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THE DAWN CHORUS IN A EUCALYPT FOREST BIRD COMMUNITY, SEASONAL SHIFTS IN TIMING AND CONTRIBUTION OF INDIVIDUAL SPECIES

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An analysis of the early morning period of maximum communal song (dawn chorus) at different times of the year in an eastern Australian eucalypt forest bird community showed the following: (1) it characteristically extended from 35–30 to 10–5 minutes before sunrise; (2) it was largely a feature of the spring breeding season; (3) not all members of the community contributed to it; (4) the major contributors changed seasonally, partly due to some species singing minimally when they had young.

INTRODUCTION

The dawn chorus, the simultaneous calling of many bird species around sunrise, is a major feature of bird communities. Although it has long attracted the attention of investigators, e.g. Kacelnik (1979), Henwood and Fabrick (1979), Kacelnik and Krebs (1982), only limited attempts (Leopold and Eynon 1961) have been made to document it in a quantitative framework. This has not yet been done for Australia.

The present paper investigates early morning song in an Australian eucalypt forest bird community. It explores: (a) if the dawn chorus is a discrete feature and, if so, its time of initiation and duration; (b) if its characteristics vary seasonally; (c) the species taking part, when during the total chorus and to what extent they individually contribute and; (d) if the major contributors change seasonally.

METHODS

For description of the area of study and study site see Keast (1985, 1994a).

The study was based on 10 series of 4–5 morning data sets gathered between 40 minutes before sunrise, and/or ahead of the time the first birds in the community started to sing, and one hour after sunrise. The dates extended from late July, 1986, to January, 1987, with a later April, 1988, data set being added to increase seasonal spread (Fig. 1). Documentation was from under cover at a fixed site on an elevated plateau edge from which all bird songs could be heard for an estimated 100 m to either side and behind, and 200 m down the slope below. Equipment used was a voice recorder, stop watch, prepared record sheets and, initially, a 50 cm parabola with microphone, and Sony Walkman tape recorder. The time each species first sang was recorded. The vocalization data was developed in terms of consecutive 5-minute divisions from time of first singing. Data from different days and seasons was made comparable by using sunrise as the common reference point. Times of sunrise were provided by the Commonwealth Meteorological Service. The number of 5-minute divisions pre-sunrise was 18 in July increasing to 21 in December.

