

9 Leg of Silver Gull (Larus novaehollandiae)

5 Leg of Coot (Fulica atra)



Department of Fisheries and Wildlife
108 Adelaide Terrace
PERTH

WETLANDS OF THE SOUTH-WEST OF WESTERN AUSTRALIA, WITH SPECIAL REFERENCE TO THE BUSSELTON AREA

1978

FISHERIES AND WILDLIFE

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I INTRODUCTION

This document has been prepared by the Western Australian Department of Fisheries and Wildlife to provide general information on the wetlands (swamps, rivers, estuaries, etc.) of the south-west of Western Australia, their value as wildlife conservation areas, their ecology, and some of the problems of their management.

Particular attention is directed towards the wetlands of the Busselton area, namely the Broadwater and the Wonnerup and Vasse Estuaries. A brief account of their value to wildlife and their need for management is given, and an outline of the Department's intentions in relation to future management of these areas is also provided.

The document discusses the broad principles of wetland conservation and management mainly in relation to waterbirds as these are a relatively familiar and well-studied group. It should be remembered from the outset, however, that wetlands provide essential habitats for a whole range of plants and animals other than waterbirds, each species with its own specialised requirements.

II WETLANDS

The principal wetland areas of the south-west have been defined in the report of the Conservation Through Reserves Committee (1974) which based its "Wetland Systems" on unpublished work by waterfowl biologist Dr. T.L. Riggert. These systems are shown in Figure 1. Basically, they fall into two categories - inland and coastal.

Wetlands of the inland systems are typically shallow expanses of open, saline water, and vary in size from less than one hectare to many thousands of hectares. Due to low rainfall and high evaporation rates most are seasonal, being dry for varying periods through summer and autumn. Under drought conditions many inland wetlands may remain dry for most or all of the year. Permanent freshwater wetlands, essential for several species of waterbirds, are scarce and becoming scarcer. Few sizeable drought refuges exist in the inland.

Wetlands of the coastal systems are of several types including estuaries and rivers, and saline, brackish and freshwater lakes and swamps. Most of the estuaries and many of the lakes and swamps are permanent and therefore of special importance as drought refuges for the waterbirds of the south-west.

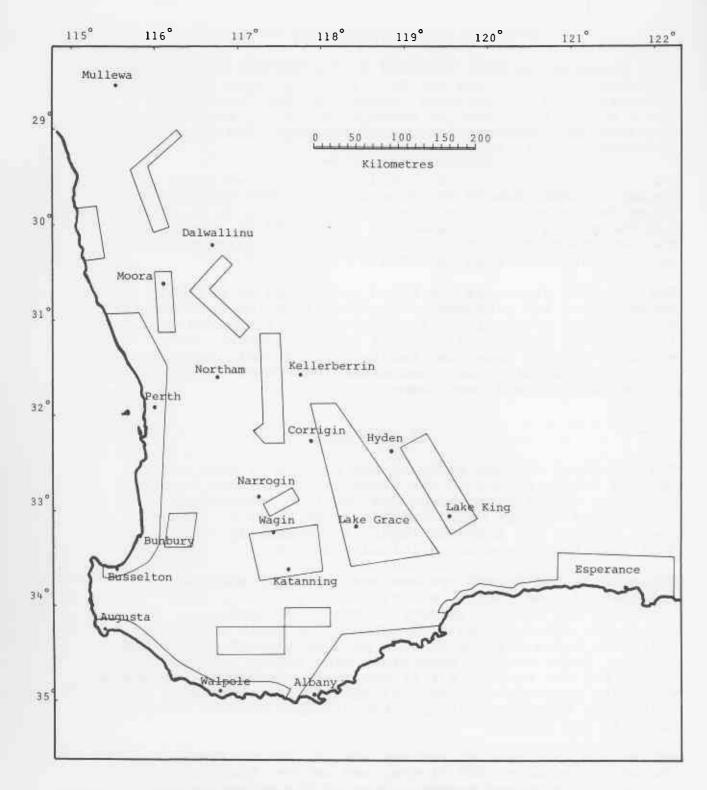


Figure 1. Wetland areas in south-western Australia

III WATERBIRDS

A. THE SPECIES

Seventy-three species of waterbirds which are dependent upon wetlands for at least part of their annual cycle have been regularly recorded in the south-west of Western Australia (Table 1). Thirty-four other species have been recorded occasionally (Table 2).

