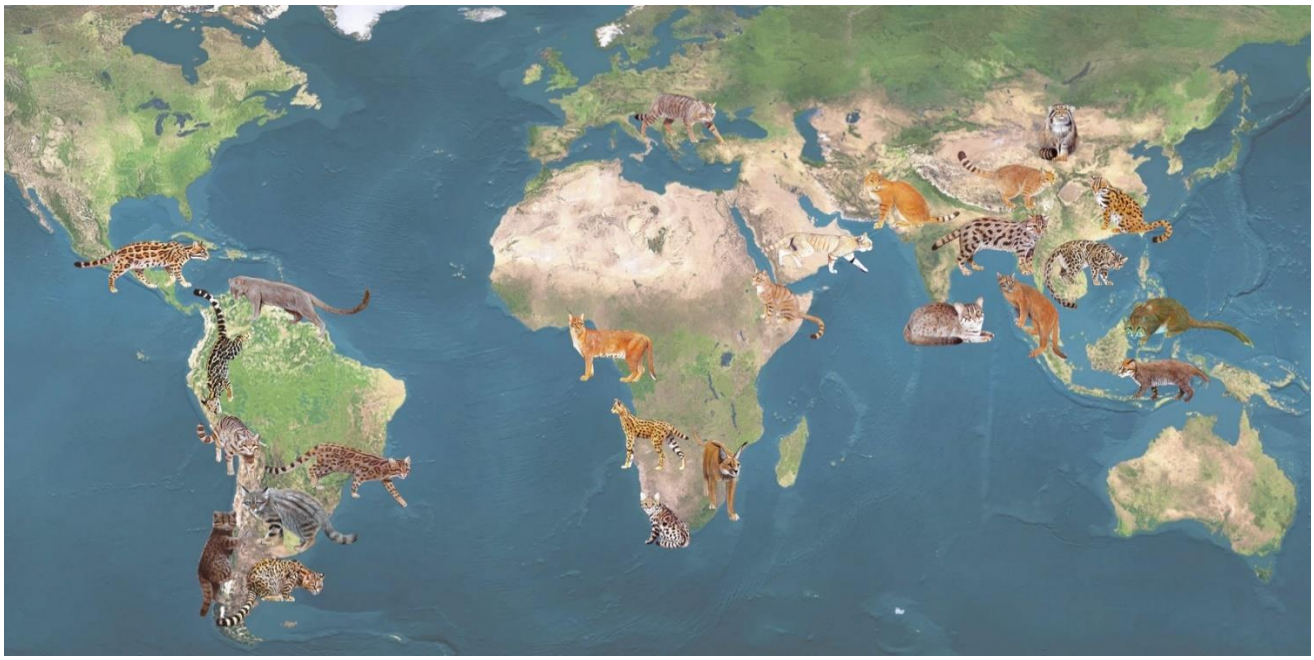
IUCN SSC Cat Specialist Group

Small Cat Report



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IUCN SSC

SPECIES SURVIVAL COMMISSION
CAT SPECIALIST GROUP

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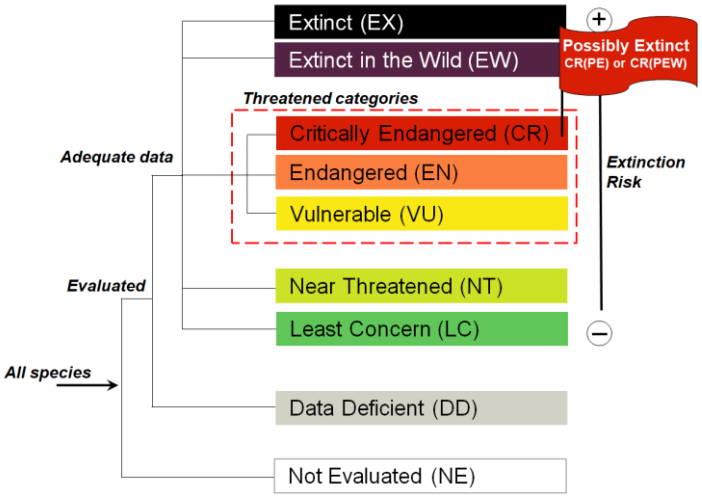
Contents

Glossary & Abbreviations

AOO	Area of occupancy is a scaled metric that represents the area of suitable habitat currently occupied by the taxon. Extant ranges should be considered in AOO calculation.
Cat SG	IUCN SSC Cat Specialist Group
Cathemeral	Activity pattern of irregular intervals during the day or night (synonym: metaturnal)
CSGSD	The IUCN SSC Cat Specialist Group Spatial Database (CSGSD) is the database were the Cat SG stores distribution records per species. For each record the reference, period, year, date, country, administrative region, locality, type of observation (camera trapping, telemetry, mortality, genetic, human mortality, tracks, scat, kill/prey, kill/livestock, direct sighting, calls, hear saying, photo, capture, hair), the accuracy (GPS, Map & Compass, Locality Reference, Regional Reference) and the source (publication, personal contact, workshop) are noted. The species distribution maps generated from this database re used as baseline for the maps for the Red List Assessments.
EOO	Extent of occurrence is the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon excluding cases of vagrancy.
Extinct range	The species was formerly known or thought very likely to occur in the area (post 1500 AD), but it has been confirmed that the species no longer occurs because exhaustive searches have failed to produce recent records, and the intensity and timing of threats could plausibly have extirpated the taxon. Extinct ranges should not be considered in the calculation of EOO.
Generation length	Generation length is the average age of parents of the current cohort (i.e. new born individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population.
IUCN	International Union for Conservation of Nature
Mature individuals (number of)	The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction.
NP	National Park
Old records	As old records we defined all records <2000.
Population size	The IUCN defines population as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life forms, population size is measured as numbers of mature individuals only.
PA	Protected Area
Recent records	As recent records we defined all records ≥ 2000. This is in accordance with the definition of "extant range" by the IUCN, where recent records are defined as records from the last 20–30 years. The Red List uses three generation length as time span for the measurements of population size declines. The generation length of the species considered varies between 3.6 to 6 years. Thus 20 years, as timespan used for the definition of recent records, is also close to three generation length of the larger small cats.
RLA	Red List Assessment
RLA Guidelines	*Guidelines for Using the IUCN Red List Categories and Criteria* of the IUCN (IUCN Standards and Petitions Committee 2022
SCALP Categories	SCALP (Status and Conservation of the Alpine Lynx population) Category 1 (C1): hard facts such as dead individuals or observations which have been verified with photos, captured animals or genetic proofs; Category 2 (C2): reports which were verified by trained people such as kills or animal tracks; Category 3 (C3): reports of kills, tracks, and scats that are not verified and all observations that are not verifiable such as animal sounds or sight observations. In the CSGSD (Cat Specialist Group Species Database), records are classified into 14 different types and not for all records it is known if they were reported by a trained person or not. We made the following SCALP categorisation of observations: C1: Camera trapping, telemetry, mortality, genetic, photo or capture; C2: tracks, scat, kill/prey and kill/livestock; C3: direct sighting, calls and hear saying
SSC	Species Survival Commission

IUCN Red List Categories

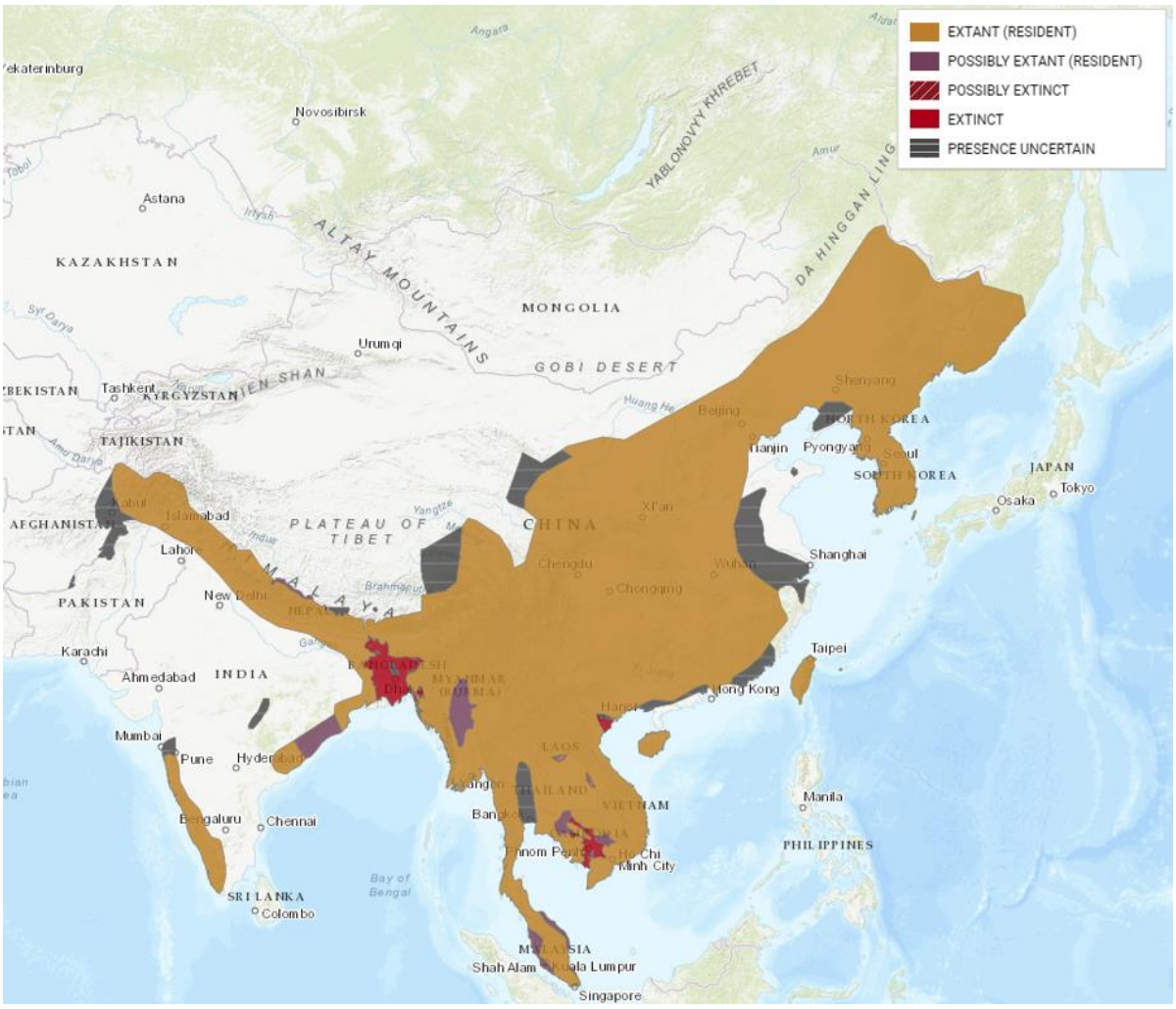


Extinct	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the wild	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the Criteria A to E for Critically Endangered (→ Appendix I), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the Criteria A to E for Endangered (→ Appendix I), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the Criteria A to E for Vulnerable (→ Appendix I), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened	A taxon is Near Threatened when it has been evaluated against the Criteria (→ Appendix I) but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern	A taxon is Least Concern when it has been evaluated against the Criteria (→ Appendix I) and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are often included in this category.
Data Deficient	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.
Not Evaluated	A taxon is Not Evaluated when it has not yet been evaluated against the Criteria.

Red List Criteria additionally used before 2001:

Lower Risk (R)	A taxon is lower risk when it has been evaluated, does not satisfy the Criteria for any of the categories Critically Endangered, Endangered or Vulnerable.
Rare (R)	Taxa with small world populations that are not a present "Endangered" or "Vulnerable" but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.
Indeterminate (I)	Taxa known to be "Endangered", "Vulnerable" or "Rare" but where there is not enough information to say which of the three categories is appropriate.
Insufficiently Known (K)	Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

Presence coding for IUCN Red List maps



RLA distribution map of the Mainland Leopard Cat with its presence coding.

Extant	The species is known or thought very likely to occur currently in the area, which encompasses localities with current or recent (last 20–30 years) records where suitable habitat at appropriate altitudes remains. Extant ranges should be considered in the calculation of EOO.
Possibly Extant	There is no record of the species in the area, but the species may possibly occur, based on the distribution of potentially suitable habitat at appropriate altitudes, although the area is beyond where the species is Extant (i.e. beyond the limits of known or likely records), and the degree of probability of the species occurring is lower (e.g. because the area is beyond a geographic barrier, or because the area represents a considerable extension beyond areas of known or probable occurrence). Identifying Possibly Extant areas is useful to flag up areas where the taxon should be searched for. Possibly Extant ranges should not be considered in the calculation of EOO.
Possibly Extinct	The species was formerly known or thought very likely to occur in the area (post 1500 AD), but it is most likely now extirpated from the area because habitat loss and/or other threats are thought likely to have extirpated the species, and there have been no confirmed recent records despite searches. Possibly Extinct ranges should not be considered in the calculation of EOO.
Extinct	The species was formerly known or thought very likely to occur in the area (post 1500 AD), but it has been confirmed that the species no longer occurs because exhaustive searches have failed to produce recent records, and the intensity and timing of threats could plausibly have extirpated the taxon. Extinct ranges should not be considered in the calculation of EOO.
Presence Uncertain	A record exists of the species' presence in the area, but this record requires verification or is rendered questionable owing to uncertainty over the identity or authenticity of the record, or the accuracy of the location. Presence uncertain records should not be considered in the calculation of EOO.

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Introduction

In recent years projects and resources for the conservation of small cats have increased remarkably. Despite this, small cats receive considerably less attention from governmental and non-governmental conservation organisations, and also from the scientific community in comparison to the large cats. Biological and ecological information for many small cat species is still limited, which in turn means there is a paucity of robust data to undertake a proper assessment of their conservation status within the frame work of the IUCN Red List of Threatened Species™. Information is generally limited or publicly available from only a few studies covering a tiny fraction of their total ranges. With a few exceptions, among which the Iberian Lynx *Lynx pardinus* is the most outstanding example, an understanding of the conservation needs of smaller cats is limited, and they are seldom the subject of specific long-term projects and/or large-scale conservation programmes.

The state of knowledge for the 33 non-Pantherinae cat species is diverse. In some cases, we have a clear understanding of conservation needs and can propose and initiate measures immediately. In other cases, we lack even basic information on distribution or habitat use. Most small cats occupy very specific ecological niches; they live in particular habitats, where they hunt a specific selection of prey species. They are often the perfect candidates as indicator species for their typical environments. Furthermore, small cats are considered to be cute and cause less conflict with people than larger cats. That makes them ideal flagships for raising awareness for conservation among local people and the international community.

The IUCN SSC Cat Specialist Group Cat SG is mandated to continuously monitor the conservation status of the felids and to support the strategic planning for their conservation. As an IUCN SSC Specialist Group, the Cat SG combines membership from scientists and conservationists from scientific institutions, NGOs and GOs and plays an overarching role in cat conservation. It has a role in fostering cooperation with species-specific networks for the small cats, allowing us to consistently improve our understanding and continuously advancing the conservation of these species. Much more than for the Panthera species, small cat conservation assessments are mosaics of generally rather small tesserae, where only a broad cooperation of data providers allow us to see the whole picture.

Our overall approach to species conservation is through the Species Conservation Cycle (Fig. 1.1), the IUCN SSC's principle of "ASSESS – PLAN – ACT". The ASSESS component, i.e. the continuous evaluation of the conservation status of the species through the Red List Assessment (RLA) and nowadays also through the allied Green Status Assessment (GSA) is a key task of taxonomic Specialist Groups of the SSC. The PLAN component is addressed through the development of Conservation Strategies and Action Plans based on the respective IUCN Guidelines (e.g. IUCN SSC Species Conservation Planning Sub-Committee 2017, Breitenmoser et al. 2015). The ACT component is undertaken by the numerous members of the network of SSC volunteers and the organisations they represent through the implementation of national or local Action Plans or the initiation of research or conservation projects. The assessments of the species should be done in a way to facilitate not only the planning, but also the implementation of conservation measures. The results of the conservation measures should then in turn feed back into the ASSESS component allowing an improved re-evaluation of the species status based on new information and data which then informs Conservation Strategies and Actions Plans (PLAN component) which again allow to adapt and optimise conservation actions according to the newest findings (ACT component).

ASSESS: Understand and inform the world about the status and trends of biodiversity

PLAN: Develop collaborative, inclusive and science-based conservation strategies, plans and policies.

ACT: Convene and mobilise conservation actions to improve the status of biodiversity.

Fig. 1.1 The Species Conservation Cycle as established in the IUCN Species Strategic Plan 2017–2020.

The IUCN Red List of Threatened Species™ (Red List) assesses the extinction risk of a species based on a comprehensive, objective and scientifically rigorous approach using the IUCN Red List Categories and Criteria (see Glossary). The RLAs provide information on the taxonomy, distribution range, population (size and trend), habitat, ecology, use, trade, threats and conservation actions (IUCN Standards and Petitions Committee 2022). The Red List informs species-based UN conventions (e.g. the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Migratory Species of Wild Animals (CMS)) and national legislations, and helps identifying priorities for conservation planning and measures. RLAs are widely consulted in species conservation by many governmental and non-governmental actors. Considering their significance, it is important that assessments are of the highest possible reliability, based on the most robust scientific information available for any species.

Of the non-Panthera cats, we did not include in this Report the genus Lynx (Eurasian Lynx, Bobcat, Canada Lynx, Iberian Lynx), nor the Puma and Cheetah. For these species, generally, many projects are already ongoing and a lot of publications are available (although often not from across the entire range of all these species). The Eurasian Lynx, Bobcat, Canada Lynx and Puma are considered as Least Concern. The conservation needs of the Endangered Iberian Lynx has been well addressed by specific conservation efforts over many years. This is also the case for the Vulnerable Cheetah. We did also not include the Mainland Clouded Leopard nor the Sunda Clouded Leopard into this report as they make part of the Pantherinae.

The Cat SG is dedicated to advance the conservation of cats and their living spaces. This requires (1) improving our knowledge on small cats, (2) raising awareness for their conservation, (3) building-up a "small cat community" (e.g. through species-specific networks), and (4) initiating specific conservation programmes wherever needed and possible. In most cases it is unrealistic to develop large-scale programmes for the conservation of a small cat similar to those developed for most Panthera species, therefore much more emphasis must be given to cooperation and networking. Existing small-scale research and conservation projects, small cat specialists and enthusiasts must improve the accessibility of their data, and work together and share their information and insights in order to make greater use of the data available. All data and information are useful, including chance observations and anecdotal records which can help us to gain a better understanding of the general picture.

In the last five years, the funding for small cat conservation has grown exponentially. Several organisation today support small cat conservation work, particularly the ACT component (e.g. Panthera,

MbZ, WCN, SWCCF, Re:wild, SCCA). The in situ projects made possible through this funding will generate data that could substantially contribute to improve the assessments for small cats. This report is also meant to inform project implementors on the weaknesses and gaps of the present assessments.

The purpose of this report is hence to "assess the assessments" and evaluate the current Red List presentations of the status of the smaller cat species, highlighting gaps in information and knowledge that weaken the current reliability and robustness of assessments. The report also looks at new information available that may have been missed in assessments. It also highlights the importance of improving accessibility and public availability of any new information as it is gathered, and provide a strategy to overcome knowledge gaps through the development of species working groups to foster cooperation and information sharing. The report is aimed at researchers, institutes and conservation programs and aims inform them to help shape future conservation and research efforts to address these gaps. Only if ecological data on distribution and threats is collected, accessible and shared, can it be incorporated to assess the conservation status of species robustly to inform future strategic plans and conservation interventions.

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Goal and objectives of this review report

In this report we focus on the ASSESS component of the Species Conservation Cycle (Fig. 1.1.), which then feeds into the PLAN and ACT components and ultimately feeds back into future assessments cyclically thus providing the framework for an adaptive approach to species conservation.

The goal of this report is to guide and streamline the RLAs of the lesser cat species over the next few years by informing and training assessment teams and to inform the cat conservation community on knowledge gaps, and help to prioritise future conservation action and research, and facilitate cooperation for the long-term exchange of information of the small cat species. The objectives to reach this goal are to

- Identify the main gaps of knowledge per species based on the published information collected and propose how to tackle those issues;
- Evaluate the RLAs of the small cat species concerning their correctness and consistency according to the IUCN Red List Guidelines;
- Check and assess the consistency of the assessments and the application and interpretation of the Red List guidelines and rules regarding Categories and Criteria between the species RLAs, as well as the presentation and completeness of the information in the RLAs;
- Provide an overview of the knowledge base of the small cat species by scanning the readily available information on the species;
- Identify the most common problems and general challenges that can arise when applying the IUCN RLA Categories and Criteria to (small) cat species;
- Detect sections/aspects that need to be updated/adapted during the next re-assessment of the species due to changes in the Guidelines on using the IUCN Red List Categories and Criteria;
- Develop recommendations on how to address the identified issues and challenges as well as on how cat species RLAs can be streamlined to make them more consistent with each other and with the IUCN Guidelines;
- Inform the respective assessment teams of each species on the specific aspects identified in the last RLA for their species; and
- Make the broader conservation community aware of the results and recommendations of the Small Cat Report.

When looking at the consistency and correctness of the RLAs, we also evaluated whether an evidentiary or precautionary approach was applied when listing the species. Indeed, the dependability of the RLAs of the smaller cats varies greatly. This is not only a consequence of varying/dissimilar knowledge bases, but is also due to the fact that the more limited the information, the more uncertainty there is and the broader the leeway for the assessment teams to make their own interpretations. Generally, the IUCN Red List Guidelines allow some flexibility for variation in interpretation to be applicable to all taxa. However, they also provide guidance on how to deal with data uncertainty and risk tolerance (IUCN Standards and Petitions Committee 2022). Ensuring consistency of assessments and application of Red List rules regarding Categories and Criteria within and between RLAs of the species is necessary because it facilitates not only the comparison of assessments between species, but also the evaluation of population trends and improvements of the status of a certain species over time, and thus enhances the quality of (re)assessments. If general problems and challenges arising when applying the IUCN RLA Categories and Criteria are tackled in the same way for all (small) cat species, i.e. applying for example an evidentiary approach, then the RLAs and hence the extinction risk of the small cat species can be compared with each other across species. Improved (re)assessments also help to improve Conservation Strategies and Action Plans and to enhance con-

servation measures. In addition, in the face of long-term global threats such as climate change and habitat conversion, robust species assessments and reassessments can add to a broader understanding of environmental change. Small cat species are potentially important indicators and their assessments need to be robust, repeatable and based on reliable information.

The Small Cat Report is, on the one hand, a Cat SG internal document to guide and streamline the assessments of the lesser cat species over the next few years, and to inform the respective assessment teams on the results concerning their species, but on the other hand, should also inform the broader cat conservation community on gaps in knowledge and information availability and on further research needs, in order to support future conservation projects and facilitate cooperation for the long-term conservation of the small cat species.

First and foremost, this report is not a critique of assessors, they can ultimately only work with the data they have available. Also, the Small Cat Report is not an assessment on the quality of conservation and research projects. We did not analyse the role or effectiveness of different stakeholders in regard to small cat conservation nor did we assess the procurement and allocation of financial resources for small cat conservation and research. It is not an assessment of conservation projects for small cat species over the last years which has increased greatly. We focused in this report on the ASSESS component. This report does however pave the way for additional reports on the roles and importance of different stakeholders in small cat conservation as well as a report on the development of available resources for small cat conservation and small cat projects and programmes.

1. Taxonomic scope and overview on taxonomic information

Kitchener et al. (2017) used a traffic-light system for highlighting the certainty of a (subspecies) classification based on morphological, molecular, biogeographical and other evidence. For accepting a taxon (•), good evidence in the three principal categories was required. In case of uncertainty or lack of consensus, a conservative approach was applied.

We used a similar traffic light evaluation scheme to assess the certainty of the classification of each species considered (Table 1.1). The classification at species level was confirmed for most small cats, except for the Andean Cat *Leopardus jacobita*, the Ocelot *Leopardus pardalis*, the Pampas Cat *Leopardus colocola* and the Northern Tiger Cat *Leopardus tigrinus* (Oncilla), which might be split into several species based on new molecular-genetic findings (Table 1.1). For the *Felis* complex, there are also open questions, e.g. the status as species or subspecies, respectively of *F. lybica ornata*, *F. l. lybica* and *F. bieti*. For most species, the subspecies level classification is still uncertain, mainly because recent morphological, molecular or phylogeographic studies are missing (Table 1.1). For all these species, further research is needed to confirm their (sub)species classification.

Table 1.1. Overview of the evaluation of the species' taxonomy according to Kitchener et al. (2017), based on the evaluation scheme; Green = good, no major uncertainty of classification, yellow = in need of improvement, uncertainty at subspecies level, red = in need of major improvement, uncertainty at species level.

Species	Taxonomic classification	Changes in classification according to Kitchener et al. (2017)
F. chaus	🟡	Reduction from 10 to 3 subspecies
F. nigripes	🟢	Reduction from 2 subspecies to monotypic
F. margarita	🟡	Reduction from 4 to 2 subspecies
F. bieti	🔴	Reduction from 2 subspecies to monotypic
F. silvestris	🟡	Including now only the forest cats of Europe, wildcats from Asia and Africa have been assigned to a separate species *F. lybica*. 2 subspecies are recognised
F. lybica	🔴	Reduction from 19 to 3 subspecies. Split from *F. silvestris*
O. manul	🟡	Reduction from 3 to 2 subspecies
P. rubiginosus	🟡	3 subspecies, no change
P. planiceps	🟡	Monotypic, no change
P. viverrinus	🟡	2 subspecies, no change
P. bengalensis	🟡	Reduction from 6 to 2 subspecies, split into two species *P. bengalensis* and *P. javanensis*
P. javanensis	🟢	Reduction from 5 to 2 subspecies
H. yagouaroundi	🟢	Reduction from 8 subspecies to monotypic
P. marmorata	🟡	2 subspecies, no change
C. badia	🟢	Monotypic, no change
C. temminckii	🟡	Reduction from 5 to 2 subspecies
L. jacobita	🟡	Monotypic, no change
L. pardalis	🟡	Reduction from 9 to 2 subspecies
L. wiedii	🟡	Reduction from 11 to 3 subspecies
L. colocola	🔴	Reduction from 3 species, 10 subspecies to 1 species, 7 subspecies
L. guttulus	🟢	Monotypic, no change
L. tigrinus	🔴	Reduction from 3 to 2 subspecies
L. geoffroyi	🟡	Reduction from 4 to 1 subspecies
L. guigna	🟢	2 subspecies, no change
L. serval	🟡	Reduction from 6 to 3 subspecies
C. aurata	🟡	2 subspecies, no change
C. caracal	🟡	Reduction from 8 to 3 subspecies

Uncertainties in the classification of the small cat species according to Kitchener et al. 2017

The main issues concerning the subspecies classification of each species were identified by Kitchener et al. (2017) as follows:

🟡 **Jungle Cat** *Felis chaus*

Three subspecies are inferred to occur based on one study on skull morphometrics and one on the variation in mitochondrial genes. However, one of these three potential subspecies has not yet been examined in detail. A phylogeographic study is required to confirm the subspecies classification.

🟢 **Black-footed Cat** *Felis nigripes*

There is evidence that the species is monotypic with some clinal variation only.

🟡 **Sand Cat** *Felis margarita*

The species shows different pelage colouration and skull size, but no phylogeographical studies have been conducted so far. Preliminary genetic analysis indicates that there are only two subspecies, one in North Africa and one in South-west Asia and the Arabian Peninsula.

🔴 **Chinese Mountain Cat** *Felis bieti*

No recent taxonomic study of the species exists. *F. bieti* is morphologically distinct to *F. l. ornata* and possibly sympatric with it. Yu et al. (2021) conducted a genome-wide analysis, which supports the classification of *F. bieti* as subspecies of *F. silvestris*. However, due to the relatively deep divergence of the wildcat taxa, Yu et al. (2021) proposed to elevate all wildcat lineages to species level which would result in the following species: Asiatic Wildcat *F. ornata*, African Wildcat *F. lybica*, European Wildcat *F. silvestris*, House Cat *F. catus* and Chinese Mountain Cat *F. bieti*.

🟡 **European Wildcat** *Felis silvestris*

The former species *F. silvestris* was split into *F. silvestris* and *F. lybica*. The distinction of two subspecies is based on current geographical isolation. However, as there are no recent morphological and molecular studies of geographical variation in Europe and beyond, the separation in two subspecies is not fully proven. Moreover, there are several geographically distinct European metapopulations, but the phylogenetic significance of this separation is not known.

🔴 **Afro-Asiatic Wildcat** *Felis lybica*

The former species *F. silvestris* was split into *F. silvestris* and *F. lybica*. Based on the identification of three distinct clades within *F. lybica*, three subspecies are tentatively identified. However, further research is needed to confirm this. According to Yu et al. (2021), there would also be the option to split *F. l. ornata* into its own species from *F. lybica* based on the relatively deep divergence of the wildcat taxon.

🟡 **Pallas's Cat** *Otocolobus manul*

No recent molecular or morphological studies have been conducted. The two subspecies were suggested based on morphology and biogeography, but the colour variation is possibly largely clinal. Therefore, the Pallas's Cat might even be a monotypic species.

● **Rusty-spotted Cat** *Prionailurus rubiginosus*

No phylogeographic study of the species exists. Three subspecies are retained mainly based on biogeography and morphology. The suggestion of two subspecies on Sri Lanka is based on taxonomic differentiations in other species between the wet and dry zone in Sri Lanka (i.e. the two recognised subspecies of Loris; *Loris tardigradus* in the wet zone and *Loris lydekkerianus*). The variation within subspecies is unclear.

● **Flat-headed Cat** *Prionailurus planiceps*

This species is considered monotypic, but a study in 2014 indicated the possible existence of different haplotypes between two individuals from the Malay Peninsula and Borneo, respectively. However, until a more comprehensive study is completed, the species will continue to be considered as monotypic.

● **Fishing Cat** *Prionailurus viverrinus*

No comprehensive analysis is available for this species. Based on mitochondrial and nuclear markers, the phylogeographical patterns from specimens from northern Indochina are known, but not from the rest of its range. Thus, until more data is available, two subspecies are currently recognised.

● **Mainland Leopard Cat** *Prionailurus bengalensis*

The former *P. bengalensis* has been split into two species *P. bengalensis* and *P. javanensis*, based on a molecular study showing a deep genetic divergence between Sundaland and Mainland Leopard Cats, with possible overlap on the Malayan Peninsula. Moreover, there is biogeographical separation and clear morphological differences between the two species, although the boundary between the species is not known yet. Based on mitochondrial genomes and further evidences of two clades, two subspecies of the Mainland Leopard Cat are tentatively recognised.

● **Sunda Leopard Cat** *Prionailurus javanensis*

The former species *P. bengalensis* has been split into two species *P. bengalensis* and *P. javanensis* (see above). Based on morphological variation, phylogeographical study, and the clear geographic separation two subspecies are recognised for the Sunda Leopard Cat.

● **Jaguarundi** *Herpailurus yagouaroundi*

This species is polymorphic, with the dark/grey pelage being most commonly associated with wet, dense forests, and the red coat with dry, open habitats. However, there is no molecular evidence for subspecies, and therefore it is regarded as a monotypic species.

● **Marbled Cat** *Pardofelis marmorata*

A recent molecular study and two different pelage patterns indicate that there are two subspecies. However, more studies are needed to confirm this and also to examine whether the Marbled Cats inhabiting Borneo belong to an additional subspecies.

● **Borneo Bay Cat** *Catopuma badia*

The Borneo Bay Cat is considered to be monotypic. Although polymorphic, there appears not to be any geographic separation of the colour morphs.

● **Asiatic Golden Cat** *Catopuma temminckii*

A comprehensive study of whole mitochondrial genomes and pelage colouration showed a more or less distinct clade including animals from the Malay Peninsula and Sumatra. Therefore, two subspecies, one on mainland Asia and one inhabiting the Malay Peninsula and Sumatra are suggested.

● **Andean Cat** *Leopardus jacobita*

The species is considered monotypic. However, a genetic analysis indicated that there exist two Evolutionary Significant Units. Moreover, a study on microsatellites found that four populations of the species are genetically isolated from each other but morphological samples were not sufficient to demonstrate whether these subpopulations represent distinct subspecies.

● **Ocelot** *Leopardus pardalis*

The species is recognised as having two subspecies, one from Texas and Arizona south to Costa Rica, while the other ranges throughout South America, as far south as Argentina. There is however evidence of other morphological differences between populations, indicating the possible existence of other subspecies. Moreover, a study in 2010 suggested the two currently recognised subspecies as being different species. More research is needed.

● **Margay** *Leopardus wiedii*

Molecular studies indicate three phylogeographic groups (1 – South America, south of the Amazon, 2 – South America, north of the Amazon, and 3 – Central America). However, a recent morphological study found no significant geographic variation. The three subspecies remain a provisional categorisation, until more comprehensive molecular and morphological studies are available.

● **Pampas Cat** *Leopardus colocola*

The taxonomy of the Pampas Cat is rather confusing. Various authors have suggested that this species should be split into up to 9 species. On a molecular level, genetic differentiation between subspecies shows a phylogeographic structure with recent partitions at the same level as intra-specific partitions observed in other felids, and are therefore not considered as species-level partitions. However, it is admitted that this could also be caused by very recently diverged species. The actual situation is not fully understood and requires further research. Until further information becomes available, one species with seven subspecies is recognised.

● **Southern Tiger Cat** *Leopardus guttulus*

This species, also called Southern Tigrina, was recently recognised as distinct from the Northern Tiger Cat *L. tigrinus*. More research on distribution and morphology of the Southern Tiger Cat is required. Until further research, the Southern Tiger Cat is recognised to be a monotypic species.

● **Northern Tiger Cat** *Leopardus tigrinus*

This species, also called Northern Tigrina, is recognised to have two subspecies, one ranging through northern South America, possibly as far south as Bolivia and northern Argentina (*L. t. tigrinus*), the other in Costa Rica and possibly Panama (*L. t. oncilla*). Further research is required to confirm the taxonomy of the Northern Tiger Cat. It is not yet clear whether the north-western South American Tigrinas as well as the Tigrinas from Central America each comprise yet another species, *L. pardinoides* and *L. oncilla* respectively.

● **Geoffroy's Cat** *Leopardus geoffroyi*

This species is regarded as monotypic, with a morphological cline (skull morphology and pelage colouration) in relation to different habitat types throughout its range. Molecular studies are required.

● **Guiña** *Leopardus guigna*

Based on a phylogeographic pattern indicating separation between northern and southern populations, two subspecies are recognised.

● **Serval** *Leptailurus serval*

No recent morphological and molecular studies on the species have been conducted. However, based on phylogeographical patterns found in other African species, three subspecies are suggested for the serval. Currently, no molecular studies are available to confirm this.

● **African Golden Cat** *Caracal aurata*

No molecular or skull morphometric studies exist. The two subspecies are suggested based on biogeographical patterns as known from other African rainforest species. A molecular study is required to confirm the number of subspecies and if there is a wide area of intergradation should two or more subspecies be recognised.

● **Caracal** *Caracal caracal*

No recent morphological and molecular studies exist. The possible distinction of 3 subspecies is based on the phylogeographic pattern found in savanna ungulates in Africa and the distinct patterns found in the Cheetah and Lion across Africa, and not on a study conducted directly on the Caracal.

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2. Methods

2.1 Species accounts

To provide an overview of the knowledge base of all small cat species, we have performed a thorough review of available data and information and considered the most current Red List Assessment (RLA) of the species. We did not specifically reach out to any organisation or researcher to collect additional information and have based our analysis on the publicly available data to reflect the circumstances under which information is used by assessors composing a RLA. We compiled the current knowledge base for each species in a species account, starting from the latest Red List Assessment (RLA) and considering all additional information on the species in the IUCN Cat SG Library as well as found with Google Scholar[1]. We have limited the search to the years since 2015 (the last general update of the Red List of the small cat species), assuming that all significant information on a species had already been integrated into the RLA 2014–2016. The species accounts were compiled during the years 2019–2022; hence for some species, papers published during the past three years may not yet have been considered. The search was conducted using both the common vernacular English as well as old and new scientific names. Threats to the species (as outlined in the assessment) have been compiled in a table. Threats without geographic reference were considered as range-wide or unknown. The awareness of and attention given to the species was assessed considering current projects, networks and organisations that were found as a result of the searches described above.

Important new information compared to the last RLA (11 from 2015, 11 from 2016, 1 from 2020 and 4 from 2022) is highlighted in the Species Accounts *in italic,* all other information originates from the last RLA of the species. For the RLA sections 'Justification', 'Geographic Range', 'Population', 'Habitat and Ecology', 'Use and Trade' and 'Threats' we present a summary in each species account. We did not consider the section 'Conservation', as it presents more generic information.

2.2 Distribution maps

For each species, we created a distribution map allowing us to compare the range presented in the RLA with information from published literature. The Cat SG maintains a database with georeferenced information (points, polygons) for each cat species. Additional records from the literature review have been integrated into this IUCN SSC Cat Specialist Group Spatial Database (CSGSD). Records have been grouped into ***recent*** (records with SCALP Category [→ glossary] and from the year 2000 onwards), ***recent records without known SCALP*** category from the year 2000 onwards and ***old/unknown*** (records before the year 2000 and/or without known year). The distribution from these records has then been compared with the distribution range (see page 7 for definitions) of the respective species according to the latest RLA.

[1] All references discovered in this research are being integrated into the IUCN SSC Cat SG Digital Cat Library (http://www.catsg.org/catsglib/index.php), which now contains over 15,000 references relevant to cat conservation.

2.3 Evaluation of knowledge base and IUCN Red List Assessment

We summarised the results of our evaluation of the RLAs of the Felidae and of the online readily available knowledge base in a matrix for each species, applying a traffic-light system (● good; ● mediocre; ● bad). This evaluation matrix has been integrated into the species accounts.

The *Guidelines for Using the IUCN Red List Categories and Criteria* of the IUCN (RLA Guidelines; IUCN Standards and Petitions Committee 2022), have been updated since the RLAs conducted in 2015 and 2016. They now contain more detailed explanations of terms and definitions and on how to apply certain Criteria. Consequently, there may be a need for more explanations or corrections in future re-assessments compared to previously done ones. In addition to the RLA Guidelines, the Cat SG applies the following principles for any RLA of a cat species:

- Contrary to the suggestion in the IUCN Red List Guidelines to "*resist an evidentiary attitude and adopt a precautionary but realistic attitude to uncertainty when applying the Criteria*" (IUCN Standards and Petitions Committee 2022, p. 21), we prefer to apply an evidentiary attitude to risk/uncertainty. We never know quite enough, but for cats – compared to other taxonomic groups, especially non-vertebrates – we do normally have sufficient data to make quantitative judgements or at least qualified estimations or guesses.
- When suspecting, inferring or projecting a population size reduction, we apply a more evidentiary approach. Data from the past are often inaccurate, and an incorrect judgement of a decline may lead to unjustified up-listing (and in turn, in a future assessment with better data, an "inexplicable" down-listing). Moreover, models and their underlying assumptions to predict population reduction must be well explained and provide reasonable evidence. (Quantitative) evidence is needed and assumptions must be explained and be logical.

To evaluate the latest RLAs for the small cats, we specifically considered three aspects:

- Quality/reliability of information and knowledge presented in the RLA according to pre-defined criteria (*Evaluation of Information used in the RLA*; Table 2.1);
- Consistency and integrity of RLA per chapter; quantitative and qualitative inclusion of then available information into the RLA and consideration of IUCN Red List Guidelines and Documentation Standards (*Consistency of RLA*; Table 2.2)
- Amount and quality of new information available since the last RLA (*New information since last RLA*; Table 2.3).

Evaluation of the quality of information and knowledge presented in the last Red List Assessment

To evaluate the quality of information and knowledge used in the frame of the last RLA of a species, we developed a traffic light system with criteria and requirements for each chapter of the RLA (Table 2.1). The *Guidelines for Using the IUCN Red List Categories and Criteria* define certain rules to be followed by the assessors and demand specific "supporting information" for any assessment that needs to be accepted by the Red List Unit (IUCN Standards and Petitions Committee 2019). Depending on whether a species falls into a Threatened Category or not, more or less detailed information is required (IUCN 2013). For Least Concern species, for example, narratives about Geographic Range, Population, Habitat and Ecology, and Threats are not required, nor is the information on Use and Trade mandatory. Our evaluation of the RLAs however goes beyond the rules set by the Guidelines, as we requested more information for a good assessment and as we not only judged the inherent integrity of a RLA, but also checked each section against the published information available then and now.

Table 2.1. Scheme to evaluate the information used in the most recent RLA of a species, regardless to the knowledge base then available. For each section of the RLA, a traffic-light colour shows the relative quality of the assessment for the respective feature according to the criteria given below.

Feature	Traffic light criteria		
	Good	**Mediocre – In need of improvement**	**Bad – In need of major improvement**
Distribution	Detailed information and recent records (original research) post 2000 for majority of range	Detailed information for majority of range (incl. old records and/or compilations)	Only generic information at country level (i.e. extant, possibly extant; no site data) for majority of range
Population	Global population estimate based on scientific robust methods; trend known	Rough global population estimate and/or robust density/abundance estimations from at least 3 sites in different parts of range	No global population estimates and/or robust density/abundance estimations from 2 sites in different parts of range at most
Habitat	Detailed information on habitat preferences and use from across the range	Generic information on habitat preferences and use across range	Generic habitat information from parts of range only
Ecology	Information on majority of: diet, land tenure system and life history from at least 3 different sites	Information on majority of: diet, land tenure system and life history from 1–2 sites	Incomplete or missing information on diet, land tenure system, and life history
Use & Trade	Recent information on use and trade (source, destination, purpose, amount, trend)	Recent information on at least 2 aspects of use and trade (source, destination, purpose, amount, trend)	Recent information on max. 1 aspect of use and trade, or old information only
Threats	Detailed recent information on main threats across range including their impact	Detailed information on threats across range	Generic information on threats or detailed information from part of range only

Evaluation of the consistency of the Red List Assessment per species and per chapter/feature

The consistency of the RLA of a species has been evaluated with respect to the then valid version of the *Guidelines for Using the IUCN Red List Categories and Criteria* as well as the updated version wherever applicable. Moreover, the assessment has been evaluated against the *Documentation Standards and Consistency Checks for IUCN Red List Assessments and Species Accounts* as well as to the requirements as defined by ourselves (IUCN 2013). The Guidelines must be correctly applied, and the assignment of Category and Criteria of a species must be convincing, based on the information and data provided in the assessment.

Furthermore, the persuasiveness of the Justification has been assessed. The Justification must present the justification of the Category and Criteria met or nearly met (for species qualifying as Near Threatened). Moreover, inferences or uncertainty in data and information interpretation with relation to the Criteria and thresholds have to be stated. Key issues from the other sections of the RLA should be used in the Justification to summarise the reasoning for the categorisation of the species. The assessment of a species should be comprehensible from the Justification alone.

Furthermore, we checked if the information and knowledge available at the time of the last RLA of a species had been considered and correctly integrated into the last RLA, and if the then available information (e.g. according to the Digital Cat Library) and data were considered, correctly integrated and analysed as well.

Table 2.2. Scheme to assess the consistency of the RLA in regard to the correct integration and interpretation of the knowledge base and information then available (publications in the timespan from the former RLA until the most recent one). Requirements defined were applied for each section of the RLA (see Evaluation Matrix).

Good	Mediocre – In need of improvement	Bad – In need of major improvement
Available knowledge was fully considered and correctly integrated. RLA Guidelines were correctly applied and documentation standards met	Most of available knowledge (most important publications) used and correctly integrated. Minor shortcomings regarding application of RLA Guidelines and documentation standards	Only part of available knowledge used and correctly integrated. Major shortcomings regarding application of RLA Guidelines and/or documentation standards

Evaluation of new information available per species per chapter since the last Red List Assessment

We evaluated the new information and knowledge available since the last RLA of a species per chapter by applying a traffic light system. We have considered the amount of new information available since the last RLA as well as the quality of the new information that we have found through our internet research (→ Chapter 2.1; Table 2.3). Note that the colour green in this case indicates a remarkable advance of the knowledge and hence indicates the need for an update of the RLA.

Table 2.3. Scheme to assess the new information and knowledge available on a species since the last RLA.

Good	Mediocre	Bad
Quantitatively and/or qualitatively important (e.g. robust density estimates) new information available	Some new information available and/or important additions (e.g. home range estimates)	No significant and/or very little new information available

Based on the results from our evaluations, we assessed the urgency of a re-assessment of the RLA of a species and defined recommendations for its future conservation.

References

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3. Species accounts

3.1 Neotropics

3.1.1. Andean Cat (*Leopardus jacobita*)

Endangered C2a(i) (Villalba et al. 2016)

Red List history

Year	1982	1986	1988	1990	1994	1996	2002*	2008	2016
cat. & crit.	R	R	R	R	K	VU	EN C2a(i)	EN C2a(i)	EN C2a(i)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

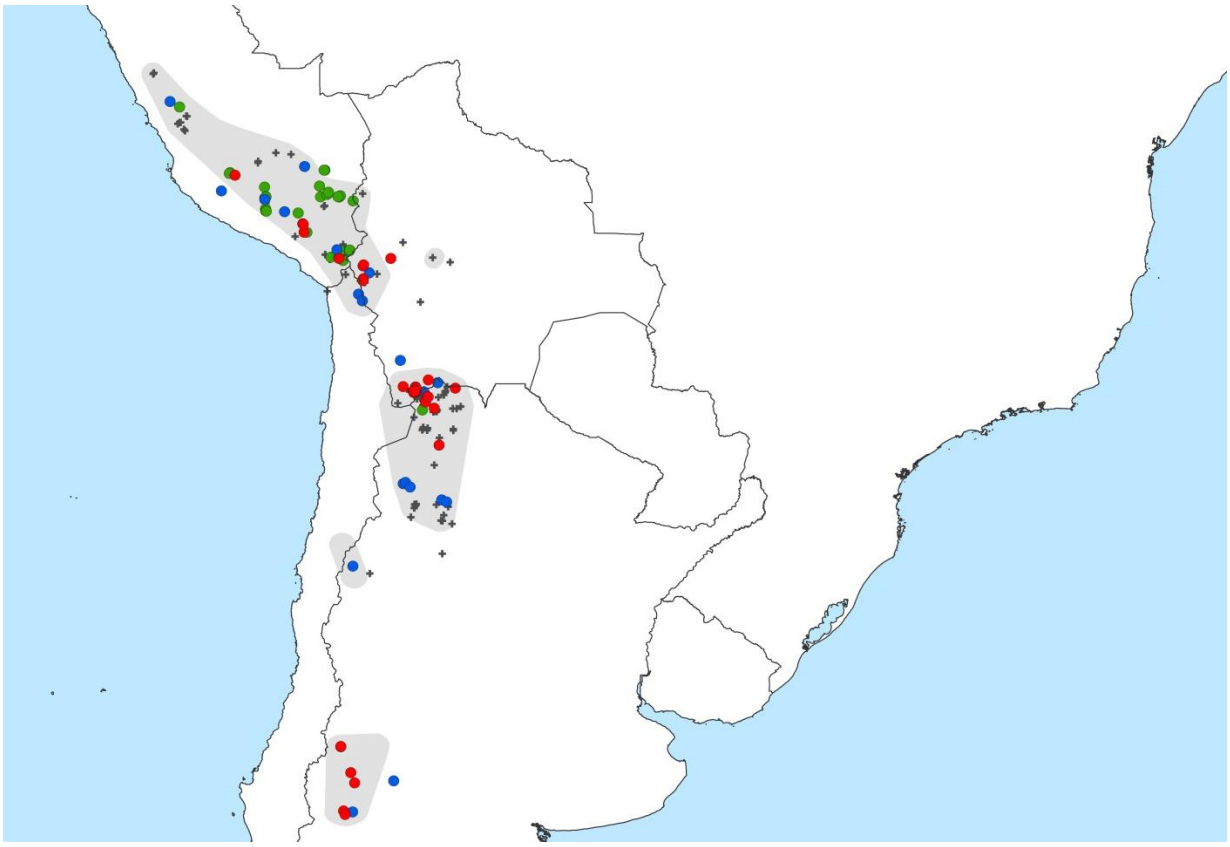

Fig. 3.1.1.1. Andean Cat observation records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Villalba et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Andean Cat is considered monotypic, but further research is needed to confirm the subspecies classification (Kitchener et al. 2017).

Justification: The Andean Cat is listed as Endangered. Its extent of occurrence (EOO) was estimated at 1,530,818 km². The Andean Cat, however, relies on steep rocky environments and in a Patagonian study, such habitat composed only 1.4% of the study area. Another study in Patagonia found Andean Cats in only 3% of cells of a 10x10 km grid (S. Walker & R. Palacios, unpub. data). As the Patagonian steppe is not representative for the largely highland habitats, it was estimated that 10% of the EOO is actually occupied by Andean Cats. The lowest density estimated for Andean Cats is 1.8 individuals per 100 km² (Huaranca et al. 2013). Applying this density to the EOO would result in 2,755 individuals. However, no information is available on the population structure. Using a default value of 50% mature individuals results in 1,378 mature individuals. Ten subpopulations were distinguished. Contrary to the global population estimate, an occupied area of 40% was used within the subpopulations (M. Lucherini et al., unpub. data, J. C. Huaranca unpub. data, N. Lagos, unpub. data). The largest subpopulation contains an estimated 172 mature individuals (see Supplementary Information to the Red List Assessment. Additionally, a continued decline of the population was inferred from the threats (habitat loss and degradation, persecution, climate change), the natural fragmentation of the habitat and the increasing trend in fragmentation due to habitat loss and degradation (Lucherini & Merino 2008, IEB, CASEB, CCG-UC – CONAMA 2010, Novaro et al. 2010, Ribera 2013, Walker et al. 2013, Ministerio del Ambiente 2014, SCDB 2014, Tellaeche 2015, M. Bennett et al. subm., *published as Bennett et al. 2019*.).

Geographic Range: The Andean Cat has been found in the high Andes of Argentina, Bolivia, Chile and Peru, as well as in the lower southern Andes, but also in Argentina's Patagonian steppe and scrub habitats and Chile's Atacama Region (Perovic et al. 2003, Sorli et al. 2006, Cossíos et al. 2007, Martinez et al. 2008, Napolitano et al. 2008, Novaro et al. 2010, Villalba et al. 2012, Villalobos et al. in prep.). It is patchily distributed throughout its range from central Peru to central Argentina (Cossíos et al. 2007, Novaro et al. 2010). *Recent confirmed records exist from almost the whole range of the Andean Cat (Fig. 3.1.1.1). The notable exception is in central Bolivia, as well as minor areas towards central Peru and northern Argentina. There are very few recent records lying outside the distribution range according to the last Red List Assessment (Fig. 3.1.1.1). They are in central Argentina, southern Bolivia, western Peru, plus an unconfirmed record from eastern Peru (Cossíos & Madrid 2003, Cossíos et al. 2012, Tellaeche et al. 2020).*

Population: In northern Chile, density of Andean Cats was genetically estimated to be 2 individuals per 100 km² (Napolitano et al. 2008). In north-western Argentina, Andean Cat density was estimated from camera traps to be 7–12 individuals per 100 km², compared to 74–79 Pampas Cats per 100 km² (Reppucci et al. 2011) and in central western Bolivia at 1.8 individuals per 100 km², compared to 4.9 Pampas Cats per 100 km² (Huaranca et al. 2013). These densities were estimated in areas that are believed to be among the most favourable for Andean Cat, and where a large number of records stems from (Marino et al. 2011). Elsewhere, the Andean Cat is expected to be rarer and occurring at lower densities. Populations were found to be divided into a northern and a southern "Evolutionary Significant Unit" (ESU). Additionally, the northern ESU is divided into two separate management units (Cossíos et al. 2012). Based on the Andean Cat's EOO and the lowest recorded density, the total population is estimated at 1,378 mature individuals (cf. above). Based on genetic analysis and the Andean Cat's distribution 10 subpopulations were identified. *The Andean Cat is classified as Critically Endangered in Bolivia, Endangered in Chile and Peru, and Vulnerable in Argentina (CONAMA 2009, MMAyA 2009, Ojeda et al. 2012, SERFOR 2018).*

Habitat: Andean Cats are found in arid and sparsely vegetated areas of the high Andes, where they prefer rocky and steep terrains. They can also be found in scrub and steppe habitats, and the Patagonian steppe in the southern Andes in central Argentina (Napolitano et al. 2008, Novaro et al. 2010).

Ecology: Diet studies were performed in Argentina, Bolivia and Chile. The main prey of the Andean Cats are the Short-tailed Chinchilla and the Mountain Vizcacha, and rodents in general (Yensen & Seymour 2000, Walker et al. 2007, Napolitano et al. 2008, Viscarra 2008, Torrico 2009, Marino et al. 2010, Tellaeche 2010). The Andean Cat is solitary apart from in the mating season and females with kittens (Villalba et al. 2004). Camera-trapping in Argentina, Bolivia and Chile generated 37.6% of Andean Cat pictures at night, 34.4% crepuscular, and 28% during the day (Lucherini et al. 2009). A radio-collared cat was most active at dusk and night and covered a home range of 65.5 km² (Villalba et al. 2009). *Male Andean Cats' home range in Argentina was measured at 58.5 km² and 46.9 km² (Kernel 95%), and that of a female at 79.9 km² (MCP 100%; Tellaeche 2015).*

Use & Trade: The Andean Cat and Pampas Cat are by some local communities in Argentina, Bolivia, Chile and Peru known under the same name – titi or osqollo. Their skin or a stuffed animal are used in traditional ceremonies (Villalba et al. 2004). They are also hunted for food and traditional medicine in central Peru (Cossíos et al. 2007).

Threats: see Table 3.1.1.1.

Table 3.1.1.1. Threats to the Andean Cat for different locations according to Villalba et al. (2016) *and other sources*.

Threat	**Location**
Habitat loss (incl. degradation)	Range-wide (AGA 2011, *Bennett et al. 2019*); Patagonia (Walker et al. 2013)
Climate Change	Range-wide (*Bennett et al. 2019*)
Illegal killing (incl. targeted for use, persecution/control)	Range-wide (Villalba et al. 2004); Argentina (Lucherini & Merino 2008, Tellaeche & Lucherini unpublished data); Bolivia (Villalba et al. 2012); Chile (Iriarte 1998, Sanderson 1999); Peru (Cossíos & Madrid 2003, Cossíos et al. 2007, *Pino Charja 2017*); Patagonia (Novaro et al. 2010, *Novaro et al. 2017*)
Prey depletion (incl. intra-guild competition)	Range-wide (Nowell & Jackson 1996); Argentina (Lucherini & Luengos Vidal 2003, Walker et al. 2007, Reppucci 2012)

Knowledge base

The available knowledge base is quite good with robust information available for significant parts of the range of the Andean Cat. However, readily available information and data on several aspects are also still lacking for this species. The distribution of the Andean Cat is quite well known and a distribution model has been made for the species. Ten subpopulations and their extent have been identified. Recent confirmed records cover the majority of the known distribution range. Three population density estimates exist from some of the most favourable habitat, but not for less favourable areas. The population size has been estimated, however, the information on population size is somewhat confusing (see Evaluation of the Red List Assessment). Habitat types, use and requirements, diet, activity and (spatial) ecology are known, but in some cases only from a couple of areas and not from across the range. Some information on the use and trade of the species is known, such as the source and purpose of it as well as some details on its local and traditional use. However, the trend and amount are not known and references in this section are from <2008. Threats across the range are stated but their impact and scope are not known. A network exists since 1999, and Conservation Plans were developed in 2004 and updated in 2011.

Evaluation of the Red List Assessment

The assessment of the Andean Cat (Villalba et al. 2016) needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available, the Justification should include more information to justify the Category and Criteria chosen;
- The Justification could be shortened only highlighting key issues to summarise the reasons of the listing;
- The Criterion under which the Andean Cat is listed should be mentioned in the Justification;
- The continuing decline in mature individuals and in subpopulations as well as the population size estimation should be further explained;
- Differences between the number of mature individuals estimated for all 10 subpopulations and the number of mature individuals estimated based on EOO should be explained;
- Some of the information is not stated under the appropriate section e.g. the EOO is not stated under Geographic Range, the number of mature individuals and the population decline are stated in the Justification but not under Population, some threats are only mentioned in the Justification but not under Threats;

The listing as Endangered C2a(i) (small population size and decline; → Appendix I) is based on an inferred continuing population decline and an estimated number of mature individuals of 1,378. Such population decline is assumed to be the consequence of increasing habitat loss and fragmentation. In the newest version of the IUCN Red List Guidelines (V15.1, 2022) the definitions of the data qualifiers (observed, estimated, inferred, suspected) were specified. Based on these specifications, the continuing decline would now be classified as suspected and not inferred. The number of mature individuals was estimated based on the lowest density (1.8 per 100 km^2) registered for the species applied to 10% of the EOO and taking 50% as mature individuals. Why 10% of the EOO was assumed to be occupied by Andean Cat and why 50% of the population is assumed to be mature individuals should be further explained. There is a significant difference in number of mature individuals estimated for the 10 identified subpopulations (436) and the number based on 10% of the EOO (1,378). Additional explanations would help to understand this difference.

Table 3.1.1.2. Evaluation matrix of the Andean Cat. According to the Criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟢	🟡	🟡	🟡
Consistency of RLA	🟢	🟡	🟢	🟢	🟡	🟡
New information since last RLA	🟡	🔴	🔴	🟡	🔴	🟡

Conclusions and recommendations

The information and knowledge available on the Andean Cat are quite good (Table 3.1.1.2; Fig. 3.1.1.1). Several species-specific projects are taking place with accessible information, and a conservation strategy as well as a network for the Andean Cat exists. Its classification as Endangered should be strengthen by further explanations so that the readers can follow easier the reasoning behind it. Furthermore, the RL Guidelines have been specified in a crucial aspect of the assessment (concerning the definitions of the data qualifiers). Additionally, the points listed above should be addressed in the

next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines. Therefore, although there is little new available information on the species, there is a need for a re-assessment of the Andean Cat for the IUCN Red List.

There is a need for:

- Confirmation of the number of Andean Cat subpopulations and their connectivity between each other;
- Increased amount of data on abundance and/or density estimates distributed over the range;
- Clarification of the Andean Cat's taxonomy (→ Chapter 1);
- Assessment of the impact of threats, especially the impact of harvest/trade;
- Revision of Conservation Strategy (last version from 2011–2016);
- Re-assessment of the species for the IUCN Red List.

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3.1.2 Pampas Cat (*Leopardus colocola*)

Near Threatened A2c (Lucherini et al. 2016)

Red List history

Year	1994	1996	2002*	2008	2016
cat. & crit.	I	LR/LC	NT	NT (close to VU A3)	NT A2c (close to VU A2c)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

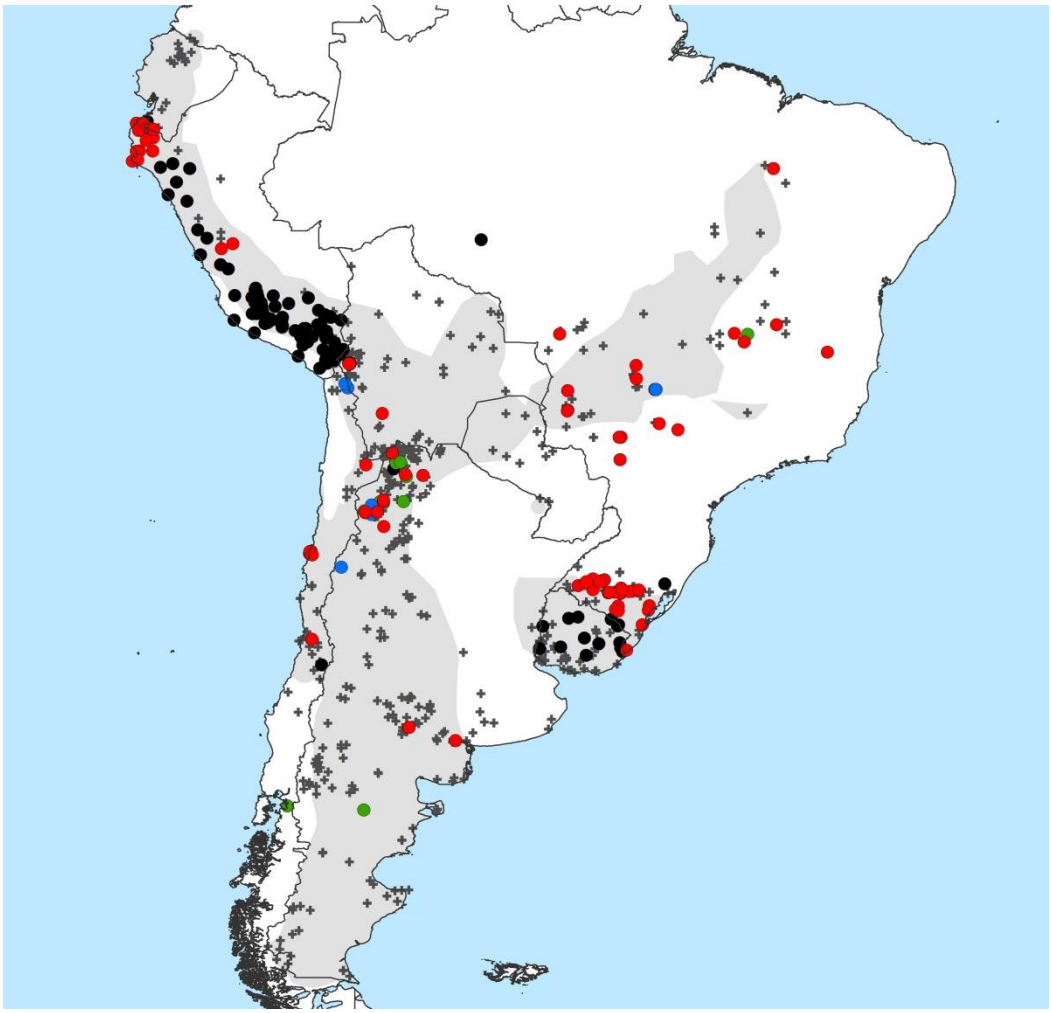

Fig. 3.1.2.1. Pampas Cat observation records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Lucherini et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The taxonomy of the Pampas Cat is not yet fully understood and requires further research. Currently, seven subspecies are recognised, namely: *L. c. colocola, L. c. braccatus, L. c. munoai*, *L. c. budjnj*, *L. c. garleppi, L. c. pajeros,* and *L. c. wolffsohni* (Kitchener et al. 2017).

Justification: The Pampas Cat is listed as Near Threatened. It is generally (very) rare (5–20 individuals per 100 km²) and thought to be declining in various parts of its range. The main reason for the decline is habitat loss, aided by predation by Dogs, hunting and road mortality. The available data from the dry Gran Chaco indicates a loss of 0.63–1.75 % of habitat per year through transformation to cropland (Clark et al. 2010), in which the Pampas Cat does not occur. With a generation length of seven years (Pacifici et al. 2013), this amounts to a population decline of up to 36.5% over three generations. Moreover, the taxonomy of the Pampas Cat is still not fully resolved, but clear differences were found between regional subpopulations. These may represent different subspecies or even different species *(see also Kitchener et al. 2017)*. Little or no historical and/or current gene flow was found between some of these populations, further threatening the long-term viability of the Pampas Cat. Consequently, the conservation status of these regional populations should be regarded separately. Based on all these considerations, and because neither its abundance nor the reasons for its rarity are known, Near Threatened is the likely category (almost qualifying for a threatened category under A2c). It may qualify for Vulnerable in the future and requires monitoring.

Geographic range: The Pampas Cat occurs in most of Argentina, but appears to be extinct in the Pampas of central Argentina, except in the southern and dry portion (Pereira et al. 2002 and recent unpublished surveys). In the Argentine Espinal, it is limited to grassland habitats. It is similarly limited to the high-altitude grasslands in the Yungas eco-region in north-west Argentina (Di Bitetti et al. 2011). The species is found throughout most of Uruguay as well as in the dry forests (chaco, cerrado) of Bolivia, Paraguay, Brazil and along the Andean Mountain chain through Peru and Ecuador, and possibly marginally into Colombia (Silveira 1995, Nowell & Jackson 1996, Ruiz-Garcia et al. 2003, Dotta et al. 2007). However, a survey on small cats was unable to detect the Pampas Cat in the Bolivian chaco dry forest (Cuellar et al. 2006). In the Brazilian pampas, it is limited to the well-preserved habitat areas. *Recent confirmed records exist only from very limited areas within the Pampas Cat's distribution range (Fig. 3.1.2.1). Especially eye-catching are the clusters in north-western Peru and Ecuador, where camera-trapping was performed (García-Olaechea & Hurtado 2018), and in southern Brazil, which stem from a compilation of road mortalities across the country and across species (Grilo et al. 2018). Moreover, a number of recent confirmed records is known from the border area between Argentina, Chile and Bolivia. Elsewhere, recent confirmed records are scarce (Fig. 3.1.2.1). Recent confirmed records are lacking from the majority of the range in all range countries. However, some of the existing recent confirmed records in Brazil lie outside the known distribution range, extending its range towards the east (Nascimento et al. 2016, Silva Arimoro et al. 2017, Dias 2017, Breviglieri et al. 2018, Grilo et al. 2018, Valadão et al. 2018, de Oliveira et al. 2020). There is also an unconfirmed recent report from Chile from outside the extant and possibly extant distribution range (Diaz-Ruiz et al. 2019).*

Population: In Brazil, the Pampas Cat is listed as Vulnerable (C1) (Queirolo et al. 2013). The situation is thought to be the same in Uruguay. The Pampas Cat is considered rare in most of Patagonia, where it is less recorded than other felids. In the Brazilian pampas, the Pampas Cat was found to be rarer than Geoffroy's Cat as well. In Argentine Mesopotamia (Corrientes province), the species is also thought to be rare. The same is the case for the Monte eco-region (Pereira et al. 2011) the Yungas eco-region (Di Bitetti et al. 2011) and for Peru. The population in the High Andes and Puna of Argentina are thought to be stable, but in central Argentina (Cordoba, San Luis) it appears to be declining (Pereira et al. 2002). In Bolivia and Peru, the population is in slight decline, too. The subpopulation in the Tumbesian region, western Ecuador & north-western Peru, appears to be morphologically distinct, but is now extremely rare as well. The population in Uruguay and the Brazilian state of Rio

Grande do Sul was shown to be genetically distinct from those in the Brazilian Cerrado and from the populations in Argentina (Santos et al. in prep.). Densities were estimated for the High Andes & Puna eco-regions (74–78 individuals per 100 km²; Gardner et al. 2010), the Argentine Espinal (11–17 individuals per 100 km²; Caruso et al. 2012), the Brazilian Pampas grasslands, marshy Pantanal and Cerrado savannas (1–5 individuals per 100 km², but possibly more common in protected areas; Araujo Bagno 2004, Godoi et al. 2010) and Mirador State Park, Brazil (10–20 individuals per 100 km²; Oliveira et al. 2010, Oliveira 2011). *The Pampas Cat is listed as Vulnerable in the National Red Lists of Argentina, Bolivia and Ecuador (MMAyA 2009, Espinosa & Tirira 2011, Ojeda et al. 2012). In Ciudad de Piedra Area, Bolivia, a Pampas Cat density of 4.9 individuals per 100 km² was estimated (Huaranca et al. 2014).*

Habitat: The Pampas Cat is found in rather open habitats outside South America's moist forests, i.e. dry scrub and grassland, but also dry woodland, swampy wetland and rocky areas (Silveira 1995, Nowell & Jackson 1996, Pereira et al. 2002, Tellaeche 2015). *Pampas Cats were also found in mangrove areas (García-Olaechea & Hurtado 2017), in the Atacama Desert (Rau et al. 2015), the Sechura desert (García-Olaechea & Hurtado 2020) and on military training areas in Brazil (Silva Arimoro et al. 2017).*

Ecology: Pampas Cats mainly feed on small mammals, including mountain viscachas and small rodents, but also on ground-dwelling birds (Nowell & Jackson 1996, Silveira et al. 2005, Walker et al. 2007, Napolitano et al. 2008, Fajardo et al. 2014). In Emas National Park, Brazil, they were found to be mainly, but not exclusively, diurnal (Silveira et al. 2005), whereas in the High Andes, 71% of camera trap photos were taken at night (Lucherini et al. 2009). Home range (90% MCP) in Emas National Park, Brazil averaged 19.5 km² (Silveira et al. 2005), whereas in the High Andes, their home ranges averaged 14.9 km² (95% Kernel; Tellaeche 2015). *Specifically found among Pampas Cat prey items were also Guinea Pigs (Migliorini et al. 206), House Mice and Rats (García-Olaechea & Hurtado 2018), introduced European Hares (Buenavista & Palomares 2017), Ducks (Fajardo Quispe 2014) and lizards (García-Olaechea & Hurtado 2018). Pampas Cats were cathemeral in Peru's Sechura Desert and in the seasonally dry tropical forest stretching across Peru and southern Ecuador. However, there was less diurnal activity in the desert than in the dry forest (García-Olaechea & Hurtado 2020). In the mangrove forest of San Pedro de Vice, north-western Peru, preliminary home range size of a female was 1.8 km² after six months of observations (García-Olaechea & Hurtado 2018). In the Jujuy Province, Argentina, the home range of a male reached 43.4 km², while two females occupied home ranges of 8.6 km² and 9.6 km², respectively (100% MCP; Tellaeche 2015). In the high Andes of Bolivia, one female Pampas Cat had a home range of 55.3 km² (Villalba et al. 2009).*

Use & Trade: The Andean Cat and Pampas Cat are by some local communities in Argentina, Bolivia, Chile and Peru known under the same name – titi or osqollo. Their skin or as a stuffed animal are used in traditional ceremonies (Villalba et al. 2004). They are also hunted for food and traditional medicine in central Peru (Cossíos et al. 2007). *García-Olaechea & Hurtado (2018) recorded two captures for the pet trade.*

Threats: see Table 3.1.2.1.

Table 3.1.2.1. Threats to the Pampas Cat for different locations according to Lucherini et al. (2016) *and other sources*.

Threat	Location
Habitat loss (incl. degradation)	High Andes (Bolivia, Peru); Argentina; Brazil; Peru
Illegal killing (Persecution/control)	High Andes (Bolivia, Peru); Brazil; Peru
Predation by Dogs	High Andes (Bolivia, Peru); Brazil Peru
Road mortality	Brazil (*Fischer et al. 2003, Grilo et al. 2018)*
Hybridisation with *L. tigrinus*[1]	Central Brazil (Trigo et al. 2008)

[1]The study by Trigo et al. (2008) was performed before the split of L. tigrinus and L. guttulus. The locations where the hybrids were found lie in the range of today's L. guttulus, or in one case just north of the boundary between the species, which is still uncertain and the degree of overlap is not known.

Road mortality: According to the Red List (Lucherini et al. 2016), "given [the Pampas Cat's] rarity, in Brazil, road kills are also considered a threat for some populations." *A review of 21,512 road kills in Brazil from 1988 to 2017 was able to identify 33 road killed Pampas Cats (plus 9 not further identifiable Leopardus sp. And 8 not further identifiable felids; Grilo et al. 2018).*

Knowledge base

The available knowledge is limited. The distribution range is not known in detail in large parts of its range. Recent confirmed records are lacking from the large majority of the extant and possibly extant distribution range in all range countries. However, in Brazil, there are some recent confirmed records from outside the RL distribution range. Only few density estimates exist and no abundance estimates appear to have been carried out at either regional or global level. It is known from a variety of habitats, and several diet studies have been undertaken. However, there is less information available on habitat use, activity and home ranges. Even with the new information on home ranges from two different areas (from a total of 1 male and 3 females), sample sizes are still quite small. Some information on use and trade of the species is known such as the source and purpose of it as well as some details on its local and traditional use. However, the trend and amount are not known and references in this section are from <2008. General threats are known, but without their impact and scope (and without reference).

Evaluation of the Red List Assessment

Little information is available on the Pampas Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available the Justification should include more information to justify the Category and Criteria chosen;
- The suspected population decline should be supported by more evidence and further explanations, e.g. on the impact of threats;
- The Justification includes key information not stated anywhere else in the assessment (e.g. assumption and justification of the suspected decline in population size based on habitat loss);

- Some statements should be better aligned with each other, e.g. in the Justification it is stated that habitat (quality) loss is the major cause for the population decline, but neither under Geographic Range nor under Habitat and Ecology a continuing decline in AOO, EOO or habitat quality is specified. In the Justification, forest loss in the dry Chaco is given as evidence for habitat loss but under Habitat and Ecology the typical habitat type of the Pampas Cat is stated to be the dry scrub and grasslands;
- The calculation of the EOO would provide further information;
- Several of the then available publications were not considered, e.g. Beltran et al. 2009, Cossíos et al. 2009, Garcia Esponda et al. 2009, Lucherini et al. 2009, Villalba et al. 2009, Giordano et al. 2012, Santos 2012, Villalba et al. 2012, da Silva et al. 2014, Espinosa et al. 2014, Huaranca et al. 2014 and Cuyckens et al. 2015. These publications include information on distribution records, diet, population structure (management units) and evidence of hybridisation with *Leopardus tigrinus*.

