



The species diversity, distribution, and conservation status of the terrestrial mammals of Iran

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Located at the crossroad of the Palearctic, Saharo-Arabian, and Oriental zoogeographic realms, and with its great environmental diversity, Iran harbors a high complexity and richness of fauna and flora. Knowledge about the Iranian mammal fauna has greatly increased over recent years thanks to the growing availability of molecular tools, which brought marked changes in taxonomy, but also because of intensive field surveys resulting in growing distributional data. These data are, however, scattered throughout numerous publications and unpublished sources, most of which are difficult to access. Here, we present a comprehensive review of the current mammal species taxonomies with an update on systematics and their spatial distribution based on all possible sources spanning the period between 1758 and today. We updated the geographical distribution of all Iranian land mammals, providing their regional extent of occurrence and area of occupancy, as well as mapped species richness. Based on this information, we then assessed the conservation status of Iran's mammals using the International Union for Conservation of Nature Red List criteria, providing a regional status assessment. The current species list of terrestrial mammals of Iran comprises 192 species from 34 families, of which eight species are endemics. Since the publication of Karami et al. (2008), 13 new species or new records have been added to the mammals of Iran and 32 changes in classification or nomenclature have been made. The Alborz and Zagros mountains accumulate the highest species richness. Nearly 13% of the species in Iran are threatened, and a further 14% are near to qualifying for threatened status. With the current review, we provide an up-to-date summary of the current knowledge about the terrestrial mammals of Iran that can serve as a guideline for mammalogists, a reference for monitoring regional biodiversity status and trends, and a framework for planning management actions to sustain biodiversity conservation.

Key words: Iran, mammalian fauna, regional red list, richness, southwest Asia, systematic checklist, taxonomy, terrestrial, zoogeographic affinities

Iran is located on the meeting point of three main zoogeographic realms: the Palearctic, Saharo-Arabian, and Oriental (Holt et al. 2013). While the two principal mountain ranges of the Alborz (= Elburz) and the Zagros, as well as the Caucasian

region, are part of the Palearctic realm, the central basin region belongs to the Saharo-Arabian realm, and the lowlands of southeastern Iran are adjacent to the westernmost portion of the Oriental realm (Fig. 1). In addition, Iran exhibits great

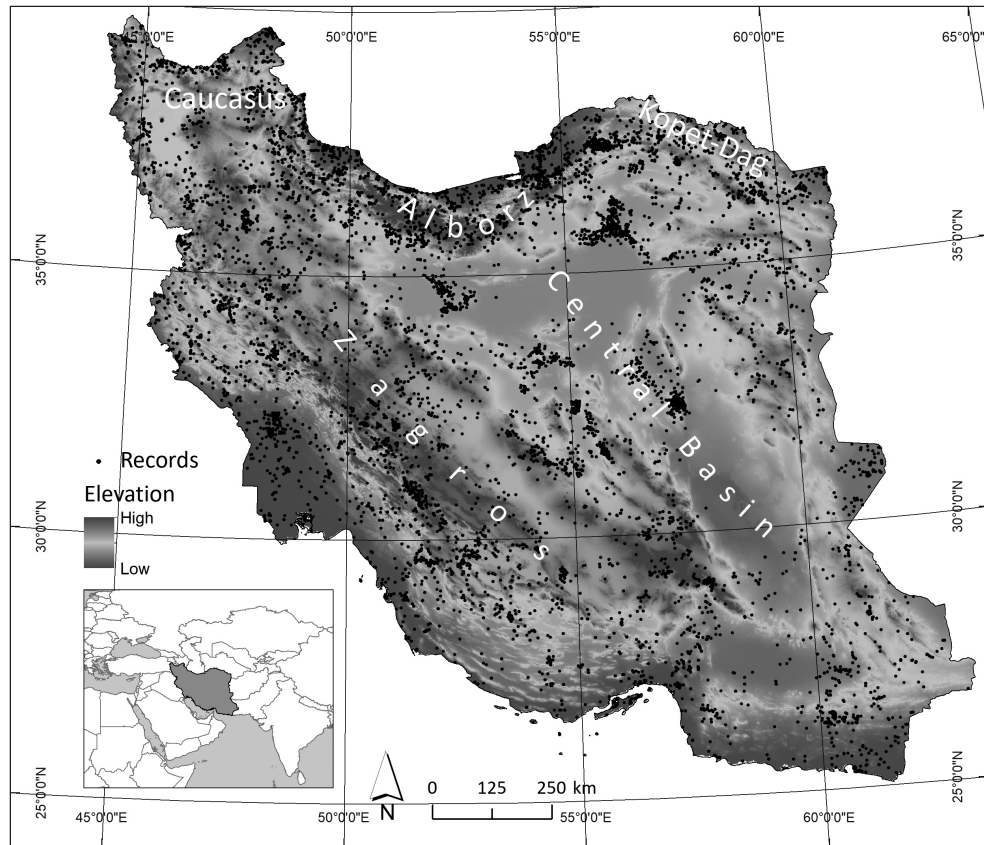


Fig. 1.—Distribution of all occurrence records of terrestrial mammals in Iran, elevational variation, main place names mentioned in the text, and geographic location of Iran (small inset).

physiographic complexity and climatic diversity resulting in multiple transition zones between biomes within its boundaries, thus leading to a large variety of habitat types, from temperate humid forests to the most extreme deserts on Earth (Zohary 1973; Zehzad et al. 2002; Djamali et al. 2011). Regionally, Iran's geographical location makes it a proverbial bridge between the Mediterranean and Arabia on one side, and between central Asia and Indian regions on the other. This geographic and topographic diversity is reflected in a diverse mammalian fauna. For example, 45 bat species occur across Britain and Europe overall (Dietz and Kiefer 2016), but 51 bat species have been recorded in Iran, a number accentuated by the fact that the sampling efforts are not comparable.

The complex and diverse mixture of terrestrial mammals occurring in Iran (Firouz 2005) has attracted the interest of both naturalists and scientific explorers. The first description of the mammalian fauna of Iran dates back to 1758, when Carl Linnaeus (*Systema Naturae* 1758:40) described and named two carnivores, the golden jackal (*Canis aureus*) and the striped hyena (*Hyaena hyaena*), with type localities in Iran. Since then, several researchers have attempted to document the mammals of Iran, but the first comprehensive list of Iranian mammals was compiled by William T. Blanford, who reported 89 species for Persia (former name of Iran—Blanford 1876). Significant contributions to this field were made by Xavier Misonne (1959) and Douglas Lay (1967), who listed 135 and 124 species of terrestrial mammals, respectively. The seminal three-volume

Mammals of Iran by Esmail Etemad (1978, 1984, 1985; in Persian with a summary in English) included the most-detailed research on 138 species of Iranian land mammals, and two comprehensive treatments on the Iranian bat fauna (De Blasé 1980; Benda et al. 2012) provide valuable knowledge regarding the species diversity and distribution of Iranian mammals. Two field guides by Harrington and Dareshuri (1977) and Ziaie (1996, 2008) help with identification based on habitat and species characteristics. Later, Karami et al. (2008) published an annotated checklist and increased the number of land mammal species of Iran to 178. Finally, a recent atlas of the mammals of Iran by Karami et al. (2016) extended the species diversity of the terrestrial mammalian fauna of Iran and presented a list of 184 species. All above species counts included two locally extinct species, the Asiatic lion (*Panthera leo persica*) and the Caspian tiger (*P. tigris virgata*), and excluded the Caspian seal (*Pusa caspica*), Sirenia, and Cetacea.

Research on Iranian mammals has greatly increased in the last decade with an immense accumulation of knowledge. On the one hand, the increasing application of modern techniques led to marked taxonomic revisions. For instance, wild sheep (*Ovis orientalis*) and wild cats (*Felis silvestris*) each have been split into two separate species (Rezaei et al. 2010; Kitchener et al. 2017). On the other hand, intensive field surveys have resulted in an impressive accumulation of new distributional data. For instance, up until a decade ago, the range of Pallas's cat (*Otocolobus manul*) was thought to be restricted to a few

localities in northeastern Iran, but now the species is confirmed to occur in no less than 14 regional provinces (Farhadinia et al. 2016).

Part of this information was presented in the *Atlas of Mammals of Iran* by Karami et al. (2016) (Table 1), which provides a wealth of information on morphology, ecology, behavior, breeding, habitat, distribution, and abundance for the mammalian fauna of Iran with range maps and color photos for most of the species. The *Atlas*, however, does not comment on taxonomy, and thus, the final list of species emerged mostly based on Karami et al. (2008), with minor revision. In addition, many new distributional data, many of them in Persian and thus not accessible to the general scientific community, have appeared over the past decade or since the release of Karami et al. (2016). The specimens in museum collections that were missed or omitted, and the many new taxonomic revisions published in recent years, require a more comprehensive and up-to-date list of the terrestrial mammals of Iran.

The *Atlas of Mammals of Iran* also does not use in-text citations, which makes it difficult to use by students, researchers, and conservationists (Kilpatrick 2018). The citations are neither given on the species accounts nor in the distributional data. In the absence of bibliographic references in the species accounts, tracking taxonomic changes is difficult, while absence of

references for the distributional data of each species renders unclear the mapping of the range of each species. Finally, only a few copies of the *Atlas* were published, and they are kept in the Iranian Department of Environment (DoE), which means that their availability is restricted and they are out of reach of the general audience.

The new findings, both in taxonomy and distributional records, as well as the general inaccessibility of much of the information for a wider audience, justify compiling a new list and a review of the land mammals of Iran. Here, we use an extensive literature survey of the terrestrial mammals of Iran: 1) to review the current knowledge about the taxonomy (at the subspecies level) and 2) to map the geographical distribution of these species. Based on these data, we also: 3) assess the conservation status of Iranian land mammals using International Union for Conservation of Nature (IUCN) Red List criteria; 4) present information about endemism and zoogeographical affinities for each species; and 5) map the distribution of species richness. This paper aims to survey and summarize what is known about the terrestrial mammals of Iran in order to present a comprehensive account of the current knowledge of the mammalian fauna of Iran. With this aim, we have attempted to collect all the information available to us about the diversity and distribution of Iranian land mammals from numerous publications and unpublished sources, much of which are difficult to access

Table 1.—List of known land mammals of Iran, in this study, and Karami et al. (2008, 2016) with the number of records (*n*), zoogeographic affinities (ZOA), Regional IUCN Red List categories and criteria (IUCN-R), and global status (IUCN-G). Under ZOA, “indefinable” stands for species occurring in more than two zoogeographical regions.

