23351/12/82—800—L/485 WILLIAM C BROWN, Government Printer, Western Australia

DEPARTMENT OF
FISHERIES AND WILDLIFE
WESTERN AUSTRALIA

REPORT Nº 58

Published by the Director of Fisheries and Wildlife, Perth,
under the authority of the Hon. Minister for Fisheries and Wildlife

---

1982 Review of Rainfall and Wetlands in the South-West of Western Australia

BY

J. A. K. LANE

AND

D. R. MUNRO

PERTH
WESTERN AUSTRALIA

1983

Department of Fisheries and Wildlife

108 Adelaide Terrace

PERTH

REPORT

No.58

1982 REVIEW OF RAINFALL AND WETLANDS IN THE SOUTH-WEST OF WESTERN AUSTRALIA

BY

J.A.K. LANE and D.R. MUNRO

1983

Western Australian Wildlife Research Centre
P.O. Box 51, Wanneroo, W.A. 6065.

23351—1

CONTENTS

FIGURES

TABLES

Dept. Fish. Wild. West. Aust. Rept. No. 58, 1983, 1-41.

1982 REVIEW OF RAINFALL AND WETLANDS IN THE SOUTH-WEST OF WESTERN AUSTRALIA

J.A.K. Lane and D.R. Munro, Western Australian Wildlife Research Centre, P.O. Box 51, Wanneroo, W.A. 6065.

ABSTRACT

An account is given of the biological principles involved in decisions concerning duck-shooting seasons in the south-west of Western Australia.

Conditions for waterfowl during 1982 are described through the use of rainfall statistics and data obtained from the Department's wetland monitoring programme.

1982 was characterized by exceptionally high rainfall in January and well-below average rainfall from February to October.

1982 was the seventh consecutive year of below-average rainfall in all five Meteorological Districts of the south-west. 1976 to 1982 has thus been the south-west's driest seven-year period for more than seventy years.

The record-breaking rains of January caused widespread flooding in the south-west, particularly in the Blackwood and Frankland River catchments. Lakes of these river systems retained high water levels in succeeding months.

Low winter rainfall and limited runoff resulted in a general decline in water levels in remaining areas of the south-west during 1982.

Due to poorer-than-average conditions overall, a RESTRICTED duck-shooting season was declared for the summer of 1982-83.

I INTRODUCTION

This publication has been prepared for the duck-shooting community, and for others who share an interest, either

23351—2

professional or amateur, in the management of waterbirds and wetlands in Western Australia. The aims of the document are twofold:

i) To briefly explain the biological principles upon which decisions concerning duck-shooting seasons in the south-west of the State are based, and

ii) To describe, by the use of graphs, table and diagrams, the conditions for waterfowl which prevailed during the 12 months prior to determination of the 1983 duck-shooting season.

The report relates only to the south-west of the State, that is, the South West and Eucla Land Divisions. A continuous open season applies in the remainder of the State due to the vast areas and very small number of inhabitants involved and to the difficulty of access to most breeding areas following rain. The report gives little attention to the eastern half of the Eucla Land Division (i.e. the Nullarbor Plain) as rainfall in this area is generally less than 250 mm per annum and wetlands are virtually non-existent.

II RAINFALL, WETLANDS AND WATERFOWL BREEDING

Rainfall in the south-west of Western Australia is markedly seasonal. On average, approximately 70% of the total annual rainfall occurs during the months May to September, with 35% being recorded during June and July. As a consequence the wetlands (swamps, lakes, rivers, etc.) of the south-west show marked seasonal variations in water area and depth, with water levels rising during the wetter months of winter and spring and then falling during summer and autumn when little rain occurs and evaporation rates are high.

Waterfowl breed when conditions are most favourable, that is, when food and water are most abundant. In the south-west of W.A. this occurs during spring and early summer, when water levels reach their peak and warm weather accelerates the growth of aquatic plants and animals.

Nest construction and egg-laying may commence as early as June and continue until November or even December. For most species, however, peak nesting activity occurs during August and September. Broods of ducklings are most commonly seen from September to November and the great majority of young birds are flying by January. Waterfowl numbers are thus at a peak early in the New Year. This is when duck-shooting seasons are held.

III DUCK SHOOTING SEASONS

Duck-shooting seasons are confined to January - March each year in order to minimise their impact on duck populations. This can be explained as follows:

Game-species of ducks are highly fecund, that is, they are capable of producing large numbers of offspring each year, provided conditions are favourable. Single broods of five or more ducklings are a common sight during spring and early summer. Consequently, at the end of each successful breeding season, duck numbers are swollen by the addition of new birds. As the summer-autumn dry season progresses, and conditions for waterbirds deteriorate, many birds die due to a variety of natural causes such as lack of food or water, predation and disease. Such deaths are referred to collectively as "natural mortality". First-year birds in particular have a high rate of natural mortality, largely due to lack of experience in locating adequate resources. By holding the shooting season early in the year one is able to minimise the impact on duck populations since a significant proportion of the ducks killed are birds which would normally die from natural causes before the next breeding season. Thus shooter-induced mortality is timed to, as far as possible, replace natural mortality, rather than add to it. It follows that, upon completion of breeding, the sooner the shooting season is held, the less the effect on the number of birds surviving to the following breeding season. The later the season, or the longer it extends, the greater the effect on numbers surviving to breed.

IV VARIATIONS IN RAINFALL AND CONDITIONS FOR BREEDING

Rainfall, of course, varies from year to year, and as a consequence so does the availability of water for breeding purposes. Thus in years of average or better-than-average rainfall, conditions for waterfowl breeding are usually good and the number of young produced is high; whereas, in years of exceptionally low rainfall, little surface water is available and production is greatly reduced.

Duck-season decisions must take these variable conditions into account. In Western Australia the practice now is to declare FULL SEASONS when conditions for breeding have been average or better-than-average, RESTRICTED SEASONS when conditions have been poor, and NO SEASONS when conditions have been particularly poor for a number of years. The principal objective of this system is to ensure that shooting does not cause a serious reduction in the size of the breeding stock during dry years or periods of prolonged drought. Specifications for FULL, RESTRICTED and NO SEASONS are as follows:-

	FULL SEASON	RESTRICTED SEASON	NO SEASON
Opening Date	2nd weekend in January	2nd weekend in January	-
Opening Day	Saturday	Sunday	-
Opening Time	6.00 PM	6.00 AM	-
Season Length	10 weeks	4 weeks	-
Bag Limit	10 birds of any game species	5 birds of any game species	-

V ASSESSMENT OF CONDITIONS

Prior to 1978 conditions for waterfowl breeding were assessed each year through ground and aerial surveys of important waterfowl sites. Water levels were recorded as dry, low, half full, high or full. Notes were also made of waterfowl numbers and, where possible, waterfowl breeding activity.

In 1977 the authors decided that a more precise system of evaluation was required and so undertook a programme of installation of depth gauges on selected wetlands. Gauges were installed on 27 wetlands from November 1977 to December 1978 and in 1979 and 1980, 28 in 1981 and 10 in 1982. This has completed the gauging programme.

The 119 wetlands which have been gauged are distributed throughout the south-west of the State, mainly south of a line through Dongara, Merredin and Esperance. Most are Wetland Nature Reserves (including Game Reserves) vested in the Western Australian Wildlife Authority and managed by the Department of Fisheries and Wildlife. These depth gauges permit precise monitoring of water levels and thus allow more meaningful comparisons of conditions to be made from one season to another. The gauges also make it possible to determine rates of water loss during the annual dry season and thus enable us to forecast "dry-out" dates for individual wetlands or groups of wetlands each year.

A lack of pre-1978 data prevents us from being able to make precise comparisons of present-day water levels with those of earlier years. How then does one judge the normality, or otherwise, of present-day conditions? Since wetland condition and rainfall are intimately related we have turned to annual rainfall data for this purpose.

VI USE OF RAINFALL DATA IN ASSESSMENT OF CONDITIONS

Annual District Average rainfall data for Western Australia are available* from as early as 1913. These data provide a convenient means for examining long-term trends in annual rainfall in each of the five Meteorological Districts of the south-west, and over the south-west of the State as a whole. They thus enable us to assess the degree of abnormality of rainfall in particular years or groups of years, from 1913 to the present. By this means we are able to consider how typical or atypical present conditions may be, when viewed over a long period of time, in this case 70 years.

District Average rainfall data do have one disadvantage however. By averaging rainfall over each Meteorological District, they fail to reveal the "patchiness" of rainfall within a District. This problem can be overcome through the use of data from individual weather stations to produce maps of rainfall distribution, as will be seen later in this report.

VII CONCLUSION

As discussed above, controls on duck shooting in the south-west of Western Australia are considered necessary to protect game species from over-exploitation, particularly during dry years and periods of prolonged drought. These controls are achieved principally through the restriction of shooting to Full, Restricted or No Seasons, as appropriate. Rainfall data and wetland monitoring data are now used as a basis for determining the type of season to be declared each year.

The data contained in the remainder of this report (Figures 1-39, and Table 1) were presented to the November 1982 meeting of the W.A. Wildlife Authority's Bird Committee to assist members of that Committee in their consideration of the proposed 1983 duck-shooting season.

Following the Bird Committee meeting, the Minister for Fisheries and Wildlife, Mr R.C. Old, announced a Restricted duck-shooting season in the South-West and Eucla Land Divisions of the State. The full text of the Minister's media release was as follows:

> A limited duck shooting season of six weeks has been declared for the South West and Eucla land divisions for 1983.
>
> Announcing this today, the Minister for Fisheries and Wildlife, Mr Dick Old, said the season would open at

---

*From the Commonwealth Bureau of Meteorology

6.00 a.m. on Sunday, 9 January 1983, and would close at 11.59 p.m. on Sunday, 20 February 1983.

The daily bag limit would be a total of five birds of any declared game species, with no limit on the Mountain Duck.

To take any wild duck species, shooters are required to hold a licence which may be obtained from the Fisheries and Wildlife Department's Perth head office or any of the district offices. The licence fee is $5.00.

Mr Old said the Department was preparing a "Duck Shooters' Guide" pamphlet which would specify various details such as season length, licence requirements, bag limits, open and closed areas, and the names of declared game and protected duck species. The pamphlet would be available soon from any of the Department's offices.

Mr Old said the South West and Eucla land divisions covered an area enclosing most of the agricultural areas of the State, running from Kalbarri to Merredin, to Norseman and to the State border about 200 kilometres north of Eucla.

"For the rest of the State - the Kimberley, North West and Eastern land divisions - a continuing open season has been declared with a daily bag limit of ten birds of any declared game species", he said.

Mr Old said the southern part of the State had had a run of dry seasons in recent years. As a result, for each of the last few summers there had not been a full duck shooting season.

"However, sufficient rains have fallen during the past year to allow a limited six week season to be declared for the coming summer. In addition, shooters generally have displayed responsibility and restraint", Mr Old said.

Mr Old said he was confident that shooters would continue to observe the restrictions and bag limits during the coming open season so that shooting pressure on game duck populations was minimised.

"It is important that breeding stocks are maintained for future seasons", he said.

"Moreover, I look forward to the day when good rainfalls and wetland conditions will make it possible once again to declare a full duck shooting season."

VIII CONDITIONS FOR WATERFOWL IN 1982

A. RAINFALL

1982 was characterized by exceptionally high rainfall in January, and well-below average rainfall from February to October.

The flood-producing rains of 20-22nd January (See Figures 3 and 5) were caused by the combination of tropical cyclones "Errol" and "Bruno". Rainfall was heaviest in the Collie - Harvey and Katanning - Arthur River areas with more than 200 mm of rain being recorded in less than three days. Many January rainfall records were broken, seven of these being as follows:

	Old Record	New Record
Arthur River	57 mm	261 mm
Broomehill	93	226
Brunswick	79	205
Dwellingup	77	237
Harvey	103	219
Katanning	87	217
Mandurah	78	225

Rainfall in subsequent months was well-below average throughout the south-west (See Figure 5). Virtually no rain fell in April and rainfall in May was 36% (North Central) to 61% (South Central) below normal. Normal or near-normal falls were recorded in most Districts in June (South Central being the exception with 42% below normal) however July rainfall was well-below normal in the North Coastal, North Central and South Central Districts (55%, 62% and 51% below normal respectively). August - October rains in these three Districts were generally normal to above normal however rains in the Central Coastal and South Coastal District for this period were generally below normal.

The overall result for the April - October period (when 80-91% of total annual rainfall is normally expected) was that Rainfall Averages for all five Meteorological Districts of the south-west were below average, most markedly so. Thus North Coastal -18%, Central Coastal -24%, North Central -26%, South Coastal -33% and South Central -39%.

B. WETLANDS

The exceptional rainfall of 20-22nd January caused widespread flooding in the lower south-west, particularly along the Frankland River, the Blackwood River, and two of the Blackwood's tributaries, the Beaufort and Coblinine Rivers. Floodwaters subsided by early February, however lakes in the middle and upper reaches of the Blackwood catchment retained high water levels in succeeding months. Most increased in depth by 1-2 metres from January (pre-rain) to March (post rain) and several increased by more than two metres. The largest recorded increases were Towerinning +2.60 m, Coyrecup and Queerearrup

+2.23 m, Dumbleyung +2.20 m, and Flagstaff +2.02 m. Lakes of the upper reaches of the Arthur River (the northernmost tributary of the Blackwood) also benefited from the heavy rains. Thus Dulbinning increased by 0.67 m, Toolibin +0.35 m (approx), Walbyring +0.83 m and Bokan +0.50 m.

Lakes to the south-east of the Blackwood catchment also showed dramatic increases in depth from January to March. Largest increases here were Anderson +2.54 m, Gnowangerup Res. 26264 +1.28 m, Plantagenet Res. 25386 +0.68 m and Camel +0.54 m. Smaller increases were recorded on the south coast east of Albany, thus Albany Res. 27157 +0.20 m (approx.) and Moates +0.12 m.

Lakes to the north-west of the Blackwood catchment as far as the Swan Coastal Plain also benefited from the rains, however increases in water level were slight and were rapidly offset by the high evaporation rates of subsequent months. Thus only one gauged lake of the Coastal Plain was deeper in March than in January (Harvey Res. 12632 +0.05 m).

Lakes lying outside the 100 mm January '82 isohyet (see Figure 3) did not receive significant runoff and only one January - March depth increase (Dundas Res. 33113 +0.35 m) was recorded.

As outlined in the preceding section, rainfall over most of the south-west was substantially below average during the winter wet-season. Runoff was limited and many gauged wetlands showed little or no increase in depth during the winter period (see Figures 10-14, 16-19, 29, and 33-37). As a consequence, water levels of most gauged wetlands were lower in spring of 1982 than in spring of the previous year. A simple comparison of Nov '81 and Nov '82 depths (see Table 1) shows that of the 109 lakes monitored in both years, 27 decreased in depth by 0.3 m or more, 17 increased in depth by 0.3 m or more, the remainder varying by less than 0.3 m. The largest Nov '81 to Nov '82 depth decreases were Eneminga -1.61 m, Pinjarrega -1.29 m, Ninan - 1.18 m, Streets -1.09 m, White Water -1.08 m, and Logue -1.07 m. The largest increases were Towerinning +2.04 m, Anderson +1.92 m, Dumbleyung +1.75 m, Coyrecup +1.54 m, Coblinine +1.39 m, Queerearrup +1.21 m, and Martinup +1.01 m. Lakes with higher water levels in Nov '82 than Nov '81 were confined to the Blackwood catchment, south-east to the Stirling Range area, a proportion of wetlands on the Swan Coastal Plain, and Mullet Lake near Esperance. Comparison of November 1979, 1980, 1981 and 1982 depths shows that Nov '82 depths were the highest for four years for each of 13 lakes in the Blackwood catchment and 3 lakes on the Swan Coastal Plain. November '82 depths were also the lowest for four years for each of 12 lakes along the south coast from Lake Muir to Esperance and for 4 lakes on the Swan Coastal Plain.

Cumulative percentage graphs and paired t-tests (see Figure 7) show that water levels overall (i.e. over all areas covered by the depth-gauging programme) in January, March and May of 1982 were significantly greater than those recorded in January, March and May of the previous year. Water levels overall in July, September and November 1982, however, were not significantly different from those of 1981.

IX ACKNOWLEDGEMENTS

We would like to thank members of the West Australian Field and Game Association Inc. for the valuable contribution which they have provided by assisting in the monitoring of gauged wetlands of the south-west. We would also like to thank the Commonwealth Bureau of Meteorology for supplying rainfall data, Mr Tony Birman for preparing the illustrations, Dr Andrew Burbidge for commenting on the manuscript, and Technical Officer Grant Pearson for his assistance in the monitoring programme.

23351—3

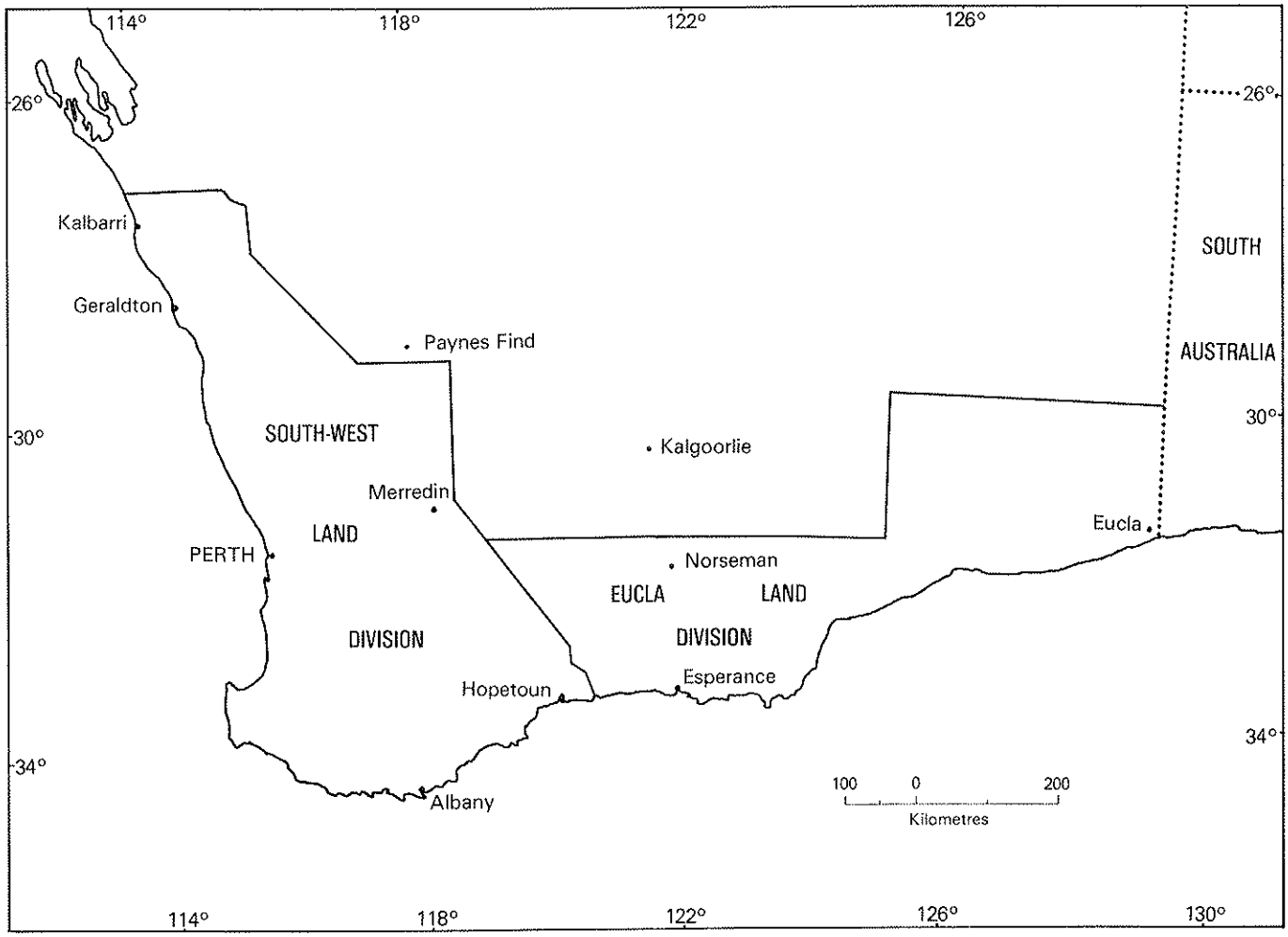


FIGURE 1. Boundaries of the South-West and Eucla Land Divisions.

