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THE STATUS AND DISTRIBUTION OF MEDITERRANEAN MAMMALS

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Contents

Acknowledgements iv

Executive summary vi

1.

All of IUCN's Red Listing processes rely on the willingness of scientists to contribute and pool their collective knowledge to make the most reliable estimates of species status. Without their enthusiastic commitment to species conservation, this kind of regional overview would not be possible. A list of all participating scientists can be found at the end of this

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Aim

e Mediterranean Biodiversity Assessment is a review of the conservation status of a wide range of Mediterranean species – mammals, reptiles, amphibians, freshwater and marine fishes, freshwater molluscs, dragonflies, freshwater crabs and crayfish, and selected groups of vascular plants. is Red List publication summarizes results for Mediterranean terrestrial mammals, and provides the first overview of the conservation status of these species to follow IUCN regional Red Listing guidelines. It identifies species

is needed on a number of issues including habitat and foraging requirements, population size and trends, impacts of pesticide use on prey species, and methods to minimize impacts of wind farms.

For **non-volant** (flightless) **small mammals** more sustainable agricultural practices are needed to prevent habitat loss and degradation both from agricultural intensification and land abandonment. Legislation and enforcement of existing measures are needed to prevent the introduction of alien invasive species such as the American Mink *Neovison vison*. Measures to raise public awareness of the diversity, importance and threats to small mammals are needed in order to modify their "pest" image and explain their ecological importance.

For **large mammals**, recommendations include improvement of management of protected areas and of the wider environment, better enforcement of existing laws and regulations controlling hunting (including new legislation in some cases), and development and implementation of species-specific management plans for the most threatened species. Restoring habitats and wild prey populations at the landscape level is essential for the conservation of threatened large carnivores; large herbivores similarly require landscape-level actions to ensure the maintenance of grazing systems.

e conservation of large carnivores can be controversial – understanding people's attitudes towards predators and gaining their acceptance is crucial to the success of conservation and management programmes.

1.1 The Mediterranean context

e Mediterranean Basin, stretching west to east from Portugal to the Levant, covers three continents (Europe, Asia and Africa).

e region is characterized by its climate, where cool and wet winters alternate with long, hot, dry summers. In some areas, for example in Libya and Egypt, annual rainfall can be as low as 50mm per year, whereas in the well-watered regions, such as the Adriatic coast of the Balkan countries, rainfall is over 1,000mm. With almost 5,000 islands and islets, the Mediterranean comprises one of the largest groups of islands in the world. e islands are of high value to global biodiversity due to their wealth of species, relatively high levels of endemism, long history of isolation, and tolerance of many kinds of disruptions, as well as their role as a natural laboratory for evolutionary studies.

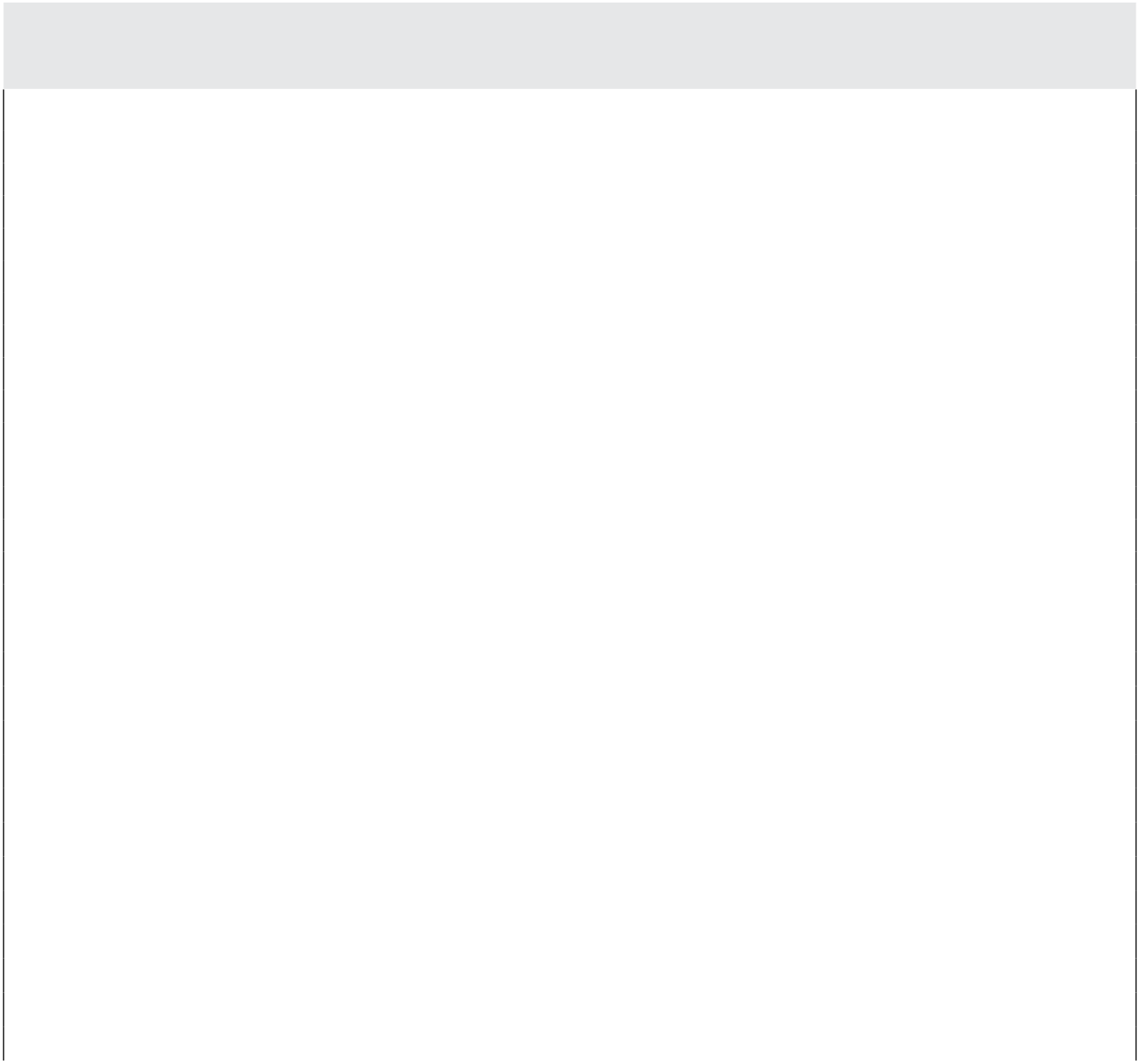
Besides the variety of these climatic, geological and hydrological features, the Mediterranean has experienced intense human development and impact on its ecosystems for thousands of years, and various forms of human settlements have existed there for at least 8,000 years. is has created a mosaic of natural and cultural landscapes, with thousands of habitats, ranging from high mountains to large rivers, from wetlands and forests to deserts, which favor the di erentiation and existence of numerous species, leading to the high level of endemism found in the region. It is therefore not surprising that the Mediterranean Basin is one of the world's richest places in terms of animal and plant diversity and has been recognized as one of 34 Biodiversity Hotspots (Mittermeier *et al*. 2004).

