Corella, 1987, 11(1): 20-27

NUMBERS OF WATERBIRDS AT A SWAMP IN FERNDALE, WESTERN AUSTRALIA, 1978 to 1981

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Received: 26 July, 1985

Weekly counts of waterbirds on a small swamp were made from January 1978 to May 1981. Three species accounting for 67% of the birds counted were the Eurasian Coot (33%), Pacific Black Duck (23%), and Grey Teal (11%). Greater numbers of birds were observed during the summer months than at other times of the year. Species showing significant seasonal variation in numbers were the Eurasian Coot, Pacific Black Duck, Grey Teal, Australian Shelduck, and Little Black Cormorant; those with more constant numbers throughout the year were the Hardhead, Dusky Moorhen, and Australasian and Hoary-headed Grebe. Variations between years in the pattern of fluctuating numbers were noted and some of the variations may be related to events such as drought.

INTRODUCTION

Observation of the birds of Australian wetlands has yielded information that shows how their habits are adapted to the seasonal variation in climate over the continent. Frith (1982) has summarised what is known of Australian waterfowl, and described how, by contrast with the regular movements of northern hemisphere waterfowl, those of Australian species are irregular and closely linked to the variable rainfall in the arid parts of the country. There is, however, a tendency for the nomadic movements to be away from the arid interior towards coastal wetlands during the dry season, with the direction of movement reversing as the wet season's rains fill the ephemeral swamps farther inland.

This paper reports the results of observations that were carried out on a small swamp in the Perth metropolitan area over a period of 3½ years. It is intended to provide information that will add to that yielded by studies of wetlands on the Swan coastal plain carried out by Ford (1958), by Riggert (1977) for the Australian Shelduck *Tadorna tadornoides*, and by Gentilli and Bekle (1983) for Grey Teal *Anas gibberifrons*.

METHODS

From January 1978 to May 1981, observations were made of birds on, and in the vegetation surrounding, a permanent swamp lying close to the Nicholson Road Bridge over the River Canning in Ferndale, Western Australia (32°01′S., 115°56′E., Figure 1). The swamp is unnamed and will be referred to in this paper as the NRB (Nicholson Road Bridge) swamp. It was originally a salt-water, estuarine marsh, but was transformed into a permanent, fresh-water swamp with the construction in 1927 of a weir at Kent Street, Cannington, about 2.5 km downstream from the swamp (Pen, 1983). The swamp has an area of about 0.83 hectares and lies in a paddock of low dense swards of grasses, sedges, and herbs, that are grazed by sheep, cattle, and horses. Around the swamp perimeter grow *Eucalyptus rudis*, *Melaleuca rhaphiophylla*, *M. lanceolata*, and *M. incarna*, with shrubby areas dominated by *M. lateritia*. Areas of *Typha orientalis* form dense, tall herblands, especially at the upper end of the swamp. The vegetation is typical of the riverine environment along nearby stretches of the Canning River and its backwaters (Pen, 1983).

