HOME RANGES AND SOCIAL BEHAVIOUR
OF THE DOWNY WOODPECKER *PICOIDES PUBESCENS*
IN WINTER

by

Erik MATTHYSEN(*), David CIMPRICH (**)
and Thomas C. GRUBB jr. (**)

(*) Department of Biology, University of Antwerp (UIA),
Universiteitsplein 1, B-2610 Wilrijk, Belgium
(**) Department of Zoology, Ohio State University,
Columbus, OH 43210, USA

SUMMARY

Few detailed studies have been performed on winter social behaviour of temperate-zone woodpeckers, in contrast to other resident forest birds. We collected information on individually colour-ringed Downy Woodpeckers (*Picoides pubescens*) in central Ohio, North America, during December 1989 and January 1990. Woodpeckers were generally seen with one or two conspecifics in the vicinity. Male-female associations were observed more often than expected by chance. Woodpeckers tended to space out individually within their sex class, but they tolerated members of the opposite sex. However, there were no signs of territorial defense or permanent pair bonds. Such loose social structure has not been documented in resident birds before. Our observations contradict earlier reports of individual territoriality in the Downy Woodpecker, while they are compatible with other studies on intersexual competition and niche divergence.

Key-words : Downy Woodpecker, *Picoides pubescens*, home range, territory, social coherence, pair bond.

INTRODUCTION

Resident forest birds have been the focus of a large number of studies on social behaviour in winter (*e.g.* MATTHYSEN, 1990, 1993). Several types of social structure have been described in detail, including mixed flocks, single-species flocks, and several territorial systems (see MATTHYSEN, 1993 for a review). Although woodpeckers (family Picidae) are a prominent component of most (if not all) forest communities, there are few detailed investigations on the social behaviour of non-communally breeding species (see CRAMP, 1985 for a review of European woodpeckers). The subject of this study is the Downy Woodpecker *Picoides pubescens* which is perhaps the most abundant North American woodpecker. Information on its social

organization is limited to descriptive studies based on few individuals (LAWRENCE, 1966 ; KILHAM, 1983). This species is of particular interest since studies on foraging behaviour have demonstrated that sexes separate into different foraging niches because of male dominance (GRUBB, 1982 ; PETERS and GRUBB, 1983 ; MATTHYSEN *et al.,* 1991). This view implies that male and female Downy Woodpeckers live in the same areas in winter, contradicting KILHAM's (1983) suggestion of individually defended territories. Individual territories (defended against all conspecifics of either sex) are found in many other temperate zone woodpeckers (*e.g.* BOCK, 1970 ; HOGSTAD, 1978 ; CRAMP, 1985). In an attempt to resolve this contradiction, as well as present general information on social behaviour of a temperate-zone wood-pecker, we collected data on individually marked Downy Woodpeckers in two central Ohio woodlots during the winter of 1989-1990.

STUDY AREA AND METHODS

The study was conducted in two Morrow County, Ohio woodlots (plot A = 21.1 ha, plot B = 8.8 ha) isolated from other woodlands by at least 125 m, except for one or two narrow fencerows containing shrubs and trees. The habitat consisted of deciduous woodland dominated by beech (*Fagus*) and maple (*Acer*) on uplands and by a more diverse community of oaks (*Quercus*), walnut (*Juglans*), sycamore (*Platanus*) and ash (*Fraxinus*) on lowland areas.

Between 7 and 12 December, woodpeckers were trapped at feeders and marked with coloured leg-streamers. The birds were sexed by plumage differences, but could not be aged. We recorded wing length (unflattened wing chord), tail length and body mass of each bird. The four feeders in plot A and five in plot B had been continually supplied with sunflower seeds and suet for three weeks before the trapping session. All supplementary food was removed after the last day of trapping.

Over the course of the next two months, we made 36 systematic searches of the plots for Downy Woodpeckers and other bark- foraging species between 15 December 1989 and 28 January 1990. Plots were visited on alternating days, and complete searches took 3-4 hours in plot A and 5-7 hours in plot B. During most searches we found over half of the Downy Woodpeckers present in the woodlot. For each Downy Woodpecker encountered, we recorded individual identity, location, presence of conspecifics and of other bark-foraging species. Sightings were located with reference to a 50 × 50 m grid of numbered poles. We considered observations on the same individual to be statistically independent if they were separated by at least 1 hour or 200 m. Most individuals were observed only once or twice on a given day.

