

Mass-breeding by Hoary-headed Grebes *Poliiocephalus poliocephalus* at Lake Bathurst, New South Wales

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Abstract. During surveys of the waterbirds of the Lake Bathurst wetland system on the Southern Tablelands of New South Wales, near Canberra (Australian Capital Territory) in most months from 1980 onwards, Hoary-headed Grebes *Poliiocephalus poliocephalus* were found breeding on only six occasions. Nests were built along islands that formed only when Lake Bathurst and the neighbouring Southern Morass reached specific water depths. At higher and lower water levels, Grebes were present but did not breed. The maximum number of nests in a season was 985, much greater than any reported in the literature, but young were produced in only three seasons. Nest failures resulted from falling water levels, heavy rain (and associated rise in water level) or a wind-induced temporary rise in water level. Partial reflooding of the lake triggered late nesting, in April, but the nests were abandoned as the water level fell. High mobility, congregating at refilling wetlands and attempts to nest late in the season by this species may be responses to the ‘boom and bust’ scenario of inland wetlands.

Introduction

The Hoary-headed Grebe *Poliiocephalus poliocephalus* is found on terrestrial and estuarine wetlands in temperate and tropical Australia. It tends to prefer larger bodies of water with submerged vegetation. Large flocks of many thousands can be found in winter in coastal areas (Marchant & Higgins 1990), e.g. up to 25,000 at the Western Treatment Plant, Victoria (Loyn *et al.* 2014). In response to rainfall, the species can congregate in large numbers at inland waters after they fill (Marchant & Higgins 1990). Breeding occurs mainly away from the coast (Marchant & Higgins 1990; Cooper *et al.* 2014; Loyn *et al.* 2014). Eggs have been recorded from August to March over the full breeding range of the species, although most clutches are initiated between September and January (Marchant & Higgins 1990; Cooper *et al.* 2014).

Hoary-headed Grebes nest as single pairs but also often in colonies. However, records on colony size from across the breeding range are limited. Hobbs (1958, p. 131) reported “such colonies sometimes being 100 pairs strong” in south-western New South Wales. According to the Australian Nest Record Scheme, colonies can include up to 300 pairs (Marchant & Higgins 1990). Frith (1976) reported a loose colony of 400 nests from Lake Bathurst in southern New South Wales.

This paper reports on other major breeding events of this species at Lake Bathurst recorded during regular surveys from April 1980 onwards.

Study area and methods

Lake Bathurst (35°02'S, 149°41'E), at 680 m above sea level, is located on the Southern Tablelands 50 km north-west of Canberra, Australian Capital Territory. It extends to ~1350 ha when full and its depth can reach 7 m (Braithwaite 1982; Abell 1995), although since 1980 it has never been full to capacity. It was at its highest, with a maximum water depth of 3.3 m between 1989 and 1993 (Abell 1995). In

most years it is separated into a major ‘East Basin’ and a smaller ‘West Basin’ with dry lakebed and a few pools in between. At times the lake has dried up completely (e.g. in the second half of 1987). Over the last ~20 years, shrinking to drying out and partial refilling, mainly of the eastern part, have been the norm (Lenz 2014).

To the east, two small ephemeral lakes, the Southern and Northern Morasses (maximum size ~125 ha and ~300 ha, respectively) are separated from Lake Bathurst by wave-built ridges. They contain fresh water; Lake Bathurst is saline. The Morasses are fed by creeks whereas Lake Bathurst is sustained by groundwater discharge (Abell 1995). Following good rains, overflow from the Northern Morass runs directly across paddocks into Lake Bathurst. Grazing land surrounds all three lakes, all of which are used by waterbirds that can move readily between them (Lenz 2014).

The bed of Lake Bathurst is composed of sand and gravel. The water is clear. The submerged water plant Milfoil *Myriophyllum propinquum* forms dense stands at higher water levels, and Widgeon Grass *Ruppia* sp. becomes the dominant underwater vegetation when waters recede and the lake turns more saline (Braithwaite 1982; Abell 1995). There is no reedy vegetation along the lake’s shores.