B. THEIR MOVEMENTS

The various species can be roughly divided into four groups according to their movements.

- Residents birds which remain in the south-west throughout the year, e.g. most species of ducks, the Black Swan, grebes, cormorants and bitterns.
- Nomads birds which move in and out of the southwest on an irregular cycle, e.g. the White-necked Heron and Yellow-billed Spoonbill.
- 3. Australian Migrants birds which regularly move in and out of the south-west (although a proportion may stay the year round), e.g. the Pelican and Strawnecked Ibis.
- 4. International Migrants birds which breed in other countries and migrate to the south-west (and other places) each year, e.g. the sandpipers and some other waders. Most international migrants are from the northern hemisphere. One species - the Doublebanded Dotterel - migrates from New Zealand.

As is often the case it is difficult to define categories accurately. Thus, the Grey Teal is usually a resident but under some conditions it may become nomadic. Birds banded in the south-west have been recovered in the Northern Territory, Queensland, New South Wales, Victoria and South Australia.

Within the south-west there are regular movements related to water availability. During winter and spring, when wetlands are most extensive, many species spread throughout the inland areas to breed. With the advent of summer and the drying-out of many of the inland water-bodies most birds move to the permanent coastal wetlands, remaining there through the autumn. Local movements also occur, especially between saline wetlands and nearby sources of fresh-water where the birds drink.

TABLE 1. WATERBIRDS REGULARLY RECORDED ON WETLANDS OF SOUTH-WESTERN AUSTRALIA.

