scale of song similarity was inadequate for comparisons to the Singing Honeyeater patterns reported here.

In applying the Canary software to this analysis, an important point is raised. When differences in two songs are primarily a result of an offset in the frequency axis but the shapes of the elements are similar, the resulting low correlation seems somewhat misleading. This is a consequence of applying a visual analysis to the two spectrograms rather than hearing the two songs. The latter perception makes the difference more apparent. In any case, the question of how the birds perceive similarity and difference is an experimental issue that can be addressed by manipulation of features of songs and presentation of the altered stimuli via the playback paradigm (e.g., Baker 1991).

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NOVEL METHOD FOR ESTIMATING HOURS OF OVIPOSITION, ILLUSTRATED BY DATA ON GRAY CATBIRDS[1]

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Key words: Hour of egg-laying; oviposition; Gray Catbird; Dumetella carolinensis.

The hour of egg-laying has been studied less than many other features of nesting, e.g., clutch size or incubation period. Lack of information on the hour of laying may be due to the difficulty of obtaining precise records. Without mechanical devices, such as used by Haftorn (1966) to determine laying times of *Parus* spp., most investigators have relied either on two daily visits to a nest that bracketed egg-laying (Skutch 1952, Brackbill 1958), or on observations on the arrival of a female at her nest to lay (Nolan 1978, Muma 1986) and her departure after laying (Muma 1986). These procedures are time-consuming. Also, because some species lay inconveniently close to sunrise, few investigators of life histories routinely record the hour of laying. This is unfortunate because there is much interspecific vari-

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ation in the hour of laying (Skutch 1952, Scott 1991) whose causes have not been studied, apart from some speculations by Schifferli (1979) and Weatherhead et al. (1991). To facilitate acquisition of laying times, I propose a method that requires only observations from single daily visits to nests made before a clutch is complete, provided that certain conditions are met. I emphasize that the proposed method is not intended for field use, but it is based on observations made incidentally from visits to nests for other purposes, e.g., determination of clutch size. The method seems particularly suitable for data that may already be available in nest record programs. For example, the Ontario Nest Records Scheme (Peck and James 1983) contains more than 500 record cards for each of more than 40 species (Peck 1993).

THE METHOD

Logical basis. For species that lay at 24 hr intervals the probability of an observer finding the egg of the day at the time of a daily visit depends on whether the visit preceded or followed the daily laying. If visits are too early, the probability of finding a new egg is zero; if too late, the probability of finding a new egg is one. At some time between these two extreme times of visits half the visited nests will have a new egg and half will not. This is the median time of the daily laying period.

Procedure. First, for each record of a day's visit, it is necessary to establish that a newly recorded egg was indeed laid on the day of the visit. Various clues from visits either on the same or on other days of the laying period of a particular individual may identify the days on which each egg of a clutch was laid. For example, two visits on one day may show that an egg was laid between two visits; assuming that laying occurs daily, as is true for many species, then the laying of other eggs in this clutch can be assigned to the other days in the laying period. Also, if a passerine nest is visited late on one day, say around 16:00 hr, and a new egg is found on the next day it is almost certain that the new egg was laid on the second day, because only a few passerines, notably some thrushes (Brackbill 1958, Weatherhead et al. 1991), are known to lay in the afternoon.

Second, establish the length of the laying interval from the nesting data, if this is not already known. Laying intervals are usually recorded in life-history studies and in compendia of bird biology (e.g., Campbell and Lack 1985). For the sake of argument, I assume a 24 hr interval, which is common among passerines.

Third, group the observations according to the presence or absence of the egg of the day and assign each record to a time period, e.g., an hour interval. The choice of the length of this time period depends on the number of observations and the range in time of the daily laying period. If the latter is protracted, then the number of observations required per time period will be greater than that required for a species with a shorter daily laying period.

Fourth, determine for each time period the proportion of nests containing a new egg. At this point, it will be clear if almost all visits had been made to nests either before or after the egg of the day was present. That is, there were almost no time periods that contained several nests with and several nests without a new egg. If this be true, the method cannot be satisfactorily applied.

