WETLANDS OF THE SWAN COASTAL PLAIN PAST AND PRESENT

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ABSTRACT

Prior to agricultural development and urbanisation of the Swan Coastal Plain the area was rich in wetlands, which supported a large array of endemic plant and animal species and served a number of ecosystem maintenance functions. During the last 100y approximately 70% of the wetlands have been drained, filled or cleared of vegetation so that they no longer fulfil their former functions.

Representatives of all the wetland types of the coastal plain still exist and these are briefly described in terms of geomorphological setting, vegetation and water regime. Most of the wetlands dry over summer and the remaining permanent lakes are extremely important to waterbirds. More intensive water extraction (and subsequent lowering of the water table) has the potential to affect waterbirds adversely as well as to cause other deleterious changes in wetlands.

INTRODUCTION

The Swan Coastal Plain, which is usually regarded as the area west of the Darling Scarp between Lancelin to the north and Bunbury to the south (Fig. 1), contained a profusion of wetlands at the time of European settlement. These supported large numbers of waterbirds (Riggert 1966) and many aquatic plants and animals (Aplin 1976, How 1978, Davis & Rolls 1987, Marchant et al. 1987).

Perth is unique amongst Australian cities in being situated in an area so rich in wetlands. Ironically, building a city on this asset has devalued it; the majority of wetlands in the metropolitan area have been filled in, drained or drastically modified as urban development has proceeded (Riggert 1966, Bekle 1981). Agricultural development has had a similar effect on much of the rural part of the coastal plain.

In recent years there has been increasing emphasis on the need to maintain the ecological character of wetlands on the coatal plain as well as to prevent their direct loss through drainage etc. The two ecologically degrading processes that have received most attention are eutrophication and the possibility of water levels dropping because of increased use of groundwater (Ventriss this volume).

TYPES OF WETLANDS

The distribution and types of wetlands that occur on the Swan Coastal Plain are most easily understood if they are related to the geomorphology of the area (Semeniuk this volume). The physical geography of lakes in the Perth metropolitan area has been discussed by Bekle (1984).

The Quindalup Dune System, which is the most recent formation and occurs along the coast (Fig. 1), contains mostly saline lakes in interdunal depressions. The lakes, which formed as a result of sea level changes 3,000-6,000 y BP, are connected to the water table and have no overflow outlets so that their salinity levels are often the result of salts concentrating by evaporation over a long period of time (Moore & Turner this volume). The lakes contain water throughout the year and the fringing vegetation usually consists of Juncus kraussii and Baumea juncea along the shoreline with Melaleuca rhaphiophylla or M. cuticularis farther back. Lakes Richmond (Kenneally et al. 1987), Cooloongup and Preston are examples of Quindalup Lakes.

Many of the lakes in the Spearwood Dune System are permanent although others dry out for part of the year. The lakes occur in interdunal depressions without overflow outlets and, like all the dune lakes, are connected to the water table (Seddon 1976). The permanent lakes generally have an area of deeper open water fringed with beds of sedges that are often extensive. The main sedge species is B. articulata and M. rhaphiophylla usually grows on the landward side of the sedges. Loch McNess (McComb & McComb 1967) and Lake Joondalup (Davis & Rolls 1987) are relatively undisturbed examples of this type of lake. The seasonal or semi—permanent lakes support M. rhaphiophylla or E. rudis woodland depending on the degree of inundation. Star Swamp (Watson & Bell 1981) is an example of a Melaleuca wetland; Perry Lakes is a disturbed example of a eucalypt-dominated one.

