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Selection of avian prey by breeding Sparrowhawks *Accipiter nisus* in southern Norway: The importance of size and foraging behaviour of prey

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Selection of avian prey by breeding Sparrowhawk *Accipiter nisus* males in southern Norway was studied by comparing the proportions of different bird groups among prey items collected at nests, with their proportions in the bird community, as estimated by point censuses. Birds weighing 51–80 g were most vulnerable to predation, while birds < 15 g or > 250 g were little preyed upon. Ground-foraging species were more vulnerable than tree- or bush-foraging species. In tree- or bush-foraging species, vulnerability increased with increasing prey weight.

1. Introduction

In most studies, small- and medium-sized birds have comprised more than 95% by numbers of the diet of the Sparrowhawk *Accipiter nisus* (Tinbergen 1946, Holstein 1950, Hagen 1952, Uttendörfer 1952, Newton 1978, Opdam 1978, Geer 1981, Newton & Marquiss 1982, Frimer 1989). Only in vole peak years in northern Europe, have mammals comprised up to about 20% of the total number of prey (Sulkava 1964).

The sexual size dimorphism enlarges the food niche of the Sparrowhawk (Tinbergen 1946, Holstein 1950, Sulkava 1964, van Beusekom 1972, Opdam 1975, Geer 1981, Newton & Marquiss 1982). This may be the main reason for the great extent of size dimorphism in this species, because bird-hunting raptors probably hunt most successfully within a limited prey size range (Newton 1979, Andersson & Norberg 1981). Despite this, studies have not shown that prey size, below an upper limit, is important in the prey selection of hunting Sparrowhawks. In Finland Pygmy Owls *Glaucidium passerinum* took more birds of medium weight (10–40 g), and less birds of "extreme" weights (<10 and >40 g), than expected from their proportions in the bird community (Kellomäki 1977).

Differences in habitat use, feeding regime, physique, appearance and behaviour may also affect the vulnerability of various prey species to Sparrowhawk attacks (Newton 1986). Especially habitat selection and foraging behaviour should influence the Sparrowhawk's chances of detecting, surprising and/or pursuing potential prey. By comparing the proportions of different bird species in the diet of breeding Sparrowhawks with their proportions in the bird community, both Tinbergen (1946) and Opdam (1978) found that birds foraging in scrub and dense foliage were least vulnerable to predation in the breeding season. Similarly, during winter time, birds using the outer portions of branches were more vulnerable to Pygmy Owl predation than birds using the inner parts or tree tops (Ekman 1986).

In addition to prey availability, preference for, or avoidance of, certain habitats or prey species may affect the diet of the Sparrowhawk. In the Netherlands, Sparrowhawks hunted more near human settlements than in poor forests (Tinbergen 1946, Opdam 1978). In Scotland, male Sparrowhawks used woodland, particularly broadleaved forests, more than open land when hunting, while female Sparrowhawks used open land more than woodland (Marquiss & Newton 1981, 1982).

The aim of the present study was to reveal any selection by male and/or female Sparrowhawks in relation to the size, foraging habitat and foraging behaviour of their avian prey.

2. Study area and methods

This study was conducted during 1983–1988 in southern Norway (58°43′N, 8°44′E). The study area covers about 250 km^2, and is situated 100–300 m a.s.l., 15–30 km inland from the coast, in the boreonemoral zone (Abrahamsen et al. 1977). The climate is suboceanic, and in winter snow covers the ground from December through April.

The study area is hilly and sharply undulating. It is dominated by forests, with a relatively strong infusion of lakes (10%) and bogs (5%). Less than 2% is agricultural land. The forests are characterized by a fine-grained mosaic of young, medium-aged and old coniferous, mixed and deciduous stands, with Scots pine *Pinus silvestris*, Norway spruce *Picea abies*, oak *Quercus* spp., aspen *Populus tremula* and birch *Betula* spp. as the dominant tree species.

Prey remains were collected from 15 Sparrowhawk breeding territories (Table 1). Most territories were visited every tenth day from early May to late August. In late June – early July, all nest sites were thoroughly searched, in order to collect as many prey as possible from early summer. In late August, when the hawks had left the nesting area, the thorough search was repeated. Early and late summer seasons were separated because Sparrowhawk females normally do not hunt during the period from egg-laying until the nestlings are half-grown (Holstein 1950, Newton 1986), which in my study area is in the first half of July. All prey remains from early summer were collected at plucking posts near the nests. In late summer, remains were collected both at plucking posts and from nests. A total of 1241 prey items were found in early summer and 1370 in late summer.