The listing as Near Threatened under Criterion A, Subcriterion A2c (population size reduction in the past; → Appendix I) is based on a suspected population size reduction of 36.5% in the past 21 years (three generations). Such population decline is assumed to be the consequence of loss of habitat and reduction in its quality, and of other threats such as predation by Dogs, hunting and road kills. Additionally, a limited or non-existent gene flow between populations is mentioned. The suspected population decline should be further supported by more explanations and evidence beside the stated yearly forest transformation into cropland of 0.63 to 1.75% in the dry Chaco region. Moreover, the species is stated to be found in different habitats (grasslands, marshy Pantanal, savannas, dry scrub, dry woodland, swampy wetland, rocky areas, forested areas, agricultural fields, sugar cane plantations, sparse desert). The Pampas Cat is stated to be rare or very rare based on densities of 5–20 individuals per 100 km^2, but in some regions it can reach densities of 74–78 per 100 km^2. Compared to densities of other small cat species in South America (e.g. Southern Tiger Cat 1–25, Northern Tiger Cat 1–20, Andean Cat 7–12 individuals per 100 km²), the Pampas Cat seems to be more abundant than other small cat species.

Table 3.1.2.2. Evaluation matrix of the Pampas Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🟡	🔴	🟡	🟡	🔴
Consistency of RLA	🟡	🟡	🟡	🟡	🟡	🟡
New information since last RLA	🟡	🔴	🟡	🟡	🔴	🟡

Conclusions and recommendations

The information and knowledge available on the Pampas Cat are limited (Table 3.1.2.2; Fig. 3.1.2.1). One species-specific project and some studies have been conducted on the Pampas Cat. Its classification as Near Threatened should be further supported by more explanations and the provision of more evidence so that the reader can follow easier the reasoning behind it. Additionally, the points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines. Therefore, although there is little new available information on the species, there is a need for a re-assessment of the Pampas Cat for the IUCN Red List.

Our knowledge base on the Pampas Cat must be expanded. There is a need for:

- Confirmation of the Pampas Cat distribution (incl. gathering of by-catch data from camera-trapping surveys);
- Clarification of the Pampas Cat taxonomy
- Quantitative data on Pampas Cat abundance and/or densities and trend;
- Confirmation of the Pampas Cat habitat use;
- Information about the Pampas Cat's ecology;
- Assessment of the impact of threats (incl. use and trade) on the Pampas Cat;
- Establishment of a conservation plan, where appropriate;
- Re-assessment of the species for the IUCN Red List.

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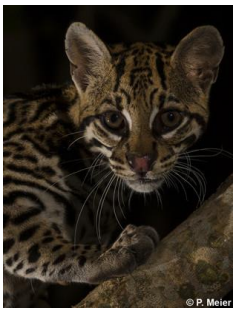
3.1.3 Ocelot (*Leopardus pardalis*)



Least Concern (Paviolo et al. 2015)

Red List history

Year	1982	1986	1988	1990	1996	2002*	2008	2015
cat. & crit.	VU	VU	VU	VU	LR/LC	LC	LC	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

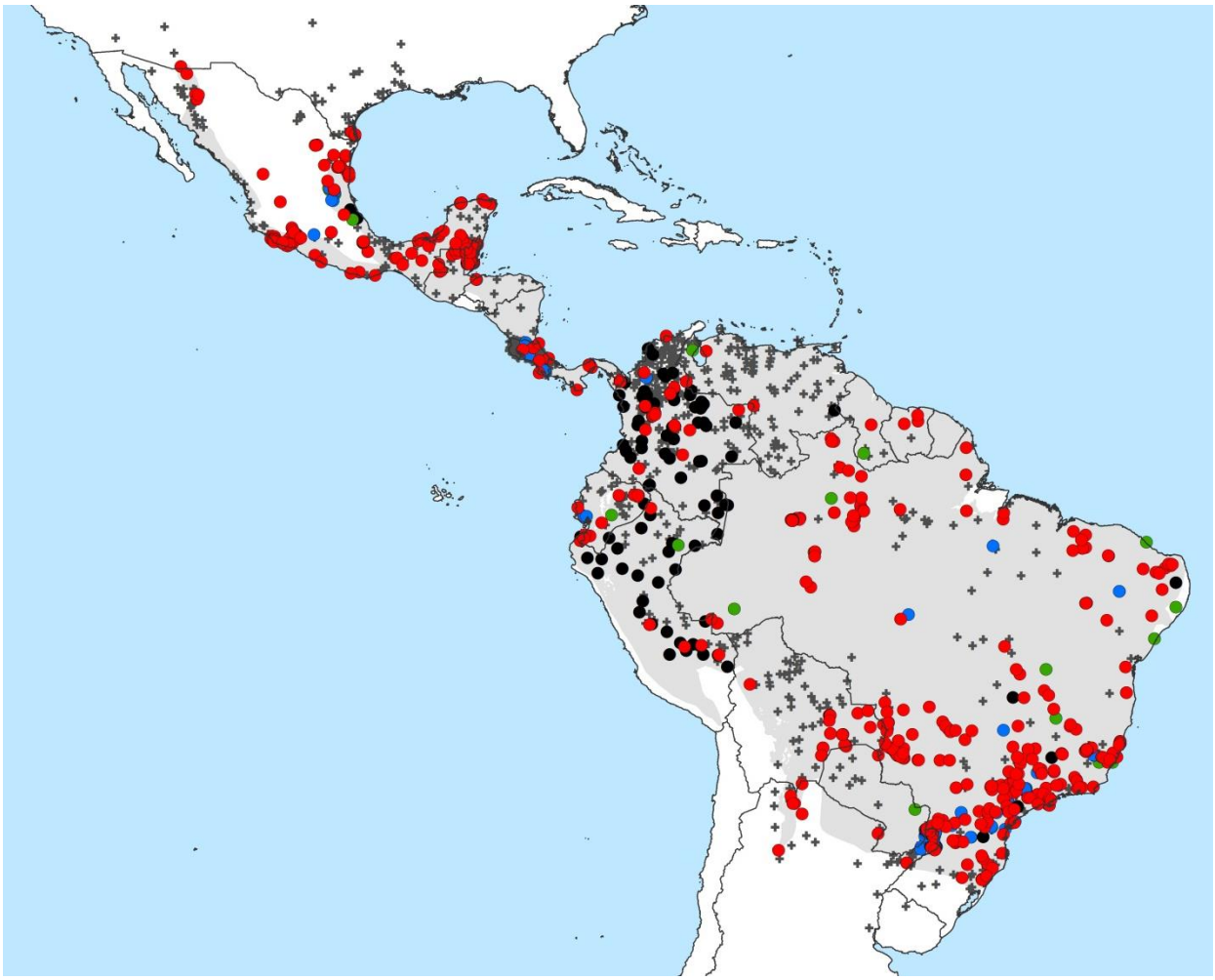


Fig. 3.1.3.1. Ocelot records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Paviolo et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: The Ocelot is currently recognised to have two subspecies, namely *L. p. pardalis* and *L. p. mitis* (Kitchener et al. 2017). More research, however, is needed as a 2010 study suggests that these two subspecies are actually different species.

Justification: The Ocelot is listed as Least Concern, due to its wide distribution from the south-western United States to northern Argentina, and being typically the most common feline throughout this range. Ocelot densities are suggested to have a positive relationship with rainfall and a negative relationship with latitude, given the highest densities are found in Tropical areas (Di Bitetti et al. 2008). While populations of > 40,000 mature individuals can be found in Brazil (Oliveira et al. 2013), other areas contain significantly smaller populations, and some areas face population declines. Regardless, these population declines have not yet been considered enough of a threat to change the range-wide Red List classification of the Ocelot. However, with the proliferation of habitat loss and fragmentation, logging activities, vehicle collisions and poaching, the Ocelot may be facing a suite of exponentially harmful threats (Di Bitetti et al. 2008, Payan et al. 2013). Nonetheless, the Ocelot in Colombia has managed to survive in oil palm landscapes and cattle ranches (Boron & Payan 2013, Diaz-Pulido & Payan 2011). Additionally, in Argentina, although under heavy pressure from poaching and logging in the subtropical areas (Di Bitetti et al. 2006, 2008, 2010), Ocelots persist with a population size of 1,500–8,000 individuals (Aprile et al. 2012). Although these populations indicate some resistance to human influence, the populations of north-eastern Mexico and Texas on the other hand, have experienced drastic declines as well as a reduction in genetic diversity as a result of population isolation (Janecka et al. 2011, 2014). The number of Ocelots in Texas is thought to be around 50–80 individuals. The future of these Ocelot populations remains uncertain if conservation attention is not directed there. The overall population trend is indicated to be decreasing.

Geographic Range: Currently, the Ocelot's distribution spans from Texas in the US along the coast of Mexico throughout Central and South America, south to north-eastern Argentina and throughout Brazil *(De Bastiani et al. 2015)*. The Ocelot does not occur in Chile. Previously it was recorded in the United States in Arizona and Arkansas (Stangl & Young 2011, Avilas-Villegas & Lamberton-Moreno 2012). *However, there are at the moment three recent confirmed records in the United States; one camera trap record from southern Arizona (Anonymous 2012) and two from southern Texas (Haines et al. 2005, Sternberg & Mays 2011). There is an old record in Arkansas (Rappole et al. 1985) and one in California (Rappole et al. 1985). Recent confirmed records of the Ocelot exist only across parts of its range (Fig. 3.1.3.1). Most recent confirmed records origin from camera trap studies. Recent confirmed records outside the RLA range of the Ocelot exist in Argentina (Albanesi et al. 2016), Colombia (Cruz-Rodríguez et al. 2015, Jiménez-Alvarado et al. 2015, Boron et al. 2018, Meza-Joya & Cardona 2019) and Mexico (Barcenas & Medellin 2010, Charre-Medellín et al. 2015, Martinez-Calderas et al. 2015, García-Bastida et al. 2016, Galindo Aguilar et al. 2016, Servín et al. 2016, Hernández-Sánchez et al. 2017, Peña-Mondragon & Peña-Cuellar 2017, Perez-Valdez 2018).*

Population: Population densities vary greatly, but range roughly from 2.5 – 160 individuals per 100 km². It has been suggested that Ocelot densities decrease with latitude and increase with rainfall due to an increase in productivity (Di Bitetti et al. 2008). Primary productivity is thought to determine the abundance of Ocelots across their range, but at local scales, their abundance is often negatively affected by logging, poaching, or by competition with other species (Di Bitetti et al. 2008). The lowest densities were found in the Pine Forest of Belize (Dillon & Kelly 2007), in dry areas of Mexico (González et al. 2003), and in the Caatinga in north-eastern Brazil (Oliveira 2012). The maximum estimated density was found on the Barro Colorado Island in Panama (Rodgers et al. 2014). The species is considered Endangered in the United States (U.S. Fish and Wildlife Service 2010) and Mexico (Norma Oficial Mexicana 2010), and Vulnerable in Colombia (Rodriguez-Mahecha et al. 2006), Argentina (Aprile et al. 2012) and populations outside the Amazon region in Brazil (Machado et al. 2005). *Densities as low as 1.58 individuals per 100 km² were found in Sonora Mexico (Gomez-Ramirez et al. 2017),*

4–18 individuals per 100 km² in the Sierra Abra-Tanchipa Biosphere Reserve region, San Luis Potosí, Mexico (Martinez-Hernandez et al. 2014), 11.8 individuals per 100 km² on average on the Fazenda São Nicolau, Mato Grosso State, Brazil, (Trinca 2014) and 1.8 individuals per 100 km² in the Bojonawi Reserve in Colombia (Garrote et al. 2019). In Ecuador, Ocelot densities are reported as being higher in the dry season than rainy season (Romo et al. 2017), indicating that the correlation between primary productivity and abundance is inconsistent across the Ocelot's range. In Colombia, in Corpoguavio jurisdiction, Ocelot density was estimated at 46.6 individuals per 100 km² (Valderrama-Vásquez 2013), in Kaa-Iya del Gran Chaco National Park, Bolivia, at 1.7–51.7 individuals per 100 km² (Noss et al. 2012) and in the Talamanca-Caribe Biological Corridor, Costa Rica at 10.3–6.5 individuals per 100 km² (Gonzales-Maya & Cardenal-Porras 2011).

Ocelots are currently classified as Least Concern due to their assumed high abundance and genetic diversity. However, if habitat fragmentation persists, genetic diversity may be lost, calling for urgent reassessment of their conservation status, by considering other contributing factors (Monroy-Vilchis et al. 2019).

Habitat: The Ocelot occupies a wide range of well-structured habitat types with sufficient vegetation cover, ranging from scrublands to tropical rainforests (Emmons 1988, Emmons et al. 1989, Sunquist & Sunquist 2002). They have been recorded up to 3,000 m, but typically occur below (Nowell & Jackson 1996, Sunquist & Sunquist 2002), in mangrove forests, costal marshes, savanna grasslands, thorn scrubs, as well as tropical and subtropical forest (primary, secondary, evergreen, seasonal and montane). *The Ocelot tends to be most commonly associated with closed, dense habitats such as evergreen forest (Tardio & Da Silveira 2015, De Cassia Bianchi et al. 2016, Janecka et al. 2016, Regolin et al. 2017, Monroy-Vilchis et al. 2019), and areas near fresh water (Vera 2017, Wolff et al. 2019). Ocelot habitats however may also include tropical (Torres-Romero et al. 2017) and subtropical dry forest (Monterrubio-Rico 2017), floodplain forests (Tobler et al. 2015), coniferous, evergreen, deciduous, or semi-deciduous forests (Perez-Valdez 2018), coastal forests (Ferreguetti et al. 2017), lowland forests (Mosquera et al. 2016), montane and pre-montane forests, riparian forests (Zimbres et al. 2018) as well as riparian corridors (Michalski et al. 2010). Ocelots significantly avoid Bamboo forests (Vera 2017). They may also occur in dry thorn scrub of the semiarid chaparral, Caatinga and Chaco (Penido et al. 2016, Penido et al. 2017), in mangroves and seasonally flooded savanna, both pristine and disturbed (Torres-Romero et al. 2017). Ocelots have also been recorded in mosaic habitats where the native vegetation has been partially replaced by pine plantations, oil palm plantations (Boron et al. 2018), wetland palm plantations (Yaap et al. 2015), or agricultural fields. Moreover, Ocelots are sensitive to human presence and activity as well as the occurrence of domestic Dogs (De Matos Dias et al. 2019), and rarely occur abundantly in areas where these factors are high (Blake et al. 2016, Bogoni et al. 2016, Boron et al. 2018).*

Ecology: Ocelots are typically nocturno-crepuscular, with occasional daytime activity (Oliveira & Cassaro 2005, Di Bitetti et al. 2006), and are generally the most abundant cat species throughout their range. They are also suggested to negatively impact smaller sympatric felids (Di Bitetti et al. 2010, Oliveira et al. 2010). The Ocelot does not appear to be negatively affected by Jaguars and Pumas, despite using similar habitats (Di Bitetti et al 2010, Davis et al. 2011). Their diet is made up of mostly small mammals, birds and reptiles, but may also include larger sized prey (>800 g) such as Agoutis, Pacas, armadillos and monkeys (Crawshaw 1995, Sunquist & Sunquist 2002, Moreno et al. 2006, Bianchi et al. 2010, *Rocha-Mendes et al. 2010*). Males have larger home ranges than sympatric females, but there is high variation in home range sizes between regions (Dillon & Kelly 2008). In the subtropical forests of Brazil and Argentina, the largest home ranges were identified (43 km² for males, and 16 km² for females; Crawshaw 1995), whereas the smallest home ranges (2–6 km² for males and 1–3 km² for females) were observed in Texas, the Brazilian Pantanal, the Peruvian Amazo-

nia and the Bolivian Chaco (Lopez 1985, Emmons 1988 Crawshaw & Quigley 1989, Laack 1991, Maffei & Noss 2008).

At Laguna Atascosa NWR, Texas, U.S. Ocelots preyed primarily on rodents but also on birds and lagomorphs (Booth-Binczik et al. 2013). Mainly rodents were also preyed on in Devonian Scarp, Parana, Brazil (Silva-Pereira et al. 2011). At *Los Ebanos Ranch, Tamaulipas, Mexico, mean home ranges of 15.1 and 8.5 km² were found for males and females respectively (Caso 2013). Many studies challenge the "ocelot-effect" that the Ocelot has a negative effect on the smaller cat species (Perez-Irineo & Santos-Moreno 2016), and argue that the distribution of small and medium felids is more strongly influenced by prey availability and landscape attributes such as forest type (Perez-Irineo et al. 2017) than by intraguild competition (Nagy-Reis et al. 2017). It has also been suggested that the Ocelot's nocturnal behaviour is an avoidance mechanism, allowing it to coexist with the cathemeral Puma and diurnal humans (Salvador & Espinosa 2015, Massara et al. 2018, Mendes et al. 2020). Research from the Brazilian Caatinga suggests that Ocelots are more predominantly nocturnal in areas with harsh conditions such as extreme heat by day compared to less harsh environments, where daytime activity is more common (Penido et al. 2017). There is also research to suggest that Ocelot hunting efficiency improves in full moon, due to switching their target prey species according to the moon phases. Furthermore, although at higher risk of predation from Puma or Jaguar by increased moonlight, the benefit of greater foraging on bright nights outweighs the risk of predation (Pratas-Santiago et al. 2016). Ocelots use communal latrines as well as scent marking by spraying urine as a message board between conspecifics (Woolridge et al. 2019). It has been suggested that both males and females use communal latrines and scent marking to advertise breeding condition, or to assess the area for suitable mates (Rodgers et al. 2015, King et al. 2016, Romo et al. 2017). Home range size is possibly strongly influenced by the spatial distribution and availability of prey and mating opportunities (Machado et al. 2017). In Belize, average home ranges of females reached 21.1 km² while male home ranges were 33.0 km² (95% fixed kernel; Dillon 2005). Intrasexual overlap in home ranges is common, because it is costly to maintain individual territories when density is high (Rodgers et al. 2015). The Ocelot can hybridise with the Margay. Hybrids were found in the Beni Cerrado, north-east of Bolivia (Dias 2013).*

Use & Trade: The Ocelot is threatened by the illegal trade of pets and pelts (Sunquist & Sunquist 2002). *Although widespread commercial harvests for the fur trade ceased decades ago, illegal fur and souvenir trades still persist (D'Cruze et al. 2017, Avila-Najera et al. 2018), and Ocelots are also still used in the pet trade (Santos-Fita et al. 2012, Romo et al. 2017).*

Threats: See table 3.1.3.1.

Table 3.1.3.1. Threats to the Ocelot for different locations according to Paviolo et al. (2015) *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation)	Range-wide (Sunquist & Sunquist 2002, *Graham 2017*); Argentina (Di Bitetti et al. 2008, *Figueiredo et al. 2015*); *Belize (Wultsch et al. 2016);* *Brazil (Crouzeilles et al. 2015, Figueiredo et al. 2015, Delciellos 2016, Nagy Reis et al. 2017, Costa et al. 2019);* *Colombia (Boron et al. 2018, Garcia-R et al. 2019);* *Mexico (Gil-Fernandez et al. 2017, Mora 2017, Cogan 2018);* *U.S.A. (USFWS 2016)*
Illegal and incidental killing (incl. targeted hunting for use and trade, persecution/control)	Range-wide (Sunquist & Sunquist 2002); Argentina (Di Bitetti et al. 2008); *Brazil (Delciellos 2016, Peters et al. 2016, D'Cruze et al. 2017);* *Mexico (Santos-Fita et al. 2012, Lira-Torres et al. 2014);* *Peru (Sánchez & Vasquez 2007, Hurtado & Pacheco 2015)*
Road mortality	*Brazil (Saranholi et al. 2015, Magioli et al. 2016, Pasa et al. 2019);* *Mexico (Cogan 2018, Gonzalez-Gallina & Hidalgo-Mihart 2018);* *U.S.A. (USFWS 2016)*
Poorly managed protected areas	*Colombia (Garrote et al. 2019)*
Diseases	*Brazil (Braz & Umeda 2016, Furtado et al. 2016, Soares et al. 2017, Stella et al. 2017, Wriblewski et al. 2018, da Cunha Araujo et al. 2019)*
Competition from free-ranging domestic Dogs	*Brazil (Paschoal et al. 2012, Massara et al. 2015)*

Knowledge Base

The knowledge base on the Ocelot is relatively good. There are many publications including the Ocelot with some focusing on the species itself. The distribution of the Ocelot is relatively well known but there are several regions for which no recent confirmed records exist (Fig. 3.1.3.1). No recent population abundance or trend estimates exist. Only a guestimate for the global population, a population estimate for Argentina and one for Texas (U.S.) are available, their basis, however, is unknown. Several population density estimates exist across the Ocelot's range but the density is highly variable. The preferred habitats of the Ocelot are well documented, as well as their occasional use of mosaic habitats. There are several home range estimates for the species. Some information on its ecology is available such as on its diet, activity patterns as well as hunting and marking behaviour. Few information on its use and trade exists. The amount of trade is unknown and consequently also its significance as a threat. General threats are known across most of its range but their impact and scope are not well researched. Some new threats have been identified since the last RLA (Table 3.1.3.1). There is a recovery plan for the Ocelot in the U.S. but no further plans for any other range country.

Evaluation of the Red List Assessment

The RLA for the Ocelot (Paviolo et al. 2015) is generally well done. However, it needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The Justification includes some key information not stated anywhere else in the assessment e.g. global population guestimate, population size estimates for Argentina and Texas; regional population trends, some information on threats;
- Where available, the Justification should include more explanation on why the Ocelot is listed as Least Concern, e.g. estimation of the effective population of > 40,000 mature individuals and that the Ocelot is the most common species;

- The population size estimation should be further explained;
- The calculation of the EOO would add information;
- The information provided in the assessment could be expanded;
- The indicated current decreasing population trend should be supported by further explanations;
- It would be good to give some further information on the density estimates e.g. where they come from;
- In the Use and Trade section the species is not indicated as used. Some information on its value and end use is provided but more details are only provided under Threats;
- Several of the then available publications were not considered (e.g. Goulart et al. 2009, Horne & Haines 2009, Martinez 2009, Payan 2009, Barcenas & Medellin 2010, Rocha-Mendes et al. 2010, Tirelli 2010, Arzate et al. 2011, Gonzales-Maya & Cardenal-Porras 2011, Kuhnen et al. 2011, Monroy-Vilchis et al. 2011, Silva-Pereira et al. 2011, Sternberg & Mays 2011, Rendon-Franco et al. 2012, Ahumada et al. 2013, Caso 2013, Dias 2013, Rocha et al. 2013, Valderrama-Vásquez 2013, Valdez-Jimenez et al. 2013, Cove et al. 2014, de Oliveira & Pereira 2014, Fort 2014, Martinez-Hernandez et al. 2014). These publications include species distribution records and provide information on density, activity patterns, home range, diet, habitat use, diseases and interspecific relations.

The listing of the Ocelot as Least Concern is justified, but more explanations and evidence would help the reader to follow easier the reasoning behind the listing of Least Concern. Its listing is based on the statement that the Ocelot is the most common felid species in most of the tropical and subtropical habitats of the Neotropics and that the indicated population decline does not seem to affect the species as much as to qualify it for a threat Category. Several of the then available publications have not been considered in the last RLA.

Table 3.1.3.2. Evaluation matrix. According to the Criteria and requirements defined in the methods section, the available information at the time of the last assessment, the consideration and correct inclusion of this information into the last Red List Assessment and the new available information since the last Red List Assessment have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟡	🟢	🔴	🔴
Consistency of RLA	🟡	🟡	🟡	🟡	🔴	🟡
New info since last RLA	🟡	🟡	🟡	🟢	🟡	🟡

Conclusions and recommendations

The knowledge base of the Ocelot is quite good and several publications focusing on the species exist as well as many bycatch records (e.g. from camera trap studies on other targets species or biodiversity inventories). Recent distribution information is available for a large part of its extant distribution area and some confirmed records from outside its known range (Fig. 3.1.3.1). Some information was not considered in the last RLA and some new information is available. Therefore, a re-assessment is needed to include this information, consider new distribution records and address the points listed above.

The knowledge base on the Ocelot is quite good. However, there is still a need for:

- Confirmation of the Ocelot's distribution (incl. further bycatch data from camera-trapping surveys of other target species);
- Quantitative data on Ocelot abundance and/or densities and trends;
- Assessment of impact of threats (e.g. habitat loss and fragmentation, poaching);
- Establishment of a conservation plan, where appropriate;
- Conduction of an amendment of the RLA or directly a re-assessment.

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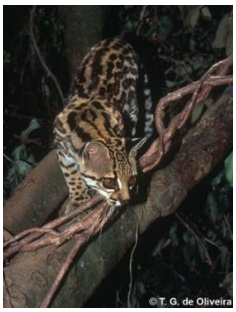
3.1.4 Margay (*Leopardus wiedii*)



Near Threatened A3cde (de Oliveira et al. 2015)

Red List history

Year	1982	1986	1988	1990	1994	1996	2002*	2008	2015
cat. & crit.	VU	VU	VU	VU	K	LR/LC	LC	NT (likely VU A4c in future)	NT (likely VU A3cde in future)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

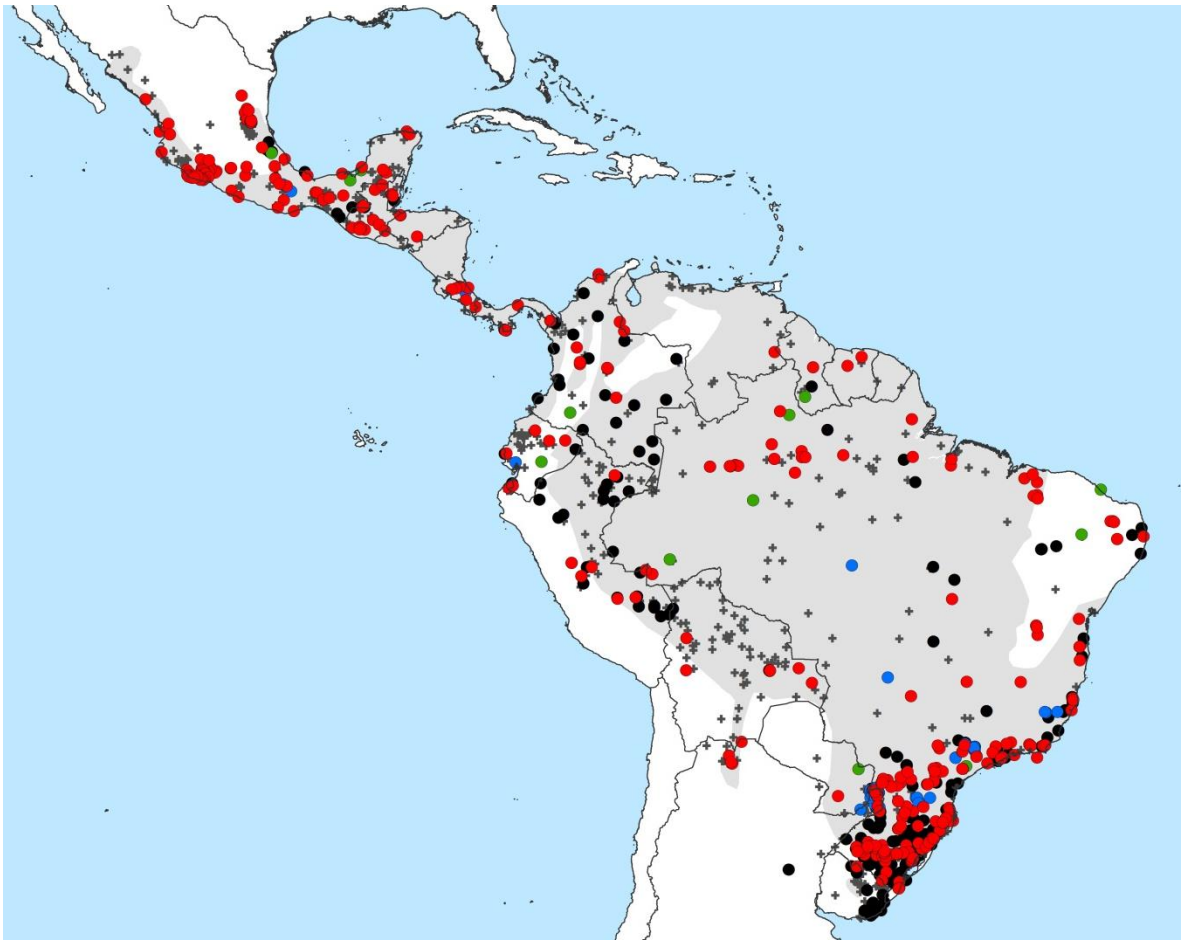


Fig. 3.1.4.1. Margay observation records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (de Oliveira et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: Currently, the Margay is provisionally recognised to consist of three subspecies, namely *L. w. wiedii*, *L. w. glauculus* and *L. w. vigens* (Kitchener et al. 2017). More morphological and molecular research, however, is required.

Justification: Margays are threatened by habitat loss due to land conversion. Populations are expected to decline by almost 30% over the next 18 years (3 generations). Although the global population is thus Near Threatened, individual populations are threatened. The Margay's AOO is much smaller than its EOO. Even in its suggested stronghold of Amazonia, recent estimates showed Margays to be actually rather uncommon (Payán 2009, Oliveira et al. 2010, Oliveira 2011). Throughout much of its range, Margays are negatively impacted by the co-occurring Ocelot ('the Ocelot effect'; Oliveira et al. 2010, Oliveira 2011). Ocelots are especially abundant in protected areas thus Margay conservation should concentrate outside PAs. Viable populations are probably only possible in Amazonia. Typical Margay densities are around 1–5 individuals per 100 km² (Payán 2009, Oliveira et al. 2010, Bianchi et al. 2011, Oliveira 2011, S. Carvajal pers. comm.). The expected further habitat loss in the Amazon over the next 10 years will fragment and isolate the remaining populations in the stronghold, but the same is true elsewhere where the species is much rarer. Protected areas outside the Amazon probably will not (and may not even at present) support viable populations (Oliveira et al. 2010, Oliveira 2011). The Margay will probably soon qualify for VU A3cde and should be periodically reviewed.

Geographic Range: The Margay can be found from Mexico's tropical lowlands southwards to northern Argentina, Paraguay, north-central Rio Grande do Sul state in Brazil and along riverine forests into northern Uruguay (Nowell & Jackson 1996, Dotta et al. 2007, Tortato et al. 2013a). In northeastern Brazil, it can only be found in the Atlantic Forest domain (Oliveira & Cassaro 2005, Tortato et al. 2013a). The Margay's AOO is much smaller than its EOO. *A range wide habitat suitability model estimated a range of approx. 1.5 million km² of highly suitable habitat for the Margay, 5.9 million km² of moderately suitable habitat and 7.1 million km² habitat with a low suitability. The highly suitable habitat was mostly found in Brazil's Atlantic Forest, as well as the forests of southern Mexico, Belize and Guatemala (Espinosa et al. 2018). For most countries few recent confirmed species records exist, the majority comes from southern Brazil, the Atlantic coast and Central America (Fig. 3.1.4.1). These records originate mainly from camera trap studies in certain areas and in southern Brazil additionally from road-mortality surveys (e.g. Grilo et al. 2018). Especially eye-catching are the missing recent confirmed records in central Brazil (Fig. 3.1.4.1). Recent confirmed records outside the known distribution range are from Brazil in Paraiba (Barboza et al. 2016, Barros et al. 2016), Bahia (Meira et al. 2018), Rio Grande do Norte (Barboza et al. 2016) and Rio Grande do Sul (e.g. da Silva et al. 2014, Kasper et al. 2016, Gomide & Loebmann 2017, Grilo et al. 2018), from Uruguay (e.g. Caravino et al. 2017, Espinosa et al. 2018, Bergos et al. 2018), from Bolivia (Arispe et al. 2007), from Peru (Martinez 2015, Cassios & Zevallos 2019, Pardo 2019, Santos et al. 2019), from Ecuador (Hodge & Arbogast 2016), Colombia (Dios et al. 2016), and from Mexico (e.g. Carvajal-Villareal et al. 2012, Aranda et al. 2015, Flores 2019, Tellez 2018).*

Population: Nationally, the Margay is listed as Near Threatened in Colombia (Rodriguez-Mahecha et al. 2006), as Vulnerable in Argentina (Díaz & Ojeda 2000, *Ojeda et al. 2012*) and Brazil (Tortato et al. 2013a), and as Threatened in Costa Rica (MINAE cited in de Oliveira et al. 2015) and Mexico (SEMARNAT 2002). Margays are usually uncommon to rare (Payan 2009, Oliveira et al. 2010, Tortato et al. 2013, S. Carvajal pers. comm.). Densities normally reach 1–5 individuals per 100 km², but were found to reach up to 15–25 individuals per 100 km² in exceptional and highly localised cases (Oliveira et al. 2010, Oliveira 2011). Densities of Margays are expected to be much lower than 5 individuals per 100 km² where Ocelots are present at densities of more than 10 individuals per 100 km² (Oliveira et al. 2010). Possibly due to this 'Ocelot effect', Margays do not seem to reach population sizes high enough for long term persistence in any Conservation Unit outside the Amazon mega-reserves

(Oliveira et al. 2010, Oliveira 2011). Viable populations are expected outside protected areas, or where Ocelot numbers are low. Populations are declining due to habitat loss from deforestation (IUCN Cats Red List workshop 2007 cited in de Oliveira et al. 2015). *The Margay is also listed as Near Threatened in the National Red List of Bolivia (Romero-Muñoz et al. 2009), and as Vulnerable in Ecuador, Nicaragua and Venezuela (Ojasti & Lacabana 2008, Espinosa & Tirira 2011, Manzanarez et al. 2018). Density estimate in the Sierra Nanchititla, Mexico, was estimated at 12.4 individuals per 100 km² (Monroy-Vilchis & Soría-Díaz 2011). Density estimates for the state of Oaxaca, south-eastern Mexico, were 68 individuals per 100 km² (co-occurring Ocelot: 22 individuals per 100 km²) in the Los Chimalapas region (Perez-Irineo & Santos-Moreno 2016), and 81 individuals per 100 km² (co-occurring Ocelot: 7.8 individuals per 100 km² in the Sierra Norte (Perez-Irineo et al. 2017).*

Habitat: Margays are usually found below 1,500 m, but have been recorded up to 3,000 m in the Andes (Oliveira 1994). They can mainly be found in forest habitat/habitat with sufficient tree cover, but have been reported occasionally outside forested areas. These forests can range from large continuous to small fragments in savanna ecosystems, and from evergreen to deciduous (Nowell & Jackson 1996, Oliveira 1998, 2011). It is not found in the semi-arid Caatinga scrubland apart from a few evergreen forest enclaves (T. de Oliveira pers. comm.). Margays are believed to be less tolerant of human settlement and habitat alterations than the Ocelot and Tiger Cat, but were still found to use highly disturbed forests, abandoned plantations and other agroforestry systems with abundant tree cover (J. Schipper pers. comm., Oliveira et al. 2010, Tortato et al. 2013a). *Margays were also detected in floodplain/seasonally flooded forests (Antunes 2016, Alvarenga et al. 2018, Hidalgo-Mihart et al. 2017), and by now also in semi-arid Caatinga thorny scrub (Meira et al. 2018). They were also sometimes found in agriculture/forest mosaics, but not always: Margays were observed around Raphia taedigera palm plantations in Costa Rica, but not within them (Yaap et al. 2015). In Pará, Brazil, Margays were found equally within oil palm (Elaeis guineensis) plantations and surrounding primary forests (Mendes-Oliveira et al. 2017). In Guatemala, the species was observed within coffee plantations as well as the surrounding forests in one area, and in a second area only in the forests surrounding the coffee plantations (Escobar Anleu 2015). In Bahia, Brazil, Margays were found in a rubber plantation as well as the surrounding forest reserve and riparian areas (Dechner et al. 2018). Nevertheless, Nagy-Reis et al. (2017) indicated a higher occupancy closer to Reserves, where disturbance is usually lower.*

Ecology: Margays are mostly nocturnal-crepuscular (e.g. *di Bitetti et al. 2010, Oliveira-Santos et al. 2012*). Margays prey on terrestrial as well as scansorial small mammals, but also on lizards, birds and sometimes on larger medium-sized mammals like squirrels, rabbits, agoutis and small monkeys. Most prey items are terrestrial and average prey size is around 250 g (Oliveira 1998, Wang 2002, Oliveira & Cassaro 2005, Bianchi et al. 2011). They are better adapted to live in trees than other cat species and were believed to be more arboreal. However, it was shown that Margays mostly travel and hunt on the ground, and mostly spend time in the trees to rest (Oliveira 1998, Oliveira et al. 2010, Tortato et al. 2013a). Home ranges for four males in Mexico were estimated at 4.1 km² and for one female at 1 km² (Carvajal-Villarreal et al. 2012). Overall, home ranges were reported to range between 1–20 km² (Oliveira et al. 2012). *Opportunistically, Margays seem to prey on bats (Rocha-Mendes & Bianconi 2009) and to take poultry (Tortato et al. 2013b). They also prey on invertebrates (Rocha-Mendes et al. 2010).*

Use & trade: Margays used to be heavily hunted for the fur trade together with Ocelot. Illegal hunting for domestic markets and the underground skin trade is still reported in some areas (Nowell & Jackson 1996), and illegal trade for the pet and pelt market is still a current threat. *Margays are used by some local communities across the range for its fur, as pets, but also for bushmeat and for medicinal and cultural purposes (Santos-Fita et al. 2012, Barbosa & Aguiar 2015, Cova & Prieto 2015, Garcia*

del Valle 2015, Barboza et al. 2016, Galindo Aguilar et al. 2017, da Silva Poricarpo et al. 2018, Álvarez-Solas et al. 2018, Gutierrez-Santillan & Ruiz-Gutierrez 2019).

Threats: see Table 3.1.4.1.

Table 3.1.4.1. Threats to the Margay for different locations according to de Oliveira et al. (2015) *and other sources*.

Threat	Location
Habitat loss (incl. degradation & fragmentation)	Outside Amazonas basin (No reference); *Amazonia, Brazil (Benchimol & Peres 2015);* *Mexico (Mora 2017)*
Road mortality	- (No reference)[1]; *Brazil (Grilo et al. 2018);* *Mexico (González-Gallina & Hidalgo-Mihart 2018)*
Illegal killing (incl. targeted hunting for use and trade, persecution/control)	- (Nowell & Jackson 1996); *Brazil (Peters et al. 2016)* *Mexico (Santos-Fita et al. 2012)*
Diseases	Tamaulipas, Mexico (No reference)
Invasive species (wild boar)	*Rio Grande do Sul, Brazil (Hegel et al. 2019)*

[1] "-" means that this threat was mentioned in the RLA but not the location where it occurs.

Knowledge Base

The available knowledge base is limited for the Margay and only some new information on the species is available (Table 3.1.4.2). A habitat suitability model for the species exists. However, no presence locations from northern South America were included into the model. Beside this model, little information on the distribution of the Margay below the country level is available. Few density estimates exist. Possible causes of the significant density variations (5-81 individuals per 100 km^2) have not been researched. No information on the population size of the species is available. The negative effect of the Ocelot on the Margay is not fully clear. Habitat types used are generally known but only some information on the diet, activity and home range size is available. The tolerance of the Margay to human disturbance and its use of modified habitats are not fully clear. With regard to its use and trade, little information is available. The amount of trade is unknown and consequently also its significance as a threat. General threats are known for only some parts of its distribution range. Their relative importance, scope and impact at population level are not known. No conservation strategy or action plan exists.

Evaluation of the Red List Assessment

Little information is available on the Margay. This makes an evidence-based assessment for the species challenging. Moreover, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available, the Justification should include more information to justify the Category and Criteria chosen;
- The EOO and AOO should be calculated as it is stated that the AOO of the Margay is much smaller than its EOO;
- The geographic range section could be expanded and more details on its distribution also below country level be provided, if available;
- For the population densities it would be nice to have further information i.e. the regions;
- The negative impact of the Ocelot on the Margay could be further explained;
- In the population section conservation units are mentioned but no details on them provided;

- Reference for the continuing decline due to primarily habitat loss to deforestation is referenced with 2007 IUCN RL workshop. If possible, further explanations or more recent references should be provided;
- In the population section the population decrease is stated as suspected but in the Justification as predicted. This should be aligned with each other and further explanations on the decline be provided;
- The decline in AOO, EOO or habitat quality, stated as basis for the population reduction, should also be stated in the section considering continuing decline in habitat;
- Information on Use and Trade is included in the Threat Section but should also be stated under the section Use and Trade. Further information on the Use and Trade (beside the end use), if available, should be included;
- The section Threat does only include two references, which are both old;
- Several of the then available publications were not considered (e.g. Rocha-Mendes & Bianconi 2009, di Bitetti et al. 2010, Garcia-Alaniz et al. 2010, Perez-Oroneo & Santos-Moreno 2010, Rocha-Mendes et al. 2010, Monroy-Vilchis & Soria-Diaz 2011, Vanderhoff et al. 2011, Buenrostro-Silva et al. 2012, Ojeda et al. 2012, Oliveira-Santos et al. 2012, Canon-Franco et al. 2013, Dias 2013, Tortato et al. 2013a, b). These publications include information on diet, behaviour, activity patterns, density and distribution records.

The listing as Near Threatened is based on a suspected (or predicted) population decline of almost 30% during the next 18 years (3 generations). Such population decline is assumed to be the consequence of habitat loss, actual or potential levels of exploitation and effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites. Recent information on exploitation of the species should be included and the impact of habitat loss as well as the effect of the Ocelot on the Margay should be further explained to make it easier for the reader to follow the reasoning of the listing.

Table 3.1.4.2. Evaluation matrix of the Margay. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟡	🟡	🔴	🔴
Consistency of RLA	🟡	🔴	🟢	🟢	🔴	🟡
New information since last RLA	🟡	🟡	🟡	🔴	🟡	🟡

Conclusions and recommendations

The classification of Near Threatened should be further explained in the RLA. Few specific projects on the species have been conducted. Moreover, several recent confirmed records lie outside the RL distribution and some new information on the species exists (Fig. 3.1.4.1; Table 3.1.4.2). Additionally, the points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines**.** Thus, the Margay should be re-assessed for the IUCN Red List.

The knowledge base on the Margay has to be extended for robust reassessments. There is a need for:

- Confirmation of the Margay's distribution (incl. further by-catch data from camera-trapping surveys of other target species);
- Quantitative data on Margay abundance and/or densities and trends;

- Information on the Margay's ecology (e.g. home range size, adaptability to habitat alterations, tolerance to human disturbance);
- Assessment of impact of threats, especially the impact of habitat loss, exploitation and the Ocelot effect;
- Establishment of a conservation plan, where appropriate;
- Conduction of a re-assessment of the species for the IUCN Red List.

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3.1.5 Jaguarundi (*Herpailurus yagouaroundi*)

Least Concern (Caso et al. 2015)

Red List history

Year	1982	1986	1988	1990	1996	2002*	2008	2015
cat. & crit.	I	I	I	I	LR/LC	LC	LC (close to NT A3c)	LC (close to NT A3c)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

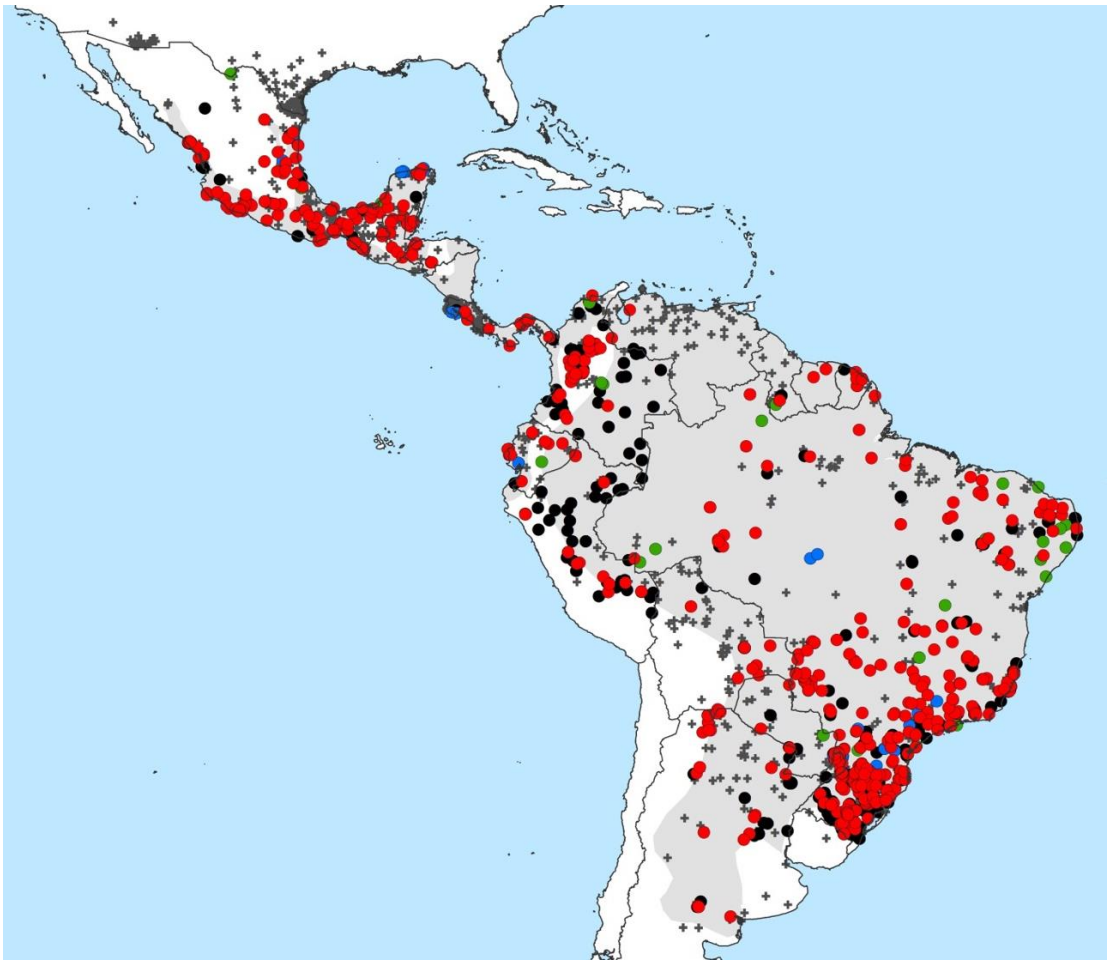

Fig. 3.1.5.1. Jaguarundi records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Caso et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: The Jaguarundi, despite being polymorphic, is recognised to be monotypic (Kitchener et al. 2017).

Justification: Contrary to former belief, the Jaguarundi appears to be a species of low abundance, and in need of population monitoring. Although occasionally found in disturbed areas such as pastures, Jaguarundis are threatened by habitat fragmentation due to most commonly being associated with open areas such as savannahs (Caso 2013). The Brazilian savannahs of the Cerrado are under immense industrial and agricultural pressure, which poses a serious threat to the species. Due to the estimated low density, the negative impact of Ocelots, and an extent of occurrence significantly smaller than the area of occupancy (de Oliveira *et al*. 2010, de Oliveira 2011, Caso 2013), there appears to be no current conservation area able to sustain a long-term viable population of Jaguarundi, aside from perhaps the mega-reserves in the Amazon basin. In Brazil, the Jaguarundi was considered Vulnerable (C1) due to its reduced AOO, expected population decline due to habitat loss and fragmentation, low population densities and estimated effective population size (Almeida *et al.* 2013). The Jaguarundi populations of Mexico appear to be stable, aside from the Gulf Coast Jaguarundi subspecies (*P. y. cacomitli*) in the north-east of Mexico. Due to the lack of information about the Jaguarundi it is difficult to make a range-wide assessment, however, it is possible that it would already classify for Near Threatened (A3c), and therefore its status must be regularly reviewed.

Geographic Range: The Jaguarundi occurs from the eastern lowlands of Chipinque National Park in Nuevo Leon, Mexico (NE limit) and the western lowlands of Mexico, all the way to southern Brazil, Paraguay, Uruguay (Dotta et al. 2007) and south through central Argentina at *ca.* 39°S. Although the Jaguarundi largely occurs in the lowlands, it has been reported up to occur at heights up to 3,200 m in Colombia (Cuervo et al. 1986). While formerly reported in the southern USA, they are most likely extinct there today (Sunquist & Sunquist 2002, Caso 2013). *Jaguarundi presence was recently confirmed in all distribution range countries except for the USA and Nicaragua* (Fig. 3.1.5.1). *There are even recent confirmed Jaguarundi records from several places outside of its extant Red List distribution range e.g. from Mexico (Garcia-Alaniz et al. 2010, Salinas-Camarena et al. 2016, GBIF 2020), Guatemala (Mármol-Kattan et al. 2019), Honduras (Caicedo 2018), Panama (Santos et al. 2019), Colombia (da Silva 2014, Boron et al. 2018, Meza-Joya & Cardona 2019, GBIF 2020), Peru (da Silva et al. 2016, García-Olaechea et al. 2019, Santos et al. 2019), Argentina (di Bitetti et al. 2011, da Silva 2014) and Brazil (da Silva 2014, Espinosa et al. 2017, Grilo et al. 2018). Moreover, Grattarola et al. (2016) also confirmed the presence of Jaguarundi in Uruguay, after some uncertainties about their existence there for several years. However, in some areas of its extant distribution range according to the Red List, confirmed recent records are missing such as in Venezuela (except one record in the north-west), Guatemala (except one record) south of Colombia, larger parts in north-west Brazil (Fig. 3.1.5.1). According to the habitat suitability model of Espinosa et al. (2017), large parts of the current RLA distribution range has moderate to high suitability for the Jaguarundi. Large parts of the Amazon basin show only low suitability for the species (Espinosa et al. 2017).*

Population: Contrary to former reports (Nowell & Jackson 1996), research indicates that the Jaguarundi is an uncommon, low-density species. It is listed as Near Threatened in Argentina (Diaz & Ojeda 2000), and Threatened in Mexico (SEMARNAT 2010). Jaguarundi densities are very low everywhere where they have been sampled. They are more commonly found at densities of 1–5 individuals per 100 km² or lower (de Oliveira *et al.* submitted), but can reach up to 20 individuals per 100 km² in a few restricted high-density areas (Caso 2013). *The Jaguarundi is listed as Least Concern in the National Red List of Argentina (Aprile et al. 2012) and Nicaragua (Manzanarez et al. 2018), Threatened in Mexico (Avila-Najera et al. 2015), and Vulnerable in Brazil (Bonjorne de Almeida et al. 2013: ICMBio). Despite its diurnal activity, it is rarely detected in monitoring studies (Porfirio et al. 2018). Several authors suggest that perhaps the lack of records does not necessarily reflect abundance of the species, but rather its elusive habits, further adding to the ambiguity of its population status (Cruz-Jacome et al. 2015, Paz et al. 2018, Porfirio et al. 2018).*

Habitat: The Jaguarundi occurs in a wide variety of habitats, both open and closed. These range from Monte desert, semi-arid thorn scrub, swamp and savannah woodlands to restinga and primary rainforest (Nowell & Jackson 1996). Although Jaguarundis do occur in open habitats, here they tend to stick to areas of vegetative cover such as secondary growth, disturbed areas or even human induced grasslands (Mexico; de Oliveira 1994, Caso 2013). Due to its use of open habitats, the Jaguarundi is perceived as more tolerant of human disturbance than some of the other felids. *The Jaguarundi also frequently uses riparian areas, particularly in Mexico (Giordano 2015), however, in Brazil they have also been observed using riparian forests as biological corridors (Preuss 2015). In Argentina, Jaguarundis have been observed close to bodies of water, and far from urban areas (Rimoldi & Chimento 2015), but also in open shrubland with sparse natural grasses (Luengos Vidal et al. 2017). In Costa Rica, Jaguarundis were recorded near the edges of monospecific Raphia taedigera palm plantations (Yaap et al. 2015), and in São Paulo, Brazil, they were found also in eucalyptus plantations (Tofoli et al. 2009). However, in Colombia, Jaguarundis were found to significantly avoid pasture areas and oil palm plantations (Boron et al. 2018). According to the habitat suitability model of Espinosa et al. (2017), the highest suitability areas for Jaguarundi occur in forested environments, tropical and subtropical grasslands and savannas and in xeric vegetation.*

Ecology: The Jaguarundi is mostly terrestrial, although it is also able to move about in trees (de Oliveira 1994). Because it is mostly diurnal, it tends to be the most easily seen Neotropical felid, which led to the assumption that it was common. Jaguarundi mostly feed on small mammals, reptiles, and birds with a mean mass of 380 g, however, larger sized prey (>1 kg) has also been recorded (de Oliveira & Cassaro 2005, de Oliveira et al. 2010). Home range sizes vary significantly. In Belize home ranges of up to 100 km^2 (Konecny 1989) and in Mexico of 16.2 km^2 for males and 12.1 km^2 for females were estimated (Caso 2013). The Jaguarundi is often negatively impacted through competitive pressure with the more dominant Ocelot (de Oliveira et al. 2010, Caso 2013). *The Jaguarundi is a generalist predator. In São Paulo, Brazil, it was found to prey on small mammals (Percentage of occurrences: 42.5%, mostly rodents), birds (21%), invertebrates (20%), reptiles (14%, mostly snakes) and larger mammals (3%; Tofoli et al. 2009). In Paraná, Brasil, Jaguarundi scats contained small rodents, marsupials, as well as the larger sized Paca and Pygmy Brocket Deer, but also invertebrates. This presented the broadest niche of the six carnivores considered in that study (Rocha-Mendes et al. 2010). Invertebrates are relatively common in Jaguarundi scat (primarily arthropods), but are suggested to merely help sustain individuals between the capture and consumption of larger prey (Giordano 2015). Male Jaguarundis appear to have larger home ranges than females across their extant distribution range, but intra- and intersexual overlap in habitat use is common. While home range size varies greatly depending on habitat, sex, season, and competition, a synthesis of existing knowledge found most home ranges of Jaguarundi to be ≤25 km^2 (Giordano 2015). The estimate of home ranges up to 100 km^2 for the Jaguarundi of Konecny (1989) are questioned. They are thought to be inaccurate due to a VHF antenna system leading to biases in the estimations (A. Caso and A. Rabinowitz pers. Comm.). Being a diurnal felid, Jaguarundis are able to temporally segregate and minimise competition with the nocturnally active Ocelot, the predominantly crepuscular and nocturnal Puma, and the Margay (di Bitetti et al. 2010). However, despite previous belief that interspecific competition between the dominant Ocelot and the smaller Jaguarundi ("Ocelot effect") was the primary reason for the Jaguarundis diurnal activity and low numbers, it appears that prey availability has a greater influence on the spatiotemporal ecology of the Jaguarundi than the intraguild pressure from a dominant competitor (Gómez-Ortiz et al. 2015, Migliorini 2018).*

Use & Trade: *A recent study in Mexico identified 27 species that are vulnerable to overuse, one of which being the Jaguarundi (Avila-Najera et al. 2018). Exploitation of Jaguarundi can be for various reasons, but the most common are medicinal, food, human-wildlife conflict, ornamental purposes or*

taken as pets (Gonzalez et al. 2016, Luna de Oliveira et al. 2017, Avila-Najera et al. 2018, da Silva Policarpo et al. 2018, Silva Souto et al. 2018).

Threats: see Table 3.1.5.1.

Table 3.1.5.1. Threats to the Jaguarundi for different locations according to Caso et al. 2015 *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation)	*Brazil (da Silva Zantini et al. 2018, de Abreu Bovo at al. 2018);* Mexico (Caso 2013, *Gonzalez-Gallina & Hidalgo-Mihart 2018*); *Peru (Hurtado et al. 2017)*
Illegal and incidental killing (incl. persecution/control)	Range-wide (Nowell & Jackson 1996, IUCN Cats Red List workshop 2007); *Brazil (Alves et al. 2009, Giordano 2015);* Mexico (Caso 2013, *Giordano 2015*)
Road mortality	*Venezuela (Giordano 2015); Argentina (Castilla et al. 2017); Brazil (da Silva Zantini et al. 2018, de Abreu Bovo et al. 2018, Correa et al. 2019); Mexico (Sánchez Soto & Sánchez Soto 2017, Gonzalez-Gallina & Hidalgo-Mihart 2018)*
Prey depletion	*Range-wide (Sandom et al. 2017)*
Diseases	*Brazil (Furtado et al. 2016, Viana et al. 2020)*

Knowledge Base

Despite being the most widely distributed small felid in the western hemisphere, and the second most widespread carnivore in the Americas, the available knowledge about the Jaguarundi is very limited. Although the Jaguarundi is mentioned as a side-note in several studies, there are few focusing on the species alone. Majority of the studies mentioning Jaguarundi come from Brazil, but even so, a detailed population assessment is lacking. There is no national or global population size estimate available for the Jaguarundi. Habitat types and use are known, and diet studies are available from several countries and regions indicating similar information. The knowledge on home ranges is detailed for Belize, Mexico and Brazil. General threats to the Jaguarundi across its range are known and identified, however the full impacts of these threats are not well understood. The Jaguarundi is included in the Ocelot Working Group. A recovery plan exists only for an area where the species is currently deemed extinct (southern USA).

Evaluation of the Red List Assessment

Little published information is available on Jaguarundi, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The Justification includes some key information not stated anywhere else in the assessment (e.g. status of species in Brazil, information on threats such as habitat conversion in Brazilian savannas);
- Where available, the Justification should include more explanations on why the Jaguarundi is listed as Least Concern and more evidence for the suggestion that the species may already qualify for Near Threatened under A3c should be provided, as e.g. no continuing decline neither in AOO, EOO or in area, extent and/or quality of habitat is indicated further in the assessment;
- The calculation of the EOO would provide additional information;

- If possible, the Geographic Range and the Population section should be expanded including more details on its distribution in the range countries and where densities have been recorded;
- The indicated decreasing population trend should be supported by further explanations;
- Several of the then available publications were not considered e.g. Alves et al. 2009, Bertrand 2009, Giorgione et al. 2009, Tofoli et al. 2009, Rocha-Mendes et al. 2010, de Cassia Bianchi et al. 2011, di Bitetti et al. 2011, Giordano et al. 2011, Silva-Pereira et al. 2011, Buenrostro-Silva et al. 2012, Garcia et al. 2012, Pires 2012, Santos-Fita et al. 2012, Ahumada et al. 2013, Boron & Payán 2013, Castano-Uribe et al. 2013, Escobar-Lasso et al. 2013, Holbrook et al. 2013, U.S. Fish & Wildlife Service 2013, da Silva 2014, da Silva et al. 2014, de Almeida et al. 2013. These publications provide information on distribution records, threats, status, diet and genetics of the Jaguarundi.

Table 3.1.5.2. Evaluation matrix of the Jaguarundi. According to the Criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟢	🟢	⚪	🔴
Consistency of RLA	🔴	🔴	🟢	🟡	⚪	🟡
New information since last RLA	🟡	🔴	🟡	🟡	🟡	🟡

Conclusions and recommendations

An evidentiary RLA of the Jaguarundi is difficult because of the generally limited data base, especially in regard to its population status, abundance and density (Table 3.1.5.2). Few specific projects have been conducted on this species, however, several by-catch records (e.g. from camera trap studies on other target species or road kill studies) are reported. Recent distribution information is available for a large part of the Extant distribution area and even confirmed records showing that the species is distributed further than previously thought (Fig. 3.1.5.1). Some information was not considered in the last RLA, and some new information has become available since the last RLA (Table 3.1.5.2). Although the new available information on the species is limited, there is a need for a re-assessment of the Jaguarundi due to the need to adapt distribution range to the new confirmed records. Additionally, the points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines.

Foremost, our knowledge base on the Jaguarundi must be broadened. There is a need for:

- Confirmation of the Jaguarundi's distribution (incl. gathering of by-catch data from camera-trapping surveys of other target species, surveys in areas with no or few recent confirmed records e.g. El Salvador, Nicaragua, Venezuela, Guyana, Suriname, Paraguay, northern and north-eastern Brazil);
- Quantitative data on Jaguarundi abundance and/or densities and (local) population dynamics;
- Information about the Jaguarundi's ecology (e.g. home range size, life history, adaptability to habitat alterations, interspecific relationships with other carnivores);
- Assessment of the impact of threats, especially the impact of habitat loss and conversion as well as persecution;
- Establishment of a conservation plan, where appropriate;
- Re-assessment of the species for the IUCN Red List is already in planning

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3.1.6 Southern Tiger Cat (*Leopardus guttulus*)

Vulnerable C1 (de Oliveira et al. 2016)

Red List history	
Year	**2016**
cat. & crit.	VU C1

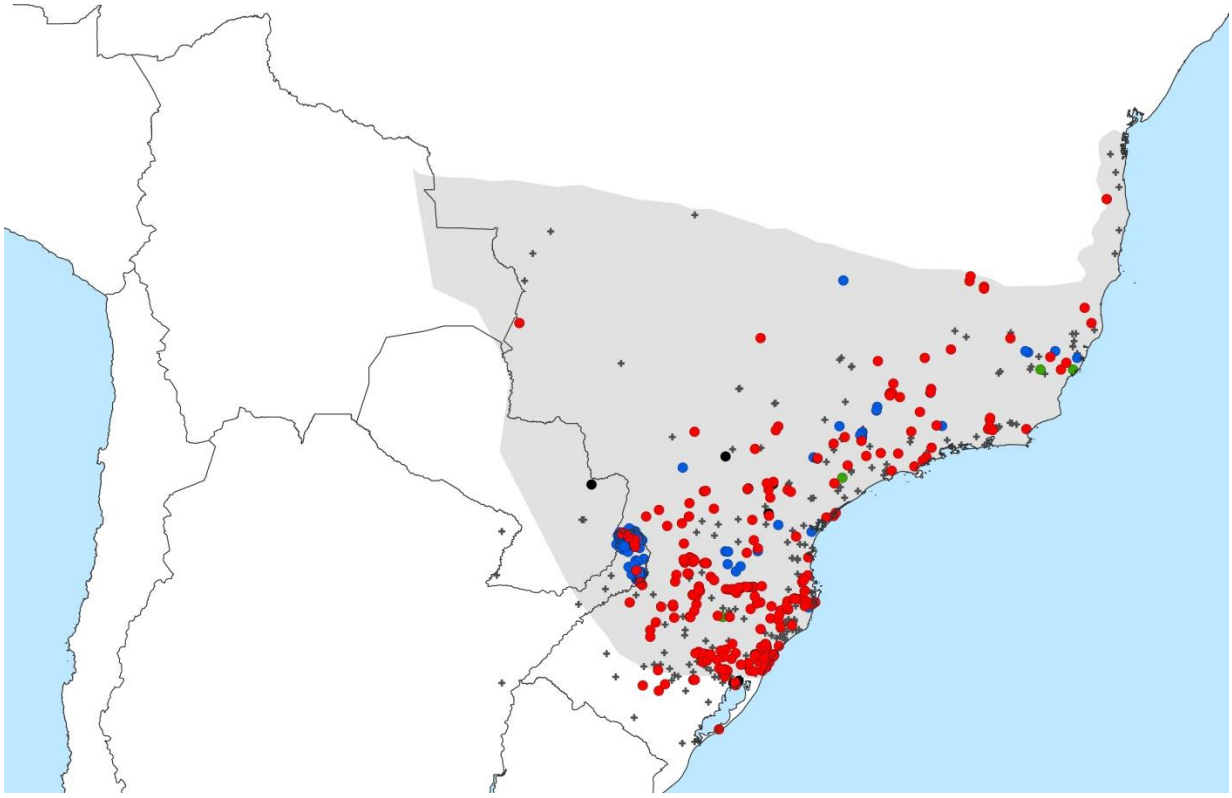

Fig. 3.1.6.1. Southern Tiger Cat observation records from the CSGSD. Grey area = extant distribution according to the Red List; dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (de Oliveira et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Southern Tiger Cat (also known as Southern Tigrina) is considered a monotypic species (Kitchener et al. 2017). Further research, however, is required.

Justification: *L. guttulus* was only recently recognised as a distinct species from *L. tigrinus* (Trigo et al. 2013a) and the northern limits of its distribution are not yet clear. The species' EOO is large (ca. 3,287,075 km²), but its AOO is considerably smaller (max. 473,254 km²) and limited to the threatened Cerrado and Atlantic Forest habitats. Even within its AOO, Southern Tiger Cats are unlikely to occur in some parts due to fragmentation and very small patch sizes. As no species occupies all natural areas

in its range, the actual AOO would be even smaller. Southern Tiger Cats are always found at very low densities between 1 and 5 individuals per 100 km², due to the 'Ocelot effect'. This especially is the case in protected areas (de Oliveira et al. 2010, de Oliveira 2011). As such, the majority of the population is expected to live outside protected areas, where it experiences severe pressure from land development and habitat conversion. In the state of Santa Catarina, Brazil, the reported density halved from 25 to 13 individuals per 100 km² between 2005 and 2013/14, which probably was caused by prey depletion (de Oliveira et al. 2008, 2013, Kasper et al. 2016a, M. A. Tortato, pers. comm.). A continuation of this decline would result in an 80% population reduction over three generations (15 years) in this area. In a second area, the population density dropped from 20 individuals per 100 km² in 2008 to less than 10 individuals per 100 km² in 2015. If this decline goes on, the population is expected to disappear within three generations. The global population suffers from habitat loss and fragmentation. The Cerrado biome is experiencing high rates of loss (Klink & Machado 2005, MMA/IBAMA 2011). Additional threats consist of illegal killing due to conflicts with rural owners, competition with and diseases spread by domestic Dogs, indiscriminate use of rodent poisoning, and road mortality (de Oliveira et al. 2008, 2013, Baréa & Leite 2012, R. Leite-Pitman & T. Trigo, pers. comm.). Moreover, there is extensive hybridisation with *L. geoffroyi* at the geographic limits of their distribution, with 38.2% of Southern Tiger Cats being introgressed from *L. geoffroyi* (Trigo et al. 2008, 2013a). Using the AOO and the lower end of typical densities, a declining population of 6,047 mature individuals was estimated (de Oliveira 2011, de Oliveira et al. 2010, 2013). The likely overestimate of the AOO is compensated by the use of the lower end of typical densities. A continuing population decline of over 10% in three generations is estimated based on the population decline of 50%, and even more in two important conservation areas for Southern Tiger Cats. With its low population size (<10,000 mature individuals) combined with the high observed population reductions, the species could soon qualify for Endangered.

Geographic Range: Southern Tiger Cats occur from central Brazil southwards to southern Brazil, the Argentinian provinces of Misiones and Corrientes, and eastern Paraguay, but are absent from the Paraguayan Chaco. The northern limits of its range and the extent of a possible overlap with *L. tigrinus* are still unclear. It is currently regarded as reaching Central Brazil in the states of Minas Gerais, Goiás, the border area of the Pantanal of Mato Grosso do Sul, and the Atlantic Forest area of eastern Bahia (T. de Oliveira, pers. comm.). The occurrence is limited to altitudes below 2,000 m (de Oliveira et al. 2008). *Most confirmed recent records of the Southern Tiger Cat are from the southern part of its range (Rio Grande do Sul, Santa Catarina, Parana in Brazil, Misiones in Argentina) and along the Atlantic coast (São Paulo, Rio de Janeiro, Espirito Santo, Brazil; Fig. 3.1.6.1). Most are mortality records originating from road kill studies (da Silva et al. 2014, Grilo et al. 2018) and camera trap records (e.g. Oliveira-Santos et al. 2012, Bogoni et al. 2016, Brocardo 2017, Pereira et al. 2018, Costa et al. 2019, Rodriguez 2019). The recent confirmed records in Argentina originate from one camera trap study (di Bitetti et al. 2010). For the Brazilian departments Mato Grosso and Goias no recent confirmed record exists and only one for Mato Grosso do Sul (Hannibal et al. 2017). No records of the species were found for either Bolivia or Paraguay. There are few confirmed recent records outside the current RLA distribution range of the species in Rio Grande do Sul (Trigo et al. 2013b, da Silva et al. 2014, Grilo et al. 2018; Fig. 3.1.6.1).*

Population: The Southern Tiger Cat is listed as Vulnerable in Argentina (Diaz & Ojeda 2000; still as *L. tigrinus*) and Brazil (MMA 2014). Its densities vary, but are generally low. Based on its body size, a density of 91 individuals per 100 km² would be expected. However, estimated densities are generally 1–5 individuals per 100 km² or even much lower where Ocelots are present (the 'Ocelot effect'), and reach between 13 and 25 individuals per 100 km² only in a few isolated areas and where Ocelots are absent or very rare (Oliveira 2011, Oliveira et al. 2010, 2013). The best and likely most viable population is thought to be found in the state of Santa Catarina, Brazil, based on the remaining amount of

Atlantic Forest, habitat connectivity, and the general absence of Ocelots (de Oliveira et al. 2008). However, previously found densities of 25 individuals per 100 km² have been reduced to 13 or 7 individuals per 100 km², probably due to prey depletion (de Oliveira et al. 2013, M. Tortato, pers. comm.). Thus, the remaining population size in Santa Catarina is estimated at 1,500–2,800 (more likely towards the lower limit). In other areas, population declines of 67% were observed, caused of an increase in Ocelots (de Oliveira 2011, Marques 2013). Reductions from 20–24 individuals per 100 km² to 8 individuals per 100 km² have also been observed which were not caused by the 'Ocelot effect' (de Oliveira 2011, Kasper et al. 2016a). The 'Ocelot effect' is probably also responsible for Southern Tiger Cats being mostly found outside the protected areas of two of Brazil's most threatened biomes – the Atlantic Forest and the savannahs. Their remaining natural cover areas are around 8% and less than 40%, respectively. Based on the species' AOO and typical lower population densities, a declining global population of 6,047 mature individuals was estimated (de Oliveira 2011, de Oliveira et al. 2010, 2013). The AOO is probably overestimated, but compensated for by the choice of the lower end densities. The population is projected to decline by 10–30% over the next three generations due to a decline in AOO and habitat quality. Although present in several protected areas, populations of Southern Tiger Cats are expected to be far below 200 individuals in most cases, and to not exceed 500 individuals in any conservation unit (de Oliveira et al. 2008). *The Southern Tiger Cat is listed as Endangered in the state of Bahia, Brazil (Cassano et al. 2017). Density in the state of Santa Catarina, Brazil, was estimated at 7–13 individuals per 100 km², with higher trapping success in areas where other cat species (Margay, Ocelot, Puma) were absent (Olivera-Santos et al. 2012). In Misiones, Argentina, the negative impact of the 'Ocelot effect' grew with increasing human disturbance (Cruz 2017, Cruz et al. 2018a).*

Habitat: Southern Tiger Cats can be found in habitats from dense tropical and subtropical rainforests, deciduous/semideciduous and mixed pine forests, open savannahs, to beach vegetation – both pristine and disturbed (Tortato & de Oliveira 2005, de Oliveira et al. 2008, 2013, de Oliveira 2011). Within the Pantanal, the species is rare and was found only in the dry savannahs, but not in the marshy areas. Southern Tiger Cats can tolerate disturbed habitat as long as sufficient natural cover is present. Consequently, it is restricted to mosaics of forest, savannah and small-scale agriculture. Telemetry studies and scat analysis show that Southern Tiger Cats use agricultural areas only along its borders, where they profit from high rodent densities (Facure-Giaretta 2002, de Oliveira et al. 2010). The species is mostly found at altitudes below 2,000 m. *A habitat model for Misiones, Argentina showed Southern Tiger Cats to be mostly associated with native Atlantic Forest (Cruz et al. 2018b). The species was also found in disturbed formations and in abandoned eucalyptus plantations (Bovo et al. 2018, Campos et al. 2018).*

Ecology: Southern Tiger Cats are mostly nocturno-crepuscular. However, they show considerable diurnal activity, too, which is believed to serve the avoidance of predation by sympatric Ocelots (de Oliveira et al. 2010). The species preys mostly on small mammals, birds and lizards, with an average prey size of <100 g, but may predate upon prey of over 1 kg as well (Facure-Giaretta 2002, de Oliveira et al. 2008, Tortato 2009, Trigo et al. 2013b). Information on home ranges is scarce, but indicates home ranges about 2.5 times bigger than expected from its body size, i.e. between 2 and 25 km² (de Oliveira et al. 2010). This may again be a reaction to larger potential predators. *Some studies found Southern Tiger Cats to be cathemeral (di Bitetti et al. 2010, Cruz 2017, Marques & Fabian 2018, Nagy-Reis et al. 2019) or fully diurnal (Masara 2016, Massara et al. 2016), which was again shown to be dependent on the presence of larger cat species (Oliveira-Santos et al. 2012). The species is a generalist predator (Nagy-Reis et al. 2019). Diet studies in the Brazilian states of Espírito Santo (Seibert et al. 2015), Paraná (Rocha-Mendes et al. 2010, Silva-Pereira et al. 2011, Rinaldi et al. 2015), Rio Grande do Sul (Kasper et al. 2016b) and São Paulo (Wang 2002, de Campos 2009, Nagy-Reis et al. 2019), as well as in Misiones, Argentina (Cruz 2017), all found small mammals being the main part of the diet (43–*

85%, mainly rodents). Birds and reptiles were usually the second- and third-most common items in the diet, but sometimes more birds were consumed and sometimes more reptiles. In Misiones, Argentina, 64% of the biomass consumed consisted of prey items weighing less than 100 g, 29% of prey items between 100 and 1,000 g, and 7% of prey items weighing more than 1,000 g (Cruz 2017). Insects and plant matter are also occasionally found in Tiger Cat's scats. In fact, the stomach content of one road killed individual in Rio Grande do Sul exclusively contained butterflies (Kasper et al. 2016b). However, these items do not contribute to the energy intake per se. During observations in north-eastern Argentina of a nest of lineated woodpeckers, which was 7.7 m up from the ground on an isolated snag, a Southern Tiger Cat was encountered high up on the tree. Predation of the nestlings by the Southern Tiger Cat was not directly observed, but inferred from the dead nestlings that were found (Cockle et al. 2016).

