The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2023: T15961A50660903
Scope(s): Global
Language: English

Panthera pardus ssp. tulliana, Persian Leopard

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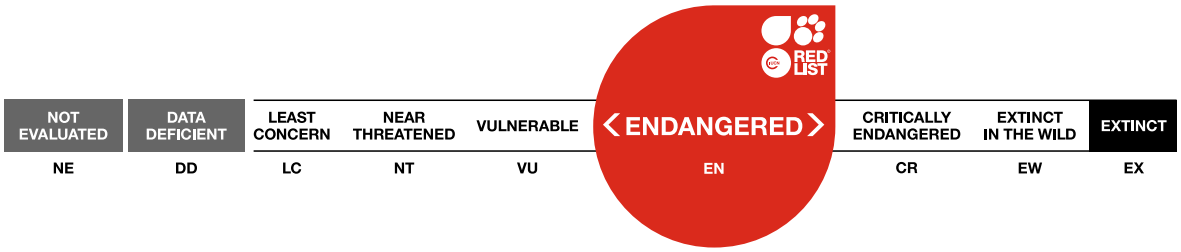

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Citation: Ghoddousi, A. & Khorozyan, I. 2023. *Panthera pardus* ssp. *tulliana*. *The IUCN Red List of Threatened Species* 2023: e.T15961A50660903. https://dx.doi.org/10.2305/IUCN.UK.2023-1.RLTS.T15961A50660903.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Carnivora	Felidae

Scientific Name: *Panthera pardus ssp. tulliana* Valenciennes, 1856

Synonym(s):

- *Panthera pardus* ssp. *dathei* Zukowsky, 1959
- *Panthera pardus* ssp. *sindica* Pocock, 1930
- *Panthera pardus* ssp. *ciscaucasica* (Satunin, 1914)
- *Panthera pardus* ssp. *saxicolor* Pocock, 1927
- *Panthera pardus* ssp. *transcaucasica* Zukowsky, 1964

Parent Species: See *Panthera pardus*

Common Name(s):

- English: Persian Leopard, Anatolian Leopard, Caucasian Leopard, Central Asian Leopard, North Persian Leopard, West Asian Leopard
- Arabic: Nimr
- Armenian: Hovaz, Indzariuts
- Azerbaijani: Bebir
- Georgian: Jiki, Leopardi
- Kazakh: Kabilan
- Kurdish: Piling
- Persian: Palang, Palang
- Pushto; Pashto: Praang
- Russian: Bars, Leopard
- Turkish: Kaplan, Leopar, Pars
- Turkmen: Gaplan
- Urdu: Tendwa
- Uzbek: Qoplon

Taxonomic Source(s):

Kitchener, A.C., Breitenmoser-Würsten, C., Eizirik, E., Gentry, A., Werdelin, L., Wilting, A., Yamaguchi, N., Abramov, A.V., Christiansen, P., Driscoll, C., Duckworth, J.W., Johnson, W., Luo, S.-J., Meijaard, E., O'Donoghue, P., Sanderson, J., Seymour, K., Bruford, M., Groves, C., Hoffman, M., Nowell, K., Timmons, Z. and Tobe, S. 2017. A revised taxonomy of the Felidae. The final report of the Cat Classification Task Force of the IUCN/SSC Cat Specialist Group. *Cat News Special Issue* 11.

Taxonomic Notes:

The Persian Leopard is a phylogenetically distinct subspecies distributed in Southwest Asia (Rosen and Mengüllüoğlu 2022). The Latin name of the Persian Leopard is defined as *Panthera pardus tulliana* Valenciennes, 1856, which is the oldest valid taxonomic name assigned to the Leopard in the region (Kitchener *et al.* 2017). Originally, this name was given to the Anatolian Leopard from western Anatolia (present Türkiye). The similarity of the originally described Persian Leopard *P. p. saxicolor* Pocock, 1927 from Iran and the Caucasian Leopard *P. p. ciscaucasica* (Satunin, 1914) from the Caucasus is scientifically proven both morphologically and genetically (Khorozyan *et al.* 2006, Rozhnov *et al.* 2011, Sorokin *et al.*

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2011, Khorozyan 2014, Farhadinia *et al.* 2015). The Leopards from Iran and Afghanistan are also genetically similar (Manati 2008). However, similar comparative studies of original *P. p. tulliana* in Türkiye are still nascent (Bilgin *et al.* 2016). If Leopards from western Türkiye and other parts of Southwest Asia are confirmed to be the same, then the name *P. p. tulliana* is valid, otherwise, the priority name will go to *P. p. ciscaucasica* as the earliest available. Additional genetic research is required to compare the marginal *P. p. tulliana* populations with the two geographically closest subspecies, *P. p. nimr* (Hemprich & Ehrenberg, 1833) in the Arabian Peninsula and *P. p. fusca* (Meyer, 1794) in eastern Pakistan and Indian subcontinent (Asad *et al.* 2019). A hypothesis that the Indus River may separate *P. p. tulliana* and *P. p. fusca* was recently weakened by a study that showed the presence of both these subspecies to the east of the Indus (Asad *et al.* 2019). The most recent genetic research demonstrated that Arabian Leopards show signs of introgression with Persian Leopards (Mochales-Riaño *et al.* 2022).

Assessment Information

Red List Category & Criteria: Endangered C2a(i) ver 3.1

Year Published: 2023

Date Assessed: May 11, 2023

Justification:

We estimate the entire wild Persian Leopard population to number at least 750–1,044 individuals or 450–626 mature individuals, all subpopulations (Caucasus Mountains, Alborz-Kopetdag Mountains, Zagros Mountains, and the Hindu Kush-Western Himalayas) to contain less than 250 mature individuals and infer the whole Persian Leopard population to be declining. Therefore, the Persian Leopard is classified as Endangered under criterion C2a(i). Three out of four subpopulations (Caucasus Mountains, Zagros Mountains, and the Hindu Kush-Western Himalayas) contain <250 mature individuals each, and the largest one (northern Iran and Central Asia) is right on this threshold (209–264). The estimate of the leopard number in the largest subpopulation is based on visual observations of leopards and their presence signs, which can be exaggerated due to double counts of the same wide-ranging individuals, especially males. To reduce this bias, we stick to the lower bound of this estimate (209 mature individuals) as more realistic.

Iran is the stronghold of the global Persian Leopard population containing up to 83% of it (528–732 individuals; Farhadinia *et al.* 2022b, Ghoddousi *et al.* 2022a; see explanation below). The total estimate is very close to the commonly cited estimate of 550–850 individuals (Kiabi *et al.* 2002) used for Iran so far. For Iran, the number of mature individuals is estimated at 317–439. The country contains 38.6% (204,005 km^2) of core habitat patches in the entire region but only 9.1% of these patches are under protection and a mere 0.95% are covered by strict reserves and national parks (Bleyhl *et al.* 2022). Annual human-caused mortality rates vary greatly from 1.8 to 17.5 leopards/year depending on the methodology, despite overlapping study years (Sanei *et al.* 2012, 2016; Naderi *et al.* 2018, Parchizadeh and Adibi 2019, Parchizadeh and Belant 2021a, Soofi *et al.* 2022b). With the leopard's generation length of 7.42 years (Stein *et al.* 2020), leopard losses to human-caused factors make 1.8–24.6% of the total population for one generation, 3.6–49.3% for two generations, and 5.4–73.9% for three generations. These estimates are based on leopard killing cases reported by conservation authorities and as retrieved from social media but actual human-caused mortality rates can be higher by 45% due to non-detection of killing cases (Soofi *et al.* 2022b).

