges

Herbs

Peppermint Open Low Woodland over Coastal Heath

(T) = trap site.

[R] = Rotenone site.



0 — 100 metres

Traps were mostly in water 30 cm deep at edge of TS; two (in S.E. of lake) were in water > 100 cm deep near prolific Myriophyllum. The result was 4–20 Pseudogobius in each trap, totalling 62 fish.

- Pseudogobius were visibly plentiful in sandy shallows and in the TS (Baumea vaginalis, B. juncea, Juncus kraussii). Many could have been obtained by dab-netting.
- Some surface movements, possibly of galaxiids, were noted.

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FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Quitjup Lake Lat: 34°23′ S, Long: 115°35′ E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Central Forest / Nannup Shire: Nannup

Forestry Map (1:50 000): Jasper

Date of Survey: 24-25/4/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0·25 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 1+%, Rotenone = 1% Boat used? _____

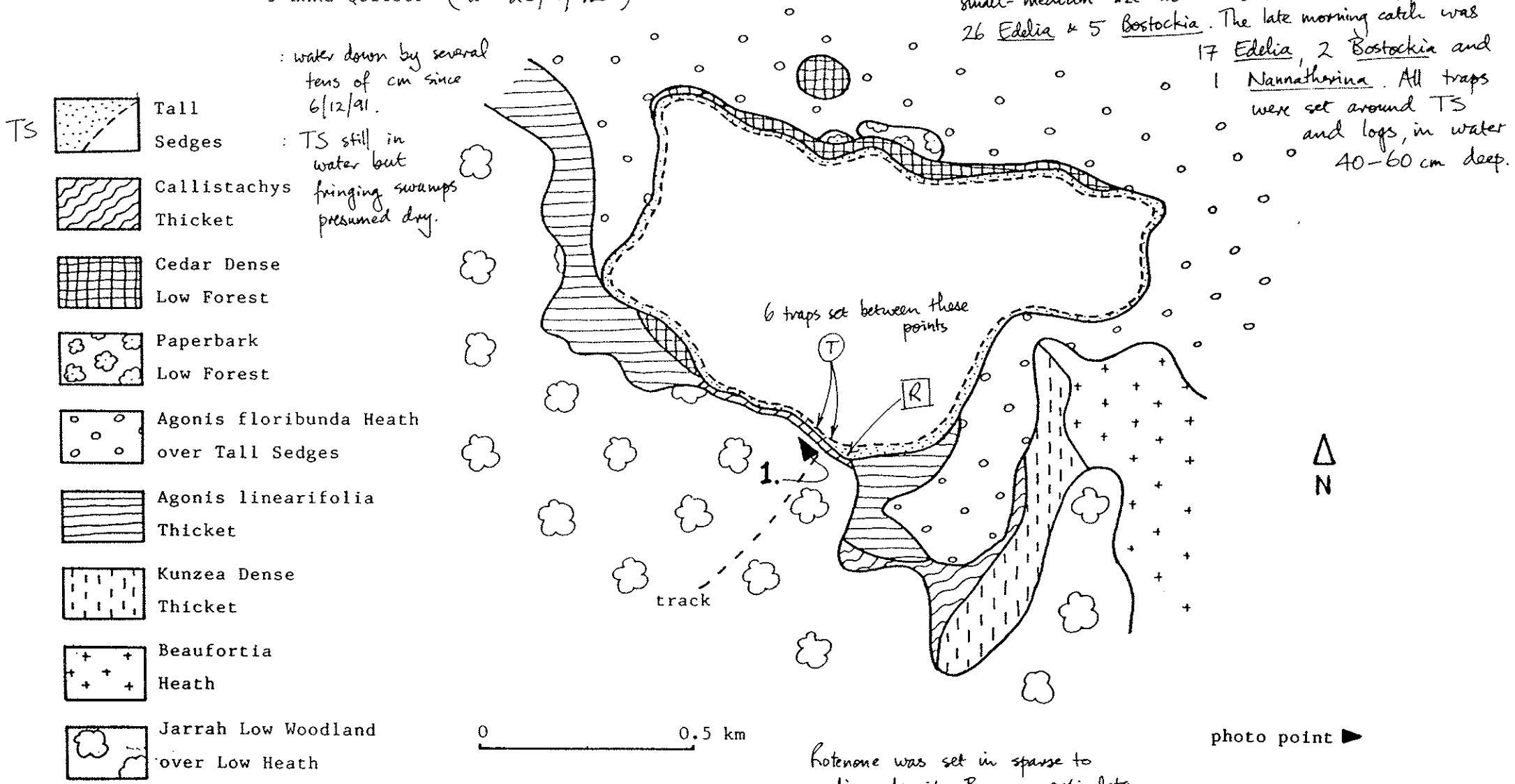
Capture Methods Used: baited traps ✓ x 6, dab-netting _____, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	7	11	18	r, l, s, d	< 60
Edelia vittata	43	20	63	r, l, s, d	< 60
Nannatherina balstoni	1	4	5	r, l, s, d	< 60
Totals 3 species	51	35	86		

Comments (conditions/other fauna/management):

- water level fallen some tens of cm since 6/12/91; fringing swamps were presumed to be dry.
- 6 marron were in traps left overnight.
- large carapaces of cooked marron were scattered around the 'campsite' at the end of the access track; also a lot more litter was around the campsite than on 6/12/91.
- Birds: Pacific Black Duck (3), White-faced Heron (2), Little Pied Cormorant (5), Little Black Cormorant (4).
- water was murky and difficult therefore to see fish in.

5 LAKE QUITJUP (24-25/4/92)



Traps were set overnight and again (at same sites) during the morning. There were 6 marron of small-medium size in the catch at dawn, plus 26 Edelia & 5 Bostockia. The late morning catch was 17 Edelia, 2 Bostockia and 1 Nannatherina. All traps were set around TS and logs, in water 40–60 cm deep.

Rotenone was set in sparse to medium density Baumea articulata and B. vaginalis with a few logs; water was < 40 cm deep. Catch was: 20 Edelia, 11 Bostockia & 4 Nannatherina.

(T) = trap site.

[R] = Rotenone site.

Photo 1. Quitjup Lake, 25/4/92; fringing tall sedges were inhabited by *Nannatherina balstoni*.

Photo 2. Marron were abundant at Lake Wilson, 22-23/4/92.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Jasper Lat: 34°24' S, Long: 115°41' E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Central Forest / Nannup Shire: Nannup

Forestry Map (1:50 000): Jasper

Date of Survey: 23-24/4/92 Duration: (overnight)/half day/(full day).

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) ✓, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.21 (surface water)

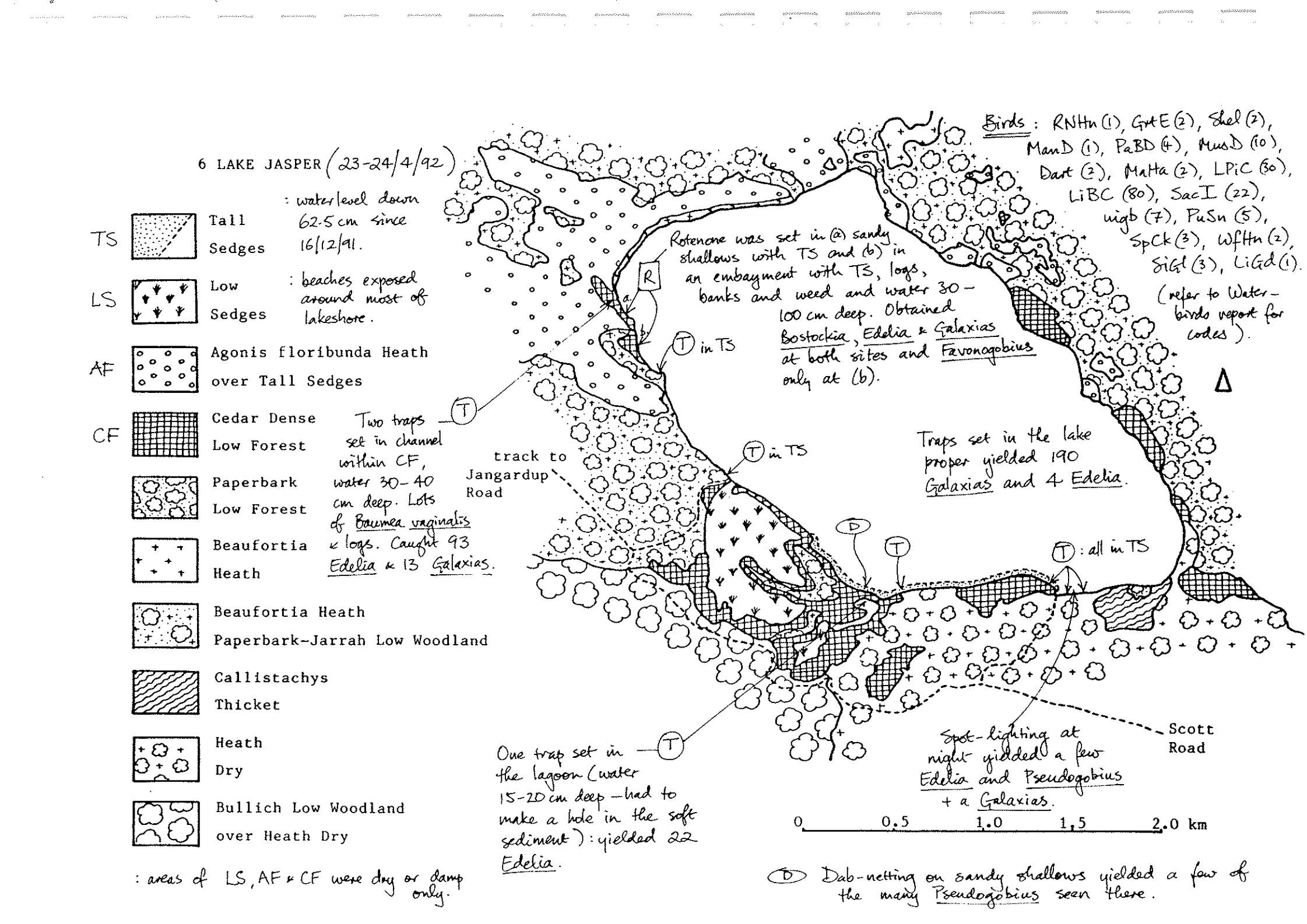
% of Wetland Shore/~~Area~~ Surveyed: all methods = 1 %, Rotenone = <1 % Boat used? ✓

Capture Methods Used: baited traps ✓x6, dab-netting ✓, spotlighting ✓, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias occidentalis	204	36	240	r, l, b, w, s, d	0-100+
Bostockia porosa	0	8	8	"	0-50
Edelia vittata	121	110	231	"	0-50
Favonogobius suppositus	0	2	2	r, l, b, w, d	>50
Pseudogobius olorum	5	3	8	r, s	<30
Totals 5 species	330	159	489		

Comments (conditions/other fauna/management): · Birds : see list on map.

- water down by 62.5 cm from 16/12/91 ; beaches now exposed on most of shoreline.
- fringing swamps to SW and W were dry or damp only ; small channel in cedar forest in W and lagoon in the SW (see map) still held shallow water.
- Galaxias were abundant ; more than 50% of specimens had cysts (sometimes over much of body) and several were so afflicted that they could be caught by hand
- Edelia and a few Galaxias were caught in the channel and lagoon (see map).
- Pseudogobius were commonly seen on lake bed in sandy shallows — quite small & pale.
- Children camping at lake reported finding cobbler (Tandanus?) in holes in the sand on some beaches.


6 LAKE JASPER (23-24/4/92)
: water level down 62-5 cm since 16/12/91.
: beaches exposed around most of lakeshore.
TS
Tall Sedges
LS
Low Sedges
AF
Agonis floribunda Heath over Tall Sedges
CF
Cedar Dense Low Forest
Paperbark Low Forest
Beaufortia Heath
Beaufortia Heath Paperbark-Jarrah Low Woodland
Callistachys Thicket
Heath Dry
Bullich Low Woodland over Heath Dry
: areas of LS, AF & CF were dry or damp only.
Birds : RNHn (1), GrtE (2), Shel (2), ManD (1), PaBD (4), MusD (10), Dart (2), MaHa (2), LPiC (30), LiBC (80), SacI (22), migb (7), PuSn (5), SpCk (3), WfHn (2), SiGl (3), LiGd (1).
(refer to Water-birds report for codes).
Rotenone was set in (a) sandy shallows with TS and (b) in an embayment with TS, logs, banks and weed and water 30-100 cm deep. Obtained Bostockia, Edelia & Galaxias at both sites and Favonogobius only at (b).
R
a
b
T in TS
T
Two traps set in channel within CF, water 30-40 cm deep. Lots of Baumea vaginalis & logs. Caught 93 Edelia & 13 Galaxias.
track to Jangardup Road
T in TS
Traps set in the lake proper yielded 190 Galaxias and 4 Edelia.
D
T
T : all in TS
Scott Road
T
One trap set in the lagoon (water 15-20 cm deep - had to make a hole in the soft sediment) : yielded 22 Edelia.
Spot-lighting at night yielded a few Edelia and Pseudogobius + a Galaxias.
0 0.5 1.0 1.5 2.0 km
D Dab-netting on sandy shallows yielded a few of the many Pseudogobius seen there.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Wilson Lat: 34° 26′ S, Long: 115° 43′ E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Central Forest / Nannup Shire: Nannup

Forestry Map (1:50 000): Jasper

Date of Survey: 22-23/4/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) ✓ tussock bases, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.21 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 3 %, Rotenone = 1.5 % Boat used? _____

Capture Methods Used: baited traps ✓ x 3, dab-netting _____, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Tandanus bostocki	Ø	8	8	l, b, s	30
Bostockia porosa	Ø	93	93	l, b, s	0-40
Edelia vittata	50	64	114	r, l, b, s	0-40
Totals 3 species	50	165	215		

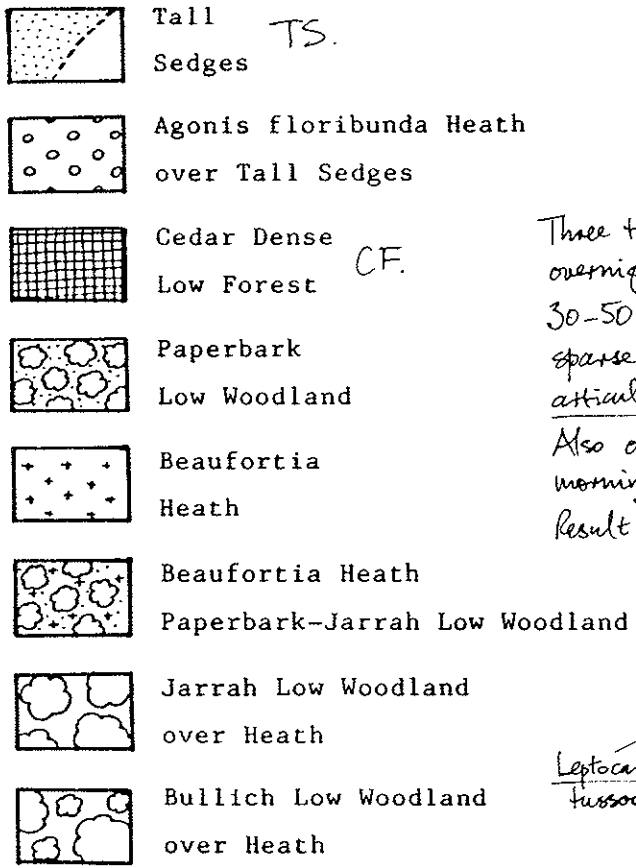
Comments (conditions/other fauna/management):

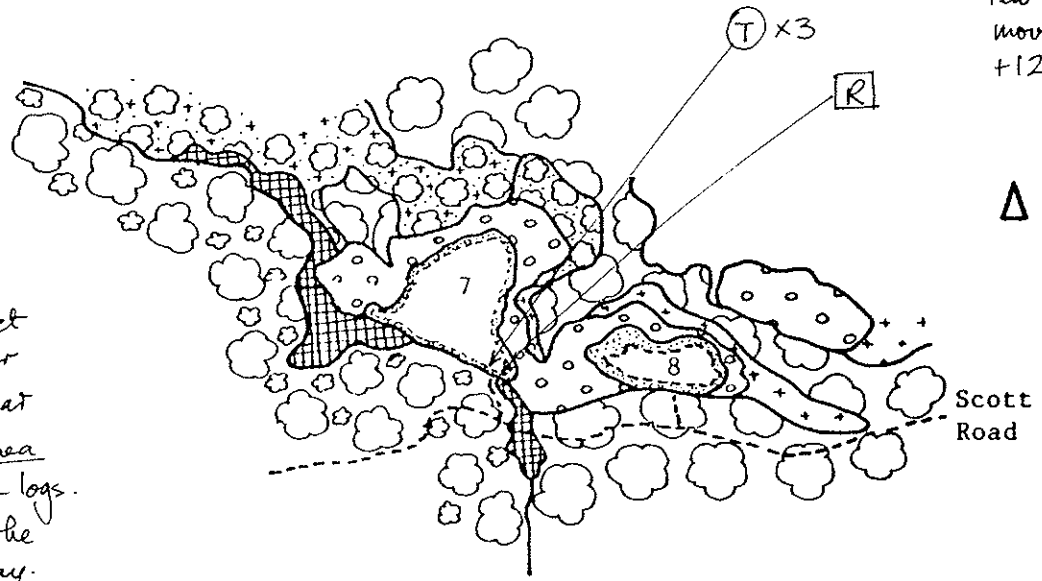
- water was lower than on 14/12/91 : bases of tussocks of Leptocarpus now exposed in many parts of lake-shore. (root mounds)
- traps set overnight contained 16 medium-sized marron next morning.
- Tandanus all came from a group of tussock-bases that contained many holes below the water-line and some exposed root-mats.
- Many of the Bostockia were recovered in and around fallen logs.
- Birds: Little Pied Cormorant.

