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Abstract: The Eurasian lynx *Lynx lynx* is widely distributed in Asia, but is one of the least known cats. Despite being the largest small cat in Iran, general information about lynx previously consisted of a few historical records (>15) and anecdotal observations from various sources. From 2006-2009 we conducted surveys by means of literature reviews, questionnaires and interviews, and examined museum specimens to determine the species distribution in Iran and document major threats to its persistence. We collected 167 new geographic records mainly from the past three decades, here used to describe the actual and probable distribution of the Eurasian lynx in Iran. We found confirmed and probable presence (category 1 and 2 records) in 19 out of 30 provinces and possible presence (category 3) in an additional 6 provinces, mainly in the south and east. Our results indicate a larger distribution of lynx in Iran than previously published (confirmed presence in 3, unconfirmed in 9 provinces). However, we can at present not yet assess the development and potential fragmentation of the distribution range and therefore advise judging the species conservation status with caution.

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Distribution and conservation status of the Eurasian lynx in Iran

A preliminary assessment

The Eurasian lynx *Lynx lynx* is widely distributed in Asia, but is one of the least-known cats. Despite being the largest small cat in Iran, general information about lynx previously consisted of a few historical records (>15) and anecdotal observations from various sources. From 2006–2009 we conducted surveys by means of literature reviews, questionnaires and interviews, and examined museum specimens to determine the species distribution in Iran and document major threats to its persistence. We collected 167 new geographic records mainly from the past three decades, here used to describe the actual and probable distribution of the Eurasian lynx in Iran. We found confirmed and probable presence (category 1 and 2 records) in 19 out of 30 provinces and possible presence (category 3) in an additional 6 provinces, mainly in the south and east. Our results indicate a larger distribution of lynx in Iran than previously published (confirmed presence in 3, unconfirmed in 9 provinces). However, we can at present not yet assess the development and potential fragmentation of the distribution range and therefore advise judging the species conservation status with caution.

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The Eurasian lynx has one of the widest range of all cat species, with a distribution from Norway in the northwest to China in the southeast (Nowell & Jackson 1996, Sunquist & Sunquist 2002). However, populations in Europe and southwest Asia are generally small and iso-

lated (Breitenmoser et al. 2008). The lynx was intensively studied in Europe, but little information is available from its Asian range outside Siberia (Nowell & Jackson 1996). Although there is no consensus on the classification and geographical distribution of

subspecies yet, Western Asia is considered home of two subspecies of the Eurasian lynx, namely the Himalayan lynx *L. l. isabellinus* in Turkmenistan, Afghanistan and Pakistan, and the Caucasian lynx *L. l. dinniki* in Iran, northern Iraq, the Caucasian countries and Turkey (Hatt 1959, Ellerman & Morrison-Scott 1966, Roberts 1997, Lukarevsky 2001, Habibi 2003, von Arx et al. 2004, Karami et al. 2008). As with the other smaller felids in Iran, the actual distribution of the Eurasian lynx is poorly known and only from old or general publications (i.e. Lay 1967, Harrington & Dares-huri 1976, Etemad 1985, Nowell & Jackson 1996, Firouz 2005, Ziaie 2008). Nevertheless, sporadic records from different parts of the country indicated that our knowledge about this animal might be incorrect. Presumably, the lynx suffers from declining prey populations, especially small ungulates, as a consequence of poaching and habitat degradation. However, the lack of systematic monitoring and ecological studies so far make it impossible to assess the conservation status of the species. The purpose of our study was to understand the actual confirmed and possible range of the Eurasian lynx in Iran and to document major threats to its survival. It is the first documentation of Eurasian lynx distribution in Iran based on a thorough review of existing records and a systematic investigation throughout the country, which could contribute to establishment of a conservation strategy supporting the survival of the species in Iran.

Methods

The study was carried out from July 2006 to December 2009. We established a database hosting data from three sources: (1) information derived from existing literature on lynx from Iran and border areas of adjacent countries (Afghanistan, Armenia, Iraq, Pakistan, Azerbaijan, Turkey and Turkmenistan), with the name and exact geographical position of each location; (2) lynx records from questionnaires sent to all 30 provincial offices of the Iranian Department of the Environment (DoE) to gather their recent cat observations; (3) information resulting from intensive interview surveys among wildlife experts, game wardens, hunters and taxidermists, focusing on the lynx's historical and probable range. Records in the database were attributed to three categories of reliability, namely "confirmed" (category 1), "probable" (category 2) and "possible" (category 3) observations. Confirmation of presence based on available

