

REVIEW

Danger underground and in the open – predation on blind mole rats (Rodentia: Spalacinae) revisited

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ABSTRACT

1. Being totally blind with no tail or pinnae, blind mole rats are the most specialised rodents for the subterranean lifestyle. However, they come to the surface occasionally due to unusual climatic events, for foraging, to collect hay for bedding material, for dispersal as subadults, due to intraspecific aggression, and in illness.
2. The only previous review suggests that surface activity of and predation on blind mole rats is rare and that they are preyed on mainly at night by owls.
3. Based on 57 scientific publications, 14 unpublished reports and several personal observations (from 15 countries), the present review reveals that altogether 26 species of bird and mammal prey on blind mole rats either regularly or occasionally. It is evidenced that not only the number of predators, but also the importance of blind mole rats in their diet has been seriously underestimated.
4. The tight relationship between the colour of the soil and the colour of the pelage of blind mole rats suggests the importance of diurnal raptors via their selective impact. Predation by mammals happens relatively often, and mustelids hunt blind mole rats not only on the surface, but probably also inside their burrows. The labyrinth-like structure of the burrows may play a vital role in confusing mammalian predators trying to hunt inside the burrows, and may increase the blind mole rat's chance of escape.
5. With the proven importance of blind mole rats as a food resource for several threatened species of birds of prey, the survival, reproductive success, and population size of these species may partly depend on the density of the rodents. Although many species within the blind mole rat subfamily are themselves threatened to various extents, the role of blind mole rat populations in carnivore and raptor conservation should be considered and evaluated.

INTRODUCTION

The analysis of food remains from raptors and mammalian predators provides us with information on their foraging habits, ethology, and ecology as well as on the distribution and abundance of their prey species. In some cases – secretive or little-known species – the life of the prey animal itself is unveiled in surprising detail.

Blind mole rats (subfamily Spalacinae) can be found in the Balkan Peninsula, on the steppes of Central and Eastern Europe, in the Middle East (Asia Minor and the coastline of the Levant) and in a narrow coastal strip in north-east Africa (Musser & Carleton 2005). Cytogenetic research (Lyapunova et al. 1971) and molecular genetic work (Hadid et al. 2012, Chişamera et al. 2013) has provided evidence of deep divergences within the subfamily, therefore the two-genera (*Spalax* and *Nannospalax*) classification scheme has been followed here in accordance with the most recent publications (Németh et al. 2009, 2013b, Arslan et al. 2011, Kryštufek et al. 2012, Chişamera et al. 2013). The species of the subfamily have adapted to subterranean life (Méhely 1909, Topachevskii 1969, Savić & Nevo 1990). These small mammals have cylindrical bodies with no external ears, a vestigial tail, very short legs, and are completely blind as an adaptation to spending their entire life in their tunnel system built underground (Vásárhelyi 1926, Topachevskii 1969). This subterranean way of life protects them from almost every predator (Vásárhelyi 1926, 1929, Watson 1961, Topachevskii 1969). However, they come to the surface occasionally (Pocock 1917, Montagu 1924, Vásárhelyi 1926, 1929, Bate 1945, Nevo 1961, 1979, Heth 1991; Fig. 1). In the literature, various reasons are given for the surface activity of blind mole rats, such as unusual climatic events (Méhely 1909, Vásárhelyi 1926, 1929), flooding (Sterbetz 1960, Horváth & Vadnai 2006), foraging activity (Loisel 1916, Montagu 1924, Vásárhelyi 1926, Nevo 1961), collecting hay



Fig. 1. Greater blind mole rat *Spalax microphthalmus* on the surface (photo: G. Csorba).