7 LAKE WILSON (22-23/4/92)

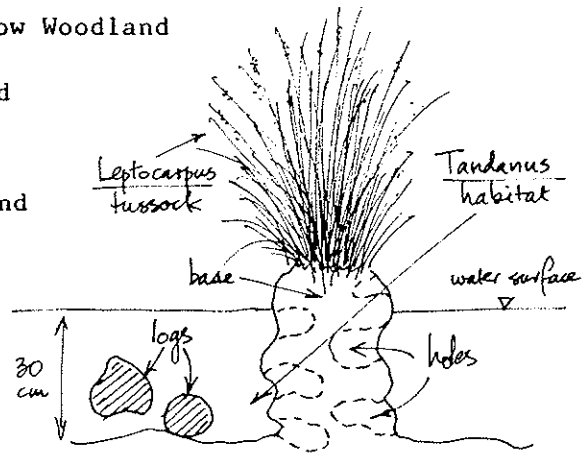
8 LAKE SMITH

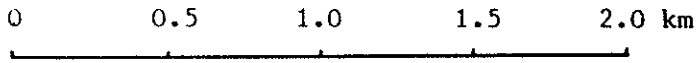
Note: response of fishes to Rotenone after setting it was:
+ 15 minutes: first Edelia (biggest @ +30);
+ 30 minutes: first Bostockia (biggest @ +90).
Few fish seen moving after +120 minutes.





Three traps were set overnight in water 30-50 cm deep near sparse TS (Baumea articulata) and/or logs. Also operated in the morning till midday. Result was: 50 Edelia + 16 marron.





(T) = fish trap site.

[R] = Rotenone site.

Rotenone was set in water 0-40 cm deep in front of CF where there were plenty of logs and partly-exposed bases of the tussock-sedge Leptocarpus sp.. Obtained 93 Bostockia including some large ones; 64 Edelia and 8 Tandanus. (First Tandanus only sighted at + 60 minutes after setting the R..)

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Smith Lat: 34° 26′ S, Long: 115° 43′ E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Central Forest / Nannup Shire: Nannup

Forestry Map (1:50 000): Jasper

Date of Survey: 22-23/4/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0·17 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 30%, Rotenone - 5 % Boat used? _____

Capture Methods Used: baited traps ✓, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	Ø	14	14	s, r	0-30
Edelia vittata	112	35	147	s, d, r	0-50+
Nannatherina balstoni	2	Ø	2	s, r	40
Totals 3 species	114	49	163		

Comments (conditions/other fauna/management):

- water lower than on 13/12/91; narrow beach exposed at parts of S shore and most bases of tussocks of Leptocarpus were no longer in water. However, the band of Baumea articulata around the rest of the lakeshore was still mostly in water.
- 3 marron, one of 24 cm total length, were caught in traps set overnight: there were no fish in with the marron!
- one trap set in edge of dense B. articulata yielded 2 large Nannatherina.
- Birds: Purple Swamphen (1).
- Galaxiids also were present (movements seen at water surface) but none caught – tried dab-netting.

7 LAKE WILSON

8 LAKE SMITH 22-23/4/92

: water significantly lower than on 13/12/91 ..... narrow bits of beach were exposed on south shore and most tussock bases were out of water.

: TS (Baumea articulata) in E, N & W parts of lake were still in water.

TS Tall Sedges

Agonis floribunda Heath over Tall Sedges

Cedar Dense Low Forest

Paperbark Low Woodland

Beaufortia Heath

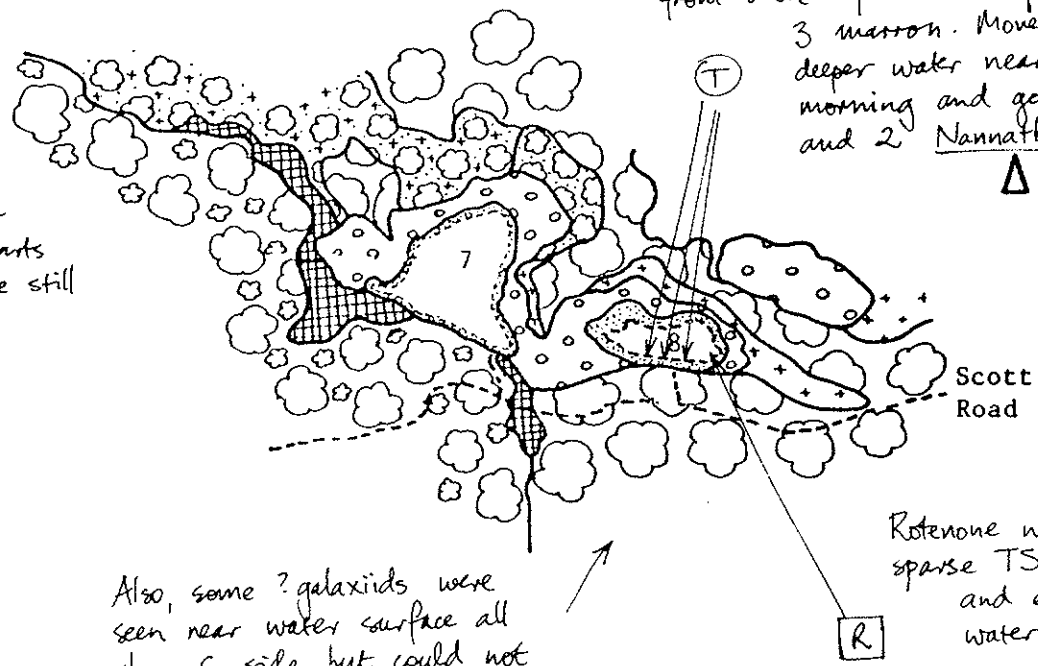
Beaufortia Heath Paperbark-Jarrah Low Woodland

Jarrah Low Woodland over Heath

Bullich Low Woodland over Heath

T = trap site.

R = Rotenone site.



Traps were set overnight in water 30-40 cm deep a few metres out from shore: yielded nil fish and 3 marron. Moved traps to deeper water near TS in the morning and got 112 Edelia and 2 Nannatherina.

Also, some ? galaxiids were seen near water surface all along S side but could not be caught despite quite a lot of effort dab-netting.

Rotenone was set in sparse TS (B. articulata) and edges of tussocks: water was < 30 cm deep

'Catch' was 35 Edelia and 14 Bostockia.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Yeagarup Lake Lat: 34° 32' S, Long: 115° 43' E
Land Status: within State Forest (Charley Block).
CALM Region/District: Southern Forest / Pemberton Shire: Manjimup
Forestry Map (1:50 000): Warren

Date of Survey: 6-7/5/92 Duration: overnight/half day/full day.
Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) ✓, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.
Wetland Salinity (ppt): 0-10 (surface water)
% of Wetland Shore/~~Area~~ Surveyed: all methods = 4%, Rotenone = 2 % Boat used? _____
Capture Methods Used: baited traps ✓×6, dab-netting ✓, spotlighting ✓,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias occidentalis	1	0	1	r, s	40
Bostockia porosa	2	1	3	r, l, b, s, d	10-100+
Edelia vittata	16	5	21	r, l, b, s, d	10-100+
* Gambusia affinis	11	0	11	r, s	<30
Totals 4 species	30	6	36		

Comments (conditions/other fauna/management):

- water level not very different to 18/12/91.
- during rain periods, silt was washed into the lake at the picnic site; perhaps coincidentally, this was the site where Gambusia were captured at night with a dab-net and spotlight. (Could the Gambusia be easily eliminated at Yeagarup?)
- 6 marron were caught overnight in two traps left in deep water under banks (see map): no fish were in these traps. Two more marron at 25 cm total length were caught in rush/shallows during the day, also in traps.
- Birds: Swan (5), Little Pied Cormorant (1), Aust. Grebe (1).

9 LAKE YEAGARUP (6-7/5/92)
10 NAENUP SWAMP
11 UNNAMED LAKE

TS

Tall Sedges : water not very different in depth to 18/12/91.

Low Sedges : (T) = trap sites.

: [R] = Rotenone sites.

Beaufortia Heath

Cedar Dense Low Forest

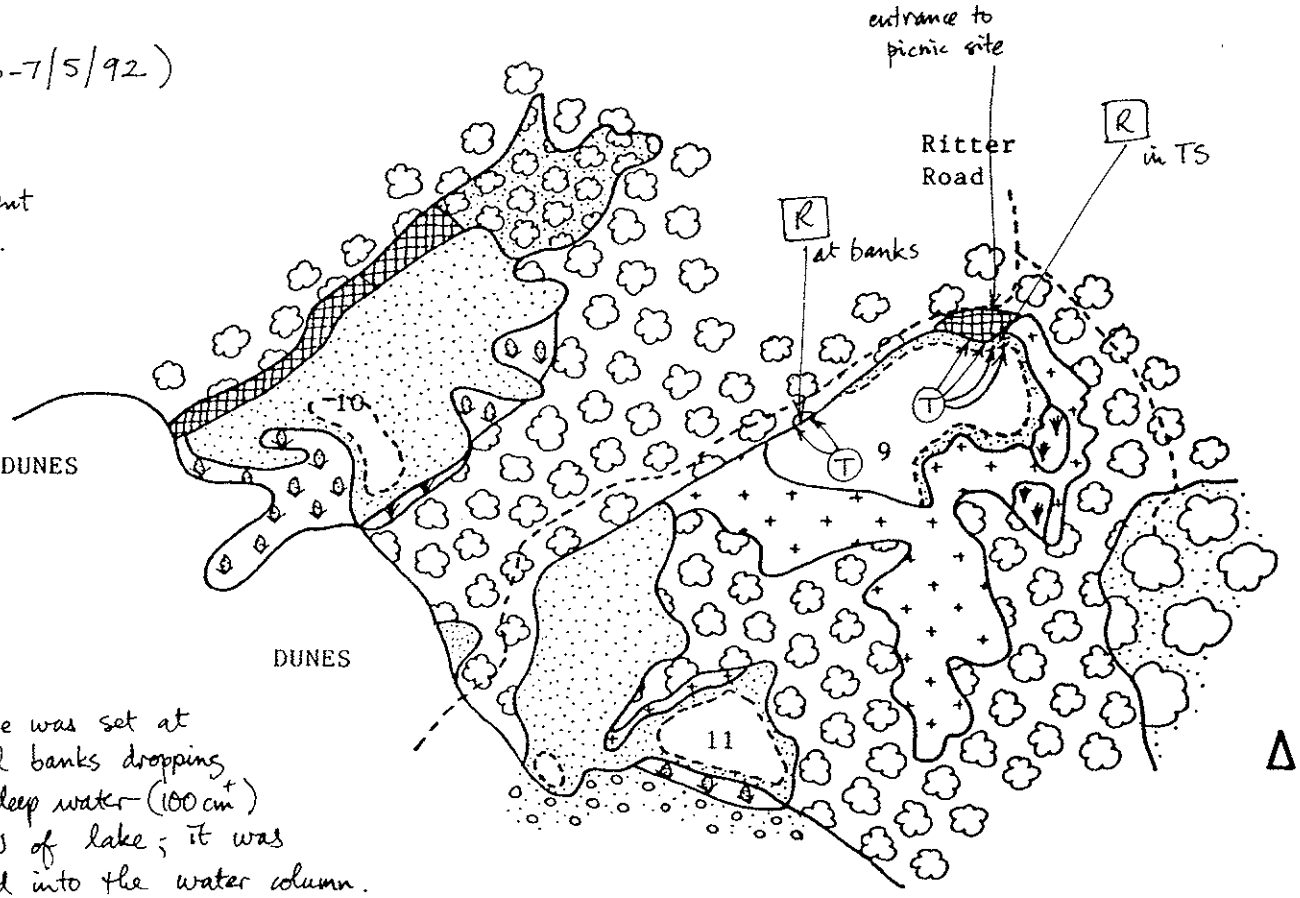
Paperbark Low Woodland

Banksia Low Woodland

Heath Coastal

Jarrah Low Woodland over Heath

Karri Forest



Rotenone was set at vertical banks dropping into deep water (100 cm+) in SW of lake; it was stirred into the water column.
Result was 2 Edelia and 1 Bostockia.

Rotenone was also set in shallower water (10-40 cm deep) in far N part of lake but also with similar result: few fish —
3 Edelia.

Spot-lighting at shallows beside picnic area at night yielded 10 Gambusia, all near silt freshly washed into the lake that day.

Two traps at the banks/deep-water yielded 1 Edelia and 1 Bostockia by day and 6 large marron by night. Four traps set in N of lake in TS, logs etc. and water 40-60 cm deep yielded:
15 Edelia,
1 Bostockia,
1 Galaxias &
1 Gambusia.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Naenup Swamp Lat: 34° 32' S, Long: 115° 52' E
Land Status: within State Forest (Charley Block)
CALM Region/District: Southern Forest / Pemberton Shire: Manjimup
Forestry Map (1:50 000): Warren

Date of Survey: 6-7/5/92 Duration: overnight/half day/full day.
Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.
Wetland Salinity (ppt): 0.10 (surface water)
% of Wetland Shore/~~Area~~ Surveyed: all methods = <2%. Rotenone = 1% Boat used? _____
Capture Methods Used: baited traps ✓x4, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded * = exotic species	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
nil					
Totals nil species			nil.		

Comments (conditions/other fauna/management):

- water at least 50 cm lower than on 17/12/91.
- traps left overnight had 25 gilgies Cherax sp. the next morning.
- macroinvertebrates such as 'water boatmen' were abundant.
- Birds: Purple Swamphen (1), Spotless Crake (2).

9 LAKE YEAGARUP
10 NAENUP SWAMP
11 UNNAMED LAKE

(6-7/5/92)

TS — Tall Sedges : water ca. 50 cm lower than on 17/12/91.

Low Sedges

Beaufortia Heath

Cedar Dense Low Forest

Paperbark Low Woodland

Banksia Low Woodland

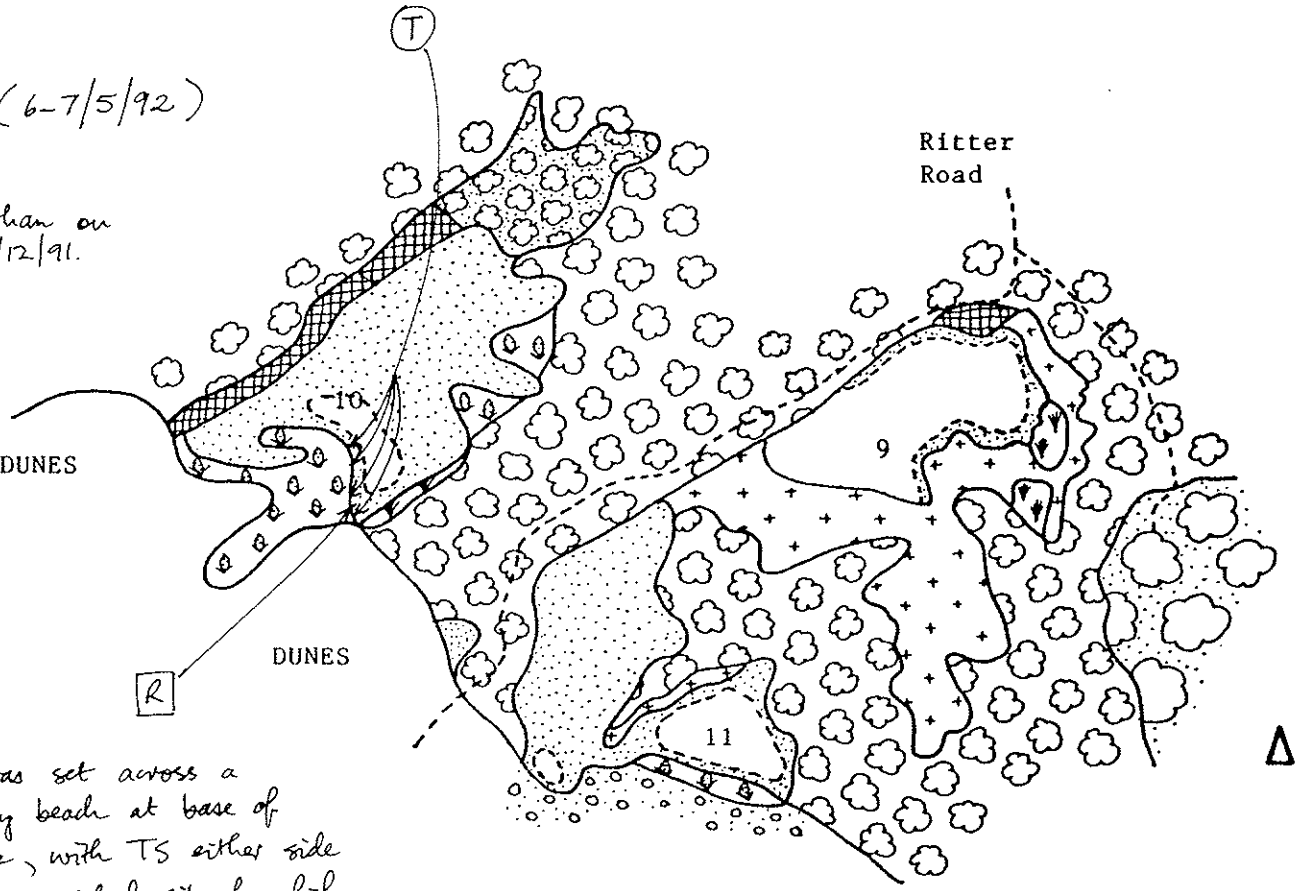
Heath Coastal

Jarrah Low Woodland over Heath

Karri Forest

(T) = fish trap sites.

[R] = Rotenone site.



Rotenone was set across a steep sandy beach at base of sand-dune, with TS either side — normally an ideal site for fish. Water was < 50 cm deep and there was plenty of litter on the lake-bed. Result → nil fish.

Traps x 4 were set in TS in water 30-50 cm deep. Three gilgies were caught in the day and 25 overnight but nil fish.

