HOKKAIDO UNIVERSITY

Title	Territorial Behaviour Between Two Pairs of the Bengalee in Two Different Cages (With 11 Text-figures)
Author(s)	MASATOMI, Hiroyuki
Citation	北海道大學理學部紀要, 14(3), 387-409
Issue Date	1960-12
Doc URL	https://hdl.handle.net/2115/27320
Type	departmental bulletin paper
File Information	14(3)_P387-409.pdf

Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP

Territorial Behaviour Between Two Pairs of the Bengalee in Two Different Cages[1)]

By

Hiroyuki Masatomi

(Zoological Institute, Hokkaido University, Sapporo)

(With 11 Text-figures)

Amongst the perching birds there are various types of territory. The pairs of the song sparrow (Nice 1943) or the robin (Lack 1943), for instance, usually disperse widely from each other establishing rigid territories through the year, while the chipping sparrow (Walkinshaw 1944) or the starling (Kuroda 1955-7) have such definite territory around the nest in the breeding season alone. It has been reported that there are many different types of territory even among the birds of the Family Ploceidae. Amongst the species who practice colonial nesting certain ones such as the zebra finch *Poephila guttata* and the bronze mannikin *Lonchura cucullata* show distinct territorial behaviour to defend a nest cavity for each pair (Morris 1954, 1957), while others, for instance, the sociable weaverbird *Philetairus socius*, forming definite breeding territories for their colonies, have probably no territory accepted as belonging to an individual pair (Friedmann 1935). Moreover, the howfinch *Coccothraustes coccothraustes* shows different territorial behaviour under diverse breeding conditions (Mountfort 1956).

The Bengalee, *Lonchura striata* var. *domestica*, belonging to the subfamily Estrildinae of the Ploceidae, is a completely domesticated bird of which the wild origin is uncertain. It exists exclusively as a cage bird; it has an extremely gregarious and gentle nature which enables its successful breeding even in very small cages. It is very difficult to assume the general character of the nesting habit of this bird in a flock, because the diverse types of artificial cages or conditions are nothing but their "natural" habitat.

In a previous paper, the present writer reported a case of the communal use of one and the same nest by two pairs of Bengalee under certain conditions (Masatomi in press). In the present case, however, two pairs respectively established territories in the cages during the breeding period and engaged in various territorial acts around the ready-made nests settled in their two different cages. The cages were both of an elongate style but one was set horizontally, the other vertically.

Material and method: The four birds here observed were all bred in the writer's laboratory from common parents, but not from the same clutch; they were named MA (♂), FA (♀), MB (♂), and FB (♀) respectively. MA and FA (Pair A) were both about fourteen months old after fledging at the start of the present observation and had been

1) Contribution No. 497 from the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan.

reared together in an isolated cage as a pair for eleven months. They had already had experience of normal copulation, egg-laying and brooding of their youngs. MB and FB (Pair B) were both about seven months old after fledging and had been isolated for three months in another cage without any nest. They also had copulated frequently, but the female could not lay for the lack of a nest.

Two types of wired cages were used for the observation. One was a long cage set horizontally, 60 cm. in width, 40 cm. in height, 175 cm. in length, with seven perches put transversely at the same height (17 cm.) and interval (30 cm.). Two artificial dome nests were located on the two outermost perches (Fig. 1 left). The perches were numbered P1～P7 from left to right. A feeder filled constantly with grain, a water vessel, and a dish with crushed shell were placed on the floor of the cage between P2 and P3, and another set of these supplied between P5 and P6.

The second cage was set vertically, 180 cm. in height, 60 cm. in width, and 60 cm. in length. Six perches numbered P1～P6 from above to below were settled horizontally at the distance of about 40 cm, but they were not set in a common vertical plane. P2, P4 and P6 were near the front, while alternatively P1, P3 and P5 near the rear of the cage. Two similar artificial dome nests made of straw were fixed respectively on P1 and P5. At the same height as P2 and P6 cups always filled with grain, water bottles and vessels with crushed shell were hung separately on the front wire of the cage. Some fragments of softened straw were scattered about on the floor as nest material (Fig. 1).

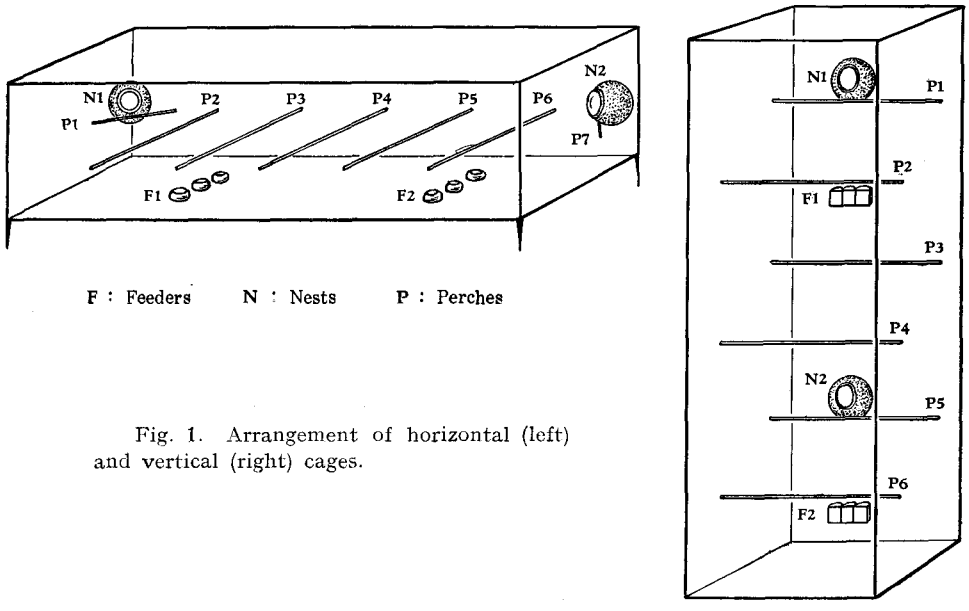


Fig. 1. Arrangement of horizontal (left) and vertical (right) cages.

All four birds were released first in the horizontal cage and kept in it for about one month, thereafter transferred into the vertical cage and observed there for about five weeks as well. The routine observations were carried out every day for one hour without interruption which were supplemented with many intermittent records taken through the whole period.

Observations

1. General events in the horizontal cage: MA and FA began to copulate just before this observation and were at about one month after the fledging of their first youngs. MB and FB, reared in a smaller cage without nest cavity in rather worse condition, also mated very often before their release into the observation cage. Therefore, it is sure that the pair bond had already been established in the two groups before transfer into the horizontal cage.

On the day of transfer (15th June) no remarkable agonistic behaviour, except repellent touch, was seen at all among them, but MA sang sometimes solitarily and attempted with full masculine courtship display to approach the other birds, especially towards MB and copulated twice with him (homosexual copulation). MB showed a passive attitude against such activity of MA and avoided it in most cases. The behavioral difference of these birds at the first encounter may suggest the unbalance of their force at that time. Pair B searched actively all over the cage soon after release, but Pair A, staying mostly rightwards in the cage, first came into N1, got into and out it frequently during a short time (unstable roosting behaviour), and roosted in it with the other birds at night. MB and FB more or less hesitated to go into N2 as compared with Pair A, but no noticeable hostile acts were seen between the pairs or the individuals at the roosting in the evening.

The next day, however, MA already sometimes took warning posture with rapid wing and tail flicking accompanied by low alarm calls against Pair B approaching to N2, although MB and FB often rested leisurely in N2 in the daytime. Such activities of MA may indicate the development of his assertion on the nest as property.

Following three days after the release Pair A always nested in N2 and B in N1 separately at night, and at the same time the territories based upon the defense of each nest were rapidly formed in the confined space. In the first week, mutual courtship ceremonies (male advance with his upright posture, fluffed feathers, wavering body and song, and female's statical horizontal posture with her tail quivering) were obstructed immediately by the intervention of the other birds, particularly by MA. The behaviour pattern of the intervention may have been a mixture of sexual and aggressive behaviour.

