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Prey composition of the little owl *Athene noctua* in an arid zone (Egypt, Syria, Iran)

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A b s t r a c t . The little owl is the only owl whose pellets were found in extreme desert conditions. Pellets were collected at 34 roosting sites in Egypt, Syria and Iran in 1996–2002. Altogether 5 939 prey items identified in the food in these countries belonged to 4 classes, 14 orders, 42 families, 92 genera and about 180 species of invertebrates. Mammals included 36 species (9.7 %), birds 33 taxa (3.0 %), amphibians only 3 ind., but reptiles (4.3 %, Lacertidae, Agamidae and Gekkonidae) were more abundant than in European studies. Pellets from all countries contained abundant deserticolous species of mammals (genera *Gerbillus, Meriones, Cricetulus, Allactaga*), eudominant deserticolous tenebrionid beetles (i.e. *Pimelia* spp., *Blaps*) (16.4–26.8%, in total 19%), dominant coprophagous and deserticolous species of Scarabeidae (5.9–8.6%, in total 6.8%), grasshoppers and crickets (Orthoptera, 5.7–16.4%, in total 9.7%). Significant and characteristic components of food in these arid countries were poisonous sunspiders (Solifugae 4–11.4%), but also scorpions (Scorpionidea, 0.2–3.3%), neither being found in pellets from Europe, and earwigs (Dermaptera, 1.7–13.4%).

Key words: diet, *Athene noctua*, desert, Middle East, Mediterranean

Introduction

The little owl has a distribution ranging from the Atlantic to the Pacific Ocean, and from 20° to 55° N. Its distribution in various zoogeographic areas significantly influences its prey composition (for C Europe G l u t z & B a u e r 1980, W Palearctic – G é n o t & N i e u w e n h u y s e 2002). The largest differences are expected between sites belonging to temperate, subtropical and tropical zones, because of differences in food supply. The proportion of invertebrates, mainly insects, in food should increase gradually from C Europe to the Mediterranean zone (d e l H o y o 1999). However, from the arid zone, only partial results have been published from Egypt (G o o d m a n 1988), Jordan (A l - M e h i m et al. 1997), Israel (M i e n i s 1971, Z i n n e r 1988), Tunisia (V e r n o n et al. 1973, K a y s e r 1995), and also from several countries of the former Soviet Union, e.g. from the Caspian Sea (G u s e v 1956, P o p o v 1962) and the Aral Sea (I s h i n i n 1965).

Analyses of pellets from central Europe showed a dominance of insects, first of all in the vegetation period and during breeding. Other methods (video-camera) have identified of a high presence of earthworms (Lumbricidae, i.e. J u i l l a r d 1984, V a n Z o e s t & F u c h s 1988).

During expeditions to the countries of the SE Mediterranean zone and the Middle East from 1996–2002 we collected samples of pellets of this bird in Egypt, Syria and Iran. The quantitative analysis of food remains has enabled us to outline the variability of food spectra

from 34 samples, and characterize the specific features of the diet of the little owl in arid zones, in comparison to the other parts of the Palaearctic.

Study Area and Study Sites

Pellets from five localities in Egypt (E 1-5), 12 samplings from Syria (S 1–12) and 17 samplings from Iran (I 1-17) along the altitudinal gradient (from –45 m to 1860 m a.s.l.) were analysed (the abbreviations see also in Fig. 1, Appendix 1. and Tables 2, 3).

Egypt

1. Siwa – centre of an oasis, an abandoned and destroyed old medina, 12.4.2002, 29° 12' N, 25° 31'E, 100 m a.s.l.
2. Al Qasr – W edge of oasis Dakla, one of the crypts of sheiks, 17.4.2002, 25° 42'N, 28° 51'E, 50 m a.s.l.
3. Tineida – E edge of oasis Dakla, sandstone towers at the desert's boundary, 18.4.2002, 25° 28'N, 29° 20'E, 50 m a.s.l.
4. Sakkara – pyramids, 1 km from the irrigated valley of the Nile River, 15.4.2002, 29° 48'N, 31° 11'E, 100 m a.s.l.
5. Faiyum – an abandoned building near to a hotel on the shore of the lake Birket Qarum, 28.4.2002, 29° 29'N, 30° 46'E, – 45 m a.s.l.

Syria

1. Maaloula – a limestone canyon, 1 km S from the town, stony semidesert, 30.4.2001, 33° 51'N, 36° 32'E, 1400 m a.s.l.
2. Resafa – ruins of a town, abandoned in the 11th century, 14.4.2001, 35° 38'N, 38° 46'E, 310 m a.s.l.
3. Halabiyeh – walls of a Romanian fortress ancient ruins on the right shore of the Eufrat River, 15.4.2001, 35° 41'N, 39° 49'E, 270 m a.s.l.
4. Zalabiyeh – walls of a Roman fortress ancient ruins on the left shore of the Eufrat River, 5 km E from the former, 15.4.2001, 280 m a.s.l.
5. Tell Sheikh Hamad – archaeological excavations on the left bank of the River Khabur, 19.–20.6.1996, 35° 39'N, 40° 44'E, 280 m a.s.l.
6. Tell Sheikh Hamad – the same locality, 18.4.2001
7. As Suwar – a settlement on the right shore of the Khabur River, an abandoned building, 18.4.2001, 35° 38'N, 40° 42'E, 280 m a.s.l.
8. Qal at Rabah – rocks by the Arabian castle 1 km from a town, 21.4.2001, 35° 01'N, 40° 40'E, 240 m a.s.l.
9. Dura Europos, rocks under a Roman fortress, above Eufrat River, 19.4.2001, 34° 45'N, 40° 44'E, 200 m a.s.l.
10. Mari, archeological excavations, 18.6.1996, 34° 33'N, 40° 54'E, 190 m a.s.l.
11. Qasr al Hayr, ruins of the Arabian hunting-lodge in the desert, 21.4.2001, 35° 04'N, 39° 04'E, 280 m a.s.l.
12. Rashid, 10 km E from the settlement in basaltic rocks in black desert, 26.4.2001 32° 40'N, 36° 40'E, 1000 m a.s.l.

Iran

1. Robat Sharwaf – 25 km SW from Gonbadli, a fortress caravanserai in the desert, 11.5.1997, 36° 16'N, 60° 39'E, 560 m a.s.l.
2. Robat-e-Chah Gonbad – a fortress caravanserai in the desert, 8.–9.5.1997, 33° 30'N, 57° 38'E, 1120 m a.s.l.
3. Esfahk – abandoned part of a settlement damaged by an earthquake, 11.10.2002, 33° 25'N, 56° 48'E, 60 m a.s.l.
4. Shah Abbasi – two fortress caravanserais in the desert, 11.–12.10.2002, 32° 43'N, 55° 22'E, 1150 m a.s.l.
5. Jafar Abad – 5 km SE from Deh Zire, abandoned buildings in the oasis, 27.4.1996, 33° 46'N, 51° 49'E, 800 m a.s.l.
6. Kashan – above the alluvium of a small river, 10 km W from the town, 2.5.1997, 33° 59'N, 51° 17'E, 1100 m a.s.l.