Dab-netting also yielded nil fish though there were plenty of water-boatmen + other macro-invertebrates.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Un-named Lake near Yeagarup Lat: 34° 33' S, Long: 115° 52' E

Land Status: within State Forest (Charley Block).

CALM Region/District: Southern Forest / Pemberton Shire: Manjimup

Forestry Map (1:50 000): Warren

Date of Survey: 6-7/5/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.14 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 2%. Rotenone = <1% Boat used? _____

Capture Methods Used: baited traps ✓x6, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias occidentalis	7	0	7	r, l, s	30-40
Edelia vittata	47	10	57	r, l, s	0-40
Totals species	54	10	64		

Comments (conditions/other fauna/management):

- water level lower than 18/12/91 but not much difference in shoreline.
- one gilgie in overnight traps, one also in daytime traps.
- Galaxias were obtained at three trapping sites.

9 LAKE YEAGARUP
10 NAENUP SWAMP
11 UNNAMED LAKE (6-7/5/92)

TS

Tall Sedges : water lower than on 18/12/91 but shoreline similar — to outer edge of TS.

Low Sedges

Beaufortia Heath

Cedar Dense Low Forest

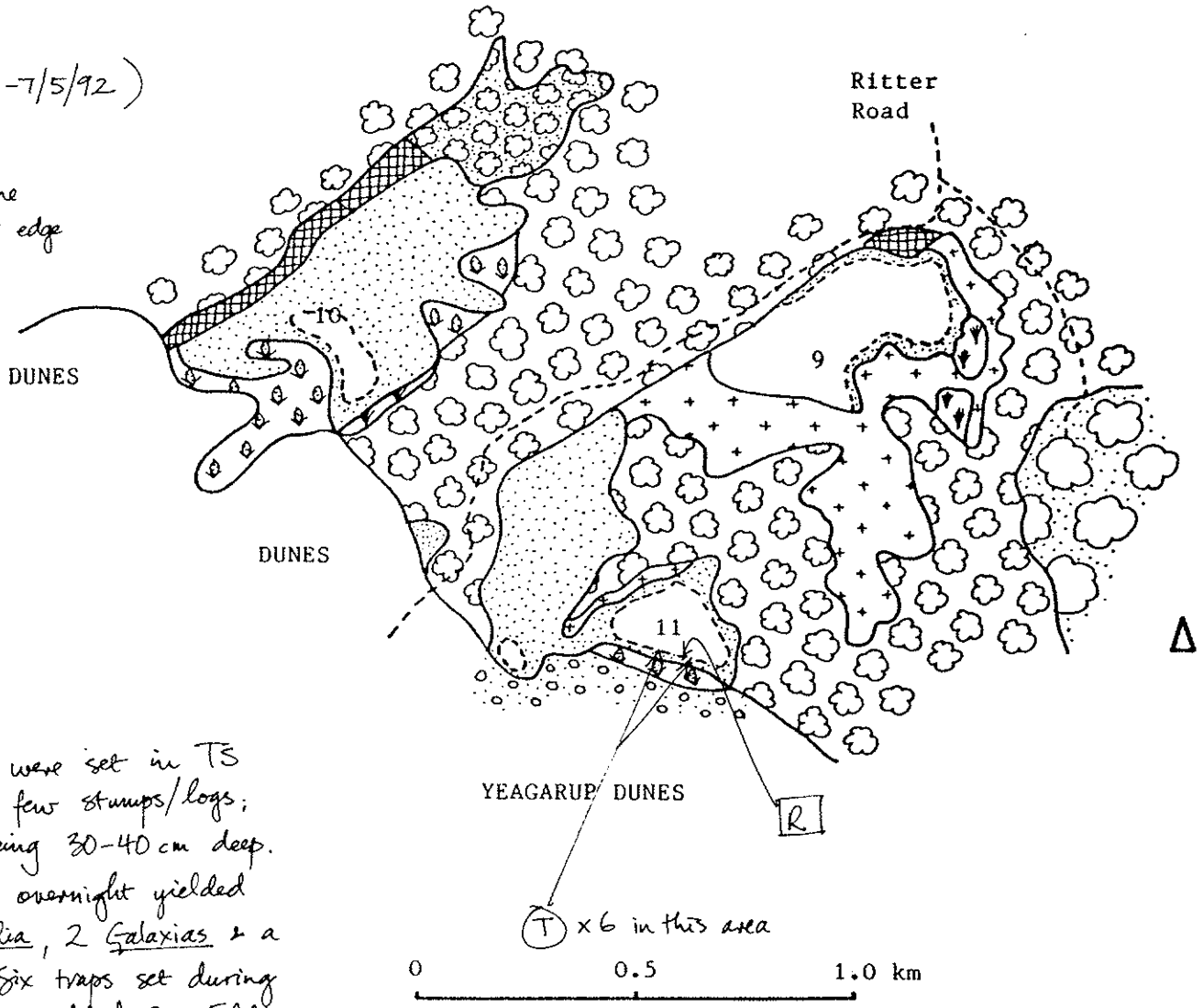
Paperbark Low Woodland

Banksia Low Woodland

Heath Coastal

Jarrah Low Woodland over Heath

Karri Forest



Δ

(T) = trap site.

[R] = Rotenone site.

6 Traps were set in TS with a few stumps/logs; water being 30-40 cm deep. Two set overnight yielded 17 Edelia, 2 Galaxias & a gilgie. Six traps set during the day yielded 30 Edelia, 5 Galaxias & a gilgie.
Galaxias were in 3 traps.

Rotenone was set in sparse TS (Baumea articulata & B. vaginalis) with water 0-40 cm deep.
Result: 10 Edelia.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Warren R. Oxbow Lat: 34° 34' S, Long: 115° 55' E

Land Status: within State Forest (Dombakup Block).

CALM Region/District: Southern Forest / Pemberton Shire: Manjimup

Forestry Map (1:50 000): Warren

Date of Survey: 7/5/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) _____, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.59 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 4%. Rotenone = 1% Boat used? _____

Capture Methods Used: baited traps ✓×4, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	Ø	3	3	l, w, s	< 50
Edelia vittata	13	31	44	l, w, s, d	0-100
* Gambusia affinis	15	Ø	15	l, s	< 50
Totals 3 species	28	34	62		

Comments (conditions/other fauna/management):

- water shallower (40cm?) than on 17/12/91; muddy shores exposed at W. end of wetland and few if any clumps of sedges were still in water.
- Gambusia were visibly plentiful in shallows, often near water surface, and were in the areas where Rotenone was set but none were obtained from Rotenone. More could have been obtained by dab-netting than the 15 taken.

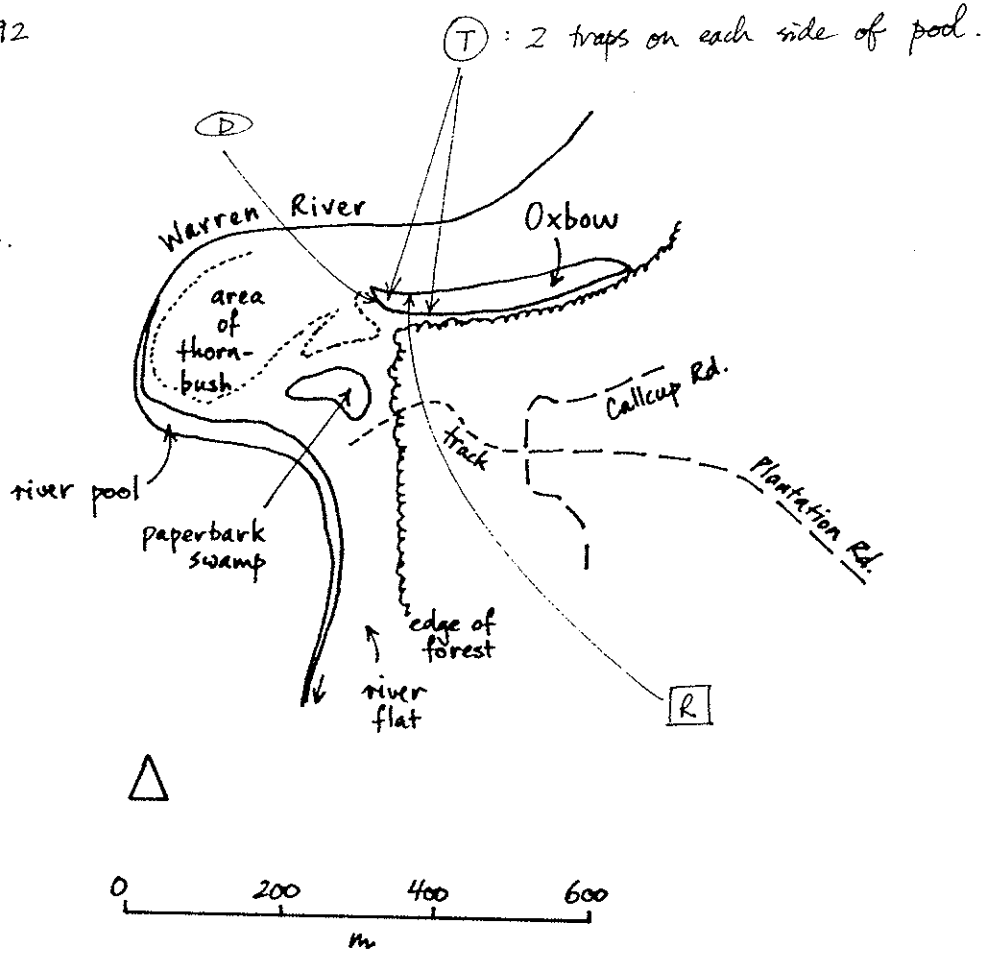
A4 WARREN RIVER OXBOW (7/5/92)

: water down by 50 cm since 17/12/92

Traps (T) were set around logs and submerged weed in water 40–100 cm deep. Result was catch of 13 Edelia.

[R] : Rotenone was set around logs and submerged weed in water 0–50 cm deep. Obtained 3 Bostockia and 31 Edelia.

Dab-netting ⊂ Dab-netting (D) at west eas end of pool yielded 15 Gambusia but many more were visible in the shallows.



W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Doggerup Lake Lat: 34° 43′ S, Long: 116° 04′ E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Southern Forest / Pemberton Shire: Manjimup

Forestry Map (1:50 000): Northcliffe

Date of Survey: 7-8/5/92 Duration: overnight / half day / full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) ✓,
logs (l) _____, banks (b) ✓, weed (w) _____,
water < 50 cm (s) ✓, water > 50 cm (d) ✓.

Wetland Salinity (ppt): 0.11 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 7%. Rotenone = 1% Boat used? _____

Capture Methods Used: baited traps ✓x5, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
⊙ Galaxiella nigrostriata	7	3	10	r, t, s	< 30
Galaxias occidentalis	7	0	7	r, b, s, d	0-80
⊙ Lepidogalaxias salamandroides	7	2	9	r, t, s	< 30
Bostockia porosa	1	2	3	r, t, s	0-50
Edelia vittata	205	29	234	r, t, b, s, d	0-80
⊙ Nannatherina balstoni	11	0	11	r, t, s	< 30
Totals 6 species	238	36	274		

Comments (conditions/other fauna/management): water levels higher by ?20cm on 18/12/91, with some spread into fringing areas.

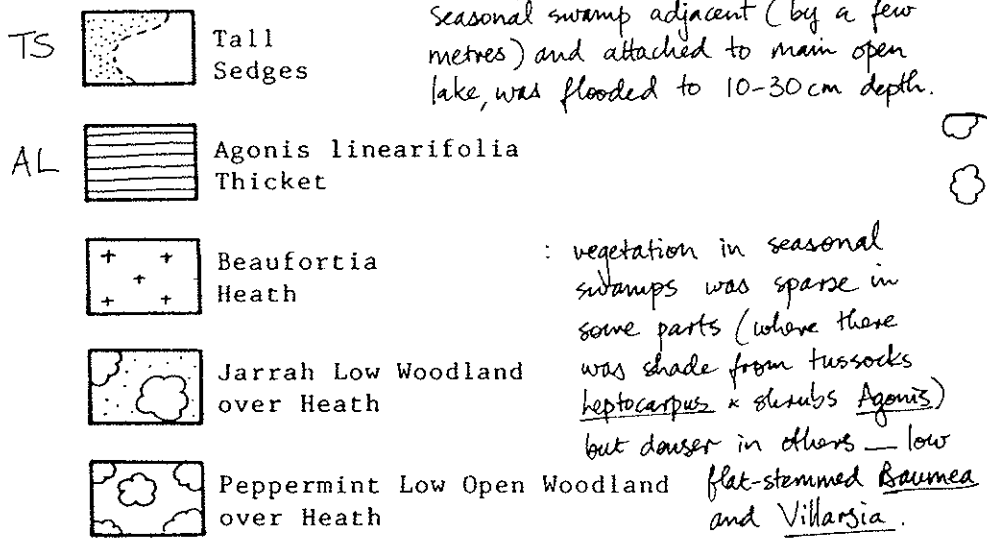
⊙ These species were obtained only in recently re-flooded (seasonal) swamp attached to the main (open) lake, being mostly < 10 cm deep but up to 30 cm deep and with moderately dense cover/shade of tussocks (eg. Leptocarpus) and thicket shrubs (eg. Agonis) to 1.0m height. (See map) Method was to push a dab-net through thin litter layer on floor of these parts of the wetland; all except Galaxias were included in the catch.

- Galaxias was obtained in overnight-set traps at edge of deeper lake.
- Galaxiella had bold black and white longitudinal stripes and reddish tails.
- Edelia & Nannatherina entered traps set in the seasonal shallows only a few minutes after setting.

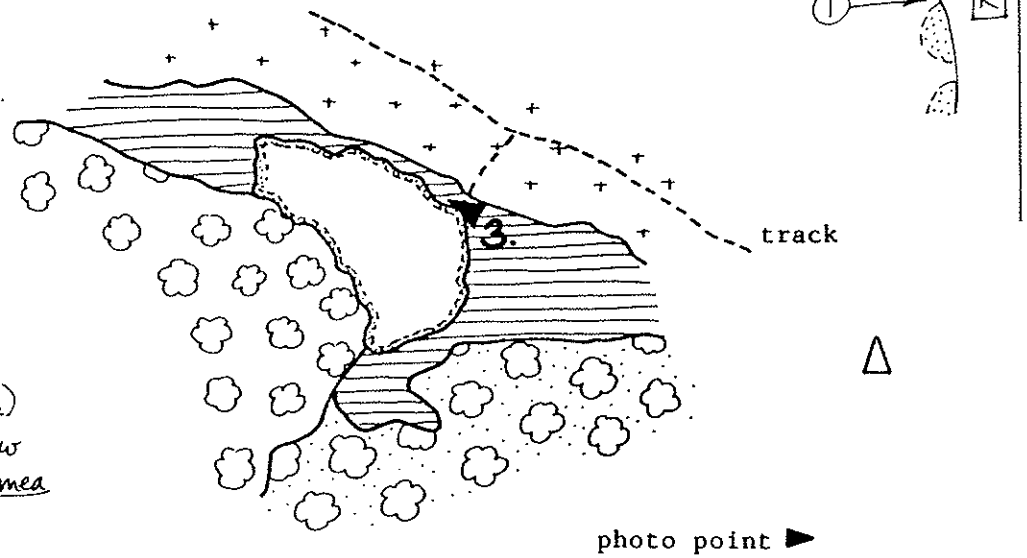
12 DOGGERUP LAKE (7-8/5/92)

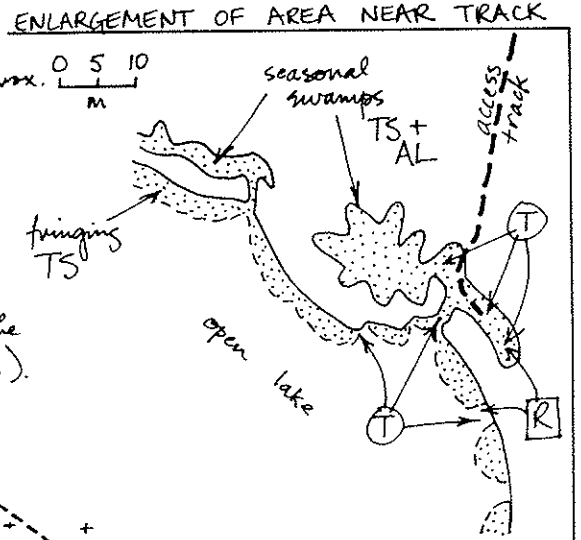
: water-level risen since 18/12/91, possibly due to renewed streamflow. Seasonal swamp adjacent (by a few metres) and attached to main open lake, was flooded to 10-30 cm depth.

Dab-netting was done in the seasonal swamps — for ca. 50 m to the right of the access track. Net was pushed through thin layer of litter on floor of swamps. Yield was: 8 Edelia, 1 Bostockia, 1 Nannatherina, 4 Galaxiella nigrostriata and 7 Lepidogalaxias (latter in the shallowest parts).



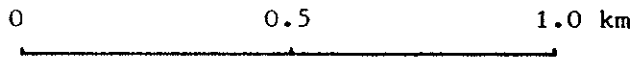
: vegetation in seasonal swamps was sparse in some parts (where there was shade from tussocks Leptocarpus & shrubs Agonis) but denser in others — low flat-stemmed Baumea and Villarsia.





(T) = Trap sites. Two set at edge of open lake overnight yielded many Edelia and 7 Galaxias, water was (a) 40 cm (lots of short sedges) and (b) 80 cm (under bank formed by tussocks) deep. These and one set in open shallows of embayment yielded some more Edelia by day. Three traps set in water 15-20 cm deep in the seasonal swamp yielded large numbers of Edelia, 3 Galaxiella nigrostriata and 11 Nannatherina (some quite large).

