# Clutch Size And Breeding Seasons In A Nest Box Population Of The Tree Sparrow (Passer Montanus)

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## *Introduction*

This nest box project was started in 1984 - not for the purpose of studying the breeding biology of the Tree Sparrow (Passer montanus) but out of general ornithological interest. The study site was in an area where the number of natural tree cavities were limited in number. Two nest boxes were occupied by Tree Sparrows in the first year (1984) and the population increased each year until 17 boxes were utilised by this species in 1988.

Throughout the project a record has been kept for each nesting attempt; number of eggs, number of nestlings produced and success or failure of each clutch. All pulli have been ringed and a winter ringing programme of the population by mist netting at both baited and natural sites within or close to the study area has been carried out. In this preliminary report, however, only clutch size and length of breeding season of this population of Tree Sparrows has been analysed, from data collected between 1984 and 1988.

Analyses of the data collected in this study are interesting as the breeding biology of the Tree Sparrow has received less interest by ornithologists in the British Isles compared with other species which readily utilise nest boxes, eg. Great Tit (Parus major) and the Starling (Sturnus vulgaris). The Great Tit is, in general, a non-migratory species, can easily be trapped at baited sites and unlike the Tree Sparrow, can be aged and sexed in the hand out of the breeding season, increasing the value of data for both ecological and population studies. Research into the breeding biology of the Starling has been encouraged because it can be a pest species in both agricultural and urban situations. A further interesting feature of this study is that the study site - near Blairgowrie, Tayside -is at the edge of the Tree Sparrow's range in Scotland (Thorn 1986 and Sharrock) 1976).

## *Site*

The study site is in countryside essentially open and agricultural with scattered hedgerow and roadside trees and small areas of woodland.

It is situated near Blairgowrie, Tayside, at an altitude of 65 m: National Grid Reference N0166436; Coordinates 56 35'N 3 2VW.

Nest boxes were positioned over an area of approximately 25 ha, not in a regular grid or pattern but affixed to hedgerow trees and in small patches of mixed deciduous woodland and around the perimeter of Darroch Wood a small (5 ha) Oak woodland most of which was coppiced in 1947. As a consequence of coppicing there were few

natural cavities suitable for hole nesting birds in the woodland. The herb layer within Darroch Wood is dominated by Wild Hyacinth (Endymion non-scriptus) and the shrub layer is scanty or largely absent.

Barley and Raspberries are the major agricultural crops grown in and surrounding the study area although, to a lesser extent, Swedes, Potatoes and Oats are also grown together with small areas of permanent pasture.

## *Methods*

This project was started in 1984 with 15 boxes. The number of boxes was gradually increased to 25 (See Figure I). The nest boxes were constructed with wood and conformed to the basic design, size and shape illustrated in Flegg and Glue (1971) although the nest hole was positioned in the front of the box instead of the side. The hole diameter was 33 mm. The boxes were nailed to the trunks of trees 3 m from the ground.

The boxes were inspected weekly or more frequently between mid-April and mid-August each year from 1984 to 1988. Nest material was removed from the boxes at the end of the breeding season.

Date of first egg laid in each clutch was noted and the data were placed in 10(11) day periods of each month 1-10, 11-20 and 21-30(31) days of each month. It was assumed that eggs were laid at I day intervals (Seel 1964). Note was taken of unhatched eggs from previous clutches. A complete clutch was defined as the maximum number of eggs recorded when the eggs were warm and being incubated by an adult bird. A small proportion of clutches was riot completed due to predation of, or desertion by, the adult bird(s).

Meteorlogical data (monthly mean air temperatures) were obtained from a Meteorological Station, situated 31 km North-west of the study site, at Faskally, Tayside: National Grid Reference NN918599; Altitude 94 m.

## *Results*

Figure 1 illustrates the number of boxes occupied each year by four different species over the five year period between 1984-88. The number of boxes available each year was gradually increased (Figure I) with only 15 boxes in position in the study area in the first three years.

