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Nest site and food composition of the Eagle Owl *Bubo bubo* in Mongolia

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We examined 11 Eagle Owl *Bubo bubo* nests in Mongolia during 2004–06. Five nests were located in cliffs, three in rock columns, two in sandy precipices and one on a rock ledge. Mean height (above ground) of the nest site structure was 7.6 (SD 5.9) m and height of nest entrance was 3.1 (SD 2.5) m. Mean clutch size was 1.7 (SD 0.9) and the number of fledglings was 1.5 (SD 0.5). Nest structure or entrance height did not correlate with the number of eggs laid ($r = 0.1$, $r = 0.4$) or young fledged ($r = 0.001$, $r = 0.1$). We identified 276 prey from pellets and remains from nests or nearby perches. Pellets averaged 63.5 (SD 14.2) by 22.2 (SD 4.1) mm and weighed 10.6 (SD 4.6) g when collected. Seventeen species of birds were taken as prey, and represented 32.2% of prey biomass (26.1% by frequency), while 13 mammal species constituted 67.8% of the biomass (72.2% by frequency). The most frequent avian prey was the Eurasian Sparrowhawk *Accipiter nisus*; the most frequent mammalian prey was the Mongolian Five-toed Jerboa *Allactaga sibirica*. Amphibians and beetles together represented a very small percentage (0.23%) of the diet biomass.

Key words: Eagle Owl, *Bubo bubo*, Mongolia, nest, diet

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INTRODUCTION

The Eagle Owl *Bubo bubo* is a generalist predator that uses a variety of breeding habitats (Mauersberger 1980, Piechocki *et al.* 1981, Shagdarsuren 1983, Stephan 1994, Ali 1996, Snow & Perrins 1998, Gombobaatar *et al.* 2001, Boldbaatar 2002). The *B. b. ussuriensis* subspecies is a common resident found all over Mongolia (Fomin & Bold 1991). Our aim was to describe Eagle Owl nest structures and diet in the Mongolian steppe.

METHODS

During 2004–06, we located and measured 11 active and inactive Eagle Owl nest sites (Fig. 1) using methods in Fox *et al.* (1997) and Gombobaatar (2006). In May and June, we checked three active nests three

times and eight nests once. At the first check, chicks were usually 1–2 days old. After the first check, we rechecked nests every two weeks. We collected 59 pellets and 129 prey remains from the nest and under nearby perches (within 2–10 m of nests) during the breeding season. We kept the prey remains and pellets in sealed bags with attached label describing name, date and notes of each site. We followed Gombobaatar (2006) method for analysing pellets and prey remains. Prey were identified using Bannikov (1954), Dulamtsuren (1987), Tsendsuren (1987), Tsendsuren & Ulykpan (1979), Namkhaidorj (1988), Ivanov & Shtegman (1978), Shagdarsuren (1983), Svensson (1984), Fomin & Bold (1991) and from collection material at the Zoology Department and Ornithological Laboratory of the National University of Mongolia, Ulaanbaatar. Prey weights for calculating biomass were derived from Dementiev & Gladkov (1954), Ivanov & Shtegman (1978), Svensson (1984), Avirmed (2003),



Figure 1. Locations of 11 Eagle Owl nests studied in Mongolia, 2004–06.

Adiya (2000), Bannikov (1954), Dulamtseren (1987), Enkhbold (unpubl. data) and Sokolov & Orlov (1980). Unidentified prey remains were excluded from biomass estimates. We used descriptive analyses (for height of substrates, sizes of clutch and pellet, weight of prey species) and correlation analyses (on height of substrate and number of eggs and chicks; frequency and weight of prey species of birds and mammals) for statistical analysis as developed by Krebs (1989) and Jump 5.0 Statistical Discovery from SAS Software, USA and Microsoft Excel. Means \pm SD are given.

