The Breeding Season at Moruya, New South Wales

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Results of a study of birds breeding in forest habitat near Moruya N.S.W. for four seasons from 1975 to 1978 are presented. The breeding season of birds studied is rather short and sharply defined, and occurs between early August and late December.

Though the breeding seasons of Australian birds have been examined in northern, western and inland areas (Carnaby 1954; Frith and Davies 1961; Lavery *et al.* 1968; Marshall and Serventy 1957; Maclean 1976; Robinson 1955), details for birds in south-eastern regions seem lacking. For four seasons from 1975 to 1978 I have collected data on the birds breeding in two small areas near Moruya, N.S.W., and these are now presented.

My study areas have been two plots, each of ten hectares, one in fairly undisturbed forest of Spotted Gums *Eucalyptus maculata* and Grey Ironbarks *E. paniculata,* the other in more varied woodland, which is regenerating after considerable clearing in the past. Some details of both areas have been given elsewhere (Marchant 1979). Each season I searched or watched throughout both areas almost daily from late July to January and usually for most of the day. Though I did not find every nest started by each pair of birds in the areas, I probably missed few because my searching was regular and exhaustive and because I found few old nests that I had overlooked when occupied. I also found some nests in similar habitat round my areas, as far away as 500 metres.

Methods

For this discussion I have used only nests for which I could accurately date the laying of the first egg. For most easily accessible nests this date was observed exactly but for some it was deduced by applying the known facts of incubation and nestling periods and laying routine (Marchant 1980) to a definite event (hatching of eggs or fledging of young) or to an assessment of the age of the young. For totally inaccessible nests a reasonably accurate date was obtained by observing when incubation or feeding of young began or when young fledged.

In the graphs of Figure 1, nests found have been grouped in periods of five days but, instead of showing the actual number found in each period, the running average of three periods is given in order that the fluctuations from one period to the next may be reduced but not removed. The origin for the five-day periods is midnight on 31 July - 1 August. The same five-day periods are used in Figures 2 and 3. Rainfall, maximum and minimum temperatures, all recorded in the area daily, have been summed or averaged for the same periods.

General Breeding Season

Numbers of nests of all species combined are shown separately for each season in Figure 1. The graphs are of course dominated by the nests of a few common species, of which I usually found more than ten each year. Eastern Yellow Robins (for scientific names, see Figures 2 and 3), the two whistlers, Grey Fantails, Superb Fairy-wrens, the two thornbills, Yellow-faced Honeyeaters and Red-browed Firetails account for the bulk of nests each year but the total presentation shows rather clearly that the breeding of almost all species is confined to the period from 1 August to 31 December. The few nests found before 1 August belonged to White's Thrush (1) and Crescent (1) and New Holland (2) Honeyeaters, all of which seem aberrant and will be discussed later. Similarly, a few nests of Eastern Yellow Robin (1), Grey Fantail (3), Rufous Fantail (1), Yellow-faced Honeyeater (4), Red-browed Firetail (4) and Mistletoebird (1) have been started in January, though not in January 1978, and even once as late as March for the Red-browed Firetail. Otherwise I have found no nests begun between 1 January and

1 August*.

A proximate cause for the start of general breeding, which appears to take place rather regularly and promptly in August - September, is not obvious; in 1975 and 1978 it occurred in the first five days of August, in 1976 about 20 August and in 1977 not until the beginning of September. July and August were dry in all four years, as generally happens in these parts, and, though there is a suggestion that the start of laying coincided with the average daily maxima reaching 20°C, in 1977, when the latest start occurred, the daily maxima had not fallen much below 20°C since May and were indeed well above this limit throughout August, when no nests were found. Here, it may be remarked that the drastic drop in daily maxima by about 10°C early in September 1977 apparently had no effect on the start of nests, unless it stimulated it, though such a cold snap in Britain would probably have delayed or interrupted nesting of species such as tits *Parus* spp (Lack 1966 : 20). Apparently the only constant feature of phenology that could induce breeding is increasing length of daylight and doubtless this plays its part, though at these latitudes daylight increases by little more than one hour from 1 July to 1 September.

