DISEASE RISK ANALYSIS FOR INTRODUCTION OF CHEETAHS (*Acinonyx jubatus*) TO INDIA

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EXECUTIVE SUMMARY

Cheetahs were last seen in India in the late 1940s before being declared extinct there in 1952. A consultative meeting of global experts, held at Gajner in 2009, concluded that the re-introduction of this species was worth considering for both ethical and conservation purposes. The Ministry of Environment & Forests, Government of India mandated the Wildlife Institute of India with this task and plans are currently underway to reintroduce cheetahs from southern Africa (South Africa and Namibia) into reserves within India.

During such introductions however, the management of health risks, both communicable and non-communicable, are extremely important to maximise the survival of translocated animals and to minimise the risk of introducing a novel health hazard to the destination country. To analyse and manage the possible outcomes of situations involving health risks in projects like this, a process known as disease risk analysis has been adopted by World Organisation for Animal Health (OIE) & International Union for Conservation of Nature (IUCN). The objective of this document is thus to identify all possible health risks of concern, while providing an evidence-based analysis of the said risks to the cheetahs translocated from southern Africa to reserves in India. In addition, health risks posed to native fauna in India due to the translocation are considered.

In order to compile the list of potential communicable hazards and to determine possible disease-management actions, a systematic scientific literature search was carried out to identify all potential pathogens (micro- and macro parasites) hazardous to cheetah in southern Africa, as well as those pathogens known and potentially present in large felids in India. Additionally, personal communications with cheetah health experts and unpublished/anecdotal reports were also considered while compiling the health hazards of free ranging cheetahs in southern Africa.

Whilst cheetahs in captivity are prone to several disease conditions, these are rarely detected in free-living cheetahs. According to IUCN assessment in 2014, infectious diseases are not considered to be a significant threat to wild cheetah populations. This is ascribed to their low natural population density. Cheetahs are also largely solitary and do not prey on other carnivores. These two factors limit opportunities for disease transmission both to and from cheetahs.

The risk of the re-introduced cheetahs either transmitting or contracting any communicable diseases was judged to be low or very low in most cases. These risks, as well as those of diseases that pose a medium level of risk, could be minimised through the administration of several vaccines and anti-parasitic treatments as well as the use of selective diagnostic tests during the pre- and post-export quarantine period.

Some non-communicable hazards were judged to potentially pose a low to medium level of risk to the re-introduced cheetahs. These include eco-climatic risks, starvation, interspecies aggression and genetic risks, which were judged to be low or very low. Mortality risks, related to the capture or translocation of cheetahs or to poaching, were judged to be at a medium level. These can, however, be minimised by the use clear capture and translocation protocols and intensive post-release monitoring.

In conclusion, both communicable diseases and non-communicable hazards have thus been considered in this analysis. Whilst the risks may be moderate for a few diseases and hazards, strategies have been put in place to minimise these to within acceptable levels.

DISEASE RISK ANALYSIS FOR INTRODUCTION OF CHEETAHS *(Acinonyx jubatus)* TO INDIA

Introduction & Background

Reintroductions and conservation translocations of large carnivores have increasingly been recognised as a strategy to conserve threatened species and restore ecosystem functions (Kock et al. 2010; IUCN/SSC 2013). It is now largely accepted that the number of wildlife translocation initiatives are likely to intensify in near future, as attempts are increasingly being made to conserve species amid human caused environmental changes (Sainsbury and Vaughan-Higgins 2012). The cheetah is the only large carnivore that has been extirpated from India, mainly by over-hunting and loss of habitat in historical times (Divyabhanusinh 1984). The last cheetahs were seen in India in the late 1940s before they were declared extinct in 1952 (Divyabhanusinh 1984; Divyabhanusinh 2000). India now has the economic ability to consider restoring its lost natural heritage for ethical as well as ecological reasons. With this context, a consultative meeting of global experts was held at Gajner in September, 2009. A consensus was reached at this meeting for conducting a detailed survey of selected sites to explore the potential of conservation introduction of the cheetah in India. The Ministry of Environment & Forests, Government of India mandated the Wildlife Institute of India with this task andplans are currently underway to reintroduce cheetahs from southern Africa (South Africa and Namibia) into reserves within India (Ranjitsinh and Jhala 2010; Jhala et al. 2021).

Bringing the cheetah back to India, important in itself, would have equally important ramificationson biodiversity conservation and community livelihood upliftments. While introducing cheetah, one would have to save not only its prey-base comprising certain threatened species, but also other endangered species of the grasslands/ open forest ecosystems, some of which are on the brink of extinction. Amongst these are the caracal (*Caracal caracal*), the Indian wolf (*Canis lupus pallipes*) and three endangered species of the bustard family- the Houbara (*Chlamydotis undulata macqueenii*), the lesser florican (*Sypheotides indica*) and the most endangered of all, the great Indian bustard (*Ardeotis nigriceps*). The grassland/ open forest dependent species, both avifaunal and faunal, have suffered a more drastic decline than any other species adapted to other biomes, simply because these habitats have undergone the most qualitative and quantitative decimation of all ecotypes in the sub-continent. The communities living in these marginal semi-arid ecosystems would benefit immensely

from ecotourism opportunities associated with the cheetahs as well as from the sharing of revenues obtained as gate receipts from Wildlife Reserves where cheetah populations will be established (Jhala et al 2021).

Amongst the ten surveyed sites in five central Indian States, Kuno Palpur National Park (KNP) in the State of Madhya Pradesh was rated high on the priority list for considering the introduction of the cheetah because of its suitable habitat and adequate prey base. Additionally, a lot of restorative investment had already been made at this site for introducing the Asiatic lions. Kuno National Park today is 748 km^2, that is devoid of human settlements and forms part of the larger Sheopur-Shivpuri dry deciduous open forest landscape spanning an area of 6,800 km^2. KNP has thus been chosen as the first site for the cheetah introduction since it is ready with the required level of legal protection, prey, and habitat to sustain a populationof cheetahs. Additionally, Mukundara tiger reserve, Gandhi Sagar Wildlife Sanctuary, and Nauradehi Wildlife Sanctuaryhavebeen identified as future sites for the establishment of cheetah populations in India (Jhala et al 2021). Cheetah restoration will be part of a prototype for restoration of original cheetah (Divyabhanusinh 2000) habitats and their biodiversity, helping to stem the degradation and rapid loss of biodiversity now underway. Lessons learnt from this process will benefit the management of these ecotypes, the most overused, least managed and yet one of the most productive biomes in the country.

During such introductions however, the management of healthrisks, both communicable and non-communicable, are extremely importantto maximise the survival of translocated animals and to minimise the risk of introducing a novel health hazard to the destination country (IUCN/SSC, 2013; Beckmann et al., 2022). While carnivores in general are susceptible to a wide array of infectious diseases and many such diseases have evolved over millions of years within natural ecosystems, rapid changes in land use, climate change and intercontinental travel all increase the risk of disease transmission to immunologically naïve populations (McCarthy et al. 2007, Munson et al., 2008; Baker et al. 2022). Thus, as a precautionary measure, it is necessaryto carry out a rigorous scientific assessment to establish prevalence of potential carnivore diseases in the founder cheetah stock, as well as the carnivore

population at the release site, so as to better inform disease prevention and mitigation strategies. Additionally, numerous othernon-communicablehealth risks such as stress related diseases, environmental pollutants, inter species aggression, nutritional insufficiency, anthropogenic trauma, etc.,may also affect the survival and establishment of a viable cheetah population at the release site.Thus, in the currentdocument, theterm 'disease' implies to both communicable and non-communicable health risks that can be detrimental to the success of the transcontinental cheetah introduction (Beckmann et al. 2022).

DISEASE RISK ANALYSIS

The concept of risk and risk assessments has been an intricate part of human history (Aven 2016). Records of using risk assessment as a formal aid in human decision-making process can be dated back as early as 3200 B.C (Covello and Mumpower 1985). Nonetheless, usage of risk assessment and risk management as a scientific field is less than half a decade old, developed largely to evaluate the risk to human health by hazards (Sainsbury and Vaughan-Higgins 2012; Aven 2016). Using Covello and Merkhofer's (1993) method to analyse disease risks that threaten human health, the World Organization for Animal Health (OIE) subsequently adapted a qualitative risk analysis process for the disease associated with anthropogenic movements of domestic animals (Murray et al. 2004; Sainsbury and Vaughan-Higgins 2012; Hartley and Sainsbury 2017).

Wildlife translocation is 'the intentional movement of living organisms from one geographical area for free release into another with the object of establishing, re-establishing or augmenting a population' (Kock et al. 2010). Until recently, such translocations programmes were commonly implemented without considering the wildlife disease aspects (Davidson and Nettles 1992; Hartley and Sainsbury 2017). However, with the increased recognition of potential impact of diseases on the outcome of such conservation interventions (Davidson and Nettles 1992; Woodford and Rossiter 1993; Cunningham 1996; Kock et al., 2010), the wildlife disease risk analysis was conceptualised. Over last two decadesvarious qualitative and quantitative frameworks were devised to access the risks of disease associated with wildlife translocations (Leighton 2002; Armstrong et al. 2003; Miller 2007; Sainsbury et al. 2012; Sainsbury and Vaughan-Higgins 2012). Subsequently, by consolidating the current Knowledge on the subject, the IUCN and OIE jointly published the Manual of Procedures for Wildlife Disease Risk Analysis(DRA) and provided a framework for developing, interpreting and utilising disease risks in wildlife conservation initiatives (OIE and IUCN, 2014). While the said DRA provides a framework for considering stress and other non-communicable conditions during conservation translocations, in practice these have tended to receive less attention than infectious disease. Nonetheless, recent advances in the field have stressed the importance of all possible wildlife health outcomes, both the communicable and non-communicable ones during conservation translocations (Beckmann et al. 2022).

The major components of wildlife DRA include hazard identification, risk assessment,

risk management and risk communication (fig 1.), all of which are executed through combined efforts of a multisectoral technical team, including veterinarians, biologists, conservationists, wildlife managers and other stakeholders (Jakob-Hoff et al. 2014; OIE & IUCN 2014).

With the above preface, the objective of the current document is to identify all possible health risks of concern, while providing an evidence-based analysis of the said risks to the cheetahs translocated from southern Africa to reserves in India and health risks posed to native faunain India due to the translocation, while simultaneously preserving the translocated cheetah'sresilience and adaptive capacity at the translocated sites.

Figure 1 : Steps in the disease risk analysis process as per the DRA framework by OIE & IUCN (2014).

Problem Description

'What is the specific question for this DRA? What kind of risk analysis is needed?'
(Jakob-Hoffet al., 2014).

Where the translocated species originates from a different continent, such as the current project, there is a risk that it might lead to transfer of novel pathogen to release site. Equally, exposure to release site endemic pathogens, to which African cheetah are naïve and potentially immune-incompetent, poses risk. Further, as it is an intercontinental translocation, many of the other associated ecological and environmental risks can affect the survival and establishment of a viable cheetah population at release sites in India.

The current DRA thus attempts to specifically focus on the following:

a. Identify all possible health hazards (communicable and non-communicable), associated with translocation of cheetahs to India.

b. Evaluate and classify the level of risk involved with each identified hazard.

c. Formulate risk management measures to avoid disease risks through the proposed introduction

d. Develop protocols for operationalization of risk management measures

e. Risk communication through engagement of relevant experts and stake holders, so as to maximise the quality of analysis as well as effective implementation of protocols developed.

Hazard Identification

The hazard identification step asks 'What can cause disease in the population(s) of concern?', 'How can this happen?' and 'What is the potential range of consequences?'
(Jakob-Hoffet al., 2014).

The goal of the hazard identification step is to essentially identify all possible health risks of concern, both to the founder cheetah stock, as well as the carnivore population at the release site.

❖ **A hazard here is defined as**

- Communicable Hazard: *Any novel pathogen (micro and macro) that may be introduced with Cheetah to India or a pathogen novel to the southern African Cheetahs in India.*
- Non-communicable Hazard: *Any ecological, environmental, and anthropogenic stressor that can have a negative impact on survival and establishment of a viable cheetah population*

❖ **Communicable Hazards**

In order to compile the list of potential communicable hazards and to determine possible disease-management actions, a non-systemicscientific literature search was carried outto identify all known and potential pathogens (micro- and macro parasites) hazardous to cheetah in southern Africa, as well as those pathogens known and potentially present in large felids in India. Additionally, personal communications with cheetah health experts and unpublished/anecdotalreports were also considered while compiling the health hazards of free ranging cheetahs in southern Africa. It is not possible to be exhaustive or comprehensive on this subject as novel pathogens do arise at times and unknowns exist on carnivore pathogens and diseases. To the best available knowledge all known and potential hazards have been identifies.

a. Diseases Impacting Captive and Free-Ranging Cheetahs

In captivity, cheetahs are affected by several diseases that are very rare or have never been diagnosed in their wild counterparts. These include lymphoplasmacytic gastritis, veno-occlussive disease of the liver, various renal problems (glomerulosclerosis, renal amyloidosis, cortical and medullary fibrosis and renal oxalate nephrosis) (Munson

1993; Terio et al. 2018). The aetiology and pathophysiology of these diseases is still unclear, but there is little epidemiological evidence in support of them being transmissible. It is largely believed that these diseases are caused by husbandry and nutritional factors that are not ideal in the captive environment (Robert and Walzer 2009; Terio et al. 2018). Further, according to IUCN assessment in 2014, infectious diseases are not considered to be a significant threat to wild cheetah populations. This is ascribed to their low natural population density (IUCN 2015). Cheetahs are largely solitary and do not prey on other carnivores. These two factors limit opportunities for disease transmission both to and from cheetahs.

Cheetahs, are susceptible to the diseases that typically affect domestic cats such as feline herpesvirus, feline infectious peritonitis, feline calicivirus and feline panleukopenia virus as well as a range of diseases within a broader host range such as rabies, sarcoptic mange, tuberculosis (MTB) and anthrax, etc (Jager, Booker & Hubschle 1990; Munson 1993). The incidence of these diseases in wild populations is however extremely low (Terio et al. 2018).The diagnosis and screening of diseases in cheetahs is further compounded since most tests used to determine infection status are not validated in this species but in certain tests such as virus neutralisation the results are likely to be accurate. The serological database is very limited and heavily reliant on a few studies. Therefore, the true picture and status of an infection in any context based on antibody detection is limited and antigen-based tests become more relevant.