However, this ancient, rich and diverse region is now facing severe pressure. e Mediterranean-rim countries hold around 400 million people, and 135 million of them live on the Mediterranean coast. e Blue Plan estimates that the population of the northern-rim nations will grow by around 4 million between 2000 and 2025; the population of the southern- and eastern-rim nations will grow by around 98 million over the same period. Considerable economic disparities exist within the region, with the GNI per capita of the Mediterranean EU countries (USD 20,800) being ten times that of the North African ones (USD 2,100) (World Bank 2006). Poor people depend heavily on natural resources and the loss of biodiversity is undermining the potential for economic growth, a ecting the security of populations (food, health, etc.) and limiting their options. On the other hand, economic development increases the pressures on the environment and hence conservation challenges and options in the region are driven by these economic inequities. Mediterranean countries are also an international travel destination for nearly 250 million visitors per year – 31% of all international tourists – the majority of whom visit the coastal zone (Blue Plan 2008). Many visitors to the region are drawn by its natural beauty, but heavy pressure from visitors and residents alike is causing severe environmental degradation.

Furthermore, low rainfall combined with unsustainable farming practices has also led to desertification, erosion, salinization and land degradation in many areas, with for example 30% of Greece being declared "threatened" and 60% of Portugal facing a moderate risk of desertification. Forests have always played, and still play, an important role in the daily life of the Mediterranean peoples. Although Mediterranean forests provide low direct economic returns on wood products in comparison to the Northern European forests, they play a crucial role in maintaining key ecosystem components for securing human welfare and life in the region. Previously, exploitation of the natural landscape was long, slow and relatively sustainable. In the past decades, that balance between nature and humankind has been lost. Urbanization, coastal development, pollution, agricultural intensification, unsustainable exploitation of natural resources and climate change are just some of the many human activities that are leading an ever-increasing number of Mediterranean species to be facing a high risk of extinction.

1.2 Mediterranean mammals: diversity and endemism

Mammals are a well-known class of vertebrates, including many familiar domesticated species and pets, as well as our own species *Homo sapiens*. All mammals are warm-blooded, and all female mammals possess mammary glands (mammae), which are used to suckle the young with milk. Mammals are further distinguished by the possession of hair or fur, although this is limited to early developmental stages in cetaceans (whales and dolphins). e vast majority of mammals giress1gand 1u(alwacu.)9lC



Terrestrial mammals native to the Mediterranean belong to ten major groups: Carnivora (carnivores), Cetartiodactyla (even-toed ungulates, dolphins and whales), Chiroptera (bats), Eulipotyphla (shrews, moles and hedgehogs), Hyracoidea (hyraxes) Lagomorpha (rabbits, hares and pikas), Macroscelidea (elephant shrews), Perissodactyla (odd-toed ungulates), Primates (primates) and Rodentia (rodents).

Marine mammals native to the Mediterranean belong to two taxonomic orders, the Cetartiodactyla and Carnivora. Mediterranean marine carnivores are represented by a single species, the Mediterranean Monk Seal *Monachus monachus*. Fourteen species of whales and dolphins regularly occur in the Mediterranean region (Table 2), with a further eight species recorded as vagrants (Reeves and Notarbartolo di Sciara 2006).

e majority of Mediterranean mammal species are small non-volant and volant mammals belonging to the orders Rodentia (rodents), Chiroptera (bats), and Eulipotyphla (shrews, moles and hedgehogs) (see Table 1). e largest mammal family in the Mediterranean, and also the largest and most diverse family at the global level, is the Muridae (rats and mice), with 62 species. Murid subfamilies present in the Mediterranean include the Deomyinae (spiny mice), the Gerbillinae (gerbils and jirds) and the Murinae (Old World rats and mice). Other families with a particularly large number of representatives in the Mediterranean region include the Vespertilionidae (evening bats and vesper bats – 45 species) and Cricetidae (hamsters and voles – 36 species).

Just over one-quarter of terrestrial mammal species are endemic to the Mediterranean. Endemism is particularly high in the small non-volant mammals (Rodentia and Eulipotyphla). Larger terrestrial mammals and bats tend to be more mobile and wide-ranging, and the majority of these species have ranges extending outside the region. However, among larger mammal species there is a high proportion of endemism in the lagomorphs (hares, rabbits and pikas – 5 out of 9 species present are endemic to the Mediterranean). e Barbary Macaque is endemic to the

Mediterranean, and consequently 100% of primate species occurring in the region are endemic.

Although mammals are one of the better known taxonomic

Table 2. Diversity and endemism in cetacean (whale, dolphin and porpoise) families in the Mediterranean region*

Order	Family	Number of species	Number of endemic species	Percentage endemic
Cetartiodactyla	Balaenopteridae	3	0	0%
	Delphinidae	8	0	0%
	Phocoenidae	1	0	0%
	Physeteridae	1	0	0%
	Ziphiidae	1	0	0%
	Total	14	0	0%

* Cetacean families are listed for the sake of completeness, but were not included in the assessment process reported here and are not covered in subsequent sections of this publication. is list does not include species considered to be vagrants in the region by Reeves and Notarbartolo di Sciara (2006).