COMMON NAME	SCIENTIFIC NAME	F00D	NESTING HABITAT
ittle Grebe	Podiceps novaehollandiae	Aquatic insects and plants	Among rushes or on rafts of floating vegetation.
oary-headed Grebe	Podiceps poliocephalus	Aquatic insects and plants	Among rushes or on rafts of floating vegetation.
rested Grebe	Podiceps cristatus	Aquatic animals and plants	Among rushes or on rafts of floating vegetation.
elican lack Cormorant	Pelecanus conspicillatus Phalacrocorax carbo	Fish and crustacea Fish and crustacea	Islands. Branches of trees in swamps
ittle Black Cormorant	Phalacrocorax sulcirostris	Fish and crustacea	Branches of trees in swamps Offshore islands.
ied Cormorant ittle Pied Cormorant	Phalacrocorax varius Phalacrocorax melanoleucos	Fish and crustacea Fish and other aquatic animals	Branches of trees in swamps
arter	Anhinga rufa	Fish and other aguatic animals	Branches of trees in swamps
rown Bittern	Botaurus poiciloptilus	Frogs, crustacea, fish	Rushes.
ittle Bittern	Ixobrychus minutus	Small aquatic animals	Rushes and low tree-branche in swamps.
lack Bittern	Ixobrychus flavicollis	Fish, crustacea, frogs	Low tree-branches in swamps
ankeen Night Heron	Nycticorax caledonicus	Small aquatic	Low tree-branches in swamps
hite Egret	Egretta alba	Fish and frogs and other small aquatic animals	Trees in swamps.
hite-faced Heron	Ardea novaehollandiae	Crustacea, frogs, insects, fish.	Usually trees in swamps.
hite-necked Heron	Ardea pacifica	Small aquatic	Usually trees in swamps.
Mhite Ibis	Threskiornis molucca	Small aquatic animals	Rushes and trees in swamps.
Straw-necked Ibis	Threskiornis spinicollis	Small aquatic and terrestrial animals -	Usually rushes and trees in swamps.
		particularly	
ellow-billed Spoonbill	Platalea flavipes	grasshoppers Small aquatic	Bushes and trees in swamps
lack Swan	Cygnus atratus	animals Aquatic vegetation,	Islands and dense swamp
reckled Duck	Stictonetta naevosa	grasses Aquatic vegetation	vegetation. Bushes and trees just above
ountain Duck	Tadorna tadornoides	Mainly aquatic	water level. Hollows in trees often away
lack Duck	Anas superciliosa	animals and plants Mainly aquatic	from water. On ground, or in bushes and
rey Teal	Anas gibberifrons	vegetation Aquatic plants and small aquatic animals	trees. Hollows in trees; marginal vegetation.
Chestnut Teal	Anas castanea	Mainly aquatic vegetation	On ground or in marginal vegetation.
Shoveler	Anas rhynchotis	Aquatic plants and small aquatic animals	
Pink-eared Duck	Malacorhynchus membranaceus	Microscopic plants and animals	Bushes and holes in trees near water.
Thite-eyed Duck	Aythya australis	Mainly aquatic vegetation	Rushes, bushes and trees in water.
Jood Duck	Chenonetta jubata	Tērrestrial plants, mainly grasses	Holes in trees.
lue-billed Duck	Oxyura australis	Aquatic plants and insects	Rushes in swamps.
husk Duck	Biziura lobata	Aquatic animals and some vegetation	Rushes and bushes in swamp
Swamp Harrier	Circus approximans	Small waterbirds and other small animals	Rushes; crops near wetland
Osprey Lewin Water-Rail	Pandion haliaetus Rallus pectoralis	Fish Insects, molluscs,	In trees or on ground. Rushes in swamps.
Banded Rail	Rallus phillippensis	worms Small animals and	On ground among grass.
arsh Crake	Porsana pusilla	seeds Small aquatic animals, some	Rushes in swamps.
potted Crake	Porzana fluminea	plants Small aquatic	Rushes in swamps.
potless Crake	Porzana tabuensis	animals and plants Small aquatic	Rushes in swamps.
Black-tailed Native-Hen	Gallinula ventralis	animals and plants Aquatic and	Marginal swamp vegetation.
ousky Moorhen	Gallinula tenebrosa	terrestrial plants Plants	Nests low in rushes, bushes
Wamphen	Gallinula porphyrio	Plants, frogs,	and trees. Rushes and dense vegetation
Coot	Fulica atra	molluscs, crustacea Aquatic vegetation	in swamps. Low in swamp vegetation.
Red-kneed Dotterel	Charadrius cinctus	and small animals Aquatic insects Aquatic insects and	On ground near water. On ground.
Mooded Dotterel	Charadrius cucullatus	other small aquatic	on ground.

TABLE 1. Cont'd.

COMMON NAME	SCIENTIFIC NAME	FOOD	NESTING HABITAT
Red-capped Dotterel	Charadrius ruficapillus	Insects and other small aquatic	On ground, usually near water.
Large Sand-Dotterel	Charadrius leschenaultii	animals Worms, crustacea and other small	Breeds in northern hemisphere.
Grey Plover	Pluvialis squatarola	aquatic animals Worms, crustacea and other small	Breeds in northern hemisphere
Eastern Golden Plover	Pluvialis dominica	aquatic animals Worms, crustacea and other small	Breeds in northern hemisphere
Whimbrel	Numenius phaeopus	aquatic animals Small aquatic animals	Breeds in northern hemisphere
Bastern Curlew	Numenius madagascariensis	Small aquatic	Breeds in northern hemisphere
Greenshank	Tringa nebularia	Insects, crustacea, fish and other	Breeds in northern hemisphere
Marsh Sandpiper	Tringa stagnatilis	aquatic animals Small aquatic animals	Breeds in northern hemisphere
Wood Sandpiper	Tringa glareola	Small aquatic animals	Breeds in northern hemisphere
Common Sandpiper	Tringa hypoleucos	Small aquatic animals	Breeds in northern hemisphere
Grey-tailed Tattler	Tringa brevipes	Small aquatic animals	Breeds in northern hemisphere
Knot	Calidris canutus	Small aquatic animals	Breeds in northern hemisphere
Great Knot	Calidris tenuirostris	Small aquatic animals	Breeds in northern hemisphere
Sharp-tailed Sandpiper	Calidris acuminata	Small aquatic	Breeds in northern hemisphere
Red-necked Stint	Calidris ruficollis	Small crustacea, worms and other small aquatic	Breeds in northern hemisphere
Curlew Sandpiper	Calidris ferruginea	animals Small crustacea, worms and other small aquatic	Breeds in northern hemisphere
Bar-tailed Godwit	Limosa lapponica	animals Worms, molluscs, small crustacea and other small	Breeds in northern hemisphere
Pied Stilt	Himantopus himantopus	aquatic animals Insects, molluscs, small crustacea and other small	Vegetation in shallow water.
Banded Stilt	Cladorhynchus leucocephalus	aquatic animals Brine shrimps and other small crustacea	On ground near water.
Avocet	Recurvirostra novaehollandiae	Worms, molluscs and other small aquatic animals	Vegetation in or near shallow water.
Silver Gull	Larus novaehollandiae	Omnivorous	Offshore islands.
Caspian Tern Crested Tern Whiskered Tern	Sterna caspia Sterna bergii Sterna hybrida	Fish Fish Small aquatic	Offshore islands. Offshore islands Floating vegetation.
Fairy Tern Sacred Kingfisher	Sterna nereis Halcyon sancta	animals Fish Fish, insects and other small animals	Islands. Hollows in trees, mounds, banks.
Reed Warbler Little Grassbird	Acrocephalus australis Megalurus gramineus	Insects Insects and small aquatic animals	Rushes in water. Low in thick vegetation near water.