Order and Family	This study	Karami et al. (2016)	Karami et al. (2008)	<i>n</i>	ZOA	IUCN-R	IUCN-G
Order Eulipotyphla							
Erinaceidae	<i>Erinaceus concolor</i>	<i>E. concolor</i>	<i>E. concolor</i>	61	Palaearctic	LC	LC
	<i>Hemiechinus auritus</i>	<i>H. auritus</i>	<i>H. auritus</i>	75	Saharo-Arabian	LC	LC
	<i>Paraechinus aethiopicus</i>	<i>P. aethiopicus</i>	<i>P. aethiopicus</i>	3	Saharo-Arabian	DD	LC
	<i>Paraechinus hypomelas</i>	<i>P. hypomelas</i>	<i>P. hypomelas</i>	103	Saharo-Arabian	LC	LC
Soricidae	<i>Crocidura caspica</i>	<i>C. caspica</i>	<i>C. caspica</i>	15	Palaearctic	LC	DD
	<i>Crocidura gmelini</i>	<i>C. gmelini</i>	<i>C. gmelini</i>	12	Palaearctic	LC	LC
	<i>Crocidura gueldenstaedtii</i>	-	-	67	Palaearctic	LR	DD
	<i>Crocidura katinka</i>	<i>C. katinka</i>	<i>C. katinka</i>	-	-	-	-
	<i>Crocidura leucodon</i>	<i>C. leucodon</i>	<i>C. leucodon</i>	22	Palaearctic	LC	LC
	<i>Crocidura suaveolens</i>	<i>C. suaveolens</i>	<i>C. suaveolens</i>	24	Palaearctic	LC	LC
	<i>Crocidura susiana</i> ^a	<i>C. susiana</i>	<i>C. susiana</i>	5	Saharo-Arabian	EN B2ab	DD
	<i>Crocidura zarudnyi</i>	<i>C. zarudnyi</i>	<i>C. zarudnyi</i>	6	Saharo-Arabian	LC	LC
	<i>Suncus etruscus</i>	<i>S. etruscus</i>	<i>S. etruscus</i>	31	indefinable	LC	LC
	<i>Suncus murinus</i>	<i>S. murinus</i>	-	4	Introduced	NA	LC
	<i>Neomys milleri</i>	<i>N. anomalus</i>	<i>N. anomalus</i>	2	Palaearctic	DD	LC ¹
	<i>Neomys teres</i>	<i>N. teres</i>	<i>N. teres</i>	4	Palaearctic	LC	LC
	<i>Sorex volnuchini</i>	<i>S. volnuchini</i>	<i>S. volnuchini</i>	4	Palaearctic	DD	LC
Talpidae	<i>Talpa davidiana</i>	<i>T. davidiana</i>	<i>T. davidiana</i>	3	Palaearctic	NT	DD
	<i>Talpa levantis</i>	<i>T. levantis</i>	<i>T. levantis</i>	1	Palaearctic	DD	LC ²
	<i>Talpa talyshenses</i>	<i>T. caucasica</i>	<i>T. caucasica</i>	5	Palaearctic	LC	LC
Order Chiroptera							
Pteropodidae	<i>Rousettus aegyptiacus</i>	<i>R. aegyptiacus</i>	<i>R. aegyptiacus</i>	55	Afrotropical	LC	LC
Rhinolophidae	<i>Rhinolophus blasii</i>	<i>R. blasii</i>	<i>R. blasii</i>	37	indefinable	LC	LC

Table 1.—Continued

Order and Family	This study	Karami et al. (2016)	Karami et al. (2008)	n	ZOA	IUCN-R	IUCN-G
	-		<i>Rhinolophus bocharicus</i>				
	<i>Rhinolophus euryale</i>	<i>R. euryale</i>	<i>R. euryale</i>	26	Palaearctic	LC	NT
	<i>Rhinolophus ferrumequinum</i>	<i>R. ferrumequinum</i>	<i>R. ferrumequinum</i>	92	indefinable	VU B2ab	LC
	<i>Rhinolophus hipposideros</i>	<i>R. hipposideros</i>	<i>R. hipposideros</i>	50	Palaearctic	VU B2ab	LC
	<i>Rhinolophus mehelyi</i>	<i>R. mehelyi</i>	<i>R. mehelyi</i>	17	Palaearctic	VU B2ab	VU
Hipposideridae	<i>Hipposideros fulvus</i>	<i>H. fulvus</i>	<i>H. fulvus</i>	1	Oriental	DD	LC
	<i>Asellia tridens</i>	<i>A. tridens</i>	<i>A. tridens</i>	56	Saharo-Arabian	LC	LC
Rhinopomatidae	<i>Rhinopoma hardwickii</i>	<i>R. hardwickii</i>	<i>R. hardwickii</i>	28	Saharo-Arabian	LC	LC
	<i>Rhinopoma microphyllum</i>	<i>R. microphyllum</i>	<i>R. microphyllum</i>	83	Saharo-Arabian	LC	LC
	<i>Rhinopoma muscatellum</i>	<i>R. muscatellum</i>	<i>R. muscatellum</i>	77	Saharo-Arabian	LC	LC
Rhinonycteridae	<i>Triaenops persicus</i>	<i>T. persicus</i>	<i>T. persicus</i>	8	Saharo-Arabian	DD	LC
Emballonuridae	<i>Taphozous perforatus</i>	<i>T. perforatus</i>	<i>T. perforatus</i>	9	Saharo-Arabian	LC	LC
	<i>Taphozous nudiventris</i>	<i>T. nudiventris</i>	<i>T. nudiventris</i>	17	Saharo-Arabian	LC	LC
Molossidae	<i>Nyctinomus aegyptiacus</i>	<i>N. aegyptiacus</i>	<i>Tadarida aegyptiaca</i>	3	indefinable	LC	LC ³
	<i>Tadarida teniotis</i>	<i>T. teniotis</i>	<i>T. teniotis</i>	26	Palaearctic	LC	LC
Miniopteridae	<i>Miniopterus pallidus</i>	<i>M. pallidus</i>	<i>M. schreibersii</i>	73	Palaearctic	VU B2ab	NT ⁴
Vespertilionidae	<i>Myotis bechsteini</i>	<i>M. bechsteini</i>	<i>M. bechsteini</i>	4	Palaearctic	NT	NT
	<i>Myotis blythii</i>	<i>M. blythii</i>	<i>M. blythii</i>	145	Palaearctic	LC	LC
	<i>Myotis capaccinii</i>	<i>M. capaccinii</i>	<i>M. capaccinii</i>	15	Palaearctic	VU B2ab	VU
	<i>Myotis davidii</i>	<i>M. davidii</i>	<i>Myotis aurascens</i>	22	Palaearctic	LC	LC
	<i>Myotis emarginatus</i>	<i>M. emarginatus</i>	<i>Myotis nipalensis</i>	23	Palaearctic	LC	LC ⁵
	<i>Myotis hyrcanicus</i> ^a	<i>M. hyrcanicus</i>	<i>M. emarginatus</i>	1	Palaearctic	DD	LC ⁶
	<i>Myotis mystacinus</i>	<i>M. mystacinus</i>	<i>M. mystacinus</i>	1	Palaearctic	DD	LC
	<i>Myotis nattereri</i>	<i>M. nattereri</i>		2	Palaearctic	NT	LC
	<i>Myotis schaubi</i>	<i>M. schaubi</i>	<i>M. schaubi</i>	11	Palaearctic	LC	DD
	<i>Eptesicus anatolicus</i>	<i>E. anatolicus</i>	<i>E. anatolicus</i>	10	Palaearctic	LC	NE
	<i>Eptesicus bottae</i>	<i>E. bottae</i>	<i>E. bottae</i>	2	Saharo-Arabian	NT	LC
	<i>Eptesicus gobiensis</i>	<i>E. bobrinskoi</i>	<i>E. bobrinskoi</i>	1	Palaearctic	DD	LC
	<i>Eptesicus nilssonii</i>	<i>E. nilssonii</i>	<i>E. nilssonii</i>	2	Palaearctic	DD	LC
	<i>Eptesicus ognevi</i>			5	Palaearctic	LC	NE
	<i>Eptesicus pachyomus</i>	<i>E. pachyomus</i>		2	Oriental	NT	NE
	<i>Eptesicus serotinus</i>	<i>E. serotinus</i>	<i>E. serotinus</i>	27	Palaearctic	LC	LC
	<i>Rhynptesicus nasutus</i>	<i>R. nasutus</i>	<i>Eptesicus nasutus</i>	11	Saharo-Arabian	LC	LC ⁷
	<i>Nyctalus lasiopterus</i>	<i>N. lasiopterus</i>	<i>N. lasiopterus</i>	1	Palaearctic	DD	VU
	<i>Nyctalus leisleri</i>	<i>N. leisleri</i>	<i>N. leisleri</i>	9	Palaearctic	LC	LC
	<i>Nyctalus noctula</i>	<i>N. noctula</i>	<i>N. noctula</i>	7	Palaearctic	NT	LC
	<i>Pipistrellus kuhlii</i>	<i>P. kuhlii</i>	<i>P. kuhlii</i>	125	Palaearctic	LC	LC
	<i>Pipistrellus nathusii</i>			1	Palaearctic	DD	LC
	<i>Pipistrellus pipistrellus</i>	<i>P. pipistrellus</i>	<i>P. pipistrellus</i>	73	Palaearctic	LC	LC
	<i>Pipistrellus pygmaeus</i>	<i>P. pygmaeus</i>	<i>P. pygmaeus</i>	5	Palaearctic	DD	LC
	<i>Barbastella barbastellus</i>	<i>B. barbastellus</i>	<i>B. barbastellus</i>	4	Palaearctic	NT	NT
	<i>Barbastella caspica</i>	<i>B. darjilingensis</i>	<i>B. darjilingensis</i>	7	Palaearctic	NT	LC ⁸
	<i>Otonycteris hemprichii</i>	<i>O. hemprichii</i>	<i>O. hemprichii</i>	18	Saharo-Arabian	LC	LC
	<i>Otonycteris leucophaea</i>	<i>O. leucophaea</i>		5	Saharo-Arabian	LC	DD
	<i>Plecotus auritus</i>	<i>P. auritus</i>	<i>P. auritus</i>	1	Palaearctic	DD	LC
	<i>Plecotus macrobullaris</i>	<i>P. macrobullaris</i>	<i>P. macrobullaris</i>	14	Palaearctic	LC	LC
	<i>Plecotus strelkovi</i>	<i>P. strelkovi</i>		1	Palaearctic	DD	NE
	<i>Hypsugo arabicus</i>	<i>H. arabicus</i>	<i>H. arabicus</i>	1	Saharo-Arabian	DD	DD ⁹
	<i>Hypsugo savii</i>	<i>H. savii</i>	<i>H. savii</i>	22	Palaearctic	LC	LC
	<i>Vespertilio murinus</i>	<i>V. murinus</i>	<i>V. murinus</i>	7	Palaearctic	LC	LC
Order Carnivora							
Felidae	<i>Acinonyx jubatus</i>	<i>A. jubatus</i>	<i>A. jubatus</i>	729	Afrotropical	CR D	VU
	<i>Caracal caracal</i>	<i>C. caracal</i>	<i>C. caracal</i>	191	indefinable	NT	LC
	<i>Felis chaus</i>	<i>F. chaus</i>	<i>F. chaus</i>	150	Indefinable	LC	LC

