STUDY ON FOOD INGESTION AND TYPES OF FOOD FOR ROOKS (*CORVUS FRUGILEGUS* L.)

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Abstract. In the present study we have focused on aspects related to the feeding process in rooks, (*Corvus frugilegus* L.). The glandular stomach, together with the gizzard and the bowel, from three separate individuals were preserved in 80 degree alcohol and then dissected and analysed in order to observe food remains of animal origin. The respective individuals, two adults and a chick with partially formed plumage were found dead in nature. The stomach contents of one of the adults consisted in starling feathers, (*Sturnus vulgaris* L.), grey with green iridescence, lighter towards the top. The other adult's stomach contained only remains of household waste (egg shell and meat). The chick's stomach contained three fragments of *Geotrupes* sp., (Coleoptera: Scarabeidae) and one of *Lucilia* sp. (Diptera: Bracycera) and the bowel contained four traces of scarabaeoids. The rooks had ingested small stones in order to maintain their gizzard functional. Early in the spring, in March, after the snow melted, I have gathered pellets from two winter roosts. "Titu Maiorescu" Campus and "Anastasie Fatu" Botanical Garden from Iaşi. Pellet elimination has been noted even in a specimen that was raised in captivity. Aspects concerning feeding have been researched from an ethological point of view in a rookery from Iaşi municipality and on feeding territories from the central area of Moldova.

Keywords: feeding, pellets, cereals, insects, soil, remnants, walnuts.

Rezumat. Studiu despre ingestia alimentară şi tipurile de hrană utilizate de cioara de semănătură, (*Corvus frugilegus* L.). În prezentul studiu ne-am propus prezentarea unor aspecte legate de hrănirea ciorii de semănătură, (*Corvus frugilegus* L.). Stomacul glandular, împreună cu stomacul triturator (pipota) şi cu intestinul subţire, provenind de la trei indivizi, s-au conservat în alcool de 80 de grade şi s-au analizat, apoi, prin disecţie, în scopul determinării unor resturi alimentare de origine animală. Indivizii respectivi – doi adulţi şi un pui, cu penajul parţial format – au fost găsiţi morţi, în natură. Conţinutul stomacal al unuia dintre adulţi a constat în pene de graur, *Sturnus vulgaris* L., cenuşii cu irizaţii verzi, la vârf de culoare deschisă. La celălalt adult s-au găsit numai resturi menajere (coji de ouă, carne). La pui s-au găsit în stomac 3 fragmente de *Geotrupes* sp., (Coleoptera: Scarabeidae) şi unul de *Lucilia* sp. (Diptera: Bracycera) iar în intestinul subţire 4 fragmente de scarabeide. Ciorile ingeraseră pietricele, pentru menţinerea funcţionalităţii pipotei. Primăvara devreme, în martie, după topirea zăpezii, am strâns ingluvii din două staţionare de dormit iarna: Campusul Studenţesc „Titu Maiorescu” şi Grădina Botanică „Anastasie Fătu” Iaşi. Eliminarea de ingluvii s-a înregistrat inclusiv la un exemplar crescut în captivitate. Aspectele legate de hrănire s-au urmărit din punct de vedere etologic, într-o colonie din municipiul Iaşi şi pe teritorii de hrănire din zona centrală a Moldovei.

Cuvinte cheie: hrănire, ingluvii, cereale, insecte, sol, resturi, nuci.

Introduction

The way of life of the rook is related with meadows and cultivated fields, from where it gets its food (mainly invertebrates). Our research was developed on favorable feeding and breeding territories from counties like Iaşi, Vaslui, Bacău and Neamţ. We have gathered evidences from Iaşi municipality concerning contents from the stomach of dead specimens, in order to determine some systematic groups of animals that were used as food. We have also gathered pellets that were accumulated during the winter period under rook's roosts.

Their way of getting food was studied inside and around Iași municipality, on feeding territories. During the reproductive season we have seen the food transfer from parents to the young, in nests, in a rookery from Tătărași (Iași). In the summer of 2011 I have rehabilitated a young rook; during this process I have gathered data concerning its pellets.