RESULTS AND DISCUSSION

Nest sites and reproductive success

Five nests were located in cliffs, three in rock columns, two in sandy precipices and one in a rock ledge. These nest sites were similar to Eagle Owl nests in similar habitat in Kazakhstan (Karyakin *et al.* 2007, Pazhenkov & Korzhev 2006) but differed from those in forest and taiga habitats northeastern Kazakhstan (Karyakin *et al.* 2005a) where nests were on the ground at the base of pine trees, and human disturbance was a major cause of breeding failure.

Nest sites consisted of natural large cavities, holes, or crevices that had 2–4 m tall bushes (*Amygdalus pedunculata*) at the entrance and were in the proximity of a lake or other water source. Nest sites were located among small broken rocks or on rock ledges on mountain slopes and rocky mountain outcrops, or in sand cliffs on riverbanks (Fig. 2). Mean height (above ground) of nest site structure (e.g. cliff faces) was 7.6 (± 5.9 m, 0.5–20) and height of nest entrance was 3.1 (± 2.5 m, 0–7). Nest cavities were well sheltered from the elements and close to nests of other steppe birds including the Upland Buzzard *Buteo hemilasius*, Red-

billed Chough *Pyrhcorax pyrrhcorax*, and Northern Raven *Corvus corax*. Three breeding pairs had 2–5 potential nest sites 5–20 m from each other within their breeding territory. Many breeding pairs occupied nests for more than one year, a habit reported for this species in Kazakhstan (Karyakin & Barabashin 2006).

Eggs were laid in a scrape on sandy and gravel substrate. Average clutch size was 1.7 (± 0.9 , 1–3) and brood size was 1.5 (± 0.5 , 1–2), smaller than those reported in Kazakhstan (Pazhenkov & Korzhev 2006, Karyakin *et al.* 2007). Nest structure or entrance height was not correlated with the number of eggs laid ($r = 0.1$, $r = 0.4$) or young fledged ($r = 0.001$, $r = 0.1$). We suspect that variation in the reproductive success of the Eagle Owl was related to prey availability. A more detailed study is required of prey availability vs. prey taken to understand this relationship.

Prey use

We identified 276 prey remains from pellets and at 11 Eagle Owl nests (Appendix 1). Air-dried pellets averaged 63.5 ± 14.2 by 22.2 ± 4.1 mm and weighed 10.61 ± 4.6 g. Of the 276 prey identified, 72.1% were mammals, 26.1% birds, 0.7% amphibian, and 1.1% beetles. These results are consistent with Eagle Owl diet studies in Russia (Dementiev & Gladkov 1954) where it rarely eats fish, amphibians or invertebrates.

The most frequent mammalian prey identified were the Mongolian Five-toed Jerboa *Allactaga sibirica*, Campbell's Hamster *Phodopus campbelli*, and the Daurian Hedgehog *Mesechinus dauricus* (Appendix 1). We reason that the relatively high percentage of Mongolian Five-toed Jerboa and Campbell's Hamster in the diet was because they are active at night when Eagle Owls are hunting.

The predominant avian prey identified were Common Sparrowhawk *Accipiter nisus*, Saker Falcon



Figure 2. Nesting habitat of the Eagle Owl in Mongolia (photo by S. Gombobaatar).

Falco cherrug, Little Owl *Athena noctua* and Chough (Appendix 1). Most (65%) of the avian prey species were observed to breed in the nesting territories of Eagle Owl (unpubl. data), whereas 35% were passage migrants, and included Common Sparrowhawk, White Thrush *Zoothera dauma*, and Eye-browed Thrush *Turdus obscurus* that were observed to perch (and roost) on bushes near Eagle Owl nest sites – probably the reason of high numbers in the owl diet.

