TUFTED TITMOUSE BREEDING BEHAVIOR

HERVEY BRACKBILL

THIS study of the Tufted Titmouse (*Parus bicolor*) is based mainly on data from 130 birds color-banded from 1944 through 1968 in suburban Baltimore, Maryland, and on three nestings, none entirely successful, in a box at my home. Many observations were made at my window feeding shelf. Already documented for this species are sedentariness (Van Tyne, 1948; Laskey, 1957), permanence of mating (Van Tyne, 1948), incubation and brooding by the female alone and care of young by both parents (Laskey, 1957), all of which I have also observed. This paper elaborates on some of those topics, but concentrates on gaps in the species' life history. Comparisons of behavior are made with other crested species of American titmice.

Sexual dominance.—The male Tufted Titmouse shows dominance over his mate throughout the year; females show subordination to other males as well. At all seasons paired birds are commonly on my 20-inch-square feeding shelf together. Yet I have a number of records of males coming while their mates were present and driving them about, or driving them away entirely and sometimes following. I also once saw a male fly at his mate in a bush and drive her several yards.

I have records of four pairs: three observations on one pair (24, 25 March, 7 April) and five on another (23, 26 October, 11, 19 November, 20 January) that had not yet nested; one (27 May) on a pair that had nested the preceding year, and another (13 June) on a pair with young just out of the nest. Dr. Keith L. Dixon (*in litt.*) has seen similar "driving" of the female Plain Titmouse (*P. inornatus*) in the prenesting period.

Females also subordinate themselves on the feeder to their mates and to other males. On a 2 January one quivered her wings, uttered a "*zhee-zhee-zhee*" and fled when her mate of a year's standing came. When I use a 6-inch-wide pull-string trap on the shelf this subordination becomes striking. For example while a male was opening a seed on the shelf rim one 15 October, his mate came and entered the trap. Before she had chosen a seed he entered for another and she went out empty-billed and waited until he had got his and flown, then she reentered and got hers. On a 21 June a different female did the same when a male not her mate came. Male dominance was shown, too, during the nestings I watched, as detailed below under *Feeding of nestlings*.

Pair formation.—Observations on two immature birds in 1958 suggest that attacks like those described above figure in pair formation. A male that was raised in my yard and a female that I banded 20 July (the first new titmouse of the year, and first seen that day) were traveling together by themselves on 22 July, and they continued to associate, though not always alone. Over a considerable period this female showed apparent nesting impulses, and during that time the male repeatedly flew at her. On 2 and 6 August the female looked into a nest box, and three times on those days I saw the male dash at her; the birds went off in chases. On 28 August the female toyed with string. On 12 September she again showed interest in a box and on 14 September I saw another chase. By the year's end the birds' association seemed looser. They were last seen in the same flock 22 February, and later in 1959 they proved to have taken other mates. Dixon (1949) records similar behavior in the earliest phases of Plain Titmouse courtship.

Pairs, determined by observed nestings, by possession of fledglings, or by association for at least a year, have formed at all seasons. Examples are: two immatures paired perhaps by their first 30 July and definitely by 24 October; an immature female paired with an adult male by her first 12 November; an immature male paired between his first 5 and 27 February; a widow whose old mate was last seen alive 31 May and was found dead 3 June paired by that same 3 June with a male that had been a widower since 26 May of the previous year; and a widower whose old mate was last seen 14 January paired anew by 23 January.

In the case of at least the juveniles referred to, which always disappeared during the nesting period and then returned, it is clear that pairing occurred before territory establishment, as Dixon (1949) found with the Plain Titmouse.

Permanent mating; a "divorce."—With one exception, the pair bonds of my birds have lasted until one of the members disappeared. One pair was present about my home continuously for 40 months. Sometimes, as mentioned above, one or both members go unseen while nesting (cf. Laskey, 1957) or while molting. In 1967 a pair separated; the male moved into a new area, where he associated with a new female, and his old mate took a new partner.