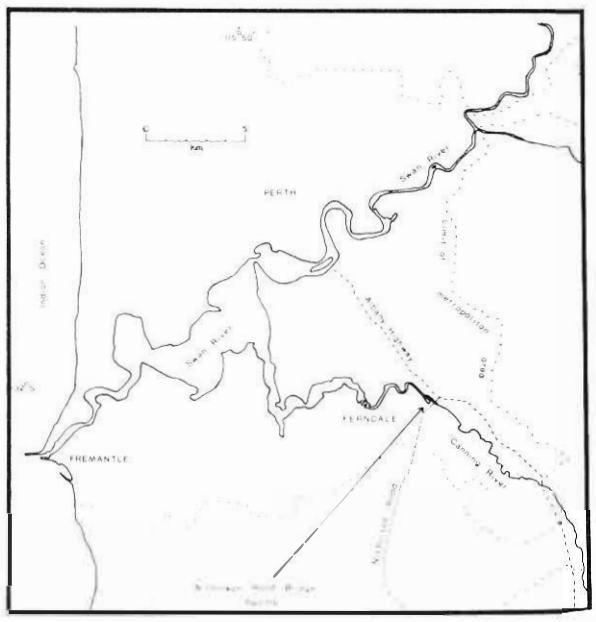

Figure 1. *Map showing the position of the Nicholson Road Bridge swamp.*

Observations were carried out between 0800-1100h, usually at weekly intervals. Birds were counted as the observer walked along the western margin of the swamp from the southern to the northern end. About half way along the open water of the swamp, the trunk of a fallen paperbark protruded horizontally into the water and provided a vantage point, from which further observations were made. The same tree trunk was used as a standard against which the water level of the swamp was measured. Rainfall data were obtained from records published for Perth City (Department of Science, Bureau of Meteorology, 1978-1981).

RESULTS

Twenty-five species of waterbirds were observed on the swamp. A total of 10 287 birds (including multiple sightings of individuals) was recorded during the 3½ years of observations, of which a third were the Eurasian Coot *Fulica atra*, 23 per cent Pacific Black Duck *Anas superciliosa*, 11 per cent Grey Teal, and 7 per cent Australian Shelduck. None of the remaining 20 species contributed more than 4 per cent of the total population.

Figure 2 shows the mean weekly number of individuals and species of waterbirds for each month in relation to the rainfall and the water level of the swamp. Numbers of both individuals and species follow the same seasonal pattern of variation; the Spearman rank correlation coefficient between them is 0.83 ($p<0.001$). They are both highest at times of the year when the Perth district rainfall is least and lowest when the amount of rain received is greatest. There is a lag between the onset of the winter rains and the start of the birds' dispersal, and a delay in the build-up of numbers towards the end of the dry summer season. This is evident in both numbers of individuals and of species, especially the former, for which the delay in response to rainfall appears to extend over 1 to 3 months after the onset of the wet season (Table 1). The height of water in the swamp correlates with the rainfall (0.733, $p<0.01$), with occasional variations, such as in November and December 1979, which probably reflect the effect of the weir's operation.

Figure 3 shows the monthly variations in numbers for the 11 most numerous species; Table 2 provides details of the 14 other species observed. As a few species contributed a large number of individuals to the swamp's population of birds, they will have had a major influence in determining the pattern of numbers of individual birds shown in Figure 2a. Chi-square tests on the data in Figure 3 show that, for the Eurasian Coot, Pacific Black Duck, Little Black Cormorant *Phalacrocorax sulcirostris*, Australian Shelduck, and Grey Teal, the seasonal variation in numbers was statistically significant at the $p<0.001$ level.

TABLE 1

Spearman rank correlation coefficients of mean weekly numbers of birds each month with mean monthly rainfall.

Rainfall of:	same month	1 m'th before	2 m'ths before	3 m'ths before	4 m'ths before
Correlation	-0.304	-0.722	-0.909	-0.745	-0.389
Significance level	n.s.	<0.01	<0.01	<0.01	<0.05