Use & trade: Southern Tiger Cats used to be heavily traded, especially when the trade in Ocelot declined. International trade is nowadays very limited, but there is still illegal hunting at the local level, usually for the domestic market.

Threats: see Table 3.1.6.1.

Table 3.1.6.1. Threats to the Southern Tiger Cat for different locations according to de Oliveira et al. (2016) *and other sources*.

Threat	**Location**
Illegal killing (incl. targeted hunting for use and trade, persecution/control)	*Brazil (Tortato et al. 2013, Peters et al. 2016)*
Prey depletion	Santa Catarina, Brazil (de Oliveira et al. 2008, 2013, M. A. Tortato, pers. Comm.)
Habitat loss (incl. fragmentation)	Brazil (Klink & Machado 2005, MMA/IBAMA 2011)
Hybridisation with *L. geoffroyi*	Edges of their distribution (Trigo et al. 2008, 2013a, *Lehugeur 2013*)
Competition by Dogs	- (de Oliveira et al. 2008, 2013. Baréa & Leite 2012, R. Leite-Pitman & T. Trigo, pers. Comm.)[1]
Diseases	- (de Oliveira et al. 2008, 2013. Baréa & Leite 2012, R. Leite-Pitman & T. Trigo, pers. Comm.)[1]
Road mortality	*Brazil (da Silva et al. 2014, Juraszek & Golec 2015, Grilo et al. 2018, Zanardo 2018, Ferregueti et al. 2020)*

[1] "-" means that this threat was mentioned in the RLA but not the location where it occurs.

Knowledge Base

The knowledge base on the Southern Tiger Cat is still limited. The majority of its range is in Brazil, and that is also where the majority of information is coming from. Especially from Paraguay, very little is known. Across around half of its extant Red List range no recent confirmed species records exist (Fig. 3.1.6.1). The AOO is thought to be overestimated and declining. The RLA presents density estimates and used them to estimate a global abundance of the species based on the AOO. Density declines were observed in several areas. The habitat types used by the Southern Tiger Cat are known. Activity patterns are known but have been shown to vary even more than previously believed. The species' diet was not known very well. However, there are several studies from Brazil and Argentina, which are either new or have already been available at the time of the RLA that have added to that knowledge. Home ranges are estimated to be between 2 and 25 km², but this is based on a sample size of only four individuals from two areas in Brazil (de Oliveira et al. 2010[2]). Use and trade is described in the RLA as largely restricted to the local fur and pet market, but without references. A variety of threats is listed for Brazil. No conservation strategy exists.

[2] de Oliveira et al. 2010 originates from before the species-split and the data is presented as *L. tigrinus*. However, the concerned areas are now attributed to the distribution range of *L. guttulus*.

Evaluation of the Red List Assessment

Little information is available on the Southern Tiger Cat. This makes an evidence-based assessment for the species challenging. Moreover, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available, the Justification should include more explanations and evidence for some statements, e.g. the estimation of a 10% continuing population decline over 15 years;
- Further explanations on the continuing decline in AOO should be provided;
- In the Population section, if available further explanations for the density estimates and where declines were detected would be helpful;
- The estimation of the global population of 6,047 mature individuals should be supported by further explanations and evidence;
- There are some discrepancies in regard to the projected population decline;
- Further explanations why for the generation length the upper range was used, as in the wild the species reproduces only until 8 years and not 12 as in captivity, should be provided;
- Information on trade and use should be included under Use and Trade and not only in the Threat section;
- Several of the then available publications were not considered (e.g. Goulart et al. 2009, di Bitteti et al. 2010, Rocha-Mendes et al. 2010, di Bitteti et al. 2011, Silva-Pereira et al. 2011, Santos 2012, Vitaliano 2012, Canon-Franco et al. 2013, Lehugeur 2013, Trotato et al. 2013, Trigo et al. 2014, da Silva et al. 2014, DeMatteo et al. 2014, de Oliveira & Pereira 2014, Mata et al. 2015, Seibert et al. 2015, de Bastiani et al. 2015).

The listing of the Southern Tiger Cat as Vulnerable under Criterion C1 (small population size and decline; → Appendix I) is based on an estimated population size of 6,047 mature individuals and an estimated decline of 10% over the next 3 generations due to observed declines in several areas. Not for all declines it is clear where they were observed and thus it is difficult to completely follow the reasoning. More explanations should be added. The estimation of the population size should also be supported by further explanations e.g. which density has been used, what percentage was assumed to be mature individuals etc. Presenting a range of population size estimates taking into account the different densities detected and the lowest and highest suspected AOO, would be helpful to understand the reasoning behind the number of mature individuals. The projected population decline of 10–30% should also be supported by more explanations. In the Population section there is a discrepancy in regard to the basis of the future decline. It is once stated to be based on a decline in AOO and habitat quality (which would according to the updated version of the RL Guidelines (IUCN Standards and Petitions Committee 2019) not be valid anymore), once to be based on detected reductions in key areas and once to be estimated (not projected).

Table 3.1.6.2. Evaluation matrix of the Margay. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟡	🟡	🟡	🔴
Consistency of RLA	🟢	🟡	🟢	🟡	🟡	🟢
New information since last RLA	🟡	🔴	🔴	🟢	🔴	🟡

Conclusions and recommendations

The data base on the Southern Tiger Cat is limited and little new information is available (Table 3.1.6.2). This makes an evidentiary RLA difficult. For part of its extant distribution range no recent confirmed records exist (Fig. 3.1.6.1). The points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines.

The knowledge base on the Southern Tiger Cat must be broadened. There is a need for:

- Confirmation of the Southern Tiger Cat's distribution, especially its northern limits in regard to distribution overlap with the Northern Tiger Cat;
- Quantitative data on Southern Tiger Cat abundance, densities and (local) population size;
- Research on the taxonomy of the Southern Tiger Cat, e.g. hybridisation zones with other cat species (Geoffroy's Cat, Pampas Cat, Northern Tiger Cat).
- Information about the Southern Tiger Cat's ecology;
- Assessment of the impact of threats especially hybridisation with other species (Geoffroy's Cat, Pampas Cat, Northern Tiger Cat), prey depletion, habitat loss;
- Establishment of a conservation plan, where appropriate;
- Re-assessment of the species for the IUCN Red List.

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3.1.7 Northern Tiger Cat (*Leopardus tigrinus*)

Vulnerable A2c (Payán & de Oliveira 2016)

Red List history	
Year	**2016**
cat. & crit.	VU A2c

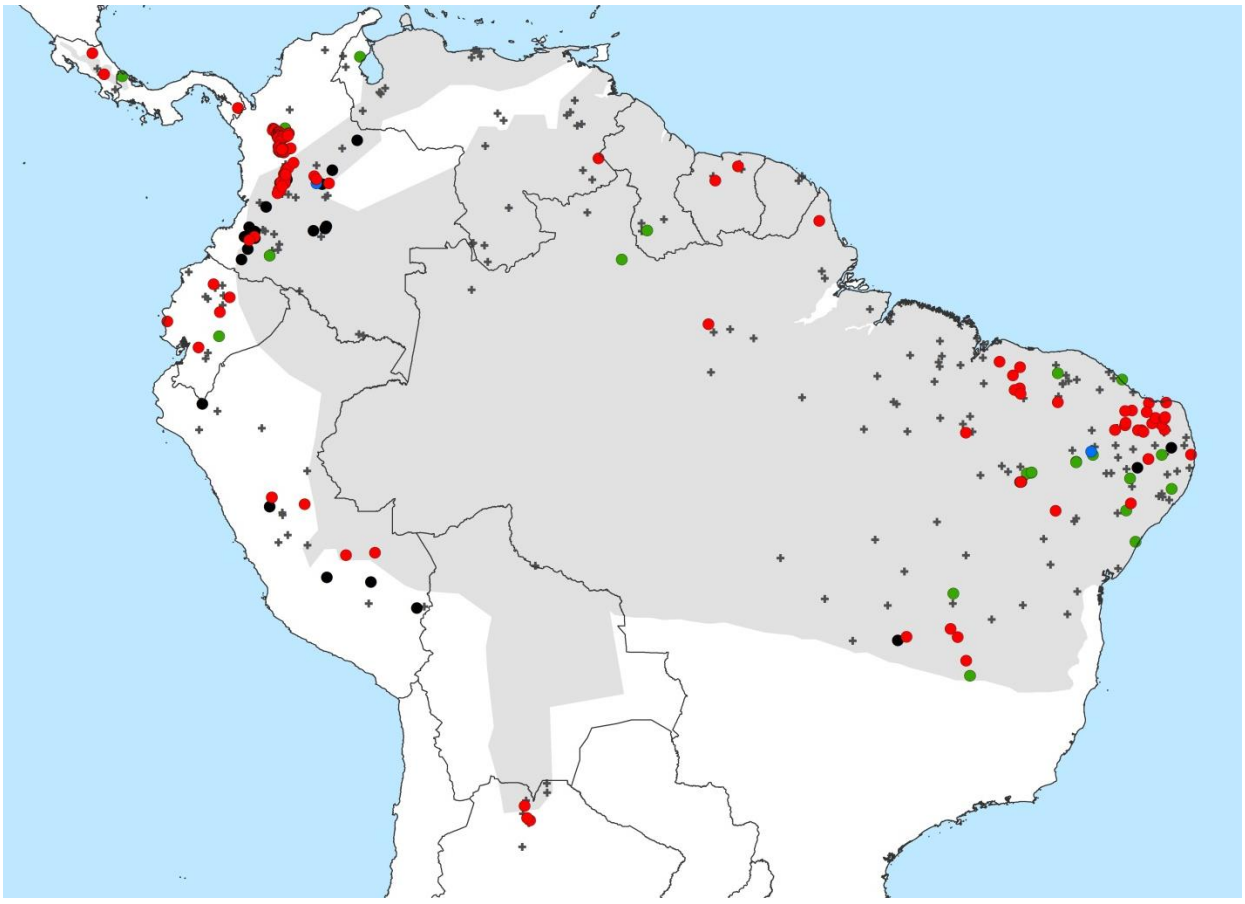

Fig. 3.1.7.1. Northern Tiger Cat observation records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Payán & de Oliveira 2016) and *additional information available* (in italic).

Taxonomic Notes: The Northern Tiger Cat (also known as Northern Tigrina or Oncilla) is currently recognised to consist of two subspecies, namely: *L. t. tigrinus* and *L. t. oncilla* (Kitchener et al. 2017). More research, however, is required.

Justification: *Leopardus tigrinus* and *L. guttulus* have only recently been split into separate species (Trigo et al. 2013a). While no gene flow was found between *L. tigrinus* and *L. guttulus, L. tigrinus*

shows hybridisation with *L. colocola* (Trigo et al. 2013a). There are also suggestions that the Central American population is a distinct species (Johnson et al. 1999, Trigo et al. 2008). *L. tigrinus* occurs from Costa Rica to north-eastern Brazil (Hunter & Barrett 2011, Trigo et al. 2013a). It is widespread and has been reported from Andean montane and mist forests, Central American forests, Amazon forests, Rupununi Savannas, and Brazil's Cerrado and Caatinga habitats, but is rare everywhere (Moreno et al. 2011, de Oliveira 2011, Payán & Gonzalez-Maya 2011, de Oliveira et al. 2013). The Amazon is regarded only as a marginal habitat with distribution in small isolated enclaves. Extensive camera-trap studies throughout the Amazon Basin did not capture Northern Tiger Cat in 56,837 trap-days, concluding it to be the rarest carnivore (T. de Oliveira et al., unpub. Data). Densities in the Cerrado and Caatinga are estimated at 1–5 individuals per 100 km² (de Oliveira et al. 2010, 2013). Abundance is estimated to be lower than that of Jaguar, Puma and Ocelot, with suggested fluctuations or declines of 10–40% in some areas, with unknown causes (T. e Oliveira 2011, unpub. Data). Ocelots are thought to negatively impact Northern Tiger Cats (de Oliveira et al. 2010, Oliveira 2011). The majority of Northern Tiger Cats are probably found outside protected areas and outside the Amazon basin lowland rainforest (de Oliveira 2011). They are threatened by habitat conversion to agriculture. For example, habitat losses are estimated at 50% or more in the Brazilian Cerrado and Caatinga (Klink & Machado 2005, IBAMA/MMA 2011a, CI 2012), more than 20%/10,000 km²/year in the Brazilian Amazon (Morton et al. 2006), and at an overall loss of 90% in the northern Andes' cloud forest (Bubb et al. 2004, Garavito et al. 2012). Such loss of habitat is the main threat in Panama, Venezuela, Colombia and Brazil. Moreover, threats include killing in retaliation for poultry depredation and for the skin and pet trade, road mortality, as well as competition and disease transmission from domestic Dogs (de Oliveira et al. 2013, Marinho 2015). The extent of the threat through hybridisation with *L. colocola* is unknown (Trigo et al. 2013a), but if *L. tigrinus* is confirmed to consist of further distinct species, remaining sub-populations will be even smaller. Brazil shows high rates of habitat loss, fragmentation and isolation (Klink & Machado 2005, Morton et al. 2006). This habitat suppression, unlike habitat degradation, results in equivalent population declines. The AOO was estimated at 893,200–1,020,800 km² for the subspecies *L. t. tigrinus* and *L. t. pardinoides* (Payán & Gonzalez-Maya 2011). Estimated abundance of one population in the Caatinga, Bahia state, Brazil, declined by 25.9% from 2021 to 2015 (L. P. de Castro Meira, T. G. de Oliveira, pers. comm.). A maximum entropy algorithm was used to model the population decline over three generations. Declines of 12.7% and 36.8% were estimated for the last 3 generations (15 years) in Colombia and Brazil, respectively (de Oliveira et al. 2013, IBAMA/MMA 2014). Assuming a stable population for Central America, the overall decline is estimated to be 31.7% over the last three generations. As such, the species is classified as Vulnerable. The global population is estimated 10,000–11,000 individuals, with expected further declines and a simultaneous lack of conservation actions.

Geographic Range: Northern Tiger Cats range from Costa Rica to Central Brazil. After its recent split from *L. guttulus*, neither the southern limits of occurrence are, nor the extent of a possible overlap with *L. guttulus* are yet clearly known (T. Oliveira, pers. comm.). Whilst the subspecies *L. t. oncilla* is mainly found in the Costa Rican cloud forests, *L. t. pardinoides* occurs mostly between 1,500 and 3,000 m in the northern Andes, and *L. t. tigrinus* in north-eastern Brazil in the Cerrado, the Caatinga and adjacent deciduous forests. All the rest of its range appears to be marginal (T. de Oliveira unpub. Data or in prep.). Northern Tiger Cats are thought to be extremely rare in the Amazon basin and its occurrence to be heavily fragmented (de Oliveira 2004, T. de Oliveira, unpub. Data). Some records from the Amazon basin exist, but the Northern Tiger Cat was never captured during 12 extensive camera trap studies along all of the basin. It has not been found on the Darien Peninsula and in the Llanos (Payán et al. 2007). The first confirmed record from Bolivia was reported as recently as 2000. From Ecuador and Peru, only few museum specimens exist. The savannahs of Mirador State Park and the protected areas around Nascentes do Rio Parnaíba National Park, Brazilian mid-north, as well as

the Andean protected areas in Colombia seem to be the most important areas for the conservation of the Northern Tiger Cat (de Oliveira *et al.* 2008, 2014; Payán & Gonzalez-Maya 2011). Although the Northern Tiger Cat has a wide EOO (13,406,366 km²), its AOO is considerably smaller (893,200–1,020,800 km²) and is continually declining (Morton et al. 2006, Mulligan 2010). This is due to conversion to agriculture-pasture of large portions of the high Andes, the Brazilian Cerrado and Caatinga, which are unsuitable to the species (Klink & Machado 2005, de Oliveira et al. 2008, IBAMA/MMA 2011a, b, Payán & Gonzalez-Maya 2011, CI 2012). Additionally, de Oliveira et al. (2014) and Marinho (2015) have shown that Northern Tiger Cats avoid open areas and proximity to settlements. As such, the actual AOO should be even smaller. *Recent confirmed records (here mortality and camera trap records) only exist over a minor part of the Northern Tiger Cat's range, mainly in the north-east and north-west of its range (Fig. 3.1.7.1). Especially in the centre of its range there are no records at all. Several recent confirmed records exist outside its current RLA distribution such as in Costa Rica (dos Santos 2019), Panama (Fort 2008), Colombia (Arias-Alzate et al. 2014, Botero-Cañola et al. 2016), Ecuador (Cueva et al. 2010, Espinosa & Medrano 2015, Cervera et al. 2016, Palacios et al. 2017, Sánchez-Karste & Córdova 2018), Peru (Cossíos & Zevallos 2019, Huarcaya et al. 2019) and Argentina (Albanesi et al. 2016, 2019).*

Population: Northern Tiger Cats are listed as Vulnerable in Colombia and as Endangered in Brazil (MAVDT 2005, Rodriguez-Mahecha et al. 2006, IBAMA/MMA 2014). The species is rare everywhere. Densities have been expected at 1 individual per 100 km² in the Amazon, and estimated at 1–5 individuals per 100 km² in other portions of the range (de Oliveira et al. 2010, 2013). In Central America and Brazil, Northern Tiger Cats are rarely caught on camera traps, even where their occurrence is known, which is believed to be due to naturally low number and not due to trap shyness (T. de Oliveira, pers. comm., J. Schipper, pers. comm.). Northern Tiger Cats are negatively affected by the presence of Ocelots – the so called "Ocelot effect" – and do not reach high enough effective population sizes for long term persistence in any Conservation Unit (de Oliveira et al. 2010, de Oliveira 2011). Where Ocelots are absent, densities of Northern Tiger Cats may reach 5–20 individuals per 100 km², but the upper end of this range is only reached in very few and isolated areas (de Oliveira et al. 2010, de Oliveira 2011). By applying the lower end density of 1 individual per 100 km² to the AOO, a global population size of 8,932–10,208 individuals are estimated. A population decline of more than 10% is expected for the coming decades based on deforestation rates (Morton et al. 2006, Mulligan 2010, Garavito et al. 2012). *The Northern Tiger Cat is listed as Vulnerable in Ecuador (Espinosa & Tirira 2011). The species was listed as Critically Endangered in the national Red List of Nicaragua in 2013, but is not mentioned in the newer version of 2018 (Rivera & Manzanarez 2013, Manzanarez et al. 2018). In the state of Minas Gerais, densities of 4.5 individuals per 100 km² at the Porto Cajueiro Private Reserve, and 9.1 individuals per 100 km² at the Grande Sertão Veredas National Park were estimated (Oliveira 2018). For two sites in Mirador State Park in the state of Maranhõ, SECR estimates were 8.68 ± 3.9 (3.75–20.1) individuals per 100 km² and 11.3 ± 5 (5.0–25.5) individuals per 100 km², respectively. This results in an estimated population size of 287 (127-661) individuals in Mirador State Park, and with extrapolation to a possible population some 700 individuals in the protected areas of the northern savannas, and of 2,000–3,000 individuals in the states of Maranhão, Tocantins, Piauí and Bahia (de Oliveira et al. 2020). In all the aforementioned study sites, Ocelots were present, but rare.*

Habitat: The Northern Tiger Cat can be found in a large variety of habitats ranging from Andean montane and cloud forests, Central American forests and Amazon forests to Rupununi Savannahs and Brazil's Cerrado and Caatinga domains (Moreno et al. 2011, Oliveira 2011, Payán & Gonzalez-Maya 2011, Oliveira et al. 2013). However, it is absent from the llanos, and was not recorded during 56,837 camera-trap days at twelve different study sites throughout the Amazon basin (T de Oliveira et al., unpub. Data). The highest ever record is from 4,800 m (Cuervo et al. 1986), but most records stem

from below 3,000 m. In Central and north-western South America, the species is found mainly in montane cloud forests above 1,000 m in Costa Rica and between 1,500 and 3,000 m in the Andes, respectively, whereas in Brazil most records are from below 500 m (de Oliveira et al. 2008, T. de Oliveira, pers. comm., J. Schipper, pers. comm.). Northern Tiger Cats can occur in disturbed areas and close to human settlements if there is enough cover and prey base, but prefers denser woody cover more distant from settlements (de Oliveira et al. 2008, Marinho 2015). *In Antioquia, Colombia, Tiger Cats were also recorded within cypress and pine plantations (Ariaz-Alzate et al. 2014)*.

Ecology: Northern Tiger Cats are mostly nocturno-crepuscular, but with some diurnal activity, too. However, in some areas of Brazil they might be diurnal. Diet is known to rely on small mammals (<100 g), birds and lizards but otherwise still poorly understood (Trigo et al. 2013b). Home ranges were estimated at 1–17 km², which is much larger than expected for a cat of this size (de Oliveira et al. 2010). *The Northern Tiger Cat showed varying degrees of diurnal activity in the states of Piaui and Minas Gerais, Brazil, and was found to be cathemeral in the state of Rio Grande do Norte, Brazil (Oliveira 2016, Oliveira 2018, dos Santos 2019). In Costa Rica, melanistic Northern Tiger Cats were found to be more diurnal than non-melanistic ones. Melanistic individuals benefit from better camouflage in dense forest under brighter conditions than non-melanistic ones (Mooring et al. 2020). In the Boqueirão da Onça region, northern Bahia, Brazil, Northern Tiger Cat occupancy was positively correlated with rock cavy (Kerodon rupestris) occupancy. It was speculated that the cavy's preferential use of rocky outcrops made encounters more predictable and enabled the Tiger Cats to maximise foraging efficiency (Dias et al. 2019).*

Use & trade: In the past, Northern Tiger Cats were heavily used in the fur trade (Payán & Trujillo 2006). Nowadays, some illegal hunting remains, largely for the domestic market. Local communities use Northern Tiger Cats for their fur (apparel, ornamental purposes) and as pets*, but also as bushmeat, for medicine and for magical/religious ceremonies (Alves et al. 2016, Barboza et al. 2016, Allgas et al. 2017, Oliveira et al. 2017, Álvarez-Solas et al. 2018, Souto et al. 2018)*.

Threats: see Table 3.1.7.1.

Table 3.1.7.1. Threats to the Northern Tiger Cat for different locations according to Payán & de Oliveira (2016) *and other sources*.

Threat	**Location**
Habitat loss (incl. Degradation & fragmentation)	Andes (Payán & Gonzalez-Maya 2011, CI 2012)
	Cerrado & Caatinga, Brazil (IBAMA/MMA 2011a, b, de Oliveira 2011, de Oliveira et al. 2013)
	Colombia (Payán & Gonzalez-Maya 2011)
Diseases	Brazil (de Oliveira et al. 2013, *Lessa et al. 2016, de Oliveira et al. 2020*)
Road mortality	Brazil (de Oliveira et al. 2013, *Grilo et al. 2018*)
	Colombia (Castillo-R. et al. 2015)
Illegal killing (persecution/control)	Brazil (de Oliveira et al. 2013, *Alves et al. 2016, da Silva Almeida 2018*)
	Colombia (Payán & Gonzalez-Maya 2011)
Hybridization	With Pampas Cat (*L. colocola*): North-east & Central Brazil (Trigo et al. 2013a, *Santos 2012*)
	*With Margay (*L. Wiedii*) and Ocelot (*L. Pardalis*): Argentina, Bolivia, Colombia, Ecuador & Venezuela (Ruiz-Garcia et al. 2017)*
Competition & predation by domestic Dogs	*Brazil (Lessa et al. 2016, de Oliveira et al. 2020)*
Climate change	*Range-wide (Vale et al. 2015)*

Knowledge Base

The knowledge base on the Northern Tiger Cat still warrants significant improvement. In general, most information originates from Brazil, with relatively little information originating from the rest of the species' range. Across most of its extant RL distribution range, no recent confirmed records exist,

but there are several confirmed records outside its extant range (Fig. 3.1.7.1). The AOO is thought to be declining. The RLA presents density estimates and used them to estimate a global abundance of the species based on the AOO. However, only the results of Oliveira et al. (2020) provided "the first published density estimates of Tiger Cats" (de Oliveira et al. 2020). An additional density estimate from another area was also presented in the thesis by Oliveira (2018). Both of these density estimates originate from Brazil, with no hard data from the rest of the range. The habitat types used by the Northern Tiger Cat are known. Activity pattern is known to differ between areas, and the basics of the Northern Tiger Cat's diet is known too, but according to the RLA "is still very poorly studied". Home ranges are estimated to be between 1 and 17 km², but this is based on a sample size of only 4 individuals from 2 areas in Brazil (de Oliveira et al. 2010[3]). Use and trade is described in the RLA as largely restricted to the local fur and pet market, but without references. More recent publications add bushmeat, medicine and magical/religious ceremonies to the list of uses for the Northern Tiger Cat (Alves et al. 2016, Barboza et al. 2016, Allgas et al. 2017, Oliveira et al. 2017, Álvarez-Solas et al. 2018, Souto et al. 2018). A variety of threats is listed for Brazil, but little for the rest of the range. No conservation strategy or action plan exists.

Evaluation of the Red List Assessment

Little information is available on the Northern Tiger Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The Justification could be shortened highlighting the key points for justifying the listing of the species;
- The Justification contains information not stated anywhere else in the assessment e.g. estimated population reduction;
- The population decline of 31.7% should be strengthened by further explanation and evidence;
- The information on the total population in the Population section with 8,932–10,208 adults should be aligned with the figures stated in the Justification (less than 10,000–11,000);
- There are some inconsistencies regarding the population decline percentages stated in the Justification and in the different parts of the Population section e.g. the population decline in Colombia is stated at 12.7% in the Justification, but at 7.2% in the Population Section as well as in regard to the highest detected population density (20 individuals per 100 km² in the Population Section; 25 per 100 km² in the section Habitat and Ecology);
- Some information in the section Geographic Range belongs to the section Habitat and Ecology or Population;
- It is not fully clear how the EOO has been calculated and if the estimated AOO is for the whole species or only for the subspecies *L. t. pardinoides* and *L. t. tigrinus*;
- Several of the then available publications were not considered (e.g. Alves et al. 2009, Castano & Corrales 2010, da Cunha 2012, Garcia e al. 2012, de Oliveira et al. 2013, Gonzales-Maya et al. 2013, Payán & Gonzales-Maya 2013, Ramirez-Chaves et al. 2013, Escobar-Lasso et al. 2014).

[3] In fact, de Oliveira et al. 2010 present data from a further four individuals from two further areas. However, these areas are now attributed to the distribution range of *L. guttulus*.

The listing as Vulnerable under Criterion A, Subcriterion A2c (population size reduction in the past; → Appendix I) is based on an estimated population decline of 31.7% in the past. Such habitat decline is assumed to be the consequence of habitat loss. Further explanations would help the reader to understand the reasoning behind the population decline. In the population section the decline is stated to be suspected and not estimated. An estimated decline could, according to the newest version of the IUCN Red List Guidelines (V15.1, 2022), not be based on a decline of the AOO (IUCN Standards and Petitions Committee 2022). Additionally, further explanations should be added why the two population reductions estimated for Colombia and Brazil can be applied for the whole range of the species. There are some inconsistencies between the different sections.

Table 3.1.7.2. Evaluation matrix of the Northern Tiger Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟡	🟡	🟡	🔴
Consistency of RLA	🟡	🔴	🟢	🟢	🟡	🟢
New information since last RLA	🟢	🟢	🔴	🟡	🟡	🟡

Conclusions and recommendations

The data base of the Northern Tiger Cat is limited although there are several projects in place. This makes an evidentiary assessment difficult. There is some new information on the species available (Table 3.1.7.2) and there are several recent confirmed records of the species outside its extant RL distribution range (Fig. 3.1.7.1). The points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines. Moreover, the relevant information not considered in the last RLA, should be included. Hence, the Northern Tiger Cat should be re-assessed.

The knowledge base on the Northern Tiger Cat must be expanded. There is a need for:

- Confirmation of the Northern Tiger Cat's distribution, especially southern limits in regard to distribution overlap with the Southern Tiger Cat;
- Quantitative data on Northern Tiger Cat abundance, densities and (local) population sizes;
- Research on the taxonomy in regard to further species and number of subspecies;
- Information about the Northern Tiger Cat's ecology;
- Assessment of the impact of threats especially hybridisation with other species (Pampas Cat, Southern Tiger Cat), prey depletion, habitat loss;
- Establishment of a conservation plan, where appropriate;
- Re-assessment of the species for the IUCN Red List

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3.1.8 Geoffroy's Cat (*Leopardus geoffroyi*)

Least Concern (Pereira et al. 2015)

Red List history

Year	1996	2002*	2008	2015
cat. & crit.	LR/LC	NT	NT A	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

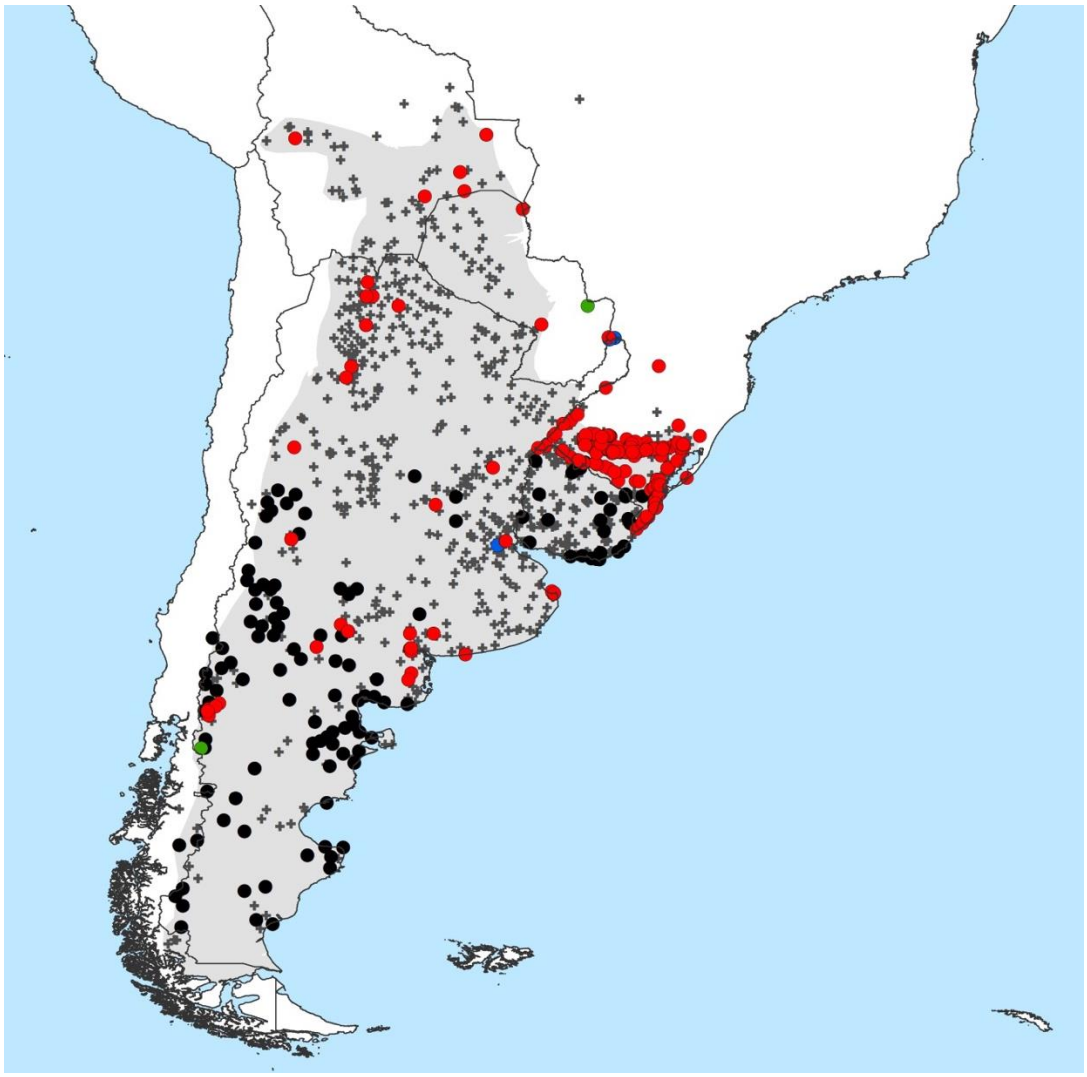

Fig. 3.1.8.1. Geoffroy's Cat observation records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Pereira et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: This species is regarded as monotypic (Kitchener et al. 2017), with a morphological cline (skull morphology and pelage colouration) in relation to different habitat types throughout its range. Molecular studies are however required.

Justification: The Geoffroy's Cat is widespread and abundant across most of its range, and is therefore, listed as Least Concern. It occurs in a wide variety of habitat types such as the dry forests of the Bolivian Chaco (Cuéllar et al. 2006) and the Argentine Espinal (Caruso et al. 2012), scrublands of the Monte (Pereira et al. 2011), relicts of the natural Pampas grasslands (Manfredi et al. 2006), lowland cropland areas of the Andean subtropical forests (Di Bitetti et al. 2011 cited in Pereira et al. 2015), grasslands of southern Brazil (Trigo et al. 2013a), and up to elevations of 3,750 m in the Andes. The Geoffroy's Cat has been noted for its adaptability to the conversion of sub-tropical forests into croplands, and habitat alteration by livestock management. As for its range, a recent expansion into north-eastern Argentina was documented by Rinas et al. (2014; cited in Pereira et al. 2015). In Chile, the Geoffroy's Cat is considered rare (Iriarte et al. 2013 cited in Pereira et al. 2015), while it is considered Vulnerable in Rio Grande do Sul, Brazil (Almeida et al. 2013). The greatest threats facing the Geoffroy's Cat appear to be anthropogenic mortality (road-kills, retaliatory killing due to poultry predation), as well as some potential negative effects from current climate trends (Canepuccia et al. 2008, Pereira & Novaro 2014). The Geoffroy's Cat overlaps with *L. guttulus* in southern Brazil, where a hybrid zone has been identified (Trigo et al. 2008, 2013a). This hybrid zone is important for the conservation of both species. However, while some studies indicate there is a natural origin for this event, further studies are required to rule out the influence of human-induced changes in habitat or population densities in these areas, on the hybridisation of these two *Leopardus* species. If the latter is responsible, then perhaps the hybridisation is not so much a natural event in evolutionary history, but rather a threat to the species by means of compromised genetic integrity.

Geographic Range: The Geoffroy's Cat's distribution covers the majority of the southern portion of South America. The distribution includes south-eastern Bolivia, Paraguay and Argentina (east of the Andes), southern Brazil (below ca. 30°S), Uruguay, as well as the Strait of Magellan in Chile. The Geoffroy's Cat has been recorded from sea level up to 3,800 m (de Oliveira 1994, Nowell & Jackson 1996, Cuéllar et al. 2006, Dotta et al. 2007, M. da Silva, pers. comm.). *New records indicate the occurrence of the Geoffroy's Cat in the province of Palena in the Los Lagos region (Comau Fjord) in Chile (Corral 2019). Furthermore, there are records indicating the presence of the Geoffroy's Cat further north in Brazil, in the states of Paraná (ca. 25°S) and Mato Grosso do Sul (ca. 20°S; de Bastiani et al. 2015). Recent confirmed records outside its extant Red List distribution range exist in Paraná (Bertrand & Newman 2014), Rio Grande do Sul (da Silva et al. 2014, Grilo et al. 2018) and Santa Catarina (Grilo et al. 2018), Brazil, and one in Paraguay (González et al. 2019). Recent confirmed records in Rio Grande do Sul (Brazil) originate from road kill studies (da Silva et al. 2014, Grilo et al. 2018). No recent confirmed records were found for southern and large parts of central Argentina as well as for the majority of its extant Red List range in Paraguay and Uruguay (Fig. 3.1.8.1).*

Population: Although commercial hunting from the 1960s to the 1980s significantly reduced population sizes, the Geoffroy's Cat is still relatively common throughout its range (Nowell & Jackson 1996). Formerly considered Vulnerable in Argentina, it was recently downgraded to Least Concern (Ojeda et al. 2012). Being restricted to small areas in the south and east of Chile, it is considered rare (CONAMA 2009). In Brazil, it is considered Vulnerable, due to only inhabiting the southern state of Rio Grande do Sul (Almeida et al. 2013), however some personal observations report its abundance in the Pampas (T. Trigo pers. obs.). In contrast, in Bolivia the Geoffroy's Cat is the second most abundant felid, after the Ocelot (Cuéllar et al. 2006). The density of the Geoffroy's Cat was estimated at 9–

40/100 km² in the Kaa-Iya del Gran Chaco National Park in the Bolivian Chaco (Cuéllar *et al.* 2006), at 45/100 km² in Argentine Espinal (altered dry shrublands; Caruso *et al.* 2012), at 7–12/100 km² in Torres del Paine National Park in Chile (W. Johnson pers. com. In Nowell & Jackson 1996) and at up to 190–220/100 km² in the Lihué Calel National Park in Argentine Monte, including several transient individuals (Pereira et al. 2011). However, transient individuals may also include juveniles, and therefore the density estimate may be inflated and must be interpreted with caution (Pereira et al. 2011). *In Bolivia, the Geoffroy's Cat is listed as Near Threatened (Romero-Muñoz 2009). Its density in the Brazilian pampa was estimated at 34.54 (±13.51) – 41.78 (±16.12)/100 km² (Tirelli et al. 2019).*

Habitat: The Geoffroy's Cat ranges throughout the Pampas grasslands and arid Chaco woodlands, as well as up to elevations of 3,800 m in the Bolivian Andes (M. Da Silva pers. comm. 2014). It occurs in a wide variety of arid or semi-arid habitat types (Pereira et al. 2006) in the subtropical and temperate Neotropics. Some of these habitat types include scrubby woodlands, Patagonian scrub, dry forests and savannas of the Chaco, Monte desert/semi-desert, wetlands (e.g. Paraná River delta; Pereira et al. 2005) and the Pampas grasslands, in both pristine and disturbed areas (de Oliveira 1994, Pereira & Aprile 2012). Although the Geoffroy's Cat uses open and closed areas, they seem to prefer open areas with dense cover, and do not occur in rainforests. The Geoffroy's Cat is sympatric with the Pampas Cat (*L. colocola*) throughout most of its range. *The Geoffroy's Cat prefers areas far from roads and close to fresh water (Tirelli et al. 2019). They also occur in coastal areas (Caruso et al. 2020). In forested areas the Geoffroy's Cat is likely to be less abundant, due to being outcompeted by the more arboreal Margay (Bou et al. 2019). The Geoffroy's Cat also has the ability to occur in highly degraded human-developed areas, provided some shrublands are available (Caruso et al. 2016). As such, the species is obviously to some degree tolerant to habitat alterations. However, in a study in Patagonia where native open vegetation was transformed into conifer plantations, the Geoffroy's Cat was only ever detected in native vegetation (incl. remains of native vegetation between plantations) and in firebreaks, but never within plantations (Lantschner et al. 2012). Habitat suitability is higher for the Geoffroy's Cat in areas where annual precipitation exceeds 151 mm, and drought years can have significant negative impacts on both the ecology and demography of the species (Cuyckens et al. 2016).*

Ecology: Geoffroy's Cat shows a predominantly nocturnal activity pattern. It seems to be the most abundant felid of the temperate Neotropics (Oliveira & Cassaro 2005 cited in Pereira et al. 2015, Lucherini et al. 2006, Pereira & Novaro 2014). In the beech forests of Torres del Paine National Park in Chile, mean home range size for the Geoffroy's Cat ranged from 2.3–6.5 km² for two females, and 3.9–12.4 km² for five males (Johnson & Franklin 1991). In the wet Pampas grassland of Argentina, the mean home range size ranged from 2.5–3.4 km^2, with male home ranges 25% larger than those of females (Manfredi et al. 2006). In Argentina's Lihue Calel National Park, male home range size ranged between 2 and 3 km^2, and females between 0.2 and 0.6 km^2 (Pereira et al. 2012). However, in adjacent cattle ranches, home ranges scaled up to 4.4 km^2 for males, and up to 3.7–4.9 km^2 for females. Both Geoffroy's Cat and European hare densities declined markedly during periods of drought in the same area: six radio-collared individuals died of starvation due to the fall in abundance of hares from 56 to less than eight individuals per 100 km² (Pereira et al. 2006). Diet varies according to location in Argentina (Manfredi et al. 2004), but consists primarily of small rodents, while including other locally abundant species such as birds. In Lihue Calel (Argentina), small mammals represented at least 63% of the food items throughout the year (Bisceglia et al. 2008). In Chile, rodents and hares are primarily taken (Johnson & Franklin 1991). In Uruguay and Brazil, fish and frog remains were found in the stomachs of Geoffroy's Cats (Sunquist & Sunquist 2002). Plains Vizcachas are also prey (Branch

1995), but in areas where they have become extinct, they are replaced by introduced European Hares (*Lepus europaeus*).

The Geoffroy's Cat spends most of its time on the ground, despite also being able to climb well (Antonio et al. 2017). During the day it likes to rest in thickets or in hollow trees. Woodlands play an important role in the ecology of the Geoffroy's Cat. They are used as refuges, hunting areas, or for territorial markings in latrines (Pereira 2009, Soler et al. 2009, Manfredi et al. 2012). Activity patterns may differ according to region. Albanesi et al. (2016) recorded the Geoffroy's Cat in the Yungas foothills 55% of the time at night, 36% at twilight, and 9% in broad daylight. They also note that the species' activity may vary in accordance to lunar phases, but differing correlations in different areas. For example, in the Campos del Tuyú Wildlife Reserve, Argentina, Geoffroy's Cat's activity was positively correlated with the night's brightness, whilst in Ernesto Tornquist Provincial Park activity was negatively correlated with the brightness of the night (Manfredi et al. 2011). In southern Brazil the Geoffroy's Cat activity peaks between 21:00-22:00 h in the Autumn, and 20:00-21:00 h in Summer, while maintaining bimodal activity throughout the entire year (a peak of nocturnal activity and a peak of twilight activity). It is suggested that the Geoffroy's Cat maximises hunting efficiency by synchronizing its activity periods with that of its preferred prey (Gomide & Loebmann 2017). When prey is scarce, Geoffroy's Cat in central Argentina was observed to shift its activity from primarily nocturnal to mostly diurnal (Pereira 2010). In the Espinal of central Argentina, one study found the mean intrasexual home range overlap to be 38%, with an average of 21.9% between females and 37.9% between males. The home range overlap for intersexual pairs was significantly higher, with a mean of 41.5% but ranging from 1.5–99.9% (Castillo et al. 2019). The extent of overlap often varies according to prey availability (Castillo et al. 2019). Body mass and home range size appears to be correlated in males in southern Brazil, but not in females (Tirelli et al. 2018). The Geoffroy's Cat shares its habitat with the Pampas Cat and other large felids such as the Puma. They occasionally fall prey to Puma (Martinez et al. 2016, Gelin et al. 2017). In the Andean Patagonian Forest in Argentina, it is thought to compete with the Guiña (Leopardus guigna; Lucherini & Vidal 2003, Cuyckens et al. 2015). In the Andean Forest of Patagonia as well as the coastal areas of Buenos Aires province, diet segregation facilitates the coexistence of the Geoffroy's Cat with the Culpeo (Lycalopex culpaeus) with high spatio-temporal overlap (Gantchoff & Belant 2016, Caruso et al. 2020). There is also a spatial and dietary segregation with L. guttulus where the two species overlap (Trigo et al. 2013b). Some studies suggest that a low density of Ocelots contributes to a higher density of the Geoffroy's Cat in central Argentina and Bolivia (Perez-Irineo et al. 2017). In Uruguay, following the elimination of large felids over time, the Geoffroy's Cat, Margay and Pampas Cat have filled the niche of top predators (Bou et al. 2019). Further diet studies exist, e.g. from central Argentina (Bisceglia et al. 2011, Palacios et al. 2012, Guidobono et al. 2016) and southern Brazil (Sousa & Bager 2007, Trigo et al. 2013b, Migliorini et al. 2018), which found the same pattern as presented in the RLA. Although invasive European hares are consumed by the Geoffroy's Cat in Patagonia, the majority of the diet still consists of native species (Palacios et al. 2012).

Use and Trade: The Geoffroy's Cat was highly exploited for the international fur trade from the 1960s to the 1980s, but little trade took place after 1988, and the species was then upgraded to CITES Appendix I in 1992 (Nowell & Jackson 1996). Nowadays, some local illegal trade may, however, still occur, e.g. on cattle ranches near Lihue Calel National Park Argentina, poaching, among other causes, accounted for most of the reported Geoffroy's Cat deaths (Pereira et al. 2010). *In the Peninsula Valdez, Argentina, hunting pressure has been found to significantly affect the demography and dispersal patterns of Geoffroy's Cat (Pereira & Novaro 2014). Geoffroy's Cats are also used in the pet trade, by*

hybridizing them with domestic cats to create the "safari cat" (Vervaecke et al. 2016), although this occurs very rarely.

Threats: See table 3.1.8.1.

Table 3.1.8.1. Threats to the Ocelot for different locations.

Threat	Location
Habitat loss (incl. fragmentation)	Argentina (Canepuccia et al. 2008, Pereira et al. 2014 cited in Pereira et al. 2015, *Campos et al. 2017*)
	Uruguay (*Maccio 2015)*
Climate change	Argentina (Canepuccia et al. 2008, Pereira et al. 2014 cited in Pereira et al. 2015)
	Range-wide (*Vale et al. 2015* – minimal threat)
Illegal and incidental killing (incl. Targeted hunting for use and trade, persecution/control)	Range-wide (Nowell & Jackson 1996)
	Uruguay (*Maccio 2015*, *Gonzalez et al. 2017)*
	Argentina (Pereira et al. 2010, *Camino et al. 2016, Cuyckens et al. 2016, Marinho et al. 2017, Dean et al. 2019)*
	Brazil (Peters et al. 2016)
Road mortality	Argentina (Pereira et al. 2010, *Attademo et al. 2011, Castilla et al. 2017, Marinho et al. 2017*)
	Brazil (*da Silva et al. 2014, Corrêa et al. 2017, Grilo et al. 2018, Silveira et al. 2018,)*
	Uruguay (*Maccio 2015, Gonzalez et al. 2017)*
Diseases	Argentina (Beldomenico et al. 2005, Uhart et al. 2012, *Arrabal et al. 2017, Romig et al. 2017*, *Vega et al. 2018)*
	Brazil (*Trindade et al. 2018, Trindade et al. 2019)*
Predation by domestic Dogs	Argentina (Pereira et al. 2010, *Marinho et al. 2017*)
	Brazil (*Tirelli et al. 2018)*

Knowledge Base

The available knowledge base is limited for the Geoffroy's Cat. Although often mentioned in side-notes or mammal surveys, there have been very few studies published in the last years, that focus explicitly on the Geoffroy's Cat (Cuyckens et al. 2016, Guidobono et al. 2016, Tirelli et al. 2018, Castillo et al. 2019, Tirelli et al. 2019, Fernandez et al. 2020). In general, most studies originate from or are based in Argentina, a country which contains the majority of the species' distribution range. Across large parts of its extant Red List range no recent confirmed species records exist. Despite often being labelled as the most abundant felid in the temperate Neotropics (Migliorini et al. 2018), there are relatively few studies detailing population estimates of the species. No global population size estimate exists, yet the current population trend is listed as stable. Density estimates exist for Argentina, Bolivia (Chaco), Brazil and Chile (Torres del Paine National Park). Detailed information on home ranges exists mainly from Argentina, however home range estimates are also available from the Brazilian Pampa as well as Torres del Paine National Park (Chile). The habitat types and use are relatively well known, and the Geoffroy's Cat is often noted for its adaptability to human-altered landscapes (Caruso et al. 2017, Puechagut et al. 2018). Use and trade appears to have been a more dominant threat between the 1960 and 1980's, after which the international fur-trade ceased. Threats by means of human-influenced mortality (retaliatory killing for livestock depredation, some poaching, domestic Dog attacks and road mortality), habitat alterations, and diseases may still greatly impact Geoffroy's Cat populations throughout their distribution range, although the true impact is not well known. No conservation strategies or action plans exist.

Evaluation of the Red List Assessment

The RLA for the Geoffroy's Cat (Pereira et al. 2015) is generally well done. Some few points should be considered when re-assessing the species:

- Additional information and/or evidence why the species is considered so widespread and abundant could be provided in the Justification and Population Section;
- The Justification contains some information not stated anywhere else in the RLA, e.g. information on hybridization;
- The Geographic Range section could be expanded including more details on its distribution in the range countries, if available;
- Further explanation should be given for the indicated current stable population trend;
- Information on use and trade is only stated under the threat section but should also be mentioned under Use and Trade;
- Habitat loss and fragmentation is identified as a main threat but, in the Justification, it is mentioned that the species profited from some habitat conversion, some further explanations would be helpful;
- If possible, the section Conservation should be expanded;
- Several of the then available publications were not considered (e.g. Castillo et al. 2008, Trigo et al. 2008, Ribicich et al. 2010, Pereira 2010, Bisceglia et al. 2011, di Bitetti et al. 2011, Manfredi et al. 2011, Saavedra et al. 2011, Cuyckens et al. 2012, Palacios et al. 2012, Manfredi et al. 2012, Canon-Franco et al. 2013, Lehugeur 2013, Trigo et al. 2013, Bertrand & Newman 2014, da Silva et al. 2014, Nascimento 2014, Trigo et al. 2014). These publications provide information on distribution records, taxonomy, hybridization, diseases, diet, activity patterns and spatial ecology, and should be included in the next re-assessment.

Table 3.1.8.2. Evaluation matrix of the Geoffroy's Cat. According to the Criteria and requirements defined in the methods section, the available information at the time of the last assessment, the consideration and correct inclusion of this information into the last Red List Assessment and the new available information since the last Red List Assessment have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟡	🟢	🟡	🔴
Consistency of RLA	🟡	🟢	🟢	🟡	🟡	🟡
New information since last RLA	🟡	🟡	🟡	🟡	🔴	🟡

Conclusions and recommendations

The listing of the Geoffroy's Cat as Least Concern is comprehensible based on the information provided in the Justification. There are no indications of neither a high enough population decline nor a small enough population size to classify the species as Near Threatened. Although the Geoffroy's Cat faces different threats, there is evidence that it profits from land conversion and has some tolerance towards habitat alteration. The species' population trend is considered to be stable.

The information base of the Geoffroy's Cat is limited, especially in regard to its abundance and no population size estimation exists and recent confirmed records are missing across large parts of its assumed extant distribution range (Fig. 3.1.8.1). This makes an evidentiary RLA challenging. There is only a limited amount of new information on the Geoffroy's Cat available (Table 3.1.8.2). The points raised above should be addressed in the next re-assessment and the new distribution records and information be included.

There is a need for:

- Confirmation of the Geoffroy's Cat distribution (incl. further collection of by-catch data from camera-trapping surveys of other target species);
- Quantitative data on Geoffroy's Cat abundance and/or densities;
- Research on population dynamics (i.e. impact of prey fluctuations on Geoffroy's Cat population);
- Assessment of the impact of threats on the Geoffroy's Cat (especially impact of habitat alteration, human-caused mortality, diseases and hybridization);
- Establishment of a conservation plan, where appropriate;
- Amendment of the RL assessment or re-assessment

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3.1.9 Guiña (*Leopardus guigna*)

Vulnerable A2abc; C2a(i) (Napolitano et al. 2015)

Red List history

Year	1994	1996	2002*	2008	2015
cat. & crit.	I	VU	VU C2a(i)	VU A2a; C2a(i)	VU A2abc; C2a(i)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

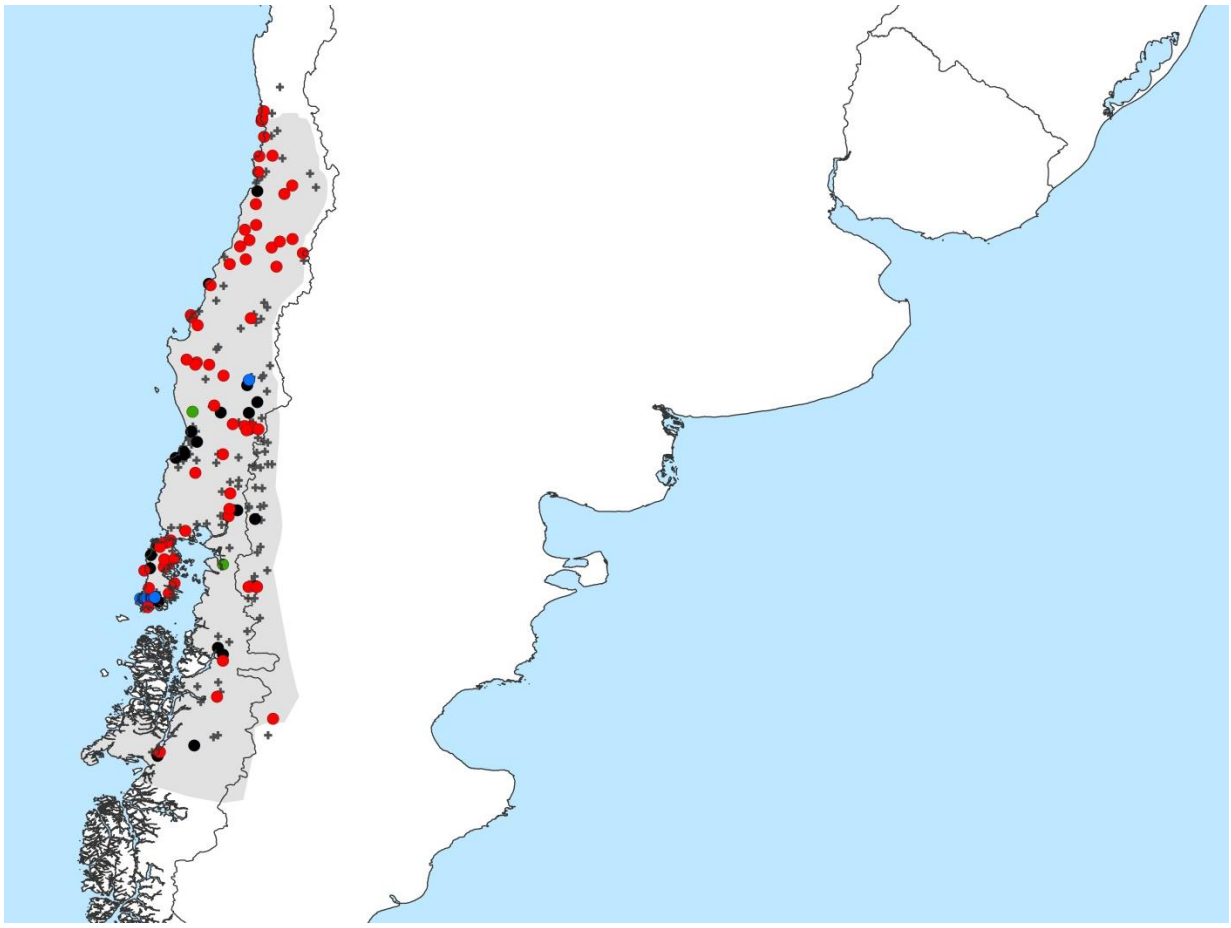

Fig. 3.1.9.1. Guiña observation records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated or without known SCALP category.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Napolitano et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: The Guiña is recognised to consist of two subspecies, namely: *L. g. guigna* and *L. g. tigrillo* (Kitchener et al. 2017).

Justification: The Guiña has a relatively small extent of occurrence (300,000 km²) and has a requirement for vegetation cover. Chilean temperate rainforests have suffered losses of 4.5% per year from 1975 to 2000 (67% reduction of total forest area) and the same loss rate is predicted for 2010–2020. Ongoing habitat deterioration and conversion is also leading to increased fragmentation. Evidence suggests that such fragmentation leads to lower genetic diversity and a population decline. A pattern of Ne >> N (bottleneck) infers a possible current decline in Guiña subpopulations. Moreover, Guiña occur at lower densities and use larger home ranges in fragmented landscapes, are frequently killed in traffic accidents or as retaliation for poultry depredation, and have increased contact probabilities with domestic cats, facilitating disease transmission. Additionally, climate change may be another important potential threat for the Guiña. An abundance index based on DNA samples, camera-trapping and radio-tracking qualifies the Guiña for Vulnerable under A2a and A2b. Moreover, the above-mentioned annual forest loss rate is suspected to have caused a population decline of at least 30% over the last three generations (18 years), qualifying for Vulnerable under A2c. Realistic input data resulted in a plausible range of between 5,980 and 92,092 mature individuals. According to the precautionary approach suggested in the Red List Guidelines, the lower ends of the estimates were used. As such, the global population is <10,000 mature individuals, and four of six geographic groups have ≤1,000 mature individuals, qualifying for Vulnerable under C2a(i). However, based on the two geographic groups with >1,000 mature individuals, on the higher end of the estimates, or if the rate of decline is lower than suspected, the Guiña could possibly be Near Threatened.

Geographic Range: The Guiña has an estimated extent of occurrence of 300,000 km² ranging in Chile from 30° to 48° S and in Argentina from 39° to 46° S west of 70° W and from sea level to altitudes of 2,500 m. The border between the northern subspecies *L. guigna tigrillo* and the southern *L. guigna guigna* is 38°S (Napolitano et al. 2014). In principle, the Guiña occurs over most of its range, but the area is fragmented due to loss of habitat (i.e. native temperate forest). It is also found on Chiloé island (Sanderson et al. 2002). *Recently confirmed records for the Guiña exist across most of its whole distribution range. Most of them originate from two studies on disease transmission between species (Mora et al. 2015, Sacristán et al. 2019) and few camera-trapping records (e.g. Galvez et al. 2013, Fletschutz et al. 2016, Moreira-Ace et al. 2016, Barceló & Simonetti 2017, Zúñiga et al. 2016, Galves 2015, Hernández & Céardenas 2018, Sepúlveda-Sánchez & Skewes 2015). There are two recently confirmed records just slightly outside its known distribution range: one from the Province of Maule (Sacristán et al. 2019) and one from the province Coquimbo, Chile (Napolitana et al. 2020).*

Population: Densities were estimated for a fragmented landscape on Chiloé island, Chile, at 5–77 individuals per 100 km² (Sanderson et al. 2002), and for a pristine landscape in Laguna San Rafael and Queulat National Parks, Chile, at 45–330 individuals per 100 km² (Dunstone et al. 2002). For the global estimation of abundance, the density estimate for a fragmented landscape was used. It was assumed that 80% of the total area is occupied and that 50% of the population are mature individuals. The distribution range can be divided into six geographic groups, to which the same process has been applied (Table 3.1.9.1). In central Chile, 24 subpopulations were estimated to occur (Acosta-Jamett et al. 2003). The population is decreasing. Densities were lower in exotic pine plantations than in primary native forest (Acosta-Jamett & Simonetti 2004). *In Argentina, the Guiña is listed as Endangered (Ojeda et al. 2012).*

Table 3.1.9.1. Abundance estimates for the Guiña per geographic group (Napolitano et al. 2015).

Geographic group	Estimated number of mature individuals	
	Lower bound	Upper bound
Northern group	1,600	24,640
Central group	1,000	15,400
Lake District group	1,800	27,720
Chiloé District group	180	2,772
Argentinian group	1,000	15,400
Laguna San Rafael group	400	6,160
Total	**5,980**	**92,092**

Habitat: The northern subspecies *L. guigna tigrillo* uses Mediterranean matorral and sclerophyll woodlands and forests, whereas the southern *L. guigna guigna* inhabits moist temperate mixed forests such as the Valdivian temperate rainforest, the Araucaria forests and north Patagonian Forest in Chile, which include southern beech and bamboo in the understorey. In Argentina, Guiñas inhabit moist montane forest similar to the Valdivian, also including a multi-layered structure with bamboo, lianas and epiphytes (Nowell & Jackson 1996, Lucherini et al. 2000, Napolitano et al. 2014). They are tolerant to a degree of habitat alteration and can be found in secondary forest, exotic pine and eucalyptus plantations, fragmented landscapes and on the borders of rural settlements and agricultural areas (Sanderson et al. 2002, Acosta-Jamett & Simonetti 2004). Guiñas require vegetation cover (e.g. forests with heavy understorey), which they probably use for dispersion, stalking prey and reproduction. The species was only found in plantations in proximity to native primary forests or regeneration understorey (Acosta-Jamett & Simonetti 2004). In some instances, thicket forests with dense shrubby understorey were even preferred over primary forest (Freer 2004). Cover is also important for corridors: on Chiloé island, corridors may be as narrow as 3 m wide to move between forest fragments, but Guiñas avoid areas with vegetation <0.4 m high (Sanderson et al. 2002). Connectivity depends on such vegetation corridors, but also on safe road crossing structures (culverts, over- and underpasses, etc.; Sanderson et al. 2002, Acosta-Jamett et al. 2003, Acosta-Jamett & Simonetti 2007). *Radio-collared individuals were observed to make particular use of forest edges, while forest patches that were smaller than 0.5 km^2 were used relatively rarely (Schuettler et al. 2017). Guiñas were observed crossing open habitat only up to distances of 100 m to reach suitable habitat patches again (Dunstone et al. 2002 cited in Vásquez Fernández 2015). The importance of undergrowth was also shown by Simonetti et al. (2013): Guiñas were found in pine plantations with undergrowth, but were absent after experimental removal of the undergrowth.*

Ecology: Guiñas mainly hunt on the ground for small mammals (i.e. mostly rodents, but also small marsupials), birds and reptiles (Correa & Roa 2005). They are also known to scavenge (Freer 2004). Home range sizes were estimated in different habitats and areas. Generally, they are larger in fragmented areas than in pristine ones. Size ranges from 0.3–2.2 km² in pristine Laguna San Rafael and Queulat National Parks (Dunstone et al. 2002) to 1.3–22.4 km² on Chiloé Island (Sanderson et al. 2002). In fragmented landscapes, home ranges overlap between the two sexes, but not within (Sanderson et al. 2002), whereas in the protected areas extensive overlap was observed (Dunstone et al. 2002). Dispersal distance reached up to 13.9 km (mean = 5.5 ± 4.9) in a fragmented landscape, and 1.83 km (mean = 1.4 ± 0.25) in protected areas (Dunstone et al. 2002, Sanderson et al. 2002). *In the Malleco National Reserve, Chile, the majority of Guiña's prey consisted of arboreal/scansorial small mammals, although ground-dwelling ones appeared to occur more frequently in the area (Figueroa et al. 2018). The species was also observed attempting to prey upon cavity-nesting bird nestlings, i.e. nest boxes with Thorn-tailed Rayadito (Aphrastura spinicauda) in Chile's Araucanía district (Altamirano et al. 2013). Guiñas were also found to prey on the exotic European Rabbit (Oryctolagus cuniculus; Buenavista & Palomares 2018). They can be active day and night (Moreira-Arce et al. 2015, Zúñiga et al. 2016). Melanistic individuals showed stricter nocturnal activity than*

spotted ones (Hernández et al. 2015). Average home range size in the Chilean Araucanía region was 6.23 km² (Schuettler et al. 2017). In Argentina, the Guiña is negatively influenced through intraguild competition, especially with the Geoffroy's Cat (L. geoffroyi; Lucherini & Luengos Vidal 2003).

Use & Trade: There is no information indicating that this species is used and/or traded.

Threats: see Table 3.1.9.2.

Table 3.1.9.2. Threats to the Guiña for different locations according to Napolitano et al. (2015) *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation)	Central group (Wilson et al. 2005, Echeverría 2006, 2008)
	Lake district group (Wilson et al. 2005, Echeverría 2006, 2008)
	Chiloé island group (Armesto et al. 1998, Sanderson et al. 2002)
	Araucanía district, Chile (Fleschutz et al. 2016)
Reduced genetic diversity	- (Napolitano et al. 2014)[1]
Illegal killing (persecution/control)	Central & southern Chile (Silva-Rodríguez et al. 2007, Herrmann et al. 2013, Zorondo-Rodríguez et al. 2014, *Napolitano et al. 2016*)
	Chiloé island (Sanderson et al. 2002, Napolitano 2012, Napolitano et al. submitted, *Sacristán et al. 2018*)
	Valdivia area, Chile (Sacristán et al. 2018)
Road mortality	Chiloé island (Napolitano 2012, Napolitano et al. submitted)
Predation by domestic Dogs	-[1]
Diseases	Chiloé island (Mora et al. 2015)
	Los Ríos, Chile (López Jara 2017)
Climate change	Chile (Marquet et al. 2010)
	Range wide (Cuyckens et al. 2015, Vale et al. 2015)

[1] "-" means that this threat was mentioned in the RLA but not the location where it occurs.

Knowledge base

The knowledge base on the Guiña has its limitations. Recently confirmed distribution records exist across large parts of its distribution range but there are some regions without any or only unconfirmed/old records. Its distribution limits are quite well known. Twenty-four subpopulations have been estimated in Chile. Densities are known from a fragmented landscape and a pristine landscape. In both cases, densities were estimated based on the home ranges of radio-collared individuals. The density estimate from a fragmented landscape was used to produce abundance estimates for the six identified geographic groups. However, the estimate is extremely broad, with the upper bound almost 20 times higher than the lower bound. The upper bound of the not used density estimate for a pristine landscape would be another four times higher. Habitat use and requirements are well known. Home ranges have been studied in two areas and include information on dispersal distances. Diet has been studied several times and information on activity patterns exists too. The species is not used and traded. A variety of threats is known, but largely without information on the impact. In Chile, a National Action Plan has been developed.

Evaluation of the Red List Assessment

The assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available the Justification should include more information to justify the Category and Criteria chosen;

- The statement in the Justification where the population reduction is stated to be based on a decline in AOO and in habitat quality should be aligned with the one of the Geographic Range section where a decline in the EOO but not in AOO or habitat quality is mentioned;
- The suspected population decline of at least 30% in the past over three generations is stated to be based on habitat loss (Subcriteria A2c) but also Subcriteria A2ab are listed. Further explanations would support the listing of the species under these subcriteria;
- The division of the species into different groups and their connectivity to each other would profit from more explanations, e.g. in the Justification six geographical groups, in the Conservation section two conservation units and five genetic groups and in the Geographic Range section 24 subpopulations are mentioned;
- The estimation of mature individuals should be supported by further explanations;
- Some information stated under Geographic Range should be moved to the Taxonomic Notes section;
- Of the few then available publications, some were not considered (e.g. Ojeda & Isenrath 2012, Altamirano et al. 2013, Simonetti et al. 2013, de Oliveira & Pereira 2014). These publications provide information diet, intraguild predation and habitat use of the Guiña.

The listing as Vulnerable under Criterion A, Subcriteria A2abc (population size reduction in the past; → Appendix I) is based on a suspected population size reduction of 30% in the past 18 years (three generations). The population decline is assumed to be the consequence of loss of habitat and reduction in its quality and based on direct observation as well as on an index of abundance. The evidence given for the population decline is a 67% reduction of total forest area for the period 1975–2000. Similar forest loss rates were predicted for the period 2010–2020. Considering 3 generations, the habitat reduction from 1996–2014 should be considered to determine the population decline. In regard to the application of Subcriterion A2a; in the Justification it is stated that the index of abundance to apply Criteria A2a is based on DNA samples, camera-trapping and radio-tracking data but "a" refers to direct observation, "b" refers to an index of abundance. Further explanations on why these two Subcriteria apply would help the reader to understand the reasoning behind the population decline. For the application of Criterion C2a(i) each subpopulation must contain ≤ 1,000 mature individuals. This should be further elaborated in the assessment. It is not fully clear, if the number of geographical regions corresponds to the number of subpopulations or how they are linked together. Further explanations for the population estimate should be added e.g. why 50% of the population were considered mature individuals, why occupancy of 80% of the total area was chosen and why exclusive home ranges were assumed (which are only exclusive in fragmented landscapes. Why the lower bound of the population estimate and not the average has been chosen should be supported by some further explanations if possible.

Table 3.1.9.3. Evaluation matrix of the Guiña. According to the Criteria and requirements defined in the methods section, the available information at the time of the last Red List Assessment (RLA), the consideration and correct inclusion of this information into the last Red List Assessment and the new available information since the last Red List Assessment have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟢	🟡	⚪	🟡
Consistency of RLA	🟡	🔴	🟢	🟢	⚪	🟢
New information since last RLA	🟡	🔴	🟡	🟡	⚪	🟡

Conclusions and recommendations

The classification of the Guiña as Vulnerable would profit from further explanations. The knowledge base on the Guiña is moderate and there are few recent publications on the species. There is little new (recent) information available on the Guiña (Fig. 3.1.9.1; Table 3.1.9.3) and few specific projects have been conducted on this species. Nevertheless, the species should be re-assessed and the points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines.

There is a need for:

- Confirmation of the number of groups/conservation units and the fragmentation of the population;
- Information on the Guiña's ecology
- Quantitative data on Guiña's abundance and/or densities and trends;
- Assessment of impact of threats, especially the impact of habitat loss and fragmentation, diseases and the impact of retaliation killing;
- Conduction of a re-assessment of the species for the IUCN Red List.

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3.2. Africa and Eurasia

3.2.1 Jungle Cat (*Felis chaus*)

Least Concern (Gray et al. 2016)

Red List history

Year	1996	2002*	2008	2016
cat. & crit.	LR/LC	LC	LC	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

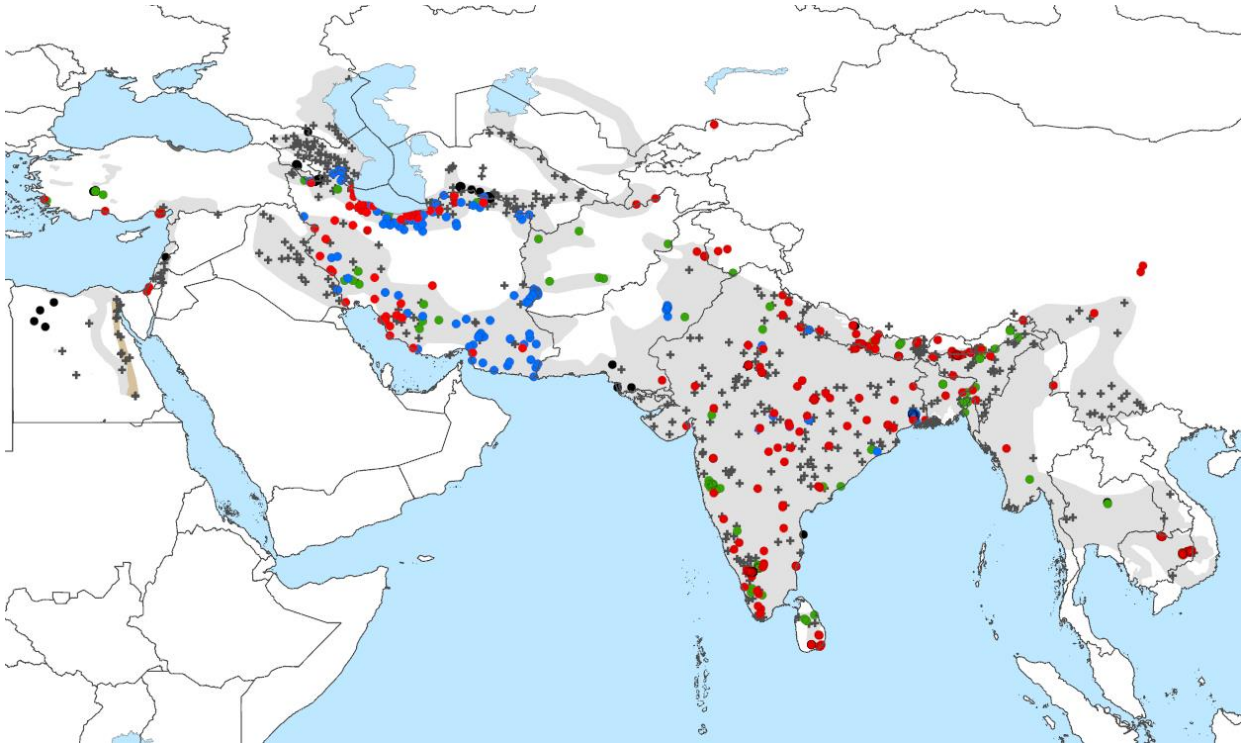

Fig. 3.2.1.1. Jungle Cat records from the CSGSD. Light grey area = extant, grey = possibly extant, dark grey = presence uncertain, light brown = possibly extinct distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999, or not dated. The Presence Uncertain range of the species is not shown in the map.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Gray et al. 2016) and *additional information available* (in italic).