The range to which Pair A was accustomed gradually increased, and the defense was very steadily made at the right half of the cage, stronger at the right side. In this stage Pair B would move about only N1, P2 and the ground under those objects; sometimes they were confined for a while to the left corner of the bottom of the cage by the vigorous attacks of A. FA started to lay one egg per day eight days after the release, and four eggs in total. Such dominant-submissive relationship between the pairs kept up about two weeks as it was, but MB occasionally began to make an attack on Pair A since the first egg-laying of FB on

the fortnight, and in the latter half of the first month the territory of Pair B tended to spread gradually. The size of the territories of the two pairs seemed to be almost equal at the last stage in the horizontal cage. All eggs laid by the females developed into some early stage of embryo but died within the shells. One of two eggs laid by FB fell out of the nest and broke some days after the egg-laying ceased. Thereafter, another left in N1 and two of four eggs incubated by A in N2 fell also on the floor three weeks after the beginning of the observation. It could be conjectured as the main cause of this abandonment that many onslaughts of the incubating or attentive birds would often be launched from the nests towards the other pair.

2. *General events in the vertical cage* : On 17th July both pairs were removed from the horizontal cage and transferred into the vertical one, when the balance of power between the pairs seemed to be stationary and their incubation declined without success in each.

No apparent aggressive activities related to the defense of territory were aroused among the birds on the first day in the vertical cage. Only the threatening behaviour was assumed infrequently, not to defend some objects or areas but to prevent the intervention of other birds in the courting ceremony. Pair A often rested with calmly in the upper nest (N1) while Pair B, especially FB, tended to avoid it passively, although no particular territorial defense of Pair A was ever seen around it. At the first night Pair B nested in N2 (nest below) and thenceforth both pairs began to form the territories firmly centering about the nests respectively. The next day, the attentive birds at first allowed either opposite bird to alight even on their own nest, but the frequency of threatening behaviour gradually increased in both pairs and the zones where the threat was elicited against the fellow members extended around the nests. Thus two territories defended with vigorous attacks and other aggressive activities were established rapidly in the upper and the lower parts of the cage.

FA laid her first eggs on the tenth day after removal in N1 and FB next day in N2 successively; each female laid a total of three eggs in her own nest. Furiously defending their nests from the other pair as in the horizontal cage, Pair A and B incubated their eggs. All embryos developed to some stage but died as in the previous case. Two eggs in each nest fell and cracked in the latter half of the incubation period.

Reproductive behaviour : Because the pairs were already formed before the four birds were placed together in the common cage, courting behaviour was observed more often between MA and FA, MB and FB, than between any other combination. But MA often approached towards MB and FB with the masculine courting display in the horizontal cage in the early period. Although the precise function of this behaviour (courting to homosexual mate or one of the other pair) is not yet clear in this species, it is said that it may probably indicate

not only the outbreak of the sexual drive but also a temporary demonstration of dominance (or at least reduction or dormancy of fear against the *mate* in some cases).

In both cages courting ceremonies were followed in a few cases by the final copulation in each pair, but mostly it was obstructed by the interference of a third individual. Whether copulation was performed successfully or not depended on the manner of the courting birds (stimulator) and the condition of the third birds (reactor) at the time. For instance, the full pre-copulative display of courting bird and/or very strained or highly sexually motivated third bird did not encourage the accomplishment of the ceremony, but mounting without courting display of male and/or low tension of the third bird usually led to the perfect copulation between pair mates. Generally the actual mounting for coition does not always occur near the nest in the male reared with his mate alone in a relatively larger cage. Consequently the performance of ceremony within the vicinity of their own nests as in the present case may function to avoid the intervention of other birds and the violation of the neighbour territory. The defense of a special mating place was not seen at all.

Table 1. Frequency of total nest material collecting act through the two periods.

Cage \ Bird	FA	MA	FB	MB
Horizontal	10	58	7	16
Vertical	2	11	4	14
Total	12	69	11	20

On the first and the second day all birds often pulled the nappy straw of N2 and pecked furiously the inside wall of the nest, but they, especially MA, collected and carried some pieces of straw for nest building only after the occupation of the respective nests (Table 1). The low frequency of nest material collection of MA in the second cage may originate from the fact that he had to pass through the territory of Pair B to carry the material which was scattered on the bottom under N2.

In the first cage Pair A incubated their eggs normally, but the incubating activity of Pair B was quite irregular in spite of their own egg-laying and relief of incubation between the mates of B was also not entirely clear in contrast to that of the other pair (Fig. 2). This may denote that Pair B was not in adequate breeding state. It is assumed that the difference in the breeding status between the pairs would reflect considerable effects on many aspects of the territorial behaviour of the assemblage in the first cage. Needless to inquire here, the

appearance and strength of the aggressiveness in the Bengalee may correspond to the status of the brooding drive, as in many other animals (cf. Collias 1944, Tinbergen 1951).

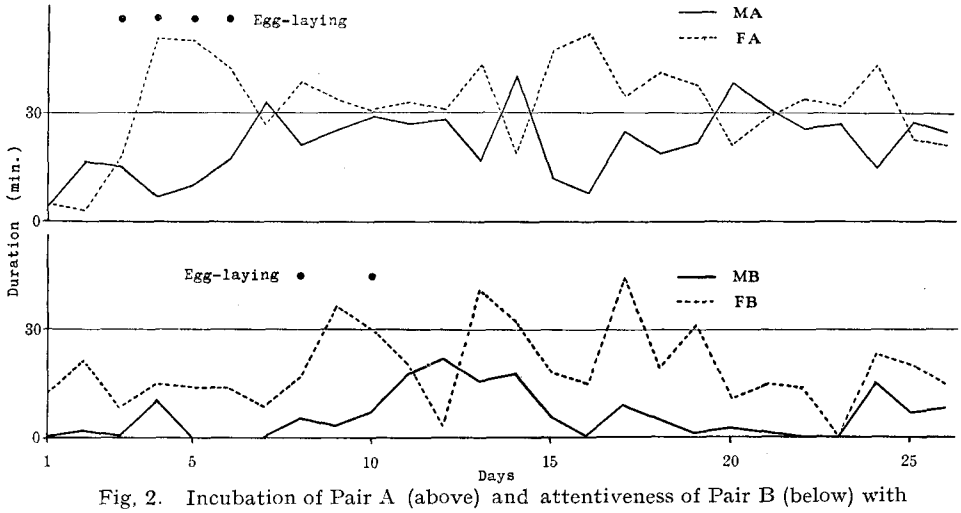


Fig. 2. Incubation of Pair A (above) and attentiveness of Pair B (below) with or without eggs in horizontal cage.

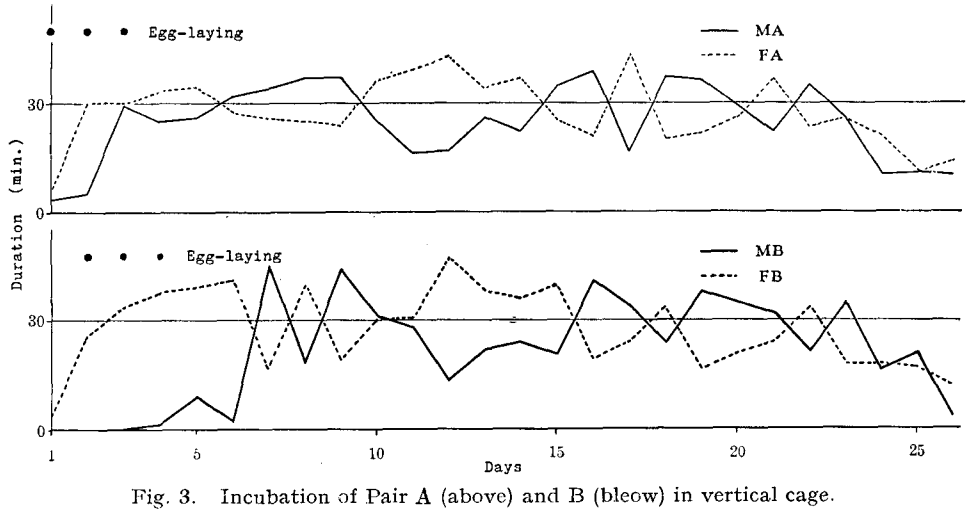


Fig. 3. Incubation of Pair A (above) and B (bleow) in vertical cage.