7. Natanz – an abandoned mosque on the town periphery, 2.5.1997,
   33° 31'N, 51° 54'E, 1680 m a.s.l.
8. Espidan – over the alluvium of a small river, near a settlement 3 km E from Nasran, 2.5.1997,
   33° 27'N, 52° 02'E, 1330 m a.s.l.
9. Nain – ruins of the Zoroastrian temple in the centre of the town, 3.5.1997,
   32°52'N, 53° 05'E, 1560 m a.s.l.
10. Yazd – W town edge, rocks near Zoroastrian Towers of Silence, 6.4.2000
    31° 49'N, 54° 21'E, 1320 m a.s.l.
11. Yazd – the same locality, 12.10.2002
12. Fahrej – sandstone towers 5 km NW from the settlement, 7.5.1997,
    28° 59'N, 58° 50'E, 620 m a.s.l.
13. Pasargad, an abandoned building in an archaeological area, 13.10.2002,
    30° 14'N, 53° 01'E, 1860 m a.s.l.
14. Sarvestan – under the outer walls of an old mosque, 20.4.2000,
    29° 20'N, 53° 05'E, 1600 m a.s.l.
15. Firuz Abad – an old mosque Atas Kade, 20.4.2000,
    28° 53'N, 52° 30'E, 1500 m a.s.l.
16. Chahak – 20 km from Bandar-e Ganaveh, rocky town 5 km from seashore 15.10.2002,
    29° 39'N, 50° 27'E, 10 m a.s.l.
17. Choqa Zambil – wall of a gully by a ziggurat, 18.10.2002,
    32° 01'N, 48° 32'E, 70 m a.s.l.

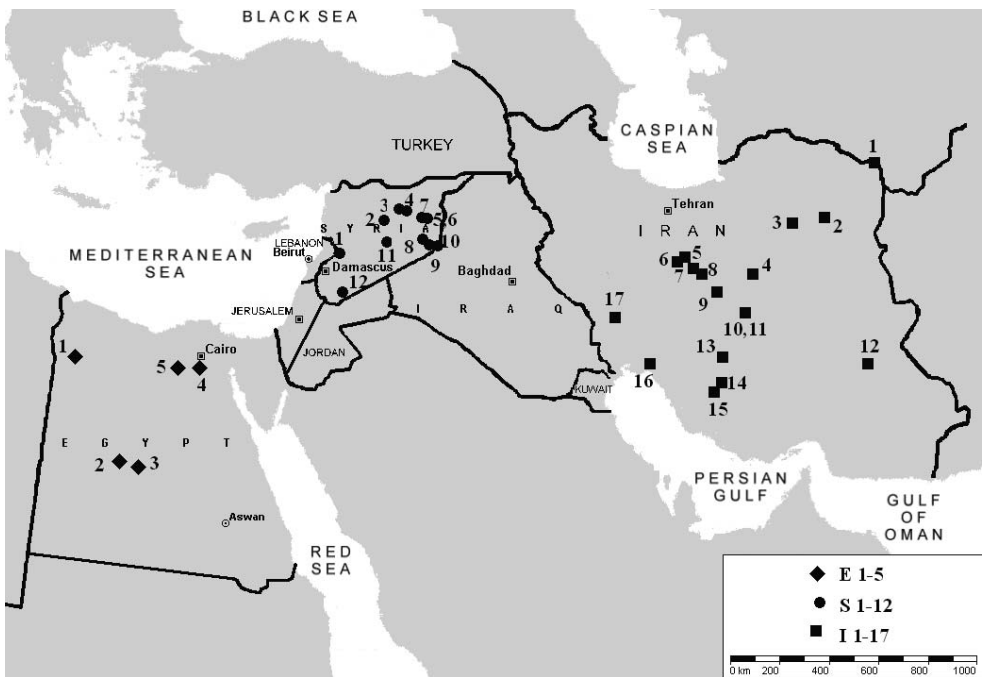

Fig. 1. Map of study area with distinguished study sites (E1-5, S1-12, I1-17).

Material and Methods

The pellets were collected from roosting sites (abandoned buildings, ruins and rocks – see description of the study sites) during a series of one month expeditions organized by the Faculty of Natural Sciences of the Charles University, Praha and Department of the Natural Sciences of The National Museum in Praha: Egypt 2002, Syria 1998, 2001 and Iran

1996,1997, 2000 and 2002. The samples were treated in 5 % NaOH to decompose hair and feathers. The identification of the prey species was performed on the following bones: skulls in mammals and reptiles: bill, humerus, metacarpus and tarsometatarsus in birds and os ilium in frogs. Prey abundance was determined according to the highest abundance of the examined bones. The identification of the osteological material was done through comparison with skeletons of chordates in collections of the Botanic Garden of the Comenius University in Blatnica and also with the data from literature Lay (1967), Harrison & Bates (1991), Kumerloeve (1975), Osborn & Helmy (1980), Mendelssohn & Yom-Tov (1987), Gromov & Erbajeva (1995) and Porter et al. (1996). Examining the material under a stereomicroscope Meopta (magnification 5–25x), we identified invertebrate taxa and determined their abundance based on the characteristic parts of their bodies (i.e. heads of insects, chelicera of sunspiders, claws of scorpions). The list of abundance of the individual taxa in the individual samples is in Appendix 1.

The quantitative analysis of the samples was performed using the marked differences from the mean method (MDFM, Obuch 2001). The values of positive (+) and negative (-) MDFM are given together with the values of the absolute (Tables 1–4), or relative (Table 5) abundance. The taxa and samples were ranked based on the similarity of the (+) values of MDFM (Tables 1–5). Values 1+, 2+, 1-,2-, etc. indicate the degree of marked differences and they are calculated as in Obuch (2001)

Tables 1–4 summarise the proportion of the individual species of mammals and birds, families of reptiles and the orders and classes of invertebrates, Table 5 compares the food composition according to the classes.

Results

Food composition in Egypt (Table 1, Appendix 1)

The collected material altogether comprised 1 315 prey items, belonging to 4 classes, 12 orders, 32 families, ca. 69 genera and 125 species of invertebrates. Mammals (10.0 %) were represented by 8 species, birds (1.5 %) by 8 taxa. We have also observed unidentified species of frogs (Anura) and lizards (Lacertidae) (together 2.6 %). From invertebrates, dominant and regularly present were the beetles from the family Tenebrionidae (n = 26.8%) (from species >15 mm primarily the genera *Pimelia, Blaps*, <12 mm mainly *Gonocephalum, Opatrum*), followed by earwigs (Dermaptera, 13.4%), represented by two species belonging to the families Labiduridae and Forficulidae, locusts of the family Acrididae (9.3%) and the beetles of the family Scarabeidae (8%), mainly *Scarabeus, Typhoeus*. In one locality mantids (*Mantis*) were abundant, in three (from five in total) were found smaller species of solifugs (mainly Solpugidae). Compared with Syria and Iran, we found significantly lower number of scorpions (only the genus *Buthus* sp.).