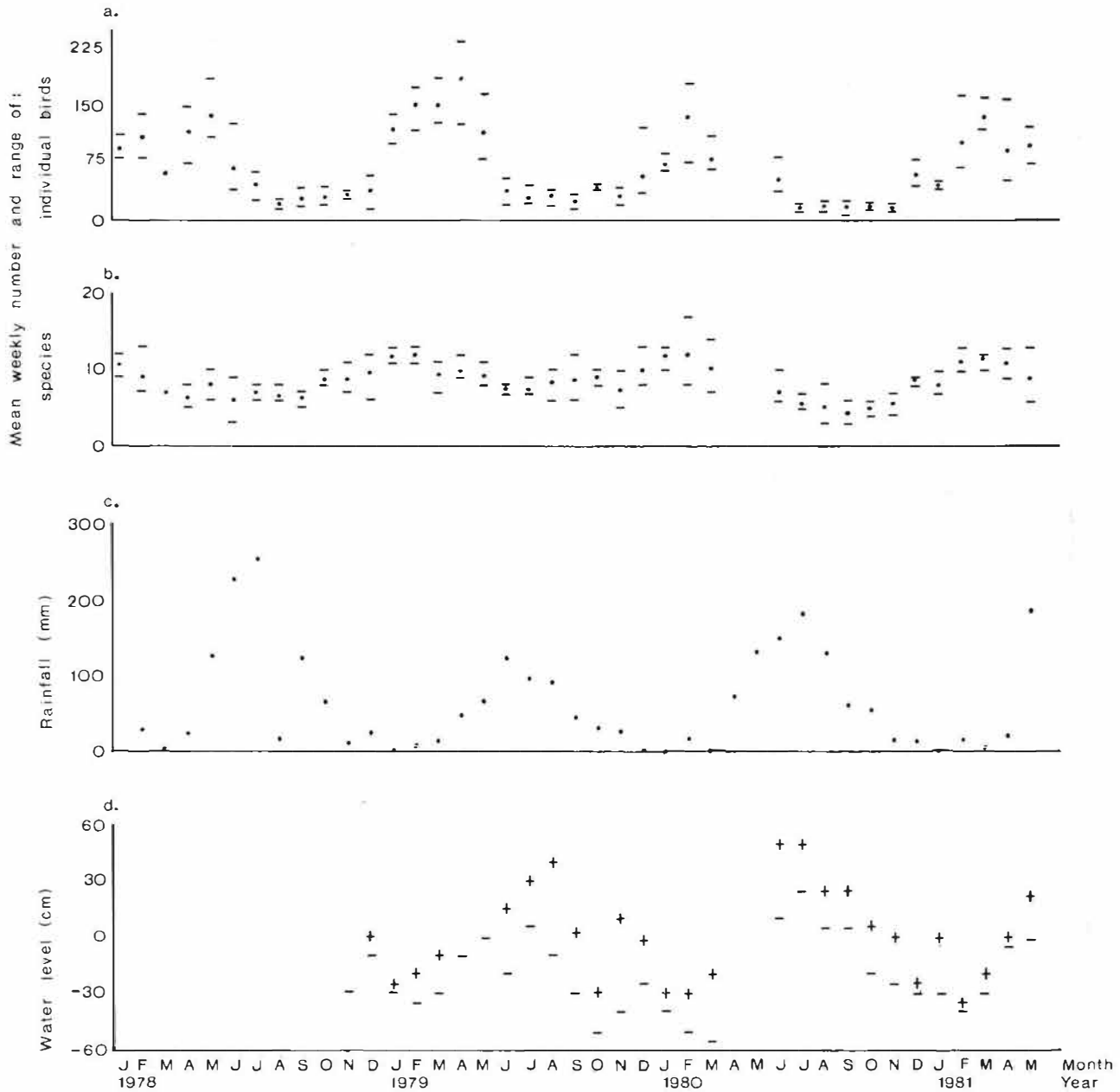

Figure 2. *Mean weekly numbers of individuals and species of waterbirds for each month in relation to the rainfall and water level of the swamp.*
a. *Mean (*) weekly number of birds on the swamp and the range (—) of numbers for each month, January 1978 to May 1981.*
b. *Mean (*) weekly number of species on the swamp and the range of numbers (—) for each month, January 1978 to May 1981.*
c. *Monthly rainfall, January 1978 to May 1981.*
d. *Maximum (+) and minimum (—) water level of the swamp each month, November 1978 to May 1981, measured in relation to a zero marker (0).*

TABLE 2

Species of waterbirds occasionally observed at NRB swamp

Species	Numbers of occasions birds seen	Comments
Black Cormorant *Phalacrocorax carbo*	12	Very occasional summer visitor
Little Pied Cormorant *P. melanoleucos*	60	Present in very small numbers throughout the year
Pied Cormorant *P. varius*	1	
Musk Duck *Biziura lobata*	2	
Great Egret *Egretta alba*	25	Present in very small numbers throughout the year
Pacific Heron *Ardea pacifica*	9	Very small numbers present October to December 1978
Rufous Night Heron *Nycticorax caledonicus*	5	Seen occasionally between December 1979 and July 1980
White-faced Heron *A. novaehollandiae*	56	Present in very small numbers throughout the year
Sacred Ibis *Threskiornis aethiopica*	20	Seen occasionally in small numbers, especially in 1978 and 1979
Straw-necked Ibis *T. spinicollis*	1	
Australian Pelican *Pelecanus conspicillatus*	46	Flocks of up to 18 birds seen in 1978 and 1979, especially July to January. None seen in 1980 and 1981
Black-fronted Plover *Charadrius melanops*	1	
Australian Shoveler *Anas rhynchotis*	21	Present in very small numbers throughout the year
Yellow-billed Spoonbill *Platalea flavipes*	13	Present in very small numbers late summer to winter