Table 1.—Continued

Order and Family	This study	Karami et al. (2016)	Karami et al. (2008)	n	ZOA	IUCN-R	IUCN-G
	<i>Felis lybica</i>			245	Afrotropical	LC	LC ¹⁰
	<i>Felis margarita</i>	<i>F. margarita</i>	<i>Felis margarita</i>	44	Saharo-Arabian	LC	LC
	<i>Felis silvestris</i>	<i>F. silvestris</i>	<i>Felis silvestris</i>	18	Palaearctic	NT	LC
	<i>Lynx lynx</i>	<i>L. lynx</i>	<i>Lynx lynx</i>	140	Palaearctic	NT	LC
	<i>Otocolobus manul</i>	<i>O. manul</i>	<i>Felis manul</i>	87	Palaearctic	NT	NT
	<i>Panthera leo</i>	<i>P. leo</i>	<i>P. leo</i>	31	Indefinable	EX	VU
	<i>Panthera pardus</i>	<i>P. pardus</i>	<i>P. pardus</i>	485	Indefinable	EN C2a(i)	VU
	<i>Panthera tigris</i>	<i>P. tigris</i>	<i>P. tigris</i>	38	Oriental	EX	EN
			<i>Uncia uncia</i>				
Hyaenidae	<i>Hyaena hyaena</i>	<i>H. hyaena</i>	<i>H. hyaena</i>	400	Indefinable	NT	NT
Herpestidae	<i>Urva auropunctata</i>	<i>Herpestes javanicus</i>	<i>H. javanicus</i>	11	Oriental	LC	LC ¹¹
	<i>Urva edwardsii</i>	<i>Herpestes edwardsii</i>	<i>H. edwardsii</i>	66	Oriental	LC	LC ¹²
Canidae	<i>Canis aureus</i>	<i>C. aureus</i>	<i>C. aureus</i>	453	Indefinable	LC	LC
	<i>Canis lupus</i>	<i>C. lupus</i>	<i>C. lupus</i>	626	Indefinable	NT	LC
	<i>Vulpes cana</i>	<i>V. cana</i>	<i>V. cana</i>	74	Saharo-Arabian	NT	LC
	<i>Vulpes corsac</i>	<i>V. corsac</i>	<i>V. corsac</i>	14	Palaearctic	VU B2ab	LC
	<i>Vulpes rueppellii</i>	<i>V. rueppellii</i>	<i>V. rueppellii</i>	37	Saharo-Arabian	NT	LC
	<i>Vulpes vulpes</i>	<i>V. vulpes</i>	<i>V. vulpes</i>	617	Indefinable	LC	LC
Ursidae	<i>Ursus arctos</i>	<i>U. arctos</i>	<i>U. arctos</i>	429	Palaearctic	EN C2a(i)	LC
	<i>Ursus thibetanus</i>	<i>U. thibetanus</i>	<i>U. thibetanus</i>	444	Indefinable	CR B2ab, C2a(i)	VU
Mustelidae	<i>Lutra lutra</i>	<i>L. lutra</i>	<i>L. lutra</i>	105	Indefinable	VU B2ab	NT
	<i>Lutrogale perspicillata</i>	<i>L. perspicillata</i>	<i>L. perspicillata</i>	2	Oriental	DD	VU
	<i>Martes foina</i>	<i>M. foina</i>	<i>M. foina</i>	111	Palaearctic	LC	LC
	<i>Martes martes</i>	<i>M. martes</i>	<i>M. martes</i>	24	Palaearctic	LC	LC
	<i>Meles canescens</i>	<i>M. meles</i>	<i>M. meles</i>	107	Palaearctic	LC	LC ¹³
	<i>Mellivora capensis</i>	<i>M. capensis</i>	<i>M. capensis</i>	34	Indefinable	LC	LC
	<i>Mustela nivalis</i>	<i>M. nivalis</i>	<i>M. nivalis</i>	59	Palaearctic	LC	LC
	<i>Vormela peregusna</i>	<i>V. peregusna</i>	<i>V. peregusna</i>	34	Palaearctic	LC	VU
Procyonidae	<i>Procyon lotor</i>	<i>P. lotor</i>	<i>P. lotor</i>	3	Introduced	NA	LC
Order Perissodactyla							
Equidae	<i>Equus hemionus</i>	<i>E. hemionus</i>	<i>E. hemionus</i>	71	Saharo-Arabian	EN B2ab, C2a(i)	NT
Order Artiodactyla							
Suidae	<i>Sus scrofa</i>	<i>S. scrofa</i>	<i>S. scrofa</i>	323	Indefinable	LC	LC
Cervidae	<i>Capreolus capreolus</i>	<i>C. capreolus</i>	<i>C. capreolus</i>	60	Palaearctic	EN C2a(i)	VU
	<i>Cervus elaphus</i>	<i>C. elaphus</i>	<i>C. elaphus</i>	66	Palaearctic	EN C2a(i)	LC
	<i>Dama mesopotamica</i>	<i>D. mesopotamica</i>	<i>D. dama</i>	4	Palaearctic	CR B1ab, B2ab, C2a(i)	EN
Bovidae	<i>Capra aegagrus</i>	<i>C. aegagrus</i>	<i>C. aegagrus</i>	408	Palaearctic	VU C2a(i)	VU
	<i>Gazella bennettii</i>	<i>G. bennettii</i>	<i>G. bennettii</i>	185	Saharo-Arabian	EN C2a(i)	LC
	<i>Gazella cf. gazella</i>	<i>G. gazella</i>	<i>G. gazella</i>	1	Saharo-Arabian	EN B1ab, B2ab, D	VU
	<i>Gazella subgutturosa</i>	<i>G. subgutturosa</i>	<i>G. subgutturosa</i>	178	Saharo-Arabian	EN C2a(i)	VU
	<i>Ovis gmelini</i>	<i>O. gmelini</i>	<i>O. orientalis</i>	116	Palaearctic	VU C2a(i)	VU ¹⁴
	<i>Ovis vignei</i>	<i>O. vignei</i>		344	Palaearctic	VU C2a(i)	VU ¹⁵
Order Rodentia							
Sciuridae	<i>Funambulus pennantii</i>	<i>F. pennantii</i>	<i>F. pennantii</i>	16	Oriental	LC	LC
	<i>Sciurus anomalus</i>	<i>S. anomalus</i>	<i>S. anomalus</i>	38	Palaearctic	NT	LC
	<i>Spermophilopsis leptodactylus</i>	<i>S. leptodactylus</i>	<i>S. leptodactylus</i>	3	Palaearctic	NT	LC
	<i>Spermophilus fulvus</i>	<i>S. fulvus</i>	<i>S. fulvus</i>	43	Palaearctic	LC	LC
	<i>Spermophilus xanthoprymnus</i>	<i>S. xanthoprymnus</i>	<i>S. xanthoprymnus</i>	6	Palaearctic	NT	NT
Gliridae	<i>Dryomys nitedula</i>	<i>D. nitedula</i>	<i>D. nitedula</i>	65	Palaearctic	LC	LC
	<i>Glis glis</i>	<i>G. glis</i>	<i>G. glis</i>	50	Palaearctic	LC	LC
	<i>Myomimus personatus</i>	<i>M. personatus</i>	<i>M. personatus</i>	3	Palaearctic	NT	DD
	<i>Myomimus setzeri</i>	<i>M. setzeri</i>	<i>M. setzeri</i>	7	Palaearctic	LC	DD
Dipodidae	<i>Scarturus elater</i>	<i>Allactaga elater</i>	<i>A. elater</i>	104	Palaearctic	LC	LC
	<i>Scarturus euphraticus</i>	<i>Allactaga euphratica</i>		2	Saharo-Arabian	NT	NT
	<i>Scarturus hotsoni</i>	<i>Allactaga hotsoni</i>	<i>Allactaga firouzi</i> <i>A. hotsoni</i>	30	Saharo-Arabian	LC	LC
	<i>Scarturus vinogradovi</i>	<i>Allactaga toussi</i>	<i>A. toussi</i>	11	Palaearctic	LC	NT