1.3 Species threatened status

e threatened status of plants and animals is one of the most widely used indicators for assessing the condition of ecosystems and their biodiversity. It also provides an important tool underpinning priority-setting exercises for species conservation. At the global scale the best source of information on the conservation status of plants and animals is the *IUCN Red List of reatened Species* (see www.iucnredlist.org). e Red List provides taxonomic, conservation status, and distribution information on taxa that have been evaluated using the *IUCN Red List Categories and Criteria: Version 3.1* (IUCN 2001). is system is designed to determine the relative risk of extinction, with the main purpose of cataloguing and highlighting those taxa that are facing a higher risk of extinction (i.e., those listed as Critically Endangered, Endangered and Vulnerable).

1.4 Objectives of the assessment

is assessment of mammals in the Mediterranean basin has two main objectives:

To assist in regional conservation planning by assessing the status and distribution of all species occurring within the region; and

To develop a network of regional experts to support future assessments and the updating of the information on these species.

e assessment provides two main direct outputs:

A report on the status of the mammals of the Mediterranean

2. Assessment methodology

2.1 Global versus regional assessment

e present study was an assessment of the regional conservation status of all Mediterranean mammal species (excluding the cetaceans), following the *Guidelines for Application of IUCN Red List Criteria at Regional Levels* (IUCN 2003). It complements and contributes to the global status assessments of Mediterranean mammal species carried out through the Global Mammal Assessment (GMA) (see Schipper *et al*. 2008). A regional approach to identifying threatened species complements global conservation status assessments, and provides information at an appropriate scale for international conservation policies and legislation that have a regional focus. e information provided here will help to put national conservation priorities into a Mediterranean context, thus maximising the e ectiveness of local and national conservation measures, and facilitating the development of integrated regional conservation strategies.

2.2 Geographic scope

e Mediterranean basin was defined politically to include the following countries and territories[1]: Albania, Algeria, Andorra, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Libyan Arab Jamahiriya, FYR Macedonia, Malta, Monaco, Montenegro, Morocco, Occupied Palestinian Territories, Portugal (including Madeira), San Marino, Serbia, Slovenia, Spain (including the Canary Islands), Switzerland, Syrian Arab Republic, Tunisia, Turkey and Western Sahara (Figure 2).

2.3 Taxonomic scope

All mammal species native to the Mediterranean or naturalized before 1500 A.D. were included in the assessment, with the exception of the cetaceans (whales, dolphins and porpoises) that are assessed at the regional level through a separate initiative led by the IUCN SSC Cetacean Specialist Group (Reeves and Notarbartolo di Sciara 2006). Domesticated species are not eligible for classification according to the IUCN Red List Categories and Criteria, and were excluded from the assessment. Species introduced to the Mediterranean region by man after 1500 A.D., as well as species that are vagrant or of marginal or uncertain occurrence, were classed as Not Applicable.

e Mediterranean mammal assessment uses the third edition of *Mammal Species of the World* (Wilson and Reeder 2005) as its default taxonomy for most taxonomic groups, although it departs from this in a few justified circumstances. Distinct subpopulations and subspecies of mammals within the Mediterranean were not individually assessed as part of this project.

Expert participants at the Mediterranean Mammal Red List workshop held in Málaga, Spain, 29 October – 2 November 2007. Photograph © Sandra Simoes.

[1] As listed by United Nations

2.4 Assessment protocol

For every mammal species native to the Mediterranean or naturalized before 1500 A.D., the following data were compiled; Species' taxonomic classification, Geographic range (including a distribution map), Red List Category and Criteria, Population information, Habitat preferences, Major threats, Conservation measures (in place, and needed), Species utilization, Other general information and Key literature references.

ese data were compiled in collaboration with the IUCN Global Mammal Assessment (GMA) and European Mammal Assessment (EMA). For detailed information on the GMA and EMA data compilation processes, see Schipper et al. (2008) and Temple & Terry (2007). Many Mediterranean mammal species had already been preliminarily reviewed during at least one other regional or taxon-focused workshop, including the Africa Small Mammals workshop (24-30 January 2004, United Kingdom), the European Mammal Assessment workshop (18-22 May 2006, Austria), and the Southwest Asia Mammals Workshop (22-25 November 2005, Turkey).

2.5 Review workshop (2007) and evaluation of assessments

3. Results

3.1 Threatened status of mammals

Approximately one-sixth (16.5%) of mammal species assessed were found to be threatened with extinction in the Mediterranean, of which 3.0% were Critically Endangered, 5.1% were Endangered and 8.4% were Vulnerable (Table 3 and Figure 3). A further 7.7% were considered Near reatened, and 2.7% were already Extinct or Regionally Extinct. A relatively high proportion of species, 12.5%, were considered to be Data Deficient. Species classed as threatened (Critically Endangered, Endangered and Vulnerable) are listed in Table 4.

