

## Waterbirds at Lake Gregory: Available Data and Information Required

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### ANECEDOTAL ACCOUNTS

There is little information available about waterbirds at Lake Gregory prior to 1977. Nevertheless, some of the early European explorers were most impressed by the abundance of waterbirds and Carnegie (1898, p. 371) who camped there in April 1886 wrote 'The lakes and creek abound in wildfowl of all kinds...so dense was the crowd of shags, pelicans, snipe, small gulls, whistling duck, teal and other birds, that to say there was acre upon acre of wildfowl would not be wide of the mark...'. The lake was slightly brackish at the time.

Among more recent visitors Dr P.E. Playford commented that in July 1973 'The bird life is spectacular, with flocks of hundreds of pelicans and numerous Black Swans, ducks and other waterbirds'.<sup>1</sup> Wildlife Officer L. Campbell visited the lake in August 1975 and reported that there were 'huge' numbers of Brolgas and Pacific Black Ducks, 'plentiful' Australian Pelicans and Black Swans, and that Pink-eared Ducks were present among 'many different' species of waterbird.<sup>1</sup>

### WATERBIRD SURVEYS

The first detailed survey of waterbirds at Lake Gregory was undertaken by Smith and Johnstone (1978), who spent 6-7 November 1977 there and traversed 13 km of the eastern shoreline of Mulan Lake between Salt Pan Creek and Lens Bore. The lake was approximately half-full and Smith and Johnstone recorded about 10 900 birds comprising 26 species (Table 5.1). The approximate length of the shoreline of Mulan Lake and Lera Water-hole is

70 km and, if birds were evenly distributed around the shore of the lake, Smith and Johnstone's count suggests the total number of waterbirds was around 50 000 (Table 5.1). Bulbi Plain, which has a shoreline of approximately 16 km, may also have contained water and, therefore, additional birds. One species was recorded breeding during Smith and Johnstone's survey (Table 5.2).

The lake system was surveyed again from 23-28 April 1979 when the water level was very low (Start and Fuller 1983). Survey effort was concentrated around Sturt and Djaluwon Creeks and only 69 birds were recorded on the Mulan Lake and a total of 19 species in the lake and creeks (Table 5.1).

There was a substantial inflow in summer of 1979/80 and the lake system was approximately two-thirds full when 20 km along the western shore of Bulbi Plain and eastern shore of Mulan Lake was surveyed between 30 May - 4 June 1980. Approximately 34 000 birds of 26 species were counted (Start and Fuller 1983) and, on the basis of the proportion of shoreline traversed, probably 100 000 birds were present (Table 5.1).

In 1982 the Lake Gregory system flooded into the surrounding desert after heavy rains in the catchment (McKenzie *et al.* 1983). The lake was visited between 10-15 May 1983 by J.B. Paton and others when still extensively flooded, although tide-marks on trees within Mulan Lake suggested it was about 1.2 m below the maximum flood level. The low dunes around the lake were still inundated. In contrast, during surveys by Smith and Johnstone (1978) and Start and Fuller (1983), the shoreline comprised only mudflats without any inundated trees. Only small parts of Mulan Lake and Lera Water-hole were surveyed by Paton and about 2000 birds of 28 species were recorded (Table 5.1). Five species were recorded breeding (Table 5.2).

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<sup>1</sup> Department of Conservation and Land Management file on Lake Gregory.

Between 26-29 August 1986 Lake Gregory was surveyed by a group from the Royal Australasian Ornithologists Union (RAOU). The system was full, being flooded beyond its mapped boundary, and many of the dead trees fringing the lake (killed by earlier flooding) were still inundated. The main survey was preceded by an aerial survey in May; in August virtually all the lake complex was covered (Jaensch and Vervest 1990). Almost 240 000 waterbirds of 57 species were counted (Table 5.1). Five species were recorded breeding (Table 5.2).