for bedding material (Vásárhelyi 1926, 1929), dispersal of the young and the subadults (Vásárhelyi 1929, Nevo 1961, Topachevskii 1969, Heth 1991, Rado et al. 1992), intraspecific aggression (Vásárhelyi 1926, 1929, Zuri & Terkel 1996), and illness (Vásárhelyi 1929). Although Nevo (1961) suggests that blind mole rats may be active on the surface during the mating season, possibly while searching for mates, mating takes place underground (Vásárhelyi 1926, 1929, Topachevskii 1969, Gazit et al. 1996, 1998, Gazit & Terkel 2000), and recent investigations show that blind mole rats usually search for mates underground (Moldován 2014). During their surface movements, blind mole rats are vulnerable to predation (Vásárhelyi 1926, Topachevskii 1969, Heth 1991 and references therein). A detailed review of surface activity of and predation suffered by blind mole rats in Israel by Heth (1991) suggests that blind mole rats are rarely active on the surface, and consequently, they are rarely taken by predators, and that they are preyed on mainly at night by owls.

Since Heth's (1991) publication, further evidence of predation on blind mole rats has come to light from the whole distribution area of the subfamily, and these data, reviewed here, make a significant contribution to our current knowledge.

METHODS

We compiled data on the predation of blind mole rats from 57 scientific publications, from a further 14 unpublished studies and reports, and from several personal observations. These sources were written in 10 different languages and refer to predation of blind mole rats in the territories of about 15 countries, representing a good coverage of the whole distribution area of the subfamily. However, information on blind mole rats' surface activity and predation phenomena are limited primarily to qualitative accounts.

RESULTS

According to our present knowledge, altogether 26 species of birds and mammals prey on blind mole rats either regularly or occasionally (Table 1).

Owls

ATHENE NOCTUA

The little owl *Athene noctua* is a small, mainly nocturnal species that, because of its compactness and strength, is able to catch large prey for its size, although its diet is dominated by young individuals (Van Nieuwenhuysse et al. 2008). Most data on its mole rat consumption come from areas in the Middle East (Dor 1947a, Kumerloeve 1955) inhabited by the