There was no significant variation during the year in the numbers of the Hardhead *Aythya australis*, Dusky Moorhen *Gallinula tenebrosa*, and Australian and Hoary-headed Grebes *Tachybaptus novaehollandiae* and *Poliocephalus poliocephalus*. (I was unable to distinguish between the latter two species and the figures represent their combined numbers.) The numbers of the Maned Duck *Chenonetta jubata*, Black Swan *Cygnus atratus*, and Purple Swamphen *Porphyrio porphyrio* were too small to be tested. However, the graphs suggest that the Maned Duck and Black Swan were present only during the warm months of the year, and the Purple Swamphen were present in small numbers throughout the year.

There were some differences between years in the pattern of fluctuation of bird and species numbers. For example, species numbers were slightly, but not significantly, higher during the dry winter of 1978 than in other years (Figure 2b). The numbers of birds on the swamp were significantly higher in the summer of 1979 than in other summers (Figure 2a and Table 3). While several species contributed to these increased numbers, only the Eurasian Coot numbers were significantly greater over the 5 months of peak bird numbers, January to May (Table 3a). The Pacific Black Duck were, however, seen in significantly higher numbers than usual in the first half of the peak period (Table 3b).

DISCUSSION

The results of 3½ years of observations on the birds on the NRB swamp agreed in many respects with what is already known from studies elsewhere in south-west Australia. Serventy and Whittell (1976) rated the Pacific Black Duck as Western Australia's most common duck, with the Grey Teal almost as numerous. This corresponded to their relative abundance in this study and in the studies by Ford (1958) in the Bibra Lake District (32° 06'S., 115° 49'E.) and by Morris and Knott (1979) on Lake Claremont (31° 59'S., 115° 47'E.). Sedgwick (1973) found