An exceptional cold spell with daily maximum temperatures between − 20 and − 10 °C and continuous snow cover lasted from 15 to 24 December. No observations were made between 23 December and 8 January. Because of the possible effects of this cold spell, some of the January results will be discussed separately. In plot A, six males and seven females were marked and later observed, and we recorded four sightings of an unmarked female, probably the same individual. In

January, five marked males and four marked females were observed in this plot, plus a single observation of the unmarked female. Thus, the total population was estimated at 14 individuals in early December and 10 in January. In plot B, six males and 14 females were marked. Seventeen of these were observed later, and 16 in January. The number of unmarked individuals in this plot was estimated from the proportion of observations of unmarked birds (Petersen index), resulting in a total estimate of 28 woodpeckers in early December and 22 in January. Because of the difference in proportion of marked birds, data on home range overlap will be discussed separately for the two plots.

A woodpecker was considered to be in conspecific company if another woodpecker was present within 50 m. An association is defined as two woodpeckers within 50 m of one another. Observations of three or four woodpeckers within 50 m of each other therefore contained three and six associations, respectively. Aggression rates were expressed as the number of observed conflicts among Downy Woodpeckers divided by the number of associations in a particular category (e.g. male- male associations).

The extent of sociality between any two individuals was quantified using a coherence index (EKMAN, 1979),

$$\text{Coherence} = \frac{N_t}{N_t + N_a + N_b}$$

where N_t is the number of observed associations of individuals A and B, and N_a and N_b the number of observations of A and B in the absence of the other individual. Coherence could be underestimated if an individual disappeared during the observation period, but most individuals with observations sufficient to estimate coherence (see below) were observed throughout the study period.

We used the RANGES IV software (KENWARD, 1990) to calculate home range sizes from minimum convex polygons containing 100 %, 90 % and 75 % of the observations. The 90 % and 75 % polygons were calculated by excluding observations furthest from the arithmetic mean of all positions. This mean position was recalculated after each excluded position. Unless otherwise stated, home range sizes and overlaps refer to 90 % polygons. Home range overlap was calculated as the proportion of the combined range of two individuals that was shared. For each bird the most similar home range was defined as the home range it overlapped most with.

Coherence and home ranges were calculated for all individuals with at least five observations. These were all the marked birds observed in January (9 in plot A, 16 in plot B) with the exception of four marked females in plot B that were infrequently observed. We chose this rather low limit of five observations in order to extract the maximum possible information on social structure from our data. Only two of the included individuals were observed less than 10 times (2 females in plot B). Within our data set, home range size (100 %, 90 % and 75 % polygons) was not correlated with the number of observations (all r < 0.1 and P > 0.2). This

was true even if plots and sexes were separated (all $r < 0.4$, $P > 0.2$). Therefore home range sizes did not appear to be biased by number of observations.

RESULTS

Sociality

Downy Woodpeckers were found in conspecific company in 63.1 % of all observations ($N = 477$). Among all observations of at least two Downy Woodpeckers together ($N = 122$), observations on three or more birds were not infrequent (28 %). Associations of two birds ($N = 81$) were mainly male-female (75 %), a percentage that is significantly higher than the expected 50 % if birds with an even sex ratio had associated at random ($X^2_1 = 20.7$, $P < 0.001$). This test is conservative, since any deviation in the sex ratio would lower the expected frequency of male-female associations.

Coherence

Social coherence among Downy Woodpeckers was relatively weak. Only eight pairs of individuals had a coherence larger than 0.1, with a maximum of 0.25. Seven out of these eight pairs were male-female. Only two pairs had a coherence larger than 0.15 (plot A, M1-F1, total $N = 36$, $C = 0.24$; plot B, M2-F3, total $N = 16$, $C = 0.25$). Most woodpeckers were observed in association with three to seven different individuals during the course of the study.

Conflicts

We observed 30 conflicts or aggressive displays among a total of 196 associations. Most conflicts were limited to birds being displaced from a foraging site, or at most short- distance chases. We saw nothing resembling extended territorial border fights or intruders being chased out of a defended area. Conflicts between birds of the same sex ($15/66 = 23.7$ %5) were more frequent than those between birds of opposite sexes ($15/122 = 12.3$ %; $G_1 = 3.29$, $P < 0.01$). Most of the observed male-female conflicts were won by the male (10 wins, 3 losses, 2 unknown), but this asymmetry was not significant (binomial two-tailed test, $P = 0.09$).