Table 1. Known predators of blind mole rats

Predator species	Country or territory	Blind mole rat taxon	Percentage of blind mole rats in the diet (%)	Reference	
Owls	Little owl	<i>Athene noctua</i>	7	Kumei-fove 1955	
	Barn owl	<i>Tyto alba</i>	7	Dor 1947c	
			7	Aczél-Fridrich & Hegyeli 2009	
			0.4%	Abi-Said et al. 2014	
			7	Obuch & Benda 2009	
			5.17%	Shehab 2005	
			0.15%	Shehab & Al Charabi 2006	
			7	Obuch & Benda 2009	
			0.2–1.4%	Charter et al. 2009	
			7	Nevo 1961	
		7	Dor 1947b, c		
		0.3%	Heth 1991		
		0.35%	Obuch & Benda 2009		
		0.20%	Tóres et al. 2005		
		7	Aczél-Fridrich, unpublished data		
		0.53%	Charter et al. 2012		
		7	Bate 1945		
		7	Endes 1988		
		1–5%	Hamar & Sütova 1965		
		7	De Cupere et al. 2009		
		7	Cermák et al. 2006		
		7	Bates & Harrison 1989		
		7	Bayle & Prior 2006		
		7	Vetrov & Kondratenko 2006		
		3.66–4.14%	Kondratenko & Topinets 2006		
		8%	Atamas & Topinets 2006		
		7	Malovichko et al. 2012		
		0.5%	Inbar, unpublished data in Heth 1991		
		7	Mitev & Boev 2006		
		0.88–4.24%	Hegyeli, unpublished data		
		7	Mendelssohn 1972a, b		
		7	Heth et al. 1988		
		7	Levi & Sheila, unpublished data in Heth 1991		
		7	Milchev et al. 2012		
		7	Mendelssohn 1972a, b		
		7	Topachevski 1969		
		7	Festetics, unpublished data in Glutz von Blatzheim et al. 1971		
		7	Ham 1977, 1980		
		7	Vasic & Misirlic 2002		
		7	Viter 2013		
		33%	Marin et al. 2004		
		4.17%	Hovath, unpublished data		
		19%	Malovichko 2012		
		3.5–5.7%	Topachevski 1969		
		7	Leshem 1975		
		7	Maninger, unpublished data in Heth 1991		
		7	Vatev 1987		
		41–49%	Kravchenko 2008		
		44.4%	Shevtsov 2001		
		7	Aderet 1973		
		7	Maninger, unpublished data in Heth 1991		
		7	Redinov 2009		
		7	Ponomarenko 2008		
		1.09%	Redinov 2012		
		1.1%	Clochia 1967		
		1.6%	Topachevski 1969		
		7	Ben-Yzhak & Ben-David, unpublished data in Heth 1991		
		7	Vásárhelyi 1926		
		7	Inbar, unpublished data in Heth 1991		
		7	Atamas & Topinets 2006		
		7	Hegyeli, unpublished data		
		7	Topachevski 1969		
		7	Vásárhelyi 1926		
		7	Vásárhelyi 1926		
		7	Topachevski 1969		
		7	Vásárhelyi 1926		
		7	Ablientsev 1951		
		7	Vásárhelyi 1926		
		7	Ablientsev 1951		
		7	Ben-David 1988, Gorsuch & Larivière 2005, Heth & Todrank 1995		
		7	Vásárhelyi 1926, 1929		
		7	Németh et al. 2013a		
		7	Hegyeli, unpublished data		
		7	Birkner-Braun et al. 2007		
		7	Topachevski 1969		
		7	Csathó, unpublished data		
		7	Vásárhelyi 1926, 1929		
Diurnal raptors	Egyptian vulture	<i>Neophron percnopterus</i>	7		
	Black kite	<i>Milvus migrans</i>	7		
	Eastern imperial eagle	<i>Aquila heliaca</i>	7		
	Steppe eagle		<i>Aquila nipalensis</i>	7	
			<i>Aquila fasciata</i>	7	
			<i>Aquila chrysaetos</i>	7	
			<i>Buteo rufinus</i>	7	
				7	
	Common buzzard		<i>Buteo buteo</i>	7	
				7	
				7	
	Other birds	Rough-legged buzzard	<i>Buteo lagopus</i>	7	
		Hen harrier	<i>Circus cyaneus</i>	7	
		Hooded crow	<i>Corvus cornix</i>	7	
		Stoat	<i>Pica pica</i>	7	
Eurasian magpie		<i>Halcyon sylvatica</i>	7		
Smayra kingfisher		<i>Larus cachinnans</i>	7		
Caspian gull		<i>Vulpes vulpes</i>	7		
Red fox			7		
Wild mammals		Least weasel	<i>Mustela nivalis</i>	7	
		Stoat	<i>Mustela erminea</i>	7	
	Stone marten	<i>Martes foina</i>	7		
	European polecat	<i>Mustela putorius</i>	7		
	Steppe polecat	<i>Mustela eversmanni</i>	7		
	Marbled polecat	<i>Vormela persusana</i>	7		
	Dog	<i>Canis lupus familiaris</i>	7		
			7		
Domesticated mammals	Cat	<i>Felis silvestris catus</i>	7		
			7		
			7		

The symbol “?” denotes the lack of information.

smallest species of blind mole rat (Méhely 1909, Topachevskii 1969), *Nannospalax* (superspecies *ehrenbergi*). However, data were also recorded in the Carpathian Basin (Aczél-Fridrich & Hegyeli 2009) where a medium-sized member of the subfamily *Nannospalax* (superspecies *leucodon*) occurs.

TYTO ALBA

Heth (1991) referred to the barn owl *Tyto alba* as the blind mole rat's most important aboveground predator. Most data were recorded in the Middle East (Dor 1947b, c, Nevo 1961, Heth 1991, Shehab 2005, Tores et al. 2005, Shehab & Al Charabi 2006, Charter et al. 2009, Obuch & Benda 2009, Abi-Said et al. 2014), and only a single, uncertain account from Central Europe is known to us (Zs. Aczél-Fridrich, personal communication). According to these analyses, blind mole rats make up about 0.2–5.0% of the barn owl's diet.