Dixon (1949) found that pairs of the Plain Titmouse stay together throughout the year, but both he (loc. cit.) and Price (1936) also report a "divorce" in that species, in one case the female and in the other the male moving to a new area.

Summary of my nestings.—1958: Building began between 16 and 24

April, laying 27 April–2 May, hatching 14–15 May, "helper" appeared 17 May, nest disturbed by predator 31 May, single nestling escapes.

1959: Same pair, same box on an oak trunk. Building began 8 or 9 April, laying 22–28 April, hatching 10–11 May, nestlings disappeared 13 or 14 May.

1963: Different birds, same box. Building began about 13 April, laying 19–21 April, female disappeared 21 April.

Courtship feeding.—I have seen courtship feeding done from the period of nest-site selection into the 2nd day of hatching. In 1963 after one pair had begun to build in my box, a second pair appeared and for 2 days tried to take the place over; on both days the second male fed his mate. In 1948 I saw a male feed a female that a week earlier had no brood patch (Brackbill, 1949). In 1959 I saw definite feedings from the 6th or 7th day (of 11 or 12 days) of nest-building until after one egg had hatched, and thought it might have been done on the 2nd hatching day. In 1958 I saw it from the day the last egg was laid into the 2nd hatching day. Laskey (1957) reports it from at least the building period through incubation, but saw none after young were hatched. Dixon (1949) says it occurs in the Plain Titmouse from the beginning of building until the young hatch, and (1955) in the Black-crested Titmouse (*P. atricristatus*) during building and probably beyond.

The male sometimes feeds his mate at the box hole (Dixon (1949) reports the variation in the Plain Titmouse) but much oftener away from the nest. My 1958–59 male usually lit on what I called a "doorstep" branch a few feet from the box, either silently or with a few whistles, and the female flew out of the box to him or to another tree to which he then followed. She sometimes quivered her wings before being fed, sometimes afterward, sometimes not at all; occasionally he quivered his wings afterward. The male's disposition to make on-nest feedings seems to develop very slowly; except for one attempt during building in 1959, I first saw this done on the 8th day of incubation and Laskey (1957) reports the same thing.

Nest-site selection.—I have seen immature birds of both sexes look into my nest boxes on dates from 26 June to 27 August, twice a female, once a male, six times birds of unknown sex. I have watched adults inspect the boxes from 27 February to 28 April, four times females, once a male with food in his bill. Thus females showed greater interest in the boxes than did males. Dixon (1949) saw only females of the Plain Titmouse inspect nest sites.

Copulation.—I have seen copulation but once, at noon on 5 March 1950; I do not know the stage of the birds' nesting. The pair had been foraging,

and the male whistling considerably. He was about 45 feet up in an oak when the female flew into a tree 10 yards from him. He stopped whistling, faced her, and for 30 to 45 seconds craned with bill straight forward and opened slightly, head, neck, and back practically on a line, wings vibrating in a very small arc. Throughout this he uttered a high, thin "eeee." Watching him, I ignored the female, but finally he increased the arc of his wing-quivering and the loudness of his "eeee" for several seconds, then flew a few yards to another branch where I then saw the female displaying similarly. The male flitted to her and copulated for 2 seconds or so with wings raised high and beating rapidly. Afterward the birds sat silently and undemonstratively a few inches apart for several seconds, then disappeared. Johnston (1944) describes copulation very similarly, and Offutt (1965) more sketchily.

Building.—I saw only the females take furnishing into the box in my three nestings. At another location one year, a silent bird that was gathering material was always accompanied by a whistling one; undoubtedly they were female and male, respectively. Dixon (1949) saw only the female carry material at one nest of the Plain Titmouse and (1955) saw a female Black-crest gathering material, accompanied by her mate.

All my three nests were occasionally added to during the laying period, and the long-lived nests also during incubation, in 1958 until at least the day before and in 1959 until at least the 2nd day before hatching began. Laskey (1957) also saw occasional building down to the 10th day of incubation, and Dixon (1949) found that the female Plain Titmouse adds to the nest during egg laying.