It is clear from the figure (Fig. 3) that both pairs incubated their eggs earnestly and normally at the same time in the second cage. The incubation period was prolonged in each because of dead eggs, and the normal attentiveness

began to decline about twenty three days after the start of their incubation. The inattentive period became longer than the attentive one about one month after, so that the eggs were very often left alone in the nests.

Antagonistic behaviour: One of the most remarkable phenomena characterizing territoriality of birds is the antagonistic relationship between the pairs or the individuals concerned. The agonistic activities chiefly dealt with in the present paper took three forms as follows (description of the details of this behaviour will be published elsewhere). *Attack*: Rushing flight towards an opponent from some far distance so as to collide with it. *Threat* and *threatening approach*: Threat, seen usually before attack, is an almost straightened posture with sleeked feathers, head oriented towards the opponent, and slightly lowered body. Threatening approach is a movement with threat posture by hop or short flight. *Stab* and *fight*: In case of attack or threat from some distance the opponent gives way to the aggressor in most cases to evade actual trouble, but in some cases practical contact occurs between the combatants. Unilateral aggression was recorded here as stabbing and mutual bill-fencing as fight. The head, face and its vicinity of the competitors are usually aimed at as the targets. It is sure that the approach-avoidance relationship among the members of the quartet has a definite connection with dominancy, but it was very difficult to discern this relation sufficiently because of the confined space and speady movement of the birds.

a) *Attack*: The first appearance of attacking behaviour, FA against Pair B, in the horizontal cage was recorded at four days after the original meeting, followed by attacks of MB against MA. These acts might not always have been intended to expel the birds who had violated a certain localized area around a special object, but might be derived initially from the cooperative behaviour of pair mates at the time of nesting. When one mate of a pair intended to go into or actually nested in their empty nest, the other mate would dare to attack the other individuals to drive them far away, even though the latter were in such far distance from the nest as on the another nest or its vicinity where they were supposedly safe from any attack. This was already noticed in the unisexual groups of the Bengalee (Masatomi 1959). Such behaviour (cooperative attack) would provoke the outbreak of primary territorial attack among them in resistance to the invasion of an aggressor into the opponent's defense area, or the fleeing flight of the passive birds into the territory of the attacker.

Attacks of Pair A were at first clearly stronger than those of Pair B. Pair B occasionally approached N2 and its precincts to attack within about one week after the release, but most of the flights were cooperative attacks and the attacker always returned to its own area immediately without perching near N2. This may have resulted from a larger fear of the aggressor in spite of the explosion of its attack drive and/ or the instant counter-attack of the opponent. It is generally accepted that in many birds the individual showing some agonistic behaviour has a tendency to flee as well as a tendency to attack at any moment (cf. Tinbergen

1953, Hinde 1953, Morris 1954, Moynihan 1956). The aggressive flights of Pair B towards the right side of the cage within the first ten days did not always correspond to the extent of their territory at the time. It could be recognized from the other activities that Pair B had no more than a small left side territory (Figs. 4, 10 and 11). The attack frequency of B increased after half a month and its attacking area also expanded gradually. Area defended by B with territorial attack seemed to become slightly larger than that by A after about twenty days and to be almost equal to the area of the latter at the end of the period (Fig. 4).

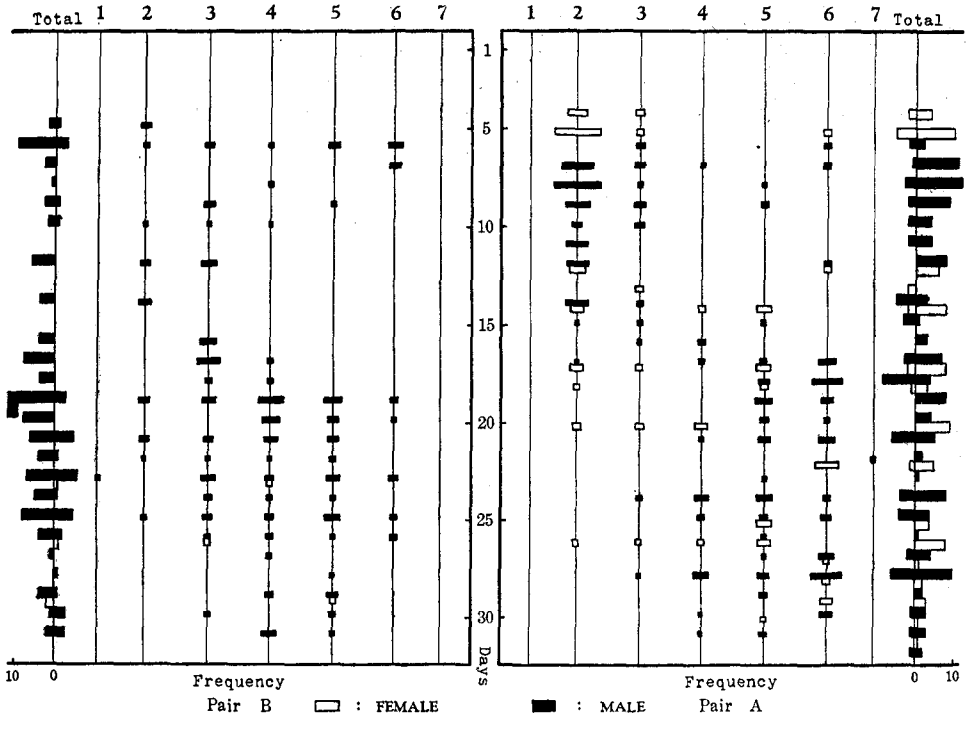


Fig. 4. Attacks from each perch (No. in above) in horizontal cage. Marginal histograms show the total frequency of attacks against opposite males (outside) and females (inside).

The severe aggressive activities such as attack or fight were not seen among the present individuals of Bengalee within the first four days in the vertical cage, although dashing flights like attack were elicited sometimes under the appearance of sexual stimulus, i.e. courting display of male or female. In this stage the hostile acts observed were mainly threat or threatening approach, but the attacks to guard some objects or areas from the other pair members were found certainly

among them on the fifth day after the removal. The cage seemed to be divided spatially within one week into two areas bounded from each other loosely by the border between P3 and P4. About ten days after MA intentionally flew down through the territory of B at intervals, perhaps to collect nest material, to the lowest perch (P6). The members of Pair B, of course, vigorously attacked him at once, but MA, afterwards, alighted occasionally on the perch purposely. It may suggest that the territory of B was not so rigid in nature, except the nest itself or its near smaller region.