Lake Bathurst lies within the so-called Area of Interest (‘the Canberra Region’) of the Canberra Ornithologists Group (COG) (see Canberra Ornithologists Group 2018). I have organised and conducted regular waterbird surveys at Lake Bathurst on behalf of COG since April 1980 (Lenz 2014). Surveys were carried out less regularly in the first year but at monthly intervals whenever possible from June 1982 onwards. In 1992, I made two extra visits to monitor the number of Hoary-headed Grebe nests.

Lake Bathurst was fully accessible via private properties. The surveys were conducted by walking around the lake at a distance from the shore that minimised disturbance to the waterbirds. Birds were recorded with the use of telescopes (Zeiss Jena Asiola, 24× and 42×). Some fence-lines (erected during earlier dry spells) running across and

along the lake assisted in partitioning the lake, so several observers could participate in the counts, each covering a particular section. On most occasions, however, there were only 1–3 observers. The aim was always to survey the entire area covered with water and to record all waterbirds. The Southern Morass could be surveyed from a road along its eastern shore. The Northern Morass was out of reach except for a brief initial period.

Results

Because of the topography of the Lake Bathurst wetland system, some areas of grassland (and granite boulders) can turn into islands at specific water levels. At Lake Bathurst, water depth has to be high enough to flood the southern part of the lake before islands emerge. At the Southern Morass, islands form only at relatively low water levels. These islands can be used by several species of waterbirds for nesting. Hoary-headed Grebes build their semi-floating nests close to the shores of these islands in lines and clusters. Since 1980, the Grebes have bred only in some years on the main lake and the Southern Morass, in total six times (Table 1).

Hoary-headed Grebe breeding events at Lake Bathurst

Before 1980

Frith (1976) mentioned 400 nests without providing any more information. This particular breeding event took place in 1969 (L.W. Braithwaite pers. comm.; no date was given in Frith 1976).

Fjeldsa (1983) studied Hoary-headed Grebe behaviour in New South Wales between 1 October and 2 December 1979. “Establishment of a colony and mating was followed near Canberra” (Fjeldsa 1983, p. 129), i.e. at Lake Bathurst (Davey 1987) but no information on colony size was given.

Since 1980

Over the nearly 40 years that the waterbird surveys have been conducted, Hoary-headed Grebes have been found nesting only six times (Table 1). Details are provided below.

1981

During the survey on 13 December, 1750 adult Hoary-headed Grebes were counted and 475 nests were found around islands in the southern part of the lake (Case 3,

Table 1. Breeding events of Hoary-headed Grebes at Lake Bathurst and the Southern Morass, New South Wales. Occupied nests had adult Grebes incubating on them.

<i>Case</i>	<i>Date</i>	<i>No. nests</i>	<i>Outcome</i>	<i>Reference/observers</i>
Lake Bathurst				
1	1969	400		Frith (1976)
2	Nov. 1979	‘Nests’		Fjeldsa (1983)
3	13 Dec. 1981	475	Many families	H.M. Doyle, A. Drake, M. Lenz
4	Dec. 1992–Feb. 1993*	Max. 985 occupied	All 1st and replacement clutches flooded; no young	M. Lenz
5	Oct.–Dec. 1993	609 occupied	Falling water level, all nests abandoned; no young	M. Lenz
Southern Morass				
6	18 Dec. 1988	2 occupied	22 Jan. 1989: 2 young	H.M. Doyle
7	16 Apr. 2012	24 occupied	Falling water level; nests abandoned by 5 May	Lenz & Kamprad (2012)
8	Aug.–Oct. 2016	Max. 70 occupied	Young in Sep. and Oct.	J. Kamprad, P. Milburn Lenz (2016)

*See Table 2 and text for details.

