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THE FOOD SPECTRUM OF SPARROWHAWK (*Accipiter nisus* L.) AND KESTREL (*Falco tinnunculus* L.) IN THE CHŘIBY UPLAND, THE CZECH REPUBLIC

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Abstract

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In 2006–2008, mapping the sparrowhawk (*Accipiter nisus* L.) and kestrel (*Falco tinnunculus* L.) occurred in the SE part of the Chřiby Upland. At the same time, the food spectrum of these birds of prey was determined during nesting periods. The area under monitoring represented about 25–30 km^2.
In each of the species, food was always monitored in a period from February to July at four nesting localities. The food spectrum was analysed by the direct observation of birds of prey, according to leftovers of food in the surroundings of nests and in nests of the predators. In *Accipiter nisus*, the food spectrum consisted of birds (85%), mammals (3%) and other animals (12%). *Turdus merula* was the most frequent prey. In *Falco tinnunculus*, the food spectrum consisted of birds (18%), mammals (76%) and other animals (6%). *Microtus arvalis* was unambiguously the most frequent prey.

Accipiter nisus, *Falco tinnunculus*, food spectrum

This paper deals with the food spectrum of two bird of prey species living in the hilly agricultural-forest country of the Chřiby Upland, namely sparrowhawk (*Accipiter nisus* L.) and kestrel (*Falco tinnunculus* L.). Both predators are virtually of the same size but differ in their nesting bionomy and food. In recent years, populations of both species show stabilized and slightly increasing character in the CR after declines in the eighties. Nevertheless, detailed findings on the food spectrum are virtually insufficient. Literature sources on the food ecology of these predators are rather obsolete (particularly as for sparrowhawk). Farský (1928) and Sládek (1963) dealt with the food of sparrowhawk and kestrel in our country.

MATERIALS AND METHODS

The food composition of feathered birds of prey can be determined by various methods (Mlíkovský, 1998). Since the studied nesting localities were known very well the method of direct monitoring could be used. Particular nesting localities were monitored in regular intervals. The monitoring was always carried out in sufficient distance and safe hiding place for birds not to be disturbed in no way. Conventional binoculars were used for monitoring. Although it is possible to determine some types of prey very well as well as what the predator subsequently does with the prey, this method is considerably time-consuming and includes always only certain part of the food spectrum and in many cases even not quite exactly. Therefore, analyses of leftovers of prey were particularly used. Not-swallowed leftovers of prey were determined in the period of nesting right in nests, in places of the regular processing of food, such as tear-off stumps in sparrowhawks, places under trees in kestrels, where the prey is swallowed or at least partly processed. Food residues were collected and subsequently determined with a certain periodicity. Easily detectable residues of prey were determined and recorded right in place; hardly identifiable residues were examined in detail. The type of prey was determined according to a key or the own collection of feather established already in previous years and including feather of our most common birds. In kestrel, the food spectrum was examined rather limitedly because of the considerable demandingness of the prey type determination. Kestrel feeds on small mammals (about 95%), which can be largely determined from remaining bones (ie mainly according

to jaws with teeth). A considerable disadvantage of obtaining food residues in the vicinity of a nest consists in a fact that remainders of bones, feather and bowels are very attractive for other meat-eating species of animals. The determination of food came about in 2006–2008 always from February to July. To obtain food residues, which occurred in a nest or on the nest plateau (thereinafter only nest) it was necessary to get to the nest. As for the sparrowhawk, a picker set for the collection of seed or mountaineering equipment was used for this purpose. As for kestrel, it was possible to reach its nest mostly without using a special climbing equipment (in the most difficult cases a ladder was used). Climbing to the bird nest was carried out only twice throughout the nesting period because of considerable demandingness and necessary calm for birds. The first inspection of a nest was carried out roughly in the half of time of incubation, which is about the 15th day after the start of incubation. The concrete time of hatching the chicks was determined visually by means of binoculars. When the chicks were roughly 15 days old, which is about half of a time spent by chicks on a nest, the second climb was realized and the number of chicks in the nest was determined. The age of chicks was determined by qualified estimation in relation to the determined facts concerning the factual time of hatching the chicks.

DESCRIPTION OF LOCALITIES

Particular localities are described only by capital letters of alphabets because of certain protection from potential risks, eg robbing the nests. The staff of the Buchlovice Forest District, where the research was carried out, also required describing names of particular localities in this way. The studied area occurs in the SE part of the Chřiby Upland. Particular localities are situated in border stands of the whole upland forest complex. A national road of the 1st class E 50 goes through the area dividing it to two halves.

