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Studies on the biometry, foraging- and reproductive biology of the quail *(Coturnix coturnix,* Linnaeus 1758) in Hungary

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SUMMARY

In our study we examined body size, reproduction biology and feeding characteristics on illegally shot quail carcasses in Hungary. During this inspection we collected such a set of data, which could contribute to the understanding of the species' role in the Central European agro ecological environment.

Measurements of cocks (wing length, tail length, bill length, tarso-metatarsus length and body mass) practically corresponded with those found in the literature. Wing length of hens was longer while other measurements were more or less identical with earlier mentioned data. Morphological data set of cocks and hens was compared with t-test, which didn't show significant difference between the sexes (P = 0.95). Data of adult and juvenile cocks were also compared with t-test. Since there was not any statistically significant difference between the two age groups we drew the conclusion that juveniles reach the adult body size until October.

We revealed remarkable genital activity in both sexes. Almost 25% of the adult hens and more than 50% of adult cocks had active genitals. We found no individual in the group of immature and juvenile cocks with active genitals. Thus we assume that wild quail cocks do not reproduce before their second year of life.

As an evaluation of results of the feeding research we concluded that the studied quail population consumed the seed-food practically without selection until the feeling of fullness. The number of plant and animal species in the diet was rather low. The frequency of consumed plant seeds was predominant (93%) while the proportion of animal materials was very low in autumn.

Keywords: quail, *Coturnix coturnix,* feeding ecology, reproduction biology, morphology, biometry.

Introduction

The quail is a small sized representative of the order Galliformes. At the beginning of the 20th century it was a widespread species in Hungary and a very popular game bird. As a result of the population's significant decline its hunting was banned in 1954 and put on the list of protected species in 1971. Nowadays the quail is considered as a vulnerable species because of its unfavourable conservation status. This species is listed in Appendix III. of the Bern Convention, Appendix II. of the Bonn Convention and Annex II/2. of the EU Birds Directive. There are few data on quail's foraging in the literature. The last Hungarian article on this topic was published in 1953. This half-century-long gap can be explained with the species' conservation status: being protected there are difficulties in the collection of data. We were called upon by the authorities as experts to examine illegally shot quail carcasses. During this inspection we had the opportunity to collect such a valuable and unique set of data what could contribute to the understanding of the species' role in the Central European agro ecological environment of today.

Overview of the literature

Quails are migratory birds. Nowadays they prefer field habitats for living and breeding. However it was a typical species of grasslands and wooded steppes formerly, today we find quails mostly in arable land habitats, where agronomical activities have a great influence on their life-conditions and reproduction. Abandoned fields are the most favourable areas for them but they show a preference for agronomical ecotones, too (*Horváth* 1973, *Keve et al.* 1953). In the background of the population's decline there are several factors acting simultaneously. The major component is thought to be the change in the aspects of agronomic production manifesting itself in the cultivation of monocultures and the intensification of farming, e.g. use of herbicides and pesticides (*Horváth* 1973).

Measurements

Measurements of several specimens had been taken by different authors. Breeding individuals and birds of passage was measured in Switzerland by *Sutter* (in *Glutz et al.* 1973). The mean values of different measures of cocks were as follows: wing length 111.1 mms, tail length 37.6 mms, bill length 12.1 mms, tarso-metatarsus length 26.2 mms and the body mass 108.1 grams. Those of hens were: wing length 113.4 mms, tail length 40.3 mms, bill length 11.3 mms, tarso-metatarsus length 26.4 mms and the body mass 116.7 grams. *Warga* (1930) carried out investigations on live birds in Hungary without sexing. He found that the mean wing length was 109.1 mms and the body mass was 87 grams. According to *Horváth* (1973), who studied birds also in Hungary, the measured values were as follows: wing length 100–112 mms, tail length 32–37 mms, bill length 11–12 mms, tarso-metatarsus length 23–28 mms and the body mass 52–125 grams.

Reproduction biology

Central European populations arrive back from their wintering areas in April. Breeding starts normally in May, however, we know about nests as early as in late April (*Horváth* 1973). Due to replacement clutches breeding season may extend even until August. Quails gain sexual maturity at the age of one year but there are records of reproduction in the year of hatching, too. The hen lays one egg each day. Clutch consists of 6–16, normally 9–13 eggs (*Horváth* 1973). Only the hen incubates the eggs. Chicks hatch after a 17–20-day-long incubation period (*Boswell et al.* 1993, *Kerley et al.* 2000).