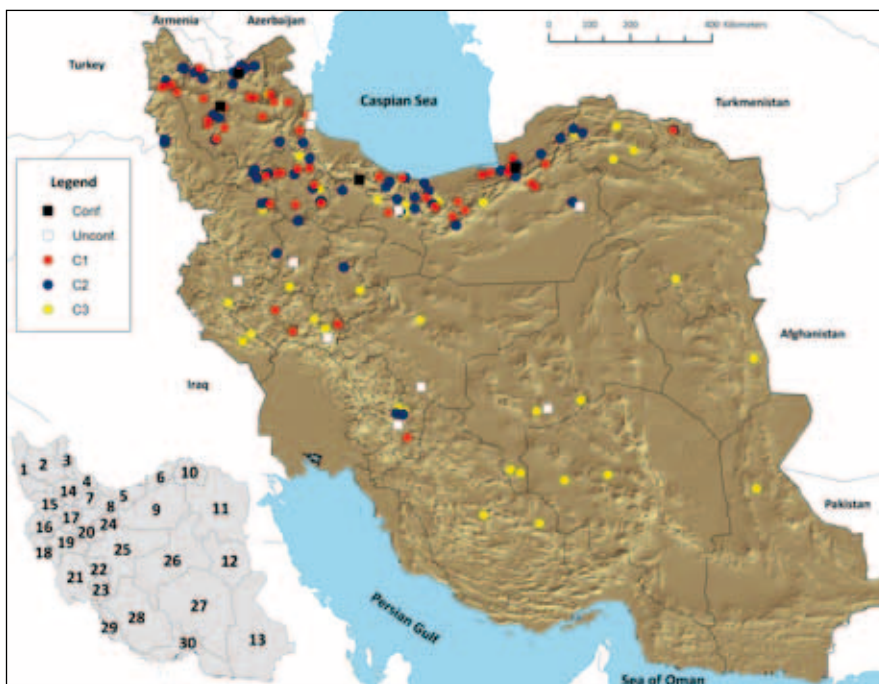


Fig. 1. Distribution of Eurasian lynx in Iran. Past records (Conf. and Unconf., taken from previous publications) and range according to records compiled for this study (C1, C2 and C3) from 2006–2009 (provinces and sums in Table 1).

photos or movies, or lynx carcasses or other remains of the species that we saw ourselves or that was verified by reliable experts. Observations by trained persons (e.g. field biologists, skilled game wardens, experienced hunters, and taxidermists) were assigned to category 2, whereas category 3 includes all unconfirmed reports, unverified observations and evidence from unknown sources.

Furthermore, 43 natural history and wildlife museums and private collections across the country were visited, and some of the world's best-known museums were contacted for specimens of Eurasian lynx from Iran in their collections.

The database also contained specific details of each observation, including characteristics of the location, number and behavior of the animal(s) in the time of sighting, and other significant details. A GIS-based map was developed to show all sites of observation according to the categories (Fig. 1).

Results and Discussion

Blanford's Eastern Persia: The Zoology and Geology (Blanford 1876) made the first known reference to the "possible" presence of Eurasian lynx in Ghilan (Gilan) and Mazandaran provinces (Table 1, Fig. 1). Ognev (1935) stated its probable occurrence in Iran from Gilan, Mazandaran and Asterabad (former name for Gorgan). Misonne (1959) mentioned that according to a report from Satunin from 1905, the cat lives in very low density in highland forests of the Talysh (Talesh) Mountains. However, evidence for lynx presence in Iran remained uncertain until Lay (1967), who reported a lynx skin in a Tehran fur market, which according to the dealer came from the vicinity of Tabriz, East Azarbayjan.

During the survey, we sent questionnaires to all 30 provincial DoE offices and interviewed 212 persons. 79 of them had information about the species. Questionnaires were returned from only 14 provinces. 6 offices reported lynx records; however most of them were unconfirmed anecdotal records (C3). From the interview surveys, we compiled a total of 167 lynx reports from across the country, of which 33.5% ($n=56$) were confirmed records (C1), 38.3% (64) probable (C2), and 28.2% (47) reports, mostly from untrained people, classified as possible records (C3). Confirmed and probable reports, comprising 71.8% of all records, came consistently from the north and north-west of the country, whereas unconfirmed records came from the central-south and eastern provinces (Fig. 1).

Table 1. Number of lynx records compiled during "this study", compared to previous publications ("past records", i.e. Misonne 1959, Lay 1967, Harrington & Dareshuri 1976, Etemad 1985, Firouz 2005, and Ziaie 2008) No. = province numbers as shown in Fig. 1; Conf. = confirmed records, Unconf. = unconfirmed records; C1 = Category 1 (confirmed), C2 = Category 2 (probable), C3 = Category 3 (possible).