The differences between the individual samples were considerable (Table 1): in Siwa were found high proportion of insects, in Al Qasr were abundant lizards and sunspiders, near Tineida gerbils (*Gerbillus*), in Sakkara beetles (Coleoptera), in Faiyum synantropic rodents (*Mus, Rattus*).

Food composition in Syria (Table 2, Appendix 1)

Altogether 2 700 prey items belonged to 3 classes, 10 orders, 31 families, about 75 genera and about 133 species of invertebrates. Mammals (6.3 %) were represented by 14 species, birds (2.3

Table 1. Food composition of the little owl in Egypt (in number of individuals, marks + and – show marked differences MDFM between study sites, values 1+, 2+, 1-,2-, etc. indicate the degree of marked differences).

Prey \ Study site	Siwa	Al Qasr	Tineida	Sakkara	Faiyum	Total n	[n%]
Orthoptera	2+ 102	49	11	2- 13	1- 40	215	16.35
Hymenoptera	1+ 21	9	3	2- 0	1- 16	49	3.73
Mantodea	1+ 12					12	0.91
Diptera	1+ 7	6			1- 0	13	0.99
Solifugae	13	2+ 35	5	2- 0	3- 0	53	4.03
Lacertidae	4	1+ 16		11	1- 3	34	2.59
Gerbillus amoenus		2	1+ 9	4	1- 0	15	1.14
Coleoptera	1- 56	95	49	1+ 247	1- 132	579	44.03
Dermaptera	2- 6	33	11	2- 5	1+ 121	176	13.38
Araneidea	1	2	1	1- 0	1+ 21	25	1.90
Mus cf. *domesticus*	2- 1	1- 6	1- 1	1- 7	1+ 80	95	7.22
Rattus rattus					1+ 8	8	0.61
Gerbillus pyramidum		6	2	1		9	0.68
Phylloscopus sp.	1	1			2	4	0.30
Mammalia	**3- 1**	**1- 15**	**12**	**1- 13**	**1+ 91**	**132**	**10.04**
Aves	**3**	**4**	**3**	**4**	**6**	**20**	**1.52**
Amphibia, Reptilia	**4**	**1+ 16**	**0**	**11**	**1- 5**	**36**	**2.74**
Evertebrata	**218**	**229**	**82**	**265**	**333**	**1127**	**85.70**
Total n	226	264	97	293	435	1315	100
Index of diversity H'	2.29	2.74	2.39	0.98	2.54		

%) by 22 taxa, one species of Anura; from the reptiles mainly Lacertidae (3.0 %) and Agamidae (0.9 %). Ants of the family Myrmicidae (n = 39.5%) were eudominant food component in three of the 12 localities. We suggest that the ants had been associated with cadacers when eaten. Similarly to Egypt and Iran, there was regular and high presence of beetles of families Tenebrionidae (16.4%), Scarabeidae (5.3%). Dominant were also sunspiders (Solifugae, 6%). Earwigs (Dermaptera) – a regular component in the diet of the little owl, were in Syria infrequent (1.7%). More abundant were poisonous scorpions (Scorpionidea – 3.3%), primarily the genera *Androctonus, Buthus* (s.l.) from families Buthidae and Diplocentridae.

Of reptiles, Lacertidae were more abundant in samples from the ruins of Resafa and Agamidae from the ruins of Halabiyeh and from the black desert. Of mammals, the highest abundance was observed in *Mus* cf. *macedonicus* (3.8 %), primarily in localities in irrigated fields. In Eastern Syria, near rivers gerbil *Gerbillus mesopotamiae* (0.9 %) was quite abundant.

Food composition in Iran (Table 3, Appendix 1)

Altogether 1 924 prey items belonged to two classes, 10 orders, 28 families, 75 genera and about 135 species of invertebrates. The proportion of mammals was the highest (13.4 % – 24 species) of all three studied countries. Birds (4.9 %) were represented by 18 taxa, reptiles were abundant, with Gekkonidae (3.6 %), Lacertidae (3.0 %) and Agamidae (1.5 %).

In addition to dominant tenebrionids (17.2%), we found an unexpectedly high proportion of sunspiders (11.4%), primarily species belonging to the family Solpugidae. Also abundant were ants of the family Myrmicidae (9.2%), large species (>33 mm) of earwigs (Dermaptera, 6.5%) and scarabeids (4.9%).

Table 2. Food composition of the little owl in Syria (in number of individuals, explanations – see Table 1).

Prey\ Study site	2	3	11	12	7	8	4	5	6	9	10	1	Total n	[n%]
Lacertidae	1+ 30	18	6	3	10	3	4	1- 0	1- 0	1	6	1- 0	81	3.00
Agamidae	1- 0	1+ 16	1	1+ 6							1		24	0.89
Hymenoptera	1+457	1+368	1+158	2- 13	3- 9	2- 15	2- 11	1- 30	2- 20	2- 13	3- 3	2- 27	1124	41.63
Solifugae	4- 0	2- 3	1+ 26	2+ 30	2+ 51	1+ 17	11	6	2- 0	3	4	14	165	6.11
Coleoptera	2- 56	2- 33	76	43	1+103	1+ 75	1+ 93	45	1+ 93	1+ 54	24	58	753	27.89
Dermaptera	2- 0	1- 3	1- 0		1		1+ 8	2+ 22		6	6	1	47	1.74
G. mesopotamiae	1- 1	1- 0			5			1+ 8	1+ 6		3	2	25	0.93
M. macedonicus	3- 1	2- 2	2- 1	1- 0	13	7	9	1+ 16	1+ 14	2+ 27	1+ 13	1- 0	103	3.81
Gastropoda							1+ 5						5	0.19
Araneidea					4		1	1+ 6	4			1	16	0.59
Orthoptera	1- 20	22	2- 1	13	10	7	7	11	1- 1	4	1+ 15	2+ 44	155	5.74
Scorpionidea	3- 0	2- 1	9	9	1+ 22	1	4	1- 0	10	2		2+ 32	90	3.33
C. migratorius												1+ 6	6	0.22
P. domesticus			2			1		1	1		4	2	11	0.41
G. dasyurus				4	3						1	1	9	0.33
M. tristrami				2	1		2					2	7	0.26
G. cristata				1				1	1	2	2		7	0.26
A. arvensis			2					1	2				5	0.19
Alaudidae			1	3								1	5	0.19
P. kuhlii	1								1		3		5	0.19
Mammalia	**3- 3**	**3- 2**	**1- 6**	**9**	**1+ 22**	**8**	**11**	**1+ 27**	**1+ 23**	**2+ 30**	**1+ 19**	**9**	**169**	**6.26**
Aves	**2- 2**	**1- 3**	**10**	**1+ 12**	**4**	**2**	**1**	**3**	**7**	**3**	**1+ 11**	**5**	**63**	**2.33**
Amphib. Reptilia	**30**	**1+ 34**	**8**	**9**	**10**	**3**	**5**	**1- 0**	**1- 0**	**1**	**7**	**1- 0**	**107**	**3.96**
Evertebrata	**534**	**434**	**270**	**108**	**200**	**115**	**140**	**120**	**134**	**83**	**1- 48**	**175**	**2361**	**87.44**
Total n	569	473	294	138	236	128	157	150	164	117	85	189	2700	100
Index of diversity H'	1.01	1.28	1.92	3.08	2.53	1.95	2.21	2.81	2.26	2.32	3.21	2.53		

Table 3. Food composition of the little owl in Iran (in number of individuals, explanations – see Table 1).