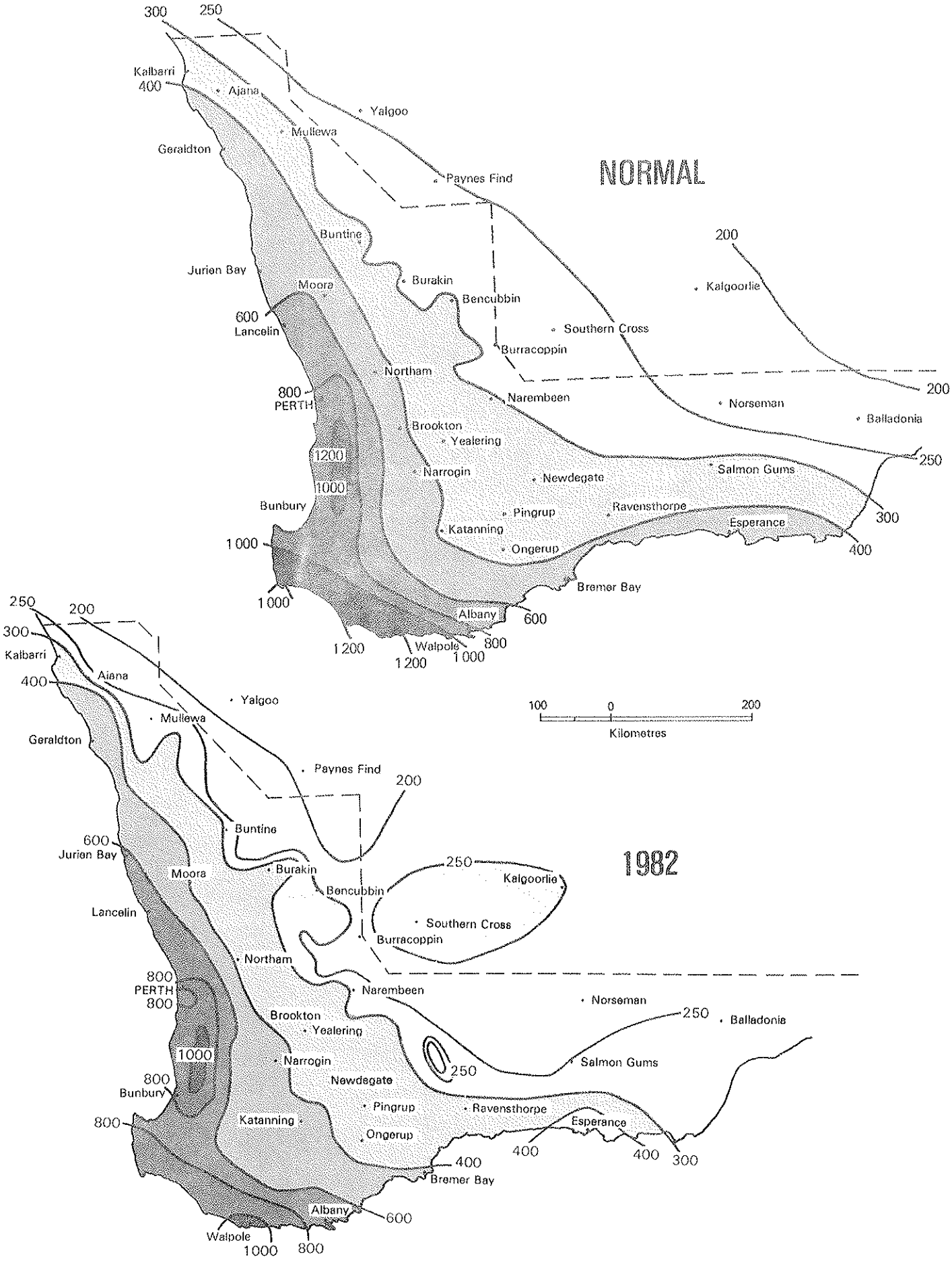


FIGURE 2 Rainfall recorded (mm) in the south-west of Western Australia, Jan.-Oct. 1982 and Jan.-Oct. Normal

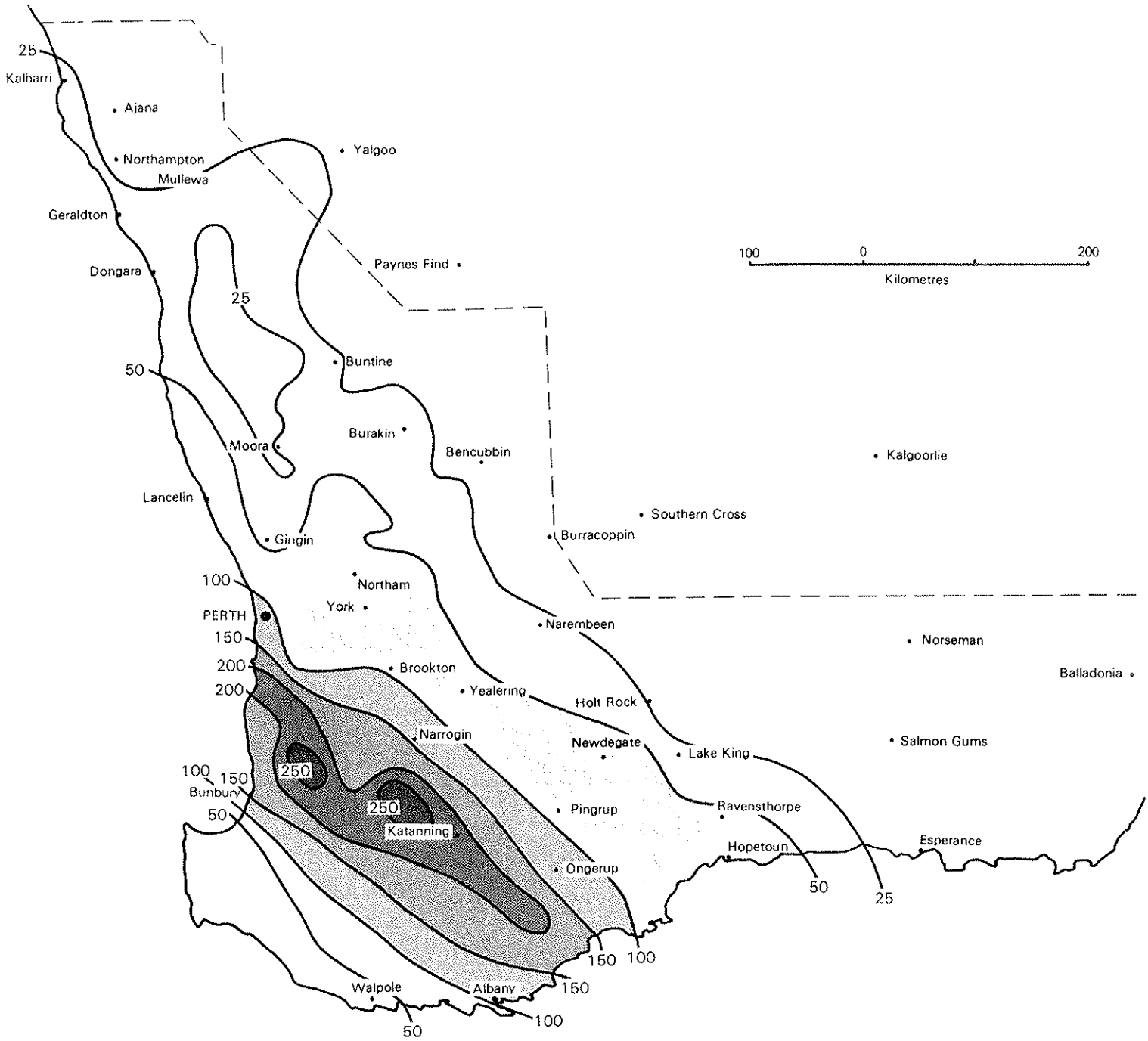


FIGURE 3 Exceptional rainfall recorded 20th-22nd January 1982.

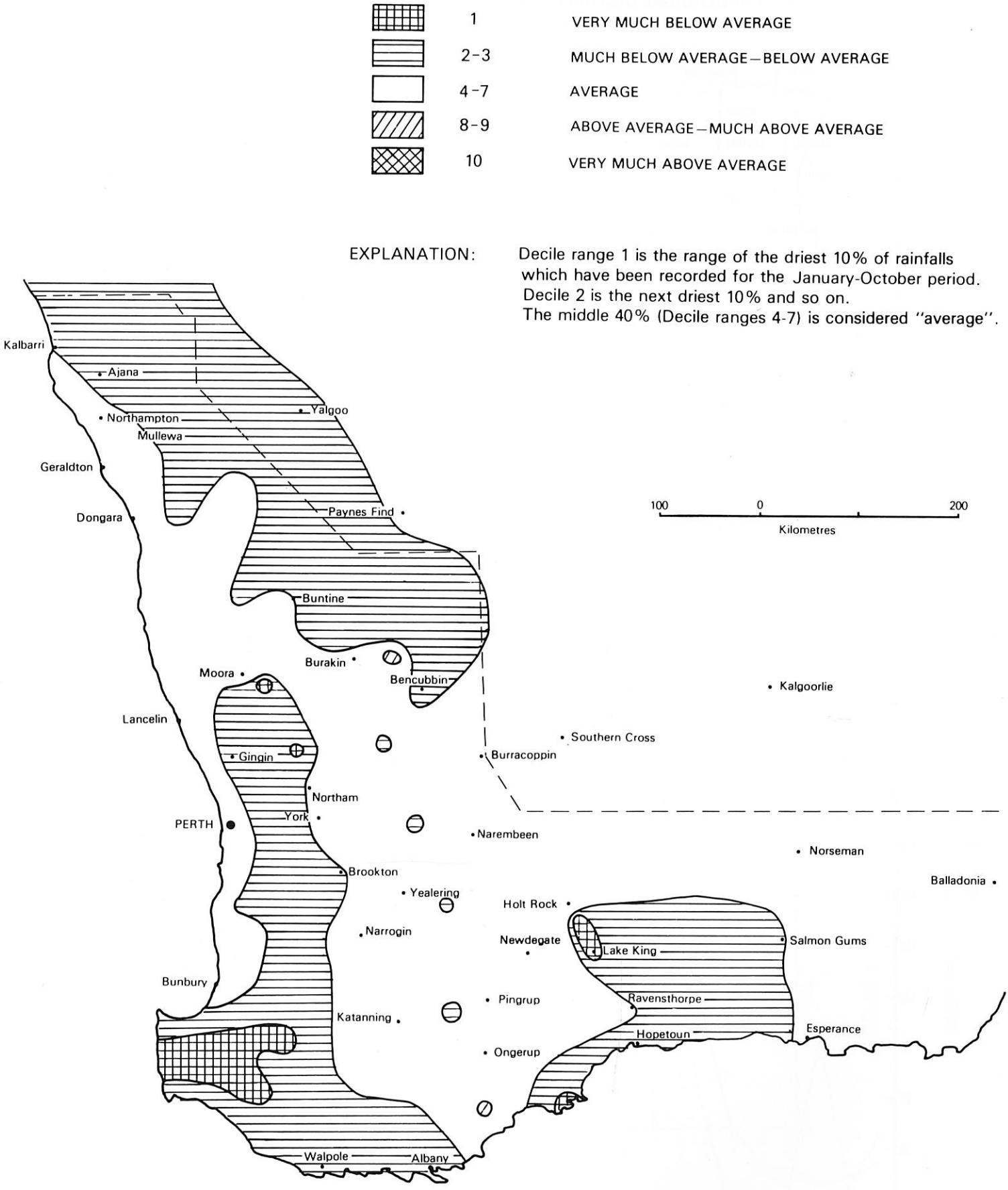


FIGURE 4 Distribution of Decile Range numbers of rainfall, Jan.-Oct. 1982

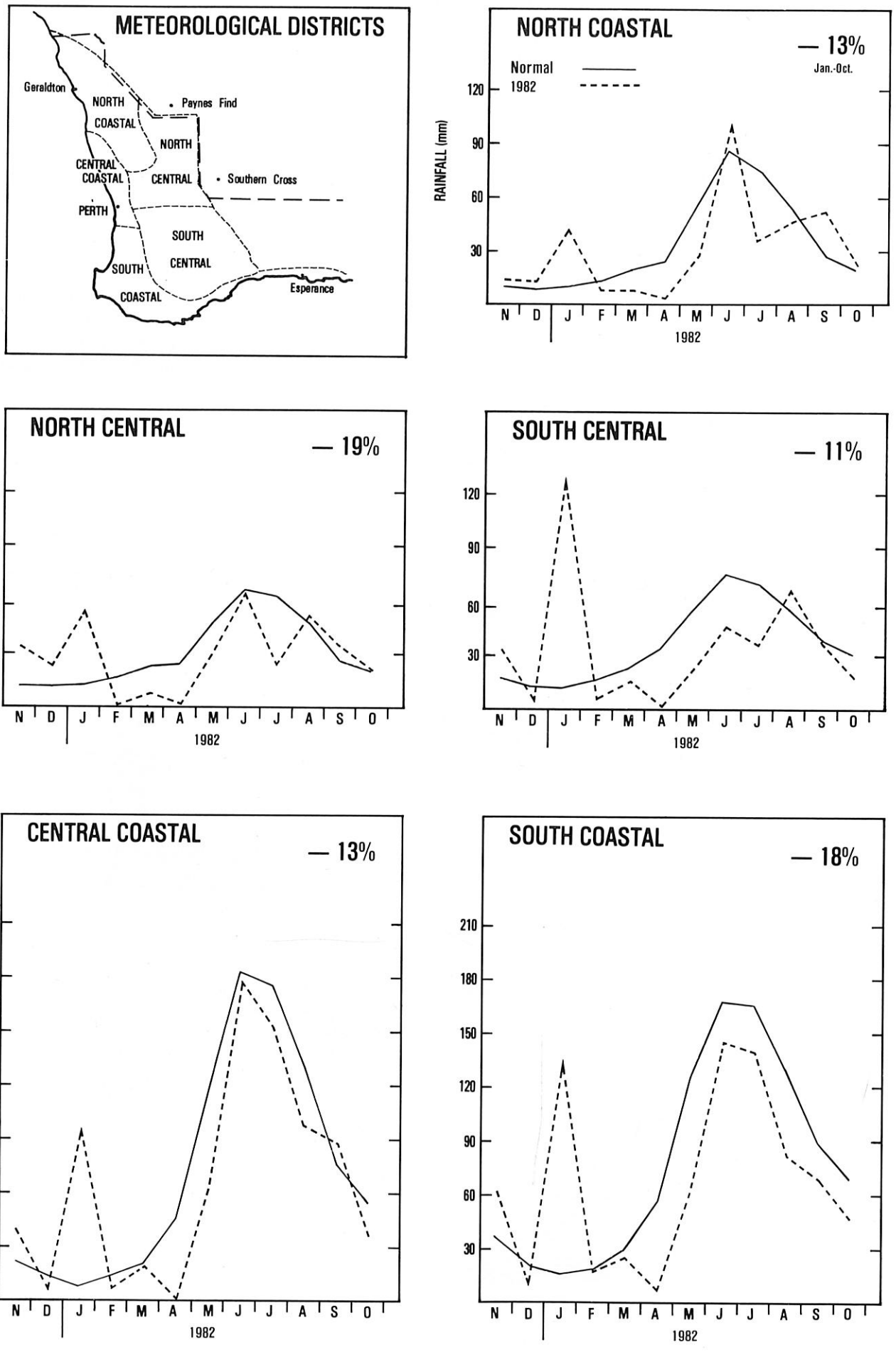


FIGURE 5 Rainfall recorded monthly in each of the five Meteorological Districts of the south-west, November 1981 to October 1982 and November to October Normal. Percentage departures from Normal (Jan.-Oct.) for each Meteorological District are also shown.

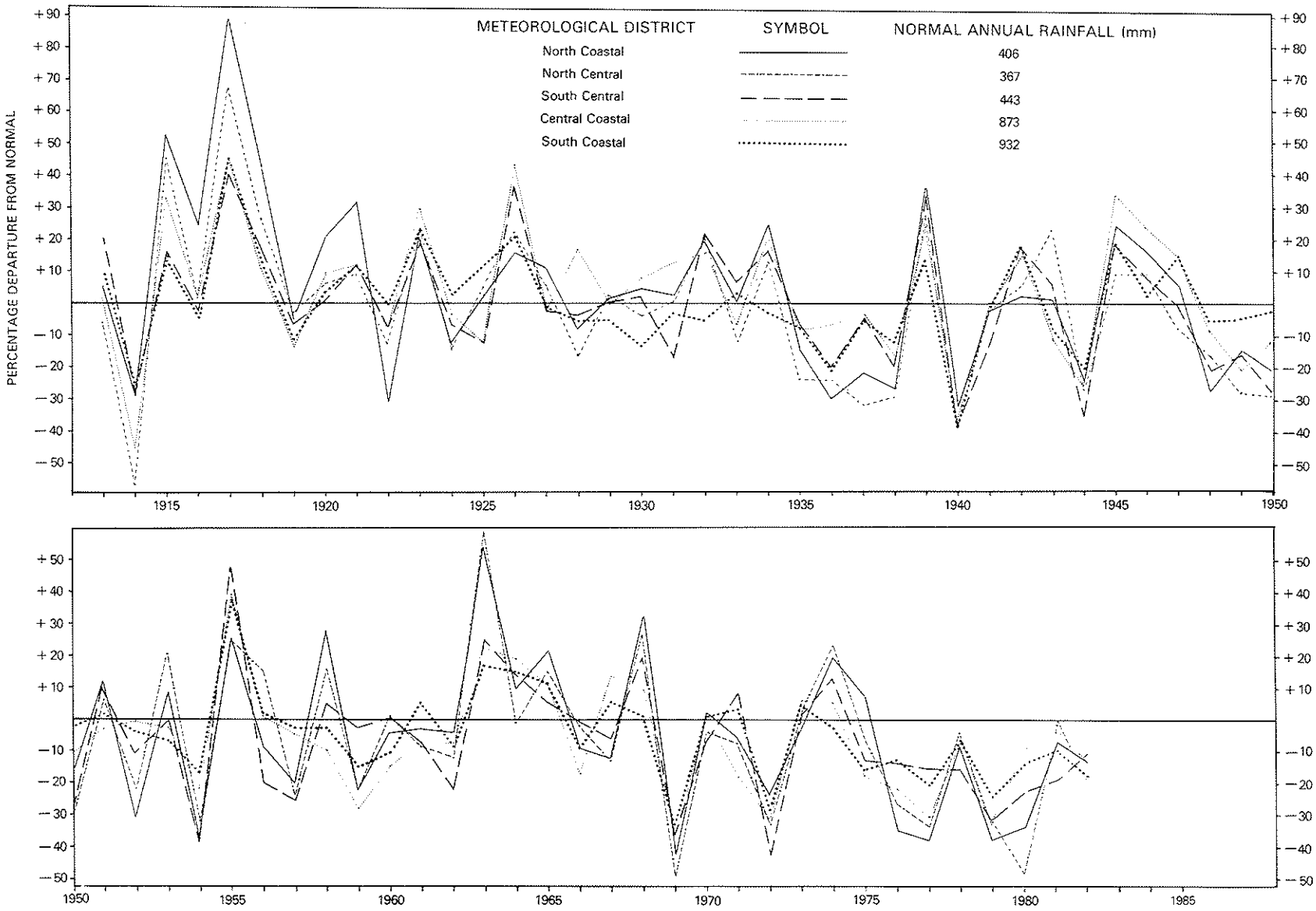


FIGURE 6 Rainfall recorded annually in each of the Meteorological Districts of the south-west, from 1913 to 1982. expressed as percentage departures from normal.

Percentage departures from normal for 1982 are based on January-October rainfall.

Normal rainfalls for this period are 93-96% of annual totals.

TABLE 1 : NOVEMBER DEPTHS OF MONITORED WETLANDS; 1978-1982.
Refer to Figure 39 (fold-out map at end of report) for wetland locations.

*Nonalling Lake's outlet was dammed prior to winter of 1979.

WET-LAND No.	WETLAND NAME	DEPTH (metres)					MAXIMUM RECORDED NOV-JAN DEPTH DECREASE (metres)
		NOV 1978	NOV 1979	NOV 1980	NOV 1981	NOV 1982	
1	YARRA YARRA				0.09	<0.10	-
2	LOGUE		DRY	DRY	1.55	0.48	0.65
3	CAPAMAURA			DRY	0.70	DRY	0.47
4	EGANU	1.78	0.20	DRY	2.28	2.00	0.46
5	PINJARREGA		1.10	DRY	2.14	0.85	0.39
6	STREETS	0.04	DRY	DRY	1.21	0.12	0.48
7	HINDS		DRY	DRY	1.00	<0.20	0.39
8	NINAN	0.25	0.23	DRY	1.96	0.78	0.43
9	MOLLERIN			DRY	<0.01	DRY	-
10	MT MARSHALL 26687				0.03	DRY	-
11	WALYORMOURING	0.03	0.03	DRY	0.51	<0.08	0.41
12	CAMPION		DRY	DRY	0.65	0.21	0.57
13	NOONYING		0.85	DRY	1.18	0.48	0.38
14	BRUCE ROCK 30969					1.07	-
15	DOBADERRY			DRY	0.49	0.14	0.49
16	BEVERLEY	1.65	0.63	0.24	1.70	1.24	0.50
17	MEARS	1.74	0.72	DRY	1.00	0.66	0.54
18	NONALLING*		DRY	0.88	0.75	0.71	0.43
19	WHITE WATER				1.08	DRY	-
20	BROWN		<0.16	DRY	1.46	0.65	-
21	YEALERING	1.67	0.56	0.32	1.94	1.61	0.56
22	DULBINNING		DRY	DRY	0.70	0.37	-
23	TOOLIBIN	DRY	DRY	DRY	1.35	1.05	-
24	WALBYRING		DRY	DRY	0.37	0.60	0.37
25	TAARBLIN	DRY	DRY	DRY	<0.08	DRY	-
26	BOKAN		DRY	0.02	0.39	0.20	0.39
27	WHITE NARROGIN				0.05	DRY	-
28	LITTLE WHITE		DRY	0.47	0.81	0.81	0.20
29	KWOBRUP		0.14	DRY	DRY	0.71	-
30	COYRECUP	1.00	DRY	<0.13	0.35	1.89	0.35
31	CASUARINA	DRY	DRY	<0.49	0.90	0.60	0.29
32	COOMELBERRUP	0.53	DRY	DRY	0.36	0.89	0.36
33	COBLININE		0.91	1.27	1.21	2.60	0.39
34	DUMBLEYUNG		<0.13	0.13	0.25	2.00	-
35	GUNDARING	0.82	0.48	0.67	0.95	1.65	0.48
36	WAGIN 2088					0.55	-
37	PARKEYERRING	0.49	DRY	<0.10	0.60	1.28	0.41
38	FLAGSTAFF		DRY	0.14	0.26	0.64	0.26
39	WARDERING	0.82	0.24	0.66	0.99	0.70	0.40
40	QUEEREARRUP	0.34	DRY	0.30	0.57	1.78	0.34
41	MIRIPIN				0.43	0.66	0.35
42	MURAPIN				0.18	1.01	-
43	MARTINUP		DRY	0.24	0.33	1.34	-
44	WEST ARTHUR 5456			DRY	0.80	0.51	0.35
45	TOWERINNING	1.69	0.81	0.54	1.10	3.14	0.51
46	RED BRUCE ROCK				0.04	DRY	-
47	CORRIGIN 12900					0.19	-
48	KONDININ		0.20	DRY	0.62	0.25	0.36
49	GOUNTER			DRY	0.10	0.10	-
50	VARLEY				DRY	DRY	-
51	ACE			DRY	<0.02	DRY	-
52	PALLARUP			DRY	<0.07	DRY	-
53	BIDDY					0.74	-
54	KENT 29020			DRY	DRY	DRY	-
55	BRYDE		DRY	DRY	DRY	DRY	-
56	ALTHAM				DRY	DRY	-
57	CAIRLOCUP			DRY	DRY	DRY	-
58	YAALUP					1.28	-

TABLE 1 - cont'd...