Taxonomy: The Jungle Cat currently is recognised to consist of three subspecies, namely: *F. c. chaus*, *F. c. affinis* and *F. c. fulvidina* (Kitchener et al. 2017). A phylogeographic study, however, is required to confirm the subspecies classification.

Justification: The Jungle Cat is assumed to be the most common cat species in South Asia (India, Nepal, Bangladesh). Elsewhere, it has experienced population declines: in Egypt (Glas 2013), South-west

Asia (Abu-Baker et al. 2003), parts of Turkey (Ogurlu et al. 2010), the Caucasus (IUCN 2007), central Asia (Habibi 2004), and South-east Asia (Duckworth et al. 2005, Gray et al. 2014). In India, there is evidence of continued and probably accelerating loss of habitat (especially through industrialisation and urbanisation), and of ongoing poaching for both skins, and due to human-wildlife conflict (Choudhury 2010, Chowdhury et al. 2015, S. Mukherjee *in litt.* 2014, H. S. Baral *in litt.* 2014, D. Jathana *in litt.* 2014). The average global decline is deemed to be insufficient to merit listing the species as Near Threatened. Hybridisation with domestic cats might also occur, but this is yet to be proven.

Geographic range: In the west, the Jungle Cat's range reaches Egypt, where it occurs mostly in the Nile River valley (Glas 2013) and continues through Israel, southern Lebanon, north-western Jordan, western Syria, and into Turkey where it has a fragmented distribution, but an unknown status (Abu-Baker et al. 2003, Avgan 2009, Gerngross 2014). Its range covers Iraq, Iran, the Caucasus (Armenia, Azerbaijan, Georgia, Russia), central Asia (Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan, Afghanistan, and possibly Kyrgyzstan), Pakistan, India, Sri Lanka, Nepal (up to 2,400 m), Bangladesh, Bhutan and South-east Asia (Myanmar, Thailand, Cambodia, Laos PDR and southern China) north of the Isthmus of Kra (Nowell & Jackson 1996, Duckworth et al. 2005, Sanei et al. 2016). *Recent confirmed records were found mainly from Iran and India (Fig. 3.2.1.1). However, even in India larger areas within the Red List distribution range remain without recent confirmed records. This is also true for many other range countries with no or only very few recent confirmed records (Fig. 3.2.1.1). On the other hand, we found some recent confirmed records outside the current extant distribution range in Bhutan (Jamtsho et al. 2021), China (Li et al. 2019), Iran (Shahinpour et al. 2022), India (Noor et al. 2017) and Sri Lanka (Karunarathna et al. 2017).*

Population: The Jungle Cat is considered threatened and is included in the Red Data Books of Russia, Armenia, Azerbaijan and Georgia (IUCN 2007). The population size in North Dagestan, Russia, was estimated at 150 animals (Kuryatnikov & Varziev 1983 cited in Gray et al. 2016). The long-term trend for Europe is believed to be a decline both in number and area. In Russia, there are an estimated total of 500 animals left (Prisazhnyuk & Belousova 2007). In Georgia, only a very small population exists (I. Macharashvili pers. comm. 2007). In Dagestan, Russia, annual population estimates from 2009–2013 were 105, 216, 177, 110 and 307 animals, respectively (Yarovenko 2014). It is thought that the large fluctuations are a result of declining population after severe winters. In South-west Asia, the Jungle Cat is considered to be rare and threatened (Abu-Baker et al. 2003, Habibi 2004), but the species is still common in Pakistan, India and Bangladesh (Mukherjee 1998, Duckworth et al. 2005, Patel 2011). Across southern China and South-east Asia, the Jungle Cat appears to be rarer than sympatric small cats, with a potential stronghold in the Eastern Plains Landscape Protected Area complex in Cambodia (Duckworth et al. 2005, Lynam et al. 2006, Gray et al. 2014). In Tugai habitat in Central Asia, Jungle Cat density was estimated at 40–150 individuals per 100 km² (Belousova 1993 cited in Nowell & Jackson 1996). Where Tugai forests declined, density was estimated being lower than 20 individuals per 100 km² (Nuratdinov & Reimov 1972 cited in Nowell & Jackson 1996). The global population is thought to be decreasing. *In the respective National Red Lists, it is listed as Least Concern in Nepal, as Near Threatened in Bangladesh and Sri Lanka, as Vulnerable in Israel, and as Endangered in China (Dolev & Perevolotsky 2004, Jnawali et al. 2011, IUCN Bangladesh 2015, Jiang et al. 2016, Ratnayaka 2018). In Nepal, the population is estimated to exceed 10,000 individuals (Jnawali et al. 2011).*

Habitat: The Jungle Cat can mostly be found in wetlands with water and dense vegetative cover, such as reed swamps, marsh and littoral and riparian environments, in scrubland and deciduous dipterocarp forest, but also in oases, and along riverbeds, grassland, shrubby woodland, dry deciduous forest and clearings in moist forests (Nowell & Jackson 1996, Gray et al. 2014, Yarovenko 2014, Sanei et al. 2016). It is likely absent from all closed-canopy forests, but can use agricultural areas that retain

patches of scrub and are subject to a low intensity of human use (Duckworth et al. 2005). Jungle Cats also occur in landscapes with irrigated cultivation, e.g. sugar cane plantations in India and pisciculture ponds and irrigation ditches in Israel. In Azerbaijan, Jungle Cat presence increased with the development of a local irrigation system and decreased with its abandonment (Vereschagin 1959). The mowing of the seasonally flooded riverine Tugai vegetation has resulted in lower Jungle Cat densities (Nowell & Jackson 1996). *Occasionally, Jungle Cats also seem to be able to tolerate urban environments as they have been found on the campus of Pulchowk Engingeering College in the middle of Lalitpur, Nepal (Basnet et al. 2017).*

Ecology: In Pench Tiger Reserve in India, Jungle Cats mostly showed nocturnal activity patterns, whereas in Cambodia they were mostly diurnal (Majumder et al. 2011, Gray et al. 2014). Jungle Cat's main prey species are small mammals – mainly rodents (Majumder et al. 2011, Adhya 2014). In southern Russia, waterfowl, however, constitutes the Jungle Cat's main prey species. Besides rodents and birds, Jungle Cats feed on hares, nutria, lizards, snakes, frogs, insects, fish and fruit, and may even kill young swine, subadult gazelles and chital fawns (Sunquist & Sunquist 2002, Ogurlu et al. 2010, Majumder et al. 2011, Patel 2011).

Use & Trade: Illegal killing and trade still occurs in India and in other parts of South Asia, but also in Afghanistan, Egypt, Indochina, Jordan, Turkey and Iran (Sunquist & Sunquist 2002, Choudhury 2010, Ogurlu et al. 2010, Sanei et al. 2016). *Jungle Cats were found for sale at markets in Myanmar during surveys performed in 1991–2006 and again in 2016–2017, albeit rarely in comparison to other felid species (Shepherd & Nijman 2008, Min et al. 2018).*

Threats: see Table 3.2.1.1.

Table 3.2.1.1. Threats to the Jungle Cat for different locations according to Gray et al. 2016 *and other sources.*

Threat	**Location**
Habitat loss	India (S. Mukherjee *in litt*. 2014, D. Jathana *in litt*. 2014); Iran (Avgan 2009, Gerngross 2014, Sanei et al. 2016); Turkey (Ogurlu et al. 2010)
Pollution	Turkey (Ogurlu et al. 2010)
Illegal and incidental killing (incl. targeted hunting for use and trade, persecution/control)	Afghanistan (Habibi 2004); Egypt (Glas 2013); India (Sunquist & Sunquist 2002, Choudhury 2010); Indochina (Duckworth et al. 2005); Iran (Sanei et al. 2016); Jordan (Abu-Baker et al. 2003); *Myanmar (McEvoy et al. 2019);* South Asia (Chowdhury et al. 2015, H. S. Baral *in litt*. 2014); Turkey (Ogurlu et al. 2010)
Predation by feral Dogs	*Nepal (Basnet et al. 2017)*

Knowledge Base

Only very few studies focussing on the Jungle Cat species have been conducted in the past years. Most information originates from India, which is an important range country for the species, with limited information from the other range countries. Especially for East and South-east Asia, no details on its distribution below the country level, is available. The distribution in Iran is well confirmed by recent records, but for the rest of the range countries, we found either only very few or no recent records for larger areas within the assumed range (Fig. 3.2.1.1). No global population size estimate exists for the Jungle Cat. Population estimates were published only for the Russian state of Dagestan, for Russia as a whole (but with no methodological details given), as well as a rough guestimate for

Nepal, two old density estimates from the natural Tugai habitat in Central Asia, and some generic information on its status in some of its range countries. References on the status and trend of the species date back to <2008 (date of previous RLA). Habitat preference and use were reported, and diet studies originate from various countries, but there is no information on home ranges available. Detailed data on the use and trade of the Jungle Cat does not exist, nor is their potential impact known. General threats of the species across its range are noted, and for several countries the specific threats are identified, but causes and impacts are not fully understood. No conservation strategy or action plan exists for the species. Some conservation projects are known.

Evaluation of the Red List Assessment

The RLA for the Jungle Cat (Gray et al. 2016) is correctly done considering the available information. The Justification contains all information to justify the listing of Least Concern. The limited information at the time of the last assessment has largely been considered and has correctly been integrated into the assessment. However, the following aspects can be improved:

- More evidence for the assumed population declines should be provided;
- Although not mandatory for an LC species, the calculation of the AOO would provide valuable information to provide future evidence for the assumed range contractions;
- Information on Use and Trade is only included in the Threat section, but should also be addressed under Use and Trade;
- Information in the different sections would profit from consistent grouping according to regions or per country;
- A network for the species should be established;
- Some of the then available publications were not considered, (e.g. Chutia 2010, Jutzeler et al. 2010, Gupta 2011, Gray et al. 2012, Ramesh et al. 2013, Choudrat et al. 2014, Sanil et al. 2014, Tantipisanuh et al. 2014, Willcox et al. 2014).

Table 3.2.1.2. Evaluation matrix of the Jungle Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟢	🟡	🟡	🟡
Consistency of RLA	🟡	🟡	🟢	🟢	🟡	🟢
New info since last RLA	🟡	🟡	🟡	🔴	🟡	🟡

Conclusions and recommendations

The knowledge base on the Jungle Cat was limited at the time of the last assessment, and there is little new information available (Table 3.2.1.2). Very few specific projects have been conducted on this species; most information originates from by-catch data from studies focussing on other carnivores or mammals, foremost from protected areas. The current RLA of the Jungle Cat is comprehensible and in accordance with the updated RL Guidelines (IUCN Standards and Petitions Committee 2019). Hence, considering the limited new information available, there is no urgent need for a reassessment of the Jungle Cat. However, recent distribution information and new records outside of the Extant range (Fig. 3.2.1.1) should be integrated into the existing RLA as an amendment.

The general knowledge on the Jungle Cat should be extended. There is specific need for:

- Confirmation of the Jungle Cat's distribution (incl. further by-catch data from camera-trapping surveys of other target species and chance observations (e.g. traffic accidents) particularly also outside of protected areas);
- Quantitative and robust data on Jungle Cat abundance/densities and population trends are needed; a series of consistent long-term monitoring in certain representative reference areas would be most welcome;
- Information on the Jungle Cat's ecology and population biology (e.g. home range size, dependence of and response to prey availability, adaptability to habitat alterations);
- Assessment of impact of various threats, especially the impact of habitat loss and persecution;
- Establishment of a conservation plan, where appropriate;
- Amendment of the current RLA based on new distribution records from 2020 was published in 2021;
- Re-assessment of the species for the IUCN Red List as significant and new information becomes available.

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3.2.2 Black-footed Cat (*Felis nigripes*)

Vulnerable (Sliwa et al. 2016a)

Red List history

Year	1996	2002*	2008	2016
cat. & crit.	LR/LC	VU C2a(i)	VU C2a(i)	VU C2a(i)

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

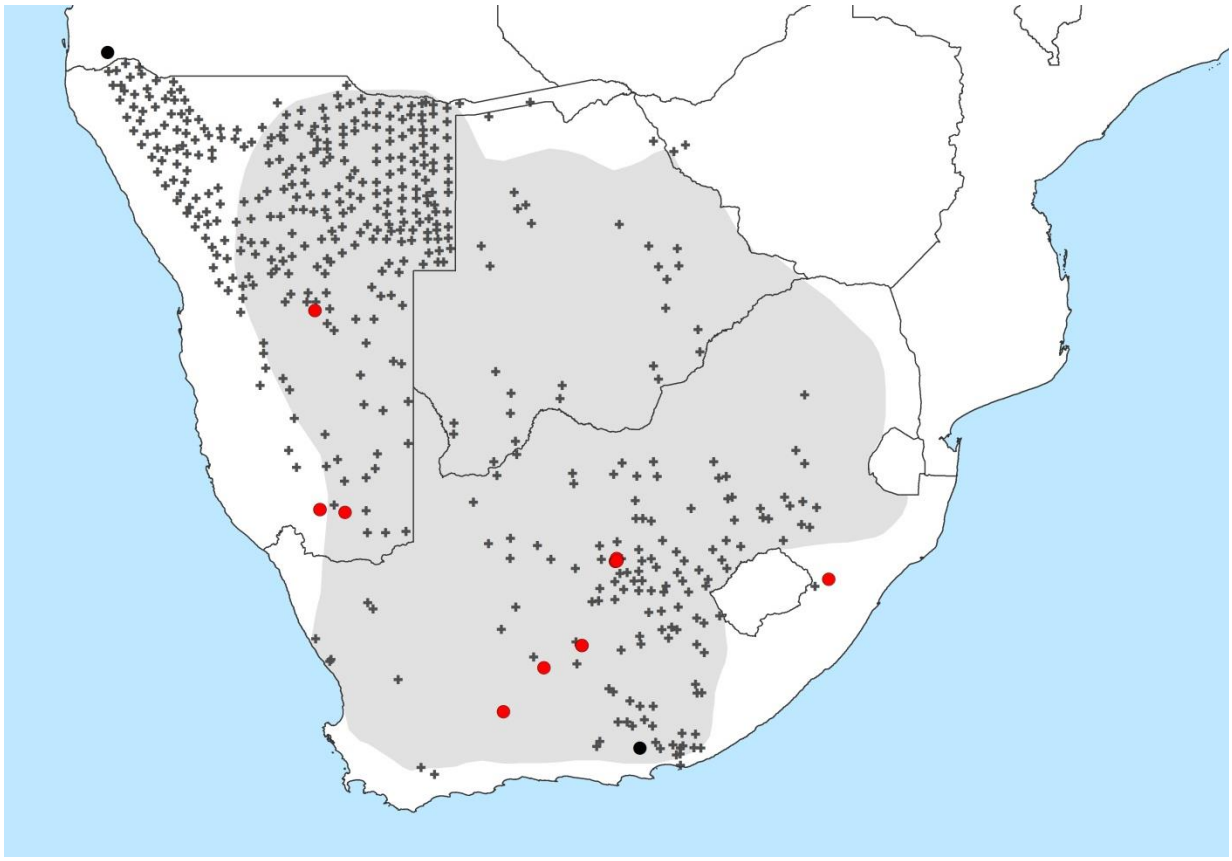

Fig. 3.2.2.1. Black-footed cat records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999, or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Sliwa et al. 2016a) and *additional information available* (in italic).

Taxonomy Notes: The Black-footed Cat is recognised to be monotypic (Kitchener et al. 2017), but does exhibit clinal variation.

Justification: There is a national Red List assessment for South Africa by Wilson et al. (2016), which was used as a basis for the global assessment by Sliwa et al. (2016a). The Black-footed Cat occurs only in the arid regions of southern Africa within relatively restricted and patchily distributed habi-

tats. There is very limited historical data, which has led to inconsistencies and perpetuated inaccuracies in current literature and thus affected the accuracy of conservation measures. This is owed also to the cat's ecology and behaviour (naturally rare, nocturnal, cryptically coloured and small-sized). It is hence difficult to estimate population sizes and trends, but densities are known to be low. The highest densities reported are in the central Karoo region of South Africa – the assumed stronghold of the species. 9,707 mature individuals with no subpopulation >1,000 individuals were estimated based on an assumed density range (see below). However, the definition of subpopulations needs to be improved. Moreover, this estimate is based on uneven sampling across the range, resulting in inaccurate density isopleths. This first attempt at a population estimate will need improvement as more data become available. Prey depletion (through bushmeat poaching, especially of springhare (*Pedetes capensis)*, persecution (direct or incidental), road collisions and predation by domestic animals are suspected to cause a general, continuing decline. Moreover, a density decline from 17 per 100 km² in 1998/99 to 8 per 100 km² in 2005–2015 during a long-term study in Benfontein, Northern Cape, South Africa, also infers a continuing decline. 50% of radio-collared individuals are lost annually from natural mortality and predation by Black-backed Jackals (*Canis mesomelas*) and Caracals (*Caracal caracal*). Increased intraspecific competition and intraguild predation (by overabundant mesopredators such as Black-backed Jackals) may be an emerging threat. As the population size is estimated to be below 10,000 mature individuals with no subpopulation >1,000 individuals and with an inferred continuing decline, the Black-footed Cat is listed as Vulnerable C2a(i). However, the used densities were low, systematic field surveys across the range are missing, and the definition of the subpopulations is not robust. As a result, the assessment is precautionary. A reassessment should be performed as soon as better data become available. A key intervention for the Black-footed cat is the establishment of large conservancy areas and sustaining viable springhare subpopulations, where other refuge systems do not exist.

Geographic Range: The Black-footed Cat has the smallest range of the African felids (Nowell & Jackson 1996). It occurs only in southern Africa in the arid grasslands, dwarf shrub, and savannah of the Karoo and Kalahari. The majority of its range lies in South Africa, but extends into Botswana, Namibia marginally into Zimbabwe, and probably also into extreme southern Angola (Sliwa 2013). There are no records from Eswatini (M. Reilly & A. Monadjem, pers. comm 2014) and Lesotho (N. Avenant, pers. comm. 2014), where the species is most likely absent. South Africa and Namibia are the strongholds. Old records exist from Botswana, but only limited recent ones (Sliwa 2013). The South African population shows an increased range compared to previous literature (Wilson et al. 2016). However, this is more likely due to increased reporting and research efforts rather than true range expansion (Wilson 2016). There have only been 251 records (incl. fossil specimens) before the year 2000. Since then, over 545 records have been collected. Camera trapping is not really applicable to this species; only 1 record comes from a camera trap (B. Wilson, unpub. data). Overall, only c. 692 verifiable locality records can be reliably mapped (Wilson 2016). In the east, the Black-footed Cat's range extends to just west of Kruger National Park into north-western KwaZulu-Natal. Recent records come from further south and south-westwards in the Southern Cape and more westwards in the Northern Cape than previously recorded (Wilson 2016). Protected areas have been surveyed intensively, but the Black-footed Cat was only recorded in Addo Elephant National Park, Mountain Zebra National Park (both Eastern Cape Province) and in SA Lombard Nature Reserve (North West Province; Wilson 2016). Their absence might be due to unsuitable habitat and/or higher densities of mesopredators. Black-footed Cats probably occur in Karoo National Park, but further surveys are needed in protected areas. The EOO for South Africa is estimated at 930,000 km² (Wilson 2016). However, the AOO is likely to be much lower due to the fragmented distribution because of sensitivity to environmental disturbances and threats (Sliwa 2013). *Very few (confirmed) recent records of the Black-footed Cat are available (Fig. 3.2.2.1). Two of these recent confirmed records lie outside of the current RLA distri-*

bution range; one in South Africa in the Drakensberg Mountains (Ramesh & Downs 2015) and one in Grunau, Namibia (Sliwa et al. 2020). For large parts of the current RLA distribution range no old records neither exist (Fig. 3.2.2.1).

Population: Black-footed Cats are naturally rare and secretive. The scarcity of records (see above) makes it difficult to come up with population size estimates. Long-term telemetry studies have been performed at Benfontein and Nuwejaarsfontein, both in the Northern Cape province of South Africa (Sliwa 2004, Sliwa et al. 2010). Based on radio-collared individuals in Benfontein, a density of 17 individuals per 100 km² was estimated in 1998/99, which decreased to 8 individuals per 100 km² between 2005 and 2014. In Nuwejaarsfontein, the density was estimated at 6 individuals per 100 km² from 2009–2014 (Sliwa 2004, Sliwa et al. 2014). However, it is suspected that these are exceptionally high densities due to favourable climate and human site management. In inferior habitat, densities may be much lower (Sliwa 2013). A density of 3 individuals per 100 km² seems a realistic estimate across larger scales and may represent viable subpopulations in the long-term (B. Wilson & A. Sliwa, unpub. data). To estimate the population size, density estimates of 3, 2, and 1 individuals per 100 km² as high, medium, low densities were used. Density isopleths were established across the range based on verified records. The high, medium and low-density areas included 50%, 20% and 25%, respectively, of the range (Fig. 3.2.2.2). A total population of 9,707 mature individuals was estimated (70% of a total of 13,867 individuals).

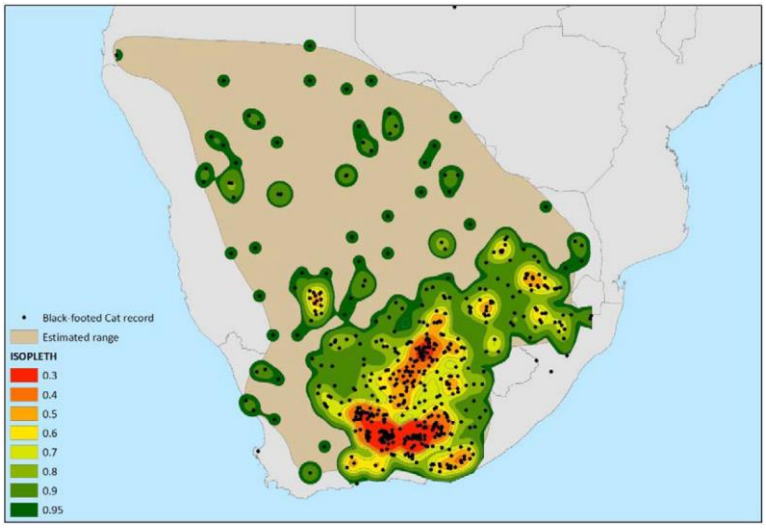

Fig. 3.2.2.2. Heat map of distribution records for Black-footed Cat (*Felis nigripes*). Isopleth bands containing the % of distribution records are shown on the left of the figure (Sliwa et al. 2016a, supplementary information).

Additionally, none of the subpopulations has an estimated population size of > 1,000 mature individuals. However, further information on dispersal rates and distances, connectivity and (genetic) subpopulation structure needs to be enhanced to improve subpopulation definitions. Current data consists of a minimum home range estimate for females of 7.1–8.6 km² (Sliwa 2004, Kamler et al. 2015) and a dispersal distance of 20 km (A. Sliwa, unpub. data). Clusters within 50 km of each other and distances of 100 km apart were suspected to separate subpopulations. Even the very high density of 17 individuals per 100 km² would in a cluster of 2,500 km² only result in a subpopulation of 425 individuals. It has to be noted, that these are probably underestimates. There is no consistent search effort and the calculated density zones are probably influenced by differing methodologies. Single records may be due to under-sampling and may actually have higher densities. On the one hand, areas outside South Africa are probably significantly under-sampled, but on the other hand, are expected to have low densities nonetheless (Namibia: M. Küsters pers. comm.). However, for South Africa, the population estimate is probably more robust, but still is only a replicable first-step methodology that needs improvement with better data. Moreover, the current estimate depends heavily

on the definition of the high-density areas. Increasing the high-density area from 50% to 70% would result in an estimate of 11,797 mature individuals. The high, medium and low density for the isopleths were selected precautionarily and also need calibration with better data. The population of the Black-footed Cat is suspected to be generally declining, with few areas with stable subpopulations. This decline is inferred from a documented decrease in density in a long-term study in Benfontein, Northern Cape province, South Africa. In 1998/99, density was estimated at 17 individuals per 100 km², but dropped to 8 individuals per 100 km² in 2005–2015 (e.g. Sliwa et al. 2014). Black-backed Jackals and Caracals may also limit Black-footed Cat populations through interspecific competition and intraguild predation (see Kamler et al. 2015). Half of all radio-collared cats were killed by larger predators (Black-footed Cat Working Group, unpub. data). *The Black-footed Cat is listed as Vulnerable in the National Red List of Mammals of South Africa, Eswatini and Lesotho (Wilson et al. 2016). The South African population is estimated at 8,334 mature individuals (Wilson et al. 2016).*

Habitat: The Black-footed Cat is found in dry, open savannah, grasslands and Karoo semi-desert containing little shrub and tree cover. It can be found at altitudes up to 2,000 m in areas with a mean annual rainfall of 100–500 mm. It is absent from the driest and sandiest parts of the Namib and Kalahari deserts (Sliwa 2013).

Ecology: The Black-footed Cat is strictly crepuscular and nocturnal and may hunt even at -8°C at night (Olbricht & Sliwa 1997). They spend the day in dens, usually dug by springhares, ground squirrels (*Xerus inauris*) or aardvarks (*Orycteropus afer*), or in hollow, abandoned termite mounds. Black footed cat females weigh on average 1.30 kg, males 1.93 kg (Sliwa 2013). In the wild, Black-footed Cats may reach an age of 5–7 years (Black-footed Cat Working Group, unpub. data). In captivity, their life expectancy may reach up to 16 years. They generally are solitary, apart from females with kittens and during mating periods. The mating season is from August to March, but mating may occur year-round and two litters may be produced per year. After a gestation of 63–68 days, one to four kitten (usually two) are born in a Springhare burrow or hollow termite mound (Olbricht & Sliwa 1997, Skinner & Chimimba 2005). Kittens reach independency at 3–4 months old. However, they remain in their mother's territory for extended periods (Sliwa 2013). Home range size was on average 16.1–20.7 km² for males and 8.6–10 km² for females at Benfontein (Sliwa 2004, Kamler et al. 2015). The home ranges of males overlap with those of females by 60–67% (Sliwa 2004). Home range size is dependent on food availability and assumedly much larger in more arid regions. The nightly travel distance of the Black-footed Cat is 8.42±2.09 km (Sliwa et al. 2010). Overall, 54 different prey species were recognised. Small mammals of 5–40 g contributed 39% of prey biomass, followed by mammals of >100 g (17%) and small birds <40 g (16%). In total, prey biomass consisted of 72% mammals, 26% birds, and 2% reptiles and amphibians. In winter, prey items consisted more of larger birds and mammals (>100 g). For females with kittens, small rodents such as the large-eared mouse (*Malacothrix typica*) play a particularly important role. *One individual was observed to use an Aardwolf den for an hour, with the Aardwolf also inside (Sliwa et al. 2018a). Home range sizes are known to reach up to 21.5 km² for females (Sliwa et al. 2016b) and up to 79.9 km² for males (Sliwa et al. 2018b).*

Use & Trade: In the Northern Cape and Eastern Cape provinces, South Africa, hunting permits were applied for, but never granted. Nevertheless, some taxidermists in South Africa have mounted hunted animals, showing that there is an interest for this species (Wilson 2016). There used to be a demand from zoos in the 1970, with animals caught and exported from today's Eastern Cape and Northern Cape provinces (Olbricht & Sliwa 1997). However, the species is difficult to maintain in captivity and the demand for individuals has decreased significantly (Sliwa & Schürer 2006).

Threats: see Table 3.2.2.1.

Table 3.2.2.1. Threats to the Black-footed Cat for different locations according to Sliwa et al. 2016a *and other sources.*

Threat	Location
Illegal and incidental killing (incl. targeted hunting for use and trade, persecution/control)	Range-wide (Nowell & Jackson 1996, Sliwa 2013, Wilson 2016)
Predation by domestic Dogs	Range-wide (Sliwa et al. 2014, Wilson 2016)
Intraguild predation	South Africa (Avenant & du Plessis 2008, Kamler et al. 2015, Wilson 2016, BFCWG, unpub. data)
Habitat loss (incl. degradation & fragmentation; loss of den burrowing species)	Range-wide (Olbricht & Sliwa 1987, Lindsey et al. 2013, Sliwa 2013, B. Wilson unpub. data); Botswana (Butynski 1973, 2013)
Diseases	Range-wide (Olbricht & Sliwa 1987, Terio et al. 2008, Lamberski et al. 2009*, Zimmermann 2009, Sliwa et al. 2016b*)
Road mortality	Range-wide (Wilson 2016)
Climate change	Range-wide (Sliwa et al. 2009, *Zanin et al. 2021*)

Knowledge Base

Sliwa et al. (2016a) pointed out that several aspects of the general knowledge on the Black-footed Cat need improvement. Remarkably, very few confirmed recent records of the species are available (see Fig. 3.2.2.1). More surveys are needed to better establish the distribution range – especially outside of South Africa – or, rather, a system to collate confirmed observations would be needed, especially as different to many other small cats, Black-footed Cats rarely are recorded as by-catches in camera trap surveys for other species. The population size estimate so far performed bases on several unproven assumptions and should be repeated when better data on distribution and densities are available. Many aspects on habitat use and ecology are known, but mostly from one long-term study site. There are indications for a current interest in use and trade of the species but little concrete information is available. General threats are known, but not their impact on the population, as in situ studies of population dynamics are lacking. New information since the last RLA is scarce.

Evaluation of the Red List Assessment

Almost no survey/monitoring data is available on the Black-footed Cat. This makes an evidence-based assessment for the species very challenging. The 2016 assessment needs to be revised according to the updated RLA Guidelines to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The Justification should include more information to justify the Category and Criteria chosen;
- Subpopulations are speculative and the number of mature individuals in each subpopulation is suspected, but according to the IUCN Guidelines for C2a(i), number of mature individuals in subpopulations need to be estimated. Further information on how the subpopulations were identified and where they occur should be included;
- The inferred continuing population decline is mainly based on one study in one particular area where the second density estimate has been done over a period of 10 years. It is not known if this case study is representative for the overall population trend, but further studies are not available;
- The delineation of the subpopulations and the estimation of the number of mature individuals is rather speculative. It should be supported by further research and would likely profit from a range-wide habitat suitability model and selected ground-truthing and/or a range-wide survey;
- The calculation of the EOO would provide additional information;

- If possible, information on the Life History should be included in the corresponding section;
- Some information under Use and Trade should be moved to the Threat section.

Table 3.2.2.2. Evaluation matrix of the Black-footed Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🔴	🟡	🔴	🔴
Consistency of RLA	🟢	🟡	🟢	🟡	🟢	🟢
New info since last RLA	🔴	🔴	🔴	🟡	🔴	🔴

Conclusions and recommendations

An evidentiary RLA (as generally preferred) of the Black-footed Cat is difficult due to the generally limited and geographically restricted data base, especially in regard to its population size, structure, status, density and trend (Table 3.2.2.2). Few in situ projects in only few specific areas have been conducted. Recent distribution information is not available for most parts of the assumed extant distribution area and little new information has become available since the last RLA (Table 3.2.2.2). According to the Guidelines to apply Criterion C2a(i), the number of mature individuals in subpopulation have to be estimated. (This is a critical aspect given the estimation of 9,707 MI, which is very close to the threshold of 10,000 between VU and NT.) The uneven sampling of species records across the region may have highly biased the overall population estimate. More evidence for the continuing decline in the population size would make the reasoning more convincing. There is a need for more wide-spread information on the status of the species to conduct a more evidentiary assessment of the Black-footed Cat. The species should be re-assessed to address the points listed above. However, as new data is scarce, too, the knowledge base on the Black-footed Cat must be enhanced. There is a need for:

- Studies on the distribution of the Black-footed Cat especially outside of South Africa (incl. compiling by-catch data from camera-trapping surveys of other target species, surveys in areas with no or few recent confirmed records, and compiling information on mortalities);
- Quantitative data on the Black-footed Cat's abundance and/or densities and (local) population dynamics as well as subpopulation structure and sizes;
- Further information on the habitat use and ecology (e.g. to inform a range-wide habitat modelling exercise);
- Assessment of the impact of threats, especially the impact of (indirect) persecution and the scale of its Use and Trade;
- Range-wide survey
- Re-assessment of the species for the IUCN Red List as soon as more information on the species is available.

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3.2.3 Sand Cat (*Felis margarita*)

Least Concern (Sliwa et al. 2016)

Red List history

Year	1994	1996	2002*	2008	2011	2016
cat. & crit.	K	LR/LC	NT	NT	NT	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

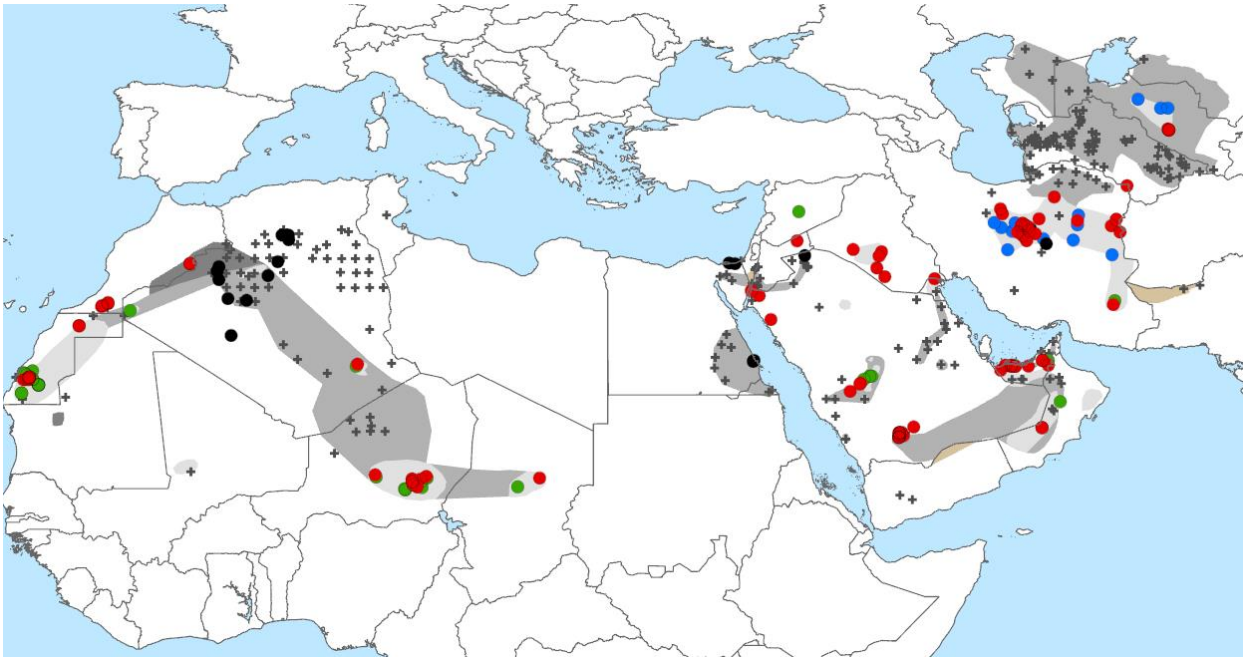

Fig. 3.2.3.1. Sand Cat records from the CSGSD. Light grey area = extant, grey area = possibly extant, dark grey area = presence uncertain and light brown area = possibly extinct distribution range according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. The Possibly Extinct range is not shown in the map.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Sliwa et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Sand Cat is currently recognised to consist of two subspecies, namely *F. m. margarita* and *F. m. thinobia* (Kitchener et al. 2017). Howard-McCombe et al. (2020) found confirmation for the genetic differentiation between the African populations (*F. m. margarita*) and those of Arabian or Central Asian origin by analysing the mitochondrial control region, mitochondrial NADH subunit 5, and cytochrome b genes (643 bp). This merits further investigation with nuclear loci and further sampling.

Justification: The Sand Cat is listed as Least Concern. Its population is estimated at 27,264 mature individuals and thus exceeds the threshold for threatened status under criterion C. Moreover, there

is not enough evidence for a range-wide decline which would qualify it as threatened under Criterion A. However, the Sand Cat occurs at low densities, is rarely recorded and local declines have been reported (Banfield et al. 2014, Sher Shah & Shobrak 2016 in prep). It is unknown, whether the species is naturally rare due to low primary productivity, or if it is difficult to detect, or if its rarity is caused by threats. The status of the Sand Cat is difficult to assess as its ecological needs as well as its distribution and population size are still poorly understood. More research on the species is needed to assess its status and distribution. There are some new records of the Sand Cat but changes in its distribution cannot easily be measured. Threats and human induced negative impacts on desert ecosystems have however rather increased.

Geographic Range: The Sand Cat has a patchy distribution with disjunct distribution in the deserts of Northern Africa and South-West and central Asia. Its extent of occurrence (EOO) is wide with 15,414,561 km². The gaps in its distribution range possibly are based on missing records but they could also reflect species absence (Hemmer et al. 1976, Nowell & Jackson 1996). Recent records are missing from large areas of its distribution range (e.g. Jordan, Palestine, Qatar, and Yemen; Banfield et al. 2014) but the species was recorded in isolated areas with no old records (e.g. deserts in Syria, western Saudi Arabia, western Iraq and central Chad; Serra et al. 2007, Strauss et al. 2007, Mohammad et al. 2013, M. K. Mohammad, pers. obs. February 2016, Rabeil et al. 2016).

Geographic Range Africa: In North Africa the species inhabits the former Western Sahara (administered by Morocco; Chevalier et al. 2012, Sliwa et al. 2013, Chevallier et al. 2014, Rodríguez-Siles et al. 2015, Breton et al. 2016), Algeria (within and close to Ahaggar Cultural Park, Algerian Grand Erg Occidental, Béni Abbès region and Tindouf area; Belbachir 2009, F. Belbachir, pers. comm. 2011, K. De Smet, pers. comm. 2014, R. Tahri, pers. comm. 2016, I. Belbali, pers. comm. 2016) and Egypt (northern Sinai peninsula and rocky deserts; Saleh & Basuony 1998, Goodman & Helmy 1986). No confirmed records exist from Libya, Tunisia and west of the Nile River in Egypt. It was recorded in Niger, Chad and Mali (Rabeil et al. 2016, O. Hamerlynck pers. comm. 2011). In Mauritania the Sand Cat historically occurred in the Adrar Mountains and Majabat al Koubra (Lamarche 1980). *Across the majority of the current extant and possibly extant distribution range of the Sand Cat no recent confirmed records exist (Fig. 3.2.3.1). Of the few recent confirmed records, few lie outside the current extant and possibly extant range such as in Morocco (Hinckley et al. 2020).*

Geographic Range Asia: In Asia, the Sand Cat has been recorded in Syria (around area of Palmyra; Serra et al. 2007), Iraq (West Al-Najaf desert, Al Jufaira oasis; Banfield et al. 2014, Mohammad et al. 2013), Iran (in desert habitats in the centre, east and south-east, some records from the north; Farhadinia et al. 2008, Ghadirian et al. 2016) and Uzbekistan (breeding population in Southern Kyzylkum desert; Burnside et al. 2014). Its presence in Palestine is uncertain and no recent reports from Turkmenistan and no dated records from Kazakhstan exist. Whether populations from Pakistan are connected to those of Central Asia via Afghanistan is unknown. Across the Arabian Peninsula, the species is distributed patchily. Its status is not well known (Mallon & Budd 2011). It is supposed to be very rare in Jordan and United Arab Emirates (Bunaian et al. 2001, Cunningham 2002, Mallon & Budd 2011, Banfield et al. 2014). The species has been recorded in Oman (Empty Quarter and Wahiba Sands; A. Spalton, pers. comm. 2016), Saudi Arabia (Empty Quarter; *Amin et al. 2021,* Banfield et al. 2014, Mallon & Budd 2011, Sher Shah & Cunningham 2008, Strauss et al. 2007, T. Wacher pers. comm. 2016), Qatar (Mallon & Budd 2011) and in Kuwait close to Saudi Arabia and Iraq (Banfield et al. 2014). In Yemen no confirmed records exist and it is possibly extinct (Mallon & Budd 2011). *Few confirmed records exist from the United Arab Emirates and some unconfirmed ones from the Eastern Region of Abu Dhabi Emirate (Ahmed et al. 2016). In Pakistan the Sand Cat is considered to occur in Nushki and Chaghai (Baluchistan), but it is possibly already extinct (Rais 2017). Across the majority of the current extant and possibly extant distribution range of the Sand Cat no recent confirmed records exist (Fig. 3.2.3.1). Of the few recent confirmed records, few lie outside the current extant and possi-*

bly extant range such as in Iraq (Al-Sheikhly et al. 2017), Saudi Arabia (Aloufi & Amr 2018) and the United Arab Emirates (al Zaabi et al. 2019). The record in Jordan (Hamidan & Gheyyath 2017) lies in the presence uncertain range of the species.

Population: There are few records of the Sand Cat, and it is often considered to be rare (Sliwa 2013). In Israel, the species is now considered locally extinct (Noam Leader, Israel Nature and Parks Authority, in litt. 2014). Only one density estimate from a telemetry study in southern Israel exists where a density of 2.9 individuals per 100 km² was estimated (M. Abbadi, in Sliwa 2013). Based on this density and the estimated AOO, the total global population of the Sand Cat is estimated at 27,264 mature individuals. In Saudi Arabia in the Saja / Umm Ar-Rimth Protected Area, the potential Sand Cat density based on the number of cats trapped was 16.66 individuals per 100 km² in 2002 and 14.27 individuals per 100 km² in 2005 (Sher Shah & Shobrak 2016, in prep., Sher Shah, Shobrak & Boug 2016, in prep.). The capture rate decreased to 2.83 individuals per 100 km² in 2006 (one cat caught), and in 2007 and 2009 no Sand Cats were caught in the same trapping grid (Sher Shah & Shobrak 2016, in prep., Sher Shah et al. 2016, in prep.). In low-quality habitat, such as shifting sand dunes, densities of Sand Cats may be very low (Sliwa 2013). Numbers may fluctuate in response to environmental conditions leading to prey declines and recoveries (Sunquist & Sunquist 2002). The Sand Cat population on the Arabian Peninsula is considered to be declining at an unknown rate (Mallon & Budd 2011, Banfield et al. 2014). In some areas however, more Sand Cats may occur than suspected (T. Wacher, pers. comm. 2016). Strong holds of the Sand Cat are probably the Western Sahara, South Algeria, Niger, Chad, south-western Saudi Arabia and the border area of south-eastern Saudi Arabia with Oman and the United Arab Emirates, and Iran. The status of the species in Central Asia, Pakistan and Turkmenistan is largely unknown (Burnside et al. 2014). *The Arabian Sand Cat is listed as Near Threatened in the Regional Red List and as Endangered in the United Arab Emirates and Abu Dhabi Red Lists, respectively (Ahmed et al. 2016). Less than 250 mature individuals were estimated for the Emirate of Abu Dhabi (Ahmed et al. 2016). The Arabian Sand Cat populations are thought to be declining across their range (Ahmed et al. 2016).*

Habitat: The Sand Cat is a specialist of sandy deserts. It is mainly found around sparse vegetation possibly supporting small rodent prey (Nowell & Jackson 1996). The species inhabits also stony deserts (Nowell & Jackson 1996). In Morocco, the Sand Cat occurs in sandy areas with perennial grass, low bushes and Acacia trees (Sliwa et al. 2013). In Iran, it is found in sand dunes with Saxaul Haloxylon trees and arid flat plains with little vegetation (Ghadirian et al. 2016). In the Arabian Peninsula, the Sand Cat mainly inhabits sandy habitats but occurs also in areas of hard, rocky substrate (Cunningham 2002, Banfield et al. 2014). It is absent where the soil is compacted (Heptner & Sludskii 1972). The species is well adapted to the extremes of a desert environment and thus able to live in areas far from water (Nowell & Jackson 1996, Sunquist & Sunquist 2002, Sliwa 2013). In Central Asia the Sand Cat withstands 40° Celsius in summer (80° Celsius on sand surface) and -25° Celsius in winter (Ghadirian et al. 2016). The species uses burrows as resting sites and to escape the sun (M. Strauss pers. comm. 2008, M. Sher Shah pers. comm. 2016). Sand Cats dig their burrows themselves or they use the ones of other species (i.e. from Red Foxes *Vulpes vulpes* or porcupines *Hystrix* sp.; Breitenmoser & Breitenmoser 2011, Banfield et al. 2014). In the Moroccan Sahara in winter, Sand Cats seem to hide amongst rocks or under vegetation during the day (Breton et al. 2016). *In the United Arab Emirates, the Sand Cat was found in inter-dune gravel flats with scattered calcrete hills just next to sparsely vegetated sand dunes. The gravel flats were dominated by Haloxylon salicornicum shrubs and Pennisetum divisum (Ahmed et al. 2016). In the Uruq Bani Ma'arid Protected area, Empty Quarter, Saudi Arabia, the Sand Cat showed a small preference for the internal parallel dune system in comparison to the gravel valley habitats and escarpment plateau (Amin et al. 2021). The habitat suitability study in central Iran of Torabian et al. (2017) indicated that Sand Cats preferred sand dunes covered with Haloxylon persicum. The potential habitat and habitat suitability of the Sand Cat for the*

central landscape in Iran has been modelled by Khosravi et al. (2018, 2019). They found that Sand Cats depend on shrubland which presents good cover, stabilises soil for dens and harbours higher densities of rodents. Agricultural patches represent an important food source for the Sand Cat (Khosravi et al. 2019). Patch density of shrubland and agriculture had strong relationships with Sand Cat habitat suitability (Khosravi et al. 2019). According to Ghafaripour et al. (2018) food and cover availability seem to influence the habitat use pattern and habitat selection of the Sand Cat.

Ecology: The Sand Cat seems to be primarily nocturnal, but can also be crepuscular in winter (Abbadi 1993, Nowell & Jackson 1996, Breton et al. 2016). Its main prey species are small rodents such as spiny mice *Acomys* spp., jirds *Meriones* spp., gerbils *Gerbillus* spp. and jerboas *Jaculus* spp. and *Allactaga tetradactyla*. In Africa, it also takes young cape hares *Lepus capensis*. The Sand Cat also hunts small birds like greater hoopoe lark *Alaemon alaudipes*, Desert lark *Ammomanes deserti*, and preys on reptiles such as smaller desert monitor *Varanus griseus*, fringe-toed lizards *Acanthodactylus* spp., sandfish *Scincus*, short-fingered gecko *Stenodactylus* spp., horned and sand vipers (*Cerastes spp.)*, and insects (Abbadi 1993, Dragesco-Joffé 1993, De Smet 1998, Cunningham 2002, Sliwa 2013). In western Iraq, Euphrates jerboa *Allactaga euphratica*, Libyan jird *Meriones libycus* and Cheesman's gerbil *Gerbillus cheesmanni* are the presumed prey species (M. K. Mohammad pers. obs. February 2016). On the Arabian Peninsula, Sand Cats preyed on spiny-tailed lizard *Uromastyx aegyptia* and jird *Meriones arimalius* and possibly hunts locusts when they swarm (Cunningham 2002, Banfield et al. 2014). The Sand Skink *Scincus mitranus* and Arabian Toad-head Lizard *Phrynocephalus arabicus* are possibly important prey species of the Sand Cat (Sunquist & Sunquist 2002). The Sand Cat is capable of rapid digging to reach prey animals underground and possibly covers kills with sand (Schauenberg 1974). The Sand Cat is able to satisfy its moisture requirements from prey alone but drinks water if available (Sliwa 2013). Home range sizes likely vary according to ecological conditions and vegetation availability for prey species. In southern Morocco, initial home ranges (100% MCP) of two males and one female were 35.3 km², 21.8 km² and 13.4 km², respectively (Breton et al. 2016). A radio telemetry study in Israel estimated the home range of one male at 16 km² (Abbadi 1993). The annual ranges (95% MCP) of seven Sand Cats in the Saja/Umm ar-Rimth reserve, Saudi Arabia, were estimated at 19.6–50.7 km² (Sher Shah & Shobrak 2016 in prep). Seasonal ranges of males and females considerably overlap with each other and male home ranges may overlap with each other (Sher Shah & Shobrak 2016 in prep.). Sand Cats are able to move long distances in a single night (5–10 km; Abbadi 1993). In Morocco, one male travelled a straight-line-distance of more than 14 km in less than 30 h (Breton et al. 2016). *In the Uruq Bani Ma'arid Protected area, Empty Quarter, Saudi Arabia, the Sand Cat was strictly nocturnal (Amin et al. 2021). The Sand Cat also strictly hunts at night (Ahmed et al. 2016). Sand Cats were observed to rest in bird nests in acacia trees Acacia raddiana in Morocco (Bompar et al. 2019).*

Use & Trade: Locally, the species is traded for the pet trade. No more information on Use and Trade information on the species is available.

Threats: see Table 3.2.3.1.

Table 3.2.3.1. Threats to the Sand Cat for different locations according to Sliwa et al. 2016 *and other sources*.

Threat	Location
Habitat loss (degradation, conversion & loss)	Range-wide, Pakistan, Syria, Iraq, *Arabian peninsula (Ahmed et al. 2016), Uzbekistan (Brigthen & Burnside 2019), Iran (Ghafaripour et al. 2017), United Arab Emirates (Al-Zaabi et al. 2019)*
Illegal and incidental killing (bycatch, poisoning, stuck in fences, persecution)	Range-wide, Iran, *Uzbekistan (Brigthen & Burnside 2019), Iran (Ghafaripour et al. 2017), Pakistan (Rais 2017), Iraq (Al Sheikhly & Haba 2017, Aloufi & Amr 2018), United Arab Emirates (Al-Zaabi et al. 2019)*
Prey depletion (through droughts, habitat destruction, completion by feral and domestic Dogs and Cats)	Range-wide, *Arabian Peninsula (Ahmed et al. 2016), United Arab Emirates (Al-Zaabi et al. 2019)*
Disease transmission	Range-wide, *United Arab Emirates (Al-Zaabi et al. 2019)*
Predation by domestic Dogs	Iran, *Iran (Ghafaripour et al. 2017)*
Pet trade	Locally
Hybridization	*United Arab Emirates (Al-Zaabi et al. 2019)*

Knowledge base

The knowledge of the Sand Cat is very limited. There are few studies focusing on the species itself and generally few distribution records are available, and even fewer are confirmed ones (Fig. 3.2.3.1). The species is mentioned in few publications and a large part of the knowledge on the species is based on publications from before 2000. The AOO is speculated. The population information is scarce. Only one density estimate exists on which the global number of mature individuals is based upon. There is no information on population abundance for any region nor is there on the trend of the species. Habitat types used and important habitat features are partly known. Main prey species are known too. Some information on home range size and activity patterns is available from few sites. Since the last assessment in 2016, limited new information on its distribution, ecology and threats and some new information on habitat use are available. The knowledge on its population and distribution is however still very limited. General threats are known from large parts of its range. Impacts of the threats on the species and their scope are however not known. A conservation strategy for the Arabian Sand Cat exists.

Evaluation of the Red List Assessment

The RLA of the Sand Cat (Sliwa et al. 2016) is well done. Based on the information presented the listing of the Sand Cat as Least Concern is justified. The information and data on the species available at the time of the last RLA has been considered and correctly been integrated into the assessment. The information on the species is well organised and for some sections grouped per region.

Table 3.2.3.2. Evaluation matrix of the Sand Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟡	🟡	⚪	🟡
Consistency of RLA	🟢	🟢	🟢	🟢	⚪	🟢
New information since last RLA	🔴	🔴	🟡	🟡	⚪	🔴

Conclusions and recommendations

An evidentiary RLA of the Sand Cat is difficult because of the generally weak data base (Table 3.2.3.2). The listing as Least Concern (→ Appendix I) is based on an estimated total population size of 27,264 mature individuals (exceeding the threshold for Near Threatened under Criterion C) and missing evidence of a high enough range wide decline over three generations to classify for Near Threat-

ened or Vulnerable under Criterion A. Very few specific projects have been conducted on this species, and considering the wide distribution range, very few distribution records exist. Hence no recent distribution information is available for most of the Extant or Possibly Extant distribution area (Fig. 3.2.3.1). Information on the Sand Cat is still scarce.

Foremost, our knowledge base on the Sand Cat must be broadened. There is a need for:

- Confirmation of the Sand Cat's distribution;
- Quantitative data on Sand Cat abundance and/or densities;
- Development of reliable survey methods
- Research on the threats and their impacts on the Sand Cat;
- Information about the Sand Cat's ecology (incl. activity patterns, habitat requirements, behaviour etc.);
- Establishment of a conservation plan, where appropriate;
- Expand the existing networks;
- Re-assessment of the species for the IUCN Red List once more information is available.

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3.2.4 Chinese Mountain Cat (*Felis bieti*)

Vulnerable C1 (Luo et al. 2022)

Red List history

Year	1994	1996	2002*	2008	2010	2015	2022
cat. & crit.	K	DD	VU C2a(i)	VU C2a(ii)	VU C2a(ii)	VU C2a(i)	C1

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

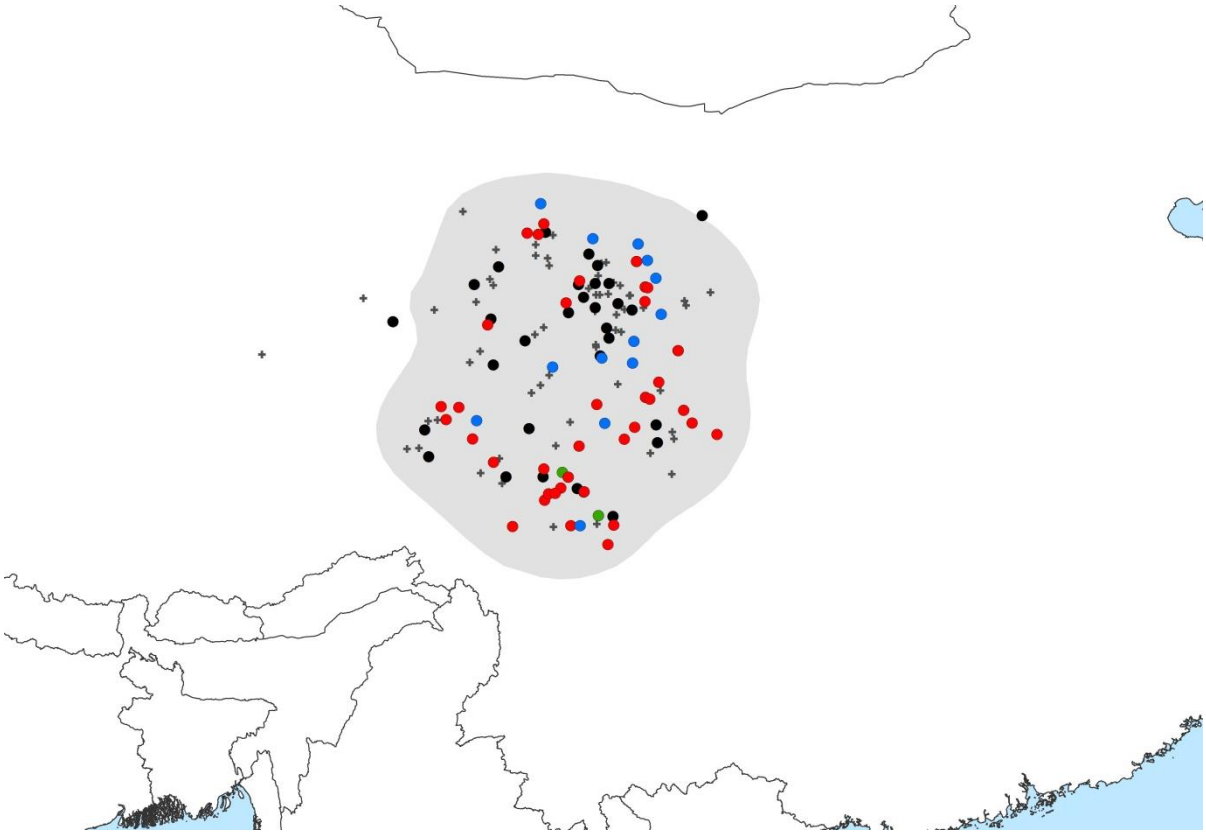

Fig. 3.2.4.1. Chinese Mountain Cat records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1 or very likely C1; blue = C2 or very likely C2; black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Luo et al. 2022) and *additional information available* (in italic).

Taxonomic Notes: The Chinese Mountain Cat is recognised as monotypic (Kitchener et al. 2017). This monotypic classification is a result of the relatively deep divergence of all wildcat lineages. However, the taxonomy of the species in relation to other wildcat taxa has not reached a unanimous agreement Recently, Yu et al. (2021) conducted a genome-wide analysis to render support of the Chinese

Mountain Cat as equidistant with the Asiatic wildcat, and hence should be recognised as a wildcat subspecies.

Justification: The Chinese Mountain Cat is listed as Vulnerable under Criterion C1. Its population size is estimated to be fewer than 10,000 mature individuals with a projected decline of 10% over 10 years. The expected decline is due to continuing habitat loss (expansion of infrastructure construction in the range), lack of protection, accidental killing, opportunistic hunting and its general rarity in surveyed areas. The distribution range of the Chinese Mountain Cat is limited to the north-eastern Qinghai-Tibet Plateau and is very likely fragmented. More information and data on population size, trend and threats are urgently needed in order to assess this species more evidence-based in the future. The species is elusive and occurs only on a remote plateau area between 2,000 and 5,000 m (He et al. 2004). The little information that is available might already be outdated, too. Since the previous Red List assessments (Sanderson et al. 2010a, Riordan et al. 2015), no substantial gains in knowledge have been made. No evidence of the Chinese Mountain Cat was found by the Second National Assessment on Wildlife Resources of China (State Forestry Administration of China 2009). However, the increased popularity of citizen nature activities, camera trapping surveys, sign surveys and local community-based conservation programmes on the Qinghai-Tibet Plateau have recently led to much more frequent sightings and evidence of presence of the species. Thus, the range map could be updated at the county level, but scientific studies of extant wild populations are urgently required. Threats listed in the previous assessments (Sanderson et al. 2010a, Riordan et al. 2015) included accidental killing through poisoning rodents, as well as targeted hunting for the illegal fur trade. Additionally, habitat loss, degradation and fragmentation and road mortality are now listed as threats, due to overgrazing and infrastructure development, which also applies to other species on the Plateau (e.g. Tibetan Antelope *Pantholops hogsonii*, cf. Xu et al. 2019; Przewalski's Gazelle *Procapra przewalskii*, cf. Yu et al. 2017). Yu et al. (2021) found a widespread signal of genetic introgression of the Chinese Mountain Cat to co-occurring Domestic Cats *F. catus*. This raises concerns about the potential (but so far unconfirmed) gene flow in the opposite direction, potentially disrupting the genetic integrity of *F. bieti*. Current conservation measures, incl. current protected area management, need to be assessed for their efficacy.

Geographic Range: The Chinese Mountain Cat is endemic to China. It is only found on the eastern Qinghai-Tibet Plateau in eastern Qinghai province, north-western Sichuan province, south-west Gansu province and in a limited area in south-east Tibet province. Earlier reports from Xinjiang, Ningxia and Inner Mongolia are thought to be either from Asiatic wildcats or domestic cats, or could not be verified (Jacobi 1923, Allen 1938, Pocock 1951, Haltenorth 1953, Guggisberg 1975, Groves 1980, Gao 1987, Wang 1990, Sunquist & Sunquist 2002, Smith & Xie 2008). Detailed presence information for 67 counties is listed in the assessment and its Supplementary Information. The EOO is estimated at 941,620 km², with an estimated continuing decline. *Two recent records and two without confirmation and date lie outside of the extant distribution area (Fig. 3.2.4.1).*

Population: A density estimate of the closely related wildcat has been used to estimate the Chinese Mountain Cat's population size. Based on collected records, the Chinese Mountain Cats does not inhabit the full EOO. A density of 1–10 individuals per 100 km² has been applied to 50% and 25% of the EOO, respectively. The resulting population estimate ranges from 2,354-47,081 individuals, with an assumed 50% mature individuals (i.e. 1,177–23,540 mature individuals). The population is probably fragmented and is decreasing due to ongoing threats. As a result, the current population is conservatively estimated to number fewer than 10,000 mature individuals. The ongoing threats will result in a projected decline in mature individuals of 10% over the next 10 years.

Habitat: The Chinese Mountain Cat is locally knowns as "grass cat". It occurs between elevations of 2,500 and 5,000 m in high-elevation steppe grassland, alpine meadow, alpine shrubland, coniferous

forest edge, desert or semi-desert, and loess hilly steppe (Liao 1988, Tan 1991, He et al. 2004, Sanderson et al. 2010b, Webb et al. 2016). *In Xinlong County, Sichuan Province, it was also pictured in mixed forest (Wang et al. 2021). In a study by Kong & Li (2022) of collared Chinese Mountain cats in a basin between the Qilian Mountains and the Daban Mountains, Chinese Mountain cats were mainly found in reforestation areas, farmlands and scrubland. They used different types of habitats mainly plantations, grassland, pasture, farmland and native Bushwood. Only rarely they were found in riparian areas or even more seldom in settlements (Kong & Li 2022). The cats were restricted to areal shelter habitats (Kong & Li 2022).*

Ecology: The Chinese Mountain Cat lives solitary except during the mating season. It is primarily nocturnal or crepuscular (Tan 1991, Chen et al. 2005, Smith & Xie 2008, Sanderson et al. 2010b). One breeding female was observed to use multiple breeding dens in Qinghai (Han et al. 2020). A good den site may allow the Chinese Mountain Cat to tolerate a moderate level of disturbance, e.g. one female with four kittens killed a Himalayan Marmot (*Marmota himalayana*) and afterwards used its den located ca. 120 m away from a Tibetan herdman's house (Han et al. 2020). *Rodents are the major prey of the Chinese Mountain Cat. They take mainly Mole Rats, White-tailed Pine Vole, and Pikas, but also birds such as Pheasants (Nowell & Jackson 1996). Average home range size of the Chinese Mountain Cat is 3.04 km^2 (95% MCP) and 5.36 km^2 (100% MCP). The home range size of females was larger than the ones of males (Kong & Li 2022).*

Use & Trade: The Chinese Mountain Cat is hunted for the skin trade, although not as much as in the past (Chen et al. 2005). The market value of the skin is actually rather low and no reliable figures for the number of skins in trade are available. In 1980, 30 Chinese Mountain Cat skins were taken in Sichuan province and around 50 skins were openly sold in Songpan and Jiuzhaigou in 1998 and 2001, and in three towns in Ganzi in 2005 (Wang 1990, Nowell & Jackson 1996, Chen et al. 2005) as well as 16 skins in 1986 in the markets in Lingxia, Gansu province (Sunquist & Sunquist 2002). However, targeted hunting for the skin trade appears not to be a major threat.

Threats: see Table 3.2.4.1.

Table 3.2.4.1. Threats to the Chinese Mountain Cat for different locations according to Luo et al. (2022) *and other sources*.

Threat	Location
Habitat loss (incl. degradation & fragmentation)	Range-wide (Yu et al. 2017, Xu et al. 2019)
Incidental & illegal killing	Range-wide (-)
Road mortality	Range-wide (Li S., Song D. & Liu Y., pers. obs. 2020, Kong & Li 2022)
Hybridisation with domestic cats	Range-wide (Yu et al. 2021)

Knowledge base

The knowledge on the Chinese Mountain Cat is rather limited. The presence of the species is known from 67 counties in China, albeit in several cases 'only' from a "reliable source, though without recently confirmed record, likely due to lack of survey" (Luo et al. 2022, Supplementary Information). The global population estimate is based on density estimates from the closely related Asiatic Wildcat. Several habitat types used by the species have been identified, but little is known about its ecology. The purpose of trade is known. General threats are known, too, but the information comes again partially from other species – e.g. on road impact from the Tibetan Antelope and Przewalski's Gazelle. The scale and impact of most of the threats on the species are not known. There is neither a conservationists' network or conservation plan and only one conservation project specifically focusing on the Chinese Mountain Cat is known.

Evaluation of the Red List Assessment

The RLA for the Chinese Mountain Cat (Luo et al. 2022) is generally well done. Little information on the species makes an evidentiary RLA of the Chinese Mountain Cat difficult. Some few aspects should be addressed with the next re-assessment:

- In the Justification, the evidence and background of the projected population decline of 10% over 10 years should be further elaborated and explained;
- The Justification could be shortened highlighting the key aspects and the justification for the listing;
- In the Population section it should be further explained why a fragmentation of the population is suspected and the assumption of 50% of individuals as mature should be further explained;
- Some of the information stated in the Threat section would better be placed in the Use and Trade one.

The listing of the Chinese Mountain Cat as Vulnerable under Criterion C1 is justified. Some aspects should further be explained to make the listing even more clear e.g. projected decline and population size estimate.

Table 3.2.4.2. Evaluation matrix of the European Wildcat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟡	🔴	🔴	🔴
Consistency of RLA	🟢	🟡	🟢	🟢	🟢	🟢
New information since last RLA	🔴	🔴	🔴	🟡	🔴	🔴

Conclusions and recommendations

An evidentiary RLA of the Chinese Mountain Cat is difficult because of the generally limited data base, especially in regard to its population status, abundance and density as well as ecology and threats (Table 3.2.4.2). The scale and impact of the different threats are mostly not known. From the RLA of 2015 to the one in 2022 not much new information was available, indicating that further research on the species is urgent.

There is a need to enhance our knowledge base on the Chinese mountain. It is essential to:

- Confirmation and further investigation of the Chinese Mountain Cat's distribution;
- Studies on hybridisation and range overlap between *F. bieti* with *F. lybica* and *F. catus*;
- Quantitative data on Chinese Mountain Cat abundance and/or densities and population size and trends;
- Further information on the Chinese Mountain Cat's ecology and habitat (use);
- Assessment of the impact of threats, especially in regard to hybridization;
- Establishment of a conservation plan and network;
- Re-assessment of the species has been conducted in 2021. The species should be re-assessed as soon as more information is available or when the taxonomy of the Felis complex changes.

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3.2.5 European Wildcat (*Felis silvestris*)

Least concern (Gerngross et al. 2022)

Red List history

Year	2015*	2022
cat. & crit.	LC	LC

*The Assessment in 2015 was performed before the taxonomical split of *F. silvestris* and *F. lybica*

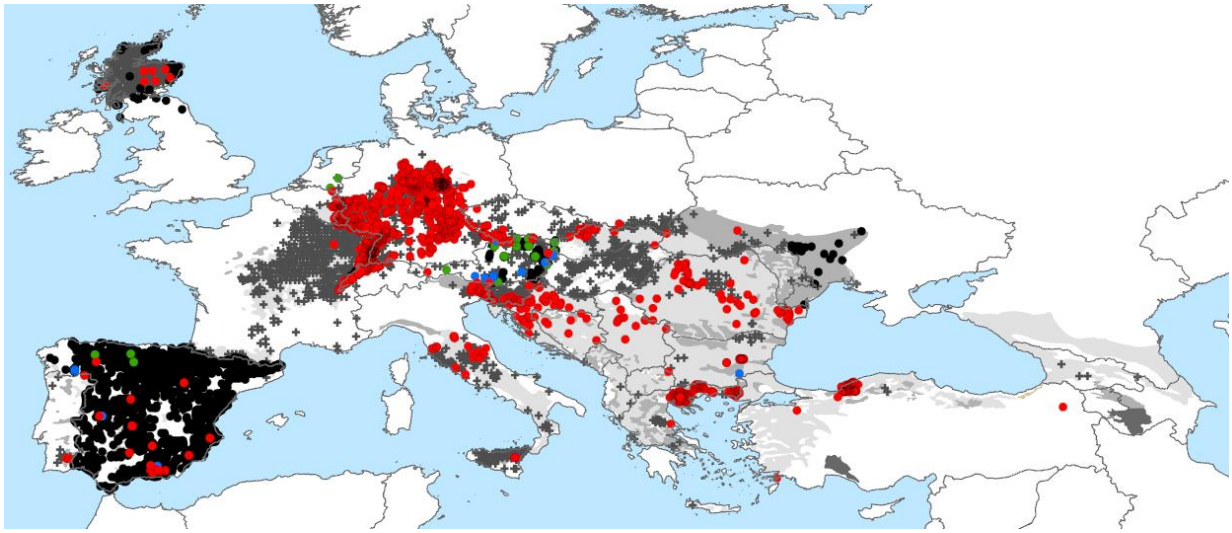

Fig. 3.2.5.1**.** European Wildcat records from the CSGSD. Light grey = extant, grey = possibly extant, dark grey = presence uncertain and light brown = possibly extinct distribution range according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3; black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Gerngross et al. 2020) and *additional information available* (in italic).

Taxonomic Notes: The European Wildcat is recognised to consist of two subspecies based on current geographic isolation, namely: *F. s. silvestris* and *F. s. caucasica* (Kitchener et al. 2017). More research, however, is needed.

Justification: Despite having limited reliable information on range-wide population trends and size, it is not likely that the population has declined by 20-25% over the last three generations. Additionally, the population size far exceeds 2,000 mature individuals. For example, in the Western-Central European area of its extant range, it is estimated that there are 25,600 Wildcats, when assuming a low average population density of 10 individuals per 100 km². Reliable information is available on population dynamics and change of the distribution range at local or national scale, but not at transboundary or meta-population levels. There thus is no consistent information available to test whether threats and trends differ between and within metapopulations (Breitenmoser et al. *in prep*). In line with the information being available, Wildcat conservation mostly has had local focus, with some

(sub)populations and/or meta-populations receiving uneven attention. In the case of Scotland, this reflects the critical status of the population, but in other cases the degree of conservation focus often is unrelated to a population's range extension or assumed conservation status (Breitenmoser et al. *in prep*.). Considerable differences have been found regarding the distribution of the Wildcat in Europe, Anatolia (Turkey) and the Caucasus compared to the previous assessment of Yamaguchi et al. (2015). The reduced scale of the RLA due to the recent taxonomic split of *F. silvestris* (from *F. lybica*) allowed the compilation of more detailed information than was possible in previous assessments. The European Wildcat's distribution range was found to be smaller on the Iberian Peninsula and in Scotland, its occurrence could not be confirmed on the Ukrainian-Belarusian border, and the occurrences in Corsica, Sardinia, and southern Turkey were found to rather refer to the Afro-Asiatic Wildcat. The Wildcat's distribution range, however, was found to be larger in France, Germany, the Apennine Peninsula, south-eastern Europe and Ukraine. These differences, however, do not necessarily reflect increases/decreases in certain regions as they are thought to be a result of better data and improved surveys.

Geographic Range: Within Europe, the distribution range of *Felis silvestris silvestris* is split into four continental meta-populations, island populations and a population of Caucasian Wildcats (*F. s. caucasica*; Fig. 3.2.5.1). The continental meta-populations all are fragmented to an unknown degree. All of the meta-populations will be discussed separately below. Data availability and quality vary between countries. The European Wildcat is relatively widespread, but a neglected species in most range countries. Most regions need further surveying, using standardised monitoring of the distribution of the species.

1. Western-Central European meta-population

The Western-Central European metapopulation mostly occurs in the Continental biogeographic region, but also in the Atlantic and the Alpine biogeographical region. Here, Wildcats have extended their range onto the Swiss plateau and likely the (Pre) Alps. This meta-population's largest contiguous distribution area, i.e. the main distribution area, can be found in north-eastern France, south-western Germany, Luxembourg, the province of Wallonia in Belgium, the province of Limburg in the Netherlands, and the Swiss Jura Mountains. The previously isolated subpopulations from both central Germany and Massif Central in France are increasingly connecting with this main distribution area. In France, the present distribution range extends less far south than Yamaguchi et al. (2015) stated in the previous RLA. This, however, is rather be a result of improved data than range loss. The European Wildcat's range has expanded by 30% over the last 30 years in France. The Wildcat has repopulated areas where it has previously gone extinct, e.g. the Netherlands (Janssen et al. 2016) and the Jura region in Switzerland (Nussberger et al. 2018). *Recently, the Wildcat has recolonised Austria (Gerngross et al. 2021).*

2. Apennine Peninsula and Sicilian meta-population

In the Apennine Peninsula and Sicily there is an ongoing northward expansion along the central-north Apennine Mountain systems as well as on Sicily (in the central parts and on the west coast). The lack of research methodology standardisation and high levels of hybridisation, however, result in difficulty drawing inferences about expansions or demographic trends within Italy.