In 1958 I discovered the nest near completion on 24 April; the box had been empty 17 April; laying began 27 April. In 1959 just a bit of material was in place 9 April, building was done through at least 19 April, and laying began 22 April. I believe that in 1963 building began 13 April; laying began 19 April. Laskey (1957) found a nest already under way 24 March and laying began 2 April. Thus the furnishing of a box may take 6 to 11 days.

Eggs.—The clutch in 1958, when this female was at least 2 years old, was six; in 1959 it was seven. The 1963 female, at least 4 years old, disappeared the day she laid her third egg. Each laid one egg daily. The 1958–59 bird laid before leaving the nest in the morning after sleeping there, which on 11 mornings was at times ranging from 05:19 to 05:41 e.s.t., 14 to 28 minutes after sunrise. In 1958 this bird did not sleep in the nest until she had laid her first egg; I checked on the preceding three nights. In 1959 I did not check until the first egg appeared; she slept

in the box from that night on. The 1963 bird did not do so until she had two eggs; she laid her third before her first departure that morning, 44 minutes after sunrise.

During the laying period the eggs were almost invariably covered with nesting material when the box was unoccupied, occasionally covered only partly, sometimes an inch deep. When incubation began I rarely found a bit of material over them during the female's absences. Dixon (1949) found the eggs of the Plain Titmouse covered during the laying period only.

Incubation.—Incubation was by the female alone, as Laskey (1957) also found. Price (1936) and Dixon (1949) so report for the Plain Titmouse and Dixon (1955) for the Black-crest.

On the 2nd to 6th laying days in 1959 I marked each egg as soon as the female left the nest in the morning and always found the eggs covered. When I marked No. 2 I noted that although it was slightly warm, No. 1 was cold, and when I marked Nos. 3 and 4 I found all the eggs cold. Only with the marking of No. 5 did I begin to find the clutch warm. It seems, therefore, that until there were four eggs (of the clutch of seven) the bird must have slept atop the covering material. Laskey (1957) tells of a nest examined one night; its four eggs were cold although a bird was present.

In 1958 daytime incubation began on the 5th (next to last) laying day, or possibly on the 4th when I did little watching. In 1959 there was some daytime incubation from the 1st laying day, but full intensity was not reached till the set was complete.

In 1958 between the times the last egg was laid and the first hatched, I watched for 49½ hours; the bird was on the nest 78.4 per cent of the time. In 1959 she sat 70.4 per cent of 24¼ hours that I watched. The percentage varied through the day. In 1958 during 12 observation periods 100 to 200 minutes in length distributed through the day, it ranged from 64.1 to 94.6; in 1959 during 9 observation periods of 90 to 150 minutes, it ranged from 57.2 to 95.0. In both years incubation was most intensive during the first half of the morning; from midmorning to near midafternoon it was considerably less so; then the intensity rose again, but not to the early morning degree.

In 1958, 67 sittings ranged from 4 to 70 minutes and averaged 27. In 1959, 22 sittings ranged from 9 to 46 minutes and averaged 27.2. A bird Laskey (1957) watched averaged 39 minutes for 18 sittings.

In 1958, 76 inattentive periods ranged from 1 to 44 minutes and averaged 7.3. In 1959, 33 ranged from 2 to 22 minutes and averaged 10.1. Laskey's bird (loc. cit.) averaged 18 minutes for 23 inattentive periods.

In both 1958 and 1959 my female usually ended her sittings of her own

accord, but sometimes did so when the male whistled in a wood close by, when he came to give her food, or when he came to feed the nestlings while the eggs were hatching. Dixon (1949) found that female Plain Titmice sometimes ended sittings in response to calls or song by their mates.

