without signals from other birds, the speed with which the birds assembled suggests otherwise. Even a slight delay would have meant loss of some of the food from the group.

Although it is generally acknowledged that birds in flocks profit energetically from each others' discoveries of food, the possibility of advantage to the discoverer, beyond the food it consumes, does not seem to have been considered. In this case MOOMXO probably profitted in other ways too. As the oldest member of the unit (at least 11 years old) and as a member since the study began in 1970, she was probably related to others in the unit (Brown and Brown, Science 211:959–960, 1981). In addition, some of the recruits fed some of the winged ants to the nearby fledglings, which included those of MOOMXO together with those of two other females. MOOMXO may also have been related to these other fledglings. Thus, there is a distinct possibility that MOOMXO benefitted her indirect fitness as well as her direct fitness (Brown and Brown, Symp. Natural Selection and Social Behavior, Chiron Press, New York, New York, 1981) by calling the attention of her flock members to this transient resource.

I have observed similar, though less dramatic and less thoroughly documented, instances of rapid exploitation of emergences of reproductive ants in the Mexican Jay and the Grey-crowned Babbler (*Pomatostomus temporalis*).

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Effect of unlimited food availability on the breeding biology of wild Eurasian Tree Sparrows in West Malaysia.—Ward and Poh (Ibis 110:359–363, 1968) suggested that Eurasian Tree Sparrows (*Passer montanus*) in Singapore initiate and finish breeding and molt 2–3 months earlier than conspecifics in South China, thereby completing these energy-consuming activities before food becomes scarce for Singapore birds. They observed that tree sparrows in Singapore (1°N) breed mainly from January to mid-May. The molt of primaries barely overlaps the breeding season and terminates by late August when the testes of adult males have fully regressed. The marked decline in the number of sparrows sighted and in mean adult body weight which occurred from October to December indicate a period of low food abundance.

If the timing of breeding and molt in tree sparrows is responsive to local food availability, then a population with year-round access to high-quality food should either breed continuously, as does the Common Moorhen (*Gallinula chloropus*) (Siegfried and Frost, Ibis 117:102–109, 1975), or at least extend its breeding season if the necessity for gonad rehabilitation precludes continuous breeding (Lofts and Murton, pp. 1–107 *in* Avian Biology, Vol. 3, Farner and King, eds., Academic Press, New York, New York, 1973). I studied the effect of unlimited food availability on the timing of breeding and molt of tree sparrows at the Universiti Pertanian Malaysia (UPM) campus (Serdang, Selangor; W. Malaysia; 3°N) where these birds congregated at the Poultry Unit to feed freely on the enriched commercial mash (17% protein and 3.2% calcium by dry weight) provided to laying hens. The "natural" tree sparrow diet consists of grass seeds and insects which are only seasonally abundant (Nawawi and Jantan, Science and Education Diploma Program Third Year Project Report, Universiti Pertanian Malaysia, 1977). A study of marked individuals mist-netted at the Poultry Unit confirmed that these sparrows were residents, nesting in inaccessible sites of the masonry of nearby buildings and returning regularly to feed on the mash (Hamdan et al., Science and Education Diploma Third Year Project Report, Universiti Pertanian Malaysia, 1977).

Study area and methods.—The UPM campus is within the West Coast Rainfall Region of Peninsular Malaysia which experiences high rainfall during the intermonsoon periods in April and October–November, and low rainfall during February and July (Dale, Trop. Geog. 13: 23–37, 1959) (see Table 1).

From July 1976–June 1977, four mist nets were used to collect tree sparrows in one morning (08:00–10:00) of each month at the Poultry Unit. Nets were placed close to chicken sheds to minimize the visibility of the mesh to sparrows coming in to feed; very few birds were caught as they left the Unit after feeding since the nets were conspicuous against the sky. Sparrows were weighed soon after capture to the nearest 0.5 g and then were sexed by dissection. The length of the usually larger left testis in each adult male was measured to the nearest mm. The broadest dimension of the ovary in adult females was similarly measured whereas the diameter of the largest follicle was measured to the nearest 0.5 mm; oviduct condition, well-developed or not, was also noted. After post-juvenal molt subadults were distinguished from adults by the degree of cranial ossification. The occurrence of molt (feather growing in sheath) was also recorded.