Table 1). Some Grebes were still incubating while many others were in the water with their young. The visits on either side of this date were either too early (23 August) or too late (7 February) to provide more information about this breeding event, but clearly many pairs had been successful in hatching young. Compared with breeding in later years (see Table 1 and text below), the 1981 breeding season at Lake Bathurst was the most successful.

1992–1993

At the beginning of December 1992, Hoary-headed Grebes had built 31 nests, spread around four islands. By the end of that month, Grebes were incubating on 756 nests, distributed around six islands (Case 4, Table 1; Table 2). Four of the islands were located in the southern and south-eastern parts of the lake (688 nests), two in the south-west (68 nests).

A heavy downpour of rain (45 mm: Bureau of Meteorology 2019) on 4 January 1993 caused a quick rise in water level. Many of the nests were flooded or destroyed, as the visit to the nesting area in the south of the lake on 7 January revealed (Table 2). All clutches were lost. No Grebes were incubating, but many were adding plant material to the nest remains or had started building new nests. The greatest impact was on the colony at site II, which appeared to have been completely destroyed, with just 42 nest remains from the previous 324 active nests. This site was completely abandoned and stayed so for the remainder of the breeding season, while the other five sites continued to be used for breeding (Table 2).

By 24 January 1993, five colonies held a total of 985 occupied nests, an increase of 276 nests from the previous month (Table 2). In November and December, numbers of adult Hoary-headed Grebes across the lake were stable at ~1860; this had increased by a further 400 birds in January (Table 3).

On 10 February 1993, all repaired and new nests were deserted. Most structures looked waterlogged or were partially submerged, and eggs were seen either still in the nests or floating in the water. Grebes no longer showed any interest in the remaining nest structures. The only major rainfall between my visits on 24 January and 10 February was just 10 mm on 25 January (Bureau of Meteorology 2019). If this rain had been combined with a strong wind (prevailing winds are westerlies), it is likely that water could have been temporarily pushed up against the nests, drowning their contents.

Table 2. Numbers of Hoary-headed Grebe nests at Lake Bathurst during the 1992–1993 breeding event (Case 4, Table 1). A sudden rise in water level after heavy rain flooded all nests (756) during early January 1993. Replacement clutches and additional nests (total of 985) were again flooded between late January and early February 1993.

Colony	1 Dec. 1992	7 Jan. 1993	24 Jan. 1993	10 Feb. 1993
		Nest remains/ new nests*		Nest remains*
I	1	202	402	0
II	17	42	0	0
III		93	195	189
IV	4	191	112	106
Subtotal	22	528	709	295
V	9	?	100	0**
VI		?	176	0**
Total	31		985	295

*See text.

**Visit to south-western part of lake with Colonies V and VI, 20 February 1993: no sign of nests but 174 Grebes still present (I. Crawford, A. Howard pers. comm.).

At wind speeds >10 km/h, a 'fetch' can be produced, pushing water towards the eastern shore, resulting in oscillations in water level at Lake Bathurst of up to >20 cm (Abell 1995). Such wind effects were noted on some windy survey days, with water being moved across the otherwise dry lakebed.

1993

The first nests (13) were recorded on 26 October at the edge of one island. On 30 November, nests numbered 609 (Case 5, Table 1). These were distributed around six islands, five located in different parts of the East Basin, and one in the West Basin. The nest aggregations around these islands comprised 20 (13 in October), 108, 120, 102, 17 and 242 (south-west) nests, respectively.

By the next visit (30 December), the water level had dropped sufficiently to render all nests accessible from the shore (open to predation by Red Foxes *Vulpes vulpes*). The islands and the nests were surrounded by only very shallow water or mud. All nests were deserted, and the

Table 3. Monthly numbers of Hoary-headed Grebes at Lake Bathurst and the Southern Morass, 1992–1993 and 1993–1994, the two years with large breeding colonies. Brackets indicate incomplete totals, when not all areas of the wetland system were surveyed; ? indicates that there was heavy lasting fog, when observers recorded only a few waterbirds and Grebes were not counted.

Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
1992–1993											
98	(237)	1830	1482	1864	1855	2289	(174)	1860	?	(329)	337
1993–1994											
(661)	1218	1900	1791	3130	1371	3380	2500	826	405	794	201

number of Grebes on the lake system had dropped by almost 60% (see Table 3). No young Grebes were noted.

Breeding events at the Southern Morass

On 18 December 1988, two Hoary-headed Grebe nests were located next to an island. At least one pair of Grebes produced two young (Case 6, Table 1).

The East Basin of Lake Bathurst and the Southern Morass experienced a partial refill, to an extent not witnessed for the previous 15 years, after 222 mm of rain fell over the area between 29 February and 9 March 2012 (Bureau of Meteorology 2019). On 18 March, a total of 128 Hoary-headed Grebes was found across both waterbodies. At Lake Bathurst, two Grebes were seen carrying blades of Serrated Tussock *Nasella trichotoma* deeper into a flooded stand of this grass. The site did not seem suitable for nesting, and a month later that section of the lake had dried up again. No further indications of breeding on the lake were noted. However, the number of Grebes in total had increased to 950 (Lenz & Kamprad 2012).

On 16 April 2012, next to two small islands on the Southern Morass, 24 Grebes were incubating (Case 7, Table 1). The refilling of the lake had triggered a late breeding event, although by 5 May all these nests had been abandoned. Foxes would have been able to reach one of the islands, which was located close to shore (because of a drop in water level). However, the nests near the second island were still surrounded by deeper water but had also been abandoned. The lateness of the season and the onset of cooler weather might have ultimately terminated this breeding attempt (Lenz & Kamprad 2012).

Higher rainfall in January 2016 (115 mm) and 299 mm between June and September (Bureau of Meteorology 2019) resulted in some flooding of the eastern part of Lake Bathurst and of the Southern Morass. At the latter, a few islands were formed. In August, three Hoary-headed Grebe nests were located next to an island (Case 8, Table 1); the number of occupied nests had increased to 70 in September. Young Grebes were recorded in September and October. However, it appeared that some nests failed, possibly from flooding after rainfall in September and October. Twelve nests were still present in October, but by November most Grebes had left, and none were recorded on the Southern Morass in December (Lenz 2016).

Discussion

Breeding status in the Canberra Region

Cooper *et al.* (2014, p. 132) noted for the Hoary-headed Grebe that in New South Wales “most breeding activity occurs away from the coast”. In the Canberra Region, this species is commonly found within the Australian Capital Territory, at Lake George and at the Lake Bathurst wetland system. However, in the Australian Capital Territory only single pairs have been recorded breeding occasionally on small waterbodies with submerged vegetation (Davey 1987; Taylor & Canberra Ornithologists Group 1992; Wilson 1999).

At Lake George (15 km west of Lake Bathurst, and significantly larger), Lamm (1964) noted the regular presence of this species but no breeding. This lake has been surveyed regularly for waterbirds by COG since 1979 (Lenz 2014). There appears to be only one breeding record in that time: following good rain in March and April 1989 and some reflooding of the lake, Geoff Duggan (pers. comm.) located one nest with three eggs on 6 May among a stand of flooded thistles, a notably late record for a nest still containing eggs. The fate of this nest is not known.

In contrast, at the Lake Bathurst wetland system Hoary-headed Grebes are very commonly recorded, reaching a maximum of 3380 birds (Table 3). The species has nested in several years in significant numbers, and in the 1992–1993 breeding season the aggregation of almost 1000 nests (see Tables 1–2) far exceeded those recorded in the literature (Frith 1976; Marchant & Higgins 1990).

What features make Lake Bathurst and the Southern Morass such favoured breeding sites?