In 1958 the female once ended her night in the east-facing nest box 1 minute before sunrise and once 25 minutes after sunrise. In 1959 on three evenings she went into the box for the night 52, 67, and 83 minutes before sunset; no correlation with sky cover was apparent.

Hatching.—In 1958, three of five eggs hatched during daylight, the others at unknown hours; hatching was spread over something between 14½ and 18¼ hours—egg No. 1 did not hatch, or the spread presumably would have been greater. In 1959, three of four eggs hatched during daylight, the other between 17:13 and 05:14 e.s.t., and so possibly during darkness; hatching was spread over at least 33 hours, with 45½ the maximum possible. In 1958 when No. 1 did not hatch, No. 3 hatched first; all other eggs hatched in sequence.

Incubation period.—In 1958 the marked last egg was laid 2 May before 05:30 and hatched 15 May between 05:31 and 09:25; that is an incubation period of slightly over 13 days, the maximum possible being about 13 days 4 hours. In 1959 the marked last egg was laid 28 April, presumably at a similar hour, and hatched 11 May between 14:03 and 14:50; the incubation period was therefore 13 days and about 9 hours. Laskey (1957) gives the period as "13–14 days." These findings contrast with the "exactly 12 days" reported by Dickey (in Bent, 1946: 398).

How the male learned of the hatch.—During the latter part of the incubation period in 1958, including the morning of the first hatching day, I occasionally saw the male feed the female in the nest box. In this way alone he would eventually have discovered when hatching began, but apparently he actually learned it either by the female's excited behavior or through seeing her carry food. In 1959 I never saw the male go to the box during incubation, and I was not present when the first egg hatched.

With the particular hope of determining this point, I watched the 1958 nest with special closeness when hatching seemed near. The observation period during which it occurred began at 12:55. At 13:10 the male appeared and flew at a Starling (*Sturnus vulgaris*) foraging on the lawn, then vanished. The female made several sittings. At 13:39 the male came near with food, whistled, and the female flew out of the box to the wood close by; he flew after her. At 13:45 she returned and made several sittings with no sign of him. At 15:09 she left the box with egg shell. At 15:13 she returned and, though I could not see food in her bill, a

succession of unusually short sittings and absences suggested feedings of the nestling. At 15:58 upon alighting on the doorstep branch with visible food she gave some whistles—she had done this twice before since the hatch, but also on earlier days—and soon began quivering her wings strongly. Then I saw the male in a tree 20 feet from her, also quivering his wings. The female flew there and, apparently 1 to 2 feet apart, both birds quivered their wings for some seconds. At 15:59 the male flew to the box, looked in lengthily, and left. Half a minute later the female entered with her food and stayed. In only 3 minutes the male returned, leaned in and delivered food, and in the next 7 minutes did this twice more.

Females of several other species have been thought to indicate the hatch to their nonincubating mates by special restlessness or calls. Nice (1943: 230) believes this true of the Song Sparrow (*Melospiza melodia*) and gives other examples from the literature; Lawrence (1948) adds the Chestnut-sided Warbler (*Dendroica pensylvanica*) and Nashville Warbler (*Vermivora ruficapilla*).

Wing-quivering.—At no time before that 15:58 occasion had I seen the female quiver her wings en route to the nest. The following morning courtship feeding was performed in the nest tree once with neither bird quivering its wings. But from then on to the end of the nesting both wing-quivered eight of the nine times I saw them on the doorstep branch together, now one and now the other initiating it. The female also wing-quivered repeatedly upon alighting there alone, her mate or the helper being sometimes in the box, sometimes nowhere about, and the male did so once when he arrived alone. Once when the female and the helper came to the doorstep while the male was in the box, the female quivered her wings until her mate left. In 1959 I saw the female alone do such wing-quivering, again beginning shortly after hatching had started. In contrast to that behavior at the nest, only once did they wing quiver during the 11 occasions in 1959 that I saw this pair meet on my feeder while they had nestlings. Another pair that I saw meet 19 times away from the nest while they had nestlings or fledglings never did wing-quivering.