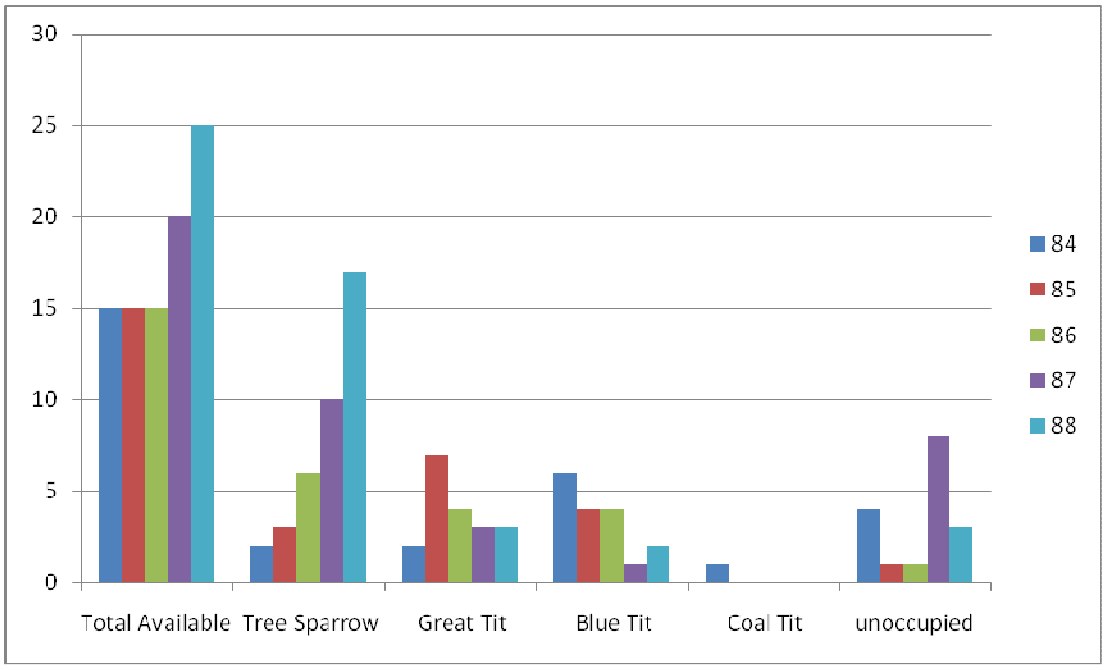



Fig 1:- Total Number and species occupancy of boxes in the study area 1984 -1988

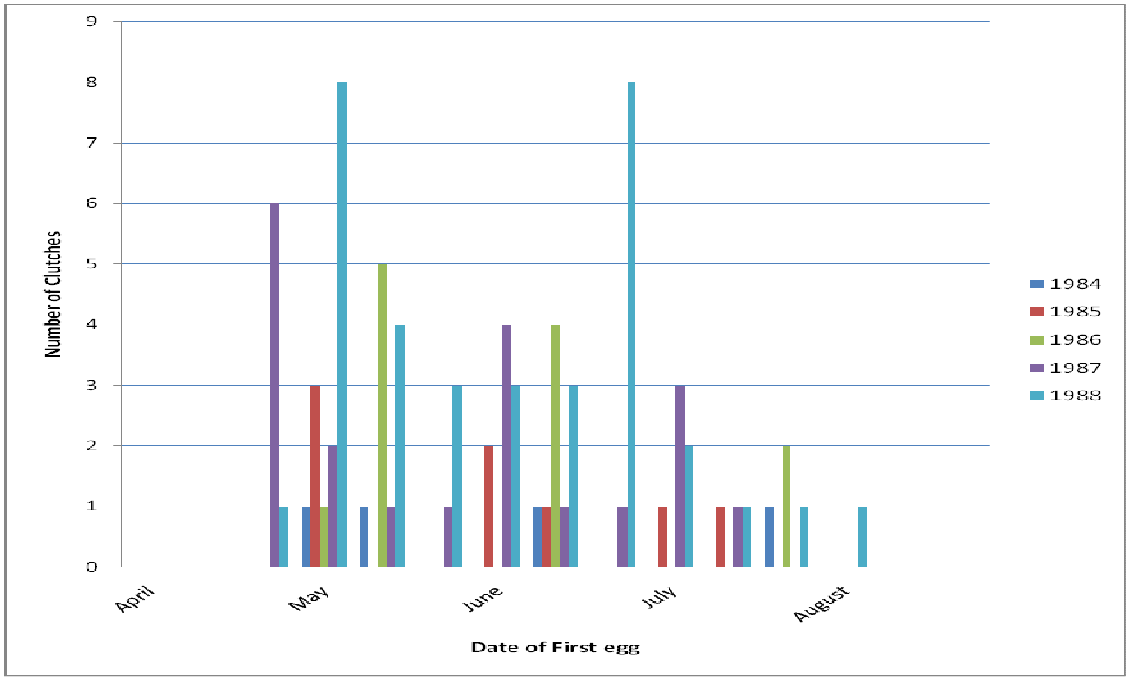
Note In 1987 a Blue Tit pair occupied a box early in the season and subsequently the same box was occupied by Tree Sparrow in late summer.