Table 4. reatened Mediterranean mammal species

Order	Family	Scienti c name	Common name	Red List Category	Endemic?
CARNIVORA	CANIDAE	*Lycaon pictus*	African Wild Dog	CR	
CARNIVORA	FELIDAE	*Leptailurus serval*	Serval	CR	
CARNIVORA	FELIDAE	*Lynx pardinus*	Iberian Lynx	CR	Yes
CARNIVORA	FELIDAE	*Panthera pardus*	Leopard	CR	
CARNIVORA	MUSTELIDAE	*Mustela lutreola*	European Mink	CR	
CARNIVORA	PHOCIDAE	*Monachus monachus*	Mediterranean Monk Seal	CR	
CETARTIODACTYLA	BOVIDAE	*Gazella subgutturosa*	Goitered Gazelle	CR	
CETARTIODACTYLA	BOVIDAE	*Nanger dama*	Dama Gazelle	CR	
PERISSODACTYLA	EQUIDAE	*Equus africanus*	African Wild Ass	CR	
CARNIVORA	FELIDAE	*Acinonyx jubatus*	Cheetah	EN	
CARNIVORA	FELIDAE	*Lynx lynx*	Eurasian Lynx	EN	
CETARTIODACTYLA	BOVIDAE	*Gazella cuvieri*	Cuvier's Gazelle	EN	Yes
CETARTIODACTYLA	BOVIDAE	*Gazella dorcas*	Dorcas Gazelle	EN	
CETARTIODACTYLA	BOVIDAE	*Gazella leptoceros*	Slender-horned Gazelle	EN	
CETARTIODACTYLA	BOVIDAE	*Oryx leucoryx*	Arabian Oryx	EN	
CETARTIODACTYLA	BOVIDAE	*Ovis orientalis*	Urial	EN	
CHIROPTERA	VESPERTILIONIDAE	*Nyctalus azoreum*	Azores Noctule	EN	Yes
CHIROPTERA	VESPERTILIONIDAE	*Pipistrellus maderensis*	Madeira Pipistrelle	EN	Yes
CHIROPTERA	VESPERTILIONIDAE	*Plecotus teneri ae*	Canary Long-eared Bat	EN	Yes
EULIPOTYPHLA	SORICIDAE	*Crocidura canariensis*	Canary Shrew	EN	Yes
PERISSODACTYLA	EQUIDAE	*Equus hemionus*	Asiatic Wild Ass	EN	
PRIMATES	CERCOPITHECIDAE	*Macaca sylvanus*	Barbary Macaque	EN	Yes
RODENTIA	MURIDAE	*Gerbillus hesperinus*	Western Gerbil	EN	Yes
RODENTIA	MURIDAE	*Meriones dahli*	Dahl's Jird	EN	
CARNIVORA	CANIDAE	*Vulpes cana*	Blanford's Fox	VU	
CARNIVORA	HYAENIDAE	*Hyaena hyaena*	Striped Hyaena	VU	
CARNIVORA	MUSTELIDAE	*Vormela peregusna*	European Marbled Polecat	VU	
CARNIVORA	URSIDAE	*Ursus arctos*	Brown Bear	VU	
CETARTIODACTYLA	BOVIDAE	*Ammotragus lervia*	Aoudad	VU	
CETARTIODACTYLA	BOVIDAE	*Capra aegagrus*	Wild Goat	VU	
CETARTIODACTYLA	BOVIDAE	*Capra nubiana*	Nubian Ibex	VU	
CETARTIODACTYLA	BOVIDAE	*Gazella gazella*	Mountain Gazelle	VU	
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus euryale*	Mediterranean Horseshoe Bat	VU	
CHIROPTERA	RHINOLOPHIDAE	*Rhinolophus mehelyi*	Mehely's Horseshoe Bat	VU	
CHIROPTERA	VESPERTILIONIDAE	*Myotis capaccinii*	Long-fingered Bat	VU	
CHIROPTERA	VESPERTILIONIDAE	*Plecotus sardus*	Sardinian Long-eared Bat	VU	Yes
EULIPOTYPHLA	SORICIDAE	*Crocidura zimmermanni*	Cretan White-toothed Shrew	VU	Yes
EULIPOTYPHLA	TALPIDAE	*Galemys pyrenaicus*	Pyrenean Desman	VU	Yes
LAGOMORPHA	LEPORIDAE	*Lepus castroviejoi*	Broom Hare	VU	Yes
LAGOMORPHA	LEPORIDAE	*Lepus corsicanus*	Corsican Hare	VU	Yes
RODENTIA	CRICETIDAE	*Arvicola sapidus*	Southwestern Water Vole	VU	Yes
RODENTIA	CRICETIDAE	*Dinaromys bogdanovi*	Balkan Snow Vole	VU	Yes
RODENTIA	CRICETIDAE	*Mesocricetus auratus*	Golden Hamster	VU	Yes
RODENTIA	CRICETIDAE	*Prometheomys schaposchnikowi*	Long-clawed Mole Vole	VU	
RODENTIA	DIPODIDAE	*Allactaga tetradactyla*	Four-toed Jerboa	VU	Yes
RODENTIA	GLIRIDAE	*Myomimus roachi*	Roach's Mouse-tailed Dormouse	VU	Yes
RODENTIA	MURIDAE	*Gerbillus hoogstraali*	Hoogstraal's Gerbil	VU	Yes
RODENTIA	MURIDAE	*Meriones sacramenti*	Buxton's Jird	VU	Yes
RODENTIA	SCIURIDAE	*Spermophilus citellus*	European Ground Squirrel	VU	

3.4 Spatial distribution of species

3.4.1 Species richness

Information on the species richness of mammals within orders and families has already been given in Section 1.2 and Tables 1 and 2. e geographic distribution of mammal species richness in Mediterranean basin countries is presented in Figure 4. e mountainous parts of the region clearly stand out as areas of high species richness. In the European part of the Mediterranean region, this includes the Pyrenees, Massif Central, Alps, Apennines, Carpathians, and the mountains of the Balkan peninsula. In Asian and African parts of the Mediterranean, this includes the mountains of Turkey, the Levant region, and the Atlas, Anti-Atlas and Rif ranges in north-west Africa. Looking at mammalian diversity from a country perspective, the top five countries in terms of species richness are (in descending order): Turkey, Morocco, Italy, Israel and France (see Table 7). Turkey has a particularly high species richness as it is a large country that spans several biogeographic regions. Although the Balkan region has very high species richness, the individual countries in this region are small and none of them appear in the top five.

3.4.2 Distribution of threatened species

A map showing the distribution of threatened mammals in the Mediterranean (Figure 5) reveals somewhat di erent patterns from depictions of overall species diversity. North-west Africa, Turkey and the Levant all hold important concentrations of threatened species. Although overall species richness in the

Figure 4. Species richness of Mediterranean mammals

3.4.3 Endemic species richness

Figure 6 shows the distribution of endemic mammal species (ie, those that are unique to the Mediterranean and are found nowhere else in the world, see Table 1). Endemic species richness is particularly high in the Maghreb, although the Iberian and Italian peninsulas also hold important concentrations of endemic mammals, as do the Mediterranean islands.