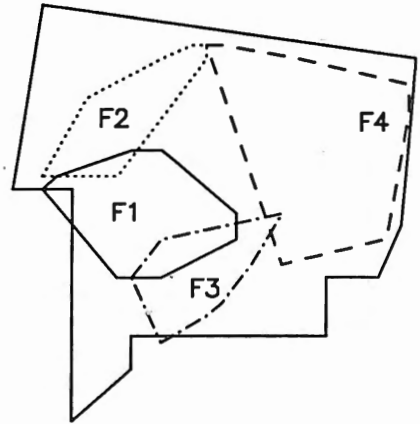### Home range size

Home range size did not vary between plots or sexes (two-way ANOVA on 100 %, 90 % and 75 % polygons, all $P > 0.1$; data in Table 1). Mean home range size was 6.9 ± 2.9 ha (S.D.) for the 100 % polygon, 5.0 ± 2.3 ha for the 90 % polygon and 3.3 ± 1.8 ha for the 75 % polygon ($N = 21$). We found no significant correlations between home range size (90 % polygons) and any morphological measurement (body mass, wing length, tail length; $N = 20$, all $r < 0.4$, $P > 0.1$), even when sexes were analyzed separately (all $r < 0.6$, $P > 0.1$).
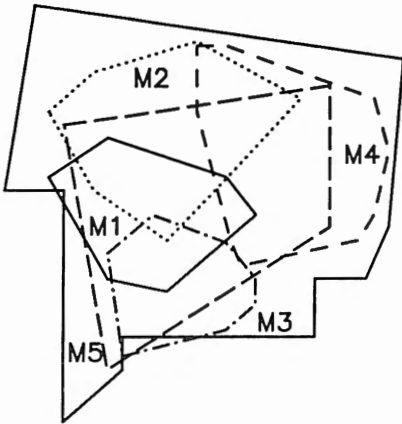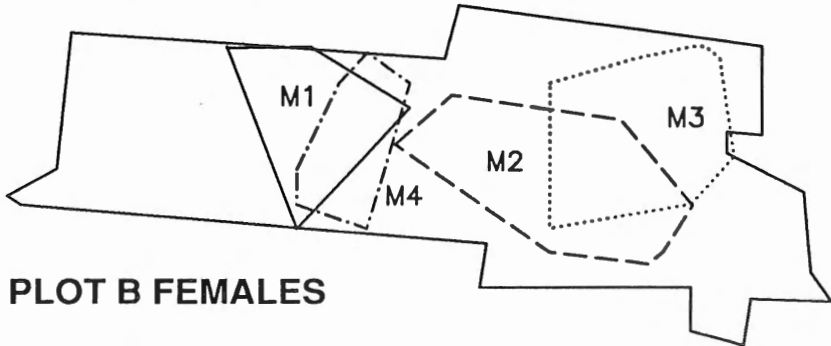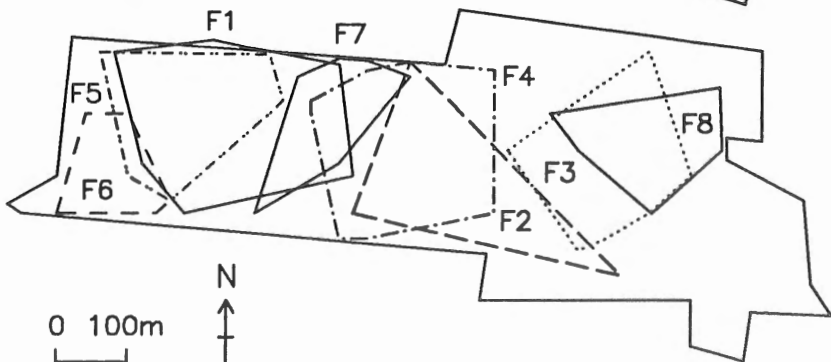
Fig. 1. — Home ranges (90 % polygons) of individually marked Downy Woodpeckers that were present throughout the study period. Not shown are four individuals that were observed fewer than five times each (all in plot B).

TABLE 1

Winter home range sizes (90 % polygons) and overlap with the most similar home range for Downy woodpeckers with at least five observations. Overlap is the percentage of their combined home range size that two individuals share, and the most similar home range is the one with the highest overlap. N = number of observations.