There was no inflow of water into Lake Gregory in the summers of 1986/87 and 1987/88 so that it was only one-third full when surveyed between 30-31 March 1988 by S.A. Halse and G.B. Pearson. The northern and eastern shorelines of Mulan Lake and Lera Water-hole were traversed from Sesbania Creek to Lens Bore, a distance of almost 40 km. Thirty-two species were recorded in the lake itself and adjacent parts of Sturt Creek and, by extrapolating the numbers seen of the more common species, it was calculated that the Lake Gregory system contained approximately 600 000 waterbirds (Table 5.1). The birds were most dense in Lera Water-hole.

Halse and Pearson's estimate of the number of birds on the Lake Gregory complex represents one of the highest waterbird 'counts' in Australia. Although they are confident of the order of magnitude of their estimate, there is a need for more detailed surveys to provide exact numbers. In an attempt to do this the RAOU visited the lake between 11-12 May 1988, six weeks after Halse and Pearson, made an aerial survey and also covered most of the lake on the ground (Jaensch and Vervest 1989). In contrast to six weeks previously, only 75 000 birds were counted. Thirty-six species were recorded (Table 5.1).

Altogether 59 species of waterbird have been recorded at Lake Gregory in the seven surveys since 1977 that are reported here (Table 5.1). Eight species have been observed breeding (Table 5.2).

## MAJOR SPECIES

Very high numbers of some species have been recorded at Lake Gregory (Table 5.1). Of special interest are Pink-eared Ducks. By extrapolating their count to the whole lake (allowing for the fact that densities were higher in Lera Water-hole than elsewhere) Halse and Pearson estimated 150 000 - 200 000 Pink-eared Ducks were present in March 1988. This is a much higher number than recorded anywhere else in Australia. To put it in context, surveys of 20-30 estuaries and 200-350 lakes and swamps in south-western Australia each March

between 1986-88 recorded only about 2200, 7900 and 6100 Pink-eared Ducks, respectively (Jaensch and Vervest 1988 a, b). Surveys of approximately 12 per cent of the land area of eastern Australia each October between 1983-87 recorded a maximum of 121 000 and a minimum of 17 000 Pink-eared Ducks (Braithwaite *et al.* 1985 a, b, 1986, 1987; Kingsford *et al.* 1988).

Similarly, very large numbers of Grey Teal (~150 000) Eurasian Coots (~100 000) and Hardheads (~60 000) were estimated to be present in March 1988 (similar numbers of Eurasian Coots were recorded in 1986) that far exceeded numbers counted in the annual waterfowl counts in south-western Australia (Jaensch and Vervest 1988 a, b). The count of Hardheads was of special Western Australian relevance; annual counts of this species in the south-west between 1986-88 were 433, 747 and 1351, respectively. About 51 000 Hardheads were recorded in Lake Argyle in August 1986 (Jaensch and Vervest 1989).

The estimate of 50 000 Pacific Black Ducks in March 1988 is as high as has been recorded anywhere in northern Australia; the highest count from Lake Argyle is 16 000 in November 1979 (Gowland 1983) and only about 50 000 Pacific Black Duck were counted in Lake Gallilee in Queensland in October 1984 when it contained over 1 000 000 waterbirds (Braithwaite *et al.* 1985b).

Although the 5000 - 10 000 Maned Duck estimated to be present in March 1988 is not high in terms of the numbers that occur in a region, such a large aggregation does not occur elsewhere in Western Australia.

Numbers of Little Black Cormorants at Lake Gregory were very high (~60 000) in both 1986 and 1988; these are possibly the highest counts for the species at one locality in Australia (see Jaensch and Vervest 1989). Numbers counted in the annual surveys in south-eastern Australia varied between 4000 and 24 000 (Braithwaite *et al.* 1985 a, b, 1986, 1987; Kingsford *et al.* 1988).

Masked Lapwings are confined to the northern part of Western Australia although the species is widespread in eastern Australia. Halse and Pearson estimated that 10 000 were present in March 1988 which represents a significant concentration of this widespread bird. Similarly, 10 000 - 15 000 Sharp-tailed Sandpipers were estimated to be present in March 1988, which represents a significant concentration of the species although larger numbers have been recorded previously at Anna Plains and in eastern Australia (Blakers *et al.* 1984).