The description of localities of *Accipiter nisus*

Locality A: A nesting locality occurring at the edge of the Holý kopec nature reserve. The sparrowhawk nests occur within a distance of 200 m of the road E 50. It refers to about a 40-year mixed stand. In all cases, nests occurred on a larch, the proportion of which was rather high in the stand.

Locality B: This nesting locality occurred also in the vicinity of the road E 50 but somewhat closer to Buchlovice. The mixed stand is aged about 70 years and thus, the height of nests corresponds also to this age.

Locality C: This nesting locality occurs at the edge of the Smraďavka recreation region in the complex of a spruce monoculture aged about 60 years.

Locality D: The most interesting locality occurring in the garden of the State castle of Buchlovice. The locality is exceptional both from the aspect of the number of visitors as well as the species composition of trees offering the ideal hunting environment for sparrowhawk.

The description of localities of *Falco tinnuculus*

Locality A1: A nest occurring in the recess of the Buchlov castle wall. The locality is surrounded particularly by forest complexes and wooded meadows.

Locality B1: A nest at this locality is placed in the tower of the St. Martin church in Buchlovice. The church is situated almost in the centre of the village.

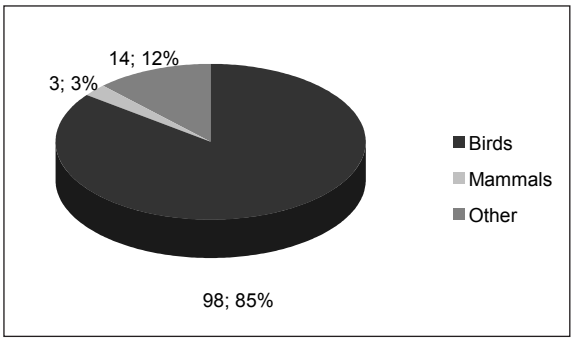
Locality C1: It refers to a nest established in a bird box of a barrel. This bird box was hung out by workers of the Buchlovice rescue station. The box is placed on a solitary tree in the middle of the agricultural landscape behind Buchlovice.

Locality D1: It refers again to nesting in a bird box. The box is situated on a wooden functionless power line pole occurring on a former municipal landfill, at present the biological waste landfill behind Buchlovice.

RESULTS

The food spectrum of *Accipiter nisus*

In total, some 115 more or less well distinguishable residues of food were evaluated.



1: *Numerical and percentage expression of particular kinds of prey of sparrowhawk (number of items; % proportion)*

Based on Fig. 1, it is evident that birds create the highest proportion of prey, viz. 85 %, mammals 3 % and other animals, such as insects, reptiles, *Annelida* etc. create 12 % (see Tab. I). *Turdus merula* was the most frequent prey.

The greatest amount of food was found at locality D and then at localities A, B and C. At all localities regardless of the amount of prey, birds markedly predominated. Insect occurs very few and mammals occur nearly exceptionally.

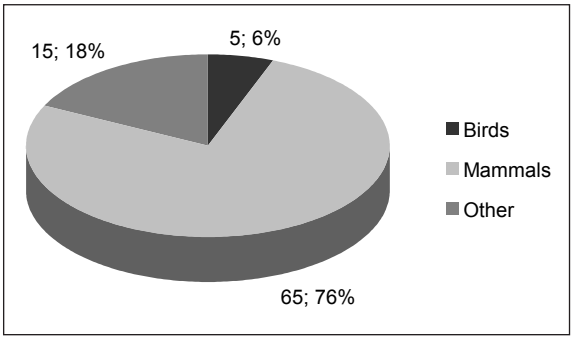
I: *The food spectrum of Accipiter nisus in nesting seasons 2006–2008*

LOCALITY	A	B	C	D	Total	Rate %
GENUS – BIRDS						
Columba livia f. *domestica*	3	1	3	4	11	9.6
Garrulus glandarius	3	2	3	1	9	7.8
Turdus merula	1	6	4	5	16	13.9
Passer spp.	2	4	4	5	15	13
Turdus spp.	5	4	0	4	13	11.3
Columba spp. (wild)	4	1	0	4	9	7.8
Erithacus rubecula	2	0	0	3	5	4.4
Sturnus vulgaris	1	0	0	0	1	0.9
Emberiza citrinella	0	0	0	1	1	0.9
Fringilla coelebs	5	1	0	2	8	6.9
Other birds	4	3	1	2	10	8.7
Total	**30**	**22**	**15**	**31**	**98**	**85.2**
GENUS – MAMMALS						
Apodemus spp.	1	0	0	0	1	0.9
Glis glis	0	1	0	1	2	1.7
Total	**1**	**1**	**0**	**1**	**3**	**2.6**
OTHER						
beatles, inset…	2	4	5	3	14	12.2
Total	**2**	**4**	**5**	**3**	**14**	**12.2**
TOTAL	**33**	**27**	**20**	**35**	**115**	**100**

In total, only two species of mammals were found (field mouse and dormouse). Based on these results, it is possible to deduce that sparrowhawk is aimed at hunting the mammals only exceptionally. Insect and other components of food occurred rather abundantly.