Prey\ Site	14	3	9	13	10	15	4	5	17	16	6	7	12	2	11	1	8	Total n	[n%]
G. cristata	1+ 5								1	1			1	2		3	2	15	0.78
C.migratorius	1+11	1+6	3+32	1		2	2- 0	8			4	2	1- 0	1- 0	1- 0	2		68	3.53
P.domesticus	1	1	2+19	1		1	3	5		1		1			1		4	38	1.98
M. abbotti	3		2+12	1+10	2	2	1- 0	1			1	1	1	1			1	35	1.82
Hymenoptera	8	3	2- 0	1+14	2+57	1+16	1+56	1- 6	10	2- 0	1-10	8	2- 4	1-12	1- 8	6	2	220	11.43
Orthoptera	9	5	1- 1	5	8	1+12	1+59	1+23	1+20	1+23	10	1- 6	3- 0	2- 2	14	8		205	10.65
M. libycus			1				1+12	1+ 6				1		1				21	1.09
G. nanus							1+18	1	1		1		1+16		1			38	1.98
P. pipistrellus						1+ 5												5	0.26
Mus sp.									2+19									19	0.99
Scorpionidea	4	2			1		9	1	4	2+25	3	2	1- 1	1	3	1		57	2.96
Solifugae	1- 3	3	1- 2	1- 0	2- 0	1- 1	26	15	10	1+19	2+74	1+22	2- 3	15	21	1- 4		218	11.33
Dermaptera	2		1- 0	1- 0	1- 0		3- 0	1+26	1- 0	4	2- 0	2+32	2+ 53	2- 0	5	2		124	6.44
Coleoptera	36	14	2- 5	1+32	1- 8	1-10	82	56	1-22	1-10	1-28	1-23	1+101	1+73	56	29	6	591	30.72
A. elater			1		2		2							2+15	2			22	1.14
M. crassus					1					2				1+8	5			16	0.83
Lacertidae			1				1- 1	1+ 8	4			1	4	2+22		2		43	2.23
Gekkonidae		4			5		5		3	1			1- 0	1- 0	2+26	1+8		52	2.70
Agamidae	1		1			2	8		1		3			4	1	1		22	1.14
Araneidea				1		2							5		2			10	0.52
J. jaculus										2			5	2				9	0.47
M. persicus	2				1						3		1			2		9	0.47
Alaudidae	2													2		3		7	0.36
S. etruscus	1			1				2	1			1						6	0.31
C.suaveolens								2	2							1		5	0.26
Mammalia	**19**	**6**	**2+47**	**15**	**1- 6**	**9**	**34**	**24**	**1+23**	**1- 5**	**1- 9**	**1- 8**	**24**	**28**	**1- 8**	**9**	**1**	**275**	**13.36**
Aves	**1+10**	**1**	**2+23**	**1**	**1- 0**	**3**	**1- 5**	**6**	**4**	**8**	**1- 1**	**2**	**1- 3**	**10**	**1- 2**	**1+9**	**1+6**	**94**	**4.89**
Amph., Rept.	**1- 1**	**4**	**2**	**1- 0**	**5**	**2**	**14**	**9**	**8**	**1- 1**	**1- 3**	**1- 1**	**1- 4**	**1+26**	**1+27**	**1+11**	**0**	**118**	**6.13**
Evertebrata	**62**	**27**	**3- 8**	**52**	**74**	**41**	**237**	**127**	**66**	**81**	**127**	**93**	**168**	**103**	**109**	**54**	**8**	**1437**	**74.69**
Total n	92	38	80	68	85	55	290	166	101	95	140	104	199	167	146	83	15	1924	100
I. divers. H'	3.06	2.58	2.49	2.15	1.71	2.78	2.85	2.88	3.08	2.80	2.20	2.68	2.09	2.74	2.66	3.39	2.04		

The diversity of study sites throughout Iran area was reflected in evident differences in the composition of the individual samples. Differences were also observed between the samples from within a locality collected in different years (Yazd, 2000 and 2002). Four samples contained fairly abundant Orthoptera (10.8 %) and Hymenoptera (11.6 %), three samples Coleoptera (31.2 %) and Solifugae (11.5 %). Of mammals there were abundant *Cricetulus migratorius* (3.5 %) and *Mus* cf. *abbotti* (1.9 %), in the Mesopotamian lowlands the second being replaced by the taxon *Mus* sp. In deserts there were abundant gerbil

Table 4. Comparison of prey composition in the little owl *Athene noctua* from Egypt, Syria and Iran. (in number of individuals, marks + and – show marked differences between study countries, explanations – see Table 1).

Prey \ Country	Egypt	Syria	Iran	Total n	[n%]
Mus cf. *domesticus*	2+ 95	4- 0	3- 0	95	1.60
Rattus rattus	1+ 8	1- 0	1	9	0.15
Gerbillus pyramidum	1+ 9	1- 0		9	0.15
Gerbillus amoenus	1+ 15	1- 0	1- 0	15	0.25
Dermaptera	1+ 176	2- 47	124	347	5.84
Mantodea	1+ 12	2	1- 0	14	0.24
Coleoptera	1+ 579	753	591	1923	32.38
Diptera	1+ 13	1- 0	1	14	0.24
Orthoptera	1+ 215	1- 155	205	575	9.68
Araneidea	1+ 25	1- 16	1- 10	51	0.86
Mus cf. *macedonicus*	3- 0	1+ 103	4- 0	103	1.73
Gerbillus dasyurus		1+ 9		9	0.15
Gerbillus mesopotamiae	1- 0	1+ 25	2- 0	25	0.42
Scorpionidea	3- 2	1+ 90	57	149	2.51
Hymenoptera	3- 49	1+1124	1- 220	1393	23.46
Cricetulus migratorius	3- 0	2- 6	2+ 68	74	1.25
Gerbillus nanus	2- 0	3- 0	2+ 38	38	0.64
Gekkonidae .	2- 0	3- 0	2+ 52	52	0.88
Allactaga elater	1- 0	2- 0	1+ 22	22	0.37
Jaculus jaculus		2	1+ 9	11	0.19
Mus cf. *abbotti*	1- 0	2- 0	1+ 35	35	0.59
Mus sp.	1- 0	2- 0	1+ 19	19	0.32
Meriones libycus	1- 0	2- 0	1+ 21	21	0.35
Meriones crassus	1- 0	1- 3	1+ 16	19	0.32
Meriones persicus		1- 0	1+ 9	9	0.15
Galerida cristata	1	7	1+ 15	23	0.39
Passer domesticus	1- 3	1- 11	1+ 38	52	0.88
Agamidae	2- 0	24	1+ 22	46	0.77
Lacertidae	34	81	43	158	2.66
Alaudidae	1	5	7	13	0.22
Isoptera		4	7	11	0.19
Suncus etruscus		3	6	9	0.15
Pipistrellus kuhlii		5	3	8	0.14
Mammalia	**132**	**1- 169**	**1+ 275**	**576**	**9.70**
Aves	**1- 20**	**1- 63**	**1+ 94**	**177**	**2.98**
Amphibia, Reptilia	**1- 36**	**107**	**1+ 118**	**261**	**4.39**
Evertebrata	**1127**	**2361**	**1437**	**4925**	**82.93**
Total n	1315	2700	1924	5939	100
Index of diversity H'	2.56	2.46	3.41		