Feeding biology

The diet of quails varies seasonally and according to age groups. After their springtime arrival quails predominantly feed on green plant material and insects. Considerable proportion of essential amino acids originate from Arthropods. Consumption of insects provides adequate protein resource for egg production. Other related Galliformes (e.g. pheasant and partridge) prefer the most abundant, energy-rich food-sources during the incubation period. In case of this type of food the uptake and handling time is short, thus parents are not forced to stay away for long from the incubated nest (*Horváth* 1973). Hatchlings until the age of 2–3 weeks principally feed on insects. Later they gradually change to plant materials, chiefly half-ripe seeds (*Keve et al.* 1953).

In late summer, before the autumn migration the quail becomes again phytophagous. In this period they take not only ripe but half-ripe and unripe weed seeds. Seeds found in lower-higher proportion in formerly examined craw-contents belonged to 132 species of 32 families. These studies on quails were carried out mostly at the end of summer, in August and in September. Green plant materials were indicated in low quantities from craw-contents, while half-ripe and ripe seeds dominated these samples. Quails mainly took seeds of grass species (*Table 1.*). These plants were present in 93% of examined craw-contents, and the number of species was 23 (*Guyomarc* and *Combreau* 1989, *Badenhorst* and *Kerley* 1996, *Combreau et al.* 2001).

Quails feeding on ground were able to take seeds of cultivated plants after harvesting. Among the fallen cereal seeds wheat was the most common species (19%), which was followed by barley (10%). Seeds of other cultivated plants played insignificant role in the diet of quails. Green plant materials occurred accidentally, while other materials (e.g. underground parts and fruits) were entirely absent even in the phytophagous period of the year. Green parts of plants were present only in minimal quantities in examined craws (*Horváth* 1973).

In certain phases in quails' life (egg-laying, breeding) consumption of animal material is considerable. Quails cover their need for animal protein particularly with feeding on insects. They are able to catch preys moving on the ground or on plants up to the height they can reach. Previous studies suggested that quails take insects and larvae that are unable to fly or move slowly. These surveys didn't reveal a preferred range of body size of preys. Craws, beside large insects, contained very tiny (2–3 mm long) arthropods, too.

Table 1. List of plant species' seeds consumed by quail
(*Horváth* 1973, *Keve et al.* 1953)

English name	Scientific name
Yellow foxtail	*Setaria lutescens*
Green foxtail	*Setaria viridis*
Millet	*Panicum miliaceum*
Annual woundwort	*Stachys annua*
Common amaranth	*Amaranthus retroflexus*
Fat hen	*Chenopodium album*
Knotgrass	*Poligonum aviculare*
Wild mignonette	*Reseda lutea*
Hemp	*Cannabis sativa*
Summer pheasant's eye	*Adonis aestivalis*
Large pheasant's eye	*Adonis flammea*
Black nightshade	*Solanum nigrum*
Darnell	*Lolium temulentum*
Castor-oil	*Ricinus communis*
Dewberry	*Rubus caesius*

Insects found in craws belonged to the following groups: Coleoptera, Hymenoptera, Heteroptera, Ortoptera and Diptera. Among beetles Harpalus, Galeruca and Sitonia species were dominant in spite of their hard chitin shield. Consumption of ants (Formicidae), especially *Tetramorium caespitum* was outstanding (*Keve et al.* 1953).
The proportion of Molluscs in craws was insignificant. Quails swallowed little snails accidentally when taking grits or to meet Ca and P demand.
Quails are considered to be beneficial in agricultural areas for eliminating large amount of weed seeds and insects.

Material and Methods

Material

Studies were conducted on a sample of 50 carcasses hunted illegally in October 2001 in Hungary. The sample included 28 cocks, 13 hens and 9 of unidentified sex. Birds were properly eviscerated and deep-frozen before the examination.

Studies on morphology

After the carcasses had got unfrozen we took body measurements: eviscerated body mass (g), body length (mm), bill length (mm), wing length (mm), length of tarso-metatarsus (mm) and tail length (mm).

Studies on reproduction biology

Birds were sexed on the basis of genitals and additionally the throat patch of cocks was used, too. The sexual activity (active or inactive) was determined according to the sizes of follicles in the ovary of hens and testis of cocks. For aging the birds we took into consider the moult condition. As a result of all these methods we classified cocks into three groups: adult, sub adult and juvenile.
Condition of birds was assessed on the basis of the volume of breastbone's superficial (*musculus pectoralis superficialis*) and profound (*musculus pectoralis profundus*) muscles, i.e. the palpability of furcula (*crista sterni*).

