The Foraging Deployment of Velvet-fronted Nuthatches and Elegant Titmice

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The authors studied the foraging habits of two Philippine birds—the velvet-fronted nuthatches and elegant titmice—found in mixed companies of birds. They found out that in mixed flocks containing both species, nuthatches forage on the trunks and proximal parts of branches while titmice forage on the distal parts of branches.

Mixed companies of small and medium-sized birds foraging amicably together seem to be a common sight in tropical and temperate forests[1] Such groups are characterized by heterogeneity and variability in species composition. In Philippine forests, as many as 10 or more distinct species make up these mixed flocks, which contain both insectivorous and omnivorous birds.

The functions of these mixed companies of birds have been the subject of speculation by some writers[2] who suggest the following functions of the association: (1) it increases vigilance and gives rapid warning of danger; (2) it affords protection from predators; (3) it results in discovery of food concentrations; and (4) it is essentially display behavior designed to regulate population densities. Not one of these suggested functions are so far sufficiently documented as to be acceptable to ornithologists and ecologists.

Whatever the explanation of the association, it is obvious that it benefits the birds involved. Otherwise it would not have survived to the

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[1] V. C. Wynne-Edwards, **Animal Dispersion in Relation to Social Behavior** (New York: Hafner Publishing Co., 1st ed., 1962), pp. 415-418.

[2] Wynne-Edwards, **loc. cit.**

present. Our main interest in this study, however, is not to determine its functions but to know something about the spacing system adopted by the components of these mixed flocks.

To put it another way, we have asked the question: What locations of the environment are utilized for foraging by the component species? We decided to ask this question, for purposes of the present study, with regard to the velvet-fronted nuthatch (**Sitta frontalis**) and the elegant titmouse (**Parus elegans**), two of the 10 or so species which regularly occur in the mixed flocks. We do not imply by the choice that the other species are less important. Our choice was dictated in part by the limited time available to us for the field work and in part by previous observations that these two species appeared to have similar foraging movements: both possess remarkable agility to clamber about trunks and branches of trees, tirelessly scrambling about upwards and downwards as they search for food. In fact, their tree-climbing abilities strongly resemble the remotely-related woodpeckers and tree-creepers. These two species would therefore most likely compete with each other in terms of foraging substrate.

Study Areas and Methods

Observations were made in the submontane and lowland forest of southeastern Negros, specifically in Cuernos de Negros, Lake Balinsasayao, the hydroelectric area in Amlan, and Sitio Jumalon in Siaton during the period between August, 1968 and July, 1969. The elevations of these study areas range from 200 feet (Jumalon) to 3,500 feet (Lake Balinsasayao) above sea level. Only one of us (Gonzales), with one or two assistants, did the field work, which was limited to week-ends and short vacations on account of school duties. Supplementary observations were made in Mt. Katanglad, Bukidnon Province, and in the Takalon forests, South Davao province, all in Mindanao, in May and June, 1969, at the altitudes of from 1,600 to 3,880 feet above sea level.

The observers roamed the forests until they encountered a mixed flock, which they followed as far as was possible. Notes were recorded on: (1) composition, including numbers of distinct species and numbers of individuals of each species, (2) spatial distribution, or foraging position, of the member species with special reference to the nuthatch, and the titmouse; (3) amount of fighting, if any, between these two species. Notes were also taken on the behavior of nuthatches and titmice when foraging alone and away from mixed flocks.

In the later part of the study, a few nuthatches and titmice were shot with a shotgun. Their stomachs were subsequently removed and preserved in 10% formalin solution for later examination in the laboratory.

Observations

Composition of the Flocks

Of 18 mixed flocks observed, 11 (63%) behaved essentially as closed units, drifting in concert in one direction. For such flocks, identification and almost complete counting of all their component species were possible. However, it was not so for those flocks which were rather open or diffused in distribution in the vegetation. In this situation only the nuthatches and titmice were given attention.