There is a tendency for wetlands of the Bassendean Dune System not to contain water for as long as other dune wetlands (Seddon 1976) but the Bassendean dunes have a greater vegetation diversity (Cresswell & Bridgewater 1985). The Bassendean wetlands occur in interdunal depressions and water drains from swamp to swamp before eventually moving into functional drainage lines (Seddon 1976). The wetlands range from permanent, or almost so, to ephemeral. The permanent wetlands, of which Booragoon Lake is an example, contain M. rhaphiophylla and, in some cases, the shrubby M. teretefolia. There are a large number of seasonal closed canopy M. rhaphiophylla wetlands, of which there are many examples in farmland on the northern and southern coastal plain. The swamp beside Gibb Road, Forrestdale, is a metropolitan example. Melaleuca preissiana occurs more commonly in the Bassendean system than the other dune systems; it is less tolerant of water-logging and occurs behind M. rhaphiophylla (on higher ground) or sometimes alone in emphermeral wetlands.

There are many shallow, open lakes in the Bassendean system that are fringed with sedges or rushes and Melaleucas. Lake Forrestdale is an example from the eastern edge of the Bassendean system. Small closed sedge wetlands also occur; often they are only winter wet areas. Some of the best examples of these wetlands occur in the uncleared areas of the northern coastal plain but metropolitan examples, such as the meadow beside the Gibb Road Melaleuca swamp, still exist.

The eastern most formation on the coastal plain, the Pinjara Plain, is of alluvial origin and the soil consists of clay or sand over clay rather than the deep sand of the dune systems. As a result, the wetlands of this system are often less dependent on groundwater levels and are usually joined by well defined water courses (Seddon 1976). There is a paucity of large wetlands on the eastern side of the Pinjarra Plain, which is dominated by winter wet areas such as Yule Brook Reserve (Speck & Baird 1984). Wooded wetlands similar to those of Bassendean system occur along the eastern boundary of the Pinjarra Plain.

The other major geomorphic unit on the Swan Coastal Plain is the Estuary and River System. Samphire marsh occurs along the shoreline in saline areas with rush species, such as J. kraussii, between the samphire and riparian woodland, which consists of M. cuticularis, M. rhaphiophylla, M. preissiana and Casuarina obesa according to salinity and elevation. There are large expanses of this habitat on the Peel-Harvey Estuary; Alfred Cove is an example on the Swan River. The freshwater sections of rivers are fringed with M. rhaphiophylla and E. rudis (Pen 1983). There are frequently large areas of Melaleuca wetland associated with rivers and estuaries, such as on the eastern side of Peel Inlet and along the Canning River (Pen 1983).

WETLAND LOSS

Arnold & Sanders (1981), in probably the most authoritative published survey of wetlands of the Swan Coastal Plain, concluded that over 50% had been lost to landfill or drainage. In an earlier, more formal study of wetland loss Riggert (1966) calculated that by 1966 49% of wetlands on the coastal plain between Yanchep and Rockingham had been drained, filled or cleared, 31% between Rockingham and Harvey had been lost and 96% had been lost between Harvey and Busselton. Riggert's figures included areas like the Swan River and Peel—Harvey Estuary that contain a lot of open water that has not been, and is unlikely to be, modified so that, theoretically at least, he probably under-estimated loss of small wetlands. On the basis of a recent aerial survey of the coastal plain, I believe that a reasonable working figure is that, averaged over the whole coastal plain, 70% of wetlands have either been lost or have been drastically modified by clearing of vegetation.

However, exact percentage losses of wetlands are not important. The pertinent fact is that there has been massive loss of wetlands on the Swan Coastal Plain and the process is continuing in spite of the increasing biological importance of the wetlands as inland areas turn saline (Halse 1987). This process is not unique to Perth; Benson & Howell (in press) estimated that only 24% of the original estuarine and freshwater wetland vegetation remains in Sydney.

The only areas on the coastal plain that now contain pristine wetlands are the northern coastal plain west of Gingin and Yalgorup National Park. There are also many relatively undisturbed wetlands around the Peel-Harvey system and, in spite of modification by agriculture, the wetland-rich Harvey River Flats still contain a very large number of wetlands that are probably of prime importance to waterbirds.