No.	Province	Past records		This study		
		Conf.	Unconf.	C1	C2	C3
1	Azarbayjan-e Gharbi (West Azarbayjan)	0	0	4	5	0
2	Azarbayjan-e Sharqi (East Azarbayjan)	2	0	12	16	1
3	Ardabil	0	0	4	1	1
4	Gilan	0	2	1	0	0
5	Mazandaran	0	1	9	7	1
6	Golestan	1	0	4	6	1
7	Qazvin	1	0	0	1	0
8	Tehran	0	0	2	3	3
9	Semnan	0	1	3	2	1
10	Khorasan-e Shomali (North Khorasan)	0	0	0	2	3
11	Khorasan-e Razavi (Razavi Khorasan)	0	0	1	1	2
12	Khorasan-e Jonubi (South Khorasan)	0	0	0	0	1
13	Sistan va Baluchestan	0	0	0	0	1
14	Zanjan	0	0	10	13	6
15	Kordestan (Kurdistan)	0	0	1	2	2
16	Kermanshah	0	1	0	0	0
17	Hamadan	0	1	1	1	1
18	Ilam	0	0	0	0	4
19	Lorestan (Luristan)	0	1	3	0	4
20	Markazi	0	0	0	1	1
21	Khuzestan	0	0	0	0	0
22	Chahar Mahall va Bakhtiari	0	0	0	1	1
23	Kohgiluyeh va Buyer Ahmad	0	1	1	0	0
24	Qom	0	0	0	0	0
25	Esfahan	0	1	0	2	4
26	Yazd	0	1	0	0	4
27	Kerman	0	0	0	0	3
28	Fars	0	0	0	0	2
29	Bushehr	0	0	0	0	0
30	Hormozgan	0	0	0	0	0

The search among natural history and wildlife museums and private collections provided 21 specimens, of which we were able to confirm the origin of 14 (C1). Outside Iran, we contacted the National Museum of Natural History (USNM), the Field Museum, Chicago (FMNH), the Natural History Museum (NHM, formerly British Museum Natural History) and the Swedish Museum of Natural History (Naturhistoriska riksmuseet, NRM). Only the latter had a specimen collected in Iran in 1915, but the exact locations was not clear (P. Nilsson, pers. comm.).

Former descriptions of lynx distribution in Iran showed the species mainly in the northwest of the country (Etemad 1985, Harrison & Bates 1991, Firouz 2005, Ziaie 2008), which was confirmed by our findings. This is a region known for its high biodiver-

sity, but confirmed lynx records were limited to those reported by Lay (1967) and some unspecified reports by Ziaie (2008). Khan-Mohammadi (1998) reported frequent lynx observations from Zanjan province (No. 14 in Table 1, Fig. 1, Fig. 2), which was surprisingly never considered in other publications (e.g. Firouz 2005, Ziaie 2008). In adjacent regions, the species has been reported from Hakkari, Van and Agri, eastern Turkey (Serez 1992, Can 2004), several parts of Nakhichivan and Talish Mountains, Azerbaijan (Askerov in litt. 2009), and Nuvadi area (former name for Ernadzor) and Khosrov Reserve, southern Armenia (Khorozyan in litt. 2009). Our survey revealed 44 new records from the three northwestern provinces (No. 1-3 in Table 1, Fig. 1), of which 20 were confirmed records.



Fig. 2. Lynx habitat in Iran. Anguran Wildlife Refuge, Zanjan province (Photo F. Jafarzadeh).

Toward the east, in the Alborz Mountains, a skin was obtained from Rudbar-e Alamut, Qazvin province (Etemad 1985). Ziaie (2008) noted a single record from high altitudes in Gorgan. We discovered 16 verified lynx records from this mountainous chain (No. 4-8 in Table 1). Lynx presence was also confirmed for Semnan province (Fig. 3).