Birds were identified from flight or tail feathers (Newton & Marquiss 1982, Selås 1989a). Unidentified pipits *Anthus* sp. were classified as Tree Pipits *A. trivialis*, because Meadow Pipits *A. pratensis* rarely breed in my study area (Røstad 1981, Bengtson 1988). However, two Meadow Pipits were identified from prey remains collected in May. All unidentified leaf-warblers *Phylloscopus* sp. were classified as Willow Warblers *P. trochilus*, because Willow Warblers are very common in my study area, while Chiffchaff *P. collybita* and Wood Warbler *P. sibilatrix* are rare. Similarly, possible Marsh Tits *P. palustris* were classified as Willow Tits *Parus montanus*, because they are common in the area, while Marsh Tits are rare (Røstad 1981).

Table 1. Number of prey items collected in nests of Sparrowhawks and at plucking posts near nests, during the period 1983–88.

Breeding territory	Year 1983	1984	1986	1987	1988	Total
1	90	107	–	–	–	197
2	–	–	58	–	–	58
3	–	–	97	127	169	393
4	–	–	98	–	–	98
5	–	–	–	124	340	464
6	–	–	–	72	109	181
7	–	–	–	66	–	66
8	–	–	–	–	151	151
9	–	–	–	–	239	239
10	–	–	–	–	186	186
11	–	–	–	–	68	68
12	–	–	–	–	84	84
13	–	–	–	–	149	149
14	–	–	–	–	141	141
15	–	–	–	–	136	136
Total	90	107	253	389	1772	2611

Juvenile birds were recorded as nestlings when flight and tail feathers were less than three-quarters grown, and as fledglings when these feathers were more than three-quarter grown (Newton & Marquiss 1982). Grouse and wader chicks were recorded as nestlings.

I divided the bird species in the study area into 10 weight groups, according to their mean body weight as given by Haftorn (1971): (1) ≤ 10 g, (2) 11–15 g, (3) 16–20 g, (4) 21–25 g, (5) 26–50 g, (6) 51–80 g, (7) 81–120 g, (8) 121–250 g, (9) 251–500 g and (10) > 500 g. These intervals were selected in order to get at least one, and preferably three or four, common species in each weight group. Nestlings and fledglings were assigned the same weight group as adults. For calculations of the weight portion of each species in the diet of the Sparrowhawk, however, juveniles were assumed to weigh 80% of adults. The only exception was the Capercaillie *Tetrao urogallus*, where the mean weight of the chicks found was estimated to be 20% of the mean weight of adult females.

Each bird species was grouped as to belonging to either forest or open land, according to main foraging habitat, and to one of three different foraging behaviour categories; (1) tree- and bush-foraging, (2) ground-foraging, and (3) aerial-foraging. Habitat selection and foraging behaviour are based on Haftorn (1971), Røstad (1981), Solheim (1987) and my own observations.

The breeding density of passerines (except corvids) in a forested area of 495 km^2, overlapping my study area, was found to be 476 pairs per km^2 in 1979, based on point census (Røstad 1981). During the period 23 May – 21 June 1979, Røstad (1981) censused 212 systematically selected points (spaced 1–2 km apart) in a random order, and recorded a total of 2651 individuals of 69 bird species. In order to correct for interspecific differences in detectability and song activity, Røstad (1981) estimated a dominance value for each species, corresponding to the species' percentage of all breeding individuals in the bird community, from the formula $(100R_iS_i/E_i^2)/(\Sigma R_iS_i/E_i^2)$, where R_i = total number of censused individuals of species i, E_i = maximum distance from the observer to the censused individual of species i, and S_i = estimated song activity, based on Røstad's own experience. S_i was given the values 0.25, 0.5, 0.75 and 1.0, from high to low song activity.

To compare the relative abundances of different bird species or groups of species in the diet of the Sparrowhawk and in the bird community, I used Røstad's (1981) estimated dominance values. Among the recorded prey items, I found only five species not recorded by Røstad (1981); Meadow Pipit, Bluethroat *Luscinia svecica*, Mistle Thrush *Turdus viscivorus*, Greenfinch *Carduelis chloris* and Redpoll *C. flammea*. Because Meadow Pipit, Bluethroat and Redpoll have not been recorded breeding in my study area (Bengtson 1988), the individuals found as prey were probably taken during the spring migration. Mistle Thrush and Greenfinch, on the other hand, breed throughout the study area, although not commonly.