Nevertheless, it is to be noted that the cheetahs selected to be introduced to India are all of wild origin and these cheetahs in the southern African meta population programme are often individually identifiable and monitored quite closely through radio-telemetry. Cheetahs within the programme that become ill are immobilized if deemed necessary and examined by wildlife veterinarians and the causes of mortality if any, are determined in most cases and recorded. Disease surveillance in this population of cheetahs is therefore considered to be good.

The information on source areas for founder cheetah stock are tabulated below.

Table 1. Information on the potential source of founder cheetah stock along with the country of origin and numbers to be imported. Cheetahs in South Africa are quarantined at two locations 1) Rooiberg Veterinary Services (9 cheetahs), 2) Pinda Game Reserve (3 cheetahs) and in Namibia all cheetahs are quarantined at the boma facility of Cheetah Conservation Fund.

Source location	Country	Number of cheetahs to be imported
Tswalu	South Africa	4
Matlabas	South Africa	2
Mapesu	South Africa	1
Welgevonden	South Africa	2
Phinda	South Africa	3
Cheetah Conservation Fund boma	Namibia	5
Erindi Game Reserve	Namibia	3

Table 2. A comprehensive list compiled from published literature and other available veterinary reports of known infectious diseases that could affect or be transmitted by cheetahs.

Viral diseases documented in Cheetah

Disease	Information
Feline Immunodeficiency Virus (FIV)	Although FIV is usually very species specific, domestic cat FIV has been reported in other felids (O'Brien et al., 2012). These viruses appear more prevalent in social felids like lions as the disease is thought to be transmitted through saliva i.e. grooming and fighting (Pecon-Slattery et al., 2008). FIV has also not been reported to cause clinical disease in most wild felids except for the Pallas' cat (Brownet al., 2010). Free-ranging cheetahs in Namibia (n=48) all tested seronegative for FIV in 2004 (Munsonet al., 2004) and in 2010 (Thalwitzeret al. 2010a).
Feline leukaemia virus (FeLV)	A single captive cheetah was diagnosed with multicentric –T-cell lymphoma associated with FeLV in Namibia in 1995 (Marker et al., 2003). This was the first confirmed case of FeLV in a non-domestic felid. An outbreak occurred in the Florida panther population(Cunningham et al., 2008) and later in a population of Iberian lynx. In all cases, the source of the infection was thought to be from domestic cats. FeLV related disease has not been diagnosed in free-ranging cheetahs. The seroprevalence is generally low (Munson et al. 2004) in most surveys and no free-ranging cheetahs have yet tested positive for the FeLV antigen using PCR (Krengelet al. 2015). This disease is therefore unlikely of concern for the translocation of cheetah to India.
Feline herpesvirus (FHV1)	Captive cheetahs are commonly infected with feline herpesvirus. The lesions are often limited to the eyes and upper respiratory system (Van Vuuren et al., 1999). In some cases they can develop corneal ulcers and proliferative lesions on the face and forelimbs (Munson et al., 2004). This disease is only rarely seen in wild cheetahs even though many seroconvert (Munson et al., 2004; Thalwitzer et al. 2010a).
Feline calicivirus (FCV)	Feline calicivirus antibodies are commonly detected in the serum of free-ranging cheetahs (Thalwitzeret al., 2010b).

	Clinical symptoms that include mild upper respiratory disease and ulceration of the tongue are only really seen in younger captive cheetahs.
Feline enteric coronavirus (Feline infectious peritonitis) (FIP)	Feline enteric coronavirus (FCoV) most often causes mild enteritis, but in some cases, it can result in a fatal disease called feline infectious peritonitis (FIP). In 1983, an outbreak of FIP occurred in a captive cheetah population in North America resulting in mortality of over 60% of the animals (Heeney et al., 1990; Terio et al., 2018). Since then, fatalities in the North American captive population have been rare (accounting for < 2.9% of deaths between 1991 and 2016). The seroprevalence of FCoV in southern Africa is very low in free-ranging cheetahs and no clinical cases have been reported in free-ranging individuals (Terio et al., 2018)
Feline panleukopenia virus (FPLV)	Feline panleukopenia virus is a common parvovirus that is widespread amongst domestic cats around the world. It is highly contagious and spreads by direct and indirect contact. The virus typically affects young captive cheetahs (less than 1 year of age). There are currently no reports of clinical cases from free-ranging cheetahs in southern Africa(Terio et al., 2018).
Canine parvovirus	Canine parvovirus emerged (possibly from the feline panleukopenia virus) in domestic dogs in the late 1970s. The original strain (CPV type 2) spread worldwide rapidly. Cheetahs have been shown to be susceptible to the virus. Several other outbreaks have been reported from zoos in North America and captive facilities in South Africa. The outbreaks probably originate from unvaccinated dogs infected with the virus.
Canine distemper virus	Canine distemper outbreaks have been reported in several felid species including lions, tigers and leopards. Although cheetahs have shown to have positive CDV titres, no clinical cases have been reported in either captive or free-ranging cheetahs (Munson et al., 2004). Immunohistochemical screening of cheetahs with so called “cheetah myelopathy” were negative for CDV (Shibly et al. 2006) There is thus no evidence that CDV causes any disease symptoms in cheetahs and it is highly unlikely that they are able to transmit the virus.
Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)	The Covid 19 virus has been shown to affect domestic cats and dogs, large captive felids such as lions and

	tigers and farmed mink. To date, no single case has been reported in a cheetah despite outbreaks at zoos where cheetahs are housed. It is therefore highly unlikely that cheetahs are susceptible or transmit the disease.
Rabies	Rabies affects a wide range of mammals. The virus is endemic in both Africa and India. Very few cases are reported in cheetahs. In 2007 a BBC reporter was bitten by a female cheetah that subsequently died of rabies. A small proportion of the free-ranging cheetahs in Namibia have been shown to have rabies antibodies. (Thalwitzer et al. 2010a)

Bacterial diseases documented in Cheetah

Disease	Information
Anthrax	Multiple published and anecdotal cases reported in wild and captive cheetahs. Cheetahs are highly susceptible to the disease, dying acutely after consuming anthrax infected carcasses. Wildcheetahs do not have serum antibodies to anthrax (Switzer et al., 2016). The reason for this is most likely due to the fact that cheetahs rarely scavenge.
Tuberculosis	Spillover infections of Mycobacterium bovis have been recorded in a small number of cheetahs in and around the Kruger National Park in South Africa (Keet et al., 1996; De Vos et al., 2001). Cheetahs do not hunt or scavenge on buffalo who are the primary hosts of the disease and infection rates are therefore likely to be low. No cases of MTB have been recorded in other areas of South Africa or Namibia.

Protozoal diseases documented in Cheetah

Disease	Information
Babesia spp	Various babesia species have been detected in the blood samples of cheetahs in southern Africa and Tanzania, including Babesia felis, Babesia leo and Babesialengau(Bosman et al., 2010). To date there is no evidence to suggest that any of these species cause clinical symptoms in cheetahs. The transmission of the parasites is likely to be through specific tick vectors.

Other haemoprotozoal parasites (Cytauxzoon felis, Haemoplasma felis and Theileria-like)	A range of protozoal parasites are occasionally detected in the blood samples of cheetahs. None are known to cause clinical disease and are therefore considered to be incidental findings. Transmission is likely to be through specific tick species.

Parasitic diseases documented in Cheetah

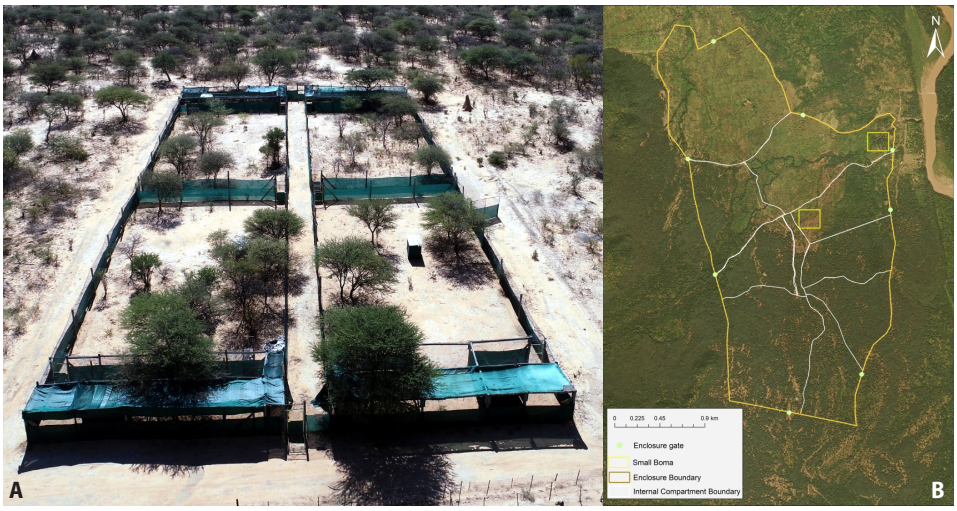
Disease	Information
Sarcoptic mange	Free-ranging cheetahs in Masai Mara (Kenya) have been shown to have high sarcoptic mite infection rates (12.77%).This can lead to severe skin lesions in cubs but rarely are adults severely compromised by this infection. Similar infections have not been reported in the southern African cheetah populations. Sarcoptic mites have a worldwide distribution.
Ollulanustricuspis	This nematode parasite inhabits the stomachs of a wide range of felid species. It was thought to have caused clinical symptoms in a cheetah in a zoo in New Zealand. The parasite has however not been recorded in any species in sub-Saharan Africa

Miscellaneous diseases

Disease	Information
Amyloidosis	To date, significant amyloidosis has not been detected in free-ranging cheetahs and it is not considered a threat to cheetahs in Southern Africa (Munson et al 2005, Terio & Mitchell, unpublished data). When diagnosed in captive cheetahs, it is always associated with some other chronic source of inflammation in the animals (i.e., It is a secondary disease) and there is no epidemiological evidence supporting the suggested prion-like transmission of this disease. An association between genotype and Serum Amyloid A levels was detected supporting a genetic component to the disease; however, housing type showed an even stronger impact on Serum Amyloid A levels (Franklin et al., 2015). Even in captive cheetahs, renal amyloidosis is associated with renal medullary fibrosis and appears to be a secondary disease since the renal medullary fibrosis precedes the deposition of amyloid (Mitchell et al 2018).

b. Diseases impacting captive and free-ranging carnivores in India

Carnivores in India have been documented tobe affected by a wide array of debilitating pathogens (Arora, 2003; Nayak et al., 2020), many of which are either native to or easily transmissible from domestic species. Published literature documents numerous disease accounts in captive setups, whilst information on free-ranging carnivores is scarce and a country wide active disease surveillance program on the latter is yet to be initiated. Further, similar to cheetah, the diagnosis and screening of diseases is further complicated as most serologic tests used to determine infection status are not validated for native carnivore species and thus not accurate. Nonetheless, a number of important infections have been recorded in free ranging carnivore species in India. Canine distemper has been confirmed as cause of mortality in atleast four wild tigers in India, two of which are from central Indian landscape (Nigam et al. 2016),while a recent outbreak of canine distemper in Gir landscape had led to death of significant number of Asiatic lions (Mourya et al. 2019). Historically rabies has been documented in wild felids from India, including tigers and leopards, but appears to be quite rare (Burton 1950). Apart fromthese, diseases like tuberculosis (Arora 2003), Leptospirosis (Arora 1984), Feline panleukopenia (Sharma 1997), etc. and protozoans such as babesia and toxoplasma have also been recorded among various non-domestic felids in India (Nigam et al. 2016).



A. Quarantine enclosure in Namibia, **B**. Map of the 6 km^2 electric fenced boma with internal compartments. The squares represent the quarantine bomas with double fencing.

Table 3. A comprehensive list compiled based on published literature and other available veterinary reports of known infectious diseases in carnivores of India are tabulated below.

Viral diseases documented in Indian carnivores

Disease	Information
Feline immunodeficiency virus (FIV)	No seropositive/ clinical cases recorded from large felids in India
Feline leukaemia virus (FeLV)	No seropositive/ clinical cases recorded from large felids in India
Feline herpesvirus (FHV1)	Seropositivity has been observed in free-ranging carnivores in India, including lions and tigers (Jhala, Unpubl data). Currently no clinical cases from free ranging large felids inIndia.

Feline calicivirus (FCV)	Seropositivity has been observed in free-ranging carnivores in India, including lions and tigers (Jhala, Unpubl data). Currently no clinical cases from free ranging large felids inIndia.
Feline enteric coronavirus (Feline infectious peritonitis) (FIP)	No specific virologically proven report of this disease in wild felids in India. However, gross lesions indistinguishable from infectious peritonitis have been recorded in two tigers which died in the Dudwa Tiger Reserve Utter Pradesh (Arora, 1994).
Feline panleukopaenia virus (FPLV)	Numerous cases recorded in captive carnivores throughout the country (Rao et al.,1995; Sharma, 1997; Arora, 2003). In the past National Zoological Park, New Delhi has lost pumas, snow leopard, golden cat, tiger cubs and Jaguars from the disease and The Lady Hydari Park Meghalaya has reports of the disease in Clouded leopards (Neofelisnebulosa). Currently no reports from free ranging large felids in India.
Canine parvovirus	Handful cases recorded in captive large felids (Arora, 2003; Chandran et al., 1993) High seropositivity has been observed in free-ranging sympatric carnivores (Bhat, et al., 1998; Belsare et al., 2014)
Canine distemper virus	Disease has been confirmed in tiger, lion, leopard, Indian wolf, etc. in captivity (Arora 2003). High seropositivity to Canine distemper virus (CDV) has been observed wild sympatric carnivores such as Indian wolves, red fox, Indian fox, golden jackal, striped hyenas, etc (Jethva and Jhala; 2004; Belsare et al., 2014). Canine distemper has been confirmed as cause of mortality in at least four wild tigers in India, two of which are from central Indian landscape (Nigam et al. 2016). A large-scale outbreak and mortality have also been reported in Asiatic lions of Gir Landscape (Mourya et al., 2019).
SARS-CoV-2	In 2021, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was detected in captive Asiatic lions of two zoological parks, one in the in Southern India (Mishra et al., 2021 and another in the North (Karikalan et al., 2021) A free ranging Indian Leopard (Panthera pardus) from Bijnor range of Uttar Pradesh State was found positive with Delta variant of SARS-CoV-2 (Mahajan et al., 2022)
Rabies	Rabies is endemic in India, with feral dogs suspected to be the major source of disease transmission (MoH&FW, 2021). Historically rabies has been reported in wild felids from India, including tigers and leopards (Burton 1950), but appears to be quite rare. However, disease has been frequently observed in wild canids including Indian wolves, Golden Jackel and Indian Fox (Shah et al., 1976; Arora, 2003; Jethva and Jhala 2004; Madhusudana et al., 2013).