Northeastern Iran was rarely considered to be home of the Eurasian lynx and reliable evidence was never found. Its presence in adjacent southern Turkmenistan was much debated. Lynx was reported from Kopet-Dag in several publications (e.g. Ognev 1935, Guggisberg 1975, Matjuschkina 1978, Tumilson 1987, Rustamov & Sopyev 1994), however, Heptner & Sludskii (1972) assumed that the rare lynx was not a resident animal, but an occasional visitor from northern Iran. Already Ognev (1935) believed that the lynx occurred in the Khorasan Mountains. The most recent information came from Lukarevsky (2001) who conducted intensive surveys in the Kopet-Dag Mountains in Turkmenistan. He found no reliable or otherwise convincing data on lynx presence. Nevertheless, like Heptner & Sludskii (1972), he did not exclude the possibility of lynx forays from Iran. Our survey asserted a few non-verified lynx reports from scattered areas through the Khorasan region (No. 10-12 in Table 1). However, we recorded a C1 presence of the species from Tandureh National Park, Razavi Khorasan next to the Turkmenistan border. Our C1 and C2 records from Golestan, North Khorasan, and Razavi Khorasan provinces (Fig. 1) confirmed the presence of Eurasian lynx in northeastern Iran and support the at least occasional oc-

currence of lynx in southern Turkmenistan.

Eurasian lynx has not been found in western Afghanistan and Pakistan (Habibi 2003, Roberts 1997). It is only said to be resident in the Hindu Kush range and across the Himalayas extending to Inner Mongolia in China (Hassinger 1973, Habibi 2003). From eastern Iran, we received some scarce and unverified reports (No. 12-13 in Table 1) that came mainly from local hunters; however, we do not consider those to be any evidence for the presence of the species.

In western Iran and along the Zagros Mountain (No. 15-23 in Table 1), lynx was rarely reported to occur. Lay (1967) and Heptner & Sludskii (1972) noted that the species was presumably present throughout the Zagros Mountains. Ziaie (1996, cited by Firouz 2005) noted its presence from Dena Protected Area, Kohgiluyeh va Buyer Ahmad province. However, together with a few locations across the region, the record is indicated as "unverified observation" in the new edition of A Field Guide to the Mammals of Iran (Ziaie 2008). Hatt (1959) noted some specimens from Iraqi Kurdistan, also quoted by Harrison & Bates (1991), but Amr (2009) omitted the lynx from his checklist of mammals of Iraq because the species was not reported in the country for 50 years. We found 6 confirmed lynx reports from the region but because of the low scientific knowledge and absence of any serious carnivore study in the Zagros region, compared to other parts of the country, most sporadic reports remained unverified (n=18).

Lynx reports from other parts of the country are rare but need consideration. From the south and central provinces (No. 24-30 in

Table 1), we received 15 reports of lynx observations, but none of them were accepted by us. The region is inhabited by caracal *Caracal caracal* and many local game wardens and residents use the same names for these two similar looking cat species. However, the lynx might indeed be more widely spread than northern and western Iran, and possible observations throughout the country deserve a more careful examination.

We documented 68 dead lynx, mostly from sites outside of the current protected areas. Despite much higher research efforts within these areas, only 34% of all confirmed reports (C1) were made within protected areas. Poaching accounted for 50% of confirmed lynx mortalities, followed by killing by shepherd dogs and herders (20%) and road accidents (6%). Though part of the killing was probably retaliation for attacks on livestock, we do not consider lynx as a problem animal as the lynx-human conflicts seemed not to be high. However, these losses might still be important for the lynx population.

We present the so far most comprehensive illustration of the Eurasian lynx in Iran, which indicates that the species distribution is mainly associated with two main mountainous chains, namely Alborz and Zagros. However, the animals were also seen in marginal areas, which need more surveys. Most of our confirmed reports are outside of the present protected areas network, which could indicate that the lynx population might not sufficiently profit from these safer areas, and that the species should be considered when designating new protected areas. On the other hand, 84% of C1 records were dead lynx, and this may indicate that human made mortality in protected areas is lower. However, the lynx has not yet been assessed thoroughly, and it is impossible to present even a rough estimation of the size and trend of the population, and its conservation status in Iran. Although our study indicates a wider distribution than previously thought, we do not understand recent changes and potential fragmentation of the distribution area.

Our findings strongly recommend more lynx research projects and regional surveys to increase the knowledge of the geographic range, habitat and prey preferences, population trends, and threats to the lynx for establishing effective conservation plans.

Our study will be continued, focusing on areas where lynx presence is not fully confirmed (C2 or C3 only) in order to provide an actual map of the Eurasian lynx distribution in Iran,

and – through continuous monitoring – to detect possible changes in the distribution. Considering the possibility that the west and the northeast of the country may host two different subspecies, the subspecies status of the lynx would be another important question to pursue. As long as such important aspects as population size and trend, threats and phylogenetic and conservation status are not really understood, we recommend treating the Eurasian lynx in Iran as a vulnerable species.

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Fig. 3. Eurasian lynx caught in Khosh Yeylaq Wildlife Refuge, Semnan province, 1993 (Photo Semnan office of DoE).