The incubation activities of both pairs began to decrease in the middle

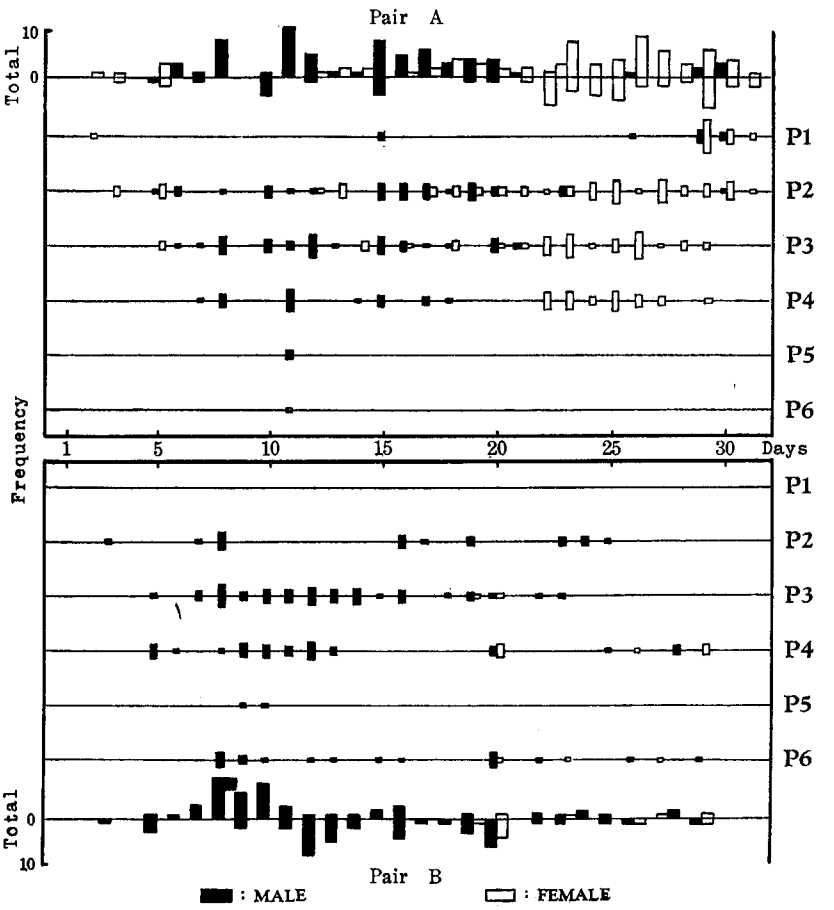


Fig. 5. Attacks from each perch in vertical cage. Marginal histograms show the total frequency of attacks against opposite males (above) and females (below).

of the observation period. Then Pair B frequently essayed to go up to the upper perches within the territory of Pair A, so that A, FA in particular, used to make many territorial attacks on B, especially on MB. The area protected by the defense-attacks of Pair A was reduced considerably to only the nest itself and near vicinity of P1 (Figs. 5 and 7).

Fleeing flight evoked frequently an added aggression of the owner of the neighbour territory on account of the infringement of the fleeing birds. The limited space must be a large factor in these surplus acts in the present case.

b) *Threat and threatening approach*: As one of the aggressive acts threat and threatening approach were more generally observed in each cage than attack within the assemblage. What act follows after these threatening behaviours be-

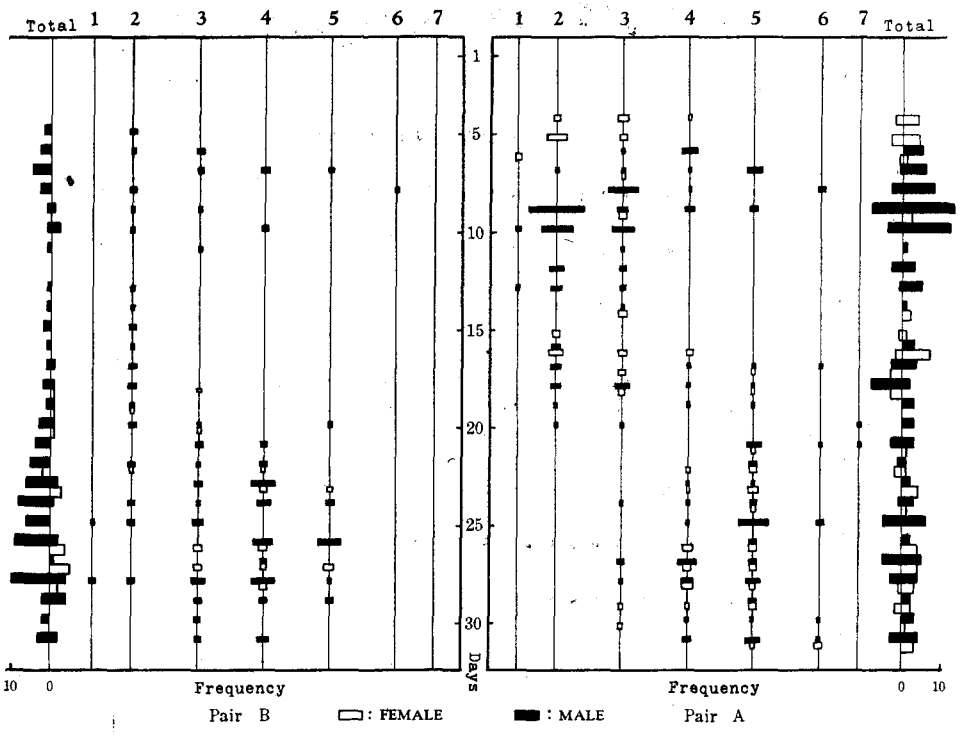


Fig. 6. Threatening activities on each perch (No. in above) in horizontal cage. Marginal histograms show thet otal frequency of attacks against opposite males (outside) and females (inside).

tween the birds concerned depends on the complicated situations mingled with various internal and external factors at any time. For instance, when one dared to approach the other bird which was taking threat posture against it, the latter

generally burst out the attack at once against the former from the above mentioned posture. When one immediately avoided the other, the latter, being very sensitive to the movement of the former, usually suspended to threat. In some cases one took a threat act soon after its violent attacks and in other cases one repeated alternately the threat and attack activities.

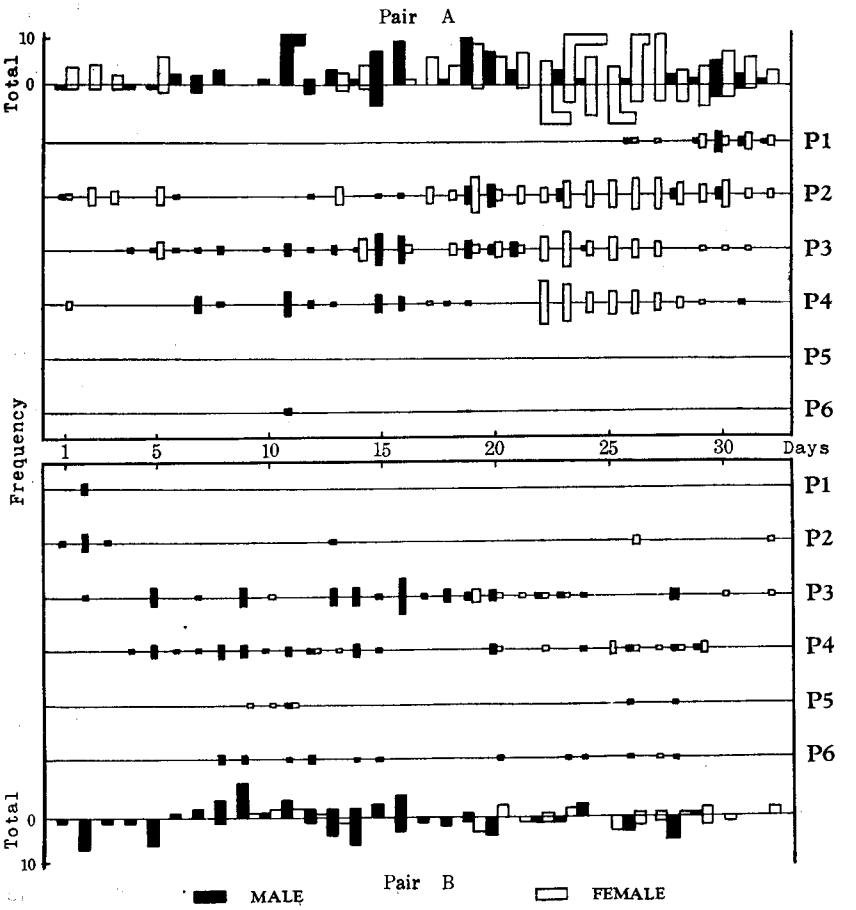


Fig. 7. Threatening activities on each perch of vertical cage. Marglna histograms show the total frequency of attacks against opposite males (above) and females (below).