WETLAND CONDITIONS

Water regime and depth

Urbanisation and clearing for agriculture have both resulted in a rise in the water table and increased surface run—off into wetlands. Many coastal plain wetlands are deeper and contain water longer now than they did in their natural state. The dead trees in wetlands such as Blue Gum Swamp and Lake Claremont are evidence that these permanent swamps used to dry out. In spite of the increase in water levels, because of very high evaporation rates in summer, most wetlands on the coastal plain are still ephemeral (see Fig. 2); Riggert (1966) estimated that 67% of the wetland area disappeared over summer. This means that waterbirds are concentrated into a small number of permanent wetlands during this period (Jaensch & Vervest 1988) and from a waterbird viewpoint it is important to maintain current water regimes in the permanent wetlands.

Water sources

The wetlands in the dune systems are connected to the water table and, in their original condition, groundwater was their primary source of water (Humphreys this volume). This is still the case in Lake Clifton, where stromatolite-like structures are associated with groundwater inflow into the lake. Deterioration in quality of the groundwater input could have dramatic effects on the ecology of the lake (Moore & Turner this volume). However, for many dune lakes, including Lake Joondalup, urbanisation has increased the importance of surface run-off as a water source (Congdon 1985) and in these cases the quality of surface inflow is often more important than that of groundwater.

Wetlands on the Pinjarra Plain are usually connected to the water table but surface run-off has always constituted their primary water source (Seddon 1976).

Vegetation

The types of vegetation occurring within wetlands have been briefly described (see also Pen 1983, Bekle 1984) but, in fact, wetland-associated vegetation extends well above the waterline. Wetlands require a band of this 'riparian' vegetation, which itself needs appropriate soil moisture conditions, to function properly. Changes in groundwater level can affect both wetland and riparian vegetation dramatically.

Water chemistry

Water chemistry of the Swan Coastal Plain wetlands is variable and is dealt with superficially here; Davis & Rolls (1987) give complete accounts for six metropolitan lakes and Bekle (1984) gives some data on others. The ionic composition of water from all wetlands is dominated by sodium chloride but salinity is variable, ranging from about 40ppt TDS in Lake Clifton in summer to 1ppt TDS in most coastal plain lakes in winter (see Fig. 2). There is evidence of increasing salinity on several parts of the coastal plain; the Harvey irrigation area, 35% of which is now affected by soil salinity, is an example of this phenomenon (George 1988). Salinity is already a threat under current agricultural and groundwater management practices; the situation will probably worsen with more intensive water extraction and irrigation.

Most of the larger coastal plain wetlands are alkaline (see Fig. 2); there are no strongly acidic wetlands. The alkalinity of most lakes probably reflects soil chemistry and high levels of photosynthesis.

The most striking aspect of the water chemistry of the coastal plain wetlands is the high nutrient levels of some disturbed lakes (Table 1). When nutrient levels are elevated algal blooms occur, which can be measured by chlorophyll-a concentrations. Wetlands with dark humic-stained water that has low light penetration are an exception to the generalization that increased nutrient levels cause algal blooms; they do not support algal blooms even though nutrients (particularly phosphorus) may be massively elevated (Table 1, Wrigley et al. 1989).