Individual	Home range size (ha)	N	Most similar home range	% overlap
Plot A :				
M1	4.3	31	F1	74
M2	6.0	19	M5	32
M3	3.5	24	F3	50
M4	6.8	26	F4	75
M5	10.7	14	M1	29
F1	3.6	23	M1	74
F2	2.1	16	M2	29
F3	2.2	19	M3	50
F4	6.5	21	M4	75
Plot B :				
M1	4.3	10	F7	45
M2	7.4	15	F3	36
M3	6.4	17	F3	59
M4	3.0	17	M1	35
F1	7.7	30	F5	48
F2	6.5	6	F4	47
F3	4.8	9	M3	59
F4	6.7	24	F2	47
F5	4.4	13	F1	48
F6	2.0	16	F5	9
F7	2.8	14	M1	45
F8	3.0	12	M3	47

Home range overlap

Mean overlap with the most similar home range was 48.6 ± 16.8 % (N = 21 ; range 9 to 75 % ; Table 1). In plot A, mean overlap with the most similar home range of the opposite sex was significantly greater than mean overlap with the most similar home range of the same sex (57 ± 21 % and 14 ± 14 %, Wilcoxon test, N = 9, z = 2.3, P = 0.02). With the exception of one individual with a relatively large home range (M5), home ranges in plot A can be arranged in four male-female pairs with large overlap within, but not between pairs (Fig. 1, Table 1). In plot B there was no difference between mean overlap with the most similar home range of

the opposite and the same sex (35 ± 18 % and 36 ± 13 %, Wilcoxon test, $N = 12$, $z = 1.6$, $P > 0.1$). There was no obvious pairwise arrangement of home ranges in plot B (Fig. 1, Table 1).

DISCUSSION

Downy Woodpeckers in our study population had relatively small home ranges (< 10 ha) in midwinter. We do not know to what extent they may have visited nearby woodlots, but since on most visits nearly all individuals were found, we believe most of the individuals resided mainly or exclusively in the study woodlots. Some additional individuals may have had a major part of their home range outside the plot and therefore have been observed infrequently. One marked female, for instance, was observed only a few times during the study but also found in an occasional visit to a woodlot near plot B. The disappearance of some individuals between early December and January could have been caused by mortality and/or emigration to other habitats associated with the unusually frigid temperatures in late December. Another possibility is that some individuals had been attracted by the supplementary food in late November and stayed for some time after the food was removed.

Downy Woodpeckers were often found in association with conspecifics (63 % of all observations). This sociality may have been the result of direct social attraction, but also a passive consequence of different individuals being attracted to the same mixed-species flock (SULLIVAN, 1984a,b). Two lines of evidence seem to suggest that Downy Woodpeckers tend to live in pairs. First, they were observed more often in male- female pairs than expected. Second, there was less aggression and more home range overlap (in one of the study plots) between members of different sexes. The lack of difference in home range overlap within and between sexes in plot B may have been due to the large number of unmarked individuals.

The high degree of association between sexes explains the widespread occurrence of sexual resource partitioning in this species, since this allows both sexes to forage together while reducing competition (PETERS and GRUBB, 1983). However, it is not clear why females did not avoid males to a larger extent, since in the absence of males they could shift to the preferred foraging niche (MATTHYSEN et al., 1991).

However, although the high frequency of male-female associations and the pairwise arrangement of male and female home ranges (in plot A only) are suggestive of winter pair bonds, these putative « pairs » do not behave as such. None of the possible male-female combinations were observed with any regularity, and there was no tendency for woodpeckers to associate with specific individuals of the opposite sex. The apparent similarity in home ranges of some males and females may have been due to a heterogeneous distribution of resources in the area or to topological constraints on positions or boundaries of home ranges. Alternatively, birds with similar home ranges may simply be former breeding partners still residing on the former breeding territory (MATTHYSEN, 1993). Out of nine

Downy Woodpeckers that were observed frequently in plot A, at least six had been present in the previous winter (CIMPRICH, pers. obs.). No such information is available for plot B. Woodpecker males and females living in the same part of the wood may well have been former mates, or future mates, but this is not clearly reflected in their behaviour.

The Downy Woodpeckers in our study area resembled most other temperate zone woodpeckers (with the exception of communal breeders, *e.g.* SHERRILL and CASE, 1980; STACEY and KOENIG, 1984) in lacking clear social bonds outside the breeding season. Our observations revealed high degrees of tolerance and home range overlap, especially between sexes, although birds did not behave as mated pairs. Other woodpecker species are often territorial individually or in pairs in winter (KILHAM, 1959, 1983; LAWRENCE, 1966; BOCK, 1970; HOGSTAD, 1978; CRAMP, 1985). Without presenting quantified support, Kilham (1983) suggested that most Downy Woodpeckers in New Hampshire defended individual winter territories, a description that is clearly at variance with our results. Climate, food availability and proportions of residents and migrants in the population may all cause between-population variation in social organization (DAVIES, 1976; PULLIAM and MILLIKAN, 1982; SMITH and VAN BUSKIRK, 1988; MATTHYSEN, 1990). The widespread occurrence of sexual niche partitioning in Downy Woodpecker populations (reviewed by PETERS and GRUBB, 1983) suggests that individual territoriality is probably uncommon in other populations of this species as well, since spatial separation in territories would remove the necessity for niche separation.

