Blue-faced Parrot-Finch. *Erythrura trichroa sigillifera (Estrildidae)*. This finch was observed from 3000 ft to the summit of Mt. Talawe. It is widespread in the southwest Pacific but had been reported only once previously from New Britain (Thompson 1964).

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HIGH NEST DENSITY AND NON-RANDOM NEST PLACEMENT IN THE CEDAR WAXWING

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The nesting of the Cedar Waxwing (*Bombycilla cedrorum*) has been described as loosely colonial (Lack 1968) although isolated nests are regularly found. In July 1969, I found a group of nests that measurably extends our knowledge of the intensity of nest clumping or coloniality known for this species. Twenty nests were found in a 2.3-acre white pine (*Pinus strobus*) plantation in Cheboygan County, Michigan. Besides its high nest density, the situation was also noteworthy in that the nests showed a nonrandom distribution.

The plantation was rectangular in shape and measured 194 × 44 m. Nearly all the pines were between 3 and 7 m in height. They were planted in north-south rows and most trees in a row were contiguous. The rows were 2–5 m apart and many pines touched trees in adjacent rows. The plantation was bordered on the east and west by dry grassy fields some 80 m in width. Beyond the east field was a vegetable garden, and then some hayfields. Beyond the west field was a forest of large aspens (*Populus* sp.). This forest directly bordered the south side, but a dirt road ran east-west through the forest about 8 m from the plantation. To the north, the plantation was bordered by a large expanse of dry, sandy fields sparsely covered with grasses.

NEST DENSITY AND PLACEMENT

The entire plantation was searched on 5, 18, and 26 July. Intervening visits were made in order to check nests. I suspect that I missed additional nests, since cues such as scolding were not provided by the birds and high nests were difficult to see. Seventeen nests were located in crotches formed by a main trunk and a branch. Two nests were 0.5 and 1.5 m out from the trunk. The exact placement of the last nest is uncertain since it was found dangling from a branch. Young probably fledged from this nest, as it contained many pieces of feather sheathing. All other nests had eggs and/or young when found. Estimates of nest heights averaged 3.4 m and ranged from 1.7 to 6.1 m.

The total nest density was 8.7 nests per acre. But not all 20 nests were active at the same time. The minimum number of active nests at any one time was between 10 and 17 and probably at least 13. The minimum density of active nests was 4.4–7.4 nests per acre, and was probably at least 5.7. Some nests were quite close to each other. Pairs of nests definitely active at the same time were 9.7, 8.5 and 7.0 m apart. Two nests which may have been from a pair overlapping first and second nestings were 10.0 m apart. Putnam (1949) also noted occasional pairs of close nests, "in three cases not over 25 ft separated two nests." But it is not stated that these were active nests of different pairs.

The plantation described in this paper appears to have had the highest confirmed nesting density of Cedar Waxwings. High nest densities of waxwings in other studies are 27 nests in 28 acres (Messersmith 1963; using Messersmith's diagram, I find the size of his study area to be 38, not 28, acres), 21 nests in about 18 acres (Lea 1942), 14 nests in 5 acres (Young 1949), and 17 nests in about 16 acres (Saunders 1911). Only Young's study clearly stated what the maximum number of active nests was at any one time: eight nests (1.6 nests per acre), probably due to eight pairs. Harrington (in Bent 1950:84) noted a nest density of 11 in a radius of about 25 ft (about 0.16 acres) in a clump of white pines. Only four of the nests had eggs and none held young. A week later all of the nests were deserted. Thus, none was successful. It is possible that the number of pairs nesting in Harrington's pine clump was much below 11, since some pairs may have accounted for more than one nest. Conceivably, some or most of the nests were abandoned or had suffered predation by the time of Harrington's first visit.

Figure 1 shows the placement and status of each nest within the plantation at about the midpoint of this study. The placement of the nests can be analyzed statistically in the following manner. The plantation is split into quarters with east-west lines of

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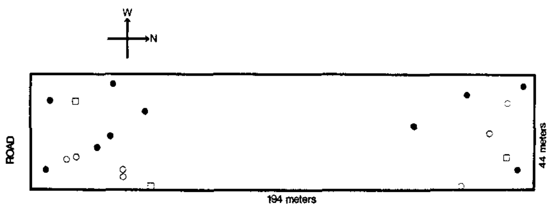

FIGURE 1. Location and status of 20 Cedar Waxwing nests in a 2.3-acre white pine plantation in July (filled circles, indicate active nests; open circles, possibly active; open squares, inactive).

division. To apply this analysis properly, not all nests can be used since there may be a tendency to carry out second breeding attempts near the first nest. The minimum number of pairs with nests at any one time was 10 (six in the south and four in the north quarter). The two inner quarters are next combined to produce a central half, and the two outer quarters a disjunct marginal half. The null hypothesis states that nests are distributed randomly between these two halves. The probability that 10 nests would occur in one half and none in the other on a random basis is $\leqslant 0.002$ (using a two-tailed application of the Binomial Test). There was thus a definite tendency to place nests at the ends of the plantation.

