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UTILIZATION OF AN VIDEO CAMERA IN STUDY OF THE GOSHAWK (*ACCIPITER GENTILIS*) DIET

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Abstract

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In 2009, research was carried out into the food spectrum of goshawk (*Accipiter gentilis*) by means of automatic digital video cameras with a recoding device in the area of the Chřiby Upland. The monitoring took place at two localities in the vicinity of the village of Buchlovice at the southeastern edge of the Chřiby Upland in a period from hatching the chicks to their flying out from a nest. The unambiguous advantage of using the camera systems at the study of food spectrum is a possibility of the exact determination of brought preys in the majority of cases. As much as possible economic and effective technology prepared according to given conditions was used. Results of using automatic digital video cameras with a recoding device consist in a number of valuable data, which clarify the food spectrum of a given species. The main output of the whole project is determination of the food spectrum of goshawk (*Accipiter gentilis*) from two localities, which showed the following composition: 89% birds, 9.5% mammals and 1.5% other animals or unidentifiable components of food. Birds of the genus *Turdus* were the most frequent prey in both cases of monitoring. As for mammals, *Sciurus vulgaris* was most frequent.

goshawk (*Accipiter gentilis*), species determination, prey

This paper deals with the food spectrum of one species of birds of prey living in the upland agricultural-forest landscape in the Chřiby Upland. It refers to goshawk (*Accipiter gentilis*). It was possible to monitor the food spectrum of birds of prey till the time when it was possible to hunt the predators and thus to ensure the sufficient amount of cadavers for the following analysis of stomachs. Particularly Farský (1928) and Sládek (1963) dealt with the method of determining the food spectrum by the analysis of stomachs. However, after the prohibition of hunting the birds of prey it was not possible to obtain the sufficient amount of cadavers for further analyses (obtaining the cadavers was limited only to the accidental collection of died individuals). Therefore, the detailed study of food was restricted rather to the analysis of leftovers of food in nests or analyses of vomited food ("pellets") or to the direct observation of brought or hunted food.

Of course at present, the digital technology makes possible to take food brought to chicks right on nests by means of digital cameras and recording devices, namely in principle consecutively for 24 hours with the excellent quality of records. The most modern technology makes possible to monitor the behaviour of birds right on their nest, namely with a sound record without the physical presence of an observer of the system operator.

Using this technology in practice brings updating and concrete unimpugnable findings on the food ecology of the given animal species. It is possible to complete or specify at present already partly obsolete findings of authors dealing with the food spectrum of birds of prey and, thus, to learn more on the biology of the studied species. It is necessary to take this study as a partial result of the whole extensive project on the biology and ethology of goshawk.

The present condition of studied problems

In the worldwide scale, many experts deal with the research into populations of birds of prey from various aspects; nevertheless, there are rather few quality publications on these problems. Most often, those species are monitored, which tolerate the presence of man well or species nesting localities of which occur at accessible places.

In the Czech Republic, attention is paid to problems of birds of prey and their populations on the long-term basis particularly from the aspect of population densities, especially in the context of other species of birds (Šťastný, Bejček, 1993; Šťastný, Bejček, Hudec, 1996, 2006; Mlíkovký, 1998; Závalský, 2004). At present, genetics appears to be an important helper at monitoring and research into birds. At present, detailed analyses of populations as well as of individual birds are processed at a very high level. Thanks to the use of genetics we can obtain so far unknown findings on the biology of particular species. However, elementary research into the food spectrum is many times neglected just at the expense of genetic methods.

Therefore, many experiments differ both in the technology used and outputs obtained. The ornithological laboratory of Palacký University in Olomouc dealt first with monitoring the food spectrum of birds by means of camera systems in the CR. Specialists from this laboratory used industrial safety recording devices to monitor the food of eagle owl and black stork.

Abroad, this technology was used already some time earlier. On the basis of taking animals by means of cameras a society called New Forest Gateway (www.newforestgateway.org) dealing with monitoring animals in their natural environment has originated.

MATERIAL AND METHODS

The composition of food of feathered birds of prey can be determined using many methods (Mlíkovský, 1998). For this study, the method of automatic photography was used to examine a food spectrum. In short, it is possible to say using camera systems to take the movement of birds in their nests.