TABLE 2. WATERBIRDS OCCASIONALLY RECORDED ON WETLANDS OF SOUTH-WESTERN AUSTRALIA.

COMMON NAME

SCIENTIFIC NAME

Cattle Egret
Reef Heron
Little Egret
Glossy Ibis
Royal Spoonbill
Magpie Goose
Whistling Tree-Duck
Mute Swan
Mallard

Whistling Tree-Duck * Mute Swan * Mallard Garganey Green Pigmy Goose White-breasted Sea Eagle Painted Snipe Pied Oystercatcher Double-banded Dotterel Mongolian Dotterel Oriental Dotterel Australian Dotterel Turnstone Terek Sandpiper Pectoral Sandpiper Long-toed Stint Sanderling Broad-billed Sandpiper Black-tailed Godwit Ruff (d) and Reeve (9) Australian Pratincole Oriental Pratincole Pacific Gull Kelp Gull Gull-billed Tern Roseate Tern Arctic Tern White-winged Black Tern

Ardeola ibis Egretta sacra Egretta garzetta Plegadis falcinellus Platalea regia Anseranus semipalmata Dendrocygna arcuata Cygnus olor Anas platyrhynchos Anas querquedula Nettapus pulchellus Haliaeetus leucogaster Rostratula benghalensis Haematopus ostralegus Charadrius bicinctus Charadrius mongolus Charadrius veredus Peltohyas australis Arenaria interpres Tringa cinerea Calidris melanotos Calidris subminuta Crocethia alba Limicola falcinellus Limosa limosa Philomachus pugnax Stiltia isabella Glareola pratincola Larus pacificus Larus dominicanus Sterna nilotica Sterna dougalli Sterna paradisea Sterna leucoptera.

^{*} Introduced Species.



Plate 1:-Pink-eared Duck (Malacorhynchus membranaceus) Photo by A. and S.R. Tingay