Results.—There was significant (males: $F[11,81] = 10.04$, $P < 0.001$; females: $F[11,71] = 10.07$, $P < 0.001$) and similar monthly variation in mean gonad size of both males and females (Fig. 1a,b). Birds of both sexes measured in July 1976 and in the period December 1976–June 1977 had significantly larger gonads than birds measured in the period August–November 1977 (Scheffé test, $P < 0.001$). The pattern of variation in maximum follicle size (Table 1) parallels the pattern of gonadal development described above, with enlarged follicles observed in months when ovaries were enlarged (Pearson product-moment correlation, $r = 0.61$, $P < 0.01$). Females with muscular, well-developed oviducts were collected from February–June 1977.

Adult males and females did not show the same pattern of weight change (Fig. 2a,b). Males collected in the period September–December 1977 were significantly heavier than males collected in other months (Scheffé test, $P < 0.001$) but the mean body weight of adult females did not vary seasonally ($F[11,74] = 1.34$, $P > 0.10$).

Although body molt was observed in all months except May 1977, a higher proportion of molting adults was collected during August–November 1976 (Table 1). Similarly, higher proportions of adults molted primaries from August–October 1976 but, unlike the pattern observed for body molt, this was followed by a period of 3 months (November 1976–January 1977) during which primary molt was not observed. In subsequent months there was no discernible trend in the frequency of primary molt observed in the population samples; but in 2 months, March and June 1977, primary molt did not occur. Sparrows in various stages of post-juvenal molt were present in all months except January 1977 and comprised 50% or more of the samples collected in August 1976, and May and June 1977 (Table 1).

Discussion.—These data strongly suggest that the breeding season of tree sparrows on the UPM campus may be at least 2 months longer than that of tree sparrows in Singapore. Three lines of evidence support this. Firstly, enlarged gonads occurred in males and females from December 1976–June 1977 and this presumably marked the time during which breeding was physiologically possible. Secondly, newly fledged juveniles appeared in early February 1977. If the time between oviposition and fledging of a brood for Malaysian tree sparrows is about the same as in temperate populations (30–35 days; Bethune, Gerfaut 51:387–398, 1961; Chia et al., Acta Zoologica Sinica 15:527–536, 1963; Pinowski, Ekol. Pol. 16:1–58, 1968; Seel, Ibis 110:129–144, 1968), then egg-laying began as early as late December on the UPM cam-

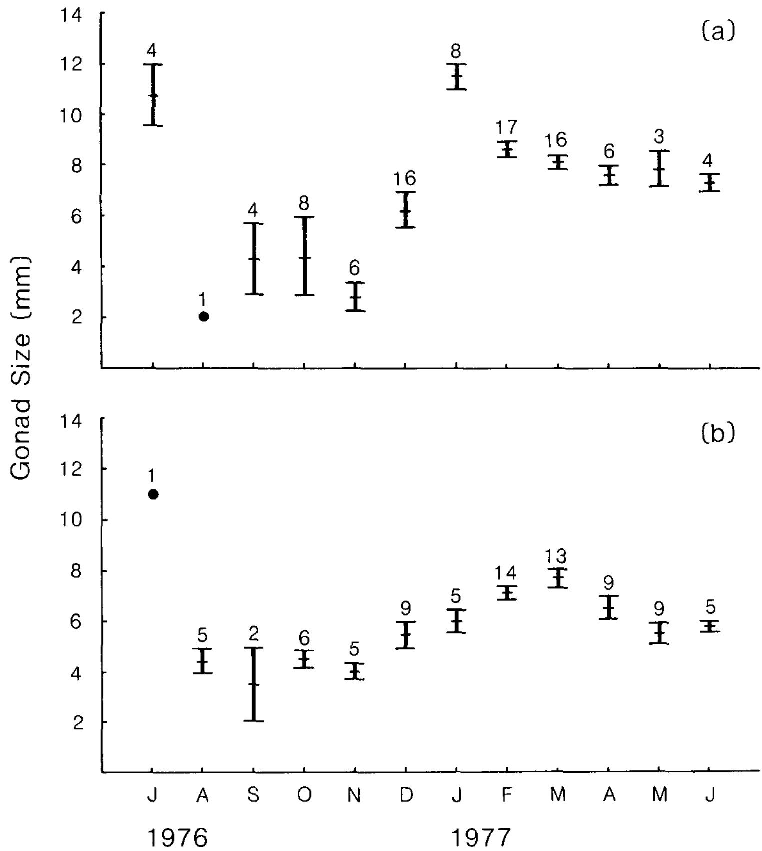

FIG. 1. Monthly variation in gonad size of adult Eurasian Tree Sparrows on UPM campus ($\bar{x}$ ± SE, N given): (a) length of left testis; (b) broadest dimension of ovary.