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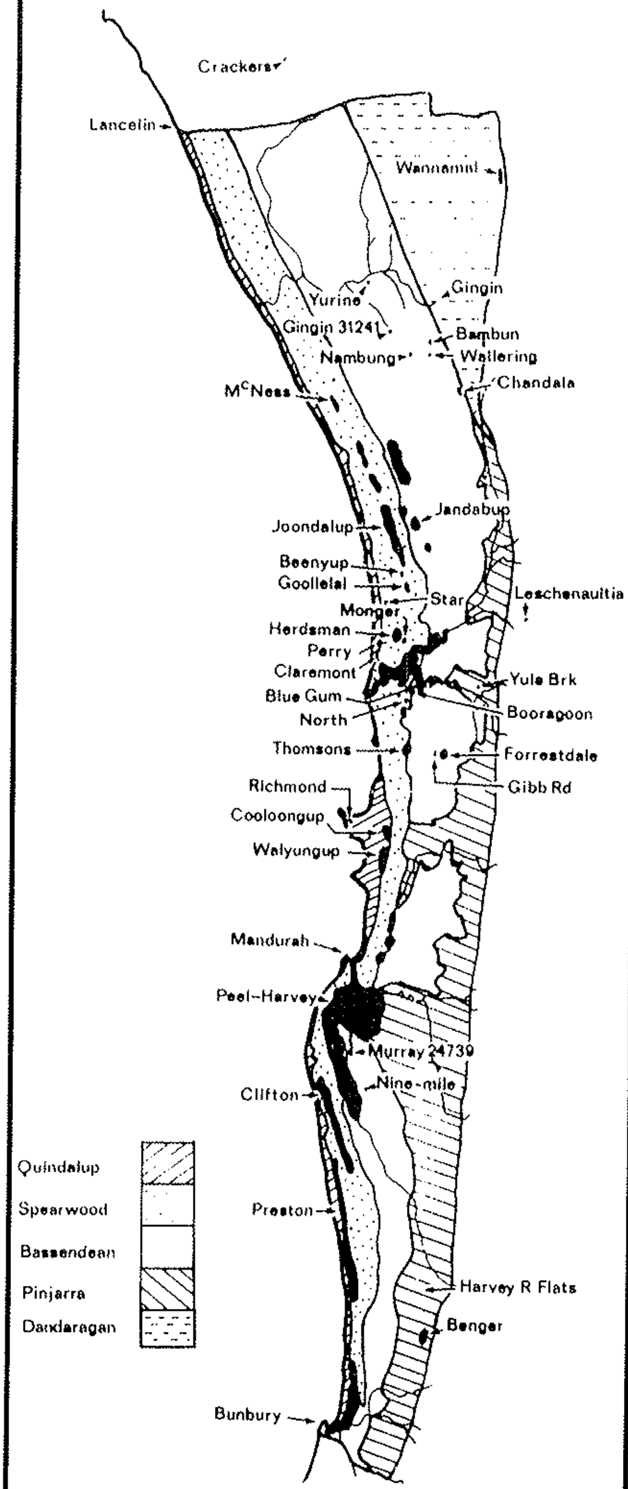


Fig. 1. Swan Coastal Plain showing geomorphological formations (after MacArthur & Bettenay 1960) and wetlands mentioned in text. The Dandaragan Plateau is also shown.

Table 1. Nutrient levels in water of some wetlands on the Swan Coastal Plain and adjacent areas (adapted from Gordon & Chambers 1987). Values represent mean levels in µg/l.

Location	Total P	Total N	Chl'a'	Source	Comment
Rural					
Loch McNess	11	870	<1	Gordon et al. (1981)	Permanent slightly disturbed lake
Lake Leschenaultia	15	—	<1	Atkins et al. (1977)	Permanent artificial lake
Crackers Swamp	70	1900	—	Halse & Pearson (unpubl.)	Semi—permanent 'undisturbed' swamp
Harvey wetlands (reserve)	45—280	2000—8000	<1	Chambers (unpubl.)	Seasonal 'undisturbed' humic swamps
Harvey wetlands (farmland)	240—30000	1300—14500	<1	Chambers (unpubl.)	Seasonal disturbed humic swamps
Urban					
Lake Jandabup	~30	~3000	~2	Davis & Rolls (1987)	Semi—permanent slightly disturbed lake
Lake Joondalup	~80	~3800	~5	Davis & Rolls (1987)	Permanent slightly disturbed lake
Thomsons Lake	~140	~4100	~6	Davis & Rolls (1987)	Seasonal 'undisturbed' lake
Lake Goollelal	214	1320	9	Congdon (1986)	Permanent moderately disturbed lake
North Lake	~230	~2600	~40	Davis & Rolls (1987)	Permanent disturbed lake
Beenyup Swamp	490	2560	24	Congdon (1986)	Seasonal slightly disturbed swamp
Lake Monger	~460	~5800	~500	Davis & Rolls (1987)	Permanent very disturbed lake