Definite and constant points, where the threatening behaviour was carried out by the members of each pair, did not exist at all for the duration of one day only, but the vague threatening areas which overlapped approximately the at-

tacking areas were recognized continuously through the whole period in both cages (Figs. 6 and 7). However, the threat zone of MA seemed to exist in general at the outside, while that of MB at the inside of his attacking area. The case of MA may be interpreted as a result of the fact that the violation of MB into the more inner region of the territory of A caused directly the owner to attack the intruder, and approach of A towards the nest of B depressed violent aggressive activities of A because of increased fear against the opponents. MB, on the other hand, took at first a threat posture against the approaching opponents, and, if the latter showed no signs of "appeasement or deceptive display" (see Moynihan 1955), so he used to fly at them.

c) *Stab and fight*: Neither direct body contact and small individual distance nor fight between the birds in definite antagonistic relation are observed in a relatively large cage, because the attacked individual generally flees before the actual contact occurs. Agonistic stabbing was not observed in the present case, but a few fights happened between MA and MB in both cages, in the horizontal cage during the middle stage, from the 17th to 23rd June. This stage corresponded approximately with the period in which MB began to increase his influence and expand his territory. In the vertical cage the stage in which the fighting took place also agreed with the period of frequent ascending movements of MB to the upper perches included in the territory of A (Table 2). From these

Table 2. Frequency of total fighting in two cages.

Cage	Combatant	Perches						
		P1	P2	P3	P4	P5	P6	P7
Horizontal	MA-MB	—	2	3	1	—	—	—
Vertical	MA-MB	—	—	2	5	—	—	
	FA-FB	1	1	—	—	—	—	

facts it may be comprehended in the present case that the growth and balance of power of the two male birds seem to be one of the most important causes to evoke fighting. That two combatants in equal situation tended to make an actual fight was supposed also in other finches (Morris 1954).

Amicable behaviour: Pair or subgroup formation is generally accompanied by two social relations among the members of a flock; one is development of antagonistic relation among the members except between the mates, and the other is formation of rapprochement relationship between certain birds. The types of these relations have many varieties in character. Clumping, social preening and song were considered here as amicable behaviour for ease in recording. *Clumping*: Body-to-body contact with raised feathers and crouched posture on the perch, as in many other Estrildines (Moynihan and Hall 1954, Morris 1957). The degree of contact, the feather and the body posture at clumping show

many varieties in each case, but these details were ignored in the present description. Clumping often can serve as a sign of social preening. The tendency to clump generally disappears even between the pair mates during their incubation and brooding (Masatomi 1957). *Social preening*: One bird preens the fluffed feathers of another who is clumping with it or resting near by. This also has various behaviour patterns (see Moynihan and Hall cit.) and is interrupted as well, having connection with vanishment of clumping behaviour, during the brooding period. *Song*: Only the male of the Bengalee sings with or without courting, courting song and stationary song, as in the case of the zebra finch and the bronze mannikin (Morris 1954, 1957). Singer with stationary song does not orient himself towards any other bird, although he usually fluffs his feathers as in courting. A courting mate with song tends to advance towards his mate, hopping and waving himself with fluffed feathers. These songs generally diminish during the incubation and brooding period.

a) *Clumping*: In the horizontal cage MA and FA clumped with each other only during the first two days on N2 and P5, but never did so thereafter. On the other hand, MB and FB, particularly FB showed actively the tilting head posture, suspected to be a releaser to invite social preening, clumped intermittently throughout in the whole period and in the last stage of the first period even continuously every day (Table 3). The difference of clumping activities between the two pairs

Table 3. Frequency of total clumping activity in two cages.
Left individuals are active and right ones passive.

Horizontal cage	Nests and perches									Total
	N1	P1	P2	P3	P4	P5	P6	P7	N2	
FA→MA	—	—	—	—	—	1	—	—	1	2
MA→FA	—	—	—	—	—	—	—	—	2	2 > 4
MA→FB	—	—	—	1	—	1	—	—	—	2 — 2
FB→MB	—	—	19	9	11	7	1	1	—	48
MB→FB	—	—	1	1	—	1	—	—	—	3 > 51

Vertical cage	Perches						Total
	P1	P2	P3	P4	P5	P6	
FA→MA	3	2	4	—	—	—	9
MA→FA	2	—	2	—	—	—	4 > 13
FA→FB	1	—	—	—	—	—	1 — 1
FB→MB	6	6	15	23	1	—	51
MB→FB	4	5	3	4	—	—	16 > 67

may be due to the disparity of the brooding condition of each pair; Pair A bred sufficiently, while Pair B did not. In the vertical cage no clumping of Pair A was observed at all from 24th July to 24th August, nor did MB and FB ever clump with each other from 30th July to 20th August. The fact that the clumping was not seen at all in each pair for about one month may suggest clearly that both

pairs were fully in breeding conditions. The frequency of clumping was higher in Pair B than in A, but this may be related somewhat to individual differences (Table 3). The pair mates would generally clump with each other on the perches near their own nests within their own territories, but there was no definite constant localization of clumping. The pairs tended to clump anywhere, if they were only within their own territories, so that the area in which to clump varied in size in conncetion with the change of territorial size. Contrariwise it may be suggested that the extent of territory of one pair is estimated probably with the clumping area.

b) *Social preening*: Social preening was usually carried out as the result of clumping except for some cases without clumping or body contact. Therefore, it was a matter of course that the frequency and the area of preening were almost equal with those of clumping. In the present case both the females actively preened their males in each pair, although this is not always a general trait in Bengalee. The different frequency of social preening between the pairs may depend to some extent on the individual difference or the physical condition of the birds clumping (Table 4).

Table 4. Frequency of total social preening in two cages. Left individuals are active and right ones passive.

Horizontal cage	Nests and perches							Total
	N1 & P1	P2	P3	P4	P5	P6	N2 & P7	
F A→M A	—	—	—	—	—	—	24	24 > 37
M A→F A	—	—	—	—	—	—	13	13
F B→M B	40	16	4	5	6	1	—	72 > 93
M B→F B	8	6	3	1	2	1	—	21

Vertical cage	Nests and perches								Total
	N1	P1	P2	P3	P4	P5	P6	N2	
F A→M A	21	4	3	4	—	—	—	—	32 > 45
M A→F A	8	4	—	1	—	—	—	—	13
F B→M B	—	7	10	14	14	—	—	11	55 > 83
M B→F B	—	6	3	2	17	—	—	—	28

c) *Song*: Before establishment of territory the males occasionally courted with song the birds of the other pair. This act must had been incited directly by an intensified sexual drive, but if the courting act "can be thought of as a three-point conflict between the tendencies to flee, attack and mate" (Morris 1954, 1955), the courting males in the present case might have also the larger attacking and mating tendencies and weak fleeing tendency. Then it is conceivable that the courting bird might be temporalily dominant to the opposite pair mate courted at the time. The songs after the establishment of territory were almost always stationary and expressed always within the bird's own territory (Fig. 8). Frequent

appearance of song through the whole period in the horizontal cage and some songs during the early stage of incubation in the vertical cage by MB were perhaps related with his weak incubation drive at the time. Nevertheless, those songs seemed to be emotional and not to accompany remarkable repellent or attractive posture, which exerted no influence on the other birds apparently. Therefore,