Plate 3.—Spotted Crake (Porzana fluminea) Photo by A.G. Wells



Plate 2 —Curlew Sandpiper (Calidris ferruginea)
Photo by G.S. Chapman



Plate 4.—Swamphen (Gallinula porphyrio)
Photo by A. and S.R. Tingay

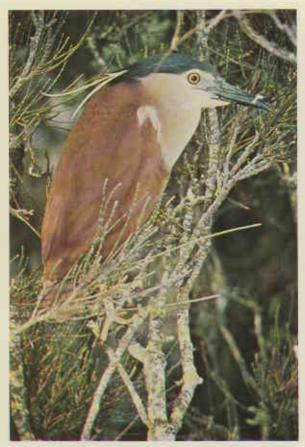


Plate 5.—Nankeen Night Heron (Nycticorax caledonicus)
Photo by R. Garstone



Plate 7.—Pied Cormorant (Phalacrocorax varius)
Photo by V.N. Serventy

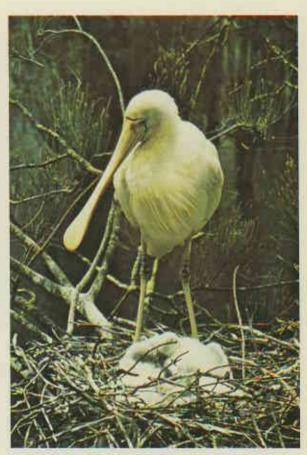


Plate 6.—Yellow-billed Spoonbill (Platalea flavipes)
Photo by R. Garstone



Plate 8.—Pied Stilt (Himantopus himantopus)
Photo by A. and S.R. Tingay



Plate 9.—Crested Grebe (Podiceps cristatus)
Photo by R. Garstone



Plate 10.—Black Swan (Cygnus atratus)
Photo by R. Garstone



Plate 11.—White-faced Heron (Ardea novaehollandiae)
Photo by R. Garstone



Plate 12.—Bar-tailed Godwits (Limosa lapponica)
Photo by G.S. Chapman

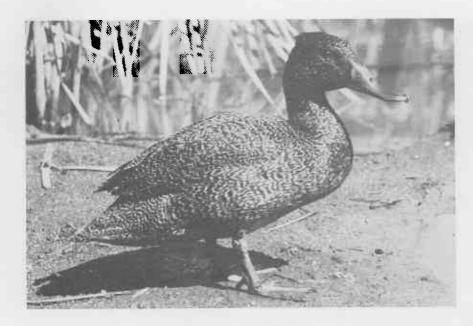


Plate 13. Freckled Duck (Stictonetta naevosa) Photo by E. Slater

Plate 14. Straw-necked Ibis (Threskiornis spinicollis) Photo by A. and S.R. Tingay



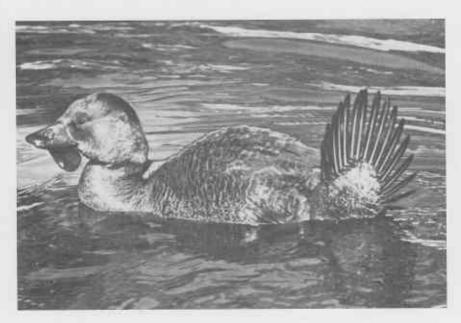


Plate 15. Musk Duck (Biziura lobata) Photo by R. Garstone

C. FEEDING AND BREEDING

A variety of bird species is able to co-exist in a wetland because they are able to exploit different food organisms and feeding areas. The 107 species recorded in the south-west display a bewildering array of physical characteristics. There are beaks that are short, long, straight, up-curved, blunt, sharp, shovelshaped or gilled; there are long necks and short necks, long legs and short legs, webbed feet, lobed feet and toed feet; there are big birds and small birds, diving birds and dabbling birds, etc. Each of these peculiar physical features may enable a bird to feed either on a particular food item which other birds are unable to catch or collect, or to feed in a particular type of habitat which other birds are unable to reach (Fig 2). Thus, the Pink-eared Duck has a specialised bill which enables it to filter minute organisms from the water, whereas the Darter's bill is designed for spearing fish. Neither species can exploit the other's food supply. On the other hand the Black Swan and the Black Duck are able to eat similar types of food. However the Swan, because of its much longer neck, is able to feed on plants at depths of up to one metre whereas the Black Duck cannot reach beyond a depth of about 30 cm.

Different species may also select different nest sites (Fig 2). Some prefer to nest in low vegetation around the edges of swamps whereas others may nest in rushes, or in forks or hollows of trees. A few build floating nests in areas of shallow water.

Of course few, if any, wetlands provide the full range of feeding and nesting habitats. This is actually provided by the existence of a number of different types of wetlands throughout the south-west region. There is thus a need to conserve a wide variety of wetlands so that the greatest possible range of waterbird habitats is available.