The number of boxes was increased to 21 in 1987 and a further four boxes added in 1988 to make a total of 25 available boxes. It is clear from Figure If that there has been a high occupancy rate throughout the study period with only one box unoccupied in both 1985 and 1986 although not once in any year have all boxes been utilised.

It is evident, however, that the proportion of the four species utilising the boxes has altered between 1984 and 1988 (Figure 1). The number of Tree Sparrows breeding in the study area has shown a remarkable increase each year, even allowing for the fact that the number of boxes available has increased from 17 to 25 over the five year period. Only two boxes were occupied by Tree Sparrow in 1984 but by 1988 17 boxes were used by this species. There is no clear trend with time in the number of Great Tit breeding in the nest boxes available. Seven boxes were utilised by this species in 1985 but in the other four years between two and four boxes were occupied by Great Tit. In contrast to both Tree Sparrow and Great Tit the number of Blue Tit (Parus caeruleus) breeding in the nest boxes appear to show a decline over the five year study despite an

increase in the number of boxes over the same period. The fourth species to breed in the available nest boxes was Coal Tit (Parus ater) when one pair bred in 1984.

Figure 2 highlights the large increase in number of Tree Sparrow clutches laid over the five year period. It also shows the pattern of clutch initiation both between years and within each season. Although the amount of data is small for the first two seasons, 1984 and 1985, from inspection of the data it would appear that there is synchronisation of clutch initiation with time within a complete season. It is clear that there were three peak periods of egg laying in 1986 and 1987, with each peak of activity decreasing as the season progressed. In 1988 only two distinct peaks of clutch initiation are evident, with a longer time span between peaks compared with the previous two years. Four clutches were not completed in May 1988 due either to predation of, or desertion by, the adult bird(s). This may have resulted in repeat laying and consequent interruption of the normal pattern of the timing of egg laying within the population.




It is also interesting to note from Figure 2 that the date of commencement of egg laying varies from year to year. In 1986 the first egg laying peak occurred between 11-20 May, which contrasts with a peak of clutch initiation between 21-30 April in 1987. As variations in environmental factors may directly or indirectly affect time of breeding in several bird species (Perrins and Birkhead 1983), April mean temperature data and the date of commencement of breeding in the study population for each year is listed in Table I and allows comparisons between years to be made.