ASIO OTUS

Four records of long-eared owl *Asio otus* predation on blind mole rats come from the Middle East (Bate 1945, Charter et al. 2012) and Central Europe (Hungary and Romania) (Hamar & Šutova 1965, Endes 1988). Blind mole rats make up 0.5–5.0% of the diet.

BUBO BUBO

Plenty of data are available in the scientific literature suggesting that the Eurasian eagle owl *Bubo bubo* frequently preys on blind mole rats. Records come from the Middle East (Bates & Herrison 1989, Inbar, unpublished data in Heth 1991, Bayle & Prior 2006, Čermák et al. 2006, De Cupere et al. 2009), Central Europe (Zs. Hegyeli, unpublished data, HNHM Mammal Collection), and Eastern Europe (Atamas & Tovpinec 2006, Kondratenko & Tovpinets 2006, Mitev & Boev 2006, Vetrov & Kondratenko 2006, Malovichko et al. 2012). Blind mole rats fit well into the size range of the most common prey species of Eurasian eagle owls in Europe (Mitev & Boev 2006, Sándor & Ionescu 2009).

Diurnal raptors

NEOPHRON PERCNOPTERUS

The Egyptian vulture *Neophron percnopterus* is the only vulture (Aegypiinae) that has been proven to prey on blind mole rats. There are accounts and observations from two countries in the region of south-eastern Europe (Milchev et al. 2012) and the Middle East (Mendelssohn 1972a, b, Heth et al. 1988, Heth 1991). Most of the observations

occurred in Israel, and Mendelssohn (1972a) noted that '... even the mole rat (*Spalax ehrenbergi* Nehring, 1989), a subterranean rodent of much lower density than voles and other field mice, appeared surprisingly often in the food of diurnal birds of prey, especially the Egyptian vulture and the black kite ...'.

MILVUS MIGRANS

There are three records in the scientific literature showing that blind mole rats occur in the diet of the black kite *Milvus migrans*. Beside the notes of Mendelssohn (1972a, b) outlined earlier, Topachevskii (1969) in his monograph on blind mole rats highlighted the black kite's role as an avian enemy of the blind mole rat within the range of the former Soviet Union.

AQUILA HELIACA

Among the eagle species that are known to eat blind mole rats, most of the data pertain to the eastern imperial eagle *Aquila heliaca*. Data were recorded in Eastern Europe (Malovichko 2012, Viter 2013), Central Europe (Festetics in Glutz von Blotzheim et al. 1971, Ham 1977, 1980, Misirlic 1986, Vasic & Misirlic 2002), the Balkan region (Marin et al. 2004), and Asia Minor (M. Horváth unpublished data). After revising all information collected in the former Yugoslavia, Vasic and Misirlic (2002) classified the blind mole rat as 'additional prey' in the imperial eagle's diet. The blind mole rat amounts to 4.17% of the imperial eagle's diet in the Sakar Mountain, based on the Bulgarian study (Marin et al. 2004), while it made up 19% of the diet in the vicinity of Gereede in Turkey (M. Horváth, unpublished data). The percentage of blind mole rat remains in the imperial eagle's diet can reach 33% in Ukraine (Viter 2013). Plausibly, one of the most significant diurnal predators of the blind mole rats in Eastern and Central Europe is the imperial eagle.

AQUILA NIPALENSIS

Topachevskii (1969) mentioned the steppe eagle *Aquila nipalensis* as an avian enemy of the blind mole rat. This account from the former Soviet Union is the only one suggesting that the steppe eagle preys on blind mole rats. Tingay et al. (2008) draw attention to an account of the steppe eagle's foraging behaviour in Ethiopia '... in which an eagle ambushed subterranean blind or semi-blind mole rats (*Spalax* genus) by waiting to observe heaving soil before pouncing and burying its talons just below the surface of the earth (Brown 1976) ...'. As Ethiopia lies far away from geographical range of blind mole rats, the observation must pertain to other fossorial rodents, either *Tachyoryctes* or

Heterocephalus glaber. However, with this ability, the steppe eagle is potentially capable of actively hunting blind mole rats.