Table 1.—Continued

Order and Family	This study	Karami et al. (2016)	Karami et al. (2008)	<i>n</i>	ZOA	IUCN-R	IUCN-G
	<i>Scarturus williamsi</i>	<i>Allactaga williamsi</i>	<i>A. williamsi</i>		Paelearctic	LC	LC
	<i>Dipus sagitta</i>	<i>D. sagitta</i>	<i>D. sagitta</i>	1	Paelearctic	DD	LC
	<i>Jaculus blanfordi</i>	<i>J. blanfordi</i>	<i>J. blanfordi</i>	53	Saharo- Arabian	LC	LC
	<i>Jaculus loftusi</i>	<i>J. jaculus</i>	<i>J. jaculus</i>	24	Saharo- Arabian	LC	LC ¹⁶
	<i>Jaculus thaleri</i> ^a	<i>J. thaleri</i>	<i>J. thaleri</i>	2	Saharo- Arabian	DD	DD
Sapalacidae	<i>Pygeretmus pumilio</i>	<i>P. pumilio</i>	<i>P. pumilio</i>	15	Paelearctic	VU B2ab	LC
Calomyscidae	<i>Nannospalax xanthodon</i>			2	Paelearctic	DD	DD
	<i>Calomyscus bailwardi</i> ^a	<i>C. bailwardi</i>	<i>C. bailwardi</i>	81	Paelearctic	LC	LC
	<i>Calomyscus elburzensis</i>	<i>C. elburzensis</i>	<i>C. elburzensis</i>	88	Paelearctic	LC	LC
	<i>Calomyscus grandis</i> ^a	<i>C. grandis</i>	<i>C. grandis</i>	11	Paelearctic	NT	DD
	<i>Calomyscus hotsoni</i>	<i>C. hotsoni</i>	<i>C. hotsoni</i>	14	Saharo- Arabian	LC	LC
	<i>Calomyscus mystax</i>			5	Saharo- Arabian	NT	LC
Cricetidae	<i>Calomyscus urartensis</i>	<i>C. urartensis</i>	<i>C. urartensis</i>	4	Paelearctic	LC	LC
	<i>Arvicola amphibius</i>	<i>A. amphibius</i>	<i>A. amphibius</i>	46	Paelearctic	LC	LC
	<i>Chionomys nivalis</i>	<i>C. nivalis</i>	<i>C. nivalis</i>	28	Paelearctic	VU B2ab	LC
	<i>Cricetulus migratorius</i>	<i>C. migratorius</i>	<i>C. migratorius</i>	268	Paelearctic	LC	LC
	<i>Ellobius fuscocapillus</i>	<i>E. fuscocapillus</i>	<i>E. fuscocapillus</i>	40	Paelearctic	LC	LC
	<i>Ellobius lutescens</i>	<i>E. lutescens</i>	<i>E. lutescens</i>	101	Paelearctic	LC	LC
	<i>Ellobius talpinus</i>	<i>E. talpinus</i>	<i>E. talpinus</i>	6	Paelearctic	NT	LC
	<i>Mesocricetus brandti</i>	<i>M. brandti</i>	<i>M. brandti</i>	29	Paelearctic	LC	NT
	<i>Microtus afghanus</i>	<i>Blanfordimys afghanus</i>	<i>B. afghanus</i>	11	Paelearctic	LC	LC ¹⁷
	<i>Microtus daghestanicus</i>			1	Paelearctic	DD	LC
	<i>Microtus irani</i>	<i>M. irani</i>	<i>M. irani</i>	38	Paelearctic	LC	DD
	<i>Microtus kermanensis</i> ^a			4	Paelearctic	LC	DD
	<i>Microtus majori</i>	<i>M. majori</i>	<i>M. majori</i>	1	Paelearctic	DD	LC
	<i>Microtus mystacinus</i> ^a	<i>M. levis</i>	<i>M. levis</i>	12	Paelearctic	LC	NE
	<i>Microtus obscurus</i>	<i>M. arvalis</i>	<i>M. arvalis</i>	12	Paelearctic	LC	NE
	<i>Microtus paradoxus</i>	<i>M. paradoxus</i>	<i>M. paradoxus</i>	28	Paelearctic	LC	LC
	<i>Microtus qazvinensis</i> ^a	<i>M. qazvinensis</i>	<i>M. qazvinensis</i>	13	Paelearctic	LC	LC
	<i>Microtus schelkovnikovi</i>	<i>M. schelkovnikovi</i>	<i>M. schelkovnikovi</i>	6	Paelearctic	NT	LC
	<i>Microtus socialis</i>	<i>M. socialis</i>	<i>M. socialis</i>	110	Paelearctic	LC	LC
	<i>Microtus transcaspicus</i>	<i>M. transcaspicus</i>	<i>M. transcaspicus</i>	13	Paelearctic	LC	LC
Hystricidae	<i>Hystrix indica</i>	<i>H. indica</i>	<i>H. indica</i>	363	Oriental	LC	LC
Muridae	<i>Acomys dimidiatus</i>	<i>A. dimidiatus</i>	<i>A. dimidiatus</i>	31	Saharo- Arabian	LC	LC
	<i>Apodemus hyrcanicus</i>	<i>A. hyrcanicus</i>	<i>A. hyrcanicus</i>	36	Paelearctic	LC	NT
	<i>Apodemus mystacinus</i>	<i>Apodemus avicennicus</i>	<i>A. avicennicus</i>	3	Paelearctic	DD	LC
	<i>Apodemus ponticus</i>	<i>Apodemus flavicollis</i>	<i>A. flavicollis</i>	5	Paelearctic	DD	LC
	<i>Apodemus uralensis</i>	<i>A. uralensis</i>	<i>A. uralensis</i>	13	Paelearctic	LC	LC
	<i>Apodemus witherbyi</i>	<i>A. witherbyi</i>	<i>A. witherbyi</i>	200	Paelearctic	LC	LC
	<i>Gerbillus aquilus</i>	<i>G. aquilus</i>	<i>G. aquilus</i>	15	Saharo- Arabian	LC	LC
	<i>Gerbillus cheesmani</i>	<i>G. cheesmani</i>	<i>G. cheesmani</i>	2	Saharo- Arabian	LC	LC
	<i>Gerbillus henleyi</i>	<i>G. henleyi</i>	<i>G. henleyi</i>	1	Saharo- Arabian	DD	LC
	<i>Gerbillus mesopotamiae</i>	<i>G. mesopotamiae</i>	<i>G. mesopotamiae</i>	10	Saharo- Arabian	VU B2ab	LC
	<i>Gerbillus nanus</i>	<i>G. nanus</i>	<i>G. nanus</i>	140	Saharo- Arabian	LC	LC
	<i>Golunda ellioti</i>	<i>G. ellioti</i>	<i>G. ellioti</i>	10	Oriental	LC	LC
	<i>Meriones crassus</i>	<i>M. crassus</i>	<i>M. crassus</i>	185	Saharo- Arabian	LC	LC
	<i>Meriones dahli</i>			1	Paelearctic	DD	EN
	<i>Meriones hurrianae</i>	<i>M. hurrianae</i>	<i>M. hurrianae</i>	17	Oriental	LC	LC
	<i>Meriones libycus</i>	<i>M. libycus</i>	<i>M. libycus</i>	313	Saharo- Arabian	LC	LC
	<i>Meriones meridianus</i>	<i>M. meridianus</i>	<i>M. meridianus</i>	27	Saharo- Arabian	LC	LC
	<i>Meriones persicus</i>	<i>M. persicus</i>	<i>M. persicus</i>	409	Saharo- Arabian	LC	LC

Table 1.—Continued

Order and Family	This study	Karami et al. (2016)	Karami et al. (2008)	<i>n</i>	ZOA	IUCN-R	IUCN-G
	<i>Meriones tristrami</i>	<i>M. tristrami</i>	<i>M. tristrami</i>	58	Saharo-Arabian	LC	LC
	<i>Meriones vinogradovi</i>	<i>M. vinogradovi</i>	<i>M. vinogradovi</i>	42	Saharo-Arabian	LC	LC
	<i>Meriones zarudnyi</i>	<i>M. zarudnyi</i>	<i>M. zarudnyi</i>	1	Saharo-Arabian	DD	DD
	<i>Mus macedonicus</i>	<i>M. macedonicus</i>	<i>M. macedonicus</i>	38	Palaearctic	LC	LC
	<i>Mus musculus</i>	<i>M. musculus</i>	<i>M. musculus</i>	444	Oriental	LC	LC
	<i>Nesokia indica</i>	<i>N. indica</i>	<i>N. indica</i>	140	Palaearctic	LC	LC
	<i>Rattus norvegicus</i>	<i>R. norvegicus</i>	<i>R. norvegicus</i>	45	Introduced	NA	LC
	<i>Rattus pyctoris</i>	<i>R. pyctoris</i>	<i>R. pyctoris</i>	6	Palaearctic	NT	LC
	<i>Rattus rattus</i>	<i>R. rattus</i>	<i>R. rattus</i>	62	Palaearctic	LC	LC
	<i>Rhombomys opimus</i>	<i>R. opimus</i>	<i>R. opimus</i>	142	Palaearctic	LC	LC
	<i>Tatera indica</i>	<i>T. indica</i>	<i>T. indica</i>	214	Oriental	LC	LC
Myocastoridae	<i>Myocastor coypus</i>	<i>M. coypus</i>	<i>M. coypus</i>	9	Introduced	NA	LC
Order Lagomorpha							
Leporidae	<i>Lepus capensis</i>			376	Saharo-Arabian	LC	LC
	<i>Lepus europaeus</i>	<i>L. europaeus</i>	<i>L. europaeus</i>	44	Palaearctic	LC	LC
	<i>Lepus tolai</i>	<i>L. tolai</i>	<i>L. tolai</i>	21	Palaearctic	LC	LC
Ochotonidae	<i>Ochotona rufescens</i>	<i>O. rufescens</i>	<i>O. rufescens</i>	140	Palaearctic	LC	LC
Total	192	184	178				

*Endemic to Iran.

1: classified as LC on the IUCN (under *Neomys anomalus*), but it has not been separately assessed; 2: classified as LC on the IUCN (under *Talpa caucasica*), but it has not been separately assessed; 3: classified as LC on the IUCN (under *Tadarida aegyptiaca*), but it has not been separately assessed; 4: classified as NT on the IUCN (under *Miniopterus schreibersii*), but it has not been separately assessed; 5: classified as LC on the IUCN (under *Myotis mystacinus*), but it has not been separately assessed; 6: classified as LC on the IUCN (under *Myotis mystacinus*), but it has not been separately assessed; 7: classified as LC on the IUCN (under *Eptesicus nasutus*); 8: classified as LC on the IUCN (under *Barbastella leucomelas*), but it has not been separately assessed; 9: classified as DD on the IUCN (under *Pipistrellus arabicus*); 10: classified as LC on the IUCN (under *Felis silvestris*), but it has not been separately assessed; 11: classified as LC on the IUCN (under *Herpestes auropunctatus*); 12: classified as LC on the IUCN (under *Herpestes edwardsii*); 13: classified as LC on the IUCN (under *Meles meles*), but it has not been separately assessed; 14: classified as VU on the IUCN (under *Ovis orientalis gmelini*); 15: classified as VU on the IUCN (under *Ovis orientalis*); 16: classified as LC on the IUCN (under *Jaculus jaculus*), but it has not been separately assessed; 17: classified as LC on the IUCN (under *Blanfordimys afghanus*).

(for details of the sources of species data, see [Supplementary Data SD1](#)).

MATERIALS AND METHODS

To gather data on the taxonomy and distribution of the terrestrial mammals of Iran, we reviewed a total of 873 publications, including journal articles, books, dissertations, documents, and abstracts, spanning the period 1758–2018. In addition, we also collected distributional data from online databases of museum specimens, databases for Iranian protected areas, unpublished reports from the Iranian DoE (the legal entity responsible for issuing the national directives for environment and wildlife protection), and personal communications for unpublished data.

Taxonomic data.—For taxonomic review, we adopted [Wilson and Reeder \(2005\)](#) as a starting point. During the review process, the taxonomy was updated whenever appropriate to include published revisions after 2005, especially recent molecular studies. More specifically, we followed the *Handbook of the Mammals of the World* for classification of carnivores ([Wilson and Mittermeier 2009](#)), hoofed mammals ([Wilson and Mittermeier 2011](#)), lagomorphs and rodents ([Wilson et al. 2016, 2017](#)), and insectivores ([Wilson and Mittermeier 2018](#)), but for Chiroptera we referred to “Bat fauna of Iran” ([Benda et al. 2012](#)). The relevant information (synonymy, common name, and distribution) for each species was

extracted from species accounts of these reference works. Each species entry includes the currently used scientific name followed by the name of the author(s), date of description, the standardized common name, and the type locality. The recent revisions and comments on taxonomic status are cited where appropriate. Taxonomic changes were also applied at order, family, and genus levels when relevant, and comments have been provided. In addition, we identify species that have not yet been documented to occur in Iran, but which are known to occur in adjacent countries close to Iranian borders and may be found within the country. By contrast, we do not include any domesticated mammals of Iran. Finally, it is important to clarify that we did not use [Karami et al. \(2016\)](#) as a reference base, either for taxonomy or distribution.

Distribution data.—A georeferenced database was assembled, which included the scientific name, geographic coordinates (latitude and longitude), geographic location (at the province, municipality, county, and locality or village levels; [Supplementary Data SD1, Fig. SD1](#)), author or collector name, date of occurrence record, and, if relevant, the Protected Area’s name, museum’s name, or catalogue number of the specimens. Further details about sources of information are provided in [Supplementary Data SD1](#). Here, we list only the main sources:

- 1) Literature review searching for all publications (both in English and in Persian) that might include original data on the terrestrial mammals of Iran, including journal

articles, books, field guides, and academic theses. Overall, we compiled 7,520 species occurrence records for 192 species, including data from seven orders: Eulipotyphla ($n = 251$), Chiroptera ($n = 1,199$), Carnivora ($n = 2,027$), Perissodactyla ($n = 93$), Artiodactyla ($n = 654$), Rodentia ($n = 2,994$), and Lagomorpha ($n = 302$).