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Current knowledge allows only to make inferences about population decline but not to estimate it quantitatively. Poaching causes the removal of mostly mature individuals in their prime age of reproduction, resulting in a decrease in both the number of mature individuals and the total population. Adult males make most of the victims due to their wide-ranging behaviour and higher chances to clash with humans (Naderi *et al.* 2018). High natural mortality of cubs (*ca* 50%, Balme *et al.* 2013) and a lower but still tangible loss of adults to natural factors such as hunger and inter- and intra-specific competition (Farhadinia *et al.* 2018a) can prevent population recovery and contribute to the reduction of population size. In comparison to Africa (Balme *et al.* 2013), Asian landscapes contain fewer competitors but still cub mortality is expected to be high due to human pressures and prey scarcity. Additionally, an increasing trend of fragmentation of the Persian Leopard population in northern Iran supports the declining population trend. Landscape connectivity has been reduced between the Turkmen and Iranian populations due to border fencing (Farhadinia *et al.* 2022a) and between Golestan National Park and the eastern Alborz Mountains because of land-use change and human-leopard conflict in parts of this range (Ghoddousi *et al.* 2020). The primeval Hyrcanian forest, which is the main habitat for Persian Leopards in northern Iran and Azerbaijan's Talysh Mts., has been heavily affected by poaching, habitat loss and prey depletion, causing very patchy distribution and high human-induced mortality of leopards in northern Iran (Ghoddousi *et al.* 2019b; Soofi *et al.* 2018, 2019). Considering high anthropogenic mortality of Persian Leopards in Iran, we infer a continuously declining population as losses to human factors are unlikely to be fully compensated by birth rates and immigration. Additionally, we are not aware of leopard reintroduction to boost population recovery in Iran.

The small population of the Persian Leopard in the Caucasus is increasing (Khorozyan *et al.* 2022) and a few populations in Iranian protected areas are assumed to be stable (Ghoddousi *et al.* 2010, Farhadinia *et al.* 2021a, Ghoddousi *et al.* 2022a). The status of Persian Leopard in the eastern part of its range is largely unknown but the subspecies is believed to be extinct in Tajikistan or quasi-extinct in Uzbekistan (Ostrowski *et al.* 2022). The whole Persian Leopard population is assumed to be declining.

Previously Published Red List Assessments

2016 – Not Evaluated (NE)

2008 – Endangered (EN)

1996 – Endangered (EN)

1994 – Indeterminate (I)

Geographic Range

Range Description:

The current distribution area of the Persian Leopard is estimated to cover only 27% (Bleyhl *et al.* 2022) or 16–28% (Jacobson *et al.* 2016) of its historical distribution area around the year 1750. The reconstructed historical range covered an area of 3,314,667 km^2 (Bleyhl *et al.* 2022) and extended from northwestern Anatolia along the coasts of the Aegian and Mediterranean seas southwards to present-day Lebanon, northern Israel and northern and eastern Iraq, eastwards through most of Iran and Afghanistan (except for deserts and snow-capped mountaintops) to northern Pakistan, and northwards to the foothills of the Russian Greater Caucasus.

Currently, the Persian Leopard is present in Afghanistan, Armenia, Azerbaijan, Georgia, Iran, Iraq (Kurdistan), Kazakhstan, Pakistan, Russia (North Caucasus), Türkiye and Turkmenistan. In addition, it is possibly extant in Uzbekistan and possibly extinct in Tajikistan where it historically existed but no records are known in the past decades. The range is divided into four sub-regions, each containing one subpopulation: (1) the Caucasus Ecoregion (Armenia, Azerbaijan, Georgia, eastern Türkiye, northwestern Iran, the Russian North Caucasus); (2) northern Iran and Central Asia (Turkmenistan, Kazakhstan); (3) western range (southern and western Iran, Iraqi Kurdistan, southeastern Türkiye); and (4) eastern range (Afghanistan, western and northern Pakistan, Uzbekistan, Tajikistan) (Farhadinia *et al.* 2022b, Ghoddousi *et al.* 2022a, Khorozyan *et al.* 2022, Ostrowski *et al.* 2022). These subpopulations are designated primarily due to their ecological confinement to the main mountain systems of the range, including the Caucasus Mountains, Alborz-Kopetdag Mountains, Zagros Mountains, and the Hindu Kush-Western Himalayas, respectively (Bleyhl *et al.* 2022).

The largest population exists in Iran (Farhadinia *et al.* 2022b, Ghoddousi *et al.* 2022a). Iran also holds the largest continuous tracts of suitable habitat in the region, mostly across the Alborz Mountains in the north and the Zagros Mountains in the southwest (Ahmadi *et al.* 2020, Bleyhl *et al.* 2022). Most records come from the Alborz Mountains (Yusefi *et al.* 2019, Ashrafzadeh *et al.* 2020), and some protected areas located in north-eastern Iran harbour moderate to high densities of leopards (2.63–8.86 individuals/100 km^2; Farhadinia *et al.* 2022b). Fewer records are available from other parts of Iran, including (1) the corridors in the provinces of West Azerbaijan, East Azerbaijan and Ardabil linking the Caucasus and the Alborz Mountains, (2) corridors in the provinces of Kurdistan and Kermanshah connecting the Zagros Mountains from Iran with those of Iraqi Kurdistan and eastern Türkiye, and (3) the potential source populations in Iran's East Azerbaijan and Lorestan provinces (Ghoddousi *et al.* 2022a, Khorozyan *et al.* 2022). Leopard occurrence records and density estimates are low throughout the Zagros Mountains and especially in the western, central and eastern parts of the country (Ghoddousi *et al.* 2022a). The Iranian population is linked with the populations in Turkmenistan, the Caucasus and Iraqi Kurdistan, and possibly also with those in Türkiye, Afghanistan and Pakistan. However, transboundary connectivity is a big problem due to border fencing (Iran/Turkmenistan - Farhadinia *et al.* 2022a; Afghanistan/Pakistan - Ostrowski *et al.* 2022) and the small size of borderline populations (for all other countries), making the Iranian population a highly uncertain source for dispersing animals to other subpopulations.

The second largest range of the Persian Leopard is found in Turkmenistan, mostly in the Kopetdag and Sunt Hasardag Ridges and in Badhyz Nature Reserve, all located along the state border with Iran (Farhadinia *et al.* 2022b; H. Hojamuradov pers. comm. 2023, N. Hudaikuliev pers. comm. 2023). Small populations are also confirmed to the north of Kopetdag, in the Uly Balkan and Kichi Balkan Ridges. Some individuals may reach the Garabogazgol Depression in the extreme north of Turkmenistan through the Ustyurt Plateau and further penetrate into southern Kazakhstan (confirmed in 2000, 2007, 2015, 2018 and 2021) and western Uzbekistan (Farhadinia *et al.* 2022b). Leopard records also come from south-eastern Uzbekistan bordering Afghanistan, Tajikistan and Turkmenistan (Babatag, Kugitang and Boysun Mts.) but none of them were confirmed for the past decades and they also can be confused with Snow Leopards (*Panthera uncia*) in Boysun (Ostrowski *et al.* 2022).

In the South Caucasus, the main "core" is concentrated on the southern part of the Lesser Caucasus Ridge including the Zangezur Ridge shared by Armenia and Azerbaijan's Nakhchyvan Republic, and the Meghri, Bargushat, Vayk and Geghama ridges of southern Armenia (Khorozyan *et al.* 2022). It is

connected with the population in West and East Azerbaijan provinces of Iran and forms the so called "Zangezur triangle". The other population confined to the Talysh Mts. in south-eastern Azerbaijan is linked with the regionally major population in the Alborz Mountains of Iran. A single male is recorded in Tusheti Protected Areas on the Greater Caucasus Ridge in northeastern Georgia. This individual regularly moves between Tusheti and Khunzakhsky Nature Park in the Republic of Dagestan (B. Lortkipanidze pers. comm. 2022, 2023; Y. Yarovenko pers. comm. 2022, 2023). Apart from Khunzakhsky Nature Park, the Persian Leopard range in the Russian North Caucasus includes the Tlyaratisky Sanctuary in Dagestan, Prielbrusye National Park in the Kabardino-Balkarian Republic, Shatoysky District in the Chechen Republic, and the leopard reintroduction areas in the Caucasus Biosphere Reserve and the Republic of North Ossetia-Alania with their vicinities (Khorozyan *et al.* 2022, Rozhnov *et al.* 2022; P. Weinberg pers. comm. 2022, 2023; Y. Yarovenko pers. comm. 2022, 2023). Long-distance dispersals are recorded from Nakhchyvan to southwestern (Askerov *et al.* 2019) and northern Armenia (Khorozyan *et al.* 2022), and from northern Armenia to eastern Türkiye (V. Ananyan pers. comm. 2022, D. Mengüllüoğlu pers. comm. 2022), indicating a potential for recolonization of suitable habitats.

