

WATERBIRDS ON A SMALL ESTUARINE WETLAND — A SIX YEAR STUDY.

PAULINE REILLY

19 Lialeeta Ave, Fairhaven, Victoria 3231

Received: 25 July 1996

Bird species and numbers on a small estuarine wetland in south-western Victoria were recorded for six years from 1990 to 1995 inclusive. Observations were made by telescope at least once daily and the maximum number of birds was recorded each half-month. Note was taken of the water level. Some seasonality and a preference for low to medium water levels was shown. This permanent wetland is important for its aesthetic value, as a foraging area and as a refuge in times of drought.

INTRODUCTION

Estuarine habitat forms a large and important part of Australian wetlands. There are many published papers that relate to large wetlands (Lamm 1965; Briggs 1977; Whyte 1981, waterbird numbers relative to water level; Crome 1988, breeding after swamp drying; Lawler and Briggs 1991; Geering 1993, individual waterbird species; White 1993 waterbird numbers and Lawler *et al.* 1993, arid zone wetlands), yet none of them are estuarine. Norman (1983) recorded Anatid populations in a saline habitat at Corner Inlet, Victoria. Only one of six wetlands investigated by Gosper *et al.* (1983) was subject to tidal fluctuations. Apart from broad ecological factors common to all the above studies, the investigations by Norman (1983) and Gosper *et al.* (1983) are the only ones comparable to Mellors Swamp. The aim of this paper is to detail which wetland birds use Mellors Swamp, a small estuarine wetland on the Painkalac Creek in south-western Victoria and how their numbers are affected by season or water level or events inland.

STUDY SITE

A small estuarine wetland at Aireys Inlet (38°28'S, 144°06'E), 125 km southwest of Melbourne, Victoria, is situated on the Painkalac Creek and extends two kilometres up an open valley, part of which is cleared and used for grazing. The creek, which rises in the forested foothills of the Otway Ranges, was dammed upstream in 1981. This dam restricts the natural water flow in the creek and periodic releases of water in the hotter months during dry years do little to maintain the flow.

The southern portion of the wetland was protected in 1995 by a conservation covenant when the Surf Coast Shire entered into an agreement with the Trust for Nature to give it permanent protection. This southern portion is divided by the Great Ocean Road and the part south of this road is known as Mellors Swamp, where this study was conducted. At Mellors Swamp there is continual variation from fresh to saline water with tidal inflow.

Mellors Swamp is bounded on the north and west by the Great Ocean Road, on the south by a high sand dune separating it from Bass Strait, on the east by a sandstone cliff and coastal heath, thence to a gravel road bordered by dwellings (Fig. 1). It covers approximately 24 ha. In 1983 before the start of this study a portion was excised by filling and by slashing of the border vegetation to create an emergency refuge in case of bushfire. Periodically a sandbar

forms across the mouth of the creek. Stream flow and rain fill the wetland and water spreads into the floodplain. Birds exploit this increased feeding area and only the largest are visible above the vegetation. Flooding can occur in wet summers as well as in winter.

When the sandbar at the mouth of the creek is breached, either by high water levels in the creek forcing its way out or artificially (a high water level adversely affects dwellings upstream), water flow is confined to the creek bed, with tidal inflow alternately covering and exposing the mudflats. The water is then at its most brackish.

The dominant species of vegetation in the wetter areas are: *Juncus kraussii*, *Isolepis nodosus*, *Gahnia filum*, *Schoenus breviculmis* and *Phragmites australis*; and above high water level: *Poa poiformis*, *Gahnia radula*, *Leptospermum continentale* and *Leucopogon parviflora*. A small group of straggling old *Melaleuca lanceolata* on the sand dune is used almost continuously for roosting by cormorants *Phalacrocorax spp* and occasionally by Great Egrets *Ardea alba*.

The area is used for recreation: birdwatching, fishing, canoeing, windsurfing and swimming, with considerable human activity during the summer holidays. Its main value for humans is aesthetic and as a focus for Aireys Inlet, the village named after the estuary. It also acts as a firebreak in the event of bushfire. Until late 1995, all drainage from septic tanks and dwellings on the surrounding hills of the Aireys Inlet/Fairhaven village emptied into the Painkalac Creek. Total connection to the sewerage system is to be completed in 1997.

METHODS

This paper covers the six year period from January 1990 to December 1995, with only short gaps in recording, except for an absence of records for June 1991. My home commands a clear view of the whole of Mellors Swamp to the east; the south western corner is about 200 m distant and a (D = 60 mm, F = 415 mm, K = 20 mm) telescope stands in a position available for frequent use. I observed in early morning and late afternoon, when viewing was at its best, as well as frequently throughout each day. Every half month I recorded for each species seen, the maximum number of individuals at any time. I also recorded at the beginning of each half month whether the creek was tidal (i.e. the sandbar was breached) and, if not, the level of the water — low, medium or high. If levels altered during the half month, this was also noted. Bird species were classed as regular (species present either all the time or at regular intervals); irregular (species present often but at irregular intervals); or occasional (species rarely present).