pus. Food supplements experimentally presented to Great Tits (*Parus major*) (Källander, Ibis 116:365–367, 1974), to Carrion Crows (*Corvus corone*) (Yom-Tov, J. Anim. Ecol. 43:479–498, 1974), and to Kestrels (*Falco tinnunculus*) (Dijkstra et al., Ibis 124:210–213, 1982) have been shown to significantly advance the laying date of the first egg. Finally, well-developed oviducts were observed in females sampled during the period February–June 1977.

Oviduct hypertrophy in wild and domestic birds is dependent on estrogen secretion from the ovary (Witschi and Fugo, Proc. Soc. Exper. Biol. Med. 45:10–14, 1940; Brant and Nalbandov, Poul. Sci. 35:692–700, 1956; van Tienhoven, pp. 1088–1169 *in* Sex and Internal Secretions, Vol. 2, Young, ed., Williams and Williams, Baltimore, Maryland, 1961; Murton and Westwood, Avian Breeding Cycles, Oxford Univ. Press, London, England, 1977). High levels of estrogen are only present when follicle development occurs (Kern, Z. Zellforsch. 126:297–319, 1972; Lofts and Murton 1973; Murton and Westwood 1977; Wyndham et al., Ibis 123:511–518, 1981). The presence of a well-developed oviduct, therefore, indicates either

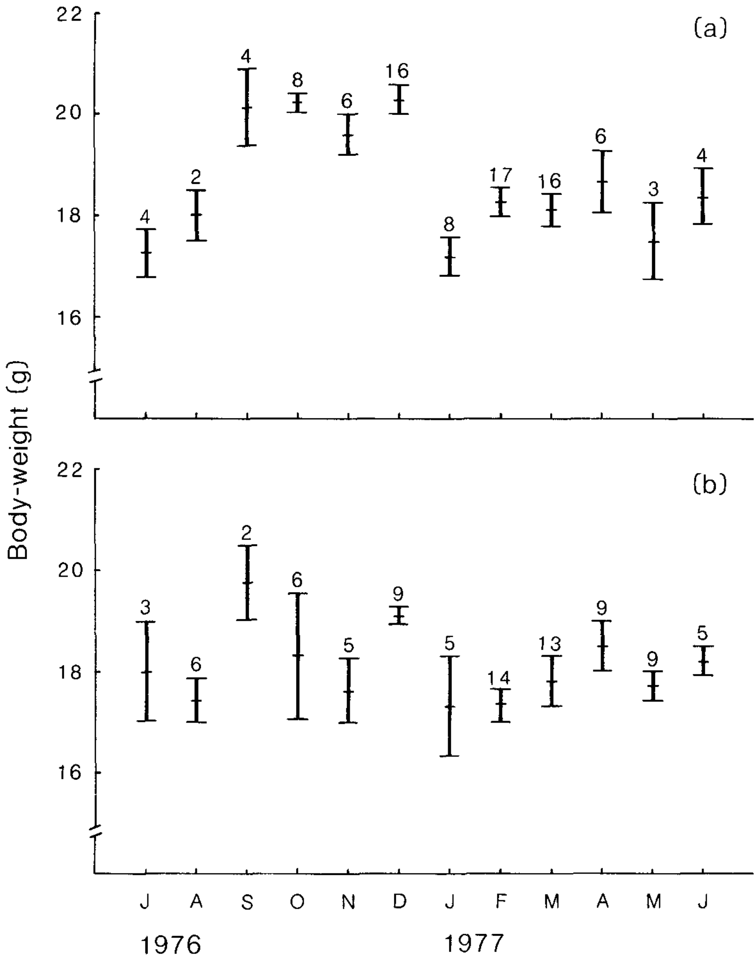

FIG. 2. Monthly variation in body weight of adult Eurasian Tree Sparrows on UPM campus ($\bar{x}$ ± SE, N given): (a) adult males; (b) adult females.

that oviposition has occurred in the recent past (oviduct involution requires 10–15 days in White-crowned Sparrows [*Zonotrichia leucophrys*] [Lewis, Condor 77:46–59, 1975], and about 8 days in several species of African finches [R. B. Payne, pers. comm.]) or that oviposition will occur in the near future. Conservatively estimated, the breeding season of the UPM sparrows ends in mid-June if the observed, well-developed oviducts are regarded as undergoing involution. If the reproductive condition of the UPM sparrows in July 1976 is typical, however, then the breeding season of this population can be reckoned as ending in August and, thus, lasting 8 months.