In Iraq, the Persian Leopard persists almost entirely in the Kurdistan Region and specifically in the Bamo, Qara Dagh, and Khoshk Mountains (Ghoddousi *et al.* 2022a, Horeni *et al.* 2022a, b), which represent the western extension of the Zagros Mountains. Additionally, there are sporadic reports from the provinces of Diyala, Sulaymaniyah, Halabja, Erbil and Duhok (Ghoddousi *et al.* 2022a; H. Raza pers. comm. 2023).

The most recent leopard records in Türkiye come from the surroundings of Lake Van in the southeast, Iğdir Province (Ağri Dağı/Mt. Ararat) in the east, and Artvin Province in the northeast (Khorozyan *et al.* 2022), as well as from the western Taurus Mountains in the southwest (Ünal *et al.* 2023). Exact record locations are not available for security reasons in the borderline areas (Ghoddousi *et al.* 2022a), complicating a better understanding of the current distribution of Persian Leopards in this country.

In Pakistan, a majority of leopard records originate from the north Indus/Himalayan region encompassing Azad Jammu and Kashmir, Khyber Pakhtunkhwa, Islamabad Capital Territory and Gilgit Baltistan. Much less information about Leopard occurrence is known from the rest of the country in Balochistan, Sindh and Punjab (Ostrowski *et al.* 2022). This regional difference may indicate that leopards seem to be more abundant in northern Pakistan or local reporting is higher than elsewhere, or both these factors can be valid. Occurrence of leopards in cooler high-altitude areas, which are commonly inhabited by Snow Leopards, may suggest a possible expansion of the Persian Leopard's range in Pakistan (Ostrowski *et al.* 2022).

Information on Persian Leopard distribution in Afghanistan is much less detailed than from other countries but apparently representative as most of the records have been retrieved from publicly posted pictures and footages on social media. The central part of the Hindu Kush Ridge and its offshoots towards the east are the main strongholds of the Persian Leopard in Afghanistan, including the provinces of Nuristan, Bamyan, Farah, Daykundi, Ghor, Laghman and Nangarhar (Ostrowski *et al.* 2022).

Country Occurrence:

Native, Extant (resident): Afghanistan; Armenia; Azerbaijan; Iran, Islamic Republic of; Iraq; Pakistan; Russian Federation; Turkmenistan; Türkiye

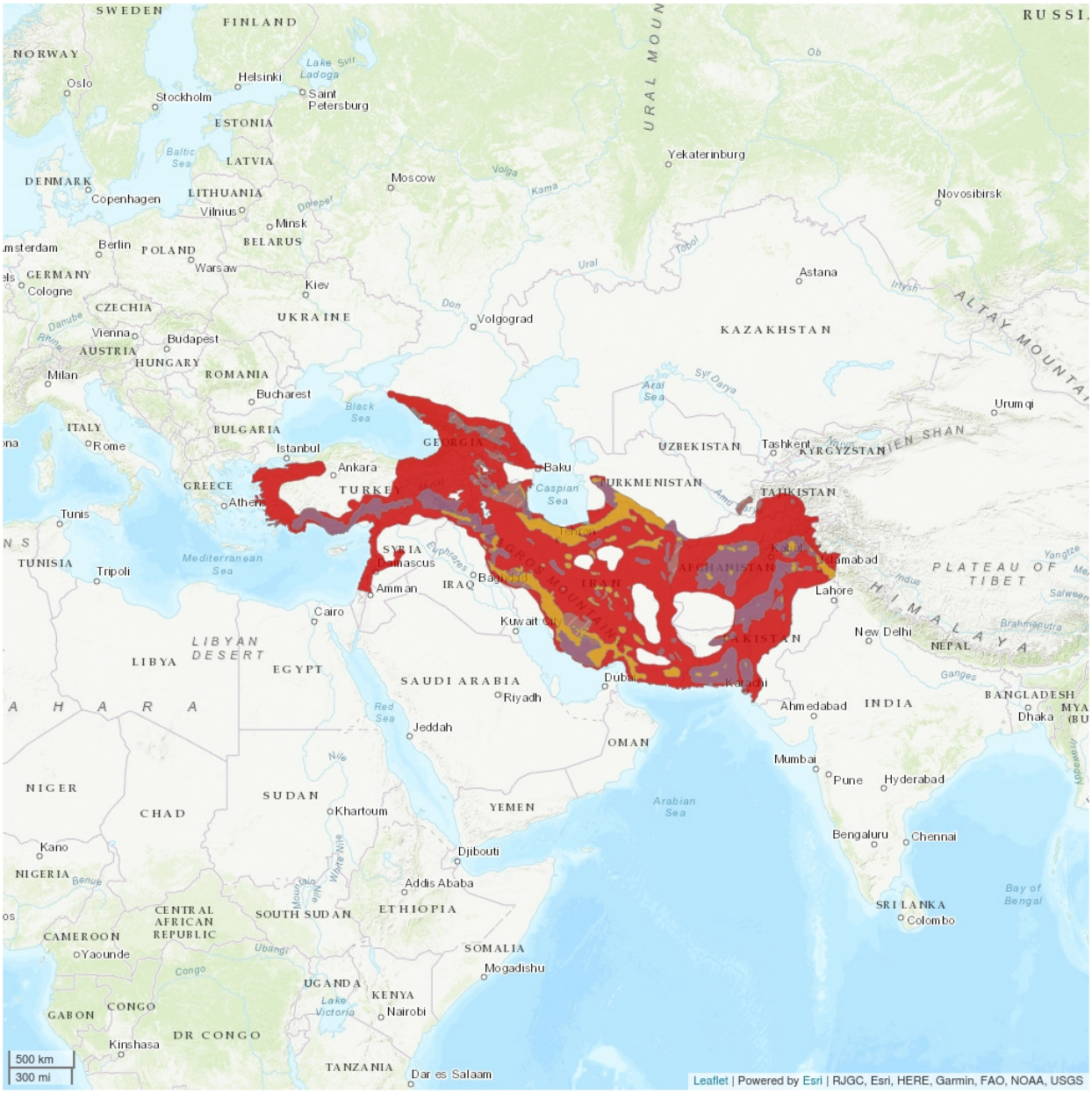
Native, Possibly Extant (seasonality uncertain): Uzbekistan

Extant & Vagrant: Georgia

Possibly Extant & Vagrant: Kazakhstan

Possibly Extinct & Origin Uncertain: Tajikistan

Distribution Map



Legend

- EXTANT (RESIDENT)
- POSSIBLY EXTANT (RESIDENT)
- POSSIBLY EXTINCT
- EXTINCT

Compiled by:

Bleyhl, P., Gerngross, P., et al. 2023

The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

Population

A minimum of 750–1,044 Persian Leopards are currently estimated considering that some countries (Türkiye, Pakistan, Afghanistan) do not have population estimates. As the population size in Iran and most other countries are the total counts, we estimate the number of mature individuals as 60% (30% adult males, 30% adult females) of this figure (Swanepoel *et al.* 2014, 2016), i.e., a minimum of 450–626. The national breakdown of these estimates is given below.