In the flocks whose members were identified and counted, the most abundant group was that of the yellow white-eye (**Zosterops**). The titmice and other species were present in relatively smaller numbers (Table 1). In this connection, it may be noted that, with reference to titmice, the local situation appears to be somewhat different from that in Europe and North America, because in these continents the congeners of the elegant titmouse are usually the most numerous in woodland flocks.[3] In both situations, however, nuthatches participate as a minority group.

Occurrence of Nuthatches and Titmice in Mixed Flocks

Although velvet-fronted nuthatches and elegant titmice were regularly found in mixed-species flocks, they were not always in each other's company. Of 11 mixed-species flocks encountered in this study, 5 contained the two species foraging together; the other 6 contained only one or the other.

The difference in the frequency of occurrence of nuthatches and titmice in mixed flocks may be correlated with altitude at which observations were carried out. Nuthatches were seldom seen in mixed flocks encountered at elevations below 2,000 feet. Titmice, on the other hand, were frequent participants in mixed flocks met with at all altitudes, from as low as 2000 feet or less above sea level (forest of Jumalon) to as high as mountain peaks. These observations would seem to corrobo-

3 Wynne-Edwards, **loc. cit.**, and D. H. Morse, "Foraging Relationships of Brown-headed Nuthatches and Pine Warblers," **Ecology** (Vol. 48, 1967).

rate those of Delacour and Mayr,[4] according to whom titmice are "found from coasts to tops of mountains, in forests, often hunting for insects in flocks mixed with other kinds of birds." Of nuthatches, the same authors say that they "frequent forests at different altitudes."[5] At least in Negros Oriental, our observations would suggest that velvet-fronted nuthatches rarely descend below 2,000 feet or so.

Foraging Deployment of Nuthatches and Titmice

Table 2 summarizes the foraging behavior of velvet-fronted nuthatches and elegant titmice when together in mixed flocks, and the general position of the other members of the flocks. Both nuthatches and titmice tended to limit their foraging activities to the understory. The other members of mixed flocks generally spent much of their foraging time in the upperstory.

From the figures in Table 2, the following table can be set up for chi-square tests of feeding positions of the two species when both are present in mixed flocks on the null hypothesis that they do not differ in feeding position:

	Trunk and Proximal Parts of Branches			Distal Parts of Branches and Twigs		
	Titmice	Nuthatches	Total	Titmice	Nuthatches	Total
Observed number	0	17	17	11	0	11
Expected number	8.5	8.5	17	5.5	5.5	11
	$X^2 = 17$				$X^2 = 11$	
	$P = < .001$				$P = < .001$	

The null hypothesis can be rejected. The two species when in mixed flocks exhibited different foraging positions: velvet-fronted nuthatches foraged on the trunks and proximal parts of the branches whereas elegant titmice foraged on the distal portions of the branches. However, in the absence of titmice, the nuthatches also foraged on the distal parts of branches and even on the terminal twigs (four observations). Conversely, the elegant titmice were observed to venture into the proximal parts of branches and trunks in the absence of the nuthatches (two observations). By partitioning the feeding sites in trees, these two species apparently

[4] Jean Delacour and Ernst Mayr, **Birds of the Philippines** (New York: The Macmillan Co., 1st ed., 1946), p. 218.

[5] Delacour and Mayr, **op. cit.**, p. 220.

minimize or avoid competition. This is probably one reason for the co-existence of these species in mixed flocks.

It is interesting to note that at no time during the whole period of study was serious conflict, or actual combat, observed to occur between individuals of the two species. The closest to an aggressive behavior was that shown by titmice on Jan. 26 (Table 2) when they seemingly supplanted nuthatches which were foraging on the distal parts of branches. Except for that incident, both species appeared to avoid each other, perhaps by some visual mechanism. For example, velvet-fronted nuthatches on two occasions (Dec. 19, 1968 and Jan. 19, 1969, Table 2), were observed to lag behind for a few minutes as the group drifted towards a new direction. With almost all other members gone, the nuthatches could fully exploit the environment.