With respect to the previous research into birds of prey in the Chřiby Upland (Tomešek, 2007, 2008, 2009), goshawk was selected, namely by reason of the highest experience with the nesting behaviour of this species. Two localities were chosen occurring in the east of the central area of the Chřiby Upland in the vicinity of the village of Buchlovice.

In the spring season, these localities were surveyed and occupied nests were found. Through a several-day regular observation the stage of the bird clutch was estimated. If the goshawk female only lays eggs or sits already firmly on its clutch. According to these facts the date if the camera system installation on the nest was planned. This term was very important for further success of the whole project. It referred to a period closely before hatching the goshawk chicks, because if the camera was installed too early the female could leave the clutch. If the camera was installed later it would affect results because the first days of feeding chicks would not be taken in the record. Moreover, newly hatched chicks could be undercooled.

The actual installation of the camera system on a nesting tree proceeded by means of several helpers and a photographer. Mountain- and tree-climbing technology was used. The camera was placed at the bird nest. The camera took the movement of birds on the nest and this record was transmitted by means of a cable to a recording device placed at the tree foot in a waterproof box. The source of energy was ensured by means of a car battery, which was also placed in a waterproof box at the tree foot. Both equipments were dug in and masked under the soil surface. The whole equipment including boxes and cables was treated by a masked paint to eliminate possibilities of theft.

The battery capacity sufficed about 48 hours and then a discharged battery had to be replaced by a new battery. Thus, the replacement of batteries took place once after two days in maximum quietness and caution toward nesting birds.

For checking the record a six-inch LCD monitor was used, which could be connected to a data recording device. In this way, it was possible to monitor current events in the nest or to find out tentatively what happened in the past. The recording device was specific equipment similar to a generally

1: *Completely connected recording device*

2: *Visual display monitoring movements on the nest*

used DVD recorder. However, this equipment cannot be used in combination with a standard TV set some functions being different. This equipment is specified as 4CH MPEG 4 DVR. A hard disk of a capacity of 1 TB was used for the storage of records.

The whole camera system was drawn up on the basis of requirements of the author in cooperation with Elnika Company in Varnsdorf dealing with camera safety technology.

Camera systems were placed on a nest for a period of about two months, i.e. till the time when chicks left their nest. During this period, nearly 800 GB of quality and very valuable material was acquired from each of the equipment.

After dismantling the equipment, the record was evaluated either directly through monitoring on a mobile monitor or in a computer by means of a special program making possible to transfer the record from a DVR (recording device) to a PC. Next procedure consisted in the determination of brought food, which could be identified on the record.

Description of localities

Camera systems were placed at two localities, which were marked by names of Buchlovice and Břestek. The map and coordinates of nesting localities are not given in this paper for reasons of safety and protection from vandalism.

The locality of Břestek

The locality is situated in the neighbourhood of the recreation part of the village of Břestek occurring in the vicinity of a deep terrain depression. Nests are constructed at a considerable height mainly on larch trees, which occur in the close vicinity of this depression. The stand age is 90 years. Management set of stands No. 456.

The locality of Buchlovice

It refers to a nesting locality situated in a forest complex between Buchlovice and Osvětimany. It is a locality with commercial forests differentiated both in diameter and height; management set of stands No. 455. The stand age, where the nesting locality occurs, is about 90 years. The nests are placed at a considerable height on larch or beech trees. The stand part number is not given purposely.

RESULTS

The locality of Břestek

Results give data processed at the Břestek locality where bringing 233 pieces of food were recorded by means of a camera. Three chicks hatched there (2 ♀ and 1 ♂). The chick male disappeared from the nest at an age of 14 days. A reason of this disappearance is not, unfortunately, known.

According to Tab I, it is evident that the highest proportion of prey consisted of birds, namely 93.6%. Mammals created 5.2%. As for the rest of prey it referred to brought prey, which could not be identified in the camera record (1.3 %). In the following Tab. I, the animal species or genus is given as well is its frequency (abundance).