- 2) Online occurrence records in Global Biodiversity Information Facility Data Portal (<http://www.gbif.org>), VertNet (<http://www.vertnet.org>), and also from museum (London Natural History Museum, United Kingdom; Smithsonian National Museum of Natural History, United States; and Royal Belgian Institute of Natural Sciences Museum, Belgium) websites whenever their data were not presented in the above-mentioned portals or data presented were incomplete. We assembled 1,779 species occurrence records for 109 species including Eulipotyphla ($n = 113$), Chiroptera ($n = 44$), Carnivora ($n = 200$), Artiodactyla ($n = 26$), Rodentia ($n = 1,306$), and Lagomorpha ($n = 90$).
- 3) Lists of mammals recorded in 459 areas under the protection of Iran (DoE-GIS 2016), including: 1) National Parks ($n = 31$); 2) Wildlife Refuges ($n = 49$); 3) Protected Areas ($n = 166$); 4) National Natural Monuments ($n = 39$); and 5) No-Hunting Areas ($n = 174$; [Supplementary Data SD1, Fig. SD2](#)). We compiled 2,382 occurrence records for 43 species including Eulipotyphla ($n = 79$), Carnivora ($n = 1,288$), Artiodactyla ($n = 657$), Rodentia ($n = 173$), and Lagomorpha ($n = 185$).
- 4) Unpublished observations, including: 1) DoE reports; 2) records of DoE provincial offices; 3) field observations collected by the collaborators mentioned in the acknowledgements; 4) gray literature and internet websites containing distribution data (e.g., <http://www.iew.ir/>; <http://www.irandeserts.com/>); and 5) ad hoc observations collected from 2002 to 2017 by the authors of this study (GHY and KF). We compiled 3,284 occurrence records for 37 species including Carnivora ($n = 2,617$), Artiodactyla ($n = 638$), and Perissodactyla ($n = 29$).

We mapped the distributions of species projected to the Universal Transversal Mercator (UTM) on the 39N fuse, using Arc GIS 10.1. (ESRI 2012), superimposed over a 25×25 -km grid cell size. Distribution maps were produced using all records available with the exception of those for medium- and large-sized mammals, for which we did not include occurrence records from species that are now extirpated within a particular province boundary. The exceptions are the maps for two regionally extinct species (*Panthera leo* and *P. tigris*) that inevitably include only historical records.

We further determined both the extent of occurrence and the area of occupancy following the methods of IUCN (2017): 1) extent of occurrence is defined as the area of the minimum convex polygon that encompasses all observations; and 2) area of occupancy is defined as the area within its “extent of occurrence” which is occupied by a species, based on the 25×25 -km UTM grid cells. All calculations were made using Arc GIS 10.1. (ESRI 2012) on the 39N fuse of the UTM projection.

We assessed the conservation status of species by determining the relative extinction risk according to guidelines provided by the IUCN (IUCN 2012a, 2012b, 2017). We applied the rules and definitions (based on criteria of population reduction, geographic range, small population size and decline, and very small or restricted population) in the IUCN Red List Categories and Criteria Version 13 (IUCN 2017). Threatened species include those assessed as Critically Endangered, Endangered, or Vulnerable (IUCN 2017). We also present the global IUCN Red List status of each species (IUCN 2018).

We listed the species endemic to Iran (only those species with 100% of their range limited to Iran) and generated a mammalian species-richness map by calculating the number of species present in each 100×100 -km UTM grid cell. Finally, we presented the zoogeographic affinities of Iranian mammals based on the percentage of distribution of each species in each of the realms (Holt et al. 2013). Each species was assigned to a specific realm whenever more than 50% of the global distribution was located inside that realm.

RESULTS

Diversity.—The list of known terrestrial mammals of Iran includes 192 species, distributed among 90 genera, 34 families, and seven orders (Table 1; [Supplementary Data SD2](#)). A summary of all major taxonomic changes reported in this study compared to previous ones (Karami et al. 2008, 2016) is provided in Table 1. In the species synopsis ([Supplementary Data SD2](#)), we present a full taxonomic listing of all recognized taxa, including synonymized names, and provide annotations concerning recently described new taxa, nomenclatural and taxonomic updates, and significant taxon-related controversies or developments. The majority of the terrestrial mammal species are represented by small volant and nonvolant species belonging to the orders Rodentia ($n = 76$) and Chiroptera ($n = 51$). The medium- and large-sized mammals include species belonging to Carnivora ($n = 31$), Artiodactyla ($n = 10$), and Perissodactyla ($n = 1$). The most diverse family is vespertilionid bats (Chiroptera: Vespertilionidae) with 34 species, followed by murid rodents (Rodentia: Muridae) with 29 species. The genus *Microtus* (Rodentia: Cricetidae) with 12 species (four originally described from Iran) is the most diverse one, followed by *Meriones* and *Myotis* with nine species each.

In total, compared with Karami et al. (2008), 45 species names have been added as a result of taxonomic revisions ($n = 32$) or by finding new species to add to the fauna of Iran ($n = 13$). Some of these changes ($n = 17$) were included in Karami et al. (2016), while other taxonomic changes ($n = 28$) are compiled here for the first time (Table 1).

Among Eulipotyphla, few species have been subjected to taxonomic changes, given the small number of studies on this group of mammals in Iran: 1) *Neomys anomalus* was replaced by *N. milleri*, because the name *anomalus* is not applicable to the Iranian populations (the taxon is only confined to a part of the Iberian Peninsula—Igea et al. 2015); 2) *Talpa caucasica* was replaced by *T. talyschenses*, which was identified as a

distinct species by [Bannikova et al. \(2015\)](#); 3) *Crocidura gueldenstaedtii* (a former subspecies of *C. suaveolens*) has been raised to full species rank ([Burgin et al. 2018a](#)); and 4) Katinka's shrew (*Crocidura katinka*) has been eliminated from the faunal list of Iran, since there is no evidence to support the presence of the species in Iran ([Burgin et al. 2018a](#)). On the other hand, in [Karami et al. \(2016\)](#), there is only one change that was examined: *Suncus murinus* was reported as a new species for the country, although the species has been previously recorded in the southwestern part of the country ([Farhang-Azad 1969](#)).

In Chiroptera, there has been a steady flow of taxonomic changes, additions, and subtractions that were recognized by [Karami et al. \(2016\)](#): 1) *Hipposideros fulvus* was found to be new for the mammalian fauna of Iran ([Benda et al. 2012](#)); 2) *Rhinolophus bocharicus* was removed, as it has been shown that the only known sample from Iran most likely belongs to a juvenile *R. ferrumequinum* ([Benda et al. 2012](#)); 3) *Myotis nattereri* was recorded for the first time in 2012 in the country, while all previous records of *M. nattereri* from Iran (cf. [De Blasé 1980](#)) were re-identified as *M. schaubi* ([Benda et al. 2012](#)); 4) *Myotis aurascens* was removed from the list of Iranian species, as it has been shown that the large-sized member of the whiskered bats morpho-group (previously reported as *M. aurascens*) belongs to *M. mystacinus* sensu stricto ([Benda et al. 2012, 2016](#)); 5) *Myotis nipalensis* was replaced by *M. davidii*, which is a prior synonym ([Benda et al. 2016](#)); 6) *Myotis hyrcanicus* has been recently described as a new species in the whiskered bats (or *M. mystacinus*) morpho-group ([Benda et al. 2012](#)); 7) two species of *Eptesicus*, *E. ognevi* and *E. pachyomus*, which were formerly considered subspecies of *E. bottae* and *E. serotinus*, respectively, were raised to full species rank by [Juste et al. \(2013\)](#); 8) *Eptesicus nasutus* was replaced by *Rhynchptesicus nasutus* ([Juste et al. 2013](#)); 9) *Otonycteris leucophaea* was recognized as a distinct species by [Benda and Gvoždík \(2010\)](#); 10) *Plecotus strelkovi* has been described as a new species by [Spitzenberger et al. \(2006\)](#); 11) *Miniopterus schreibersii* was replaced by *M. pallidus*, which has been elevated to species rank ([Furman et al. 2010](#)); and 12) *Tadarida aegyptiaca* was replaced by *Nyctinomus aegyptiacus*, since monophyly of the *Tadarida* genus was rejected ([Lamb et al. 2011](#)). Furthermore, [Karami et al. \(2016\)](#) followed [Foley et al. \(2015\)](#) in recognizing Rhinonycteridae as a separate family with only one species (i.e., *Triaenops persicus*) in Iran.

Since the publication of [Karami et al. \(2016\)](#), there have been a few additional changes regarding bats: 1) *Eptesicus bobrinskoi* was replaced by *E. gobiensis*, as the former is treated as a small-sized subspecies of the latter ([Artyushin et al. 2012](#)); 2) *Barbastella darjilingensis* was replaced by *B. capsica*, a former subspecies of *B. leucomelas* that has been raised to full species rank by [Kruskop \(2015\)](#); and 3) *Pipistrellus nathusii* was recently recorded from the north of the country ([Naderi et al. 2017a](#)).

Carnivora is another group that has been subjected to multiple taxonomic changes: [Kitchener et al. \(2017\)](#) retained *Felis lybica* as a distinct species; *Meles canesens* has been elevated to species rank ([Del Cerro et al. 2010](#); [Tashima et al. 2011](#));

Urva javanicus = '*Herpestes javanicus*' has been replaced by *Urva auro-punctata* ([Veron et al. 2007](#)); and one change has been made at the level of genus, from *Herpestes* to *Urva* ([Veron and Jennings 2017](#)). Two other taxonomic changes also were reported in [Karami et al. \(2016\)](#): *Felis manul* was replaced by *Otocolobus manul* ([Werdelin et al. 2010](#)), and the snow leopard (*Uncia uncia*), which was listed by [Karami et al. \(2008\)](#), was eliminated from the mammals of Iran due to its doubtful historical occurrence.

There was only one taxonomic change in ungulates (both Artiodactyla and Perrisodactyla) since [Karami et al. \(2016\)](#): *G. gazella* was replaced by *G. cf. gazella*, as the taxonomic position of gazelle populations occurring in Persian Gulf islands is uncertain ([Wronski et al. 2010](#); [Lerp et al. 2013](#)). Two other recent taxonomic changes were included in [Karami et al. \(2016\)](#): *Ovis orientalis* was replaced by *O. gmelini* ([Groves and Grubb 2011](#)), and *Dama dama* was replaced by *D. mesopotamica* ([Pitra et al. 2004](#)).