Bacterial diseases documented in Indian carnivores

Disease	Information
Anthrax	Documented in clouded leopard (*Neofelis nebulosa*), jaguar (*Panthera onca*), and Indian leopard (*Panthera pardus*) in captivity (Arora, 2003). Not recorded in large felids in India, however sporadic cases have been observed in wild animals throughout the country, including megaherbivores such as elephants (Arora, 2003).
Bovine Tuberculosis	Numerous sporadic cases in captivity, including species such as lions, tigers, leopards and sloth bears (Arora 2003). Recently, a pair of endangered Asiatic lions (*Panthera leo persica*) imported from India to the United Kingdom were also found TB positive (Molenaar et al., 2020). Highly prevalent in domestic livestock, with an estimated 21.8 million cases in India (Srinivasan et al., 2018). There is hardly any authentic report of tuberculosis in free ranging carnivore species except the one, which mentioned tuberculous hepatitis encountered during necropsy of an adult tiger (*Panthera tigris*) that died in Dudwa Tiger Reserve, in 1987 (Nigam et al. 2016).
Leptospirosis	Handful cases recorded in captive large felids of India. The disease was serologically diagnosed in one 21-month-old male tiger (Panthera tigris) that died at Zoological Garden, Lucknow (Arora, 2003). Serological evidence has been documented in free-ranging Asiatic lions (*Panthera leo persica*) and one confirmed case in a free-ranging Bengal tiger (unspecified landscape; Arora, 2003)

Protozoal diseases documented in Indian carnivores

Disease	Information
Babesia spp	There are numerous reports on clinical babesiosis in captive wild felids from India (Arora, 2003; Mishra et al., 2008). Species recorded in wild carnivores in India include B. canis and B. cati (Mudaliar et al., 1950; Rafiqi et al., 2018). Though the reports from wild felids are rare, Asiatic lions that were affected with the recent Canine distemper outbreak in Gir were found to be co-infected with Babesia.
Cytauxzoon felis	The disease was previously thought to be absent in India. However, a fatal case of feline cytauxzoonosis was reported in a kitten in a domestic cat in 2009, diagnosed based on clinical signs and evidence of microscopic intraerythrocytic piroplasms (Varshney et al., 2009). Subsequently, the disease was reported

	from African-Asian lion hybridsin Bannerghatta Biological Park, India (Manjunath et al., 2013). The status in wild populations is yet to be ascertained.
Trypanosomiasis	Numerous cases recorded in captive large felids, including tigers (Upadhye and Dhoot, 2000; Arora, 2003; Gupta et al., 2009). Currently no clinical cases from free ranging large felids of India have been reported.
Toxoplasma gondii	Seropositivity has been observed free-ranging carnivores in India, including Lions and tigers (Jhala, Unpub. data).

Parasitic diseases documented in Indian carnivores

Gastro-intestinal parasites recorded in Indian large felids include Paragonimus westermanni, Ancylostomatidae sp., Aelurostrongylus sp., Bronchostrongylus sp., Subcrenatus sp., Capillaria sp., Dirofilariaimmitis, Galonchusperniciosus, Gnathostoma Spinigerum, Molineus sp., Mammomonogamus so., Ollulanustricuspis, Physaloptera sp. Pseudophyllidea sp., Taenia sp., Strongyloides sp., Toxocara sp. Toxascarissp and Trichuris sp. (Nigam et al., 2016).

Seroprevalence of major carnivore diseases in India

In order to ascertain seroprevalence of major carnivore diseases in India, 79 large carnivore, 12 feral dog serum samples from across India and 56 free-ranging dog samples from the vicinity of Kuno National Park were analysed as part of the current cheetah introduction project. Serum samples were analyzed for the presence of IgG antibodies against canine distemper virus (CDV), canine parvovirus (CPV), canine adenovirus (CAV), Feline panleukopenia virus (FPLV), Feline herpes virus (FHV), Feline calici virus (FCV) using dot-ELISA kits (BioGal's Immunocomb kit, Bio Galed, kibbutz Galed, Israel, 192400). Antibodies against Feline corona virus (FeCoV), Feline immunodeficiency virus (FIV), Ehrlichia canis, Borrelia burgdorferi, Anaplasma phagocytophilum/ A. platys, Toxoplasma gondii as well as for the antigens of Dirofilariaimmitis and Feline leukemia virus (FeLV)were tested using immunochromatography assay kits (Anigen Rapid Test Kit, Bionote Inc., Gyeonggi-do, 18449, Republic of Korea). Results of the analysis are tabulated below:

Table 4. Results of seroprevalence studies of major carnivore diseases in India

Infectious Disease (antibodies)	Bengal Tigers	Asiatic Lion	Snow Leopard	Indian Wolf	Golden Jackel	Striped Hyena	Feral Dogs	Feral Dogs from Kuno
	(n=20)	(n=14)	(n=2)	(n=14)	(n=11)	(n=18)	(n=12)	(n=56)
Canine distemper virus (CDV) antibodies	+	+	+	+	+	+	+	+
Canine parvovirus (CPV) antibodies	+	+	+	+	+	-	+	+

Canine adenovirus (CAV) antibodies	+	-	-	+	+	+	+	+
Feline panleukopenia (FPLV) antibodies	+	+	-	DA	NA	+	NA	NA
Feline herpes virus (FHV) antibodies	+	+	-	DA	NA	+	NA	NA
Feline calicivirus (FCV) antibodies	+	+	-	NA	NA	+	NA	NA
Feline corona virus (FeCoV) antibodies	+	-	-	NA	NA	-	NA	NA
Feline immuno deficiency virus (FIV) antibodies	-	-	-	NA	NA	-	NA	NA
Feline leukemiavirus (FeLV) antigen	-	-	-	NA	NA	-	NA	NA
Dirofilariaimmitis antigen	-	+	-	+	-	-	-	+
Ehrlichiacanis antibodies	-	-	-	-	+	-	+	+
Anaplasma phagocytophilum/ A. platys antibodies	-	+	-	-	-	-	+	+
Toxoplasma antibodies	+	+	+	NA	NA	-	NA	NA

*+ = Positive; - = Negative; NA = information not available

❖ Non-communicable Hazards

There are numerous non-communicable health risks which can potentially arise out of ecological, environmental and anthropogenic factors associated with the translocation. While most of them have been dealt in detail by Jhala et al. 2021 in the form of 'Action Plan for Introduction of Cheetah in India', the same have been briefly addressed here through the DRA perspective.

Health Risk	Information
Eco-climatic risks	In an intercontinental translocation such as the current, unfavourable and severe climatic variations between source and release sites can have adverse effects on establishment of viable cheetah population. Climate risks thus have potential to affect the survivability of translocated cheetah at release sites.

Interspecies aggression risk	Besides availability of safe habitats and ample prey, cheetahs are limited by competing carnivores. In African systems, cheetahs are often killed by lions and sometimes by spotted hyenas and leopards. Cheetahs have difficulty in recruiting cubs to adulthood in areas with high density of competing carnivores. Similar dynamics might also be present at release sites.
Demographic and genetic risk	The sub species being translocated is different from the locally extinct cheetah-subspecies of India (Acinonyx jubatus venaticus). The IUCN (2003) clearly states that would be no genetic mixing of subspecies during translocations. Further, an important consideration for conservation translocations is that the sourcing of animals should not be detrimental for the survival of the source population.
Capture and Translocation risk	Cheetahs are known to be susceptible to capture stress and often succumb to stress related myopathy. Chase by helicopter for darting and capture, long exposures to intermittent disturbing stimuli during transportation, and exertion are some causes of capture myopathy related deaths of cheetahs.
Starvation risk (Starvation during quarantine & starvation post release)	Cheetahs need to feed every 2-4 days, depending on the size of the last meal. Starvation leads to undue stress and sets in a full cascade of events, including lowered resistance to infections and manifestation of disease symptoms from usually innocuous infections of parasites and pathogens
Husbandry related risks	Cheetahs are known to be affected by numerous non-communicable health risks in captivity, mostly arising out of husbandry and associated stress, and can have profound effect by limiting the sustainability of these populations. Wild-caught cheetah stemporarily held in captivity may also develop diseases like those noted in captive-born cheetahs, which may impact the cheetahs' survival when released back into the wild.
Poaching risk	In spite of enhanced protection and stringent laws post enactment of Wildlife Protection Act, 1972 sporadic events of poaching can still be seen in India, including some of the release sites. Unless dealt with appropriately, such events can have adverse effects on establishment of viable cheetah population.
Other anthropogenic risk	In the recent past, with its goal to be self-reliant and be at par with developed nations, India has witnessed a drastic spurt in the developmental projects. Urbanization, rural development, enhancement of road networks, etc have all created more opportunities for wildlife to come into direct contact with humans. Ensuing incidents such as road traffic collision, entanglement in barriers, electrocution, non-targeted persecution, etc might affect the survival of large carnivores in general.

Risk Assessment

The main purpose of risk assessment is to ascertain for each hazard of concern, a) the likelihood of release (introduction) into the area of concern; b) the likelihood that the species of interest will be exposed to the hazard once released; and c) the consequences of exposure (OIE and IUCN, 2014).

Communicable hazard

To estimate the level of risk associated with each communicable hazard, the probability that cheetahs would be infected or contaminated by the hazard were identified and the possible pathway by which the pathogen would be released to the destination environment are described. The results were combined with release, exposure, and consequence assessments to estimate the risk level, as described by Murray et al. (2004) and Sainsbury and Vaughan-Higgins (2012). The same has been provided as **Annexure 1.** Based on the data, the level of risk associated with a hazard as either described as very low, low, medium, or high (Murray et al., 2004)

Table 6. The risk assessment criteria for Introduction of Cheetah (*Acinonyx jubatus*) to India

Disease/ Causative agent	Recorded in captive Cheetah	Recorded in free ranging Cheetah	Are Cheetah vectors	Recorded in felids of India	Potential spillover to native fauna	Zoonotic Potential	Risk Level
Feline immuno deficiency virus (FIV)	No	No	No	No	No	No	Very low
Feline leukaemia virus (FeLV)	Yes	No	No	No	Yes	No	Low
Feline herpesvirus (FHV1)	Yes	Yes	No	Yes	No	No	Medium
Feline calicivirus (FCV)	Yes	Yes	No	Yes	No	No	Medium
Feline enteric coronavirus (Feline infectious peritonitis) (FIP)	Yes	No	No	Yes	No	No	Low
Feline panleukopaenia virus (FPLV)	Yes	No	No	Yes	No	No	Very low
Canine parvovirus	Yes	No	No	Yes	No	No	Very low/ Medium
Canine distemper virus	No	No	No	Yes	No	No	Very low
SARS-CoV-2	No	No	No	Yes	No	Yes*	Very low
Rabies	Yes	Yes	Can be	Yes	No	Yes*	Very low
Anthrax	Yes	Yes	Can be	No	No	Yes*	Very low
Bovine tuberculosis	No	Yes	No	Yes	No	No	Medium
Leptospirosis	No	No	No	Yes	No	Yes*	Very low
Babesia spp	Yes	Yes	No	Yes	No	Yes	Medium
Cytauxzoon felis	Yes	Yes	No	Yes	No	No	Medium
Trypanosomiasis	Yes	Yes	No	Yes	No	No	Medium

Toxoplasma gondii	Yes	Yes	No	Yes	No	Yes	Low
Sarcoptic mange	Yes	Yes	No	Yes	No	No	Low
AA Amyloidosis	Yes	No	No	No	No	No	Very low
GI Parasites	Yes	Yes	Yes	Yes	Yes	No	High

Non-communicable hazard

To estimate the level of risk associated with each non-communicable hazard, the probability that cheetahs would be exposed to each such hazard were identified.Thehazard assessmentswere then carried out through a logical and referenced discussion, so as to arrive at a subjective judgement based on Jhala et al. 2021 (Annexure 1).