I: *The food spectrum of Accipiter gentilis in the nesting season 2009 – the Břestek locality*

LOCALITY – BŘESTEK	Number pcs	Percentage
GENUS (SPECIES) – BIRDS		
Turdus merula	46	19.8
Turdus philomelos	31	13.3
Streptopelia decaocto	29	12.5
Columba livia	10	4.3
Columba palumbus	3	1.3
Dendrocopos sp.	22	9.5
Picus sp.	1	0.4
Buteo buteo	1	0.4
Strix aluco	1	0.4
Garrulus glandarius	27	11.6
Parus major	1	0.4
Coccothraustes coccothraustes	1	0.4
Other birds	45	19.3
Total	**218**	**93.6**
GENUS (SPECIES) – BIRDS		
Clethrionomys glareolus	1	0.4
Glis glis	2	0.9
Sciurus vulgaris	6	2.6
Lepus europaeus	1	0.4
Mustela nivalis	2	0.9
Total	**12**	**5.2**
OTHER		
Unidentifiable prey	3	1.3
Total	3	1.3
TOTAL	**233 pcs**	**100%**

At least, 12 species of birds and 5 species of mammals became the goshawk prey. Other species were not identifiable and, therefore, they were included into the category of other birds or mammals. Common Blackbird (*Turdus merula*), which was brought by parents even in 46 cases (19.8 %), was the most abundant prey of the class "birds". Then followed song Thrush (*Turdus philomelos*), which was brought in 31 cases (13.3 %). Eurasian Collared Dove (*Streptopelia decaocto*) was another important prey (29 cases, 12.5%) as well as Eurasian Jay (*Garrulus glandarius*) (27 cases, 11.6 %). Birds created great number of prey; however, it was not possible to determine the species (45 cases, 19.3 %).

As for mammals, Red Squirrel (*Sciurus vulgaris*) was the most frequent prey (6 cases, 2.6 %). Three cases of prey could not be determined at all (if it referred to mammals, birds or something another).

3: *Turdus philomelos passing on the prey, loc. Břestek, the age of the young – 4 days*

The locality of Buchlovice

Results give data processed at the Buchlovice locality where 445 pieces of brought food were recorded by means of a camera. Four chicks hatched there (2 ♀ and 2 ♂). All chicks leaved the nest and flied out in due course.

At the Buchlovice locality, the largest proportion of food consisted again of birds (84.5 %). Mammals created nearly 13.9% of the food spectrum. The rest of prey could not be identified (1.6 %).

At this locality, 9 identifiable species of birds and 6 species of mammals became prey. Other species could not be identified. Therefore, they were included in the category of other birds or mammals. The most frequent prey at this locality was song Thrush, which was brought by the parents of chicks in 71 cases (15.9 %). Then followed Common Blackbird, which was brought in 68 cases (15.3 %). Eur-

II: *The food spectrum of Accipiter gentilis in the nesting season 2009 – the Buchlovice locality*

LOCALITY – BUCHLOVICE	Number pcs	Percentage
GENUS (SPECIES) – BIRDS		
Turdus merula	68	15.3
Turdus philomelos	71	15.9
Streptopelia decaocto	55	12.4
Columba livia	36	8.1
Columba palumbus	25	5.6
Dendrocopos spp.	19	4.2
Phasianus colchicus	12	2.7
Anas platyrhynchos	8	1.8
Garrulus glandarius	43	9.7
Other birds	39	8.8
Total	**376**	**84.5**
GENUS (SPECIES) – MAMMALS		
Martes sp.	5	1.1
Glis glis	6	1.4
Sciurus vulgaris	14	3.2
Lepus europaeus	9	2
Mustela nivalis	2	0.4
Rattus norvegicus	18	4
Other mammals	8	1.8
Total	**62**	**13.9**
OTHER		
Unidentifiable prey	7	1.6
Total	**7**	**1.6**
TOTAL	**445 pcs**	**100 %**

4: *Installation of the video camera near the nest*

5: *Positioning the video camera on the trunk*

asian Collared Dove (55 cases, 12.4%) and Eurasian Jay (43 cases, 9.7%) were another prey. Domestic Pigeons (*Columba livia f. domestica*) (36 cases, 8.1 %), Common Woodpigeon (*Columba palumbus*) (25 cases, 5.6%) and species of the genus *Dendrocopos* (19 cases, 4.2%) created also more important prey. Great number of prey consisted of birds, which could not be determined (39 cases, 8.8 %). As for mammals, Red Squirrel (4 cases, 3.2%) being followed by Brown Rat (*Rattus norvegicus*) (18 cases, 4%) were the most frequent prey. Also brown European Hare (*Lepus europaeus*) (9 cases, 2%) occurred rather frequently.