Bird species excluded

Some birds were excluded from the counts:

- Those birds inhabiting the floodplain vegetation that could not be identified on a daily basis through the telescope: Quail *Coturnix*

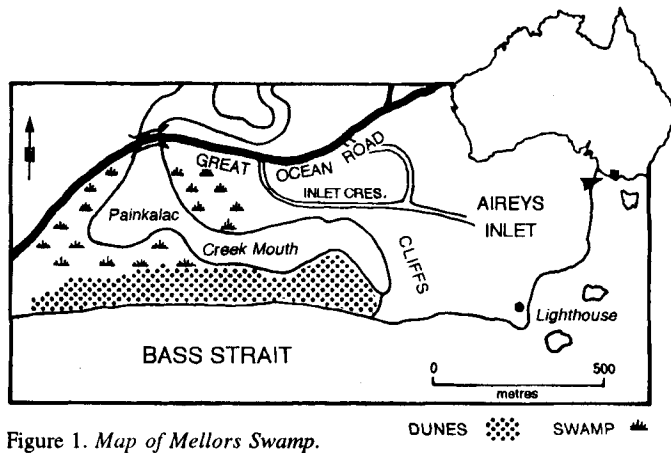


Figure 1. Map of Mellors Swamp.

spp, Latham's Snipe *Gallinago hardwickii*, Purple Swamphen *Porphyrio porphyrio*, Dusky Moorhen *Gallinula tenebrosa*, Blue-winged Parrot *Neophema chrysostoma*, White-fronted Chat *Epthianura albifrons*, Clamorous Reed Warbler *Acrocephalus stentorus*, Golden-headed Cisticola *Cisticola exilis* and Little Grassbird *Megalurus gramineus*. I regarded a Swamp Harrier *Circus approximans*, observed on four occasions only, as a visitor from more extensive areas of open water and swampland further inland. Small waders were infrequent and not clearly identifiable from a distance: Red-capped Plover *Charadrius ruficapillus*, Black-fronted Dotterel *Elseornis melanops* and Hooded Plover *Thinornis rubricollis*;

- Pacific Gull *Larus pacificus* and Crested Tern *Sterna bergii*, that sheltered on the wetland during rough weather, were counted but not included in the analysis as they are not confined to wetlands. Silver Gull *Larus novaehollandiae* was treated similarly. Though normally few in number, they arrived in their hundreds when the mudflats dried out completely in autumn 1992 and large numbers of crickets emerged.

Water levels

Water levels were variable and recorded as:

Tidal: Periods when the creek mouth was open, the mudflats exposed and the creek confined to its course. Tides flowed through the mouth and daily high tides inundated the mudflats.

Non-tidal:

Low — The creek was confined to its course or there was a thin layer of water on the mudflats. Before the sandbar had a chance to build up after recent closure, high seas washed in and increased the water level.

Medium — The mudflats were well covered with water.

High — Water reached the edge of the vegetation on the sand dune side and seeped into the grassland. This category included flooded levels, when the water was deep and grasslands were still emergent but waterlogged. Flooded levels were short-lived. They always resulted in breaching of the sandbar either naturally or artificially.

RESULTS

Fluctuations with changing water levels

Results for the fluctuations of species both seasonally and with changing water levels are presented graphically in Figure 2 for the 12 more common species. The scale of recording of water level was too coarse (that is, half monthly) to show the small

variations of change in bird numbers unless the levels changed at the beginning or end of a recording period. For instance, an excerpt from my records reads: 'January 1990 creek mouth closed but mudflats dry and exposed; rain 1 February mudflats covered; 3 February flooded; 11 February sandbar breached; 16 February creek mouth closed'.

Throughout the year, total bird numbers tended to be greatest when the water level was between low-and-medium, decreasing as it rose towards medium and high. Total bird numbers were fewest when the wetland was tidal and the sandbar had been breached, except for the few days immediately after breaching of the sandbar. Figure 3 shows the average over all years of waterbird numbers at the different levels.

Usually after breaching of the sandbar, there was a slight increase in the number of individuals present for a few days but in 1994 the result of breaching was spectacular. The creek mouth had remained closed for a year, apart from a period of two days, during which time the waters ran low, medium and high again, until the night of 12 October 1994. Pressure of water had caused the entire bar to break with rapid emptying of the estuary. Hundreds of fish, many still alive, lay on the banks. There was a big influx of waterbirds. Pacific Herons, sporadic visitors, numbered 38 and White-faced Herons numbered 68; only one or two birds of the latter species had been present for the previous six weeks. Exactly one year later in October 1995, the creek mouth breached in its normal fashion. This did not produce any spectacular results.