Table 7. The non-communicable risk assessment criteria for Introduction of Cheetah (*Acinonyx jubatus*) to India

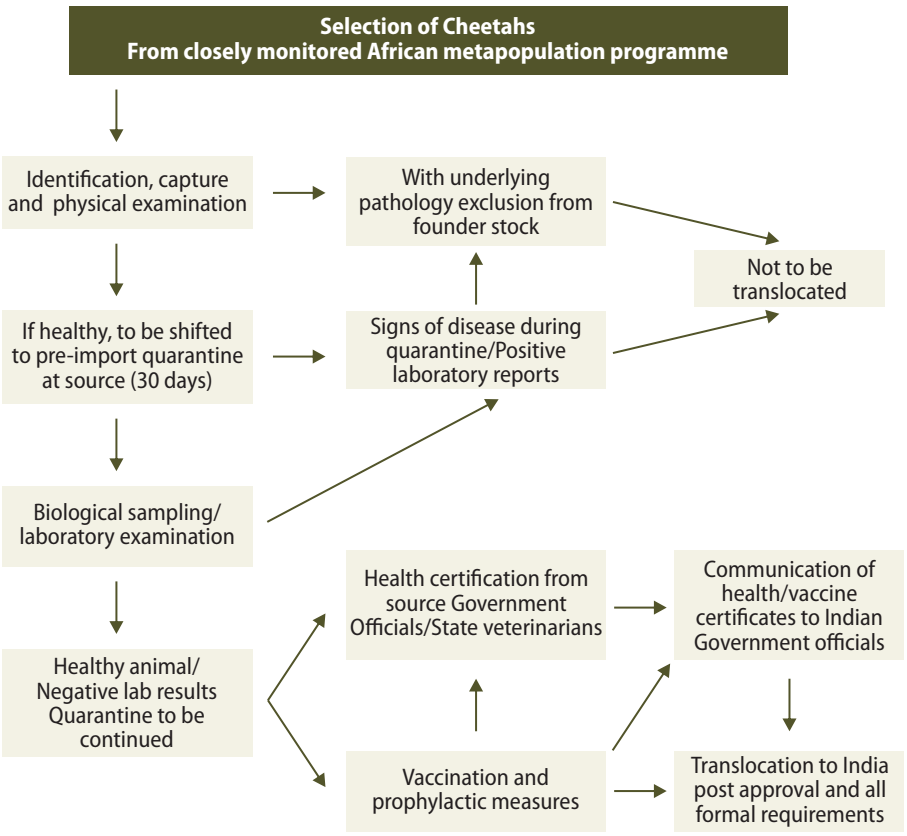
Hazard	Recorded in free-ranging Cheetah at source	Recorded in felids at release sites	Cheetah susceptible at release sites?	Risk Level
Climate or weather risks	Yes	Yes	Maybe	Very low
Interspecies aggression risk	Yes	Yes	Yes	Low
Demographic and genetic risk	No	Not applicable	Yes	Very low
Capture and Translocation risk	Yes	Not applicable	Yes	Medium
Starvation risk (Starvation during quarantine & starvation post release)	Yes	Not applicable	Maybe	Low
Husbandry related risks	Yes	Not applicable	Yes	Low
Poaching risk	Yes	Yes	Yes	Medium
Other anthropogenic risk	Yes	Yes	Yes	Medium

RISK MANAGEMENT

The current step helps in reviewing the potential reduction of health risk to reintroduced and recipient populations, as well as decide upon the management options and evaluate their likely outcomes.

Management interventions for communicable hazards

All the cheetah being translocated (founder stock) to India would be sampled and screened in the country of origin using appropriate molecular diagnostics/ seroprevalence methods, details of which have been tabulated in Table 7. All founder cheetah would be kept under observation in a quarantine facility in the host country for



manifestation of any illness after capture. Any cheetah found to be a carrier of a pathogen novelto India would not be considered for translocation. Vaccinations and health checks/ treatments as per the domestic norms (DAHD, 2020) would be implemented in the country of origin before cheetah are transported to India. The following decision-making tree will be followed to evaluate the inclusion criteria for individual cheetahs from each source site, both in South Africa and Namibia.

Table 7. The decisions and recommendations made to mitigate major risks associated with the identified hazards during pre and post translocation quarantine.

Disease	Pre – Introduction Risk management (Southern Africa)	Post – Introduction Risk management (India)
Feline immunodeficiency, virus (FIV)	(1) Clinical examination (2) Field or lab-based test for FIV/FeLV antigen prior to translocation. Vaccine for FIV no longer available due to low efficacy, and use would be very doubtful in wild felids.	(1) Clinical examination on arrival (2) Quarantine for 30 days
Feline leukaemia virus (FeLV)	(1) Clinical examination (2) Field or lab-based test for FIV/FeLV antigen prior to translocation. Vaccine not considered necessary considering the absence of disease in free-ranging cheetahs and low risk of exposure to domestic cats in India	(1) Clinical examination on arrival (2) Quarantine for 30 days
Feline herpesvirus (FHV1)	(1) Quarantine 30 days prior to translocation (2) Clinical examination (3) Vaccinate against FHV1 with killed vaccine, two doses 3 to 4 weeks apart (Catvax4 – Design Biologix/ FelOVax) - Last dose given 1 month before translocation.	(1) Clinical examination on arrival (2) Quarantine for 30 days
Feline calicivirus (FCV)	(1) Quarantine 30 days prior to translocation (2) Clinical examination (3) Vaccinate against FCV with killed vaccine, two doses 3 to 4 weeks apart (Catvax4 – Design Biologix/ FelOVax). Last dose given 1 month before translocation	(1) Clinical examination on arrival (2) Quarantine for 30 days
Feline enteric coronavirus (Feline infectious peritonitis) (FIP)	(1) Quarantine 30 days prior to translocation (2) Clinical examination (3) Determine FCoV antibody titres prior to translocation	(1) Clinical examination on arrival (2) Quarantine for 30 days

Feline panleukopaenia virus (FPLV)	(1) Quarantine 30 days prior to translocation (2) Clinical examination (3) Vaccinate against FPLV with killed vaccine, two dose 3 to 4 weeks apart (Catvax4 – Design Biologix/ FelOVax). Last dose given 1 month before translocation.	(1) Clinical examination on arrival (2) Quarantine for 30 days
Canine parvovirus	(1) Quarantine 30 days prior to translocation (2) Clinical examination (3) Vaccinate against CPV with killed vaccine, two dose 3 to 4 weeks apart (CPV – Design Biologix). Last dose given 1 month before translocation.	(1) Clinical examination on arrival (2) Quarantine for 30 days
Canine distemper virus	(1) Clinical examination Vaccination not required as there is no evidence that cheetahs either show symptoms or transmit this disease	(1) Quarantine for 30 days
SARS-CoV-2	(1) Quarantine 30 days prior to translocation	(1) No action needed
Rabies	(1) Clinical examination (2) Vaccination with any of the killed rabies vaccines. Two doses 3-4 weeks apart	(1) Clinical examination on arrival (2) Quarantine for 30 days
Anthrax	(1) Clinical examination	(1) No action required
Tuberculosis	(1) Clinical examination (2) Blood sampling for CXCL9 gene expression assay as well as the Dual Path Platform (DPP) Vet TB Serologic Assay (Chembio Diagnostic Systems, Inc., http://chembio.com	(1) Clinical examination on arrival (2) Quarantine for 30 days
Protozoal diseases	(1) Treat with a long acting oral isoxazoline (fluralaner - Bravecto®) which is very effective against ticks and fleas, providing protection for several months	(1) Treat with a long acting oral isoxazoline (fluralaner - Bravecto®) before release (2) Blood screening for protozoans prior to release.
Gastro-intestinal prasites	(1) Treat with a long acting oral isoxazoline (fluralaner - Bravecto®) prior to translocation (2) Treat with single oral dose of fenbendazole + praziquantel before translocation	(1) Treat with single oral dose of fenbendazole + praziquantel before release (2) Parasite load to be checked prior to release.

It is to be noted that the proposed vaccines have not been formally tested for efficacy in Cheetahs. Nonetheless, these vaccines have been extensively used over the years by wildlife veterinarians and veterinary wildlife specialists throughout southern Africa. With no evidence for adverse reactions or disease breakdown after delivery of these vaccines in southern Africa, it is safe to assume reasonable efficacy but without challenge studies certainty is not possible to confirm the same. The founder cheetah

would still be sampled at the time of transportation to India to ascertain the post vaccine protective antibody titres.

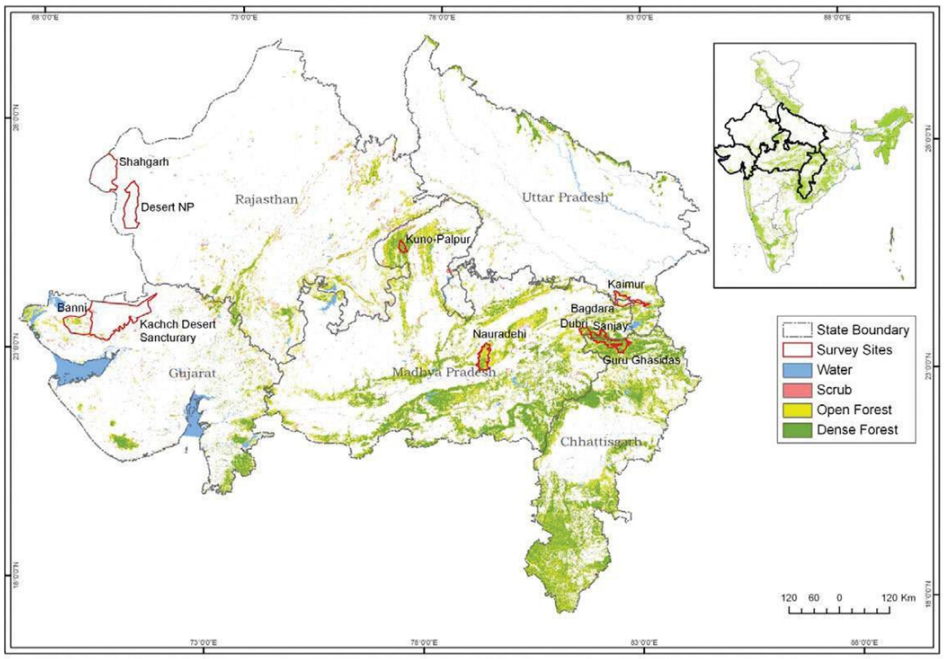
As per the domestic requirements for the import of felids (tiger, lion, snow leopard, leopard, cheetah, puma, jaguar, other large & lesser cats) into India by the Department of Animal Husbandry & Dairying (DAHD), 2021- Ministry of Fisheries, Animal Husbandry & Dairying, Government of India following observations will also be made during pre-import quarantine period:

a. Show /shows no clinical sign of diseases including Rabies, Feline enteritis, Feline pan leukopenia, Leptospirosis, Distemper, Scabies, Pseudorabies (Aujeszky's disease), Blood parasites (protozoan diseases) including Babesiosis, Anaplasmosis, Trypanosomiasis and Toxoplasmosis prior/during the transport.

On arrival in India, the cheetahs would be housed in the predator proof double fenced enclosure during quarantine, so as to ensure no direct exposure to resident carnivore population during quarantine period. Further, each animal will be visually evaluated from a distance on a daily basis. The behaviour, body condition and appetite (on feeding days) will be recorded. Cheetahs will be subjected to biological sampling and necessary veterinary interventions by a team of trained veterinarians posted in Kuno and Mukundara facilities as per the need. As per the DAHD directives and the inputs from Regional Quarantine Officer, the cheetahs will be subjected to any laboratory tests as deemed necessary. After 27 days in quarantine, the designated veterinarian team will submit the health status report of each cheetah to the regional quarantine officer and based on that report final quarantine clearance certificate will be obtained from the regional quarantine officer (RQO). If there is any animal mortality, it will to be reported to RQO immediately and a post-mortem examination will be done immediately and its report submitted to RQO for further action. Only after receiving the final quarantine clearance certificate, the cheetahs will be released to the wild. Further, each cheetah will be radio-collared and monitored closely post release for at least a couple of years. Cheetahs within the programme that become ill will be immobilized, isolated in a holding cell and examined by the veterinary team. Such individuals will be held in isolation until the risk is evaluated or health restored. The causes of mortality if any will also be determined and recorded in each case. Simultaneously, resident animals' health monitoring will also be carried out routinely and seroprevalence studies will be implemented in the landscape for continued disease surveillance.

Management Interventions for Non-Communicable Hazards

Eco-climatic risks: In order to ascertain the climate and weather suitability, cheetah presence locations from Southern Africa (South Africa, Namibia, Botswana and Zimbabwe) were used along with relevant eco-climatic covariates to model equivalent niche space in India using Maximum Entropy Models (MaxEnt; Phillips et al. 2004; Jhala et al. 2021). Cheetah presence locations (16,495), along with data on land use and landcover (LULC), precipitation & temperature, elevation, aridity, and human impacts from both southern Africa and India were considered. The analysis showed that the climatic niche of the cheetah from southern Africa exists in India with Kuno NP having a high probability of cheetah habitat suitability. Cheetah habitat suitability was best explained by grassland, scrub and open forest systems, semi-arid environments, low human impacts, and temperatures that tended to be hotter compared to cooler regimes.



The location of potential cheetah re-introduction sites surveyed in the states of Rajasthan, Gujarat, Madhya Pradesh, Uttar Pradesh and Chhattisgarh in India.

Interspecies aggression risk: Cheetah are known to persist at low densities with lions, leopards, and spotted hyenas. In Pinda Game Reserve, cheetahs have fared extremely well and contributed maximum number of individuals to the South African meta population program despite Pinda having a high lion and leopard density (Simon Naylor Pers. Comm.). In Kuno there are no tigers or lions; Kuno has a high density of leopards and striped hyenas. Though leopards are not considered a threat to adult cheetahs, they can be a threat to cheetah cubs. Striped hyenas are not much of a threat to cheetahs or cubs accompanied by mothers; however, striped hyenas could predate very young cubs in the lair when the mother is out hunting. Under natural conditions these risks are ecologically sustainable and the cheetahs have evolved strategies to counteract them and survive. Therefore, the threat from competing carnivores is not considered as a serious hazard to establishing cheetah population in Kuno and elsewhere in India.

Demographic and genetic risk

The 2013 IUCN guidelines suggest the introduction of the same or closely related genetic stock for conservation introductions. Since cheetahs are now extinct in India,

Predator proof outer power fencing of the soft release boma.

there is no question of hybridization of the introduced subspecies with extant subspecies within India. Based on full genome analysis all extant cheetah subspecies are almost genetically equidistant from *Acinonyx jubatus venaticus* (Prost et al. 2022). In such a situation, other aspects such as a) a large source population that can sustain offtake of founders for India without detrimental effects 2) high genetic diversity of the source, 3) behaviourally appropriate individuals that can survive under free ranging conditions and yet be possible to manage were the criteria for selecting cheetahs from Namibia and South Africa (*A. j. jubatus* subspecies).

It is well established that small populations have a high chance of extinction due to the stochasticity of the environment, demographic processes, and loss of genetic variability (Frankham2010; Frankham et al. 2009). To ensure persistence of the cheetahs in India for the long-term we have 1) we have attempted to have a large gene pool represented in the founder population by sourcing over 35-40 individual cheetahs from the most genetically diverse extant cheetah populations in the world i.e. South Africa and Namibia, over a period of five years. 2) Introduce cheetahs in 3-5 locations in India allow these populations to build up individually while being managed as a single metapopulation within India (Hanski 1998) with occasional introductions from Southern Africa. The ultimate aim being to manage the Indian population and the Southern African population as a single metapopulation with human mediated geneflow between them. 3) Population Viability Analysis (Jhala et al 2021) suggests that this strategy of managing cheetah populations in India reduces the risk of extinction to a negligible probability.