Messersmith (1963) also noted a tendency for nest placement near an edge in a red pine (*Pinus resinosa*) plantation. Thirty of the 100 nests of the Cedar Waxwing and seven other species were in roughly one ninth of the plantation along the eastern edge. He attributed this nest clumping to avoidance of certain parts of the plantation due to differential tree densities and to the proximity of water near the eastern edge. Applying the same type of analysis used in testing the distribution of nests in the plantation I studied shows that nests in Messersmith's plantation were significantly clumped near the eastern edge ($P < 0.001$).

DISCUSSION

Several factors may have combined to result in the high breeding density of waxwings that I observed. The pine plantation provided a huge number of sites for nest placement. Although real, this factor was probably the least important since this species will place its nest in a wide variety of foliage from small bushes to large trees and it is highly unlikely that nest sites are a limiting factor. The most important factor may have been related to the food supply in the immediate area. Breeding waxwings are known to fly long distances in feeding (Saunders 1911, Allen 1930), but one would certainly expect them to minimize their energy expenditure and nest near rich food sources if possible. The pines themselves did not appear to provide much food, but the adjacent fields and forest edges had an abundant supply of insects. More importantly, wild cherry trees (*Prunus* sp.) in the field to the north provided the greatest density of fruit that I saw in the region in 1969. The area around the plantation may have satisfied the food requirements of nesting waxwings extremely well because insect food is important in the first few days of nestling life, after which fruit becomes the major food (Putnam 1949).

The waxwings may have responded to an especially rich food source by nesting close to it, but they did not also respond by increasing their clutch size. Fifteen nests in the plantation had a mean clutch size of 4.27 eggs, and 35 nests in other localities in the same region in 1969 had a mean clutch size of 4.28 (SD, 0.72 and 0.83, respectively). These 35 nests appeared to be randomly placed in areas lacking obvious sources of food. Their dispersion ranged from isolated to small aggregations of up to about six nests.

The large number of breeding waxwings in the plantation may have made predator detection, confusion, and deterence more likely than at isolated nests. Dense pine plantations may also be areas that are rarely frequented by predators. Except for bird nests, there would seem to be little in a plantation of small pine trees to attract predators and it seems unlikely that predators would make a systematic effort to search several thousand trees. Nests were not watched after hatching occurred but all 11 nests that were not deserted were successful in reaching hatching. Ample comparative data on nesting success of waxwings in other localities in the region are lacking but the success rate (at least until hatching) of the plantation nests is suggestive of a reduced rate of predation.

The plantation was fairly homogeneous in structure and the few areas with higher or lower than average foliage density did not correlate with nest distribution. The nest clumping at the north and south ends may indicate a preference for maximizing the amount of edge or habitat discontinuity in the immediate nest area. It may be significant that the most central nests at the north and south sides were nearly the same distance in from the ends (48 and 47 m, respectively). Alternatively, the clumping might be due to the tendency of waxwings to nest near one another rather than near edges. Two pairs could have initially nested at opposite ends of the plantation with subsequent pairs placing their nests near one of the established nests. Both of these factors may have been operative but the latter would seem to be less important, since I have never observed such extreme nest clumping in waxwings nesting in habitats that had many discontinuities. On the other hand, my personal experience of many edge species has given the impression, albeit subjective, that nests are more likely to be placed near habitat discontinuities than deep within a habitat type. Selection on the Cedar Waxwing and other ecotone species might be expected to favor a preference for including habitat discontinuities near nests. This would make it probable that the nests are near suitable foraging habitat.

SUMMARY

The unusually high density of 20 Cedar Waxwing nests in a 2.3-acre plot (consisting entirely of a pine plantation) is described. The minimum number of nests active at any one time was 10–17. The plantation was probably highly suitable for waxwing nesting because the area around it contained a rich food supply. A strong clumping of nests near the ends of the plantation may represent a widespread tendency among many bird species to maximize the amount of habitat discontinuity in the immediate nest area.