**Table 1.** Dates of the first peak of clutch initiation (see Figure 2) and the April monthly mean air temperatures at Faskally 1984-88 (Clutch data for 1984 were insufficient to be included in the table).

| Year | First Clutch | Peak April Mean Temperature (C) |
|---|---|---|
| ***1984*** | | 7.7 |
| ***1985*** | 1-10 May | 6.7 |
| ***1986*** | 11-20 May | 4.7 |
| ***1987*** | 21-30 April | 8.3 |
| ***1988*** | 1-10 May | 6.8 |

It can be noted from Table I that a low monthly mean temperature (4.7 C) in April 1986 resulted in the late commencement of breeding in that year and contrasts with the early breeding of the Tree Sparrow population in 1987 when the April mean temperature was high (8.7 C). In 1985 and 1988 the April monthly mean temperatures of 6.7 C and 6.8 C were intermediate between the two extreme years of 1986 and 1987 and resulted in the breeding seasons starting at appropriate intermediate periods in these two years.

Figure Ib illustrated the increase in nest box utilisation by the Tree Sparrow population over the five year period and Figure 2 showed the number and timing of clutches initiated. Further clutch data is listed in Table 2.

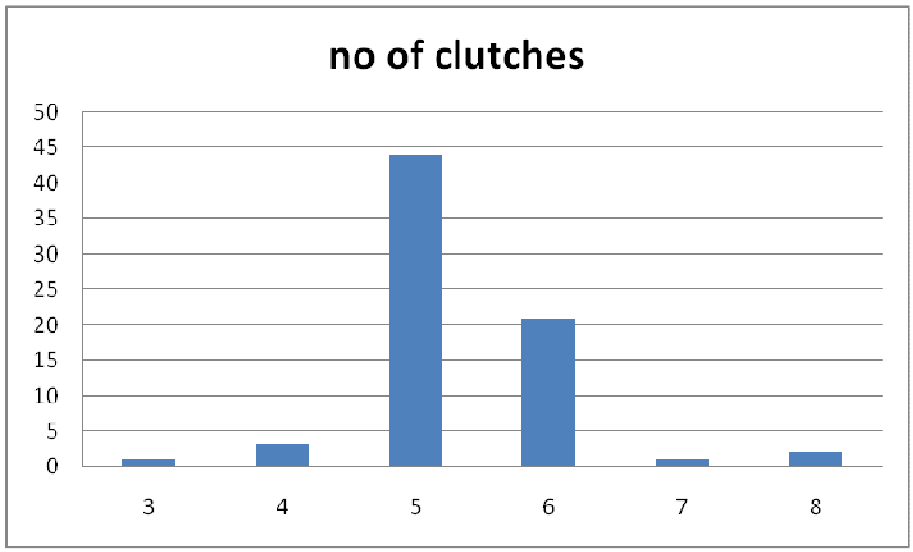
**Table 2:-** Number of boxes utilised, clutches initiated, clutches unsuccessfully completed and the ratio of clutches started to boxes utilised.

| Year | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| ***Number of clutches initiated*** | 4 | 8 | 12 | 20 | 35 |
| ***Number of clutches not completed*** | 0 | 1 | 1 | 0 | 5 |
| ***Number of Boxes Utilised*** | 2 | 3 | 6 | 10 | 17 |
| ***Ratio of Clutches initiated to number of boxes utilised*** | 2 | 2.7 | 2 | 2 | 2.1 |

It can be seen (Table 2) that the mean number of clutches per box has remained remarkably uniform over the five year period, with the mean value ranging from 2.0-2.7. The majority of clutches were completed although 5 out of a total 35 were not completed in 1988 - due to predation of or desertion by the adult bird(s). A total of 79 clutches were initiated, ie, at least one egg was laid over the five year study period of which seven clutches, ie, 8.9% were not completed. There was no evidence to show that disturbance by the human researcher was a factor in nest desertion.