Fish entered these traps only a few minutes after they had been set. →



R : Rotenone was set in the lake — in a bay, beside dense TS — and part of it was put in the seasonal swamp nearby. Water was 0-50 cm deep and 0-30 cm respectively. Yield was 29 Edelia & 2 Bostockia in the bay and 3 Galaxiella + 2 Lepidogalaxias in the swamp.

Photo 3. Swampy parts of Doggerup Lake, 8/5/92; habitat for *Lepidogalaxias salamandroides* and *Galaxiella nigrostriata*.

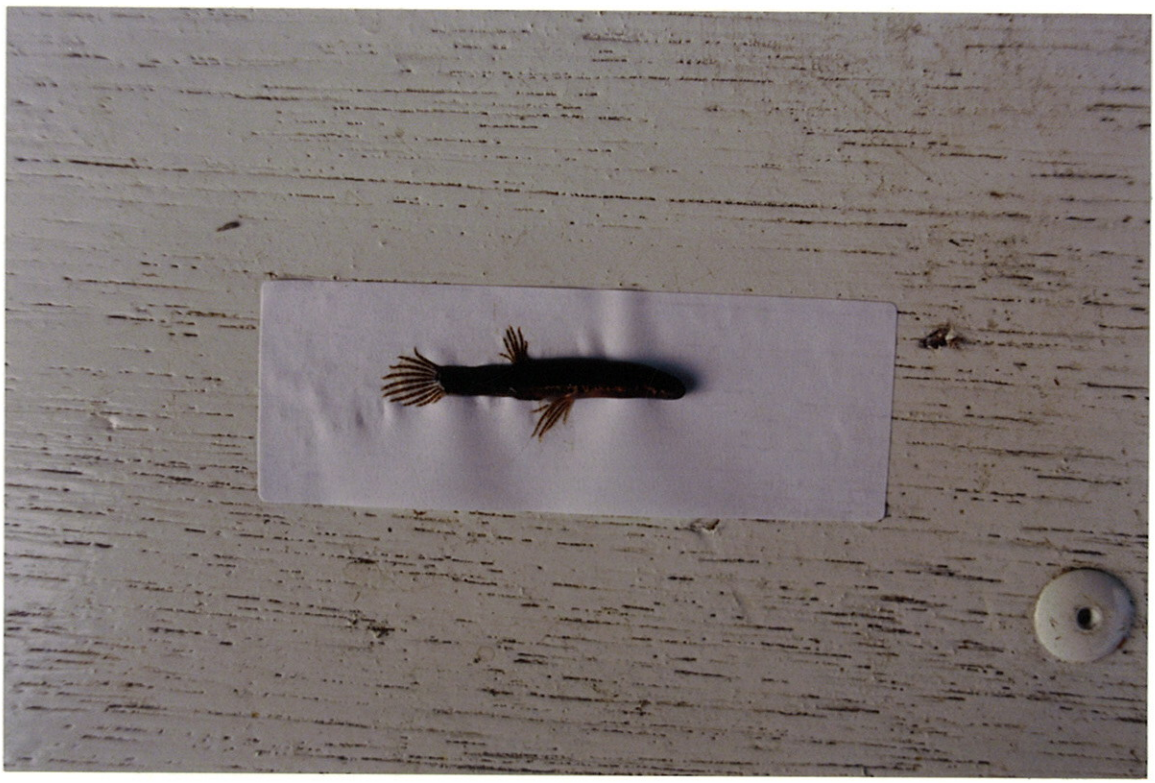


Photo 4. Specimen of *Lepidogalaxias salamandroides* freshly obtained from Doggerup Lake, 8/5/92. Note the distinctive fin structure. (Label length = 102 mm.)

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Samuel Lat: 34° 44' S, Long: 116° 04' E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Southern Forest / Pemberton Shire: Manjimup

Forestry Map (1:50 000): Northcliffe

Date of Survey: 8/5/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) _____, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.09 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 4%. Rotenone = <2% Boat used? _____

Capture Methods Used: baited traps ✓x6, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded * = exotic species	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxiella munda	Ø	1	1	r, s	30
Bostockia porosa	Ø	1	1	r, s	30
Edelia vittata	61	1	62	r, s	30-40
Totals 3 species	61	3	64		

Comments (conditions/other fauna/management):

- water level similar to 18/12/91; stream flowing in steadily.
- Galaxiella and Bostockia were in shallows near inflow stream, with dense flat-stemmed Baumea sedge and thick lake-bed litter.
- Birds: Little Pied Cormorant (3), White-faced Heron (2), Little Grassbird (1).
- some Edelia were dab-netted in the inflow stream.

13 LAKE SAMUEL (8/5/92)

TS — Tall Sedges — *Baumea vaginalis* + flat-stemmed *Baumea* (preissii/riparia).

Low Sedges

CF — Cedar Dense Low Forest

Beaufortia Heath

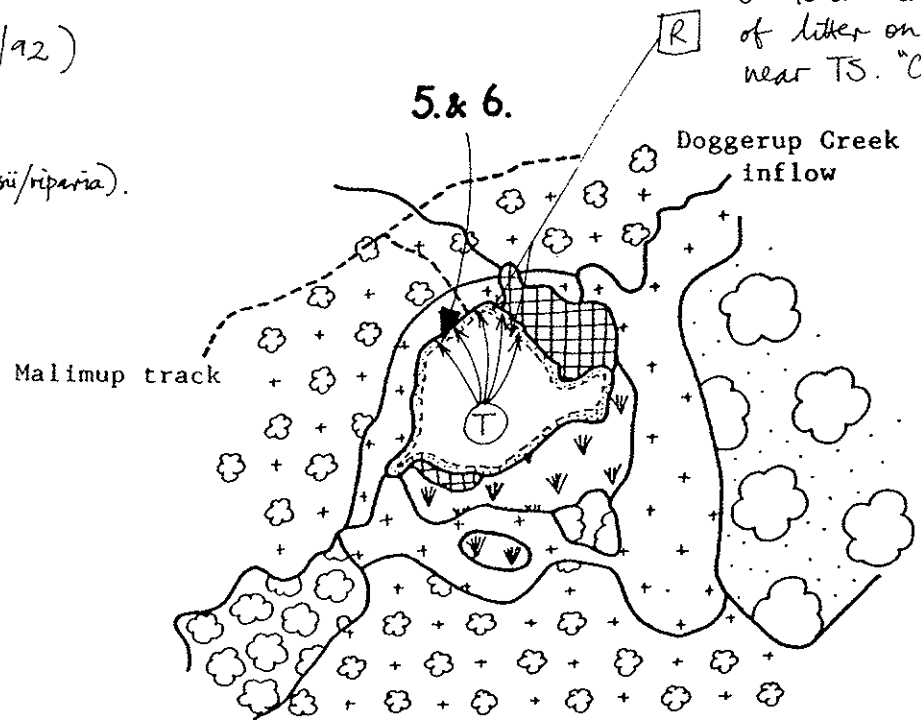
Heath Dry

Jarrah Low Woodland over Heath

Karri Forest

(T) = trap site.

[R] = Rotenone site.



Rotenone was set over water 0–40 cm deep, with a lot of litter on lake bed, and near TS. "Catch" was *Edelia* x 1, *Bostockia* x 1 and one *Galaxiella munda*.

Traps set in or beside TS in water 30–40 cm deep yielded 50+ *Edelia*. A few more were caught in traps near TS beside the CF in shallower water.

Some *Edelia* were dab-netted in/near the inflow stream at north end of lake.

Photos 5 & 6. South-western part of Lake Samuel, looking south, 8/5/92. *Galaxiella munda* was recorded in this lake.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Florence Lat: 34° 44' S, Long: 116° 06' E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Southern Forest / Pemberton Shire: Manjimup

Forestry Map (1:50 000): Northcliffe

Date of Survey: 7-8/5/92 Duration: overnight / half day / full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) ✓, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0·18 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 10%. Rotenone = 3% Boat used? _____

Capture Methods Used: baited traps ✓, dab-netting ✓, spotlighting ✓, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	Ø	2	2	s, l	0-30
Edelia vittata	Ø	16	16	r, l, b, s	0-40
Nannatherina balstoni	2	Ø	2	r, s	15
Totals 3 species	2	18	20		

Comments (conditions/other fauna/management):

- water down at least 30 cm depth since 18/12/91; majority of tussock bases were no longer in water — water was only at the very bottom of the bases — but some at the SW side were still well flooded.
- Nannatherina were in a trap left overnight beside a tussock that still had 5 cm of water (depth) at its base. Bostockia: one, quite large, regurgitated a "koonac" Charax sp..
- Birds: Maned Duck (2), Pacific Black Duck (2), Little Black Cormorant (1).
- Lots of long-necked tortoises (dead) found around shores.
- Lepidogalaxias (6) were scooped from litter in shallow pool on access track beside the bitumen road.

14 LAKE FLORENCE (7-8/5/92)

TS Tall Sedges

Cedar Dense Low Forest

Beaufortia Heath

Heath Dry

Karri Forest

(T) = trap site.

[R] = Rotenone site.

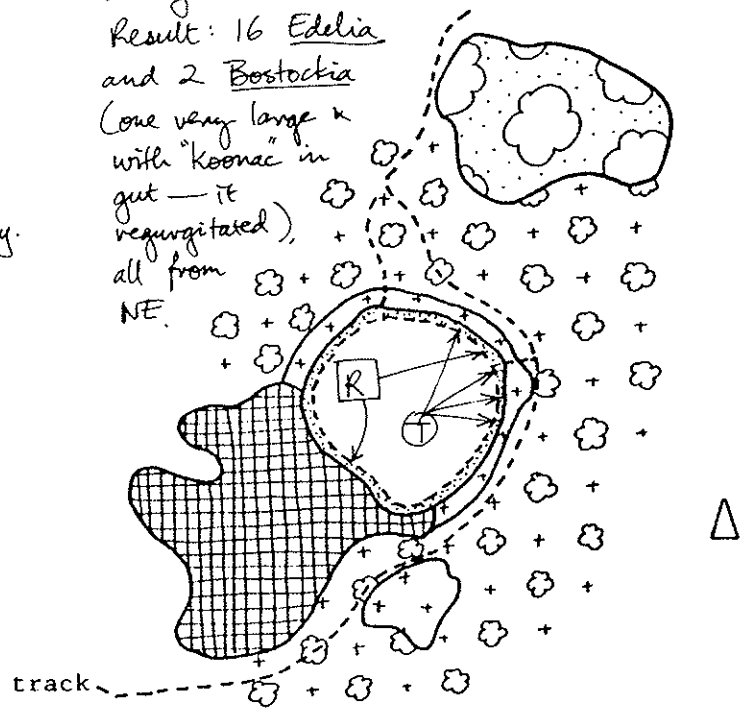
: water depth was ?30cm less than on 18/12/92.

: fringing swamps and pools on southern access track were all dry.

: beach was exposed around most of the shore but not in SW, where tussocks of Leptocarpus were still inundated.

: fallen logs were more plentiful at SW side of lake than elsewhere.

Rotenone was set in front of tussocks that had a few cm of water at their bases (NE lot) and also among tussocks that were still well flooded (SW lot). Result: 16 Edelia and 2 Bostockia (one very large & with "koonac" in gut — it regurgitated), all from NE.



Traps were left overnight in water 20 cm deep, some being 3-4 m offshore (to reach that depth). Yielded 2 Nannatherina which were in the trap nearest to a still partly flooded tussock-base at N. end of lake.

Extensive dab-netting (push method) on lake bed in the NE & SW did not yield any fish. Spotlighting in NE at night also was fruitless.

[6 Lepidogalaxias were netted by pushing through litter in pool (10cm deep) on access track beside the highway. Pool recently re-flooded.]

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Gardner R. Lake Lat: 34° 50' S, Long: 116° 06' E
Land Status: within D'Entrecasteaux National Park
CALM Region/District: Southern Forest / Pemberton Shire: Manjimup
Forestry Map (1:50 000): Broke Inlet

Date of Survey: 3-4/4/92 Duration (overnight) (half day) / full day.
Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.
Wetland Salinity (ppt): 0.40 (surface water)
% of Wetland Shore/Area Surveyed: all methods = 6 %. Rotenone = 2 % Boat used? ✓
Capture Methods Used: baited traps ✓, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxiella sp.	1	Ø	1	s	30
Bostockia porosa	Ø	6	6	r, l, s	0-30
Edelia vittata	21	76	97	r, l, s	0-30
Nannatherina balstoni	2	2	4	r, l, s	0-20
Totals 4 species	24	84	108		

Comments (conditions/other fauna/management):

- access was by the Tragedy Track: all dry but track narrow (winter wet).
- water much lower than on 19/12/91: water retreated from most of the tall sedges at eastern end of narrow part of lake (see map), leaving muddy edges. Water was less than 20 cm deep at far eastern end. Deeper areas to the west.
- a Galaxiella was dab-netted from the moving boat but it escaped. (G. nigrostriata was obtained here by Edward et al. in 1991.)
- two of the Nannatherina were in a trap left in 20cm of water overnight.
- Birds: Yellow-billed Spoonbill (2), Spotless Crake (1). A "koonac" was in one of the overnight traps.

15 GARDNER RIVER LAKES (3-4/4/92)

TS — Tall Sedges

Agonis floribunda Heath over Tall Sedges

Cedar Dense Low Forest

Beaufortia Heath

Heath Dry

Marri Low Woodland

Karri Forest

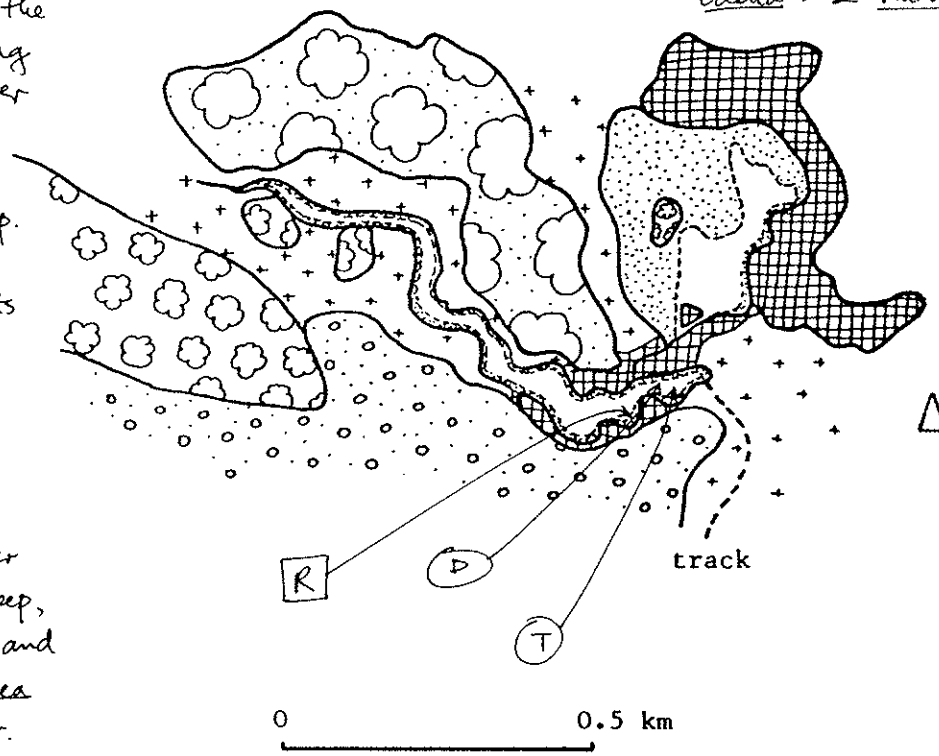
(T) = fish traps.

[R] = Rotenone site.

: water much lower than on 19/12/91, having retreated from most of the fringing TS and exposing muddy edges. Water at far east end of narrow section was < 20 cm deep. Deeper water was in the wider parts of the narrow section.

Substrate : silty.

Three traps were set overnight in shallows < 20cm deep, each being several metres from shore. Caught 20 Edelia + 2 Nannatherina.



Rotenone was set in water <30 cm (mostly < 10cm) deep, with lots of small logs and some edges of TS (Baumea articulata) still in water.

Yield was 80+ fish, mostly Edelia, with several Bostockia (one quite large) and 2 Nannatherina (one quite large).

(D) Dab-netting from the moving boat produced a Galaxiella sp. but it escaped before it could be identified.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Maringup Lake Lat: 34° 50' S, Long: 116° 12' E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Southern Forest/ Pemberton Shire: Manjimup

Forestry Map (1:50 000): Broke Inlet

Date of Survey: 2-3/4/92 Duration: (overnight)/half day (full day)

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.26 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 2 %. Rotenone = 1 % Boat used? ✓

Capture Methods Used: baited traps ✓x6, dab-netting ✓, spotlighting ✓, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias occidentalis	6	8	14	r, l, s	0-50
Bostockia porosa	Ø	48	48	r, l, s	0-40
Edelia vittata	635	336	971	r, l, w, s, d	0-100+
Nannatherina balstoni	Ø	23	23	r, l, s	0-40
Atherinosoma wallacei	3	Ø	3	r, s	30
Pseudogobius olorum	Ø	9	9	r, l, s, w	0-40
Totals 6 species	644	424	1068		

· Birds: see list on map.

