

Breeding habitats of Sparrowhawks (*Accipiter nisus*) and Goshawks (*A. gentilis*) in the Southern Alps

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Abstract — The breeding habitats of Goshawks and Sparrowhawks were studied at the level of the nest site, of the area close to the nest, and of the presumed home range. The general features of the home ranges of the two hawks coincided. In contrast, both the territories and the nest sites differed sharply: compared to the Sparrowhawk, the Goshawk preferred territories where trees were older, bigger, and spaced at wider distances, and where the shrub and tree cover was lower, and the grass cover was higher. These preferences may be related to the size difference, and to interference competition between the two hawks.

Introduction

The breeding habitats of European birds of prey that live in wooded environments have been described quantitatively in few instances, for Sparrowhawk (*Accipiter nisus*), Goshawk (*A. gentilis*), Common Buzzard (*Buteo buteo*) and Honey Buzzard (*Pernis apivorus*) in North and Central Europe (Hald-Mortesen 1974, Newton 1986, Kostrzewa 1987, Jedrzejewski *et al.* 1988), but no comparable information is available for Southern Europe. However the conservation concern for many raptors and their susceptibility to human impact call for detailed information on their habitat requirements. We investigated the breeding habitats of the Goshawk and Sparrowhawk, at the level of the nest site, of the presumed territory, and of the home range surrounding this territory.

Methods

Breeding of the two hawks was studied in the province of Trento, Central-Southern Alps, a 6300 km² area, 30% of which lies from 100 to 1000 m a.s.l., 50% from 1000 to 2000 m, and 20% above 2000 m. About half of the landscape is wooded, mainly with deciduous trees up to 1200 m, and mainly with conifers from 1200 to 1800 m. We located 9 nests of Sparrowhawks and 11 nests of Goshawks in this area from 1983 to 1986; the nests were found following the indications of local bird-watchers, game-wards of forest managers. All the nests considered were successful. For each nest, the habitat was studied at three scales:

- 1) Nest site, i.e. the nest and the nest tree. We measured: altitude a.s.l., nest height, tree circumference at breast height, total height of the tree, depth of the green layer of the canopy, depth of the dead layer of branches, tree species, ground slope and aspect.
- 2) Breeding territory, i.e. the small, strongly defended area around the nest, where little or no hunting occurs (Fischer 1983, Newton 1986). Five points were selected, one centered at the nest tree, and the other four at 50 m from the nest, along each compass direction. At each point, the nearest tree was chosen in the 4 quadrants (point center quarter method, Cottam *et al.* 1953); we took the same measurements as at the nest tree for each of these trees (except for altitude and nest height), and we recorder the distance of the tree from the central point, the cover by trees, by shrubs (from 3 to 0.5 m high), by grass (<0.5 m high) and by rocks, within 10 m from the point. The measures taken at the 4 trees around a point were averaged, and each territory was described by 5 sets of variable values.
- 3) Home range, i.e. the total area assumed to be used by the breeding pair. During breeding, Sparrowhawks hunt mostly within 1 km from their nest (Marquiss and Newton 1982). Detailed data on the home range of Goshawks were not available; in an area in the Southern Alps neighbouring Goshawk nests are spaced at an average distance of 5.7 km (Benussi and Perco 1984), and in a part of the Apennines their average distance was 3.6 km (Penteriani 1991).

We adopted a conventional, fixed home range radius of 1 km from the nest for the Sparrowhawk, and of 3 km for the Goshawk, and within these distances, the cover of the main biotope types, the area of altitudinal bands, and the directions of slope were measured on 1:25,000 scale maps.

The variables expressed in percentages were normalized by transformations before entry into the Discriminant Analysis.

Results

The nests of both species were widely scattered

throughout the study area, and no geographical segregation of the two hawks was apparent.

More than two thirds of the assumed home ranges of both hawks were wooded, mainly with conifers (Table 1): woods covered 48% of the area (36% conifer and 12% broadleaved) in the entire region we investigated, hence both hawks included in their ranges a greater share of land covered by conifers than expected by random. No significant difference emerged in the proportions of biotope types within the home ranges of the two hawks, except for "Pastures", which were more abundant in the Goshawk ranges; this difference was due to the wider range assumed for the Goshawk (3 km vs. 1

Table 1. Biotope types within the home ranges of the two hawks. Means (and ranges in parentheses). Significance of the differences tested by Mann-Whitney U test.