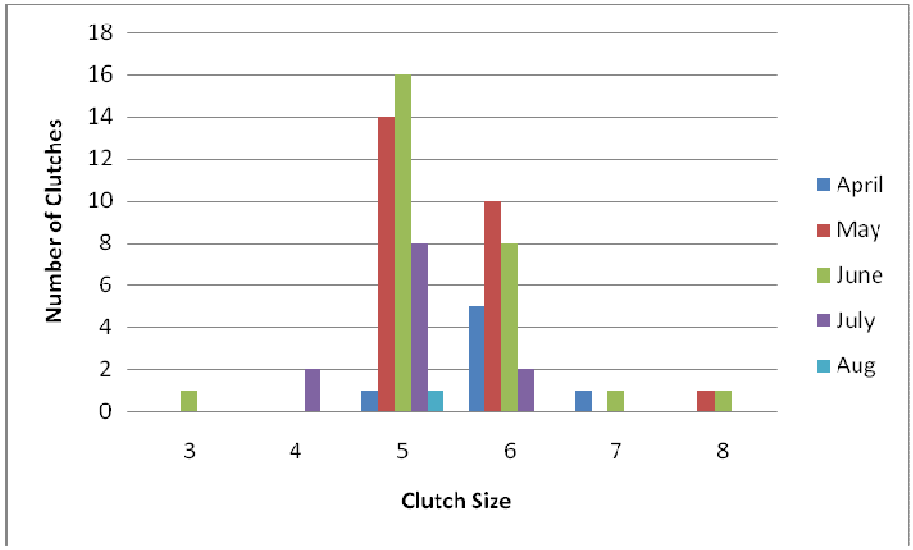
Using the combined data from the five year study period, a total of 72 clutches, the range and frequency of the number of eggs laid in each completed clutch is illustrated in Figure 3. It can be seen that a clutch of five eggs was the most frequent clutch size although values ranged from three to eight. Mean clutch size was 5.33 ± 0.09 (mean ± SE).

Figure 3: Number of eggs in each complete clutch 1984-88( n=72)




Separation of the above data into monthly classes (date of first egg laid) reveals differences in clutch size within the breeding season (Figure 4). Although five eggs was the most frequent clutch size in each month, proportionally, the number of clutches with six eggs increased in May and June. In addition, clutches with more than six eggs were only recorded in these two months. Consequently, mean clutch size was higher in the middle of the breeding season. May (5.52 ± 0.14) and June (5.40 ± 0.17) compared with April (5.00 ± 0.22) and July (5.00 ± 0.17).

Figure 4: Number of eggs in each completed clutch 1984-88




## *Discussion*

The status and distribution of the Tree Sparrow in the British Isles has been recorded in Sharrock (1976) and for Scotland in Thorn (1986). Recent thorough research into the status of this species in the British Isles has been reported in Summers-Smith (1989). This latter study covered the period mainly from 1972 to 1985 but also with some data

from 1860 onwards. His study revealed that the total number of Tree Sparrow in the British Isles has exhibited large fluctuations in size, with population maxima occurring at the turn of the century and the mid-1960's, he estimated that the breeding population was over 850,000 pairs in the mid-1960's and fell to about 285,000 pairs in 1985.

The increase in the number of Tree Sparrow occupying the breeding in the study site nest boxes between 1984 and 1988 (Figure la) was unlikely to reflect a change of status of the species throughout Scotland but may be one of the unexpected and inexplicable fluctuations in local populations which this species sometimes undergoes (Sharrock 1976). Alternatively, the availability of nest boxes in an area with few natural nesting cavities may have induced and encouraged a local population increase.

Concomitant with the increase in the Tree Sparrow population in this study there appeared to be a decline in the number of Blue Tit utilising the available nest boxes (Figure 1). This decline may be due to inter-specific competition between the two species for nest sites, as the larger Tree Sparrow can defend a nest box against (Parus) spp. and even successfully usurp these species from nesting holes. (Lohrl, 1978 cited by Summers-Smith, 1988). A longer series of data would be needed, however, before the decrease in the number of Blue Tit occupying nest boxes could be confirmed statistically.

The apparent synchronisation of egg laying (Figure 2) in the Tree Sparrow population is interesting and can be compared with an analyses of British Trust for Ornithology (BTO) nest record cards of the Tree Sparrow in the British Isles over the period 1950-1962 by Seel (1964). Seel tabulated the seasonal distribution of clutch initiation from a total of 826 clutches classified into 5-day periods. Distribution of egg laying with time throughout the breeding season showed three peaks of activity occurring respectively in the 5-day periods 6-10 May, 5-9 June and 20-24 July with laying terminating at the beginning of August. He also demonstrated that the onset of the breeding season did not vary between geographical regions within Britain.