The count of 898 Freckled Ducks made in August 1986, although not high in absolute terms, is the largest concentration of this species recorded in Western Australia. Freckled Ducks are gazetted 'rare and endangered' under the Western Australian Wildlife Conservation Act.

## SIGNIFICANCE FOR WATERBIRDS

### Number of waterbirds

The number of waterbirds estimated to be present at Lake Gregory in March 1988 places it among the most important wetlands in Australia in terms of maximum number of birds counted and makes it easily the most important Western Australian wetland. The only Australian lake from which a higher count has been published is Lake Gallilee, in which more than 1 000 000 birds were counted in 1984; although similar numbers probably occur in nearby Lake Buchanan (Braithwaite *et al.* 1987). The surveys of Lake Gregory are too few and incomplete to gauge how many birds it usually supports but it would appear from Table 5.1 that the lake often contains more than 100 000 birds, which probably makes it the most important inland wetland in Australia in terms of regularly supporting high numbers of birds. Some coastal sites (e.g. the Coorong in South Australia and Eighty-mile Beach in Western Australia) support more birds but these are predominantly waders whereas Lake Gregory supports mostly ducks, coots and cormorants.

The origin of the birds in Lake Gregory in March 1988 (and August 1986) is unclear. However, waterbird counts in eastern Australia in October 1987 were extremely low (Kingsford *et al.* 1988), which suggests the possibility that some birds may have moved westwards from eastern Australia into the Northern Territory and Kimberley. Conditions were dry in the Kimberley during the summer of 1987/88 and Lake Gregory (perhaps together with Lake Argyle) may have supported a large proportion of the birds in the region. After heavy rains in the Kimberley and north-western Australia the birds dispersed and only moderate numbers remained at Lake Gregory by May 1988 (Table 5.1). If this speculative scenario is correct Lake Gregory has a very important, albeit sporadic, role in waterbird conservation at a national level. There is no doubt that waterbirds move long distances in response to rainfall or other factors; Frith (1962) showed that Grey Teal banded in the Northern Territory during a drought in eastern Australia subsequently moved extensively into eastern Australia, the Kimberley and south-western Australia. Recoveries in northern Australia of Grey Teal and

Pacific Black Duck banded in the south-west show that the reverse movement also occurs.<sup>2</sup>

The significance of Lake Gregory as a dry season refuge for birds in the Kimberley is unclear without more detailed waterbird counts at Lake Gregory and in the Kimberley and a better understanding of the Australia-wide movements of waterbirds. However, the fairly consistently high numbers of birds recorded during winter suggests that it may have an important, regular role in this respect. Its role as an Australia-wide refuge, if it exists, is probably secondary to the regional role.

The large number of Sharp-tailed Sandpipers at the Lake in March 1988 was probably a pre-migratory concentration and in years when water levels are suitable Lake Gregory may be used extensively by the less marine wader species on their return migration to the northern hemisphere.

### Breeding

It is not clear at which time of the year most breeding occurs at Lake Gregory but it probably has a Kimberley pattern because that is where the catchment area of the lake lies. Most breeding in the Kimberley occurs during January - March (Slater 1959; Halse and Jaensch 1989). Lake Gregory has already been shown to be an important breeding site for Little Black Cormorants and Caspian Terns (Table 5.2; see Jaensch and Vervest 1990). It is possible that Lake Gregory is a recruitment area for Little Black Cormorants, Caspian Terns and some other species, with birds born at the lake subsequently dispersing to other parts of Australia. A significant number of Pied Cormorants bred there in 1986 and several other species have been recorded breeding.

However, information about breeding is incomplete and is virtually limited to the results of winter surveys. Additional surveys during the presumptive breeding season during a year when the lake contains plenty of water are required to determine fully the importance of Lake Gregory and the anastomosing channels of Sturt Creek as breeding areas for waterbirds.