In terms of numbers of nests found and early start, 1975 and 1978 were the best seasons. In both years there was substantial rain in May and June in contrast to the poor rainfall or virtual drought in 1976 and 1977. Such rain in early winter may have its effect on the subsequent breeding season. Also, substantial rain after the start of breeding may have an effect because in 1976 the heavy fall in mid-October perhaps resuscitated breeding, which had apparently started to decline from the beginning of the month. Yet, it may be more likely that heavy rain inhibited breeding and was a cause of few nests being found in the middle of the month. All the occupied nests of honeyeaters that I knew before the rain started had been deserted with eggs (4 Yellow-faced Honeyeaters, 1 Yellow-tufted) or the nestlings had died in them (2 Yellow-faced Honeyeaters, 1 New Holland) by the time the rain stopped. At least, the rain probably caused an increase in replacement nests in late October and early November.

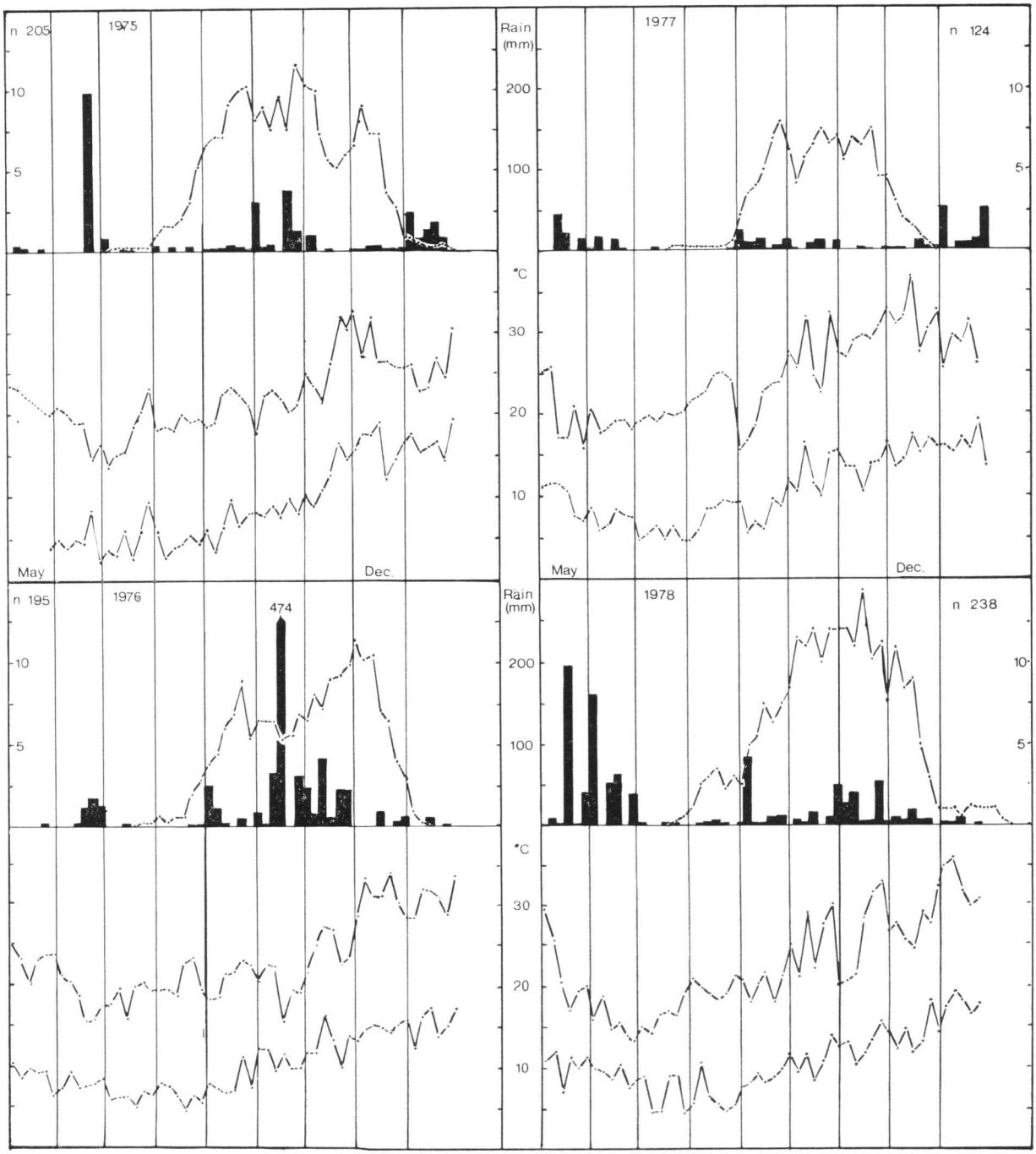
No doubt rainfall during the breeding period maintains the state of the vegetation and the crop of insects, thus helping the birds to continue with nests but the poor showing of rain and nests in 1977 suggests that falls of less than 25 mm, perhaps even of less than about 50 mm, are of little avail. In any case once the daily maxima approached 30°C, the number of new nests began to decline and the decline was not arrested, even when substantial rain fell in January (1975 and 1977). Apart from the desiccating effect of heat on the environment, there can be direct danger to nestlings, especially in nests exposed to direct sunlight, even for short periods. A brood of two Yellow Robins, which hatched in the morning of 12 December 1975, was dead next morning after a maximum of 42.5°C in the previous afternoon. More surprisingly, a brood of three Yellow Robins, eight days old, well feathered and presumably capable of thermoregulation, succumbed in the nest after an hour or two of direct sunshine on 22 December 1976, when the maximum in the shade was 38°C. Three nestling Yellow-faced Honeyeaters, 6-8 days old, died in the nest during hot weather (35°C max.) on 9-10 January 1979.