The datum set illustrating date of clutch initiation in this study (Figure 2) although small, also suggests three main peaks of egg laying activity, although in 1988 only two peaks are apparent. The data, however, also suggest that there is variation in the onset of breeding between years which may be correlated with air temperature. The crude temperature parameter used in this project, the monthly mean air temperature for April, appears to show a remarkable positive correlation with onset of laying (Table 1). Caution must be exercised here, however, as the data are few and several more seasons' data would be necessary to allow statistical analysis.

Seel (1968a) conducted a three year study of a breeding Tree Sparrow population at Oxford, England. His data suggested that the onset of breeding was correlated with a rise in temperature in April when mean temperatures reached about 10 C with a 6-day lag period. During his study period, however, the onset of breeding occurred in April each year and did not show the wide variation in t he timing of first clutch initiation found in this study.

In general, for birds in temperate regions, breeding occurs early when Spring temperatures are high and conversely, late in cold Springs (Perrins and Birkhead 1983). For many temperate species, day length may be the proximal factor in determining the

timing of breeding seasons (Perrins 1979). However, ultimate factors such as temperature may have a large affect on the exact date of the onset of breeding.

It could be postulated that low temperatures may affect clutch initiation in the Tree Sparrow both directly and indirectly. At low temperatures the Tree Sparrow would need more food for body maintenance which could delay the onset of breeding condition in the potential breeding population. Indirectly, low Spring temperatures could affect the availability of invertebrate food supply by delaying the hatching and growth of insect and other invertebrate prey. If indeed there is a correlation between temperature and the onset of breeding in the study population several factors, not necessarily mutually exclusive, could therefore contribute to the timing of egglaying in first clutches.

The available data presented (Table 1), although insufficient for statistical analyses, does suggest a suitable avenue for future research, when further clutch initiation data have been collected. A more detailed analysis of temperature values utilising the day-degrees concept or the calculation of a running 5-day daily mean temperature may yield more precise effects of temperature on the timing of the initiation of egg laying in the study population.

Mean clutch size for all completed clutches (n=72) in the study population over the five year study period was 5.33 ± 0.09 (± SE). This can be compared with a mean (n=259) of 5.05 ± 0.05 which Seel (1968b) calculated for his Oxford, England population. From an analyses of information retrieved from BTO nest records which comprised of data collected throughout the British Isles, Seel (1964) calculated a mean clutch size of 4.7 ± 0.03 (n=616). The mean clutch size for the present study at Blairgowrie, Tayside therefore is slightly higher than Seel calculated for his larger samples.

In this project the commonest clutch size was five in every month of the breeding season (Figure 4). Five eggs were found in 61.6% of all completed clutches. It is interesting to note that, proportionally, the number of clutches with six eggs was greater in May and June when compared with April at the start of the breeding season and July at the end of the season. As clutches of five or six eggs comprised 90.4% of all completed clutches this resulted in a higher mean clutch size in the middle of the breeding season.

An analyses of variance of clutch size over the four months - April, May, June and July was not possible as the mean variances of clutch size were not homogeneous (Fowler and Cohen 1987). A statistically significant difference in clutch size between months could therefore not be demonstrated.

Analyses of data from this ongoing study for this preliminary report have yielded some useful and interesting results. Several trends have been noted, namely:-

1. An increase in the Tree Sparrow population
2. A change in species composition utilising the available nest boxes.
3. A possible link between April mean air temperature and the seasonal onset of breeding in the study population.
4. An apparent increase in clutch size in the middle of the breeding season.

Continuation of field observations in this ongoing study will produce more quantitative information which may reinforce and confirm interpretation of the data presented in this paper, by allowing increased use of objective statistical analyses.

## *Acknowledgements*

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