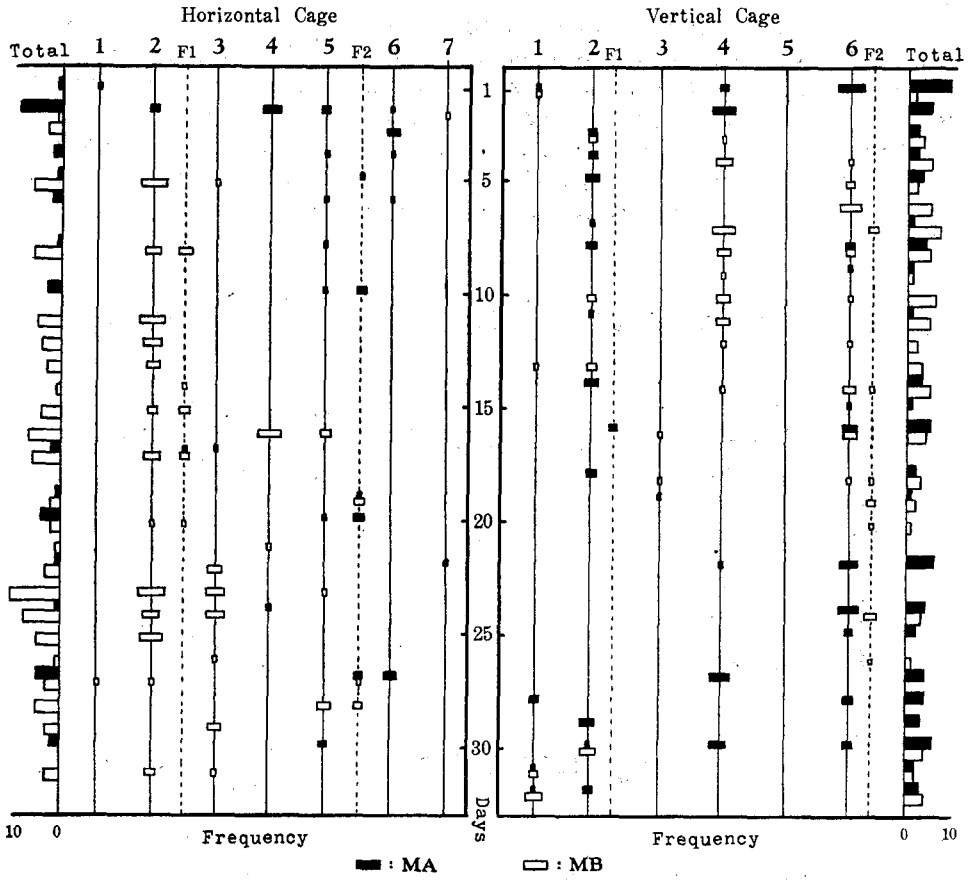


Fig. 8. Songs of males on each perch (No. in above)and at feeders, F1 and F2, in two cages.

the song of this bird may be not a preclamation of territory in contrast to the case of many other passerines (e.g. Kendeigh 1941, Lack 1943, and see also Armstrong 1947). It is impossible to find out an advertising song in the Bengalee, as in the case pointed out in some Estrildines (Moynihan and Hall 1954, Morris 1957).

Maintenance behaviour: The maintenance activities carried on in-

dependently in individual life, such as feeding, bathing, roosting, self-preening, moving and nesting, must be more or less restricted so far as the bird lives with other individuals in one assemblage. Especially the area in which these behaviours occur becomes limited by the formation of several territories in one cage. In other words, as stated by Hinde (1956), restriction of these activities to defined area (site attachment) is one of the main components in the establishment and maintenance of a territory.

a) Feeding: A food container was placed near each nest in the present case. If it was included within a territory the birds of the other pair who approached it were attacked in most cases by the owner of the territory. Although MB and FB never went to feed to F2 for two weeks after the third day subsequent to their release in the horizontal cage, they fed frequently at that feeder in the latter half of the period. Feeding at F2 instead of F1 near their own nest was attended by the growth of their power and extent of their activity area.

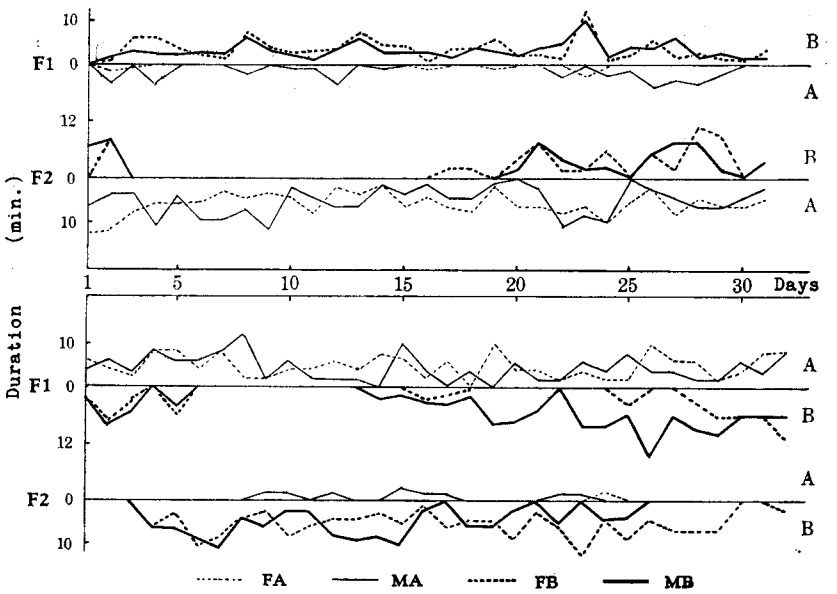


Fig. 9. Feeding in horizontal (above) and vertical (below) cages.

Both pairs fed at first separately in each food dish in the vertical cage, but at the end of their life in it they began to pick grain at F2 together (Fig. 9). The birds which came to the food dish placed in the opponent territory were usually attacked at once by its owner for the sake of the defense of their territory, but not always for the sake of the food dish alone. A food dish out of territory was never guarded with defense-attack by all members. Both pairs dared sometimes to go

and feed enough at the feeder included in the territory of another pair, but it must be noticed that feeding behaviour seemed to give in some cases somewhat an appeasement effect on the attacking tendency of the opponent.

b) Self-preening and resting: A resting or relaxed Bengalee frequently preens itself on perch or in nest. The members used to preen themselves on the perches in each territory of both cages, but there was not any defined preening point or place in the cages. However, they would show the self-preening more often near the border of two territories, or area of high tension, than in the vicinities of the nests, or more safe place to rest. This may partly be connected with the fact that the Bengalee incubating in an isolated large cage has generally a

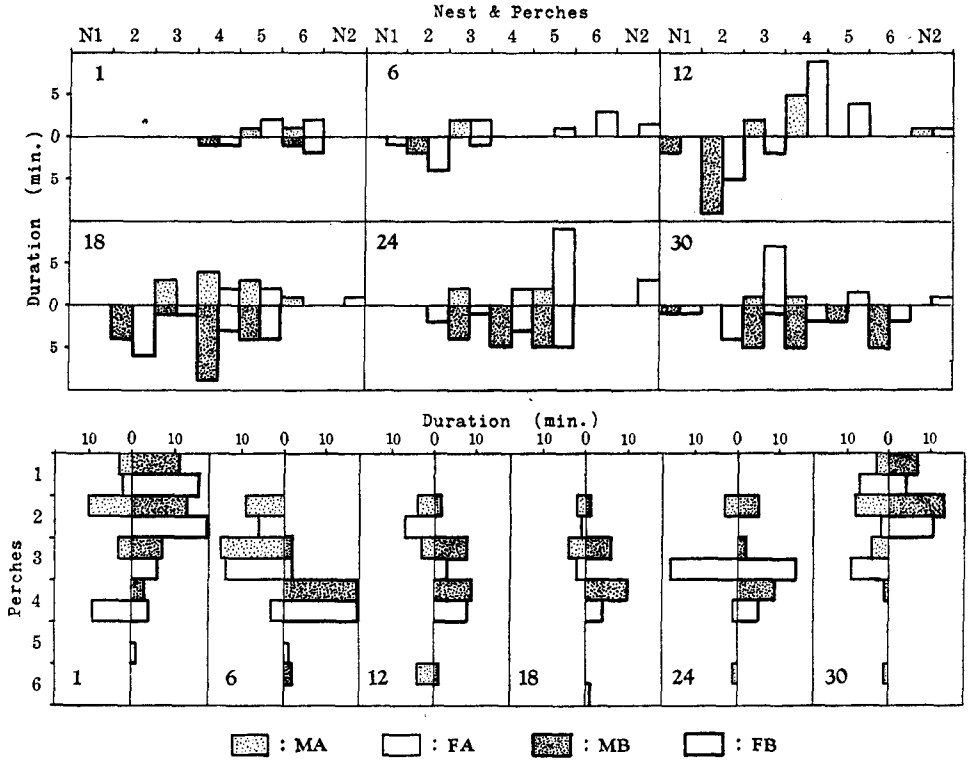
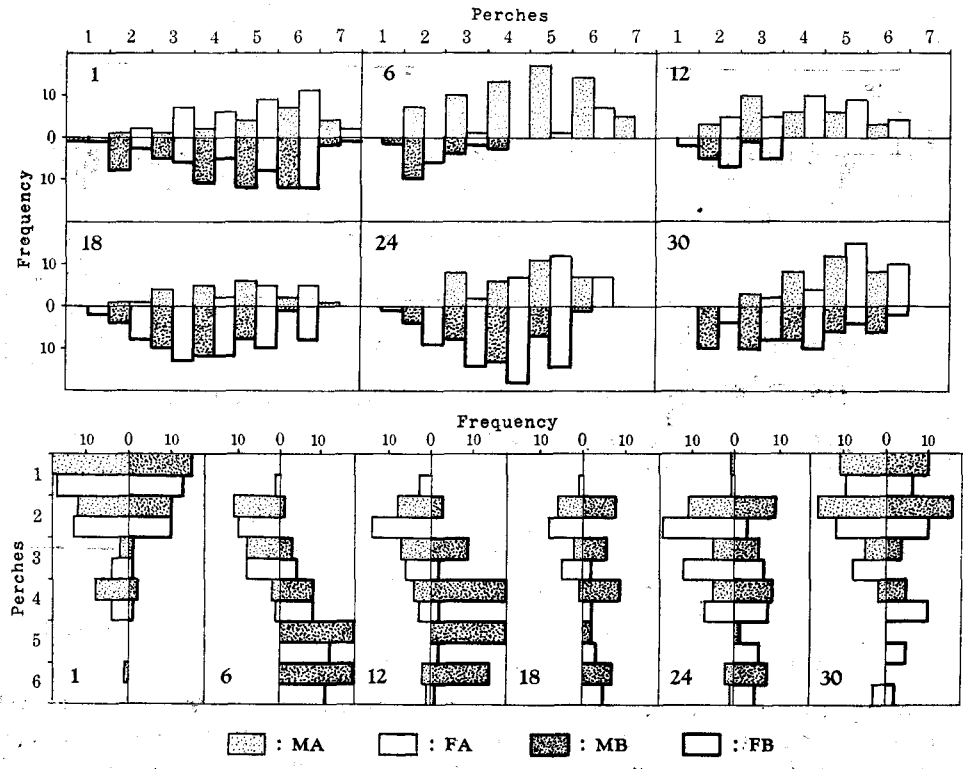