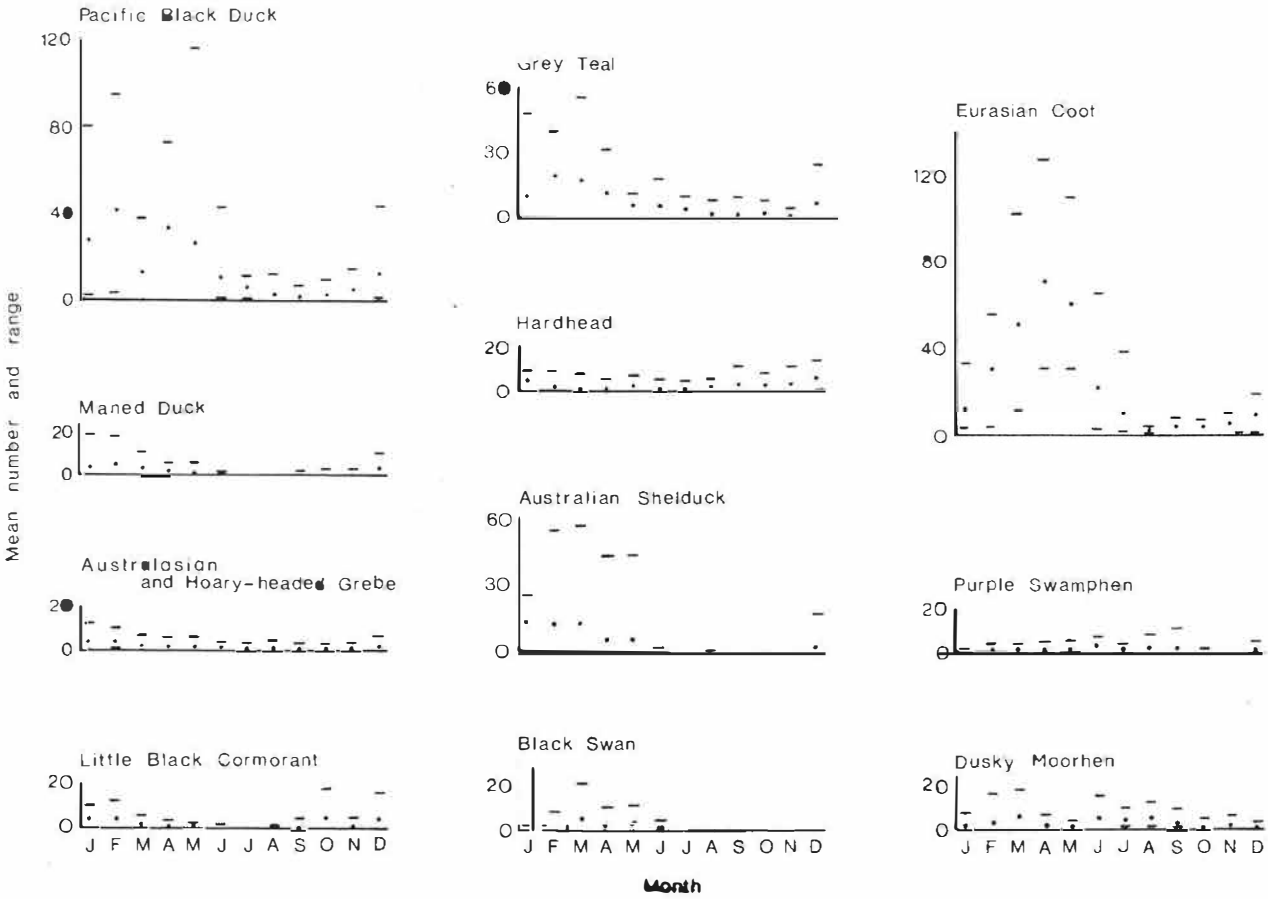

Figure 3. *Mean (*) weekly numbers of individual species on the swamp and the range (—) of numbers for each month, summed over all years of observations, 1978 to 1981.*

that the Pacific Black Duck was usually the most common duck on Benger Swamp (33° 10′S., 115° 50′E.), but sometimes outnumbered by the Grey Teal. Both were at times outnumbered by other species such as the Hardhead, Australian Shelduck, and Black Swan (Sedgwick, 1973; Bekle, 1983). The large number of Eurasian Coot in this study was atypical when compared with results published for other permanent waters on the Swan coastal plain. There are, however, records of coots as the most numerous waterfowl present on wetlands elsewhere in Australia, for example, on Lake George (35° 06′S., 149° 25′E.) (Lamm, 1964) and on Dangars Lagoon (30° 41′S., 151° 30′E.) (Whyte, 1981) in New South Wales.

Frith (1982) pointed out that the movements of waterfowl in Australia are determined by the availability of food, which in turn, for many species, depends on the extent of bodies of water and ultimately on rainfall within their catchment areas. The rainfall pattern over the south-west region of Western Australia is typified by that of Perth, although the amounts received inland are less and falls may start later and end earlier in the year than in Perth. It is possible that the lag between the onset of the winter rains in Perth and the departure of the summer visitors from the NRB swamp reflected the time required for the levels of inland water and their food supplies to build up. Gentilli and Bekle (1983),

TABLE 3

Mean weekly numbers of birds seen on NRB swamp in summer and autumn

Data from	Species	Year 1978	1979	1980	1981	x^2	df	p
a Jan.-May† 1978, 1979, 1981	All species	109	147		103	9.51	2	**
	Eurasian Coot	41	58		45	3.29	2	b
	Pacific Black Duck	40	40		11	18.50	2	***
	Dusky Moorhen	1	6		2	a		
	Australian Shelduck	3	11		21	a		
	Grey Teal	11	15		5	4.92	2	b
b Jan.-Mar. 1978-1981	All species	96	141	98	107	11.97	3	**
	Eurasian Coot	36	35	17	39	9.41	3	*
	Pacific Black Duck	26	46	22	18	16.57	3	**
	Dusky Moorhen	1	9	2	2	a		
	Australian Shelduck	6	15	6	26	20.83	3	***
	Grey Teal	17	14	29	5	18.13	3	***