Laskey (1957) also records that "throughout the nestling period, the female was seen quivering her wings many times when she saw her mate," and Dixon (1949) saw both male and female Plain Titmice flutter their wings during periods of nestling care. The significance of the act is not clear.

Feeding of nestlings.—The parents shared evenly the work of feeding the nestlings. During 38½ hours that I watched the pair feed the five young in 1958, the male made 162 feedings, the female 159, the helper 90,

and unidentified birds 31. (This is the same helper Skutch (1961: 213) mentions; the figures here are corrected ones.) In 1959 I watched for 16 hours, chiefly while eggs were still hatching; the male made 29 or 30 feedings (one to four young), the female 20 or 22 despite the time spent brooding.

In 1958 I found no steady increase in the feeding rate, and no daily rhythm such as Laskey (1957) observed. The overall feeding rate was 11.5 per hour, or 2.3 per bird per hour. If the helper's feedings are deducted and all the unidentified feedings divided between the parents (any error will be small), the parental rate was 9.1 feedings per hour, or 1.8 per bird per hour. My 1959 data are too few for analysis.

In both years when one parent was still on the doorstep branch en route to make a feeding when the other alighted there with food, the male always entered the box first, irrespective of which arrived first. I saw this happen nine times in 1958 and once in 1959. Once when the 1958 helper and the female were on the doorstep together, the helper fed first. An explanation of this might have been that the female after making her feeding would stay and brood, but on only 2 of the 12 occasions did she do this. Twice the male and once the helper took food into the box while the female was brooding, but I never saw the female enter the box while either of them was inside.

Only once in 1958 did I see the first feeding of the day; it was made 2 minutes after sunrise by the female, who no longer was brooding at night. In 1959 I saw the male bring food once at 11 minutes after sunrise. While the nestlings were being brooded at night the female sometimes made the last feeding of the day as she retired, but occasionally the male delivered food once or twice during the 2 to 8 minutes after that. After night brooding ended, the female made the last feeding on two evenings that I watched. Final feedings (seven observations) were made 18 to 32 minutes before sunset; feedings stopped earliest on a drizzly evening, but there was no steady correlation with sky cover. These times are similar to those observed by Laskey (1957).

Brooding.—In 1958 I only twice saw the female brood in the daytime after the young were 6 and 7 days old, briefly on cool mornings 5 and 8 days later. Brooding was most intensive in the early morning, and tended to decrease as the young grew, but ranged irregularly from 1.5 to 66.6 per cent of my watches, often 1 to 3 hours long. Laskey (1957) found that night brooding stopped at the age of 12 and 13 days; on this I have no data. On 4 days the female went into the box for the night 23 to 39 minutes before sunset, and on another day 79 minutes before. Laskey (*idem*) records eight roosting times of 5 to 28 minutes before sunset

and one of 63 minutes before. I have no data on morning departures from the nest.

Nest sanitation.—In 1958 both parents and also the helper cleaned the nest. I saw the male dispose of 31 sacs, the female 16, the helper 7. The young hatched 14 and 15 May. I saw the male swallow droppings as he left the box after making feedings on 16 and 17 May; later on 17 May and thenceforth he always carried them away, so far as I could see. The female carried them away from 18 May on; presumably she had eaten them until then. The helper carried them away from 19 May on.

The helper.—The 1958 helper began its work on the 2nd day after hatching was complete and continued it throughout the nesting. This bird was one of the female's offspring by a different 1957 mate, and had traveled with her, her new mate, and some of her other young continuously into mid-February, after which I always saw it at the feeder alone, and usually coming from a different direction than the nesters' range. A few days after this nesting ended I trapped it and found that it had no brood patch; this, the female's granting of dominance to it, and, in Mrs. Laskey's view (*in litt.*), hostility shown to it by the nesting male, all suggest that it was a male.