AQUILA CHRYSAETOS

There is only a single observation made in Israel suggesting that the golden eagle *Aquila chrysaetos* may feed on mole rats (Maninger, unpublished data, in Heth 1991).

AQUILA FASCIATA

There are five observations of the Bonelli's eagle *Aquila fasciata* preying on blind mole rats in Israel (Leshem 1975).

BUTEO LAGOPUS

Stomach content analysis of 18 individual rough-legged buzzards *Buteo lagopus*, conducted in the winter period in Romania, revealed a single individual blind mole rat, accounting for 1.6% of the rough-legged buzzard's food in the sample (Ciochia 1967).

BUTEO BUTEO

In the literature, three indications, all from Ukraine, show that the common buzzard *Buteo buteo* hunts blind mole rats (Ponomarenko 2008, Redinov 2009, 2012). Two of them include quantitative data showing that the buzzard's food contains up to 1% mole rats (Ponomarenko 2008, Redinov 2012).

BUTEO RUFINUS

There are four accounts from three different countries in the literature, suggesting that the long-legged buzzard *Buteo rufinus* preys on blind mole rats. Observations were made in the Middle East (Aderet 1973, Maninger unpublished data, in Heth 1991), in the Balkan region (Vatev 1987), and in Eastern Europe (Shevtsov 2001, Kravchenko 2008). Blind mole rats account for almost half (44%) of the long-legged buzzard's food in the Olexandriya district, Kirovograd oblast, Ukraine (Shevtsov 2001), and similarly high percentages (41–49%) were recorded in a separate study in Prysamarije, Dnipropetrovsk oblast, Ukraine (Kravchenko 2008). Among the data from the literature, this is by far the highest ratio among predators that hunt blind mole rats.

CIRCUS CYANEUS

The hen harrier *Circus cyaneus* was mentioned by Topachevskii (1969) as an avian predator of the blind mole rat. No quantitative data are available on the degree of blind mole rat predation.

Other birds

Not only birds of prey, but members of other families, mostly opportunist species, can occasionally catch mole rats. A hooded crow *Corvus cornix* was observed to feed on a blind mole rat in Israel (Ben-Yzhak and Ben-David, unpublished data, in Heth 1991), while in Romania, a predation attempt by this species on Méhely's blind mole rat *Spalax antiquus* was described by Herman (1872). The Eurasian magpie *Pica pica* was found to eat blind mole rats in Hungary (Vásárhelyi 1926). Blind mole rats are preyed on by the Smyrna kingfisher *Halcyon smyrnensis* in Israel (Inbar, unpublished data, in Heth 1991) and by the Caspian gull *Larus cachinnans* in Ukraine (Atamas & Tovpinec 2006).

Mammals

VULPES VULPES

Besides mustelids, the only wild mammal species that is known to prey on blind mole rats is the red fox *Vulpes vulpes* (Topachevskii 1969, Hegyeli, unpublished data).

MUSTELIDAE

Vásárhelyi (1926) observed in Hungary that the least weasel *Mustela nivalis*, the stoat *Mustela erminea*, and the steppe polecat *Mustela eversmannii* hunt blind mole rats. Topachevskii (1969) mentions the least weasel, the stone marten *Martes foina*, the European polecat *Mustela putorius*, and the steppe polecat as predators of blind mole rats within the borders of the former Soviet Union. According to Ukrainian observations, the European and the steppe polecat are able to enter blind mole rat burrows in order to hunt them there. Of 157 Podolsk mole rat *Spalax zemni* burrows that were investigated, 68 were opened by polecats during the autumn and winter periods (Ablentsev 1951).