WET-LAND No.	WETLAND NAME	DEPTH (metres)					MAXIMUM RECORDED NOV-JAN DEPTH DECREASE (metres)
		NOV 1978	NOV 1979	NOV 1980	NOV 1981	NOV 1982	
59	GNOWANGERUP 26569					DRY	-
60	GNOWANGERUP 26264			0.07	DRY	0.84	-
61	ANDERSON				0.20	2.12	-
62	CAMEL			0.19	DRY	0.17	-
63	CRANBROOK 25812			0.20	0.06	0.02	-
64	ENEMINGA			DRY	3.00	1.39	-
65	GURAGA					2.14	-
66	CRACKERS			DRY	0.05	DRY	-
67	KARAKIN		0.55	0.82	0.98	0.72	0.82
68	WANNAMAL	1.14	1.15	1.24	1.23	1.30	0.80
69	YURINE		1.01	0.66	2.20	1.42	0.60
70	GINGIN 31241		2.08	2.14	2.07	2.03	0.60
71	BAMBUN		2.27	2.31	2.32	2.26	0.50
72	NAMBUNG		DRY	0.07	0.49	0.20	0.41
73	MUNGALA		0.10	0.12	0.70	0.29	0.45
74	WALLERING				0.97	0.47	0.46
75	CHANDALA		0.74	0.82	0.70	0.81	0.44
76	CHITTERING	1.39	1.38	1.45	1.31	1.42	0.45
77	TWIN SWAMPS		DRY	DRY	DRY	DRY	-
78	ELLEN BROOK		0.12	0.28	0.18	0.10	0.28
79	JANDABUP	1.35	1.25	1.22	1.27	1.15	0.39
80	JOONDALUP	3.01	2.87	2.88	2.92	3.03	0.35
81	THOMSONS	0.94	0.17	0.86	0.90	0.92	0.44
82	FORRESTDALE	0.92	0.30	0.79	0.93	0.64	0.42
83	MURRAY 24739			0.57	0.32	0.41	0.57
84	NINE MILE				1.37	1.77	0.29
85	HARVEY 12632			1.16	1.08	1.47	0.51
86	WILD HORSE				0.21	1.17	0.21
87	BOYUP BROOK 18239			<0.05	DRY	DRY	-
88	UNICUP			0.60	0.64	0.19	0.35
89	RED MANJIMUP				0.29	DRY	0.28
90	MUIR		0.14	0.17	0.52	<0.02	0.26
91	BYENUP	2.40	2.27	2.14	2.38	2.12	0.29
92	TORDIT-GARRUP	3.15	2.91	2.75	2.88	2.65	0.29
93	POORGINUP	0.55	0.53	0.55	0.54	0.44	0.23
94	YARNUP			0.80	0.94	0.80	0.20
95	WARRINUP			0.21	0.12	DRY	-
96	KWORNICUP		0.41	0.26	0.39	<0.09	0.33
97	POWELL				0.96	0.94	0.23
98	PLANTAGENET 25386		0.73	0.48	0.41	0.51	0.73
99	WHITE ALBANY				0.23	<0.09	0.18
100	ALBANY 26385				0.84	0.64	0.22
101	PLEASANT VIEW		2.20	1.52	1.15	0.79	0.28
102	ANGOVE				1.81	1.81	0.12
103	MOATES		4.44	4.51	4.32	4.22	0.46
104	GARDNER				2.08	2.00	0.10
105	ALBANY 27157			1.10	0.84	0.77	0.23
106	METTLER					0.44	-
107	JERDACUTTUP		2.41	1.30	0.62	0.43	0.38
108	SHASTER		1.04	0.17	0.20	DRY	0.37
109	ESPERANCE 21640				DRY	DRY	-
110	GORE		1.72	1.35	1.32	1.04	0.33
111	SHARK		2.40	2.25	2.29	2.22	0.25
112	WARDEN		1.53	<0.84	0.66	0.40	0.32
113	MULLET			0.57	0.53	0.58	0.37
114	CRONIN				0.18	DRY	-
115	DUNDAS 33113		0.34			DRY	-
116	ESPERANCE 27768				DRY	DRY	-
117	ESPERANCE 27985				DRY	DRY	-
118	ESPERANCE 32776				DRY	DRY	-
119	ESPERANCE 32128					DRY	-

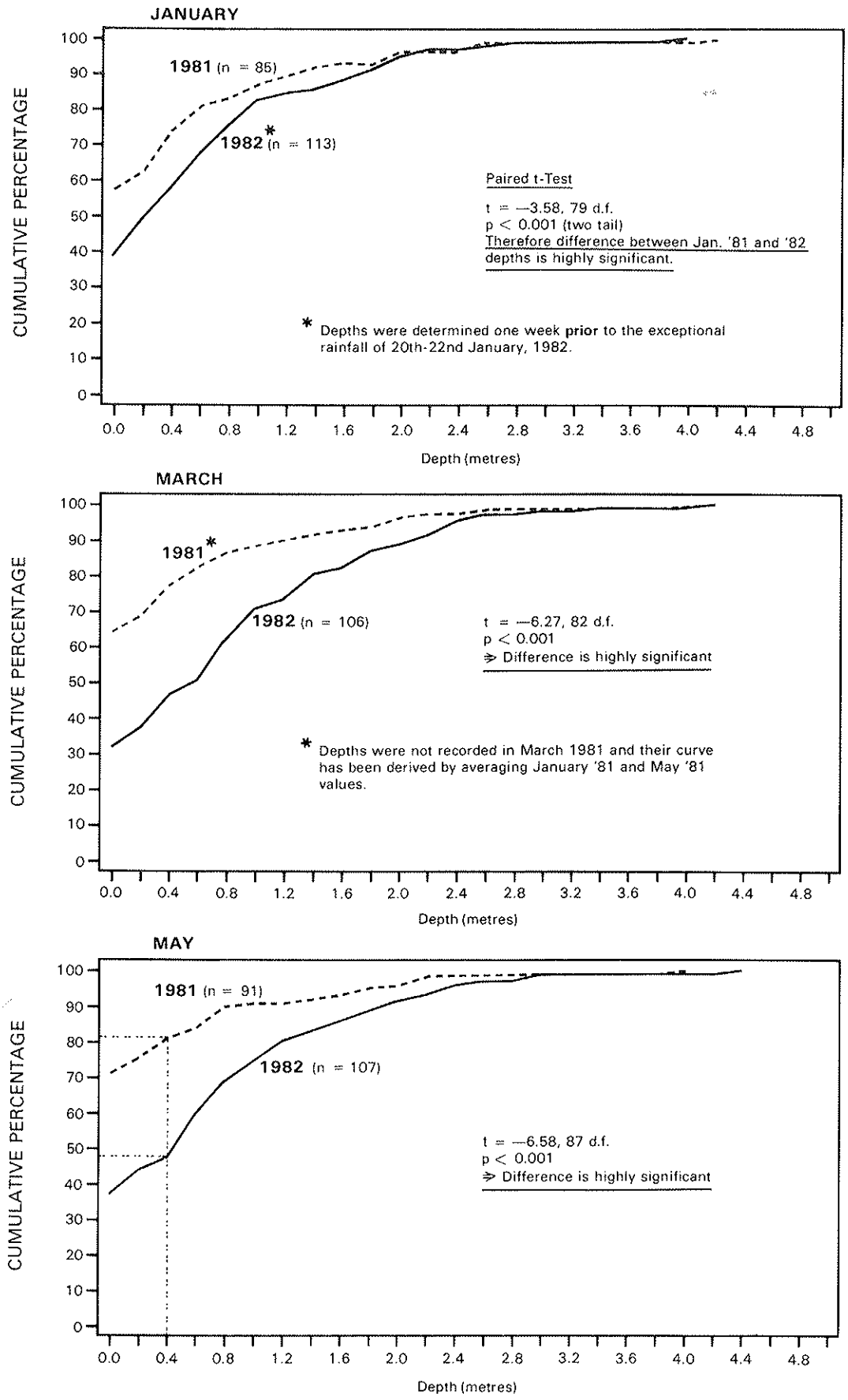


FIGURE 7 CUMULATIVE PERCENTAGES OF WETLAND DEPTHS
"n" is the total number of wetlands monitored.
This figure shows, for example, that in May 1981 81% of monitored wetlands had depths of less than 0.4m whereas in May 1982 only 48% were less than 0.4m deep. Thus water levels in monitored lakes were higher in May '82 than May '81. Similar comparisons can be made for other months.

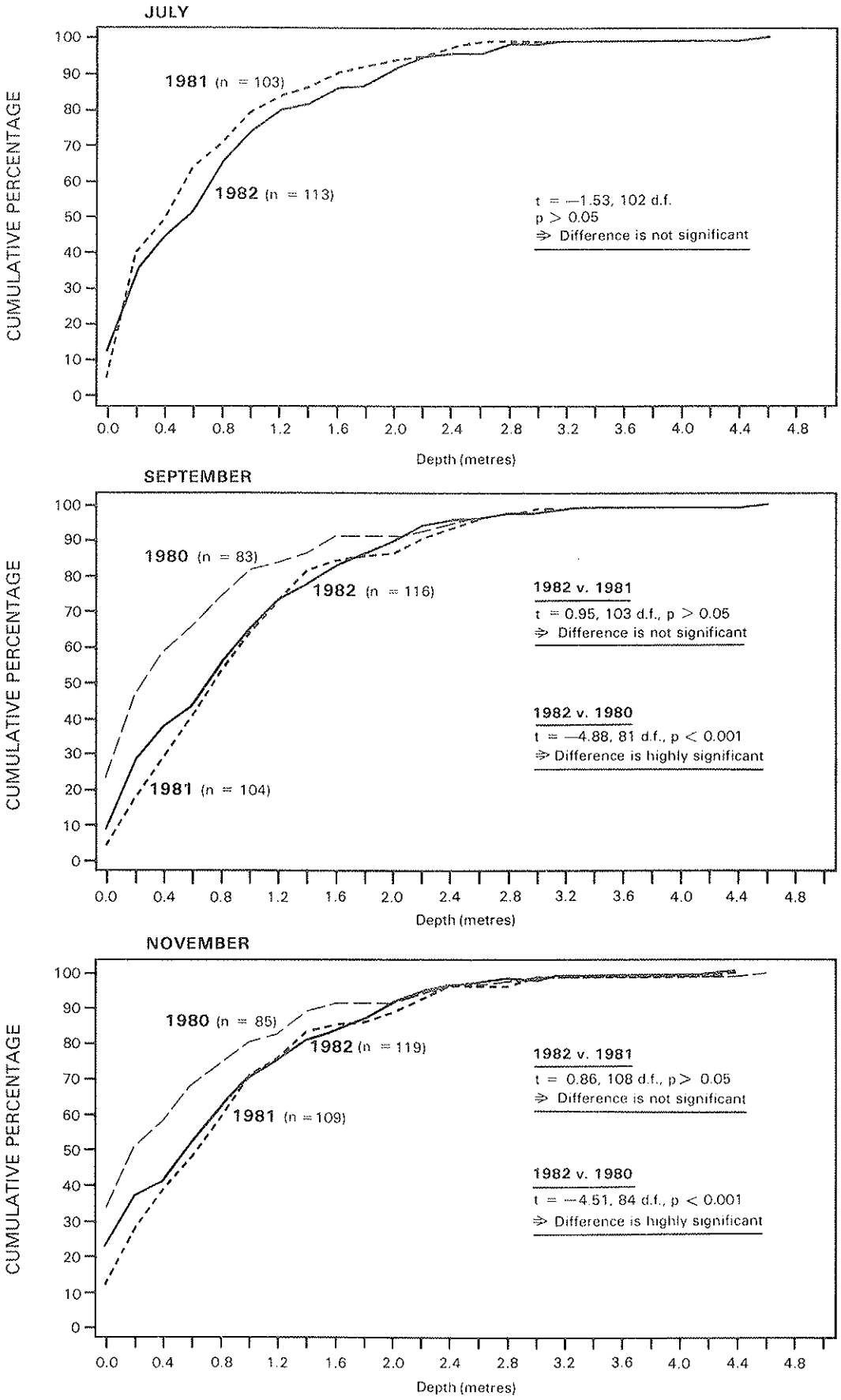


FIGURE 7 (contd.)
Paired t-tests (two-tail) show that depths recorded in January, March and May 1982 were significantly different from those recorded in 1981, the 1982 depths being greater. Depths recorded in July, September and November 1982 were not significantly different from those of 1981.
September and November 1982 depths *were* significantly different from those of 1980, the 1982 depths being greater.

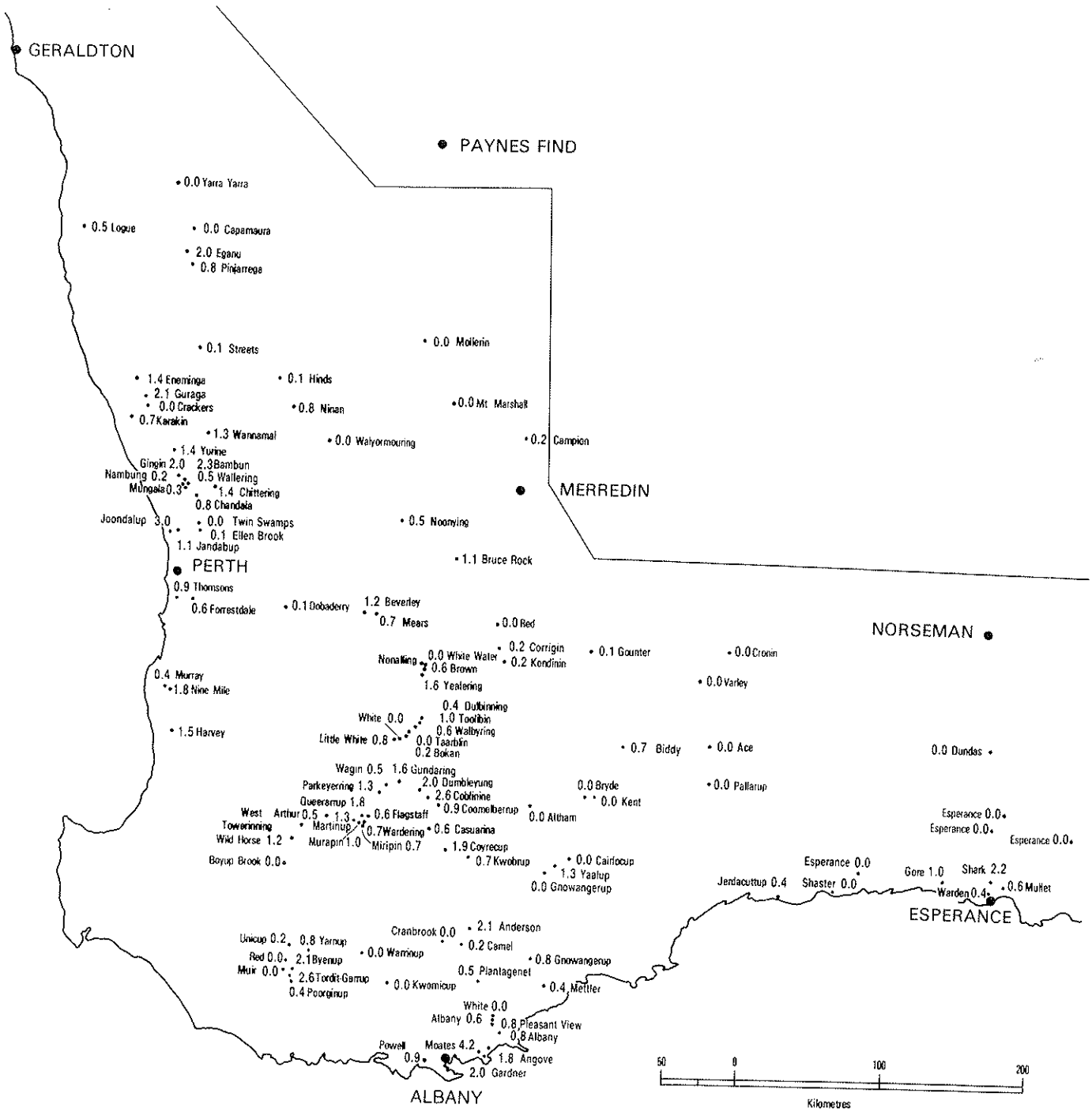


FIGURE 8. Depth of gauged wetlands, November 1982.

FIGURE 9. LAKE EGANU (Wetland No. 4)

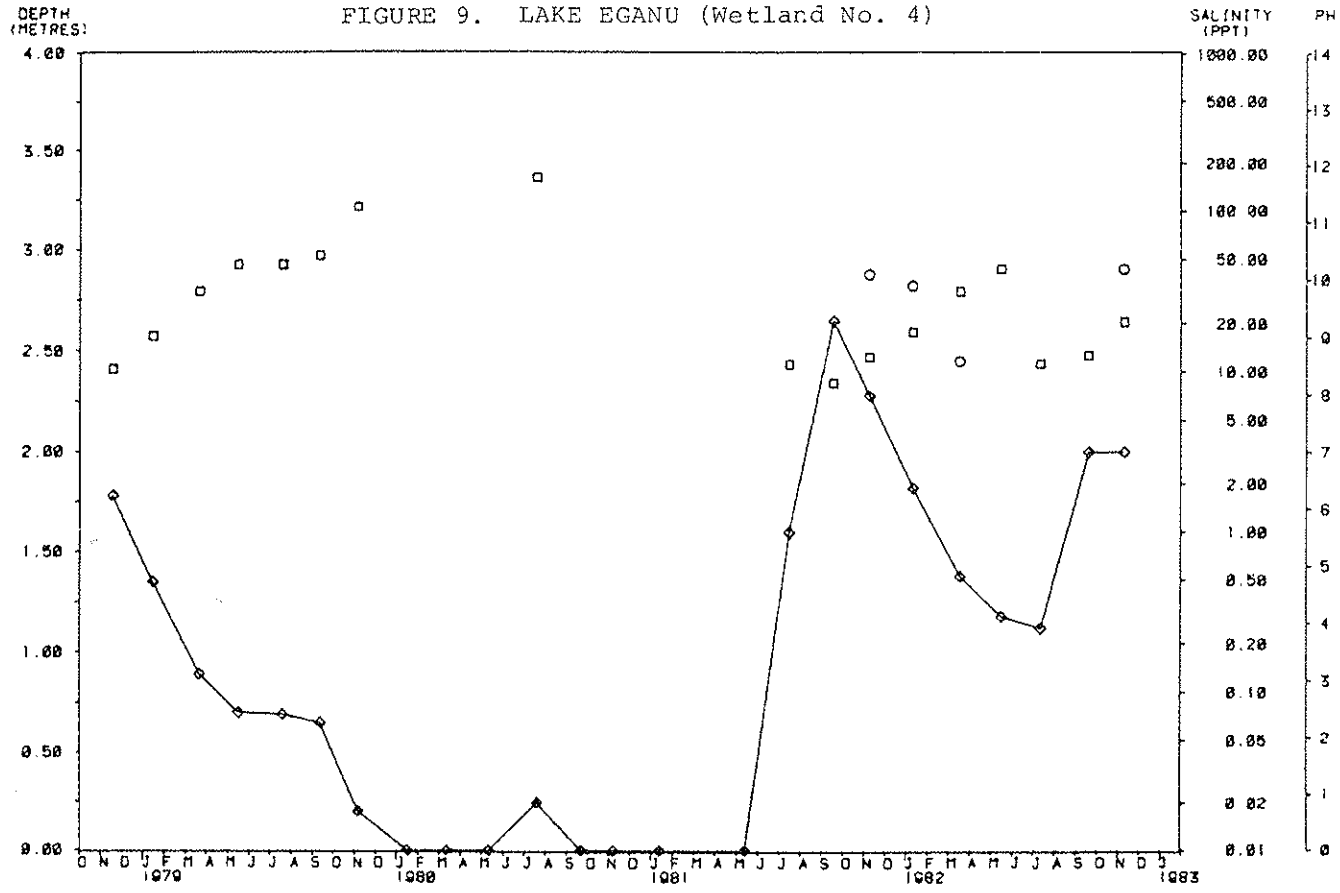
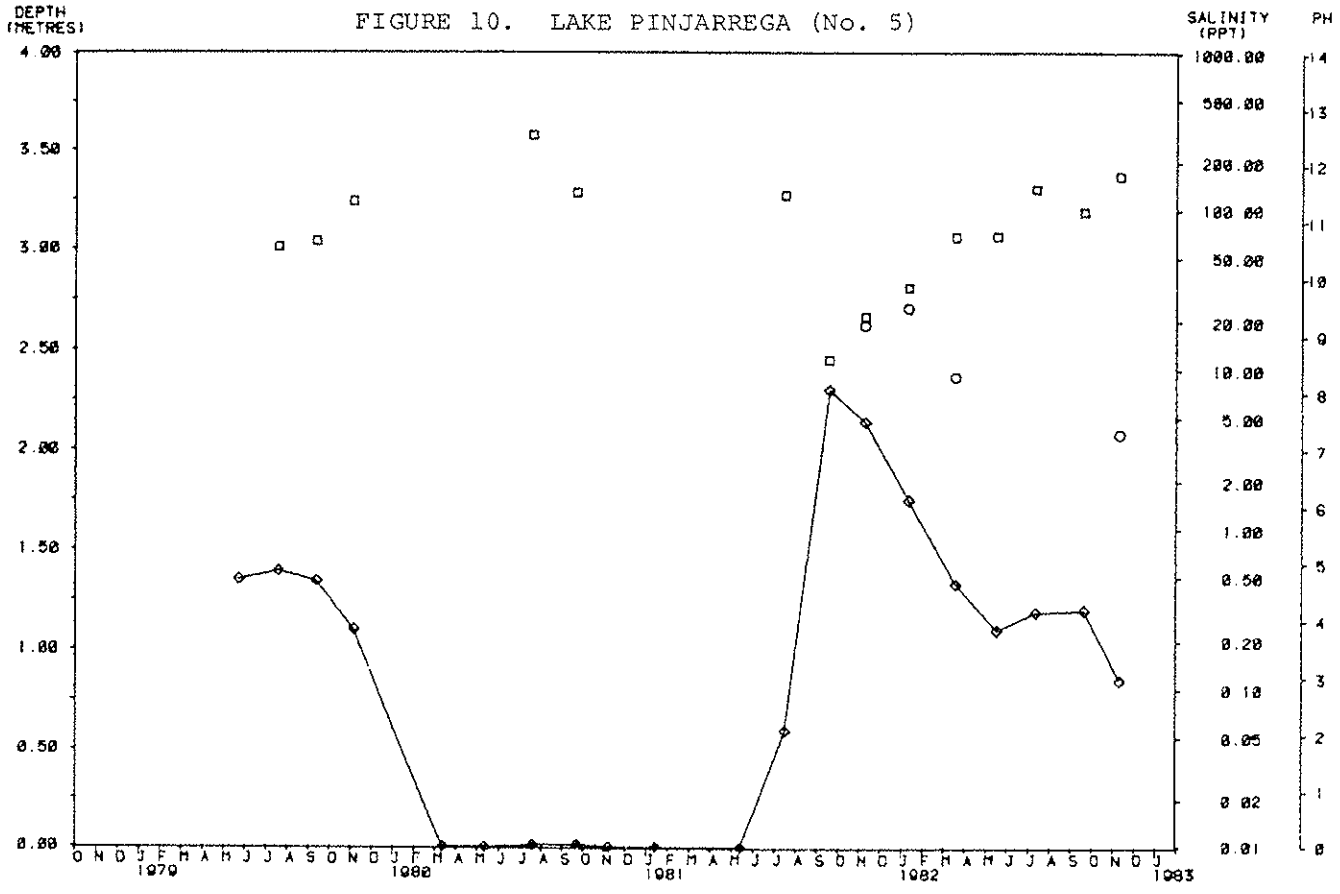