The population stronghold of the Persian Leopard is in Iran but its accurate size is yet unknown and the total estimate of 550–850 individuals (Kiabi *et al.* 2002) still remains the only one available and widely cited. Most of the population is recorded in the Alborz Mountains and its surroundings in northern Iran and estimated by the government as 288–355 individuals, including 100 in Razavi Khorasan, 80–100 in Mazandaran, 40–60 in Semnan, 35–45 in North Khorasan, 20–25 in Alborz, 10–20 in Tehran and 3–5 in South Khorasan provinces (Farhadinia *et al.* 2022b). Considering the national estimate of 550–850 individuals as realistic, 200–320 leopards are roughly estimated for the Zagros Mountains and adjacent landscapes of southern and western Iran (Ghoddousi *et al.* 2022a). Population size in the Iranian Caucasus (parts of West Azerbaijan, East Azerbaijan, Ardebil and Gilan provinces) is unknown. However, we found strong linear relationships (R_2 = 0.87, $p < 0.001$) between the numbers of the most reliable records (category C1, Molinari-Jobin *et al.* 2012) and the minimum and maximum population estimates used in sub-regional Persian Leopard status assessments (Farhadinia *et al.* 2022b, Ghoddousi *et al.* 2022a, Khorozyan *et al.* 2022, Ostrowski *et al.* 2022). Using these relationships, we predicted the leopard numbers in the Iranian Caucasus as 40–57 individuals. So, the total Persian Leopard population in Iran is estimated as 528–732, which is consistent with the commonly cited 550–850 individuals (Kiabi *et al.* 2002). Assuming that mature individuals make 60% of the total count as described above, we estimate their number in Iran at 317–439.

In Central Asia, the Persian Leopard population occurs mainly in the Kopetdag region of Turkmenistan with an estimated population of 60–80 individuals, 0–5 individuals may occur in Kazakhstan (Farhadinia *et al.* 2022b) and there are no recent confirmed records from Uzbekistan and Tajikistan (Ostrowski *et al.* 2022).

The minimum Persian Leopard numbers in the South Caucasus counted from camera-trapped individuals are 6–17 in Azerbaijan including cubs, 3–9 in Armenia and one in Georgia (Khorozyan *et al.* 2022). Additionally, two males were camera-trapped and recorded by border surveillance systems in eastern Türkiye (Khorozyan *et al.* 2022). In the Russian North Caucasus, the population consists of six reintroduced individuals from Sochi Breeding Centre that survived by February 2022 (Khorozyan *et al.* 2022, Rozhnov *et al.* 2022), three new individuals released in July 2022 (P. Weinberg pers. comm. 2022), two wild leopards in the republics of Kabardino-Balkaria and Chechnya, and one moving between the Republic of Dagestan and Georgia (Khorozyan *et al.* 2022, Rozhnov *et al.* 2022; Y. Yarovenko pers. comm. 2022, 2023).

The Persian Leopard population in Iraqi Kurdistan is estimated by camera-trapping and direct observations to number at least nine adult individuals, including three males in the Qara Dagh Mts., three males and two females (one of them with two cubs) in the Bamo Mts., and one male in the Koshk Mts. (H. Raza pers. comm. 2023; Horeni *et al.* 2022a, b). One male leopard fell victim to a gin trap set by a herder in Batifa County of Duhok Province in 2021, which is currently held at the Duhok Zoo.

Population estimates for Türkiye, Pakistan and Afghanistan are absent (Ghoddousi *et al.* 2022a, Ostrowski *et al.* 2022). However, we estimate 130–178 leopards for Pakistan from the above-mentioned relationship between the numbers of the most reliable records and the population estimates. These figures are indicative and targeted abundance estimation studies are needed within the Persian Leopard range in Pakistan.

Thus, using the available estimates (Farhadinia *et al.* 2022b, Ghoddousi *et al.* 2022a, Khorozyan *et al.* 2022, Ostrowski *et al.* 2022) and the relationships between occurrences and reported abundances (see above), we estimate the sizes of Persian Leopard subpopulations as follows: the Caucasus Ecoregion – at least 63–97 including 38–58 mature individuals; northern Iran and Central Asia – 348–440 including 209–264 mature individuals; western range – 209–329 including 125–197 mature individuals; eastern range – at least 130–178 including 78–107 mature individuals.

Long-term population trends of the Persian Leopard are difficult to ascertain due to temporal differences in survey efforts, differences in methodologies and their reliability, and a lack of scientific estimates over time (Ghoddousi *et al.* 2022b). For example, in Turkmenistan the population size was estimated as 130–150 by the late 1980s and 78–90 by the late 1990s (Lukarevsky 2001), and the most recent estimate is 60–80 (Farhadinia *et al.* 2022b). Whether these numbers indicate a decline in the 1980–1990s and a subsequent stabilization is unclear because the methodology of leopard population assessments in this country is not critically evaluated. We are not aware of any scientific estimation of leopard densities from camera-trapping in Turkmenistan, even though this technique has widely and intensively been used there.

Similarly, it is impossible to evaluate trends in leopard numbers in the Caucasus Ecoregion before and after 2000, because current reliable records come mostly from camera-trapping and pre-2000 records originated mainly from leopard killings, which are incomparable in principle (Khorozyan *et al.* 2022). However, it is obvious that the population of the "Zangezur triangle" (southern Armenia, Azerbaijan's Nakhchyvan Republic) adjoining northwestern Iran has been recovering from the mid-2000s, with breeding, dispersals and resident status well documented by camera-traps (Askerov *et al.* 2015, 2019; Khorozyan *et al.* 2022). Robust estimation of Persian Leopard densities in the Caucasus is essential but hampered by limited numbers of recaptures. The entire Caucasus population is still spreading, with wide-ranging males appearing in many (even unexpected) sites but it is not stabilized yet due to habitat fragmentation and insufficient numbers of females and breeding events (Khorozyan *et al.* 2022).

Leopard densities and abundance estimates are available from Iran and the Caucasus, mostly by camera-trapping but also by DNA fingerprinting (in Parvar Protected Area, see below). The highest densities in the entire range were estimated in the national parks (NP) of northeastern Iran: 8.86 individuals/100 km^2 in Sarigol NP, 5.57 in Tandoureh NP, 3.10 in Salouk NP (Farhadinia *et al.* 2019, 2022b), and 2.63 in Golestan NP (Hamidi *et al.* 2014). With 30 and 20 adult individuals detected in Tandoureh and Golestan NPs, respectively, these two protected areas hold the largest populations of Persian Leopards across their range (Farhadinia *et al.* 2022b). However, Sarigol NP and Salouk NP are very small and their high-density estimates may derive from camera-trapping of the core areas intensively used by leopards. The other abundance estimates in northern Iran include 11 individuals in Salouk NP, 10 in Sarigol NP, 10 in Kiasar NP, seven in North Alborz Protected Area (PA), and seven in Parvar PA (Farhadinia *et al.* 2022b). Leopard density and abundance estimates in protected areas of southern and western Iran are lower than in the north: 1.87 individuals/100 km^2 in Bamu NP

(Ghoddousi *et al.* 2010) and 1.0–1.6 in Bafq PA (Farhadinia *et al.* 2021a). The abundance estimates include 18 individuals in Dena PA (Ghoddousi *et al.* 2022a), six in Bakhtegan NP (Ghoddousi *et al.* 2022a), 5–11 in Bamu NP (Ghoddousi *et al.* 2010, 2022a), 5–8 in Bafq PA (Farhadinia *et al.* 2021a), and only one male in a protected area and two private conservancies in Mehriz County, Yazd Province (Ghoddousi *et al.* 2022a). Leopard numbers are also estimated in some unprotected lands of southern Iran, such as 18 individuals in the Hashtbandi area (2015–2019) and four on Mt. Zendan, both in the east of Hormozgan Province (Ghoddousi *et al.* 2022a). A later (2020) study in the Hashtbandi area captured only 11 individuals because at least three leopards were killed in retaliation to human-leopard conflict (M. Arianejad pers. comm. 2021).

In only two protected areas, namely Bamu NP and Bafq PA, leopard numbers were estimated by the same method over several years, making it possible to track their temporal trends. The Persian Leopard population in Bamu comprised of six individuals in 2007–2008 (Ghoddousi *et al.* 2010), five in 2019 and seven in 2021 (Ghoddousi *et al.* 2022a). In Bafq, there were eight individuals in 2012 and five in 2016 (Farhadinia *et al.* 2021a). Therefore, in both these areas the leopard populations were relatively stable.