The marbled polecat *Vormela peregusna* is also known for hunting blind mole rats. A single act of predation on the surface was seen in Israel, but at the same time, marbled polecats were often observed to occupy blind mole rat burrows (Ben-David 1988). Although a scat analysis of the species found no signs of blind mole rat predation (Ben-David 1988), Gorsuch and Larivière (2005) mentioned blind mole rats as part of the marbled polecat's winter diet. In addition, Heth and Todrank (1995) found that Israeli blind mole rats tend to avoid the urine of the marbled polecat, which further supports the idea that this small mammalian predator is able to enter the tunnel system of blind mole rats.

DOMESTICATED MAMMALS

Not only wild mammalian predators, but also two domestic mammals are known for hunting blind mole rats. Most of

the data were collected in Hungary (Vásárhelyi 1926, 1929, Németh et al. 2013a) and in Romania, where local farmers claim that dogs, especially herding dogs, occasionally catch blind mole rats. Burrows of the Transylvanian blind mole rat *Nannospalax (leucodon) transsylvanicus* and Méhely's blind mole rat are sometimes opened by shepherd dogs in Transylvania, Romania (Hegyeli, unpublished data). Domestic cats preying on blind mole rats are known from observations made in Israel (Brickner-Braun et al. 2007), Hungary (Vásárhelyi 1926, 1929, Csathó, personal communication), and in the former Soviet Union (Topachevskii 1969).

DISCUSSION

As evidenced in this review, the number of predatory species that prey on blind mole rats is much higher than was suggested previously, and the importance of blind mole rats in their diet has been seriously underestimated. Following on from their frequent occurrence in the diet of a wide variety of predators, we must go through a paradigm shift concerning the ecology and behaviour of spalacines, previously thought to follow an almost exclusively subterranean lifestyle.

Heth (1991) concluded that the majority of predation of blind mole rats is performed by owls, and therefore that surface activity occurs mainly at night. We also provide evidence showing that owls are important predators of blind mole rats; however, the impact of diurnal predators was significantly underestimated by Heth (1991). The occasionally very high percentage of blind mole rats in the diet of birds of prey (Shevtsov 2001, Kravchenko 2008, Viter 2013) suggests that in areas where these rodents are abundant, raptors hunt them very effectively. This fact also serves as proof that blind mole rats are not active on the surface only at night. Investigations dealing with the activity pattern of blind mole rats clearly show mainly diurnal monophasic locomotor activity (Rado et al. 1993, Zuri & Terkel 1996). The tight relationship between the colour of the soil and the colour of the pelage of blind mole rats (Heth et al. 1988) suggests the importance of diurnal predators via their selective impact on blind mole rat pelage colour.

Because of the 'almost complete absence of evidence of surface predation by mammals', Heth (1991) concluded that this kind of predation is very uncommon. Nevertheless, predation by mammals happens relatively often and there is a high likelihood that mustelids hunt blind mole rats, not only on the surface, but also inside their burrows. The complexity of the burrow system of a subterranean rodent is affected by many factors including food availability and soil conditions (Spinks et al. 2000, Šumbera et al. 2003, Románach et al. 2005, Lövy et al. 2015), and the role of behavioural strategies in determining the structure of the

tunnel system has also been reported (Lövy et al. 2015). The labyrinth-like burrows of blind mole rats include tunnels obstructed with soil, dead-end tunnels, and often a narrow channel spiralling down vertically (Vásárhelyi 1926, Bodnár 1928, Hickman 1990, Németh 2006, authors' personal observations). This complex structure probably plays a vital role in confusing mammalian predators that try to hunt inside the burrows, and increases the probability that blind mole rats can either escape or hide from their enemies. The anti-predatory role of the structure of the burrow system is also supported by studies on other groups of subterranean rodents (Brown & Hickmann 1973, Hickman 1977, Šklíba et al. 2008). However, due to the general lack of detailed investigations and review papers, it is difficult to compare the aboveground and underground predation pressure on blind mole rats with that on other subterranean or fossorial rodents. Although many authors discuss this comparison and make generalised statements, direct observations and personal accounts are rare (e.g. Ansell 1960, Genelly 1965, Pienaar et al. 1980, De Graaff 1981, Vassallo et al. 1994, Bennett & Faulkes 2000, Cultrera et al. 2006). However, the high number of avian and mammalian predators of blind mole rats indicates that other, less well-adapted subterranean rodents may suffer even more significant predation both above and below the ground.