Capture and Translocation risk

Prolonged chase for darting and capture, long exposures to intermittent disturbing stimuli during transportation, and exertion are some causes of capture myopathy related deaths of cheetahs. These can be avoided by appropriate darting techniques, use of appropriate anaesthetic drugs (for example 1.5 to 2.5 mg medetomidine + 150 to 200 ketamine + 5mg midazolam for an adult cheetah), good and efficient practices of handling animals, transportation in individually specifically designed crates over routes that involve minimal time and stressors. Use of long-lasting tranquilizers like (water-soluble perphenazine) are recommended for long journeys that may expose the cheetahs to several stressors. Transportation of cheetah from the quarantine

facilities in South Africa and Namibia is planned to be done in the most efficient manner. Cheetah will be individually crated in IATA certified crates and driven to the nearest airport (Windhoek and Johannesburg) from where they would be loaded onto a chartered flight to India. After customs formalities are completed (facilitated through prior information) the cheetah will be air lifted to Kuno National Park soft release enclosure directly by Indian Air Force helicopters. Though the logistic arrangements are the best possible, the journey is long and cheetahs will be exposed to a relatively high level of stress. We should be ready for stress related myopathy and mortality in some individuals.

Starvation risk

Cheetah need to eat every 2-4 days, depending on the size of the last meal. Starvation sets in a full cascade of events, including lowered resistance to infections and manifestation of disease symptoms from usually innocuous infections of parasites and pathogens. If starvation is prolonged beyond a point, recovery even after being fed a meal is often difficult. Under *natural* conditions starvation would occur when a cheetah is unable to hunt (due to injury or very old age) or due to paucity of prey. In a reintroduction starvation in founding population needs to be managed so that precious individuals are not lost.It is possible that some wild cheetahs do not accept dead meat in a confined boma resulting in starvation. This situation can be addressed by confining the cheetah in a smaller space and initially feeding the animal with meat chunks using long poles. In India the boma within Kuno National Park is large with natural prey. Cheetahs will have the opportunity to hunt and get used to chital deer as their primary prey. Cheetahs will be monitored using telemetry to locate them and visually scored in terms of their belly fullness scores to determine that they have fed. If a cheetah is found to be starving (belly score "empty") for subsequent two days the cheetah will be supplemented with food and ensured that it eats. After the cheetahs are released under free ranging conditions, each cheetah will be monitored with Satellite and VHF telemetry and a visual confirmation on each animal's status obtained each day. Here too if the cheetah is observed to go without eating for 3 days or more it will be supplemented for the first six months after release, to ensure that the starvation is not induced due to a new locale and lack of knowledge of the cheetah regarding the distribution of its prey. It would not be easy to supplement free ranging cheetahs with food, for this the founder population will be habituated to a single vehicle which will bring food for them in the bomas.

Southern African cheetah would be used to predating antelope, hare, warthogs, and some other small mammals and large birds. In India the majority of prey would consist of chital deer, nilgai antelope, Indian gazelle, wild pigs, and peafowl. In size, shape, and behaviour, the Indian prey species would be almost similar to those that the cheetahs from Africa are used to hunting. Cheetahs are extremely adaptable and like all carnivores have a search image for a certain size of prey that behave like prey. We see no major problems to the cheetahs from southern Africa to readily predate on available prey species in Kuno National Park.

An important aspect on which the establishment of cheetah population depends is on the availability (abundance) of suitable prey. Kuno prey base has been monitored since 2006 and has shown a remarkable recovery with a realized growth rate of chital the most abundant ungulate in the system r=0.33 (SE 0.04), (Jhala et al. Un.Pub.). Currently the density of prey in Kuno National Park is ~45 and of chital is ~30 individuals per km^2. This density rivals density estimates of many tiger reserves and African Reserves where cheetah populations are thriving. Based on the prey density and abundance in Kuno National Park the carrying capacity for cheetah was estimated at 21 adult individuals, and in the long-term, after restoration of the larger landscape about 40 cheetahs could be supported (Jhala et al 2021). Thus, cheetah should not have any problem in locating and hunting appropriate prey within Kuno National Park. However, there is a possibility that cheetah may disperse out of the Protected Area in natural prey poor areas and livestock rich areas, giving rise to the possibility of conflict with human interests. In such situations the cheetahs that have ventured out will be attempted to be driven back into the protected area failing which they will be darted and relocated to within the National Park.

Husbandry related risks

Cheetahs that are captured and quarantined can be victims of stress induced manifestation of diseases in otherwise tolerant hosts. Often mild infections, blood parasites, and endo parasites that are usually asymptomatic can cause symptoms and become life threatening under stress. Appropriate treatment for parasites during the quarantine period reduces the manifestation of these disease as well as reduces the risk of inadvertently introducing novel parasites into the recipient country. Holding wild cheetahs in appropriately sized quarantine bomas in secluded areas free of stressors is an important aspect of quarantine management. Cheetah should have space and cover to retreat away from humans as otherwise wild cheetah can get extremely stressed. The quarantine/soft release facility built in Kuno is large with natural vegetation and sufficient area for each cheetah (50-100ha). The quarantine facility is fenced with electrification to prevent movement of any animals and is made free of carnivores from within the fenced area.

Poaching risk

Since cheetahs will be new to India, there is currently no organised illegal market for their parts, products or pet trade. Unlike tigers, elephants and rhinoceros that have a high demand for their body parts, cheetah is not a sought-after commodity in the international illegal trade for cheetah body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parts, however cheetah cubs do feature in the pet trade (Durant et. al. 2022). Due to the very few numbers in the initial years of the introduction, we do not expect any illegal market driven poaching of the cheetahs in India. However, bush meat consumption is prevalent in the Kuno Landscape (Ranjitsinh and Jhala 2010), and the possibility of cheetahs being non-target victims to traps, snares, and possible gunshots does exist. Such activities are higher outside of the Protected Area (Kuno National Park) and during the initial years attempt will be made to bring back any founding cheetah that disperses outside of the Protected Area. This would be done by a dedicated trained veterinary team with the best of the drug combinations and equipment. The founding cheetah individuals are carefully selected for behavioural traits that would allow for their management in the form of capture and retrieval. Despite the best of efforts we expect some mortality from poaching. This mortality will be compensated by *immigrants* from Southern Africa and from recruitment in the Kuno National Park which we expect to act as a source and the human inhabited buffer habitat as a sink.

Other anthropogenic risk

Large carnivores do not mix well with local communities because carnivores often kill livestock and sometimes attack humans. This problem is severe when local communities are not exposed to large carnivores in their recent history and have lost the lifestyles that allow them to coexist with carnivores. Amongst communities that live in close proximity with large carnivores, lifestyles and animal husbandry practices have evolved to minimize conflicts with carnivores. The communities in the vicinity of Kuno National Park have been living with large carnivores since historical times that include leopards, striped hyenas, wolves and in the recent past tigers and dhole. They have honed skills of animal husbandry (livestock accompanied by herders and dogs, livestock corralled at night, etc.) that minimize losses to large carnivores. Compared to all other large carnivores' cheetahs come into conflict with human interests the least. There are no recorded instances of a wild cheetah attacking a human. Cheetahs avoid any kind of conflict and will be driven away by a guard dog. A public awareness program has been undertaken in neighbouring villages by the forest department and local administration where in the cheetah mascot “Chintu Cheetah” is used to communicate the facts of cheetah as a species and its harmless nature to school students and the public. However, cheetahs do predate on small livestock like sheep, goats, and cattle calves. This can cause retaliation from communities. To prevent any form of retaliation the cheetah project has built in a budget for paying immediate compensation for any livestock that is killed by cheetahs immediately. Since all founder cheetahs will be radio collared and located several times in a day, any livestock kill made by them will be known to the park authorities and biologists monitoring the cheetahs. Cheetah rarely return to a kill, they eat their fill as a single meal and move on, thereby reducing the possibility of feeding on a poisoned carcass.In areas around Kuno National Park, bushmeat consumption is present (Ranjitsinh and Jhala 2010). The area outside the National Park is likely to have snares set for wildlife and cheetah can be caught as a non-target species to detrimental effect.All attempts will be made to capture and bring cheetahs back into the Protected Area if they disperse into human dominated areas of the landscape.

RISK COMMUNICATION

'Who has an interest, who has knowledge or expertise to contribute, and who can influence the implementation of recommendations arising from the DRA?'

- Jakob-Hoff and Co-workers, 2014.

The current section deals with engagement of relevant experts and stake holders to maximise the quality of analysis as well as effective implementation of recommendations for mitigating risks.

The proposed introduction of Cheetah is a Government of India initiative as per the approvals of the Supreme Court of India in 2020. The Cheetah Project in India is being overseen by the National Tiger Conservation Authority(NTCA), Ministry of Environment Forest and Climate Change (MoEF&CC), Government of India(GoI) guided and directed by the committee of experts designated by the Supreme Court of India. Wildlife Institute of India, also an autonomous institute under the MoEF&CC was given the task of providing technical assistance to theprojectby the NTCA and the expert committee on cheetah. For systematic operation of the projectand for transparency, an action plan for introduction of cheetah in India(With Emphasis on the First Release Site-Kuno National Park) has already been put in the public domain (Jhala et al., 2021). Delegations from India, represented by officials from National Tiger Conservation Authority, Ministry of Environment Forest and Climate Change, Madhya Pradesh Government, and the Wildlife Institute of India (Bureaucrats, Veterinarians, Wildlife Managers and Biologists)have visited both Namibia and South Africa for Government to Government discussions, understanding cheetah conservation management first hand and learning the techniques required for handling and translocation of cheetahs to India. Cheetah experts (biologists, managers of game reserves, and veterinarians) from South Africa and Namibia have visited the cheetah reintroduction sites (Kuno, Mukundara, Gandhi Sagar) and provided guidance to the project. All international experts have concurred on the suitability of the selected sites as cheetah habitats and are in agreement with the action plan (Jhala et al. 2021) that lists the managerial interventions required prior to the translocation of the cheetahs to India. The international experts all concur on the readiness for Kuno National Park to receive the first batch of cheetahs in 2022.

Based on mutual consultations, the following stake holders were identified:

India

Stake holder	Authorised Official	Role
Supreme Court Appointed Committee	Dr. M. K. Ranjitsinh; Director Wildlife Institute of India; Dept. Inspector General, Ministry of Environment, Forest and Climate Change	Provide direction, guidance, monitor the progress of the project and report quarterly to the hon'ble Supreme Court of India
Ministry of Environment Forest & Climate Change, Government of India	Sh. Chandra Prakash Goyal, Director General of Forests and Special Secretary.	Overall Project Supervision
National Tiger Conservation Authority, Government of India	Dr. S. P. Yadav, Member Secretary & Dr. Amit Mallick, Inspector General	Direct Authority for the Supervision of the Project
Forest Government of Madhya Pradesh, Government of Madhya Pradesh	Dr. J. S. Chauhan, Chief Wildlife Warden	Supervision of the Project within the State of Madhya Pradesh
Department of Animal Husbandry and Dairying, Government of India	Dr Abhijit Mitra,Animal Husbandry Commissioner, Government of India.	Responsible for providing approvals for cheetah's imports (health/disease)
Wildlife Institute of India, Government of India	Director, Dean, Project PI Dr. S. P. Yadav, Director; Dr. Y. V. Jhala, Dean and Scientific lead on the project.	Technical and Scientific aspects of the Project, Monitoring, Research, Assessments (habitat, prey, diseases, cheetahs).

Namibia

Stake holder	Authorised Official	Role
Ministry of Environment, Forest and Tourism	Executive Director	Guide/Supervise the project in Namibia and provide suitable cheetah for India's reintroduction project. Oversee CITES permits, and other legal requirements
Cheetah Conservation Fund	Dr. Laurie Marker, Director & Staff of CCF	Coordinate, organize appropriate cheetahs, quarantine, vaccinations, radio-collar, crating and assist in transportation, provide guidance
Indian High Commission, Windhoek, Namibia	Sh. Prashant Aggarwal, Indian High Commissioner & HC Staff	Facilitate coordination with the Government of Namibia, logistics and coordination.

South Africa

Stake holder	Authorised Official	Role
Department of Forests, Fisheries, and Environment, Government of South Africa (DFFE)	Director General	Guide and Supervise the project in South Africa and assist with providing suitable cheetah for India's reintroduction project from South African Parks.
South African National Biodiversity Institute (SANBI)	Chairperson SANBI	Provide Scientific inputs and CITES related permissions.
Faculty of Veterinary Science, University of Pretoria	Dr. Adrian Tordiffe, Dr. Leith Meyer	Assist with health certification, care, vaccinations, translocations
Metapopulation Manager	Vincent van der Merwe	Provide appropriate cheetah from private Game Reserves, assist with logistics of holding, quarantine and transportation
Endangered Wildlife Trust	CEO and Manager Large Carnivore Initiative	Facilitate the logistics and fund flow from India
Munyawana Conservancy Hluhluwe, KwaZulu-Natal	Simon Naylor, Conservation Manager	Provide cheetah for India, assist with logistics, holding facility, quarantine, veterinary support, advise, guidance and fund flow from India.
Indian High Commission, Pretoria, South Africa	High Commissioner and HC Staff	Coordinate with the Govt. of South Africa, Advise, supervise the logistics in South Africa. Facilitate international transportation of cheetahs and collaborators.

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Disease Risk Analysis of various disease hazards identified for introduction of cheetah from southern Africa to India.