For prey species which were estimated to form > 0.1% of the bird community (Røstad 1981), a catch-supply-ratio (CSR; Opdam 1978) of adult birds was calculated by dividing the frequency of prey items in the Sparrowhawk's diet by the estimated dominance value (Røstad 1981). For each weight group, a CSR value was calculated by dividing the frequency of prey items (adult birds only) in the Sparrowhawk's diet by the sum of the estimated dominance values (Røstad 1981) of all birds in this weight group, whether they were found as prey or not.

3. Results

3.1. Diet composition

Birds comprised 97% by both prey number and weight. The remaining prey were voles, which are excluded from the present analysis. The frequency of different species among avian prey, and their estimated dominance values in the bird community (Røstad 1981), are given in Appendix 1.

Sixty species of birds were recorded as prey. The ten most common species made up 73% of the total avian prey number.

Mean weights of both adult and juvenile prey were 30 g in early summer. In late summer, mean weights of adult and juvenile prey were 31 and 27 g, respectively. Bird species of a mean adult weight less than 50 g, made up 81% of

Fig. 1. Proportions of birds belonging to four different weight groups in the diet of breeding Sparrowhawks, as percentages by numbers (A) and weight (B). Mean weights from Haftorn (1971). n = 2527 prey items.

avian prey by number and 49% by weight, while birds with adult weights ranging from 51 to 120 g constituted 19% by number and 48% by weight (Fig. 1). The Song Thrush *Turdus philomelos* was the most important prey, making up nearly one quarter of the total food by weight.

Approximately 70% of the avian prey were classified as adult birds. The weight distribution of adult birds did not differ significantly between prey items collected within or outside the area censused by Røstad (1981) ($\chi^2 = 12.98$, df = 8, P > 0.1). Neither did the weight distributions of adult birds differ significantly between prey from 1988, when most of the data were collected, and 1983-1987 ($\chi^2 = 7.35$, df = 8, P > 0.1), nor between early and late summer ($\chi^2 = 10.40$, df = 8, P > 0.1).

Of 55 prey species weighing 6–120 g, 37 accounted for more than 0.1% of the bird community recorded by Røstad (1981). These species made up 94% of the total number of adult bird prey. Among them, forest-foraging species made up 86%, both in early and late summer. The proportions of tree/bush-foraging and ground-foraging species were 33.6% and 65.5% in early summer, and 33.5% and 64.7% in late summer. Thus, the habitat and foraging mode of the prey were very similar in early and late summer.

There was no significant difference between early and late summer in the proportion of juveniles ($\chi^2 = 0.20$, df = 1, P > 0.1). However, the proportions of juveniles varied significantly between weight groups (Fig. 2; $\chi^2 = 55.1$, df = 9, P < 0.001). First, the juvenile proportion was lower in prey weighing 21–25 g, than in prey weighing 51–80 g (p < 0.05). Second, it was lower in prey weighing 26–50 g, than in prey weighing 6–25 g and 51–120 g, even if the Crossbill *Loxia curvirostra* (mean adult weight 41 g) and the Parrot Crossbill *L. pytyopsittacus* (mean adult weight 50 g), which normally breed in winter, were excluded (P < 0.05). This is, because very few juvenile Wrynecks *Jynx torquilla* (mean adult weight 38 g) were found. If this species is also excluded, there are no differences between prey weighing 26–50 g and the other weight groups (P > 0.1).

In those species weighing 6–120 g, which accounted for more than 0.1% of the bird community, there was a tendency towards an increasing proportion of juveniles among prey with increasing clutch size (Spearman rank correlation, $r_s = 0.32$, n = 37, P < 0.1). If Wryneck is excluded, the correlation is significant ($r_s = 0.38$, n = 36, P < 0.05). Mean clutch sizes are taken from Haftorn (1971).

3.2. Selection of adult prey

Birds weighing 16–120 g were caught more (CSR > 1), and birds weighing 5–15 g, and more than 120 g were caught less (CSR < 1) than expected from their proportions in the bird community (Bonferroni Z-test (Neu et al. 1974), P < 0.01). This was also the case when birds found in early and late summer were treated separately (Fig. 3).