Comments (conditions/other fauna/management):

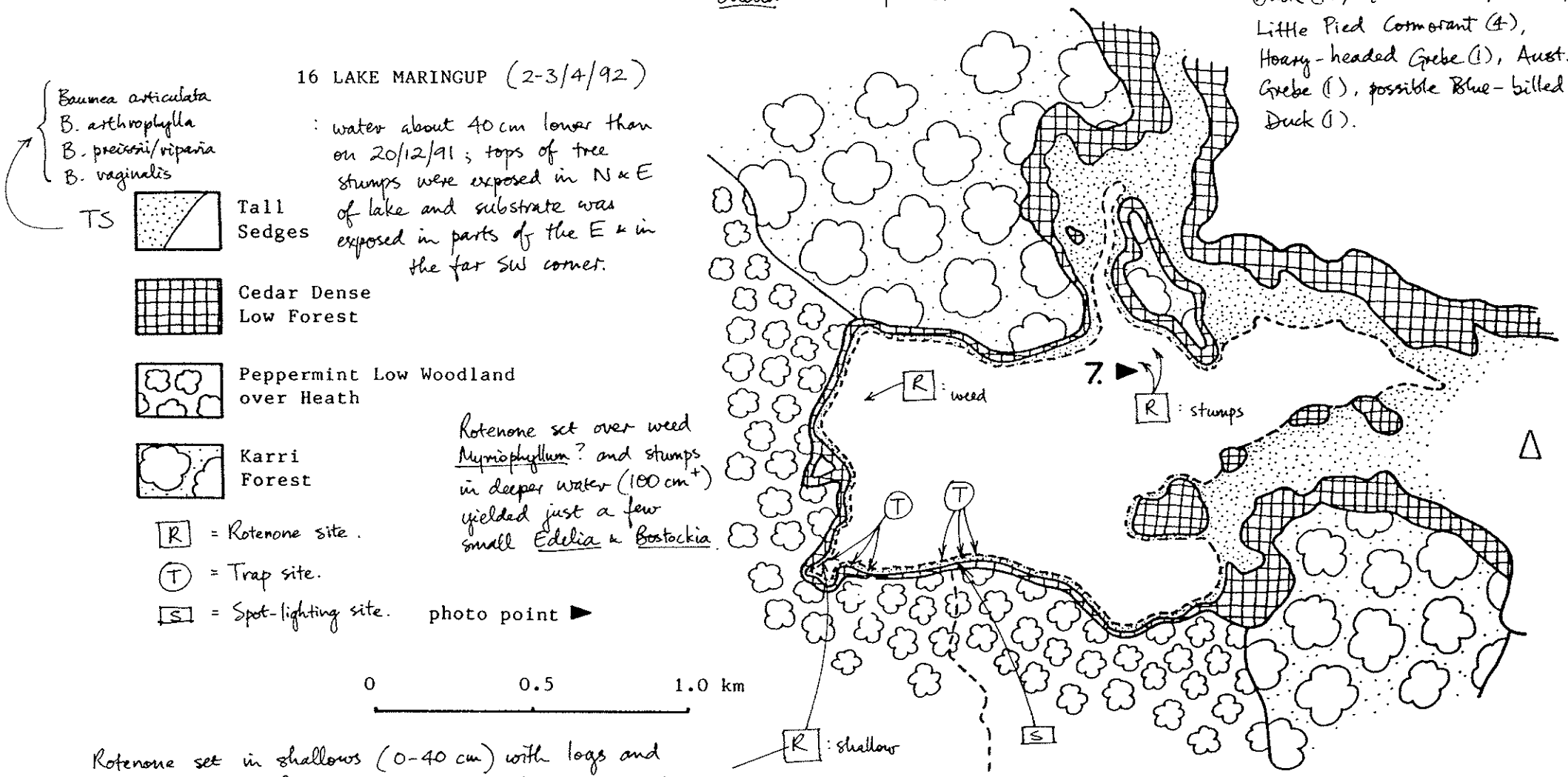
- water ca. 40 cm lower than depth on 20/12/91; tops of giant karri tree stumps were exposed in north and east of lake; some "metaphyton"/substrate exposed at E end.
- many of the Bostockia were large sized; Edelia varied widely in size and many were red on belly etc..; Atherinosoma were large to small in size.
- Atherinosoma were all obtained by spotlighting at night in sandy shallows (see map).
- Pseudogobius were commonly seen on top of the "metaphyton" (soft substrate).
- one large marron was seen at night in shallows near trap; another/same caught in another trap overnight.
- Rotenone tried in deeper water (100 cm+) but with little success.

16 LAKE MARINGUP (2-3/4/92)

: water about 40 cm lower than on 20/12/91; tops of tree stumps were exposed in N & E of lake and substrate was exposed in parts of the E & in the far SW corner.

Traps x6 set in water 30–50 cm deep in/near TS, yielded several hundred Edelia and a few Galaxias.

Birds: Coot (270), Musk Duck (5), Swan (2), P. Swamphen (3), Marsh Harriet (1), P. Black Duck (4), Gt. Crested Grebe (2), Little Pied Cormorant (4), Hoary-headed Grebe (1), Aust. Grebe (1), possible Blue-billed Duck (1).



Rotenone set over weed Myriophyllum? and stumps in deeper water (100 cm+) yielded just a few small Edelia & Bostockia.

Rotenone set in shallows (0–40 cm) with logs and sparse sedges in far SW corner yielded >250 Edelia, >40 Bostockia (many of them large), 23 Nannatherina, a few Galaxias and a few Pseudogobius. Substrate was soft "metaphyton".

One marron was caught in overnight trap nr. S.

Spot-lighting over shallows/sand near TS (Baumea articulata) yielded 3 Atherinosoma of various sizes.

Photo 7. Giant tree stumps below the water surface at Maringup Lake, 3/4/92, provided shelter for fishes.

Photo 8. Large marron *Cherax tenuinamus* were found at several wetlands, including Maringup Lake (2/4/92), in fish traps left overnight.

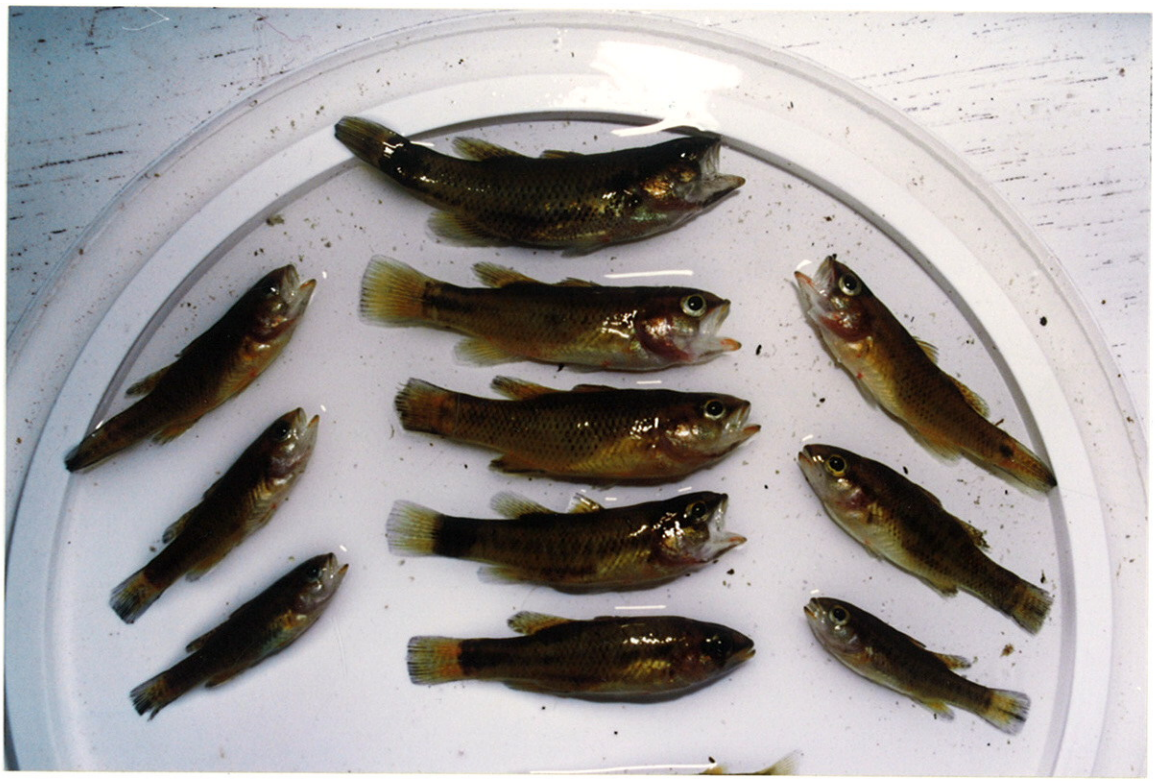


Photo 9. Some of the 23 *Nannatherina balstoni* recorded at Maringup Lake, 2/4/92, soon after capture. (Lid outer diameter = 200 mm).

Photo 10. Some of the 48 *Bostockia porosa* obtained at Maringup Lake, 2-3/4/92. (Lid outer diameter = 200 mm).

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: East of Broke Inlet Lat: 34° 57' S, Long: 116° 32' E

Land Status: within D'Entrecasteaux National Park

CALM Region/District: Southern Forest / Walpole Shire: Manjimup

Forestry Map (1:50 000): Walpole

Date of Survey: 2/4/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) _____, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) _____.

Wetland Salinity (ppt): 1-11 (surface water)

% of Wetland ~~Shore~~/(Area) Surveyed: about 40 % Boat used? _____

Capture Methods Used: baited traps _____, dab-netting ✓, spotlighting _____,
Rotenone poison _____

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxiella nigrostriata	3	/	3	s, r	0-10
Galaxias occidentalis	1	not	1	s	0-10
Bostockia porosa	20	/	20	s, r	0-10
Edelia vittata	18	used	18	s	0-10
Nannatherina balstoni	3	/	3	s, r	<5
Totals 5 species	45	–	45		

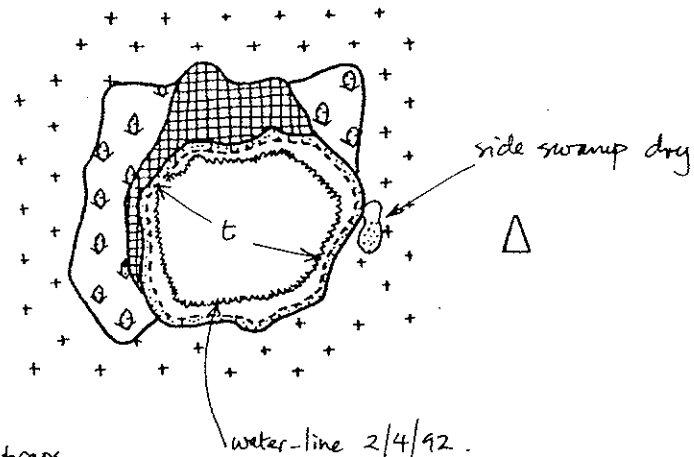
Comments (conditions/other fauna/management):

- wetland reduced to pool no more than 10 cm deep with wide beach right around it.
- two small clumps of Baumea vaginalis still had a few cm of water in them and there the following were found: all 3 Nannatherina, 4 Bostockia, 1 Galaxiella.
- all other fish were in open water.
- substrate was very fine silt (black) with gravelly sand underneath that.
- all fishes were obtained by pushing the dab-net* through the sediment/litter on lake bed and sorting through the accumulated material. (*quickly)
- remains of Great Cormorant and koonac found. Many tracks of herons & crakes in the mud.

17 BROKE INLET LAKE (2/4/92)

: water reduced to a pool up to 10 cm deep surrounded by a wide beach; substrate was fine black silt/litter over gravelly sand.

t = small tussocks of TS still in a few cm of water → all Nannatherina found there plus 1 Galaxiella and several Bostockia.



TS Tall Sedges : Baumea vaginalis dominant.

Cedar Dense Low Forest

Banksia Low Woodland

Beaufortia Heath

No Rotenone used here because of potential for excessive kill of fish. Water too shallow for traps.

All fish obtained by pushing a dab-net in front of the operator, fairly quickly, in the soft lake-bed sediments. About 40% of the water area was covered this way.

Result: Edelia x 18 (all small), Bostockia x 20 (all small), Nannatherina x 3, Galaxias occidentalis x 1 and Galaxiella nigrostriata x 3.

0 0.5 1.0 km

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Owingup Swamp Lat: 35°00′ S, Long: 117°04′ E

Land Status: within Quarrum Nature Reserve

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 20/3/92 Duration: overnight/half day/(full day)

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) ✓ rocks, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 1·80 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 6%. Rotenone = 2 % Boat used? _____

Capture Methods Used: baited traps ✓, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxiella nigrostriata	Ø	1	1	r, s	< 40
Galaxias occidentalis	3	4	7	r, s	< 40
Bostockia porosa	Ø	17	17	r, s	< 30
Edelia vittata	60	122	182	r, s	< 30
Nannatherina balstoni	Ø	6	6	r, s	< 30
Atherinosoma wallacei	62	14	76	r, s	30-40
Favonogobius suppositus	Ø	6	6	r, s	< 30
Pseudogobius olorum	9	Ø	9	r, s	< 40
Totals 8 species	134	170	304		

· Other fauna: tortoise (car. 22 cm), mussels, shrimps, leeches.

· Birds: see list on map.

Comments (conditions/other fauna/management):

· water lower than on 9/1/92: wide beach flats exposed at SE side of lake (see map).

· boggy mud around some parts of the beds of tall sedges Baumea articulata.

· most of the Edelia caught live were in traps; all of the Atherinosoma caught live were obtained by plunging a dab-net in front of the moving operator.

· Rotenone was set in Baumea articulata and yielded 7 species; it was also set in a patch of Typha orientalis within B. articulata, where it yielded six spp. (not Galaxiella).

[· a follow-up visit on 1/4/92 was done to look for adult specimens of Galaxias; use of traps and dab-nets yielded 1-2 individuals of six of the eight species — no Galaxiella or Nannatherina.]

19 OWINGUP SWAMP (20/3/92)

: deepest water found was 90 cm.

TS — Tall Sedges : B.a. Baumea articulata; T.o. Typha orientalis

Cedar Dense Low Forest

Beaufortia Heath

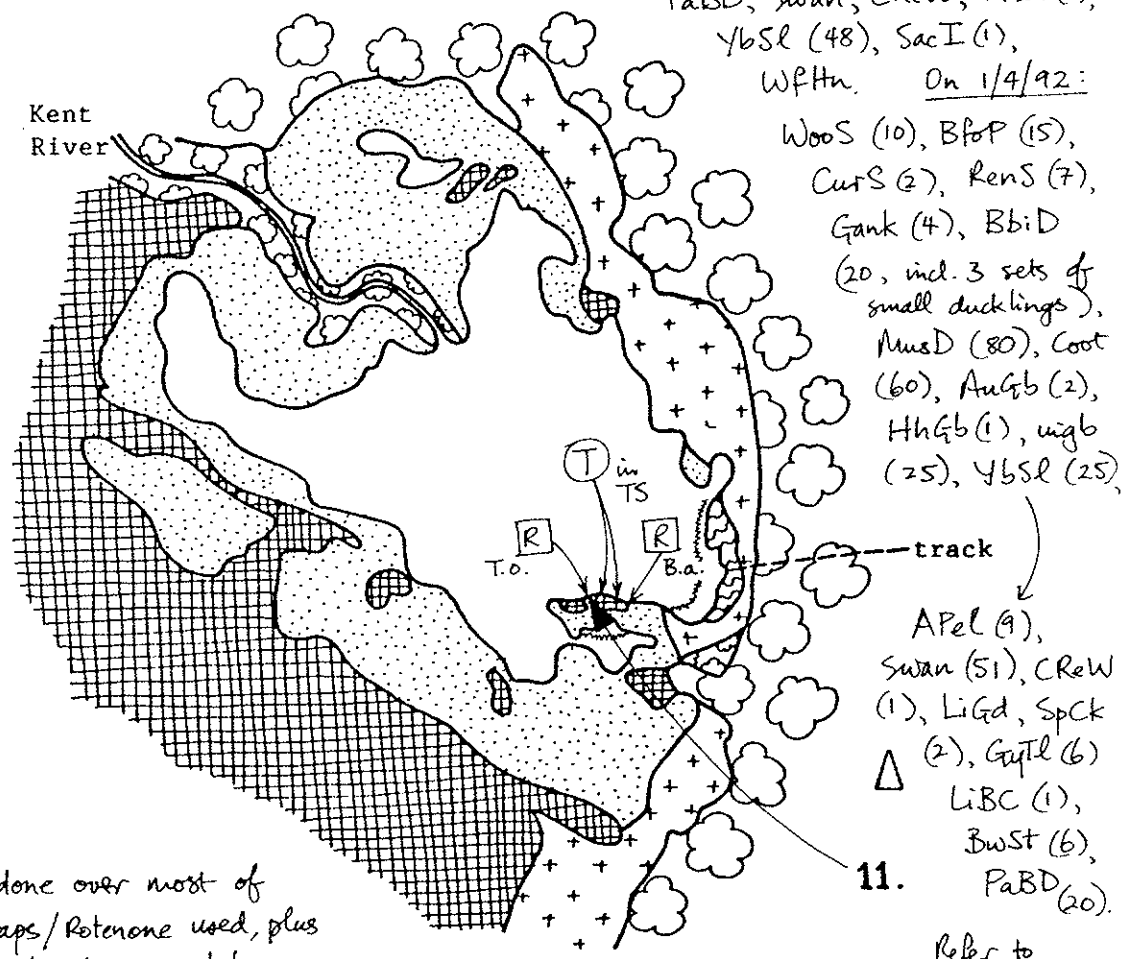
Callistachys Thicket

Paperbark Low Woodland

Jarrah Low Woodland over Heath

: beach on SE side of lake was much wider on 20/3/92 than on 9/1/92.

4 Traps were set in TS (B.a.) at south part of Swamp in water 30-40 cm deep. These yielded 58 Edelia & 5 Pseudogobius.



Birds: on 20/3/92: SpCk (5), Gank (2), Matta, Shel, BfoP, PaBD, Swan, CReW, APel (4), YbSl (48), SacI (1), WfHn. On 1/4/92: WooS (10), BfoP (15), CurS (2), RenS (7), Gank (4), BbiD (20, incl. 3 sets of small ducklings), NmsD (80), Coot (60), AuGb (2), HhGb (1), migb (25), YbSl (25), APel (9), Swan (51), CReW (1), LiGd, SpCk (2), GytI (6), LiBC (1), BwSt (6), PaBD (20).