In Rodentia, several species have been subjected to taxonomic changes since [Karami et al. \(2016\)](#): 1) '*Allactaga toussi*' = *Scarturus toussi* was replaced by *S. vinogradovi* ([Michaux and Shenbrot 2017](#)); 2) *Jaculus jaculus* was replaced by *J. loftusi* ([Shenbrot et al. 2016](#); [Michaux and Shenbrot 2017](#)) because the name *jaculus* is not applicable to the Iranian populations; 3) *Microtus arvalis* was replaced by *M. obscurus*, which has been elevated to species rank based on the genetic distance found between *arvalis* and *obscurus* ([Tougaard et al. 2013](#)); 4) *Microtus levis* was replaced by *M. mystacinus*, as the name *mystacinus* is a prior synonym ([Mahmoudi et al. 2014](#)); 5) *Apodemus avicennicus*, which was previously described as a new species, has been synonymized with *A. witherbyi* ([Darvish et al. 2015](#)); and 6) *Apodemus flavicollis* has been deleted from the faunal list, since according to [Darvish et al. \(2015\)](#), there is no evidence to support the presence of the species in Iran. In addition, seven new rodent species have been found in recent years in Iran that were not listed in [Karami et al. \(2016\)](#). These include *Apodemus mystacinus* ([Darvish et al. 2014](#)), *A. ponticus* ([Mohammadi et al. 2014](#)), and *Calomyscus mystax* ([Akbarirad et al. 2015](#)), which were recorded for the first time in the country, and three others, *Nannospalax xanthodon* ([Bukhnikashvili et al. 2017](#); [Norris 2017](#)), *Microtus daghestanicus* ([Kryštufek et al. 2016a](#); [Pardiñas et al. 2017](#)), and *Meriones dahli* ([Kefelioglu et al. 2008](#); [Denys et al. 2017](#)), for which Iran is now recognized as a part of the species range. Finally, *Microtus kermanensis* was elevated to species level by [Mahmoudi et al. \(2017\)](#), and the species status was verified by [Pardiñas et al. \(2017\)](#). Furthermore, compared with the previous list by [Karami et al. \(2016\)](#), the genus has changed for six species names: *Microtus afghanus* ([Pardiñas et al. 2017](#)), *Scarturus elater*, *S. euphraticus*, *S. hotsoni*, *S. vinogradovi*, and *S. williamsi* ([Lebedev et al. 2013](#)). Two additional changes were included in [Karami et al. \(2016\)](#): '*Allactaga firouzi*' = *Scarturus firouzi* was synonymized with '*Allactaga hotsoni*' = *S. hotsoni* ([Shenbrot 2009](#); [Dianat et al. 2013](#)), and '*Allactaga euphratica*' = *Scarturus euphraticus* was recorded for the first time in the country ([Darvish et al. 2012](#)).

Finally, among lagomorphs, *Lepus capensis* was added to the mammalian fauna of Iran, since Schai-Braun and Hackländer (2016) retained the species status of *Lepus capensis*.

Based on the above, rodents are the group with the most changes (17 species), followed by bats (14), carnivores (5), even-toed ungulates (4), moles and shrews (4), and hares (1). The occurrence of *Suncus murinus*, *Eptesicus gobiensis*, *Apodemus mystacinus*, and *Calomyscus mystax* in Iran was predicted by Karami et al. (2008) and confirmed in the following years.

A total of 19 species are known to occur in areas close to Iranian borders and thus are likely to be found within Iran in future surveys (Supplementary Data SD3). These are *Crocidura armenica*, *C. katinka*, *C. serezykensis*, *Sorex raddei*, *S. satunini*, *Myotis brandtii*, *M. buharensis*, *M. myotis*, *Pipistrellus ruyPELLII*, *Plecotus turkmenicus*, *Rhinolophus bocharicus*, *R. lepidus*, *Vulpes bengalensis*, *Gazella marica*, *Calomyscus baluchi*, *Dryomys laniger*, *Gerbillus dasyurus*, *Nannospalax ehrenbergi*, and *Nesokia bunnii*. In comparison to the previous lists of species likely to occur in Iran (Karami et al. 2008, 2016), 17 and 12 species, respectively, are newly listed here.

Conservation status.—Twenty five (13.2%) of 188 terrestrial mammals of Iran (excluding four introduced species) are assessed as threatened at the national level (Fig. 2; Table 1). Of these, three taxa are evaluated as Critically Endangered: *Acinonyx jubatus venaticus*, *Ursus thibetanus gedrosianus*, and *Dama mesopotamica*, and 22 other species are assessed as either Endangered or Vulnerable. A further 26 species (13.8%) were found to be Near Threatened. A large number of species (108 species, 57.4%) are evaluated as Least Concern, and 14.3% (27 species) as Data Deficient. Two large felids (*Panthera leo* and *P. tigris*) have become Regionally Extinct with no records in more than 50 years. The order Artiodactyla includes the most threatened species ($n = 9$), followed by Carnivora ($n = 6$), Chiroptera ($n = 5$), Rodentia ($n = 3$), Perissodactyla ($n = 1$), and Eulipotyphla ($n = 1$; Table 1). In total, nearly a quarter (27%) of the terrestrial mammals of Iran have declining populations and have been placed in threatened (Critically Endangered, Endangered, or Vulnerable) or near-threatened categories.

In several cases, there were important differences between global (according to IUCN) and regional (our assessment) conservation statuses: 1) *Acinonyx jubatus* and *Ursus thibetanus* are globally considered as Vulnerable but evaluated as Critically Endangered in Iran; 2) *Dama mesopotamica* is globally considered as Endangered but has been elevated to Critically Endangered in Iran; 3) *Panthera pardus*, *Capreolus capreolus*, *Gazella cf. gazella*, and *G. subgutturosa* are globally considered as Vulnerable but evaluated as Endangered at the regional level; 4) *Equus hemionus* is globally considered as Near Threatened but the Iranian populations (*E. h. onager*) are assessed as Endangered; 5) *Ursus arctos*, *Cervus elaphus*, and *Gazella bennettii* are globally considered as Least Concern but evaluated as Endangered in Iran; and finally 6) *Crocidura susiana* is globally listed as Data Deficient but evaluated as Endangered in Iran.

Distribution, endemism, and species richness.—The number of records (observations) of mammals ranged from one

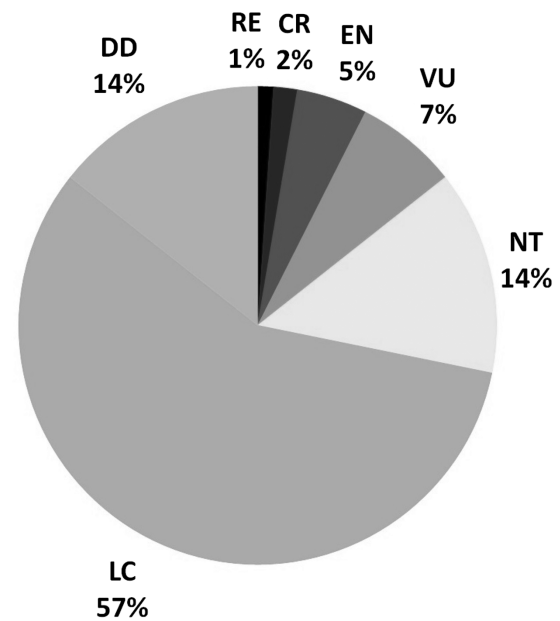


Fig. 2.—Regional Red List status of the land mammals of Iran. The categories are Regionally Extinct (RE), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), and Data Deficient (DD).

to more than 400 in a grid cell (Supplementary Data SD1, Fig. SD3). Almost one-third of the species ($n = 60$) are widespread, with current extents of occurrence covering over 50% of the country's area, whereas 132 species have restricted ranges, occupying less than 50% of Iran's mainland (Supplementary Data SD1, Table SD1). About 4.2% ($n = 8$) of the terrestrial mammals are endemic to Iran, including six rodents, one bat, and one shrew (Table 1), although *Calomyscus bailwardi* may occur in Turkey (Kilpatrick 2017). Areas concentrating high species richness are located in the Alborz and the Zagros mountains, and richness decreases towards the central basin and the lowlands of south and southeastern Iran (Fig. 3).

Zoogeographic affinities.—Nearly 60% of the terrestrial mammals of Iran (113 species) are associated with the Palearctic zoogeographical realm, 23.4% (45 species) with the Saharo-Arabian realm, 5.7% (11 species) with the Oriental realm, and 1.5% (3 species) are Afrotropical. With the exception of four introduced species (*Suncus murinus*, *Procyon lotor*, *Rattus norvegicus*, and *Myocastor coypus*), the zoogeographic affinities of the remaining species (16 species; 8.3%) are indefinable (species occurring in more than two zoogeographical regions; Table 1).

DISCUSSION

Taxonomic revision.—Over the last decade, 45 species names have changed or been reported for the first time for Iran. Thirteen of them are new species or new records, and 32 are changes in taxonomy or nomenclature resulting from revisions at the genus or species level.

Some of these changes ($n = 17$) were presented in Karami et al. (2016): 1) *Myotis hyrcanicus* was described as a new

species based on specimens from Iran; 2) five species were recorded for the first time within Iranian boundaries: *Suncus murinus*, *Hipposideros fulvus*, *Myotis nattereri*, *Plecotus strelkovi*, and *Scarturus euphraticus* (as *Allactaga euphratica*); 3) three species changed in their genus names: *Nyctinomus aegyptiacus*, *Rhynchptesicus nasutus*, and *Otocolobus manul*; and 4) eight species changed in their species names as a result of being raised to full species rank: *Eptesicus pachyomus*, *E. egnevi*, *Myotis davidii*, *Miniopterus pallidus*, *Otonycteris leucophaea*, *Ovis gmelini*, *O. vignei*, and *Dama mesopotamica*. However, many additional changes to the reported mammalian fauna of Iran ($n = 28$) are newly compiled herein: 1) seven species were recorded for the first time within Iranian boundaries: *Pipistrellus nathusii*, *Apodemus mystacinus*, *A. ponticus*, *Calomyscus mystax*, *Meriones dahli*, *Microtus daghestanicus*, and *Nannospalax xanthodon*; 2) six species names have changed in their generic part: *Urva edwardsii*, *Microtus afghanus*, *Scarturus elater*, *S. euphraticus*, *S. hotsoni*, and *S. williamsi*; 3) 13 species names have changed in their specific part as a result of being raised to full species rank: *Crocidura gueldenstaedtii*, *Neomys milleri*, *Talpa talyschensis*, *Barbestella caspica*, *Eptesicus gobiensis*, *Meles canescens*, *Felis lybica*, *Gazella* cf. *gazella*, *Jaculus loftusi*, *Microtus kermanensis*, *M. mystacinus*, *M. obscurus*, and *Lepus capensis*; and 4) *Urva auropanctata* and *Scarturus vinogradovi* have changed both in their genus and species names (Table 1). For details of the

changes in taxonomy and relevant citations, see the species synopsis in Supplementary Data SD2.

Compared with the most recent taxonomic list of mammals of the world (Burgin et al. 2018b; available online: <https://mammaldiversity.org>), our list for Iran includes only minor differences regarding the names of species. Such differences include: 1) both *Apodemus avicennicus* and *Scarturus toussi* were recognized as valid species in the mammal diversity database; however, these two taxa were synonymized with *Apodemus witherbyi* (Darvish et al. 2015) and *Scarturus vinogradovi* (Michaux and Shenbrot 2017), respectively; and 2) *Microtus kermanensis* was not recognized to be valid, although it is considered as a distinct species by others (Mahmoudi et al. 2017; Pardiñas et al. 2017). Two other taxonomic differences were included in Karami et al. (2016): 1) the name *Ovis gmelini* was proposed to replace *O. orientalis*, since the type specimen of *O. orientalis* is a hybrid of urial and mouflon from the central Alborz Mountains (Groves and Grubb 2011); and 2) the name *Tadarida aegyptiaca* was replaced with *Nyctinomus aegyptiacus* (Benda et al. 2012).