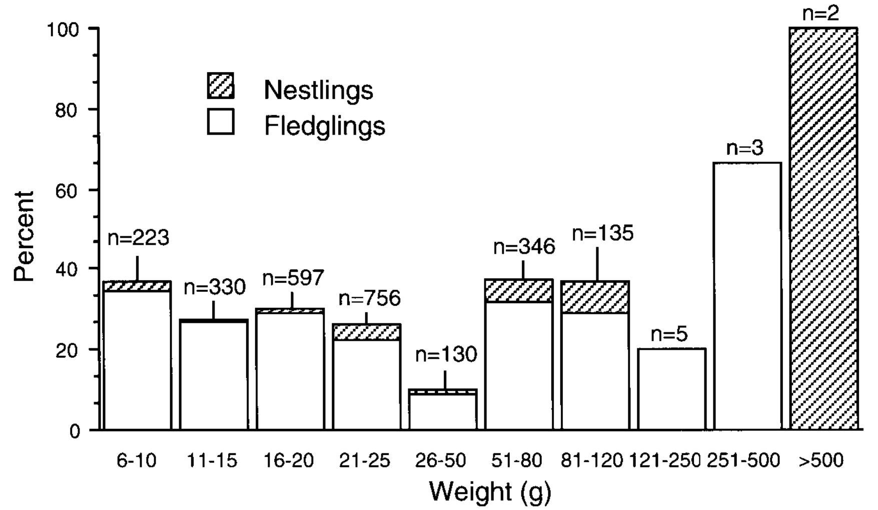

Fig. 2. Proportions of nestlings and fledglings in each of the ten weight groups of Sparrowhawk prey. Vertical lines are 95% confidence limits (omitted from three smallest samples). n = 2527 prey items.

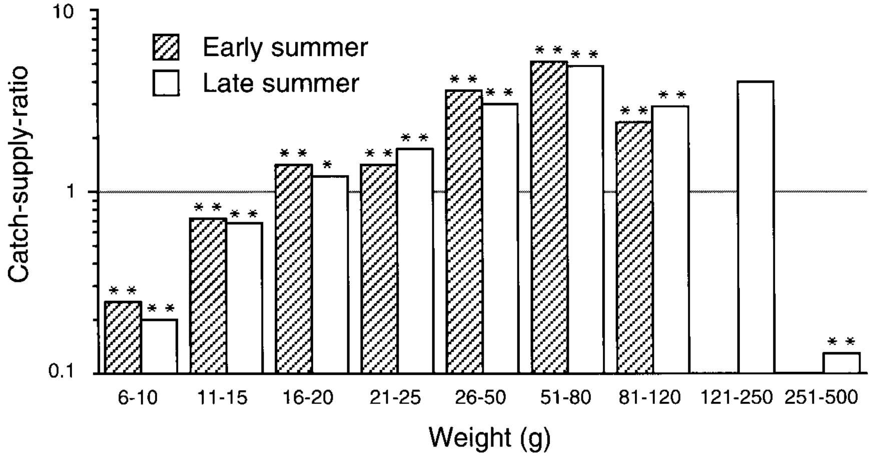

Fig. 3. Catch-supply-ratio (CSR; proportion in Sparrowhawk diet to proportion in bird community) of adult birds of different weight groups. CSR < 1 : caught less often than expected, CSR > 1 : caught more often than expected. Deviation from expected value (CSR = 1) tested by the Bonferroni-test (Neu et al. 1974). * : $P < 0.05$, ** : $P < 0.01$. n (early summer) = 844, n (late summer) = 932.

Among the 37 species weighing 6–120 g, which made up more than 0.1% of the bird community, the proportion of species caught more than expected did not differ significantly between forest and open land ($G = 0.76$, $df = 1$, $P > 0.1$), even if tree/bush- or aerial-foraging species were excluded. However, the proportion was significantly lower among tree/bush-foraging species than among ground-foraging species (Table 2; $G = 7.59$, $df = 1$, $P < 0.01$). Moreover, six of the seven tree/bush-foraging species caught more than expected are most common in deciduous forests (Røstad 1981). In contrast, most of the species mainly found in coniferous forests (Røstad 1981) were caught less than expected.