House Sparrows (*Passer domesticus*) commence molt of the juvenal plumage from 4–6

TABLE 1

MONTHLY RAINFALL, MAXIMUM FOLLICLE SIZE, AND PROPORTION OF JUVENILES AND MOLTING ADULTS IN MONTHLY SAMPLES OF EURASIAN TREE SPARROWS ON UPM CAMPUS

	Jul. '76	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. '77	Feb.	Mar.	Apr.	May	June
Rainfall (mm)	58	214	170	371	287	247	283	111	106	175	104	195
Maximum follicle size (mm)	8.0	0.5	0.5	0.5	0.5	4.0	4.0	11.0	8.0	12.0	2.0	1.0
Total no. birds	9	16	9	17	13	32	13	39	39	23	28	25
Juveniles as % total	22	50	33	18	15	21	0	18	26	35	57	64
No. of adults	7	8	6	14	11	25	13	32	29	15	12	9
Percent adults in body-molt	14	50	33	29	27	8	8	6	3	7	0	11
Percent adults molting primaries	14	25	33	21	0	0	0	9	0	27	17	0

weeks after leaving the nest (Summer-Smith, The House Sparrow, Collins, London, England, 1963). Should tree sparrows follow a comparable schedule, then the presence of juveniles exhibiting the early stages of post-juvenal molt in all monthly samples except January 1977 suggests that the breeding season at UPM may exceed 8 months. Admittedly, the evidence presented above for an extended breeding season is circumstantial and need to be corroborated by more direct breeding data from a longer term study on the UPM campus. The arguments presented would also be strengthened if a nearby sparrow population depending only on naturally occurring foods can be shown to have a breeding schedule similar to the Singapore population.

Geographic variation does not account for the suggested difference in the breeding schedules of the UPM and Singapore sparrow populations since tree sparrows breed earlier and for a longer period of time with decreasing latitude (Table 2). The UPM population, located 2° north of Singapore, appears to have a breeding season that is 2–3 months longer than the Singapore population, a pattern which is contrary to the above geographic trend. This marked difference also contrasts with the gradual rate of latitudinal variation shown in Table 2; the Singapore population differs from sub-tropical populations (23°N) with respect to duration of the breeding season by about 1 month and from temperate populations (50–52°N) by about 2 months. Climatic differences between the UPM and Singapore sites are negligible (Dale 1955, Nieuwolt, pp. 27–39 *in* Animal Life and Nature in Singapore, Chung, ed., Singapore Univ. Press, Singapore, 1973) in comparison with these more northern sites.

The observed molting pattern supports my interpretation that increased food availability is the principal factor which prolongs the breeding season of the UPM sparrows. Breeding and molting are energy-consuming activities and most bird species in the S. E. Asian tropics postpone molt until breeding has been completed (Ward and Poh 1968; Fogden, Ibis 114: 308–343, 1972; Wong, unpubl.). The tree sparrows which fed at the UPM Poultry Unit, however, molted body feathers year-round (except May 1977) and molted primaries during most of the breeding season (Table 1). The absence of primary molt in the March and June 1977 samples suggests that for the birds collected in these months, breeding activity may have been energetically too demanding for molt to occur simultaneously. However, two females nearing oviposition (egg with albumen layer in oviduct) in April 1977 were actively molting primaries. This ability to breed and molt simultaneously when high-quality food is continually available has also been reported for the Common Moorhen (Siegfried and Frost 1975).

The pattern of weight change in the UPM tree sparrows also indicates that food availability was continuously high. The post-breeding weight loss observed in the Singapore population was attributed to a decrease in food abundance (Ward and Poh 1968). In contrast, adult male sparrows on the UPM campus showed a significant post-breeding weight gain which persisted until the following breeding season, suggesting that food was readily available and that body weight was only depressed by the energetic demands of breeding. Since both parents in this species share in breeding activities from nest-building to feeding nestlings (Chia et al. 1963), it is surprising that females did not show a fluctuation in body weight similar to that of the males. Females may undertake a greater share of post-fledging care, and consequently do not manage to gain weight after the breeding season. However, observations of individually marked sparrows would be necessary to determine whether this suggested difference in parental behavior might account for the difference in the pattern of weight change observed, since this species is not sexually dimorphic in plumage.