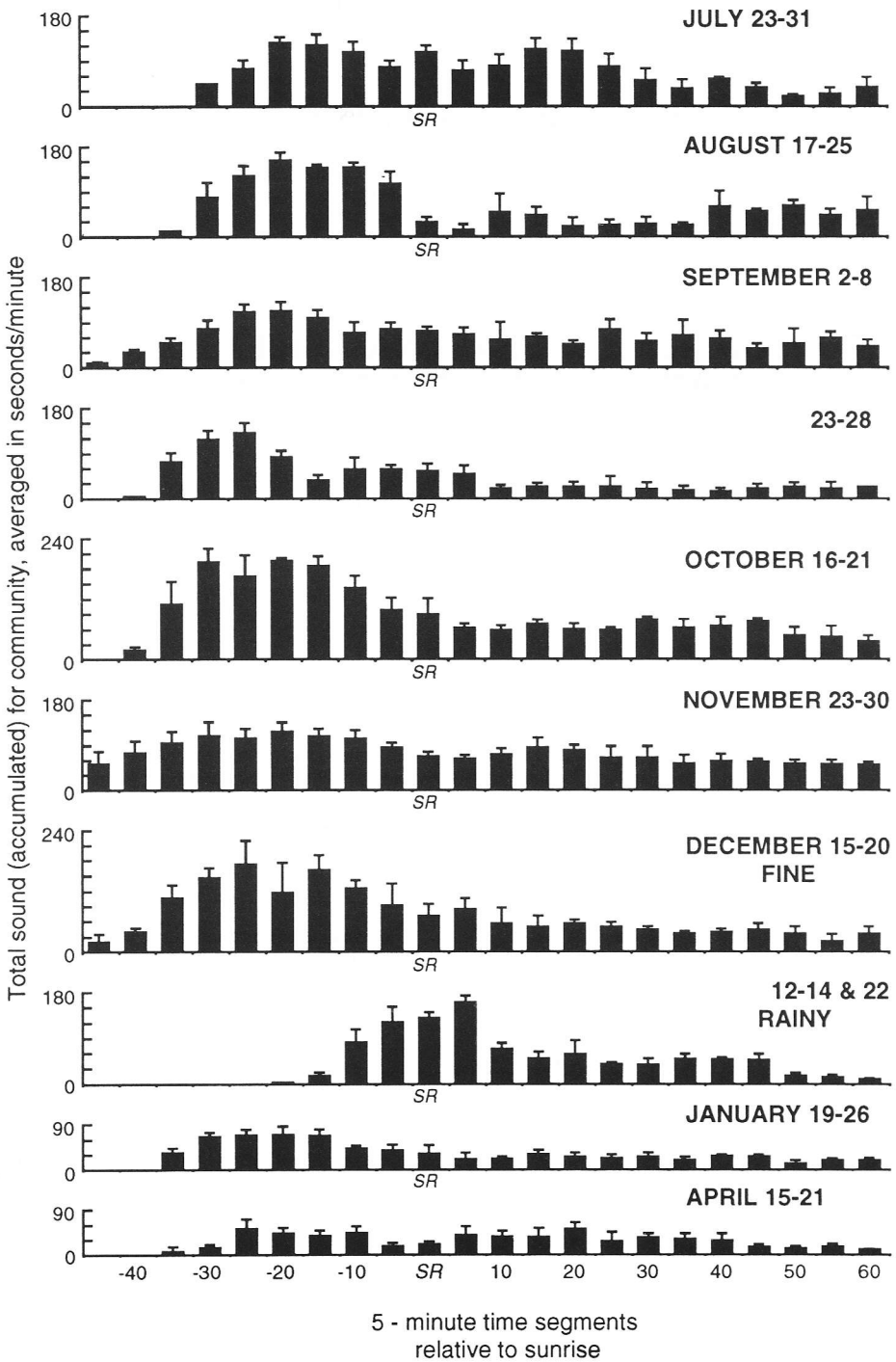

Figure 1. *Early morning community vocalization levels and patterns for 10 different date sets, relative to sunrise.*

Quantification of sound output by each species was achieved by counting the numbers of songs uttered per unit time (see Hartshorne 1956; Slater 1990). This was possible because all species used discrete songs separated by gaps (Keast 1993). Initially it was planned to make the counts from tapes but subsequently time constraints dictated that counts be made directly and incorporated on to record sheets in the field. To successfully acquire data from many simultaneously singing species the procedure was adopted of concentrating on 2–3 species for 20 seconds at a time, and repeating this several times during each 5-minute segment to obtain an average figure for numbers of songs uttered per minute for the segment.

A figure was developed for actual sound production per minute for each species by multiplying the number of songs uttered by an average length of song obtained from sonograms (Keast 1993). Results are accurate for species that used single songs of discrete length; less so for the Rufous Whistler, Grey Shrike-thrush, and White-throated Tree-creeper (for scientific names see Appendix) that used diversified repertoires. Here arbitrary lengths for 'longer', and 'shorter', songs were used.

The total community sound output for each 5-minute segment was obtained by adding the individual species data: this was then averaged (with standard deviations) for each 4–5 morning cluster. When the segments were plotted in graphical form (Fig. 1) it visually defined the start, duration, and pattern of the dawn chorus. Arrangement of the different date sets in linear order showed how the chorus changed through the seasons (Fig. 1).

Seasonal quantitative differences in total community sound output levels were tested for the pre-sunrise period by comparing levels of total community sound output for a date and its successor (e.g. July *v* April; August *v* July) using the Mann-Whitney U test (Table 1). This permitted discrimination between major segments of the breeding season — see Discussion.

Individual species data revealed the major contributors for the different dates (Fig. 2). In interests of simplicity, vocal output levels were grouped into three broad categories (footnote to Figure). Other symbols indicate cases of species being present without vocalizing, and occurrence of young in species.

Times of first singing in the morning were plotted for twelve major species on a seasonal basis — see means and standard deviations in Figure 3. This also helped bring out which species contributed mainly at the beginning, or later, in the general chorus. The Mann-Whitney U test was again used to test for significant differences between a date and its successor.

RESULTS

Twenty-one species took part in the pre-sunrise vocalization (Fig. 2). Over half were usually represented by single individuals (probably territorial males). Sometimes two Eastern Yellow Robins, Rufous Whistlers, Grey Fantails, White-throated Tree-creepers, and Spotted Pardalotes sang: in these cases results were averaged. On occasion two parties of Laughing Kookaburras, Striated Thornbills, and Little Wattlebirds, contributed. Six to eight individual Yellow-faced Honeyeaters took part in the 'first light' social singing of this species (Keast 1993).