Material and Methods

In order to get samples of stomach content from a rook we collected ten dead specimens that were found in Copou (Iași), under colonies and resting places. The digestive tube of these birds was put in 96° ethanol. The content of the stomach was analysed at an optic microscope for metals, IOR Bucharest, with a 10x objective. The systematic groups of organisms that were taken from the samples have been determined with the help of some morphologic characters of some parts (for example, fragments of exoskeleton) and also by consulting the specialty literature concerning this field. From the same areas from where we got the dead birds we also gathered pellets. For weighing the pellets we used an electronic scale Scout^{TM}Pro. The composition of the pellets was analysed with the naked eye.

In order to research, from an ethologic point of view, the aspect of feeding of a rook we first have observed a rookery from Tătărași. We took pictures with a LUMIX DMC Panasonic camera with a 27 mm wide-angle, 18x optic zoom, LEICA DC bright lens with F2.8. In order to film them we used a digital Panasonic® SDR-H80 SD/HDD video-camera, 70x optic zoom, 60 GB optic stabilizer.

We had access to three tall buildings: Bl. G6, Str. Vasile Lupu nr. 108 A; Bl. A2, Tr. T1, Str. Vasile Lupu, nr. 128 and Bl. A1, Tr. T2, Str. Vasile Lupu, nr. 138 high above the trees with nests from where we took pictures and made videos.

At the end of the nesting activity, we went to Bahlui in order to catch the young birds being fed by their parents in an open field. The observations were developed, mainly, on the piece of land from the margin of Dacia neighbourhood.

Results and Discussion

From the point of view of the relations with the agricultural ecosystems, the rooks have a beneficial impact on the ecosystem, because they help stopping the spreading of some animal pests. Having an omnivorous diet, the rooks eat both vegetal and animal food. In the winter, their basic food consists in berries and seeds and in the spring they eat small animals (Feare *et al.*, 1974; Waite, 1984). In the summer, after the harvest, they are present in the strawy crops (like wheat) looking for caryopsis that fell on the ground. On 24.07.2011 being on the North part of the Jijia valley versant, in Țigănași commune, I have noticed a flock of 133 birds that were eating on a stubble field (Fig. 1). The flock of rooks may cause some damages, especially when it comes to seeding before harvesting, when the flocks come to cultivations of cereals.

In the composition of the animal food of the rook there are a series of systematic groups of insects (adults and larva) – Coleoptera (Cicindelidae, Carabidae, Staphylinidae, Lucanidae, Geotrupidae, Scarabaeidae, Elateridae, Dermestidae, Meloidae, Tenebrionidae, Coccinellidae, Cerambycidae, Chrysomelidae, Curculionidae), Himenoptera (Formicidae), Lepidoptera (Pieridae, Tortricidae, Noctuidae, Geometridae), Orthoptera (Grylliadae, Tettigoniidae, Gryllotalpidae, Acrididae), Diptera (Tipulidae, Tabanidae, Syrphidae, Calliphoridae, Muscidae) and others (Kalotás, 1986) – and other kinds of invertebrates

(earthworms, mollusks, spiders, centipedes and others). We noticed that the short-horned grasshoppers are a frequent type of food, being very rich around Bahlui River in some periods. During June 7th-July 17th 2011 we researched the feeding territory that was situated in the South-East of Dacia (Iași), the plane surface of Bahlui. In the field there were caught birds that moved very fast in the grass in order to catch small insects from the ground.

Figure 1. Feeding in a stubble field, right after the harvest.

The rook hunts different small vertebrates, like meadow voles (*Microtus* sp.) (Macleod, 1987, quoted by Snow *et al.*, 1998). The rooks feed on the dead bodies of most species of vertebrates after the skin was removed by scavengers (Luniak, 1977). On 13.04.2012 we noticed, on a green area from Iași municipality, an adult bird that was feeding on a dead rat. The bird had an aggressive conduct in order to defend its food, also because the dead animal was on the bird's nesting territory.

Grobe (1983), quoted from Snow *et al.* (1998) argues that the rook catches fish. In order to catch fish it uses its claws. It steals eggs and squabs from nests of collared dove (*Streptopelia decaocto*) and feral pigeon (*Columba livia*). They also eat the eggs of birds that have nests on the ground, in meadows or humid areas (Kalotás, 1986).

The access of the rook to terricolous invertebrates (i.e. earthworms, wireworms and leatherjackets) is conditioned by their seasonal abundance (Holyoak, 1972; Gromadzka 1980), by the humidity of the soil and the temperature of the air (Ganzhorn, 1986, quoted by Snow *et al.*, 1998). In the summer, as the soil dries and as the temperature grows, the nesting couples get, with a higher energetic cost, the necessary invertebrates for raising their young. A part of their energy is consumed in the moulting process that starts during summer (Feare *et al.*, 1974; Purchas, 1980).