† Data are not available for April and May 1980.
a: numbers too small for the calculation of x^2
*: $p<0.05$; **: $p<0.01$; ***: $p<0.001$;
b: x^2 value does not reach significance at $p<0.05$

in their study of Grey Teal in south-west Australia, found that the rainfall of 2 weeks earlier was the best predictor of teal numbers on wetlands on the Swan coastal plain. As the Grey Teal responds more rapidly to rainfall and changes in water level than other species (Ford, 1958; Frith, 1982), it is likely to have been responsible for the early changes in bird numbers on the NRB swamp after the onset of the rains, with other species contributing to the changes 2 to 3 months later.

The increase in numbers of individuals and species of waterbirds on persistent bodies of water during the hot, dry season of the year is widespread throughout Australia, and represents the effects of the drying up of ephemeral, mostly inland bodies of water and the consequent gathering of birds on coastal refuges (Frith, 1982). A number of studies have detailed this movement for permanent waters on the Swan coastal plain (e.g. Serventy, 1948; Curry, 1981), and shown that bird numbers increased from low, overwintering levels to a peak in mid to late summer. The general pattern of seasonal variation in numbers of each species on the NRB swamp, bore a close resemblance to that found on the nearby waters of the Lake Bibra District by Ford (1958). The pattern of occurrence of the Black Swan, Maned Duck, Grey Teal, Hardhead, and Australian Shoveler *Anas rhynchotis* in the two studies was similar. Numbers of the Pacific Black Duck peaked for longer on the NRB swamp (January-May) than in the Lake Bibra District (February and March); and the Australian Shelduck were also present for longer (November-May) as compared with Ford's observation (November-March). Ford suggested that the latter were birds *en route* to or from a breeding area on Rottnest Island. Riggert's (1977) study of the ducks on Rottnest showed that they dispersed after breeding finished in October, and began to assemble for the next breeding season from March, which corresponded to the time of the first decline in numbers on the NRB swamp. Breeding on Rottnest began in June, by which time all birds had left the NRB swamp.

Gentilli and Bekle (1983) described the seasonal shifts of Western Australia's Grey Teal population to and from summer coastal refuges and temporarily flooded winter breeding areas in the arid interior. The pattern of fluctuation shown by their data for counts of Grey Teal on 21 wetlands in the Perth area from September 1979 to April 1981 corresponded closely to the counts from the NRB swamp for the same period. There were, however, two months during the summer of 1981 (January, February, 1981) when

numbers on the NRB swamp were exceptionally low for that time of year; this may be explained by the shifting of the birds between wetlands in the metropolitan area. Blakers, Davies and Reilly (1984) have commented on the constantly changing composition of Grey Teal flocks, and Briggs (1977) and Lamm (1964), working on inland waters in ew South Wales, found great variability in numbers of Grey Teal from census to census.

Bekle (1982) has documented the spread of the Sacred Ibis *Threskiornis aethiopica* into southwest Australia and suggested that they move south from the Swan coastal plain from September. Sacred Ibis were seen less often on the NRB swamp from December to April than at other times of year.

The significantly higher number of individual birds present on the swamp in the summer of 1979 compared with other summers (Table 3) might have reflected a successful breeding season associated with the high winter rainfall in 1978 following the dry year of 1977. It may also have reflected the gradual drying out of the interior of the continent. For example, Blakers *et al.* (1984) reported that Australian Pelicans *Pelecanus conspicillatus* moving away from Lake Eyre, where they had bred for the previous few years, irrupted in many parts of Australia in 1977 and 1978. The flock present on the NRB swamp in 1978 and 1979 may have represented part of that irruption.