Concerning the orders, we subscribe to Eulipotyphla (following Wilson and Mittermeier 2018) as an order with only three families (i.e., Erinaceidae, Soricidae, and Talpidae) in Iran. However, in the case of the order Artiodactyla, we follow Wilson and Mittermeier (2011) for traditional classification, although we are aware of the sister-group relationship between

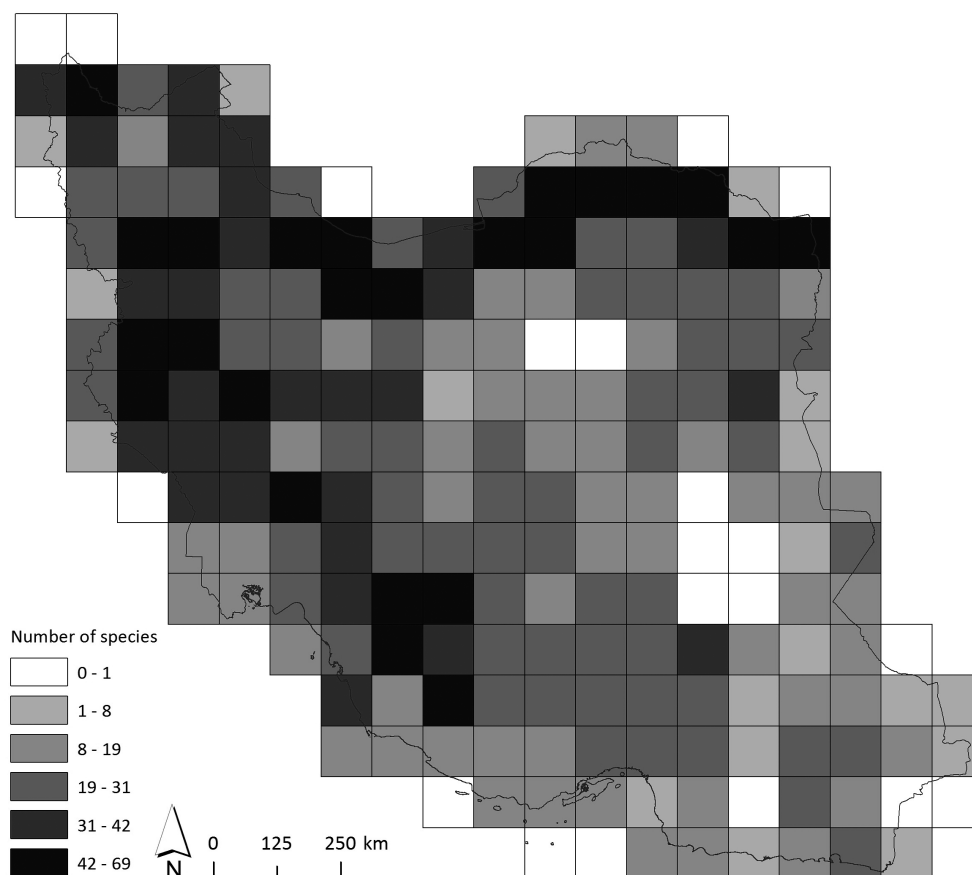


Fig. 3.—Species richness of the terrestrial mammals of Iran depicted at 100 × 100-km grid cell size.

artiodactyls and cetaceans (known as Cetartiodactyla—Spaulding et al. 2009).

Classification of the family Bovidae has been radically changed in the *Handbook of the Mammals of the World: Hoofed Mammals* (Wilson and Mittermeier 2011). Groves et al. (2011) in this handbook, and also in Groves and Grubb (2011), elevated both *Ovis gmelini isfahanica* Nasonov, 1910 and *O. g. laristanica* Nasonov, 1909 to full species rank. These authors also allocated all northeastern Iranian populations to *O. cycloceros* Hutton, 1842, but without citing any supporting analysis. Therefore, we followed Rezaei et al. (2010) who treated Iranian wild sheep as two species: *O. gmelini* [as *O. orientalis*] and *O. vignei*. In the case of *Gazella bennettii*, Groves and Grubb (2011) and Groves et al. (2011) elevated the three recognized subspecies (*G. b. fuscifrons* Blanford, 1873; *G. b. karamii* Groves, 1993; *G. b. shikarii* Groves, 1993) from Iran to full species rank and restricted the range of *G. bennettii* s. str. to India. Groves et al. (2011) also elevated gazelles from Farur Island in the Persian Gulf (formerly known as *G. gazella dareshurii*) to full species rank: *G. dareshurii*. However, these taxonomic arrangements have not been supported or proposed on any morphological or genetic grounds, and have been criticized for taxonomic inflation of bovid species (Heller et al. 2013; Zachos et al. 2013). Here, we considered the species taxonomy of *Gazella* (Artiodactyla) as recognized by Grubb (2005), who treated *G. bennettii* as one single polytypic species and *G. gazella dareshurii* as a subspecies of *G. gazella*. The details of species classification are outlined in Supplementary Data SD2.

Although molecular studies were broadly initiated in recent years, there are several taxa in Iran for which the taxonomic status is uncertain. In some cases, they deserve species status, as they have diverged from the already described species. These include *Talpa* sp. (Naderi et al. 2017b), *Calomyscus* sp. (Akbarirad et al. 2016), *Myomimus* sp. (Obuch 2001), and *Scarturus* cf. *williamsi* = '*Paralactaga* cf. *williamsi*' (Hamidi et al. 2016). Naderi et al. (2014) suggest a split of *G. glis* in the Middle East as the most plausible initial step in the early evolution of the species, and Moshtaghi et al. (2016) found previously undetected species richness in the genus '*Allactaga*' = *Scarturus*.

Knowledge about Iranian mammals is far from complete. In particular, the shrews (Soricidae), moles (Talpidae), bats (Chiroptera), and some rodent species are poorly known and remain poorly documented. Within these groups (most particularly in shrews and bats), we expect that the discovery of new species will continue given their rate of recent discoveries and finding of hidden cryptic diversity (Benda et al. 2012). From the information presented in this review, it is clear that these taxa represent priority mammal groups for future work. The Iranian mammal fauna provides an excellent opportunity for studying phylogenies for many species occurring there. The country has been demonstrated as a phylogeographic hotspot for some species (e.g., *Mus musculus*—Hardouin et al. 2015), a cradle of diversity for others (e.g., the genus *Microtus*—Mahmoudi et al. 2017), and the contact zone of different species and subspecies

(e.g., *Felis silvestris*—*F. lybica*—Ghoddousi et al. 2016; *Lepus capensis*—*L. europaeus*—*L. tolai*—Schai-Braun and Hacklander 2016).

Distribution revision.—We compiled, standardized, and organized in a georeferenced database a total of 14,965 species occurrence records, including those for Eulipotyphla ($n = 443$), Chiroptera ($n = 1,243$), Carnivora ($n = 6,132$), Perissodactyla ($n = 122$), Artiodactyla ($n = 1,975$), Rodentia ($n = 4,473$), and Lagomorpha ($n = 577$). Data on the distributions of all taxa, including detailed accounts of the species native occurrence or local extinction by province, observational uncertainties, and a summary of the general distribution context, are given (Supplementary Data SD1 for provinces and Supplementary Data SD2 for distributional data in Iran).

Distribution maps are presented for each of the 192 land mammals of Iran (Supplementary Data SD2). With the exception of bats, almost all distributional data for Iranian terrestrial mammals deposited in foreign museums are compiled along with mapped ranges for the first time. Furthermore, this is the first time that occurrence records of conspicuous species (medium- and large-sized species) have been compiled for more than 400 areas under DoE protection.

Among the medium- and large-sized mammals, 10 species of felids (including the regionally extinct *Panthera leo* and *P. tigris*) had the highest numbers of records, due to the existence of previous assessments of their distributions in Iran (e.g., Faizolahi 2016; Ghoddousi et al. 2016; Mousavi et al. 2016). For instance, the maps for Asiatic cheetah and leopard include 729 and 485 occurrence records, respectively, which are widely scattered throughout the country and cover the complete range of the species in Iran. For the brown bear (*Ursus arctos*) and the Asiatic black bear (*Ursus thibetanus*), the distribution maps are the most complete so far, thanks to the previous studies conducted on both species by one of the authors of this study (GHY). The distribution maps provided here more likely reflect the real ranges for many species, while for many others, lack of information (see Supplementary Data SD2) resulted in underestimations of the species Iranian distribution. The species for which the current available distributional data are limited to display rigorously the likely range of the species in the country are: 1) the large herbivores, especially red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*); 2) the shrews and moles in Eulipotyphla, which are poorly represented in the Iranian fauna, both in variety of species and in number of occurrences; 3) the rodents *Apodemus ponticus*, *Dryomys nitedula*, *Microtus mystacinus*, *M. schelkovnikovi*, and *Sciurus anomalus* are also expected to occur in a wider range than is shown here; and 4) the mesocarnivores *Lutra lutra*, *Lutrogale perspicillata*, *Martes foina*, *M. martes*, *Meles canescens*, *Mellivora capensis*, *Mustela nivalis*, *Urva auropunctata*, *U. edwardsii*, and *Vormela peregusna*, for which the distribution maps presented here still under-represent the actual range.

The distributions and range limits of some species are poorly resolved and the number of species currently recognized within the borders of Iran is far from being finalized. In particular, this is the case for: 1) species belonging to genera *Ellobius*,

Gerbillus, *Microtus*, and *Neomys*; 2) *Urva auropanctata* and *U. edwardsii*, and *Lepus capensis*, *L. europaeus*, and *L. tolai*, due to lack of information and possible misidentification of species in each genus; 3) *Ovis* species, in which hybrids (*Ovis gmelini* × *O. vignei*) have been detected in Fars, Kerman, Semnan, Tehran, and Yazd provinces (Rezaei et al. 2010).

The smallest number of records corresponded to the Lut and Dasht-e Kavir deserts, whereas the number of records peaked in the Golestan and Touran National Parks and Naybandan Wildlife Refuge, where intensive survey efforts are concentrated. On the regional scale, the mammal assemblage of some areas of the country, like the central Zagros Mountains, was previously under-represented (e.g., Lay 1967; Etemad 1978, 1984, 1985), but the data compiled here (e.g., Faizolahy et al. 2011) now ensure that these areas are well covered. Still, there are areas currently under-sampled, especially those located along the borders of Afghanistan and Pakistan on the east side of the country. The Alborz and Zagros mountain ranges are home to most of the observed species, which is probably related to local heterogeneity in environmental variation and land-cover and land-use that likely supports a more diverse fauna. These two mountains are also known as the hotspots for birds and they accumulate the highest richness in bird contact zones (Aliabadian et al., 2005). Species-rich areas identified in this study overlap with biodiversity hotspots for threatened mammal species and where protection efforts are still less-enforced as only 10% of these identified hotspots are covered by protected areas (Farashi et al. 2017).

Conservation revision.—Our assessments of the species conservation status revealed that most of the large mammals, especially the species belonging to Artiodactyla, Perissodactyla, and Carnivora, are currently threatened with extinction. About 41% (16 out of 39) of the species of these three orders are recognized as threatened (categorized as Vulnerable, Endangered, or Critically Endangered), compared with 13.2% for all orders. The conservation status of ungulates (equids, suids, bovids, and cervids) is of particular concern, with 91.9% of the species assessed as threatened. In other words, except for one species (wild boar, *Sus scrofa*), all ungulates that occur in Iran are currently at risk of extinction. These results mimic the concern for large herbivores at the global level (Ripple et al. 2015). Among carnivore species, 21.4% are threatened, with a further 28.5% categorized as Near Threatened. Many of these species are now reduced to very small population sizes or ranges that are much smaller than their former distributions. Lastly, we stress that the results of this study should be considered as the first step in the establishment of a more robust assessment of the species' conservation status in the country.