Prey biomass and size

The average weight of bird prey was 411.9 g (range 15–1500, $n = 18$) and 371.8 g (range 17–2000, $n = 13$) for mammals (Appendix 1). The heaviest (Goshawk) and lightest (Flycatcher) avian prey species were captured while migrating through Eagle Owl territories. The Mongolian Marmot *Marmota sibirica* and Tolai Hare *Lepus tolai* were the heaviest mammal prey identified. Weight of the most frequent prey species in the diet varied from 15 to 300 grams for birds and from 17 to 200 g for mammals (Appendix 1). Average length of prey species was 336.1 ± 176 mm (140–700) for birds and 252.8 ± 161 mm (102–630) for mammals, whereas the most frequent length of prey species was 101–400 mm. There was no difference between the body mass ($t_{22} = 2.07$, $P = 0.1$) and between the body length ($t_{27} = 2.1$, $P = 0.2$) of bird and mammal prey identified.

We conclude that prey identified from pellets over-represented mammalian prey and under-represented avian prey whereas prey remains over-represented large prey and under-represented small prey (Appendix 1). Combining pellet and prey remains data did not eliminate these biases. We suggest that pellets are still useful for estimating prey diversity but direct observations are necessary to help quantify the aforementioned diet estimate bias. Eagle Owls in our Mongolia study capture comparatively lightweight birds and mammals that are easily accessible to breeding pairs. This concurs with Karyakin *et al.* (2005b) and Kondratenko & Tovpinets (2001) who state that in the Altay Kray, Russia, the predominant prey species were small and medium-sized rodents, including the Water Vole *Arvicola terrestris*; the most frequent large mammal prey was the Tolai Hare. The variety of raptors included in the diet of Eagle Owl was surprisingly high (Appendix 1). Other Eagle Owl diet studies have recorded more diverse diets, e.g. tree bats, colubrid snakes, batrachians in Ramanujam (2001), and domestic chicken *Gallus domesticus* in Serrano (2000). This variation emphasizes the opportunistic and generalist predatory nature of the Eagle Owl across its range.