Causative Agent : Feline Immunodeficiency Virus, a Lentivirus

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
The hazard is thought to have worldwide distribution in domestic cats. Though asymptomatic when naturally occurring, individuals infected with certain strains, especially older cats, signs can include mild to progressive anaemia, moderate to severe oral disease, especially stomatitis, mild to significant weight loss, chronic or non-healing skin infections, vomiting, diarrhoea, neurologic disease, and atypical lymphosarcoma. Clinical case has so far not been recorded in non-domestic felids in India and seroprevalence studies have also showed no evidence of virus circulation in India.	FIV has not been recorded in free ranging cheetahs so far. Free-ranging cheetahs from Namibia and South Africa have tested seronegative for FIV. FIV has also not been reported to cause clinical disease in most wild felids except for the Pallas' cat. There is thus very low likelihood that translocated cheetahs would be infected on arrival to India.	Horizontal transmission is the most prevalent route. These viruses appear more prevalent in social felids like lions as the disease is thought to be transmitted through saliva *i.e.*, grooming and fighting. Most infections are species specific, but some evidence for interspecific transmission in captive collections exists. There is a very low likelihood of dissemination of the virus to Indian carnivores as i) imported cheetah would rarely be interacting with native carnivores. ii) all cheetahs marked for import to cheetah have been tested for seroprevalence and for clinical symptoms and have been negative for both.	FIV has not been detected in any free-ranging felid in India. There is very low likelihood for FIV to cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a very low likelihood of introduction of FIV from translocated cheetah to India as well as circulation and maintenance of FIV among felids at release sites in India	Disease screening to be performed before translocation in founder cheetah and carnivores at released site before introduction and preventative measures to be employed to reduce the disease risks.	Vaccine for FIV no longer available due to low efficacy, and its usefulness would be very doubtful in wild felids. Pre import screening the founder stock and carnivores at release site with field test for FIV/FeLV antigen prior to translocation. Not to import animals that have active inventions.

Causative Agent : Feline leukaemia virus (FeLV), an oncornavirus

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
The first confirmed case of FeLV-associated lymphoma in a nondomestic felid occurred in a captive cheetah. An outbreak occurred in the US in Florida panther population and later in a population of Iberian lynx. In all cases, the source of the infection was thought to be from domestic cats. Seroprevalence studies in nondomestic felids in India so far have been negative for FeLV. The virus is not considered endemic in nondomestic felids, although antigen-positive animals have been documented, as well as seropositive, asymptomatic animals. FeLV has also been isolated in leopard cat, European wildcat, and cougar. Symptoms may include anorexia, enlarged lymph nodes, persistent fever, gingivitis, stomatitis, persistent diarrhoea, neurologic signs, eye conditions, abortions, and reproductive failures.	A single captive cheetah was diagnosed with multicentric –T-cell lymphoma associated with FeLV in Namibia in 1995. This was the first confirmed case of FeLV in a non-domestic felid. The seroprevalence is generally low in most surveys and no free-ranging cheetahs have yet tested positive for the FeLV antigen using PCR. This disease is therefore unlikely of concern for the translocation of cheetah to India.	High quantities of virus shed in nasal secretions, saliva, etc.; most often transmitted to nondomestic felids via contact with or ingestion of domestic feral cats. In non-domestic felids, depending on the immune response of the individual, it can be either asymptomatic or transient. Since cheetah being introduced would undergo transport and release environment related stress and ensuing altered immunity, there is a medium likelihood that the cheetahs become either symptomatic or shed viruses if they were already infected.	FeLV has not been detected in any free ranging felid in India or in free ranging cheetah from source countries. There is low likelihood for FIV to cause disease both in introduced cheetah, as well as native felids.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a low likelihood of introduction of FeLV from translocated cheetah to India.	Disease screening to be performed before translocation in founder cheetah and carnivores at released site before introduction and preventative measures to be employed to reduce the disease risks. Any Cheetah with evidence of infection is not to be imported.	Vaccine not considered necessary considering the absence of disease in free-ranging cheetahs. Pre import screening of the founder cheetah stock and carnivores at release site with field test for FIV/FeLV antigen prior to translocation. Exclusion of feral cats at release sites If any translocated animal dies during quarantine (pre and post translocation) a thorough post mortem.

Causative Agent: Feline herpesvirus/Rhinotracheitis caused by Feline herpesvirus type-1 (FHV1)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Cheetah is susceptible to the disease and once infected, can remain carriers for lifetime. Proliferative skinlesions at mucocutaneous interfaces have been observed in the species. Currently no clinical cases have been recorded from free ranging non domestic felids in India. However, seropositivity has been observed in free ranging felid species such as Asiatic lions and Bengal tigers in India. Disease is characterised by high morbidity and low mortality. Clinical symptoms include ocular nasal discharge, anorexia, and depression. Co-infection with other respiratory viruses (especially calicivirus) and secondary bacterial infections are common in affected animals.	Captive cheetahs are commonly infected with feline herpesvirus. The disease is only rarely seen in wild cheetahs, even though many seroconvert. The founder cheetah stock are all of wild origin and therefore there is a medium likelihood of affected cheetah arriving to India.	Disease is transmitted through respiratory droplets and fomites. Though virus is shed intermittently potentially for remaining life of infected animal, the virus does not survive long in dry environments. Thus, there is a medium likelihood that affected cheetah would expose native non domestic felid species to the disease and vice versa.	Seropositivity has been observed in free ranging lions, tigers and striped hyenas in India, highlighting the presence and circulation of the virus among native felids. Thus, there is very low likelihood of cheetahs introducing the disease to India and causing diseases at an outbreak proportion.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a low to medium likelihood of introduction of FHV1 from translocated cheetah to India. However, there is very low likelihood for FHV1 to cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.	Preventative measures should be employed to reduce the disease risks.	Pre import clinical evaluation: FHV1 has an incubation period of 2 – 6 days and pre import quarantine can ensure absence of disease symptoms. Vaccinate founder stock against FHV1 with killed vaccine, two dose 3 to 4 weeks apart. Though it does not prevent infection or shedding, but can reduce severity of signs and decrease the amount of virus shedding.

Causative Agent: Feline calicivirus (FCV)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
The disease has world-wide distribution, with records from all members of Felidae. However, the disease is most common in multi-cat captive environments (e.g., shelters, breeding facilities) and in feral cats. The clinical signs are highly variable. Mild upper respiratory infection: ocular and nasal discharge. oral ulceration is a common transient sign. Systemic infection: sloughing of oral mucosa, foot pads, and other mucosal epithelia; edema; pyrexia; ulcerative dermatitis; anorexia; jaundice; and death Clinical symptoms in cheetah include mild upper respiratory disease and ulceration of the tongue, whichhave, to date only been seen in younger captive cheetahs.	Feline calicivirus antibodies are commonly detected in the serum of free-ranging cheetahs. The founder cheetah stock are all of wild origin and therefore there is a medium likelihood of affected cheetah arriving to India.	Transmitted directly through oronasal route or indirectly through fomites. Once recovered, animals can shed infectiousvirus for months to years. Thus, there is a medium likelihood that affected cheetah would expose native non domestic felid species to the disease and vice versa. The primary risk isfrom exposure to unvaccinated domestic cats. Since presence of domestic cats around release sites are negligible, there is very low likelihood of exposure to FCV through this route.	Seropositivity has been observed in free ranging lions, tigers,and striped hyenas in India, highlighting the presence and circulation of the virus among native carnivores. Thus, there is low likelihood of cheetahs introducing the disease to India and causing diseases at an outbreak proportion or vice versa.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a medium likelihood of introduction of FCV from translocated cheetah to India. However, there is very low likelihood for FCV to cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.	Preventative measures should be employed to reduce the disease risks which includes screening the cheetahs prior to transportation to India	Pre import clinical evaluation: FCV has an incubation period of 2 – 10 days and pre import quarantine can ensure absence of disease s. Vaccinate founder stock against FCV with killed vaccine, two dose 3 to 4 weeks apart. Proper cleaning of inanimate objects like crates used for transport as FCV can survive up to 14 days on fomites.

Causative Agent: Feline enteric coronavirus (FCoV)/ Feline infectious peritonitis (FIP)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Feline enteric coronavirus (FCoV) most often causes mild enteritis, but in some cases, it can result in a fatal disease called feline infectious peritonitis (FIP). Domestic cats and numerous non-domestic felids such as African lion, mountain lion, leopard, jaguar, lynx, serval, caracal, European wild cat, sand cat, and Pallas cat are susceptible. Cheetah seems to be more susceptible than other exotic felids in captivity. Clinical symptoms may include inappetence, weight loss, and fluctuating fever. Following forms have also been observed: Effusive form – ascites, thoracic and/or pericardial effusion. Dry form - Ocular lesions and CNS signs	The seroprevalence of FCoV in southern Africa is very low in free-ranging cheetahs and no clinical cases have been reported in free-ranging individuals. There is thus very low likelihood that translocated cheetahs would transmit the disease on arrival to India.	Primary mode of transmission is through feces. The virus is highly infective and can survive for approximately 2 months in a dry environment. There is thus high likelihood that affected cheetah can expose native carnivores to FCoV/FIV if translocated to India. FCoV has worldwide and ubiquitous distribution among domestic cats. Since presence of domestic cats around release sites are negligible, there is very low likelihood of exposure through this route.	The prevalence of FCoV in free ranging non domestic felids in India is unknown, except for Tigers which have shown seropositivity in free ranging conditions. Further, there are no specific virologically proven report of this disease in free ranging wild felids in India. However, gross lesions indistinguishable from infectious peritonitis have been recorded in two free ranging tigers which died in the Dudwa Tiger Reserve Utter Pradesh. If introduced to release site by translocated cheetah, disease has a low likelihood of causing significant biological consequences of infection in native felids.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a low likelihood of introduction of FIP from translocated cheetah to India. However, there is medium likelihood for FIP to cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.	Preventative measures should be strictly employed to reduce the disease risks. Disease screening to be performed before translocation in founder cheetah and carnivores at released site before introduction and preventative measures to be employed to reduce the disease risks.	Determine FCoV antibody titres prior to translocation. Any Cheetah with evidence of active FIP infection not to be imported.

Causative Agent: Feline panleukopaenia virus (FPLV), a parvovirus

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Feline panleukopenia virus is a common parvovirus that is widespread amongst domestic cats around the world. It is highly contagious and spreads by direct and indirect contact. The disease can affect non domestic felids, as well as some other carnivores. The virus typically affects young captive cheetahs (less than 1 year of age). Per acute cases may result in death. Acute cases present with fever, anorexia, depression, vomiting, diarrhoea, haematochezia, severe dehydration, septic shock, and DIC	There are currently no reports of clinical cases from free-ranging cheetahs in southern Africa. This disease is therefore unlikely of concern for the translocation of cheetah as there is a very low likelihood of affected cheetah arriving to India.	Major routes of exposure are oronasal exposure to virus and transplacental transmission. Virus sheds in all secretions in the acute phase and in feces for up to 6 weeks after recovery and viral particles may remain infectious in the environment for more than a year. Thus, there is a medium likelihood that in case an affected cheetah would arrive in India, it would expose native non domestic felid species to the disease and vice versa.	FPLV titres have been recorded from free ranging tigers, striped hyena, and lionsin India;numerous case records also exist for captive carnivores across India, highlighting the presence and circulation of the virus among native carnivores. Thus, there is very low likelihood of cheetahs introducing the disease to India and causing diseases at an outbreak proportion or vice versa.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is very low likelihood of introduction of FPLV from translocated cheetah to India and cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.	Preventative measures should be strictly employed to reduce the disease risks.	Pre import clinical evaluation: FPLV has an incubation period of 2 – 7 days and pre import quarantine can ensure absence of disease symptoms. Vaccinate founder stock against FPLV, two dose 3 to 4 weeks apart.

Causative Agent: Canine Parvovirus (CPV - Canine parvovirus type-2)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Carnivores including felids, canids, procyonids, viverrids, mustelids, ursids, and hyaenids are susceptible to the disease. The most common signs are vomiting and diarrhoea that can result in dehydration and death, immunosuppression is also common.	Cheetahs have been shown to be susceptible to the virus. Several outbreaks have been reported from zoos in North America and captive facilities in South Africa, probably originating from unvaccinated dogs infected with the virus. Clinical cases in free ranging cheetahs are however scarce. There is thus very low likelihood that translocated cheetahs would disseminate the disease in release sites.	Fecal-oral route is the major route of transmission. The virus can survive for months in cool, moist areas protected from sunlight, and are very stable when frozen; can persist in feces for 6 months at room temperature and may remain viable in the natural environment for 9-12 months. There is thus medium likelihood ofboth translocated cheetah and native carnivores being exposed to the disease in release sites.	Clinical cases have been recorded in captive large felids in Indian zoos and high seropositivity has been observed in free-ranging carnivores (lions, tigers, wolves, golden jackals, feral dogs), major source being unvaccinated dogs around protected areas. High seropositivity has also been observed in feral dogs around Kuno release site. Thus, there is very low likelihood of cheetahs introducing the disease to India (it already exists across India) and causing disease outbreak, but medium likelihood of introduced cheetah being affected by the disease at release site.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is very low likelihood of introduction of CPV from translocated cheetah to India There is medium likelihood of introduced cheetah being affected by the disease at release site.	Preventative measures should be strictly employed to reduce the disease risks.	Pre import clinical evaluation: CPV has an incubation period of 5 – 7 days and pre import quarantine can ensure absence of disease symptoms. Vaccinate founder cheetahs against CPV with killed vaccine, two dose 3 to 4 weeks apart. Vaccinate feral dogs at release sites against CPV with killed vaccine, two dose 3 to 4 weeks apart. Evaluation post vaccination to ensure protective titre would help the entire wild carnivore community.