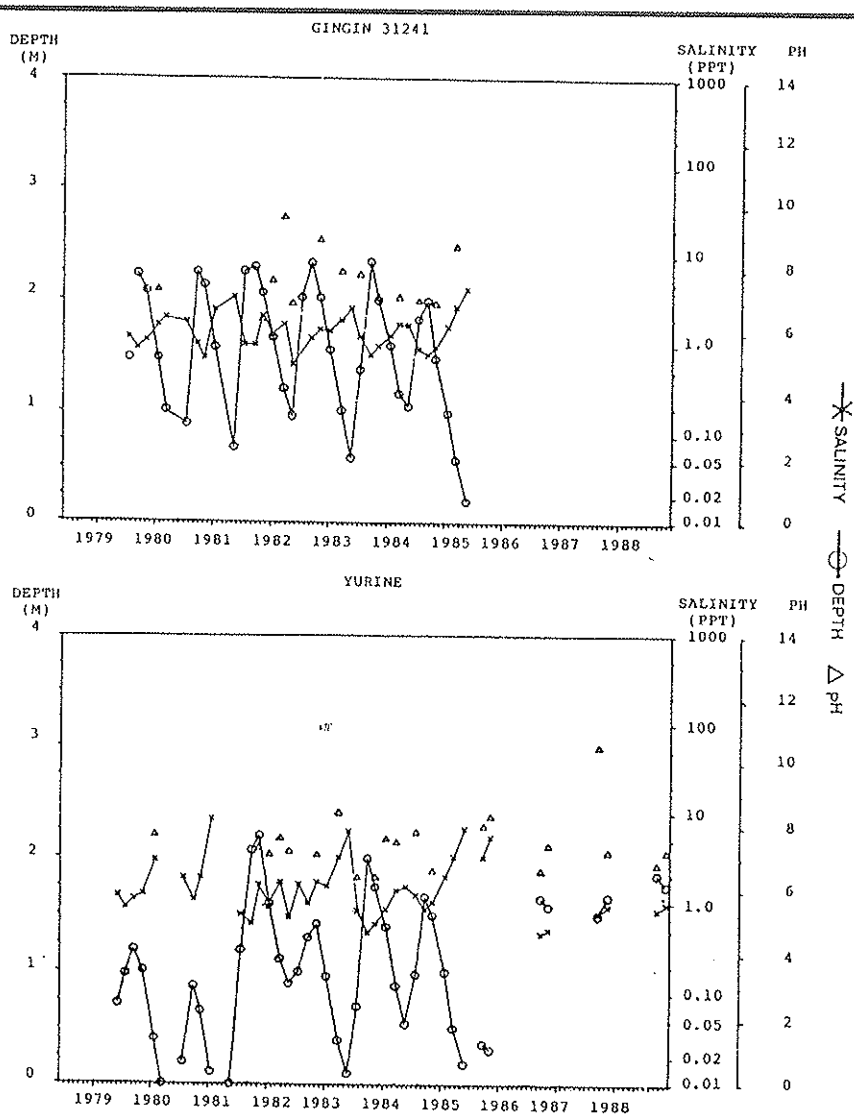