REFERENCES

- Adiya Y. 2000. Mongolian Marmot in Mongolia: Biology, ecology, conservation and economical importance. Mammalian Ecology Laboratory, Institute of Biological Sciences, Mongolian Academy of Sciences, Ulaanbaatar. (In Mongolian)
- Ali S. 1996. The Book of Indian Birds. Second revised edition. Oxford University Press.
- Avirmed D. 2003. Brandt's Vole of Mongolia. Khaan Printing, Ulaanbaatar. (In Mongolian)
- Bannikov A.N. 1954. Mammals of Mongolian Republic. Academy of Sciences, Moscow.
- Boldbaatar S. 2002. Anthropogenic factors to bird species in Udleg and neighboring areas. Amphibians, reptiles and birds of Mongolia 1: 38–45. (In Mongolian)
- Dementiev G.P. & Gladkov N.A. 1954. Birds of the Soviet Union. V.5. Nauka, Moscow.
- Dulamtsersen S. 1987. Mammals of Mongolian Republic. Mongolian Academy of Sciences, Ulaanbaatar. (In Mongolian)
- Fomin E.V. & Bold A. 1991. Catalogue of birds of Mongolian Republic. Nauka, Moscow.
- Fox N., Eastam C. & Macdonald H. 1997. ERWDA Handbook of Falcon Protocols. National Avian Research Center. ERWDA, Abu Dhabi, UAE.
- Gombobaatar S., Uuganbayar Ch., Sumiya D., Shagdarsuren O., Potapov E. & Fox N. 2001. Diet studies of breeding and wintering Saker Falcon (*Falco cherrug*) in Mongolia. Scientific Journal of the National University of Mongolia 12: 89–95. (In Mongolian)
- Gombobaatar S. 2006. Biology, ecology and conservation of Saker falcon *Falco cherrug* in Central Mongolia. PhD thesis, National University of Mongolia, Ulaanbaatar. (In Mongolian)
- Ivanov A.I. & Shtegman B.K. 1978. Identification guide to the birds of Soviet Union. Nauka, Leningrad.
- Karyakin I.V., Levin A.S., Barabashin T.O. & Karpov E.F. 2005a. Results of researches of Steppe pine forests in the Northeast of Kazakhstan. Raptor Conserv. 4: 34–43.
- Karyakin I.V., Smelansky I.E., Bakka S.V., Grabovsky M.A., Rybenko A.V. & Egorova A.V. 2005b. The Raptors in the Altay Kray. Raptor Conserv. 3: 28–51.
- Karyakin I.V. & Barabashin T.O. 2006. Birds of Prey and Owls of the Ulutau mountains. Raptor Conserv. 5: 37–49.
- Karyakin I.V., Pazhenkov A.S., Kovalenko A.V., Korzhev D.A. & Novikova L.M. 2007. Large raptors in the Mugdzhary mountains, Kazakhstan. Raptor Conserv. 8: 53–56.
- Kondratenko A.V. & Tovpinets N.N. 2001. Mammals in the Diet of Owls from the Donetsk-Don and Donetsk-Azov Steppes. Vestnik zoologii 35: 95–98.
- Krebs C.J. 1989. Ecological methodology. Harper Collins, New York.
- Mauersberger G. 1980. Ungeloste taxonomische probleme der Mongolische avifauna. Mitt. Zool. Mus. Berlin 59, Suppl. Ann. Orn. 7: 47–83.
- Pazhenkov A.S. & Korzhev D.A. 2006. Birds of prey and owls of the Shagyray plateau, Kazakhstan. Raptor Conserv. 8: 56–61.
- Piechocki R., Stubbe M., Uhlenhaut K. & Sumjaa D. 1981. Beitrage zur Avifauna der Mongolei. Teil III. Non-Passeriformes. Mitt. Zool. Mus. Berlin 57, Suppl. Ann. Orn. 5: 71–128.
- Ramanujam M.E. 2001. A preliminary report on the prey of the Eurasian Eagle Owl (*Bubo bubo*) in and around Pondicherry. Zoos' Print 16: 487–488.
- Serrano D. 2000. Use of farm chicken carcasses by the Eagle Owl *Bubo bubo*. Ardeola 47: 101–103.
- Shagdarsuren O. 1983. Raptors of Mongolia. Khaan Printing, Ulaanbaatar.
- Snow D.W. & Perrins C.M. 1998. The Birds of the Western Palearctic. Non-passerines. Oxford University Press.
- Sokolov V.E. & Orlov V.N. 1980. Identification guide to the mammals of Mongolian Republic. Nauka, Moscow.
- Stephan B. 1994. Ornithological studies in Mongolia. Mitt. Zool. Mus. Berlin. 70, Suppl. Ann. Orn. 18: 53–100.
- Svensson L. 1984. Identification guide to European passerines. Svensson, Stockholm.
- Tsendsuren A. & Ulykpan K. 1979. Insects of Mongolia. Ulaanbaatar.
- Tsendsuren A. 1987. Fauna of Mongolian Republic T1. Insects. Ulaanbaatar.

SAMENVATTING

Dit artikel behandelt de lotgevallen van 11 nesten van de Oehoe *Bubo bubo*, die in 2004–2006 in Mongolië zijn onderzocht. Vijf nesten waren op steile rotshellingen gemaakt, drie op rotspilaren, twee op steile zandhellingen en één op een rotsrichel. De nesten lagen gemiddeld 7,6 m boven de grond. De hoogte van de nestingang was 3,1 m. De gemiddelde legselgrootte was 1,7. Het aantal uitgevlogen jongen bedroeg 1,5. Geen van beide reproductiematen was gecorreleerd met de hoogte van het nest of de nestingang. De samenstelling van het voedsel werd bepaald aan de hand van braakballen en prooiresten op of bij het nest. In totaal werden 276 prooien op naam gebracht. Braakballen maten 63,5 mm bij 22,2 mm en wogen 10,6 g. Onder de prooien werden 17 vogelsoorten aangetroffen, die 32,2% van de biomassa vertegenwoordigden (en 26,1% van de aantallen). Het vaakst werd de Sperwer *Accipiter nisus* gepakt. Er werden 13 soorten zoogdieren gevonden, die 67,8% van de biomassa vertegenwoordigden (en 72,1% van de aantallen). De Siberische Paardenspringmuis *Allactaga sibirica* was het meest talrijke zoogdier onder de prooien. Amfibieën en kevers waren gerekend naar hun gewicht onbetekenend (0,23% van de biomassa).