Number of species

The total number of species recorded was 33 (excluding the 16 mentioned in the Methods), of which 7 were regulars, 9 irregulars and 17 occasional (Table 1). The number of species per half month fluctuated from 14 to 4. Fewer species were present when the mud flats were exposed or covered tidally a few days after opening of the creek mouth. Seasonally, species numbers were scored for all years and varied little: there were 22 species present in spring, 23 in summer, 24 in autumn, 24 in winter (Table 2). The number of species per year varied little: 23 in 1990, 22 in 1991, 20 in 1992, 21 in 1993, 22 in 1994 and 19 in 1995 (Table 3).

Number of individuals

The total number of individuals showed a change with seasons. Numbers were greatest in autumn (101.1 individuals, 39 per cent of annual total), dropping through winter (51.9 individuals, 20 per cent of annual total) and spring (37.0 individuals, 14 per cent of annual total), lowest in November and rising in late summer (68.7 individuals, 27 per cent of annual total) (Table 2). No annual seasonality was apparent for 37 sightings of occasional species, though these were fewest in spring (six) as against 10 or 11 in the other seasons.

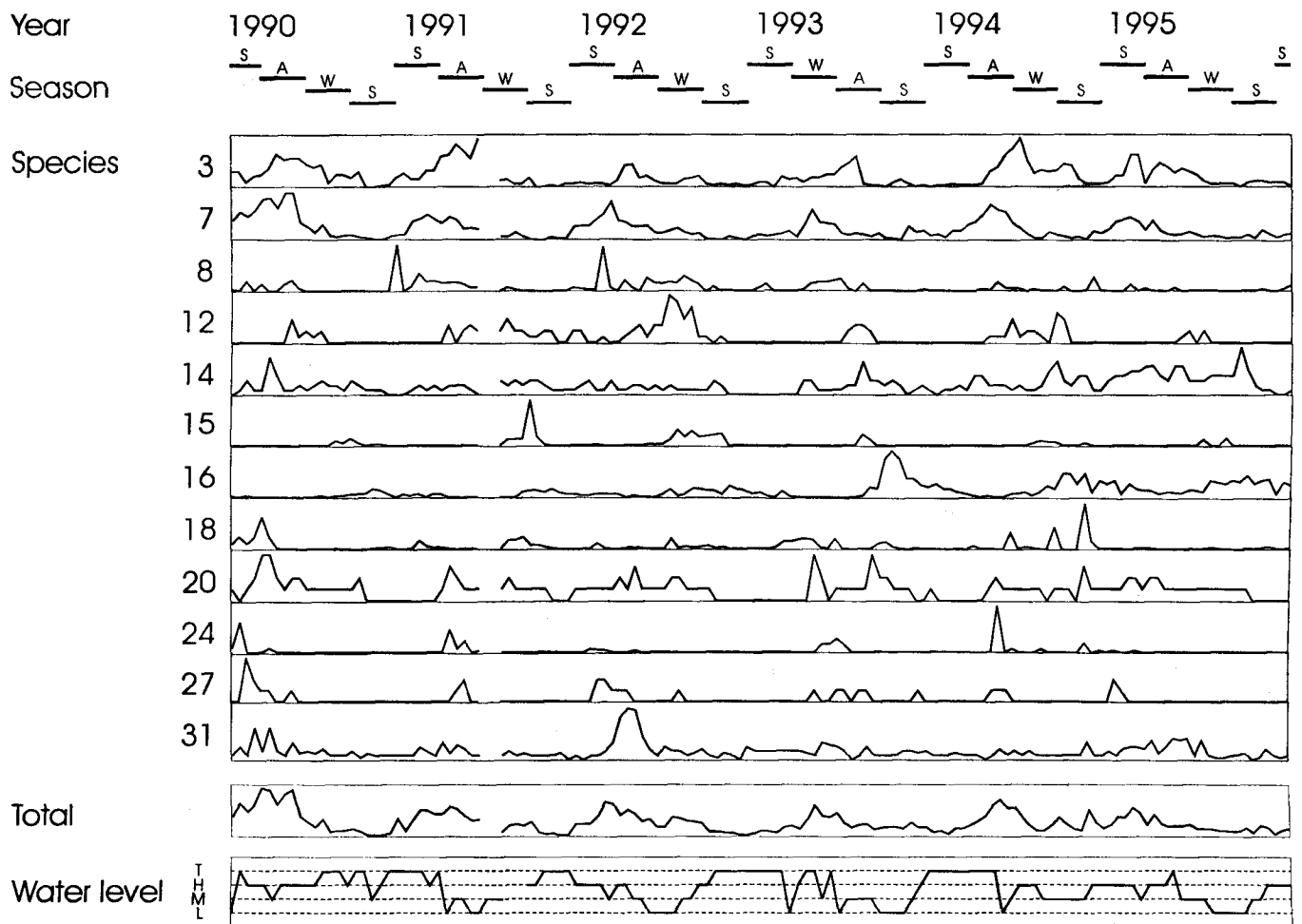


Figure 2. Maximum half-monthly counts for the 12 more common waterbirds recorded for the six years 1990 to 1995 inclusive. Top row indicates the seasons (lowest row of dots = spring; highest row = winter). Next 12 rows show maximum numbers per species per half-month. Species numbers as per Table 1. Penultimate row shows total for all above species of waterbirds. Bottom row shows water level recorded (lowest row of dots = low, medium, and highest row = high), with gaps in record showing when sandbar was breached and water levels were tidally influenced. The y-scale for each species is according to its maximum abundance (see Table 1).

The number of individuals per year dropped each year from 80.2 individuals in 1990 to 49.3 individuals in 1995, with the exception of 1994 (72.8 individuals) when there was an increase over the previous year's total (Table 3). Bird numbers were highest in the drier hot months generally coinciding with low rainfall and low water levels (Table 2).

Fluctuations in number of twelve species

I selected the 12 more common species for which there were more than 100 half-monthly records during the six years of the study, (a total of 144 half-months). Figure 2 shows the relative but not actual fluctuation in numbers (the y-axis is not constant).

BLACK SWAN *Cygnus atratus* — Seasonality was evident with numbers highest in autumn and lowest in spring (Table 2). The mean number of Black Swans fluctuated annually (Table 3) but no trend was evident. Water level had little effect on numbers (Fig. 2). I watched communal courtship of ten pairs where wings were lifted displaying extensive areas of white, the