The density estimates from the Caucasus include 0.34 individuals/100 km^2 in the Meghri Ridge of southern Armenia (Khorozyan *et al.* 2008) and three individuals/100 km^2 in Hirkan National Park (Askerov *et al.* 2021). However, it is important to note that leopard density in Meghri is outdated as it was estimated before the population recovery in the "Zangezur triangle" began, and a high estimate in Hirkan may be an overestimate as it was obtained in a small core area intensively used by several leopards.

Current Population Trend: Decreasing

Habitat and Ecology **(see Appendix for additional information)**

The Persian Leopard occurs in a variety of habitats but mainly inhabits mountain ranges covered with forests, woodlands and scrublands with an essential presence of rocky outcrops and precipitous slopes (Bleyhl *et al.* 2021, Ghoddousi *et al.* 2022a). It avoids deserts and plains but may survive also in lowlands and cold desert ecosystems (Farhadinia e*t al.* 2022b). A recent range-wide habitat mapping study (Bleyhl *et al.* 2022) identified 174 core habitat patches with at least 250 km^2 (as the smallest area able to host a breeding pair; Farhadinia *et al.* 2018c). These patches cumulatively covered around 528,000 km^2, with 39% in Iran (204,005 km^2), followed by Türkiye (19%, 100,651 km^2) and Pakistan (10%, 51,868 km^2). A connectivity analysis (Bleyhl *et al.* 2022) identified 173 corridors between the core habitat patches to be on average 31 km long (range: 1–235 km). Only 4% of them cross international borders. The Persian Leopard is known to be a wide-ranging predator, with male home ranges averaging 103.4 ± SE 51.8 km^2 in Tandoureh NP, Iran (Farhadinia *et al.* 2018c). A telemetry study (Farhadinia *et al.* 2018c) recorded an 82 km dispersal of a male leopard from Iran to Turkmenistan. Similarly, a 170 km straight-line dispersal was confirmed by camera-trapping for a male in Azerbaijan and Armenia (Askerov *et al.* 2019) and a 112 km dispersal for a male Leopard moving between Bamu and Bakhtegan NPs in Iran (Pars Wildlife Guardians Foundation, unpublished data 2021). Landscape permeability was estimated to be the lowest in central Türkiye and southern Afghanistan, eastern Pakistan and Tajikistan (Bleyhl *et al.* 2022). This may partly be due to the snow cover as a natural barrier, as shown in the Caucasus Ecoregion (Khorozyan and Abramov 2007, Gavashelishvili and Lukarevskiy 2008, Khorozyan *et al.* 2010). Accordingly, Leopards are known to prefer southern slopes of low to middle elevations, using northern slopes only during snow-free seasons (Khorozyan *et al.* 2010).

Persian Leopards are solitary and active mostly at night and in crepuscular time but also during the day over the cold season (Rosen and Mengüllüoğlu 2022). Unlike leopards from tropical regions (Balme *et al.* 2013), Persian Leopards are seasonal breeders with their mating peak occurring between January and March (Farhadinia *et al.* 2009). During this period, individuals of both sexes make calls to attract each other and mate over 2–7 days (Castelló 2020, Hunter and Barrett 2018). However, sightings of leopard cubs in colder months suggest that breeding may happen outside these months for the Persian Leopard as well (P. Sepahvand pers. comm. 2021). Both males and females regularly mark their home ranges, mostly by scrapes on ridgetop trails (*ca* 39 cm long) with urine spray and faeces but also by scratches on trees (*ca* 90 cm long) and scent-marking on shrubs and rocks (Ghoddousi *et al.* 2008). The gestation period is typically 90–106 days after which 1–4 cubs are born, which are weaned after 70–100 days. In general, leopards reach sexual maturity at 24–28 months (Castelló 2020, Hunter and Barrett 2018) but begin to breed much later (e.g., at an average age of 46 months for females) due to intraspecific competition and stabilization of land tenure (Balme *et al.* 2013). When anthropogenic mortality is low and a sufficient prey base exists, Persian Leopards can live up to around 15 years, like an adult male, which was camera-trapped continuously between 2007–2018 in Bamu NP, Iran (Ghoddousi *et al.* 2010, Pars Wildlife Guardians Foundation, unpublished report 2016).

A number of dietary studies from northern Iran and Armenia based on faecal samples (Khorozyan and Malkhasyan 2002, Taghdisi *et al.* 2013, Ghoddousi *et al.* 2016b, Sharbafi *et al.* 2016) and kills (Farhadinia *et al.* 2018b) revealed the importance of wild ungulates (80-95% of consumed biomass). Throughout the Persian Leopard range, these include the mid- to large-bodied ungulates such as the Bezoar Goat (*Capra aegagrus*), Chamois (*Rupicapra rupicapra*), Eastern Tur (*C. cylindricornis*), Goitered Gazelle (*Gazella subgutturosa*), Himalayan Goral (*Naemorhedus goral*), Himalayan Ibex (*C. sibirica*), Kashmir Musk Deer (*Moschus cupreus*), Markhor (*C. falconeri*), Mouflon (*Ovis gmelini*), Northern Red Muntjac (*Muntiacus vaginalis*), Red Deer (*Cervus elaphus*), Roe Deer (C*apreolus capreolus*), Urial (O*. vignei*), Western Tur (*C. caucasica*), and Wild Boar (*Sus scrofa*; Lukarevsky 2001, Mallon *et al*. 2007, Ghoddousi *et al.* 2016b, Sharbafi *et al.* 2016, Kaczensky *et al.* 2019, Ostrowski *et al.* 2022). The Persian Leopard's range often overlaps with that of its main prey such as mountain ungulates (Hosseini *et al.* 2019, Khosravi *et al.* 2021), especially the Bezoar Goat (Sanei *et al*. 2016, Ebrahimi *et al.* 2017) as its preferred prey species (Ghoddousi *et al.* 2017). Smaller prey such as the Indian Crested Porcupine (*Hystrix indica*) also contribute to the diet, especially when wild ungulates are scarce (Ghoddousi *et al.* 2016b, Sanei *et al.* 2016). Domestic animals include cattle, sheep, goats and dogs (Khorozyan *et al.* 2015, Ghoddousi *et al.* 2016b, Babrgir *et al.* 2017, Khorozyan *et al.* 2017, Farhadinia *et al.* 2018b, Khorozyan *et al.* 2018, 2020), which constitute the main prey in areas without sufficient wild prey (e.g., domestic goat makes up at least 50% of the diet in the Galliat region, Pakistan; Khan *et al.* 2020). The medium-sized and large carnivores sharing their habitat with the Persian Leopard include the Asiatic Black Bear (*Ursus thibetanus*), Brown Bear (*U. arctos*), Golden Jackal (*Canis aureus*), Grey Wolf *(C. lupus*), Striped Hyena (*Hyaena hyaena*), Asiatic Cheetah (*Acinonyx jubatus venaticus*), Caracal (*Caracal caracal*), Eurasian Lynx (*Lynx lynx*), Jungle Cat (*Felis chaus*), and, in some places, the Snow Leopard.

Systems: Terrestrial

Use and Trade

There is very limited information on the use and trade of live Persian Leopards or their body parts. There are occasional cases of confiscation of leopard body parts or cubs from poachers or in illegal market in

Iran but the severity and trends of such illegal trade are generally unknown (Parchizadeh and Adibi 2019, Ghoddousi *et al.* 2022a). However, evidence of the international trade of Persian Leopards originating from Iran to neighbouring countries exists (Khalaf-von Jaffa 2017). During the Soviet era, state-sponsored leopard hunting was practiced in Armenia, Azerbaijan, Georgia and Russia until the 1970s, often with official bounties, to reduce livestock losses and supply fur trade markets (Heptner and Sludsky 1972, Aghajanyan 1986). Leopard fur trade was common in Afghanistan a decade or so ago (Johnson and Wingard 2010), with a possible increase between 2004 and 2006 in the market of Kabul (Manati 2009), likely driven by the demand created by soldiers of international security forces and employees of aid agencies (Manati 2009, Kretser *et al.* 2012). Manati (2009) recorded up to 13 and 44 skins for sale in 2004 in Balkh Province, and in 2006 in Kabul, respectively. However, enforcement of trade control and foreign military personnel drawdown starting in 2012 caused a reduction in skin supplies to these markets (Z. Moheb pers. comm. 2022).