Fig. 10. Some daily records (days, 1, 6, 12, 18, 24 and 30 after start of observation) of self-preening in horizontal (above) and vertical (below) cages.

tendency to go far from the nest in inattentive period and to rest or preen itself there. Accordingly, the zone in which each bird preened itself more or less frequently would move to and fro in keeping with the removal of the border of the two territories (Fig. 10). Moreover, it may be assured commonly that preening

and resting posture with flued feathers in the Bengalee, as in other finches (e.g. Morris 1954, Hinde 1953), have a function to appease the aggressive acts of other birds under certain situations. Therefore, the preening or resting birds must have occasionally reduced the agonistic acts of the opponent at some point, in spite of mostly being attacked at that spot on other occasions. Considering those facts, it is assured that presentation of self-preening and resting are to be regarded, in virtue of themselves alone, as passive assertions of the home range to the other members.

c) *Nesting*: If there are more than two artificial nests in a relatively large cage, one of the pairs or individuals of the Bengalee reared in it tends generally to roost irregularly in some or all nests and another pair tends to rest constantly in one or more of the nests at night during inter-breeding period. The birds incubating or brooding their nestlings always occupied the nest in which they or other birds had laid the eggs, although it was observed in some cases that an incubating bird, leaving its own nest and eggs, sometimes went to other nest and



Fig, 11. Some daily records (days, 1, 6, 12, 18, 24 and 30 after start of observation) of alighting in horizontal (above) and vertical (below) cages.

incubated naturally the eggs laid by other pair.

In the present case, according to the rapid formation of territories around the nests, each pair nested separately only two days after transference to the common cages. After all four birds suspended incubation of the dead eggs, they tended to come together in a small area (such as on the same perch) without vigorous hostility, but each pair roosted in its own nest neither at night nor in the daytime. It is suggested that the nest itself is guarded by the owner as the nucleus of its territory for a considerable time even after the decrease of defended area and compensatory recovering of his gregarious tendency.

d) *Alighting on perch* : The birds flew about in lively manner from perch to perch in the daytime. The times of alighting on the perches were summed up and shown in Fig. 11 as frequency graph. During the first two days in the horizontal cage all birds searched about the cage, especially Pair B rather more actively than A, but next day the perches on which B could alight were restricted mostly to only P1–P3 due to the severe attacks of Pair. A. This state continued without change for about half a month; during this stage Pair B perched rarely on P4–P6 only excepting a few occasions to launch attack on or to flee from Pair A. Contrary to the extension of home range of Pair B in the last half of the first period, the alighting area of Pair A tended to decrease in size and the pair rarely came to P2. The lower frequency of FA in alighting on perches than that of her mate at the end of the first week was caused apparently by her longer attentive period contrariwise to the half-hearted incubation of her mate (Fig. 11).

On the other hand, all birds moved gregariously about some of the upper perches within several hours after liberation in the vertical cage. Thenafter they were separated perfectly into two pairs; each localized its movement area around the nest : Pair A in upper and B in lower ones, forming two definite territories. In the latter half of this period MB, and with slight delay FB, came to fly up purposively to the territory of Pair A and to perch or rest together on P1 with MA and FA.

Discussion

Up to the present there has been no published report on the territorial behaviour of the Bengalee. The Bengalee is found only as a cage bird produced artificially (therefore, it is impossible to compare observations under confinement with their wild habit) ; it has an extremely gregarious nature. Generally it can breed easily even in a very small box, consequently the breeding of more than one pair in a relatively large cage must have been ignored from the point of economical breeding. It is generally said that the Bengalee seems to have no aggressive tendency. Circumstantially two pairs can be nested and bred together in a common nest without any aggressive acts (Masatomi in press). However, the expression of violent aggressiveness and the establishment of distinct territory are aroused under certain situations as reported in the present paper as well as elswhere (Masatomi 1959).

Since the pioneer works by Altum (cit. Hinde 1956) and Howard (1920) various interpretations on the territoriality of birds have been presented by a number of ornithologists and ethologists (e.g. Noble 1939, Nice 1943, Hinde 1956, Tinbergen 1957 and cf. Armstrong 1947). As shown in these articles, the territory may be defined as a phenomenon in which an individual or individuals defend, either actively or passively, certain localized static objects or areas from the other birds and is characterized in general by antagonistic behaviour between the birds concerned. For the thorough understanding of territoriality, however, it is indispensable to notice some other types of behaviour, as already pointed out by Howard (1920).

In the present case the territories were clearly observed to be established and maintained definitely around the nests within the cages during the breeding period. Various types of territorial activities appeared always more or less in connection with the ultimate goal, defense of a bird's own area. When the territory has been formed in the assemblage under confinement, the appearance of some certain behaviour in one individual may be controlled by many external stimuli, such as the location in the cage, and the behaviour of the opponent, as well as internal stimuli connected with the mood, extent of ownership and sensibility at the time. Extent and structure of combat area, process and outcome of agonistic affairs were seen to be very diverse according to the cases. For instance, when a defender chased an intruder too deeply into the territory of the latter, their relative role might become reversed there instantaneously. In such case, the attacking places of the latter are not always on the immediate border line of its territory. However, the existence of the area in these cages at which the aggression was more frequently and constantly elicited by the bird, or in which other individuals generally could not intrude, was clearly proved from the total frequency of these activities, though the defended areas were not sharply defined and their extent gradually changed during the period.

The territory of one pair tends to extend and to become sharply demarcated a while before the egg-laying and to shrink at the end of the incubation period. This change in size of territory may be closely connected with increase and decrease of territorial behaviour during the breeding period. But the actual size of a territory in captivity must virtually be controlled by many factors such as available size and condition of cage, breeding state and aggressive tendency of the birds, congenital characters, rival pairs and their movement, interrelation between the individuals etc. Judging from the present case, the territory of the Bengalee may perhaps become more extensive than ever in other larger cages or aviaries. The defended area established in the vicinity of the nest in the early stage of incubation always becomes limited only to the nest itself at the end of the breeding period, although some spasmodic agonistic acts, seemingly an after effect of vigorous territorial aggression, occasionally happened out of the nest vicinity.