birds sailing together as pairs with necks hooked followed by heads pointed upwards. Pairs have courted in May and copulated at the end of September. I believe there to be only one resident pair but I was unable to find a nest closer than the Angahook Park swamp which is 2 km distant on Distillery Creek near its junction with Painkalac Creek. This swamp has been used when full of water by a pair of breeding swans each year and a pair with cygnets was observed on Mellors Swamp, possibly the same pair that I regard as resident.

PACIFIC BLACK DUCK *Anas superciliosa* — Numbers of this species were also highest in autumn and lowest in spring (Table 2). Annual numbers show a trend towards decline, except for an increase in 1994 (Table 3). Some birds were usually present whatever the water level but numbers appeared to decrease with higher water levels (Fig. 2). Birds fed together as a flock with few outliers, on exposed mudflats kept wet by tidal action. I watched a Swamp Harrier harass a single Pacific Black Duck on the water by repeatedly

swooping at it, then landing on it and holding it underwater until it drowned and eventually flying with it to the bank and eating it.

I noted copulation on the water in September 1995 and later a pair with young. The water level was high at that time and they may have nested on Mellors Swamp.

GREY TEAL *A. gracilis* — This species appeared irregularly, with numbers highest in summer/autumn and lowest in spring (Table 2). Numbers increased annually from 4.1 birds in 1990 to a peak of 7.2 birds in 1992 but declined to 1.1 birds in 1995 (Table 3). Water level did not appear to affect numbers.

HOARY-HEADED GREBE *Poliiocephalus poliocephalus* — This species was present irregularly. The greatest mean number was recorded in winter (Table 2). Water level did not appear to affect numbers.

GREAT CORMORANT *Phalacrocorax carbo* — This species was nearly always present (Fig. 2) and there was no correlation between numbers and water levels. Numbers were greatest in spring and lowest in autumn (Table 2). Numbers increased from 0.9 birds in 1990 to 5.6 birds in 1993 and have been maintained at a similar level since (Table 3). In August 1995, I noted courtship of a pair, posturing and picking up grass on the mudflats, though normally courtship takes place at the nest.

LITTLE PIED CORMORANT *P. melanoleucos* — This species was nearly always present (Fig. 2) and there was no correlation between numbers and water levels. Numbers did not vary much but were slightly greater in autumn/winter (Table 2). There appeared to be a slight upward annual trend (Table 3).

LITTLE BLACK CORMORANT *P. sulcirostris* — This species appeared in winter with some overlap into early spring (Table 2). Annual numbers were constant except for an increase in 1991/92 (Table 3).

