Between 12 and 14 May 1979 we visited Ross's Spring with Mr Walton and searched clumps of *T. irritans* by day and watched the waterhole at night but found no evidence of the occurrence of Night Parrots. Ross's Spring is a small permanent freshwater spring fed by groundwater and run-off from the surrounding dunes. It is surrounded by an open herbaceous flat and to the south-west there is a flat area carrying mallee (*Eucalyptus oleosa, E. viridis* and *E. dumosa)* with an understorey dominated by *T. irritans, Brachyloma ericoides, Caelitris verrucosa* and *Acacia* spp. This flat is surrounded by dunes where *Leptospermum-Banksia* heath grow. All of Mr Walton's observations were made in mallee scrub with *T. irritans* in the understorey.

Scarce (Howe and Tregellas 1914) reported Night Parrots at two places, one about forty-two miles (65 km) north of Murrayville near the South Australian border and the other twelve miles (19 km) south of Kow Plains. If Scarce meant south of Kow Plains homestead, which was at Cowangie, his location is some ten kilometres south-west of Ross's Spring and very close to a similar spring known as Burrels Soak (35° 25'S; 141° 26'E). Scarce's notes suggest that the habitat at his two sites was similar to that at Ross's Spring and Burrels Soak: 'in both instances the birds were in thick and large porcupine grass and were seen feeding out on the edges of the grass, in each case where the grass spreads out onto small plains. There were round tunnels through each clump . . '

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BREEDING AND MORTALITY OF BUDGERIGARS *MELOPSITTACUS UNDULATUS*

Studies of domesticated Budgerigars and a few field observations suggest that Budgerigars may have a short breeding cycle, rapidly increase numbers when seasonal conditions are good and suffer high mortality during climatic extremes. Domesticated Budgerigars are physiologically capable of breeding at three and a half to four months old (von Pohl-Apel and Sossinka 1975) and domesticated birds pair and breed at about five months old (von Engesser 1977). Domesticated Budgerigars will produce several successive clutches (Pratley 1957; Rutgers 1967) and males maintain enlarged testes and do not have seasonal cycles of gonadal recrudescence and regression (Brockway 1964b; van Tienhoven *et al.* 1966). Pairs of wild Budgerigars nest in close proximity (McGilp 1923; Keast 1966; Robinson 1939) and pairs of domesticated birds need to hear other breeding pairs for rapid and full gonadal development (Ficken *et al.* 1960; Brockway 1964b); such 'colonial nesting' and 'social facilitation' have been interpreted as adaptations in desert birds to synchronize breeding and accelerate ovulation (Immelmann 1963; Serventy 1971). Finlayson *et al.* (1932) report deaths of many Budgerigars during a heat wave, estimating a loss of 60,000 birds at one dam.

In this communication I present further information on breeding and mortality in Budgerigars and discuss whether this new information supports the proposals that Budgerigars have short breeding cycles, potentially high productivity and at times suffer high mortality. I collected information on density of nests, synchronization of breeding, clutch size, breeding success and duration of incubation and nestling development from nests at Trielmon (30° 15′S, 148° 05′E) in 1972 and 1973 and at Mokely Creek (29° 15′S, 141° 55′E) from November 1973 to November 1974. The Trielmon and Mokely Creek field areas and climatic conditions during my study are described in Wyndham (1980a). Budgerigars arrived at Trielmon both years in late January and early February, completed a breeding cycle and departed in late April and early May. Budgerigars were at Mokely Creek throughout my study but breeding ceased in the winter. I obtained further information from thirty nest records submitted to the RAOU Nest Record Scheme, twenty-three of which were submitted in 1973 by N. Schrader from Woollahara Station, Ivanhoe (32° 54′S, 144° 15′E) (see Schrader 1975). During breeding at Trielmon in 1972 and 1973 and at Mokely Creek in 1974 I searched defined areas thoroughly for nests by inspecting potential nesting hollows, watching for activity at nest entrances and listening for calling chicks. I calculated clutch size from clutches in which the number of eggs was the same on two consecutive visits at least forty-eight hours apart and from clutches that were hatching, excluding clutches that later proved to be deserted. I calculated incubation, hatching and nestling periods in the way described by Marchant (1980), calculating the mid-points between the extreme limiting times of observations plus or minus the range of this interval. A period of 16 days 23 hours plus or minus 2 days 23 hours is written 16.23 ± 2.23. Nestling success is the percentage of nests that fledge one or more young and fledging success is the percentage of eggs that produce fledgings.