Causative Agent: Canine distemper virus, a Morbillivirus

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Species within all terrestrial families of the order Carnivora (Canidae, Mustelidae, Procyonidae, Mephitidae, Hyaenidae, Ursidae, Viverridae, Herpestidae, and Felidae) are susceptible. The disease is known to have caused outbreaks in free ranging carnivore populations, either solely or in conjunction with secondary infections. Signs associated with respiratory, gastrointestinal, integumentary, ophthalmic, and the centralnervous systems are commonly seen, with system(s) affected depending on species, as well as strainvirulence and environmental condition.	Although cheetahs have shown to have positive CDV titres, no clinical cases have been reported in either captive or free-ranging cheetahs. Immunohistochemical screening of cheetahs with so called "cheetah myelopathy" were negative for CDV. There is thus no evidence that CDV causes any disease symptoms in cheetahs and it is highly unlikely that they are able to transmit the virus. There is thus very low likelihood that translocated cheetahs would disseminate the disease in release sites.	Canine distemper has been confirmed as cause of mortality in at least four wild tigers in India, two of which are from central Indian landscape wherein release site is located. A large-scale outbreak and mortality have also been reported in Asiatic lions of Gir Landscape. Both highlight the susceptibility for CDV among native carnivores. Thus, there is a very low likelihood that cheetah would expose native non domestic felid species/ carnivores to the disease as it already exists in India.	High seropositivity has been observed wild sympatric carnivores such as Indian wolves, red fox, Indian fox, golden jackal, and striped hyenas. High seropositivity has also been observed in feral dogs around Kuno National Park. Thus, there is very low likelihood of cheetahs introducing the disease to India and causing CDV outbreak, but medium likelihood of introduced cheetah being exposed to the disease at release site (no evidence exists that CDV causes any disease symptoms in cheetah)
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is very low likelihood of introduction of CDV from translocated cheetah to India and introduced cheetah being affected by the disease at release site.	Preventative measures should be strictly employed to reduce the disease risks.	Pre import clinical evaluation to ascertain absence of CDV symptoms in founder stock. Vaccinate feral dogs at release sites against CDV with killed vaccine, two dose 3 to 4 weeks apart. Evaluation post vaccination to ensure protective titre.

Causative Agent: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Though it is a disease of human concern, handful cases have been observed among non-domestic felids, particularly from zoological collections. In 2021, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was detected in captive Asiatic lions of two zoological parks, in India.	To date, no single case has been reported in a cheetah despite outbreaks at zoos where cheetahs are housed. It is therefore highly unlikely that cheetahs are susceptible or transmit the disease.	A free ranging Indian Leopard (Panthera pardus) from Bijnor range of Uttar Pradesh State in India was found positive with Delta variant of SARS-CoV-2. However, this seems to be an isolated event and mode of disease transmission is yet to be understood. There is a very low likelihood that cheetah would expose native non domestic felid species/carnivores or humans to the disease as it already exists in the country. Further, cheetah being exposed to the disease during transit or handling might be a possibility, however with very low likelihood of clinical infection.	There is very low likelihood of introduction of SARS CoV-2 from translocated cheetah to India and cause disease at outbreak proportions, both in introduced cheetah, as well as native felids
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is very low likelihood of introduction of SARS CoV-2 from translocated cheetah to India and cause disease at outbreak proportions, both in introduced cheetah, as well as native felids.	Preventative measures should be strictly employed to reduce the disease risks.	Pre import clinical evaluation to ensure absence of disease symptoms. Personnel handling the cheetah to use appropriate PPE and other essential barriers.

Causative Agent: Rabies

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Rabies affects a wide range of mammals. Infected animals will showinappetence, cranial nerve deficits,ataxia, salivating, drooping of lowerjaw, acute behavioral changes, suchas altered vocalization, aggression,docility, coma, and progressiveparalysis. Survival in affected animal is extremely rare.	Very few cases are reported in cheetahs. A small proportion of the free-ranging cheetahs in Namibia have been shown to have rabies antibodies. There is very low likelihood of introduction of Rabies from translocated cheetah to India and vice versa as the virus is endemic in both Africa and India.	Major exposure is through bites or scratches from infected individual; saliva into open wounds and mucous membranes. Confirmed cases of Rabies have been reported in wild felids from India, including tigers, leopards and wild canids including Indian wolves, Golden Jackel, Indian Fox and Striped Hyenas. Feral dogs suspected to be the major source for disease transmission. There is thus a medium likelihood of introduced cheetah being exposed to the disease.	There is very low likelihood of introduction of rabies from translocated cheetah to India and cause disease at outbreak proportions, but medium likelihood of cheetahs being exposed to the disease from interaction of non-vaccinated dogs around the release sites.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	There is very low likelihood of introduction of rabies from translocated cheetah to India and cause disease at outbreak proportions, but high likelihood of cheetahs being exposed to the disease from non-vaccinated dogs around the release sites.	Preventative measures should be strictly employed to reduce the disease risks.	Pre import clinical evaluation to ensure absence of disease symptoms. Vaccinate founder stock against Rabies, two dose 3 to 4 weeks apart. Vaccinate feral dogs at release sites against rabies, two dose 3 to 4 weeks apart and then annually. Feral dog population control around release sites would be helpful.

Causative Agent: Anthrax

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
All mammalians including humans are susceptible for the disease. The disease occurs world-wide, especially in areas with neutral or alkaline calcareous soils. Outbreaks can occur after soil disturbance following drought or flood conditions. In carnivores, chronic form of disease is observed, with oropharyngeal and gastrointestinal symptoms, usually followed by recovery but death can occurs if systemic.	Multiple published and anecdotal cases reported in wild and captive cheetahs. Cheetahs are highly susceptible to the disease, dying acutely after consuming anthrax infected carcasses. Wild cheetahs do not have serum antibodies to anthrax The reason for this is most likely due to the fact that cheetahs rarely scavenge or due to confirmed mortality in positive cases. There is very low likelihood of introduction of Anthrax from translocated cheetah to India.	Disease is usually transmitted through ingestion of spores that can come from soil, infected carcass, soil contaminated forage or blowfly contaminated browse. Not recorded in large felids in India, however sporadic cases have been observed in wild animals throughout the country, including megaherbivores such as elephants. However, outbreaks have not been recorded from release sites in India and hence there is very low likelihood of founder stock being exposed to disease post release.	The disease exists both in Africa and Asia, with confirmed reports from numerous wild animal species. However, there is very low likelihood of the disease to cause outbreaks in both cheetah and native mammalians due introduction of cheetah to the release sites.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	There is very low likelihood of the disease to cause outbreaks in both cheetah and native mammalians due introduction of cheetah to the release sites.	Preventative measures should be employed to reduce the disease risks.	Pre import quarantine and clinical evaluation to ensure absence of disease symptoms.

Causative Agent: BovineTuberculosis (*Mycobacterium bovis*)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
The disease may present itself in various forms and variable clinical signs are observed, depending on species infected and site of infection. Asymptomatic to acute symptoms and death are possible. Symptoms include: lethargy, emaciation, and other non-specific signs of illness; cutaneous ulcers, abscesses, and granulomas; enlarged abdomen and ascites; cough, dyspnoea, pneumonia; lymphadenopathy; and lameness due to bone infections.	Free ranging cheetahs in Southern Africa do not hunt or scavenge on buffalo who are the primary hosts of the disease and infection rates are therefore likely to be low. No cases of MTB have been recorded in South African (except Kruger area) and Namibian cheetah. Spillover infections of Mycobacterium bovis have been recorded in a small number of cheetahs in and around the Kruger National Park in South Africa. Thus, there is medium likelihood of transfer of the disease from translocated cheetah to India.	BTB is highly prevalent in domestic livestock in India, with an estimated 21.8 million cases in India. There is hardly any authentic report of tuberculosis in free ranging carnivore species except the one, which mentioned tuberculous hepatitis encountered during necropsy of an adult tiger (Panthera tigris) that died in Dudwa Tiger Reserve, in 1987. Sporadic cases have however been observed in free-raging prey species in India, possibly spillover from wildlife-livestock interface. Thus, there is medium likelihood of translocated cheetah being exposed to BTB during predation events.	The disease exists both in Africa and India, with confirmed reports from numerous wild animal species. There is thus medium likelihood of disease incidences in both translocated cheetah and native mammalians, either as result of introduction from cheetah or by predation of infected feral cattle at release sites.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	There is medium likelihood of disease incidences in both translocated cheetah and native mammalians, either as result of introduction along with cheetah or by predation of infected feral cattle at release sites.	Preventative measures should be employed to reduce the disease risks.	Pre import screening of the founder stock prior to translocation: Blood sampling for CXCL9 gene expression assay as well as the Dual Path Platform (DPP) Vet TB Serologic Assay. Any Cheetah with evidence of BTB not to be imported. Namibia is declared to be free of BTB and therefore cheetahs from Namibia are unlikely to be carriers of BTB. Restriction of feral cattle movement in and around release site; including active removal of existing animals if any.

Causative Agent: Leptospirosis (Leptospira spp. Approx. 250 serovars)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Disease can affect numerous mammalian species. Though non-domestic felids appear more resilient, certain clinical cases have been recorded in captive non domestic felids in India, possibly a spillover from rodent hosts. Clinical symptoms in nonhost species like non domestic felids are usually severe with renal signs being most typical symptom and include acute renal failure.	No cases reported in Cheetahs so far. There is very low likelihood of introduction of leptospirosis from translocated cheetah to India.	Serological evidence has been documented in free-ranging Asiatic lions (Panthera leo persica) and one confirmed case in a free-ranging Bengal tiger. Nonetheless actual prevalence of the disease is yet to be ascertained in free ranging conditions and it is likely to be limited to captive/zoological setup. Thus, there is low likelihood of translocated cheetah being exposed to leptospirosis during predation events.	There is very low likelihood of disease incidences in both translocated cheetah and native carnivores. Even if sporadic events occur, the ability of the disease to cause an outbreak or have ecological impact at population level in free ranging native carnivores is very low.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	From current information there is a very low likelihood of introduction of leptospirosis from translocated cheetah to India and vice versa.	General preventive measures such as pre arrival and post translocation quarantine and clinical examination.	Pre import quarantine and clinical evaluation to ensure absence of disease symptoms.

Causative Agent: Babesiosis (Babesia Spp.)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Babesiosis is considered to be ubiquitous among wildlife wherever there are tick infestations. Clinical signs may include haemolytic anaemia, hemoglobinemia, haemoglobinuria, fever, possible neurologic signs, anorexia, slight jaundice. Though majority of infections in wildlife are subclinical, co infection with certain other infections can flare up the symptoms.	Various babesia species have been detected in the blood samples of cheetahs in southern Africa and Tanzania, including Babesia felis, Babesia leo and Babesialengau. To date however, there is no evidence to suggest that any of these species cause clinical symptoms in free ranging cheetahs. The transmission of the parasites is likely to be through specific tick vectors. There is medium likelihood of introduction of babesia/ babesia transmitting ticks from translocated cheetah to India.	There are numerous reports on clinical babesiosis in captive wild felids from India. Species recorded in wild carnivores India include B. canis and B. cati. Though the reports from wild are rare, Asiatic lions that were affected with the recent Canine distemper outbreak in Gir were found to be co-infected with Babesia. There is medium likelihood of introduced cheetah being exposed to babesia spp from Indian release site.	Though babesiosis is considered ubiquitous and recorded in both African and Indian non – domestic species, the babesia spp involved are different and thus pose medium risk of clinical cases due to these novel strains among native carnivores at the release site. The translocated cheetahs are also at medium risk as they would lack host immunity, which is usually developed through exposure to particular babesia spp.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	Based on current literature there is a medium likelihood of introduction of novel babesia species from translocated cheetah to India and cheetah being exposed to babesia species of India.	General preventive measures such as pre arrival and post translocation quarantine and clinical examination.	Treating with a long acting oral isoxazoline/Fluralaner is very effective against ticks and fleas, and provides protection for several months. All cheetah should be treated well in advance before translocation to India. Blood samples from founder stock to be analysed through microscopy during post-arrival quarantine in India. Prevalence of babesia spp among native carnivores at release site also to be carried out to ascertain circulating species in release site.

Note: Similar risk for other haemoprotozoal parasites such as *Cytauxzoon felis, Haemoplasma felis* and *Theileriaexist* as there all are likely to be transmitted through specific tick vectors; however treatment of cheetahs before translocation should reduce this risk substantially.

Causative Agent: Toxoplasmosis (*Toxoplasma gondii*)

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
The disease can affect all vertebrates, primarily birds and mammals. In species sensitive to the disease, animals are often found dead with no clinical signs observed prior to death. Clinical signs if present may include respiratory signs (dyspnoea, tachypnoea, coughing), gastrointestinal signs (diarrhoea), general signs (depression, anorexia, behavioral changes), lymphadenopathy, muscle weakness, neurologic signs (blindness, ataxia, dysphagia), ocular disease (keratitis, uveitis, chorioretinitis, endophthalmitis, cataracts), and even abortion	Prevalence in free ranging cheetah is not ascertained. Nonetheless, since the disease has worldwide distribution and felids are the only definitive hosts, cheetahs may be considered to be exposed to the organism. There is thus medium likelihood of introduction ofToxoplasma from translocated cheetah to India.	Seropositivity has been observed in free-ranging domestic felids in India, including Lions, tigers, and snow leopards. Clinical cases have however not been recorded so far. There is thus medium likelihood of introduced cheetah being exposed to Toxoplasma spp from Indian release site.	Considering the worldwide distribution and the fact that infections in felids are usually subclinical, there is low likelihood of disease incidences in both translocated cheetah and native carnivores. Even if sporadic events occur, the ability of the disease to cause an outbreak or have ecological impact at population level in free ranging carnivores is low.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	Based on current literature there is there is low likelihood of disease incidences in both translocated cheetah and native carnivores.	General preventive measures such as pre arrival and post translocation quarantine and clinical examination.	Pre import quarantine and clinical evaluation to ensure absence of disease symptoms. Feral cat control, if any at the release site.

Causative Agent: Feline panleukopaenia virus (FPLV), a parvovirus

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Cheetahs in captivity can develop amyloido¬sis when insoluble amyloid fibrils deposit with¬in tissues where they disrupt organ function. Amyloidosis can be due to a genetic predisposition (protein sequence that is more likely to pre¬cipitate) or secondary to increased production of Serum Amyloid A (SAA) protein which occurs in chronic inflammation or neoplasia.	To date, amyloidosis has not been detected in free-ranging cheetahs and it is not considered a threat to cheetahs in Southern Africa. When diagnosed in captive cheetahs, it is always associated with some other chronic source of inflammation in the animals (i.e., It is a secondary disease) and there is no epidemiological evidence supporting the suggested prion-like transmission of this disease. There is thus very low likelihood of introduction of amyloidosis through translocated cheetah to India.	None as no observations have been recorded in India so far.	There is thus very low likelihood of introduction of amyloidosis through translocated cheetah to India and thus negligible likelihood of disease to have ecological impact.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	There is thus very low likelihood of introduction of amyloidosis through translocated cheetah to India and thus negligible likelihood of disease to have ecological impact.	General preventive measures such as pre arrival and post translocation quarantine and clinical examination.	Pre import quarantine and clinical evaluation to ensure absence of disease symptoms.