WHITE-FACED HERON *Egretta novaehollandiae* — During the six years of the study, annual numbers rose to a high of 7.2 birds in 1994 to drop to a low of 1.6 birds in 1995 (Table 3). Usually two birds were present with a short-lived influx after breaching of the sandbar, particularly in spring 1994. One bird had been present in two of the three preceding half-months but after the breaching 68 birds appeared for a few days. No variation with season was apparent (Table 2). Only one adult was present daily during breeding in August 1995 when it nested high in a Red Ironbark *Eucalyptus sideroxylon* about 50 m from the creek and about 300 m north of Mellors Swamp. Four young hatched. The pair later returned to Mellors Swamp with at least one young. I observed a White-faced Heron being followed by both Royal and Yellow-billed Spoonbills which apparently fed on prey it had disturbed.

GREAT EGRET *Ardea alba* — When this species was recorded, there was usually only one individual present. In most years the species was absent from October to February or March except for 1994 (Fig. 2). Whenever

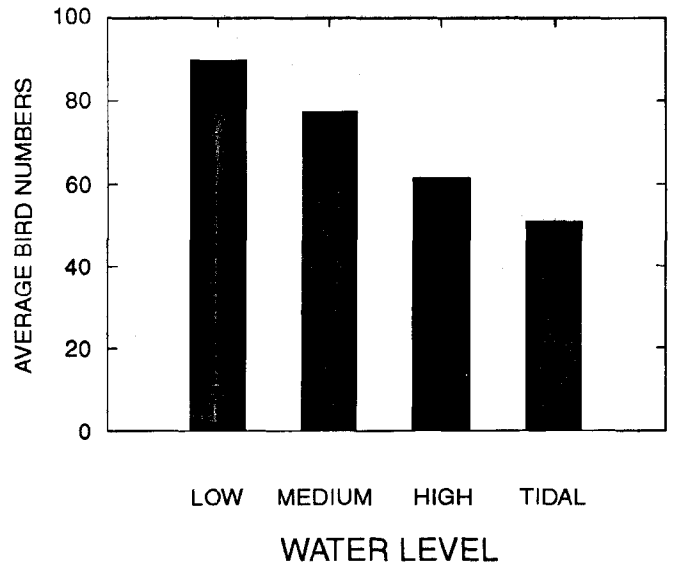


Figure 3. Average numbers of waterbirds taken over all years for each water level.

two Great Egrets were present, one continually chased the other not allowing it to settle and eventually driving it away.

AUSTRALIAN WHITE IBIS *Threskiornis molucca* — This species visited irregularly but was most likely to be present in autumn (Table 2).

YELLOW-BILLED SPOONBILL *Platalea flavipes* — This species was a regular visitor in small numbers, the greatest numbers recorded in autumn (Table 2). Numbers fluctuated annually with the highest average numbers (2.1 birds) in 1992.

ROYAL SPOONBILL *P. regia* — A few of this species appeared irregularly and fed together with Yellow-billed Spoonbills. Both spoonbills were observed to follow a feeding White-faced Heron.

MASKED LAPWINGS *Vanellus miles* were always present, usually only one or two pairs. Annual numbers were highest in 1992 (Table 3) and in autumn (Table 2). Nests or a pair with young were noted regularly. Numbers increased coinciding with the influx of crickets in autumn 1992.

Uncommon visitors

CAPE BARREN GOOSE *Cereopsis novaehollandiae* — One was present continuously for three months from March to June 1990, the first record for the district. It was not wary of people which suggests it may have been bred at Serendip Sanctuary 60 km distant where birds of this species are accustomed to people. It fed on emergent vegetation but when this became inundated it moved to grass on the road verges and was eventually hit by a car and its wing was broken. It did not survive.

AUSTRALIAN PELICAN *Pelecanus conspicillatus* — Rarely recorded in the past, one was present in very low water in February 1995.

TABLE 1

All waterbird species recorded on Mellors Swamp from 1990–1995 inclusive, showing their status (Regular, Irregular, Occasional) and the greatest number present at any one time. Numbers assigned to species are for the purpose of reference for other tables and figures.