Iran is presently the last stronghold for some severely threatened mammals, such as the Asiatic cheetah (*Acinonyx jubatus venaticus*), Persian fallow deer (*Dama mesopotamica*), and onager (*Equus hemionus onager*—Firouz 2005). It is home to the largest remaining populations of other species in the southwest Asia region, such as the Persian leopard (*Panthera pardus saxicolor*), which has more than 75% of its extant range within Iran (Jacobson et al. 2016). The country is also home to large populations of ungulates such as *Ovis gmelini*, *O. vignei*, *Capra*

aegagrus, *Gazella subgutturosa*, and *G. bennettii*, and to a wide range of carnivore species of all sizes (Firouz 2005). However, most of these species have experienced a severe reduction in their range and population numbers during the last decades (Rabiei 2003; Firouz 2005; Ghoddousi et al. 2017; Soofi et al. 2018). For instance, the status of the Asiatic cheetah (Khalatbari et al. 2017) and the Persian fallow deer (Mohammadi et al. 2015) are precarious, and onagers decreased in number during the last decades and currently only a small population survives in two geographically separated reserves (Rosenbom et al. 2015).

This review highlights the terrestrial mammals of Iran, a vast (1,648,195 km²) and diverse country that lies at the intersection of three of the world's biogeographic realms in southwest Asia. We have, at best, incorporated all the current knowledge available to us about the diversity and distribution of Iranian land mammals from widely scattered (see Supplementary Data SD4 for the full list of references consulted) or from gray or inaccessible sources, hence, not available to the general scientific community. This review has been prepared in the hope of promoting renewed interest, stimulating research, and identifying areas where knowledge is most limited. We hope this review, and particularly the species accounts and range maps (Supplementary Data SD2) that we have compiled, will serve as precursors for the conservation and management of mammals of one of the southwest Asia's most biologically diverse countries.

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SUPPLEMENTARY DATA

Supplementary data are available at *Journal of Mammalogy* online.

Supplementary Data SD1.—Details of the sources of species occurrence data and distribution maps.

Supplementary Data SD2.—Species synopsis of the mammals of Iran: taxonomy and distribution.

Supplementary Data SD3.—List of species not yet recorded, but possible to occur in Iran.

Supplementary Data SD4.—Literature cited.

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Supplementary Data

THE SPECIES DIVERSITY, DISTRIBUTION AND CONSERVATION STATUS OF THE TERRESTRIAL MAMMALS OF IRAN

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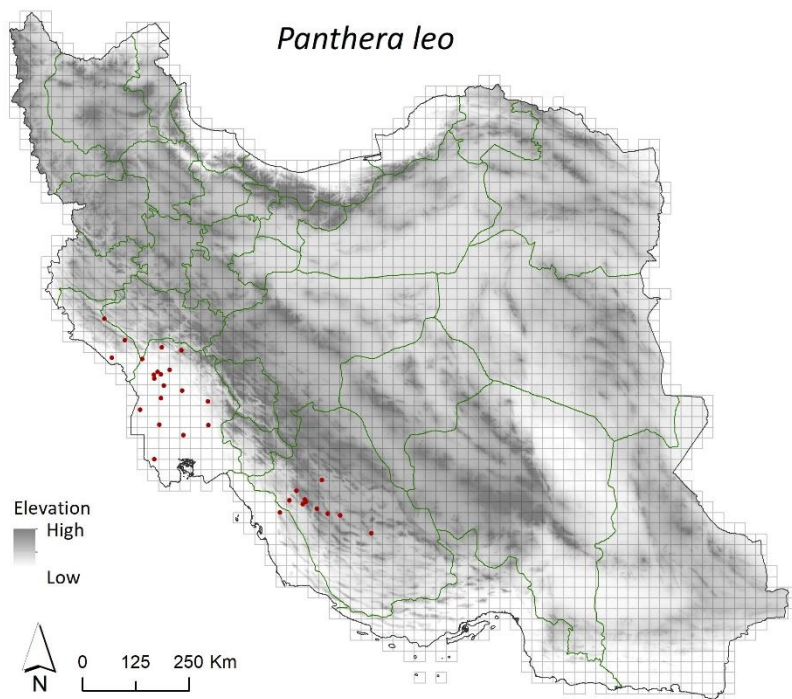
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Panthera pardus (Linnaeus, 1758)

Common name: Leopard.

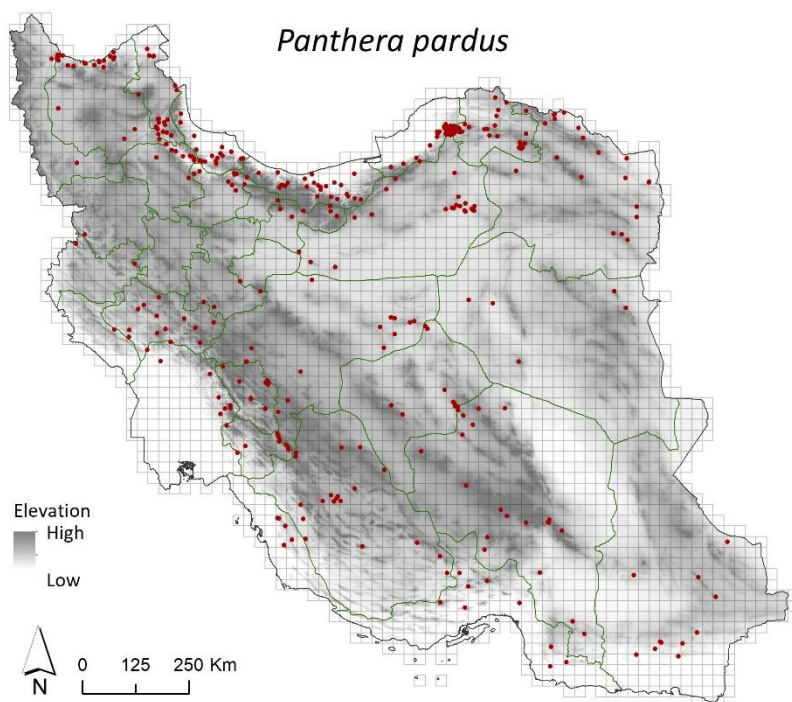
Terra typica: "Indiis", fixed by Thomas (1911a:135), as "Egypt"; see discussion by Pocock (1930).

Taxonomy: Iranian leopard populations are traditionally assigned to *P. p. saxicolor* Pocock, 1927 (Ellerman & Morrison-Scott, 1951, Corbet 1978, Uphyrkina et al. 2001). The name *saxicolor* was thought to be potentially valid for this population (Miththapala et al. 1996), but Wozencraft (2005) placed it in the synonymy of *P. p. nimr*

(Hemprich & Ehrenberg, 1833) based on older name priority. Khorozyan et al. (2006), based on cranial morphology, lumped all N Iran populations (*saxicolor*) as well as Central Asian and Caucasian populations in one subspecies: *P. p. ciscaucasica* (Satunin, 1914), with priority over *saxicolor*. They assigned all other Iranian populations to *P. p. sindica* Pocock, 1930, though, synonymy of *saxicolor* with *sindica* has been documented by results of mtDNA studies (Miththapala et al. 1996; Uphyrkina et al. 2001). Later, Khorozyan (2014) base upon skull morphology suggested the existence of only one leopard subspecies in the Middle East, *P. p. nimr* which was the first valid name described from the region. However, Kitchener et al. (2017) retained *P. p. tulliana* (Valenciennes, 1856) as a distinct subspecies including *ciscaucasica* and *saxicolor*. Seemingly, taxonomy of the subspecies occurring in Iran and neighboring areas will remain obscure until more evaluations. For the species' current status in Iran see Sanei et al. (2016a).

Distribution: Leopards are widely distributed in mountainous areas throughout the country. The current presence is confirmed in all the provinces except Hamadan, Khorasan S, Kordestan, Markazi, and Qom, where there are unconfirmed evidences of leopard presence (de Filippi, 1865; Blanford, 1876 [as *Felis pardus*]; Radde, 1886 [as *Felis panthera*]; Pocock, 1927,1930; Zukowsky, 1964 cited in Lay, 1967; Lay, 1967 [as *Felis pardus*]; Firouz et al. 1970; Harrington & Dareshuri, 1977; Etemad, 1985; Joslin, 1990; Scott, 1995; Kiabi et al. 2002; Sanei, 2004,2007,2016a; Chalani, 2005; Iranian Cheetah Society 2005,2008,2013; Ahmadzadeh et al. 2006; Darvish Sefat, 2006; Mobargha, 2006; Abdoli et al. 2010; Farhadinia et al. 2008,2015a,b; Gavashelishvili & Lukarevskiy, 2008; Ghoddousi et al.

2008a,b,c,2010; Omidi et al. 2010; Yusefi et al. 2010; Akbari 2011; Faizolahi et al. 2011a,b; Erfanian et al. 2013; Mohitban Society 2013; Taghdisi et al. 2013; Adibi, 2013; Khaleghi Hamidi et al. 2014; Rezaie, 2014; Ghadirian & Raeesi, 2015; Ahmadi & Mahmoodi, 2017; Soofi et al. 2018; CACP, unpubl.; DoE PAs unpubl. data; DoE unpubl. rep.; Grey Literatures & Internet Websites; PWHF, unpubl.; Soofi, pers. comm.).



Panthera tigris (Linnaeus, 1758)

Common name: Tiger.

Terra typica: Bengal.

Taxonomy: Iranian population of tiger (known as Caspian or Hyrcanian tiger) is extinct in Iran, with the last records from 1950s. This subpopulation was long considered as a distinct subspecies, *P. t. virgata* (Illiger, 1815), though Driscoll et al. (2009) showed that *P. t. virgata* and *P. t. altaica* Temminck, 1844 are genetically closely related to each other and should taxonomically be considered as a single subspecies (see Faizolahi 2016 for details). Wilting et al. (2015) reduced controversially and conservation-mindedly the number of valid subspecies to only two (*tigris* and *sondaica*), synonymising both *virgata* and *altaica* with nominotypical subspecies. This arrangement followed by Kitchener et al. (2017), but recently Liu et al. (2018) using genome-wide analysis retained the traditional 6 tiger subspecies, among them *P. t. altaica*. However the name *virgata* has priority over *altaica* and thus should be applied instead. Faizolahi (2016) reviews historical distribution and extinction causes.

Distribution: Known to occur in N Iran in forests and reed beds surrounding most rivers and wetlands, from Tejen in Sarakhs (Khorasan R) along the border with Turkmenistan through the south Caspian lowlands all the way along the border with Azerbaijan and Armenia to Arax near Ararat (de Filippi, 1865; Blanford, 1876 [as *Felis tigris*]; Radde, 1886 [as *F. tigris*]; Pocock, 1929 [as *F. tigris*]; Lay, 1967 [as *F. tigris*]; Harrington & Dareshuri, 1977; Etemad, 1985; Joslin, 1986,1988; Ziaie 1996,2008; Firouz, 2005; Faizolahi, 2016 and references therein).