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TONGUE STRUCTURE OF THE SUNBIRD *HYPOGRAMMA HYPOGRAMMICA*

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Hypogramma hypogrammica is an aberrantly-plumaged Malaysian sunbird usually allied to *Anthreptes* "on account of the straight keel of the lower mandible" (Shelley 1878) or *Nectarinia* on account of "its general coloration and apparently primitive nature" (Delacour 1944). In the most recent revision of the Nectariniidae, Rand (1967a) considered *Hypogramma* a monotypic genus which he placed between *Anthreptes* and *Nectarinia.*

Hypogramma hypogrammica is dull olive green in color, somewhat yellower below with bold streaking on most of the underparts, resembling in this respect certain *Arachnothera* (*A. juliae* for example) and certain female *Nectarinia* such as *N. johannae.* Iridescent coloration is restricted to males, which have a purple crescent on the nape and similar purple coloration on the lower back and upper tail coverts. Often concealed on study skins and rarely remarked upon are (in the male only) elongated tufts of white feathers at the base of the lower back. The pattern of metallic coloration, especially the nuchal patch, is unlike any other sunbird, although several species of *Anthreptes* have similar purple lower backs.

Because *Aethopyga-Arachnothera* sunbirds are easily distinguished from *Nectarinia* and *Anthreptes* by their tongue tip structure (Scharnke 1932; Delacour 1944), I wanted to examine the tongue of *Hypogramma* to establish its affinities with *Anthreptes-Nectarinia.* W. E. Lanyon kindly gave me permission to remove for examination the tongue from a skin of *Hypogramma hypogrammica intensior* (AMNH 685539) in the collections of the American Museum of Natural History.

The tongue of most sunbird species is for the major part of its length a closed tube formed by inward rolling and meeting of the edges (see cross sections in Skead 1967:28). The tongue tip is split and bitubular, but it lacks elaborate fimbriation. Virtually all species of sunbirds that have been examined have similar tongues; I have personally examined the tongues of 12 sunbird species in addition to those 23 species listed by Gardner (1925), Scharnke (1932), and Skead (1967). *Aethopyga* and *Arachnothera* differ from other sunbirds in having lateral splits at the tongue tip instead of a single median one; this separates a single, flat center piece from two lateral grooved structures (Scharnke 1932). The one important exception, *Anthreptes singalensis* (= *Chalcoparia phoenicotis*), has a flat tongue with a slight brush tip (Gardner 1925; pers. observ.); this was considered a significant enough departure from typical sunbirds to cause the species' removal from the family at one time (Scharnke 1932), but not permanently. The South African sugarbirds, *Promerops,* have semitubular, quadrifid, brush-tipped tongues which resemble honeyeater tongues in some aspects and those of sunbirds in others (Rand 1967b; Skead 1967).

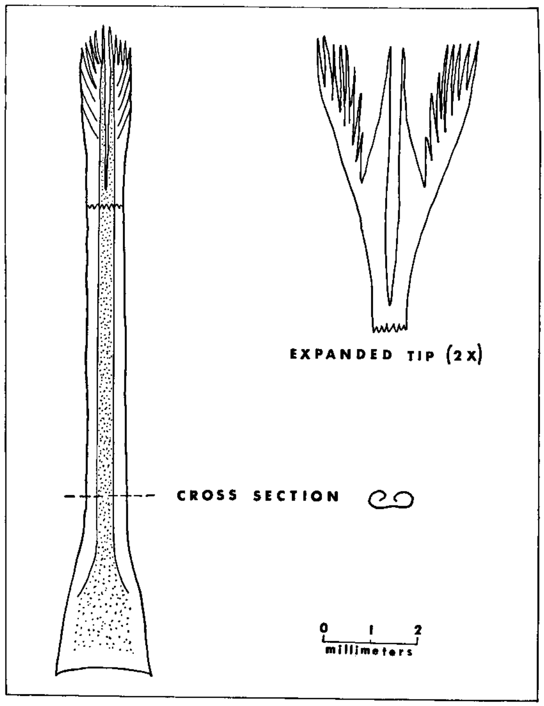

FIGURE 1. Tongue structure of *Hypogramma hypogrammica.*

The essential features of *Hypogramma*'s tongue structure are as follows (see fig. 1). a) The tongue is nontubular. The edges are curled inwards, form-