## HOW DOES THE LAKE FUNCTION?

The speculation above about the significance of Lake Gregory at a regional and national level must be

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2 S.A. Halse, D.A. Diepeveen and D.R. Munro (in prep.). Recoveries of Grey Teal and Pacific Black Ducks in south-western Australia 1952-76.

tempered with the recognition that the lake shows considerable year-to-year variation in depth that constrains its waterbird carrying capacity. The surveys since 1977 suggest that carrying capacity drops substantially when the lake is nearly dry or flooded into the surrounding sand dunes. Presumably extensive flooding makes most of the lake shoreline too deep for birds to get access to food. At intermediate depths the carrying capacity of the lake appears to be in the order of 100 000s of birds.

There is not enough information to deduce fully the seasonal pattern of waterbird abundance at intermediate depths although, as mentioned above, it can reasonably be assumed that numbers are maximal in winter. In the wet season many species probably disperse to breed on flood-plains to the north unless it is a dry year (e.g. 1988). However, at least some piscivorous species remain at the lake to breed when conditions are suitable (Table 5.2; Jaensch and Vervest 1990) and it is possible that some species of ducks and other birds also breed there or on Sturt Creek in significant numbers (see above).

The extent of breeding is undoubtedly dependent on water depth. Most of the species that occur at the lake are tree-nesting and are only likely to breed when the fringing trees are flooded. Some species probably require live trees in which to nest, although for cormorants dead trees are usually adequate. Ground-nesting species, such as terns and small waders, probably nest most frequently on the shallow lakes (Bulbi, Yuinby and Guda Plains) in the western part of the system. These contain water only when water levels are fairly high.

The food sources used by birds at Lake Gregory are not known but there are a lot of piscivorous birds (pelicans, cormorants, Darter) and the lake contains a lot of fish (Carnegie 1898, p.371).<sup>3</sup> Presumably other birds at the lake mostly feed on macrophytes, algae and aquatic invertebrates although more terrestrial species, such as Brolgas and ibises, would feed on terrestrial invertebrates and small vertebrates around the lake.

## INFORMATION REQUIRED

On the basis of the information summarized above, there appear to be four areas in which more information is required and a series of questions, some of which overlap, can be posed within these areas.

<sup>3</sup> J.B. Paton, an amateur ornithologist from South Australia, also recorded that fish were abundant in 1983 (personal communication).

### Number of waterbirds

- (1) When water levels are intermediate and the carrying capacity of the lake is high, what external factors determine the number of birds at Lake Gregory? There are probably two sets of factors operating: firstly, wetland conditions elsewhere in Australia and the Australia-wide movement of waterbirds; and secondly, seasonal conditions in the Kimberley region. Aerial surveys of waterbirds in the Kimberley in conjunction with the annual surveys in eastern and south-western Australia would show the relative importance of each set of factors in a given year and would provide data on the effect of wetland conditions at Lake Gregory and elsewhere in the Kimberley on waterbird numbers in Lake Gregory.
- (2) Where do the waterbirds seen in these large concentrations at Lake Gregory come from and go to? A colour-marking program would answer this question.

### Carrying capacity

- (3) What do birds feed upon at the lake, when and why does food availability limit numbers? Studies of diet, feeding behaviour, body weight (or condition) and construction of energy budgets, together with measurements of the biomass of different foods and their distribution in the lake, would be required to answer this question.
- (4) Are bird numbers at the lake limited by factors other than food (e.g. roosting habitat)? The behavioural studies required to answer question (3) would give some indications of the answer to this question.

### Breeding

- (5) How many species breed at the lake when conditions are favourable? Regular visits to the lake during the likely breeding season during several years with varying water depths would be required to answer this fully.
- (6) What are the breeding requirements of the species that breed in significant numbers in Lake Gregory? This question could be answered by fairly simple studies, both in Lake Gregory and elsewhere, of breeding success and habitat use by the relevant species.

## Management

- (7) How is the current management of the lake affecting its value as a site of significant waterbird aggregation and breeding? The studies outlined under **Carrying capacity** and **Breeding** would provide most of the answers required here.