At seven cases of bringing prey, it was not possible to determine prey at all (if it referred to mammals, birds or another animal species).

6: *Feeding the young, loc. Buchlovice, age – 14 days*

DISCUSSION

The method of taking the food spectrum by means of a digital camera system showed unambiguously the food of two monitored pairs of goshawk in the Chřiby Upland. Results of the paper are limited to a simplified presentation of data in the form of a percentage expression. More detailed analyses of results of the study are beyond the framework of the paper.

In Slovakia, Sládek (1963) processed the food of goshawk through the analysis of 150 stomachs. His results were completed by other 65 analyses of stomachs processed mainly by Farský (1928) generally from the CR. These results are somewhat different from our data. According to Sládek(1963), birds represent 54% (here 89 %), mammals 40.1% (here 10 %), other components are exceptional.

Both at the locality of Břestek and at the locality of Buchlovice, birds predominated unambiguously in the food spectrum of goshawk (Břestek – 93.6%, Buchlovice – 84.5 %). The importance of the method was demonstrated by Lewis *et al.* (2004) from SE Alaska using three different methods of determining a food spectrum at the same nests. At monitoring brought preys by a video camera the ratio of food was roughly as follows: birds 77.8%, mammals 22.2%. At gathering remainders of prey on a nest and in its surroundings, the ratio of food was 91.4% birds and 8.6% mammals. At gathering vomited food, the food ratio was 59.3% birds and 40.7% mammals. The main cause of differences consists probably in the difficult finding of residues of mammalian food on nests and in their vicinity (feathers are usually much more distinct than hair) and, on the contrary, their easier identification in vomited food. However, the method of monitoring the food spectrum by means of cameras appears to be most suitable because as for determination if it concerns a bird, mammal or other animal it is very well distinct even at bad light conditions and also in cases when food is already modified by partial processing (predigestion).

In the majority of surveys (either under similar or markedly different natural conditions) the higher proportion of birds is noted, which has been also demonstrated by our research. In a long-term survey realized in central Italy (Penteriani; 1997), the proportion of birds was 75% items (71% biomass). Lewis *et al.* (2006) mention the proportion of birds in the rich north of Alaska 72% and in the poorer south of Alaska 77%. An extensive survey carried out in the Wigry National Park in Poland (Zawadska, Zawadski; 1998) mentions the proportion of birds in 94% items (92% biomass) of food spectrum. According to data of Uttendörfer (1939, 1952) from the area of Germany, the proportion of birds is also up to 90% and mammals represent only 10%. Thus, it is evident that goshawks are aimed at bringing the most easily available food in large numbers and only then they turn to hunting prey on land and in undergrowth. In our case, particularly medium size birds and mainly their chicks, which did not leave their nest or were shortly after flying out from their nest, were the most frequent food. This fact was also proved by the survey of food carried out by Lewis *et al.* (2006).

Goshawk is not an exclusive food specialist. Its food is markedly affected by the species spectrum of available prey. A survey mentioned above out and carried in Alaska (Lewis *et al.*; 2006) demonstrates the preference of prey bringing the highest yield, ie a relatively large prey and, at the same time, also easily huntable (thanks to way of life or its availability). Goshawks preferred large birds and mammals and hunted them in crowns of trees. If such a prey did not occur in the given region goshawks aimed at hunting small birds and hardly huntable mammals moving on/at the ground (soil surface).