RESULTS

Budgerigars nested in naturally occurring hollows in trees, mostly coolabahs *Eucalyptus microtheca*, which grew along the banks of water-courses and on adjacent low-lying flood-plains. Budgerigars did not modify the hole or construct a nest inside the hole. Dimensions and shapes of entrances varied greatly but most had a minimum width of from three to six centimetres and were too small for the entry of Pied Butcherbirds *Cracticus nigrogularis*, a predator of Budgerigars' young, Cockatiels *Nymphicus hollandicus*, Mallee Ringnecks *Barnardius barnardi* and Galahs *Cacatua roseicapilla*, which are sympatric hole-nesting birds. Eggs were placed inside hollows at a depth of from 0.26 metres to a few metres from the entrance. Eggs and chicks usually were at the bottom of the hollow on a soft mat of decaying wood and faeces.

At Trielmon, in an area of 3.4 hectares in March 1972, I found twenty-five nests and in March 1973 twenty nests. At Mokely Creek, in an area of 4.8 hectares in October 1974, I found five nests. Density of nests was apparently governed by the availability of suitable holes. At Trielmon there was a dense stand of dead trees, many of which had suitable holes. At Mokely Creek most of the trees were alive and, of the living trees, only the older ones had suitable holes. In places there were stands of old trees and a few dead trees, or of dead trees, and it was in these stands that nests occurred. Elsewhere there were stands of young trees and in these there were no suitable holes.

I found several trees with two nests active at the same time and in a few of these the nests were at about the same stage of breeding. Nests in the same tree were from three to five metres apart. N. Schrader found three nests less than a metre apart in one tree and closely synchronized. Two of these nests successfully fledged young.

Availability of suitable nestholes did not appear to limit the number of pairs breeding. When searching, I found several holes that had suitable specifications but were not in use; also some holes were used in one breeding season but not in another. Some holes, however, were reused. At Trielmon two holes were used in all three years and several holes were used in two of the three years. At Mokely Creek one hole was used in November 1973, February and October 1974 and other holes were used on two of these three occasions.

The start of laying at a site during a breeding period was spread over a few weeks and did not have a clearly defined peak. At Trielmon in 1973 eighteen nests were started between 11 and 28 February. At Mokely Creek in 1974, after breeding had stopped during winter, an early nest was started on 7 September and a further sixteen nests were started between 28 September and 23 October. At Woollahra Station in 1973 twelve nests were started between 13 February and 16 March and, after breeding stopped during the winter, a further eleven nests were started between 11 and 22 September.

Average clutch size, all records combined, was 4.6 eggs (N = 38 clutches). Clutch size ranged from two to seven eggs and seventy-six per cent of clutches were of four or five eggs. There was no significant difference in clutch size between areas (analysis of variance test). Nest success, all records combined, was sixty-three per cent (N = 41 nests) and fledging success was forty per cent (N = 103 eggs). There was no significant difference in nesting and fledging success (χ^2 test) between areas.

The interval between laying eggs was from one to two days. Incubation started with the first egg. Incubation of the first egg of two nests took 16.23 ± 2.23 and 19.8 ± 3.0 days and for the last egg of a clutch took 16.7 ± 3.5 days (unmarked eggs). In two nests, each of five eggs, all eggs hatched over 4.16 ± 2.8 and 4.23 ± 2.4 days. Differences in development of chicks that started with asynchronous hatching were maintained during most, probably all, of the nestling period. At about four weeks, although remiges and rectrices had not grown fully, the chick if disturbed, flew from the nest. The nestling period for a first chick that fledged naturally was 34.19 ± 7.6 days and the minimum periods for the first chicks that fledged when disturbed were 28.23 and 26.1 days.

Desertion before hatching caused the loss of twenty-five per cent of nests (N = 24 nests). At Mokely Creek one clutch was lost through competition with a nesting Tree Martin *Cecropis nigricans* and another when the nest hole was used by an Australian Owlet-nightjar *Aegotheles cristatus* as a day refuge. Eight per cent of nests (N = 24 nests) lost all eggs before hatching, presumably from predation. Twenty per cent of eggs (N = 81 eggs) either did not hatch (infertile eggs and death of embryos) or hatched but the chick died shortly afterwards. Of seventeen nests that contained nestlings, in three all nestlings disappeared, presumably taken by a predator, and in two nests all chicks died. Of the remaining fifty chicks, four died or disappeared before fledging. Pied Butcherbirds took older nestlings when these came to the entrance to beg for food and also took recently fledged juveniles.

