

## EFFECT OF TESTOSTERONE PROPIONATE ON TERRITORIALITY IN FLOCKS OF RING DOVES

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A characteristic of bird flocks receiving much attention is territoriality. In studies of the organization of flocks, a significant relationship between this characteristic and the development of social hierarchies has been pointed out by several investigators. Hierarchies of two types are recognized. These are the stable peck-order as reported in chickens (Masare and Allee, '34) and the much more flexible peck-dominance as found in pigeons (Masare and Allee, '34, and Diebschlag, '41), of ring doves (Bennett, '39), and of canaries (Shoemaker, '39). Investigators of peck-dominance have suggested that the explanation of this condition is in some complexity in the form of territoriality developing in flocks.

Shoemaker ('39) observed in canaries that a bird, which is dominant over another in neutral territory, normally becomes subordinate in the nesting territory of the other bird. He says, "This factor alone would account for the peck-dominance type of social organization." Diebschlag ('41), in an analysis of the social order in a heterosexual group of pigeons, concluded that the peck-dominance system is entirely a matter of territoriality. He states that each animal attempts to fix the limits of and to defend a certain amount of space against other members of the society. Since the distribution within a dove-cote shifts somewhat easily and rather frequently, he concludes that this flexible "placeholder" prevents a "linear dominance" such as that found in the chicken. Both Shoemaker and Diebschlag see in the stability of territorial relationships, in flocks of canaries and pigeons respectively, a probable explanation of peck-dominance.

In ring dove flocks, experimentally treated with an androgen (Bennett, '40), tendency away from the characteristic peck-dominance type of social order toward a peck-right was observed. As this was accompanied an increase in terri-

toriality, the hypothesis was advanced that the possible "explanation of the increased stability observed may lie in the expression of territorialism rather than in any new development." In most of the flocks of ring doves observed, previous to treatment with an androgen, certain individuals had shown distinct territorial tendencies. They "adopted definite locations in the cages and tended to defend these against all intruders." If added to these in any flock, there were others in whom territoriality could be induced by experimental treatment, it is to be expected that a greater degree of stability would appear in the social organization of the group. The present report follows an attempt to analyze more fully the data in the ring dove investigation from the standpoint of the relationship of increased territoriality and accompanying changes in social organization.

The experimental birds, that is, those injected with an androgen, were selected because of low rank, a status characterized either by passivity or by failure to win in pecking encounters. They seldom if ever attempted defense of a location. The general procedures used are fully described in previous reports (Bennett, '39, '40). Three homosexual caged flocks, one of females, two of males, were observed daily. Records of individual locations and activities were recorded in five-minute intervals, making the reconstruction of a cage picture for any given time a possibility. Pre-injection (control) periods were followed by experimental periods. In the latter, one or two of the selected flock members in each cage received daily injections of testosterone propionate. Post-injection periods followed. Two series, one of 78 days, one of 50 days, included 48 days and 24 days, respectively, of injections. The treated birds in Series I were D and RH in the female flock, two birds in male flock A, and EB in male flock B. Three of these, one from each flock, were again experimental subjects in Series II.

In the pre-injection period of Series I both experimental female birds were passive, located much of the time on the front perch. In the injection period, D moved to the floor with occasional aggressive sallies upon the perches. RH first changed from the front perch to the back, then also located on the floor for the remainder of the period. In the post-injection period both birds soon retired to the front perch and became as passive as preceding treatment. In Series II, D again returned to the floor but alternated between it and the front perch. Again, upon cessation of injections, D became passive on the back perch.

The behavior of EB in the male flock B was characteristic for the treated males. In the pre-injection period of Series I, he was never definitely located. He engaged in frequent floor encounters, losing most of them. With injections, he began winning encounters. After three weeks, he located for a time on the front perch. With an increase in androgen dosage later in this series, he returned to the floor. Here the other birds exhibited a wariness with regard to him. In the post-injection period, he gradually became inactive on the back perch. With re-injection EB returned to the floor, becoming an aggressor there. In the succeeding post-injection period he once more settled passively on the back perch.

The androgen induced aggressiveness in the experimental subjects. As this occurred, the same birds exhibited an increased tendency to occupy new locations and to engage intruders in combat until these intruders would withdraw from the place. It was noticeable that the floor was the usual arena of defense activity. This is to be expected because of the space and freedom permitted during combats. With cessation of injections the resumption of the pre-injection status

was accompanied by a decrease in the stability of the flock structure.

The flocks observed by Diebschlag and Shoemaker were heterosexual and behavior, directly associated with the breeding cycle, complicated the picture. Since homosexual flocks were used in the case of the ring doves, the influence of sex interrelations was, in part at least removed. Whatever changes in flexibility of social order occurred were less obscured by mating and nesting activities.

Increased aggressiveness occurred in all injected birds. This was followed by a development of territorial tendencies in the same individuals, accompanied by an increased development of a peck-right type of social organization. The conclusions of Shoemaker and Diebschlag, that in the shifting conditions of the bird flocks observed by them, lay the explanation of the flexible peck-dominance type is supported by the evidence in this case. As more birds in a flock became definitely located and began aggressively to defend the regions occupied, the social structure became more fixed.

It seems clear that the injection of testosterone propionate in low ranking members of ring dove flocks increased territorialism in the flocks and contributed to an increase in the development of a peck-right type of social hierarchy.

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