Gerbillus nanus (2.0 %), jirds *Meriones libycus* (1.1 %) and *M. crassus* (0.8 %) and jerboa *Allactaga elater* (1.1 %). Of larger mammals (> 200 g), the pellets contained pika *Ochotona rufescens* (1 ind.), bandicoot rat *Nesokia indica* (2 ind.) and indian gerbil *Tatera indica* (3 ind.). *Passer domesticus* (2.0 %) was the most abundant bird recorded.

Comparison of prey structure between the countries under study

Altogether 5939 prey items identified in the food of the little owl in the three studied countries belonged to 4 classes, 14 orders, 42 families, 92 genera and about 183 species of invertebrates. The mammals were present with 36 species (9.7 %), birds with 33 taxa (3.0 %), amphibians with only 3 ind., reptiles (4.3 %), mainly Sauria from families: Lacertidae, Agamidae and Gekkonidae (Table 4, Appendix 1).

In all countries we found abundant deserticol species of tenebrionids (*Pimelia* spp., *Blaps, Opatrum, Gonocephalum*) (16.4–26.8%, in total 19%), coprophagous and deserticol species of Scarabeidae (*Scarabeus, Aphodius, Ontophagus*) (5.9–8.6%, in total 6.8%), grasshoppers and crickets (Orthoptera, 5.7–16.4%, in total 9.7%), mainly locusts (Acrididae)(3.8–10.1%, in total 5.4%). Significant and characteristic components of food in all these arid countries were sunspiders (4–11.4%), less scorpions (Scorpionidea, 0.2–3.3%), both not found in the pellets from Europe and earwigs (Dermaptera, 1.7–13.4%) (Table 4), frequently found also in Europe. Specific features of the composition of the little owl's diet linked with the individual countries were primarily determined by the availability of the given taxa in the food supply. Certain taxa were present in its food only in certain countries, i.e. Egypt – crab (Decapoda), antlions (Myrmeleonidae), click beetles (Elateridae); Syria – Meloidae, Coccinellidae; Syria and Iran – termites (Isoptera); Iran – bugs (Heteroptera) and water beetles (Hydrophilidae). However, there can be local variations and the absence of certain species can be connected with lower numbers of the prey samples and the collected pellets.

In the samples from Egypt insects of following orders were more abundant: Dermaptera, Mantodea, Coleoptera, Diptera and Orthoptera. From the mammals there were present synantropic species *Mus* cf. *domesticus*, *Rattus rattus* and arid species of gerbils *Gerbillus pyramidum* and *G. amoenus*. In Syria were abundant Hymenoptera, primarily ants and local species of mice (*Mus* cf. *macedonius*) and gerbils (*G. dasyurus* and *G. mesopotamiae*). The samples from Iran in general showed higher proportion of mammals, birds and reptiles – compared to the other two countries (8 species of mammals with plus MDFM, from birds *Passer domesticus* and *Galerida cristata*, from reptiles Gekkonidae and Agamidae).

Discussion

Characteristic features of the diet in arid zone

The little owl is the only owl, whose pellets were found in extreme desert conditions. In rocks on the desert boundary we found pellets of *Bubo bubo* (Iran, Syria), *B. ascalaphus* (Egypt) and *Strix butleri* (Israel, SE Iran). Pellets of *Tyto alba* and *Asio otus* were collected only in buildings or under trees in agricultural land. Collecting the material in the desert Dasht-e Lut in Iran we found the pellets of the little owl in abandoned fortresses – caravanserais several tens of kilometres from the human settlements in oases. In extreme arid conditions with a low

density of the potential prey, the little owl forages in a typical "nomadic" manner. Settled in a lurking place, the bird exploits the entire surrounding area and than it moves to another part of the desert. For example, in May 1997, we collected pellets in the fortress Robat-e-Chah Gonbad (I2) immediately after the bird had abandoned this site. When we visited the same locality in October 2002, we found no pellets. In Egypt, the little owl penetrated into oases separated from the valley of the Nile River and from the shore of the Mediterranean sea by hundreds kilometres of deserts. Of mammals, the little owl preferred gerbils (*Gerbillus* spp.), very rarely it also fed on birds, and important in the diet were Sauria. However, the key importance for its survival in desert is in adaptation to preying on various groups of invertebrates. The bird not only feeds on larger species of beetles, scorpions and sunspiders (about 40–80 mm), it also collects tiny ants and termites (8–15 mm).

Oases and the irrigated agricultural land were the second type of the habitat, and little owls were registered, because the stable and abundant food supply. The food contained there synantropic species of the genera *Mus, Rattus, Crocidura,* from the birds mainly *Passer domesticus*. Nevertheless, also under these circumstances, the bird sometimes fed almost exclusively on invertebrates. (e.g. in the oasis Siwa, E1).

We found a large variability in the food spectra of the little owl when foraging in arid Mediterranean zone. The species shows great flexibility in diet in relation to local food sources.

Comparison of our results with published data

To put our data on the diet of this owl in arid zone in a wider context of other Palaearctic studies (primarily in Europe), we ranked data according to the relative abundance of the individual classes in the bird's diet (Table 5). The first value describes high share of earthworms detected using a video-camera (Juillard 1984), the others were obtained by analysing pellets. The data have been ranked from highest share of insects to the lowest (from 97.5 % in Italy to 10.5 % in Uzbekistan). With gradual decreasing share of insects there is an increase primarily of mammals (2.1 % – 86.3 %). The trend of increasing proportion of insects from North to South known from literature (del Hoyo 1999) is not universally valid (see also Fig. 2). The data can even vary within the frame of a single land (Italy and Spain, Table 5). The differences in food composition is partly due to sampling in various seasons of year, but also to the different quality of pellet analysis. A high ratio of mammals in the diet is distinct along the axis NW – SE (from Central Europe to Central Asia) and is evidently connected with the continental character of the climate (primarily the countries with cold winters).