Specific Breeding Seasons

When all data are combined, as has been done so far, there is nothing to be learned about the performance of the different species. Moreover, if the data for all nests started by one species during a season are presented, matters are quickly complicated by replacement nests after loss or predation and by multiple broods. In any case, I think that the dates of laying of the first eggs of the first clutches are the only crucial ones when considering the question of why birds breed when they do. Once a bird has begun to lay, if it belongs to a species that is strictly single brooded, it usually makes one or more attempts to replace clutches that are lost; if it belongs to a species that is multibrooded, it simply goes on breeding as long as conditions allow. Thus, nests subsequent to the first clutch are largely irrevelant.

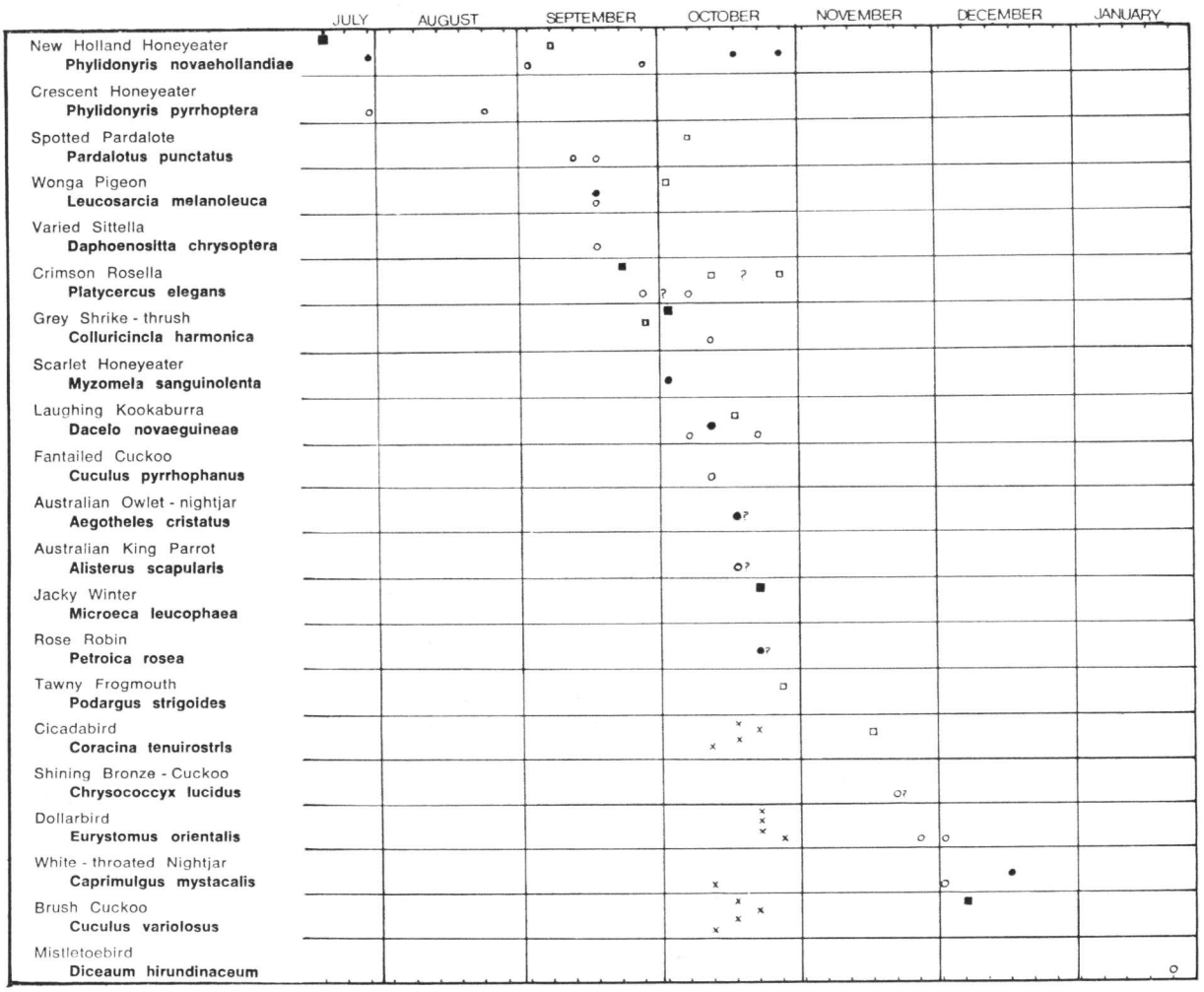
Figures 2 and 3 chart the dates of all first nests of each species breeding in the areas in five-day periods. Figure 2 contains those species for which the data seem good, either because I had many nests, often of colour-banded birds, in

* The Superb Lyrebird *Menura novaehollandiae* is excepted and not discussed further. The species is well known as laying in winter and the two nests that I have found were both started about 20 June in 1977 and 1978.



● Figure 1. *The 1975, 1976, 1977 and 1978 breeding seasons at Moruya, N.S.W. Nests are presented as graphs of the running average of nests started during each period of five days; n = total number of nests found during the season. Rainfall is imposed on the graphs as histograms and the average daily maximum and minimum temperatures for each period of five days appear below the graphs.*

● Figure 2. *Chart of laying of first eggs of first clutches for 29 species at Moruya, whose nests were common, accessible or conspicuous or all three. Solid squares, 1975; open squares, 1976; solid circles, 1977; open circles, 1978. A single symbol represents one or more nests started in a period of five days. Lines joining symbols indicate that nests were started thoughout the period concerned. First record of migrants, x.*



● Figure 3. *Chart of laying of first eggs of first clutches for 21 species at Moruya, whose nests were not found each season or were inaccessible or both. Symbols as for Figure 2.*

each season or because the dates of laying were closely known or both. Figure 3 contains the remaining species breeding in the areas but for which data were less good, either because I found nests only in one or two seasons or because dates of laying were less certain or both. There is doubt whether some nests treated as first clutches of a pair were in fact so, particularly for scarce species with only one or two pairs in the area and whose nests can be hard to find, but in general I do not think that there is much error of this sort. In all four years, the nests of several species (e.g. Eastern Yellow Robins, Leaden Flycatchers and Olive-backed Orioles), accepted as first clutches, fell in the same short period; this suggests that the choice was reasonably accurate.