Refer to Waterbirds report for species codes.

~~~ = waterline in SE of wetland.

T = trap site.

R = Rotenone site.

Rotenone set in fairly dense T.o., water 10-30 cm deep: yield was 6 species — not Galaxiella but including Nannatherina, Favonogobius.

Dab-netting was done over most of the area where traps/Rotenone used, plus farther to west and into open lake. Strategies were to plunge net ahead of operator and to scoop around dumps of B.a.. Yield was 62 small Atherinosoma and 3 Galaxias occidentalis, 4 Pseudogobius & 2 Edelia. Water 20-40 cm deep.

Rotenone set in both sparse & dense B.a., water 20-40 cm deep: yield was all species (7) except Pseudogobius (see datasheet). Fish easily sighted escaping.
~~~

Photo 11. A bed of *Typha* in shallows at Owingup Swamp, 20/3/92. Six species including *Nannatherina balstoni* were found at this site ; eight species were recorded at the Swamp.

Photo 12. Some of the *Edelia vittata* and other species obtained at Owingup Swamp.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Boat Harbour L. 1 Lat: 35°01' S, Long: 117°05' E

Land Status: within Quarram Nature Reserve

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 30/3 – 1/4/92 Duration: overnight / half day / full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓?.

Wetland Salinity (ppt): 1.10 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 2%. Rotenone = 1% Boat used? ✓

Capture Methods Used: baited traps ✓x3, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias occidentalis	1	37	38	s	<50
Bostockia porosa	Ø	2	2	r, s	<40
Edelia vittata	37	433	470	r, s	<40
Nannatherina balstoni	Ø	7	7	r, s	<40
Pseudogobius olorum	7	1	7	r, s	<50
Totals 5 species	45	480	525		

Comments (conditions/other fauna/management):

- water retreated from tall sedges/tussocks in NE of lake : substrate exposed.
- water depth was 30–40 cm where fish were trapped/poisoned ; other parts of the lake were shallower and others deeper.
- Galaxias were in large (100+), fast-moving schools some distance from shore.
- Pseudogobius commonly seen on lake bed soft substrate.
- Birds : Aust. Pelican (8), Great Egret (3), Musk Duck (1), Black-winged Stilt (25), Black Swan (46), Pacific Black Duck (50).

BOAT HARBOUR ROAD LAKES

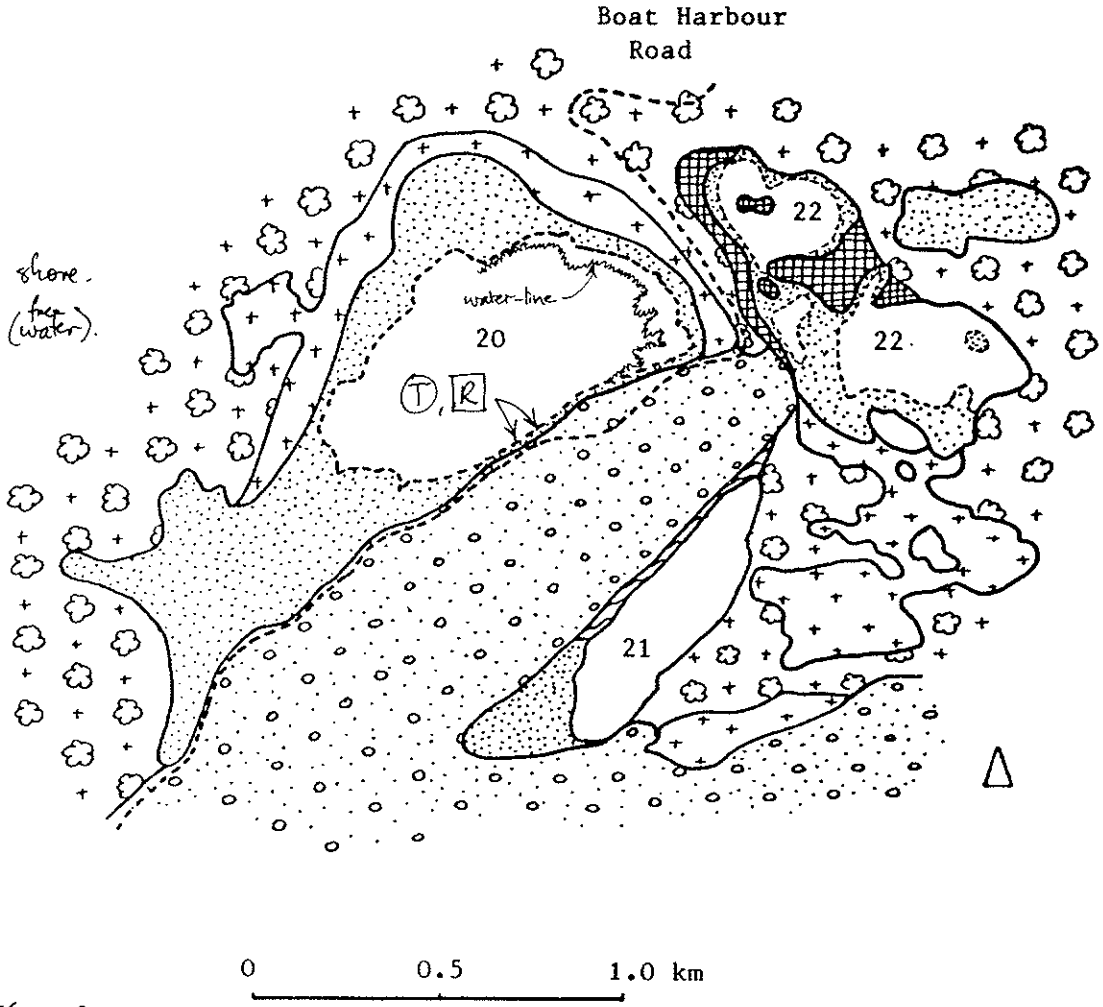
20 LAKE 1 ~~LAKE 2~~ 30/3 – 1/4/92

21 ~~LAKE 2~~

22 ~~LAKE 3~~

: soft substrate exposed in NE of lake and in places elsewhere around shore.

: much of lake probably < 50 cm deep (free water).



TS

- Tall Sedges
- Cedar Dense Low Forest
- Callistachys Thicket
- Beaufortia Heath
- Heath Dry
- Heath Coastal

(T) = fish trap sites.

[R] = Rotenone site.

Three traps were set at edge of TS (Baumea rubiginosa/preissii, B. vaginalis) and checked periodically; they were left overnight on 30/3 and 31/3/92. Water was ca. 40 cm deep. Result was 1 Galaxias, 37 Edelia and 7 Pseudogobius.

Schools of 100+ Galaxias were often seen, usually some metres out from shore. Also, Pseudogobius were commonly seen on lake-bed.

Rotenone was set at the edge of TS in water 30–40 cm deep, over soft ("bottomless") substrate. Water extended 0.3–0.5 m into the TS. Result: 37 Galaxias (mostly after first hour), 2 Bostockia, 433 Edelia, 7 Nannatherina, 1 Pseudogobius.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Boat Harbour L. 2 Lat: 35°01' S, Long: 117°06' E

Land Status: within Quarram Nature Reserve

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 30-31/3/92 Duration: overnight / half day / full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 2.11 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 15%. Rotenone = 5% Boat used? _____

Capture Methods Used: baited traps ✓x3, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
nil					
Totals nil species			nil.		

Birds: see map.

Comments (conditions/other fauna/management):

- water along NW & SE shores generally was too low for setting of traps within fringing tall sedges; therefore traps were set a few metres offshore.
- substrate generally was soft & treacherous on west side but firm enough for easy access on foot on the east side.
- there was deeper water in the Typha at SW end of lake — access difficult on western side due to soft bed.
- set traps at 2 locations and Rotenone at 3 but nil fish. Large invertebrates were common, also tadpoles.

BOAT HARBOUR ROAD LAKES

20 LAKE 1

21 LAKE 2 — 30/3 – 31/3/92

22 LAKE 3

: very little water into the TS except in the Typha, where > 50 cm deep in parts (& boggy underfoot!).

TS — Tall Sedges : Typha at SW end of lake, including "islands"; patches of Baumea articulata & B. vaginalis along NW & SE shores.

Cedar Dense Low Forest

Callistachys Thicket

Beaufortia Heath

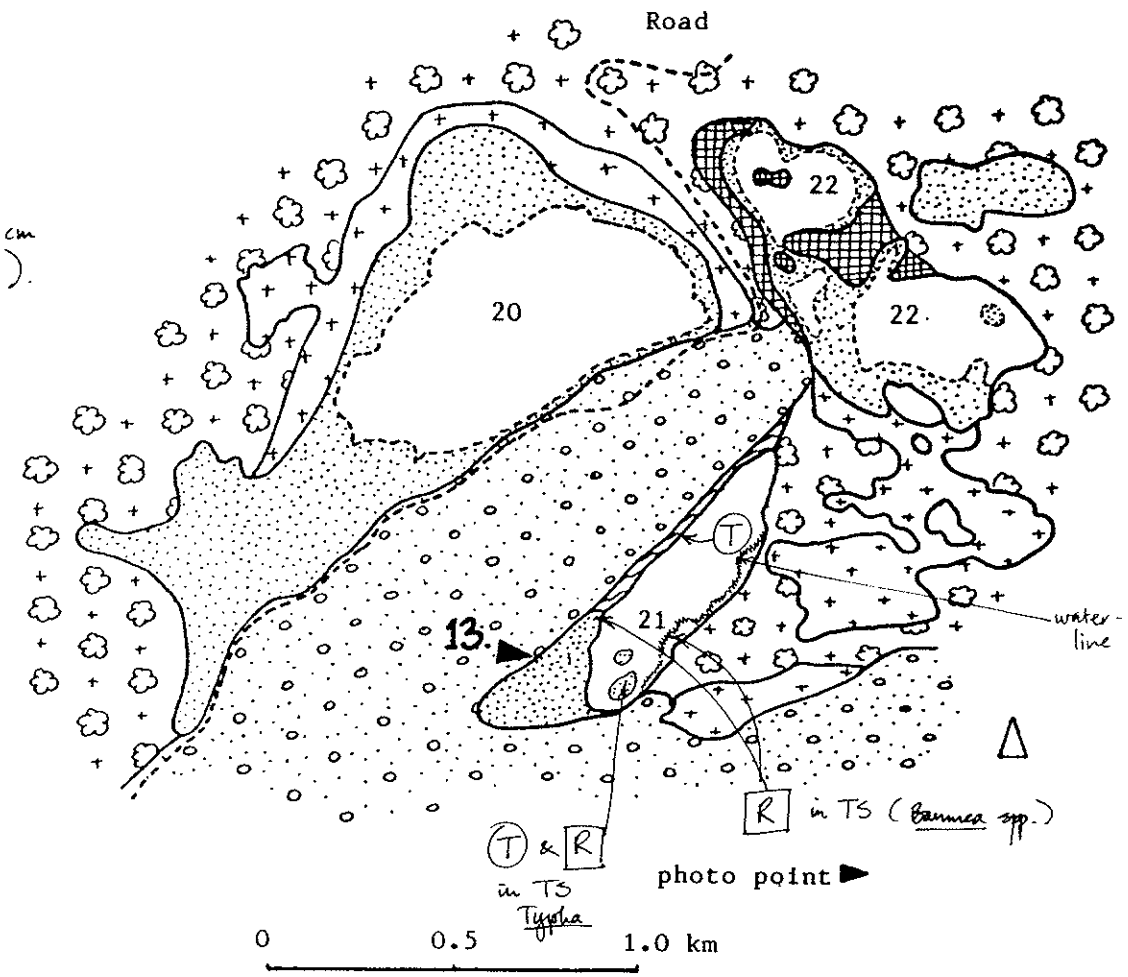
Heath Dry

Heath Coastal

Three traps set overnight on NW shore, a few metres out from edge of thin belt of TS (water too shallow beside the TS). Result → nil.

Three traps also set in TS (Typha) in far S of lake during the day but also gave nil fish.

Birds: Pacific Black Duck (60), Swan (2), Black-winged Stilt (20), Purple Swamphen (1), Grey Teal (3), Black-fronted Plover (2), Spotless Crake (1), Marsh Harrier (1).



Dab-netting failed to secure any fish, but large invertebrates (water-boatmen, Odonata, etc.) were common, likewise tadpoles.

Rotenone was set in TS at SW and S ends of lake (Typha) in water 20 – 40 cm deep and in shallower water in TS (Baumea) on SE shore. Result → nil fish.

Photo 13. Southern end of Boat Harbour Lake 2, looking east, 30/3/92. No fish were found in this isolated lake.

Photo 14. Eastern part of Boat Harbour Lake 3, looking west, 30/3/92. *Galaxias maculatus* was found in this wetland.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Boat Harbour L. 3 Lat: 35° 01' S, Long: 117° 06' E

Land Status: within Quarram Nature Reserve.

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 31/3 – 1/4/92 Duration: overnight / half day / full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.85 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 4%. Rotenone = 2% Boat used? ✓

Capture Methods Used: baited traps ✓×3, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Galaxias maculatus	1	Ø	1	r, s	?
Galaxias occidentalis	58	12	70	r, l, w, s, d	20-40
Bostockia porosa	Ø	3	3	r, l, s	20-40
Edelia vittata	269	186	455	r, l, w, s, d	20-40
Pseudogobius olorum	4	2	6	r, s	20-40
Totals 5 species	332	203	535		

Comments (conditions/other fauna/management): + narrow beach also in N basin

- broad beach exposed at far east end of lake; water area otherwise not very different to 9/1/92. Reduced depth had resulted in stumps exposed, especially in north and east basins. Plenty of water in the tall sedges.
- Galaxias maculatus was recognised only in laboratory: assumed was trapped.
- G. occidentalis were dominantly adult specimens, some quite large.
- a few Edelia & Pseudogobius were obtained by dab-netting around bases of tall sedges.
- Birds: Great Egret (5), Sacred Ibis (5), Yellow-billed Spoonbill (8), White-faced Heron (5), P. Swamphen (1), Black-fronted Plover (2), Little Pied Cormorant (3), Black Duck (30).

BOAT HARBOUR ROAD LAKES
20 LAKE 1
21 LAKE 2
22 LAKE 3 31/3 - 1/4/92.

: water lower than on 9/1/92. Broad beach & flat exposed in far east and a narrow beach & flat in the north basin. Otherwise, water still inside all the areas of TS.

: many tree stumps exposed in the north & east basins.

: extensive growth of aquatic weed (Myriophyllum ?) in central (smaller) basin.

· mussels abundant.

· large waterbirds roosting around central basin.

TS Tall Sedges

CF Cedar Dense Low Forest

Callistachys Thicket

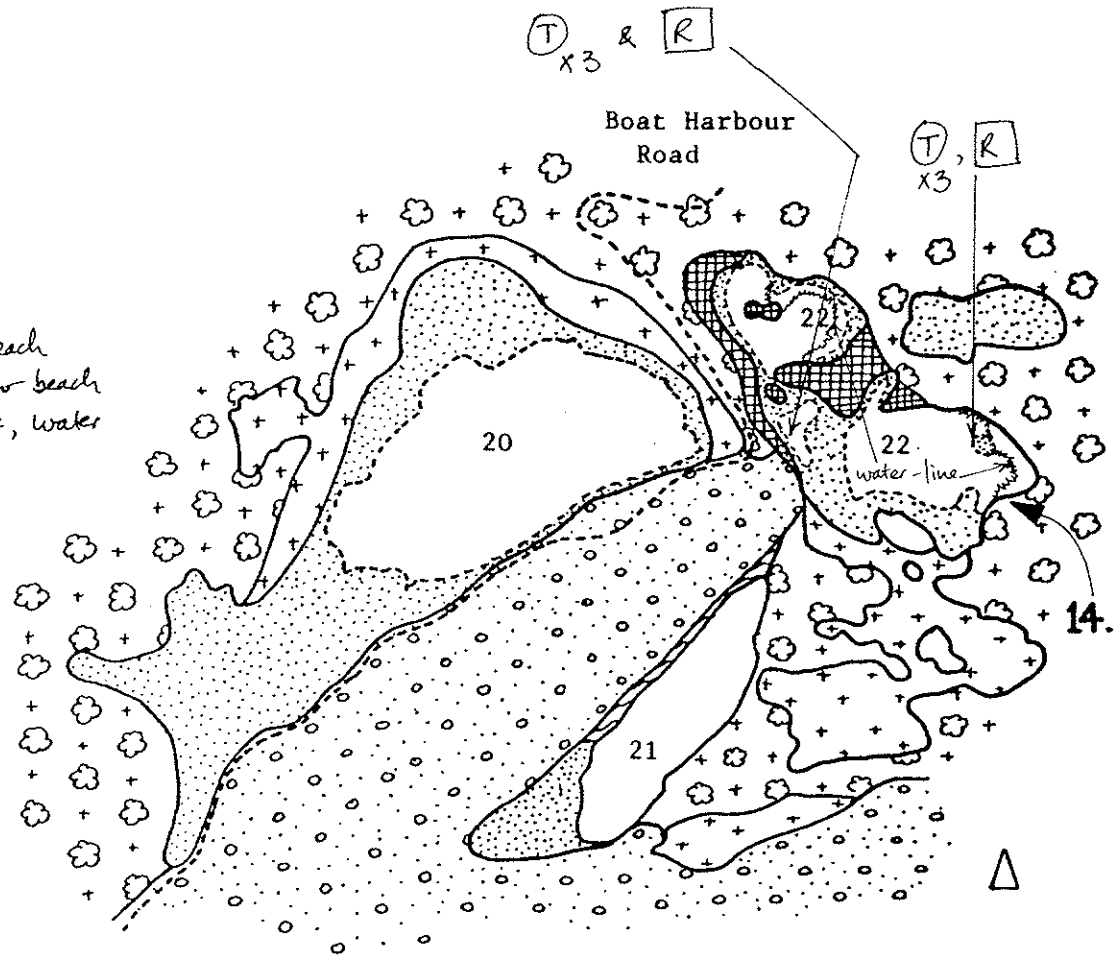
Beaufortia Heath

Heath Dry

Heath Coastal

(T) = trap site.