In the light of Ford's (1958) records of duck numbers in the Lake Bibra District at the time of the 1954-1955 drought, I had expected that the low rainfall of the winter of 1979 and the consequent shortage of permanent water in southwest Australia would have resulted in larger than usual summer congregations of birds on permanent water during the following summer. However, the total number of birds on the swamp was similar to those in 1978 and 1981, and perhaps indicated high mortality rates. On the other hand, 1979 was only the driest of several consecutive dry years and its effect may have been hidden by the cumulative effect of the drought. By 1980, the fifth consecutive year of below average rainfall and the driest period since records were begun in 1913; many important waterfowl sites were dry or virtually dry throughout the year (Lane and Munro, 1981, p.5). There was no duck shooting season in 1980-1981.

Just as the numbers of all birds showed no clear trend with rainfall variations from year to year, neither did those of individual species. Unfortunately, there are no records for two of the usual months of high bird numbers in 1980 (April and May) and the apparent impact of the drought on individual species can only be ascertained for January to March (Table 3b). The Eurasian Coot was the only species to show a significant decline in numbers that might be attributed to mortality or lower than usual fecundity. Coots are, however, known to vary greatly in numbers at any one site (Blakers *et al.*, 1984). The Grey Teal, on the other hand, showed evidence of increased numbers on the NRB swamp after the drought and, as birds typical of low rainfall country, are known for drought-induced irruptions (Frith, 1982). They were also present on the swamp in very low numbers in the summer of 1981; it is possible that this represented a population decrease from which recovery had not yet occurred. Ford (1958) found that the drought brought many Australian Shelduck to the Bibra Lake District, but in my study the results were a little ambiguous. Australian Shelduck numbers in the summer of 1979 were higher than in the previous and following years, but considerably lower than in 1981. Crawford's (1979) observations of waterfowl on coastal refuges near Darwin during the drought of 1979 showed, as I have, that some species were present in larger than usual numbers and others in smaller numbers. The response of individual species on a particular wetland to major climatic events can probably only be understood in relation to the species' behaviour and population dynamics over its entire geographical range.

ACKNOWLEDGEMENTS

I am grateful to Stephen Davies and Roger Hnatiuk for commenting on the manuscript and to Roger Hnatiuk for providing the description of the vegetation of the swamp.

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DATA EXCHANGE

This section has been included in the Journal at the request of a number of members of the Association. It is designed to allow the inclusion of material of a brief and possibly preliminary nature with a very short publication time. Suitable subject matter would include Weights and Measurements, Moult, Plumage changes, Colour of soft parts, Ageing and Sexing methods and Requests for information, etc.

It is recommended that material from 'Data Exchange' be referenced as, e.g.:

Lane, S. G. (1983), 'Weights and Measurements — Eastern Spinebill', *In* Data Exchange, *Corella* 7: 22.

Hon. Editor

Weights and Measurements

Long-billed Corellas *Cacatua tenuirostris*, collected in western Victoria 1977-1983.
Monthly Weights (g)

MALES

Month	Range	Mean	SD	n
Jan.	519-587	554	24.5	8
Feb.	531-629	577	32.4	16
Mar.	489-676	589	40.1	31
Apr.	557-640	599	34.1	4
May	528-690	602	51.5	16
June	547-639	593	30.4	10
July	491-718	627	71.8	9
Aug.	485-611	566	45.9	7
Sep.	558-689	608	46.0	10
Oct.	536-635	586	28.2	9
Nov.	503-678	577	47.0	23
Dec.	524-659	597	36.9	20

FEMALES

Month	Range	Mean	SD	n
Jan.	497-568	532	21.7	17
Feb.	473-617	544	41.8	21
Mar.	458-636	528	44.9	27
Apr.	467-624	538	42.1	14
May	493-608	547	38.1	7
June	535-571	559	12.4	8
July	477-620	557	49.7	11
Aug.	462-630	551	47.3	13
Sep.	505-718	551	57.9	13
Oct.	500-580	550	35.1	4
Nov.	515-615	562	32.6	24
Dec.	447-599	542	42.9	10

Most specimens were shot under permit by grain growers and then frozen until they could be picked up by staff of the Fisheries and Wildlife Service.

Sex was determined by dissection; age was not determined; the weights of a few birds (in November and December) which obviously had just fledged were not included.

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