The loose social structure in this woodpecker population is quite unique among bird species. However, as Matthysen (1993) pointed out, such relatively unstructured social systems are much harder to describe in detail than obvious behaviours such as strict territoriality or highly coherent flocks. Many more bird populations on which little more is known than that individuals tend to live solitarily or in small groups, may in fact be organized in this fashion.

REFERENCES

BOCK, C.E. (1970) — The ecology and behavior of the Lewis woodpecker (*Asyndesmus lewis*). *Univ. Calif. Publ. Zool.,* **92** : 1-100.

CRAMP, S. (1985) — *Handbook of the birds of Europe, the Middle East and North Africa. Vol. 4 : Terns to Woodpeckers.* Oxford University Press, Oxford, U.K. (960 pp).

DAVIES, N.B. (1976) — Food, flocking and territorial behaviour of the Pied Wagtail (*Motacilla alba yarelli* Gould) in winter. *J. Anim. Ecol.,* **45** : 235-253.

EKMAN, J. (1979) — Coherence, composition and territories of winter social groups of the Willow Tit *Parus montanus* and the Crested Tit *P. cristatus. Ornis Scand.,* **10** : 56-68.

GRUBB, T.C.Jr. (1982) — Downy Woodpecker sexes select different cavity sites : an experiment using artificial snags. *Wilson Bull.,* **94** : 577-579.

HOGSTAD, O. (1978) — Sexual dimorphism in relation to winter foraging and territorial behaviour of the Three-toed Woodpecker *Picoides tridactylus* and three *Dendrocopos* species. *Ibis,* **120** : 198-203.

KENWARD, R. (1990) — *Ranges IV. Software for analysing animal location data.* Institute for Terrestrial Ecology, Wareham, U.K.

KILHAM, L. (1959). — Territorial behavior of wintering Red-headed Woodpeckers. *Wilson Bull.,* **70** : 347-358.

KILHAM, L. (1983) — *Life history studies of woodpeckers of Eastern North America.* Nuttall Ornithol. Club, Cambridge, Mass.

LAWRENCE, L. DE K. (1966) — *A comparative life-history study of four species of woodpeckers.* Ornithol. Monogr. 5, American Ornithologists' Union.

MATTHYSEN, E. (1990) — Nonbreeding social organization in *Parus.* In : *Current Ornithology Vol. 7.* POWER, D.M. (Ed.) Plenum Press, New York and London : 209-249.

MATTHYSEN, E. (1993) — Nonbreeding social organization in migratory and resident birds. In : *Current Ornithology Vol. 11.* POWER, D. M. (Ed.) Plenum Press, New York and London : 93- 141.

MATTHYSEN, E., T.C. GRUBB Jr. and D. CIMPRICH (1991) — Social control of sex-specific foraging behaviour in Downy Woodpeckers, *Picoides pubescens. Anim. Behav.,* **42** : 515-517.

PETERS, W.D. and T.C. GRUBB Jr. (1983) — An experimental analysis of sex-specific foraging in the Downy Woodpecker, *Picoides pubescens. Ecology,* **64** : 1437-1443.

PULLIAM, H.R. and G.C. MILLIKAN (1982) — Social organization in the nonreproductive season. In : *Avian Biology Vol. 6.* FARNER, D.S., J.R. KING and K.C. PARKES (Eds.) Academic Press, New York : 169-197.

SHERRILL, D.M. and V.M. CASE (1980) — Winter home ranges of four clans of the Red-cockaded Woodpecker in the Carolina Sandhills. *Wilson Bull.,* **92** : 369-375.

SMITH, D.C. and J. VAN BUSKIRK (1988) — Winter territoriality and flock cohesion in the black-capped chickadee *Parus atricapillus. Anim. Behav.,* **36** : 466-476.

STACEY, P.B. and W.D. KOENIG (1984) — Cooperative breeding in the Acorn Woodpecker. *Scientific American,* **251** : 114-121.

SULLIVAN, K.A. (1984a) — The advantages of social foraging in Downy Woodpeckers. *Anim. Behav.,* **32** : 16-22.

SULLIVAN, K.A. (1984b) — Information exploitation by Downy Woodpeckers in mixed species flocks. *Behaviour,* **91** : 294-311.

ACKNOWLEDGEMENTS