[R] = Rotenone site.



Three traps were set in Baumea articulata (water 30-40 cm deep) in far east basin: caught lots of Edelia and Galaxias occidentalis.

Three also set overnight in central basin at edge of TS (B. articulata, B. vaginalis) beside CF in water 30-40 cm deep. Caught lots of Edelia, some Galaxias and a few Pseudogobius in each trap.

Rotenone was set in water 20-40 cm deep in B. articulata in far east, and in similar situation plus logs and weed in central basin. Total yield was 12 Galaxias, 3 Bostockia, 186 Edelia & 2 Pseudogobius.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Reserve 12046 L. Lat: 35°00' S, Long: 117°13' E

Land Status: within William Bay National Park

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 18-19/3/92 Duration: overnight/half day/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) ✓, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0.44 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 50%. Rotenone = 3% Boat used? _____

Capture Methods Used: baited traps ✓x4, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	5	9	14	r, l, s	0-40
Edelia vittata	36	18	54	r, l, s	0-40
Pseudogobius olorum	103	4	107	r, s	0-40
Totals 3 species	144	31	175		

Comments (conditions/other fauna/management):

- water lower than on 10/1/92 : 'beach' exposed in many places and water was outside of the fringing tall sedges in many places.
- large catch of Pseudogobius was due to dab-netting done around whole of lake perimeter with frequent sampling.
- Birds : White-faced Heron (1), White-bellied Sea-Eagle (1), Aust. Grebe (1), Yellow-billed Spoonbill (1), Sacred Ibis (1), Little Black Cormorant (1).
- one koonac was in a trap left overnight.

23 ↑ 12046 WILLIAM BAY ROAD (18-19/3/92)

TS Tall Sedges : mostly *Baumea articulata* plus some *B. vaginalis* and *Typha*.

CF Cedar Dense Low Forest

Heath Coastal

Blackbutt Open Low Woodland over Beaufortia Heath

Karri Forest

Jarrah Low Woodland over Low Heath

Pasture

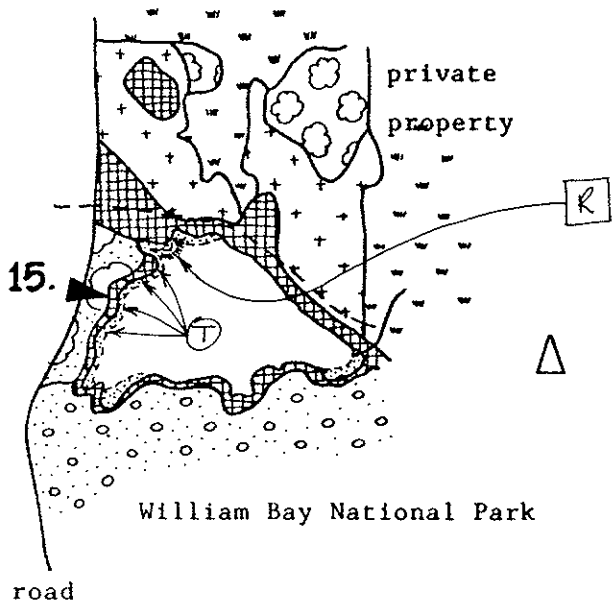
(T) = trap sites.

[R] = Rotenone site.

: water was lower than on 10/1/92; beach or mud was exposed around much of shoreline and water had left many of the TS patches.

Four traps were set: (a) two in TS (*B. articulata*) on western side and (b) two near logs in open water on western side. Water depth was 30–50 cm. Traps were checked on 18/3 and 19/3 and yielded: 5 *Bostockia*, 30+ *Edelia* and 55+ *Pseudogobius*.

Dab-netting was done at many sites around entire lake perimeter and yielded 40+ *Pseudogobius*.



0 0.5 1.0 km

Rotenone was set in shallows (0–30 cm) in far NW of lake in front of sparse *B. articulata*. Result was 9 *Bostockia*, 18 *Edelia* and 4 *Pseudogobius*.

Photo 15. The lake in Reserve 12046, William Bay National Park, 18/3/92; supporting *Pseudogobius olorum, Edelia vittata* and *Bostockia porosa*. From western side looking ESE.

W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Williams Lat: 35°01' S, Long: 117°16' E

Land Status: within William Bay National Park

CALM Region/District: South Coast / Albany Shire: Denmark

Forestry Map (1:50 000): Denmark

Date of Survey: 19/3/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) _____, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0·53 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 40%. Rotenone = 8 % Boat used? _____

Capture Methods Used: baited traps _____, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Bostockia porosa	5	34	39	r, s, d	0-50+
Edelia vittata	Ø	3	3	r, s	0-40
Totals 2 species	5	37	42		

Comments (conditions/other fauna/management):

- water lower than on 9/1/92 : beach exposed at north end and narrowly on east and west sides; water still inside tall sedges at south end.
- Bostockia caught live were obtained by dab-netting, i.e. scooping over a submerged 'ledge' in front of a strip of tall sedges in SW of lake : the fish were extracted from coarse litter (pieces of sedge) brought up in the net.
- Edelia were only in far SE of lake.
- traps were not available : all in use at another lake.

24 LAKE WILLIAMS (19/3/92)

TS

Tall Sedges : mostly *Baumea articulata*

Callistachys Thicket

Cedar Dense Low Forest

Beaufortia Heath

Granite Heath

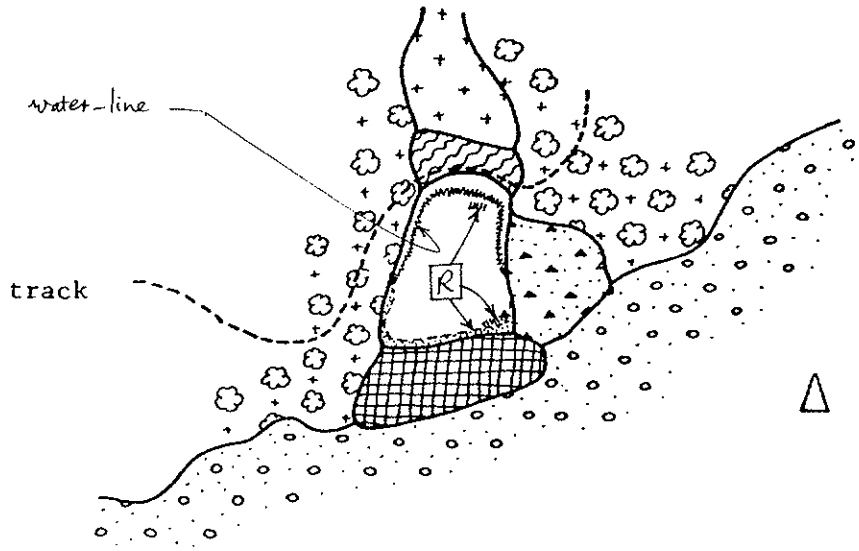
Heath Dry

Heath Coastal

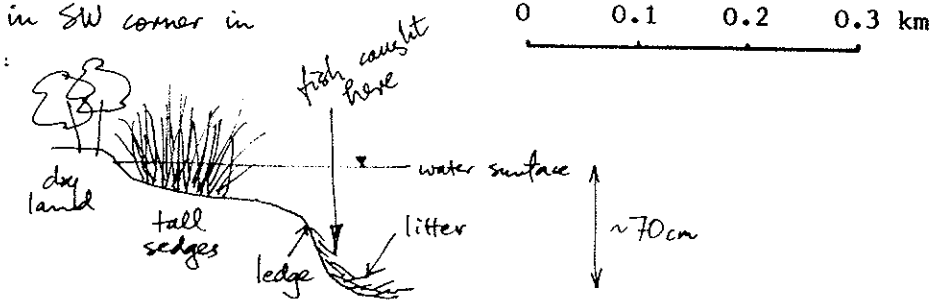
: water level down on 9/1/92 — beach exposed at N end — but water still inside all TS.

: fish traps not available for use at this lake.

(R) Rotenone was set in front of TS at south-east side of lake and in open shallows in far north. Former site gave 34 *Bostockia* and 3 *Edelia*; latter gave nil fish. Water was 20-50 cm deep in SE and 0-30 cm deep in N site.



(D) Dab-netting was done along south shore and 5 *Bostockia* were caught in SW corner in front of TS:



W.A. Department of Conservation and Land Management

FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Saide Lat: 35°03' S, Long: 117°28' E

Land Status: within Reserves 20781 (common; Shire of Albany) & 17464 (camping & recreation; un-vested).

CALM Region/District: South Coast / Albany Shire: Albany

Forestry Map (1:50 000): Denmark

Date of Survey: 17 & 19/3/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) _____, weed (w) _____, water <50 cm (s) ✓, water >50 cm (d) _____.

Wetland Salinity (ppt): 1·28 (surface water)

% of Wetland Shore/~~Area~~ Surveyed: all methods = 10%. Rotenone = 5% Boat used? _____

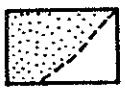
Capture Methods Used: baited traps _____, dab-netting ✓, spotlighting _____, Rotenone poison ✓

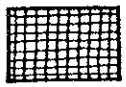
Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
⊙ Edelia vittata	1	Ø	1	s	30
Pseudogobius olorum	4	Ø	4	r, s	0–30
* Gambusia affinis	51	39	90	r, s	0–30
Totals 3 species	56	39	95		

Comments (conditions/other fauna/management):

- water level down substantially from 10/1/92 : mud was exposed right around lake perimeter and only very small areas of Typha were still in water. Mid-lake depth probably less than 50 cm.
- ⊙ the Edelia and 3 Pseudogobius and 20+ Gambusia were obtained from the outflow drain near the lake edge — still connected by water to rest of lake.
- Birds: Black-winged Stilt (10), Yellow-billed Spoonbill (35), Sacred Ibis (1), Wood Sandpiper (6), Greenshank (2), Great Egret (2), Aust. Pelican (5), White-faced Heron (1), Aust. Shelduck, P. Black Duck, P. Swamphen (5), Marsh Harrier, Dusky Moorhen (2).

25 LAKE SAIDE (17 & 19/3/92)


Tall Sedges TS: mostly Typha, some Baumea articulata in N & E.


Cedar Dense Low Thicket


Paperbark Low Woodland


Marri-Yate Low Woodland over Heath

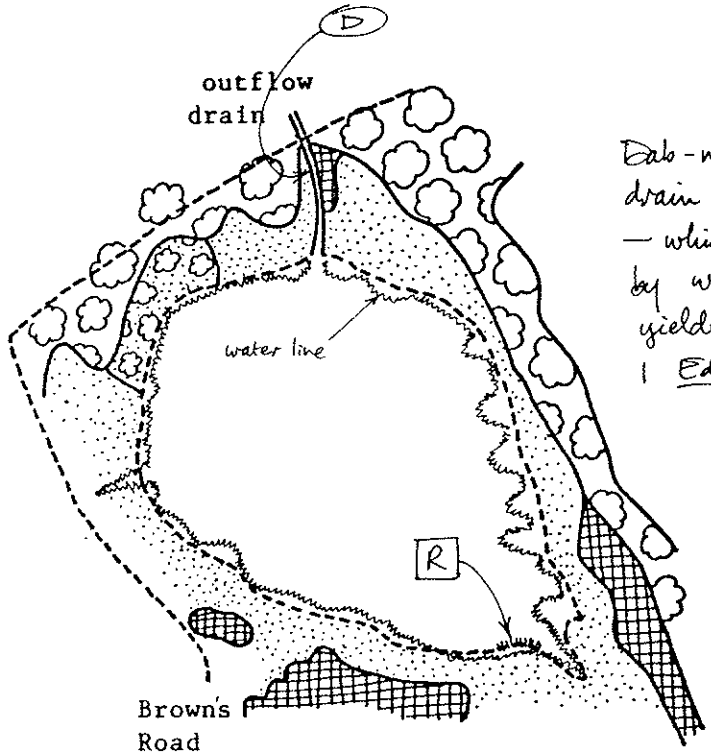
[R] = Rotenone site.

(D) = Dab-netting site.

: water much lower than on 10/1/92 — mud was exposed around most of lake perimeter. Water was inside TS only in far SE and one or two other sites.

Water was too shallow for use of traps; also very windy, so open water was choppy and unlikely to be inhabited by fish.

Set Rotenone in shallows (0-15cm) amongst sparse Typha and 'stumps' of dead Typha in far SE of lake. Result was 39 Gambusia.



Dab-netting in outflow drain (water to 30cm deep) — which was still connected by water to the open lake — yielded many Gambusia and 1 Edelia.

Also dab-netted in south of lake while walking to Rotenone site from far western side: obtained 1 Pseudogobius in Typha and many Gambusia, all in water < 20cm deep.

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FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake William Lat: 35°05' S, Long: 117°36' E

Land Status: within West Cape Howe National Park

CALM Region/District: South Coast / Albany Shire: Albany

Forestry Map (1:50 000): –

Date of Survey: 18/3/92 Duration: overnight/(half day)/full day.

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____,
logs (l) ✓, banks (b) _____, weed (w) _____,
water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 0-34 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 50 %. Rotenone = 3 % Boat used? _____

Capture Methods Used: baited traps ✓x4, dab-netting ✓, spotlighting _____,
Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
nil					
Totals nil species			nil.		

Comments (conditions/other fauna/management):

- water lower than on 10/1/92: beach exposed around whole of main part of lake and small (almost closed-off) embayments in north and SE were connected only by trickle outflow and seepage. The SE swampy embayment was almost dry — just shallow water in several pools. Maximum lake-depth was 95 cm but mostly < 50 cm.
- dab-netting was done around most of the wetland shore and embayments at numerous sampling sites; techniques included plunging in front of the moving operator and pushing through litter/sediments on the wetland bed.
- long-necked tortoise and "koonac" in SE embayment. Feathers of Maned & Pink-eared Ducks. Footprints of crakes/rails in SE embayment.

26 LAKE WILLIAM (18/3/92)

: fairly wide beach exposed around whole of lake perimeter.

: water max. depth was 95 cm but mostly < 50cm — could wade across middle of lake.

: N & SE embayments/inlets were closed off but draining out (seepage). The N inlet was 40-50cm deep in parts but SE inlet was almost dry — a few puddles left.

TS Tall Sedges

Callistachys Thicket

Heath Dry

Peppermint Open Low Woodland Over Heath Coastal

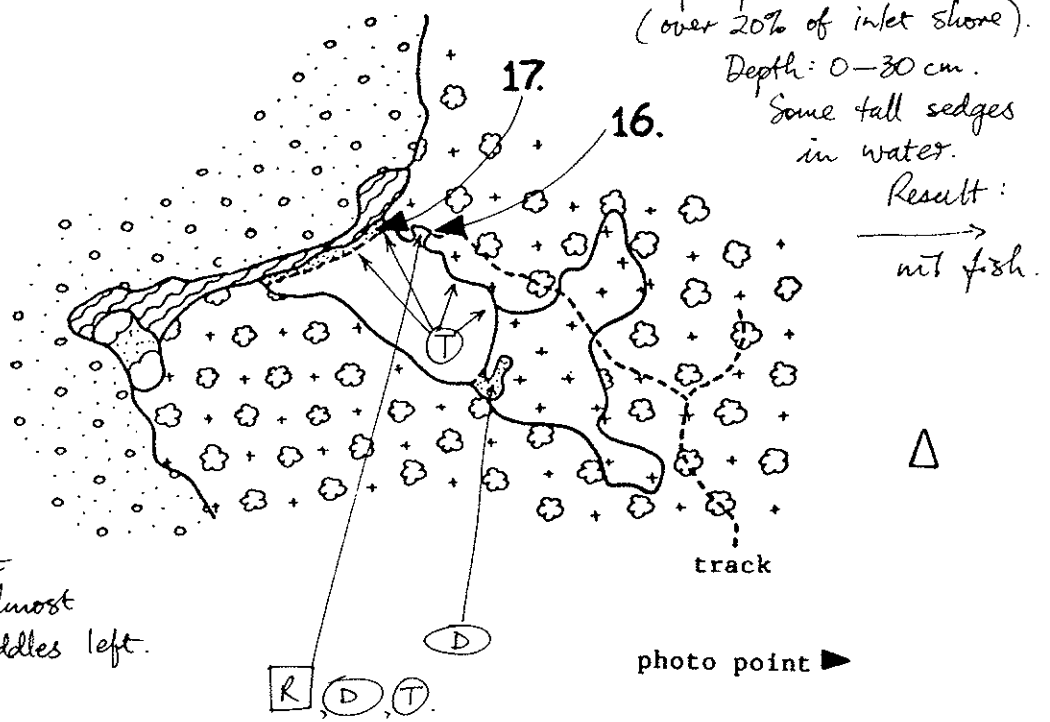
Beaufortia Heath

Karri Forest

(T) = trap site.

[R] = Rotenone site.

(D) = Dab-netting site.