The community sound output data showed, for most dates, a period of peak song between 35–30, and 10–5 minutes before sunrise (Fig. 1). Then, suddenly virtually all songsters fell silent, or curtailed singing rates. This drop does not show in the figure as clearly as it should because a few species (Spotted Pardalote, Magpie-lark, Mistletoebird) began to sing as the others ceased. The existence of a clear-cut dawn chorus in this eucalypt forest bird community is confirmed.

TABLE 1

Total community vocalization compared seasonally, seconds per minute for the pre-sunrise period. Base on adding totals for successive 5-minute segments; subsequently averaged for the 4–5 day periods (with standard deviations), members of a Hawkesbury River bird community. Asterisks indicate where differences between two consecutive samples (i.e. July–August, April–July) are significant (0.05, Mann-Whitney U test).

	Pre-sunrise period			
Dates	Mean	S.D.	U'	P
July 23–31	519.0*	36.8	9	0.0495*
August 17–25	737.4*	73.3	9	0.0495*
September 2–8	630.3	16.9	6	0.513
September 23–28	558.6*	79.7	15	0.0253*
October 16–21	1 103.1	89.6	14	0.053
November 23–30	871.5	145.4	8	0.480
December 15–20 sunny	987.3*	30.1	12	0.034*
December 12–14 and 22 rainy	219.9*	49.8	12	0.034*
January 19–26	384.9*	20.0	9	0.0495*
April 15–21	234.0*	56.0	9	0.0495*

The dawn chorus was largely a springtime feature (Fig. 1), with its degree of development and pattern varying. It started to differentiate in late July at the end of winter and ahead of the breeding season. Initially it was diffuse and distributed equally before, and after, sunrise. By mid-August, with increased courting and territorial activity, community song output increased significantly (Table 1) and the chorus assumed a distinctive pre-sunrise peak (Fig. 1). It was