	PERCENTAGE OF ESTIMATED RANGES COVERED BY:							
	Conifer Woods	Broadleaved Woods	Shrubs	Pastures	Crops	Rocks	Water	Human Settlements
Sparrowhawk	62.8 (0-96.7)	8.1 (0-34.9)	4.8 (0-43.4)	4.3 (0-20.8)	15.3 (0-28.7)	.04 (0-0.3)	3.6 (0-21.2)	1.0 (0-0.6)
Goshawk	71.0 (59.6-81.8)	2.2 (0-7.0)	1.7 (0-16.5)	10.5 (2.3-27.4)	10.0 (0-24.4)	1.9 (0-9.8)	0.9 (0-3.0)	1.7 (0-4.7)
Significance	NS	NS	NS	P<0.05	NS	NS	NS	NS

Table 2. Characteristics of the territory and of the nest site of the two hawks. Significance of the differences tested by Mann-Whitney U test (* P<0.05, **P<0.001). Altitude in m a.s.l., all other linear measures in cm; slope cover in percentage.

	SPARROWHAWK		GOSHAWK		SIGNIFICANCE OF DIFFERENCE			
	territory	site	territory	site	between the two hawks at the level of:		between the site and the territory of:	
					territory	site	Sparrowhawk	Goshawk
Altitude		1125		1231		NS		
Nest height		1120		2243		***		
Tree spacing	330		488		***			
Trunk circumference	74	84	122	177	***	***	*	***
Tree height	1650	1948	2424	3262	***	***	P<0.05	***
Canopy depth	912	1061	1256	2112	***	***	NS	***
Depth of dead branches	345	498	210	217	*	*	NS	NS
Ground slope	33	26	48	48	***	**	NS	NS
Arboreal cover	63		55		**			
Shrub cover	9		11		NS			
Grass cover	18		46		**			
Rock cover	4		6		NS			

Table 3. Discriminant analysis of the territories and of the nest sites of the two hawks. Classification results are shown as percentage of predicted vs. actual categories. The standardized discriminant function coefficients are shown for the significant variables entered in the stepwise discriminant procedure.

	TERRITORY		NEST SITE	
	PREDICTED AS:		PREDICTED AS:	
	Goshawk	Sparrowhawk	Goshawk	Sparrowhawk
ACTUAL: Goshawk	83	17	92	8
Sparrowhawk	9	91	0	100
DISCRIMINANT FUNCTION COEFFICIENTS:	tree circumference	0.97	tree circumference	0.49
	height dead branches	-0.33	nest height	0.73
	slope	0.45	slope	0.67

Table 4. Percentage of trees within the territories of the two hawks, compared with the frequencies of trees used for the nests. The difference between frequencies was not significant between nest-trees and territories of the Sparrowhawk, while it was highly significant between nest-trees and territories of the Goshawk, between the nest-trees of the two species, and between their territories ($P < 0.001$, chi-square test, tree species with expected frequency < 5 grouped into one type for the test).

	<i>Picea excelsa</i>	<i>Abies alba</i>	<i>Larix decidua</i>	<i>Fagus sylvatica</i>	<i>Pinus silvestris and nigra</i>	Other species
Sparrowhawk						
territory	75	2	13	5	3	2
nest-tree	80	7	0	0	13	0
Goshawk						
territory	47	39	8	6	0	0
nest-tree	8	92	0	0	0	0

km), and to the consequent higher probability of including mountain pastures above tree level. No difference between the home ranges of the two hawks found on the directions of slope, or in the proportions of differing altitudinal belts.

Territories and nest sites of the two species differed significantly in all the characteristics measured, except altitude, shrub cover and rock cover (Table 2). Sparrowhawk and Goshawk were discriminated almost completely at the territory scale, and completely at the nest sites scale (Table 3), by a discriminating function with only three variables (for territories: trunk circumference, depth of dead branches, and slope; for nest sites: trunk circumference, nest height, and slope). The tree species differed both at the level of territory and of nest sites (Table 4).