The earthworms are a basic trophic component, (Waite, 1981) and in captivity conditions the rooks usually refuses this type of food (Luniak, 1977). According to Purchas (1980), the specimens that were raised by men appreciate the beetles (Coleoptera) in the

same way as the wild ones do. I have noticed that in natural as well as in artificial conditions of life the rook has the tendency to catch and eat short-horned grasshoppers (Acrididae).

The vegetal food of the rook is made up from cereal caryopsis, seeds (coniferous seeds, *Acacia* seeds etc.) and fruits from cultivated or wild plants (elderberries, Virginia creeper berries, beechnuts, acorn) (Watson, 1989, quoted by Snow *et al.*, 1998). In the fall this species gathers walnuts and acorns for the winter (Purchas, 1975; Waite, 1985). The walnuts are hidden under the grass patch or under the superficial layers of the earth, or in the cracks of the trees (Hubálek, 1983). We noticed that in the spring of 2011, on G6 building from Tătărași, half of walnut shells that were left there by the rooks. The walnuts that were deposited in the fall were recovered and consumed during the winter. On the date 09.03.2012 I have noticed a rook that was cracking a walnut on a tree's branch in Tătărăși (Iași) (Fig. 2). The walnut was, probably, recovered from a depositing place that was chosen in the fall of 2011. A similar place was near a thermal substation from Tătărași at the date of 24.03.2012.

Figure 2. The consumption of a walnut during winter.

Because of winter's harsh conditions, the rooks stay in localities, looking for leftovers in garbage, near zootechnical farms and in areas were semi-tamed birds gather in order to eat the food given to them by humans (Coombs, 1978). Trash ramps attract big flocks of rooks, thousands of birds, from which many of them move to the surrounding fields (Veh, 1988, quoted by Snow *et al.*, 1998). In the winter of 2011 we went to Țuțora, (at approximately 4 km South-East from Iași municipality) in order to observe rooks feeding on the garbage ramp. Early in the morning, we can see flocks that were more or less compact, that are made up from thousands of birds that fly over the ramp looking for a place to feed.

The filed from the surrounding of the depositing place is used as a stop place where the adults spread and deposit the food on the ground.

They stay here almost all day long, they feed and rest and at the end of the day the compact flocks fly from the feeding area towards the North side of Iaşi municipality to their common sleeping places from Carol I Avenue and from the Botanical Garden. In the morning the flocks follow the course backwards in order to feed from the garbage. The garbage is the rook's main food source during winter, as is the coarse and concentrated fodder given as food for animals.

The flocks from Ţuţora probably include members of many colonies from Iaşi municipality and from localities that are favourable for nesting, situated in the South-East of Iaşi municipality. The food searching takes from and half an hour to three quarters of an hour after which the birds rest on electric wires, on other construction buildings or come down to the ground (in general they do not rest more than 15 minutes). At the next flight signal they will change their location. The birds regularly visit the colonies during the day, when they perform the well-known spiral flights in the ascending thermal air currents.

Usually, rooks avoid getting near windows or balconies, therefore they do not take leftovers from the kitchens of the apartments where birds are being fed, but they only take these leftovers when they are thrown on the ground. I personally noticed two rooks that fed from the kitchen of an apartment, food that was placed on the edge of the window or on the grate where food is kept during winter.

The feeding areas are established especially near the flowing waters because these are real points of attraction for small creatures, which are potential preys. The adults choose the areas with short herbaceous vegetation because they are easy to cross by walking, running or jumping. The banks of the river represent a common watering area, especially in places where the soil sinks because of the passage of the domesticated animals (Fig. 3).

Figure 3. Watering area in Berezeni (Vaslui County).

Usually, the rook forages on the soil, in open field areas (Waite, 1984) but in summer it occasionally catches caterpillars and even flying coleopterans from the tree crowns (Lockie, 1955). We found that the fields inside and near the localities attract the rooks, especially after the reaping of the herbaceous vegetation and the making of the stacks. This human activity (indirectly) offers feeding opportunities to other gregarious species as well – like the jackdaw and the starling. The main feeding areas for the rook flocks from Iași City are situated in the lowlands afferent to the Bahlui River, where the grass is low because of the grazing of the domesticated animals. The flocks that populate Vaslui Town use the plain areas from the Southern limit as feeding areas, also preferring the reaped grass parts. The rooks from Roman Town (Neamț County) gather on the meadow from the Moldova river valley, near the banks of the water. In Bacău County, the flocks of foraging rooks were observed in Sascut locality, both on the side of the road and on the fields from the left side of the road going to Bereşti.