FIGURE 10. LAKE PINJARREGA (No. 5)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT.FISHERIES +WILDLIFE
WATERBIRD RESEARCH

FIGURE 11. STREETS LAKE (No. 6)

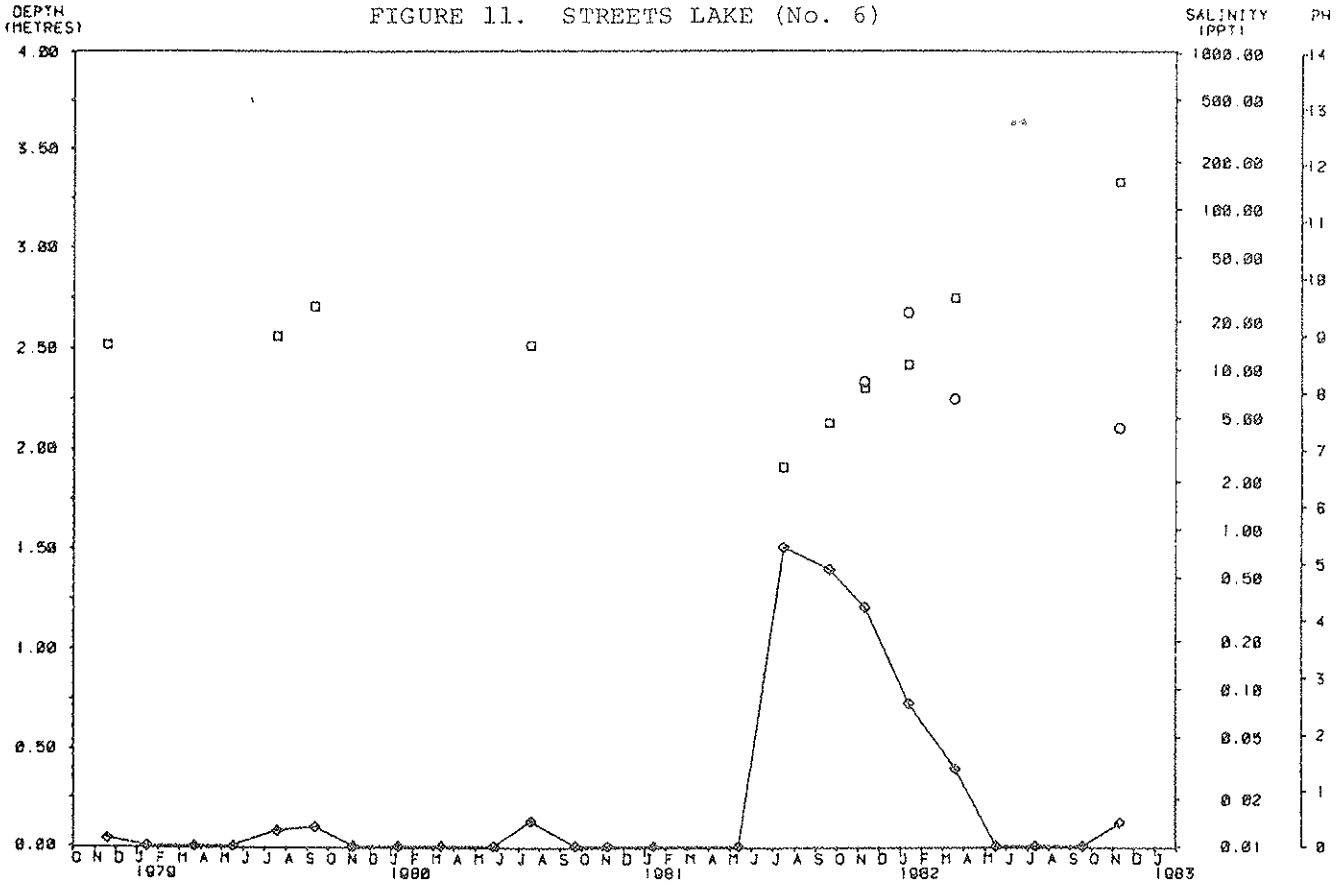
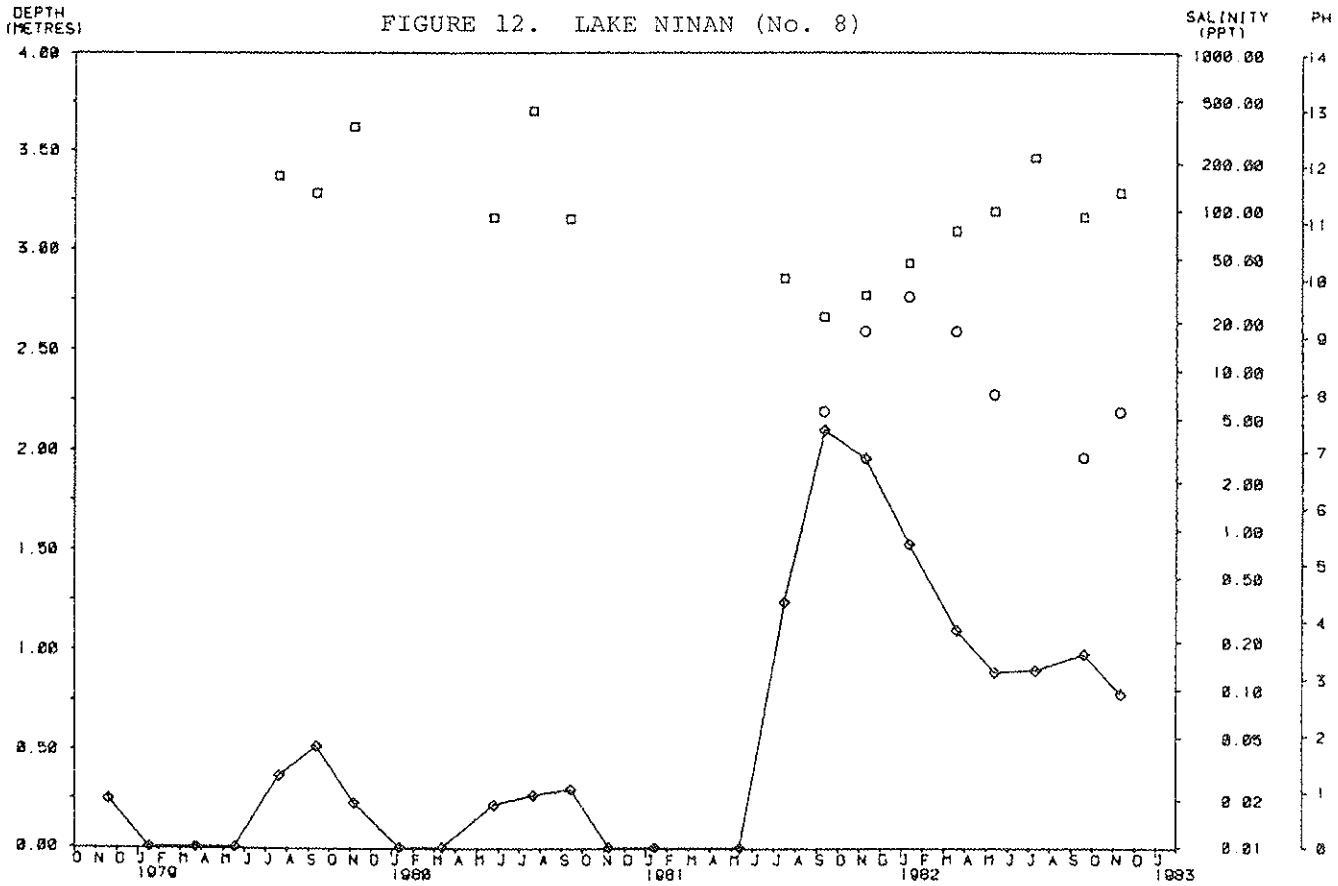


FIGURE 12. LAKE NINAN (No. 8)



◇ DEPTH □ SALINITY ○ PH FACTOR

VA DEPT. FISHERIES +WILDLIFE
WATERBIRD RESEARCH

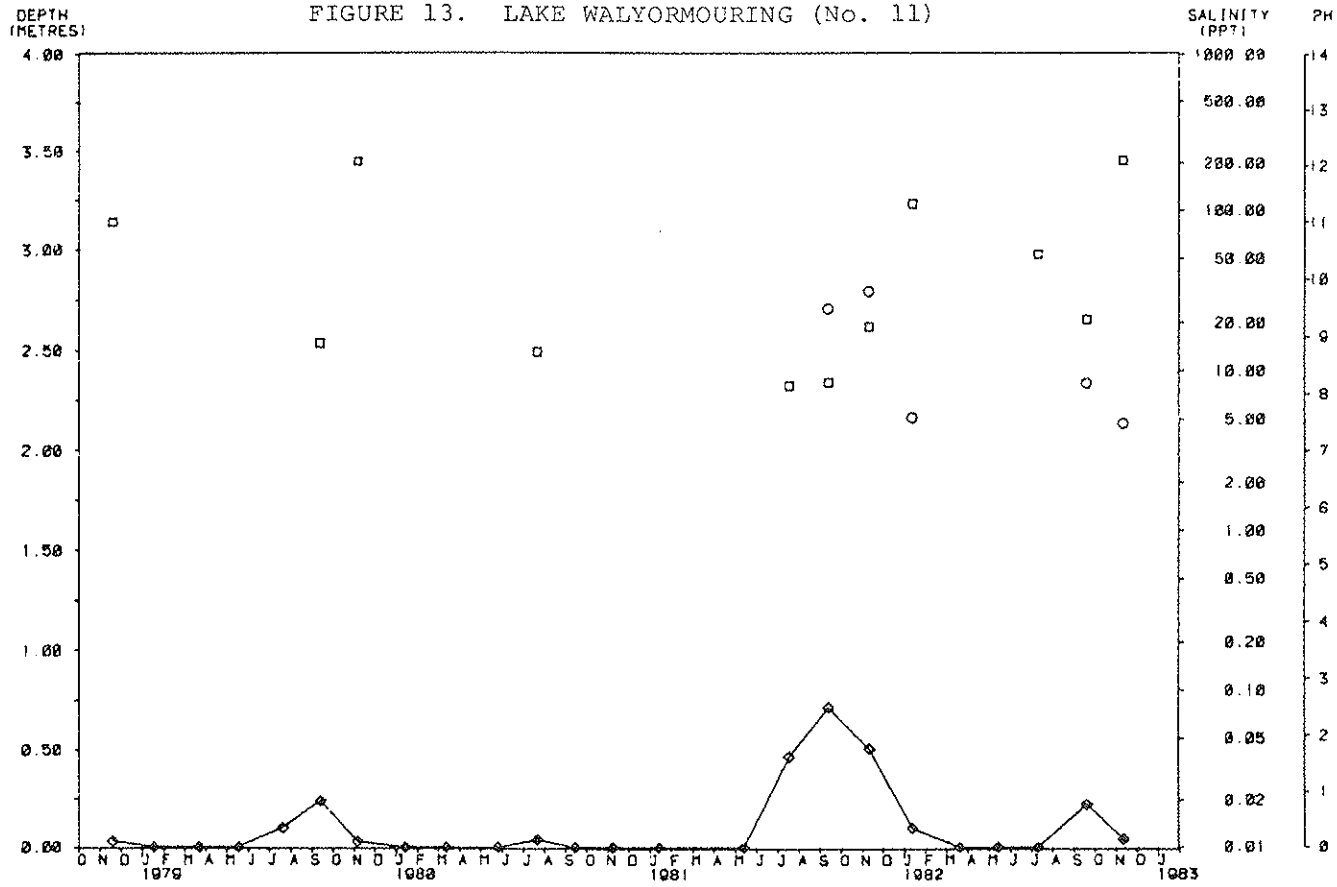


FIGURE 13. LAKE WALYORMOURING (No. 11)

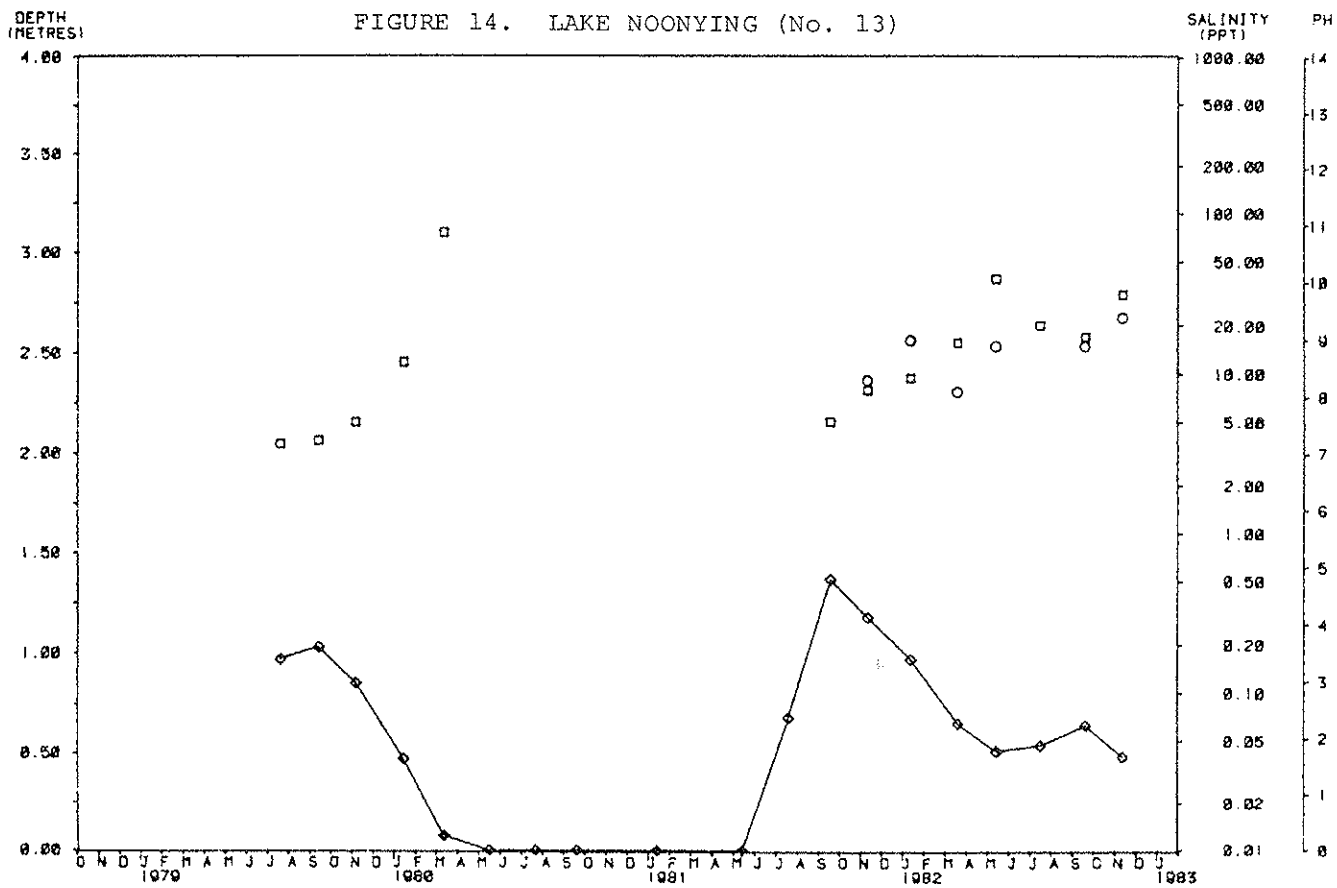


FIGURE 14. LAKE NOONYING (No. 13)

FIGURE 15. LAKE BEVERLEY (No. 16)

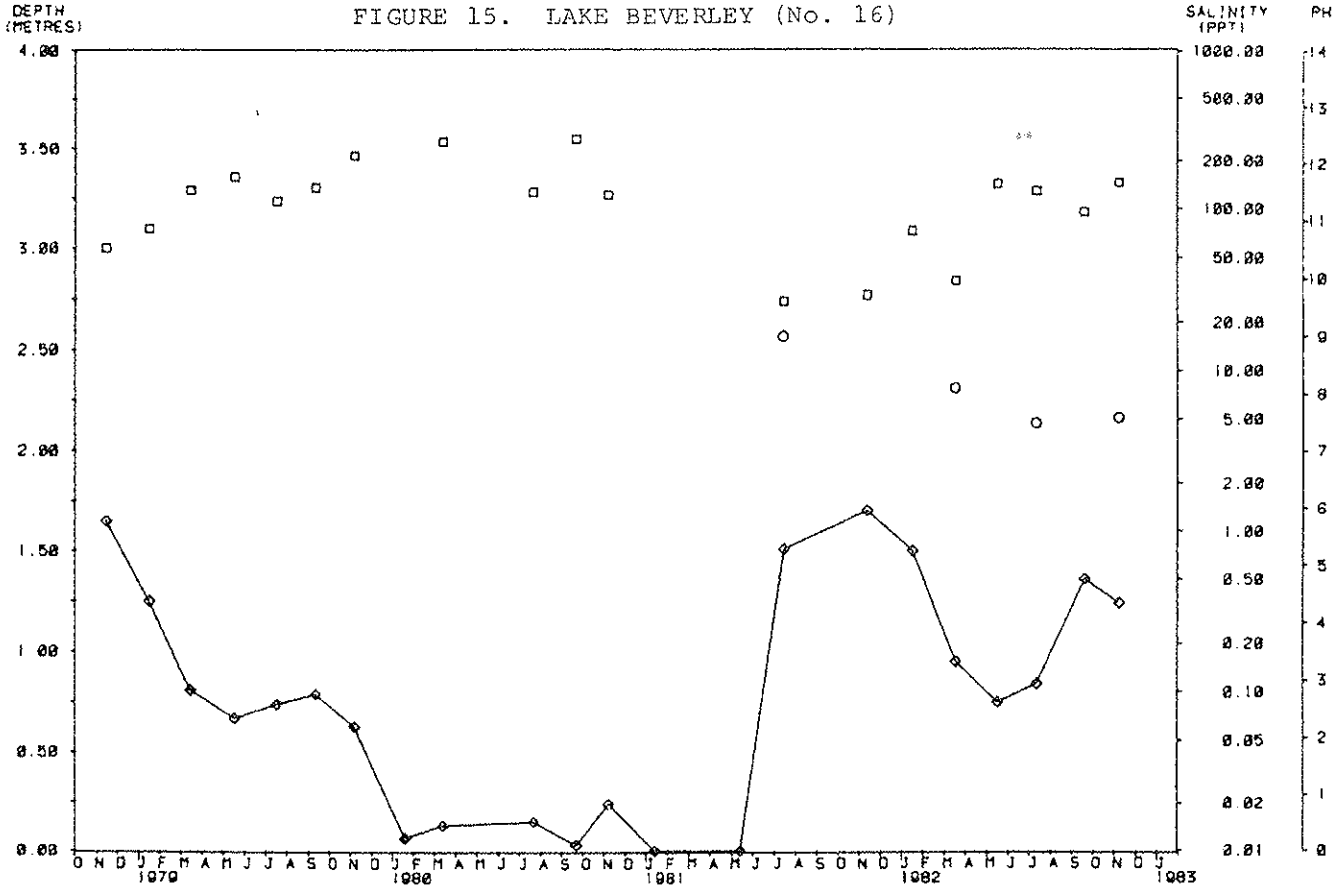


FIGURE 16. LAKE BROWN (No. 20)