Causative Agent: Gastro-intestinal Parasites

JUSTIFICATION OF HAZARD	RELEASE ASSESSMENT	EXPOSURE ASSESSMENT	CONSEQUENCE ASSESSMENT
Numerous GI parasites are known to affect non-domestic felid species. Though parasites are ubiquitous and have sometimes evolved with the host, stress and immunity factors can trigger clinical disease. Introduction of novel parasites to a naive population can also have negative effect at population level.	A range of GI parasites have been described from cheetahs. Since it is a transcontinental introduction, there is a high risk of introducing a novel parasite to India as parasite species found in source and destination country may be different.	There are numerous reports of GI parasite infestations in free ranging wild felids from India. The native carnivores at release site are in a free ranging condition and no intervention is carried out regarding parasite control to avoid ecological disturbance. There is thus high likelihood of introduced cheetah being exposed to a novel parasite at Indian release site as well as the native carnivores being exposed to new parasites from the introduced cheetahs.	Though GI parasites are considered ubiquitous and recorded in both African and Indian non – domestic species, the species involved may be different and thus pose high risk of clinical cases due to these novel strains among native fauna at the release site. The translocated cheetahs are also at high risk as they would lack host immunity, which is usually developed through exposure to particular parasite.
	RISK ESTIMATION	**RISK EVALUATION**	**RISK OPTIONS**
	There is thus high likelihood of introduction of novel GI parasite through translocated cheetah, as well as these cheetahs being exposed to novel GI parasites at release sites.	General preventive measures such as pre arrival and post translocation quarantine and clinical examination.	Treating with suitable oral de-wormers/parasiticidal during both pre-arrival and post translocation quarantine. Repeated fecal examination to ascertain absence of novel parasites during post arrival quarantine Treating with a long acting ecto and endoparasiticidal to killall parasites.

Disease Risk Analysis of various non-communicable hazards identified for introduction of cheetah from southern Africa to India.

Hazard: Eco-climatic risks			
JUSTIFICATION OF HAZARD	**EXPOSURE ASSESSMENT**	**RISK EVALUATION**	**RISK OPTION**
In an intercontinental translocation such as the current, unfavourable weather conditions and severe climatic niche variations between source and release sites can have adverse effects on establishment of viable cheetah population.	Kuno NP is classified under the Semi-arid – Gujarat Rajputana (zone 4B) bio-geographic zone with average maximum summer temperature of 42.3° C, while the lowest winter temperatures between 6 and 7° C. The average annual rainfall in the area is about 760 mm. The park falls under the northern tropical dry deciduous forest as per the revised classification of forest types of India and has numerous savannah habitat interspersed within its boundary.	The eco-climatic covariates to model equivalent niche space in India using Maximum Entropy Models shows that the climatic niche of the cheetah from southern Africa exists in India. The niche prediction in India also coincided with the historical strongholds of the cheetah in India Cheetah habitat suitability was best explained by availability of grassland, scrub and open forest systems, semi-arid environments, low human impacts, and temperatures that tended to be hotter compared to cooler regimes. **RISK LEVEL** Very low	Post arrival in India, all the founder cheetahs to be held in a large holding boma for at least 30 days to allow acclimatization. The soft-release method generally has a significantly lower mortality as it ameliorates stresses associated with the sudden release of the individuals into unfamiliar environments as in hard-release methods. Post soft release into KNP, all the founder cheetahs to be extensively monitored through radio-telemetry, to ascertain daily monitoring of movement, behavior, predation, conflict and mortality.

Hazard: Interspecies aggression risk

JUSTIFICATION OF HAZARD	EXPOSURE ASSESSMENT	RISK EVALUATION	RISK OPTION
Cheetahs across their extant range are limited by competing carnivores. In African systems, cheetahs are often killed by lions and sometimes by spotted hyenas and leopards. Cheetahs have difficulty in recruiting cubs to adulthood in areas with high density of competing carnivores. Similar dynamics might also be present at release sites.	In Kuno there are no tigers or lions; Kuno has a high density of leopards and striped hyenas. Though leopards are not as serious threat to cheetahs, they can be a threat to cheetah cubs. Striped hyenas are not much of a threat to cheetahs or cubs accompanied by mothers; however, striped hyenas could predate very young cubs in the lair when the mother is out hunting.	Cheetahs are known to persist at low densities with lions, leopards, and spotted hyenas. In Pinda Game Reserve, cheetahs have fared extremely well and contributed maximum number of individuals to the South African meta population program despite Pinda having a high lion and leopard density. **RISK LEVEL** Low	Leopards are already there in Kuno in significant numbers with a density of about 9 leopards per 100 km2. Cheetah and leopards can coexist if adequate prey base and other resources are available. Prey supplementation to be carried out if deemed necessary. Under natural conditions these risks are normal and the cheetahs have evolved strategies to counteract them and survive. Therefore, the threat from competing carnivores as a serious hazard to establishing cheetah population in Kuno and elsewhere in India is considered low.

Hazard: Demographic and genetic risk

JUSTIFICATION OF HAZARD	EXPOSURE ASSESSMENT	RISK EVALUATION	RISK OPTION
The sub species being translocated is different from the locally extinct cheetah-subspecies of India (*Acinonyx jubatus venaticus*). The IUCN (2003) clearly states that would be no genetic mixing of subspecies during translocations. An important consideration for conservation translocations is that the sourcing of animals should not be detrimental for the survival of the source population. Thus, the criteria for the source would be the availability of a continuous supply of legally obtained healthy cheetah that are genetically diverse.	The last record of cheetahs in the wild in India werein 1948. Thus, introduction of cheetahs from southern Africa will not lead to genetic mixing of subspecies. The extinct cheetah-subspecies of India currently survive as a small relict population in Iran currently numbering ~30 individuals; clearly unavailable andinappropriate as a source for reintroduction to India.	When the original indigenous organism is not available then the IUCN guidelines suggest to use the most suitable existing sub-species, that is similar in appearance, ecology and behavior to the extinct form. Since India currently does not have any native cheetah, the ecologically and behaviourally most suited population that meets the source population criteria would suffice the need since there would be no genetic mixing of subspecies. Southern Africa holds the largest cheetah (A. j. jubatus) populations ~ 4000 (about 66% of the global cheetah population) and meets the required criteria as source population and for future supplementations, without detrimental impacts on the survival of the species in its extant range. **RISK LEVEL** Very low	Sourcing of 35-40 cheetah (A. j. jubatus) asfounder stock, comprising of a large gene pool and appropriate reproductive age group from southern Africa that is genetically diverse, disease free, behaviourally sound (not overly imprinted to humans but tolerant, predator wary, capable of hunting wild prey, and socially tolerant of each other) for establishing a new cheetah population in India. Introduce cheetahs in 3-5 locations in India to allow these populations to build up individually while being managed as a single metapopulation within India with occasional introductions from Southern Africa.

Hazard: Capture and Translocation risk

JUSTIFICATION OF HAZARD	EXPOSURE ASSESSMENT	RISK EVALUATION	RISK OPTION
Cheetahs are known to be susceptible to capture stress and often succumb to stress related myopathy. Chase by helicopter for darting and capture, long exposures to intermittent disturbing stimuli during transportation, and exertion are some causes of capture myopathy related deaths of cheetahs.	Cheetahs are highly susceptible to the physiological effects of capture-induced stress. The cheetahs to be translocated to India will have to be chemically immobilised, created and subjected to long-distance air travel form source sites (Namibia and South Africa), all of which can induce capture stress. Based on the time and distance requirements to complete the transcontinental journey by air, there is a medium risk that founder stock might get affected with capture and translocation associated health risks.	Though the poten¬tial health impact of stress upon wild cheetahs during capture, transport or periods of temporary captiv¬ity warrants further study, the cheetahs undergoing transcontinental transportation are bound to endure some amount of stress. Unless addressed adequately, acute stress of capture and transportation may lead to leads **RISK LEVEL** Medium	The risk can be minimised by avoiding exertion before darting, use of appropriate darting techniques and anaesthetic drugs. Immobilization drug options to be used in adult cheetahs: - 40 to 60 mg Zoletil + 1.5 to 2.5 mg medetomidine - 1.5 to 2.5 mg medetomidine + 150 to 200 ketamine + 5mg midazolam - 1.5 to 2.5 mg medetomidine + 8 to 10mg butorphanol + 8 to 10mg midazolam. Cheetahs to be individually crated in IATA certified crates and transported through the shortest route possible. Administration of long-acting tranquilizer, water-based perphenazine (WBP) IM at a dose of 0.3mg/kg about 30 -60 minutes before crating and transport. Post arrival monitoring during quarantine for signs of stress associated risks.

Hazard: Starvation risk

JUSTIFICATION OF HAZARD	EXPOSURE ASSESSMENT	RISK EVALUATION	RISK OPTION
In a reintroduction starvation in founding population can occur due to the animals not being able to adapt to the new prey base or due to injury or illness.	Starvation sets in a full cascade of events, including lowered resistance to infections and manifestation of disease symptoms from usually innocuous infections of parasites and pathogens. If starvation is prolonged beyond a point, recovery even after being fed a meal is often difficult. Southern African cheetah would be used to predating antelope, hare, wart hogs, and some other small mammals and large birds. In India the majority of prey would consist of chital deer, nilgai antelope, Indian gazelle, wild pigs, and peafowl.	The boma within Kuno National Park is large with natural prey. Cheetahs will have the opportunity to hunt and get used to chital deer as their primary prey. Kuno prey base has been monitored since 2006 and has shown a remarkable recovery with a realized growth rate of chital the most abundant ungulate in the system. In size, shape, and behaviour, the Indian prey species would be almost identical to those that the cheetahs from Africa are used to hunting. **RISK LEVEL** Low	Cheetahs will be monitored using telemetry to locate them and visually scored in terms of their belly fullness scores to determine that they have fed. If a cheetah is found to be starving (belly score "empty") for subsequent two days the cheetah will be supplemented with food and ensured that it eats. After the cheetahs are released under free ranging conditions, each cheetah will be monitored with Satellite and VHF telemetry and a visual confirmation on each animal's status obtained each day. Here too if the cheetah is observed to go without eating for 3 days or more it will be supplemented for the first six months after release.

Hazard: Husbandry related risks			
JUSTIFICATION OF HAZARD	**EXPOSURE ASSESSMENT**	**RISK EVALUATION**	**RISK OPTION**
Cheetahs that are captured and quarantined can be victims of stress induced manifestation of diseases in otherwise tolerant hosts. Often mild infections, blood parasites, and endo parasites that are usually asymptomatic can cause symptoms and become life threatening under stress.	The founder stick will have to be held in quarantine for a minimum of 30 days as per the Indian government mandate. Holding these wild cheetahs in appropriately sized quarantine bomas in secluded areas free of stressors is an important aspect of quarantine management. Cheetah should also have space and cover to retreat away from humans as otherwise wild cheetah can get extremely stressed.	The quarantine/soft release facility built in Kuno is large with natural vegetation and sufficient area for each cheetah (50-100ha). The quarantine facility is fenced with electrification to prevent movement of any animals and is made free of carnivores from within the fenced area. Thus, stress due to confinement during quarantine is low. **RISK LEVEL** Low	Cheetahs will be visually monitored on daily basis during the quarantine period for signs of disease and illness. Appropriate treatment for parasites during the quarantine period to reduce the manifestation of disease as well as reduces the risk of inadvertently introducing novel parasites into the release sites.

Hazard: Poaching risk

JUSTIFICATION OF HAZARD	EXPOSURE ASSESSMENT	RISK EVALUATION	RISK OPTION
In spite of enhanced protection and stringent laws post enactment of Wildlife Protection Act, 1972 sporadic events of poaching can still be seen in India, including some of the release sites.	Unlike tigers, elephants and rhinoceros that have a high demand for their body parts, cheetah is not a sought-after commodity in the international illegal trade for cheetah body parts, however cheetah cubs do feature in the pet trade. Bush meat consumption is prevalent in the Kuno Landscape, and the possibility of cheetahs being non-target victims to traps, snares, and possible gunshots does exist.	Since cheetahs will be new to India, there is currently no organised illegal market for their parts, products or pet trade. Due to the very few numbers in the initial years of the introduction, any illegal market driven poaching of the cheetahs in India is not expected. **RISK LEVEL** Medium	Despite the best of efforts, some mortality from poaching is expected. Such mortality will be compensated by immigrants from Southern Africa and from recruitment in the Kuno National Park can act as a source and the human inhabited buffer habitat as a sink. Since poaching activities are higher outside of the Protected Area (Kuno National Park), during the initial years attempt will be made to bring back any founding cheetah that disperses outside of the Protected Area.

Hazard: Other anthropogenic risk			
JUSTIFICATION OF HAZARD	**EXPOSURE ASSESSMENT**	**RISK EVALUATION**	**RISK OPTION**
Large carnivores do not mix well with local communities because carnivores often kill livestock and sometimes attack humans. This problem is severe when local communities are not exposed to large carnivores in their recent history and have lost the lifestyles that allow them to coexist with carnivores.	Compared to all other large carnivores' cheetahs come into conflict with human interests the least. There are no recorded instances of a wild cheetah attacking a human. Cheetahs avoid any kind of conflict and will be driven away by a guard dog.However, cheetahs do predate on small livestock like sheep, goats, and cattle calves. This can cause retaliation from communities.	The communities in the vicinity of Kuno National Park have been living with large carnivores since historical times that include leopards, striped hyenas, wolves and in the recent past tigers and dhole. They have honed skills of animal husbandry (livestock accompanied by herders and dogs, livestock corralled at night, etc.) that minimize losses to large carnivores **RISK LEVEL** Medium	A public awareness program has been undertaken in neighbouring villages by the forest department and local administration where in the cheetah mascot "Chintu Cheetah" is used to communicate the facts of cheetah as a species and its harmless nature to school students and the public. To prevent any form of retaliation the cheetah project has built in a budget for paying immediate compensation for any livestock that is killed by cheetahs immediately. Since all founder cheetahs will be radio collared and located several times in a day, any livestock kill made by them will be known to the park authorities and biologists monitoring the cheetahs.

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