It would be of interest to determine why the UPM tree sparrow population does not in fact breed continuously. Changes in photoperiod and temperature can probably be discounted as factors which serve as cues in scheduling reproductive activities since neither vary appreciably throughout the year (Ward, J. Zool., Lond. 157:25–45, 1969). I was unable to determine whether breeding adults and nestlings use the poultry mash to the same degree

TABLE 2

LATITUDINAL VARIATION IN THE BREEDING SEASON OF THE EURASIAN TREE SPARROW

Locality	Latitude (°N)	Breeding season	Duration (months) of breeding	Reference
Warsaw, Poland	52	mid-Apr.–early Aug.	3	Pinowski (1968)
Oxford, England	52	late Apr.–late July	3	Seel (1968)
Marke, Belgium	51	late Apr.–early Aug.	3	Bethune (1961)
Kwantung, China	23	end of Mar.–Aug.	4	Caldwell and Caldwell, South China Birds, Hester May Vanderburgh, Shanghai, China, 1931
Hong Kong	22	March–August	4	Webster and Phillips, A New Guide to the Birds of Hong Kong, Sino-American Publishing Co., Hong Kong, 1976
Serdang, Malaysia	3	Dec.–June or July	7–8	Present study
Singapore	1	Jan.–mid-May	5	Ward and Poh (1968)

since nests were inaccessible. However, the stomachs of adult sparrows collected at the Poultry Unit were found to contain 80–97% poultry mash by weight (Nawawi and Jantan 1977). Chia et al. (1963) observed that insects constitute 91% of foods consumed by tree sparrow nestlings. Although the poultry mash's nutritive value may be comparable to or even surpass that of insects, its granular texture may prevent successful transport to the nestlings. If nestlings must be fed insects, then the discontinuity in breeding may occur when the abundance of insects suitable for feeding young is low. The molt and rainfall data presented in Table 1 suggest that the termination of reproductive activities may in part be controlled by the need to complete molt before the period of heavy rains. The curtailment of breeding and molt in the UPM tree sparrow population, in spite of the continuous and unlimited availability of high-quality food, indicates that the occurrence of these activities can be extended under favorable food conditions only up to a point. The ultimate extent of breeding may alternately be limited by the availability of suitable food to feed the young, and by the necessity to molt, which appears to be regulated by an endogenous schedule (Snow, Ibis 118:366–401, 1976) to avoid the period of heavy rains.

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Foraging dives by post-breeding Northern Pintails.—Dabbling ducks (Anatini), including Northern Pintails (*Anas acuta*), typically feed by "tipping-up" (Bellrose, Ducks, Geese, and Swans of North America, Stackpole Books, Harrisburg, Pennsylvania, 1976) in shallow water. Pintails are not as adapted for diving as members of the Aythyini or Oxyurini (Catlett and Johnston, Comp. Biochem. Physiol. 47A:925–931, 1974); however, incidents of foraging dives by small numbers of pintails have been reported (Chapman et al., Br. Birds 52:60, 1959; Bourget and Chapdelaine, Wildfowl 26:55–57, 1975). This paper reports on forage diving by a flock of several hundred pintails. Ecological explanations are suggested to account for the behavior and comparisons with tip-up feeding are presented.

Materials and methods.—Feeding pintails were observed with the use of a spotting scope (40X) between 11:00 and 14:00 on a 100-ha pond on Sacramento National Wildlife Refuge, Glenn Co., California, 22 September 1980. Data were collected in two ways with a stopwatch. Method 1: Dive and tip-up durations (period of head immersion) and "pauses" between dives and tip-ups of 133 individual (may include some repeat observations of the same birds) pintails were timed. Method 2: 20 other individuals were observed continuously for variable periods up to 2.5 min. The number of dives or tip-ups seen during the observation period was recorded for each bird.

Water depth was measured at dive and tip-up feeding locations. Five benthic samples (Swanson, J. Wildl. Manage. 42:426–428, 1978) were taken randomly within a 2-m-diameter