Among the same 37 species, the vulnerability increased with increasing prey weight ($r_s = 0.52$, $P < 0.01$). This was also true in species which mainly forage in trees and bushes ($r_s = 0.57$, $P < 0.05$), but not in species which mainly forage on the ground ($r_s = 0.09$, $P > 0.1$, Fig. 4).

4. Discussion

4.1. Biases due to the load size effect

Tinbergen (1946) found that large and small prey were brought to the nest by the Sparrowhawk in the same proportions as they were found among pluckings in the nest area. Furthermore, there were no observations indicating that prey caught far away from the nest were plucked outside the nest area more frequently than those caught near the nest (Tinbergen 1946). Tinbergen (1946) therefore concluded that samples of prey remains from the nest area would give a fairly good estimate of the Sparrowhawk's diet. However, for Kestrel *Falco tinnunculus* and Great Grey Shrike *Lanius excubitor*, Sonerud (1989) found that large prey were brought to the nest more frequently, and eaten at the capture site less frequently, than small ones. In contrast, Newton & Marquiss (1982) found more larger and fewer smaller items at Sparrowhawk plucking posts away from nests, than in the nest areas. This could, however, be due to the larger proportion of hunting females, which take larger prey than males, in the non-breeding part of the population. Because the

Table 2. Catch-supply-ratio (CSR) of adult birds, in species, which made up more than 0.1% of the bird community (Røstad 1981). The CSR values reflect the vulnerability to predation. – – – = very low vulnerability (CSR=0-0.5), – = low vulnerability (CSR=0.5-1.0), + = high vulnerability (CSR = 1.0–2.0), ++ = very high vulnerability (CSR > 2.0). The mean weight (g), taken from Haftorn (1971), is given in parentheses. Scientific names of the bird species are given in Appendix 1.

Habitat	Tree/bush-foraging species		Ground-foraging species		Aerial-foraging species	
Forest						
	Goldcrest (6)	– –	Robin (18)	++		
	Willow Warbler (9)	– –	Dunnock (20)	– –		
	Treecreeper (10)	– –	Tree Pipit (22)	+		
	Coal Tit (10)	– –	Chaffinch (23)	+		
	Crested Tit (11)	– –	Brambling (24)	+		
	Blue Tit (11)	+	Wryneck (38)	++		
	Willow Tit (12)	–	Redwing (68)	++		
	Siskin(13)	+	Song Thrush (75)	++		
	Pied Flycatcher (14)	–	Blackbird (100)	++		
	Spotted Flycatcher (16)	– –				
	Redstart (16)	– –				
	Great Tit (18)	+				
	Blackcap (20)	+				
	Garden Warbler (21)	+				
	Nuthatch (23)	++				
	Bullfinch (32)	– –				
	Great Spotted Wooodpecker (90)	+				
Open land						
	Lesser Whitethroat (12)	–	Whinchat (18)	++	House Martin (16)	+
	Whitethroat (15)	+	Pied Wagtail (21)	++	Swallow (20)	++
			Yellowhammer (31)	– –	Swift (40)	–
			Common Sandpiper (60)	+		
			Starling (80)	+		
			Fieldfare (107)	++		

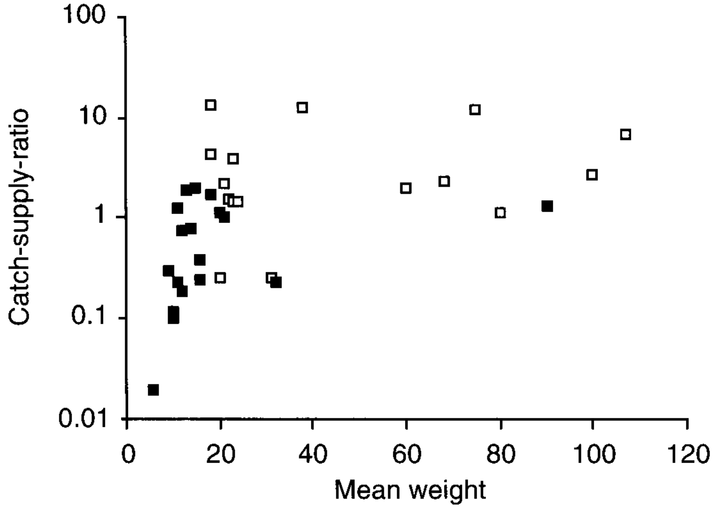

Fig. 4. Relationship between catch-supply-ratio and mean weight of adult birds, in species, which made up more than 0.1% of the bird community (Røstad 1981). Solid squares: tree/bush-foraging species, open squares: ground-foraging species. Mean weights from Haftorn (1971).