Threats (see Appendix for additional information)

The Persian Leopard's survival is severely affected by a number of anthropogenic threats. Most importantly, hunting/poaching threatens its population viability and causes local extinctions throughout the range. There are different incentives for hunting leopards in this region. The main driver is the perceived or actual risk from leopards attacking livestock, which leads to killing by direct shooting, as well as by trapping and poisoning (Kiab*i et al.* 2002, Avgan *et al.* 2016, Babrgir *et al.* 2017, Memarian *et al.* 2018, Soofi *et al.* 2019). A recent study estimated that 54% of leopard mortalities in Iran are in response to livestock depredation (Soofi *et al.* 2022b). Other studies reported 60–76% of all detected mortality cases in Iran to be caused by retaliation related to livestock losses to leopard attacks (Sanei *et al.* 2016, Naderi *et al.* 2018, Parchizadeh and Adibi 2019). In Afghanistan and Pakistan, killing leopards in response to livestock depredation is widespread (Dar *et al.* 2009, Kabir *et al*. 2014, Akrim *et al.* 2021; Z. Moheb pers. comm. 2023). Khan *et al.* (2018) estimated this number to be at least six leopards/year across Pakistan based on data from 1998 to 2015 (in total, 105 killed individuals). There have also been some rare cases of leopard attacks on humans in Iran, leading to leopard removals (Parchizadeh and Belant 2021b). Lodhi (2007) reported nine human deaths caused by leopards and the killing of 30 leopards over seven years near Ayubia NP, Pakistan. Killing out of fear or pride, in self-defence or to sell the skin and body parts have also been reported as incentives for leopard poaching in some areas of the Persian Leopard range (Moheb and Bradfield 2014, Ostrowski *et al.* 2022). Importantly, socioeconomic and political shocks, such as armed conflicts and dissolution of the Soviet Union, and poor engagement of existing institutions and enforcement mechanisms create enabling conditions for poaching. For example, after the break-up of the Soviet Union, leopards used to be killed in the Caucasus Ecoregion for own trophies or to eliminate threats to livestock until the mid-2000s (Khorozyan *et al.* 2022).

Prey loss is another major threat to Persian Leopards. Ghoddousi *et al.* (2019b) showed that poaching of wild ungulates has severely decreased the predator’s prey base in Golestan NP, Iran but the absence of Wild Boar hunting due to religious beliefs has resulted in the higher abundance of this species and it becoming the main prey for leopards (Ghoddousi *et al.* 2017). However, in Armenia and Georgia the conditions are different due to swine breeding and the transmission of African swine fever to Wild Boar populations, which can severely reduce Wild Boar abundance and potentially makes a serious impact on the survival of leopards in these countries (Sarkisyan *et al.* 2019, Khorozyan *et al.* 2022). In Turkmenistan, poaching of wild prey is a significant threat, especially in Badhyz, Uly Balkan and the Ustyurt Plateau (Kaczensky *et al.* 2019). Wild ungulate populations have severely declined or gone locally extinct in Pakistan, affecting the trophic niche breadth of the Persian Leopard (Shehzad *et al.*

2015, Khan *et al.* 2018), making domestic livestock a staple prey and intensifying retaliatory killings of leopards (Hussain *et al.* 2019, Khan *et al.* 2020). Ostrowski *et al.* (2022) reported that overhunting of Markhor and Urial may have been the main driver of the Persian Leopard's possible extinction in Uzbekistan.

A strong and range-wide threat to the Persian Leopard is habitat loss and fragmentation, impacting the available space and connectivity of habitat patches, mainly due to socioeconomic development (e.g., land-use change, roads) and overexploitation (e.g., logging; Khorozyan *et al.* 2022, Ostrowski *et al.* 2022). In northern Pakistan and parts of Afghanistan, degradation and loss of forests have been reported as major threats (FAO 2007, Karlstetter 2008). The fragmented occurrence of Persian Leopard and its wild prey in the Hyrcanian forests of northern Iran is mainly a result of widespread livestock pastoralism in this region (Soofi *et al.* 2018). Similarly, in the eastern parts of the Hyrcanian forests, the connectivity between Golestan NP and Jahan Nama PA is interrupted in some parts due to land-use change and potential avoidance of human-leopard conflict hotspots (Ghoddousi *et al.* 2020). Habitat fragmentation is also a major issue in the naturally distant arid mountain ranges of central Iran (e.g., Isfahan and Yazd provinces) where local extinctions were reported (T. Ghadirian, unpublished report 2016). Moreover, border fences may inhibit landscape connectivity in some areas. For example, a leopard GPS-collared in Iran was unable to pass the border fence with Turkmenistan (Farhadinia *et al.* 2021b). Border fences have been reported as a major barrier to leopard and/or wild prey movements in other parts of this region as well (Farhadinia *et al.* 2022a, Ostrowski *et al.* 2022). Habitat fragmentation due to roads also causes accidents that are considered among the main threats to the Persian Leopard in Iran (Sanei *et al.* 2016, Naderi *et al.* 2018, Parchizadeh and Adibi 2019). In northern Iran (e.g., on the highway dissecting Golestan NP), 27 Leopards were killed between 2000–2021 due to vehicle collisions (Iranian Department of Environment, unpublished data).

Finally, climate change and desertification of the region are expected to impact the leopard habitat (Ostrowski *et al.* 2022), and potentially pose an upcoming major threat in Iran during the next decades (Ebrahimi *et al.* 2017, Ashrafzadeh *et al.* 2019).

Conservation Actions **(see Appendix for additional information)**

The Persian Leopard is distributed across 11 countries with different levels of conservation attention, capacities, and resources to implement conservation interventions. Across its vast range, the Persian Leopard is officially protected but practical conservation work has been implemented very patchily. In terms of area-based conservation measures, only 11% of the core patch area is currently officially protected, including 3% under a strict protection regime (IUCN categories I and II; Bleyhl *et al.* 2022). There is also high variation among countries in the proportion of the core patch area being protected, with the highest rate in Russia (36%) and the lowest in Afghanistan (2%; Bleyhl *et al.* 2022). Therefore, a large share of the Persian Leopard's suitable habitat could benefit from an upgrade in protection under different area-based conservation measures such as protected areas or community conserved areas (Bleyhl *et al.* 2022) or more efficient law enforcement (Ghoddous*i et al.* 2016a, 2022). As such, efforts are underway in different countries to increase the protection status of the Persian Leopard habitat, which may act as an umbrella taxon for the regional biodiversity (e.g., for the proposed Qara Dagh Nature Reserve in Iraqi Kurdistan; H. Raza pers. comm. 2023). In most parts of the Persian Leopard range, protected areas require more political will, funding, personnel and capacity-building for implementing conservation and monitoring activities. As a significant part of the Persian Leopard's range crosses political borders (Farhadinia *et al.* 2022a), transboundary efforts are also needed to establish

and promote joint conservation and monitoring initiatives. Furthermore, the establishment of corridors between core habitat patches is a conservation priority (Bleyhl *et al.* 2017, 2022), and long-term coordinated efforts to fulfil this goal have been made in the Caucasus Ecoregion. However, the establishment of transboundary protected areas and corridors may be challenging as armed conflicts and insecurity are dominant in many borderlands in this region, restricting the access of national conservationists, let alone international cooperation (Farhadinia *et al.* 2022a, Ostrowski *et al.* 2022).