Our material collected in Egypt, Syria and Iran comes at the middle of the interval with limits determined by the extreme data about high percentage of insects and high percentage of mammals in the diet of the little owl. The presence of insects in our material was close to the mean (60 – 80 %), from other invertebrates there were abundant mainly sunspiders and scorpions. The presence of mammals was under or at the mean (6.3–14.4 %), on the other hand, the shares of reptiles (2.7–6.1 %) and birds (1.5–4.9 %) were considerably higher.

The species spectra and poisonous species in food

Insects evidently represent the highest proportion in the food in arid zone (60–80%). It is nothing exceptional – the data do not exceed the allowance limits of the mean obtained in the

Table 5. The most important taxa in the food of the little owl, comparison of formerly published and our data (order of taxa and localities was based on the similarity of + and – data by the MDFM method, explanations – see Table 1).

Reference. No. **Food taxa**	**5**	**8**	**6**	**9**	**1**	**10**	**3**	**7**	**20**	**19**	**18**
Evertebrata other	3+ 65.5	5- 0	4- 0.9	2- 2.6	9- 0	2- 3.8	2- 2.4	12.9	1- 6.2	10.2	14.3
Insecta	1- 28.2	1+ 97.5	1+ 93.6	1+ 93.1	1+ 92.9	1+ 91.9	1+ 86.5	81.8	79.5	77.2	59.8
Amphibia, Reptilia	5- 0	0.3	2- 0.2	1- 0.5	4- 0.1	1- 0.5	2- 0.1	0.7	2+ 2.7	2+ 4.0	3+ 6.1
Aves	2- 0.4	1- 0.1	2- 0.3	1.1	2- 0.3	1- 0.6	1- 0.6	2- 0.5	1.5	1+ 2.3	2+ 4.9
Mammalia	3- 2.9	3- 2.1	2- 5.0	3- 2.7	2- 6.7	3- 3.2	1- 10.5	2- 4.2	1- 10.0	2- 6.3	14.3
No. prey items	8218	706	4118	3420	8635	2201	1781	16598	1315	2700	1924

Reference. No. **Food taxa**	**2**	**4**	**13**	**12**	**15**	**14**	**11**	**16**	**17**	**Suma**	**[%]**
Evertebrata other	6- 0.2	1- 5.4	6- 0	5- 0	5- 0	3- 2.1	4- 1.0	2- 2.5	3- 1.2	9235	12.30
Insecta	72.0	60.5	62.0	1- 51.5	1- 33.7	1- 39.1	1- 32.2	2- 15.0	3- 10.5	51317	68.32
Amphibia, Reptilia	1- 0.5	1- 0.6	2- 0	1- 0	2+ 5.5	1- 0.5	1+ 1.1	2- 0	0.5	585	0.78
Aves	1- 0.8	1- 0.9	1.5	1+ 3.4	2+ 7.5	2+ 4.5	1.6	3+ 9.6	1.5	942	1.25
Mammalia	1+ 26.5	1+ 32.4	1+ 36.5	2+ 45.1	2+ 53.3	2+ 53.8	2+ 78.6	2+ 72.9	3+ 86.3	13032	17.35
No. prey items	2993	9181	1075	745	760	4064	2784	1141	752	75111	100

Reference No.: 1. Denmark, L a u r s e n (1981); 2. Germany, H a e n s e l & W a l t h e r (1966); 3. Belgium, L i b o i s (1977); 4. France, G é n o t & B e r s u d e r (1995); 5. Switzerland, J u i l l a r d (1984); 6. Spain 1, D e l i b e s et al. (1983); 7. Spain 2, M a ñ e z (1983); 8. Italy 1, L o v a r i (1974); 9. Italy 2, Z e r u n i a n et al. (1982); 10. Italy 3, C o n t o l i et al. (1988); 11. Austria, S a g e d e r (ex S c h ö n n et al. 1991); 12. Slovakia, O b u c h (2000); 13. Rumania, P o p e s c u & B l i d a r e s c u (1983 ex G é n o t & N i e u w e n h u y s e 2002); 14. Bulgaria, S i m e o n o v (1968, 1983); 15. Russia, NW Caspian See, P a v l o v (1962); 16. Azerbaijan, Apsheron peninsula, G u s e v (1956); 17. Uzbekistan, Amudarija mouth, I s h i n i n (1965); 18. Iran, own data; 19. Syria, own data; 20. Egypt, own data.

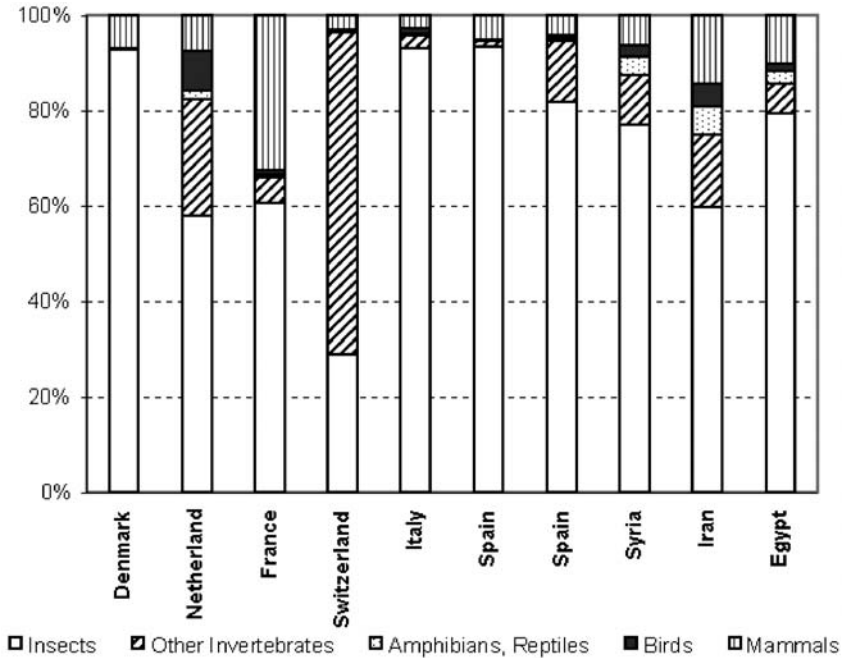

Fig. 2. Food composition (in n%) of the little owl *Athene noctua* obtained by watching with a video equipment (Netherland, Switzerland) and by pellet analysis outside the winter period along longitudinal N-S gradient of its distribution (the last three columns – own data, data from Denmark see 1, France 4, Switzerland 5, Italy 8, Spain 7, according to Table 5, Netherland – Van Z o e s t & F u c h s 1988).