Sparrowhawk often delivers partly plucked birds, even of small species (Newton 1978, own observations), the effect of different strategies of allocation for different sizes of prey (load size effect) probably has minor significance.

To test this, I checked whether increasing vulnerability from small (6–10 g) to medium sized (51–80 g) prey could be caused by selective transport of large prey and consumption of small prey at the capture site. By use of mean weight of prey from each weight group, I estimated the weight of the birds of each of the five first weight groups (6–50 g) needed to make the CSR value for the six first weight groups (6–80 g) equal. I assumed that all birds eaten by the hunting hawk were plucked outside the nest area, and that this amount was 35% of the total bird biomass captured in early summer (a maximum estimate based on data given by Newton (1986)). I found that even this consumption would not make up more than 25% of the biomass of the first five weight groups needed to efface the difference in CSR value in the six first weight groups. Thus, the load-size effect cannot wholly explain the pattern of increased predation with increasing prey weight from small to medium sized birds.

In late summer, the proportion of prey eaten by the hunting hawks will be less than in early summer, because of the increasing food requirements of the young. Thus, any load-size effect would be less important in late than in early summer. Hence, the proportion of small prey would be less underestimated in late than in early summer. On the other hand, juveniles of early breeding prey, especially small, fast-growing species, may have been counted as adults in the samples from late summer. If so, the CSR values will be too high for small species in late summer. These two opposing effects may be one reason why no differences in prey size from early to late summer were found.

During nest building, some prey could be brought to the nest area by the female, but these will most certainly constitute less than 5% of the total prey biomass in early summer (Holstein 1950). In late summer, both mates usually hunt and bring prey to the nest (Newton 1978, Geer 1981). This should result in an increase in prey size from early to late summer, because the female takes larger prey than the male (Newton & Marquiss 1982). However, one of three female Sparrowhawks in Scotland did not hunt late in the breeding season, probably because the male's prey delivery rate was high enough to meet the requirements throughout the nestling period (Newton 1978).

Use of dominance values of different bird species, as estimated by Røstad (1981), may have influenced the results in the present study. The values give the number of territorial pairs, and do not take into consideration adult, non-territorial individuals. In addition, some dominance values may have been too high or too low, because of the correcting factors used. Moreover, the time lag between the bird census and the prey collections (4–9 years) may introduce some bias, since some species may have increased or decreased during this period, and because the number of small birds may fluctuate from year to year (Svensson 1981, Solheim 1987).

4.2. Selection of prey by size

There are some agreements in CSR values between the present study and Opdam's (1978) study. Of 27 common species weighing 6–120 g, ten (37.0%) are in the same CSR group (classification as in Table 2), while eight species (29.6%) are one step higher or lower in the present study than in that of Opdam (1978). The most striking difference is the higher vulnerability of thrush-sized birds in the present study. Also, the *Sylvia*-species, which are usually found in scrubs or dense foliage, seem to be more vulnerable in my area. Here, only Dunnock *Prunella modularis* might have received a low CSR value due to its secretive habits (Solheim 1987).

According to Holstein (1950) and Sulkava (1964), the regular maximum prey size for a Sparrowhawk male is 75–80 g. Newton & Marquiss (1982), on the other hand, showed that males (mean weight 150 g) regularly took prey up to about 120 g, and they found it likely that both males and females might occasionally kill prey two to three times their own weight. Tinbergen (1946) claimed that Jays *Garrulus glandarius* (mean weight 160 g) could be taken by male Sparrowhawks, and G. A. Sonerud (pers. comm.) observed a Sparrowhawk male attempting to take a breeding female Tengmalm's Owl *Aegolius funereus* (mean weight 165–170 g (Mikkola 1983)).

Opdam (1978) stated that the Sparrowhawk male is too small to successfully hunt thrush-sized birds (51–120 g), and that the optimal prey is sparrow-sized birds (26–50 g). This is not supported by my results. The use of weight groups makes bias, linked to the estimated dominance values or to the time lag between the bird census and the prey collections, of less significance. Even if the high CSR value I found for birds weighing 51–80 g may be overestimated, due to the load-size effect, these birds were certainly hunted more than expected based on their presence in the area. It is reasonable that, within limits, the net energy gain of a prey should increase with increasing prey size (see Ekman 1986).