Species	Status	Maximum Number of Individuals
1 Blue-billed Duck <i>Oxyura australis</i>	Occasional	1
2 Musk Duck <i>Biziura lobata</i>	Occasional	1
3 Black Swan <i>Cygnus atratus</i>	Regular	32
4 Cape Barren Goose <i>Cereopsis novaehollandiae</i>	Occasional	1
5 Australian Shelduck <i>Tadorna tadornoides</i>	Irregular	10
6 Australian Wood Duck <i>Chenonetta jubata</i>	Irregular	15
7 Pacific Black Duck <i>Anas superciliosa</i>	Regular	140
8 Grey Teal <i>A. gracilis</i>	Irregular	52
9 Chestnut Teal <i>A. castanea</i>	Occasional	4
10 Pink-eared Duck <i>Malacorhynchus membranaceus</i>	Occasional	9
11 Hardhead <i>Aythya australis</i>	Occasional	2
12 Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>	Irregular	8
13 Darter <i>Anhinga melanogaster</i>	Occasional	1
14 Little Pied Cormorant <i>Phalacrocorax melanoleucos</i>	Regular	10
15 Little Black Cormorant <i>P. sulcirostris</i>	Irregular	38
16 Great Cormorant <i>P. carbo</i>	Regular	28
17 Australian Pelican <i>Pelecanus conspicillatus</i>	Occasional	1
18 White-faced Heron <i>Egretta novaehollandiae</i>	Regular	68
19 White-necked Heron <i>Ardea pacifica</i>	Irregular	38
20 Great Egret <i>E. alba</i>	Regular	4
21 Intermediate Egret <i>A. intermedia</i>	Occasional	1
22 Cattle Egret <i>A. ibis</i>	Occasional	3
23 Australasian Bittern <i>Botaurus poiciloptilus</i>	Occasional	1
24 Australian White Ibis <i>Threskiornis molucca</i>	Irregular	25
25 Straw-necked Ibis <i>T. spinicollis</i>	Occasional	3
26 Royal Spoonbill <i>Platalea regia</i>	Occasional	4
27 Yellow-billed Spoonbill <i>P. flavipes</i>	Irregular	11
28 Eurasian Coot <i>Fulica atra</i>	Occasional	2
29 Black-winged Stilt <i>Himantopus himantopus</i>	Occasional	2
30 Banded Stilt <i>Cladorhynchus leucocephalus</i>	Occasional	5
31 Masked Lapwing <i>Vanellus miles</i>	Regular	24
32 Caspian Tern <i>Sterna caspia</i>	Irregular	3
33 Whiskered Tern <i>Chlidonias hybridus</i>	Occasional	6

WHITE-NECKED HERON *Ardea pacifica* — This species visited irregularly, often singly, but after the creek mouth breached in spring 1994, 38 birds were present for a few days.

AUSTRALASIAN BITTERN *Botaurus poiciloptilus* — One bird was observed on seven different occasions from May to August 1995. Six sightings were in the south-western corner bordering the water and one was further along towards the creek mouth. All sightings were in full daylight. It may have been overlooked in the past because of its cryptic colouring and its habit of stalking and freezing. It moved away when a White-faced Heron approached.

INTERMEDIATE EGRET *Ardea intermedia* — One in March/April 1993 and one in July 1994.

BLACK-WINGED STILT *Himantopus himantopus* — Two in December 1992.

BANDED STILT *Cladorhynchus leucocephalus* — Five in January 1995.

WHISKERED TERN *Chlidonias hybridus* — Six fishing in October 1994, three in breeding plumage.

DISCUSSION

There was no clear-cut reason for presence or absence of waterbirds on Mellors Swamp, though there was seasonality with some species (Black Swan, Little Black Cormorant, Great Egret, Australian White Ibis, Yellow-billed Spoonbill) suggesting dispersal to and from breeding areas. Combined with this seasonality, during the peak of summer holidays (Christmas and most of January) disturbance caused by the influx of human visitors may have kept waterbirds away.

The drop in number of individuals (Table 3) over the six years probably results from the decline in numbers of Pacific Black Ducks that comprised a large proportion of the total.

Water level did have some effect. When water was confined to the course of the creek with dried mud surrounding, few birds were present. When daily high tides washed over the dried mud, Pacific Black Duck fed on the mudflats. During high water levels, some species exploited the changed conditions of the floodplain where only long-legged species (for example Great Egret, White-faced Heron) were evident above the vegetation. These flooded conditions were usually

TABLE 2

The mean number of each waterbird species recorded over the six years in each seasonal period on Mellors Swamp. Species numbers as per Table 1. * Indicates species present in low numbers.