Populations and habitats of many different European blind mole rat taxa are disappearing at an alarming rate, a phenomenon that raises serious conservation concerns (Kryštufek 1999, Kryštufek & Amori 2008, Németh et al. 2009, Csorba et al. 2015). Blind mole rat populations in many European countries are facing dramatic habitat loss and other threatening factors; often, the remaining habitats and populations are heavily fragmented (Németh et al. 2009, 2013a, b, c, Csorba et al. 2015). Blind mole rats play an important role in determining the species composition and community structure of vascular plants in dry grassland habitats (Zimmermann et al. 2014). Also, many of the raptors and carnivores identified as predators of blind mole rats (Table 1) are listed in the Annexes of the European Union (EU) Birds Directive or the Habitats Directive (Table 2). The Eurasian eagle owl, the Egyptian vulture, the black kite, the eastern imperial eagle, Bonelli's eagle, the golden eagle, the long-legged buzzard, and the hen harrier are included in the Annex I of the Birds Directive; the steppe polecat and the European marbled polecat are listed in Annexes II and IV of the Habitats Directive. These species were used as target species when designating Natura 2000 sites, the network of areas protected by the EU. Nature conservation projects of the EU (LIFE projects) aiming at the conservation of the Egyptian vulture, the eastern imperial eagle and Bonelli's eagle are high priority. Many of these species are also threatened globally (Tikhonov et al. 2008a, Anonymous 2014). Although the steppe polecat is classified

Table 2. Nature conservation classification of the predator species that are known to feed on blind mole rats

Species		EU Directives	LIFE priority	IUCN Red List	IUCN EU25 List
Eurasian eagle owl	<i>Bubo bubo</i>	Birds Directive Appendix I	No	Least concern	Not evaluated for birds
Egyptian vulture	<i>Neophron percnopterus</i>	Birds Directive Appendix I	Yes	Endangered	Not evaluated for birds
Black kite	<i>Milvus migrans</i>	Birds Directive Appendix I	No	Least concern	Not evaluated for birds
Eastern imperial eagle	<i>Aquila heliaca</i>	Birds Directive Appendix I	Yes	Vulnerable	Not evaluated for birds
Bonelli's eagle	<i>Aquila fasciata</i>	Birds Directive Appendix I	Yes	Least concern	Not evaluated for birds
Golden eagle	<i>Aquila chrysaetos</i>	Birds Directive Appendix I	No	Least concern	Not evaluated for birds
Long-legged buzzard	<i>Buteo rufinus</i>	Birds Directive Appendix I	No	Least concern	Not evaluated for birds
Hen harrier	<i>Circus cyaneus</i>	Birds Directive Appendix I	No	Least concern	Not evaluated for birds
Steppe polecat	<i>Mustela eversmannii</i>	Habitats Directive Appendix II, IV	No	Least concern	Endangered
Marbled polecat	<i>Vormela peregusna</i>	Habitats Directive Appendix II, IV	No	Vulnerable	Vulnerable

EU, European Union; IUCN, International Union for Conservation of Nature.

as Least Concern (Tikhonov et al. 2008b), denoting that it is not threatened globally, it is classified in the International Union for Conservation of Nature's EU 25 List as Endangered (Temple & Terry 2007), and its European populations are generally decreasing (Šálek et al. 2013). One of the LIFE+ projects funded by the EU aims to reinforce ongoing efforts to strengthen the core European populations of the saker falcon *Falco cherrug* and the eastern imperial eagle by stopping the decline of small mammal populations that serve as their prey (http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4880).

The importance of blind mole rats as a food resource for several threatened predator species suggests that the survival, reproductive success and population size of these predators may partly depend on the abundance of blind mole rats. Although many species within the Spalacinae subfamily are themselves threatened to various extents, the role of blind mole rat populations in carnivore and raptor conservation should be considered and evaluated.

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