D. EFFECTS OF FLUCTUATING WATER LEVELS

The abundance of many of the aquatic plants and animals which form the food of waterbirds is closely tied to seasonal fluctuations in water level.

Water levels in wetlands are determined principally by rainfall and evaporation rates and, in some cases, by man's control measures. The south-west has a regular winter rainfall during which water levels rise dramatically, followed by a spring with decreasing

A. FEEDING HABITATS

				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			LOW BRANCHES	Pink-eared Duck	Freckled Duck	Musk Duck	White-eyed Duck
							TREE	Mountain Duck	Grey Teal	Pink-eared Duck	Sacred Kingfisher
					SPERE		HIGH	Herons	Ibises	Egrets	Cormorants
ТЕК	1CK	ed Duck	*.	ot s			ISLANDS	Black Swan	Ducks	Dotterels	Pelican
DEEP WATER	Musk Duck	Blue-billed Duck	Darter	Cormorants	Grebes	4					
MEDIUM DEPTH	Black Swan	Grebes	Pelican			9	MEDIUM DEPTH	Black Swan			
SHALLOWS	Herons	Egrets	Spoonbills	Pink-eared Duck	Black Duck	Grey Teal					
RUSHES	Swamphen	Coot	Rails	Bitterns	Reed Warbler		RUSHES	Crakes	Bitterns	Swamp Harrier	Reed Warbler
SHALLOWS	Sandpipers	Stilts	Avocets				SHALLOWS	Grebes	Pled Stilt	33	f
ВЕАСН	Dotterels					NESTING HABITATS	ВБАСН	Dotterels			
MARGIN	Straw-necked Ibis					B. NESTIN	MARGIN	Shoveler			
						120					

FIGURE 2. Waterbird habitats in an "ideal" wetland.

Swamphen

DRAWN BY SUSAN TINGAY

rainfall and increasing evaporation rates when water levels begin to decline, followed by a summer with virtually no rain and high evaporation rates when many wetlands dry out completely. This pattern affects the availability of food as shown diagrammatically in Figure 3.

The timing of the nesting season of the various species is affected not only by the availability of food but also by the time taken to incubate the eggs and raise the young. The Black Swan, for example, has an incubation period of about 40 days and a further 5 months elapse before the cygnets can fly. This species must therefore begin nesting early in winter. As a consequence swan nests are prone to flooding, since heavy winter downpours may result in sudden rises in water level. Other species, such as grebes, rails and some ducks, which build their nests closer to the water would, if they nested early in winter, be even more susceptible to egg-loss through flooding than the Black However, because of their shorter incubation and fledging times they are able to nest later when decreasing rainfall usually results in stable or slowlyfalling water levels. Species such as the Pied Stilt which build their very small nests right on the water line and are thus susceptible to water level increases of even a few centimetres, tend to nest late in spring.

IV PROBLEMS ASSOCIATED WITH MAN

Since European settlement there has been a dramatic decline in both the area and quality of wetlands in south-western Australia. This decline has been due to a number of factors including drainage, landfill, salination, pollution, erosion and grazing (Wetlands Advisory Committee 1977).

The largest losses of wetland areas have been due to drainage for agricultural purposes. On the Swan Coastal Plain alone over 200 000 hectares of wetlands were lost by 1966. At that time 49% of wetlands had been drained in the area from Yanchep to Rockingham, 31% from Rockingham to Harvey, and 96% from Harvey to Dunsborough (Riggert 1966).

Many of the wetlands in urban areas have been lost through landfill operations, either for the disposal of industrial and domestic wastes, or to provide sites for housing, industry, recreation, and transport systems.

Salination of wetlands is a major problem in the south-west of this State. Clearing of catchment areas has resulted in flushing of ground-salts into streams, rivers and lakes. Concentration by evaporation, these salts have killed the plant and animal life of many wetlands, particularly in inland areas with poorly developed natural drainage systems.