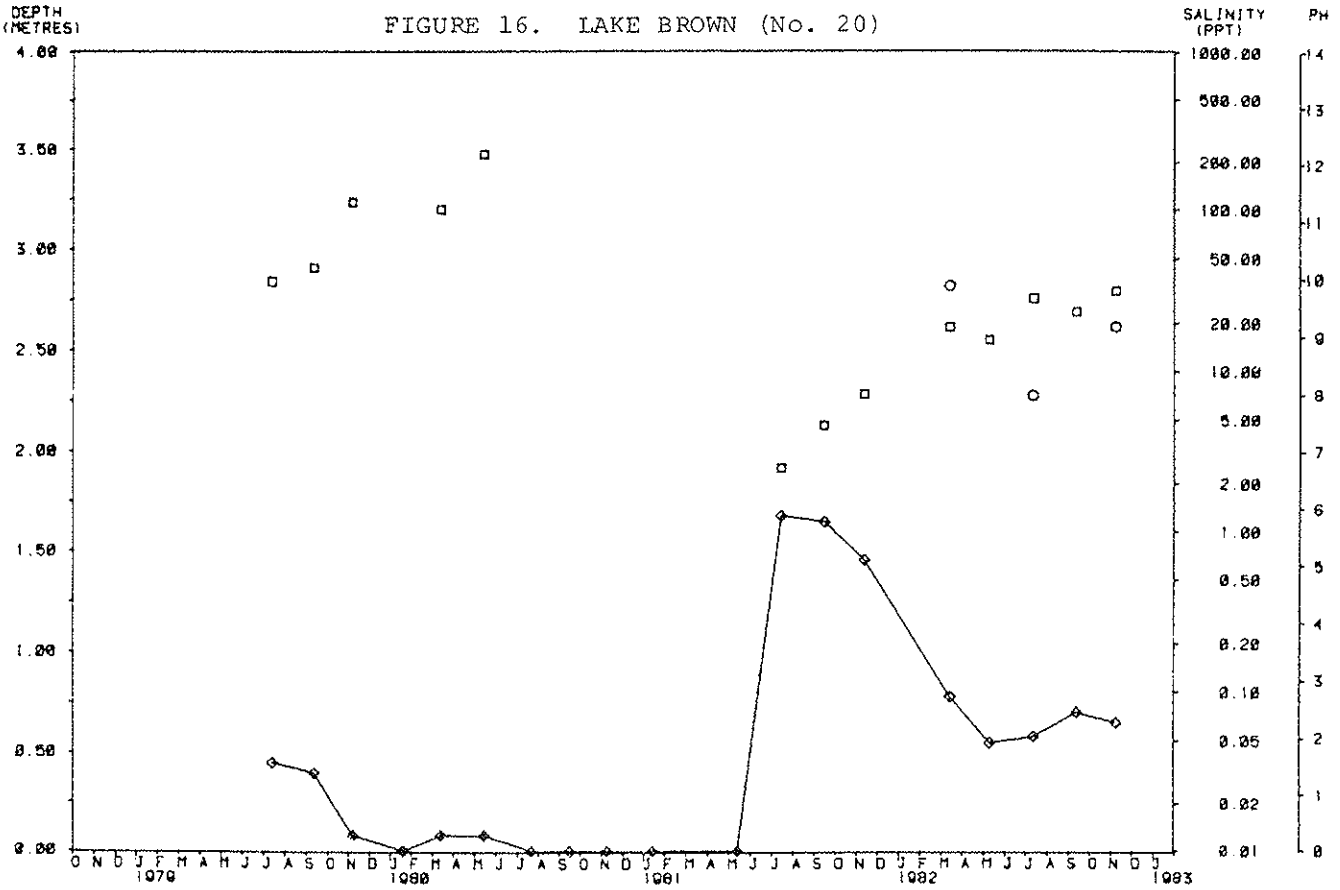


FIGURE 17. LAKE TOOLIBIN (No. 23)

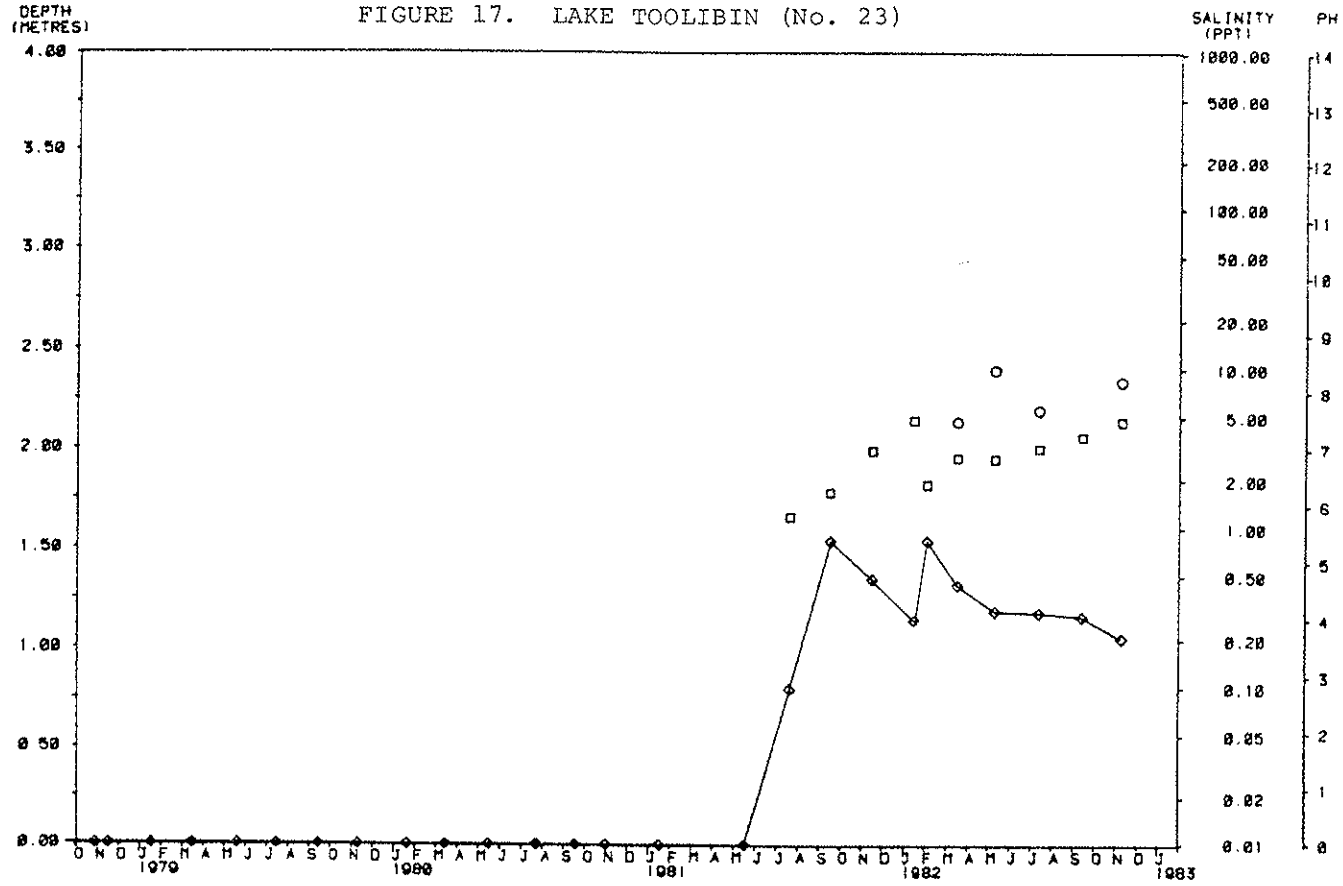
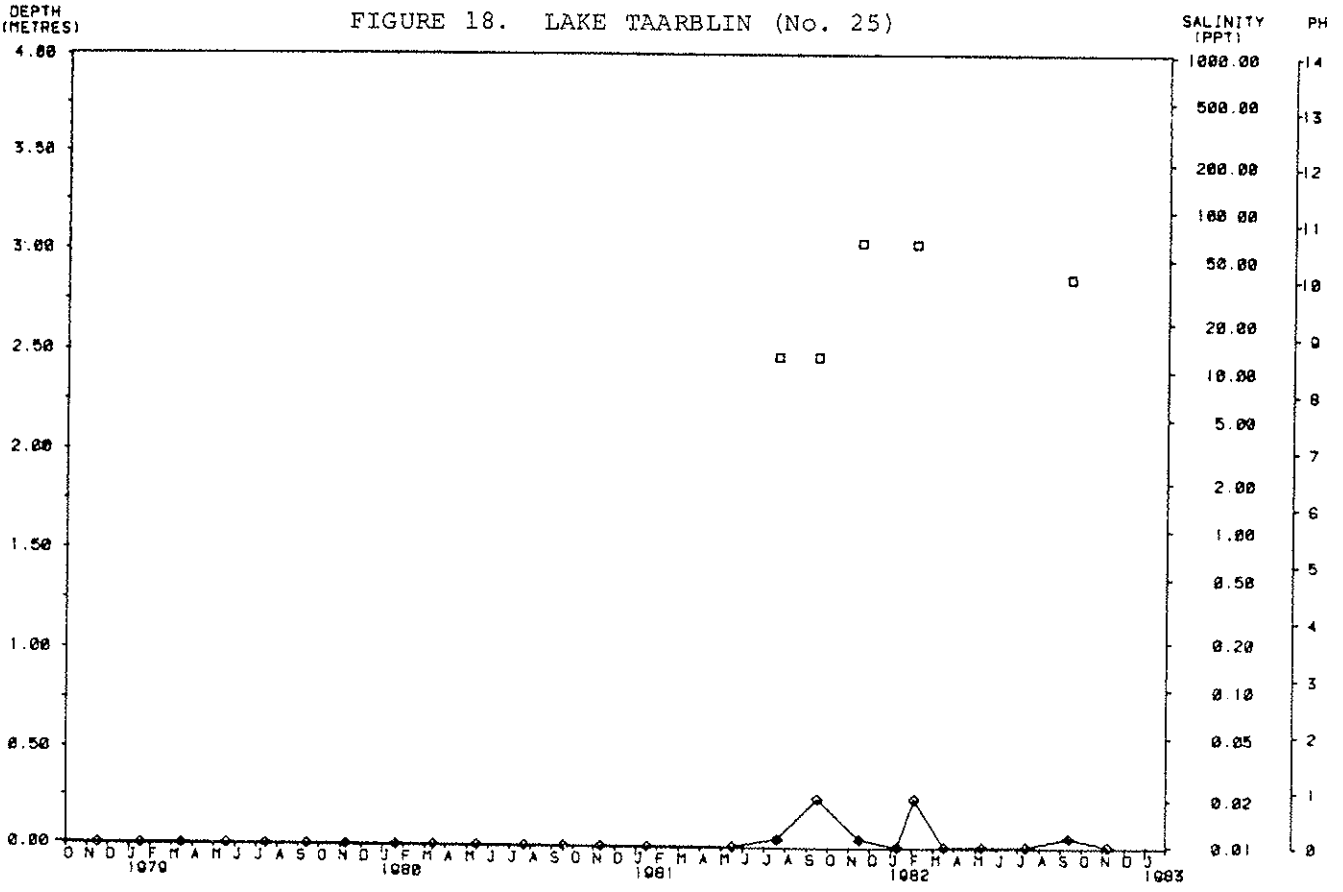


FIGURE 18. LAKE TAARBLIN (No. 25)



◇ DEPTH □ SALINITY ○ PH FACTOR

VA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH

FIGURE 19. WHITE LAKE (No. 27)

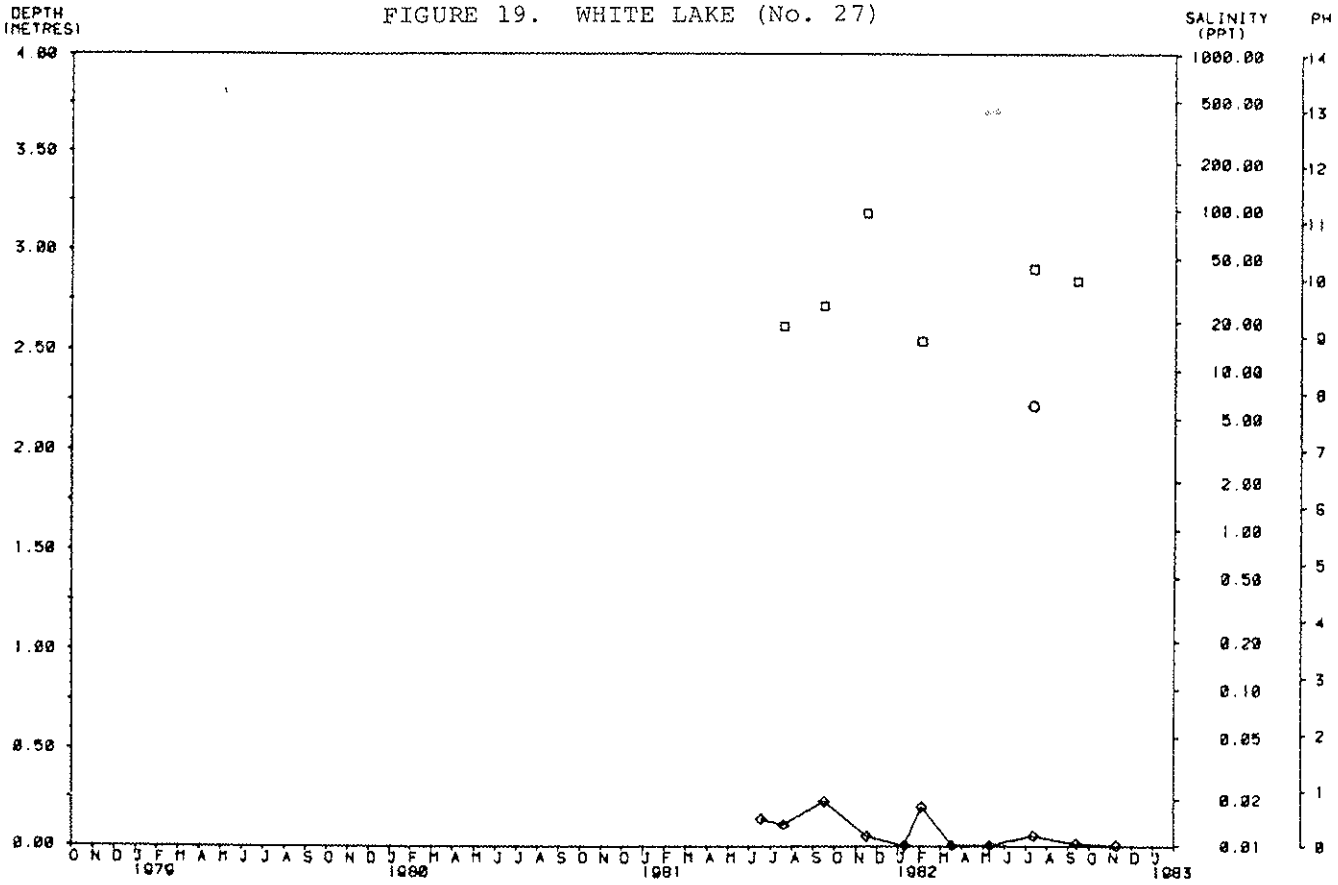


FIGURE 20. LITTLE WHITE LAKE (No. 28)

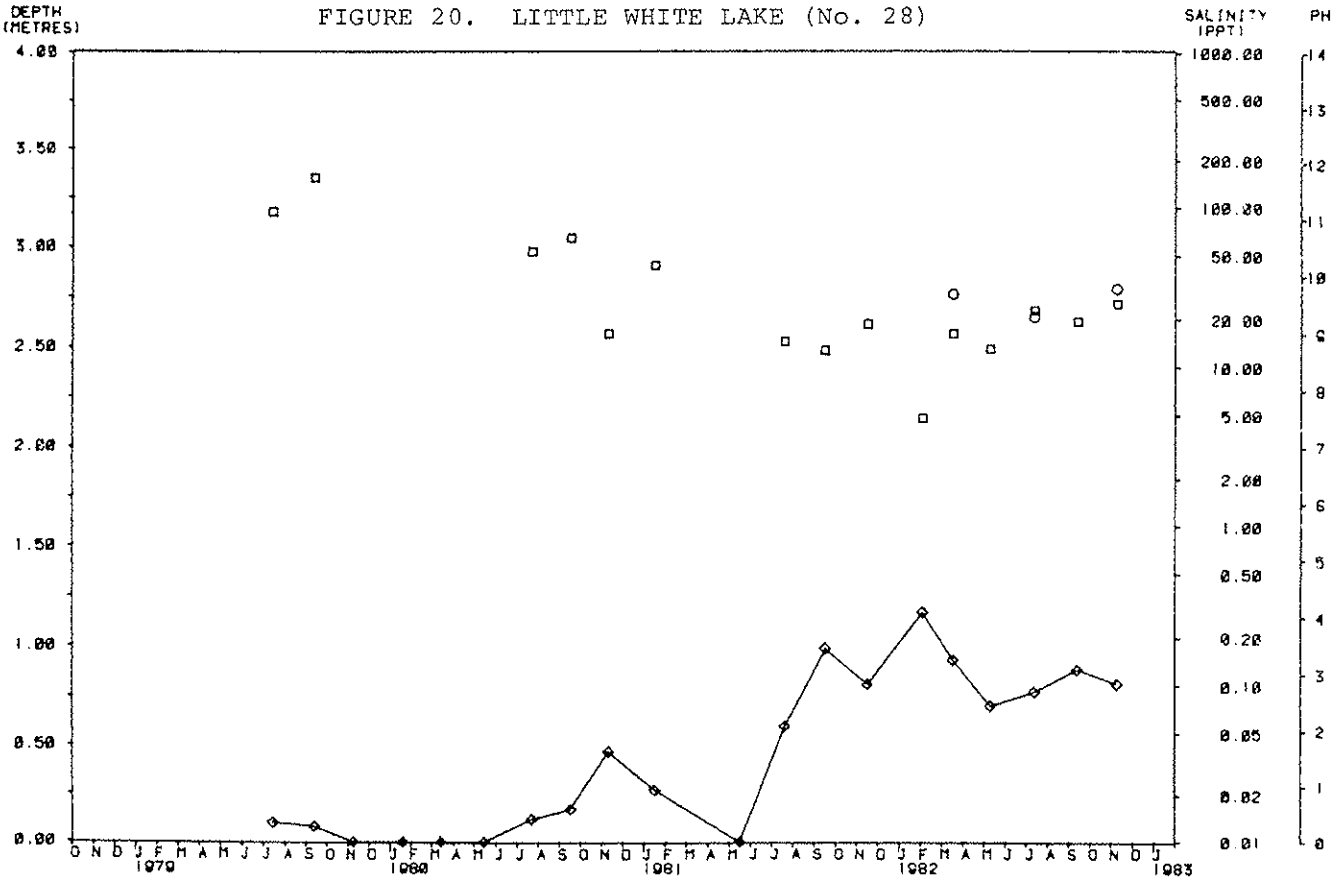


FIGURE 21. LAKE COYRECUP (No. 30)