From such open spaces, like the green spaces from the built-up areas or gardens, during the reproductive season, the rooks acquire their food and take it to the nest. The male feeds the female during the entire nesting period.

During the first two weeks from the hatching, the baby rooks are fed by their parents with invertebrates. As they grow up, the chicks receive from their parents cereal caryopses, but the invertebrates remain their main food (Feare *et al.*, 1974). The need for food is continuously growing during the first 5 days from the hatching and when the chicks are three weeks old this need is double. The fledglings also ask for food more often during their flying trainings, when they are about 30 days old (Gromadzka, 1980). On April 22nd 2011 we observed the feeding of some chicks with insect larvae and earthworms brought by the male, in the pharynx.

At the beginning of the emancipation period the juveniles use as a primary source of food and liquids the juicy fruits of the cherry trees, sour-cherry trees, mulberry trees and of other trees that fructify at the beginning of summer. In time, the fruit production decreases and the young birds begin to look for invertebrates in the grass patch of the soil. At first, they observe their parents while procuring food and they insistently ask for the food transfer. In time, they learn to feed on their own and they will form separated groups from the adults. Usually the juveniles gather in smaller groups than the adult birds. They will always have to face the hostility of the adults within the most favourable feeding areas, according to the inferior hierarchic status (Henderson & Hart, 1991). On October 1st 2010, at Ciric, we observed flocks of juveniles looking for insects among the stacks gathered after the grass reaping, on the meadow near the storage pond Ciric III.

The juveniles learn how to acquire their food with the help of certain gripping, rummaging and tapping movements of the grassy layer. During the summer of 2011, on the Jijia valley, Țigănași commune, we observed a group of juveniles rummaging the cow dung, looking for insects.

During our researches regarding the types of food consumed by the rook we had ten stomachs at our disposal, coming from ten dead specimens found in the nature. We found that one of the stomachs contained waste (egg shells, pieces of raw meat), another one contained starling feathers, the next two contained sun-flower seeds and wheat caryopses (both whole and digested) and the fifth stomach contained fragments of *Geotrupes* sp., (Coleoptera–Scarabeidae) (Fig. 4) and *Lucilia* sp. (Diptera–Bracycera). The rest of five stomachs were empty. Each stomach contained gastroliths.

Figure 4. Fragments of *Geotrupes* sp..

We first collected pellets in 2011, from a juvenile that was bred in captivity. After being fed with vegetables the subject ingested inassimilable ingredients that were subsequently eliminated in an anti-peristaltic sense. The list of administered products contained: mulberries, sour-cherries, Mahaleb cherry fruits (*Padus mahaleb*), elderberries, wheat caryopses, nutmeat, cabbage leaves. From the berry-type fruits the subject eliminated the pits and the ectocarpi (Fig. 5), from the mulberries – the center of sorosis, from the wheat grains – the pericarp and from the cabbage leaves – the nervation. All these vegetable products, except for the walnuts (which are really appreciated) were administered to the young bird by hand in order not to be wasted around the breeding site (an open balcony). The same we did with the animal source food (chicken hearts), but we need to mention that this type of food did not let any traces in the pellets. For each meal, the captive *Corvus frugilegus* individual received a quantity of food of about 37 g.

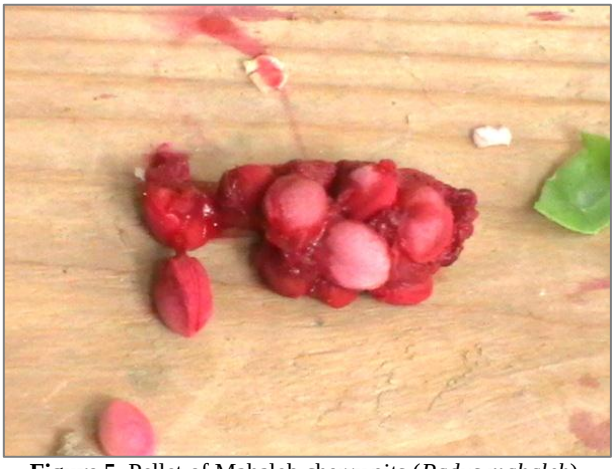

Figure 5. Pellet of Mahaleb cherry pits (*Padus mahaleb*).