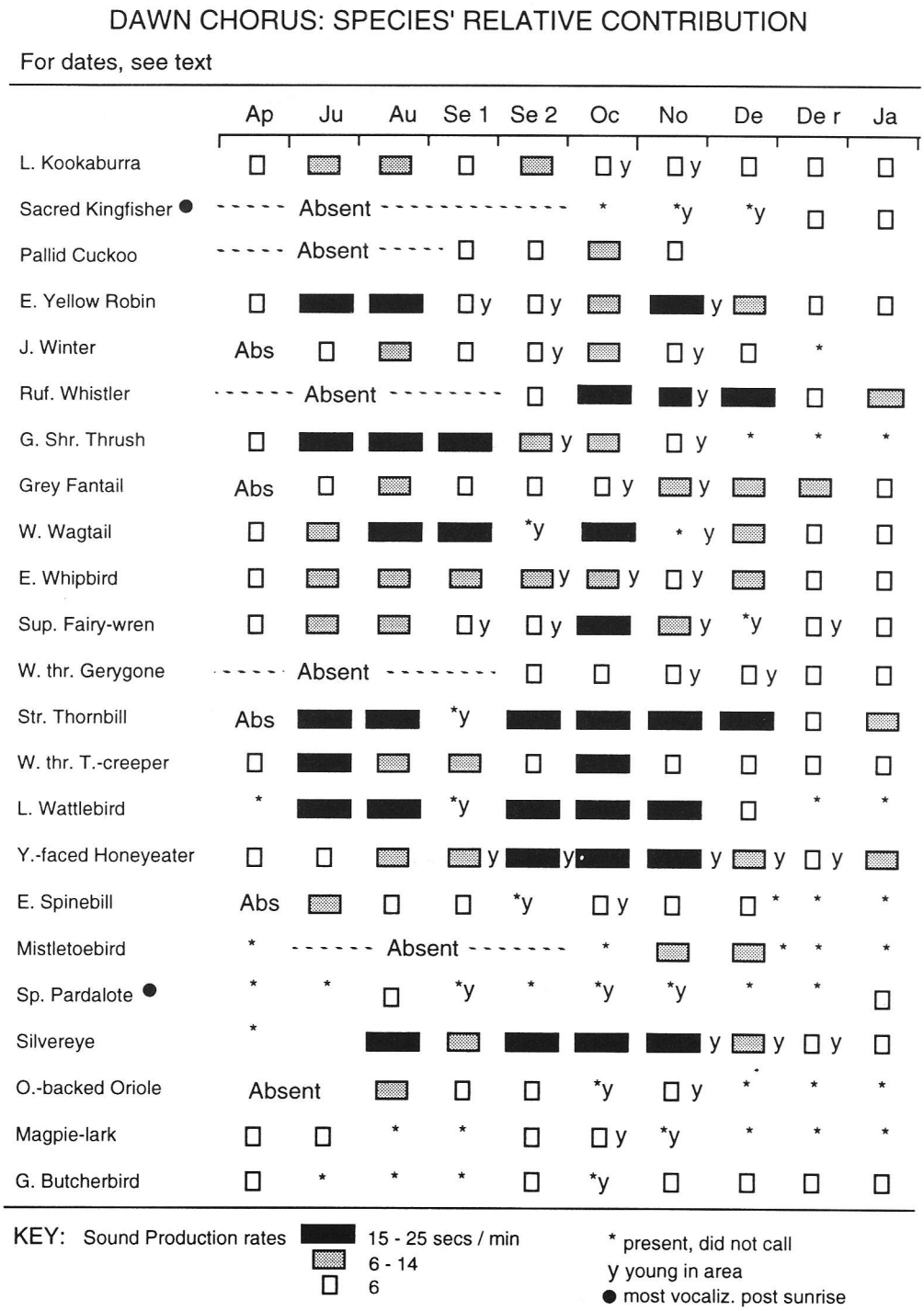

Figure 2. *Relative contribution of the different species to the dawn chorus. For exact dates see Figure 1.*

slightly suppressed in September (some species now with young and significant drop in total community vocalization (Table 1)). Return of the migrants in October, and increased vocalization by residents preparing to breed a second time, led to a significant doubling in total community vocalization in October (Table 1), and more clearly defined pre-sunrise chorus (Fig. 1). It was slightly less well delineated (note significant drop in total singing) in November when some species had young. The chorus became more clearcut with a slight but significant increase in total community vocalization (Table 1) post-breeding in December. By January, with most species now in moult and courtship and territorial activity minimal the chorus largely disappeared as a distinct feature. There was virtually no dawn chorus in April (Fig. 1). Drops in total community vocalization output from December (sunny days) to January (by over half) and January to April (by a further third), were significant.

When community sound output levels for successive pairs of dates were compared (e.g. April to July increase, August to September drop), six of the nine seasonal ones, plus the one for rainy mornings, were significantly different (Table 1). The intra-season shifts, hence, are real.

Rain in mid-December delayed the start of the dawn chorus by 20–25 minutes, and markedly reduced its length and sound production levels in the community (compare two December data sets in Fig. 1 and Table 1). (See also Keast 1994a).

Contribution of individual species to the dawn chorus

The changing seasonal contributions of the different species to the dawn chorus are summarized in Figure 2.

The following conclusions emerge:

1. Over the ten series of dates numbers of major contributors (see key) were: late July, 10; mid-August, 14; early September, 6; late September, 7; mid-October, 13; late November, 9; mid-December (fine days), 9; mid-December (rainy days), 1; late January, 3; and April, nil.

2. Major individual contributors over much of the season were: Eastern Yellow Robin, Rufous Whistler (later), Grey Shrike-thrush (mainly earlier), Grey Fantail, Willie Wagtail, Eastern Whipbird, Striated Thornbill, White-throated Tree-creeper, Little Wattlebird, Yellow-faced Honeyeater, and Silvereye. Lesser contributors were the Laughing Kookaburra, Pallid Cuckoo (mid-season), White-throated Gerygone (late September-January), Eastern Spinebill, Olive-backed Oriole, Magpie-lark, and Grey Butcherbird.

3. The dominant singers varied seasonally. In late July they were the Eastern Yellow Robin, Grey Shrike-thrush, Striated Thornbill, White-throated Tree-creeper, and Little Wattlebird. Lesser ones were the Laughing Kookaburra, Willie Wagtail, Eastern Whipbird, Superb Fairy-wren, and Eastern Spinebill. In late September, when singing was reduced in the Eastern Yellow Robin, Jacky Winter, Grey Fantail, Willie Wagtail, Superb Fairy-wren, White-throated Tree-creeper, and Eastern Spinebill, they were the Striated Thornbill, Little Wattlebird, Yellow-faced Honeyeater, and Silvereye. The high October figures incorporated the contributions of the migrant Rufous Whistler, and Pallid Cuckoo. By late January, only the Rufous Whistler, Striated Thornbill, and Yellow-faced Honeyeater, sang to any extent.