## ACKNOWLEDGEMENTS

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**Table 5.1**  
Waterbirds Recorded at Lake Gregory

	Nov 1977 <sup>a</sup>	Apr 1979 <sup>b</sup>	May/ June 1980 <sup>b</sup>	May 1983 <sup>c</sup>	Aug 1986 <sup>d</sup>	Mar 1988 <sup>e</sup>	May 1988 <sup>d</sup>
<b>LAKE CONDITIONS</b>							
Approximate condition	half full	almost dry	two-thirds full	full	full	third full	third full
Depth (m)					6.5		>3
Salinity (ppt TDS)				fresh	1.4	~ 6.0	~ 6.0
pH						~ 8.7	~ 9.1
<b>SPECIES</b>							
Great Crested Grebe <i>Podiceps cristatus</i>					842	+	77
Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>		2			5	+	47
Australasian Grebe <i>Tachybaptus novaehollandiae</i>	14		1		108		
Australian Pelican <i>Pelecanus conspicillatus</i>	420		> 6000	~ 40	3097	5000-6000†	824
Darter <i>Anhinga melanogaster</i>	30		1	~ 30	854	~ 5000	684
Great Cormorant <i>Phalacrocorax carbo</i>					4		
Pied Cormorant <i>Phalacrocorax varius</i>				~ 50	2230	~ 1000†	1340
Little Black Cormorant <i>Phalacrocorax sulcirostris</i>	330			common	59 982	50 000-60 000†	15 480
Little Pied Cormorant <i>Phalacrocorax melanoleucos</i>				mod common	589		10
Pacific Heron <i>Ardea pacifica</i>	2	4	79		18		
White-faced Heron <i>Ardea novaehollandiae</i>		*	12	3	1		
Great Egret <i>Egretta alba</i>	25		16	20+	355	+	35
Little Egret <i>Egretta garzetta</i>					5		

Table 5.1 (continued)

	Nov 1977 <sup>a</sup>	Apr 1979 <sup>b</sup>	May/ June 1980 <sup>b</sup>	May 1983 <sup>c</sup>	Aug 1986 <sup>d</sup>	Mar 1988 <sup>e</sup>	May 1988 <sup>d</sup>
Intermediate Egret <i>Egretta intermedia</i>				1	8		
Rufous Night Heron <i>Nycticorax caledonicus</i>				30+	27		
Black-necked Stork <i>Xenorhynchus asiaticus</i>	1				3		
Glossy Ibis <i>Plegadis falcinellus</i>				~4	64		
Sacred Ibis <i>Threskiornis aethiopica</i>					26	+	2
Straw-necked Ibis <i>Theskiornis spinicollis</i>			3	4+	255	+	56
Royal Spoonbill <i>Platalea regia</i>	2		1	~40+	62	+	16
Yellow-billed Spoonbill <i>Platalea flavipes</i>			7	3	20	*	2
Magpie Goose <i>Anseranas semipalmata</i>					135		3
Wandering Whistling-Duck <i>Dendrocygna arcuata</i>					1570		
Plumed Whistling-Duck <i>Dendrocygna eytoni</i>				150	13 150	+	1750
Black Swan <i>Cygnus atratus</i>	400	*	18	~30	5775	~5000	4027
Freckled Duck <i>Stictonetta naevosa</i>					898		52
Australian Shelduck <i>Tadorna tadornoides</i>		*			4		
Pacific Black Duck <i>Anas superciliosa</i>	200	*		~10	277	~50 000	1198
Grey Teal <i>Anas gibberifrons</i>	3500	*	>25 000	~12	11 133	~150 000	21 015
Pink-eared Duck <i>Malacorhynchus membranaceus</i>		*	50	~60	33 849	150 000- 200 000	9423
Hardhead <i>Aythya australis</i>	6		6	~12	16 037	~60 000	9936

Table 5.1 (continued)