Apparently I saw several of its very first visits to the nest. Although it was carrying food, it was then so fearful that it approached and retreated without actually reaching into the box. It still was fearful 20 hours later, but after much hesitation did pass food in to the brooding female. Another 4 hours later it still showed some hesitancy, but in a half-hour more was making feedings confidently, and from then on only occasionally showed some wariness in its approaches. Twice the male drove it away when he himself alighted near with food.

In the small hours of 31 May this nest was disturbed; the single nestling that escaped was not seen again until 28 June. The helper stayed about through 27 June, then vanished.

Wight (1934) saw four birds make feedings during a second nesting in Tennessee and believed two of them were first-brood juveniles.

Nestling period.—The bird raised in 1958 was the most advanced when the brood was banded and presumably was the first hatched on 14 May. It escaped from the nest on 31 May, 17 days after hatching. Laskey (1957) reports that a brood left the nest at 17 to 18 days of age.

Period of dependency.—My fledgling was 45 days old when first seen after the predation. I never saw it fed, but it still begged when 46 and 47 days old on 29 and 30 June. When 56 days old on 9 July it begged from its reflection in the feeding-shelf window—it came inward on the shelf,

faced the glass, gave "seewee" calls, and quivered its wings—and at 64 days on 17 July it quivered its wings in its father's presence.

My few other data are also partial. I first heard one family of young out of the nest 27 June. One of these birds was eating on 7 July, and so (adding to those 10 days a 17-day nestling period) was at least partly independent by the possible age of 27 days; a sibling was fed 16 July when at least 36 days old. Dixon (1949) observed Plain Titmice of one brood foraging for themselves when about 5 weeks old but still begging 23 days later.

Widow's fledglings ignored by her new mate.—A male that paired about 3 June 1957 with a widow rearing five fledglings by her previous mate was never, in much watching, seen to feed those young, and the newly-formed pair did not nest until 1958.

Duration of family ties.—Five young birds of known parentage have come to my feeder with one or both parents and with other titmice into the July, November, January, and March following their hatching. The male raised in my box associated through the following 11 March with both parents, who nested again that second year in the same box; the old male on 9 March had begun to show hostility to the son, who nevertheless paired and nested somewhere close by, remaining about through 22 October.

Van Tyne (1948) saw one juvenile stay with its parents through 22 June and a second through 10 January, and Laskey (1957) saw a pair and their son remain together "for the entire winter."

Dispersal of young.—I have had two rough indications of the distances young birds may go before settling down. One female, apparently immature when banded 20 September 1953, was seen steadily at the banding location through 10 January 1954, then disappeared; on 20 June 1955 she was discovered as a breeding bird ¾ mile to the west-southwest and was resident there through her final date of 25 May 1956. Another female, definitely immature when banded 7 October 1967, remained at the banding location through 13 April 1968, then disappeared; in the fall of 1968 she was discovered 2 miles north-northwest and she was still there in company with an unbanded titmouse 19 April 1969, the time of writing. How near to the banding locations these birds were hatched is not known.

Number of broods.—One brood is the rule at Baltimore, but I have twice thought I had evidence of two. On 29 September 1940 at a place where the species had not been seen all summer, a party of four titmice included at least one wing-fluttering, calling juvenile. An adult flew to this bird as if to make a feeding, but foliage prevented my seeing any food passed. This date indicates either a second brood or a very late renesting after failure. (In 1959, after their nestlings disappeared 13 May,

my home pair renested somewhere, for on 5 July I began seeing them with fledglings, one of which was fed as late as 16 July.)

In 1950, in the range of the birds I saw copulate on 5 March, a neighbor told me on 10 May I had just missed seeing a group of six titmice; this must have been a family and could have been my birds' first brood. Yet on 7 July I banded a juvenile that was begging from this male and that traveled with him through 20 July.

Middleton's (1949) 7-year female in Pennsylvania twice raised two broods, and Wight (1934) reports two broods raised (by unbanded birds) at Chattanooga, Tennessee, but Laskey (1957) knew of no second broods at Nashville, Tennessee.