4. Within-season drop-offs in the pre-sunrise contribution of some major species were at least in some cases, correlated with their having young — see data on Eastern Yellow Robin, Jacky Winter, Superb Fairy Wren, Grey Shrike-thrush, and Willie Wagtail (Fig. 2). When this did not apply (see Yellow Robin for November and Yellow-faced Honeyeater for September and November) it was possibly because two (or more) pairs were present, with one male vocalizing and other/s not, or because a vocal non-breeding male was present. In the Rufous Whistler and the Yellow-faced Honeyeater breeding stage appeared to have little influence on levels of vocalization. These species apparently parallel some European ones that are vocally active through most of the season (Slagsvold 1977).

Time of first singing in the various species and its relationship to the dawn chorus

The time of first singing, in relation to other contributors to the dawn chorus, is summarized in Figure 3. Significant differences in time of first

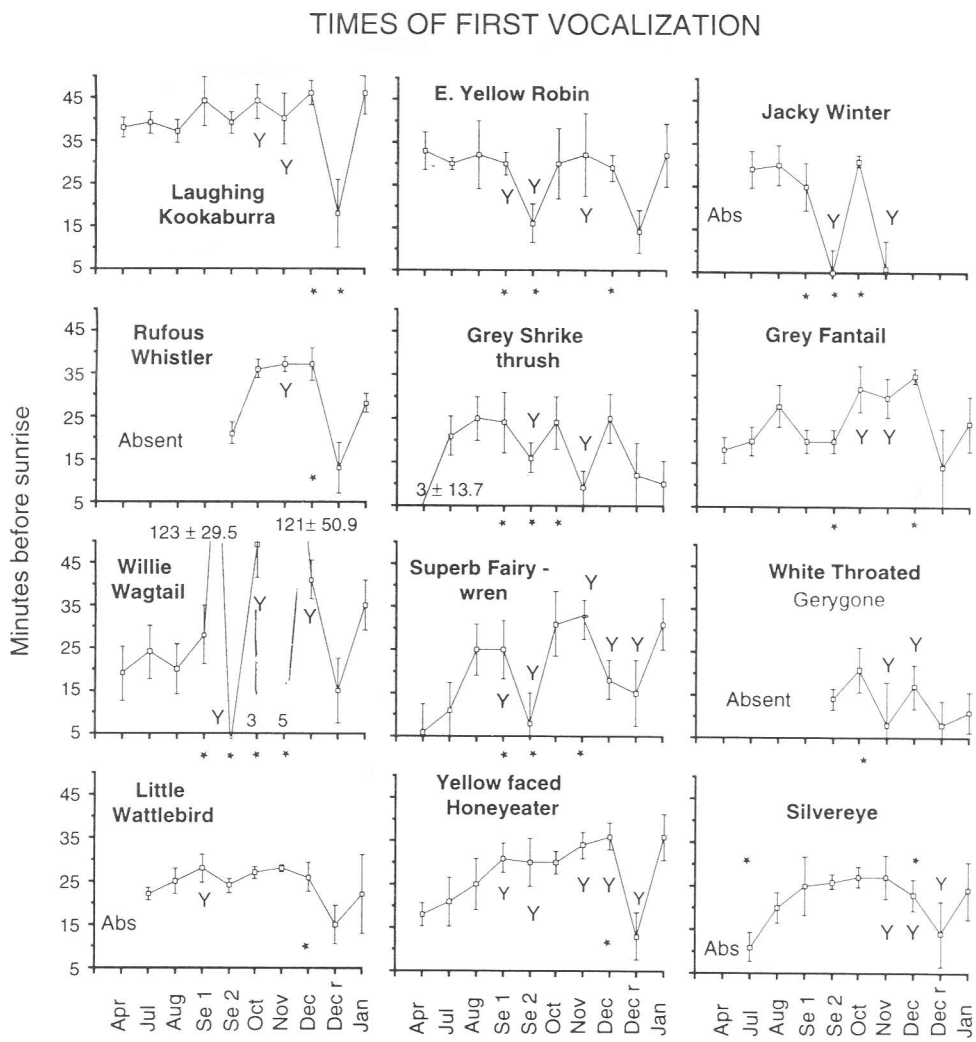

Figure 3. *Times of first vocalization, 12 major contributors to the dawn chorus, seasonal shifts, means and standard deviations. For exact dates see Figure 1. Asterisks show where a figure is significantly different from the following one (Mann-Whitney U test; p, 0.05 level). Where members of a species in the immediate area had young this is indicated.*