4.3. Selection of prey by foraging site and habitat

Much of the difference between ground-foraging and tree/bush-foraging species was due to the low CSR values for species of tiny tree/bush-foraging birds. However, the difference also existed over the range of weights that included both types (18–100 g). One reason could be that ground-foraging species have difficulty in detecting hunting Sparrowhawks, which take most of their prey by surprise (Newton 1986). In addition, ground-foraging birds are further from cover than birds foraging in trees and bushes. The most common escape tactic in small passerines is to seek dense woody vegetation or open air when attacked by *Accipiter* hawks (Newton 1986, Lima 1993).

The Wryneck is a ground-foraging species, which was particularly vulnerable (CSR = 12.7). The unusually high number of adults to juveniles in the diet of the Sparrowhawk also indicate that adult Wrynecks are subject to a heavy predation pressure. In addition, among species weighing less than 50 g, the Wryneck is the one most frequently taken by the Goshawk *Accipiter gentilis* in the study area (Selås 1989b).

In Scotland, male Sparrowhawks were found to hunt more in woodland than in open land (Marquiss & Newton 1981). However, in the present study most prey species inhabiting open land had high CSR values, and the vulnerability of these species did not differ from those living in the forest. The fine-grained mosaic of the study area could be a factor; each patch of open land is so small that hunting Sparrowhawk males do not avoid them. Among prey species found in open land, the vulnerability was especially low only for the Yellowhammer *Emberiza citrinella*. This was possibly due to a decline in the population of this species during the period from the bird census to my prey collection (Bengtson 1988), resulting in an overestimation of its dominance value.

The tendency for higher CSR values for species inhabiting deciduous forests, than for those inhabiting coniferous forest, indicates that hunting Sparrowhawk males use deciduous forest more than coniferous, as shown by Marquiss & Newton (1981). Higher hunting activity near human settlements, than in poor forests (Tinbergen 1946, Opdam 1978), could explain the relative high CSR values of the Swift *Apus apus*, House Martin *Delichon urbica,* and Swallow *Hirundo rustica,* in the present study. Overall prey availability is probably higher near human settlements and in deciduous forests, than in coniferous forests (Nilsson 1979, Røstad 1981).

The results of my study should be interpreted with caution, because of potential errors caused by the estimate of relative prey abundance that has been used. To test the general validity of the results of the present study, similar analyses, based on better quantitative bird censuses, should be carried out.

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Selostus: **Saaliin koon ja ruokailutavan vaikutus varpushaukkojen saalistukseen**

Etelä-Norjassa kerättiin varpushaukkojen pesiltä määritettiin vuosina 1983–1988 yhteensä 2611 saaliseläintä. Saaliiden runsautta pesällä verrattiin niiden runsauteen luonnossa. Kaikkein helpoimmin varpushaukkakoiraiden saaliiksi joutuivat 51–80 g:n painoiset linnut. Alle 15 g:n ja yli 250 g:n painoiset linnut esiintyivät varpushaukan saaliissa harvemmin kuin niiden runsaus ympäristössä edellytti. Maasta ravintonsa hakevat linnut joutuivat helpommin saaliiksi kuin puissa tai pensaissa ruokailevat. Painavat puista ja pensaista ravintonsa hakevat lajit joutuivat helpommin saaliiksi kuin kevyet.

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Appendix 1. Proportions of bird species in the diet of the Sparrowhawk (D) and in the bird community (C), as percentages of numbers and weight. The relative abundances in the bird community are estimated from point census (Røstad 1981), and refer to adult birds only.