3. Eastern-central, Eastern, and South-eastern European meta-population

This meta-population includes 20 out of the 34 European Wildcat Range Countries. In this area, there is a general lack of data regarding the Wildcat's distribution. There, however, is evidence for the species' expansion towards the east in Ukraine (towards steppe-like habitat; Zagorodniuk et al. 2014)

and towards the west within the Italian Alps. The European Wildcat, however, is less widespread than was previously assumed and fragmentation in south-east Europe is probably greater than shown in the current distribution map. *In 2015/2016, the European Wildcat was observed for the first time since the 1990s in Gorce National Park in southern Poland (Karužić et al. 2021).*

4. Iberian Peninsula meta-population

The Iberian Peninsula's meta-population ranges from the pre-Pyrenees towards eastern Galicia in Spain, along the Cantabrian Mountain range. In this region, core Wildcat areas are comprised of the Sierra Morena, the eastern Sierras Béticas, Sistema Central and Sistema Ibérico Mountain chains, Montes de Toledo, the Eastern Subbetic mountains in Spain and the lower Guidiana region in Portugal. The most western distribution of Wildcats of this meta-population can be found ranging from the Minho hydrographic basin in Portugal towards the Sanabria and Ancares Mountains in Spain. This meta-population's distribution has decreased, is highly fragmented and has been split into multiple isolated subpopulations since the previous assessment (Yamaguchi et al. 2015)*. In 2019/2020, no confirmed Wildcat records were found in the Spanish province of Seville, causing concern about the species' status in this region (Rodríguez-Rodríguez et al. 2020).*

5. Island populations: Scotland and the Mediterranean islands Crete and Sicily

European Wildcats can be found in Scotland and on the Mediterranean islands of Crete and Sicily (considered part of the Apennine meta-population). In contrast, *F. silvestris* cannot be found in Cyprus, the Balearic Islands, Sardinia or Corsica. On these last two, however, *F. lybica* is present after human introduction. In Scotland, its range includes the Highland Boundary fault and is believed to be contracting further, with little evidence of pure Wildcats being present in the west and far north (i.e. north of Lairg) of the region since 2010. This, however, is partly due to the improved knowledge of (extent of) hybridisation with domestic cats, increased usage of camera traps to assess Wildcat presence and tightened criteria for acceptance of Wildcat records. Due to the widespread hybridisation, there currently is no clarity on their current range in Scotland. On Crete, the European Wildcat is thought to have been introduced as this island has been separated from the mainland as of 15.97 – 11.62 million years ago.

6. Caucasian and Turkish population of Caucasian Wildcat

While *F. s, silvestris* occurs in the European part of Turkey (i.e. in the north and eastern part of Thrace), the Caucasian Wildcat subspecies (*F. s. caucasica*) can be found throughout western, north-western and northern Anatolia in Turkey and the southern slopes, western slopes and lowlands of the Caucasus Mountains in Georgia, Azerbaijan, Armenia and Russia. Its current distribution in this area is thought to be a result from human-induced fragmentation of Wildcat habitats and re-colonisation of the continent from glacial refuges (Mattucci et al. 2015). In western, north-western and northern Anatolia, Wildcat populations belong to *F. silvestris*. In the rest of Anatolian part of Turkey, *F. lybica* or hybrid populations between *F. silvestris* and *F. lybica* are present in fragmented populations. Also in the lesser Caucasus there is strong evidence that the distribution of *F. silvestris* and *F. lybica* not only overlap with each other but that there is some intermixing of these species.

There are confirmed recent records for the European Wildcat from most range countries (Fig. 3.2.5.1). However, they are unequally distributed with most of them coming from central Europe, from the western-central metapopulation, and large areas of extant distribution range lacking recent confirmed records. Few confirmed records lie outside of the extant distribution range such as in Belgium (Canters et al. 2005), Italy (Veronesi et al. 2016), Germany (Streif et al. 2016, Schaer 2018), Switzer-

land (Schaer 2018) and Turkey (Chynoweth et al. 2015). Its distribution and status in regard to intermixing with F. lybica in the lesser Caucasus however is not clear.

Population. The European Wildcat is a widespread species and the most numerous native felid in Europe. Although the Wildcat is doing well in north-western Europe, this is not the case everywhere. Below, one can see the population information for the specific metapopulations, see Gerngross et al. (2022, Supplementary Information) for country-specific information regarding population size, status and trends.

1. Western-Central European meta-population

The Western-Central European meta-population is estimated to consist of 25,600 Wildcats when assuming a low population density of 10 Wildcat per 100 km². This population can be subdivided into the Western-Central European subpopulation and the Central-German subpopulation (Tiesmeyer et al. 2020). Both of these subpopulations have expanded their ranges throughout the last 2-3 decades. *In the Swiss Jura mountains, density was estimated to be 26 ± 10 individuals per 100 km² (Maronde et al. 2020) and the population has been estimated at 1,100 individuals across the Swiss Jura Mts, the Swiss plateau and the northern Alps (Nussberger & Roth 2021).*

2. Apennine Peninsula and Sicilian meta-population

On Sicily, the Wildcat's population size has been declining on Mt. Etna. This might partly be a result of the decline of the rabbit population due to rabbit haemorrhagic disease. On Sicily, population densities were estimated to be 30 Wildcats per 100 km² in the most optimal habitats. This density however cannot be extrapolated to the meta-population level (Anile et al. 2010, 2012, 2014).

3. Eastern-central, Eastern, and South-eastern European meta-population

The eastern-central, eastern and south-eastern European population is assumed to be the largest and most widespread European Wildcat meta-population. While the Austrian and north-eastern Italian population are thought to be increasing, the Romanian and Bulgarian population are thought to be stable and the Albanian population is thought to be declining, the population size and trend of the very widespread eastern and south-eastern meta-population, however, is largely unknown (e.g. in Croatia, Greece, Moldova, Montenegro, North Macedonia and Ukraine). *In north-eastern Italy, a density was estimated at 35 ± 12 individuals per 100 km² (Fonda et al. 2022).*

4. Iberian Peninsula meta-population

On the Iberian Peninsula, the population can be divided into two subpopulations: those in the Mediterranean forests, woodlands and scrub biome (2/3 of the Iberian land area) and those in the temperate broadleaf and mixed forests biome (northern Iberian fringe; 1/3 of the Iberian land area). The populations in the Mediterranean biome are estimated to be declining. The meta-population occurs at low population densities, as low as 3.2 ± 1.2 individuals per 100 km² (Matias et al. 2021). In Sierra Arana (Andalucía, Spain) the number of breeding females is estimated to have decreased by 67% between 2004 and 2017. The population in the temperate biome, on the other hand, is seemingly stable and has much higher population densities, e.g. 20-40 individuals per 100 km² (Sayol et al. 2018). Generally speaking, though, it is likely for this Iberian meta-population to have undergone a population reduction. Wildcats on the Iberian Peninsula occur in fragmented habitat patches with such low population densities that it is deemed unlikely for these patches to be able to support viable Wildcat populations (Gil-Sánchez et al. 2020). *Recently, the estimated density of the Wildcat population in the protected area of Cabañeros National Park (Spain), was much lower than previously reported in literature, at 3.8 ± 1.7 individuals per 100 km² (Ferreras et al. 2021). Estimated density in Andalusia (southern Spain) was also quite low (6.9 ± 0.19 individuals per 100 km²), which suggests*

that the PA network is insufficient to cover a significant part of the population (Gil-Sanchez et al. 2020). In Montesinho Natural Park (Portugal) Wildcat density was estimated 3.2 ± 1.2 individuals per 100 km² (Matias et al. 2021).

5. Island populations: Scotland and the Mediterranean islands Crete and Sicily
In Scotland, a recent study deemed the Wildcat to be functionally extinct (Breitenmoser et al. 2019). In Scotland, all of the recently sampled individuals were found to have high levels of introgressive hybridisation. Scotland's population size is declining, i.e. by 90% over the last 25 years (Mathews et al. 2020), and the European Wildcat is considered to be Critically Endangered here.

6. Caucasus and Turkey (subspecies F. s. caucasica)
In the Turkey and Caucasus region, there is no population estimate available for *F. silvestris*. The status of the subspecies *F. s. caucasica* therefore is unclear as of now (Kitchener et al. 2017). In northern Anatolia, it has been estimated there are 11 (9-23) Wildcats present in a small patch of protected forest (40 km²; Can et al. 2011).

Across large parts of the European Wildcat's range, the necessary information to assess its conservation status and population size is still lacking. Conflicting trends within and between certain meta-populations (i.e. increasing and decreasing population sizes) and the lack of information from others make it impossible to assess the trend of the global population of *F. silvestris*. The European Wildcat's population size is unknown, but estimated to be 140,000 Wildcats within the extant area of approximately 1,400,000 km² (assuming a low average density value of 10 individuals per 100 km²). No extreme fluctuation in the population size of the European Wildcat can be assumed. The number of meta-populations has not changed and the number of subpopulations within meta-populations is influenced by the level of fragmentation. Currently, there are 6–8 subpopulations. *Across the European Wildcat's range, there are probably very few (if any) Wildcat populations which have little history of hybridisation with domestic cats, which makes estimation of population sizes difficult (Yamaguchi et al. 2015).*

Habitat. In Western-Central Europe, the Wildcat mostly inhabits the lower mountain regions with large deciduous and mixed forests. They can be found in all forest types, but exhibit a preference for forests that are structurally rich and have many tree hollows, dead wood piles as well as rejuvenation patches and wind-thrown areas (Liberek 1999, Hötzel et al. 2007, Jerosch et al. 2010, Dietz et al. 2015). Especially during summer, as the snow melts, Wildcats also occur at subalpine attitudes (Liberek 1999, Raimer 2001). Additionally, Wildcats can inhabit fragmented landscapes, with a mixture of forests, agricultural fields and grasslands (Germain et al. 2008*,* Beugin et al. 2020, *Mueller et al. 2020, Diakou et al. 2021*). In Apennine Italy, Wildcats can often be found in mountainous areas with natural forest cover. Wildcats prefer deciduous forests, but coniferous forests are also used (Anile et al. 2020). In Apennine Italy and Sicily, Wildcats also occur in less forested areas closer to the sea, e.g. in Tuscany and on the west coast of Sicily. Additionally, they can be found along riparian habitats in agricultural areas, e.g. in north-eastern Italy (Lapini 2006). In the Iberian Peninsula, European Wildcats often establish home ranges in close proximity to deciduous forests and far from human habitation. Females often select topographically complex habitats at mid-range elevations and tend to select higher quality habitats that give them enhanced access to shelter and food resources (Oliveira et al. 2018). A study in south-eastern Spain found that patch complexity, rabbit abundance, slope, and cover of dense scrub are positively related to Wildcat presence (Martín-Díaz et al. 2018). In Scotland, European Wildcats most often can be found in deciduous and coniferous forests, but also in the heaths and in agricultural land margins. In the Caucasus, Wildcats mostly inhabit deciduous and

mixed-deciduous forests and occur on the slopes and lowlands of the forest-covered Caucasus mountains in Armenia, Azerbaijan, Georgia and Russia. In south-western Anatolia, the Wildcat is often present in close proximity to human settlements. This is likely a result of the high Caracal density in this region (see ecology). *In Germany, it was found that Wildcats make use of agricultural landscapes (Jerosch 2021), while in Spain it was found that Wildcats are not tolerant of urbanisation (Serratosa Nuño & Rota Collell 2020). In Spain, it was found that Wildcats mainly make use of cattle pastures between August and November, when there is a higher density of prey such as montane water voles, present (Jiménez-Albarral et al. 2021*). *Across the range, females typically avoid areas near roads (Bastianelli et al. 2021).*

Ecology Rodents (predominantly voles; Germain et al. 2009, Lang 2016, Götz et al. 2018) and, where they occur, rabbits, constitute the main prey of Wildcats. Wildcats, however, also prey on other small mammals, lagomorphs, insects, reptiles, invertebrates and amphibians (Monterroso et al. 2009, Monterroso et al 2020). In the Iberian Mediterranean biome, rabbits are the preferred prey (Lozano et al. 2006, Malo et al. 2004). Males tend to have larger home ranges than females (Jerosch et al. 2017). In German habitats dominated by forest, average annual home-range sizes were 12 km² and 5 km² for males and females respectively (Götz et al. 2018). In more fragmented landscapes home ranges tend to be smaller (Germain et al. 2008, Streif et al. 2016, Jerosch et al. 2017). Females' average annual home ranges were found to be 60% smaller in richly structured, agricultural landscapes (i.e. fragmented) than in forested habitats (Götz et al. 2018). Across the Iberian Peninsula, home range sizes vary greatly, fluctuating from 1.22 to 59.78 km² (median 13.68). Males (median 14.68 km²) tend to have larger home ranges than females (median = 4.59 km²; Oliviera et al. 2018). European Wildcats are limited by the presence of sympatric large felids. Their distribution is influenced by competition with and avoidance of larger felid species (e.g. Jungle Cat *F. chaus,* Caracal, and *Lynx lynx*) and it occurs in sympatry in habitat types where it can take refuge from them. For example, in south-western Anatolia Wildcats are thought to be limited due to the Caracal *C. caracal* that occurs in high densities in the Muğla province (Ilemin & Gürkan 2010). Resting and breeding occurs in dense vegetation or deadwood structures, e.g. blackberry thickets or brushwood piles. Additionally, burrows of other mammals (e.g. Foxes and Badgers) are used as den sites (Götz & Roth 2006, Hötzel et al. 2007, Hupe 2002). *Wildcats, like many other felids, have been found to occasionally consume plants (Yoshimura et al. 2021). In Slovakia, Wildcats were found to be a possible predator of European Pond Turtle Emys orbicularis nests (Horváth et al. 2021). Wildcats have also been found to display scavenging and caching behaviours (partly covering the carcasses) in the winter in southern Slovenia and north eastern Italy (Krofel et al. 2021). Home range sizes can vary considerably, e.g. in north-eastern Italy, a mean home range of 3.36 km² was found (Fonda et al. 2022). This is much smaller than the reported values in Iberia (Gerngross et al. 2021). Home range sizes can also differ dependent on prey size and availability. In Scottish areas with an abundance of rabbits, home ranges were found to vary between 1–6 km², whilst home range sizes were estimated between 8-18 km² in Scottish areas where Wildcats relied on smaller prey such as mice and voles (Kilshaw 2011). The use of home ranges fluctuates seasonally, with males adapting the use of their home ranges during mating season in late winter and early spring and females adapting the use of their home ranges whilst rearing offspring in summer (Jerosch et al. 2017). Wildcats are also influenced by interspecific competition for territory and food with canine species. In France, the Wildcat population was affected negatively by the recovery of the Red Fox Vulpes population (after a shift in rodent control practices) (Giraudoux et al. 2020). Similarly, European Wildcats were found to spatially avoid Red Foxes in Spain (Rodríguez et al. 2020; Ruiz-Villar et al. 2021). Wildcats exposed to Golden Jackals Canis aureus were found to have*

significantly higher levels of the stress hormone cortisol, which might be a result from the potential interspecific competition (Filacorda et al. 2021). Habitat fragmentation, however, did not result in higher cortisol levels (Filacorda et al. 2021).

Use & Trade Wildcats used to be trapped in the Balkans for their fur. Except for use as hunting trophies, however, their fur is no longer of interest. In Albania, Wildcats are still poached or captured alive to be kept as pets.

Threats See Table 3.2.5.1.

Table 3.2.5.1. Threats to the European Wildcat for different locations according to Gerngross et al. (2022) *and other sources*.

Threat	**Location**
Hybridisation with domestic cats	*Croatia (Vladusic et al. 2018, Urzi et al. 2021);* *France (Say et al. 2012, Beugin et al. 2020);* *Germany (Hertwig et al. 2009, Steyer et al. 2018);* Italy (Lecis et al. 2006, Gavagnin et al 2018, Lioy et al. 2021); *North-Macedonia (Urzi et al. 2021)* Scotland (Kitchener et al. 2005, Senn et al. 2018, *Breitenmoser et al. 2019*); Range-wide *(Mattucci 2014,* Tiesmeyer et al. 2020*)*; *Serbia (Urzi et al. 2021);* *Slovenia (Urzi et al. 2021);* Spain *(Ballesteros-Duperón et al. 2015, Gil-Sánchez et al. 2015);* *Switzerland (Nussberger et al. 2014, 2018, Quilodrán et al. 2020);* Turkey *(Soyumert 2020);*
Road mortality	Germany (Steeb 2015); Italy (Falsone et al. 2014); Range-wide (Nowell & Jackson 1996, Lüps et al. 2002, Schulenberg 2005, Birlenbach et al. 2009, Klar & Trinzen 2009, Falsone et al. 2014, *Bastianelli et al. 2021*); Spain (Gerngross et al. 2022);
Illegal killing (persecution/ control)	Iberia (Gerngross et al. 2022);
Diseases	*Croatia (Sindičić et al. 2021);* *Czech Republic (Panait et al. 2021a);* Germany (Steeb 2015, Lang et al. 2016, *Panait et al. 2021a*); *Greece (Diakou et al. 2020, Diakou et al. 2021);* Italy (Gerngross et al. 2022) *Luxembourg (Panait et al. 2021a);* *Romania (Panait et al. 2021b, Panait et al. 2021a);* Scotland (Bacon et al. 2020); *Spain (Calatayud et al. 2020, Nájera et al. 2021);* Turkey (*Soyumert 2020*);
Climate change	Range-wide

Knowledge base

Despite being a widespread species and the most numerous native felid in Europe, reliable information on population dynamics, population sizes, and distribution ranges is only available at local or national scale. There is a lack of information on range-wide, transboundary or meta-population levels, which makes it difficult to determine differences in threats and trends between and within meta-populations. Some information on the Wildcat's ecology, preferred habitat types, and habitat use is available. There is little information available on use and trade, and while general threats to the European Wildcat across its range are known and identified, details on country-specific threats and their full impact are not yet understood (e.g. hybridisation with domestic cats and disease transmission). Similar to the lack of range-wide information on Wildcats, Wildcat conservation is also focused

locally as well, with (sub)populations and meta-populations receiving uneven amounts of attention that does not necessarily reflect the (sub/meta-) population's range expansion or assumed conservation status. There is no global conservation strategy and no information on conservation measures in the eastern part of its range available.

Evaluation of the Red List Assessment

The RLA for the European Wildcat (Gerngross et al. 2022) has been well done and has only some points which need to be addressed with the next re-assessment:

- The Justification includes some information that is not stated anywhere else in the assessment (e.g. some of the differences found when comparing the current distribution to the one from the previous assessment);
- The Justification could include more explanation as to why the European Wildcat is listed as Least Concern (e.g. referring also why it does not qualify as NT under Criterion B and C);
- While not mandatory for species listed as Least Concern, it would have been helpful to include the methods of the calculation of the AOO;
- Some information in the Population section would possibly be better placed in the Geographic Range section;
- If possible, some statements could be elaborated further. For example the exposure to poisons in the Threats section, or provide more information why certain metapopulations are highly fragmented;
- It would be a valuable addition to state which threats are current, future or historic (and whether they are likely to continue in the future).

Conclusions and recommendations

The listing of the European Wildcat as Least concern is appropriate based on the information provided in the assessment (Table 3.2.5.2), and the Red List Guidelines have been applied appropriately. Overall, while a lot of information (and conservation action) is available for European Wildcats, this is only the case at national or local level. There is a lack of information and conservation action on range-wide, transboundary and metapopulation levels, which should (if possible) be addressed in future RLAs. Its distribution range is not well known in several parts of its assumed range. The points mentioned above should be addressed in the next re-assessment of the species.

Table 3.2.5.2. Evaluation matrix of the European Wildcat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟢	🟢	🟡	🟡
Consistency of RLA	🟢	🟢	🟢	🟢	🟢	🟡
New information since last RLA	🟡	🟡	🟡	🟡	🔴	🔴

The knowledge base on the European Wildcat needs to be extended. There is a need for:

- Quantitative (transboundary) data on the European Wildcat abundance and/or densities and trend for the majority of its range;
- Genetic and morphological studies of *F. s. caucasica* to clarify the status and identity of Wildcat populations in the eastern region and possible contact zones with *F. lybica*;
- Assessment of the Use & Trade of European Wildcats and its impact on their conservation;

- Assessment of the impact of threats, especially of introgression and hybridisation;
- Establishment/revision of a conservation strategy and/or national action plan where appropriate and establishment of conservation strategies/plans at global or meta-population or population level.
- Re-assessment in 5-10 years or when important new information is available

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3.2.6 Afro-Asiatic Wildcat (*Felis lybica*)

Least concern (Ghoddousi et al. 2022)

Red List history

Year	2015*	2022
cat. & crit.	LC	LC

*The Assessment in 2015 was performed before the taxonomical split of *F. silvestris* and *F. lybica*

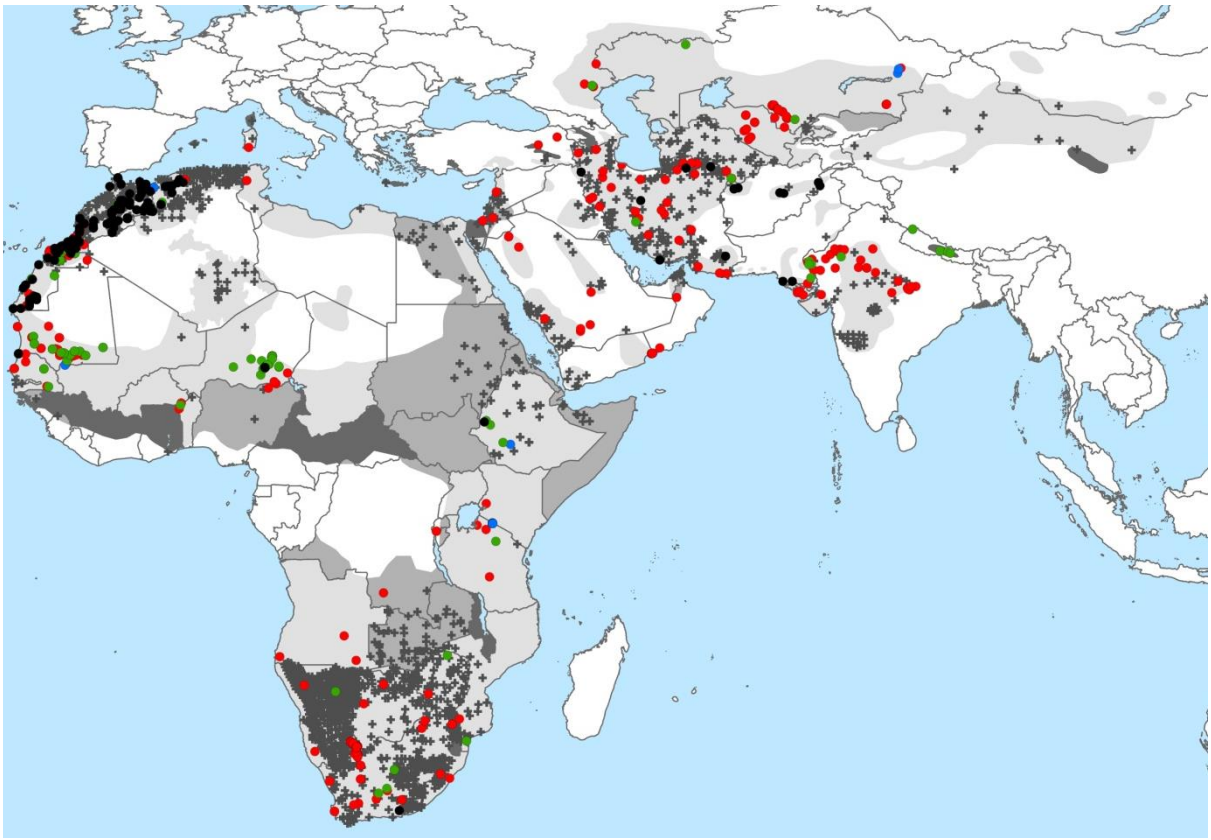

Fig. 3.2.6.1. Afro-Asiatic Wildcat records from the CSGSD. Light grey = extant, grey = possibly extant, dark grey = presence uncertain distribution range according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Ghoddousi et al. 2020) and *additional information available* (in italic).

Taxonomic Notes: Afro-Asiatic Wildcat is tentatively recognised to consist of three subspecies, namely: *F. l. lybica, F. l. cafra* and *F. l. ornata* (Kitchener et al. 2017). Further research is needed to confirm this subspecies classification.

Justification: The Afro-Asiatic Wildcat is one of the most common felid species, occurring across large parts of Africa and Asia. There is no information on trends in population and distribution available that would justify its listing as Near Threatened. Consequently, it is listed as Least Concern. However,

more information should be gathered on status, distribution, trends and threats. Populations are believed to be stable or possibly declining, but the species is threatened in some regions by ongoing land-use change, retaliatory killing, fur trade, road mortality, trapping, attacks by domestic Dogs, and hybridisation with domestic Cats (Mallon & Budd 2011, Herbst et al. 2016). Hybridisation is regarded to be an important threat throughout the distribution range and may even result in cryptic extirpations of populations (Nowell & Jackson 1996, Driscoll et al. 2007, 2011, Yamaguchi et al. 2015). Nevertheless, a study in South Africa showed low rates of hybridisation, even in human-dominated landscapes (Le Roux et al. 2015). However, additional information is needed on the amount and impact of hybridisation in order to make an improved assessment.

Geographic Range: The Afro-Asiatic Wildcat occurs across most of Africa, and from South-West Asia to India, China and Mongolia (Yamaguchi et al. 2015). In Southern Africa, the subspecies *F. l. cafra* is fairly common in most protected areas (Yamaguchi et al. 2015, Herbst et al. 2016), and can be found in Botswana (Kalahari), Namibia (Namib, Kalahari, Skeleton Coast and Koakoland), Lesotho, Mozambique, South Africa (all provinces, especially around Kalahari), and possibly in Zimbabwe. In Zambia, it is not common, and in Eswatini, its occurrence needs to be assessed (A. Monadjem, pers. comm. 2019). Northwards *F. l. lybica* occurs across the continent with the exception of closed tropical forest (Yamaguchi et al. 2015). It is widely distributed in Tanzania (mostly in the northern and central regions), Kenya (widespread but with few recent records), Uganda (widespread but with few records from the western areas), Burundi (eastern areas) and Rwanda (eastern areas). In South Sudan, Somalia, Eritrea and Djibouti, the status needs to be assessed. The subspecies can be found from Ethiopia to Sudan, Chad, Niger (widely distributed with the exception of dense humid forests), Mali (Gourma region) and across the savannas of Western Africa to Mauritania (coastal Atlantic and southern inland mountains). In Northern Africa, its distribution is discontinuous from Western Sahara (outside densely vegetated and rocky habitats), to Morocco (throughout the country, but absent from densely human populated areas), Algeria (throughout the country except in the Great Ergs), Tunisia and into Egypt (Sinai Region and Eastern Desert; Treves et al. 2010, Kingdon & Hoffmann 2013, Foley et al. 2014, Amin et al. 2018). It is also found in true deserts (e.g. Sahara), but only in association with hill and mountain habitats, such as the Ahaggar Mountains and Tassili N'Ajjer (Yamaguchi et al. 2015). The distribution of the subspecies continues around the periphery of the Arabian Peninsula (Driscoll et al. 2007) in the UAE, Yemen, Saudia Arabia (apart from deep desert sands of Rub al Khali). The boundary to *F. l. ornata* lies in western Iran, or possibly in eastern Iraq and southern Turkey (Harrison & Bates 1991, Heptner & Sludskii 1992, Can et al. 2011, Ghoddousi et al. 2016, Kitchener et al. 2017, Mousavi, Rezaei & Naderi 2019, Wuest et al. 2021). The distribution of *F. l. ornata* continues from Iran westwards and northwards. It is found in Iran (across the country apart from Caspian forests of Mazandaran and Gilan), Turkmenistan (Sunt Hasar Gad and Kopet Dag ranges as well as Bdkhyz Reserve), Tajikistan (Hissar, Hazratisho and Darvaz ranges, as well as Muzkol range in the eastern Pamirs), Uzbekistan (Novoiskava region), Kazakhstan (Mangistau, Kyzylorda, Aktobe, Almata, Atyrau, West, South and East Kazakhstan, Karagandy), Russia (Volga, southern Russia and the northern Caucasus), Afghanistan (Bamyan plateau), Pakistan (dry zones of Lower Sind as well as Lasbela and Mekran areas), India (parts of Gujarat, Haryana, Maharashtra, Madhya Pradesh, Rajasthan and a few sites in Andhra Pradesh, Karnataka and Uttar Pradesh), China (Xinjiang, Gansu and inner Mongolia), and Mongolia (patchy distribution in Dzungarian Govi Desert, Shargyn Govi in Mongol Altai Mountain Range, Trans Altai Gobi Desert, and northern Gobi; Nowell & Jackson 1996, Lydekkar 2005, Prater 2005, Driscoll et al. 2007, Yamaguchi et al. 2015, Ghoddousi et al. 2016, Rather et al. 2019, Barashkova & Karyakin 2020). There are no recent records in Kyrgyzstan (last one in 2005). However, there are possible records from Nepal (Ghimirey et al. 2019), which was considered to be outside the range of the species (Yamaguchi et al. 2015), and also records from areas in Russia (Volga, South Urals regions and pre-caucasian plains) where it was absent before the 1990s (Shevchenko 1997, Davygora 2005,

2020, Oparin et al. 2010, Shlyakhtin et al. 2011, A. Barashkova pers. comm. 2020). In the Caucasus and in Turkey the status in unclear (Can et al. 2011, Ghoddousi et al. 2016, Wuest et al. 2021). Wildcats are also found on Sardinia, Corsica and Crete, but their taxonomic status requires further research (Kitchener et al. 2017). *New records from the interior parts of Saudi Arabia suggest that the wildcat may be found in most parts of the Peninsula, not just around the periphery (Barichievy & Wacher 2016, Amin et al. 2021; Fig. 3.2.6.1).*

Recent confirmed records exist for most of the range countries of Felis lybica but there are also large parts of extant distribution range lacking confirmed recent or even historic records (Fig. 3.2.6.1). Some confirmed recent records outside the current extant distribution range exist in India (Jhala et al. 2021), Oman (Mazzolli et al. 2017), Saudi Arabia (Amin et al. 2021), Rwanda (Vale et al. 2016) and Morocco (Hinckley et al. 2020).

Population: No population assessment exists for *F. lybica*, but number are believed to be stable in the majority of its range. However, there are also possible declines due to ongoing land-use change and hybridisation as was reported in South Africa, Lesotho (Herbst et al. 2016) and the Arabian Peninsula (Mallon & Budd 2011, A. Sliwa pers. comm. 2019). In the Serengeti National Park, a density of 1–100 individuals per 100 km² was estimated (Waser 1980). *In the Red List of Mammals of South Africa, Lesotho and Eswatini, the Afro-Asiatic Wildcat is listed as Least Concern (Herbst et al. 2016).*

Habitat: The Afro-Asiatic Wildcat is absent from rainforest and sandy desert, but inhabits a broad range of habitats from deserts and scrub grassland to dry and mixed forest, ranging up to 2,000–3,000 m in mountainous areas with sufficient vegetation (Nowell & Jackson 1996, Mallon & Budd 2011, Yamaguchi et al. 2015). In China, they are found in the deserts or dry grasslands of Xinjiang, Gansu and Inner Mongolia between 1,200 and 1,700 m (S. J. Leo per. obs. 2019). In the Serengeti National Park, wildcats avoided areas of high elevation, kopjes and high scrub cover, and selected for southern Acacia woodlands, and alluvial plains and rivers (Durant et al. 2010). Where no cover exists, they may use holes from Aardvarks or Foxes (Mallon & Budd 2011, Herbst et al. 2016). Agricultural crops such as maize may also serve as shelter (Skinner & Chimimba 2005). They can also live in rural landscapes, as was shown by the presence of house rats in their diets (Skinner & Chimimba 2005).

Ecology: Across its range, the Afro-Asiatic Wildcat primarily preys on rodents and lagomorphs, secondarily on birds, but also on a variety of small prey and carrion (Nowell & Jackson 1996, Sunquist & Sunquist 2002, Herbst & Mills 2010). In one wildcat's stomach in Oman, the remains of Coleoptera, Orthoptera, lizards, mammal fur and a date stone were found (Harrison & Bates 1991). In the Serengeti National Park, wildcats were positively associated with high rodent abundance, which correlated negatively with the southern Oscillation Index (Sinclair et al. 2013, Byrom et al. 2014). In the UAE, one female had a home range of 52.7 km² (Phelan & Sliwa 2006), which is much larger than the average home range of 3.5 km² of females in the more optimal habitat of the Kalahari Gemsbok National Park, South Africa (Herbst 2009). The Afro-Asiatic Wildcat is almost exclusively nocturnal albeit with some crepuscular activity depending on food availability and temperature (Herbst 2009, F. Belbachir pers. comm. 2019). They are solitary and communicate by scent-marking. *In a study of 80 stomach contents, 44 contained exclusively Muridae (Smithers 1971). A camera trap picture from Saudi Arabia shows a wildcat dragging a dead Blandford's Fox. It is assumed that the Fox was killed by the Cat, but it is unclear whether the Cat actually consumed the Fox or whether this was the result of non-consumptive interspecific competition (Faure et al. 2021).*

Use & Trade: There is little information available on the use and trade of the Afro-Asiatic Wildcat. They are hunted or trapped for their fur among others by communities in South Africa (M. Herbst pers. obs. 2019), India (Sharma 1998, Menon 2003), Afghanistan, Kyrgyzstan, Mongolia, Saudi Arabia, Tajikistan, Uzbekistan and China. In Lesotho, they are used for clothes, hats, house ornaments, bags, blankets, necklaces and traditional medicine (CMBSL, unpub. Report). In Algeria, the species is used

occasionally for meat consumption and/or for its medicinal properties by the Ahaggar nomads, semi-nomads and residents (F. Belbachir, pers. obs. 2019). The Afro-Asiatic Wildcat is listed as a trophy species by some commercial hunting operations (M. Herbst, pers. obs. 2019). Although the species was trapped in large numbers for their fur in Asia (Nowell & Jackson 1996), there is currently no evidence of a significant international trade.

Threats: see Table 3.2.6.1.

Table 3.2.6.1. Threats to the Afro-Asiatic Wildcat for different locations according to Ghoddousi et al. (2022) *and other sources*.

Threat	Location
Hybridisation with domestic cats	Range-wide (Le Roux et al. 2015, Yamaguchi et al. 2015, Yu et al. 2021)
Competition by domestic cats (incl. disease transmission)	Range-wide (Nowell & Jackson 1996, Yamaguchi et al. 1996, Daniels et al. 1999, Madconald et al. 2004)
Road mortality	Range-wide (Ghoddousi et al. 2016, F. Cuzin, pers. comm. 2019)
Illegal and incidental killing (incl. persecution/control)	Range-wide (Hashim & Mahgoub 2008, Stuart et al. 2013, Ghoddousi et al. 2016, A. Samna pers. comm. 2019, F. Belbachir pers. obs. 2019) *southern Africa (Aulagnier et al. 2015, Acha et al. 2017, Musiwa & Mhlanga 2020, Verschueren et al. 2020, Stadler 2021)*
Habitat loss (incl. degradation)	China India (Sharma 1998)
Predation by domestic Dogs	- (TAWIRI 2009)[1]

[1] "-" means that this threat was mentioned in the RLA but not the location where it occurs.

Knowledge base

The knowledge on the Afro-Asiatic Wildcat is quite limited. It is widely distributed and appears to be common. However, its distribution is not well known, no population size estimate exists and only one old density estimate has been made. There are only few recent studies for a few areas and most information is based on old publications. Its range-wide status is not well known, neither its population trends. However, the preferred habitats are known, together with some variables influencing its occurrence. Some diet studies have been performed as well as a few telemetry studies. Trade appears to occur mainly at a local level with known purposes. General threats are known but not their impacts on the species.

Evaluation of the Red List Assessment

The RLA for the Afro-Asiatic Wildcat (Ghoddousi et al. 2022) is generally very well done and structured. Some few aspects should be addressed with the next re-assessment:

- The Justification could be elaborated on, explaining further the status of Least Concern.
- Although not mandatory, the calculation of the EOO would provide some additional information;
- In the Population section it could be further specified (if possible) in which parts of its range the species is considered to be stable and based on what e.g. expert knowledge etc.
- In the Threat section, threats could be ordered/explained more by region to make the distinction of regional and global threats clearer.

Conclusions and recommendations

An evidentiary RLA of the Afro-Asiatic Wildcat is difficult because of the generally limited data base, especially in regard to its population status, abundance and density but also in regard to its distribution and trends (Table 3.2.6.2). The scale and impact of the different threats are not known. Information on the species is scattered across its range. A first RLA of the species has been conducted and

was published in 2022. This RLA shows how scarce the information on the species is in many of its range countries. There is a need for more research on the Afro-Asiatic Wildcat and a re-assessment of the species as soon as more information is available or when the taxonomic division of the Felis complex changes.

Table 3.2.6.2. Evaluation matrix of the European Wildcat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🔴	🟡	🟡	🟢	🔴
Consistency of RLA	🟢	🟢	🟢	🟢	🟢	🟢
New information since last RLA	🔴	🔴	🔴	🔴	🔴	🔴

Foremost, our knowledge base on the Afro-Asiatic Wildcat must be broadened. There is a need for:

- Confirmation and further investigation of the Afro-Asiatic Wildcat's distribution (incl. gathering of by-catch data from camera-trapping surveys of other target species);
- Studies on hybridisation and range overlap between *F. lybica* with *F. silvestris* and *F. catus*;
- Quantitative data on Afro-Asiatic Wildcat abundance and/or densities and (local) population dynamics and trends;
- Further information on the Afro-Asiatic Wildcat's ecology and habitat (use);
- Assessment of the impact of threats and the extant of its use and trend, especially in regard to hybridisation and retaliatory killing;
- Establishment of a conservation plan, where appropriate;
- Establishment of a network;
- Re-assessment of the species has been conducted in 2021.

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3.2.7 Pallas's Cat (*Otocolobus manul*)

Least Concern (Ross et al. 2020)

Red List history

Year	1994	1996	2002*	2008	2015	2016	2020
cat. & crit.	K	LR/LC	NT	NT	NT	NT	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

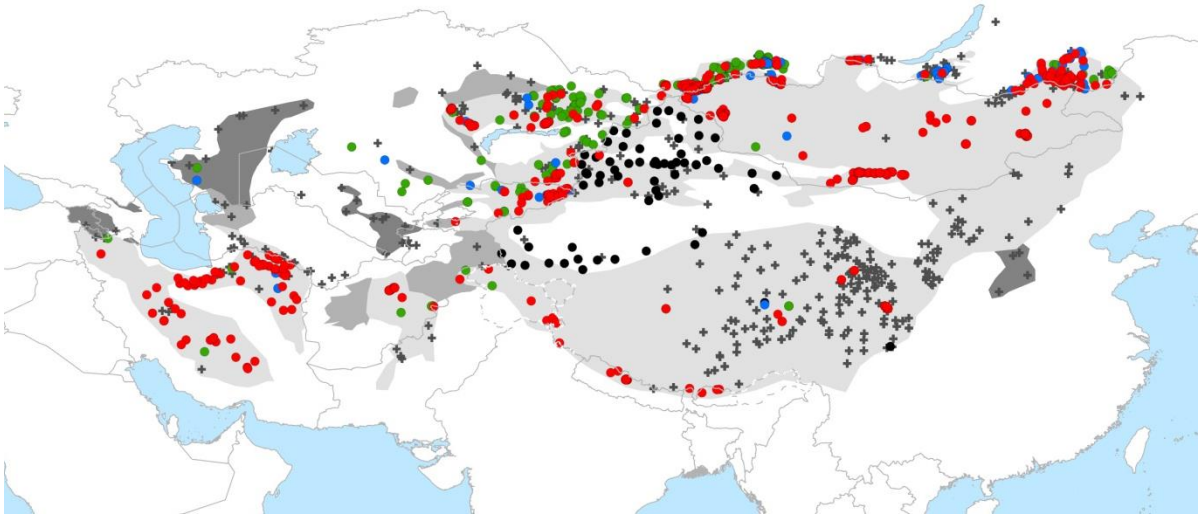

Fig. 3.2.7.1. Pallas's Cat records from the CSGSD. Light grey = extant, grey = possibly extant and dark grey = presence uncertain distribution range according to the Red List 2020; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Ross et al. 2020) and *additional information available* (in italic).

Taxonomic Notes: Pallas's Cat is currently recognised to consist of two subspecies based on morphology and biogeography, namely: *O. m. manul* and *O. m. nigripectus* (Kitchener et al. 2017). More research, however, is needed to confirm this.

Justification: Pallas's Cats have a wide, but fragmented distribution. Generally, the species occurs at low densities except in some small patches in Russia (Kirilyuk & Barashkova 2011). Only a small part of the landscape is suitable for the Pallas's Cat due to interspecific predation, and due to their habitat specialisation, such as the requirement of den sites, which are often marmot burrows. This further restricts habitat availability (Ross et al. 2010a). Relatively large areas are needed to conserve viable populations due to their low density and patchy distribution (Ross et al. 2019a). Main threats to the

species are habitat disturbance and fragmentation, but predation by sympatric carnivores, herding Dogs and human offtake are main causes of mortality (Ross et al. 2019b). Moreover, prey depletion is negatively affecting the species (Ross et al. 2019b). There is currently not enough data available that would allow to estimate population size and trend. However, the available information indicates that the global population size is unlikely to be low enough to qualify for Near Threatened (Barashkova et al. 2019). Additionally, the change in suitable habitat and level of habitat fragmentation between 1994 and 2015 was low. Therefore, the population may be more stable than previously thought. However, caution should be taken as information on the species is missing and neither the impacts of threats are fully understood nor is the species' population dynamics known. Based on the distributional data, the Pallas's Cat's global trend appears more stable than previously assumed and the species is assessed as Least Concern.

Geographic Range: The western edge of the Pallas's Cat's range lies in western Iran, and formerly extended into Armenia and Azerbaijan. It continues via Afghanistan, Pakistan, Kazakhstan and Kyrgyzstan to Russia, Mongolia, China, Bhutan and Nepal (Belousova 1993, Nowell & Jackson 1996, Koshkarev 1998, Habibi 2004, Barashkova et al. 2007, Fox & Dorji 2007, WWF 2012, Thinley 2013, Hameed et al. 2014, Shrestha et al. 2014, Snow Leopard Trust 2014, K. Zhumabai pers. comm. 2014, Barashkova et al. 2019). In Uzbekistan and Tajikistan, the species has not been recorded since the 1960s (Barashkova et al. 2019). In Turkmenistan, the only recent records are from the borderland with north-eastern Iran (A. Potaeva and T. Rosen, pers. comm. 2019). Its presence in Armenia and Azerbaijan is uncertain (Moqanaki et al. 2019). The core population is thought to be in Mongolia and China (Smith et al. 2008, Jutzeler et al. 2010). In the south-western part of its range, the most recent records are found in Iran, especially in the Alborz and Zagros Mountain chains (Karami et al. 2016, Moqanaki et al. 2019, Yusefi et al. 2019). *In 2020, a Pallas's Cat presence has been confirmed in Armenia about 140 km away from the closest old site record in the country (Khorozyan et al. 2020). Moreover, recent confirmed records have expanded the known Pallas's Cat's range in Afghanistan, China and Russia (Fig. 3.2.7.1; Moroldoev 2019, Khorozyan et al. 2020, Zhao et al. 2020, A. Barashkova wildcats.wildlifemonitoring.ru).*

Population: The Pallas's Cat occurs widely but has a fragmented distribution. In Central Mongolia, a density of 4–8 individuals per 100 km² was estimated (Ross 2009). Studies in Russia indicate that the species can periodically occur at very high densities of up to 100 / 100 km² (Barashkova & Kiriliuk 2011, Naidenko et al. 2014, Barashkova et al. 2017). However, such high densities are possibly local phenomena related to prey densities. Therefore, an average density of 4 individuals / 100 km² seems a more accurate average density of the Pallas's Cat. In Russia and Central Asia (Kazakhstan, Kyrgyzstan and Mongolia), the population was speculatively estimated at 49,000–98,000 individuals assuming all suitable habitat to be occupied (Barashkova et al. 2019). Based on the AOO, assuming a density of 4 / 100 km² and a population structure of 80% mature individuals, the global number of mature individuals was estimated at approximately 58,000 individuals. The global population trend is decreasing and the number of mature individuals inferred to be declining. The status of the Pallas's Cat in its south-western range is unknown (Habibi 2004, Hameed et al. 2014, Farhadinia et al. 2016, Moqanaki et al. 2019). The Pallas's Cats' specialisation and habitat selection are most likely the reason for their general low densities (Ross et al. 2016, 2019a). This should be considered when doing expert knowledge-based estimates of their potential population size. *The Pallas's Cat is listed as Near Threatened in the National Red Lists of Kyrgyzstan (Davletkeldiev et al. 2006 cited in Barclay et al. 2019), Mongolia (Clark et al. 2006 cited in Barclay et al. 2019) and Pakistan (Sheik & Molur 2004 cited in Barclay et al. 2019), as Endangered in China (Jiang et al. 2016) and Turkmenistan (Rustamow et al. 2011, cited in Barclay et al. 2019) and as Regionally Extinct in Armenia (Khorozyan 2010, cited in Barclay et al. 2019) and Azerbaijan (Askerov & Talibov 2013, cited in Barclay et al. 2019). In Nakhichevan, the species is considered Vulnerable (Khorozyan et al. 2020). In the Russian Trans-Baikal Krai and in*

the Republic of Altai, densities were estimated from snow tracking at 17.6–19.5 individuals per 100 km² and up to 19.6 individuals per 100 km², respectively (Kirilyuk & Barashkova 2011, cited in Barashkova et al. 2017, Barashkova et al. 2017). In 2022 Guidelines for practictioners on how to monitor the manul have been published by Moqanaki & Samelius (2022). This publication presents concepts and challenges of surveying and monitoring the manul and explains different monitoring techniques.

Habitat: Pallas's Cats are usually found in extreme continental climates, i.e. little rainfall, low humidity and a wide range of temperatures. They occur mostly in montane grassland steppe and shrub steppe, but require hiding cover such as ravines and rocky areas (Sunquist & Sunquist 2002, Ross 2009, Ross et al. 2012). Lowland desert basins or flat plains are largely unsuitable except along seasonal river courses or other disruptive cover, which are possibly used to access prey or to move to another more optimal habitat (Nowell & Jackson 1996, Ross 2009, Barashkova et al. 2019, Ross et al. 2019b). The species is rarely found in areas with persistent snow cover of over 10 cm, areas with a snow depth of 15–20 cm are therefore suggested to be the ecological limit (Heptner & Sludskii 1972, Kirilyuk & Puzanski 2000, Sunquist & Sunquist 2002). In Central Asia, the Pallas's Cat's main habitats are hilly, rocky outcrops, scree slopes, ravines and rock cover, including petrophytic dry steppe or semi-desert vegetation (Heptner & Sludskii 1972, Sludskii 1982, Kirilyuk & Puzansky 2000, Ross et al. 2010a, b, 2012, Istomov et al. 2016, Barashkova et al. 2019). In Iran, the species is found in arid grassland steppes, dry mountains to temperate open shrublands and in juniper woodland. The Pallas's Cat occurs on arid plateaus with flat and rolling mountains with some rocky and deep valleys in Afghanistan, in alpine and subalpine scrub with rugged and broken terrain with high cliffs, ridges and ravines in Pakistan, and in the mountains and foothills in Turkmenistan (Heptner & Sludskii 1972, Rustamov & Hojamyradov 1994, Chalani et al. 2008, Joolaee et al. 2014, Farhadinia et al. 2016, Talebi Otaghvar et al. 2017, Adibi et al. 2018, Moqanaki et al. 2019). In Bhutan the species is found in rolling hills dominated by glacial out-wash and alpine steppe vegetation (WWF 2012, Thinley 2013). In Nepal, it can be found in broken and rocky habitats, rolling hill slopes and in rocky hill slopes within montane grassland steppe (Shrestha et al. 2014, Lama et al. 2016, Regmi et al. 2016), and in Tibet in desert steppe habitat dominated by *Stipa* spp. as well as in mountainous alpine meadows and mountain steppe (Fox & Dorji 2007, Lie et al. 2013, Webb et al. 2014, 2016). The species lives in habitats which have some disruptive or hiding cover due to the constant risk of predation they face (Ross 2009). Open areas without suitable cover are avoided and habitats with disruptive cover such as ravines, rocky areas, shrub-steppe, and hill-slopes are highly selected (Ross 2009, Ross et al. 2010a). Despite the range of habitats that the species can be found in, refuges and dens (mostly marmot burrows and rock crevices) are thought to be critical for their survival (Ross 2009, Ross et al. 2010a, 2019a). The change in extent of suitable habitat within its EOO and level of habitat fragmentation across the species' range from 1994 to 2015 was very low (Moqanaki unpub. analyses). *In Iran, 57% of the core habitat and 29% of the corridors of the Pallas's Cat is protected and mainly in the north and north-east of the country the species has connected populations (Ashrafzadeh et al. 2020). A range-wide species distribution model identifying suitable habitat has been made by Greenspan & Giordano (2021).*

Ecology: Pallas's cast have unusually large home ranges for their body size. In Mongolia, home ranges were estimated at 159 km² for males and 64 km² for females (Ross et al. 2012). In Russia's Daursky State Nature Reserve, home ranges were estimated at 17 km² for males and 10 km² for females (Barashkova & Kiriliuk 2011). It is mostly crepuscular, but can be cathemeral (Ross 2009). Several species such as the Grey Wolf, herding Dogs and Red Foxes prey on the Pallas's Cat whose only defence is relying on their camouflage or taking cover in burrows (Ross 2009, Barashkova & Smelansky 2011, Ross et al. 2012, 2019b). The Pallas's Cat's main prey consists of small mammals, especially Pikas, but also Gerbils, Jirds, Voles, Hamsters, Ground Squirrels, young Marmots, Hares and Hedgehogs. They also feed on small birds, reptiles, invertebrates and carrion (Kirilyuk 1999, Ross et al. 2010b, Adibi et

al. 2018, Werhahn et al. 2018, Barashkova et al. 2019, Moqanaki et al. 2019). *However, the Pallas's Cat seems to rely on the most abundant prey species (Baatargal & Suuri 2021).*

Use & Trade: The Pallas's Cat can only legally be hunted in Mongolia and under a special license also in China (Lu et al. 2010, Ross et al. 2016, Barclay et al. 2019). The extent of the illegal hunting and illegal trade of the species or its body parts is unknown, but likely to be much higher than the legal hunting and to occur across all range countries (Barclay et al. 2019, Ross et al. 2019a). Occasional illegal hunting has been reported from Afghanistan and Pakistan for example (Kretser et al. 2012). Since the 1980s, the international trade in Pallas's Cats has stopped. The permit system in Mongolia is thought to be ineffective and furs are thought to be illegally exported to China. The Pallas's Cat fat and organs are used as medicine in Mongolia and Russia (Murdoch et al. 2006, Ross et al. 2016, Barashkova et al. 2019). Pallas's Cats are often mistaken for marmots which are commonly hunted, and shot (Ross et al. 2019b). In Kyrgyzstan there are indications that Pallas's Cats are often harvested in winter (T. Rosen pers. comm. 2020).

Threats: see Table 3.2.7.1.

Table 3.2.7.1. Threats to the Pallas's Cat for different locations according to Ross et al. (2020) *and other sources.*

Threat	Location
Habitat loss (Degradation & fragmentation; incl. loss of marmots as den site creators)	Range-wide (Ross et al. 2010a, Aweshali 2011, Paltsyn et al. 2012, Selles 2013; Ross et al. 2016, 2019a,b; Clayton 2016) Mongolia (FAO 1998, National Statistical Office of Mongolia 2013); Kazakhstan (A. Barahkova pers. comm. 2019) Russia (Batbold et al. 2008, A. Barashkova pers. comm. 2014)
Predation by herding Dogs	Range-wide (Barashkova & Smelansky 2011, Ross et al. 2012, Joolaee et al. 2014, Farhadinia et al. 2016, Ross et al. 2016, Ruta 2018, Barashkova et al. 2019, Ross et al. 2019b) *Iran (Nayeri et al. 2021)*
Prey depletion	China & Mongolia (Lai & Smith 2003, Clark et al. 2006, Winters 2006, Wilson & Smith 2015, Ross et al. 2016, Badingqiuying et al. 2016); Russia* and Kazakhstan* (Barashkova et al. 2019)
Illegal and incidental killing (incl. targeted hunting for use and trade, persecution/control)	Range-wide (Ross 2009, Barclay et al. 2019, Ross et al. 2019a); Afghanistan (Kretser et al. 2012); Pakistan (Kretser et al. 2012); Kyrgyzstan (T. Rosen, pers. comm.) *Russia, Dauria (Kirilyuk 2012, cited in Barashkova et al. 2019)*
Climate change	Central Asia and Himalayas (Angerer et al. 2008, Xu et al. 2009, IPCC 2014, Ross et al. 2019a)
Diseases (through increased contact with domestic Cats & Dogs)	*Range-wide (Naidenko & Demina 2019, Ross et al. 2019b)*

*only at small localised scales, which are currently not expected to threaten the species

Knowledge Base

General information on the distribution across the range of the Pallas's Cat is available with some more details for several range countries. Confirmed recent records of the species exist across all range countries except for Tajikistan, Uzbekistan and Azerbaijan. However, for parts of the extant and possibly extant range in the IUCN Red List, e.g. in China or in Mongolia, no recent confirmed records exist (Fig. 3.2.7.1). There are only four confirmed records outside the IUCN Red List extant and possibly extant distribution range (Fig. 3.2.7.1). Few density estimates, and little information on the abundance of the species across its wide range exist. The recently conducted status review has provided a summary of up-to-date information and available knowledge on the Pallas's Cat. Information on the distribution and status of the species is still scarce from most of its south-western range (e.g. Afghanistan, Armenia, Azerbaijan, Turkmenistan and Pakistan). Information on the species is espe-

cially lacking for China. Its population size was roughly estimated at 58,000 mature individuals and the population trend is thought to be decreasing. However, more robust information is needed for a realistic population estimate and to assess the trend across countries. Information on habitat types and landscape features used by the Pallas's Cat as well as its ecology is available, but there is still a lack of knowledge on population dynamics, genetics and diseases. Some information on the trade and utilisation of the species is available but the extent of legal and illegal trade is not fully clear, and neither is its impact on the population. Threats to the species are known for some parts of its range, but not for all range countries. The relative importance of threats, their scope and impacts at population level are not known. A conservation strategy for the Pallas's Cat has been published in 2019 and guidelines for practitioners on how to monitor Pallas's Cats have been developed and published in 2022. Several conservation projects are ongoing e.g. in Kazakhstan, Kyrgyzstan, Nepal, Iran, Mongolia, Bhutan, Russia, Uzbekistan, Turkmenistan and Pakistan, mainly conducted by PICA and Pallas's Cat Working group.

Evaluation of the Red List Assessment

The RLA for the Pallas's Cat (Ross et al. 2020) is comprehensive, assumptions well explained and evidences for the statements provided, followed the guidelines for using the IUCN Red List Categories and Criteria, and correctly applied the Categories and Criteria. It has only one inconsistency in the population section. The continuing decline in mature individuals is stated to be 5% within 1, 2 and 3 generations times. This means that the decline in mature individuals is always indicated to be 5% no matter over what time period. This needs correction in the next re-assessment.

Table 3.2.7.2. Evaluation matrix of the Pallas's Cat Red List Assessment of 2020. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟢	🟡	🟢	🟡
Consistency of RLA	🟢	🟡	🟢	🟢	🟢	🟢
New information since last RLA	🟡	🔴	🔴	🔴	🔴	🟡

Conclusions and recommendations

The 2020 RLA of the Pallas's Cat applied correctly the Categories and Criteria and its listing is comprehensible based on the information and data provided (Table 3.2.7.2). The Justification includes all information explaining the listing of the species. The species has been down-listed from Near Threatened to Least Concern based on better information and data available. There is not enough evidence for either a population decline high enough nor a population size small enough to classify the species as Near Threatened. Recent analysis indicates that the population is likely more stable than previously thought. However, the population is suspected to be decreasing. The population is suspected to have been reduced by 10% in the past, to have an ongoing decline by 10% and to be reduced by 10% in the future. The global population size has speculatively been estimated at around 58,000 mature individuals based on a density estimate of 4 cats / 100 km^2 and assuming 20% immature non-breeders.

Although there is much more information and data on the Pallas's Cat compiled in the RLA of 2020 than in the previous RLAs of the species, there are still too few robust population estimates available and the global population estimate is highly speculative. Further information on population dynamics in relation to prey population dynamics (cycles?) and the impact of threats on the Pallas's Cat is needed. Additionally, the Conservation Strategy should be implemented and, where appropriate, National Action Plans should be developed.

Recently, the first range-wide Conservation Strategy for the Pallas's Cat was developed and published, including new information and data on the species (Pallas's Cat Global Action Planning Group 2019). Moreover, the species has just been re-assessed for the Red List in 2020. Based on this newly collected information and data, there is a need for:

- Implementation of the Conservation Strategy (already ongoing);
- Development and implementation of National Action Plans based on the Conservation Strategy, where appropriate;
- Confirmation of the Pallas's Cat presence and status in areas without recent confirmed records especially in protected areas and predicted suitable habitat (incl. collecting by-catch data from camera-trapping surveys of other target species);
- Implement a more reliable monitoring of the Pallas's Cat across its range and at least in important key areas based on the recommendation provided by Moqanaki & Samelius (2022);
- Research on its population dynamics e.g. impacts of prey fluctuations on the populations;
- Assessment of the impact of threats (including range land deterioration and climate change) on the Pallas's Cat and mitigation measures;
- Recommend new protected areas for the Pallas's Cat as adequate.

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3.2.8 Serval (*Leptailurus serval*)

Least Concern (Thiel 2019 minor amendment –> 2015 full last RLA)

Red List history

Year	1996	2002*	2008	2015
cat. & crit.	LR/LC	LC	LC	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

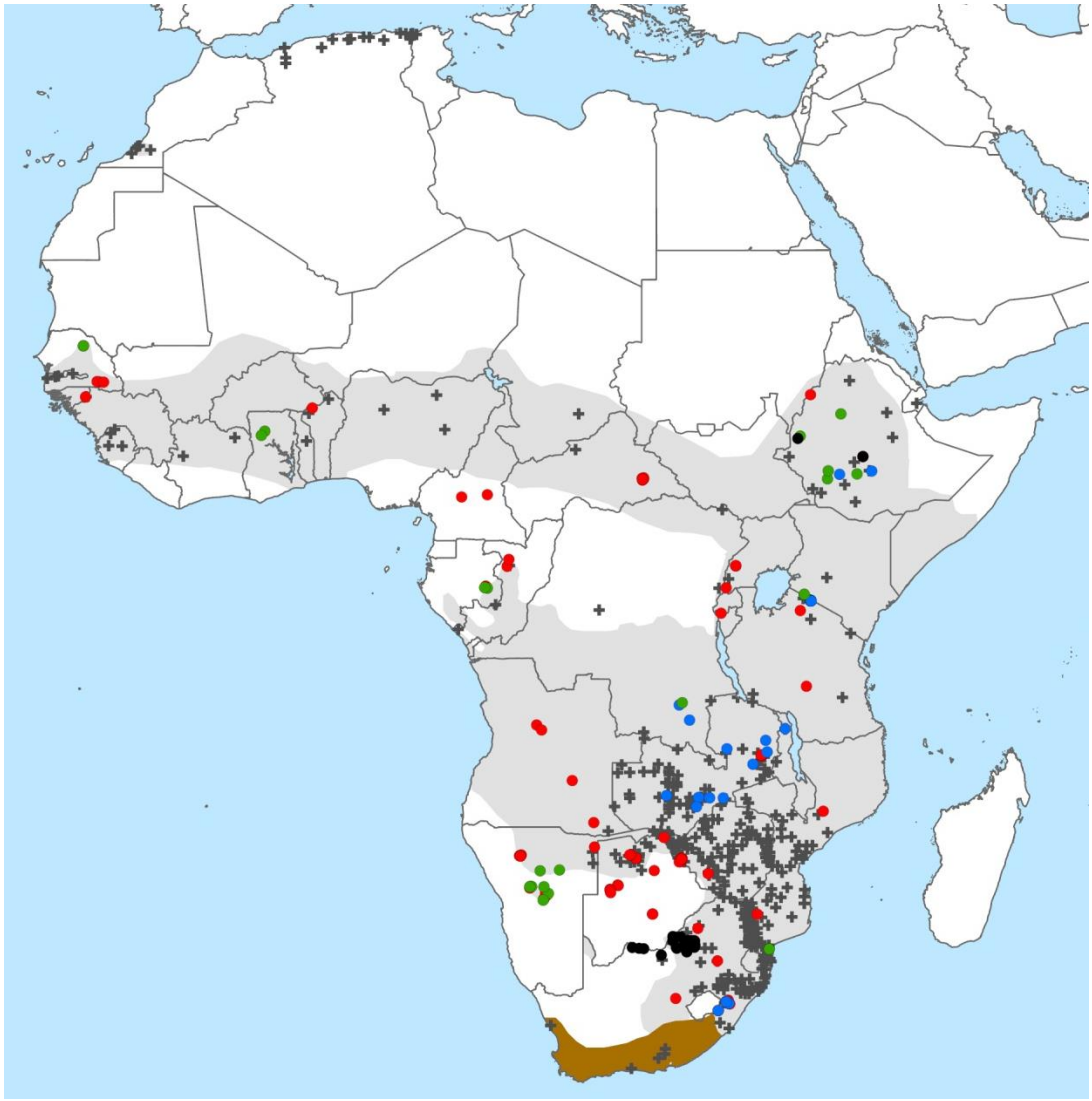

Fig. 3.2.8.1. Serval records from the CSGSD. Grey = extant, brown = extinct distribution range according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Thiel 2019) and *additional information available* (in italic).

Taxonomic Notes: Based on phylogeographical patterns found in other African species, the Serval is currently recognised to consist of three subspecies, namely: *L. s. serval*, *L. s. constantina* and *L. s. lipostictus* (Kitchener et al. 2017). There are, however, no molecular studies available to confirm this.

Justification: The Serval is listed as Least Concern as it is relatively abundant and widespread. There is evidence that the species is possibly expanding and recolonising some areas (Herrmann et al. 2008, Bout 2010, Thorn et al. 2011, Hickisch & Aebischer 2013, Mugerwa 2013). However, there is no confirmation whether these new records show an enlargement of its distribution range. Main concerns are habitat loss and degradation of wetlands and skin trade in West Africa (Ray et al. 2005). In the Sahel region, e.g. in Senegal, the Serval is rare (Clement et al. 2007). North of the Sahara, it is regionally Critically Endangered under Criterion C2a(i). There is an isolated population on the Mediterranean region occurring in Morocco and possibly Algeria (Cuzin 2003, K. de Smet, pers. comm.). In Tunisia it has been reintroduced (Hunter & Bowland 2013). The status of these populations has not been reassessed since 2007, with no confirmed records since 2003.

Geographic Range: The Serval is found widely throughout sub-Saharan Africa, except in the tropical rainforests and Saharan desert (Nowell & Jackson 1996). Along the Mediterranean region it only occurs in Morocco and possibly Algeria (Cuzin 2003, K. de Smet, pers. comm.). After going regionally extinct, east African Servals were reintroduced in Tunisia (Hunter & Bowland 2013). Its presence in Nigeria, Cameroon and Benin is based on trade evidence (Sayer & Green 1984, Gadsby 1991, Maisels et al. 2001). In southern South Africa, the Serval is extinct. There are some new records of Servals indicating an expansion and recolonisation of some areas in central South Africa and the North West province of South Africa, Gabon, eastern Central African Republic, south-western Uganda and central Namibia (Herrmann et al. 2008, Bout 2010, Thorn et al. 2011, Hickisch & Aebischer 2013, Mugerwa 2013, C. Thiel, pers. comm.). *Servals have recolonised regions in South Africa (the Provinces Free State and eastern Northern Cape) and potentially Lesotho (Ramesh et al. 2016). They have also been reintroduced in several private game reserves in the Eastern Cape province (Ramesh et al. 2016). Within South Africa, Servals commonly occur within wetland habitats of the Drakensberg Midlands but are rare in the lowland wetlands (Ramesh et al. 2016). It is unknown whether the Serval ever occurred in Egypt (Gippoliti & Oriani 2017). Bout et al. (2010) reported sightings of Servals in Gabon where they had been thought to be extinct for the last five decades (Bohm 2015). In Cameroon, the Serval was recorded outside of its extant distribution range in Deng-Deng National Park and Mpem et Djim National Park (Simo et al. 2021). Further recent confirmed records lie outside its current extant distribution range in Botswana and Zimbabwe (Finerty et al. 2019). There are large areas without any past or confirmed records (Fig. 3.2.8.1).*

Population: Except for northern Africa, the Serval is recorded in most major national parks and reserves. The status outside of reserves is not known, but the species is possibly common in suitable habitat. The Serval is tolerant of farming practices if cover and food are available (Bowland 1990, Thiel 2011). The density of Servals in Ngorongoro Crater, Tanzania, in optimal habitat, was estimated at 42 individuals per 100 km² and in Luambe National Park (Geertsema 1985), Zambia, at 10 individuals per 100 km² (Thiel 2011). *In Tanzania, the Serval's population trend is considered to be stable with Servals commonly occurring, especially in the north (Aguilar 2017). In South Africa, Servals are considered to be Near Threatened (Ramesh et al. 2016). Here, population size is estimated at 4,509–13,654 mature individuals, or when using an alternative method at 5,538–6,614 mature individuals (Ramesh et al. 2016). In Odzala-Kokoua National Park in the Republic of the Congo, Serval density was estimated at 7.7–9.8 individuals per 100 km² by Bohm & Hofer (2018). In South Africa, density on*

the farmlands was estimated at 6.5–7.7 individuals per 100 km² (Ramesh & Downs 2013). In the KwaZulu-Natal Midlands, density was estimated at 4.3–9.3 individuals per 100 km² (Ramesh et al. 2016). Serval density in an industrial site in the Mpumalanga province and a disturbed artificial wetland, Sadol refinery site in Secunda (South Africa) was estimated to be 76.20–101.21 individuals per 100 km² (Loock et al. 2018) and 150 individuals per 100 km² (Ramesh et al. 2016), respectively. This presumably is a result of the high abundance of prey animals, the lack of persecution (poaching and roadkill) and lack of competitor species (Edwards et al. 2018, Loock et al. 2018). Contrarily, low densities were recorded in Namibia, with a density of 1.28 individuals per 100 km² and 0.63 individuals per 100 km² in Khaudum National Park and Mudumu North Complex, respectively (Edwards et al. 2018). Future population surveys should be conducted in north-eastern Namibia as this region consists of ideal habitat (i.e. sufficient rainfall and vegetation cover) with a lack or low abundance of larger carnivore species including Lion and Leopard (Edwards et al. 2018). A density of 3.11–8.01 individuals per 100 km² was estimated for the Miombo woodlands of Rugha-Rungwa, Tanzania (Hardouin et al. 2021). In this park, the density in core tourist areas (2.44–4.49 individuals/100 km²) and wildlife management areas (1.34–2.82 individuals/100 km²) were much lower (Hardouin et al. 2021). This variation likely is a result of precipitation, apex predator abundance and level of anthropogenic pressures (Hardouin et al. 2021). In Botswana and Senegal, densities were estimated at 4.3–9.3 individuals per 100 km² (Ramesh & Downs 2013) and 2.51–2.82 individuals per 100 km² (Kane 2014), respectively.

Habitat: The Serval does not inhabit rainforests or desert habitats (Sunquist & Sunquist 2002). Servals are found in well-watered savanna long-grass environments in sub-Saharan Africa (Thiel 2011). They are especially associated with reed beds, swamps and other riparian vegetation types (Thiel 2011). They can also be found in brush and open woodlands, along the edge of forests, on high altitude moorlands, bamboo thickets and alpine grasslands (Geertsema 1981, Skinner 1986, Grimshaw et al. 1995, Nowell & Jackson 1996, Andama 2000). In North Africa, Servals inhabit semi-desert to cork oak forest on the Mediterranean coast (de Smet 1989, Cuzin 2003). If cover is available, they also tolerate agricultural areas (Geertsema 1985, Thiel 2011). The Serval possibly benefits from forest clearance and encroachment of savanna at the edges of the equatorial forest belt (Ray et al. 2005). *The Serval is a wetland specialist (Manqele 2017) and these habitats are important for their survival (Ramesh et al. 2015b). Servals are able to inhabit dense forests along waterways and grassy patches (Ramesh et al. 2016). In Serengeti National Park, Tanzania, Servals preferred grassland habitats and were less found in shrubland and wooded grassland (Mwampeta et al. 2020). Servals are able to adapt to diverse habitats and can use semi-natural and man-made habitats (Manqele 2017) and can potentially be classified as semi-synanthropic (Ramesh et al. 2016). Servals can exist in agricultural landscapes as long as wetlands and natural vegetation are available (Ramesh et al. 2016). The Serval can survive in degraded open habitats in Central Africa (Bout 2010 in Bohm & Hofer 2018). In farmland, mosaics of wetland seem to be a key determinant for Serval persistence (Ramesh et al. 2015b). Forest core areas, forest proximity and patch richness are also deemed important (Ramesh et al. 2015b). In South Africa, Servals are often found in highly modified areas. Small carnivores such as the Serval can do well in these disturbed areas due to their high capacity to adapt, the lack of large carnivores and abundance of small mammalian prey (Edwards et al. 2018, Emslie 2018).*

Ecology: Servals mainly prey on small mammals, especially rodents but also take birds, reptiles and arthropods (Geertsema 1985, Bowland 1990, Thiel 2011). *The Serval preys on different species such as hares and birds (Aguilar 2017). Rodents make up as much as 80% of Serval diet (Loveridge et al. 2020). In the Drakensberg Midlands, South Africa, the Serval mainly preys upon rodents but also takes ungulates, birds, reptiles, insects and small-spotted genet (Ramesh & Downs 2015). Servals also prey on fish (Ramesh et al. 2016), amphibians and other aquatic vertebrates (e.g. juvenile Nile crocodile in the Okavango Delta, Botswana; Loveridge et al. 2020). Like other felids, Servals can eat plants (Yoshimura et al. 2021). While Servals have been found to predate on livestock, such as lambs or goat*

kids in Ethiopia (Atickem et al. 2017), livestock predation only occurs rarely and whenever it does occur, it does not incur high costs (Davies-Mostert et al. 2018). Servals are solitary felines (Farr et al. 2019) and are mostly nocturnal, e.g. in Serengeti National Park Tanzania (Mwampeta et al. 2020), but also display diurnal activities (Mills et al. 2019). Intersex differences in activity patterns have been found (Bohm & Hofer 2018). In Odzala-Kokoua National Park, Republic of Congo, females were mainly diurnal and males mainly nocturnal (Bohm 2015, Bohm & Hofer 2018). This is likely to be a result from the nocturnal co-occurring spotted hyenas. Females namely have to be more careful to avoid predation of their offspring by larger predators such as spotted hyena (Bohm & Hofer 2018). Servals also spatially avoid African Golden Cats (Mills et al. 2019, Simo et al. 2021). Servals partitioned habitats with forest-dependent African Golden Cats (Mills et al. 2019), and reduced interspecific competition by specialising on smaller prey species to minimise dietary overlap (Simo et al. 2021). Serval home ranges are estimated at 38 km² for males and 6.2 km² for females in the Drakensberg Midlands, South Africa (Ramesh et al. 2016). In South Africa, on the Magaliesberg plateau, North West's Kgaswane Mountain Reserve, Servals had a home range of 2.1–2.7 km, in Mount Currie Nature Reserve home ranges of 2.9–9.4 km² and in KwaZulu-Natal Drakensberg foothills of 15–30 km² (van Aarde & Skinner 1986, Perrin 2002, Bowland 1990 all cited in Ramesh et al. 2016). In Secunda, Mpumalanga, South Africa, with a high population density, home ranges were estimated at 1–2 km² (Ramesh et al. 2016). In the Drakensberg Midlands, South Africa, the home ranges ranged from 38 km² to 46 km² for males and from 6 to 7 km² for females (Ramesh et al. 2015a). Males and females show different space use patterns which is likely to be a result of males' patrolling behaviours and relatively larger home ranges (Ramesh et al. 2015a).

Use & Trade: The international legal commercial trade is declining. However, in some countries like Senegal, the Gambia and Benin, skins are still heavily traded. Servals are traded in West Africa primarily for ceremonial or medicinal purposes, for example in Nigeria. In Zambia, Serval pelts are used as substitute for Leopard skins. *In West and South Africa, the trade is mainly for ceremonial or medicinal purposes but also for bushmeat (Ramesh et al. 2016). The use of Serval skins for ceremonial traditions is an important threat (Ramesh et al. 2016). Meanwhile, trophy hunting is not thought to impact the overall Serval population, but may cause local population declines (Ramesh et al. 2016). Servals are also captured for the pet trade (Ramesh et al. 2016). They were on offer e.g. in Facebook groups for the sale of exotic pets in Thailand (Siriwat et al. 2019).*

Threats: see Table 3.2.8.1.