Table 7. Number of mammal species in the countries and territories included in the Mediterranean assessment region

Name	Total number of species*	Number of endemic species*	Number of threatened species*
Albania	69	4	5
Algeria	95	19	14
Andorra	47	5	4
Bosnia and Herzegovina	78	4	7
Bulgaria	91	3	10
Croatia	88	3	9
Cyprus	26	2	3
Egypt	92	13	15
France	96	14	8
Greece	91	10	9
Israel	98	5	16
Italy	100	15	8
Jordan	78	1	14
Lebanon	63	2	9
Lybia	80	20	10
Macedonia, FYR	77	6	8
Malta	19	4	1
Monaco	28	1	1
Montenegro	86	6	9
Morocco	105	22	16
Palestinian Territories	27	1	5
Portugal	64	13	8
San Marino	27	1	2
Serbia	93	7	9
Slovenia	82	0	6
Spain	90	20	14
Switzerland	84	4	5
Syria	89	3	15
Tunisia	75	18	14
Turkey	144	11	17
Western Sahara	34	4	5

* Including species classed as Not Applicable (marginal occurrence). Including native and reintroduced species; excluding introduced species. Including extant, possibly extinct and extinct species (since 1500 A.D.); excluding species classed as “presence uncertain”. is list includes all terrestrial mammal species plus the Mediterranean Monk Seal; it excludes cetaceans (dolphins and whales).

3.5 Major threats to terrestrial mammals in the Mediterranean

e major threats to each species were coded using the IUCN-Conservation Measures Partnership (CMP) Unified Classification of Direct reats. In addition to the direct threats identified as actual or potential drivers of population change, accompanying non-exclusive stresses were coded with each threat to highlight how a threat impacts upon a population. A summary of the relative importance of the di erent threatening processes and the stresses that they cause is shown in Figures 7 and 8.

e threats to Mediterranean mammals are many and varied: agriculture, hunting and trapping, and invasive species are the most severe, respectively a ecting 31 (65%), 29 (60%) and 24 (50%) threatened species. ese create stresses on mammal populations in a range of ways, the most common being habitat destruction and degradation, which a ect 43 (90%) threatened species (Figure 8).

e Balkan Snow Vole *Dinaromys bogdanovi* is considered to be Vulnerable (VU). It is endemic to the Mediterranean region, where it has a very limited and fragmented range. Photography © Boris Krystufek.

Figure 6. Endemic species richness of mammals in the Mediterranean

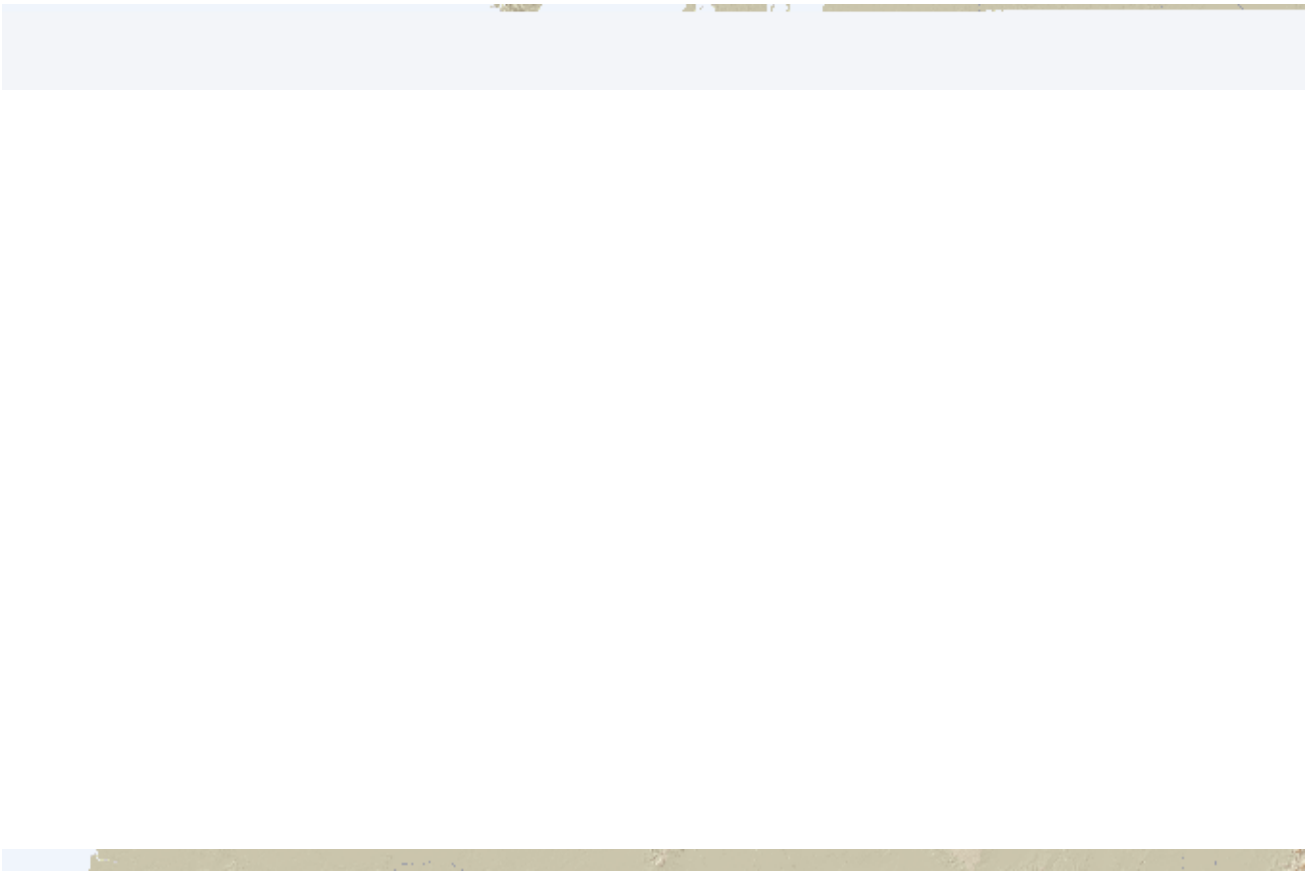
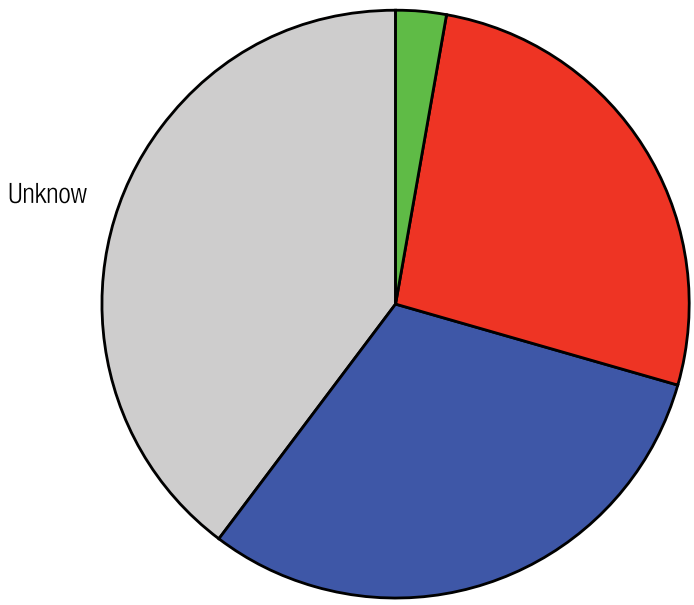