Another observation may be mentioned. On one occasion (Jan. 26, Table 2) titmice were observed to move from the underbrush, where they were feeding, to the distal parts of the tree, where nuthatches were foraging; thereupon both species flew off to separate trees about 10 feet apart. There each species foraged on all parts of the tree. The two sets of observation mentioned above indicate that the two species when present as members of a mixed flock may employ other means for maximum exploitation of available food resources, in addition to partitioning the feeding sites in any one tree.

Stomach Contents

Since the species tend to have non-overlapping feeding sites when both are present in mixed flocks, they may be expected to overlap in food habits. Unfortunately, our data on food habits are very inadequate. Only ten nuthatches and eight titmice were collected. About half of the nuthatches were taken while they were foraging with the titmice in mixed flocks; the remainder, while they were alone. Only two titmice were collected while they were with nuthatches, and six while foraging alone. Virtually all of the stomachs of these specimens contained similar kinds of food items, namely, small coleoptera and arachnids in varying proportions. Possibly, the birds share common animal food-items, but no definite conclusion can be made at this time because of the small size of the sample.

Discussion

The principle of competitive exclusion[6] postulates that species co-existing in an area must diverge in their niches to eliminate or reduce interspecific competition. Such divergence has apparently occurred in terms of foraging deployment in the case of the velvet-fronted nuthatch and the elegant titmice. These two species, which are unrelated taxonomically, exhibit some degrees of convergence in feeding movements. In mixed flocks containing both species, nuthatches forage on the trunks and proximal parts of branches while titmice forage on the distal parts of branches. This behavior is probably necessary because they take the same food items, but the evidence for this is very meager. Each of the two species appears to change its foraging deployment when alone in the mixed flocks: it ranges on all parts of the feeding trees. Apparently, these two species have evolved feeding relationships permitting them to exploit the environment maximally.

Table I. **Composition of Eleven Mixed Flocks of Birds Observed**

Species	No. of Flocks Containing Species	Total Number of Individuals Counted	Average Number of Individuals per Flock
Yellow White-eye	9	115	10.4
Velvet-fronted Nuthatch	9	22	2.0
Elegant Titmouse	7	14	1.3
Blue-headed Fantail	5	8	0.7
Yellow-backed Sunbird	4	5	0.4
Philippine Leaf Warbler	3	17	1.5
Citrine Canary Flycatcher	3	11	1.0
Verditer Flycatcher	3	5	0.4
Common Tailor Bird	3	3	0.3
Philippine Flower-Pecker	3	13	1.2
Orange-breasted Flowerpecker	1	8	0.7
Balicassiao	1	1	0.1

[6] G. Hardin, "The Competitive Exclusion Principle," **Science** (Vol. 131, pp. 1292-1297).

Table. 2. Observations on the Foraging Deployment of Velvet-fronted Nuthatches and Elegant Titmice when Together in Mixed Flocks

Date	Locality	No. of Nuthatches	Deployment	No. of Titmice	Deployment	Remarks
4 Oct '68	Hydroelectric area: 2,000-3,000' elevation	2	Trunk and proximal parts of boughs (lower half of tree)	2	Distal parts and twigs (lower half of tree)	Other species generally at the upperstory.
19 Dec. '68	Lake Balinsasayao: 3,500' elevation	3	" "	2	" "	Nuthatches fell behind group 2-3 minutes during which time they fed on all parts of tree.
19 Jan. '69	Cuernos de Negros: 2,000-3,500' elevation	4	" "	2	" "	Other species were generally at higher heights. A nuthatch fell behind group for a few minutes during which time it fed on all parts of tree.
26 Jan. '69	Cuernos de Negros: 2,000-3,500' elevation	2	" "	2	" "	Titmice fed on all parts of underbrush before transferring to distal parts of branches of tree where nuthatches were feeding; thereupon both species deployed to different trees 10 feet apart. Each species then exploited all parts of respective trees.
2 May '69	Mt. Katanglad, Bukidnon: 3,872' elevation	6	" "	3	" "	Other species generally at upperstory.