Table 3.2.8.1. Threats to the Serval for different locations according to Thiel 2019 *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation)	Range-wide (Nowell & Jackson 1996, Ray et al. 2005, Thiel 2011) *South Africa (Ramesh et al. 2016, Manqele 2017)*
Illegal and incidental killing (incl. Targeted hunting for use and trade, persecution/control)	Range-wide (Sayer & Green 1984, Gadsby 1991, Sodeinde & Soewu 1999 in Hunter & Bowland 2013, Maisels et al. 2001, Burnham & Di Silvestre in Hunter & Bowland 2013, K. de Smet & F. Cuzin pers. comm. 2007, Arce & Prunier 2006, C. Thiel, pers. comm., L. Hunter & J. Bowland, pers. comms.) *Ethiopia (Acha et al. 2017, Megaze et al. 2017, Ayechew & Tolcha 2020, Wendimu & Tekalign, no date)* *Morocco (Bergin & Nijman 2016)* *Namibia (Edwards et al. 2018)* *Nigeria (Ajagun & Anyaku 2017, Ajagun et al. 2017)* *South Africa (Ramesh et al. 2016, Sinovas et al. 2016, Manqele 2017, Davies-Mostert et al. 2018, Manqele et al. 2018)*
Rodenticide	*Namibia (Edwards et al. 2018)*
Road mortality	*South Africa (Ramesh et al. 2016, Manqele 2017, Williams et al. 2019, Quintana et al. 2022)*
Diseases	*South Africa (Du Plessis et al. 2019, Loock et al. 2021)*

Knowledge Base

The Serval is a widespread and relatively abundant felid within sub-Saharan Africa. The available knowledge on this species, however, remains quite limited. There are a lot of studies estimating (wide-ranging) Serval densities, but no global or national population size estimates, except for the one for South Africa. There is general knowledge on habitat and prey available, but not much information on Servals' ecology in general. General information on use, trade and threats is available, but their impact on the species across the range countries is not well understood.

Evaluation of the Red List Assessment

Little information is available on the Serval, making an evidence-based assessment for the species challenging. The following points should be addressed in the next re-assessment:

- There is only one assessor for the Serval RLA. If possible, more experts across the species' range should be included in the next RLA;
- Where available the Justification should include more information to justify the Category of Least Concern;
- Some of the information stated in the Threats section would be better placed under Use and Trade;
- Although not mandatory, the calculation of the EOO would provide additional information;
- The information given in the countries of occurrences table does not fully match the distribution map e.g. the presence uncertain range in Lesotho and Morocco is not displayed, neither is the possibly extinct range in Algeria shown in the map;
- If possible, information on the Life History should be included;
- If possible, the Geographic Range, Population and Threat section could be expanded, e.g. including more details on its distribution in the countries;
- Some of the then available publications have not been considered (e.g. Henschel et al. 2014, Kane 2014, Ramesh & Downs 2013, Everatt & Andresen 2012, Atickern et al. 2010, Pettorelli et al. 2009). These publications provide information on distribution records, activity, abundance and density.

Table 3.2.8.2. Evaluation matrix of the Serval. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟡	🔴	🟡	🔴
Consistency of RLA	🟡	🟡	🟢	🟡	🟡	🟡
New information since last RLA	🟢	🟡	🟢	🟢	🟡	🟢

Conclusions and recommendations

An evidentiary RLA of the Serval is not straight forward due to the limited information especially on its population size and abundance (Table 3.2.8.2). Few specific projects or studies on the species have been conducted. Most records are by-catches from studies on other species. Some new information on the species, e.g. on its habitat use and ecology, but also on its distribution, is available since the last RLA in 2015. However, for large parts of its extant distribution range, its status is not known. The listing as Least Concern is justified but should be further elaborated. A re-assessment of the Serval should be conducted to address the above stated point and to include the new available information. Our knowledge base on the Serval must be expanded. There is a need for:

- Confirmation of the Serval's distribution (incl. collection of by-catch data from camera-trapping surveys of other target species, especially in areas without any record);
- Quantitative data on global and national population size;
- Information about the Serval's ecology and its habitat requirements;
- Assessment of the impact of threats;
- Establishment of conservation plans (especially in the regions where Servals qualify for the Critically Endangered category);
- Establishment of a network;
- Re-assessment of the species for the IUCN Red List.

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3.2.9 African Golden Cat (*Caracal aurata*)

Vulnerable A2c + A3c (Bahaa-el-din et al. 2015)

Red List history

Year	1994	1996	2002*	2008	2015
cat. & crit.	K	LR/LC	VU C2a(i)	NT A2bcd	VU A2c + A3c

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

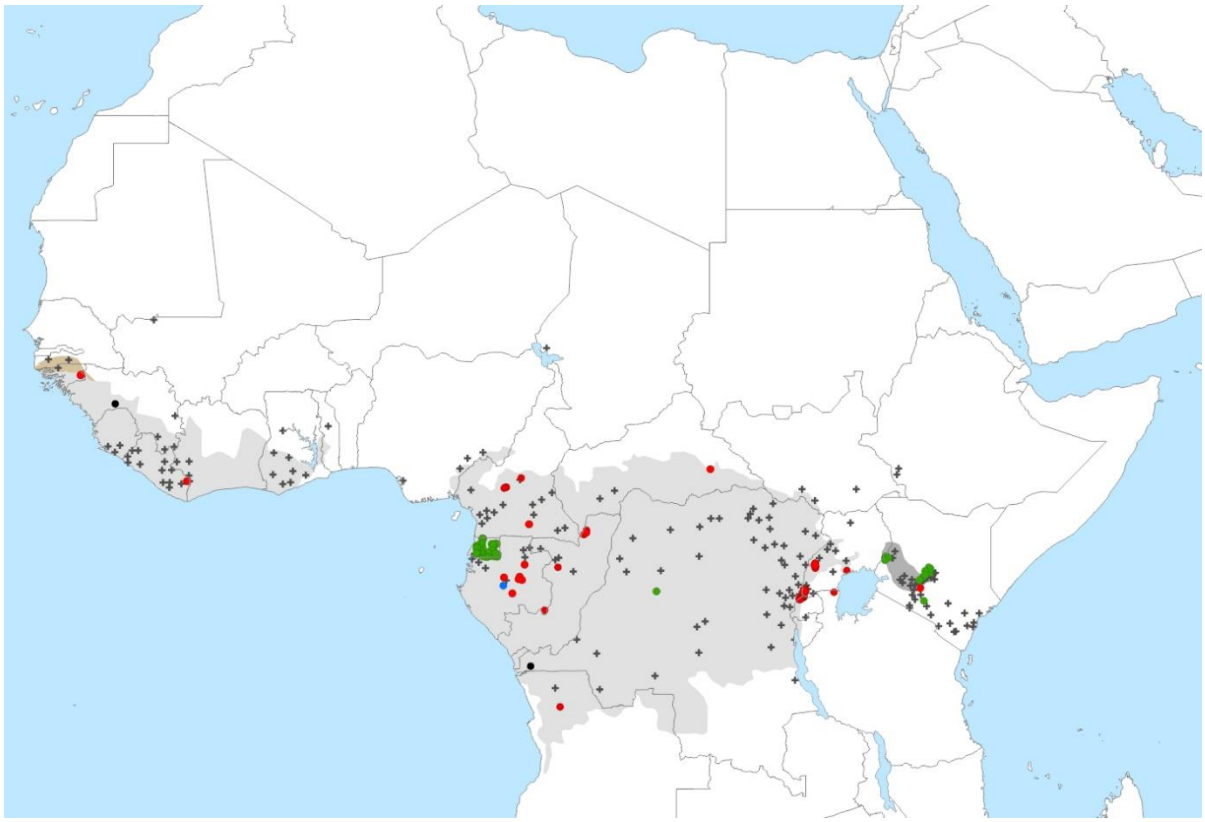

Fig. 3.2.9.1. African Golden Cat records from the CSGSD. Light grey = extant, grey = possibly extant and light brown = possibly extinct distribution range according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. The Possibly Extinct range is not shown in the map.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Bahaa-el-din et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: Based on biogeographical patterns of other African rainforest species, the African Golden Cat is currently recognised to consist of two subspecies, namely: *C. a. aurata* and *C. c. celidogaster* (Kitchener et al. 2017). A molecular study, however, is required to confirm the classification of subspecies.

Justification: The African Golden Cat is listed as Vulnerable. Little data is available on the species. The assessment is based on data on deforestation and bushmeat hunting and the inferred effects they have on the African Golden Cat, i.e. a loss of its area of occupancy (AOO) of >30% over the past 3 generations (15 years) as well as projected over the next three generations, too.

Geographic Range: The African Golden Cat is found in Equatorial Africa's forests (Fig. 3.2.9.1). West African and Central African populations are separated, with no confirmed records from The Gambia, Guinea Bissau, Togo and Benin (Nowell & Jackson 1996, Ray & Butynski 2013). In Equatorial Guinea, only 16% of suitable habitat was found to be occupied by the species (Martinez Marti 2011). *Recently, African Golden Cat presence was confirmed in Boé National Park, Guinea Bissau (Breider et al. 2016), and in Batéké Plateau National Park, Gabon (Hedwig et al. 2018). It was recorded for the first time in the Dja Faunal Reserve, Cameroon (Bruce et al. 2018), and it was also confirmed in Mpem et Djim National Park, Cameroon (Talla et al. 2019, Mouafa et al. 2022). Additionally, the first evidence of Golden Cat presence in Rwanda was found in Volcanoes National Park (Moore et al. 2019), and it was confirmed in Bwindi Impenetrable National Park, Uganda (Mugerwa 2018). Additionally, after numerous reports of sightings in Kenya over many years (Boy 2003), the first confirmed record since 1946 has been reported (Hatfield et al. 2019), confirming the cat's range in the east. The African Golden Cat has also since been confirmed for the first time in Minziro Nature Forest Reserve, Tanzania (Greco & Rovero 2020). No recent confirmed records are known for Angola, the Democratic Republic of the Congo and for the whole of West Africa except one for Guinea-Bissau (Breider et al. 2016) and Liberia (Wild Chimpanzee Foundation no date; Fig. 3.2.9.1).*

Population: The African Golden Cat is infrequently observed in the wild, and generally considered rare. The overall population is decreasing. *In the National Red List of Uganda, the species is listed as Endangered (Prinsloo et al. 2016). In Gabon, the species can also be found in secondary and logged forest but it reaches the highest densities in pristine forest habitat: Estimates range from 3.8 individuals per 100 km² in a site with subsistence bushmeat hunting to 10.2–12.8 per 100 km² in two logging concessions and 16.2 per 100 km² in a protected area (Bahaa-el-din et al. 2014, 2016 Bahaa-el-din 2015). The naïve density in Minziro Nature Forest Reserve was 4 per 100 km² (Greco & Rovero 2020).*

Habitat: African Golden Cats occur mainly in forests, but on the edges of their range, they extend into savanna regions along riverine forest (Nowell & Jackson 1996, Ray & Butynski 2013). *In Gabon, African Golden Cats occupied not only pristine forests, but also forests that were logged two years prior to the study (Bahaa-el-din 2015, cf. above). In Tanzania in the Minziro Nature Forest Reserve, there were indications that habitat intactness and human disturbance affect African Golden Cat presence as there was a higher occupancy of the species with increasing distance from the Reserve edge and human settlements (Greco & Rovero 2020).*

Ecology: Diet studies were performed in the Central African Republic, the Congo, Ivory Coast and Uganda. The main prey was found to be rodents and squirrels, followed by duikers and primates, but also birds and pangolins (Kingdon 1977, D. Jenny pers. comm. in Nowell & Jackson 1996, Hart et al. 1996, Ray & Sunquist 2001). African Golden Cats were themselves found in scats of Leopards in Gabon, as well as a carcass killed by a Leopard in the Ivory Coast (Hart et al. 1996, Henschel et al. 2005). *Prey species incorporating frequency of occurrence within four diet studies of the African Golden Cat were compiled and compared by Bahaa-el-din (2014). Activity patterns were found to vary: Golden Cat activity was cathemeral (active at any time of day and night) in the presence of largely nocturnal Leopards, but mostly nocturno-crepuscular in areas where Leopards are absent. However, as Leopard absence was concurrent with and probably caused by high human pressure, it was impossible to determine whether the change was a response directly to the increased human activity, or indirectly due to the absence of the apex predator (Bahaa-el-din 2015).*

Use & Trade: African Golden Cats are not primarily targeted, but are nonetheless caught by bushmeat hunters. Captured cats are eaten and the skin is sometimes sold in the market (T. Davenport pers. comm. in Ray & Butynski 2013). Skins also have a ritualistic use (Nowell & Jackson 1996).

Threats: see Table 3.2.9.1.

Table 3.2.9.1. Threats to the African Golden Cat for different locations according to Bahaa-el-din et al. 2015 *and other sources*.

Threat	Location
Habitat loss - deforestation	Range wide (Laurance et al. 2006, FAO 2011, Zhang 2011, Edwards et al. 2014)
Bushmeat hunting (direct & prey loss)	Range wide (Sayer 1992, Wilkie & Carpenter 1999, Ray, Hunter & Zigouris 2005, Laurance et al. 2006, Blake et al. 2007, Henschel 2008)
Human population growth	Range wide (FAO 2011, UN 2012)

Knowledge base

The knowledge on the African Golden Cat is limited. There are very few studies (only in Equatorial Guinea, Gabon, Uganda) and thus few publications on the species are available. Little information on the distribution at a higher resolution than the range country level is known. Confirmed recent records exist from Cameroon, Central African Republic, Congo, Kenya, Rwanda and Uganda. No recent confirmed records are known for Angola, the Democratic Republic of the Congo and for the whole of West Africa except one for Guinea-Bissau (Fig. 3.2.9.1). The habitat is estimated to be declining. There is no information on population size, abundance or trend of the species. However, three density estimates from different habitats in Gabon exist, also providing information on the suitability of habitats for the species and possible impacts of threats to the species. Habitat types used are known, but only some information on the diet (partly based on old references) and activity is available, together with some evidence on its hunting behaviour. No further information on its habitat use or ecology is available. With regard to use and trade, only the purpose of use is known and that individuals are often caught indiscriminately. The amount of trade is however unknown and consequently also its significance as a threat. General threats are known from Central Africa, but there is little understanding of threats in West Africa. Impacts of threats are not known (apart from one example of density estimates in forests with and without subsistence hunting) and their scope is assumed. No conservation strategy or action plan exists. A network has been established and several projects focus on the African Golden Cat.

Evaluation of the Red List Assessment

Little information is available on the African Golden Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points need to be addressed in the next re-assessment:

- Where available the Justification should include more information to justify the Category and Criteria chosen;
- The decline in the AOO, which has increased from 20% in the 2008 assessment to 30% in the 2015 assessment should be further explained;
- The projected population decline would benefit from an elaboration of the method of extrapolation;
- If possible, further information on the assumed strong impact of direct and indirect threats (e.g. bushmeat hunting) should be included;

- Several of the then available publications were not considered, e.g. Aronsen 2010, Bahaa-el-din et al. 2011, Sheil 2011, Butinsky et al. 2012, Mills et al. 2012, Bahaa-el-din & Mills 2013, Hickisch & Aebischer 2013, Sheil & Mugerwa 2013, Sheil et al. 2013. These publications include some information on site-specific abundance and on activity patterns and hunting behaviour.

The listing as Vulnerable under Criteria A, Subcriteria A2c and A3c (population size reduction in the past and future, respectively; Appendix I is based on an inferred decline of >30% in the past 15 years (3 generations). Such a population decline is assumed to be the consequence of habitat loss and bushmeat hunting. The Threats section of the RLA presents a decline of 6.5% of African Golden Cat habitat in the past 15 years due to deforestation, implying that most of the inferred population decrease is due to direct persecution and bushmeat hunting (prey depletion). Further evidence for the population decline should be provided. Listing a species based on an inferred population decline is a complex endeavour. According to the newest version of the IUCN Red List Guidelines (V14, 2019) an inferred population reduction should be calculated/estimated from indirect evidence using variables of the same general type (e.g. mortalities, harvest data, observation indices) and cannot be based on a decline of the AOO (IUCN Standards and Petitions Committee 2019).

Table 3.2.9.2. Evaluation matrix of the African Golden Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🔴	🔴	🟡	🔴	🔴	🔴
Consistency of RLA	🟡	🟡	🟢	🟡	🟢	🟢
New information since last RLA	🟡	🟡	🟡	🟡	🔴	🔴

Conclusions and recommendations

An evidentiary RLA of the African Golden Cat is difficult because of the generally weak data base (Table 3.2.9.2). Very few specific projects have been conducted on this species, and possibly available records (e.g. bycatches from camera-trapping) are not consistently reported. Hence no recent distribution information is available for most of the Extant or Possibly Extant distribution area (Fig. 3.2.9.1). Some published information has not been considered in the last RLA, and some new information has become available since (Table 3.2.9.2). The African Golden Cat should be re-assessed to address the points listed above and to bring it in line with the newest version of the RL Guidelines, which have been specified in a crucial aspect of the assessment (concerning the inferred population decline).

Foremost, our knowledge base on the African Golden Cat must be broadened. There is a need for:

- Confirmation of the African Golden Cat's distribution (incl. gathering of by-catch data from camera-trapping surveys of primates or other target species);
- Quantitative data on African Golden Cat abundance and/or densities and (local) population dynamics;
- Research on the African Golden Cat's response to habitat changes and encroachment;
- Information about the African Golden Cat's ecology;
- Assessment of the impact of threats, especially the impact of bushmeat hunting;
- Establishment of a conservation plan, where appropriate;
- Establishment of a research network;
- Re-assessment of the species for the IUCN Red List.

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3.2.10 Caracal (*Caracal Caracal*)

Least Concern (Avgan et al. 2016)

Red List history

Year	1996	2002*	2008	2016
cat. & crit.	LR/LC	LC	LC	LC

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

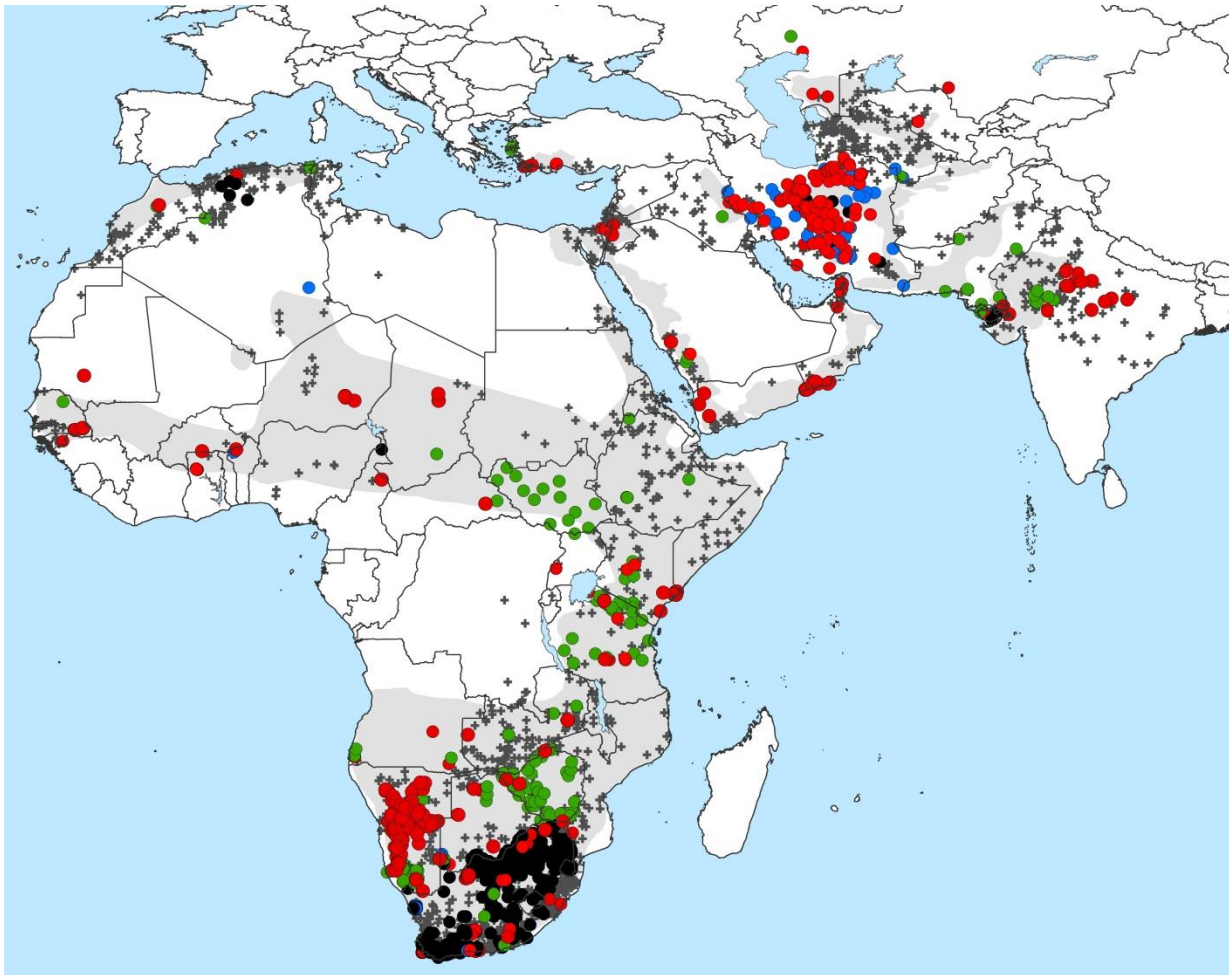

Fig. 3.2.10.1. Caracal records from the CSGSD. Grey area = extant and possibly extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Avgan et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Caracal is currently recognised to consist of three subspecies, namely: *C. c. caracal*, *C. c. nubicus* and *C. c. schmitzi* (Kitchener et al. 2017). This classification, however, is partly based on studies on other species, showing differentiations between western and central Africa and

southern and eastern Africa. This pattern could possibly also apply to the Caracal. No recent morphological and molecular studies exist.

Justification: The Caracal is listed as Least Concern. Although population declines and range loss were reported in some parts of Asia and Northern Africa (GCEP 2000, Lukarevsky 2001, Cuzin 2003, Sheikh & Molur 2004, Cowan 2013, F. Belbachir pers. comm. 2014), these losses are judged to be insignificant when compared to the global population. In the species' stronghold in Central and southern Africa, the species is very common and has a stable population (Thorn et al. 2011). The overall population trend is unknown.

Geographic Range Africa: In Africa, the Caracal is regarded as common, and is widely and continuously distributed (Nowell & Jackson 1996, Sunquist & Sunquist 2002, Stuart & Stuart 2013), albeit with substantial range losses in North and West Africa (Ray et al. 2005). In some areas of South Africa and Namibia, new and vacant areas are being (re-)colonised by the species, while in other areas in Central and West Africa, it is largely absent (Stuart & Stuart 2013). *Recent records are reported from most of the extant and possibly extant distribution range, albeit with considerable areas outside southern Africa with few or no recent records such as Angola, Nigeria, Mali, Mozambique or Sudan (Fig. 3.2.10.1). There are also occasional recent, confirmed and/or unconfirmed records from outside the known distribution range according to the Red List, namely from Mauritania, Algeria (Recent confirmed records also include e.g. the Ouarsenis Mountains in northern Algeria, where the last record dated back to 1954 (Bounaceur et al. 2018).) and South Sudan/Uganda (P. Gerngross unpub. review, Henschel 2001).*

Geographic Range Arabian Peninsula & Asia: Information is available at regional or local levels for Yemen, Oman, Saudi Arabia, UAE, Turkey, Iran, Afghanistan, Turkmenistan and India (Habibi 2004, Mukherjee et al. 2004, Farhadinia et al. 2008, Ilemin & Gürkan 2010, Avgan 2011, Mallon & Budd 2011, Albayrak et al. 2012, Kaczensky & Linnell 2014). *Recent records are reported from most areas of the known distribution range though some areas have no recent observations such as parts of Uzbekistan, Turkmenistan and Afghanistan. Recent confirmed and/or unconfirmed records outside the known distribution range come from the UAE, Iran, Kazakhstan, Pakistan and India (e.g. Gubiani et al. 2020, Moqanaki et al. 2016, http://wildcats.wildlifemonitoring.ru/, P. Gerngross unpub. review).*

Population in Africa: Little information is available on the abundance and population trend. In South Africa and southern Namibia, the Caracal is considered common with populations expanding, whereas in Central and West Africa it is largely absent or has apparently lower densities, and in North Africa it is considered to be threatened (Thorn et al. 2011, Stuart & Stuart 2013). In Morocco, it is listed as Critically Endangered (Cuzin 2003). In Egypt, it is regarded as rare, although it may be more common than believed as it is an elusive species (Hunter 2004). A density of 23–47 individuals per 100 km² was estimated in the West Coast NP, South Africa (Avenant & Nel 1998). *In the Red List of South Africa, Eswatini and Lesotho, the Caracal is listed as Least Concern (Avenant et al. 2016). "[…] the total Caracal population [in South Africa, Eswatini and Lesotho] could be anywhere between 45,000 and 150,000 individuals, depending on local densities [15–50 individuals per 100 km²] and occupancy" (Avenant et al. 2016).*

Population in the Arabian Peninsula & Asia: In the Arabian Peninsula, the species is listed as Least Concern and believed to be widespread with largely stable populations. However, in some range countries in the Peninsula, Caracal populations are declining and may already be close to being classified as Near Threatened (Mallon & Budd 2011). Caracals are considered to be rare and declining in Saudi Arabia and UAE, to be rare in Jordan where they are listed as Endangered, and to be stable and locally common in Yemen (GCEP 2000, Mallon & Budd 2011, Khorozyan et al. 2014). Its trend in Oman is unknown, but the whole peninsular population is believed to fluctuate based on prey availability (Mallon & Budd 2011). In Turkey, little information on status and distribution is available, but

the Caracal is probably Endangered (Albayrak et al. 2012). It is considered to be declining in Iran and Afghanistan, and to be threatened in the latter (Habibi 2004, Hassan-Beigi et al. 2014). In Pakistan, it is listed as Critically Endangered (Sheikh & Molur 2004). In Central Asia and India, the Caracal is rare (Nowell & Jackson 1996). In India's Kutch region, Gujarat, there are an estimated 10–15 individuals, and in Rajasthan less than 50 (Singh et al. 2014). *In the National Red List of Israel, the Caracal is listed as Vulnerable (Dolev & Perevolotsky 2004). In India's Ranthambhore Tiger Reserve, a density of 4.8 Caracals per 100 km² has been estimated (Singh et al. 2015).*

Habitat: The Caracal can be found in a broad variety of habitats including semi-desert, moist woodland and evergreen/montane forest, but prefers drier woodland and savanna regions (Sunquist & Sunquist 2002, TAWIRI 2009, Mallon & Budd 2011, Stuart & Stuart 2013). In the Arabian Peninsula, they use desert wadis, foothills, mountains and basalt fields (Mallon & Budd 2011).

Ecology: Caracals prey mainly on small- to medium-sized mammals, but also feed on birds, lizards, snakes, invertebrates, fish and even on some plant matter (Hunter 2004, Stuart & Stuart 2007, 2013; Ghoddousi et al. 2009, Mallon & Budd 2011). In India, Iran and South Africa, rodents constitute an important part of the diet (Mukherjee et al. 2004, Farhadinia et al. 2008, Braczkowski et al. 2012). Caracals are described as diurnal in Yemen, nocturnal in India, and as cathemeral in Turkey (Ilemin & Gürkan 2010, Khorozyan et al. 2014, Singh et al. 2014). Home ranges of male Caracals are mentioned for Israel (average 220.6 km²; N=?), Namibian ranch land (average 316.4 km²; N=3), Saudi Arabia (seasonally 270–1,116 km²; N=1) and South Africa (5.1–48 km²; N=?), and for females from South Africa (3.9–26.7 km²; N=?; Weisbein & Mendelssohn 1990, van Heezik & Seddon 1998, Marker & Dickman 2004, TAWIRI 2009). *Recently, Caracals were found to be cathemeral in Yazd, Iran (Akbari et al. 2016). Several more (non-recent) studies exist on diet – e.g. from Botswana, Israel & Turkmenistan (compiled in Sunquist & Sunquist 2002), from Algeria, the Arabian Peninsula, and UAE/Oman (Dragesco-Joffe 1993, Stuart & Stuart 2007, Mallon & Budd 2011) – and e.g. on home ranges of females in Israel (Weisbein & Mendelssohn 1990).*

Use & Trade: Caracals are used in the international pet trade in the United Arab Emirates, but it is unclear where these animals come from and what impact the trade has (Mallon & Budd 2011). *The Red List of South Africa, Eswatini and Lesotho (Avenant et al. 2016) reports an existing international trade in exotic pets: A special interest appears to exist in the USA, Russia, Canada and the Netherlands. The exported cats all seem to come from legal breeding centres, but there are indications that this trade is increasing. The capture of wild Caracals is currently regarded as a minor threat in South Africa, but the situation is monitored (Avenant et al. 2016). It is estimated that some 50–100 Caracals are trafficked every year from Africa via Somaliland to the Arabian Peninsula (Wirth 2016). Caracals were the second most exported hunting trophy from South Africa between 2004 and 2014 (after Lion) with 5,233 exports (IFAW 2016). Of the 4,108 reported global imports, 2,512 were reported by the United States (IFAW 2016).*

Threats: see Table 3.2.10.1.

Table 3.2.10.1. Threats to the Caracal for different locations according to Avgan et al. (2016) *and other sources*.

Threat	Location
Persecution & retaliatory killing	South Africa (Stuart 1982, Brand 1989, Nowell & Jackson 1996, Stuart & Stuart 2013, *Serieys et al. 2019);* Arabian Peninsula (Mallon & Budd 2011); Turkey (Albayrak et al. 2012); *Iran (Moqanaki et al. 2016);* *Uzbekistan (Gritsina 2019);* Afghanistan (Habibi 2004); *Pakistan (Sheikh & Molur 2004)*
Habitat loss & fragmentation	Central, West, North & North-east Africa (Ray et al. 2005); Arabian Peninsula (Mallon & Budd 2011); Asia (Sunquist & Sunquist 2002); *Pakistan (Sheikh & Molur 2004)*; India (Kolipaka 2011)
Prey base decline	Arabian Peninsula (Mallon & Budd 2011); *Pakistan (Sheikh & Molur 2004)*
Human disturbance	India (Kolipaka 2011)
Road mortality	Turkey (Albayrak et al. 2012)
Predation by herd Dogs	Iran (Ghoddousi et al. 2009)

Knowledge Base

There is generic information on the distribution of the Caracal across Africa based on habitats available, but limited information on its distribution at country level or below. For the Arabian Peninsula and Asia, there is some information at local level available for several countries. Few recent confirmed records are available for the Caracal range in Africa, outside of southern Africa. The high density of records in southern Africa is mainly based on the regional RLA of the Caracal for South Africa, Lesotho and Eswatini and several studies conducted in different provinces on carnivores including the Caracal. Across the range in the Arabian Peninsula and Asia, except for Iran, where a status review has been conducted, not many recent confirmed records exist. Interestingly, in India there are more recent confirmed records outside the current RL distribution range of the species than inside.

No global population estimate/guestimate exists. For most range countries only generic information on the status (and trend) of the Caracal is available. Many of this status information however date back to before 2008, when the previous RLA was conducted. There are only two abundance estimates from two regions in India and one old (1998) density estimate from the Western Cape, South Africa. The Caracal population for South Africa, Eswatini and Lesotho has been roughly estimated and a density for southern Africa and one for India have been estimated. Quite some information on habitats used, the species' ecology and home ranges is given. Nevertheless, for many parts of the Caracal's range this information is missing. The knowledge on use and trade is sparse too, but has been enlarged a little. For Africa the references on threats date mainly back to <2000 and very little recent information on threats for this region exists. Some more detailed information on threats is available for Turkey, Iran and the Arabian Peninsula but no detailed knowledge for the rest of its wide range. Generally, the scope and impact of threats is not known. There is no conservation strategy for the species. A network has been established and three conservation projects are known to be taking place in southern Africa as well as one on the Arabian Peninsula.

Evaluation of the Red List Assessment

The RLA of the Caracal (Avgan et al. 2016) is generally well done. Based on the information presented in the whole assessment, the listing of the Caracal as Least Concern is justified. The majority of information and data on the species available at the time of the last RLA has been considered and correctly been integrated into the assessment. The information on the species is well organised and grouped per region (Africa, Arabian Peninsula & Asia) for each section. There are a few points that should be considered in the next re-assessment of the species:

- Where available the Justification should include more information to justify the Category of Least Concern;
- The assumption that the Caracal is very common and stable in central and southern Africa should be supported by further evidence and explanations;
- Further evidence/references for the assumed population declines in parts of its range should be provided in the Justification;
- The information that the Caracal can be trophy hunted in South Africa and Namibia should be included in the Section Use and Trade;
- A few publications providing additional distribution information and information on human-Caracal conflict and persecution have not been considered e.g. Cunningham 2009, Gusett et al. 2009, Msuha 2009, Lamarque et al. 2009, Todorova 2009, Durant et al. 2009, Burton et al. 2011, Everatt & Anderson 2012, Boast 2014);

Table 3.2.10.2. Evaluation matrix of the Caracal. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🔴	🟡	🟡	🔴	🔴
Consistency of RLA	🟡	🟢	🟢	🟢	🟡	🟡
New info since last RLA	🟡	🟡	🔴	🟡	🟢	🟡

Conclusions and recommendations

The data base on the Caracal is poor outside of southern Africa and there is little new information on the species available (Table 3.2.10.2). This makes an evidentiary RLA challenging. Very few specific projects have been conducted on this species and most information originates from by-catch data from studies focused on other target species. The current RLA of the Caracal is comprehensive and in accordance with the updated RL Guidelines (IUCN Standards and Petitions Committee 2019). In the next re-assessment the points mentioned above should be addressed. Recent distribution information and new records outside of its Extant range (Fig. 3.2.10.1), as well as additional new information (e.g. on its status) should be integrated.

There is a big regional bias in regard to the information of the species towards Southern Africa. The knowledge base for the species has to be extended. There is a need for:

- Confirmation of the Caracal's distribution (incl. further by-catch data from camera-trapping surveys of other target species particularly in East, Central, West and North Africa and Central Asia),
- More information on the species in general (e.g. ecology and habitat use) especially from outside of Southern Africa;
- Quantitative data on Caracal abundance and/or densities and trends across its range;

- Assessment of impact of threats, especially the impact of habitat loss and fragmentation, retaliation killing and prey base declines;
- Establishment of a conservation plan, where appropriate;
- Establishment of a network;
- Re-assessment of the species for the IUCN Red List

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3.3. Tropical Asia

3.3.1 Rusty-Spotted Cat (*Prionailurus rubiginosus*)

Near Threatened A3c (Mukherjee et al. 2016)

Red List history

Year	1988	1990	1994	1996	2002*	2008	2016
cat. & crit.	K	K	K	DD	VU C2a(i)	VU C2a(i)	NT A3c

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

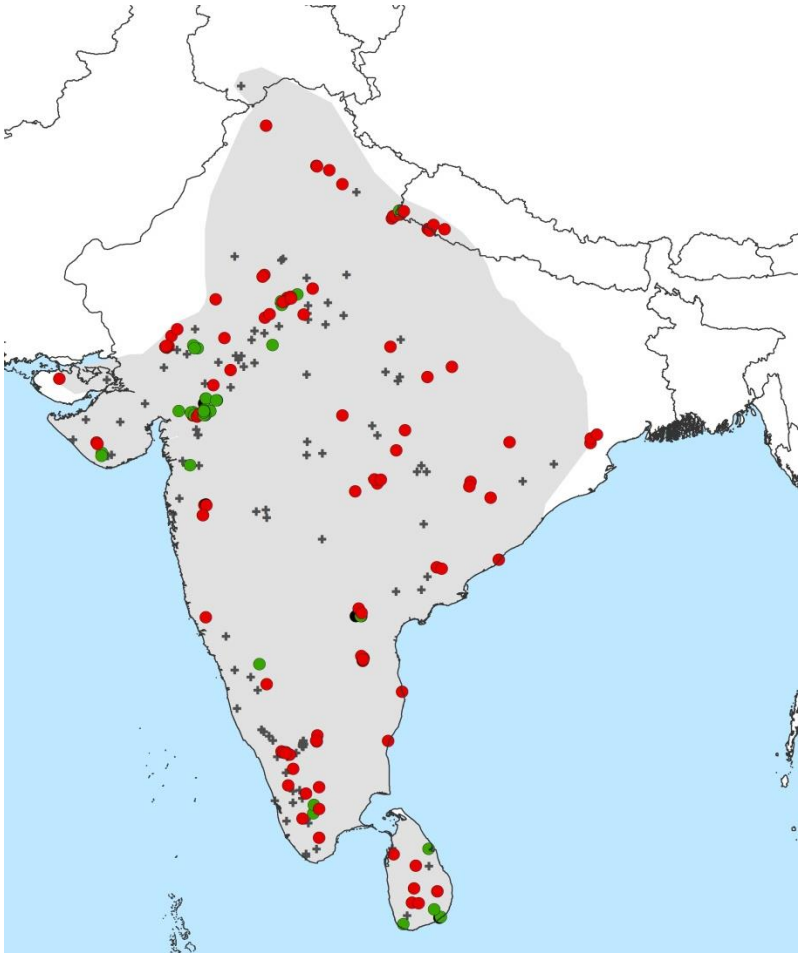

Fig. 3.3.1.1. Rusty-Spotted Cat records from the CSGSD. Grey area = extant and possibly extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Mukherjee et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Rusty-Spotted Cat is currently recognised to consist of three subspecies based on biogeography and morphology, namely: *P. r. rubiginosus*, *P. r. koladivius* and *P. r. phillipsi* (Kitchener et al. 2017). No phylogeographic study of the species exists.

Justification: The Rusty-Spotted Cat is listed as Near Threatened and is close to being classified as Vulnerable under criterion A3c. New location records were available since the previous RLA, which indicated a larger range than previously assumed (Patel & Jackson 2005, Patel 2006, Vyas et al. 2007, Behera 2008, Athreya 2010, Mukherjee et al. 2010, Jugal Tiwari *in litt.* 2013, Anonymous 2013, Ramjan Choudhary & Rabin Karaiya *in litt.* 2014, Mali & Srinivasulu 2015). However, data on population estimates and the impact of land use changes are still lacking. Preliminary data suggests a negative impact from intensive irrigated agriculture resulting in fragmentation (Roy et al. 2012, Silva et al. 2015). Only 25% of Rusty-Spotted Cat distribution in India and Nepal can be found in prime habitat, while the majority of their distribution lies outside protected areas. India's current policies aim to develop mining, industrialisation, urbanisation, solar plants, as well as agriculture (Bhardwaj & Dutta 2014, Mazoomdaar 2015 a, b, Sharma 2015). The impact of these developments remains unclear. Over the next three generations (12 years), it is estimated that the habitat outside protected areas (i.e. 75% of the range) is in imminent danger of being converted. Much of this habitat is marginal. Thus, this habitat decline of 75% translates into a possible population decline of around 20-25% (assuming that 70–80% of the population resides within prime habitat in protected areas and would therefore not be directly affected). Moreover, it is estimated that 90% of the population resides on the mainland of the Indian sub-continent and only 10% on Sri Lanka. As such, a future decline of 20–25% of the global population is suspected for the next three generations based on future habitat loss in India outside protected areas.

In the next three Rusty-Spotted Cat generations, i.e. 12 years, the prime locations where populations are likely to persist are protected areas as these are the only zones remaining close to intact. This translates to 75% of habitat in the current distributional range facing an imminent danger of being converted. As much of this is marginal habitat for the species, a 75% loss of habitat could translate to a decline of around 20-25% (assuming 70-80% of the population resides in prime habitat and a relatively direct relationship between loss of habitat and loss of mature individuals) of the current population over the next three generations. Given the much smaller landmass of Sri Lanka, the mainland population constitutes perhaps 90% or a little more of the global population and therefore has a concomitantly greater contribution to the overall 'average' global change.

Geographic Range: Recent records have enlarged the extant and possibly extant distribution range of the Rusty-Spotted Cat from Sri Lanka and India into Nepal (Ramja Choudhary & Rabin Kadariya *in litt.* 2014). Its distribution is not yet fully documented and recent records have indicated a larger range than previously believed (Chakraborty 1978, Phillips 1984, Wright 1984, Miththapala 2006, Athreya 2010, Mukherjee et al. 2010, Anwar et al. 2012, Raza Kazmi *in litt.* 2012, Jugal Tiwari *in litt.* 2013, Anonymous 2013, Dharmendra Khandal *in litt.* 2013, Pankaj Koparde and Gaurang Gowande *in litt.* 2013, Ramjan Choudhary and Rabin Kadariya *in litt.* 2014, Andrew Kittle *in litt.* 2014). According to the RLA, "within India the distribution of this species is similar to, though far more restricted than, the Jungle Cat *Felis chaus* (Mukherjee & Koparde in prep.)." A niche model for India suggests a fragmented population occurring in three broad regions in dry and moist deciduous forests with relatively low forest fragmentation (Roy et al. 2012, Silva et al. 2015). *Recent confirmed records from the state of Odisha, India, come from slightly outside the extant and possibly extant distribution range according to the RLA, and were the easternmost known records (Fig. 3.3.1.1). However, there are larger areas in India within the Red List distribution range, for which we could not find recent confirmed records (Fig. 3.3.1.1). Only few confirmed recent records were found from outside protected areas.*

Population: Little information is known about Rusty-Spotted Cat populations in terms of size, connectivity, threats and persistence in the future. No systematic surveys exist. It is thought to be rare across almost its entire range (Kunal Patel & Andrew Kittel *in litt.* 2014). It is estimated that 90% of the global population lives on the mainland, and only 10% in Sri Lanka. Of the mainland population, it is thought that some 70–80% resides in prime habitat, which constitutes only about 25% of the cat's mainland range. The remaining 75% of the range (containing some 20–30% of the population) is in danger based on Indian government policies regarding mining, industrialisation, urbanisation, solar power farms and agriculture. It is suspected that the global Rusty-Spotted Cat population will decrease by 20–25% over the next 12 years (3 generations). *The Rusty-Spotted Cat is listed as Endangered in the National Red List of Sri Lanka (MoE 2012).*

Habitat: A niche model for India suggests that Rusty-Spotted Cats primarily occur in dry and moist deciduous forests with relatively low fragmentation, and are limited by large contiguous tracts of intensive, irrigated agriculture (Roy et al. 2012, Silva et al. 2015). It can also be found close to human habitation (Worah 1991, Nowell & Jackson 1996, Mukherjee 1998, Nekaris 2003). In Sri Lanka, there are records from the Central Highlands, where small, mostly isolated forest patches (<5 km²) are interspersed with tea plantations. However, it is unknown whether Rusty-Spotted Cats occur or use these plantations, too (Andrew Kittle *in litt*. 2016). *In Sri Lanka, the Rusty-Spotted Cat was camera-trapped in the lowland dry zone, intermediate wet zone and the sub-montane wet zone (Kittle & Watson 2018), as well as in the montane zone up to 2,160 m (Nimalrathna et al. 2019). Rusty-Spotted Cats appear to be tolerant to some degree of habitat modification and have also been found e.g. in reforested areas (Guptha & Ramanuiam 2017). Females with kittens have been found denning in a tea plantation in Sri Lanka and in the attics of houses in southern India surrounded by paddy fields and coconut plantations (Phillips 1935 cited in Nowell & Jackson 1996, J. Zacharias* in litt. *1992 cited in Nowell & Jackson 1996). One cat was photographed in a farm house in a mango plantation in Gujarat, India (R. Wirth* in litt. *1994 cited in Nowell & Jackson 1996). In Maharashtra Rusty-Spotted Cat cubs were also found in sugarcane fields during harvest (Wildlife SOS 2019).*

Ecology: According to a few observations, Rusty-Spotted Cats prey on rodents (Kunal Patel & Vidya Athreya *in litt.*). *We found one study from Central India and one from Sri Lanka on the species' activity pattern. In both cases, Rusty-Spotted Cats were found to be nocturnal (Basak et al. 2018, Kittle & Watson 2018). No diet study was found. In addition to the reports of predation on rodents, there are also mentions of reptiles, birds, and other vertebrates (Athreya 2010, Mukherjee et al. 2004 cited in Devkar et al. 2016) as well as a photo-documented predation on a bat (Devkar et al. 2016). It is also suspected to prey on insects, lizards and frogs (Sunquist & Sunquist 2002). No estimate of home range size was found.*

Use & Trade: There is no information indicating that this species is used and/or traded.

Threats: see Table 3.3.1.1.

The RLA states that "there is a belief that Rusty-Spotted Cats do not get into conflict, unlike Jungle Cats, since they are believed not to prey on poultry (Manakadan & Sivakumar 2006)." *However, there are reports that Rusty-Spotted Cats prey on domestic poultry (Phillips 1935 cited in Nowell & Jackson 1996, Pocock 1939a cited in Nowell & Jackson 1996, J. Zacharias* in litt. *1992 cited in Nowell & Jackson 1996).*

Table 3.3.1.1. Threats to the Rusty-Spotted Cat for different locations according to Mukherjee et al. (2016) *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation).	India (Bhardwaj & Dutta 2014, Mazoomdaar 2015a, b, Sharma 2015, Mukherjee & Koparde in prep.)
Hybridisation with domestic cats?	Sri Lanka (Kittle & Watson 2004)
Diseases	Range-wide
Illegal killing (Persecution/control)	*Range-wide (J. Zacharias in litt. 1992 cited in Nowell & Jackson 1996)*

Knowledge base

The available knowledge base for the Rusty-Spotted Cat is unsatisfactory. Generally, the knowledge on the species appears to be mostly anecdotal, rather than from studies focused on the species. The information on distribution is judged to be incomplete by the assessment itself. Since the previous assessment, several publications on (new) Rusty-Spotted Cat distribution records have been published, and since the current assessment some more have been added and the extant and possibly extant distribution range has grown. Moreover, a niche model has been produced for India. Very few confirmed recent records were found from outside protected areas. However, most studies are conducted within protected areas, creating a bias. Thus, only based on this, it cannot be concluded that the species is mainly restricted to protected areas. No population size or density estimate for the species exists nor is anything known about its localised abundance. Also, the trend in the population is not known. There are estimates on the percentage of the population occurring in Sri Lanka and the Indian mainland, as well as estimates on the percentage of the mainland population inside and outside protected areas, but their basis is unknown. The habitat is modelled for India and quite well known, although some questions remain open, e.g. on the use of tea plantations in Sri Lanka. The behavioural ecology of the Rusty-Spotted Cat is not well known with only two recent studies noting activity pattern, but no information on the spatial ecology is available. Prey species are only mentioned anecdotally, but with no systematic study on diet. There is no trade in the species. Threats are not well understood nor their impacts or scope. There is no information on any conservation strategy, action plan, project or action on the species.

Evaluation of the Red List Assessment

Little information is available on the Rusty-Spotted Cat. This makes an evidence-based assessment for the species challenging. Moreover, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available, the Justification should include more information to justify the Category and Criteria chosen;
- The suspected population decline of 20–25% in the future should be supported by more evidence;
- In the Population Section the continuing decline in mature individuals is wrongly stated as inferred instead of being suspected (as correctly stated in the Justification);
- According to the assessment, it is difficult to gauge the population trend, and it is not explained why the population was then assumed to be decreasing;
- The assumed habitat conversion of 75% of Rusty-Spotted Cat habitat in the next 12 years should be supported by references or further explanations;
- Some of the information is not stated under the appropriate section (e.g. some information included under Distribution belongs to Habitat and Ecology or Population, some information un-

der Threats to Population, information on future suspected population decline is also placed under current population decline);

- Several of the then available publications were not considered in the last RLA, e.g. Anwar et al. 2010, Behera & Borah 2010, Patel 2010, 2011; Vasava et al. 2012, Kalle 2013, Lele & Chunekar 2013, Srinivas et al. 2013, Kumara et al. 2014, Mukherjee & Koparde 2014, Vyas & Upadhyay 2014, Davate et al. 2015, Mali & Srinivasulu 2015. These publications include mainly species distribution records.

The listing as Near Threatened under Criterion A3c (population size reduction in the future; → Appendix I) is based on a suspected population decline of 20–25% in the next 12 years (3 generations). Such population decline is assumed to be the consequence of habitat loss and fragmentation. It is supposed that 75% of the habitat (lying outside of protected areas and containing 20–30% of the total Rusty-Spotted Cat population) is in danger of being converted due to development projects and an increase in agricultural area of 10% by 2017. However, beside this figure no information on percentage of habitat decline is given not any further evidence. Generally, listing based on a supposed population decline is a tricky endeavour. Basing such a decline on habitat loss for a species, for which its distribution and the effect of habitat loss on it is poorly known, can be problematic. Moreover, the majority of species records originate from protected areas where most studies were conducted. Thus, the habitat suitability model, on which the population decline is additionally based on, could be biased towards protected areas.

Table 3.3.1.2. Evaluation matrix of the Rusty-Spotted Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🔴	🟢	🔴	⚪	🔴
Consistency of RLA	🟡	🔴	🟢	🟡	🟡	🟡
New information since last RLA	🟡	🔴	🟡	🟡	⚪	🔴

Conclusions

An evidentiary RLA of the Rusty-Spotted Cat is difficult because of the paucity of data and information on the species (Table 3.3.1.2). Very few specific projects have been conducted on this species. Most records are by-catch data originating from studies conducted in protected areas and focused on other target species. Thus, especially outside of protected areas, recent confirmed records are not widespread (Fig. 3.3.1.1). Although very little relevant information has become available since the last RL assessment (Table 3.3.1.2), the species should be re-assessed for the IUCN Red List and the points mentioned above should be addressed.

Foremost, our knowledge base on the Rusty-Spotted Cat must be broadened. There is a need for:

- Confirmation of distribution of the Rusty-Spotted Cat (especially outside of protected areas and incl. collection of by-catch data from camera-trapping surveys of other targets species);
- Quantitative data on Rusty-Spotted Cat abundance and/or density estimates (incl. proportion of population in prime habitat/protected areas);
- Information on Rusty-Spotted Cat's ecology (e.g. diet, home range size);
- Assessment of impact of threats, especially the impact of habitat loss and fragmentation, disease and conflict with humans due to poultry predation;
- Establishment of a conservation plan, where appropriate;
- Establishment of a research network;
- Re-assessment of the species for the IUCN Red List.

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3.3.2 Flat-headed Cat (*Prionailurus planiceps*)

Endangered C1 (Wilting et al. 2015)

Red List history

Year	1986	1988	1990	1994	1996	2002*	2008	2010	2015
cat. & crit.	I	I	I	K	VU	VU C2a(i)	EN C1 + C2a(i)	EN C1 + C2a(i)	EN C1

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

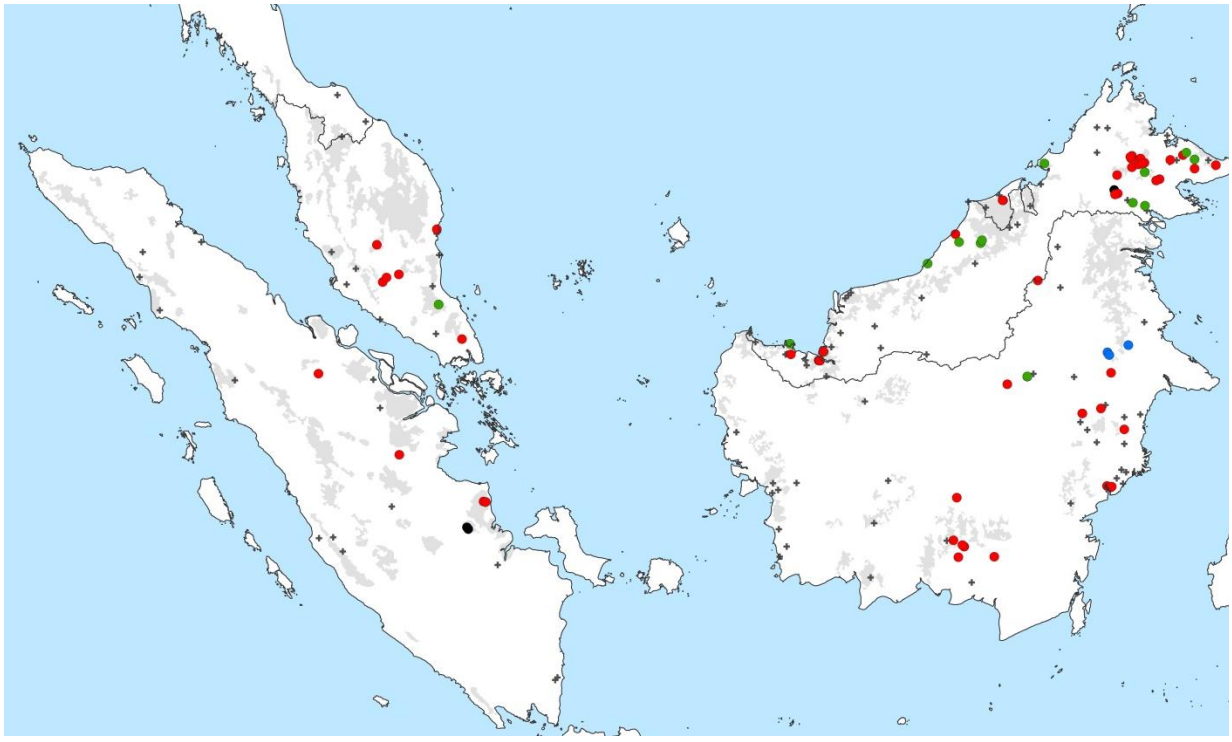

Fig. 3.3.2.1. Flat-headed Cat observation records from the CSGSD. Grey area = extant and possibly extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Wilting et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: The Flat-headed Cat is currently recognised to be a monotypic species (Kitchener et al. 2017). A more comprehensive study, however, is required to confirm this.

Justification: The Flat-headed Cat is patchily distributed within a restricted range. It occurs around wetlands in lowland forests on the Malayan Peninsula as well as the islands of Sumatra and Borneo (Wilting et al. 2010). The known distribution is based on limited presence data, mainly from by-catch information from camera trap surveys on other species. It is unclear whether this represents survey effort or actual distribution. Habitat destruction and degradation is the primary threat (Wilting et al. 2010). Since 2010, only a few new records have been generated through camera-trapping, even in

areas with supposedly the best habitat (A. Hearn pers. comm. 2014). According to a distribution model by Wilting et al. (2010), the Flat-headed Cat has lost up to 70% of its predicted historical assumed suitable habitat due to habitat degradation and transformation (see Wilting et al. 2010 for details). However the species has been recorded close to oil palm plantations indicating that the Flat-headed Cat can tolerate some degree of changes in its habitat surroundings (Wadey et al. 2014). The habitat model of Wilting et al. (2010) has been updated for Borneo (Wilting et al. 2016a). Between 2000 and 2010, an estimated 20% of suitable habitat was lost (extracted from Miettinen et al. 2011). This loss of habitat, in combination with pollution of wetlands and hunting very likely caused a population decline of at least 20% over the last 12 years (2 generations) and will cause a decline of at least another 20% over the next 12 years. No density estimates exist and it is very difficult to estimate the population size for such a patchy distribution. An area of occupancy map estimated a distribution area of about 61,000 km² for the island of Borneo (Wilting et al. unpub. data). For the Malayan peninsula and Sumatra, an area of 10,000 km² and 8,100 km² was added, respectively. Assuming a density of 4 individuals per 100 km² and correcting for mature individuals, the population plausibly contains fewer than 2,500 mature individuals. The assumed density of 4 individuals per 100 km² is judged to be conservative, as it could reach higher values in well suitable areas.

Geographic Range: The Flat-headed Cat is found only on the Malayan Peninsula and the islands of Sumatra and Borneo, where it is patchily distributed around lowland wetlands. The range map is based on a predictive species distribution model by Wilting et al. (2010) and on data of the Borneo Carnivore Symposium. The species is found in Sabah, Malaysian Borneo, along the Kinabatangan River in Deramakot and Tangkulap Forest Reserve (Mohamed et al. 2009, Wilting et al. 2010). They have also been camera-trapped in a mixed-used plantation area in East Kalimantan, Indonesian Borneo, and Pasoh Forest Reserve, Malaysia (Wahyudi & Struebing 2013, Wadey et al. 2014). *There are only relatively few recent confirmed records of Flat-headed Cats, the majority of which come from Borneo (Fig. 3.3.2.1). Only 3 recent confirmed records are known from Sumatra (Bezuijen 2000, Olviana 2011, www.tigertrust.info), but also only about ten old records. Recent confirmed records from the Malayan Peninsula stem from the southern half of Malaysia (e.g. Kamil et al. 2011, Ramli et al. 2016, Theng & Norhayati 2019) but none from northern Malaysia or Thailand. On Borneo, the majority of confirmed records since 2000 are from Sabah, Malaysia. From Sarawak, Malaysia, there are only two areas with recent confirmed records (Yasuda et al. 2007, Mohd-Azlan & Thaqifah 2020). There is also one recent confirmed record from Brunei Darussalam (Yasuda et al. 2007). From Indonesian Borneo, recent confirmed records are only known from East and Central Kalimantan. From North, West and South Kalimantan, no recent records are known, but the latter also has almost no suitable habitat according to the distribution model. It is noteworthy in Fig. 3.3.2.1 that not only most recent, but also most old records appear to come from outside the RL distribution range based on Wilting et al. (2010).*

Population: Flat-headed Cats are commonly considered to be rare, and closely associated to water bodies (Nowell & Jackson 1996, Anonymous 1996, Bezuijen 2000, Sunquist & Sunquist 2002, Meijaard et al. 2005, Yasuda et al. 2007, Barita & Boeadi pers. comm. 2006, Mohamed et al. 2009). The population is estimated at 2,499 mature individuals with a decreasing trend.

Habitat: Flat-headed Cats have been found in swampy areas, along lakes and streams, in riverine forest, peat-swamp forest and in secondary forest (Nowell & Jackson 1996, Bezuijen 2000, 2003, Meijaard et al. 2005, Yasuda et al. 2007, Mohamed et al. 2009). The majority of records comes from below 100 m and from within 3 km to larger water sources (Wilting et al. 2010).

Ecology: Flat-headed Cats are nocturnal. Remains of fish and shrimps were found in the stomachs of two dead animals. They are suspected to also predate on birds and small rodents, and have been reported to take domestic poultry (Nowell & Jackson 1996). *Camera-trapping studies generally found*

Flat-headed Cats to be mostly nocturnal, but captures do occur throughout the day (Jeffers et al. 2019, Mohd-Azlan & Thaqifah 2020). In Sabangau, Central Kalimantan, Indonesian Borneo, only two out of seven captures occurred at night (Cheyne & MacDonald 2011).

Use & trade: Skins of Flat-headed Cats are frequently seen in longhouses in the interior of Sarawak, Malaysia (Sunquist & Sunquist 2002). *An analysis by TRAFFIC of animals offered for sale on 14 Facebook Groups in Peninsular Malaysia found amongst others 2 live Flat-headed Cats offered for sale (Krishnasamy & Stoner 2016).*

Threats: see Table 3.3.2.1.

Table 3.3.2.1. Threats to the Flat-headed Cat for different locations according to Wilting et al. (2015) *and other sources*.

Threat	Location
Habitat loss (incl. degradation)	Range-wide (Nowell & Jackson 1996, Wilting et al. 2010)
Prey depletion	-[1] *Range-wide (Nowell & Jackson 1996)*
Illegal killing (Persecution/control)	Range-wide (Nowell & Jackson 1996, Sunquist & Sunquist 2002)

[1] "-" means that this threat was mentioned in the RLA but not the location where it occurs.

Knowledge Base

The available knowledge base on the Flat-headed Cat is very poor and unsatisfactory. A habitat suitability model exists and the distribution map of the RLA is based on that model. However, most known records (old & recent) appear to come from outside the RL distribution range. The habitat suitability model has since been updated. No density estimate for the Flat-headed Cat exists. The global population was estimated based on the AOO and a density guess. Flat-headed Cats are known to be wetland specialists, but details on their habitat use are not known. No studies on diet, ecology or spatial ecology exist. Little information on trade is available. Only general information is known about threats with mostly old references. On Borneo, the Borneo Carnivore Consortium and the Bornean carnivore conservation plan exist, but are not species-specific to the Flat-headed Cat. We know of three projects which include the Flat-headed Cat among its focal species. Most knowledge appears to come from Borneo.

Evaluation of the Red List Assessment

Little information is available on Flat-headed Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- Where available the Justification should include more information to justify the Category and Criteria chosen;
- The Justification includes key information not stated anywhere else in the assessment (e.g. AOO, basis for number of mature individuals;
- The calculation of the number of mature individuals and associated assumptions should be further explained in the population section;
- The continuing decline in population should be supported by more explanations. Based on the information stated it seems mainly to be suspected (for Criterion C1, it must be observed, estimated or projected);

- The projected continuing population decline should include a discussion of the method of extrapolation;
- The AOO was calculated, but not the EOO, which would provide valuable additional information;
- Some information is not stated under the appropriate section (e.g. some habitat information is included under Population) or not properly arranged (e.g. Habitats and Ecology);
- Some of the publications available at the time seem not have been considered directly in the last RLA, e.g. Cheyne et al. 2009, Hearn et al. 2010, Gumal et al. 2010, Cheyne & MacDonald 2011, Traeholt & Idris 2011, Kamil et al. 2011, Samejima et al. 2012, Tisen & Azad 2013, but they may have been indirectly included in the model of Wilting et al. (2010). These publications include species distribution records.

The listing as Endangered under Criterion C1 (small population size and decline; → Appendix I) is based on a population decline of at least 20% in the past 12 years (2 generations) and a continued decline by more than 20% in the next 12 years. Such population decline is based on the consequence of habitat loss caused by human settlement encroachment, transformation to arable land, draining for agriculture, pollution, over-use of forest resources, and threats such as hunting. In the Justification it is stated that between 2000–2010 the species lost over 20% of potentially suitable habitat. Thus, a linear relationship between habitat loss and population decline or a significant impact of hunting and other threats on the species population size is implied, for both more evidence or taken assumptions should be stated. Based on the information in the Justification, the population decline seems to be mainly suspected but according to the IUCN Red List Guidelines (V15.1. 2022) for C1, an observed, estimated or projected continuing decline is needed. More information should also be provided on the projected further population decrease of 20% and the how the number of mature individuals has been calculated should be further explained e.g. why a density of four individuals per 100 km² has been chosen and what the assumed percentage of mature individuals in the population is.

Table 3.3.2.2. Evaluation matrix of the Flat-headed Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🟡	🟡	🔴	🔴	🔴
Consistency of RLA	🟡	🔴	🟡	🟡	🟡	🟡
New information since last RLA	🟡	🔴	🔴	🟡	🟡	🔴

Conclusions and recommendations

An evidentiary RLA of the Flat-headed Cat is very difficult because of the generally very weak data base (Table 3.3.2.2). Very few specific projects have been conducted on the species, and few distribution records exist. Furthermore, most species records (recent and old) lie outside the RL distribution range (Fig. 3.3.2.1). Thus, the distribution map needs an update. Additionally, the points listed above should be addressed in the next re-assessment of the species and the assessment being aligned with the newest version of the IUCN Red List Guidelines (V15.1. 2022). Thus, the Flat-headed Cat should be re-assessed, although there is little new information on the species available (Table 3.3.2.2).

Foremost, the knowledge base on the Flat-headed Cat must urgently be broadened. There is a need for:

- Confirmation and understanding of the Flat-headed Cat's distribution, especially on Sumatra (incl. collection of by-catch data from camera-trapping survey of other target species);
- Quantitative data on Flat-headed Cat abundance and/or densities and trend;
- Information about the Flat-headed Cat's ecology, habitat use/needs and life history;
- Assessment of the impact of threats, especially the impact of habitat loss and persecution;
- Information and assessment of its Use and Trade;
- Establishment of a species-specific conservation plan, where appropriate;
- Re-assessment of the species for the IUCN Red List.

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3.3.3 Fishing Cat (*Prionailurus viverrinus*)

Vulnerable A2cd + 3cd + 4cd (Mukherjee et al. 2016)

Red List history

Year	1994	1996	2002*	2008	2016
cat. & crit.	K	LR/NT	VU C2a(i)	A2cd+4cd	VU Acd+3cd+4cd

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

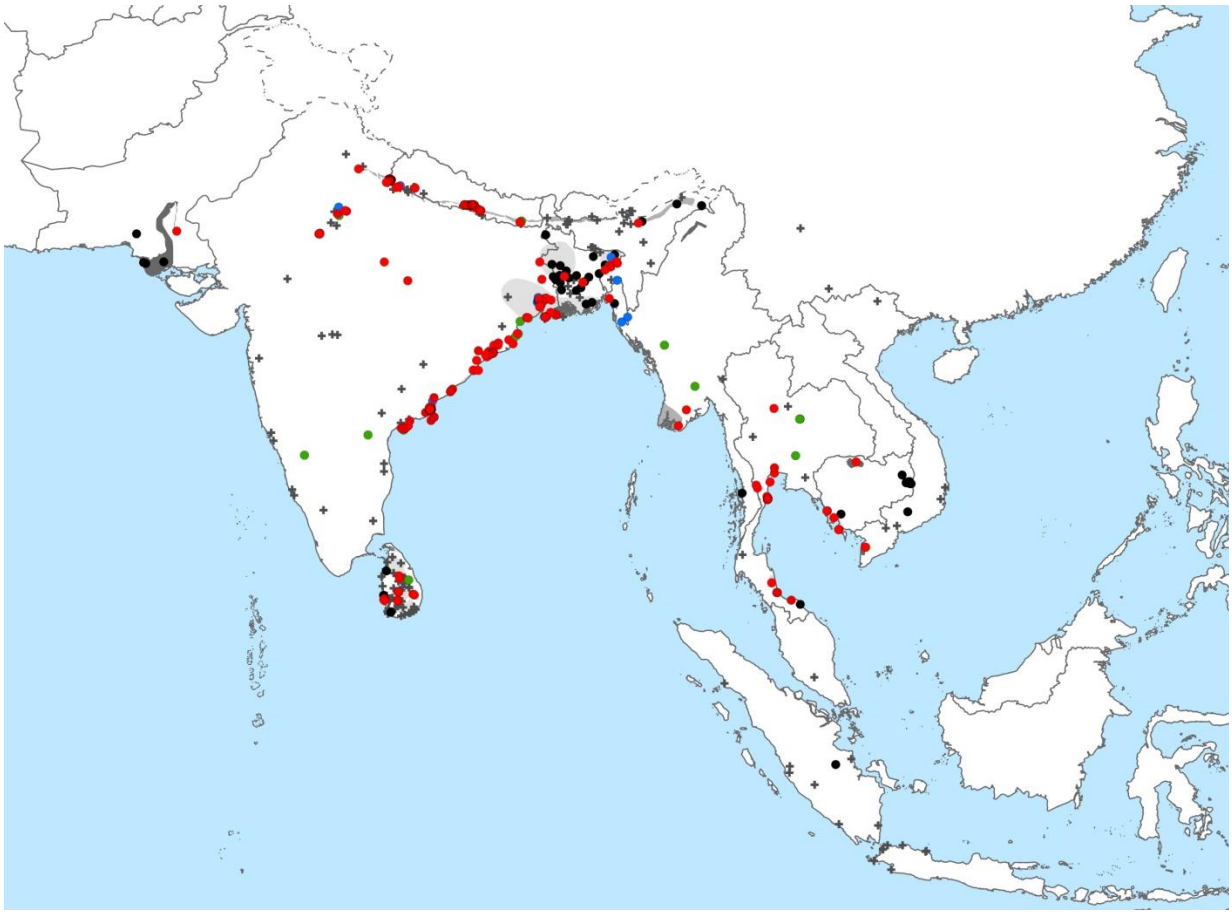

Fig. 3.3.3.1. Fishing Cat observation records from the CSGSD. Coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. For fishing Cat distribution range according to the Red List see Figure 3.3.3.2

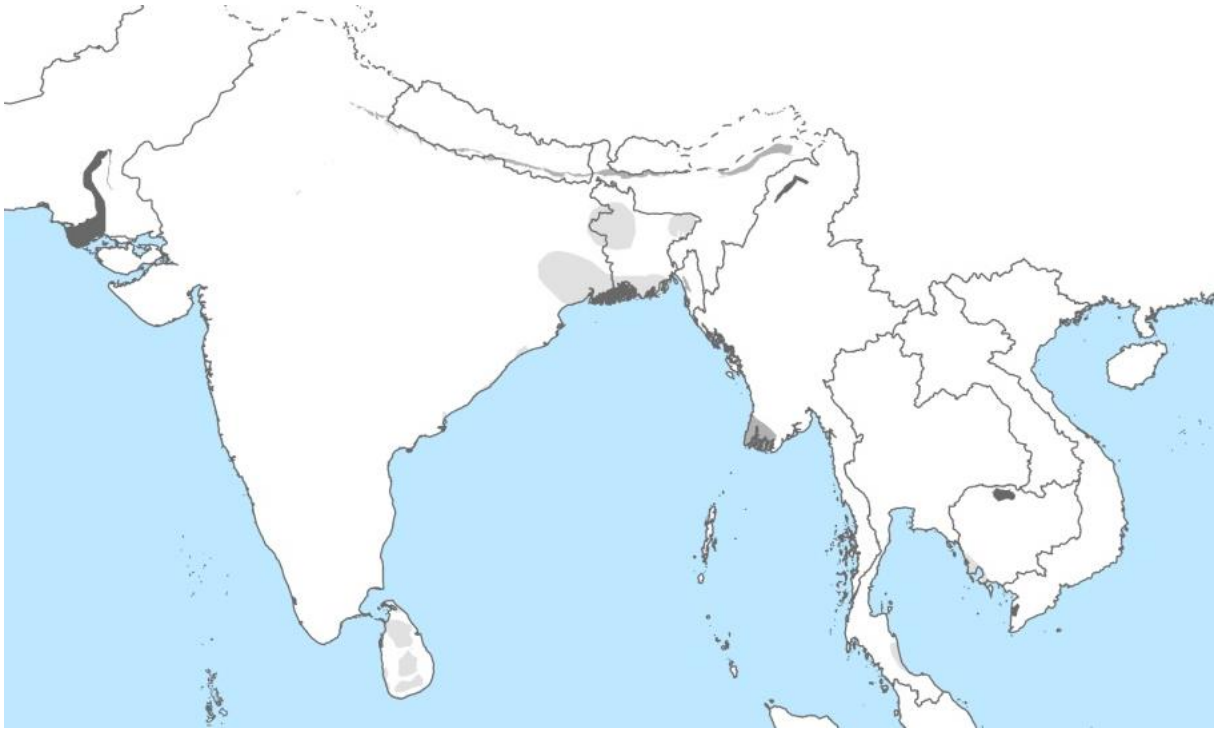

Fig. 3.3.3.2. Fishing Cat distribution range according to the Red List: light grey = extant, grey = possibly extant and dark grey = presence uncertain.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Mukherjee et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Fishing Cat is currently recognised to consist of two subspecies, namely *P. v. viverrinus* and *P. v. rhizophoreus* (Kitchener et al. 2017). More research, however, is needed as no comprehensive analysis is available.

Justification: The Fishing Cat is thought to be strongly declining across its range, especially in South-east Asia. Since 2000, there have been very few records from Vietnam, Cambodia, Thailand, Myanmar, and on Java indicating very small populations. Its presence is doubtful in Lao PDR and was never confirmed for Sumatra. In India and Sri Lanka, the species is more widespread, but largely occurs in human-dominated landscape under threat of urbanisation and industrialisation. Fishing Cat populations remain strong in Sri Lanka, Bangladesh, West Bengal in India, and in the Terai and Himalayan foothills in India and Nepal. Information on population sizes, trends, and extent of habitat is sparse and uncertain, as this species has only formally been researched since 2009 (Cutter 2015). Existing research indicates population declines due to habitat destruction and persecution (Mukherjee et al. 2012, Cutter 2015, Adhya 2016). A telemetry study in Thailand recorded the highest mortality arising from illegal killing (retaliatory killing and poaching; Cutter 2015). Habitat loss and illegal killing has globally caused a 30% population reduction over the last three generations (=15 years), and this may be much higher outside the strongholds. However, populations outside the strongholds are nowadays too small to influence the global trend significantly. Habitat loss and illegal killing is expected to continue and a decline of again 30% over the next 15 years is expected. An irreversible loss is likely over the next 15 years of 10% of the habitat in Sri Lanka, 30% in the Ganges-Brahmaputra Delta and 10% in the Terai- savanna and grasslands (Thudugala et al. pers. comm. 2015). The Fishing Cat was previously listed as Endangered. The change is non-genuine and based on increased knowledge, not on an improved status.