The pairs did not form territories to guard around the food dishes. They

defended them from the opposed pair only when the dishes were included in their extended nest territories. Feeding seemed to have a rather neutralizing or appeasement function in respect to agonistic behaviour, even in the nest territories.

In general, the territorial behaviour differed but little between the two pairs, except for some minor differences due to the different conditions of the pairs. The territory of Pair A being larger than that of Pair B and initial absolute submission of B in the horizontal cage may have been on account of the inadequate breeding condition of Pair B. On the contrary, the establishment of similar territories by both pairs in the first half period in the vertical cage may depend largely on the similar breeding and social status of the two pairs. That the outgrowth of many breeding activities, including aggressiveness, may depend on numerous internal as well external factors is demonstrated by a number of experimental studies on the various passerines (e.g. Shoemaker 1939, Marshall and Disney 1957, Hinde 1959).

The structure of the territories was essentially almost the same in both cages. The vigorously defended areas were the nests themselves with their proximal surroundings near the parts of the nests and the nearer to the nest the more strongly defended. For instance, in the vertical cage Pair A could sometimes alight on P6 having entered the territory of Pair B, but never on P5 on which N2 was located. Such defense specialized to the nest site was also observed in many passerines of colonial nesting habit (cf, e.g. Emlen 1952, Morris, 1954, 1957, Friedmann 1935). The Bengalee has a tendency to spend its daily life on high perches. In the vertical cage at the end of the last period in parallel with the increase of gregarious tendency and alternatively the decrease of aggressiveness, the pair (B), the owner of low section, frequently tended to intrude onto the upper perches.

In the present case, the males were more earnestly active in maintenance of territory than their mates, even if not constantly throughout the period. The tendency of the females to defend the territory, on the other hand, seemed virtually to be not increased during the latter half period in each cage, except for FA which in the vertical cage showed more furious territorial activities and extended her territory more aggressively than her mate. But it is still an open question whether the two sexes of the Bengalee have respectively different types of territory as observed in the humming-bird (Pitelka 1942), the red-winged blackbird (Nero and Emlen 1951), the house wren (Kendeigh 1941) and others. Although the more aggressive males, even at incubating, used generally to responded to the trespasser, the females also began the attacks at far distant place apart from their own nests as well as at the nest and its proximal surroundings.

The estabilshment of territory was clearly supported not only by the aggressive acts but also by amicable and maintenance activities. But in contrast to territorial songs of many other passerine birds the relation between song and territory formation was entirely obscure in the Bengalee.

Further, it is indubitable that the appropriate size and form of cages, enabling spatial differentiation, play important roles in the establishment of clear territories as in the present case. Finally, the probable pair-formation of two pairs before the experiment may affect the territory formation, for pair and territory of the Bengalee were not always easily formed among the other medley

assemblages of the two sexes in the same cages as those used in the present study.

Acknowledgement: The writer is greatly indebted to Professor Tohru Uchida and Dr. Shôichi F. Sakagami who have given pertinent guidance and many valuable suggestions in the course of the present study.

Summary

Two pairs of the Bengalee were reared together for about two months successively in two different large elongate cages, one set horizontally, the other vertically. Both had two artificial nests and several perches respectively. The behaviour of the birds was observed in reference to two aspects, viz., inter-pair antagonism and restriction of activity to a defined area.

In each cage both females laid eggs in the separate nests and incubated them with their mates, but the eggs were not hatched out, partly due to the frequent interference by the other pair. The Bengalee is usually regarded to be a mild tempered finch. In fact several pairs occasionally can breed in a communal nest. However, the pairs reared in the present study established more or less firm territories around their own nests within a week and defended them with vigorous attacks or other agonistic activities in the breeding period.

Both pairs tended to increase and demarcate their territories at the beginning of nest building and to decrease them at the end of their abnormal incubation periods. No essential difference in the structure of territories was found between the two pairs in the respective cages.

Pre-existence of the pair bond before the beginning of observation may be one of the most important factors in the formation of such a definite territoriality, together with other internal (e.g. breeding status) and external factors (e.g. appropriate topography of cages).

References

(Articles marked with an asterisk were not accessible to the writer).

Armstrong, E.A. 1947. Bird display and behaviour. London.

Collias, N.E. 1944. Aggressive behavior among vertebrate animals. Physiol. Zoöl., 17 : 83–123.

Emlen, J.T., Jr. 1954. Territory, nest building, and pair formation in the cliff swallow. Auk, 71 : 16–35.

Friedmann, H. 1935. Bird societies. Chap. 5 in *Handbook of social psychology*, ed. C. Murchison Massachusetts.

Hinde, R.H. 1953. The conflict between drives in the courtship and copulation of the chaffinch. Behaviour, 5 : 1–31.

———— 1956. Biological significance of the territories of birds. Ibis, 98 : 340–369.

———— 1959. Some factors influencing sexual and aggressive behaviour in male chaffinches. Bird Study, 6 : 112–122.

Howard, E. 1920. Territory in bird life. London.

Kendeigh, S.C. 1941. Territorial and mating behavior of the house wren. Illinois Biol.

Monog., 18 : 1–120.
Kuroda, N. 1955–7. Field studies on the grey starling, *Sturnus cineraceus* Temminck. Misc. Rep. Yamashina's Inst. Orn. & Zool., 7 : 7–19, 8 : 8-18, 9 : 27–38, 10 : 27–40.
Lack, D. 1943. The life of the robin. London.
Marshall, A.J. and H.J. de S. Disney 1957. Experimental induction of the breeding season in a xerophilous bird. Nature, 180 : 647–649.
Masatomi, H. 1957. Rhythms in the parental behaviour of the bengalee. (M.S. thesis).
———— 1959. Attacking behaviour in homosexual groups of the bengalee, *Uroloncha striata* var. *domestica* Flower. J. Fac. Sci. Hokkaido Univ., Ser. VI, Zool., 14 : 234–251.
———— (in press). Communal use of one and the same nest by two breeding pairs of the bengalee. Behaviour, 15.
Morris, D. 1954. The reproductive behaviour of the zebra finch (*Poephila guttata*), with special reference to pseudofemale behaviour and displacement activities. Behaviour, 6 : 271–322.
———— 1955. The causation of pseudofemale and pseudomale behaviour : a further comment. Behaviour, 8 : 46–56.
———— 1957. The reproductive behaviour of the bronze mannikin, *Lonchura cucullata*. Behaviour, 11 : 156–208.
Mountfort, G. 1956. The territorial behaviour of the howfinch *Coccothraustes coccothraustes*. Ibis, 98 : 490–495.
Moynihan, M. 1955. Types of hostile display. Auk, 72 : 247–259.
———— 1956. Note on the behavior of some North American gulls. I. Aerial hostile behavior. Behaviour, 10 : 126–178.
———— and M.F. Hall 1955. Hostile, sexual, and other social behaviour patterns of the spice finch (*Lonchura punctulata*) in captivity. Behaviour, 7 : 33–76.
Nero, R.W. and J.T. Emlen, Jr. 1951. An experimental study of territorial behavior in breeding red-winged blackbirds. Condor, 53 : 105–116.
* Nice, M.M. 1951. The role of territory in bird life. Amer. Midl. Nat., 26 : 441–487.
* ———— 1943. Studies in the life history of the song sparrow. II. Trans. Linn. Soc. New York, 6 : 1–328.
Noble, G.K. 1939. The role of dominance on the social life of birds. Auk, 56 : 263-273.
Pitelka, F.A. 1942. Territoriality and related problems in North American hummingbirds. Condor, 44 : 189–204.
Shoemaker, H.H. 1939. Effect of testosterone propionate on behavior of the female canary. Proc. Soc. exp. Biol. & Med., 41 : 299-302.
Tinbergen, N. 1951. The study of instinct. Oxford.
———— 1953. The herring gull's world. London.
———— 1957. The functions of territory. Bird Study, 4 : 14-27.
Walkinshaw, L.H. 1944. The Eastern chipping sparrow in Michigan. Wilson Bull., 56 : 193–205.