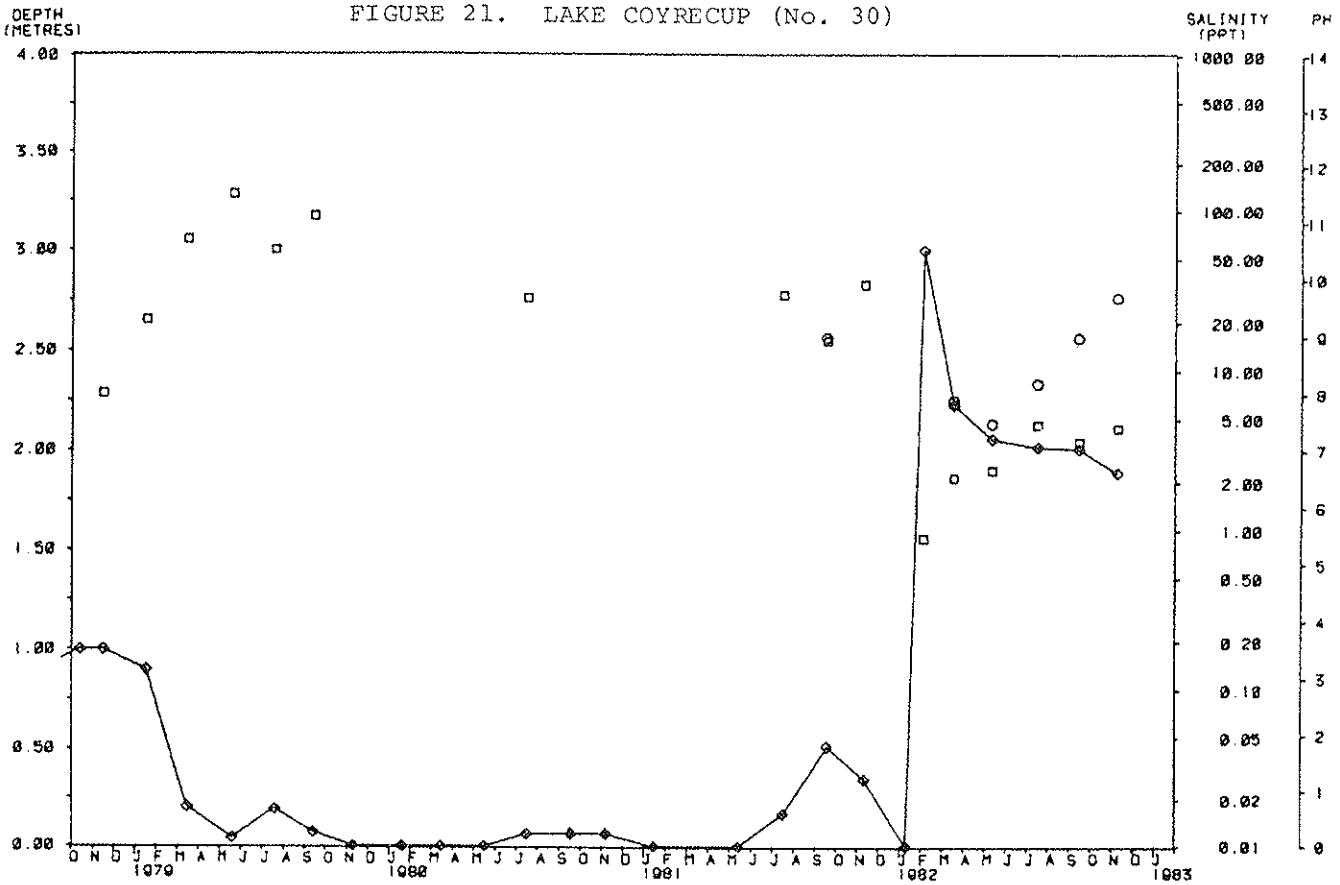
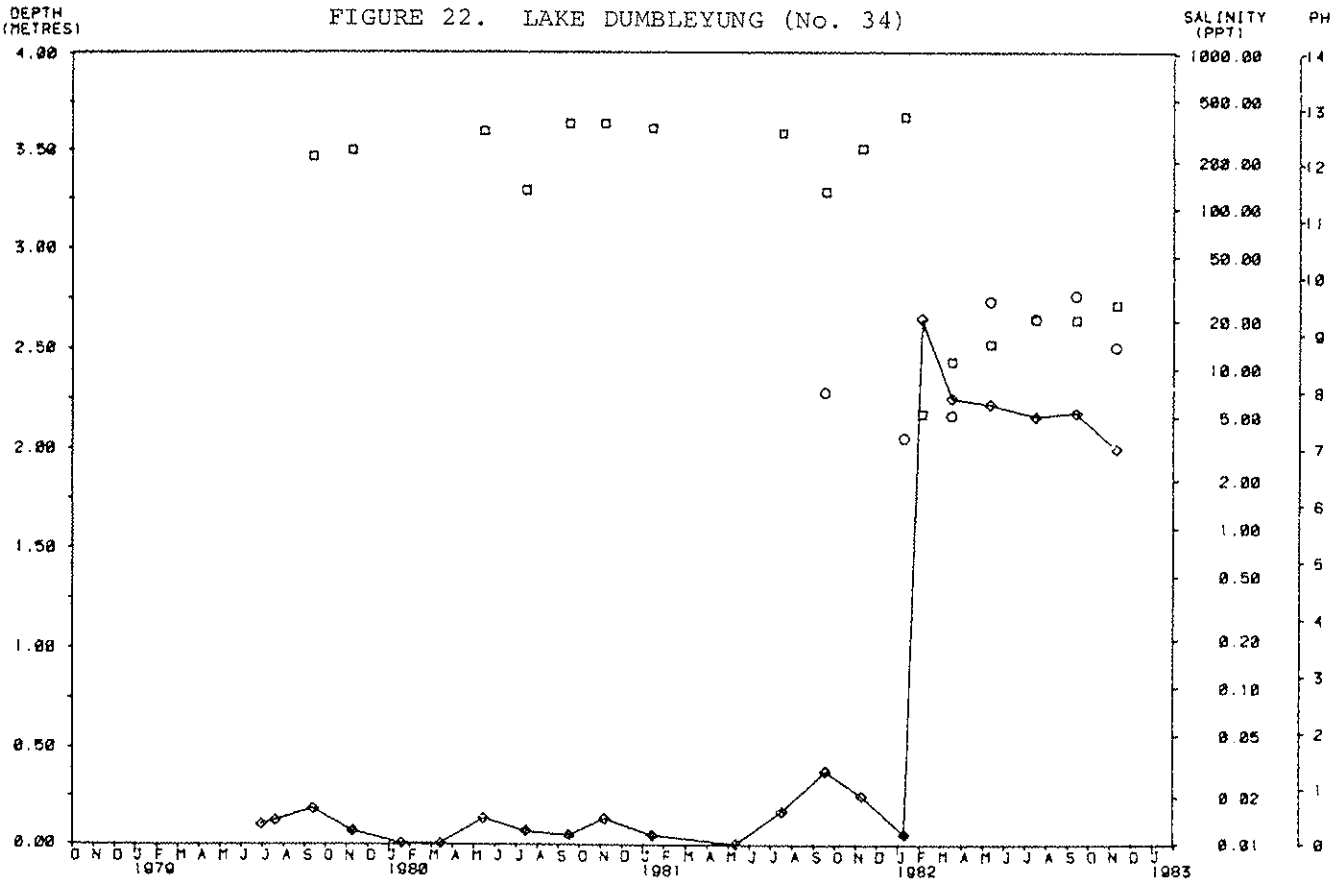


FIGURE 22. LAKE DUMBLEYUNG (No. 34)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH

FIGURE 23. LAKE GUNDARING (No. 35)

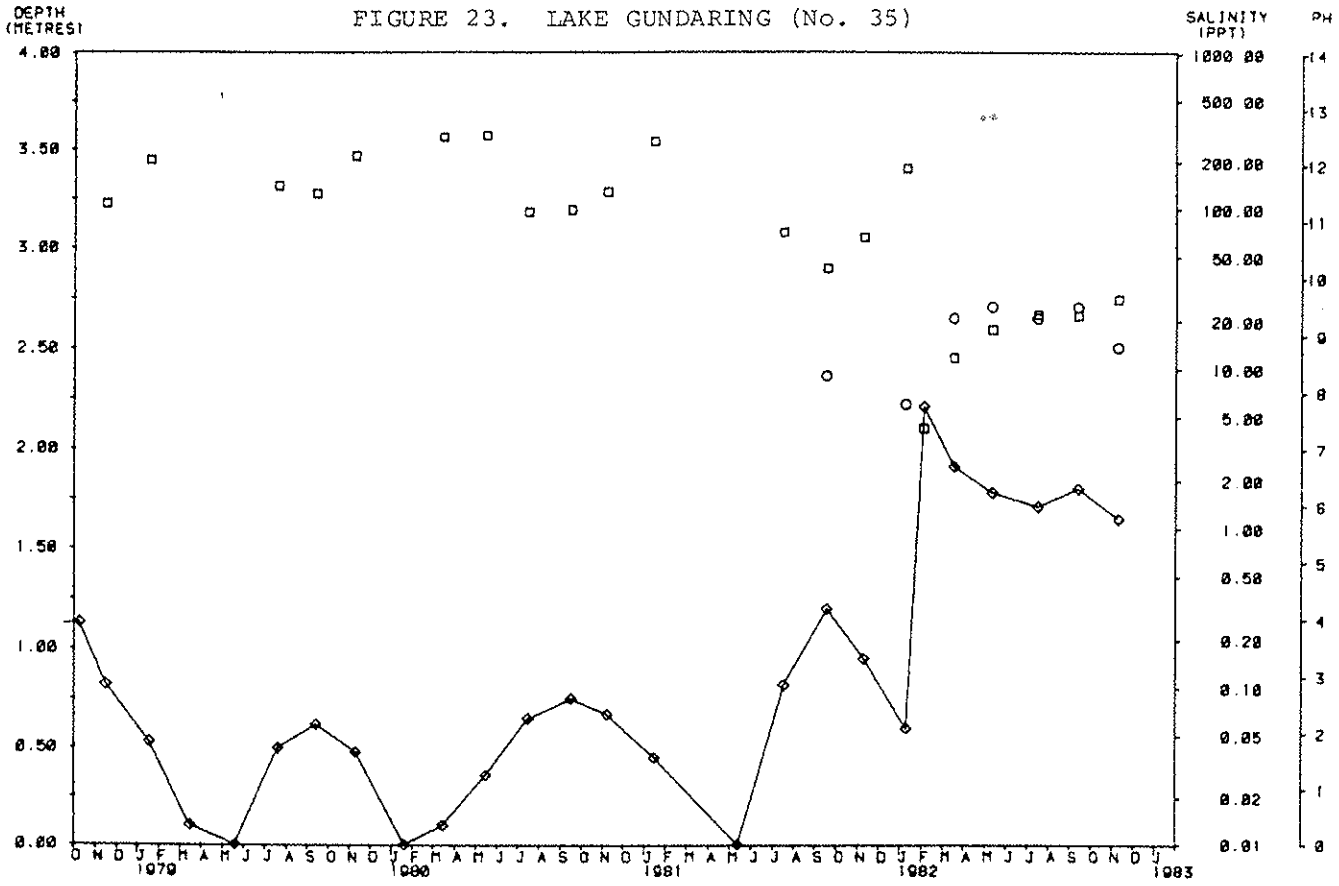
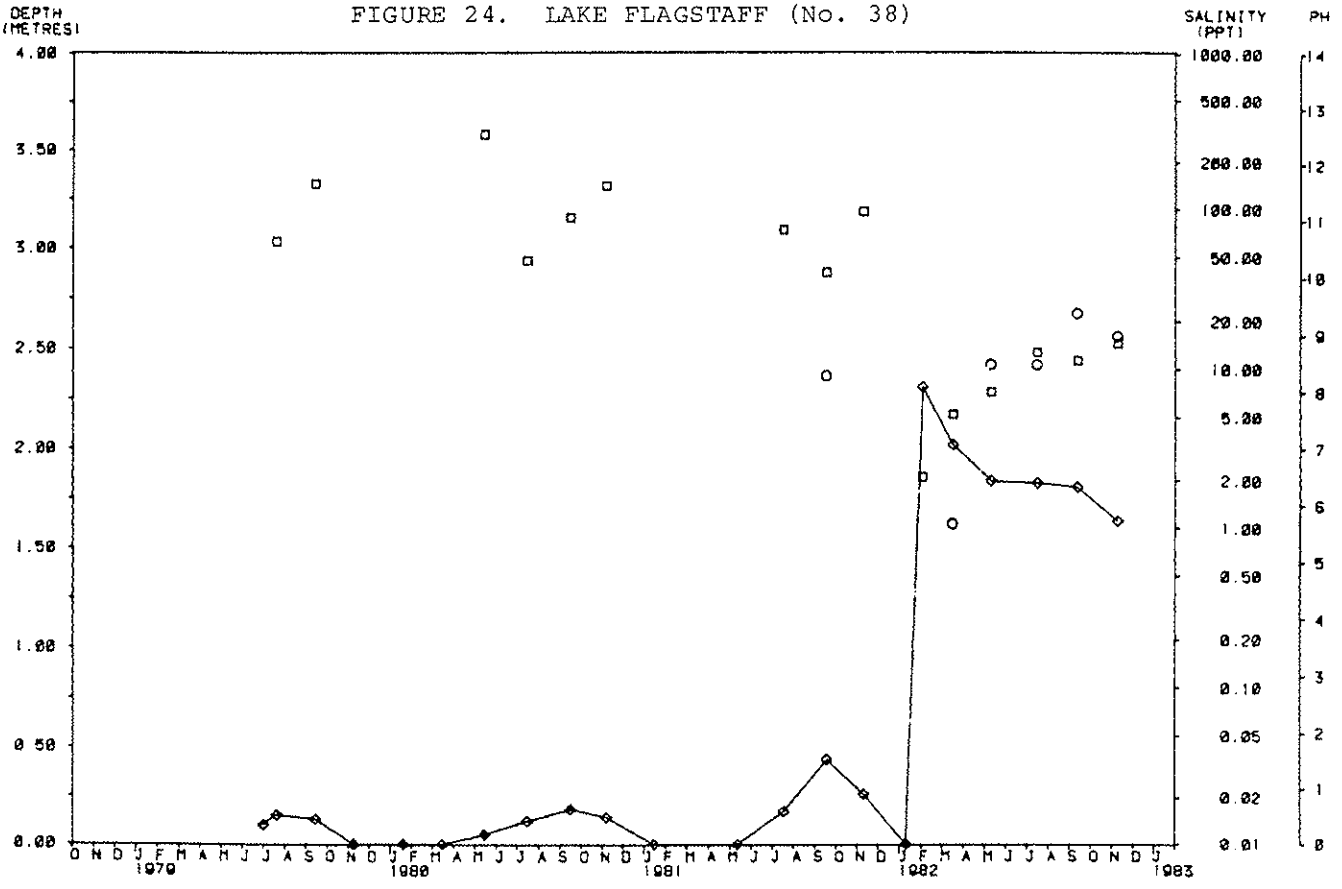


FIGURE 24. LAKE FLAGSTAFF (No. 38)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH

FIGURE 25. LAKE MARTINUP (No. 43)

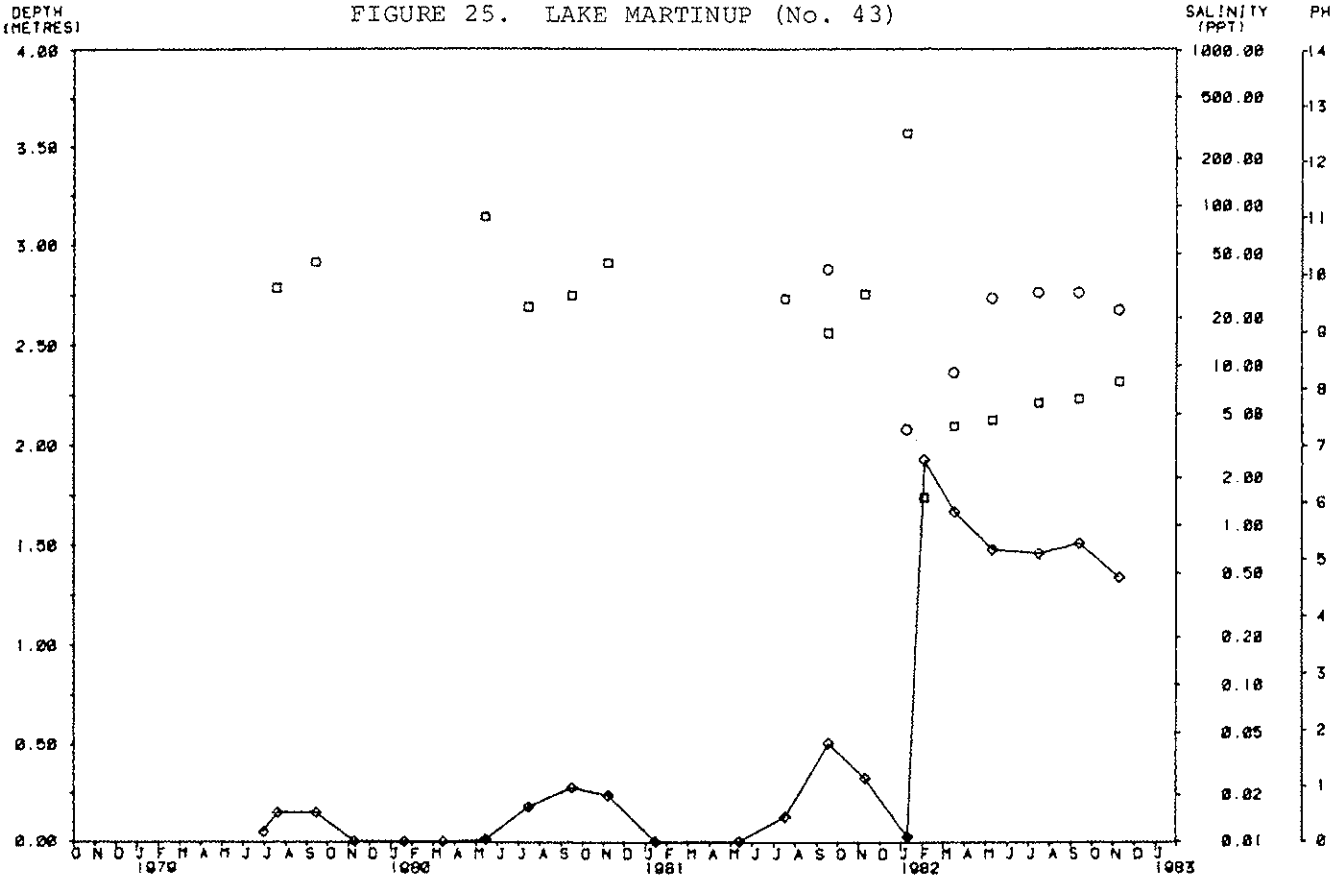


FIGURE 26. LAKE TOWERINNING (No. 45)

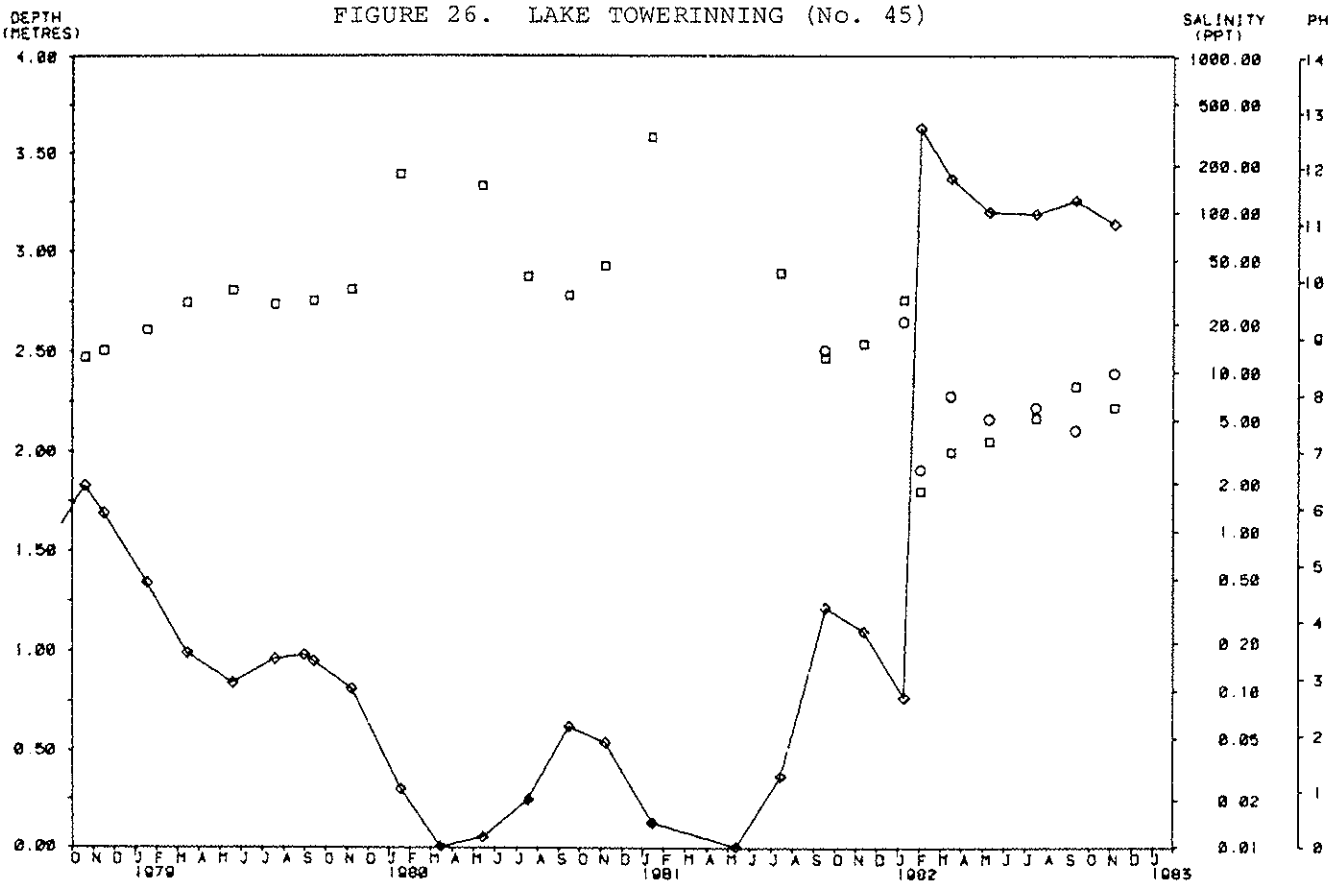


FIGURE 27. LAKE KONDININ (No. 48)

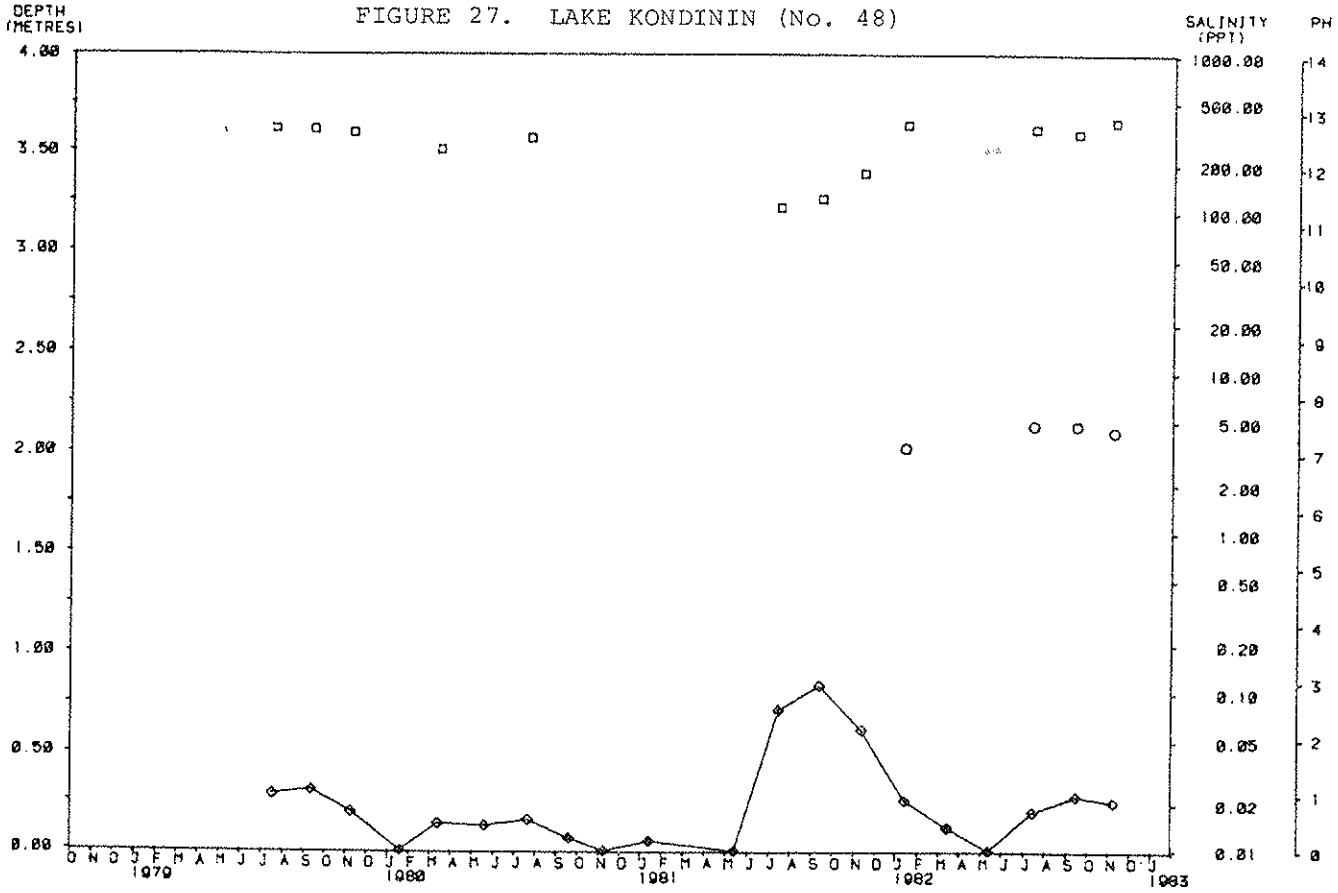


FIGURE 28. LAKE ANDERSON (No. 61)