	Percent by number		Percent by weight	
	D	C	D	C
Capercaillie *Tetrao urogallus*	0.08	0.02	1.05	1.63
Hazel Grouse *Bonasa bonasia*	0.04	0.002	0.39	0.03
Woodcock *Scolopax rusticola*	0.04	0.23	0.33	2.93
Common Sandpiper *Actitis hypoleucos*	0.47	0.23	0.89	0.57
Woodpigeon *Columba palumbus*	0.04	0.23	0.65	4.67
Cuckoo *Cuculus canorus*	0.08	0.02	0.26	0.09
Swift *Apus apus*	0.12	0.23	0.16	0.38
Great Spotted Woodpecker *Dendrocopos major*	0.75	0.73	2.21	2.67
Lesser Spotted Woodpecker *D. minor*	0.08	0.002	0.06	0.002
Wryneck *Jynx torquilla*	2.18	0.23	2.73	0.36
Swallow *Hirundo rustica*	0.55	0.23	0.36	0.19
House Martin *Delichon urbica*	0.28	0.23	0.15	0.15
Tree Pipit *Anthus trivialis*	10.57	7.3	7.37	6.58
MeadowPipit *A.pratensis*	0.08	–	0.05	–
Yellow Wagtail *Motacilla flava*	0.04	0.0007	0.02	0.001
Pied Wagtail *M. alba*	5.54	2.31	3.61	1.99
Wren *Troglodytest roglodytes*	0.04	0.002	0.01	0.001
Dipper *Cinclus cinclus*	0.16	0.01	0.31	0.03
Dunnock *Prunella modularis*	1.66	7.3	1.06	5.98
Robin *Erithacus rubecula*	9.81	2.31	5.57	0.83
Bluethroat *Luscinia svecica*	0.04	–	0.03	–
Redstart *Phoenicurus phoenicurus*	0.59	2.31	0.30	1.51
Whinchat *Saxicola rubetra*	2.49	0.23	1.46	0.17
Wheatear *Oenanthe oenanthe*	0.28	0.002	0.22	0.002
Fieldfare *Turdus pilaris*	1.86	0.23	6.11	1.01
Blackbird *T. merula*	2.45	0.73	7.51	2.99

	Percent by number		Percent by weight	
	D	C	D	C
Song Thrush *T. philomelos*	10.41	0.73	24.04	2.24
Redwing *T. iliacus*	1.94	0.73	4.06	2.03
Mistle Thrush *T. viscivorus*	0.20	–	0.70	–
Icterine Warbler *Hippolais icterina*	0.04	0.01	0.02	0.005
Blackcap *Sylvia atricapilla*	0.63	0.73	0.42	0.60
Garden Warbler *S. borin*	1.90	2.31	1.30	1.99
Whitethroat *S. communis*	0.32	0.23	0.16	0.14
Lesser Whitethroat *S. curruca*	0.20	0.23	0.07	0.11
Willow Warbler *Phylloscopus trochilus*	8.03	23.1	2.23	8.52
Goldcrest *Regulus regulus*	0.08	7.3	0.02	1.79
Spotted Flycatcher *Muscicapa striata*	1.11	2.31	0.54	1.51
Pied Flycatcher *Ficedula hypoleuca*	5.98	7.3	2.61	4.19
Long-tailed Tit *Aegithalos caudatus*	0.16	0.01	0.04	0.003
Great Tit *Parus major*	5.50	2.31	2.98	1.70
Blue Tit *P. caeruleus*	1.19	0.73	0.40	0.33
Coal Tit *P. ater*	0.24	2.31	0.08	0.95
Crested Tit *P. cristatus*	0.12	0.73	0.04	0.33
Willow Tit *P. montanus*	1.35	7.3	0.51	3.59
Nuthatch *Sitta europaea*	0.75	0.23	0.56	0.22
Treecreeper *Certhia familiaris*	0.28	2.31	0.08	0.95
Red-backed Shrike *Lanius collurio*	0.79	0.01	0.80	0.01
Jay *Garrulus glandarius*	0.20	0.07	1.02	0.46
Starling *Sturnus vulgaris*	0.71	0.73	1.84	2.39
House Sparrow *Passer domesticus*	0.24	0.07	0.24	0.09
Chaffinch *Fringilla coelebs*	10.53	7.3	7.65	6.88
Brambling *F. montifringilla*	0.28	0.23	0.22	0.23
Bullfinch *Pyrrhula pyrrhula*	0.12	0.73	0.13	0.96
Greenfinch *Carduelis chloris*	0.08	–	0.06	–
Siskin *C. spinus*	3.84	2.31	1.61	1.23
Redpoll *C. flammea*	0.04	–	0.02	–
Crossbill *Loxia curvirostra*	1.15	0.02	1.56	0.03
Parrot Crossbill *L. pytyopsittacus*	0.28	0.02	0.47	0.04
Yellowhammer *Emberiza citrinella*	0.20	0.73	0.19	0.93
Reed Bunting *E. schoeniclus*	0.83	0.07	0.47	0.05
Total number of bird prey	2527			