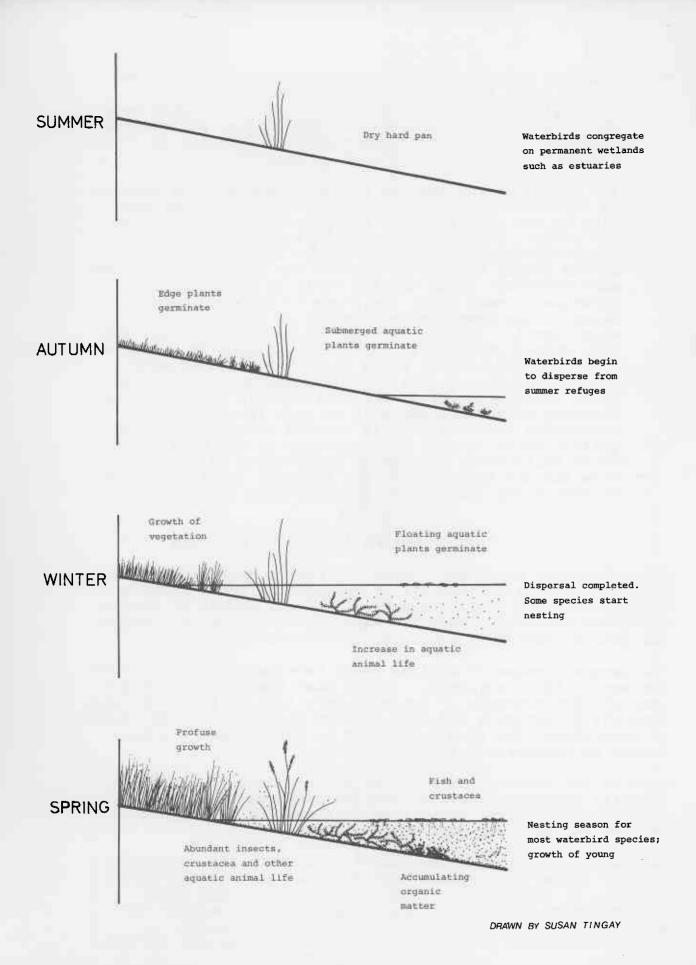


FIGURE 3. Diagrammatic representation of a seasonal wetland.

Pollution of wetlands has resulted from a number of human activities. Runoff from urban and agricultural land, for example, often contains high levels of nutrients such as fertilizers and animal wastes. These nutrients may result in excessive growth of aquatic plants, followed by a deterioration in water quality.

Increased rates of erosion, caused by unwise land-clearing practices, earthworks, mining, overstocking, off-road vehicles, etc., may result in increased sediment discharge into rivers and lakes. This can have a number of detrimental effects, including the smothering of aquatic plants, and gill-clogging (and the eventual death) of fish, shrimps and other gilled animals.

Grazing stock can also damage wetlands, by stripping and trampling fringing vegetation, preventing regrowth, eroding banks, and increasing the turbidity (cloudiness) of the water.

V THE BUSSELTON WETLANDS

A. THEIR VALUE TO WILDLIFE

The Wonnerup and Vasse Estuaries and the Broadwater form one of the most important wetland complexes of the southwest of this State.

Because of their very large size, seasonal nature and low water salinity, they provide excellent feeding and nesting habitat for a wide range of waterbirds. Though no comprehensive surveys of the total bird population have been undertaken, more than forty species are known to occur and at least seventy could be expected.

A few of the wetland's outstanding features are as follows:

- 1. Waterfowl (Ducks and Swans): Populations of up to 3 500 Black Swans have been recorded on the Vasse and Wonnerup Estuaries during late spring. Many of these swans nest in the area during winter months, mainly on the Broadwater and the eastern end of Wonnerup. Thousands of ducks, mainly Grey Teal, Black Duck and Mountain Duck, also occur from winter through to early summer. The Wonnerup Estuary appears to be an important moulting ground for Teal and Mountain Duck.
- 2. Waders: Many hundreds of both Pied Stilt and Avocet frequent the wetlands during early summer. A number of the Stilt nest along the margins of the estuaries. Several thousands of "transequatorial migratory waders"

(migrants from the northern hemisphere) also frequent the wetlands during summer as water levels decline leaving large areas of shallows and exposed mud ideal wader feeding habitat. Flocks of several hundred Sharp-tailed Sandpipers have been noted an unusual sight in south-western Australia. The rare Pectoral Sandpiper has also been recorded.