One of the most notable conservation programmes specifically targeting the Persian Leopard recovery is in the Caucasus Ecoregion. This ongoing programme was launched by WWF Caucasus Programme in 2002 and covers a variety of conservation activities with the involvement of a wide range of stakeholders and international organizations. Particularly, WWF offices in Armenia, Azerbaijan and Georgia cooperate with the national governments on long-term leopard and prey monitoring and conservation activities (e.g., establishment and strengthening of protected areas, development of local livelihood and community-based conservation projects, awareness-raising and education) in key leopard habitats in southern Armenia and Azerbaijan's Nakhchyvan Republic and Hirkan NP (Khorozyan *et al.* 2022). The monitoring activities include camera-trapping and field surveys to assess the populations of the Persian Leopard and its wild prey, respectively (Ghoddousi *et al.* 2019a). Awareness-raising and participatory conservation initiatives involving local people, including a network of leopard caretakers, have been regularly implemented. Monitoring data serve as a solid basis for the build-up of scientific knowledge on the abundance, distribution and status of leopard and its prey in the South Caucasus (Khorozyan *et al.* 2009, Talibov *et al.* 2009, Askerov e*t al.* 2015, 2019, Bleyhl *et al.* 2019, Askerov *et al.* 2020, Kuemmerle *et al.* 2020, Weinberg *et al.* 2020, Askerov *et al.* 2021, Khorozyan *et al.* 2022). High conservation attention and effective anti-poaching activities led to the recovery of Bezoar Goats, the main prey for leopards, in southern Armenia and the Nakhchyvan Republic (Khorozyan *et al.* 2022). In a separate initiative, a Persian Leopard reintroduction programme is underway since 2007 in the Russian Caucasus with the establishment of the breeding centre in Sochi National Park where 25 cubs were born, of which 10 were released into the wild in the western and central parts of the Russian Caucasus (Rozhnov *et al.* 2022). The founders of this programme were mutually unrelated and brought from different international zoos to minimize possibilities for inbreeding in their offspring. As of February 2022, six individuals were alive (three males in the Caucasus Nature Reserve and one male and two females in the Republic of North Ossetia-Alania) but no breeding has been reported so far (Rozhnov *et al.* 2022). Another three individuals were released in July 2022 in North Ossetia-Alania (P. Weinberg pers. comm. 2022).

The Turkish authorities are supporting the monitoring of leopard and prey populations in the Taurus Mountains and the Turkish Caucasus by camera-trapping and other techniques (D. Mengüllüoğlu pers. comm. 2023).

One of the main threats to the Persian Leopard, especially in Iran and Pakistan, is killings by pastoralists in response to livestock depredation. Therefore, there is an urgent need to develop and apply practical and effective conflict mitigation measures. On this front, it is crucial to support applications of livestock protection interventions (Khorozyan *et al.* 2020, Soofi *et al.* 2022a) and responsibly manage livestock grazing patterns (Ghoddousi *et al.* 2016b, Soofi *et al.* 2019). These interventions may include according to local contexts and circumstances, but are not restricted to, predator-proof corrals, compensation payments, deterrents, insurance schemes, herding and livestock guarding dogs (Khorozyan *et al.* 2017, 2020, Soofi *et al.* 2022a, c). Some of these methods, such as anti-predator cattle collars, vaccination of

livestock and Foxlights for corral fences, have been implemented in Iran with encouraging early outcomes (Khorozyan *et al.* 2020, Hormuz Wildlife Guardians Foundation, unpublished report 2021). Separation of carnivore habitats from pastures is also necessary, hence pastoralists should avoid areas of high livestock depredation risk near protected areas and in core leopard habitats (Soofi *et al.* 2018, Daberger *et al.* 2022). Finally, education of local people on the importance of the Persian Leopard and conflict management techniques is needed to reduce retaliatory killings, as it has been shown to be effective in Iran (Tavakkoli Mehr *et al.* 2011).

Vehicle collision is another important threat, especially in the Iranian stronghold of the Persian Leopard population (Naderi *et al.* 2018). Mitigating this threat is necessary by building and improving underpasses and wildlife bridges, and enforcing speed control measures, in the known roadkill hotspots such as Golestan NP (Farhadinia *et al.* 2022b).

Finally, a systematic and standardized range-wide monitoring programme is needed to obtain scientifically robust information on trends in abundance, distribution and threats of the Persian Leopard and its prey over time and space (Ghoddousi *et al.* 2022b). Such a monitoring scheme is currently being implemented in the Caucasus Ecoregion (Ghoddousi *et al.* 2019a), which is proposed to be implemented across the entire Persian Leopard range in the future (Ghoddousi *et al.* 2022b).

Credits

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Citation

Ghoddousi, A. & Khorozyan, I. 2023. *Panthera pardus* ssp. *tulliana*. *The IUCN Red List of Threatened Species* 2023: e.T15961A50660903. https://dx.doi.org/10.2305/IUCN.UK.2023-1.RLTS.T15961A50660903.en

Disclaimer

External Resources

For Supplementary Material, and for Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.4. Forest - Temperate	Resident	Suitable	Yes
1. Forest -> 1.5. Forest - Subtropical/Tropical Dry	Resident	Suitable	Yes
1. Forest -> 1.6. Forest - Subtropical/Tropical Moist Lowland	Resident	Suitable	Yes
1. Forest -> 1.9. Forest - Subtropical/Tropical Moist Montane	Resident	Suitable	Yes
2. Savanna -> 2.1. Savanna - Dry	Resident	Suitable	Yes
3. Shrubland -> 3.4. Shrubland - Temperate	Resident	Suitable	Yes
3. Shrubland -> 3.5. Shrubland - Subtropical/Tropical Dry	Resident	Suitable	Yes
3. Shrubland -> 3.8. Shrubland - Mediterranean-type Shrubby Vegetation	Resident	Suitable	Yes
4. Grassland -> 4.4. Grassland - Temperate	Passage	Marginal	-
4. Grassland -> 4.7. Grassland - Subtropical/Tropical High Altitude	Passage	Marginal	-
6. Rocky areas (eg. inland cliffs, mountain peaks)	-	-	-
8. Desert -> 8.2. Desert - Temperate	Passage	Marginal	-
14. Artificial/Terrestrial -> 14.1. Artificial/Terrestrial - Arable Land	Passage	Marginal	-
14. Artificial/Terrestrial -> 14.2. Artificial/Terrestrial - Pastureland	Passage	Marginal	-
14. Artificial/Terrestrial -> 14.3. Artificial/Terrestrial - Plantations	Passage	Marginal	-
14. Artificial/Terrestrial -> 14.4. Artificial/Terrestrial - Rural Gardens	Passage	Marginal	-

Use and Trade

(http://www.iucnredlist.org/technical-documents/classification-schemes)

End Use	Local	National	International
10. Wearing apparel, accessories	Yes	Yes	Yes
11. Other household goods	Yes	Yes	Yes
12. Handicrafts, jewellery, etc.	Yes	No	No
13. Pets/display animals, horticulture	No	Yes	No
15. Sport hunting/specimen collecting	Yes	Yes	No
16. Establishing ex-situ production *	No	No	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity
1. Residential & commercial development -> 1.1. Housing & urban areas	Ongoing	Minority (<50%)	Very rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
1. Residential & commercial development -> 1.2. Commercial & industrial areas	Ongoing	Minority (<50%)	Very rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
1. Residential & commercial development -> 1.3. Tourism & recreation areas	Ongoing	Minority (<50%)	Slow, significant declines
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 1. Ecosystem stresses -> 1.3. Indirect ecosystem effects 2. Species Stresses -> 2.2. Species disturbance		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.1. Shifting agriculture	Ongoing	Majority (50-90%)	Rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.2. Small-holder farming	Ongoing	Majority (50-90%)	Rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.3. Agro-industry farming	Ongoing	Majority (50-90%)	Rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
2. Agriculture & aquaculture -> 2.2. Wood & pulp plantations -> 2.2.1. Small-holder plantations	Unknown	Minority (<50%)	Causing/could cause fluctuations
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
2. Agriculture & aquaculture -> 2.2. Wood & pulp plantations -> 2.2.2. Agro-industry plantations	Unknown	Minority (<50%)	Causing/could cause fluctuations