Hoary-headed Grebes nest on fresh and brackish bodies of water with floating waterweed or scattered reedy vegetation well away from the shoreline (Marchant & Higgins 1990). Lake Bathurst and the Southern Morass have no reedy vegetation and, at both these lakes, the nests have always been built close to and along the shores of islands. However, because of the topography, islands form there only at specific water levels.

For many years since 1980, the Lake Bathurst wetland system, although often supporting high numbers of Hoary-headed Grebes (see Table 3), has failed to provide conditions for breeding. Breeding events here are irregular. Water depth, and with it the extent of the lake, and whether or not islands form, are clearly critical in the choice of breeding sites. Abell (1995) gave graphs for water depth of Lake Bathurst from 1981 to 1994. During Grebe breeding events on Lake Bathurst in 1981 and 1992, the water depth was 2.4–2.6 m (Cases 3 and 4, Table 1). In spring 1993, the depth was 2.2 m at the start of breeding, but it fell below 2.0 m during nesting, rendering the islands again part of the dry lakebed, and nests were abandoned (Case 5, Table 1). In years between and thereafter, water levels were either higher (maximum water depth 3.3 m in 1990) or much lower, as was typical from late 1993 to the present.

The submerged vegetation, a key element in the ecology of Lake Bathurst (Lenz 2014), provides abundant nest material for the Hoary-headed Grebe. Nests of this species are in general loosely attached to vegetation (Marchant & Higgins 1990) but, on a large lake with often windy conditions and no emergent vegetation, floating nests close to islands may provide better security. Furthermore, nests along islands are safe from foxes for as long as the water level stays relatively high.

In contrast, Lake George has no underwater vegetation. Algal mats form on this lake, and in its shallower parts the other main food source for Black Swans *Cygnus atratus* and ducks is the small leaves of the firmer-rooted Round-leaved *Wilsonia* *Wilsonia rotundifolia*. These conditions are

hardly suitable for Hoary-headed Grebes to form breeding colonies. The only record of a single Hoary-headed Grebe nest at Lake George comes from a partly submerged stand of thistles (see above).

Breeding season

Occupied Hoary-headed Grebe nests (i.e. with incubating adults) have been recorded between August and February (Table 1), well within the time that clutches have been reported elsewhere (Marchant & Higgins 1990). On only two occasions have Grebes nested later: 24 pairs were incubating clutches in April 2012; one pair at Lake George had a clutch in early May. In both cases, flooding appeared to have been a very powerful trigger for birds to attempt nesting. The late records from the Nest Record Scheme of eggs still in March come from inland New South Wales (Marchant & Higgins 1990) with higher temperatures than in the Canberra Region. The species can lay even later as the above records show. On the other hand, no detailed studies on the breeding biology of this species are available (Marchant & Higgins 1990), so the full capacity of Hoary-headed Grebes to make use of breeding opportunities still remains to be determined.

Breeding success

When Hoary-headed Grebes can nest at the Lake Bathurst wetland system, breeding success is far from guaranteed. The threats to successful nesting identified are:

- (a) Falling water levels over the incubation period, stranding the nests and making them accessible to terrestrial predators (Cases 5 and 7, Table 1);
- (b) Heavy rainfall leading to a sudden rise in water level and thus flooding of nests (Case 4, Table 1; Table 2; first set of clutches);
- (c) Wind action (a 'fetch') that can result in a temporary rise in water level causing flooding of nests (Case 4, Table 1; Table 2; second set of clutches).

It is especially notable that in the 1992–1993 breeding season from a total of 1741 clutches (756 + 985; see Table 2) not a single young Grebe was produced, because of rain and wind action. Likewise, the 609 nests of late 1993 also failed to produce any young, because of falling water levels.

In some years, at the onset of nesting, Hoary-headed Grebes at Lake Bathurst can experience 'boom' conditions that can easily turn into 'bust' situations. No comparative information is available from other sites with breeding colonies. The high mobility of this species and the large congregations in response to refilling of wetlands following rain (Marchant & Higgins 1990) may be a strategy to seek out breeding opportunities wherever they present themselves.

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