Sparrowhawks showed no preference for any particular tree species within their territory for nesting, while Goshawks strongly selected *Abies alba*.

This preference was not attributable to size differences among the conifer species, because the *Abies alba* and *Picea excelsa* available were similar in size. It may therefore be due to a greater suitability of the structure of *Abies alba* as a support for the nest.

Both hawks selected larger trees for nest sites as compared to the trees available within their territories (Table 2), but Goshawks showed greater selectivity. This selectivity by the Goshawk within its territory was confirmed by Discriminant Analysis, applied to the trees used for nesting versus the trees available in the territories; trees used by Sparrowhawks as nest sites were not discriminated from those available on the basis of the variables of Table 2 (only 50% of the trees were correctly classified), while the trees used by Goshawks were discriminated from those available in the breeding territory (78% of the trees correctly classified).

Data from the forest management authority showed that the woods used by breeding Goshawks were

older (average 113 years, range 94 to 136) than those used by Sparrowhawks (average 66 years, range 50 to 96). All the Goshawk territories were within extended stands of continuous woodland, while 2 of the 9 Sparrowhawk territories were in disjunct patches of conifers (area 37 and 70 ha). Northern slope aspects were strongly preferred by both hawks for their territories and their nest sites. Goshawk nests tended to be placed further from human activity than Sparrowhawk nests: their respective average distances were 943 and 541 m from the nearest isolated house, 2170 and 943 m from the nearest village, 619 and 554 m from the nearest road open to traffic. However, none of these differences was significant (Mann-Whitney U test).

Discussion

In North America, where 3 *Accipiter* species coexist, each species breeds in woodlands of a different structure (Reynolds *et al.* 1982, Moore and Henny 1983); the Goshawk, the larger species, prefers more mature stands than the smaller species (*Accipiter striatus* and *A. cooperi*). The same preference of the Goshawk for more mature woods than those used by the Sparrowhawk also occurs in the Northern Europe (Hald-Mortensen 1974, Newton 1986), and seems a constant feature of the species' preferences. Goshawks strongly select larger trees within the territory (Speiser and Bosakowski 1987). Similar preferences were shown by the Goshawk in our study area.

Goshawks selected breeding territories with Northern aspect, both in our study area elsewhere (Reynolds *et al.* 1982, Speiser and Bosakowski 1987). The preferences for woods differing in tree-spacing (Table 2) confirm the preferences described by Newton (1986): in England and Scotland Sparrowhawks nest in woods with mean distance between trees up to 4 m, and Goshawks from 2.4 to 8 m. Other habitat characteristics were variable: ground slope was steep in our area and gentle in other regions, the preference for conifers over broadleaf trees was reversed elsewhere (Reynolds *et al.* 1982, Moore and Henny 1983, Speiser and Bosakowski 1987).

The woods used by Sparrowhawks for breeding were three times older in our study area than in England (Newton 1986), despite their similar tree spacing. The difference is explained by the slower growth of our mountain woods.

In our study area, the global features of the home ranges of the two hawks completely coincided, but territories and nest sites differed markedly: compared to the Sparrowhawk, the Goshawk preferred territories where trees were older, bigger, and spaced at wider distances, and where the shrub

and tree cover was lower, and the grass cover was higher. All these characteristics were strongly correlated, and hence only one of them sufficed to discriminate the two hawks in the Discriminant Analysis. These preferences may be related to the size difference, and to interference competition between the two Hawks, as suggested by Newton (1986): the bigger species prefers more mature woods, because it needs more open flight paths and because it is not restricted to thick canopies by predation pressure.

Riassunto — Si è descritto l'habitat riproduttivo dell'Astore e dello Sparviere a livello di sito di nidificazione, area circostante il nido e home range stimato. La struttura generale delle aree famigliari nelle due specie coincide. Peraltro i siti di nidificazione e le aree circostanti il nido differiscono nettamente. L'Astore seleziona territori caratterizzati da alberi grossi e vecchi, più ampiamente spazati e con maggiore sottobosco prativo. Queste preferenze di habitat sono interpretabili in base alla differenza di taglia e ad interazioni competitive fra le due specie.

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