European studies (Table 5, Fig. 2). Other invertebrates also have dominant or eudominant shares (6.2–15.2%), but different taxa than in Europe (as expected not earthworms but poisonous sunspiders and scorpions). Regarding the body size of the food items, the largest species of invertebrates were scorpions (Scorpionidea, mainly Buthidae and Diplocentridae) 35–110 mm and sunspiders (Solifugae, mainly Solpugidae and Galeodidae) 18–85 mm, the smallest prey items were ants Myrmicidae (8 mm), tenebrionids (8 mm), evidently consumed together with some cadavers. In the temperate zone of Europe, almost no poisonous species of invertebrates were detected in the diet of the little owl. This is connected also with their very low presence in the food supply. Differences are evident in comparison with the data obtained in southern parts of the little owl distribution: Southern Mediterranean zone, Middle East (e.g. beetles of the family Meloidae, scorpions and sunspiders). Scorpions *Buthus occitanicus* were found in pellets of the little owl collected in Al Hamra, Tunisia (V e r n o n et al. 1973), other scorpion species in Algeria, W and SE Turkey (V a c h o n 1954, K u m e r l o e v e 1955) and Egypt (G o o d m a n 1988). Sunspiders (Solifugae) were found also in the food of other on invertebrates feeding owl species, i.e. *Otus senegalensis* (N=17.3%, F = 31.2%) in South Africa (D i x o n 1994).

Appendix 1. List of taxa, identified in the food of little owl in Egypt (E1-5), Syria (S1-12) and Iran (I1-17)/ their abundance (in number of individuals).

Gastropoda: g.sp. S4/5, Clausilidae E5/1,
Crustacea: Astacidae g.sp. E5/1
Arachnida:

Araneidea E1/1, E2/2, E3/1, E5/21, S4/1, S5/6, S6/4, S7/4, S10/1, I7/4, I10/2, I11/3, I12/5, I13/1, I15/2

Scorpionidea >40 mm S1/28, S6/6, S7/8, S9/2, S11/4, S12/6, I4/2, I14/1, I16/18, 17/1,

Scorpionidea <40 mm E3/2, S1/4, S3/1, S4/4, S6/4, S7/14, S8/1, S11/5, S12/3, I1/1, I2/1, I3/2, I4/7, I5/1, I6/3, I7/2, I10/3, I11/1, I12/1, I14/3, I16/7, I17/3

Solifugae <25mm E1/13, E2/35, E3/5, S3/3, S4/11, S8/2, I1/4, I4/6, I6/74, I7/22, I9/2, I12/3, I14/3, I17/1

Solifugae >27mm S1/14, S5/6, S7/51, S8/15, S9/3, S10/4, S11/26, S12/30, I2/15, I3/3, I4/20, I5/15, I10/21, I15/1, I16/19, I17/9

Insecta

Dermaptera: E1/6, E2/33, E3/11, E4/5, E5/121, S3/3, S4/8, S5/22, S6/6, S7/1, S9/6, S10/1, I/2, I5/26, I7/32, I10/5, I12/53, I14/2, I16/4.

Mantodea: Mantidae E1/12, S2/1, S9/1

Isoptera: g.sp. S3/4, I1/2, I4/5

Orthoptera: Tettigoniidae g.sp. E1/13, E/2, E3/2, E4/12, E5/7, S1/4, S4/1, S5/4, S9/1, S10/2, S12/1, I1/2, I3/1, I4/32, I7/1, I10/1, I14/2, I15/3, *Tettigonia* sp. E3/2, Gryllidae sp. E1/7, E2/12, E3/2, E5/17, S1/12, S2/1, S4/3, S5/2, S6/1, S7/4, S8/3, S9/1, S10/3, S11/1, I2/2, I4/2, I5/17, I6/1, I7/1, I10/9, I11/3, I13/4, I14/2, I15/3, I16/19, I17/11, *Gryllotalpa* sp. E1/1, E2/4, E5/1, S5/2, S10/4, I5/2, I6/1, I9/1, I13/1, I17/3, Acrididae g.sp. E1/70, E2/31, E3/5, E4/1, E5/15, S1/28, S2/19, S3/22, S4/3, S5/3, S7/6, S8/4, S9/2 S10/6, S12/12, I 1/6, I3/4, I4/25, I5/4, I6/8, I7/4, I10/4, I11/5, I14/5, I15/6, I16/4, I17/6, *Calliptamus* sp. E1/11

Heteroptera: g.sp. I1/2, I12/1

Neuroptera: Myrmeleonidae larvae E5/1,

Coleoptera: Carabidae E1/4, E2/17, E3/3, E4/2, E5/12, S1/4, S2/6, S3/2, S4/2, S5/5, S6/12, S7/11, S8/3, S9/7, S10/3, S11/4, I1/3, I2/1, I4/3, I5/2, I6/2, I7/1, I10/3, I11/2, I12/4, I13/4, I14/4, I16/1, I17/2, *Carabus* sp. S4/3, S6/3, *Calosoma* sp. S5/1, S6/1, S8/1, S10/2, I4/1, I17/1,

Staphylindae S5/2, I7/1,

Hydrophilidae I2/1,

Meloidae S2/2, I14/1,

Curculionidae E3/1,E5/7, S1/5, S3/1, S5/5, S6/5, S7/6, S8/9, S9/1, S10/5, S11/3, S12/6, I1/1, I2/27, I4/12, I5/1, I6/2, I7/1, I10/3, I11/1, I12/2, I13/5, I14/4, I17/1, *Cleonus sp.* I4/1

Cerambycidae E1/19, E2/20, E3/5, E4/6, E5/4, S3/1, S12/1, I1/1, I2/2, I4/3, I6/1, I9/1, I10/4, I12/1, I13/1, I17/1,

Tenebrionidae < 12mm E1/8, E2/16, E3/19, E4/186, E5/56, S1/32, S2/9, S3/15, S4/67, S5/20, S6/44, S7/60, S8/50, S9/25, S10/8, S11/34, S12/27, I1/4, I3/9, I4/48, I5/37, I6/11, I7/17, I8/3, I9/3, I10/24, I11/2, I12/87, I13/4, I14/13, I15/3, I16/8, I17/6, Tenebrionidae > 15mm E1/3, E2/9, E3/4, E4/34, E5/18, S1/2, S2/6, S3/1, S4/10, S6/8, S7/6, S9/5, S11/14, I1/4, I2/7, I4/7, I5/5, I6/4, I8/3, I9/1, I10/9, I13/3, 14/3, I15/2, I17/5, *Blaps* sp. I2/1,

Elateridae: *Ampedus* sp. E1/2, E3/1, E5/1,

Buprestidae g.sp. E1/1, E2/1, E3/4, E5/3, S1/1, S2/3, S3/2, S92, S11/3, S12/1, I4/1, I6/1, I14/1, I15/1, *Julodis* sp. S11/1, I2/27,

Scarabeidae g.sp. E1/17, E2/32, E3/10, E4/19, E5/28, S1/14, S2/23, S3/10. S4/11, S5/11, S6/13, S7/15, S8/9, S9/9, S10/5, S11/14, S12/8, I1/7, I2/5, I3/5, I4/6, I5/11, I6/6, I7/3, I10/13, I11/3, I12/3, I13/14, I14/9, I15/2, I16/1, I17/6, *Scarabeus* sp. E1/2, S2/7, S5/1, S6/7, S7/5, S8/3, S9/5, S10/1, S11/3, I1/9, I2/2, I6/1, I12/4, I14/1, I15/2, *Cetonia* sp. I13/1, *Aphodius* sp. E3/2, *Ontophagus* sp. E5/3,