Territory and range.—I have never determined the size of a nesting territory, but twice have got some idea of winter range. In a suburb of detached homes, well wooded chiefly with oaks and maples, one pair was seen over an irregular area about 515 by 160 yards and another over an area about 365 by 200 yards in their extremes; those would be at most about 17 and 15 acres. Nice (1943: 87) found winter ranges of about 20 acres. As pairs that I see all the rest of the year frequently disappear while nesting, presumably they withdraw to an area smaller than their winter range.

During the nestings at my home I paid almost no attention to my feeder, which is on the opposite side of the house from the nest box that was used. However at intervals throughout both nestings I saw on the shelf not only the nesters, but in 1958 the 1957 offspring of the female that became a helper, and in 1959 the pair's 1958 son and his mate. I also in 1959 trapped still another female with a brood patch. Apparently then, only a very limited area about a nest is defended. Offutt (1965) believes territories begin about 15 feet above the ground and extend upward.

One 24 November I had an apparent indication that winter ranges have recognized boundaries: three birds and two birds came together from opposite directions and for several minutes there was chasing and flitting about with many calls, including one that I have observed to be a hostile utterance—I have written it "ka-lée-plip" and "per-lée-ip," among other ways.

Outside the nesting season this species commonly comes to the feeder with Carolina Chickadees (*P. carolinensis*), and often with White-breasted Nuthatches (*Sitta carolinensis*) and Downy Woodpeckers (*Dendrocopos pubescens*). At any time during the winter some of the Tufted Titmice may disappear, singly or, as spring approaches, by twos. In February a new bird occasionally appears. About mid-February pairs that will nest in my immediate area begin traveling apart from other Tufted Titmice,

but they may still associate with the other species as late as mid-April. The last of the mere winterers usually vanishes about 10 April, but an occasional one has stayed as late as 19 May.

Voice.—As Dixon (1955) states, both sexes give the whistled songs, but females sing much less than males. In the 23 years I have lived in good titmouse range (1945–67), I have heard song in every month of the year—although only four times in every month of the same year. October has been the month of least song, November next poorest, then December. However in 11 years the song season has begun in late December, and it has almost always been getting under way by mid-January, to run into September. In contrast to that overall season, my song dates for known females are 5 March to 30 May, then an isolated 7 July. During both extended nestings in my box, I first saw the female sing on the 5th laying day; she continued to do so as long as the nest was active. She sang a few times in apparent answer to whistles by her mate, at times on visits to the doorstep branch during inattentive periods, but usually, it seemed, by way of signaling her arrival on that branch en route to incubate or feed the young.

I have recorded a much smaller variety of whistles by females than by males, but have noted none peculiar to females. I once heard "peetery-peetery-peetery" songs, and Saunders (*in* Bent, 1946: 403) records three-syllabled phrases as a rarity. Most songs fall into two groups, those with one-syllabled phrases ("weet" and variants) and those with two-syllabled phrases ("peto," "toolee," "chiwi," and variants). Counting 2,259 songs during 4 years, I found the two-syllabled forms the commoner, 1,272 to 987. Of this type, those of three repetitions were commonest, with four next. Of the one-syllabled type, those of five repetitions were commonest, with four a close second. During any period of singing the bird may change from one song to another, and the number of phrases in the songs given during one period varies without any pattern. Singing against each other in presumed territoriality, two birds have sometimes used the same songs and sometimes not, and sometimes answered each other song for song and sometimes not.

Age.—Through 20 October 1968 I had color-banded 130 birds that could have passed the age of 1 year; 51 are known to have done so. The other 79 included many juveniles that surely left my area for territories elsewhere, their disappearance therefore not indicating their death. Remembering that, the ages reached by adults (a category including unrecognized immatures and any birds over a year old when banded) and by known immatures are shown in Table 1.