Fifth, for the method to apply, there must be sufficient observations before and after the egg of the day was present to show a change with time from fewer than 50% of the nests containing a new egg to a proportion of nests with a new egg exceeding 50%. At some time between the two above time periods, the proportion of nests containing a new egg changes from <50% to >50%. This occurs at the median time of the daily laying period.

Finally, the number of observations must be sufficient to show a significant difference between the proportions of nests containing the egg of the day in the time periods that are adjacent to the period in which about 50% of the nests contained a new egg.

The method is most precise for species that lay at 24 hr intervals and least precise for those that lay at irregular intervals. Data from different months or areas can be combined, if allowances are made for differences in the hour of onset of daily activities in different months or regions. That is, the observed clock time of visits should be related to the time of sunrise (see Scott 1991) or to the time of onset of morning civil twilight, which provide measures of the beginning of most birds' daily activity. If, however, the times relative to sunrise among different months or areas differ significantly, they should not be combined, as differences would suggest that the time of laying relative to sunrise varies seasonally or geographically. For example, Nolan (1978:190) showed that the time of arrival at the nest to lay by Prairie Warblers (*Dendroica discolor*) did not change with date but the time of civil twilight did. Pied Flycatchers (*Ficedula hypoleuca*) vary geographically in their time of laying relative to sunrise, laying closer to sunrise in Germany than in Finland (Creutz 1955, Rosengren 1993).

TABLE 1. The number and proportion of times that the egg of the day was present at the time of observer's visit to a Gray Catbird's nest at London, Ontario.

Time of visit (EST)	Egg of the day		Proportion of nests with egg of the day
	Present	Not present	
04:30–05:29 hr	0	27	0/27 (0%)
05:30–06:29 hr	4	32	4/36 (11%)
06:30–07:29 hr	18	14	18/32 (56%)
07:30–08:29 hr	26	6	26/32 (81%)
After 08:29 hr	88	1	88/89 (99%)

ILLUSTRATION OF THE METHOD

To illustrate my method, I use a heterogeneous set of times of visits to nests of laying Gray Catbirds (*Dumetella carolinensis*), recorded at London, Ontario between mid-May and early July. Some visits were made deliberately to estimate laying hours, but most were made to obtain other data (e.g., Darley et al. 1971, Scott 1977).

I included all single daily visits. If, however, there were several visits to a nest on one day, I included only the latest visit that showed no new egg and the earliest visit that showed a new egg. In total, 216 visits to 70 nests were made beginning before sunrise (ca. 04:50 hr) and extending into late afternoon (Table 1). Times are Eastern Standard (EST).

No new eggs (eggs of the day) were present at all visits made before 05:30 hr, a few were present by 06:30 hr, most were present by 08:29 hr; and only one egg was laid after 08:29 hr (Table 1). Thus, the daily laying period spanned about three hours, with most laying occurring between about 06:30 hr and 08:29 hr.

Proportions of nests with a new egg changed significantly from 11% (4 of 36 nests) to 81% (26 of 32 nests) between 05:30–06:29 hr and 07:30–08:29 hr ($G = 37.33$, df $= 1$, $P < 0.001$). The proportion of nests with a new egg reached 50% between 06:30 hr and 07:29 hr (Table 1). Hence, I estimate that the mid-point of this hour, namely, 07:00 hr, was close to the median laying time. Most catbirds, therefore, were laying about two hours after sunrise (ca. 04:50 hr) or about two and a half hours after the onset of morning civil twilight. This estimate agrees with an earlier report based on eight nests (Scott 1991).

DISCUSSION

My estimates, as do earlier estimates of catbird laying (Shufeldt 1893, Herrick 1935, Latham 1936, Davis 1942, Sherman 1952, Zimmerman 1963, Nickell 1965), show that the daily laying period extended over several hours. Zimmerman (1963) suggested that certain females laid consistently in early morning, while others were late morning layers. Such individuality may explain the variation in the time of laying found in earlier records, notably those of Shufeldt (1893) who observed one female lay four eggs between 09:15 and 10:35 hr, whereas Davis (1942) reported that catbirds laid daily about 08:00 hr.

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