Coccinellidae S3/1,

Hymenoptera: Vespidae E2/1, S2/2, S9/1,

Apidae S1/4, S2/16, S3/12, S4/1, S 11/1, I7/1,

Formicidae E1/8, E2/6, E3/3, E5/5, S1/2, S5/6, S11/2, I4/15, I6/7, I7/1, I10/2, I13/2, I14/1, I 15/4, I17/5, *Formica* sp. E1/3, *Camponotus* sp. S1/2, S5/5, S9/1, I4/1,

Myrmicidae g.sp. E1/5, E2/2, S1/19, S2/439, S3/356, S4/10, S5/19, S6/20, S7/9, S8/15, S9/11, S10/3, S11/155, S12/13, I1/6, I2/11, I3/3, I4/40, I5/6, I6/3, I7/6, I8/2, I10/6, I11/57, I12/3, I13/12, I14/7, I15/11, I17/4,

Ichneumonidae E1/4, E5/11, I2/1, I12/1, I15/1, I17/1,

Chrysididae E1/1

Diptera: Brachycera E1/7, E2/6, I6/1.

Amphibia: *Hyla savignyi* S4/1, Amphibia g. sp. E5/2.
Reptilia: Lacertidae g. sp. E1/4, E2/16, E4/11, E5/3, S2/30, S3/18, S4/4, S7/10, S8/3, S9/1, S10/6, S11/6, S12/3, I1/2, I2/22, I4/1, I5/8, I7/1, I9/1, I12/4, I17/4. Gekkonidae g. sp. I1/8, I3/4, I4/5, I10/5, I11/26, I16/1, I17/3.

Agamidae sp. S3/16, S10/1, S11/1, S12/6, I1/1, I2/4, I4/8, I6/3, I9/1, I11/1, I14/1, I15/2, I17/1. Serpentes g. sp. S11/1, I5/1.

Aves: *Coturnix coturnix* S7/2, S11/1. *Streptopelia senegalensis* E5/2. *Streptopelia decaocto* I17/1. *Athene noctua* juv. I16/1. *Apus apus* I9/2, I17/1. *Alauda arvensis* S5/1, S6/2, S11/2. *Galerida cristata* E5/1, S5/1, S6/1, S9/2, S10/2, S12/1, I1/3, I2/2, I8/2, I12/1, I14/5, I16/1, I17/1. Alaudidae g. sp. E3/1, S1/1, S11/1, S12/3, I1/3, I2/2, I14/2. *Hirundo rustica* S11/1, I9/1. *Ptyonoprogne rupestris* S10/1. *Pycnonotus leucogenys* I16/1, I17/1. *Lanius excubitor* S10/1. *Lanius minor* S10/1. *Lanius* sp. E2/1, E3/1, S3/1. *Phylloscopus* sp. E1/1, E2/1, E5/2. Sylviidae g. sp. S11/1, I1/1. *Muscicapa striata* S11/1. *Saxicola torquata* S6/1. *Oenanthe* sp. E2/1, S2/1, S4/1, S17/1, I2/1. *Phoenicurus* sp. S8/1, S9/1. *Luscinia* sp. I7/1. *Turdus merula* S2/1. *Troglodytes troglodytes* S7/1. *Emberiza* sp. S7/1, I1/1, I5/1. *Carduelis chloris* I14/1. *Rhodospiza obsoleta* S6/1, S12/1. Fringillidae sp. S12/1, I2/1, I16/1. *Passer domesticus* E4/2, E5/1, S1/2, S5/1, S6/1, S8/1, S10/4, S11/2, I3/1, I4/3, I5/5, I7/1, I8/4, I9/19, I11/1, I13/1, I14/1, I15/1, I16/1.*Passer montanus* I2/2, I11/1. *Petronia petronia* S1/1. *Petronia* sp. I16/1. *Sturnus vulgaris* I16/1. Passeriformes sp. E1/2, E2/1, E3/1, E4/2, S1/1, S3/2, S7/1, S10/2, S11/1, S12/2, I1/1, I2/2, I4/2, I6/1, I12/1, I14/1, I15/2, I16/1.

Mammalia: *Suncus etruscus* S5/1, S6/2, I5/2, I7/1, I13/1, I14/1, I17/1. *Suncus murinus* E5/1.*Crocidura* cf. *suaveolens* S12/1, I1/1, I5/2, I17/2. *Crocidura nana* E4/1. *Eptesicus serotinus* I2/1. *Pipistrellus pipistrellus* I15/5. *Pipistrtellus kuhlii* S2/1, S5/1, S10/3, I5/2, I14/1. *Ochotona rufescens* I4/1. *Allactaga elater* I2/15, I4/2, I9/1, I10/2, I11/2. *Allactaga euphratica* S11/1. *Jaculus jaculus* S11/2, I2/2, I12/5, I16/2. *Mus* cf. *domesticus* E1/1, E2/6, E3/1, E4/7, E5/80. *Mus* cf *macedonicus* S2/1, S3/2, S4/9, S5/16, S6/14, S7/13, S8/7, S9/27, S10/13, S11/1. *Mus* cf. *abbotti* I2/1,I5/1, I6/1,I7/1, I8/1, I9/12, I10/2, I12/1, I13/10, I14/3, I15/2. *Mus* sp. I17/19. *Acomys* cf. *cahirinus* E2/1, S12/1. *Apodemus arianus* I7/3. *Rattus rattus* E5/8, I5/1. *Arvicanthis niloticus* E5/2. *Cricetulus migratorius* S1/6, I1/2, I3/6, I5/8, I6/4, I7/2, I9/32, I13/1, I14/11, I15/2. *Calomyscus bailwardi* I1/1. *Nesokia indica* S5/1, I4/1, I12/1. *Gerbillus pyramidum* E2/6, E3/2, E4/1. *Gerbillus amoenus* E2/2, E3/9, E4/4. *Gerbillus dasyurus* S1/1, S7/3, S10/1, S12/4. *Gerbillus* cf. *mesopotamiae* S2/1, S5/8, S6/6, S7/5, S9/3, S10/2. *Gerbillus nanus* I4/18, I5/1, I6/1, I11/1, I12/16, I17/1. *Gerbillus cheesmani* I5/1. *Meriones tristrami* S1/2, S4/2, S7/1, S12/2. *Meriones crassus* S8/1, S11/2, I2/8, I10/1, I11/5, I16/2. *Meriones libycus* I2/1, I4/12, I5/6, I7/1, I9/1. *Meriones persicus* I1/2, I6/3, I10/1, I12/1, I14/2. *Tatera indica* I9/1, I14/1, I16/1. *Ellobius talpinus* I1/2. *Microtus guinteri* S5/1. *Microtus socialis* I13/3. *Microtus afghanus* I1/1.

A c k n o w l e d g e m e n t s

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