Considering the 51 birds that lived 1 year or more, 26 males averaged

TABLE 1
SURVIVAL OF TUFTED TITMICE

Age attained	Male	Female	Unsexed	Total	Per cent surviving
75 "adults"					
Under 1 year	–	2	36	38	50.6
1 year	13	4	4	21	27.6
2 years	4	4	1	9	11.8
3 years	2	2	–	4	5.2
4 years	–	1	–	1	1.3
5 years	–	1	–	1	1.3
6 years	1	–	–	1	1.3
55 immatures					
Under 1 year	–	–	41	41	74.5
1 year	3	2	2	7	12.7
2 years	1	–	1	2	3.7
3 years	2	1	–	3	5.5
4 years	–	1	1	2	3.7

15.1 months of life after their first 1 March, 16 females averaged 22.4 months, 9 unsexed birds averaged 16.1. Six immature males alone averaged 17.6 months, four immature females 21.5 months, an 8-month bird was still alive at the end of this study. The five longest-lived males survived 67, 36, 35, 28, and 26 months after their first 1 March; the five longest-lived females 58, 44, 43, 37, and 27 months. Dixon (*in litt.*) found survival to average 21 months after their first 1 March for 11 males of *inornatus*, and 14 months for 11 females; the five longest-lived males survived 50, 47, 27, 27, and 27 months, and the five longest-lived females 51, 15, 15, 15, and 12 months. All but the 12-month female were alive at the end of his study. None of my "old" birds was known to be alive at the end of mine.

Laskey (1957) reports that 8 per cent of 309 birds she banded gave records extending 2 years or more. Assuming a 15 May hatching date, 125 of my 130 birds could have passed 2 years, although only 23 (18.4 per cent) are known to have done so. My oldest bird, a male attained 6 years, 4½ months.

Ectoparasite.—On 28 June 1960 I caught on a juvenile a fly Alan Stone of the Department of Agriculture identified as *Ornithomyia fringillina*, a parasite not listed by Peters (1936) for the Tufted Titmouse.

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SUMMARY

Observations on color-banded Tufted Titmice at Baltimore, Maryland, show that males are dominant throughout the year over their mates and

also over other females, and suggest that attacks expressing this dominance figure in pair formation. Pairs are formed at all times of the year; by some juveniles during their first summer or fall and before they take up territories. Pairing is normally for the life of either partner, the birds associating continuously, but one pair of a year's standing separated.

Immature birds show interest in nest sites in their first summer; the choice of one may be made by the female. Courtship feeding occurs from the period of nest-site selection into the 2nd day of hatching. One instance of copulation is described. Building is by the female alone; the furnishing of a nest box may take 6 to 11 days. Eggs are laid before the female leaves the nest in the morning after sleeping there. At one nest daytime incubation began on the 4th or 5th of 6 laying days; at another there was some daytime incubation from the 1st laying day. At one nest, until she had laid four of her seven eggs, the female apparently slept atop their covering without warming them. Daytime incubation by one female in 2 years amounted to 78.4 and 70.4 per cent of the observation time.

By two determinations, the incubation period is 13 days and a few hours. At one nest the male learned from the female's behavior that the first egg had hatched. The parents share evenly the work of feeding nestlings; at one nest a yearling offspring of the female's by a different mate helped with that and with nest sanitation. The nestling period is about 17 days. Fledglings may be fed to at least the age of 36 days and may still beg at 64 days. Some associate with their parents until the next nesting season. One brood is the rule at Baltimore, but it appears that rarely two may be raised.

The winter range of two pairs in a well-wooded suburban area was at most about 15 and 17 acres. The species is territorial, but apparently not very strongly so. Song is given by both sexes, but chiefly by the male; it may be heard in every month of the year. Of 130 marked birds, 51 are known to have passed the age of 1 year; the oldest reached 6 years 4½ months. On all points where my study and the literature enable comparisons, the breeding behavior of this species and those of the Plain and Black-crested Titmice are similar.

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2620 Poplar Drive, Baltimore, Maryland 21207