- 3. Egrets, Herons and Ibis: White Egret, White Ibis and Straw-necked Ibis are particularly abundant on the Busselton Wetlands.
- 4. Pelicans: The Vasse Estuary appears to be an important staging place for flocks of migrating Pelicans. Though numbers in the Busselton area are usually low, flocks of 204 and 316 were recorded in March of 1975 and 1976 respectively at the time when many south-west Pelicans were moving towards their breeding grounds in the north-west of the State.

B. THE NEED FOR MANAGEMENT

Almost the entire area of the Busselton Wetlands (that is, the Broadwater and the Vasse and Wonnerup Estuaries) is in private ownership. The main form of land-use-activity at present is rural, principally grazing of cattle. Existing fencelines extend throughout the wetlands, enabling stock to graze right to the water's edge. Water levels recede dramatically during summer months and large areas of the estuaries may be used for summer pasture.

Unfortunately, this grazing activity has some detrimental effects upon the wildlife value of the wetlands. Trampling and grazing of marginal vegetation occurs and this may disrupt the nesting activities of a number of waterbird species, particularly ducks, swans and waders.

In July 1976, the Environmental Protection Authority - after considering recommendations from the Conservation Through Reserves Committee, various submissions from the public, and recommendations from a special Review Committee - made the following recommendations to Government concerning management of the Broadwater and the Vasse and Wonnerup Estuaries.

"The EPA recognises that as a result of ill-defined high water mark boundaries, there is a management conflict between wetland reserves and adjacent farmlands. The EPA believes that the following recommendations will result in a mutually agreeable arrangement for fencing the areas concerned.

The EPA therefore recommends that:

- (1) the Director of Fisheries and Wildlife approaches the landholders in this area to gain their voluntary agreement to manage the appropriate areas for the protection and improvement of wetland habitats;
- (2) the Department of Fisheries and Wildlife provide technical advice for this purpose to the landowners, and consultant's advice to the EPA;
- (3) where conservation of wetlands can be shown to inhibit the productive potential of farmland, the Minister for Agriculture recommends to the State that it provides monetary compensation in the event of the owner entering into a legally-binding agreement protecting the State's investment;"

The EPA also recommended that the Mines Department not grant any mining claims on Vasse and Wonnerup without prior consultation with the Environmental Protection Authority.

These recommendations were endorsed by State Cabinet on 20th October, 1976.

C. DEPARTMENTAL INVOLVEMENT

In order to implement the EPA recommendations the Department of Fisheries and Wildlife has:

- held a half-day seminar at Busselton to acquaint landholders and other interested persons with some of the problems of wetland management, particularly in relation to Wonnerup - Vasse and the Broadwater, and
- contracted consultant surveyors to prepare detailed topographic maps and aerial photographic coverage of the wetlands, with particular emphasis on contours.

The Department also intends to have the natural vegetation of the wetlands surveyed and mapped in detail in the near future. Further studies of the area's waterbird populations and of existing land-use activities on the wetlands and adjacent low-lying areas are also being considered.

These studies will provide a sound basis for determining future management options in the area - options such as manipulation of water levels to improve nesting and feeding conditions for waterbirds. The studies will also enable the Department to determine more precisely the boundaries of areas of high conservation value.

Upon completion of the mapping studies, the Department will proceed to consult directly with landholders in the area with a view to implementing the Cabinet-endorsed EPA recommendations. Specifically the Department will seek landholders' agreement to managing areas of high conservation value in a manner which will maintain and improve their value to wildlife.

VI ACKNOWLEDGEMENTS

This document was prepared by J.A.K. Lane, B.Sc. and A.A. Burbidge, B.Sc. (Hons.), Ph.D. of the W.A. Wildlife Research Centre and is based on a report supplied to the Department under contract by A. and S.R. Tingay.

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