singing between a date and its successor are indicated by an asterisk (Mann-Whitney U test, P,0.05 level). Again, the presence of young is noted.

The Laughing Kookaburra was consistently the first bird in the community to sing, averaging in April, July, August 36, and in September, November, December, 45 minutes before sunrise. The Eastern Yellow Robin first sang on average from 33 down to 28 minutes before sunrise (most dates); it averaged 16 minutes before sunrise in September, when it had young. The Yellow-faced Honeyeater and Superb Blue-wren began singing mid-season at an average of 34–26 minutes before sunrise.

In the Little Wattlebird time of first vocalization averaged between 28 and 22, Silvereye, 27–23, Grey Fantail 34–20, minutes before sunrise. The

Willie Wagtail was, apart from the Pallid Cuckoo, the only species that sang during the night. In the prelaying period in early September and again in late October, it first sang, on average at 123 and 121 minutes before sunrise. In late September and November, when the pair in the area had young, it did not contribute to the dawn chorus and sang rarely, uttering a few songs, on average, at about 3, and 5, minutes before sunrise. During their peak seasons the late-starting Grey Shrike-thrush and White-throated Gerygone only began singing about 25 and 20, minutes before sunrise, respectively.

Not all species sang throughout the duration of the communal chorus. Some (Laughing Kookaburra, Yellow-faced Honeyeater) contributed mainly earlier, and the Grey Shrike-thrush later. Spotted Pardalotes, Magpie-larks, and Mistletoebirds, by contrast, only began singing towards sunrise. In effect, they did not contribute to the pre-dawn chorus at all.

Time of first vocalization was sometimes delayed when the birds had young — see the Eastern Yellow Robin and Jacky Winter in late September, Willie Wagtail in late September; Jacky Winter, Grey-Shrike Thrush, Willie Wagtail, and White-throated Gerygone in November. This did not apply, however, in the Laughing Kookaburra and Rufous Whistler in November.

DISCUSSION

The early morning period of peak community vocalization (dawn chorus) in this eastern forest bird community was a distinct feature with clear-cut attributes. It was characteristic only of the breeding season, restricted to the pre-sunrise period, had a duration of 25–30 minutes, and varied seasonally in its structure and attributes. Not all of the 20 species vocalized throughout the chorus, some contributing earlier, others later.

Species contributed less when they had young, and started to sing later in the morning. This is in accordance with general knowledge that singing levels are highest during courtship and drop progressively thereafter (Slagsvold 1977; Logan *et al.* 1990; Keast 1994b).

The basic features of the dawn chorus in this Ebenezer eucalypt forest bird community are possibly typical of bird communities generally. The loudest, most persistent, and continuous avian song is usually heard between dawn and sunrise (e.g. Saunders 1929; Armstrong 1963; and references therein). Individual species commonly begin singing at a particular time and in a characteristic order which is relatively constant from year to year (Armstrong 1963; Thielcke 1970). Some vary seasonally in time of first vocalization (Leopold and Eynon 1961; Thielcke 1970), although this does not apply to all (Leopold and Eynon; Armstrong 1955). These earlier workers did not attempt to relate this variation to breeding stage but Dorst (1974) suggests that species commonly start to sing earliest at the beginning of the breeding season.

There is often a minor degree of day to day variation in time of first singing (Leopold and Eynon 1961, and references therein). My findings here of a day-to-day variation of about five minutes find a parallel in the studies of Stokes (1979) on variation in awakening times of inland Australian birds.

That bad weather influences total vocalization levels, and times of first vocalization are well-known (e.g. Armstrong 1963; Robbins 1981; Keast 1994a).

The dawn chorus invites further study. In an Australian context it would be interesting to test the findings here for different latitudes and habitats. It would be valuable to determine the major contributors in different places and to see if the major species begin to vocalize at the same times, and in the same general order.

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