Figure 8. Main stresses on terrestrial mammals in the Mediterranean region



4. Discussion

4.1 Status of Mediterranean mammals

e status of Mediterranean mammals was assessed at the regional level according to the IUCN Red List Categories and Criteria (IUCN 2001), the world's most widely used system for classifying species according to their extinction risk, and the *Guidelines for Application of IUCN Red List Criteria at Regional Levels* (IUCN 2003). All native species except cetaceans (whales and dolphins) were included. Overall, one-sixth (16%) of the 298 mammal species covered in this assessment were found to be threatened with extinction in the Mediterranean[2]. Of that total, 3% were Critically Endangered, 5% Endangered and 8% Vulnerable. A further 8% were considered Near reatened, and 3% were already Extinct or Regionally Extinct.

By comparison with other Mediterranean species groups assessed to date, this is an intermediate level of threat. Previous assessments have shown that 56% of Mediterranean endemic freshwater fishes (Smith & Darwall 2006), 56% of dolphins and whales (Reeves and Notarbartolo di Sciara 2006), 42% of sharks and rays (Cavanagh & Gibson 2007), 36% of crabs and crayfish (Cuttelod *et al.* 2008), 29% of amphibians (Cox *et al.* 2006), 19% of dragonflies and damselflies (Riservato *et al.* 2009), 13% of reptiles (Cox *et al.* 2006) and 5% of birds (Cuttelod *et al.* 2008) are at risk of extinction.

Two small groups of mammals – odd-toed ungulates (Order Perissodactyla; represented in the region by the African Wild Ass and the Asiatic Wild Ass) and primates (Order Primates; one species, the Barbary Macaque) – show extremely high levels of threat with 100% of species threatened in each case. Equally alarming is the status of the even-toed ungulates (Order Cetartiodactyla), a well-known group including such species as antelopes, ibex, and wild sheep and goats. Of the 25 species from this group that are native to the Mediterranean, 11 (44%) are threatened with extinction and a further 5 (20%) are already extinct in the region. e threatened list includes all except one of the antelope species found in the region. Mediterranean carnivores and lagomorphs (rabbits and hares) also show a very high proportion of species to be threatened with extinction or already extinct.

Many of the threatened mammal species are endemic to the region, highlighting the responsibility that Mediterranean countries have to protect the entire global populations of these species. Of the 49 threatened species, 20 (41%) are unique to the region and occur nowhere else in the world.

4.2 Extinctions

By comparison with other taxonomic groups covered in the Mediterranean regional assessment (Cuttelod *et al.* 2008), a relatively high proportion of Mediterranean mammal species have been driven extinct or Regionally Extinct since 1500 A.D. as a result of human activities. is stands as a warning of the fate that may befall other Mediterranean mammals if e ective conservation actions are not urgently implemented.

One endemic Mediterranean mammal species, the **Sardinian Pika** *Prolagus sardus*, is known to have gone extinct since 1500 A.D. It lived on the islands of Sardinia and Corsica until its extinction, which probably occurred in the late 1700s or early 1800s. It is thought that habitat loss, predation, and competition with alien invasive species were responsible for its extinction.

A further seven species (2.4% of the total number of species assessed) have been extirpated from the Mediterranean as a result of human activities and are considered Regionally Extinct.

e **Lion** *Panthera leo* formerly ranged from northern Africa through southwest Asia (where it disappeared from most countries within the last 150 years), west into Europe, where it apparently became extinct almost 2,000 years ago, and east into India (Nowell and Jackson 1996, Sunquist and Sunquist 2002). Lions were driven to extinction in North Africa by hunting and habitat loss; they perhaps survived in the High Atlas Mountains up to the 1940s (Nowell and Jackson 1996, West and Packer in press).

e **Tiger** *Panthera tigris* once ranged widely across Asia, from Turkey in the west to the eastern coast of Russia (Nowell and Jackson, 1996), but over the past 100 years they have disappeared from many areas and lost 93% of their historic range (Sanderson et al. 2006). Tigers in the Mediterranean region belonged to the extinct subspecies *P. t. virgata* (Caspian Tiger). Caspian Tigers and their large ungulate prey were found in the sparse forest habitats and riverine corridors east (Turkey) and south (Iran) of the Caspian Sea and east through Central Asia into Xinjiang, China (Nowell and Jackson 1996, Abdukadir and Breitenmoser 2008). eir extinction can be attributed to hunting of both tigers and their prey, habitat loss and conversion, and increased vulnerability of small populations (Sunquist et al. 1999). e last Caspian Tiger was seen in the early 1970s, and there are none in captivity

[2] Excluding species assessed as Not Applicable.

e Iberian Wild Goat *Capra pyrenaica* is a species native to Spain and considered as Least Concern (LC). It is abundant in its range and currently expanding as a result of conservation actions and habitat changes resulting from rural abandonment. Hunting reservations and protected areas have played a crucial role in this species' recovery. Photograph © Pedro Regato.