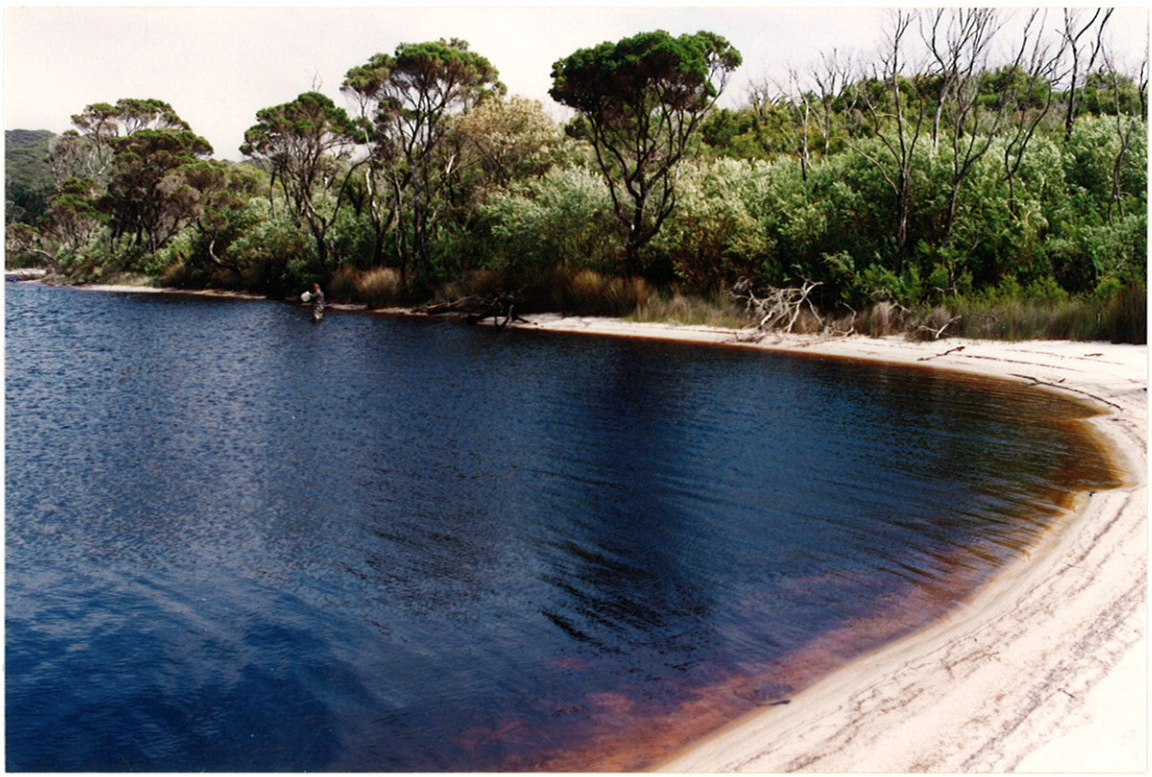
Rotenone set in N inlet was fully contained there (over 20% of inlet shore). Depth: 0–30 cm. Some tall sedges in water. Result: → nil fish.

0 0.5 1.0 km

Dab-netting was done at many sites around the lake shore and in the two embayments/inlets. Used "plunging" and "pushing" techniques. Result → nil fish, but quite a lot of large invertebrates in some areas.

· tortoise (15cm) and 'Koonac' seen in SE inlet.

Traps (4) were set a few metres out from the beach, two of them near logs, in water 30-40 cm deep. Also shifted two traps to the N inlet where they were set in 20cm of water beside sedges Baumea vaginalis. Result → nil fish.



Photos 16 & 17. Northern part of Lake William, looking west, 18/3/92. No fish were found in this isolated shallow wetland.

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FISHES IN WETLANDS ON THE SOUTH COAST OF WESTERN AUSTRALIA

SUMMARY DATASHEET

LAKE: Lake Powell Lat: 35°01' S, Long: 117°44' E

Land Status: within Lake Powell Nature Reserve

CALM Region/District: South Coast / Albany Shire: Albany

Forestry Map (1:50 000): Redmond

Date of Survey: 17 & 21/3/92 Duration: overnight/half day/(full day)

Potential Habitats (Shelter) for Fish: rush/sedge (r) ✓, thickets (t) _____, logs (l) _____, banks (b) _____, weed (w) ✓, water <50 cm (s) ✓, water >50 cm (d) ✓.

Wetland Salinity (ppt): 1.27 (surface water)

% of Wetland Shore/Area Surveyed: all methods = 6%. Rotenone = 2% Boat used? _____

Capture Methods Used: baited traps ✓x4, dab-netting ✓, spotlighting _____, Rotenone poison ✓

Species Recorded (* = exotic species)	Number obtained: caught live	Number obtained: Rotenone	Number obtained: total catch	Habitats found in (above)	Water Depths found in (cm)
Atherinosoma wallacei	Ø	1	1	r, s	ca. 30
Pseudogobius olorum	53	46	99	r, w, s	0–40
* Gambusia affinis	348	22	370	r, w, s	0–40
Totals 3 species	401	69	470		

Comments (conditions/other fauna/management):

- water level little different to 11/1/92 (then 72 cm, now 68 cm); water still inside most areas of tall sedges.
- prolific growth of fine slimy algae and water generally rather murky.
- Atherinosoma was obtained in patch of Baumea articulata in mid-north of lake (see map).
- traps not very effective — dab-netting was more effective.
- Birds: Red-necked Avocet (8), Great Cormorant (1), Black-winged Stilt (2), Pink-eared Duck (30), Straw-necked Ibis (3), Aust. Pelican (1), Yellow-billed Spoonbill (6), Aust. Shelduck (~100), Swan (~30), Coot (~200), Aust. Shoveler (~20), Spotless Crake (6).

27 LAKE POWELL (17 & 21/3/92)

: depth on gauge was 68 cm; i.e. not much change from 11/1/92. (nett)

TS Tall Sedges : Typha & Baumea articulata.

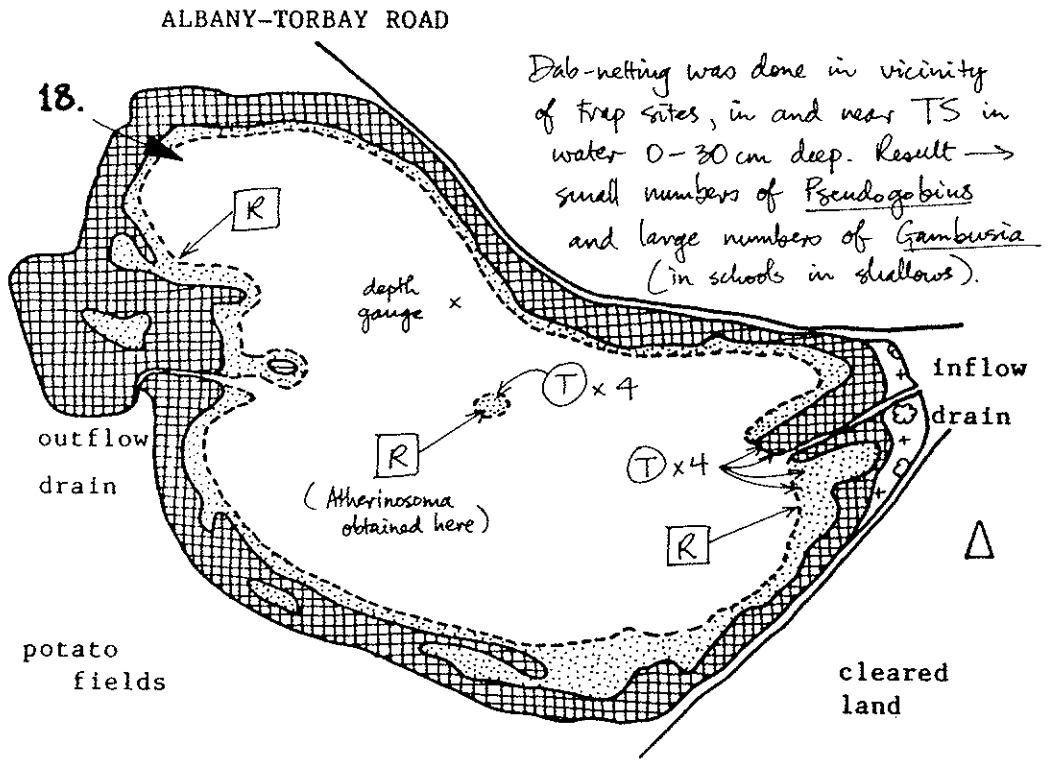
Cedar Dense Low Forest

Heath Dry

(T) = trap site.

[R] = Rotenone site.

Traps x4 yielded small numbers of both Pseudogobius & Gambusia. They were set in/near TS at eastern end of lake in 20-30 cm of water, then moved to isolated patch of TS in centre-north of lake.



Dab-netting was done in vicinity of trap sites, in and near TS in water 0-30 cm deep. Result → small numbers of Pseudogobius and large numbers of Gambusia (in schools in shallows).

Rotenone was set in (a). shallow bay in TS (Typha + Baumea) in east of lake, (b). isolated patch of TS (Baumea) in centre north of lake, and (c). edge of thick TS (Baumea) in west of lake. Water depth varied from 0-30 cm. Result was 46 Pseudogobius, 22 Gambusia and 1 Atherinosoma.

Photo 18. North-western part of Lake Powell, looking east, 21/3/92. *Gambusia* were abundant in the shallows.

Photo 19. Hardyhead *Atherinosoma wallacei* (top) and mosquitofish *Gambusia affinis* (females with black spot) from Lake Powell, 21/3/92.

APPENDIX 2

Registration numbers for fish specimens lodged with WA Museum

Wetland	Species	Registration Number
Devil's Pool	*Favonogobius suppositus*	P.30455-001
	Pseudogobius olorum	P.30455-002
	Atherinosoma wallacei	P.30455-003
Lake Davies	*Pseudogobius olorum*	P.30454-001
Quitjup Lake	*Edelia vittata*	P.30453-001
	Nannatherina balstoni	P.30453-002
	Bostockia porosa	P.30453-003
Lake Jasper	*Favonogobius suppositus*	P.30452-001
	Pseudogobius olorum	P.30452-002
	Edelia vittata	P.30452-003
	Bostockia porosa	P.30452-004
	Galaxias occidentalis	P.30452-005
Lake Wilson	*Edelia vittata*	P.30451-001
	Bostockia porosa	P.30451-002
	Tandanus bostocki	P.30451-003
Lake Smith	*Edelia vittata*	P.30450-001
	Nannatherina balstoni	P.30450-002
	Bostockia porosa	P.30450-003
Yeagarup Lake	*Edelia vittata*	P.30449-001
	Bostockia porosa	P.30449-002
	Galaxias occidentalis	P.30449-003
	Gambusia affinis	P.30449-004
Un-named Lake nr Yeagarup	*Edelia vittata*	P.30448-001
	Galaxias occidentalis	P.30448-002
Warren River Oxbow	*Edelia vittata*	P.30447-001
	Bostockia porosa	P.30447-002
	Gambusia affinis	P.30447-003
Doggerup Lake	*Edelia vittata*	P.30446-001
	Nannatherina balstoni	P.30446-002
	Bostockia porosa	P.30446-003
	Galaxias occidentalis	P.30446-004
	Galaxiella nigrostriata	P.30446-005
	Lepidogalaxias salamandroides	P.30446-006
Lake Samuel	*Edelia vittata*	P.30445-001
	Bostockia porosa	P.30445-002
	Galaxiella munda	P.30445-003

Appendix 2 cont'd

Lake Florence	*Edelia vittata*	P.30444-001
	Nannatherina balstoni	P.30444-002
	Bostockia porosa	P.30444-003
Gardner River Lakes	*Edelia vittata*	P.30443-001
	Nannatherina balstoni	P.30443-002
	Bostockia porosa	P.30443-003
	Galaxiella sp.	no specimen
Maringup Lake	*Pseudogobius olorum*	P.30442-001
	Edelia vittata	P.30442-002
	Nannatherina balstoni	P.30442-003
	Bostockia porosa	P.30442-004
	Atherinosoma wallacei	P.30442-005
	Galaxias occidentalis	P.30442-006
Lake East of Broke Inlet	*Edelia vittata*	P.30441-001
	Nannatherina balstoni	P.30441-002
	Bostockia porosa	P.30441-003
	Galaxias occidentalis	P.30441-004
	Galaxiella nigrostriata	P.30441-005
Boat Harbour Lake 1	*Pseudogobius olorum*	P.30439-001
	Edelia vittata	P.30439-002
	Nannatherina balstoni	P.30439-003
	Bostockia porosa	P.30439-004
	Galaxias occidentalis	P.30439-005
Boat Harbour Lake 3	*Pseudogobius olorum*	P.30440-001
	Edelia vittata	P.30440-002
	Bostockia porosa	P.30440-003
	Galaxias occidentalis	P.30440-004
	Galaxias maculatus	P.30440-005
Owingup Lake	*Favonogobius suppositus*	P.30438-001
	Pseudogobius olorum	P.30438-002
	Edelia vittata	P.30438-003
	Nannatherina balstoni	P.30438-004
	Bostockia porosa	P.30438-005
	Atherinosoma wallacei	P.30438-006
	Galaxias occidentalis	P.30438-007
	Galaxiella nigrostriata	P.30438-008
Lake in Reserve 12046	*Pseudogobius olorum*	P.30437-001
	Edelia vittata	P.30437-002
	Bostockia porosa	P.30437-003
Lake Williams	*Edelia vittata*	P.30436-001
	Bostockia porosa	P.30436-002
Lake Saide	*Pseudogobius olorum*	P.30435-001
	Gambusia affinis	P.30435-002
	Edelia vittata	P.30435-003

Appendix 2 cont'd

Lake Powell	*Pseudogobius olorum*	P.30434-001
	Atherinosoma wallacei	P.30434-002
	Gambusia affinis	P.30434-003

APPENDIX 3

COMPARISON OF SURVEY METHODS USED TO SURVEY FISHES IN SOUTH COAST WETLANDS AND RECOMMENDED METHOD FOR FUTURE SURVEYS

1. Comparison of Methods Used

Twenty-four per cent of the 83 records of fish at the various wetlands was from live captures only (but includes five records obtained where poison was not used); 28 per cent was from poisoning only (Table 1, below).

The sole record of *Galaxias maculatus* and half of the records of *Galaxiella nigrostriata, Atherinosoma wallacei* and *Gambusia affinis* were from live capture only. The sole records of *Galaxiella munda* and *Tandanus bostocki* and approximately two thirds of the records of *Favonogobius suppositus* and *Bostockia porosa* were from poisoning only.

Fifty-eight per cent of the grand total of fish individuals was from live capture, the remainder from poisoning. At 11 of the 22 wetlands that yielded fish (including one where poison was not used), live capture provided two-thirds or more of the total catch for the wetland; at five wetlands poisoning provided the majority; and at six wetlands, both live capture and poisoning provided more than a third.

Live capture contributed at least two-thirds to the total catch of (in decreasing order) *Galaxias maculatus, Gambusia affinis, Atherinosoma wallacei, Lepidogalaxias salamandroides, Pseudogobius olorum, Galaxias occidentalis* and *Galaxiella nigrostriata.* Poisoning contributed at least two-thirds to the total catch of *Galaxiella munda, Tandanus bostocki, Bostockia porosa* and *Nannatherina balstoni.* Poisoning was not very effective in securing *Pseudogobius olorum* even where it was visibly abundant on the lake bed.

2. Recommended Methods for Future Field Surveys

An effective strategy for surveying fishes present in a lake in the study area would require a combination of catching methods. If tall sedges are present, Rotenone should be set (as descibed in report section 2.2) beside and inside an area of dense tall sedges where water is shallowest. If thickets, logs or banks are present they should be included in this area or poisoned separately and any adjoining, seasonally inundated wetland should also be poisoned. Meanwhile, at least two baited traps should be set in each of the same habitats but some distance away from spread Rotenone. Dab-netting or seining should be undertaken where there is not enough water for trapping and where galaxiids are evident.

Assuming access is not difficult the whole procedure could be completed in half a day, or most of the day if adjoining seasonal wetland is to be surveyed.

Appendix 3: Table 1. Number of fish caught live (a), number poisoned (b) and total catch (c) at each wetland.

Species	Wetland (refer to Table 1 for wetland names and locations and dates of surveys)									
	1	2	3	4	5	6	7	8	9	10
Galaxiella munda	a/b (c)									
Galaxiella nigrostriata										
Galaxias maculatus										
Galaxias occidentalis						204/36 (240)			1/0 (1)	
Lepidogalaxias salamandroides										
Tandanus bostocki							0/8 (8)			
Bostockia porosa					7/11 (18)	0/8 (8)	0/93 (93)	0/14 (14)	2/1 (3)	
Edelia vittata					43/20 (63)	121/110 (231)	50/64 (114)	112/35 (147)	16/5 (21)	
Nannatherina balstoni					1/4 (5)			2/0 (2)		
Atherinosoma wallacei			17/0 (17)							
Favonogobius suppositus			9/2 (11)			0/2 (2)				
Pseudogobius olorum			17/5 (22)	62/17 (79)		5/3 (8)				
Gambusia affinis									11/0 (11)	
Totals	0/0 (0)	0/0 (0)	43/7 (50)	62/17 (79)	51/35 (86)	330/159 (489)	50/165 (215)	114/49 (163)	30/6 (36)	0/0 (0)

Table 1 (*continued*)

Species	Wetland (refer to Table 1 for wetland names and locations and dates of surveys)									
	11	A4	12	13	14	15	16	17	19	20
Galaxiella munda	a/b (c)			0/1 (1)						
Galaxiella nigrostriata			7/3 (10)			1/0 (1)		3/- (3)	0/1 (1)	
Galaxias maculatus										
Galaxias occidentalis	7/0 (7)		7/0 (7)				6/8 (14)	1/- (1)	3/4 (7)	1/37 (38)
Lepidogalaxias salamandroides			7/2 (9)							
Tandanus bostocki										
Bostockia porosa		0/3 (3)	1/2 (3)	0/1 (1)	0/2 (2)	0/6 (6)	0/48 (48)	20/- (20)	0/17 (17)	0/2 (2)
Edelia vittata	47/10 (57)	13/31 (44)	205/29 (234)	61/1 (62)	0/16 (16)	21/76 (97)	635/336 (971)	18/- (18)	60/122 (182)	37/433 (470)
Nannatherina balstoni			11/0 (11)		2/0 (2)	2/2 (4)	0/23 (23)	3/- (3)	0/6 (6)	0/7 (7)
Atherinosoma wallacei							3/0 (3)		62/14 (76)	
Favonogobius suppositus									0/6 (6)	
Pseudogobius olorum							0/9 (9)		9/0 (9)	7/1 (8)
Gambusia affinis		15/0 (15)								
Totals	54/10 (64)	28/34 (62)	238/36 (274)	61/3 (64)	2/18 (20)	24/84 (108)	644/424 (1068)	45/- (45)	134/170 (304)	45/480 (525)