	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.1. Nomadic grazing	Ongoing	Whole (>90%)	Slow, significant declines
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance	
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.2. Small-holder grazing, ranching or farming	Ongoing	Whole (>90%)	Slow, significant declines
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance	
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.3. Agro-industry grazing, ranching or farming	Ongoing	Whole (>90%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
3. Energy production & mining -> 3.2. Mining & quarrying	Ongoing	Majority (50-90%)	Very rapid declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
4. Transportation & service corridors -> 4.1. Roads & railroads	Ongoing	Whole (>90%)	Slow, significant declines
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding	
4. Transportation & service corridors -> 4.2. Utility & service lines	Ongoing	Minority (<50%)	Causing/could cause fluctuations
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding	
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.1. Intentional use (species is the target)	Unknown	Whole (>90%)	Very rapid declines
	Stresses:	2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.6. Skewed sex ratios -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.2. Unintentional effects (species is not the target)	Ongoing	Majority (50-90%)	Very rapid declines

	Stresses:	2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.3. Persecution/control	Ongoing	Whole (>90%)	Very rapid declines
	Stresses:	2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.6. Skewed sex ratios -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.1. Intentional use: (subsistence/small scale) [harvest]	Ongoing	Minority (<50%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.2. Intentional use: (large scale) [harvest]	Ongoing	Minority (<50%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.3. Unintentional effects: (subsistence/small scale) [harvest]	Ongoing	Minority (<50%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.4. Unintentional effects: (large scale) [harvest]	Ongoing	Minority (<50%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success	
6. Human intrusions & disturbance -> 6.1. Recreational activities	Ongoing	Minority (<50%)	Causing/could cause fluctuations
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success	
6. Human intrusions & disturbance -> 6.2. War, civil unrest & military exercises	Ongoing	Minority (<50%)	Slow, significant declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance	
6. Human intrusions & disturbance -> 6.3. Work & other activities	Ongoing	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion	

		1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance	
7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.1. Increase in fire frequency/intensity	Future	Majority (50-90%)	Causing/could cause fluctuations
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success	
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.9. Small dams	Ongoing	Minority (<50%)	Causing/could cause fluctuations
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance	
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.10. Large dams	Ongoing	Minority (<50%)	Rapid declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding	
7. Natural system modifications -> 7.2. Dams & water management/use -> 7.2.11. Dams (size unknown)	Ongoing	Minority (<50%)	Slow, significant declines
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.2. Species disturbance	
9. Pollution -> 9.1. Domestic & urban waste water -> 9.1.1. Sewage	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.8. Other	
9. Pollution -> 9.1. Domestic & urban waste water -> 9.1.2. Run-off	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.8. Other	
9. Pollution -> 9.2. Industrial & military effluents -> 9.2.2. Seepage from mining	Unknown	Minority (<50%)	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.8. Other	
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.3. Herbicides and pesticides	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.8. Other	
9. Pollution -> 9.6. Excess energy -> 9.6.1. Light pollution	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance	

9. Pollution -> 9.6. Excess energy -> 9.6.3. Noise pollution	Unknown	Unknown	Unknown
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		
10. Geological events -> 10.2. Earthquakes/tsunamis	Unknown	Unknown	Unknown
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
10. Geological events -> 10.3. Avalanches/landslides	Ongoing	Minority (<50%)	Negligible declines
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
11. Climate change & severe weather -> 11.1. Habitat shifting & alteration	Ongoing	Minority (<50%)	Negligible declines
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
11. Climate change & severe weather -> 11.2. Droughts	Ongoing	Majority (50-90%)	Rapid declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
11. Climate change & severe weather -> 11.3. Temperature extremes	Ongoing	Majority (50-90%)	Slow, significant declines
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
11. Climate change & severe weather -> 11.4. Storms & flooding	Ongoing	Majority (50-90%)	Slow, significant declines
Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.7. Reduced reproductive success		
12. Other options -> 12.1. Other threat	Ongoing	Minority (<50%)	Slow, significant declines
Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.5. Inbreeding -> 2.3.6. Skewed sex ratios		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action in Place
In-place research and monitoring
Action Recovery Plan: Yes
Systematic monitoring scheme: Yes
In-place land/water protection
Conservation sites identified: Yes, over entire range
Percentage of population protected by PAs: 11-20
Area based regional management plan: Yes
Occurs in at least one protected area: Yes
Invasive species control or prevention: No
In-place species management
Harvest management plan: Yes
Successfully reintroduced or introduced benignly: Yes
Subject to ex-situ conservation: Yes
In-place education
Subject to recent education and awareness programmes: Yes
Included in international legislation: Yes
Subject to any international management / trade controls: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Action Needed	Notes
1. Land/water protection -> 1.1. Site/area protection	-
1. Land/water protection -> 1.2. Resource & habitat protection	Wherever relevant
2. Land/water management -> 2.1. Site/area management	-
3. Species management -> 3.1. Species management -> 3.1.2. Trade management	-
3. Species management -> 3.2. Species recovery	-
3. Species management -> 3.3. Species re-introduction -> 3.3.1. Reintroduction	-
3. Species management -> 3.4. Ex-situ conservation -> 3.4.1. Captive breeding/artificial propagation	-
3. Species management -> 3.4. Ex-situ conservation -> 3.4.2. Genome resource bank	-
4. Education & awareness -> 4.1. Formal education	-

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Conservation Action Needed	Notes
4. Education & awareness -> 4.2. Training	-
4. Education & awareness -> 4.3. Awareness & communications	-
5. Law & policy -> 5.1. Legislation -> 5.1.1. International level	-
5. Law & policy -> 5.1. Legislation -> 5.1.2. National level	-
5. Law & policy -> 5.1. Legislation -> 5.1.3. Sub-national level	-
5. Law & policy -> 5.2. Policies and regulations	Legislative changes related to the status of other effective area-based conservation measures (oecm) outside of pas
5. Law & policy -> 5.3. Private sector standards & codes	Incorporation of private wildlife conservancies wherever relevant and appropriate
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.1. International level	-
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.2. National level	-
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.3. Sub-national level	-
6. Livelihood, economic & other incentives -> 6.1. Linked enterprises & livelihood alternatives	Community conserved areas in the leopard range
6. Livelihood, economic & other incentives -> 6.4. Conservation payments	-

Research Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed	Notes
1. Research -> 1.1. Taxonomy	-
1. Research -> 1.2. Population size, distribution & trends	-
1. Research -> 1.3. Life history & ecology	-
1. Research -> 1.4. Harvest, use & livelihoods	-
1. Research -> 1.5. Threats	-
1. Research -> 1.6. Actions	-
2. Conservation Planning -> 2.1. Species Action/Recovery Plan	-
2. Conservation Planning -> 2.2. Area-based Management Plan	-
3. Monitoring -> 3.1. Population trends	-
3. Monitoring -> 3.2. Harvest level trends	-

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Research Needed	Notes
3. Monitoring -> 3.3. Trade trends	-
3. Monitoring -> 3.4. Habitat trends	-

Additional Data Fields

Distribution
Extreme fluctuations in area of occupancy (AOO): No
Number of Locations: 4
Continuing decline in number of locations: No
Extreme fluctuations in the number of locations: No
Lower elevation limit (m): 83
Upper elevation limit (m): 5,200
Population
Number of mature individuals: 450-626
Continuing decline of mature individuals: Yes
Extreme fluctuations: No
Population severely fragmented: Yes
No. of subpopulations: 4
Continuing decline in subpopulations: No
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
No. of individuals in largest subpopulation: 209-264
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes
Generation Length (years): 7.42
Movement patterns: Altitudinal Migrant

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The IUCN Red List Partnership

The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: ABQ BioPark; Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; Missouri Botanical Garden; NatureServe; Re:wild; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.