Studies on feeding biology

The craw contents of quails was removed and separated. We determined animal and plant species the level of maturity of seeds present in these samples and all of them were exsiccated. Every component's mass was measured and indicated as mass percentage values compared to the total mass of the craw content.
We also examined the carcasses to find certain signs of possible disorders.

Results

Body measurements

Biometrical data of quails are shown in *Table 2*.

Table 2. Biometrical data of adult cocks, juvenile and immature cocks and hens

	Adult cocks (n = 17)			**Juvenile and immature cocks** (n = 11)			**Hens** (n = 13)		
	x min/max	conf. int	SD	x min/max	conf. int	SD	x min/max	conf. int	SD
Body mass (g)	102.9 85/135	±7.1	14.9	102.3 85/125	±8.0	12.9	110.4 85/140	±9.6	17.6
Wing length (mm)	110.9 95/150	±8.4	17.7	110.9 92/170	±12.6	20.3	127.3 103/180	±15.5	28.4
Tarso-metatarsus (mm)	27.7 17/31	±1.9	4.1	27.8 27/29	±0.6	1.0	29.8 28/34	±1.0	1.8
Tail length (mm)	37.8 28/45	±2.4	5.0	39.0 35/42	±1.8	2.9	37.7 29/44	±2.7	4.9
Body length (mm)	195.9 180/213	±4.8	10.0	189.6 150/204	±9.2	14.8	203.9 185/250	±11.7	21.6
Bill length (mm)	11.2 10/13	±0.4	0.8	11.2 10/13	±0.6	1.0	11.5 10/12	±0.4	0.7

Reproduction biology

Results are shown in *Table 3*.

Table 3. Sexual activity assessed on the basis of genitals

	Hens (%)	**Ad. cocks** (%)	**Imm. cocks** (%)	**Juv. cocks (%)**
Active	23.1	52.9	0	0
Inactive	76.9	47.1	100	100

Feeding biology

The percentage rates of these components are shown in *Table 4*.

Table 4. Frequency distribution of food components in the diet craw content of examined quails

Taxa	**Mass percentage (%)**
Annual Woundwort *(Stachys annua)*	44.54
Wheat *(Triticum aestivum)*	33.21
Little Bristle Grass *(Setaria pumila)*	14.17
Millet *(Panicum miliaceum)*	4.21
Poa sp. *(Poa sp.)*	0.21
Wolf-spiders *(Lycosidae)*	0.67
Ornamental Shield Bug *(Eurydema ornatum)*	0.21
Potsia cuprea	0.08
Unidentified	2.70

Discussion

Body measurements

Morphological data set of adult cocks and hens was analysed with t-test (DF = 16, P = 0.95, t = 2.1199). This revealed that none of the measurements differed significantly between the sexes, e.g. body mass (t = 1.2249), wing length (t = 1.8236), tarso-metatarsus (t = 1.8444), tail length (t = 0.0901), body length (t = 1.2342) and bill length (t = 1.1727). Therefore we may conclude that there isn't any statistically significant difference between the sexes when their morphology is considered.

Data sets of adult and juvenile cocks were compared also with t-test (DF = 16, P = 0.95, t = 2.1199). Since there were no measurements showing statistically significant differences between the two age groups (e.g. body mass (t = 0.1258), wing length (t = 0.0043), tarso-metatarsus (t = 0.1093), tail length (t = –0.6950), body length (t = 1.2422) and bill length (t = 0.1538) we drew the conclusion that juveniles reach the adult body size until October.

According to the data found in literature the measurements of hens and cocks are very similar. Differences of mean values of certain morphological data of cocks and hens in the majority of cases do not exceed even 5 per cent. Cocks' measurements (wing length, tail length, bill length, tarso-metatarsus and body mass) practically corresponded with those found in the literature, while hens' data differed more. Wing length of hens was in average 10 per cent longer than the values mentioned in earlier studies. Other measurements (tail length, bill length, tarso-metatarsus and body mass) were more or less identical. Since there were no former statistical evaluations on biometrical data it was impossible to analyse differences by exact mathematical methods.

Reproduction biology

Despite of the fact that quails have already stopped breeding for 2–4 months, in October, when our study was conducted we could still reveal remarkable genital activity in both sexes. Almost 25 per cent of the adult hens and more than half of adult cocks had active genitals. Since we couldn't distinguish the age groups of hens we expect the genital activity of adult hens to be very similar to the above-mentioned value of adult cocks.
We did not find any individual in the group of immature and juvenile cocks with active genitals, indicating that wild quail cocks do not reproduce before their second calendar year.