Appendix 1. Frequency and biomass of Eagle Owl prey species identified from pellets and prey remains in Mongolia, 2004–06.

Name of species	Frequency (n)	Frequency (%)	Estimated prey biomass (g)	Biomass (%)
Insects and amphibians				
Beetle Coleoptera	3	1.1	0.36	0.0
Mongolian Toad <i>Bufo raddei</i>	2	0.7	27	0.1
Birds				
Goshawk <i>Accipiter gentilis</i>	2	0.7	1500	3.5
Sparrowhawk <i>Accipiter nisus</i>	11	4.0	280	3.6
Upland Buzzard <i>Buteo hemilasius</i>	2	0.7	1100	2.6
Saker Falcon <i>Falco cherrug</i>	7	2.5	1000	8.3
Common Kestrel <i>Falco tinnunculus</i>	6	2.2	240	1.7
Lesser Kestrel <i>Falco naumanni</i>	3	1.1	240	0.8
Rock Pigeon <i>Columba livia</i>	2	0.7	360	0.8
Oriental Turtle Dove <i>Streptopelia orientalis</i>	2	0.7	350	0.8
Little Owl <i>Athena noctua</i>	6	2.2	180	1.3
Pacific Swift <i>Apus pacificus</i>	1	0.4	35	0.0
Isabelline Wheatear <i>Oenanthe isabellina</i>	2	0.7	27	0.1
Eye-browed Thrush <i>Turdus obscurus</i>	2	0.7	78	0.2
White Thrush <i>Zoothera dauma</i>	3	1.1	170	0.6
Rock Sparrow <i>Petronia petronia</i>	5	1.8	36	0.2
Chough <i>Pyrhocorax pyrrhocorax</i>	6	2.2	375	2.7
Northern Raven <i>Corvus corax</i>	3	1.1	1300	4.6
Flycatcher <i>Muscicapa</i> sp.	2	0.7	15	0.0
Unknown passerines	7	2.5	28	0.2
Subtotal	72	26.1		32.2
Mammals				
Mongolian Marmot <i>Marmota sibirica</i>	12	4.4	1500	21.2
Long-tailed Squirrel <i>Spermophilus undulatus</i>	4	1.5	250	1.2
Mongolian Five-toed Jerboa <i>Allactaga sibirica</i>	65	23.6	24	1.8
Campbell's Hamster <i>Phodopus campbelli</i>	40	14.5	17	0.8
Brandt's Vole <i>Lasiopodomys brandtii</i>	8	2.9	52	0.5
Mongolian Gerbil <i>Meriones unguiculatus</i>	10	3.6	54	0.6
Midday Gerbil <i>Meriones meridianus</i>	5	1.8	47	0.3
Daurian Pika <i>Ochotona daurica</i>	9	3.3	104	1.1
Mongolian Pika <i>Ochotona pallasii</i>	2	0.7	115	0.3
Tolai Hare <i>Lepus tolai</i>	11	4.0	2000	26.0
Daurian Hedgehog <i>Mesechinus dauricus</i>	22	8.0	500	13.0
Gerbil <i>Meriones</i> sp.	2	0.7	55	0.1
Pika <i>Ochotona</i> sp.	4	1.5	115	0.5
Unknown voles	5	1.8	50	0.4
Subtotal	199	72.2		67.8
Total	276	100		100.0

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