Predominating species or genera of prey are, at the majority of comparable (although often different in many parameters) areas, the same or similar. In the Chřiby Upland, small singing-birds of the genus *Turdus*, domestic and wood species of pigeons *Columba spp.* and jay *Garrulus glandarius* predominated or at least ranked among the most important species in the food of goshawk. The species predominated also, eg, in Granada (Padial *et al.*, 1998), in the Wigry

National Park in Poland (Zawadska, Zawadski; 1998) or in central Italy (Penteriani; 1997). The high proportion of squirrel *Sciurus vulgaris* mentioned by Penteriani (1997) and Padial *et al.* (1998) is characteristic as well. Differences in the species composition of animals between particular areas are not marked on the small area of the Chřiby Upland. Nevertheless, a certain effect of the nesting locality is evident. The Buchlovice locality occurs near a village with many separately situated buildings, often with domestic animals, livestock and also pigeons. Therefore, pigeons occur in the food of the goshawk pair from this locality much more frequently than at the other locality.

It is of interest that in the food of both pairs, the genus of woodpecker (very good flyer) occurred as one of the most frequent species of birds. It shows evidence of good hunting skills of mature goshawks. Of course, in many cases it referred also to chicks of woodpeckers. Thus, it is possible to say that if goshawks encountered newly flying out chicks of woodpeckers then the goshawks hunted down all woodpeckers. In the surroundings of the Buchlovice locality, there are also many meadows and fields, which is a breeding-ground of small game. It also occurred much more in the food spectrum of this pair than in the food spectrum of the pair from the Břestek locality.

Bringing minute food until the goshawk chicks did not try to feed themselves is an interesting finding. As soon as the chicks began to struggle for food with one another, their parents began to bring larger food. It applied to both localities. It is certainly conditioned by a fact that bringing a larger prey to more mature chicks is less energy demanding because using this food parents can feed chicks better. At the Buchlovice locality, four chicks leaved their nest in contrast to the Břestek locality where only two chicks leaved their nest. The youngest chick (male) disappeared from the nest at an age of 14 days. Unfortunately, it happened overnight, thus, a camera did not record the reason of disappearance because it was not equipped by infrared light. This fact also reflected in the amount of brought food where nearly the double amount of prey was recorded at the Buchlovice locality as compared to Břestek.

Based on records of cameras, such kinds of prey as, for example, insect or reptiles or amphibians were not found although at previous observation (using another method), remnants of cadavers of these animals were found (of course, in a very small percentage) (Tomešek, 2005). Sládek (1963) mentions these animals in a category "other" as an exceptional case. Of course, in its results, they create up to 13% food spectrum. Other authors divide the food spectrum of goshawk only between two components, namely birds and mammals.

SUMMARY

In the Chřiby Upland, the composition of food of goshawk was as follows: 89% birds, 9.5% mammals and 1.5% other animals or unidentifiable components of food. The main benefit is a fact that it refers to new data, which are related to the analysis of the food ecology of a species in the monitored area. To determine the food spectrum the most modern procedure was used giving unbiased information on the food of this bird of prey. The advantage of using camera systems at the investigation of a food spectrum is the possibility of accurate species determination of brought prey, namely in the majority of cases. A technology was used, which was as much as possible economic and effective under given conditions. The result of using an automatic digital video camera is the acquisition of a number of valuable data demonstrating the food spectrum of the given species. Based on processed results it is possible to deduce conclusions on the harmfulness of this bird of prey, for example, as for game or domestic animals. Moreover, at the use of camera systems, there is a possibility of the wireless transmission of records and thus also monitoring the whole course of nesting on Internet. Thus, possible protective measures for the bird of prey management can be based on this monitoring.

The main result of the whole project consists in the determination of the food spectrum of goshawk in the Chřiby Upland using the method of automatic taking by digital video cameras. Based on results of the actual project but also of projects from previous years, it is evident that resulting data are considerably affected by the use of a concrete methodology. It appears that the use of camera systems is the most representative method. Birds of the genus *Turdus* became the most frequent prey in both cases of our monitoring. As for mammals, it was squirrel *Sciurus vulgaris*.

Another possibility of research consists, eg, in monitoring the behaviour of birds and their chicks on a nest, which is enabled by camera systems very well. In this way, it is possible to obtain much more information on the biology of the given species. Based on these data it is possible to deduce several other conclusions, such as, eg, the amount of food in weight units, the energy value of brought prey, effects of the daytime on feeding, the frequency of the parent alternation at hatching or at feeding the chicks, effects of weather on the development of chicks and bringing food etc.

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