and Rabiei 2002). By 1875 it was restricted to south-western and western Iran, having disappeared from the rest of its range. It was considered extinct, but a small population was rediscovered in south-western Iran in 1956. e only surviving indigenous wild populations are in Dez Wildlife Refuge and Karkeh Wildlife Refuge in south-western Iran. ere is a small reintroduced population in Israel, but these animals are hybrids with the European Fallow Deer *D. dama*. Poaching and habitat destruction are two of the main threats that led to the Persian Fallow Deer's long decline and disappearance from the Mediterranean region.

e **Common Hippopotamus** *Hippopotamus amphibius* was formerly found in Egypt, although it was already rare by the time of the Renaissance. From the end of the Roman Empire up until towards 1700 at the latest, the hippo was still present in two disjunct zones in the Nile Delta and in the upper Nile.

rough the 1700s, records become increasingly scarce, and the latest definite records are from the early 1800s (Manlius 2000). Common Hippos remain widespread in sub-Saharan Africa, but they have undergone significant declines in recent years as a result of illegal and unregulated hunting for meat and ivory (found in the canine teeth) and habitat loss. ese same threats are probably responsible for the disappearance of the species from the Mediterranean region.

e **Red Gazelle** *Eudorcas rufina* is listed in some sources as an extinct species, but here it is classed as Data Deficient owing to uncertainty about whether it is a valid species. e **African Wild Ass** *Equus africanus* is considered to be extinct in the Western Palaearctic by some authors (e.g., Aulagnier *et al*. 2008), but it is here listed as Critically Endangered as there have not yet been exhaustive searches to confirm that the last individuals have disappeared from the region; however it is likely that this species is already extinct in the Mediterranean.

with poor land management practices has led to a significant reduction in the amount of suitable foraging habitat, as well as to declines in prey species (for example, insects, which have decreased in abundance as a result of the widespread use of insecticides). Destruction of riverside vegetation is a particular problem, as many bat species forage along watercourses.

Many bat species congregate to roost and breed, in a variety of sites (depending on the species) including caves, hollow trees and buildings. e disturbance and destruction of roosting and breeding sites has a negative impact on many species. is disturbance and destruction can occur as a result of a variety of human activities, for example:

Tourism and activities of speleologists in caves

Mediterranean countries have committed themselves to a more e ective and coherent implementation of the three objectives of the Convention on Biological Diversity. More specifically, they have made the important commitment “to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth”.

evidence to suggest that a disproportionate focus on large mammal conservation may have a detrimental e ect on other biodiversity values (see Gippoliti and Amori 2004, 2006 and references therein for examples). For example, mouflons continue to be introduced to Mediterranean islands (including protected areas) because they are considered typical of the region (Gippoliti and Amori 2006), even though there is evidence that overgrazing has a significant negative impact on native plants (Fabbri 1966, Greuter 1979, Gippoliti and Amori 2004), and many small Mediterranean islands are regarded as conservation priorities because of the lack of anti-grazing adaptations in the endemic plants (Greuter 2001). It is important that any conservation strategy aimed at maintaining biodiversity and its evolutionary potential takes into account the history (including recent history) of the regional biota, and makes an e ort: (1) to identify and direct attention towards ancient endemic species that escaped previous extinction events and are the repository of unique phylogenetic information; and (2) to strike an appropriate balance between conserving large, charismatic mammals (that may in some cases be relatively recent additions to the regional fauna) and protecting other forms of native biodiversity.

4.6 Conservation measures needed

Species frequently require a combination of conservation responses to ensure their continued survival. ese responses include legislation, monitoring, research, management of populations, restoration of balance between prey/predator populations, habitat conservation and restoration, land acquisition and management, and even captive breeding and benign introductions for some of the Mediterranean region's most threatened mammal species. For species threatened across their range, limited or local actions are unlikely to be su ciently strong or coherent to prevent extinction, and coordinated action is required at the regional level. Although this Red List assessment focused on the status of individual species, e ective conservation action needs to focus not just on species but also on sites in the wider landscape, considering the heterogeneous and dynamic nature of large territories on which the survival of species depends (the ability to meet species requirements inside and outside protected areas, among di erent land uses, integrating use and protection across the landscape). In this way, e orts to protect Mediterranean mammals can benefit all Mediterranean species.

As discussed in Section 4.3, a variety of threatening processes are driving species decline and extinction, and the relative importance of these threats varies across di erent taxa (although there are some important commonalities such as the primary role of habitat loss and degradation in causing species decline). Consequently, the specific conservation measures to be recommended vary between di erent species and groups of species. e following text gives further detail on the types of measures that are required. is list is by no means exhaustive; further information on the conservation needs of particular species and taxonomic groups (e.g. canids) can be found in the "Conservation Actions" section of each individual species factsheet[3], in the series of Conservation Action Plans produced by IUCN Species Survival Commission's Specialist Groups[4], and in the Action Plans produced under the Bern Convention for certain priority species in the region.

3 Available online at www.iucnredlist.org

4 IUCN SSC Conservation Action Plans have been produced for a wide range of Mediterranean species and are freely available for download from the following website, where a complete list can be found: www.iucn.org/about/work/programmes/species/publications___technical_documents/publications/species_actions_plans/

e Middle East Blind Mole Rat *Spalax ehrenbergi* is considered as Data Deficient (DD). It inhabits dry steppes, semi-desert and cultivated fields in coastal north-east Libya and central coastal Egypt. It is widespread in the eastern Mediterranean and ranges north into Turkey. Photograph © Boris Krystufek.

species are ensured (for example through corridors). Illegal, uncontrolled, or inadequately regulated hunting is a major problem that has already driven a number of large mammal species to extinction or near-extinction in the Mediterranean region – better enforcement of existing laws and regulations is needed to counter this threat and new legislation may be required in some cases. Several legislative frameworks are addressing large mammals, but e orts should be made to improve the enforcement of these agreements. Species-specific management plans (including the reintroduction of animals in the wild, following IUCN Guidelines for Re-Introductions (IUCN 1998)) have proven to be powerful tools. Additional field studies and monitoring are also needed, in particular in North Africa and the Middle East.