Feeding biology

Studied individuals predominantly consumed Annual Woundwort (*Stachys annua*) and Wheat (*Triticum aestivum*). Little Bristle Grass (*Setaria pumila*) and Millet (*Panicum miliaceum*) were present in smaller, but not neglectable quantities, while the number of seeds of Poa species (*Poa sp.*) was unimportant.
The number of animal species and their mass percentage in the diet of studied quails was very low. Referring to the season of study this coincides with the data found in former studies.
In each craw the number of diet components was low (varying between 1 and 4, mean = 2.1).
As an evaluation of the results of the feeding research we may conclude that the studied quail population consumed the seed-food practically without selection until the feeling of fullness. Our studies failed to show any kind of food preference. We find this ability very important, since this trait contributed significantly to the quail population increase recorded recently in Hungary.

A fürj (*Coturnix coturnix*, Linnaeus 1758) biometriai, táplálkozás- és szaporodásbiológiai vizsgálata Magyarországon

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Összefoglalás

A fürj a tyúkalakú madarak egyik kistermetű képviselője. Az 1900-as évek elején nagy tömegben élt Magyarország területén és igen népszerű volt vadászata. A állomány drasztikus csökkenése miatt 1954 óta tilos a vadászata és 1971 óta védett madár. Ma Európában a kedvezőtlen védelmi helyzetű fajok közé sorolják, azaz sebezhető (vulnarable) fajnak tartják. E faj szerepel a Berni Egyezmény III. mellékletében, a Bonni Egyezmény II. függelékében, valamint az EU Madárvédelmi Irányelvek II/2. mellékletében is. A szakirodalomban kevés adatot találunk a fürjek táplálkozásáról. A fürjek táplálkozásával foglalkozó utolsó hazai publikáció 1953-ban jelent meg. A fél évszázados űrt a fürj státusából fakadó védettség és ezáltal a mintagyűjtés problémája okozta. Szakértőként hatósági felkérésre vizsgálatot végeztünk illegálisan elejtett fürj tetemeken. A vizsgálat során olyan értékes és hiánypótló anyaghoz jutottunk, ami hozzájárulhat a fürj Közép-Európa jelenlegi agroökológiai környezetében betöltött szerepének megismeréséhez.

A vizsgálatainkat Magyarországon 2001 októberében elejtett, 50 vegyes ivarú (28 kakas, 13 tojó és 9 meghatározhatatlan) fürj tetemen végeztük el.

Vizsgálatainkban a kakasok szárnyhossza, farokhossza, csőrhossza, csüdhossza és testtömege nagyjából megegyezett a szakirodalmi adatokkal. A tyúkok esetében a szárnyhossz értéke volt nagyobb, a többi méret hozzávetőlegesen megegyezett a korábbi szakirodalmi adatokkal. Az ivarok testméreteit t-próbával összehasonítva megállapítottuk, hogy azok nem különböznek egymástól 95%-os megbízhatóság mellett. Az adult és a juvenilis kakasok testméreteit szintén t-próbával vizsgálva nem tudtunk statisztikailag igazolható különbséget kimutatni, így megállapítható, hogy az azévi fiatal madarak októberre elérik a kifejlett kori testméreteket.

A szaporodásbiológiai vizsgálatok eredményeit összefoglalva elmondhatjuk, hogy magas ivarszervi aktivitást mutattunk ki mind a két ivarban. Így az adult tyúkok majdnem negyede, az adult kakasok több, mint fele rendelkezett aktív állapotú ivarszervekkel.

Mivel a juvenilis és az immaturus kakasok közül egy sem mutatott ivarszervi aktivitást feltételezzük, hogy a szabadon élő fürjkakasok legkorábban a kikelésüket követő évben vesznek részt a szaporodásban.
A táplálkozási vizsgálatok eredményeit összefoglalva elmondhatjuk, hogy az általunk vizsgált fürjek a rendelkezésre álló mag táplálékot gyakorlatilag válogatás nélkül jóllakásig fogyasztják. A fogyasztott növény- és állatfajok száma egyaránt igen kevés. A tápanyagok közül a növényi magvak fogyasztása (96,3%) jóformán kizárólagos, az állati táplálékösszetevők aránya az őszi időszakban rendkívül kicsi volt.
Kulcsszavak: fürj, *Coturnix coturnix,* táplálkozásökológia, szaporodásbiológia, morfológia, biometria.

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