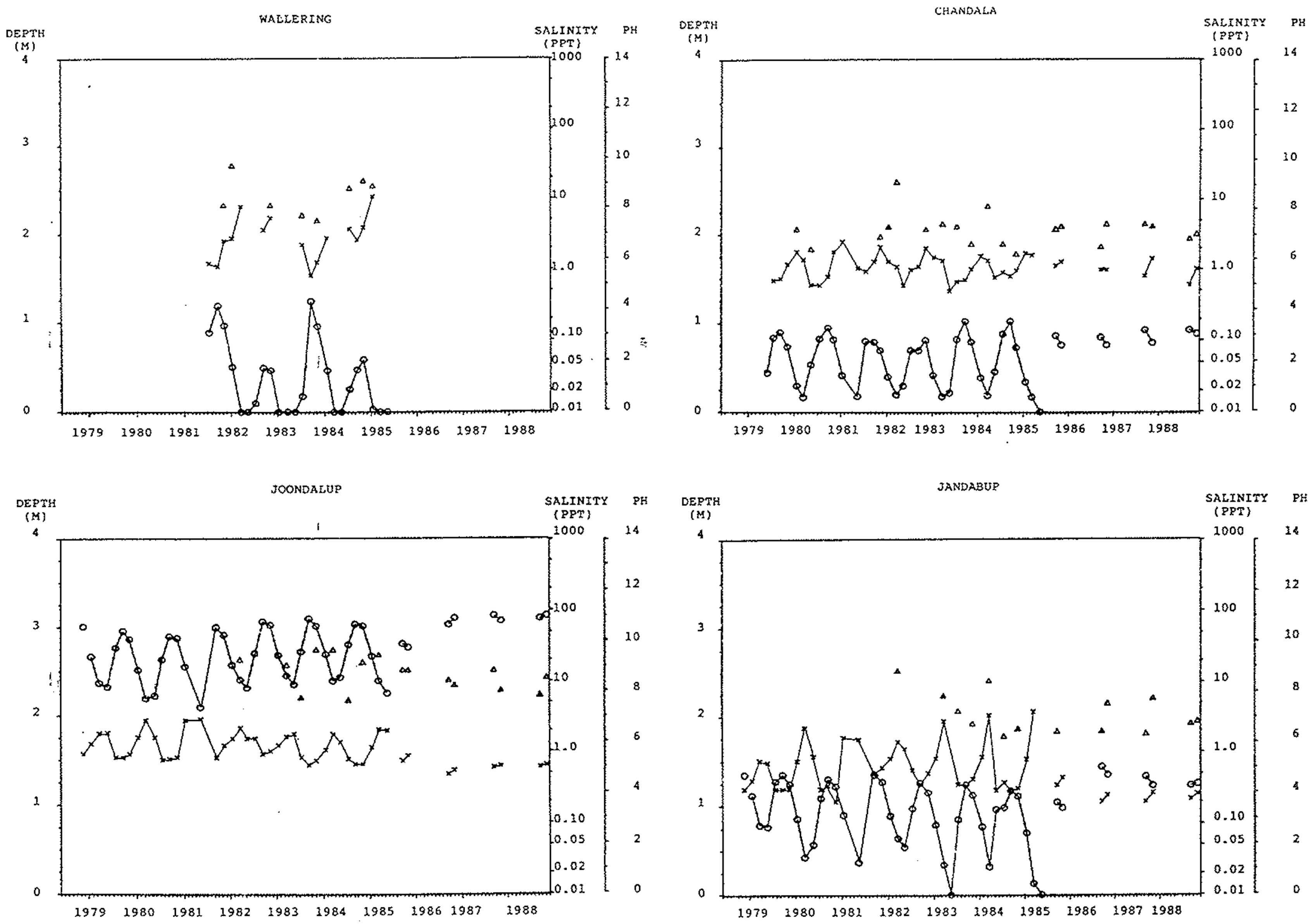