Geographic Range: The distribution of the Fishing Cat is not well known. Typical fauna survey methods are not suitable to record Fishing Cats, and an absence of records does not necessarily mean absence of Fishing Cats (Duckworth et al. 2009, 2010, Janardhanan et al. 2014, Appel 2016). Moreover, there are unauthenticated, ambiguous and erroneous records (Pocock 1939, Duckworth et al. 2009, Janardhanan et al. 2014, Appel 2016, Duckworth 2016, Willcox 2016). Additional difficulties come from putative introductions, occasional records from outside the assessment regions, residual populations in small pockets, and possible recent extinctions in parts of the range (Adhya et al. 2011, Mukherjee et al. 2012, Willcox et al. 2014, Adhya 2016, Duckworth 2016, Kantimahanti 2016, Mukherjee 2016, Willcox 2016). The Fishing Cat occurs from Pakistan to Cambodia and from the Himalayan foothills to Sri Lanka and peninsular Thailand. Its current distribution is patchy, but probably always has been due to the strong association of the species with wetlands. Only in West Bengal in India, in Bangladesh and Sri Lanka, is the Fishing Cat more widely distributed. Genetic analyses have shown that populations in northern India were connected up to the Coringa mangroves on India's east coast, but current connectivity is unclear (Mukherjee et al. 2012, Mukherjee 2016). Even within the Terai landscape, connectivity outside protected areas and along rivers is unknown. General fauna surveys in Bhutan did not record the species (Tempa et al. 2013, Banerjee & Bandopadhyay 2016). New records indicate previously unknown presence in southern Andhra Pradesh, India and Thailand's far southern coast. In South-East Asia, the distribution is extremely patchy. In Lao PDR its presence is uncertain and actually it may never have occurred there. The presence in Malaysia is also doubtful, but a record exists in Thailand very close to the border (Buatip et al. 2013). The last photo taken on Java is from 2000 (Compost *in litt.* 2012) and current presence is uncertain. Although there were claims in the past that the species is present on Borneo, Taiwan and in China, there is no credible basis for this (Nowell & Jackson 1996, Sunquist & Sunquist 2002, Jutzeler et al. 2010). The Fishing Cat is usually found at very low altitudes on the continent. Many records are below 150 m (Dahal & Dahal 2012, Dahal et al. 2015, Anwar *in litt.* 2016, Appel *in litt.* 2016), with the exception near Corbett Tiger Reserve at 330 m (Harihar *in litt.* 2012). Pocock (1939) also found a Fishing Cat skin at 1,500 m, but the origin of the skin is unclear. Contrary to the mainland, Fishing Cats on Sri Lanka have been recorded up to 1,800 m (Thudugala *in litt.* 2016). The area of occupancy of the species was estimated at 238,006 km².

The Red List assessment (Mukherjee et al. 2016) offers more detailed information per country, using the following references per country:

- Pakistan: Roberts 1977, Bhatti 2015, Islam et al. 2015, Ubairi in litt. 2015
- Nepal: Dahal & Dahal 2011, Pandey et al. 2012, Dahal et al. 2015, B. R. Lamichhane & S. Yadav pers. comm. 2016, Mishra 2016, Taylor et al. 2016, Dahal & Appel in litt. 2016
- India: Pocock 1939, Anonymous 1989, Adhya et al. 2011, Anwar *in litt.* 2011, Borah *in litt.* 2012, Datta *in litt.* 2012, Harihar *in litt.* 2012, Mukherjee et al. 2012, Sadhu & Reddy 2013, Janardhanan et al. 2014, Malla & Sivakumar 2014, Jhala *in litt.* 2015, Adhya *in litt.* 2016, Kantimahanti 2016, Qureshi *in litt.* 2016, Raj *in litt.* 2016
- Bhutan: Tempa et al. 2013, Banerjee & Bandopadhyay 2016
- Sri Lanka: Kittle in litt. 2012, Tarnayaka 2016, Thudugala 2016
- Bangladesh: Rahman et al. 2016, Chakma 2015, Chowdhury et al. 2015, A. Barlow pers. comm. 2016, Karim & Ahsan 2016
- Myanmar: Than Zaw et al. 2014, Than Zaw in litt. 2016
- Thailand: Cutter & Cutter 2009, Buatip et al. 2013, Tantipisanuh et al. 2014, J. W. Duckworth & W. Chutipong pers. comm. 2016
- Cambodia: Royan 2009, Rainey & Kong 2010, Edwards et al. 2012, Gray et al. 2012, S. Mahood pers. comm. 2016, Thaung & Herranz Muñoz 2016

- Lao PDR: Duckworth et al. 2010
- Vietnam: Willcox et al. 2014, Willcox 2016
- Indonesia (Java): Sody 1936, Melisch et al. 1996, Compost in litt. 2012, Sanderson in litt. 2016
- Indonesia (Sumatra): Duckworth et al. 2009, Sanderson 2009
- Malaysia (Peninsular): Duckworth et al. 2009, Buatip et al. 2013

Recent confirmed records of the Fishing Cats exist across part of its extant and possibly extant range (Fig. 3.3.3.1). Some recent confirmed records lie outside its current range in Bangladesh (Chowdhury et al. 2015, Karim & Ahsan 2016), Cambodia (Rainey & Kong 2010), India (Sathiyaselvam & Satyanarayana 2016, Talegaonkar et al. 2018, Ganguly 2020, Ganguly & Adhya 2020, Dutta et al. 2021, Palei et al. 2018, 2021), Myanmar (Lin & Patt 2019), Nepal (Lamichhane et al. 2014, Mishra 2016, Mishra et al. 2018, Yadav et al. 2018), Sri Lanka (Kittle & Watson 2018), Thailand (Tantipisanuh et al. 2014, Chutipong et al. 2019) and in Vietnam (Willcox et al. 2014). In Pakistan there are some recent records but without SCALP Category outside the extant range (Hassan et al. 2020). Some of the recent confirmed records lie far from the current extant and possibly extant range of the species (Fig. 3.3.3.1, Fig. 3.3.3.2)).

Population: No quantitative population information is available, for either the global abundance or for individual populations. In several countries, presence is doubtful (see above), and populations are generally believed to be isolated and small. However, the Fishing Cat is still widely distributed in Sri Lanka and Bangladesh, West Bengal in India, and in the Terai-Duar belt in India and Nepal. The species was only recently confirmed in Myanmar's Ayeyarwady delta (Than Zaw pers. Comm. 2016), but based on the available habitat, there could actually be a large population. The global population is suspected to have decreased by more than 30% over the last three generations (15 years) due to habitat loss and illegal killing. This decrease may have been even higher outside the stronghold. However, populations there are too small to significantly influence the global trend. Habitat loss and illegal killing are expected to continue. Irreversible habitat loss is likely to occur over the next 15 years by around 10% in Sri Lanka, 10% in the Terai-Duar of India and Nepal, and 30% in the Ganges-Brahmaputra Delta. Together with illegal killing, a population decline of a further 30% is likely over the next 15 years. *In the Chitwan National Park, Nepal, the density of Fishing Cats was estimated at 4.37-6.06 individuals per 100 km² (Mishra 2016). In India, a density of 53 individuals per 100 km² was estimated in the Coringa Wildlife Sanctuary in Andhra Pradesh (Malla 2016), and at 44 ± 13 individuals per 100 km² in the Lothian Wildlife Sanctuary in the Sundarbans, West Bengal (Das et al. 2017). In Khao Sam Roi Yot National Park, Thailand, a density of 14.23 ± 3.2 individuals per 100 km² was estimated (Chutipong et al. 2019).*

Habitat: Fishing Cats are strongly associated with wetlands, i.e. water bodies, marshlands with reed (*Phragmites vallatoria*), reedmace (*Typha elephantina*) and locally cultivated grasses (e.g. *Saccharum narenga*), and swamps (Adhya 2015). In Sri Lanka, the species is also found in wetlands in hilly areas (Thudugala 2016). *Fishing Cats are less common around fast-moving water bodies and can also be found in evergreen and tropical dry forest (Nowell & Jackson 1996). It is suggested that the species prefers shallow waters for hunting, as the submergence of the body results in the loss of more body heat and energy (Ganguly & Adhya 2020). One Fishing Cat was captured and collared in a highly urbanised area of Sri Lanka's capital city of Colombo, several kilometres away from wetlands, where it was observed to prey on artificial fishing ponds (Ratnayaka 2016). They can also be found in forest, scrub, reed beds and tall grass areas (Sunquist & Sunquist 2002).*

Ecology: The Fishing Cat is mostly active at night (Mukherjee 1989, Sunquist & Sunquist 2002, Lynam et al. 2013). It is a generalist hunter, preying on murids – in West Bengal mostly *Rattus rattus* and *Bandicota bengalensis* – birds and fish (Mukherjee 1989, Haque & Vijayan 1993, Adhya 2015). A single individual is estimated to eat 1–2 rodents per day (Adhya 2015). Home ranges in Chitwan NP,

Nepal, were 4–6 km² for three females, and 16–22 km² for one male (Sunquist & Sunquist 2002). *The activity pattern of Fishing Cats can be variable. Das et al. (2017) described them as mainly crepuscular in the Lothian Wildlife Sanctuary in the Indian Sundarbans. Meanwhile, Malla et al. (2019) found large differences between the activity patterns of individual Fishing Cats in Coringa Wildlife Sanctuary, India, with some even being mostly diurnal. In Thailand, one male had a home range of 11–13 km², and one female of 4 km² (Cutter 2015). Male home ranges were found to overlap with several female home ranges. Nonetheless, in the mangroves of Coringa Wildlife Sanctuary, India, considerable amounts of home range overlap were observed between individuals of the same sex, too. However, individuals of the same sex overlapping spatially largely showed temporal avoidance through their activity patterns (Malla et al. 2019). Fish was found to be their main prey in Royal Chitwan National Park, Nepal (Nowell & Jackson 1996), in Keoladeo National Park, India (Haque & Vijayan 1993), and in Thailand (Cutter 2015).*

Use & Trade: The Fishing Cat is killed for consumption. In Howrah district, India, this is done frequently as it is part of a cultural practice (Adhya 2015). The Fishing Cat is also killed for consumption in Cambodia (Thaung & Herranz Muñoz 2016) and Thailand (Cutter 2015). A wide variety of species is traded for their skins and other body parts in South-east Asia (e.g. Willcox et al. 2014). It is likely that this is also true for the Fishing Cat, but there is no evidence for a particularly high demand. The same is true for the inland pet markets on Java: Fishing Cats are sometimes seen there (e.g. Duckworth et al. 2009), but there does not appear to be a high demand. *Some Fishing Cats were also offered online as exotic pets in Thailand (Siriwat et al. 2019).*

Threats: see Table 3.3.3.1.

Table 3.3.3.1. Threats to the Fishing Cat for different locations according to Mukherjee et al. (2016) *and other sources*.

Threat	Location
Habitat loss (incl. fragmentation)	South Asia (Adhya 2015) *Nepal (Amin et al. 2018)*
Illegal killing (incl. targeted hunting for use and trade, persecution/control)	Bangladesh (Chowdhury et al. 2015) Cambodia (Thaung & Herranz Muñoz 2016, *Evans et al. 2020*) India (Kolipaka 2009, Mukherjee et al. 2012, Chowdhury et al. 2015, *Kolipaka et al. 2019, Mugerwa et al. 2020*) South-east Asia (Melisch et al. 1996, Cutter & Cutter 2009, Tantipisanuh et al. 2014, Willcox et al. 2014, Cutter 2015) *Nepal (Amin et al. 2018)*
Prey depletion	*Nepal (Amin et al. 2018)*

Knowledge base

The knowledge on the Fishing Cat needs to be expanded. Several studies focusing on the species have been conducted. There is some detailed information on its distribution in the different range countries available in the last RLA, but no recent confirmed records exist across several parts of its current extant and possible extant range and some lie far away from its current range, indicating that its presence is still not well known (Fig. 3.3.3.1). No population size estimate exists for the Fishing Cat but there are four density estimates from different areas. Habitat use and the diet are largely known and there is some information on its activity and a little on home range. With regard to use and trade, only the purpose of use is known, but not its amount or trend and consequently also its significance as a threat. General threats are known but the understanding of specific threats per country/region is limited. Two Fishing Cat networks exist, a conservation plan and numerous projects on the species across several of its range countries.

Evaluation of the Red List Assessment

The RLA for the Fishing Cat (Mukherjee et al. 2016) is generally well done but has some gaps that should be focussed on for the next re-assessment:

- The Justification should include more information to justify the Category and Criteria chosen.
- Only the AOO was calculated, but also the calculation of the EOO could provide some additional information.
- More evidence or further explanation of the assumptions for the suspected reduction of 30% or more in the population should be provided in the population section and the Justification.
- The projected population decline should include a discussion of the method of extrapolation.
- Some information included in the population section should be allocated to the distribution section.
- Some important information is only included in the justification of the continuing decline in AOO and EOO but should also be integrated into the distribution text and the Justification.
- Some of the then available publications seem not have been considered, e.g. Das et al. 2012, Giordano et al. 2013, Borries & Koenig 2014, Coudrat et al. 2014, Lamichhane et al. 2014, Zaw et al. 2014, Naidu et al. 2015. These publications include some distribution records of the species.

Table 3.3.3.2. Evaluation matrix of the Fishing Cat. According to the Criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🔴	🟡	🟡	🟢	🔴
Consistency of RLA	🟡	🟡	🟢	🟢	🟢	🟢
New information since last RLA	🟡	🟡	🟡	🟡	🔴	🟡

Conclusions and recommendations

An evidence-based RLA of the Fishing Cat is difficult because of the weak data base (Table 3.3.3.2). The listing as Vulnerable under Criteria A, Subcriteria A2cd, 3cd and 4cd (population size reduction in the past and future, respectively; → Appendix I) is based on a suspected decline of >30% in the past 15 years (3 generations) and during the next 15 years (3 generations). Such population decline is assumed to be the consequence of habitat loss and illegal killing. The listing of the Fishing Cat is largely justified but only if considering the information in the whole assessment. More emphasis of the evidence and assumptions behind the decline should be provided in the Justification. The projection of a further decline of 30% over the next 15 years cannot be fully followed based on the information provided. The distribution map is very conservative and restricted to areas with confirmed records at the time. Areas where the species is likely to occur should be included into the map as well. Additionally, there are some new distribution records and some new information on the species available and several projects ongoing. Therefore, the Fishing Cat should be re-assessed to address the points listed above and include the new information.

Foremost, our knowledge base on the Fishing Cat must be improved. There is a need for:

- Confirmation of the Fishing Cat's distribution (especially also in possible suitable areas without yet confirmed records);
- Quantitative data on Fishing Cat abundance and/or densities;
- Information about the Fishing Cat's ecology;

- Assessment of the impact of threats, especially the impact of illegal killing and trade and habitat loss;
- Review of the conservation strategy;
- Coordination of the research networks and projects;
- Re-assessment of the species for the IUCN Red List.

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3.3.4 Mainland Leopard Cat (*Prionailurus bengalensis*)

Least Concern (Ghimirey et al. 2022)

Red List history

Year	1996[+]	2002[*+]	2008[+]	2015[+]	2022
cat. & crit.	LR/LC	LC	LC	LC	LC

[*]2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published.
[+] The Assessment was performed before the taxonomical split of *P. bengalensis* and *P. javanensis*

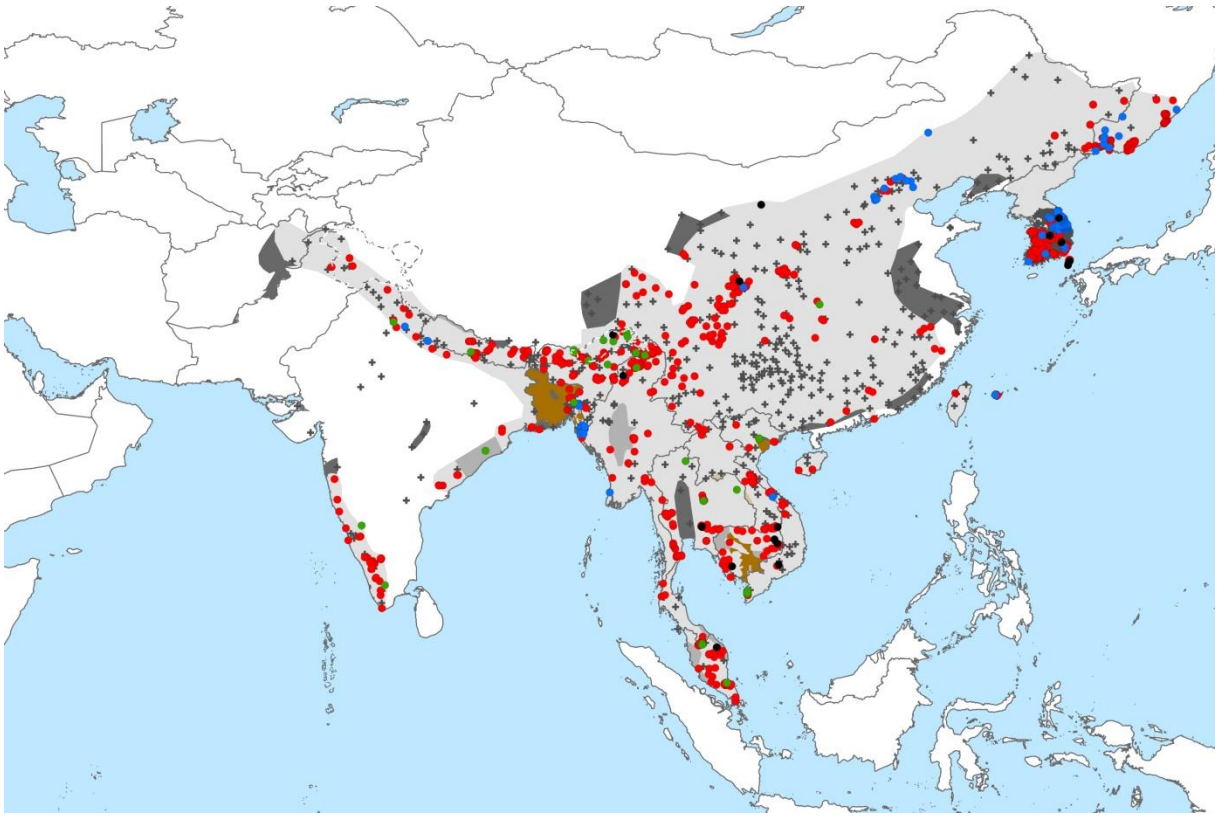

Fig. 3.3.4.1. Mainland Leopard Cat records from the CSGSD. Light grey = extant, grey = possibly extant, dark grey = presence uncertain, brown = extinct distribution range; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. Not shown is the possibly extinct and extinct range of the Mainland Leopard Cat. Remark: the species is extant in South Korea. Dark grey surrounding is only the border of the country.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Ghimirey et al. 2022) and *additional information available* (in italic).

Taxonomic Notes: The Mainland Leopard Cat is tentatively recognised as consisting of two subspecies, namely: *P. b. bengalensis* and *P. b. euptilurus* (Kitchener et al. 2017).

Justification: The Mainland Leopard Cat is listed as Least Concern as it is widely reported and seems to be common across its wide range. However, its global population size and status is not known.

Only few abundance estimates exist. Habitat has been lost and/or modified in many regions (e.g. Hansen et al. 2013) but the Mainland Leopard Cat can adapt to different habitat types. The EOO and AOO of the Mainland Leopard Cat are supposed to have remained stable. Moreover, there are no indications that the Mainland Leopard Cat has declined globally at a sufficient rate to classify it as anything else than Least Concern. It does not fulfil any of the criteria for being listed in a higher category.

Geographic Range: The Mainland Leopard Cat is widely distributed and occurs from the Russian Far East to Singapore. In the west it is present up to Afghanistan where it has been recorded in the provinces Kunar, Nangarhar, Nuristan and Takhar (Habibi 2003, Ostrowski et al. 2008, Stevens et al. 2011). In Pakistan, it has been recorded in Murree Hills, Kaghan valley, Pakistan-administered Azad Jammu and Kashmir, Swat, Dir and lower Gilgit through Hazrara district and lower (Roberts 1997, Khatoon et al. 2019). In India, the Mainland Leopard Cat is found across the Western Ghats, at higher elevations of the eastern hills and the coastal belt, in north-eastern India, in the Terai and the Duars and the Himalaya. It is also found in Andhra Pradesh and the adjacent areas of Chhattisgarh. Its presence is documented in 21 out of 28 States (e.g. Palei et al. 2015, 2018; Sanghamitra & Nameer 2018, Mukherjee et al. 2019, Jhala et al. 2020). The Mainland Leopard Cat is also widespread in Nepal, it is found in 31 out of 77 districts (e.g. Ghimirey 2017, FON Nepal 2017, 2020, Himalayan Nature 2018) and in various National Parks (e.g. Pandey 2010, Ghimirey et al. 2012, Thapa et al. 2013, Poudyal et al. 2019). In Bangladesh, the species is found in all major forest ecosystems and possibly restricted to forested areas (Ahmed et al. 2009; Khan 2008, 2010, 2015, 2018; Ahmed 2015). In Bhutan, the Mainland Leopard Cat occurs across the country in a variety of habitats (e.g. Thinley et al. 2015, Dhendup & Dorji 2018; Dhendup et al. 2019; Tenzin et al. 2019, Jamtsho et al. 2021). In Myanmar, the species is found in most regions of the country such as Kachin, Kayin, Sagaing, Shan, Rakhine, Mandalay and Bago states (Moo et al. 2017, 2018) and found in various National Parks (e.g. Linnell et al. 2014, HlaNiang et al. 2019). In Thailand, the species is widespread in the forests in protected and non-protected areas (e.g. Freeland Foundation 2019, Tantipisanuh et al. 2019, Ash et al. 2020). In Malaysia, the species occurs throughout the country. However, both the mainland and the Sunda Leopard Cat are thought to occur in peninsular Malaysia, thus its exact distribution is unknown (Patel et al. 2017). In Singapore, it is not fully clear whether the Mainland Leopard Cat or the Sunda Leopard Cat or both occur (Chua 2013). The species is also widespread in Cambodia and recorded in the major biodiversity conservation landscapes such as the Cardamom Mountains, the Eastern Plains, the Northern Plains and the Prey Lang Forest Landscape as well as in the Tonle Sap Floodplains and the Tri-Border Forest (e.g. Hayes et al. 2015, Gray et al. 2017, Thuang et al. 2017, Loveridge et al. 2018, Pin et al. 2018, McCann et al. 2020, Griffin et al. 2020). The distribution of the species in Lao PDR is largely unknown. It is thought to be widespread throughout the country and has been recorded in several protected areas (e.g. Association Anoulak 2019, Rasphone et al. 2019, Tilker et al. 2019, Brakels & Somdachit 2020, Wildlife Conservation Society, unpub. Data), but to be extirpated in some parts due to snaring. In Vietnam, the species has been recorded from various parts (Willcox et al. 2014). In China, the species occurs in Guangxi autonomous region, Hainan Island, Guizhou, Sichuan, Tibet, Yunnan, Hebei, Heilongjang, Henan, Jiangsu, Jilin, Liaoning, Nei Mongol, Shandong, Shanxi, Shaanxi, Qinghai, Hunan, Hubei, Beijing, Zhejiang, Fujian and Jiangxi province (Jinping 2010, Sheng et al. 2010, Yu 2010, Bu et al. 2016, Shi et al. 2017, Want et al. 2019, Jia et al. 2020, Liu et al. 2019, 2020; Jiang et al. 2021). In Hong Kong, the species is mostly found in the new territories. In Taiwan, its distribution is reduced to areas in the counties of Miaoli, Nantou and Taichung City (Chen et al. 2019). In the Republic of Korea, the species is widespread (Kim et al. 2021). The Mainland Leopard Cat is also found on the islands of Tsushima and Iriomote (Japan; Ross et al. 2015, Schmidt et al. 2003). In Russia, the species inhabits protected and non-protected areas in the Far East region (Pri-

morskii Krai). *There are no additional new records of the species as the most recent RLA has just been finished in 2022 (Fig. 3.3.4.1)*

Population: The status and trend of the Mainland Leopard Cat is not well known although the species is widespread. No range wide population size estimate exists and only few abundance estimates. It is thought that the population size is not larger than 1,600 individuals in Russia, fewer than 2,500 in Nepal, 100–150 in Pakistan, and 50 in Singapore (Yudin 2015, Jnawali et al. 2011). In China, the population size is estimated at around 230,000 and the population thought to be stable (Jiang et al. 2021). Due to its wide distribution across its historical range and its toleration of modified environments, it is considered to be abundant and its population to be stable. Nevertheless, it is not invulnerable to habitat loss and degradation (e.g. Chen et al. 2016). Illegal hunting likely causes population declines in some regions especially in parts of South-east Asia (e.g. Choudrat et al. 2014a, b; Willcox et al. 2014). Density estimates vary from 2.9–21.42 individuals per 100 km². In India, densities were estimated at 2.9 individuals per 100 km² in the Pakke Tiger Reserve, 4.48 in Biligiri Rangaswamy Temple Tiger Reserve, 10.45 in Bhadra Tiger Reserve, and 17.52 in Khangchendzonga Biosphere Reserve (Selvan et al. 2014, Srivathsa et al. 2015, Bashir et al. 2013). In Nepal, in the Banke National Park density was 4.85 and in Thailand in Sakaerat Biosphere Reserve 17.7 individuals per 100 km² (Dhakal 2018, Petersen et al. 2019b). On Tekong Island, Singapore, an exceptional density of 89.4 individuals per 100 km² has been estimated (Chua et al. 2016). Densities are thought to vary by habitat type and the level of human disturbance which influence resource availability, foraging success and inter-specific competition (Petersen et al. 2019b). *The Mainland Leopard Cat is listed as Vulnerable in Nepal (Amin et al. 2018) and as Near Threatened in Bangladesh (Ahmed 2015).*

Habitat: The Mainland Leopard Cat uses different habitats from tropical rainforest to temperate broadleaf forest. Marginally, it is also found in coniferous forest, shrub forest and successional grasslands (Thapa et al. 2013, Ghimirey et al. 2012, Shrivathsa et al. 2015, Coudrat et al. 2014a,b). It can also be found in mountainous areas, lowland riparian habitats and agricultural wetlands (Kim et al. 2021). The species is able to adapt to various habitats such as monocultures and plantations (Bali et al. 2007, Kumara et al. 2004, Yu 2010). This adaptability is often attributed to the presence of rodents (Lim 1999). They have been recorded up to 4,474 m in the Himalayas (Thapa et al. 2013). *The highest record so far comes from Langdu, China, at 4,579 m elevation (Buzzard et al. 2018).*

Ecology: The Mainland Leopard Cat is mainly nocturnal or crepuscular (Chua et al. 2016, Can et al. 2019, Mukherjee et al. 2019, Petersen et al. 2019a, *Sukmasuang et al. 2020, Zhao et al. 2020*). The species mainly preys on rodents such as squirrels, rats, mice but also takes ground birds and lizards. Birth dens are found in hollow trees, in bushes, under overhanging rocks in small caves, under big roots or between rocks. The Mainland Leopard Cat is a good swimmer and likes water (Yu 2010). Habitat use and activity patterns of the species are possibly influenced by resource availability and inter-specific competition (Petersen et al. 2019a). The home range of the Mainland Leopard Cat varies from 1.5 to 12.4 km² (Chen et al. 2016). *In South Korea, home range size was 2.6 km² on average (Choi et al. 2012). On Iriomote island (300 km²), average home ranges were 3 km² for males and 1.75 km² for females (Izawa et al. 1991). On Tsushima Island (10 km²), one male had a home range of 0.8 km² (Oh et al. 2010). On Taiwan, home ranges for two males were estimated at 6.5 and 9.5 km², respectively, whereas two females had home ranges of only 1.8 and 2.0 km², respectively (Chen et al. 2016). The Leopard Cat tends to use larger home ranges during the wet season than the dry season. This might be due to seasonal changes in prey availability; e.g. on Taiwan, the Spinous Country Rat showed the highest density during the dry season and was found to be the Leopard Cat's main prey species in this area (Chen et al. 2016). In Thailand, the Red Spiny Rat dominated the diet (Petersen et al. 2019a). On Pulau Tekong, Singapore, rats were also the dominant prey items, but other mammals, birds, amphibians, skinks and other reptiles and insects were also consumed (Chua et al. 2016). Similarly, in the Primorsky Region in the Russian Far East, small rodents dominated the diet, especially in*

the snow-free season. During the snowy season, the frequency of occurrence of ungulates (consumed as carrion) in the Leopard Cat diet increased significantly (Seryodkin & Burkovskiy 2019). In Khangchenzonga Biosphere Reserve, Sikkim, India, murids dominated the diet, too, followed by pikas (Bashir et al. 2014). Meanwhile, in Laohegou Nature Reserve, Sichuan Province, China, pikas were the dominant prey items, followed by rats, mice and voles (Xiong et al. 2017). In Saihanwula Nature Reserve, Inner Mongolia, China, the Leopard Cat primarily preyed on birds, specifically partridge (Zhang et al. 2011). On Iriomote island, Japan, diet consisted predominantly of frogs and toads as well as birds and Ryukyu fruit bats (Nakanishi & Izawa 2016). Two cases of cannibalism were documented in the Primorsky Region, Russian Far East (Seryodkin & Burkovskiy 2019).

Use & Trade: The illegal trade in Mainland Leopard Cats is not well known from most parts of its range. Trading and hunting for meat has been reported in parts of north-east India, South-east Asia and China. In Afghanistan it is hunted and traded. It was found at Kabul's fur Market and pelts were recorded in Nuristan Province (Karlstetter 2008, Jonson & Wingard 2010, C. Miller pers. comm.). Trade across the border between Afghanistan and Pakistan was recorded too (Ostrowski et al. 2009, Bader et al. 2013). The Mainland Leopard Cat was heavily trapped in the 1980s but still seems to be fairly common in the first decade of the 21st century. In China the legal trapping declined which is an indication for over-hunting (Yu 2010). The meat and fur is especially popular in China and Japan. This was an important factor in the decrease of the population in China in the earlier decades. In border town markets in Myanmar sale of body parts and furs has been recorded (Nijman et al. 2015). The species is also found in the wildlife trade markets of Tachileik and Mong La at the border of Myanmar-Thailand (Nijmann & Shepherd 2015). Body parts of the Mainland Leopard Cat were also found in Nepal, but this seems not to pose a serious threat in the country (Dangol 2015). Mainland Leopard Cats are also popular in the pet trade industry and illegally traded through the internet (Nguyen & Willemsen 2016). *In Thailand, Mainland Leopard Cats were offered in Facebook groups as 'exotic pets' (Siriwat et al. 2019).*

Threats: see Table 3.3.4.1.

Table 3.3.4.1. Threats to the Mainland Leopard Cat for different locations according to Ghimirey et al. 2022 *and other sources*.

Threat	**Location**
Illegal killing (incl. targeted hunting for use and trade, persecution/control)	Rangewide South-east Asia (Willcox et al. 2014, Harrison et al. 2016, Gray et al. 2018) Afghanistan (Karlsletter 2008, C. Miller pers. comm.) India (Selvan et al. 2013) Nepal Bangladesh (S. Chaudhary pers. comm. 2021) China (Yu 2010) *Taiwan (Chen et al. 2016, Best & Pei 2020)* *Vietnam (Willcox et al. 2014)*
Habitat loss (incl. fragmentation)	Rangewide Afghanistan
Pet trade (domestication, hybrid breeding)	China (CFCA 2017)
Climate Change	Rangewide (Silva et al. 2020)
Predation by free ranging Dogs	-
Diseases	Tsushima island, Japan (Ministry of the Environment of the Government of Japan, no date) China (Chen et al. 2019)
Prey depletion	-

Table 3.3.4.1. Threats to the Mainland Leopard Cat for different locations according to Ghimirey et al. 2022 *and other sources*.

Threat	Location
Road mortality	Japan (Izawa et al. 2009)
	India (Baskaran & Bhoominathan 2010)
	South Korea (Choi et al. 2012, Byun et al. 2016, Kim et al. 2019)
	Taiwan (Chen et al. 2016)
	Malaysia (Kasmuri et al. 2020)
Reduced genetic diversity	*Japan (Iriomote island & Tsushima islands; Saka et al. 2018)*

Knowledge base

The knowledge base on the Mainland Leopard Cat is generally acceptable but still not showing a high enough quality to carry out a fully evidence-based RLA. While some aspects of the knowledge on the Mainland Leopard Cat are limited other aspects are covered better. For all range countries, except for Afghanistan, confirmed recent records of the Mainland Leopard Cat exist (Fig. 3.3.4.1). However, there are still large parts of its range for which no recent confirmed distribution information is available. There are only few density estimates and population estimates/guestimates available across its vast range. The global population size is not known and its trend is only suspected to be stable. There is some knowledge on the habitats used by the Mainland Leopard Cat and its ecology, especially on their activity patterns (and on their diet) from different areas. Regarding use and trade, the purpose is known, but not the quantity. General threats are known, as well as some regionally specific threats, but their impact on the population is only suspected for some regions. There is no conservation network, or conservation plan, but there are some conservation projects that include the Mainland Leopard Cat.

Evaluation of the Red List Assessment

The RLA for the Mainland Leopard Cat (Ghimirey et al. 2022) is very well done and quite detailed. The listing of the species as Least Concern is justified and understandable. The information in the sections is grouped by country or region where possible and the information is correctly placed. The underlying assumptions of statements are explained and comprehensible. There is some additional information that could have been integrated into the Ecology or Threat section (e.g. Zhang et al. 2011, Bjun et al. 2016, Nakanishi & Izawa 2016, Xiong et al. 2017, Saka et al. 2018, Best & Pei 2020, Kamler et al. 2020, Sukmasuang et al. 2020, Zhao et al. 2020).

Table 3.3.4.2. Evaluation matrix of the Mainland Leopard Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟢	🟡	🟡	🟡
Consistency of RLA	🟢	🟢	🟢	🟡	🟢	🟢
New information since last RLA	🔴	🔴	🔴	🟡	🔴	🔴

Conclusions and recommendations

The RLA of the Mainland Leopard Cat is very well done, quite detailed and comprehensible. Almost all the available published information has been considered in the RLA. The knowledge base of the Mainland Leopard Cat is good for some regions but very limited for others (Table 3.3.4.2). No specific project on the species is known. The knowledge base on the Mainland Leopard Cat is good for some regions and limited for others. The overall population status is not very well known but based on its widespread occurrence, the species is thought to do ok. Recent distribution information is available for parts of its extant range and the species is widely recorded as by-catch in camera trap studies

focusing on other species. As the last RLA of the species has just been finished in 2022, there is almost no new information available, except some more detailed information on its ecology. The species should be re-assessed within the regular time frame of 5–10 years' time, unless there would suddenly be indications of significant major changes in its population status which call for an earlier re-assessment.

There is a need for:

- Confirmation of the Mainland Leopard Cat's distribution in areas without confirmed records (incl. further bycatch data from camera-trapping surveys of other target species);
- Quantitative data on Mainland Leopard Cat abundance and/or densities and trends;
- Assessment of the impact of threats (especially snaring, harvest and use);
- Establishment of a conservation plan, where appropriate;
- Establishment of a network;
- Regular re-assessment of the species in 5-10 years' time.

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3.3.5 Sunda Leopard Cat (*Prionailurus javanensis*)

Least Concern (Ross et al. 2015)

Red List history

Year	1996[+]	2002[*+]	2008[+]	2015[+]
cat. & crit.	LR/LC	LC	LC	LC

[*]2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published.
[+] The Assessment was performed before the taxonomical split of *P. bengalensis* and *P. javanensis*

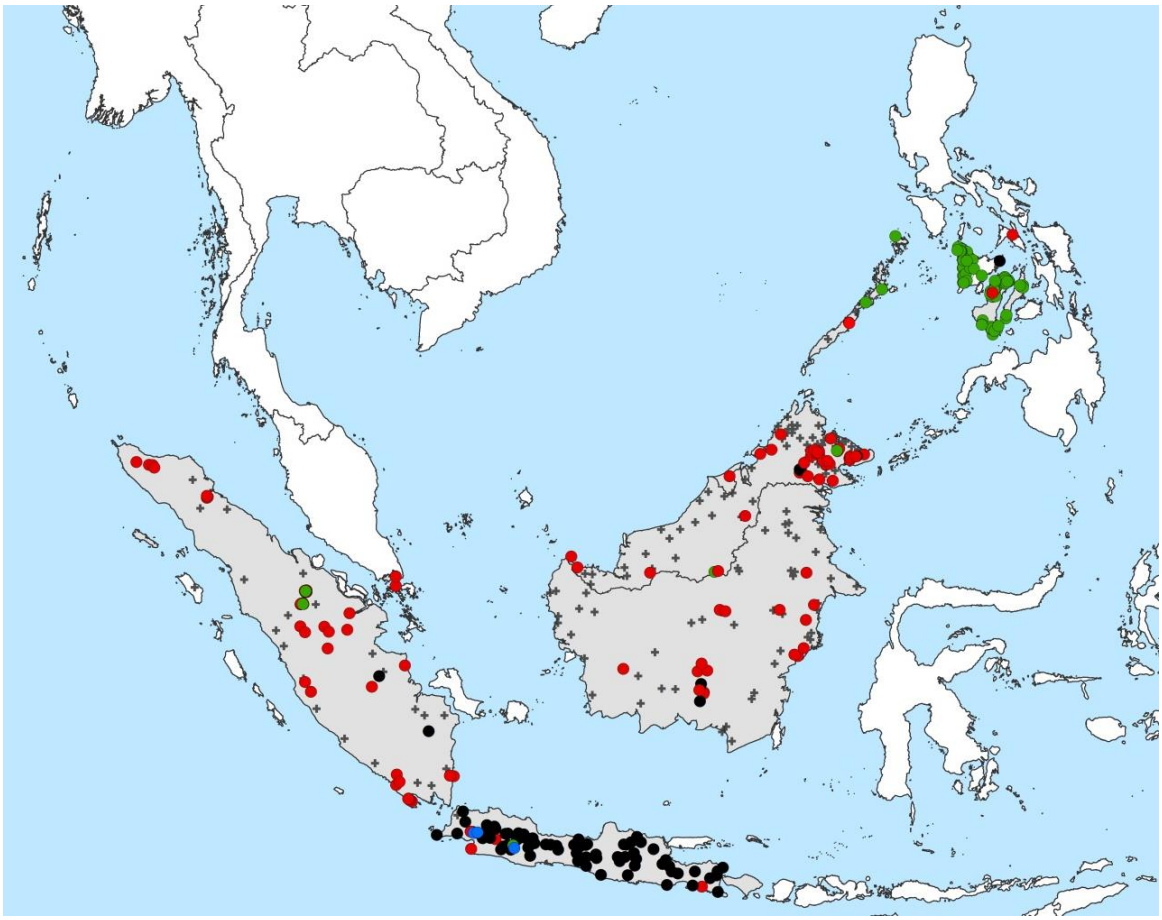

Fig. 3.3.5.1. Sunda Leopard Cat records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999, or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Ross et al. 2015) and *additional information available* (in italic).

Taxonomic Notes: The Sunda Leopard Cat is currently recognised to consist of two subspecies based on morphological variation, phylogeographical study and clear geographic isolation. These two sub-

species are *P. j. javanensis* and *P. j. sumatranus* (Kitchener et al. 2017). *). In Singapore it is not known if the records refer to P. javanensis or P. bengalensis.*

Justification: The Leopard Cat as a whole is listed as Least Concern. However, this assessment includes the information on *P. bengalensis*, which is now considered as a separate species. It is widespread and common (Nowell & Jackson 1996, Sunquist & Sunquist 2002). Over its entire range, it faces a variety of threats such as urbanisation as highlighted by studies in the Indian Western Ghats (Seto et al. 2012) or direct and indirect hunting in Vietnam (Willcox et al. 2014) and Lao PDR (Coudrat et al. 2014a, b) with the potential to cause large population declines. However, it seems to be stable across most of its range and even tolerant to habitat modifications through forest degradation (e.g. Mohamed et al. 2013) forest conversion to oil palm (Yue et al. 2015, Hearn, Ross & Macdonald unpub. data) and sugar cane plantations (Lorica & Heaney 2013). It does not fulfil any of the criteria for being listed in a higher category.

Geographical range: The Sunda Leopard Cat occurs on the islands of Borneo, Sumatra, Java and parts of the Philippines (Palawan, Panay, Negros and Cebu). Its presence on Masbate, Philippines is unconfirmed. On Guimaras, Philippines, it is presumed to be extinct. Recent records from protected and non-protected areas exist from Borneo: Danum Valley Conservation Area and surrounding production forest, Tabin Wildlife Reserve, Crocker Range National Park, Kinabatangan Wildlife Sanctuary, Kabili-Sepilok and Gomantong Forest Reserves, and Tawau Hills National Park (Hearn, Ross and Macdonald, unpub. data), Maliau Basin Conservation Area (Brodie & Giordano 2011), Deramakot Forest Reserve (Mohamed et al. 2009), Sabangau National Park (Cheyne & Macdonald 2011), Wehea Forest (Loken *et al.* unpub. data), Upper Baram region of Sarawak (Mathai *et al.* 2010); and from Sumatra: Gunung Leuser National Park (Pusparini et al. 2014), Bukit Barisan Selatan National Park (McCarthy et al. 2015). The current distribution is based on records, combined with habitat (Hansen et al. 2013) and climate data (Mukherjee et al. 2010). *Recent confirmed records exist across all range countries but there are also large areas without any. There is one recent confirmed record lying outside of the extant distribution range of the Sunda Leopard Cat in the Philippines (Lorica R. P., pers. comm.) and two in Singapore (Chua et al. 2016; Fig. 3.3.5.1). However, for Singapore it is not known if the records refer to P. javanensis or P. bengalensis.*

Population: Being widely distributed and relatively tolerant of habitat degradation, the Leopard Cat as a whole (incl. Mainland Leopard Cat) is abundant. However regional population declines may still be caused by habitat degradation combined with hunting pressure (e.g. Seto et al. 2012, Willcox et al. 2014, Coudrat et al. 2014a, b). Density estimates from three logged forest reserves in Sabah, Malaysian Borneo, are 9.6, 12.4 and 16.5 individuals per 100 km², respectively (Mohamed et al. 2013). The density increased with increased forest disturbance. The Sunda Leopard Cat is usually the most frequently recorded cat in its range (e.g. Holden 2001), particularly in disturbed habitat, e.g. logging concessions (e.g. Ross et al. 2010, Mohamed et al. 2013). Conversely, there are also several examples where the Sunda Leopard Cat is not the most abundant species (e.g. Pusparini et al. 2014, McCarthy et al. 2015, Loken et al. unpub. Data), especially in primary forests (e.g. Ross et al. 2010, McCarthy et al. 2015, Hearn, Ross & Macdonald unpub. data). The Sunda Leopard Cat is even recorded in oil palm plantations (Rajaratnam et al. 2007, Ross et al. 2010, Yue et al. 2015) although less often. The bigger the plantation (i.e. distance to natural or semi-natural vegetation), the lower the detection rate (Hearn, Ross & Macdonald unpub. data). *The National List of Threatened Fauna of the Philippines lists the Sunda Leopard Cat as Vulnerable (DENR 2019).*

Habitat: The Sunda Leopard Cat uses mostly dense secondary growth, including logged forests as described earlier, but has also been recorded in various plantations, such as Acacia (Giman et al. 2007), oil palm (Ross et al. 2010, Yue et al. 2015, Hearn, Ross and Macdonald unpub. data), sugarcane (Lorica & Heaney 2013) and coffee plantations (McCarthy unpub. data). Even though planta-

tions are utilised, forests appear to be an important habitat for the Sunda Leopard Cat as a camera trap study found more individuals and more detections in plantations within shorter distances to the nearest forest (Hearn, Ross & Macdonald unpub. data). It is suggested that plantations are used for hunting, and forest fragments for resting and breeding (Rajaratnam et al. 2007, McCarthy unpub. data). However, the exact utilisation of plantations and surrounding forests, as well as whether plantations can support stable populations is still unknown. It has also been suggested that mortality rates in disturbed areas are higher (e.g. Rajaratnam 2000). The Sunda Leopard Cat is able to live close to rural settlements and as good swimmers, are able to colonise offshore islands (Nowell & Jackson 1996, Sunquist & Sunquist 2002). *Various camera trap studies showed differing results: Some studies in Malaysian and Indonesian Borneo found Sunda Leopard Cats only within oil palm plantations and rehabilitated or disturbed forest, but not in intact or native forest (Cheyne et al. 2015, Yue et al. 2015, Bernard et al. 2019), and others only found them in primary but not in logged forests (Brodie et al. 2015). A radio-collared male and female on Palawan Island, Philippines, primarily used forests, followed by mixed brushlands. Coconut plantations and built-up areas were very rarely used (Fernandez et al. 2018). A habitat suitability analysis of Borneo predicted that the large majority of the island offers suitable habitat. Suitable habitat included forested areas, oil palm and rubber plantations, whereas swamp areas were considered to be only marginally suitable. Unsuitable areas included higher elevation areas (Mohamed et al. 2016). In a telemetry study in Sabah, Malaysian Borneo, oil palm plantations were actually used disproportionately more frequently than expected from their availability (Rajaratnam et al. 2007). A reason for this might be the relatively higher abundance in oil palm plantations of their primary prey species – in this study the Whitehead's rat – and possibly higher hunting success due to the relatively open understorey, which offers fewer holes and crevices in tangled vegetation for prey to hide in (Rajaratnam et al. 2007). Within oil palm plantations on Sumatra, Leopard Cats were more often detected in areas with increased understory vegetation without herbicide application (Hood et al. 2019). On Sumatra, transect surveys resulted in a higher number of Sunda Leopard Cat tracks being found in forest and scrub habitats than in oil palm plantations. However, the number of direct sightings was highest in oil palm plantations, followed by scrub and by forest habitats (Scott et al. 2004). In some areas, Leopard Cats might also profit from strict protection within oil palm plantations as they are sometimes regarded as a pest control agent against crop damages caused by rats (Verwilghen 2015, Hood et al. 2019). On Negros, Philippines, Sunda Leopard Cats were found to use sugarcane fields throughout the year, including during the harvest season and kittens have been regularly observed in sugarcane fields (Lorica & Heaney 2013). A habitat suitability model for the island of Java, Indonesia, has shown that in non-protected areas only 15% consists of suitable habitat for the Sunda Leopard Cat, twice as much as the total suitable habitat available within protected areas (Irawan et al. 2020).*

Ecology: The Sunda Leopard Cat is mainly nocturnal (Cheyne & Macdonald 2011, McCarthy et al. 2015, Hearn, Ross and Macdonald unpub. data) although some crepuscular and even diurnal activity has been recorded (Ross, Hearn & Macdonald unpub. Data). The average home range on Borneo was estimated at 3.0 km² (Rajaratnam et al. 2007, Hearn and Ross unpub. data). The diet of Mainland Leopard Cats consists mainly of murids (Rajaratnam et al. 2007), but may include other small mammals, eels and fish, and occasionally also carrion (Nowell & Jackson 1996). *The Sunda Leopard Cat was found to have variable circadian behaviour patterns, ranging from nocturnal to crepuscular across its range (Adul et al. 2016, Hood et al. 2019, Jeffers et al. 2019, Allen et al. 2020, Subagyo et al. 2020). On Palawan Island, Philippines, the home range of one male was estimated at 6.3 km² and that of one female at 3.9 km² (Fernandez et al. 2018). The Leopard Cat tends to use larger home ranges during the wet season than the dry season (Fernandez et al. 2018). On Palawan Island, Philippines, the faecal samples of three individuals showed mostly the remains of various rodents including native and invasive rats a tree squirrel, treeshrew and an unidentified bird (Lo et al. 2021). On a sug-*

arcane farm on Negros, Philippines, the Sunda Leopard Cats mainly preyed on non-native rats (which are regarded as pest species), and rarely on mice, amphibians, reptiles and birds (Fernandez & de Guia 2011, Lorica & Heaney 2013).

Use & Trade: Commercial trade is not as high as it used to be (Yu 2010), but it still prevalent across the majority of the Sunda Leopard Cats range. The Sunda Leopard Cat is hunted for its fur, for food and as pets. The bones are sometimes used in traditional Asian medicine (Nowell & Jackson 1996). *Nijman et al. (2019) studied the animal markets on Java and Bali: On Java and Bali, there are animal markets* varying widely in size, ranging from less than 20 to over 200 stalls or shops. *Due to a lack of law enforcement, protected species are openly displayed and sold here. The Sunda Leopard Cat is mainly offered as an 'exotic' or 'novelty' pet (Nijman et al. 2019). However, the number of cats on offer appear to be decreasing. In the mid-1990s, almost 2 cats were found per survey. This number dropped to slightly less than 0.5 cats per survey in the 2010s. They were also found in fewer markets (Nijman et al. 2019). For Java, a total trade amount of 600 Sunda Leopard Cats per year is estimated. Meanwhile, the prices for which the cats are being sold have risen. It appears that all of the individuals on offer are sourced from the wild – mostly juveniles collected as litters – with apparently no animals stemming from outside of the respective island and with no captive breeding for the market. However, the Sunda Leopard Cat seems to be of minor importance to the traders. Most stalls offer at the same time also high-end breeds of domestic cats, which are much better taken care of and generate much more revenue for the traders. There is no indication from these markets, that the Sunda Leopard Cat is intended for the international/tourist market (Nijman et al. 2019).*

Threats: see Table 3.3.5.1.

Table 3.3.5.1. Threats to the Sunda Leopard Cat for different locations according to Ross et al. 2015 *and other sources*.

Threat	**Location**
Illegal killing (incl. targeted hunting for use and trade, persecution/control)	Range-wide (Yu 2010) Sumatra, Indonesia (McCarthy 2013) *Indonesia (Nijman et al. 2019)*
Habitat loss (incl. fragmentation)	Range-wide (Nowell & Jackson 1996)

Knowledge base

The knowledge base on the Sunda Leopard Cat varies. Density estimates exist only from one study in three forest reserves on Borneo. No population estimate exists. The habitat use has been examined in several areas as well as their ecology (particularly their activity pattern) and to some degree also their diet. There is one very detailed study of the use and trade on the islands of Java and Bali, but little to no information from the rest of the distribution range. General threats are known, but not their impact on the population. The Sunda Leopard Cat is included in two regional conservation networks and action plan for Borneo, as well as few conservation projects.

Evaluation of the Red List Assessment

As the Sunda Leopard Cat has been assessed for the IUCN Red List only together with the Mainland Leopard Cat, before the split of the species, we cannot evaluate the consistency of its RLA.

Table 3.3.5.2. Evaluation matrix of the Sunda Leopard Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🔴	🟡	🔴	🟡	🔴
Consistency of RLA[1]	⚫	⚫	⚫	⚫	⚫	⚫
New information since last RLA	🔴	🔴	🟢	🟡	🟢	🔴

[1] The Consistency of the RLA could not be assessed as the species was then evaluated together with P. bengalensis before the two species were split.

Conclusions and recommendations

A specific RLA of the Sunda Leopard Cat is needed to draw further recommendations and conclusions. An assessment of the Sunda Leopard Cat has already been initiated and is expected to be published by end of 2023. However, it already seems that the knowledge base on the Sunda Leopard Cat is limited in parts of its range and further information on the species will be needed. In particular, there is no significant new information since the last RLA (before the species split) with regards to population, distributions and threats (Table 3.3.5.2).

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3.3.6 Marbled Cat (*Pardofelis marmorata*)

Near Threatened (Ross et al. 2016)

Red List history

Year	1986	1988	1990	1994	1996	2002*	2008	2016
cat. & crit.	I	I	I	K	DD	VU C2a(i)	VU C1+2a(i)	NT A or C

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

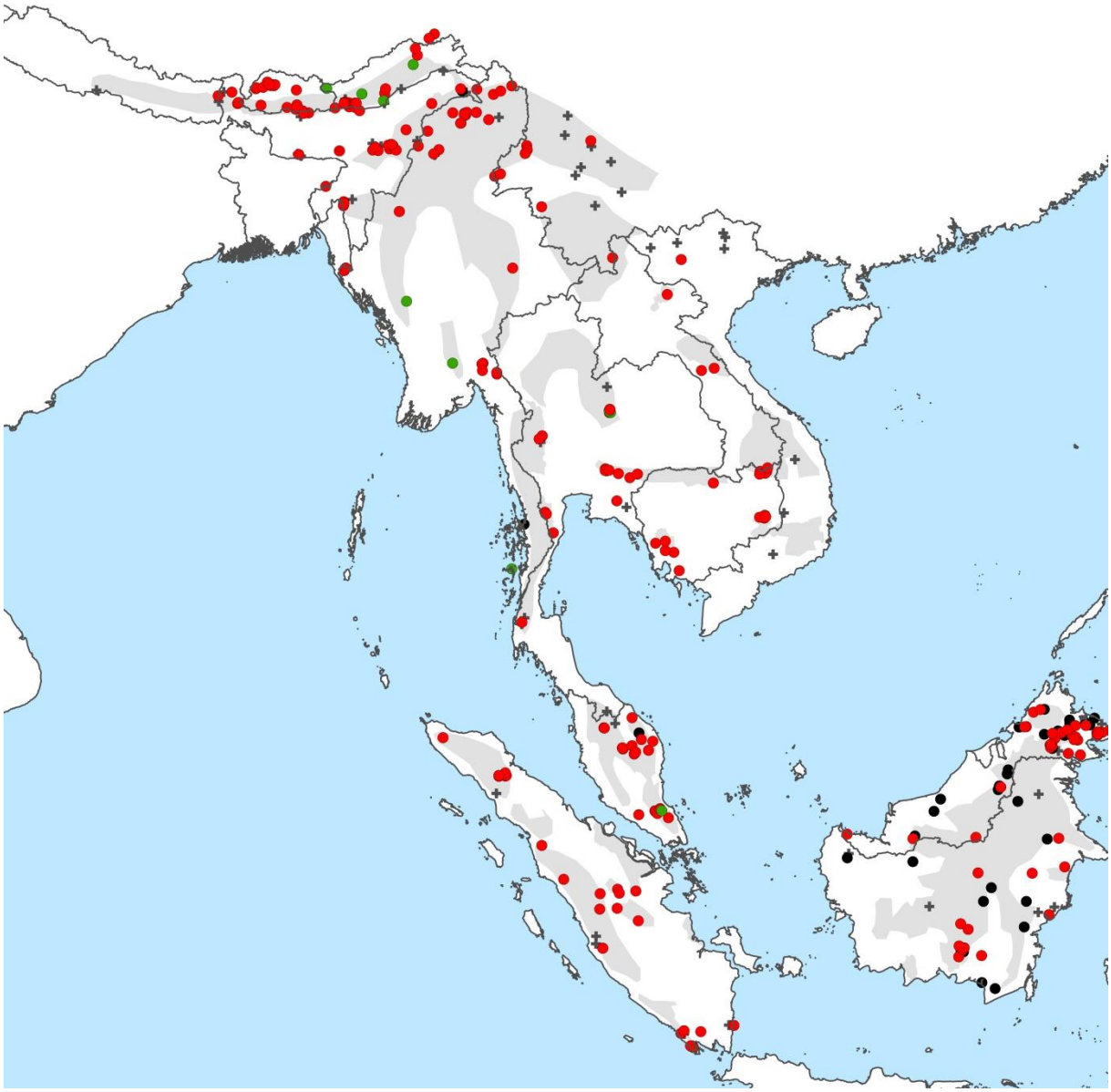

Fig. 3.3.6.1. Marbled Cat records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. The Possibly Extinct range is not shown in the map.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Ross et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Marbled Cat is currently recognised to consist of two subspecies, namely: *P. m. marmorata* and *P. m. longicaudata* (Kitchener et al. 2017). More research, however, is needed to confirm this.

Justification: The Marbled Cat is classified as Near Threatened but is close to qualify as Vulnerable under A and C. It was downlisted from Vulnerable in 2008 to Near Threatened due to further confirmation of the species and more detections. The population did not increase and the threats were not reduced. Little is known about the Marbled Cat and its status thus difficult to assess. The Marbled Cat is forest dependent but can persist in degraded forest. It is threatened by hunting but the impact of this threat is not known. No population estimates for the Marbled Cat exist but it seems unlikely, that its population is below the Vulnerable threshold for C nor that its population declines enough to qualify for Vulnerable under A. The species should be re-assessed if any of the assumptions made in this assessment are challenged or if there are indications of a fragmented population, low densities or high threat impact.

Geographic Range: The Marbled Cat occurs from the Himalayan foothills in Nepal, east into south-west China and throughout mainland South-east Asia. It inhabits the islands of Borneo and Sumatra too. The Marbled Cat has been recorded in protected and non-protected areas across its range. Many recent records in non-protected and protected areas exist across parts of its range. *Recent confirmed records of the Marbled Cat exist across part of its current extant range, but across large parts of its range no recent confirmed records could not be found (Fig. 3.3.6.1). Some confirmed records lie outside its extant range such as in Bhutan (Thinley et al. 2015, Dhendup et al. 2019, Jamtsho et al. 2021), Cambodia (Raloff 2000, Starr et al. 2010, Gray et al. 2017), China (Wen et al. 2015, Liu et al. 2020), India (Choudhury 2010, Naulak & Pradhan 2021), Indonesia (Cheyne & Macdonald 2010, Wearn et al. 2013, McCarthy et al. 2015, Hearn et al. 2016, Rustam et al. 2016, Fredriksson & Rustam 2017, Putri et al. 2017), Laos (Brakels & Somdahit 2020), Malaysia (Bakri et al. 2020), Myanmar (Than Zaw et al. 2014, Moo et al. 2017) and Thailand (Tantipisanuh et al. 2014). Most recent confirmed records are camera trap pictures collected as by-catch during studies focusing on another target species or assessing the overall biodiversity of an area.*

Population: It is likely that Marbled Cat densities vary greatly across its range. The low detection rates of Marbled Cats may arise from cameras not explicitly placed for the species. However, in many surveys the Marbled Cat was rarely detected. It is likely that the population numbers are over 10,000 mature individuals, unless the population densities are very low or the distribution extremely patchy. The current population trend is decreasing. *In Nepal the Marbled Cat is considered data deficient (Amin et al. 2018). In China, it is considered to be Critically Endangered (Jiang et al. 2016b). In the Thai law, the species is classified as endangered (Simcharoen et al. 2014). The density of Marbled Cats in Sabah, Malaysian Borneo, in the primary, lowland Danum Valley Conservation Area was 19.57 individuals per 100 km^2 and in the primary upland, Tawau Hills Park 7.1 individuals per 100 km^2. In the selectively logged, lowland Tabin Wildlife Reserve a density of 10.45 individuals per 100 km^2 was estimated (Hearn et al. 2016). In Dampa tiger Reserve, Mizoram, India, a density of 5.03 individuals per 100 km^2 was estimated (Singh & Macdonald 2017). Densities were estimated at 8.75 per 100 km^2 in Hitmanthi Wildlife Sanctuary, north-western Myanmar (Naing et al. 2017) and at 3.8 individuals per 100 km² in Nam Et – Phou Louey National Protected Area, Laos (Rasphone 2018).*

Habitat: There are indications that the Marbled Cat is *highly* forest dependent (*Rustam et al. 2016*) and mainly associated with moist and mixed deciduous-evergreen tropical forest, possibly preferring

hill forest. The species has also been detected in disturbed areas such as logged forest but not in oil palm plantations. Marbled Cats were recorded in a salt lick in Phu Khieu National Park, Thailand. *In Laos the species seems to have an affinity with hilly evergreen forests between 700 and 1,000 m (Coudrat et al. 2014). Marbled Cats seem to be highly associated with areas of increased tree/canopy cover including agroforestry land, forest plantations and selectively logged forest and not to be specifically confined to old-growth forest (Haidir et al. 2020). Habitat use, landscape resistance, corridors and core areas used by the Marbled Cat were predicted for Kerinci Seblat landscape, Sumatra (Haidir et al. 2020). Habitat use of the Marbled Cat was confined to densely forested areas away from human disturbance (Haidir et al. 2020).There are indications that Marbled Cats avoid human dominated, highly disturbed habitat types (Hearn et al. 2018). In the Eaglenest Widlife Sanctuary, Arunachal Pradesh, India, the Marbled Cat was recorded at altitudes up to 2,690 m and used only very dense canopy forest (Mukherjee et al. 2016). In Nepal, it was recorded up to 2,750 m (Lama et al. 2019) and in Jigme Dorji National Park, Bhutan, even up to 3,810 m (Dhendup 2016).*

Ecology: The Marbled Cat seems to be mainly diurnal (McCarthy et al. 2015, *Singh & Macdonald 2017, Mukherjee et al. 2016, Hearn et al. 2018 Lama et al. 2019*). Only one home range estimate for the Marbled Cat exists. A radio-collared female had a home range of 5.3 km^2 in Phu Khieu National Park, Thailand. The Marbled Cat probably preys on rodents, including squirrels and birds. *Marbled Cats are excellent tree climbers and have a partly arboreal lifestyle (Sunarto et al. 2015). In Jigme Dorji National Park, the Marbled Cat was active during day and night (Thinley et al. 2015). Although the Marbled Cat shows arboreal tendencies, it spends most time on the ground (Rasphone 2018). It is assumed that arboreal prey is important for the Marbled Cat. One Marbled Cat was observed stalking birds and one potentially preyed on a juvenile Phayre's leaf monkey Trachypithecus phayrei (Hearn et al. 2016). Squirrels, fruit bats and birds are thought to be part of its diet beside terrestrial prey such as mice, rats, fish, reptiles, frogs and insects (Banks 1949 cited in Rustam et al. 2016, Payne et al. 1985 cited in Rustam et al. 2016).*

Use & Trade: The Marbled Cat is not frequently observed in the wildlife trade but its skin, meat and bones are valued. Illegal killing and trade are possibly underreported in comparison to other species. The Marbled Cat was recorded to be hunted and skins found in several parts of India such as Arunachal Pradesh, Changlang district, West Kameng district, Pakke Kessang, East Kameng district, Ziro valley, Lower Subansiri and from Khonoma, Nagaland. *The Marbled Cat is hunted for meat and for socio-cultural rituals by some tribal groups in India (Lama et al. 2019). The meat and skin of the Marbled Cat is used for medicinal purposes by the Dayak Seberuang in Tempunak village, Borneo, Indonesia (Dewin et al. 2017). In Borneo, Indonesia, the species is consumed by the tribe Dayak Jelai Hulu Embulu Lima in Mekar Utama village, (Sunaryo et al. 2019) and used by the Kanayant Dayak tribes in Temahar village (Almey et al. 2020). The species is also hunted and traded in North Zamari Key Biodiversity Area, Myanmar (Evans et al. 2020).*

Threats: see Table 3.3.6.1.

Table 3.3.6.1. Threats to the Marbled Cat for different locations according to Ross et al. 2016 *and other sources.*

Threat	**Location**
Habitat loss (degradation & fragmentation)	Range-wide (*Hearn et al. 2016*) *Indonesia (Wilting et al. 2016)* *Sumatra (Haidir et al. 2020* *Malaysia (Rustam 2016, Wilting et al. 2016)*
Illegal killing (incl. targeted hunting for use and trade, indiscriminate snaring, persecution)	Range-wide (*Hearn et al. 2016*) *India (Lama et al. 2019)* *Indonesia (Dewin et al. 2017, Sunaryo et al. 2019, Almey et al. 2020)* *Myanmar (Evans et al. 2020)* *Borneo (Wilting et al. 2016)* *Malaysia, Sarawak (Rustam 2016)*

Knowledge base

The knowledge about the Marbled Cat is very limited. Information on the species remains spare. Only very few studies with focus on the species itself have ever been conducted. Its distribution range is not very well known with confirmed recent records in only part of its current extant range and several ones outside (Fig. 3.3.6.1). No population size estimations exist but six density estimates from different habitats. Its habitat use and ecology is also still not fully clear. For example, there is only anecdotal information on its diet and only one home range estimate for one individual exists. Since the last assessment in 2016, new information on its distribution, habitat use, ecology and its use and trade exists as well as the first density estimates of the Marbled Cat were calculated. With regard to use and trade, only the purpose of use and trade is known but not its amount. General threats across its range are known but not specifically for countries or regions. Moreover, the impacts of the threats on the species and their scope are not known. Neither a conservation strategy or action plan exists, but the Marbled Cat is included in two networks and there are some projects focusing on the species.

Evaluation of the Red List Assessment

Little information is available on the Marbled Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The subcriteria under which the species qualifies as Near Threatened should be stated as well as under which ones it would possibly qualify as VU in the future;
- Where available the Justification should include more information to justify the Category;
- The assumed population decline of 20–25% (NT A) should be supported by further explanations and evidence;
- Although not mandatory, the calculation of the EOO would provide additional information;
- Information on use and trade is included under the Threat section but should be integrated into the section Use and Trade;
- Some of the then available publications seem not to have been considered (e.g. Shepherd & Nijman 2008, Johnson et al. 2009, Morino 2009, Chutia 2010, Jutzeler et al. 2010, Ross et al. 2010a,b, Starr et al. 2010, Lyngdoh et al. 2011, Bernard et al. 2012, Brodie & Giordano 2012, Grewal et al. 2012, Bernard et al. 2013, Borries & Koenig 2014, Cheyne & MacDonald 2011, Coudrat et al. 2014, Duckworth et al. 2014, Gumal et al. 2014, Lamichhane et al. 2014, Mathai et al. 2014, Simcharoen et al. 2014 and Tantipisanuh et al. 2014). These publications include information on distribution records, activity pattern, status, trade and use.

As the subcriteria under which the species qualifies as Near Threatened are not stated, it is difficult to fully evaluate the Red List assessment. The listing as Near Threatened under Criterion A and C is based on a suspected population decline due to habitat loss and hunting. Further explanations for this population decline would help the reader to follow the reasoning.

Table 3.3.6.2. Evaluation matrix of the Marbled Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🔴	🟡	🔴	🟡	🔴
Consistency of RLA	🟡	🟡	🟢	🟡	🟡	🟡
New information since last RLA	🟡	🟢	🟡	🟡	🟡	🔴

Conclusions and recommendations

Generally, an evidentiary RLA of the Marbled Cat is difficult because of the very weak data base and little knowledge available (Table 3.3.6.2). Few specific projects have been conducted on this species, and most records originate from bycatches of camera-trapping studies focusing on other target species. Hence, the distribution information available for this species is almost certainly incomplete (Fig. 3.3.6.1). Most relevant information was considered in the last RLA (Table 3.3.6.2). The Marbled Cat should be re-assessed for the IUCN Red List as there is some new information on the species available especially on population densities and to address the few points raised above.

Foremost, our knowledge base on the Marbled Cat must be broadened. There is a need for:

- Confirmation of the Marbled Cat's distribution (incl. gathering more by-catch data from camera-trapping surveys of other target species);
- Information on the Marbled Cat's ecology and habitat use;
- Quantitative data on Marbled Cat abundance and/or densities;
- Research on the threats and their impacts on the Marbled Cat, especially in regard to habitat degradation, extent of hunting and illegal trade;
- Establishment of a conservation plan, where appropriate;
- Establishment of a research network;
- Re-assessment of the species for the IUCN Red List

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3.3.7 Borneo Bay Cat (*Catopuma badia*)

Endangered C1 (Hearn et al. 2016)

Red List history

Year	1986	1988	1990	1994	1996	2002*	2008	2016
cat. & crit.	R	R	R	K	VU	EN C2a(ii)	EN C1	EN C1

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

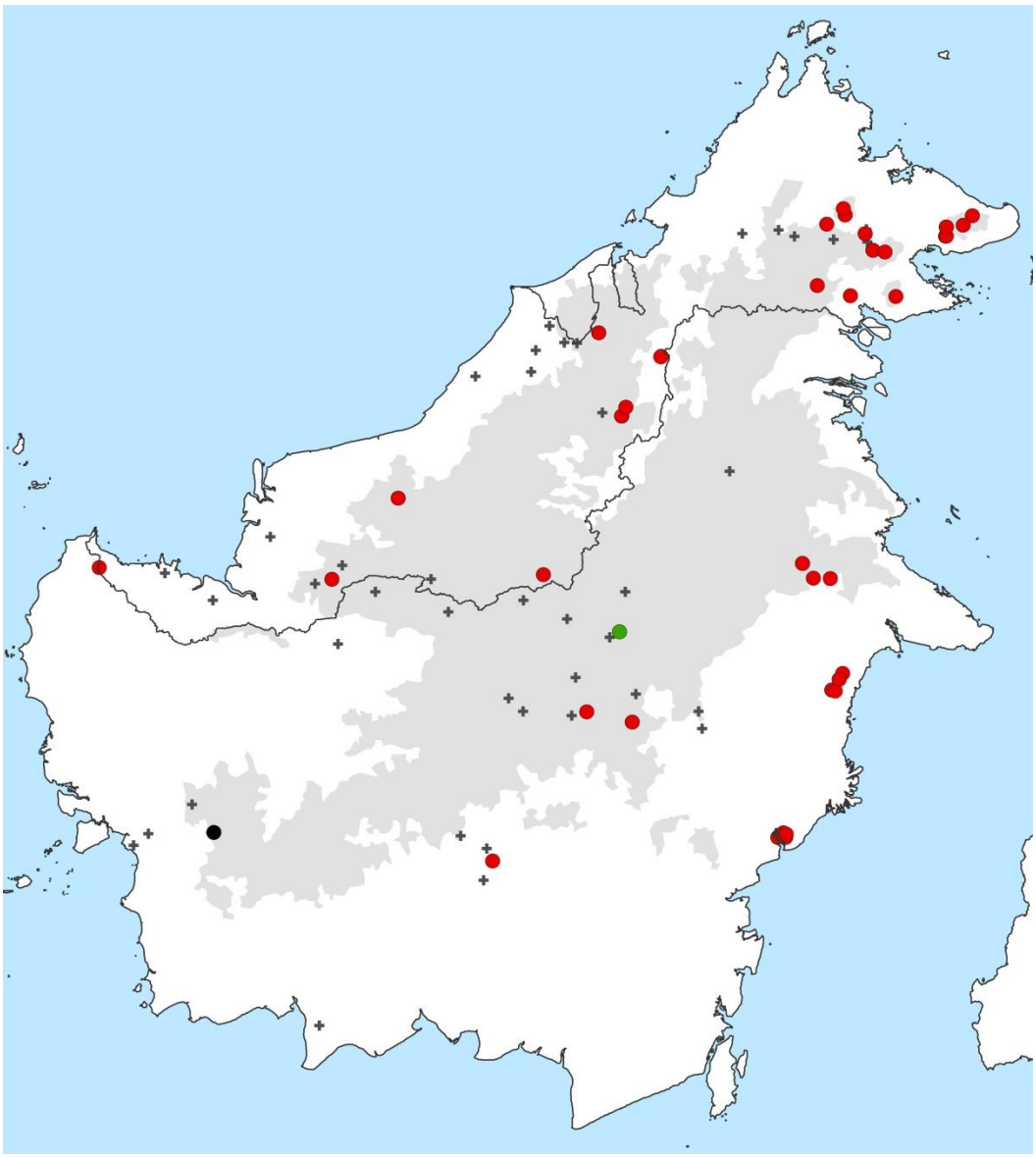

Fig. 3.3.7.1. Borneo Bay Cat observation records from the CSGSD. Grey area = extant and possibly extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (Hearn et al. 2016) and *additional information available* (in italic).

Taxonomic Notes: The Borneo Bay Cat is considered to be monotypic (Kitchener et al. 2017). Although polymorphic, there does not appear to be geographic separation of the colour morphs.

Justification: The Borneo Bay Cat is listed as Endangered. Based on habitat suitability and land cover data, it is estimated that the Borneo Cay cat's area of occupancy (AOO) decreased by approximately 30% over the last 3 generations (Miettinen et al. 2010, Borneo Carnivore Symposium 2011, Gaveau et al. 2014). Habitat degradation and conversion, together with poaching, is estimated to have caused a population reduction of 20–30% over the past two generations. Camera-trapping efforts have shown a substantially lower capture rate for Borneo Bay Cat than for the sympatric Sunda Clouded Leopard (*Neofelis diardi*), which shows estimated densities of 1–4 individuals per 100 km² (Brodie & Giordano 2012a, Wilting et al. 2012, Sollmann et al. 2014, Loken et al. unpub. data). Taking the lower end of the Sunda Clouded Leopard's density estimates and applying it to the more rarely captured Borneo Bay Cat's AOO results in an estimate of fewer than 2,500 individuals.