None of the 1,500 Budgerigars that were handled had gross external or internal signs of disease or injury. One dead Budgerigar was found at the entrance to a nest. No other dead or sick bird was found; in particular none was found during a drought at Alawoona and Pinkilla in 1970, during a heat wave at Brewarrina (29° 58'S, 146° 52'E) in January 1971, when for five successive days the maximum temperature exceeded 40 °C and on the hottest day the temperature reached 45 °C, or during floods at Mokely Creek in 1974.

CONCLUSIONS

My data on the duration of breeding in wild birds are imprecise but give periods similar to those found from studies of domesticated birds. Domesticated Budgerigars lay eggs on alternate or successive days (Brockway 1964a), take eighteen to twenty days to incubate eggs (Brockway 1964a) and their chicks fledge at thirty-six days (Brockway 1969).

I found little evidence of a short breeding cycle, adaptations to increase numbers rapidly or high mortality during climatic extremes. Groups of nests close together sometimes occurred but this probably was because nest holes were clumped and breeding in these 'colonies' sometimes was poorly synchronized. Average clutch size in Budgerigars is within the range of sizes that occur in other seed-eating parrots (Smith 1975), many of which inhabit non-arid environments. In contrast to domesticated birds, wild Budgerigars have distinct gonadal cycles of recrudescence and regression and, when not breeding, their gonads regress to a condition similar or slightly in advance of that in many other birds (von Pohl-Apel *et al.* in prep.). To complete a breeding cycle successfully, from selection of nest holes to fledging of young, Budgerigars need to be resident and have a food supply in excess of maintenance requirements for two and a half to three months. Males arrive at breeding grounds with the spermatogenic cycle well advanced but females arrive with undeveloped ovarian follicles (von Pohl-Apel *et al.* in prep.). Occupation of nest holes and development of mature follicles in domesticated Budgerigars takes about nine days (Hutchison 1977). From the start of laying to fledging of chicks in Budgerigars is seven to eight weeks, which is similar to the time taken by related platycercine parrots inhabiting non-arid environments (Smith 1975) and intermediate in the range of times taken by hole-nesting non-passerines (Lack 1968). Chicks become independent shortly after fledging (Wyndham 1980b); this also occurs in parrots inhabiting non-arid environments (Smith 1972).

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WINTER FLUCTUATIONS IN WATERBIRD NUMBERS ON A NORTHERN TABLELANDS' LAGOON OF NEW SOUTH WALES

Many Australian waterbirds move in response to seasonal and sudden climatic stimuli (Lamm 1964; Frith 1967; Briggs 1977). During the winter of 1975 I counted waterbirds at Dangars Lagoon on the northern tablelands of New South Wales to see if changes in numbers could be related to rainfall, water-level and temperature.

Dangars Lagoon is in *Eucalyptus nova-anglica–E. blakelyi* woodland four kilometres south of Uralla, 1,000 metres above sea-level, has an area of about fifty hectares when full and was formed when a stream was dammed last century. Natural drainage has altered and today Dangars relies on local rainfall for water. It dried out almost totally in 1969 (Gosper 1973) and was less than two metres deep in most places in 1975.

The soils round the lagoon were weathered from granite. An emergent rush, *Eleocharis sphacelata*, a submergent weed, *Vallisneria spiralis* and floating *Azolla* spp were the dominant vegetation. The margins were lined with *Juncus* spp and *Polygonum* spp. The range of mean summer and winter temperatures is 14-26 °C and 1-13 °C respectively. The Uralla area receives 762 millimetres of rainfall annually, sixty per cent in the summer and forty in winter. Winter snowfalls are light and there are fifty frosts a year.

I counted waterbirds one hundred times between March and September 1975, using 10 x 50 binoculars, while walking round the lagoon. I obtained rainfall and temperature data from the recording station at Laureldale Farm, University of New England, Armidale, and recorded water-level on a marked stake in the lagoon. Correlation coefficients (Snedecor and Cochran 1971) were calculated between bird numbers and climatic and water-level data.

RESULTS AND DISCUSSION

Mean numbers of thirty-four species of waterbirds observed between March and September 1975 are presented in Table I. Correlation coefficients between numbers and climatic and water-level data are in Table II. Changes in water-level, rainfall and temperature are presented in Figure 1.