The charts are arranged in order of laying of the first egg of the first clutch known for each species during the four years. There are some considerable differences in this start from year to year and some consistencies, the range in difference being from five to forty days for species in Figure 2. Some of the extreme differences are probably caused by chance but for most species (21 out of 29) the difference was 3-5 weeks and in general the starts were earlier in 1975 (11

species) and 1978 (7 species) than in 1976 and 1977, which we have already noted as dry years.

Thus, the chronological order of species as they started to breed was different from year to year but the general pattern from the beginning of September to early December, of a steady increase of breeding species, would be much the same each year. It is noticeable, however, that a few species started to nest well before 1 September and, if the Yellow-faced Honeyeater is disregarded for the moment, there is a gap of up to three weeks during August when no species began to breed. Of these species, White's Thrush, which seems unique in being a winter breeding visitor (Marchant 1979), and the Crescent and New Holland Honeyeaters, which are irregular or opportunistic breeding species, need separate consideration. In fact the two thornbills and the White-browed Scrubwren are the important species of this group of early nesters, in some years so early that their first nests form a preliminary peak during August in the graph of all nests combined, as was clear in 1978 and detectable in 1975 (Fig. 1).

Though one cannot easily explain early and late nesting in terms of the habits and requirements of the different species, most of the early nesters (before October) are those that feed on the ground (White's Thrush, White-browed Scrubwren, Eastern Yellow Robin and fairy-wrens), among leaves and twigs of the lower vegetation (thornbills), or on trunks and branches (White-throated Treecreeper); of these, the smaller species take small prey, which as larvae would be available first in the season. Somewhat larger species like the whistlers and the Eastern Whipbird, also feeding at low levels in vegetation, begin to nest about October, as does the Grey Fantail, an aerial feeder, presumably when larvae are larger or imagines are on the wing. Species that forage usually in tall tree and take large insects, e.g. the Oriole, Satin Bowerbird and Cicadabird, start to nest late. The sole seed-eater (Red-browed Firetail) is also a late nester.

The honeyeaters are best considered separately because most seem to breed to no set pattern. Perhaps the Noisy Friarbird, which takes large prey including the nestlings of other species (pers. obs.), starts rather regularly in the first half of November. It is interesting to note that, soon after it started to nest, indeed within five days, the Leaden Flycatcher also started to build and all its first nests have been within twenty metres of a Friarbird's nest. This association has been noted in the Botanical Gardens at Canberra (C. A. Appleby pers. comm.), though in open woodland at Canberra I have found both species nesting quite separately. Lewin's Honeyeater, whose nests I have seldom found, seems also to start late and perhaps as regularly but it may be a specialised feeder because adults at least often take the fruit of small trees, e.g. *Trema aspera*, and shrubs, e.g. *Leucopogon juniperinus*.

The Yellow-faced Honeyeater was peculiar in that it started nesting almost four weeks earlier in 1975 than in any other year and this was not attributable to differences in my searching. I can offer no explanation. The Crescent Honeyeater was clearly an opportunistic breeder; before the autumn and winter of 1978 I recorded it once in the area but, when the Spotted Gums flowered profusely during that period and for the only time during the four years, birds were quite plentiful and at least four pairs nested. The New Holland Honeyeater was more puzzling. One pair, which I regarded as resident, nested annually and early in the teatree on my property. In October 1977 Forest Red Gums *E. tereticornis* and other gums in one part of my property flowered well and many New Hollands came to them; at least four pairs beside the resident one bred at that time but there is no knowing whether the nests were the first of the season for the pairs concerned. Yet, every year from late November to early January many New Hollands came in when *Melaleuca hypericifolia* flowered (Marchant 1979) but I could never find a nest.