The food spectrum of *Falco tinnunculus*

In total, some 85 more or less well distinguishable residues of food were evaluated.



2: *Numerical and percentage expression of particular kinds of prey of Falco tinnunculus (number of items; % proportion)*

Based on Fig. 2, it is evident that the greatest proportion of prey is created by mammals, viz. 76%, birds create 6% and other animals, such as insect, reptiles, *Annelidae* etc. create 18% (see Tab. I). *Microtus arvalis* was unambiguously the most frequent prey.

The highest amount of residues of prey was found at locality A1 although the finding of residues was not easy because of the castle wall, where the nesting plateau was situated. Localities C1, D1 and B1 follow in the amount of found residues of food. The highest amount of found residues at locality A1 can be caused by a fact that other predators have not such access to residues of food as kestrel. In total, only two genera of birds and nine genera of mammals were found. Thus, it is possible to state that kestrel hunts birds only as exceptionally as sparrowhawk hunts mammals. A component "other" included nearly a quarter of the whole food spectrum of kestrel. In the period of nesting, the bird male participates mainly in hunting a prey. Thus, it has to hunt large amounts of food for its female with chicks but also for itself. The prey size also corresponds to the bird male size.

II: *The food spectrum of Falco tinnunculus in nesting seasons 2006–2008*

LOCALITY	A1	B1	C1	D1	Total	Rate %
GENUS – BIRDS						
Passer spp.	3	0	0	1	4	4.7
Alauda arvensis	0	1	0	0	1	1.2
Total	**3**	**1**	**0**	**1**	**5**	**5.9**
GENUS - MAMMALS						
Apodemus spp.	2	0	2	1	5	5.9
Mus musculus	6	0	0	2	8	9.4
Microtus arvalis	14	5	9	7	35	41.2
Clethrionomys glareolus	1	0	3	0	4	4.7
Apodemus agrarius	0	0	1	0	1	1.2
Talpa europaea	1	0	0	0	1	1.2
Crocidura spp.	0	0	1	2	3	3.5
Sorex araneus	0	0	2	0	2	2.3
Nyctalus noctula	4	1	1	0	6	7.1
Total	**28**	**6**	**19**	**12**	**65**	**76.5**
OTHER						
beatles, insect…	4	3	5	3	15	176
Total	**4**	**3**	**5**	**3**	**15**	**17.6**
TOTAL	**35**	**10**	**24**	**16**	**85**	**100**

DISCUSSION

Accipiter nisus

The composition of food does not differ from the expected structure. When comparing with literature, it is necessary to take into account that in this study, food was determined only in the period of nesting of sparrowhawk and thus, its composition need not be identical with year-long surveys.

Sparrowhawk is an outstanding food specialist. According to results obtained by Uttendörfer (1952) and according to his conclusions, 97.7% all food consist of birds, the rest, ie 2.3% consists of mammals. In our area, Farský (1928) and Sládek (1963) carried out the analysis of 157 and 30 stomachs of sparrowhawk, respectively. They found out in total 182 birds, 31 small mammals, 1 squirrel, 1 bat and 1 lizard in food. In 13 stomachs, considerable amount of insect was found. Results obtained are generally comparable with our study (proportion of components).