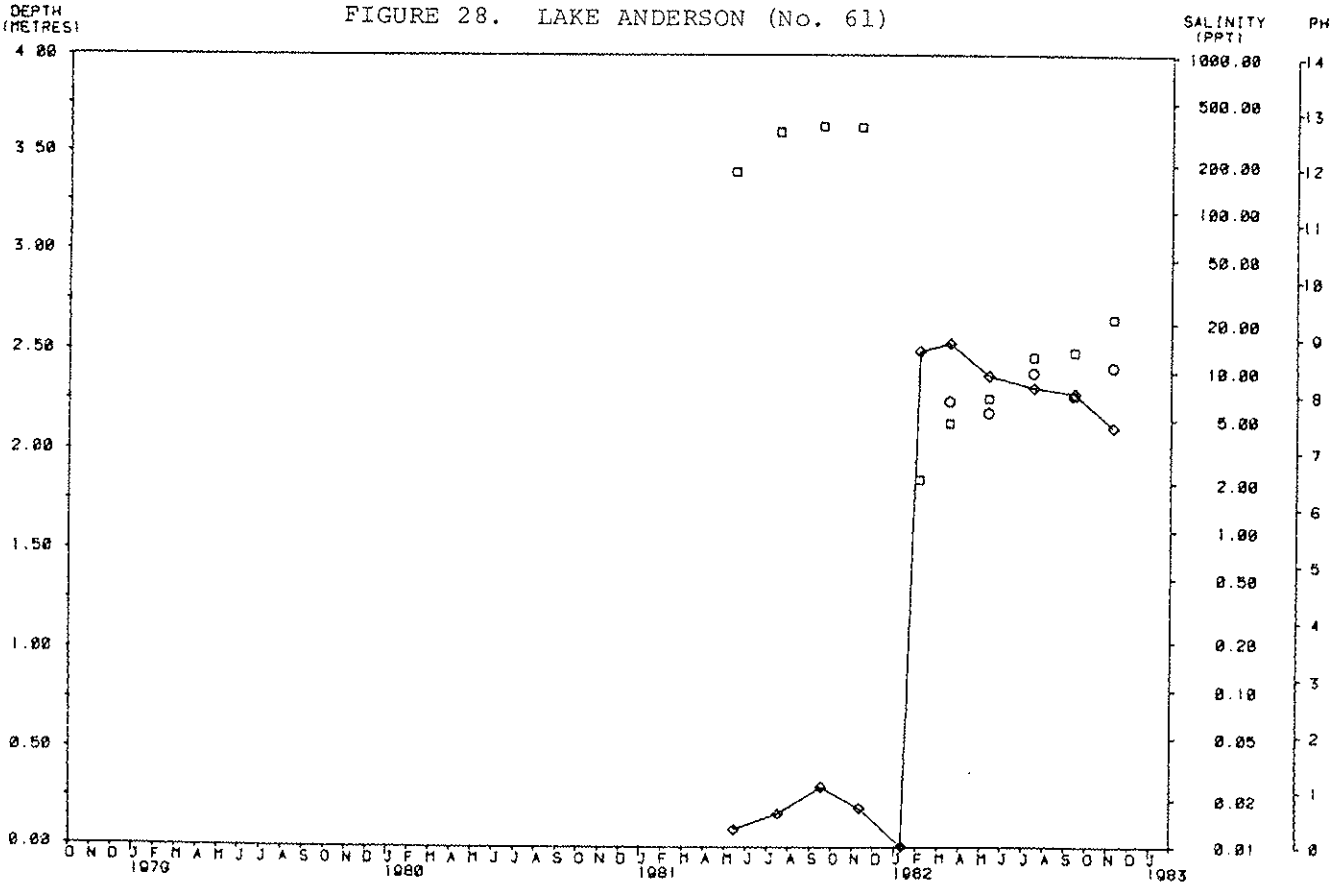


FIGURE 29. LAKE ENEMINGA (No. 64)

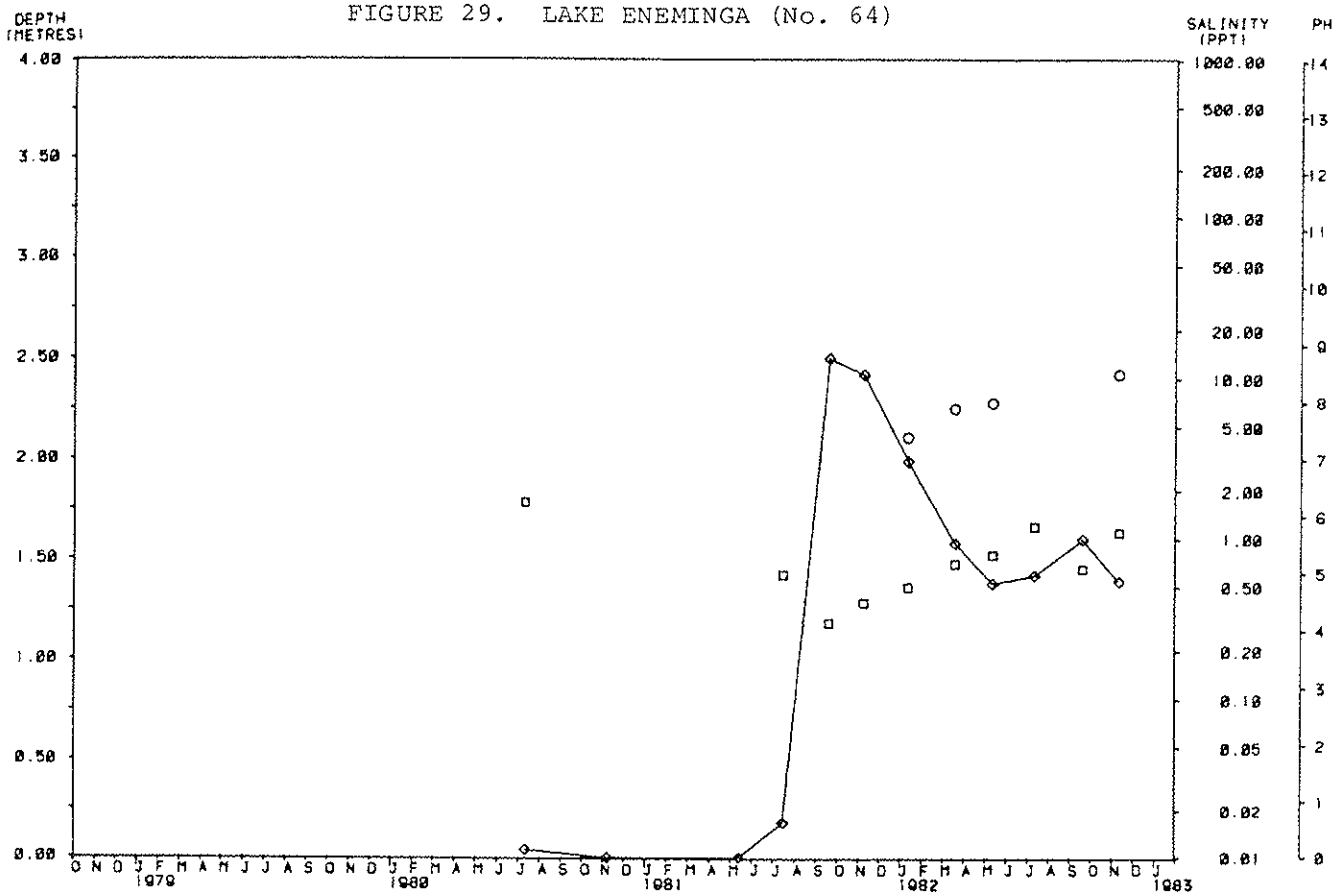


FIGURE 30. LAKE WANNAMAL (No. 68)

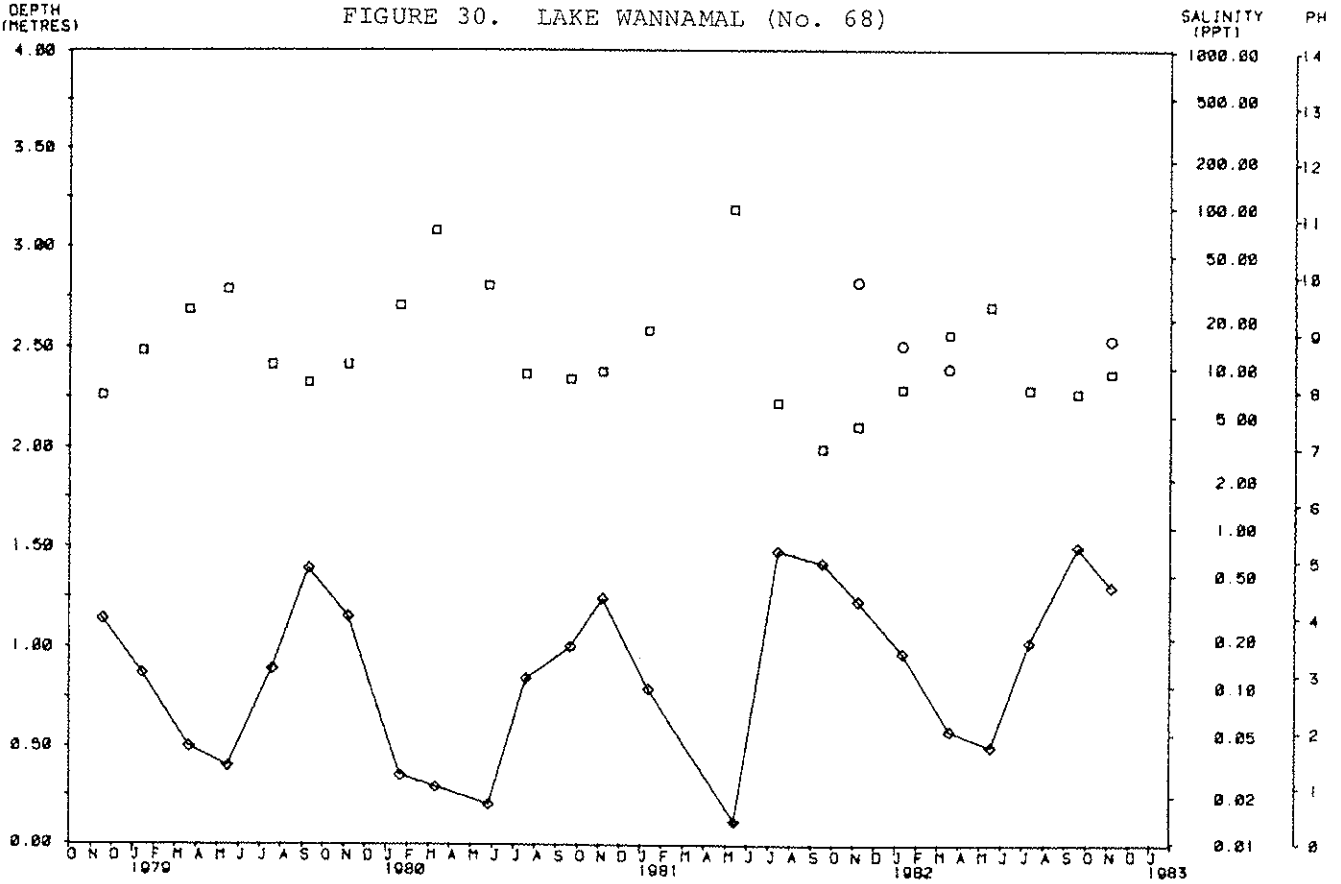


FIGURE 31. LAKE MUNGALA (No. 73)

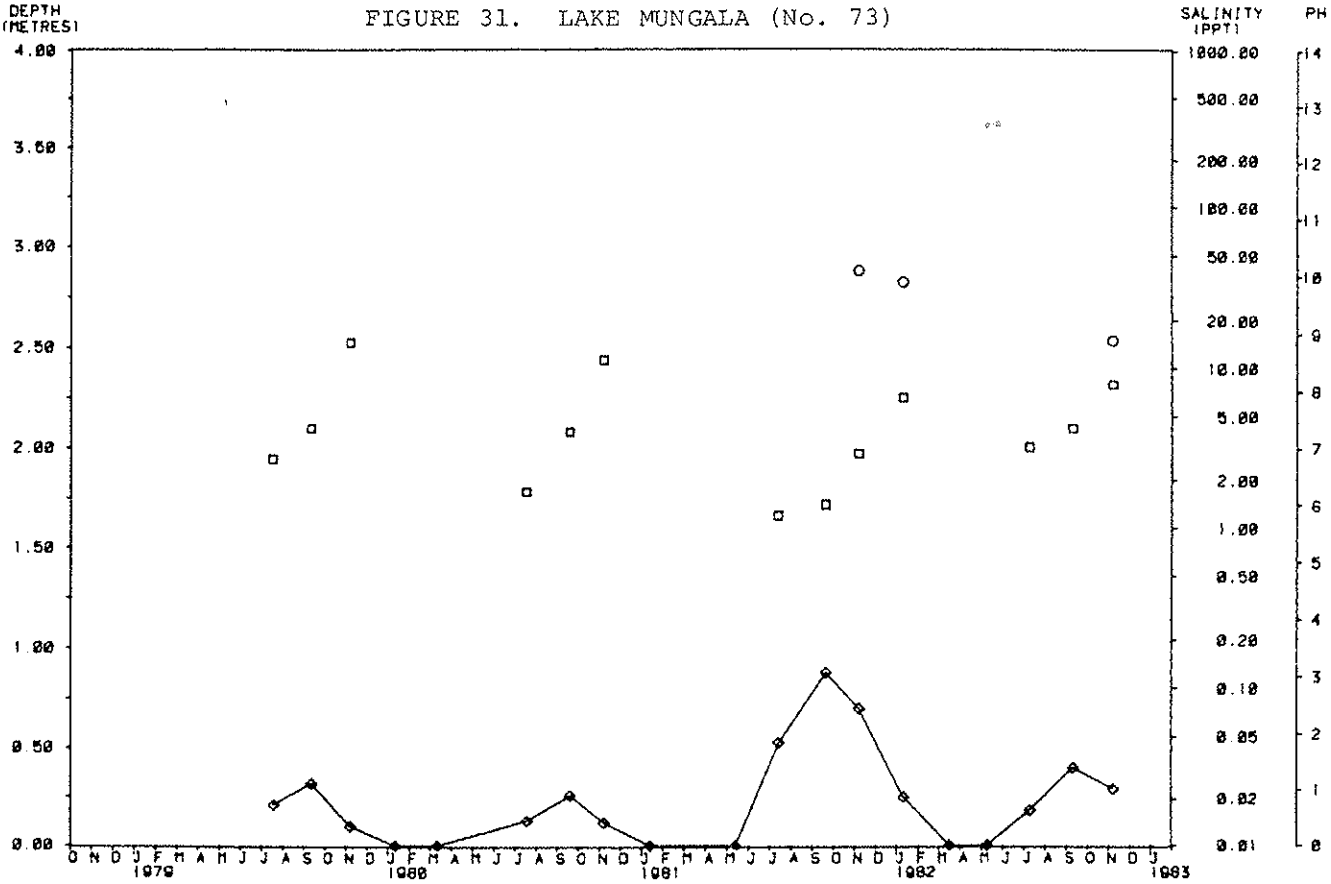
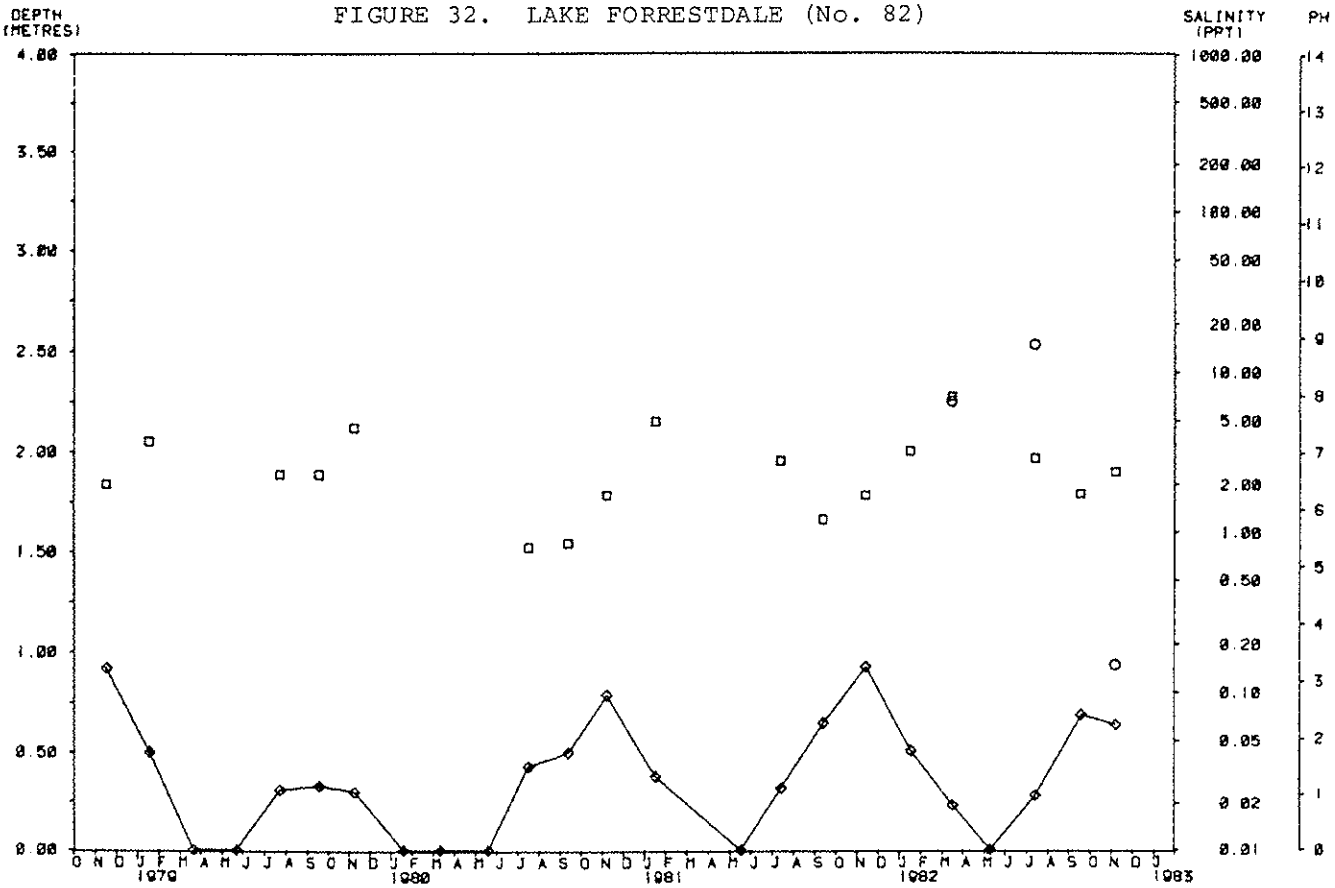


FIGURE 32. LAKE FORRESTDALE (No. 82)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH

FIGURE 33. LAKE MUIR (No. 90)