	Nov 1977 <sup>a</sup>	Apr 1979 <sup>b</sup>	May/ June 1980 <sup>b</sup>	May 1983 <sup>c</sup>	Aug 1986 <sup>d</sup>	Mar 1988 <sup>e</sup>	May 1988 <sup>d</sup>
Maned Duck <i>Chenonetta jubata</i>			4	12 +	353	5000 -10 000	105
Marsh Harrier <i>Circus aeruginosus</i>			*		2		4
Black-tailed Native-hen <i>ventralis</i>					39	+	
Purple Swamphen <i>Porphyrio porphyrio</i>					2		
Eurasian Coot <i>Fulica atra</i>	5000	2		mod common	74 258	~ 100 000	3407
Brolga <i>Grus rubicundus</i>	570	~ 50	~ 100	2	3530	+	499
Masked Lapwing <i>Vanellus miles</i>	20			2	215	~ 10 000	8
Red-kneed Dotterel <i>Erythrogonys cinctus</i>			5		73		
Oriental Plover <i>Charadrius veredus</i>	90					+	
Red-capped Plover <i>Charadrius ruficapillus</i>	+		250		515	+	116
Black-fronted Plover <i>Charadrius melanops</i>	6		> 10	few	20		
Black-winged Stilt <i>Himantopus himantopus</i>		1	1		611	+	18
Banded Stilt <i>Cladorhynchus leucocephalus</i>	34						9
Red-necked Avocet <i>Recurvirostra novaehollandiae</i>		3	25		204		174
Wood Sandpiper <i>Tringa glareola</i>	8				19		
Common Sandpiper <i>Tringa hypoleucos</i>		3			3		
Greenshank <i>Tringa nebularia</i>	4	1			4		
Marsh Sandpiper <i>Tringa stagnatilis</i>					46		



Table 5.1 (continued)

	Nov 1977a	Apr 1979b	May/ June 1980b	May 1983c	Aug 1986d	Mar 1988e	May 1988d
Bar-tailed Godwit <i>Limosa lapponica</i>					1		
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	36				1442	10 000- 15 000	10
Red-necked Stint <i>Calidris ruficollis</i>		3	1		337		100
Long-toed Stint <i>Calidris subminuta</i>					3		
Curlew Sandpiper <i>Calidris ferruginea</i>					359	+	10
Australian Pratincole <i>Stiltia isabella</i>	35				295	+	16
Silver Gull <i>Larus novaehollandiae</i>		*	~ 70	few	89	+	486
Whiskered Tern <i>Chlidonias hybrida</i>	70	*	2000	mod common	1996	+	1795
Gull-billed Tern <i>Gelochelidon nilotica</i>	56	*	9	2	82	+	
Caspian Tern <i>Hydroprogne caspia</i>	20	*	62	15+	1560	+	760
No. of Species	26	19	26	28	57	32	36
No. of Birds Counted	> 10 879	69	> 33 731	?2000	239 666	-	75 524
Estimated No. of Birds	50 000	< 1000	100 000	?	239 666	600 000	75 524

+ present but numbers not recorded

\* present in Sturt Creek just north of lake

<sup>a</sup> Smith and Johnstone (1978)

<sup>b</sup> Start and Fuller (1983)

<sup>c</sup> J.B. Paton (unpublished data)

<sup>d</sup> Jaensch and Vervest (1989)

<sup>e</sup> S.A. Halse and G.B. Pearson (unpublished data) - figures for individual species are extrapolated for the whole system based on approximate numbers per kilometre at various parts of the traverse unless marked with † when they represent numbers of birds seen.

**Table 5.2**  
Waterbirds Recorded Breeding at Lake Gregory

Species	Nov 1977 <sup>a</sup>	May 1983 <sup>b</sup>	Aug 1986 <sup>c</sup>
Darter		several, 1 nest with young	
Pied Cormorant		11 nests with young	1000 active nests
Little Black Cormorant		50 nests with eggs/young	8000 active nests
Little Pied Cormorant			10 active nests
Rufous Night Heron		2 nests with young	
Black Swan	2 broods, 1 nest with eggs	5 nests with eggs	
Red-capped Plover			+
Caspian Tern			500 active nests

+ no details given

<sup>a</sup> Smith and Johnstone (1978)

<sup>b</sup> J.B. Paton (unpublished data)

<sup>c</sup> Jaensch and Vervest (1989)