In National Park Wigry, Zawadzki and Zawadzka (2001) mention the composition of food. Birds participated in 97%, forest birds *Parus spp., Turdus spp., Picidae* and *Ficedula spp.* being preferred. In northern Finland in the Oulanka park, all 540 items in 13 nests were birds. Species of bird living in the open landscape were preferred to forest birds (Rytkönen et al., 1998). According to our results, *Turdus merula* (16.3%) and *Passer spp*. (15.3%) (ie species of the open landscape) occurred most frequently in its food. According to Nielsen and Møller (2006), 34 923 items of 117 kinds of prey was found in northern Denmark. *Alauda arvensis* (13.8%) predominated. *Passer montanus* (11.7%) and *Turdus merula* (7.7%) as well as *Passer domesticus* (5.5%) were dominant components of the food spectrum. In southern Finland (Solonen, 1997), the most important components of food (based on number) were as follows: *Fringilla coelebs* (17.1%), *Parus major* (10.7%), *Phylloscopus trochilus* (7.8%), *Passer domesticus* (7.2%), *Erithacus rubecula* (6.9%), *Anthus trivialis* (5.4%), and *Turdus philomelos* (5.4%). In general, sparrowhawk always hunts that prey (from the broader number of searched species), which occurs most frequently in its hunting district. Therefore, data from particular surveys can relatively markedly differ in the order of hunted species. It is of interest that sparrowhawk being largely a forest bird flies (particularly from smaller forest complexes) relatively often to hunt into the open landscape or the residential area of villages. Thus, it hunts bird species there living in the open landscape or scattered vegetation.

Falco tinnunculus

In principle, the composition of the kestrel food, from the aspect of the mammal/bird ratio, is reverse compared to sparrowhawk. According to our monitoring, up to 76% all food consists particularly of small mammals, insect, reptiles and finally birds. Such a composition of food, where mammals pre-

dominate in the food spectrum of kestrel, is given by the majority of authors. Hudec (1977) mentioned that the kestrel food consisted mainly of small mammals living in the open landscape, of larger insect, birds, reptiles and molluscs. Farský (1928) found in total 153 vertebrates in 113 stomachs. Out of this number, over 90% prey were small rodents, namely field mouse, water vole, common field mouse etc. Koláček (1932) found also only small rodents and one small hare in 34 stomachs. Kestrel hunts birds only in years of the low population of small rodents or under unfavourable conditions. Considerable part of its food consists of insect and larvae (Hudec, 1977). The high percentage of mammals in the prey of kestrel also confirms its food specialization.

Of course, it is necessary to mention that the food specialization is not so marked as in sparrowhawk and insect and other animals are not hunted only accidentally or in the period of nesting being unsubstitutable part of its food spectrum.

With respect to the marked synantropization of kestrels, extensive surveys of their food were carried out in the urban environment. According to Zmihorski and Rejt (2007), small rodents create some 80% food (78% biomass) of kestrels in Warsaw. Birds create only 7% items (11% biomass). The proportion of birds is higher at the beginning of winter than at the end. Kübler et al. (2005) mentioned that kestrels in Berlin hunted above all rodents. Only under conditions when populations of kestrels are low they hunt birds, namely sparrows. On the other hand, according to Yalden (1980), kestrels hunt mainly birds in Manchester. He mentions that up to 76% prey consists of birds (particularly sparrows), 22% rodents and 2% invertebrates. This fact confirms a presumption mentioned many times in the past that hunting the rodents in towns can be rather difficult for kestrels and, therefore, they hunt preferably birds if it is possible.

CONCLUSIONS

In the Chřiby Upland, the food spectrum found in *Accipiter nisus*, viz 85% birds, 3% mammals and 12% other animals and in *Falco tinnunculus*, viz. 18% birds, 76% mammals and 6% other animals, corresponds to present findings on the food ecology of both birds. Main contributions of the study are as follows: (1) a fact that it refers to new data, which are related to the analysis of nesting biology of both species in the studied area (their publication is prepared in a subsequent paper), (2) time and territorial synchronization of research into both species, ie the comparability of their food habits and preferences.

SOUHRN

Potravní spektrum krahujce obecného (*Accipiter nisus* L.) a poštolky obecné (*Falco tinnunculus* L.) v Chřibech

Dlouhodobým předmětem výzkumu je objasnění stavu populace, biologie a potravního spektra krahujce obecného (*Accipiter nisus* L.) a poštolky obecné (*Falco tinnunculus* L.). Zkoumáním potravního spektra krahujce a poštolky v letech 2006–2008 na jihovýchodním okraji Chřibů byly potvrzeny dosavadní poznatky z obdobných území. U každého druhu byla potrava monitorována vždy v období od února do července na čtyřech hnízdních lokalitách. Potravní spektrum bylo analyzováno přímým pozorováním dravců, dle zbytků potravy v okolí hnízd a v samotných hnízdech. U *Accipiter nisus* tvořili potravní spektrum z 85 % ptáci, z 3 % savci a z 12 % ostatní živočichové. Nejčastější kořistí byl *Turdus merula*. U *Falco tinnunculus* zaujímali 18 % ptáci, 76 % savci a 6 % ostatní živočichové. Nejčastější kořistí byl jednoznačně *Microtus arvalis*.

Accipiter nisus, *Falco tinnunculus*, potravní spektrum

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