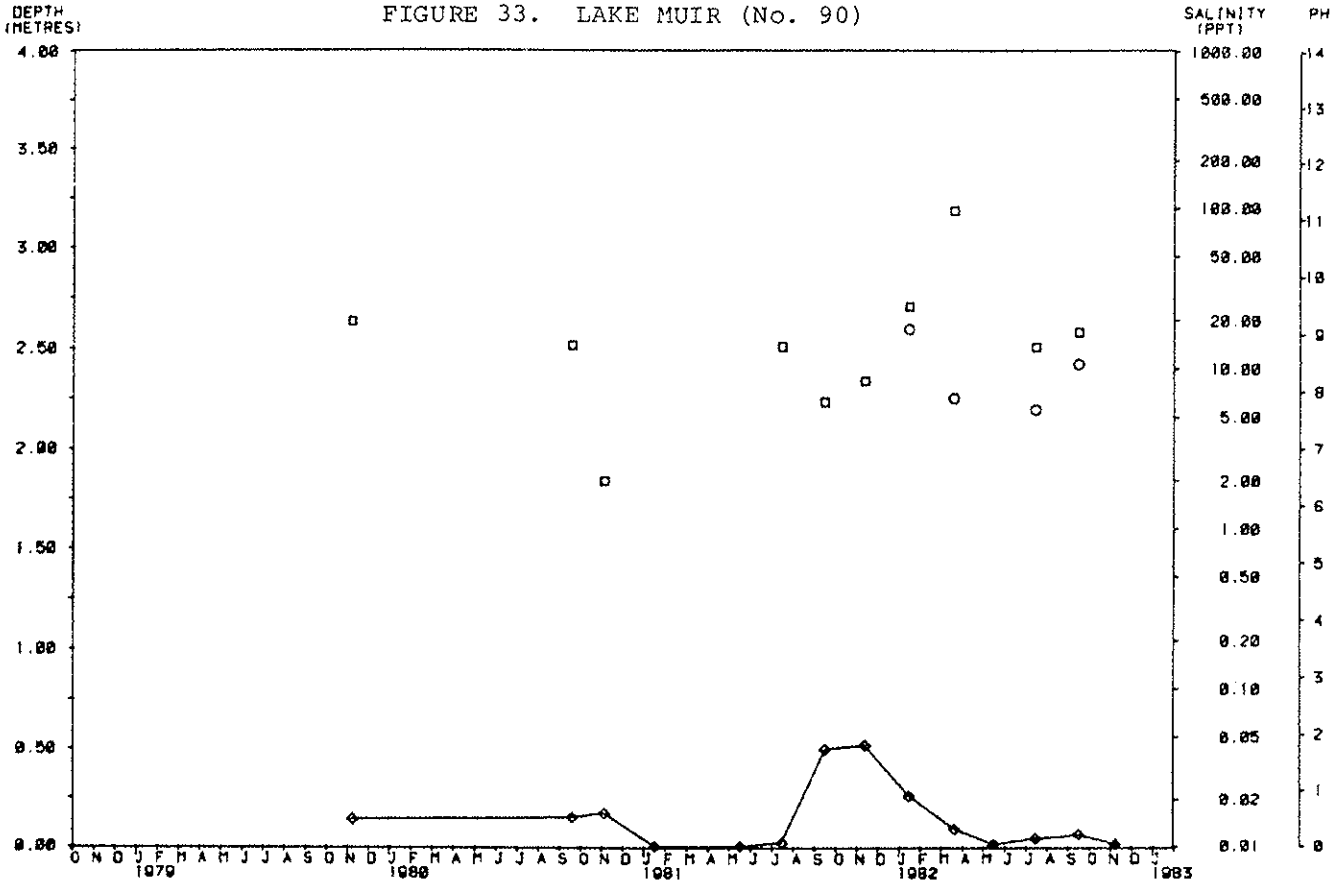
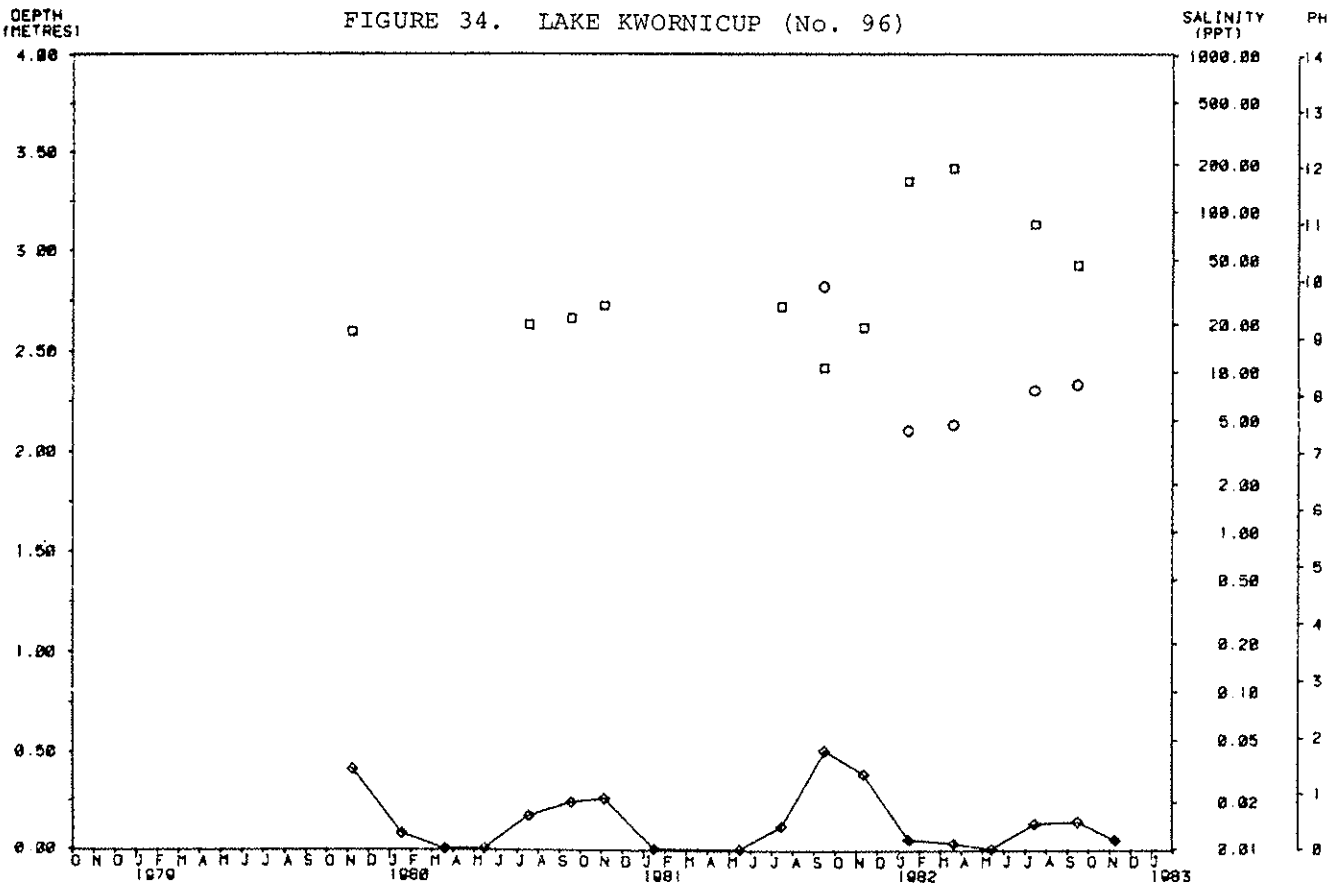


FIGURE 34. LAKE KWORNICUP (No. 96)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES & WILDLIFE
WATERBIRD RESEARCH

FIGURE 35. LAKE PLEASANT VIEW (No. 101)

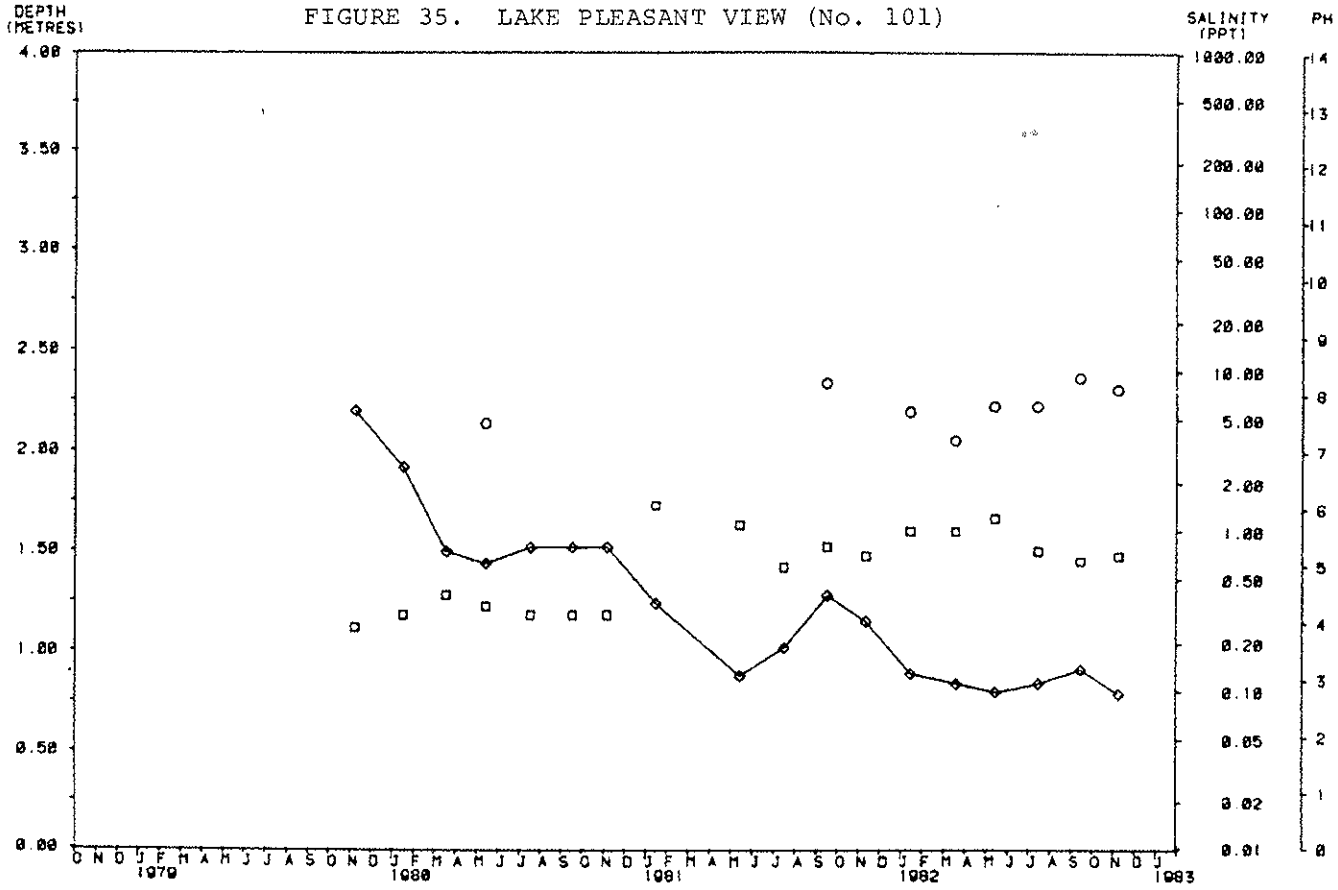
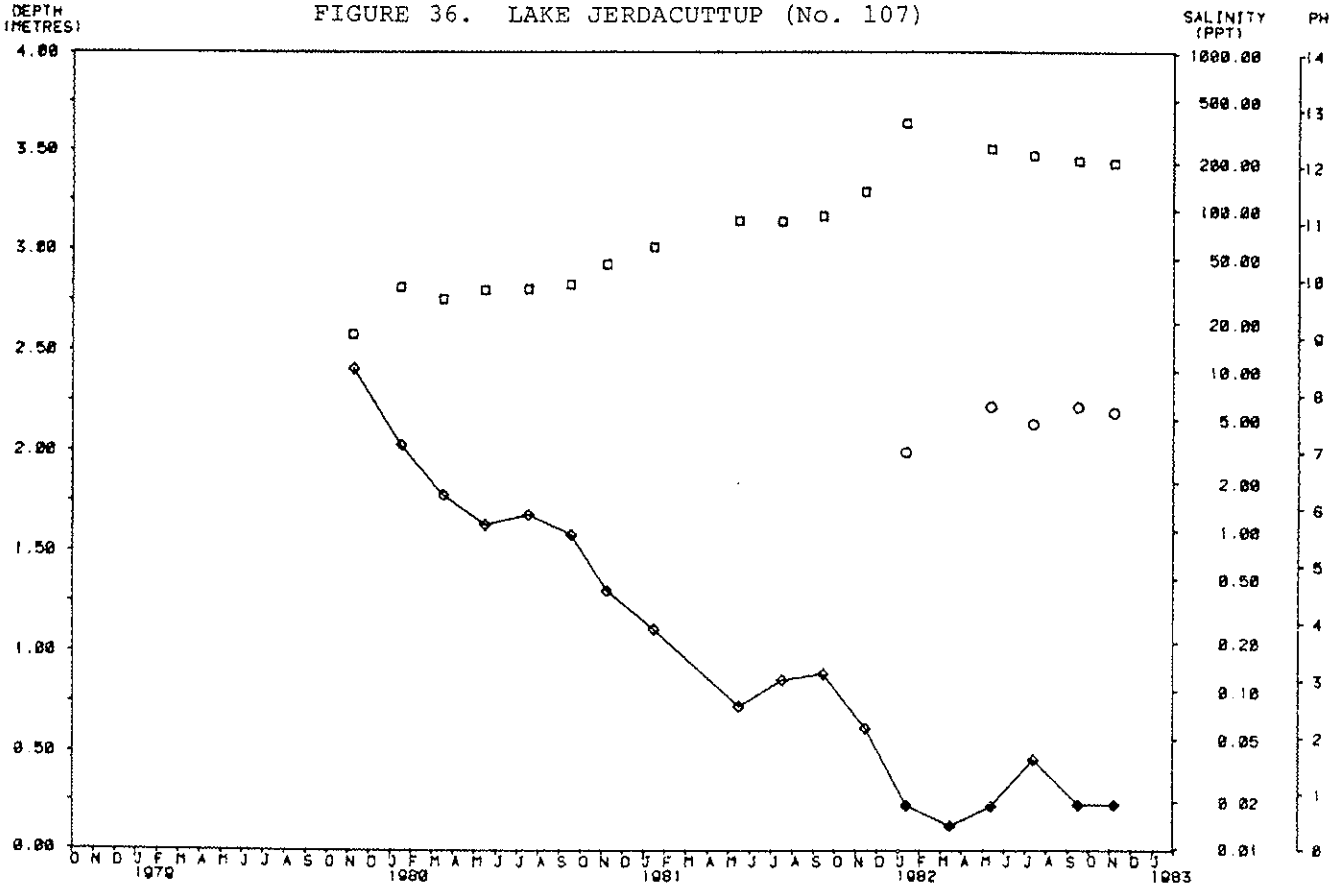


FIGURE 36. LAKE JERDACUTTUP (No. 107)



◇ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH

FIGURE 37. LAKE SHASTER (No. 108)

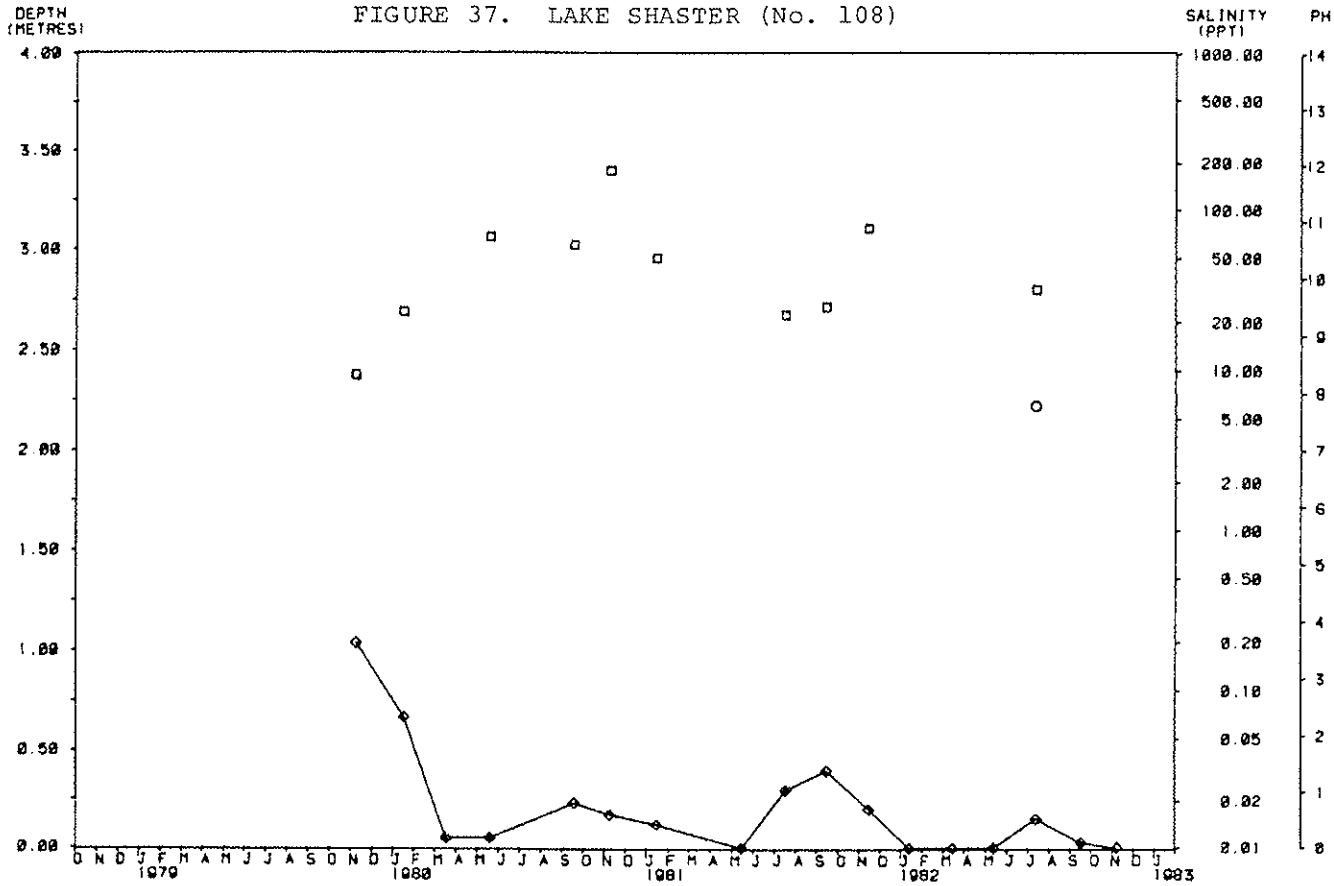
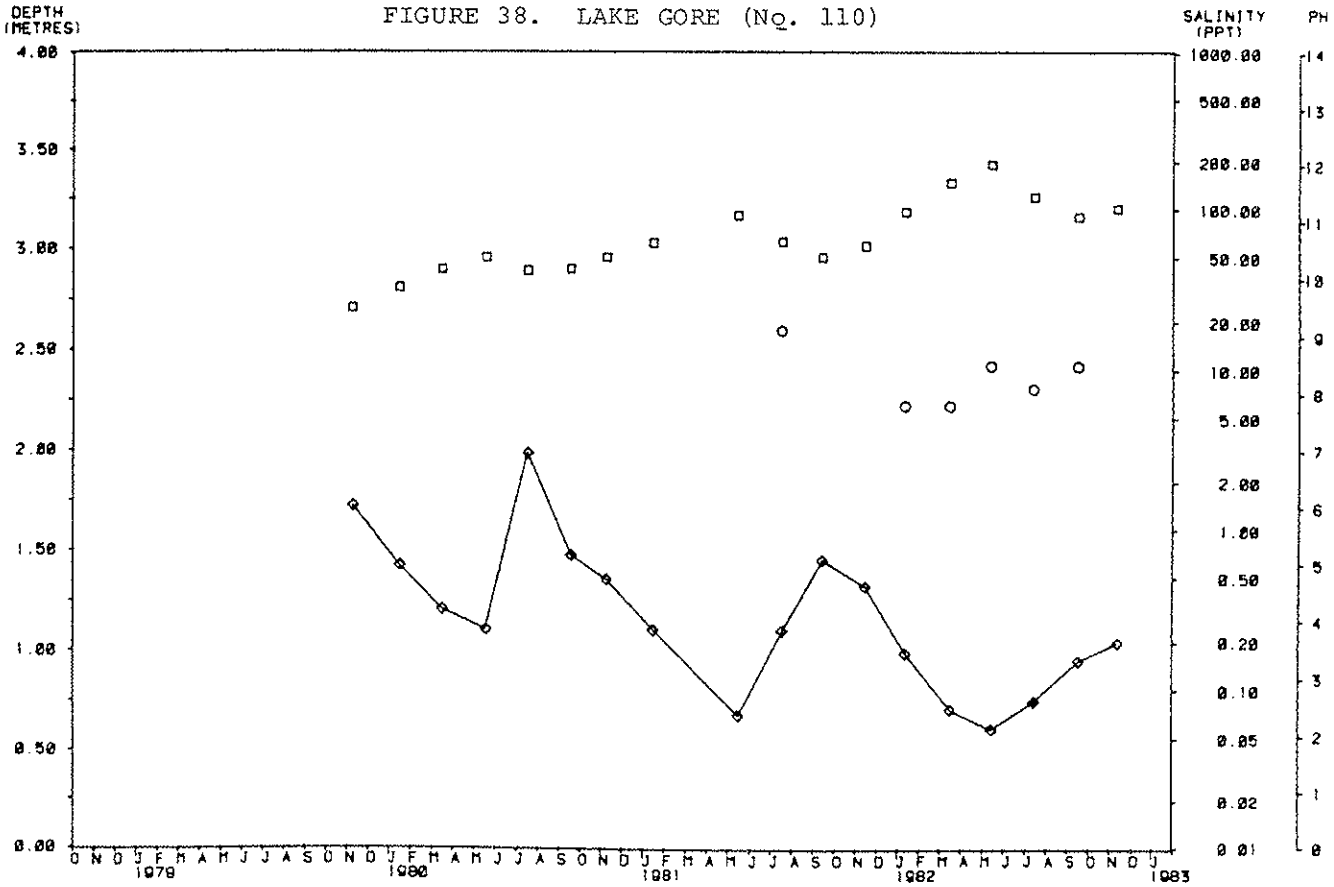


FIGURE 38. LAKE GORE (No. 110)



○ DEPTH □ SALINITY ○ PH FACTOR

WA DEPT. FISHERIES + WILDLIFE
WATERBIRD RESEARCH