Geographic Range: The Borneo Bay Cat is endemic to the island of Borneo, which hosts territories of Brunei, Indonesia and Malaysia. It is widely distributed over the island, but has so far not been detected in South Kalimantan, Indonesia (Azlan et al. 2003, Bricknell 2003, Dinets 2003, Hearn 2003, Kitchener et al. 2004, Meijaard et al. 2005, Yasuda et al. 2007, Mohamed et al. 2009, Ross et al. 2010, Hon 2011, Bernard et al. 2012, Brodie & Giordano 2012b, Wearn et al. 2013, Mathai et al. 2014, Sastramidjaja et al. 2015, Hearn et al. unpublished data, J. Sanderson pers. comm.). However, a number of felid targeted camera trap surveys failed to detect Borneo Bay Cat in places where a habitat suitability analysis predicted it to be present (Wilting et al. unpublished data, Hearn, Ross and Macdonald unpublished data, Cheyne & Macdonald unpublished data). The AOO estimated from the habitat suitability analysis may present us with false positives. *Recent confirmed records have enlarged the Borneo Bay Cats range at the western border of Sarawak (Ampeng et al. 2015), and in Central Kalimantan towards the south (Cheyne et al. 2017, Jeffers et al. 2019; Fig. 3.3.7.1). Confirmed records on the eastern coast of East Kalimantan (Fig. 3.3.7.1) stem mostly from Yasuda (2007), and Sastramidjaja et al. (2015). Both publications were used for the text of the Red List assessment, but not incorporated into the distribution map, which is largely based on* the habitat suitability modelling mentioned earlier *(Hearn et al. 2016). Presence in southern East Kalimantan has since been confirmed by Fredriksson & Rustam (2017). In the INIKEA Forest Rehabilitation Area, Sabah, presence was also recently confirmed (Laneng et al. 2019). The only presence information we have found from Brunei is the Red List assessment, referring to a personal communication from J. Sanderson. Some recent confirmed records lie outside the extant distribution range of the species in Indonesia (Sastramidjaja et al. 2015, Cheyne et al. 2016, 2019; Fredriksson & Rustam 2017, Jeffers et al. 2019) and in Malaysia (Wearn et al. 2013, Ampeng et al. 2015).*

Population: No density estimate exists for the Borneo Bay Cat. However, the Borneo Bay Cat had lower photo-capture rates than the co-occurring Sunda Clouded Leopard, which occurs at densities of 1–4 individuals per 100 km² (Brodie & Giordano 2012a, Wilting et al. 2012, Sollmann et al. 2014, Loken et al. unpublished data). Consequently, some authors drew the conclusion that the Borneo Bay Cat is even rarer than Sunda Clouded Leopard (Azlan & Sanderson 2007, Mohamed et al. 2009, Ross et al. 2010). Based on the estimated AOO of 221,000 km² and the lower end of Sunda Clouded Leopard density estimates (1 individual per km²), the population of Borneo Bay Cat is about 2,200 mature individuals.

Habitat: The Borneo Bay Cat is believed to be forest dependent. It was recorded in hill and lowland forests as well as in swamp forests, including selectively logged forests of various levels of disturbance (Nowell & Jackson 1996, Meijaard 1997, Azlan et al. 2003, Bricknell 2003, Hearn 2003, Kitchener

et al. 2004, Meijaard et al. 2005, Azlan & Sanderson 2007, Yasuda et al. 2007, Ross et al. 2010, Hon 2011, Wearn et al. 2013, Mathai et al. 2014, Sastramidjaja et al. 2015, Hearn et al. unpublished data). However, it was not found in oil palm plantations in Sabah, Malaysia (Ross et al. 2010, Yue et al. 2015). *Cheyne et al. (2017) found Borneo Bay Cat in a mosaic heath/peat-swamp forest. It was also confirmed in the rehabilitated forest of the INIKEA Forest Rehabilitation Project in Sabah, Malaysian Borneo (Laneng et al. 2019).*

Ecology: The Borneo Bay Cat is thought to be diurnal, although not strictly so (Ross et al. 2010). No studies on diet, ecology or spatial ecology are known. *No new or supporting information was found.*

Use & Trade: Borneo Bay Cats can be found in skin and pet markets (Sunquist & Sunquist 2002, Kitchener et al. 2004, Azlan & Sanderson 2007). *No new or supporting information has since been found.*

Threats: see Table 3.3.7.1.

Table 3.3.7.1. Threats to the Borneo Bay Cat for different locations according to Hearn et al. (2016) *and other sources*.

Threat	Location
Habitat loss	Range-wide (Rautner et al. 2005, *Kitzes & Shirley 2016*)
Illegal and incidental killing (incl. targeted hunting for use and trade)	Range-wide (Sunquist & Sunquist 2002, Kitchener et al. 2004, Azlan & Sanderson 2007)

Knowledge Base

The Borneo Bay Cat is very elusive and the available knowledge base is extremely poor. Although a habitat suitability analysis exists, on which the AOO is based, its results could not be confirmed through camera-trapping across some of its range. Due to few records, the cat's occurrence is still not well understood. The only source for presence of the Borneo Bay Cat in Brunei is a personal communication from J. Sanderson. There are records from outside the indicated distribution in the Red List, of which some are recent, but others are older and from publications used in the RLA narrative. However, the distribution map is largely based on the aforementioned habitat suitability exercise and not on all known records (cf. above). The species is rarely pictured during camera trap studies, and thus it is difficult to estimate density or population size. Consequently, no density estimate for the species exists. Density of Borneo Bay Cat was only estimated through comparative densities for co-occurring Sunda Clouded Leopard and extrapolating from rates of photo captures. The estimated density and the AOO from the habitat suitability analysis were used to produce a population estimate. Some information is known on habitat use and activity from the rare photo-captures, but no studies on diet, ecology or spatial ecology are known. In terms of use and trade, Borneo Bay Cats were found in skin and pet markets, but nothing more is known and references are from <2008. Thus, it is not clear if use and trade are a significant threat to the species. References for the two known general threats are also from <2008 and little information on them is provided. The scope and impacts of threats are not fully understood. The Borneo Carnivore Consortium and a Bornean carnivore conservation plan exists, but these are not species-specific to the Borneo Bay Cat. The species is also included in the South East Asian Cat Working Group. There are some projects focusing on or including the Borneo Bay Cat.

Evaluation of the Red List Assessment

The RLA for the Borneo Bay Cat (Hearn et al. 2016) is generally well done. The Justification contains all information to justify the listing of Endangered. There are a few points that should be addressed in the next re-assessment of the species:

- The continuing decline in population size should be supported by further explanations and evidence;
- The Justification includes key information not stated anywhere else in the assessment (e.g. assumptions and justification of the estimated number of mature individuals and population decline which is missing under Population, habitat decline (decline in AOO) is mentioned in the Justification but not under the Geographic range section nor under Habitats and Ecology, etc.);
- The statements in the Justification and the Geographical Range section should be aligned i.e. Habitat decline is stated in the Justification but not under trend in AOO, EOO or habitat quality;
- Some information included under Population would possibly better be placed under Habitat and Ecology;
- The calculation of the EOO would add additional information;
- Some of the then available publications seem not to have been considered, e.g. Rustam et al. 2012, Samejima et al. 2012, Mohd-Azlan & Engkamat 2013, Ampeng et al. 2015 or indirectly included into the habitat suitability model. These publications include distribution records.

The listing of Endangered under Criterion C1 (small population size and decline; Appendix I) is based on an estimated decline in mature individuals of 20–30 % over the last 2 generations (12 years). Such a population decline is assumed to be the consequence of habitat degradation, forest conversion and poaching. The Justification states that the habitat suitability model alongside landcover data from 2000 and 2010 showed an AOO decrease by 29.8% and that satellite imagery shows further AOO reduction, but this decrease is not quantified. Increased snaring is further mentioned as a cause of the population decline. This statement would benefit from further explanations and evidence. To base a population size decline on a decline in AOO is problematic for a species with such a limited distribution data.

Table 3.3.7.2. Evaluation matrix of the Borneo Bay Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟢	🟡	🟡	🔴	🔴	🔴
Consistency of RLA	🟡	🟡	🟢	🟢	🟡	🟡
New information since last RLA	🟡	🔴	🟡	🔴	🔴	🟡

Conclusions and recommendations

An evidentiary RLA of the Borneo Bay Cat is very difficult because of the poor data base and the little new information on the species (Table 3.3.7.2). Very few specific projects have been conducted on the Borneo Bay Cat. Very few (recent and old) records exist and recent distribution information is missing for large parts of its Extant distribution range (Fig. 3.3.7.1). Nonetheless, the Borneo Bay Cat should be re-assessed considering the points listed above and the assessment should be aligned with the newest version of the IUCN Red List Guidelines.

The knowledge base on the Borneo Bay Cat has to be enlarged. There is a need for:

- Confirmation of the Borneo Bay Cat's distribution, especially its presence in the Brunei and including collection of by-catch data from camera-trapping studies on other target species;
- Quantitative data on Borneo Bay Cat abundance and/or density;
- Information about the Borneo Bay Cat's ecology, including diet;

- Assessment of the impact of threats, especially impacts of hunting (direct and indirect), trade and habitat loss;
- Establishment of a species-specific conservation plan, where appropriate;
- Amendment of the current RLA to enhance understanding of the classification of the species;
- Re-assessment of the species for the IUCN Red List once more information is available.

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3.3.8 Asiatic Golden Cat (*Catopuma temminckii*)

Near Threatened (McCarthy et al. 2015)

Red List history

Year	1986	1988	1990	1994	1996	2002*	2008	2015
cat. & crit.	I	I	I	I	LR/NT	VU C2a(i)	NT C	NT

*2001 the first Guidelines for assessing taxa applying Criterion A have been published, 2003 the first version covering all Criteria and definitions was published

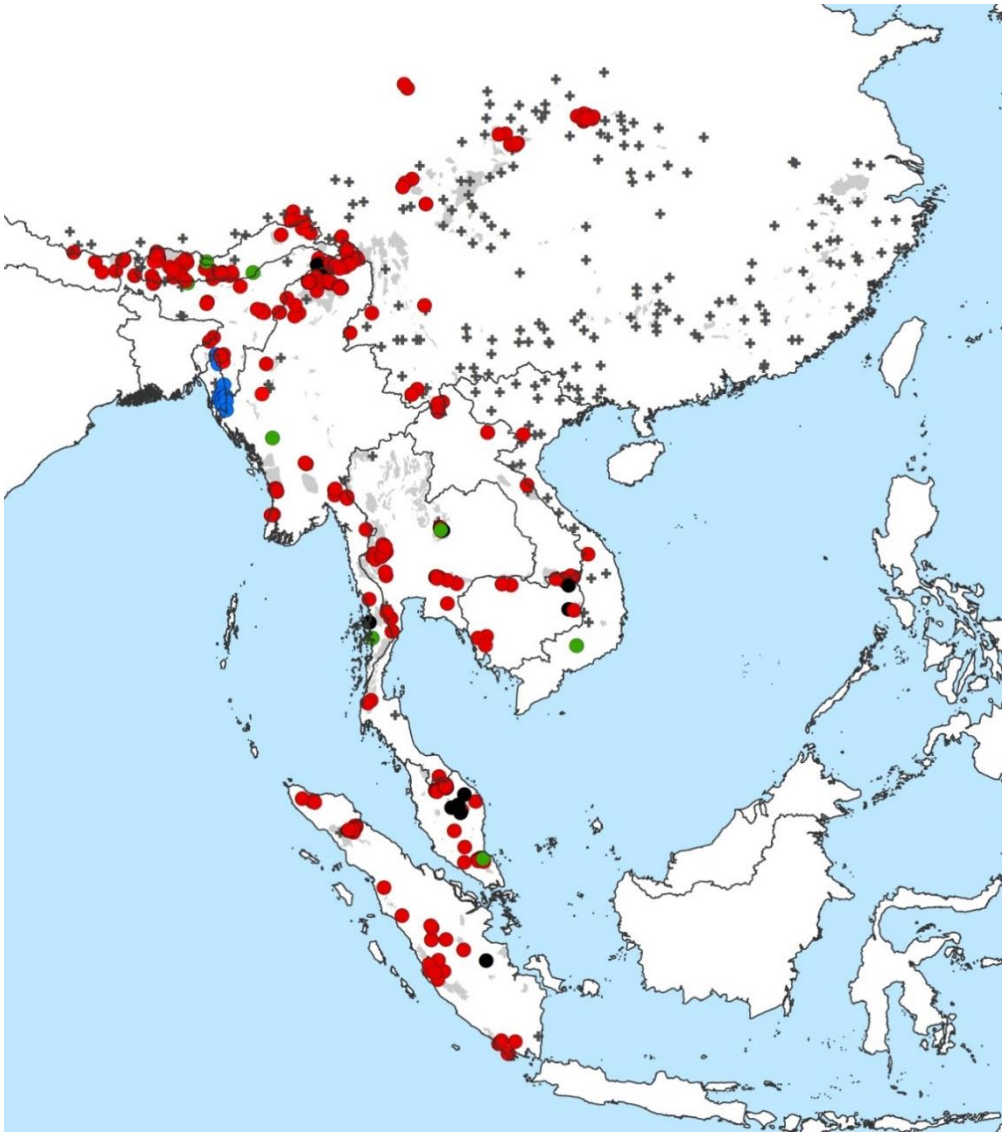

Fig. 3.3.8.1. Asiatic Golden Cat records from the CSGSD. Grey area = extant distribution according to the Red List; coloured dots = records since 2000; red = C1; blue = C2; green = C3, black = no Category; grey crosses = records up to 1999 or not dated. The Possibly Extinct range is not shown in the map.

Review of the Red List Assessment

Summary of the information from the latest available Red List Assessment (McCarthy et al. 2015) and *additional information available* (in italic).

Taxonomic Notes The Asiatic Golden Cat is currently suggested to consist of two subspecies, namely: *C. t. temminckii* and *C. t. moormensis* (Kitchener et al. 2017).

Justification: The Asiatic Golden Cat is listed as Near Threatened and thought to be very close to qualifying for Vulnerable under Criterion A. The assessment is based on a suspected population decline of over 20% and approaching 30% due to habitat loss and poaching. However, little data is available on the Asiatic Golden Cat and no density or population size estimates exist. This makes a status assessment challenging. The Asiatic Golden Cat has a wide distribution but in certain countries such as India, Bangladesh and Nepal, its distribution is limited and patchy (Datta et al. 2008, Kan 2008, Ghimirey and Pal 2009, Bashir et al. 2011, H. Rahman pers. comm.). It occurs only infrequently in eastern Cambodia, Lao PDR, Vietnam and south China with records indicating large population declines (and possibly soon extirpated) in the latter two (Duckworth et al. 1999, Johnson et al. 2006, Gray et al. 2012, 2014; Wilcox et al. 2014, P. Riordan pers. comm.). The species is widely distributed across Bhutan, Myanmar, Thailand, Malaysia and Sumatra, Indonesia but facing population declines (Ridout & Linkie 2009, Sunarto 2012, McCarthy 2013, McCarthy et al. 2015, K. Kawanishi pers. comm., S. Dahal pers. comm). The major threats to the species are habitat loss and fragmentation, and poaching (Nowell and Jackson 1996, Holden 2001, Grassman et al. 2005, Choudhury 2007, Wang 2007, McCarthy 2013, McCarthy et al. 2015). Land conversion and hydropower projects negatively impact the species. Asiatic Golden Cats are also increasingly poached to sell their pelt and body parts and is used as substitute for Tiger pelts and bones (Nowell and Jackson 1996, Duckworth et al. 1999, Lynam et al. 2006, Khan 2008, Aiyadurai et al. 2010, Pusparini et al. 2014, H. Rahman pers. comm., P. Riordan pers. comm., S. Mukherjee pers. comm., T. Gray pers. comm., S. Dahal pers. comm., A. Datta pers. comm., D. Willcox pers. comm.). In some areas it is indiscriminately killed by snares and by hunting and retaliatory killing due to livestock (mainly poultry) predation. These threats seem to be increasing (Holden 2001, Sunquist & Sunquist 2002, Khan 2008, McCarthy 2013, D. Willcox pers. comm.). The Asiatic Golden Cat population is thought to be declining across its range based on decreasing or lack of records of Asiatic Golden Cats in many areas and the increase of poaching. However, more data on the species is needed for a proper assessment and possibly will change its status to Vulnerable.

Geographical range: The Asiatic Golden Cat is found in north-east India, Bangladesh (north-east and Chittagong Hill tracts), eastern Nepal (Datta et al. 2008, Khan 2008, Ghimrey & Pal 2009, Bashir et al. 2011, Lyngdoh et al. 2011, Lalthanpuia et al. 2012, Borah et al. 2013, Velho 2013, H. Rahman pers. comm.), infrequently in Cambodia Lao PDR, Vietnam and south China (Duckworth et al. 1999, Johnson et al. 2006, Gray et al. 2012, 2014; Wilcox et al. 2014, P. Riordan pers. comm.) and widely in Bhutan, Myanmar, Thailand, Malaysia and Sumatra (Ridout & Linkie 2009, Sunarto 2011, Tempa et al. 2013, McCarthy 2013, McCarthy et al. 2015, T. Dhendup pers. comm., K. Kawanishi pers. comm., S. Dahal pers. comm). In Vietnam and south China, the Asiatic Golden Cat may be close to extinction and has already been extirpated from most of Vietnam due to indiscriminate snaring (Beijing Forestry University, unpublished data, Chinese State Forestry Administration, unpublished data, *Willcox et al. 2014*). The EOO is estimated at 1,633,537 km^2 and is thought to be declining. *In Bhutan the species was recorded in seven protected areas: Jigme Khesar Strict Nature Reserve, Jigme Dorji National Park, Jigme Singye Wangchuck National Park, Phibsoo Wildlife Sanctuary, Thrumshingla National Park, Wangschuck Centennial National Park, Royal Manas National Park and two districts outside of the protected areas in Trongsa and Wangdue phodrang but seems to be absent from the east of the country (Dhendup 2016). Recently, the Asiatic Golden Cat has also been reported from the Indian*

states Mizoram and Nagaland (Joshi et al. 2019). Recent confirmed records exist in all range countries but not across its current extant distribution range (Fig. 3.3.8.1). Especially in south China and north Thailand confirmed recent records are missing. However, there are also recent confirmed records of the Asiatic Golden Cat outside its current extent range such as in Bhutan (Dhendup & Dorji 2018, Ahmed et al. 1029, Tenzin et al. 2019, Wangyel et al. 2020), Cambodia (Edwards & Demski 2012, Gray et al. 2017), China (Li et al. 2016), India (Chatterjee et al. 2018, Ghose et al. 2019), Indonesia (Budhiana 2009, Kurniawan 2012, Sunarto et al. 2015, Poor et al. 2017, Ladyfandela et al. 2018, Radinal et al. 2019), Malaysia (Mohd Azlan & Sharma 2006, Bakri et al. 2018), Myanmar (Than Zaw et al. 2014, Niang et al. 2015, Longchar et al. 2017, Moo et al. 2017, Suzuki et al. 2019), Nepal (Nadig et al. 2016, Lama et al. 2019, Koju et al. 2020) and Thailand (Tantipisanuh et al. 2014, Siripattaranukul et al.).

Population: The Asiatic Golden Cat is assumed to reach similar abundances to other sympatric felids such as Clouded Leopard (*Neofelis diardi* and *N. nebulosa*) or Marbled Cat (*Pardofelis marmorata*). Their relative abundance varies significantly across their range (Holden 2001, Duckworth et al. 2005, Rao et al. 2005, Lynam et al. 2006, Mishra et al. 2006, Bashir et al. 2011, Sunarto 2011, McCarthy 2013, McCarthy et al. 2015). Its population is inferred to be declining and a population size reduction of 20–29% in the past is suspected. However, its population status is difficult to assess due to the lack of density estimates. *In Nepal, the Asiatic Golden Cat is listed as Data Deficient (Amin et al. 2018) and in Bangladesh as Vulnerable (IUCN Bangladesh 2015). In China, the species is even listed as Critically Endangered (Jiang et al. 2016).*

Habitat: The Asiatic Golden Cat inhabits mainly forested areas such as tropical and subtropical moist evergreen forests, mixed evergreen forests, and dry deciduous forests (Nowell and Jackson 1996, McCarthy 2013, McCarthy et al. 2015). The species can be found in closed forest habitats but also in open areas such as shrub, grasslands or open rocky areas. It has also been recorded from degraded or fragmented forest landscapes and forest fragments between coffee plantations (Duckworth et al. 1999, Holden 2001, Grassman et al. 2005, Choudhury 2007, Wang 2007, McCarthy 2013). Its habitat is inferred to be declining. The Asiatic Golden Cat has been recorded up to 3,960 m in India *and at 4,282 m in the montane forests of Wangchuck Centennial National Park, Bhutan (Dhendup 2016, Dhendup et al. 2016). The Asiatic Golden Cat is considered to be a habitat generalist without particular habitat preferences (Dhendup 2016). It also occurs in tropical forest (Dhendup 2016). As well as tropical and sub-tropical moist evergreen and dry deciduous forest, the species has also been recorded in areas of dwarf rhododendron forest and grasslands at high elevations, conifer forests (mainly Fir Tsuga Dumosa), cool broadleaf, mixed-conifer forests and in areas dominated by warm broad-leaved forests in Bhutan (Dhendup 2016). In Bhutan, the highlands may play an important role in the conservation of the Asiatic Golden Cat in the country. High altitude forest tracts are likely to act as natural corridors and lowlands are more prone to fragmentation and degradation due to increasing human activities (Dhendup et al. 2016). In the Ayeyarwady delta, Myanmar, the species was pictured in a mixed evergreen-deciduous forest, in the upland forest and at the mangrove-upland forest boundary. This habitat is possibly important to connect patches large evergreen forests (Suzuki et al. 2019).*

Ecology: The Asiatic Golden Cat was originally thought to be mainly nocturnal but according to recent findings, it seems to be mainly diurnal or crepuscular (Holden 2001, Grassman et al. 2005, McCarthy 2013, Dhendup 2016, *Singh & Macdonald 2017, Mukherjee et al. 2019, Wang et al. 2019, Kamler et al. 2020*). Home ranges of two individuals in Phu Kieu National Park, Thailand, were 33 and 48 km^2 for a female and a male respectively with high overlap (Grassman et al. 2005). According to scat analysis, the diet of the Asiatic Golden Cat includes Indochinese ground squirrel, rat and muntjac (Grassman et al. 2005). In the stomach of an Asiatic Golden Cat in Kaeng Krachan National Park, Thailand, a small snake was found (Grassman 1998). *In Jigme Dorji National Park, Bhutan, the Asiatic Golden Cat was active during day and night (Thinley et al. 2015). Occasionally, it takes domestic goats (IUCN Bangladesh 2015). In Malaysia remains of murids, small reptiles, Tragulus, and dusky leaf*

monkey (Trachypithecus obscurus) were found in scats of Asiatic Golden Cats (Koju et al. 2020). In a scat analysis study from Laohegou Nature Reserve, China, Temminck's tragopan (Tragopan temminckii), the Chinese bamboo rat (Rhizomys sinensis) and pikas (Ochotona spp.) were the most common prey species (Xiong et al. 2017). Besides, rats, voles, squirrels and birds, also remains of Wild boar (Sus scrofa), takin (Budorcas taxicolor), forest musk deer (Moschus berezovskii) and primates (golden snub-nosed monkey (Rhinopithecus roxellana) and Rhesus macaque (Macaca mulatta) were found (Xiong et al. 2017). In Myanmar in the Ayeyarwady delta, the Asiatic Golden Cat preyed mainly on mammals (rodents) followed by snakes and lizards (Suzuki et al. 2019). In Lao PDR, 13 prey species were found. Contrary to other studies, besides a variety of birds, rodents and shrews, Asiatic Golden Cats mostly preyed on ungulates followed by rodents and carnivores. The main prey species were muntjac, wild pig, mainland serow, domestic goat, palm civet and hog badger (Kamler et al. 2020). It seems that Asiatic Golden Cats are generalists and opportunistic foragers with a high niche breadth (Kamler et al. 2020). It preys mainly on small and medium-sized mammals, birds and lizards.

Use & Trade: Asiatic Golden Cat is poached for consumption and to sell its pelts and body parts (Nowell & Jackson 1996, Duckworth et al. 1999, Lynam et al. 2006, Khan 2008, H. Rahman pers. Comm., P. Riordan pers. Comm., S. Mukherjee pers. Comm., T. Gray pers. Comm., S. Dahal pers. Comm.). It is used for subsistence and traded commercially nationally and internationally. Its parts are used for food, medicine, clothing, accessories and handicrafts. The trend in offtake of the species from the wild is suspected to be increasing. Pelts have been traded along the Myanmar-Thailand and Myanmar-China border and Sumatra (Duckworth et al. 1999, Pusparini et al. 2014). Skins have also been reported in north-east India (Aiyadurai et al. 2010, A. Datta pers. Comm.). The Asiatic Golden Cat seems also to be used as substitute for Tiger skins and parts in Vietnam (D. Willcox pers. Comm.). The Asiatic Golden Cat seems to be commonly hunted by indigenous people in the Chittagong Hill Tracts (IUCN Bangladesh 2015). *In Myanmar, the meat of the species is sometimes consumed (Suzuki et al. 2019).*

In addition, the species is threatened by increasing levels of illegal hunting and poaching for consumption, and for the sale of pelts and body parts (Nowell and Jackson 1996, Duckworth *et al.* 1999, Lynam *et al.* 2006, Khan 2008, H. Rahman pers. Comm., P. Riordan pers. Comm., S. Mukherjee pers. Comm., T. Gray pers. Comm., S. Dahal pers. Comm.).

Threats: see Table 3.3.8.1.

Table 3.3.8.1. Threats to the Asiatic Golden Cat for different locations according to McCarthy et al. 2015 *and other sources*.

Threat	**Location**
Habitat loss (degradation & fragmentation)	Range-wide, *Bhutan (Dhendup 2016)* *Nepal (Rai et al. 2018, Koju et al. 2020)* *India (Nagaland Longchar et al. 2017)*
Illegal and incidental killing (targeted hunting for use and trade, persecution/control)	Range-wide *(especially high in China and Vietnam; Dhendup 2016*) *Bangladesh (IUCN Bangladesh 2015)* *Myanmar (Min et al. 2018, Suzuki et al. 2019)* *Nepal (Rai et al. 2018, Koju et al. 2020)* *Myanmar (Zaw et al. 2014, Nijman & Shepherd 2015)* *Vietnam (Willcox et al. 2014)* *Laos (Kamler et al. 2020)* *Sumatra (Weiskopf 2016)*
Pet trade	*Indonesia, Thailand (Siriwat et al. 2019)*
Prey depletion	*South-East Asia (Dhendup 2016)*
Diseases	*Nepal (Rai et al. 2018)*

Knowledge base

The knowledge on the Asiatic Golden Cat is limited. Most of the information on the ecology and habitat of the species goes back to a few studies. Generally, there are very few studies focusing on the species. Most records originate from by-catch data collected during Tiger or other biodiversity surveys. Confirmed records of the species do not exist across its whole current extant range but the Asiatic Golden Cat has also been confirmed outside its current extant range (Fig. 3.3.8.1). There is no information on population size, abundance or trend of the species. Habitat types used and diet is largely known. There is also information on its activity pattern but only two home range estimates from one site. Since the last assessment in 2015, new information on its distribution and habitat use, as well as quite some new information on its diet is available but the knowledge on its population and threats remains limited. With regard to use and trade, only the purpose of use is known and that individuals are caught both incidentally and intentionally. The amount of trade is however unknown but suspected to be increasing. General threats are known from large parts of its range. Impacts of the threats on the species and their scope are however not known. Neither a conservation strategy or action plan exists. The Asiatic Golden Cat is included in two networks and few projects.

Evaluation of the Red List Assessment

Little information is available on the Asiatic Golden Cat, making an evidence-based assessment for the species challenging. Furthermore, the assessment needs to be revised according to the updated RLA Guidelines in its next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species. In this regard, the following points should be addressed in the next re-assessment:

- The subcriteria under which the species qualifies as Near Threatened should be stated;
- Where available the Justification should include more information to justify the Category;
- Further explanations and evidences for the current decline in mature individuals and the past population decline of 20–29% should be provided as well as for the inferred continuing decline in area, extent and/or quality of habitat;
- Information on use and trade is included under the Threat section but should be integrated into the section Use and Trade;
- Few of the then available publications seem to not have been considered, e.g. Bhudiana 2008, Li et al. 2010, Sathyakumar et al. 2011, Edwards et al. 2012, Li et al. 2012, Chakraborty et al. 2013, Haidir et al. 2013 and Selvan 2013. These publications include information on distribution records.

The listing as Near Threatened under Criterion A (Subcriteria not specified; Appendix I) is based on a suspected population decline of 20–29% in recent years due to habitat loss and poaching across the species range. Further explanations would help the reader to understand the reasoning behind this decline.

Table 3.3.8.2. Evaluation matrix of the Asiatic Golden Cat. According to the criteria and requirements defined in the methods section, the information integrated into the last RLA, the consistency of the RLA and the new available information since the last RLA have been evaluated.

	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Information used in RLA	🟡	🔴	🟡	🔴	🟡	🟡
Consistency of RLA	🟢	🟡	🟢	🟢	🔴	🟢
New information since last RLA	🟢	🔴	🟢	🟡	🔴	🟡

Conclusions and recommendations

An evidentiary RLA of the Asiatic Golden Cat is difficult because of the paucity of data (Table 3.3.8.2). Few specific projects have been conducted on this species, and most records originate from bycatches of camera-trapping studies focusing on other target species. Hence, the distribution information available for this species is very limited (Fig. 3.3.8.1). Most relevant information was considered in the last RLA (Table 3.3.8.2). Limited new knowledge is available for this species (Table 3.3.8.2). Although, there is little new information on the Asiatic Golden Cat available, it should be re-assessed for the IUCN Red List and the points raised above should be addressed.

Foremost, our knowledge base on the Asiatic Golden Cat must be broadened. There is a need for:

- Confirmation of the Asiatic Golden Cat's distribution (incl. gathering more by-catch data from camera-trapping surveys of other target species);
- Quantitative data on Asiatic Golden Cat abundance and/or densities;
- Research on the threats and their impacts on the Asiatic Golden Cat;
- Information about the Asiatic Golden Cat's ecology;
- Establishment of a conservation plan, where appropriate;
- Establishment of a research network;
- Amendment of the assessment and re-assessment of the species for the IUCN Red List as soon as more information is available.

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4. Conclusion

Having "assessed the assessments" for the individual species (→ Chapter 3), we now need to take a step back again to consider the bigger picture. Consequently, the following chapters will collate the findings (→ Chapter 4.1) before we discuss specific aspects of the situation of the small cats within the Species Conservation Cycle ASSESS (→ Chapter 4.2), PLAN (→ Chapter 4.3) and ACT (→ Chapter 4.4).

4.1 Evaluation of knowledge base and IUCN Red List Assessment

4.1.1 Evaluation of quality of information and knowledge presented in the last Red List Assessment

The information available and/or used in the last RLAs of the small cat species was generally not sufficient based on our evaluation scheme (→ Table 2.1). For most species, information on their distribution is available within the majority of their range countries (yellow) and for some recent records (after 2000) for most of their range countries exist (green; Fig. 4.1 & Table 4.1). Information for the population and threats of species is mediocre (yellow) or even poor (red) for all species (Fig. 4.1 & Table 4.1).

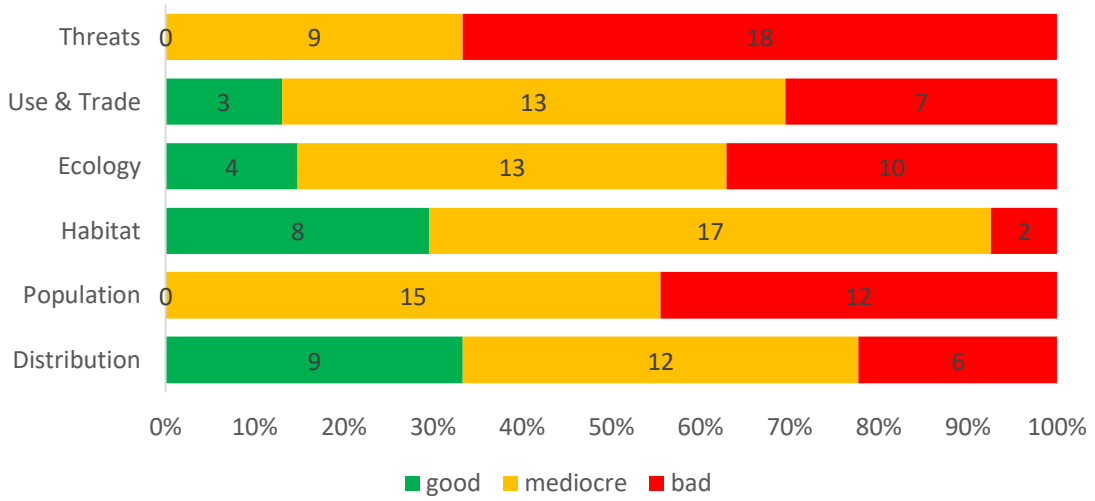

Fig. 4.1. Evaluation of the quality of information and knowledge per RLA chapter categorised in good, mediocre and bad (→ Methods and Table 2.1 for details) in percentage. The total numbers of assessments are shown.

A global population estimate based on scientific methods is unavailable for all species, and hence the range-wide population trend is not really known. For 44% of the species, global guestimates are not available, and not even reliable density/abundance estimates from at least three sites in different parts of their range exist. General information on habitat preferences and use across the range exists for the majority of the species, but only for 15% of the species, detailed information on their ecology is available. Ecological information is missing mostly for species of Tropical Asia. Detailed information on use and trade of a species including recent knowledge on source and destination countries and the purpose and quantities is only available for 11% of the small cats. For the Sand Cat, Rusty-spotted Cat, Jaguarundi and Guiña, use and trade was not elaborated in the latest RLAs. Detailed recent information on main threats and their impacts on the population across the range is not available for any species (Fig. 4.1. & Table 4.1).

Table 4.1. Evaluation of the quality of information and knowledge presented in the last Red List Assessment per small cat species per RLA section categorised according to good, mediocre or bad (→ Methods).

Species	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Neotropics						
Andean Cat	🟢	🟡	🟢	🟡	🟡	🟡
Pampas Cat	🔴	🟡	🔴	🟡	🟡	🔴
Ocelot	🟡	🟡	🟡	🟢	🔴	🔴
Margay	🟡	🟡	🟡	🔴	🟡	🟡
Jaguarundi	🔴	🔴	🟢	🟢	⚫	🔴
Southern Tiger Cat	🟡	🟡	🟡	🟡	🟡	🔴
Northern Tiger Cat	🟡	🟡	🟡	🟡	🟡	🔴
Geoffroy's Cat	🔴	🔴	🟡	🟢	🟡	🔴
Guiña	🟢	🟡	🟢	🟡	⚫	🟡
Africa and Eurasia						
Jungle Cat	🔴	🔴	🟢	🟡	🟡	🟡
Black-Footed Cat	🟡	🟡	🔴	🟡	🔴	🔴
Sand Cat	🟡	🟡	🟡	🟡	⚪	🟡
Chinese Mountain Cat	🟢	🟡	🟡	🔴	🔴	🔴
European Wildcat	🟡	🟡	🟢	🟢	🟡	🟡
Afro-Asiatic Wildcat	🟡	🔴	🟡	🟡	🟢	🔴
Pallas's Cat	🟢	🟡	🟢	🟡	🟢	🟡
Serval	🔴	🔴	🟡	🔴	🟡	🔴
African Golden Cat	🔴	🔴	🟡	🔴	🔴	🔴
Caracal	🟡	🔴	🟡	🟡	🔴	🔴
Tropical Asia						
Rusty-Spotted Cat	🟢	🔴	🟢	🔴	⚪	🔴
Flat-Headed Cat	🟡	🟡	🟡	🔴	🔴	🔴
Fishing Cat	🟢	🔴	🟡	🟡	🟢	🔴
Mainland Leopard Cat	🟢	🟡	🟢	🟡	🟡	🟡
Sunda Leopard Cat	🟢	🔴	🟡	🔴	🟡	🔴
Marbled Cat	🟡	🔴	🟡	🔴	🟡	🔴
Borneo Bay Cat	🟢	🟡	🟡	🔴	🔴	🔴
Asiatic Golden Cat	🟡	🔴	🟡	🔴	🟡	🟡

4.1.2 Evaluation of the consistency of the Red List Assessment per species per chapter/feature

The RLA Guidelines have been updated since many of the last assessments have been published. Therefore, there is a need to revise the RLAs according to the new Guidelines and to enhance the consistency of the assessments and the application of the Red List rules within and between the assessments of the small cat species. Most inconsistencies or shortcomings identified in older RLAs (→ species chapters) are reflected in recent changes in the IUCN Red List Guidelines, which are regularly updated. The consistency of the individual RLAs and the correct application of the RLA Guidelines are generally medium to good, but there is still a need for improvement in several aspects of the assessment of many species (Fig. 4.2. & Table 4.2). For 37% of the species, one or more aspects were found to have major issues needed to be addressed in the next RLA of the species. Most issues are related to the Distribution, Population, Threat and Use and Trade section (Fig. 4.2 & Table 4.2).

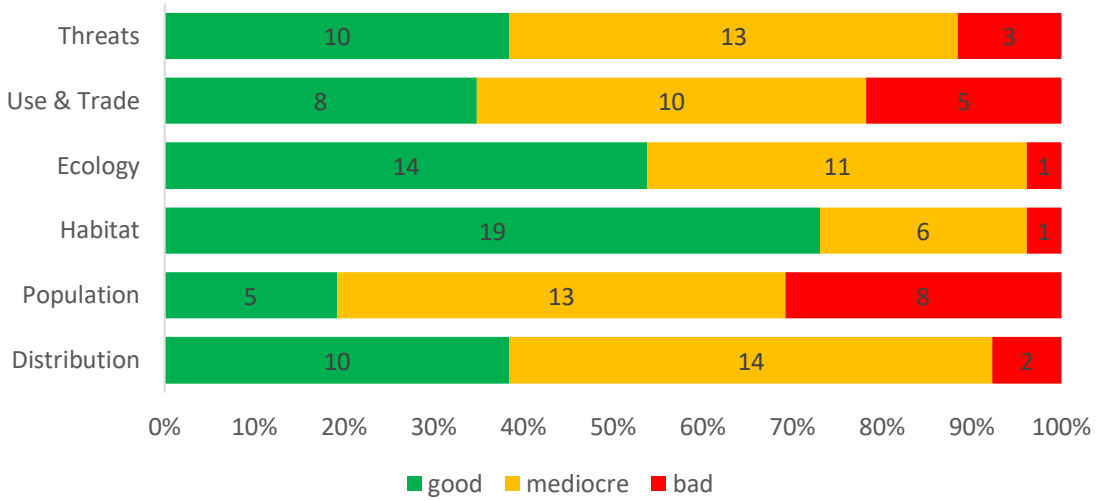

Fig. 4.2. Evaluation of the consistency of the RLA per RLA chapter categorised in good, mediocre and bad (→ Methods) in percentage. The total numbers are shown.

Based on the updated RLA Guidelines, 29% of the species had major points that need to be addressed, while 48% had minor points that need to be improved. Several assessments applied a precautionary rather than an evidentiary approach regarding the assumed population size or trend, but evidence or indications to justify the arguments and criteria applied are too often insufficient. The assessment of the RLAs of the small cat species of Africa and Eurasia did not reveal major issues to be addressed. With regard to the cat species of the Neotropics, the Population section as well as the Use and Trade parts of the RLAs should be revised according to the new RLA Guidelines. The same is true to some of the small cat species in Tropical Asia (e.g. Flat-Headed Cat, Rusty-Spotted Cat; Fig. 4.2 & Table 4.2). The sections on Habitat and Ecology were consistent for the majority of the species. In all the other sections of the RLAs, we found minor and major points that need to be addressed in future assessments.

Table 4.2. Evaluation of the consistency of the Red List Assessment per small cat species per RLA chapter categorised according to good, mediocre or bad (→ Methods).

Species	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Neotropics						
Andean Cat	🟢	🟡	🟢	🟢	🟡	🟡
Pampas Cat	🟡	🟡	🟡	🟡	🟡	🟡
Ocelot	🟡	🟡	🟡	🟡	🔴	🟡
Margay	🟡	🔴	🟢	🟢	🔴	🟡
Jaguarundi	🔴	🔴	🟢	🟡	⚪	🟡
Southern Tiger Cat	🟡	🔴	🔴	🟢	🔴	🟡
Northern Tiger Cat	🟡	🔴	🟢	🟢	🟡	🟢
Geoffroy's Cat	🔴	🔴	🟡	🟢	🟡	🔴
Guiña	🟡	🔴	🟡	🟡	⚪	🟡
Africa and Eurasia						
Jungle Cat	🟡	🟡	🟢	🟢	🟡	🟢
Black-Footed Cat	🟢	🟡	🟢	🟡	🟢	🟢
Sand Cat	🟢	🟢	🟢	🟢	⚪	🟢
Chinese Mountain Cat	🟢	🟡	🟢	🟢	🟢	🟢
European Wildcat	🟢	🟢	🟢	🟢	🟢	🟡
Afro-Asiatic Wildcat	🟢	🟢	🟢	🟢	🟢	🟢
Pallas's Cat	🟢	🟡	🟢	🟢	🟢	🟢
Serval	🟡	🟡	🟢	🟡	🟡	🟡
African Golden Cat	🟡	🟡	🟢	🟡	🟢	🟢
Caracal	🟡	🟢	🟢	🟢	🟡	🟡

Tropical Asia						
Rusty-Spotted Cat	●	●	●	●	●	●
Flat-Headed Cat	●	●	●	●	●	●
Fishing Cat	●	●	●	●	●	●
Mainland Leopard Cat	●	●	●	●	●	●
Sunda Leopard Cat[1]	●	●	●	●	●	●
Marbled Cat	●	●	●	●	●	●
Borneo Bay Cat	●	●	●	●	●	●
Asiatic Golden Cat	●	●	●	●	●	●

4.1.3 Evaluation of new information available per species per chapter since the last Red List Assessment

For most of the species considered in our report, there is, based on our online research (→ Chapter 2), very little new information available since the previous RLA (Fig. 4.3 & Table 4.3). However, we did not consider unpublished or grey literature and did not specifically reach out to any organisation, institution or species experts to collect additional information to the one found online. We are aware that several small cat projects are and have been conducted within the last years for which the results may not (yet) be publicly available. This has to be considered when interpreting the results and conclusions presented here.

We have detected important new information for one or two aspects to be considered in a future RLA since the last assessment for 37% of the species. An exception is the Serval, for which we found important new information concerning four out of six RLA sections. Again, the population information is mostly lacking; for two thirds of the species, no new important information was detected. For 44% of the species, some new information on Use and Trade is however available (Fig. 4.3 & Table 4.3).

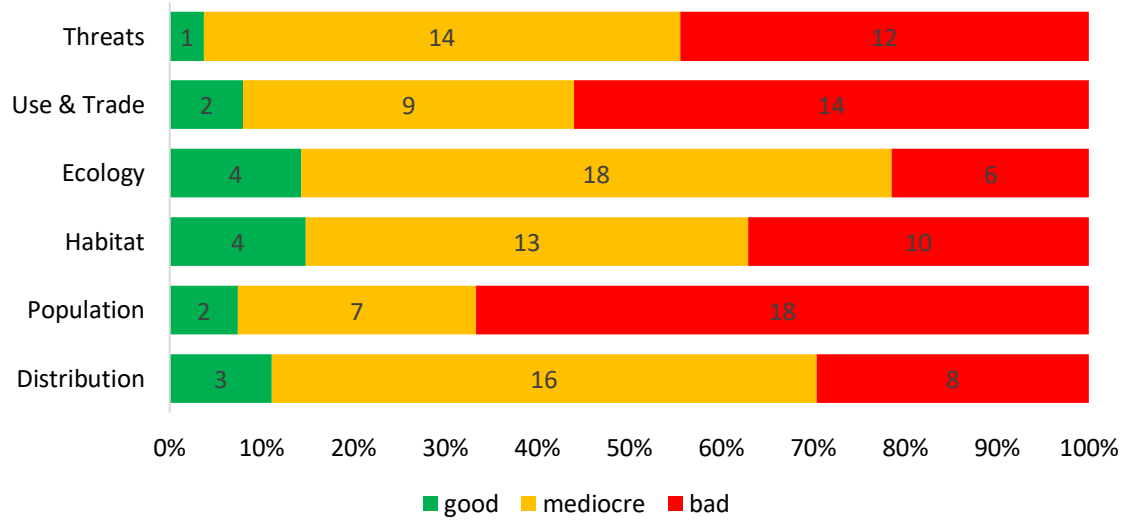

Fig. 4.3. Evaluation of new information available per RLA chapter categorised in good, mediocre and bad (→ Methods) in percentage. The total numbers are shown.

Understandably, new information is more likely to be available for those species that have not been re-assessed in the past few years (→ species chapters and Table 4.3).

Generally, there is a need for sharing and collecting more information and data on the small cat species (Table 4.1 & 4.3) to inform assessments and subsequent conservation planning Only for few species, the information (made) available and hence integrated into the last RLA seems to be adequate

(e.g. Andean Cat, Guiña, European Wildcat, Pallas's Cat and Mainland Leopard Cat; Table 4.1). For some species, more information would be available, but has not been publicised. In large parts of the realm of small cat species, studies on larger cats or other species are taking place, which could provide valuable information also for the small cats if made available, e.g. as a by-product of (camera trapping) surveys. Generally, it would be important to make findings and results of small cat projects and programmes more easily available for the general conservation community so that this information can be fed into the Species Conservation Cycle and enhance the (global) conservation of the respective small cat species.

Table 4.3. Evaluation of new information available per small cat species and per RLA chapter since the last RLA categorised according to good, mediocre or bad (→ Methods).

Species	Distribution	Population	Habitat	Ecology	Use & Trade	Threats
Neotropics						
Andean Cat	🟡	🔴	🔴	🟡	🔴	🟡
Pampas Cat	🟡	🔴	🟡	🟡	🔴	🟡
Ocelot	🟡	🟡	🟡	🟢	🟡	🟡
Margay	🔴	🔴	🟡	🟡	🔴	🔴
Jaguarundi	🟡	🔴	🟡	🟡	🟡	🟡
Southern Tiger Cat	🟡	🔴	🔴	🟢	🔴	🟡
Northern Tiger Cat	🟢	🟢	🔴	🟡	🟡	🟡
Geoffroy's Cat	🔴	🔴	🟡	🟢	🟡	🔴
Guiña	🟡	🔴	🟡	🟡	⚪	🟡
Africa and Eurasia						
Jungle Cat	🟡	🟡	🟡	🔴	🟡	🟡
Black-Footed Cat	🔴	🔴	🔴	🟡	🔴	🔴
Sand Cat	🔴	🔴	🟡	🟡	⚪	🔴
Chinese Mountain Cat*	🔴	🔴	🔴	🔴	🔴	🔴
European Wildcat*	🟡	🟡	🟡	🟡	🔴	🔴
Afro-Asiatic Wildcat*	🔴	🔴	🔴	🔴	🔴	🔴
Pallas's Cat**	🟡	🔴	🔴	🔴	🔴	🟡
Serval	🟢	🟡	🟢	🟢	🟡	🟢
African Golden Cat	🟡	🟡	🟡	🟡	🔴	🔴
Caracal	🟡	🟡	🔴	🟡	🟢	🟡
Tropical Asia						
Rusty-Spotted Cat	🟡	🔴	🟢	🟡	🟡	🟡
Flat-Headed Cat	🟡	🔴	🔴	🟡	🟡	🔴
Fishing Cat	🟡	🟡	🟡	🟡	🔴	🟡
Mainland Leopard Cat*	🔴	🔴	🔴	🟡	🔴	🔴
Sunda Leopard Cat	🔴	🔴	🟢	🟡	🟢	🔴
Marbled Cat	🟡	🟢	🟡	🟡	🟡	🔴
Borneo Bay Cat	🟡	🔴	🟡	🔴	🔴	🟡
Asiatic Golden Cat	🟢	🔴	🟢	🟡	🔴	🟡

*Species have been re-assessed in 2022

** Species has been re-assessed in 2020

4.2 ASSESS: Comparative evaluation of the IUCN Red List Assessment for small cats

Most small cat species are classified as Least Concern (12 of the 27 species considered in this report), followed by Vulnerable (7), Near Threatened (5) and Endangered (3; Fig. 4.4). All the small cat species are assessed under Criterion A or C (Fig. 4.5 → Appendix I for Categories and Criteria). Most have been classified under C1 (small population size and decline) and A2 (Population size reduction in the past where causes of reduction may not have ceased OR may not be understood OR may not be reversible). Classification under the Criterion C requires more data and information and accommodates less uncertainty than the classification under Criterion A (→ Appendix I).

For Criterion C1, the number of mature individuals must be estimated and the continuing decline in mature individuals must be observed, projected or estimated (compared to just inferred or suspected). For Criterion C2a(i) again the number of mature individuals must be estimated but the continuing decline in mature individuals can additionally be inferred and need not to be observed, estimated or projected. Thus, for population decline, more uncertainty or speculation is allowed under C2a(i) than under C1. However, for C2a(i), the subpopulations must be well delineated, based on a clearly explained definition. For C2a(i) the number or relative share of mature individuals (MI) in the subpopulations must be estimated. Inferred or suspected population sizes are not sufficient to apply Criterion C together with good information on subpopulations. This is a challenge for some small cat species listed under Criterion C (→ 3.2.2. Black-Footed Cat for an example).

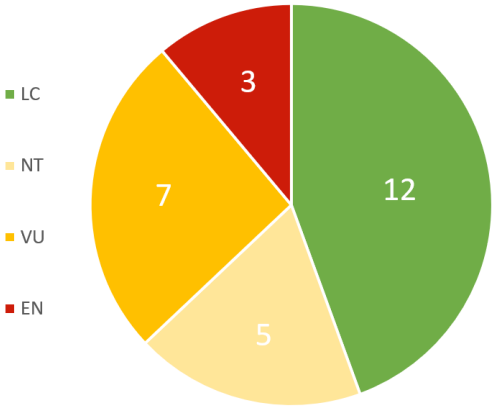

Fig. 4.4. Categories applied for assessed small cat species. LC = Least Concern, NT= Near Threatened, VU = Vulnerable, EN = Endangered.

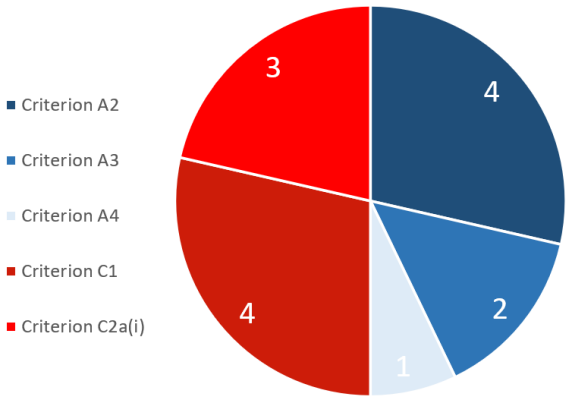

Fig. 4.5. Criteria applied for assessed small cat species. Criterion A: Population size reduction (A2 in the past, A3 in the future, A4 including past, present and future), Criterion C: Small population size and decline (C1 small population size and continuing decline, C2a(i) small population size, continuing decline and subpopulations size and composition). The Criterion was not specified for all species classified as NT and some species were classified under more than one Criterion.

Criterion A allows for more data uncertainty and to base the decline in population size more on assumptions. The population size reduction can be observed, estimated, inferred or suspected for the Subcriteria A2 (population size reduction in the past, causes of reduction may not be reversible or may not be understood or may not have ceased). For Subcriteria A4 (population size reduction over a period including both past and the future, causes of reduction may not be reversible or may not be understood or may not have ceased) the (future) trend can additionally be projected and for A3 (population size reduction in the future) projected, inferred or suspected development is allowed to be used. For all Subcriteria, the percentage of reduction in population size as well as the basis of the population size reduction must be defined (→ Appendix I). In this respect, caution has to be paid, as

not all data qualifiers can be linked to all bases of reduction (→ IUCN Red List Guidelines V. 15.1, July 2022). Species with little information and a lot of data uncertainty, are more likely to be classified under Criterion A, which requires less information and lower data quality for its application than Criterion C.

In any case, correct application of the Criteria A, B and C implies that the assessors fully understand the data qualifiers: estimated, observed, suspected, inferred, and projected. In several of the 2014–2016 RLAs, the qualifiers were not strictly applied. Since then, the IUCN Red List Guidelines (Version 15.1, 2022) have been specified and clarified in this respect. For example, an inferred population reduction must be derived from indirect evidence using variables of the same general type (e.g. mortalities, harvest data, observation indices). Accordingly, the "continuing decline" stated in some of the older RLAs would today be classified as suspected and not inferred. Such changes are not just semantic, as the qualifiers define the Criterion to be applied for the assessment (e.g. for Criterion C2a(i), the decline cannot be suspected).

In several RLAs, some of the information is not disclosed in the appropriate section of the RLA and/or the Justification contains some information not presented anywhere else in the assessment. The Justification should in fact only highlight the key factors for the listing of the species and justify it but not present additional information not included in the assessment elsewhere. Details must be provided in the appropriate sections of the RLA. Some RLAs also suffer from inconsistencies in-between sections.

Generally, one of the main challenges, when assessing small cat species, is the (very) limited data base. For many species, information on population trends, structure and status, and even on distribution is too limited to carry out robust assessments. One reason for this is that relatively few in situ projects focusing on basic biology and ecology of these species have been done so far, and that findings from small-scale and short-term projects (e.g. from master thesis projects) are often not readily available as not published in scientific journals. In contrast to the big cat species, funding and resources for studying small cat species is still modest – although increasing, limiting research and conservation. Well-performed and published studies on small cats often cover only one or few localities of their total range and might not be representative of the global situation. For many species, distribution records mainly originate from (unconfirmed) observations or by-catch data from studies focusing on other species and are therefore biased in several ways. To get access to this data is not always straight forward. Even though for many species, threats are largely known, their impact on and significance for the species generally are not understood.

Based on the points listed above, only suspected or inferred information based on (generic) expert knowledge can be used in many cases. In several RLAs, a predicted or suspected population decline is based on opinions or on observed and assumed threats to the species without understanding their impact on the populations. Due to limited knowledge on the majority of the small cat species, it is challenging or even impossible to conduct an evidentiary RLA. In contrast to the recommendations in the IUCN Red List Guidelines, the Cat Specialist Group however prefers an evidentiary approach to an assessment wherever the data base allows it, with relatively frequent repetitions of the assessment. Several assessors tend to favour a precautionary assessment because they feel that this is more cautious and less complicated. The latter is however not true, as a defensible precautionary assessment must be very carefully and convincingly justified, and this is often more difficult to do than for evidentiary, data-based assessments. In addition, a precautionary assessment leaves a bit more room for a pessimistic view, what can however later require an indefensible down-listing, as better data on the populations become available (e.g. formerly over-estimated decrease could lead to a down-listing in a follow-up assessment, in spite of the fact that the population is continuously shrinking, but less fast than previously assumed). Independent of the approach, it is important that the Justifica-

tions (the rational for the Criterion chosen and the resulting Category) of the RLAs are generally further elaborated and include more detailed explanations and/or evidence for the listing of the species. For several species, further explanations and details would make it easier to understand their classification under a certain Category and Criterion.

Overall, the main problems with to RLAs of small cat species are the generally weak supporting data bases for most species, impeding evidentiary assessments, and the misunderstanding of certain RLA definitions, which have partly been addressed in the updated IUCN Guidelines for using the IUCN Red List Categories and Criteria (2022, V 15.1). Thus, the assessments need to be revised according to the updated RLA Guidelines in their next iteration to enhance the consistency of the assessment and the application of the Red List rules within and between the assessments of the (small) cat species.

Ideally, mammal species should be re-assessed every 5–10 years. Accordingly, the RLA for many of the species considered in our report need to be updated (Table 4.4). However, this is a tremendous task and a considerable amount of work for a network of volunteers. For many of the large cats, scientific institutions and large conservation organisations maintain long-term research and/or conservation programmes, which provide a constant flow of information. This is generally not the case for the smaller cats. Therefore, networks are more important for the small cat species. As such networks are not yet in place for all small cat species (→ Chapter 4.4), assessment teams need to be organised more opportunistically, as new relevant information on a species is available. When there is any evidence that the status of a species has worsened, a re-assessment should be conducted irrespective of the length of time since the last RLA. Nevertheless, such a "warning system" requires small cat experts who consistently observe and keep abreast of population trends and exchange information. This emphasises again the importance of networks for small cats.

Table 4.4. Overview of RLAs of the small cat species by region and upcoming assessments (stand autumn 2023).

Species	Former			Latest				Remarks
	Year	Cat	Crit	Year	Cat	Crit		
Neotropics								
L. jacobita	2008	EN	C2a(i)	2016	EN	C2a(i)	→	Currently being re-assessed
L. colocola	2008	NT		2015	NT	A2c	→	2008: close to VU A3 2015: close to VU A2c
L. pardalis	2008	LC		2015	LC		→	
L. wiedii	2008	NT		2015	NT		→	2008: likely VU A4c future 2015: likely VU A3cde future
H. yagouaroundi	2008	LC		2015	LC		→	2008: close to NT A3c 2015: close to NT A3c Currently being re-assessed
L. guttulus	2008	VU	A3c	2016	VU	C1	→	2008 assessed together with *L. tigrinus*
L. tigrinus	2008	VU	A3c	2016	VU	A2c	→	2008 assessed together with *L. guttulus*
L. geoffroyi	2008	NT	A	2015	LC		↘	
L. guigna	2008	VU	A2a; C2a(i)	2015	VU	A2abc; C2a(i)	→	Currently being re-assessed
Africa & Eurasia								
F. chaus	2008	LC		2016	LC		→	
F. nigripes	2008	VU	C2a(i)	2016	VU	C2a(i)	→	Currently being re-assessed
F. margarita	2011	NT		2016	LC		↘	
F. bieti	2015	VU	C2a(i)	2022	VU	C1	→	
F. silvestris	2015	LC		2022	LC		→	2015 assessed together with *F. lybica*
F. lybica	2015	LC		2022	LC		→	2015 assessed together with *F. silvestris*

Table 4.4. Overview of RLAs of the small cat species by region and upcoming assessments (stand autumn 2023).

Species	Former			Latest				Remarks
	Year	Cat	Crit	Year	Cat	Crit		
O. manul	2016	NT		2020	LC		↘	
L. serval	2008	LC		2015	LC		→	
C. aurata	2008	NT	A2bcd	2015	VU	A2c + A3c	↗	Currently being re-assessed
C. caracal	2008	LC		2016	LC		→	
Tropical Asia								
P. rubiginosus	2008	VU	C2a(i)	2016	NT	A3c	↘	
P. planiceps	2010	EN	C1 + C2a(i)	2015	EN	C1	→	
P. viverrinus	2008	VU	A2cd+4cd	2016	VU	Acd+3cd+4cd	→	Currently being re-assessed
P. bengalensis	2015	LC		2022	LC		→	2008 and 2015 assessed together with *P. javanensis*
P. javanensis	2008	LC		2015	LC		→	2008 and 2015 assessed together with *P. bengalensis*
P. marmorata	2008	VU	C1+2a(i)	2016	NT	A or C	↘	
C. badia	2008	EN	C1	2016	EN	C1	→	
C. temminckii	2008	NT	C	2015	NT		→	Currently being re-assessed

4.3 PLAN: Conservation plans

Although 10 of the small cat species have been assessed in a threatened Category (Vulnerable or higher → Chapter 4.2), range-wide conservation strategies only exist for three species: the Andean Cat, the Pallas's Cat and the Fishing Cat. The strategy for the Guiña includes Chile, but not Argentina, where the species has a small portion of its range. Strategies/Action plans for part of the range exist for the Ocelot, Jaguarundi, Sand Cat, European Wildcat, Flat-Headed Cat, Sunda Leopard Cat, Marbled Cat and Borneo Bay Cat (Table 4.5).

Table 4.5. Overview on existing conservation plans.

Species	Conservation plan	Range	Pub. year
Neotropics			
Andean Cat*	Andean Cat Conservation Action Plan Strategic Plan for Andean Cat Conservation	Range wide	2004 2011
Pampas Cat	-		
Ocelot	USFWS Recovery Plan for the Ocelot	Part of range	2016
Margay	-		
Jaguarundi	Gulf Coast Jaguarundi Recovery Plan (U.S. Fish and Wildlife Service, 2013)	Part of range	2013
Southern Tiger Cat	-		
Northern Tiger Cat	-		
Geoffroy's Cat	-		
Guiña	Plan Nacional de Conservación de Guiña (*Leopardus guigna*) en Chile (Zúñiga et al. 2017)	Part of range	2017
Africa and Eurasia			
Jungle Cat	-		
Black-Footed Cat	-		
Sand Cat	Arabian Sand cat status review and conservation strategy	Part of range	2014

Table 4.5. Overview on existing conservation plans.

Species	Conservation plan	Range	Pub. year
Chinese Mountain Cat	-		
European Wildcat	Action Plan for the conservation of the European wildcat in Austria (Slotta-Bachmayr et al. 2012)	Part of range	2012
	Action Plan for wildcat in Luxembourg (Schneider et al. 2014)		2014
	Scottish wildcat Conservation Action Plan (SNH 2013) – until 2020		2013
	Action Plan for European wildcat in Germany (Birlenbach et al. 2009)		2009
Afro-Asiatic Wildcat	-		
Pallas's Cat	Pallas's Cat Status Review & Conservation Strategy	Range wide	2019
Serval	-		
African Golden Cat	-		
Caracal	-		
Tropical Asia			
Rusty-Spotted Cat	-		
Flat-Headed Cat	Carnivore Conservation Plan for Borneo (Mathai et al. 2016), elaborated at the Borneo Carnivore Symposium, June 2011 (Wilting et al. 2016).	Part of range	2011
Fishing Cat	Fishing Cat Conservation Strategy (In First International Fishing Cat Conservation Symposium; Appel & Duckworth 2016)	Range wide	2016
Mainland Leopard Cat	-		
Sunda Leopard Cat	Carnivore Conservation Plan for Borneo (Mathai et al. 2016), elaborated at the Borneo Carnivore Symposium, June 2011 (Wilting et al. 2016)	Part of range	2011
Marbled Cat	Carnivore Conservation Plan for Borneo (Mathai et al. 2016), elaborated at the Borneo Carnivore Symposium, June 2011 (Wilting et al. 2016)	Part of range	2011
Borneo Bay Cat	Carnivore Conservation Plan for Borneo (Mathai et al. 2016), elaborated at the Borneo Carnivore Symposium, June 2011 (Wilting et al. 2016)	Part of range	2011
Asiatic Golden Cat	-		

*2011-2016

4.4 ACT: Networks

As an entity, the Cat SG is largely restricted in its work to the ASSESS and PLAN components of the Species Conservation Cycle. Whilst the products from these components feed into the ACT component, it is not the Cat SG that can implement the resulting actions and projects that in return produce data feeding back into the ASSESS component. Whilst members of the Cat SG ACT in *in situ* conservation projects, the Cat SG itself is also limited in the number of people it can administer.

In recent years, an increasing number of working groups and networks for small cat species have been established (Table 4.6), also thanks to a substantial increase of funding for small cat species over the last few years. Only the Chinese Mountain Cat, the Afro-Asiatic Wildcat, the Serval, the Caracal, the Jungle Cat and the Mainland Leopard Cat do not have associated working groups until now.

The Cat SG is looking to strengthen its collaboration with these working groups. As of November 2023, Memorandums of Understanding (MoUs) have been signed with 3 of these small cat working

groups: the African golden cat Conservation Alliance & Working Group, the Guiña Working Group and the Manul Working Group. More shall follow in the future. The goal of these MoUs with the working groups are to help fostering the data exchange between people working on the same species, to tighten the link between ASSESS, PLAN and ACT and to improve the feedback loop through these components.

Table 4.6. Overview on existing networks.

Species	Networks
Neotropics	
Andean Cat*	Andean Cat Alliance (Allianza Gato Andino AGA)
Pampas Cat	Pampas Cat Working Group
Ocelot	Ocelot Working Group
Margay	Ocelot Working Group
Jaguarundi	Ocelot Working Group
Southern Tiger Cat	Tiger Cats Conservation Initiative
Northern Tiger Cat	Tiger Cats Conservation Initiative
Geoffroy's Cat	Geoffroy's Cat Working Group
Guiña	Guiña Working Group
Africa and Eurasia	
Jungle Cat	-
Black-Footed Cat	Black-footed Cat Working Group
Sand Cat	Sand cat working group, Sand cat Sahara Research Team
Chinese Mountain Cat	-
European Wildcat	EuroWildcat, Europe
Afro-Asiatic Wildcat	-
Pallas's Cat	Pallas's Cat Working Group, Pallas's Cat International Conservation Alliance (PICA)
Serval	-
African Golden Cat	African golden cat Conservation Alliance & Working Group
Caracal	-
Tropical Asia	
Rusty-Spotted Cat	Rusty-Spotted Cat Working Group
Flat-Headed Cat	South East Asian Cat Working Group, Borneo Carnivore Consortium
Fishing Cat	Fishing Cat Conservation Alliance, Fishing Cat Network
Mainland Leopard Cat	-
Sunda Leopard Cat	South East Asian Cat Working Group, Borneo Carnivore Consortium
Marbled Cat	Clouded leopard Working Group, South East Asian Cat Working Group
Borneo Bay Cat	South East Asian Cat Working Group, Borneo Carnivore Consortium
Asiatic Golden Cat	Clouded Leopard Working Group (also working on the Asiatic Golden Cat), South East Asian Cat Working Group

5. Recommendations

Based on the review of the RLA for the smaller cat species, we identify several points that should be addressed in the years to come to enhance the "ASSESS" component and to better inform the process stipulated by the Species Conservation Cycle (→ Introduction) and thereby to make cat conservation more effective. Generally, it is very important to take into account that the Species Conservation Cycle is an adaptive process. Information collected during an assessment of a species and its outcomes should feed into the conservation planning and be considered when defining conservation measures for the respective species. Subsequently information from conservation projects should in turn feed back into the "ASSESS" component to enhance the conservation status assessment of the species. In this regard, it is crucial that information, data and lessons learnt from conservation measures are shared amongst organisations, institutions and species researchers and made available to the broader conservation community. This would enhance cooperation and strengthen small cat conservation networks and thus benefit the (global) conservation of the small cat species.

Assess

- All (not recently assessed) small cat species should be re-assessed within the next 2–3 years to have up-to-date and consistent RLAs based on the recommendation of this report;
- The RLAs of all small cat species should be streamlined to follow the same philosophy (i.e. interpretation of the IUCN RL Guidelines). The RLAs should be consistent with each other in regard to the application of the RL Guidelines and rules;
- The consistency within and across RLAs of cat species should be enhanced and follow an evidentiary and realistic approach;
- Whenever possible, information in the different sections of the RLA should be grouped according to subspecies[4] or regions or per country and the level of detail of information provided (e.g. down to province level or site name) should be consistent within and between RLAs;
- Population size: The methods of any estimation and the underlaying assumption should be more convincingly be explained, especially if they include an extrapolation of locally observed densities across the whole range;
- Population trends and projected future population declines: Even if inferred or suspected, present population trends should be based on convincing arguments, and future declines should be based on threats that are likely to continue with high probability (e.g. over the next three generations). A shortcoming is often that the quantitative impact of an observed threat on the population is not really understood;
- Habitat decline (as a threat inferring a decline of the population) should be quantified if related to a decrease of the area occupied (AOO or EOO) by the species. If it refers to the deterioration of habitat quality, sufficient evidence must be provided to demonstrate that the carrying capacity for the species is reduced, causing a reduction of the total population size without changes in the AOO or EOO. This is, for large cats, often related to prey depletion, which is generally less understood, but is harder to demonstrate in terms of small prey species hunted by small cats;

[4] Assessing species with a large global distribution and delineated in several recognised (see Kitchener et al. 2017) is a particular challenge, as the conservation status of the subspecies may differ and lead to a verdict dominated by the largest populations.

- Special care must be taken when inferred or suspected (future) decline are based on population data from a single site or a small fraction of the global population. In such a situation, it should at least be demonstrated that the threat (e.g. habitat deterioration) assumed to be the reason for the local decline is representative over significant parts of the distribution range;
- Modelling habitat or populations can help in the estimation of population size or distribution and quantification of assumed or observed declines. But just as all other analytic approaches, modelling must be based on good and sufficient/representative data samples and must be based on realistic and defendable assumptions. Sophisticated models sometimes camouflage an inadequate data base or a lack of understanding and must be handled with care. Criterion E would allow an assessment based on a quantitative analysis (→ Appendix I); but there are indeed very few cat populations – and probably only one species, the Iberian lynx *Lynx pardinus* – where the available data would be sufficient for a reliable population viability analysis. Not surprisingly, Criterion E has never been used to assess a felid species (Fig. 4.5);
- Vice versa, field (research) studies are often conducted in prime habitat and known strongholds of a species, e.g. in protected areas. As the distribution range of most smaller cats is largely outside protected areas, the impact of certain threats on the over-all population might be underestimated from such well-preserved sites. In any case, assessors should carefully consider the reference areas chosen/available are representative for the observed population status/trend and for the range-wide threats;
- The methods and procedures to create distribution maps for the species have to be standardised to allow (better) comparison. In this regard, a Mapping Working Group has been established to elaborate guidelines on how to create distribution maps for cat species, especially highlighting how to deal with few and/or imprecise records/distribution information. As it is not possible to include all aspects and challenges of creating distribution maps in the final map based on the RL Mapping Criteria, we recommend to present further important information in online supporting materials;
- Not only the species but also the subspecies[1] should be assessed for the IUCN Red List. However, a subspecies can only be assessed after the species assessment. In this regard, where possible and feasible, subspecies should be assessed at the same time as the species or right after the species' assessment;
- It will be important to incorporate the Green Status Assessment (GSA) in the future. All small cat species should be assessed using the GSA, with priority given to the species with prominent range loss. The IUCN Green Status of Species assesses the recovery of species' populations and measures their conservation success. It complements the IUCN Red List by additionally providing a more comprehensive look at species conservation status and the effectiveness of conservation actions.

Plan

Red List Assessments and Status reports are requirements for the development of effective Conservation Strategies and Action Plans. Thus, the "ASSESS" component is the necessary basis of the "PLAN" component of the Conservation Cycle. If planning is based on a through conservation status review, it enhances the success of Conservation Strategies and Action Plans. Rigorous planning takes some time and effort, but it will allow saving time and funding during the implementation. We recommend to:

- Consider the most up to date status reports and assessment of the corresponding species when developing Conservation Strategies and Action Plans but also when planning conservation projects and programmes;
- Develop range-wide Conservation Strategies for all small cat species, or strategies for groups of species with similar needs and range, where feasible, and to
- Develop (National or local) Action Plans for small cat species, or groups of species with similar needs and range for the practical implementation of the Conservation Strategy and to concretise the conservation measures according to national needs and prerequisites.

Act

Plans alone do not save a species. They have to be implemented. Whilst threat mitigation is crucial for all small cat populations and is generally highly recommended, we restrict our recommendations here on the aspects of ACT that are more directly connected to the ASSESS and in turn to the PLAN components of the cycle: Although in recent years the resources for small cat conservation and the number of small cat projects and conservation measures considerably increased, based on the evaluation of the RLAs, there is generally still an urgent need for more research, and more readily available data on small cat species. The sharing of data, especially with regard to their distribution, populations (abundance, trend, status), and threats, including the impacts and scope of threats on the species could enhance the quality of information available, which in turn facilitates the ASSESS and PLAN components of the cycle. For some species, more information on their ecology, habitat and use and trade is still lacking. We recommend to:

- Conduct workshops on each small cat species or groups of species with similar needs and range to make a status report for each to identify their conservation status and gaps of knowledge, if possible, per region;
- Conduct further projects to collect more information on the small cat species and to address the gaps in our knowledge as well as to combat their threats and enhance their conservation;
- Regularly conduct meetings of different key stakeholders to exchange information on small cat species and enhance collaboration between groups, researchers and institutions;
- Assess and promote means for the exchange of by-catch data as it is essential to share information and it is crucial that by-catch data is more readily available. Co-operation enhances the knowledge on a species, improves informed conservation actions and helps to produce more evidence-based assessments in the future;
- Make sure that information collected and findings of small cat projects and programmes feed back into the Species Conservation Cycle by making them e.g. publicly available. This would enhance the understanding of the bigger picture of the conservation status of the small cat species and thus foster their conservation
- Strengthen and support small cat networks and working groups and improve collaboration between the different stakeholders

Appendix I. IUCN Categories and Criteria Summary Sheet

SUMMARY OF THE FIVE CRITERIA (A-E) USED TO EVALUATE IF A TAXON BELONGS IN AN IUCN RED LIST THREATENED CATEGORY (CRITICALLY ENDANGERED, ENDANGERED OR VULNERABLE).[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

- **(a)** direct observation *[except A3]*
- **(b)** an index of abundance appropriate to the taxon
- **(c)** a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
- **(d)** actual or potential levels of exploitation
- **(e)** effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals			
(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals			

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	**D2.** typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative Analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

1 Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria* and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.