Species No	Season			
	Spring	Summer	Autumn	Winter
1	0.0	0.0*	0.0	0.0
2	0.0	0.1	0.0	0.0
3	2.9	5.0	13.1	7.7
4	0.0	0.0	0.2	0.0*
5	0.5	1.1	0.7	0.4
6	0.1	0.0	0.0*	0.9
7	10.6	42.2	59.3	8.5
8	0.8	5.8	5.1	3.0
9	0.1	0.2	0.1	0.2
10	0.0*	0.0	0.3	0.0
11	0.1	0.0	0.0	0.0
12	0.3	0.1	1.0	2.0
13	0.1	0.0	0.0	0.0*
14	1.9	1.5	2.4	2.5
15	2.4	0.0*	0.1	3.2
16	7.2	2.5	0.8	3.0
17	0.0	0.0*	0.0	0.0
18	4.5	4.0	5.6	4.6
19	1.6	0.0*	0.4	0.4
20	0.6	0.5	1.5	1.2
21	0.0	0.0	0.1	0.0*
22	0.0	0.0	0.3	0.1
23	0.0	0.0	0.0*	0.1
24	0.2	0.6	1.8	0.2
25	0.0	0.0	0.3	0.0
26	0.0*	0.4	0.4	0.1
27	0.1	0.2	1.8	0.8
28	0.0	0.1	0.0	0.0*
29	0.0	0.1	0.0	0.0
30	0.0	0.1	0.0	0.0
31	2.5	3.5	6.7	2.9
32	0.3	0.7	0.1	0.1
33	0.2	0.0	0.0	0.0
Total Birds	37.0	68.7	101.1	51.9
Total number of species present per season over all years	32	23	25	25

short-lived. The creek mouth normally began discharging with a slow trickle of water through a narrow opening which eroded to permit a fast flow or else it was opened officially by mechanical means or unofficially by manual means. Low-to-medium water levels carried the greatest number of birds, although there was usually an increase in bird numbers immediately after breaching of the sandbar. This increase was not invariable. For instance, the creek mouth was closed from mid-November 1994 to mid-June 1995 but after opening the numbers of birds remained the same as in the previous six weeks. If bird numbers varied only with season, then a spring break-out of the sandbar (the period of lowest bird numbers) should not result in a large increase of numbers as it did in October 1994.

Annual numbers of birds showed a steady decline apart from 1994 which was inflated by the influx in October, perhaps the result of greatly reduced breeding

by waterbirds in the Murray-Darling Basin during 1994 (Hutchinson 1996) and their dispersal towards more permanent wetlands. In that year also a Great Egret was present throughout the year although this species was usually absent during spring/summer. Conversely, in 1995 the wet conditions that prevailed over a large area of the inland would have provided good foraging conditions and possibly were the reason fewer birds were present on Mellors Swamp. Woodall (1985) found a positive correlation between inland rains and lower bird populations on the coast. Reasons for fluctuations in bird numbers may depend upon environmental conditions both at the study area and at a remote site at anything up to ten years earlier, not just the previous year (White 1993).

The substrate of Mellors Swamp has altered over the period of this study by the clearing of vegetation and construction of a track along the western side of the wetland on the north side of the Great Ocean Road. Surfaced with yellow gravel, the track has eroded

TABLE 3

The mean number of each waterbird species recorded over the six years in each calendar year on Mellors Swamp. Species numbers as per Table 1. * Indicates species present in low numbers.

Species No	Year					
	1990	1991	1992	1993	1994	1995
1	0.0	0.0	0.0	0.0	0.0*	0.0
2	0.1	0.1	0.0	0.0	0.0	0.0
3	9.0	9.2	3.9	4.9	9.0	6.8
4	0.3	0.0	0.0	0.0	0.0	0.0
5	1.0	0.4	0.3	0.5	1.0	1.0
6	0.0	1.2	0.0*	0.0	0.3	0.0
7	48.8	32.3	31.4	25.5	35.2	23.4
8	4.1	4.8	7.2	3.3	1.9	1.1
9	0.2	0.1	0.3	0.2	0.0	0.0
10	0.0	0.0	0.0	0.4	0.0	0.0
11	0.0	0.0	0.0	0.0	0.1	0.0
12	0.4	1.4	1.8	0.4	0.9	0.2
13	0.0	0.1	0.0*	0.0*	0.0	0.0
14	1.6	1.7	1.3	1.6	2.5	3.8
15	0.6	2.8	3.1	0.6	0.6	0.6
16	0.9	1.6	2.5	5.6	5.0	4.6
17	0.0	0.0	0.0	0.0	0.0	0.0*
18	5.7	4.8	3.0	5.6	7.2	1.6
19	0.0*	0.4	0.2	0.3	2.7	0.0
20	1.1	0.9	0.9	1.0	0.8	1.0
21	0.0	0.0	0.0	0.1	0.0*	0.0
22	0.2	0.1	0.0	0.1	0.1	0.0
23	0.0	0.0	0.0	0.0	0.0	0.2
24	0.8	1.0	0.2	0.8	1.5	0.0*
25	0.4	0.0	0.0	0.0	0.0	0.0
26	0.4	0.1	0.3	0.3	0.2	0.0*
27	0.6	0.6	2.1	0.1	0.7	0.1
28	0.0*	0.1	0.0	0.0	0.0	0.0*
29	0.1	0.0	0.1	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.2
31	3.8	3.0	6.1	3.5	2.6	4.3
32	0.5	0.3	0.3	0.1	0.2	0.4
33	0.0	0.0	0.0	0.0	0.3	0.0
Total	80.2	67.0	65.0	54.8	72.8	49.3
Percentage total individuals	20.6	17.2	16.7	14.1	18.7	12.7

during heavy rain and the yellowing of the substrate on the shallow area in the south-western corner is noticeable, possibly impacting adversely on underwater invertebrates. Care needs to be taken where native vegetation (see Study Site, below the road) bordering the water is replaced. Kikuyu grass on a gently sloping bank, the upper part of which had been mown, acted as a sieve which trapped hundreds of fish during the explosive breaching of the sandbar in 1994.