Fig. 2. Seasonal changes in water depth, total dissolved solids and pH in 10 wetlands on the Swan Coastal Plain (Data supplied by J.A.K. Lane and D.R. Munro, Western Australian Department of Conservation and Land Management).


WALLERING
DEPTH (M)
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CHANDALA
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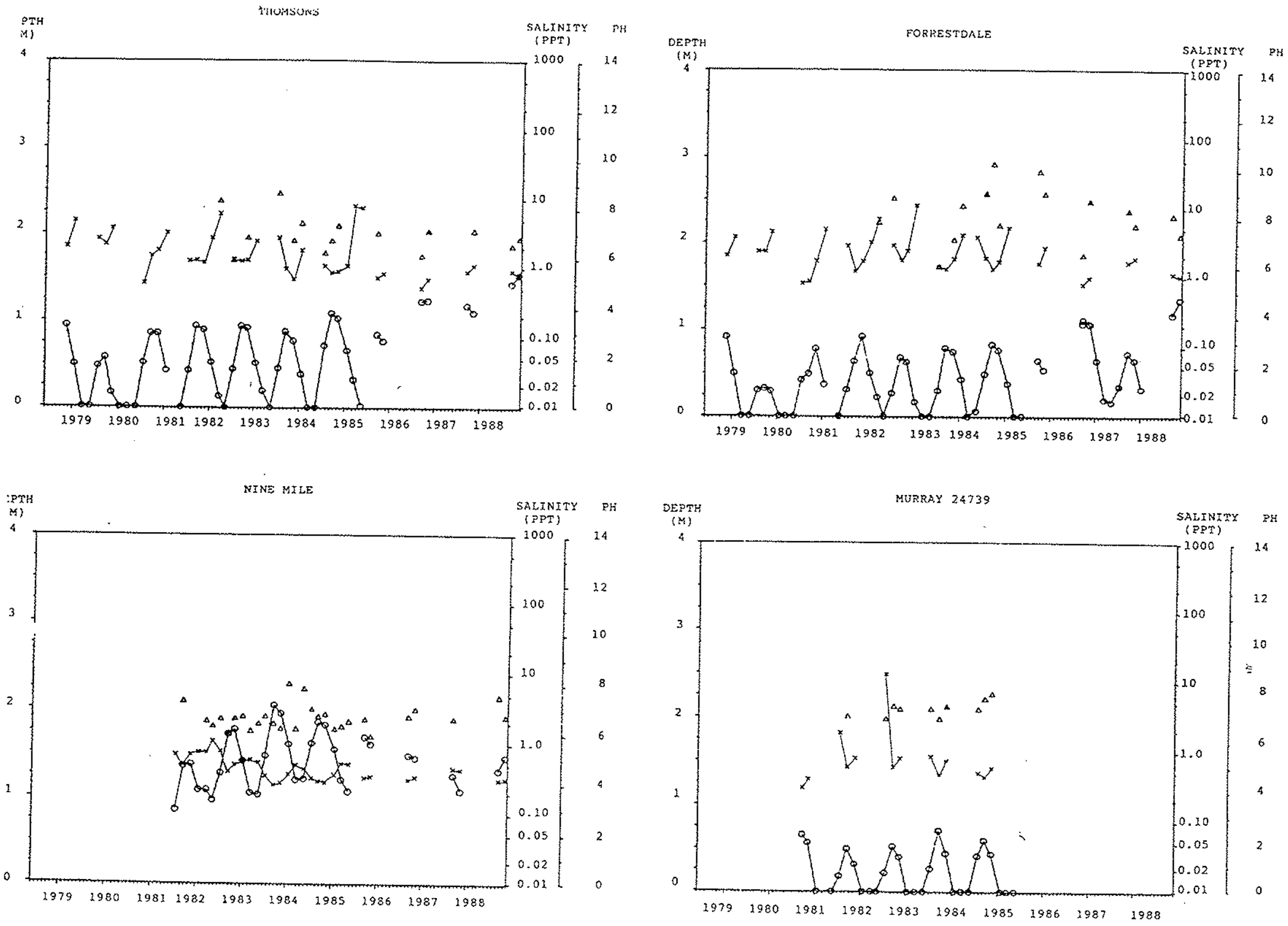
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SWAN COASTAL PLAIN GROUNDWATER MANAGEMENT CONFERENCE

– PROCEEDINGS –

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