Restoring habitats and wild prey populations at the landscape level is a key component for the conservation of threatened large carnivores, requiring significant e orts in trans-boundary cooperation. In the case of large herbivores spatial planning, policy and management e orts for the maintenance of managed grazing systems (i.e. preventing rural abandonment and the conversion of grasslands into scrubland) and the altitudinal gradient of habitat requirements is a key conservation measure. Furthermore, education and public involvement programmes among national, regional or local governmental o cials (and also among the general public) are needed to raise awareness on the value and best practice for management of large mammals. Large carnivores are very controversial from both a social and an economic standpoint (many people feel frightened by wolves and bears, and large carnivores are frequently blamed for killing livestock), and therefore their conservation is as much a socio-political issue as a biological one. Understanding people's attitudes towards predators and gaining their acceptance is crucial to the success of conservation and management programmes. Innovative ways to manage livestock and compensation payments to cover farmers' losses may be a useful means of gaining local people's acceptance about the current trend of natural re-colonization of large carnivores over large territories in northern Mediterranean countries. Tourism is a growing activity which, when properly managed, has a high potential to raise awareness and demonstrate socio-economic benefits of the maintenance of the large mammal populations that are iconic features of the Mediterranean region's rich and beautiful landscapes.

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Order	Family	Scienti c name	IUCN Red List Category (Mediterranean)*	IUCN Red List Criteria	Endemic to the region?
CHIROPTERA	VESPERTILIONIDAE	*Myotis dasycneme*			

inar)6(omys bogdanus)12(vi)]TJ/T1_)20(em.))oqd[Yd[r)20(el11 0 Td[Dnar)6(omys bogdano)12(vi)]TJ/T1_0355 Tf9.222 0 Td[V)88(ulnerable)]TJ11.888 0 Td(B2ab(i,ii,iv)

Order	Family	Scienti c name	IUCN Red List Category (Mediterranean)*	IUCN Red List Criteria	Endemic to the region?
RODENTIA	MURIDAE	*Mus spretus*	Least Concern		Yes

Appendix 2. Introduced species assessed as Not Applicable (NA) in the Mediterranean region

Order	Genus	Species	Status	Justi cation
Carnivora	*Herpestes*	*auropunctatus*	NA	Introduced after 1500 A.D.
Carnivora	*Neovison*	*vison*	NA	Introduced after 1500 A.D.
Carnivora	*Nyctereutes*	*procyonoides*	NA	Introduced after 1500 A.D.
Carnivora	*Procyon*	*lotor*	NA	Introduced after 1500 A.D.
Cetartiodactyla	*Axis*	*axis*	NA	Introduced after 1500 A.D.
Cetartiodactyla	*Cervus*	*nippon*	NA	Introduced after 1500 A.D.
Cetartiodactyla	*Hydropotes*	*inermis*	NA	Introduced after 1500 A.D.
Cetartiodactyla	*Odocoileus*	*virginianus*	NA	Introduced after 1500 A.D.
Lagomorpha	*Sylvilagus*	*floridanus*	NA	Introduced after 1500 A.D.
Rodentia	*Callosciurus*	*erythraeus*	NA	Introduced after 1500 A.D.
Rodentia	*Callosciurus*	*finlaysonii*	NA	Introduced after 1500 A.D.
Rodentia	*Myocastor*	*coypus*	NA	Introduced after 1500 A.D.
Rodentia	*Ondatra*	*zibethicus*	NA	Introduced after 1500 A.D.
Rodentia	*Rattus*	*norvegicus*	NA	Introduced after 1500 A.D.
Rodentia	*Sciurus*	*carolinensis*	NA	Introduced after 1500 A.D.

* is list may be incomplete.

Appendix 3. Methodology for spatial analyses

Data were analyzed using a geodesic discrete global grid system, defined on an icosahedron and projected to the sphere using the inverse Icosahedral Snyder Equal Area (ISEA) Projection (S39). is corresponds to a hexagonal grid composed of individual units (cells) that retain their shape and area (~22,300 km^2) throughout the globe. ese are more suitable for a range of ecological applications than the most commonly used rectangular grids (S40).

e range of each species was converted to the hexagonal grid for analysis purposes. Coastal cells were clipped to the coastline. Patterns of species richness (Figure 4) were mapped by counting the number of species in each cell (or cell section, for species with a coastal distribution). Patterns of threatened species richness (Figure 5) were mapped by counting the number of threatened species (categories CR, EN, VU at the Mediterranean regional level) in each cell or cell section. Patterns of endemic species richness were mapped by counting the number of species in each cell (or cell section for coastal species) that were flagged as being endemic to the Mediterranean region as defined in this project (Figure 6).

IUCN Red List of Threatened Species™ – Regional Assessments

e Status and Distribution of Freshwater Biodiversity in Eastern Africa. Compiled by William R.T. Darwall, Kevin G. Smith, omas Lowe, Jean-Christophe Vié, 2005

e Status and Distribution of Freshwater Fish Endemic to the Mediterranean Basin. Compiled by Kevin G. Smith and William R.T. Darwall, 2006

e Status and Distribution of Reptiles and Amphibians of the Mediterranean Basin. Compiled by Neil Cox, Janice Chanson and Simon Stuart, 2006

e Status and Distribution of European Mammals. Compiled by Helen J. Temple and Andrew Terry, 2007

Overview of the Cartilaginous Fishes (Chondrichthyans) in the Mediterranean Sea. Compiled by Rachel D. Cavanagh and Claudine Gibson, 2007

e Status and Distribution of Freshwater Biodiversity in Southern Africa. Compiled by William R.T. Darwall, Kevin G. Smith, Denis Tweddle and Paul Skelton, 2009

European Red List of Amphibians. Compiled by Helen J. Temple and Neil Cox, 2009

European Red List of Reptiles. Compiled by Neil Cox and Helen J. Temple, 2009

e Status and Distribution of Dragonflies of the Mediterranean Basin. Compiled by Elisa Riservato, Jean-Pierre Boudot, Sonia Ferreira, Milos Jovic, Vincent J. Kalkman, Wolfgang Schneider and Boudjéma Samraoui, 2009

THE IUCN RED LIST
OF THREATENED SPECIES ™

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