Data for other honeyeaters are inadequate. Eastern Spinebills probably start to nest early each year, in or even before September, but they nest high so often that it is hard to be sure. Yellow-tufted Honeyeaters invaded the area in 1976 and settled as a group of about 25 birds. The colony apparently decreased in the next two years. The only nests that I could find were widely scattered in September, October and November. Scarlet Honeyeaters occurred spasmodically each season, the males singing in an area for some days and then disappearing, which suggests that they are irregular or opportunistic breeders hereabouts; I saw only one nest and that was inaccessible. Unfortunately I could get no proper information on the nesting of White-naped *Melithreptus lunatus* and Brown-headed *M. brevirostris* Honeyeaters because both species were so hard to pinpoint and follow in the tree-tops where they nested. The White-naped did

nest more commonly in the State Forest than on my own property. The Brown-headed was noted irregularly during the breeding season and I saw only one nest, inaccessible.

It is a pity that better data are not available for cuckoos. If Brown Thornbills and White-browed Scrubwrens are the normal hosts of the Fan-tailed Cuckoo (North 1911), the cuckoo, probably starting to lay in October, then leaves itself little time to parasitise the thornbills, the latest nest of which was started on 9 November. Eggs of this cuckoo were found only in 1978 and parasitism here has been proved as often in the scrubwren's nests as in the thornbill's. The scrubwren has started nests as late as 4 December and may be the more suitable host. The Brush Cuckoo, whose eggs were found only in 1975, seems better adjusted to parasitise the fantails, which North (1903) suggests are its usual hosts.

Conclusions

In summary, the breeding season of these forest birds at Moruya is rather short and sharply defined, between early August and late December, except for one or two species that nest in winter. Thus it reminds one of the breeding season in regions with much more seasonal climates than that of south-eastern New South Wales. Most species time their breeding so that young are in the nest when food is most plentiful, this is in agreement with Lack's (1950) widely accepted proposition. However, though this presumably applies to the honeyeaters as well as all other species, most of them seem to breed less regularly or more opportunistically than the other birds and it is less easy to attribute their activities to proximate factors.

It may be noted that, of the earliest breeders, both thornbills lay at intervals of forty-eight hours and I suspect that the White-browed Scrubwren does so also. This laying routine is unusual among passerines; other examples occur amoung American flycatchers, manakins, antbirds and oven birds (Tyranni) but almost nowhere else. The thornbills in my experience do not perform courtship feeding and, being adapted to nesting early, females may find it hard to get enough food for the formation of eggs in early August or thereabouts (Lack 1968; 175) and thus have adopted a strategy of laying at a longer interval than normal among passerines. If so, the explanation does not apply to the Brown Gerygone, which also lays at an interval of forty-eight hours but starts to nest only in mid-October, or to the White-throated Treecreeper, which lays at the same interval and breeds early but indulges in much courtship feeding (pers. obs.). In contrast, Eastern Yellow Robins start to nest early, lay at intervals of slightly more than twenty-four hours and courtship feed, more than one bird often feeding the female before, during and after laying (pers. obs.). The extra help may enable the species to avoid laying at longer intervals and thus exposing the eggs to predation for longer.

Along the southern coast of New South Wales the practice is to burn off in forested land during July, August and September. Clearly this must be a calamity for all species that start to breed before October and nest in lower levels of the woodlands. Nest sites will be destroyed and food vanish. Species that start in October and November may be little less affected for the same reasons. Those species that nest high in the trees and start to do so from late October onwards may be less affected and hole-nesters, like parrots, which collect their food usually far from their nests, may also be less likely to suffer.

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