Powered boats were prohibited at the beginning of the survey period and so could not be implicated in the reduction in numbers of waterbirds. On several occasions I observed a fox *Vulpes vulpes*, once with young, on the wetland openly in daylight. On one such occasion, an Australasian Bittern and a White-faced Heron continued to forage undisturbed within easy reach of the fox but it made no attempt to attack them. Two untended dogs were noted rampaging through the wetland on several occasions and were reported to have killed some waterfowl, species not stated. I do not know whether predation by either of these species contributed to changes in the size of the bird population that I monitored.

Unlike Maddock (1991) who reported a White-faced Heron feeding on prey disturbed by a Royal Spoonbill, my observation was the reverse. Both species of spoonbill walked behind a White-faced Heron.

Although the size of the waterbird population on Mellors Swamp is small, the six year study has provided some understanding of the dynamics of birds on a small estuarine wetland. The drop in annual numbers needs to be interpreted with caution. It may be the result of increased rainfall inland. Fluctuations in the size of the bird populations from year to year may not have been evident in a study covering a shorter period (Table 3, Fig. 2). This permanent wetland is important for its aesthetic value and as a firebreak in the event of bushfire. For birds, it is a foraging area and a refuge in times of drought. The human population, both permanent and semi-permanent, of Aireys Inlet and Fairhaven has shown a steady increase. With the new sewerage system disposing sewage and waste water inland instead of

septic tanks draining effluent into the wetland, water quality of the wetland is expected to improve. What effect this will have on the waterbird population will not be evident for some years. Continued monitoring is needed to identify problems immediately they arise.

ACKNOWLEDGMENTS

I thank Prof. J. M. Cullen who helped in the analysis and presentation of the data, Will Rolland for producing the map, Winston Huggins for botanical information and two unnamed referees who greatly improved this paper. I am also grateful to the editor of *Corella* who patiently advised and assisted throughout the revision.

REFERENCES

- Briggs, S. V. (1977). Variation in waterbird numbers at four swamps on the northern tablelands of New South Wales. *Aust. Wildl. Res.* **4**: 301-9.
- Crome, F. H. J. (1988). To drain or not to drain? — intermittent swamp drainage and waterbird breeding. *Emu* **88**: 243-248.
- Geering, D. J. (1993). The effect of drought-breaking rain on the re-establishment of egret colonies in north coastal New South Wales. *Corella* **17**: 47-51.
- Gosper, D. G., Briggs, S. V. and Carpenter, S. M. (1983). Waterbird Dynamics in the Richmond Valley, New South Wales, 1974-77. *Aust. Wildl. Res.* **10**: 319-27.
- Hutchinson, M. (1996). Murray-Darling Basin Waterbird Project Update — Birds do it . . . Wingspan **6**: 19.
- Lamm, D. W. (1965). Seasonal counts of birds at Lake George, New South Wales. *Emu* **64**: 115-128.
- Lawler, W. and Briggs, S. V. (1991). Breeding of Maned Duck and other waterbirds on ephemeral wetlands in north-western New South Wales. *Corella* **15**: 65-76.
- Lawler, W., Kingsford, R., Briggs, S. V. and Milkovits, G. (1993). Movements of Grey Teal *Anas gracilis* from a drying, arid-zone wetland. *Corella* **17**: 58-60.
- Maddock, M. (1991). Observations on the biology of the White-faced Heron *Ardea novaehollandiae*. *Corella* **17**: 79-86.15.
- Norman, F. I. (1983). Grey Teal, Chestnut Teal and Pacific Black Duck at a saline habitat in Victoria *Emu* **83**: 262-270.
- White, J. M. (1993). Changes in the numbers of waterbirds on Llangothlin, New South Wales, in relation to the water level and distant flooding, 1981-84. *Corella* **17**: 117-121.
- Whyte, R. J. (1981). Winter fluctuations in waterbird numbers on a northern tablelands lagoon of New South Wales. *Emu* **81**: 243-6.
- Woodall, Peter F. (1985). Waterbird populations in the Brisbane region, 1972-83, and correlates with rainfall and water heights. *Aust. Wildl. Res.* **12**: 495-506.