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A STATISTICAL ANALYSIS OF THE NESTING SEASONS OF BIRDS IN WESTERN MALESIA

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INTRODUCTION

The seasonal nature of the nesting activity of birds resident in equatorial South East Asia has been discussed by Gibson-Hill (1952), Voous (1950), Ward (1969) and Wells in Medway and Wells (1976) and in Wells (1988). The earlier authors commented on nesting activity in relation to rainy seasons or to solar cycles. Wells discussed the aggregate data for breeding and moulting of those resident forest birds which are predominantly insectivorous and probably depend exclusively on arthropods to feed their young. The peak of breeding in the Malay Peninsula occurs March-April and of moulting four months later. Wells related breeding to seasonal abundance of food and avoidance of a dearth of the fledglings' diet While food supply is influenced by climatic factors either directlyor through forest phenology. Wells did not consider rain or the lack of it to be a likely proximate stimulus to breed and that small variations in day length would be too prone to interference by local day to day conditions, especially in forest, to serve such a function. Physiological timing dependent on the accumulation and depletion of internal food reserves was postulated as such a mechanism. Accumulation is influenced by the external food supply and factors determining it, while depletion is more rapid when reserves are utilised in moulting as well as for breeding. The Nesting Activity Index of McClure and Hussain (1968) is a scale of 0 to 100, in which the index for any calender month (or shorter period) is in proportion to 100 for that in which most nesting activity is recorded. They calculated the Nesting Activity Indices for their own records at Rantau Panjang, Selangor, and those of Edgar (1933) at Sitiawan, Perak, of Spittle (1949) at Changi, Singapore and of the following given in Gibson-Hill (1952), namely, of Banks (1950)near Kuching, Sarawak, of Ryves in Negeri Sembilan, of Ryves and Madoc in Selangor, of Madoc in Pahang and of Coope and Edgar in Perak. Their indices for North Borneo (Sabah) based on the observations of Ryves (Banks 1950, Gibson-Hill 1952) are omitted from the following analyses, because Ryves recorded in two separate localities for only five and three months respectively.

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Indices have been calculated from the data of de Beaufort and de Bussy

for Pontianak, W. Kalimantan and of Sody for Bogor and Mount Garoet (Garut), and near Tjepoe (Cepu), Java, as given by Voous (1950), and also for Narathiwat (then known as Bangnara) South Thailand, recorded by Aagaard (Gibson-Hill 1952). The localities are indicated in Figure 1. The monthly indices are given in Table 1 for the localities arranged from north to south, which includes a trend from west to east. The total number of species and/or nests for each locality is given.

At the foot of Table 1 are some additional data. These are not used in the following analyses, but provide some further indications of the main nesting season in West Malaysia and Singapore. The first line of the additional data is based upon the breeding activity of 105 passerine species from all records of nests with eggs in West Malaysia and Singapore (Ward 1969). This is not used in analysis because the area is too large. The second and third lines are the data of Ryves for Sabah mentioned above. The fourth, fifth and sixth lines are for the records of nests with eggs and/or young for respectively, the Magpie Robin *Copsychus saularis* in Selangor and Province Wellesley, the Yellow-vented Bulbul *Pycnonotus goiavier* in Johor, Negeri Sembilan, Selangor and Pahang, and the Yellow-vented Bulbul in Singapore, all based upon Foo and Medway (1970). The final line is for nests with eggs in Singapore (Ward 1969). This and the five preceding lines are omitted from analysis because of the probable lack of uniformity in search for and detection of nests.

If nesting activity is influenced by the angle of the sun or variation in official daylength (sunrise to sunset) there should be a clear relationship between latitute and season, and a difference of six months in the peak nesting activity would be expected between the localities equally far north and south. Furthermore a bimodal distribution of activity or little variation throughout the year might be expected at localities near the equator. None of these effects can be demonstrated. The peaks fall in the months March to June, the troughs fall in the months August to January (starting in July at Kuching but the Index of 15 is based on only 2 nest records for that month). There is no evidence of a bimodal distribution of activity. The minor increases during November in Perak, September and October at Deli, and December and January at Bogor/Mt. Garoet do not rival the main peaks and may be due to error in expressing the few records available. The double peak at Pontianak does not indicate true bimodality. The combined records for Bogor/Mt. Garoet show the lowest coefficient of variation, but even so there is a more than five-fold range in seasonal activity and this locality is one of the furthest from the equator, whereas Pontianak on the equator has the highest coefficient of variation.

CORRELATIONS BETWEEN LOCALITIES

The correlation coefficients of the monthly indices of nesting activity between all localities are given in Table 2 arranged in sequence so that those most highly correlated are adjacent. There are 91 correlations between the 14 localities of which 49 are significant, 11 at $P \leq 0.05$, 16 at $P \leq 0.01$ and 22 at $P \leq 0.001$. The monthly indices of nesting activity in each locality are correlated significantly at some level with those in 3 to 10 other localities. About 56% of the seasonal variation in nesting activity of all localities is common to all.