In the spring of 2012 we gathered 30 pellets. From these, 15 were from the "Titu Maiorescu" University Campus and the rest from the "Anastasie Fătu" Botanical Garden.

The ingredients of the pellets indicated us that during winter time the basic food of the rook consists of different wastes. We mainly discovered non-alimentary ingredients: plastics, paper and raw material for the gastroliths (gravel, rubble) (Table 1).

Table 1. The analysis of the rook pellets eliminated during the winter of 2011 – 2012.

No.	Date	G (g)	Composition
1.	19.03.2012	3.2	Nylon bags and waste bags
2.	19.03.2012	1.0	Nylon bags
3.	19.03.2012	2.2	Nylon bags
4.	19.03.2012	3.3	Nylon bags, hen egg shells, rubble
5.	19.03.2012	3.2	Nylon bags and rubble
6.	19.03.2012	1.0	Nylon bags and salami skins
7.	19.03.2012	0.6	Nylon bags and salami skins
8.	19.03.2012	1.0	Rubble, nylon bags, bone fragments, synthetic thread
9.	19.03.2012	1.4	Nylon bags and salami skins
10.	19.03.2012	1.7	Animal fodder and pebbles
11.	19.03.2012	0.8	Animal fodder, aluminium foil and a transparent glass shard
12.	19.03.2012	1.1	Rubble and brick fragments
13.	19.03.2012	1.2	Hen egg shell, bone and nylon bags
14.	19.03.2012	0.6	Paper, cellophane and salami skins
15.	19.03.2012	1.9	Ectocarpi and pits from the fruits of the Virginia creeper
16.	19.03.2012	1.5	Coarse fodders for the animals
17.	19.03.2012	2.8	Hen egg shell, rubble and coarse fodders for the animals
18.	19.03.2012	1.6	Coarse fodders for the animals
19.	19.03.2012	3.3	Rubble and nylon bags
20.	19.03.2012	3.1	Rubble and paper
21.	19.03.2012	1.8	Nylon bags, salami skins and coarse fodders for the animals
22.	19.03.2012	1.8	Nylon bags and paper
23.	19.03.2012	2.1	Nylon bags and hen egg shells
24.	19.03.2012	4.1	Rubble, hen egg shells and coarse fodders for the animals
25.	19.03.2012	2.2	Hen egg shells and coarse fodders for the animals
26.	19.03.2012	1.5	Coarse fodders for the animals
27.	19.03.2012	3.1	Paper and hen egg shells
28.	19.03.2012	2.3	Nylon bags and coarse fodders for the animals
29.	19.03.2012	1.3	Paper, nylon bags and coarse fodders for the animals
30.	19.03.2012	1.6	Salami skins, rubble and paper

Conclusions

The rook is a bird which is able to adapt itself to a really wide range of feeding possibilities. It can be met outside the towns, in the plains area and we may notice its preference for the crops, especially after the harvest time when both the fallen grains and the insects are easy to obtain. The rooks can also be seen in the orchards, where they seem to prefer the walnut trees as they have really ingenious methods to break the walnuts open. They let the walnuts fall from the high and they tap them on the shells joint line.

It is difficult to appreciate if the rook can be considered a harmful or useful creature and this differs from place to place or from occasion to occasion. During the harvest time and during the cereals spreading it certainly produces damages to the crops but outside these periods it consumes a lot of insects (especially when feeding their chicks). This is illustrated both by the ethological observations that we made in the settlement from the Tatarasi neighbourhood and by the study made on the stomach content of a baby rook fallen from the nest. The rooks can be limitative factors for the reproduction of other species of urban birds (the dove, the pigeon), as they destroy their chicks, their eggs, but on the other hand, they also destroy the small rodents. Still, the base of their alimentation, at least during winter time, seems to be represented by wastes. They generally avoid collecting their food directly from the kitchen window sills, where other species of birds are fed. During the emancipation period the rook juveniles show an obvious preference for fruits. We observed that the fruits are integrally consumed and the indigestible remnants can be found among the ingredients of the pellets. In order to produce pellets during the winter they ingest especially synthetic materials because these can be found on the trash platforms they use to attend.

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