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Unsustainable and illegal wildlife trade during periods of extreme hardship threatens biodiversity in North Korea

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ABSTRACT

Despite pressing conservation and humanitarian concerns regarding the sustainability of natural resource exploitation in the Democratic People's Republic of Korea (North Korea), reliable information is extremely limited as North Korea is one of the most secretive countries in the world. We used local ecological knowledge (LEK)-based interviews with North Korean defectors (refugees) to provide the first baseline data on the harvesting, consumptive use and trade of wildlife in North Korea during periods of severe economic hardship, and the potential impact on terrestrial biodiversity. As well as using wildlife as a domestic resource, the North Korean state, which is not a Party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), generates revenue through trade in wildlife products, which is reported to include threatened species and species protected under North Korean law. Our findings show that following the collapse of the North Korean economy in the 1990s, a burgeoning black market in wildlife products has emerged, for both local consumption and cross-border trade to China. This was reported to involve an extremely wide range of species, including almost all native mammal species >500 g. We warn that unsustainable and illegal wildlife trade is likely a major driver of defaunation in North Korea, threatening the conservation objectives of its neighbours, and that some cross-border trade may breach China's CITES and UN Security Council Resolution commitments. Our research demonstrates how severe human deprivation can negatively impact wildlife populations by providing incentives for the unsustainable harvesting of natural resources.

1. Introduction

Throughout human history, the harvesting of wild animals and plants has provided vital resources for human communities, including food, medicine, clothing and shelter, as well as goods that can be shared or traded (Chardonnet et al., 2002; Roe, 2008; Cawthorn and Hoffman, 2015; Fromentin et al., 2022). In the 21st century, human societies continue to exploit a wide range of wildlife resources, including more than a third of all known vertebrate species (Darimont et al., 2023). The size and global distribution of the human population, our high levels of resource use, and our ability to develop tools to enable us to harvest these resources ever more efficiently, has considerably increased the potential for overexploitation of wildlife populations, to the extent that harvesting is considered second only to habitat loss as a current driver of global vertebrate biodiversity declines (Joppa et al., 2016; Ripple et al., 2019).

There is considerable interest in improving understanding of the circumstances in which harvesting of these resources may become unsustainable (Dutton et al., 2013; Marshall et al., 2020; Elves-Powell et al., 2023). One concern is the potential relationship between economic deprivation and overharvesting of wild animals and plants (Lunstrum and Givá, 2020), including in cases where economic conditions rapidly deteriorate (Bragina et al., 2015). For example, evidence from the collapse of the Soviet Union and the subsequent economic instability experienced by many former-Soviet states in the 1990s suggested that sudden socioeconomic "shocks", especially when accompanied by quickly rising levels of unemployment in rural areas, may result in the acceleration of unsustainable hunting of highly valued species. This included surges in the poaching of tiger (*Panthera tigris*) in the Russian Far East (Galster and Vaud Eliot, 1999; Miquelle et al., 2005)

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and snow leopard (*P. uncia*) in Kyrgyzstan (Koshkarev and Vyrypaev, 2000; McCarthy et al., 2010). While multiple factors are often involved (for example, the breakdown of wildlife law enforcement), which are not always attributable to economic changes alone, macroeconomic factors may contribute to the identification of systems of concern and interdisciplinary exploration of these issues.

The Democratic People's Republic of Korea (DPRK, or North Korea) is an often overlooked, but potentially important, case. North Korea is one of the most secretive and isolated countries in the world (Kirby et al., 2014). There is currently little information on socio-ecological systems within the country, due to restrictions on research and free movement (Han et al., 2017; Elves-Powell et al., 2024a). The use and trade of wildlife in North Korea is of particular interest because it is one of the few countries to have never joined the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Several globally threatened and CITES Appendix I-listed species, in which all international commercial trade in wild specimens with Parties to the Convention is banned, are native to North Korea and have a history of trade there, such as tiger, leopard (*P. pardus*), Asiatic black bear (*Ursus thibetanus*) and long-tailed goral (*Naemorhedus caudatus*) (Jo et al., 2018). It is currently uncertain whether these species are still exploited and, in some cases, whether they are still present (ibid).

North Korea's history has been marked by periods of severe economic deprivation, including shortages of food, medicine and basic goods (Noland, 2022), prompting concerns regarding the sustainability of natural resource exploitation (Elves-Powell et al., 2024a). The North Korean economy was devastated by the Korean War (1950–53 CE), which occurred shortly after independence from Imperial Japan (Snyder and Lee, 2010). While support from the Soviet Union initially led to a period of recovery (Hong, 2004), by the late 1970s, the North Korean economy had stagnated as it struggled with declining support from the Soviet Union, economic mismanagement, spiralling national debt, and a prolonged drought (Eberstadt, 1999; Noland et al., 2000; Lee et al., 2015). These long-term issues came to a head following the collapse of the Soviet Union in 1991, which saw North Korea lose its key trading partner, culminating in the collapse of the North Korean economy (Noland et al., 2000; Lee et al., 2009; Mah, 2018). Combined with a series of poor harvests (Kang and Choi, 2014), this resulted in the breakdown of North Korea's Public Distribution System (PDS), which had been intended to provide citizens with all necessary food and basic goods, leading to widespread food shortages and a major famine. Although reliable information is difficult to obtain, estimates suggest there may have been between 600,000 and 1 million famine-related deaths in North Korea between 1995 and 2000 (Goodkind and West, 2004; Noland, 2004). One of the major changes that resulted from this human disaster was the growth of the second economy in North Korea (i.e. small-scale, "black market" commercial activities, which were increasingly tolerated by the state), as individuals turned to illegally buying and selling goods to provide essential food resources and generate income (Lankov and Kim, 2008). While most attention has been given to black market trade in agricultural products, household items, electronics and South Korean media (Chun, 1999; Choe, 2015; Kim, 2019), it has long been suspected that some wild-harvested products are being sold, particularly seafood and medicinal herbs (Chun, 1999; Lankov and Kim, 2008).

Several recent reports have linked North Korea to illegal international wildlife trade. Lukin and Zakharova (2018) noted that Rason Special Economic Zone is believed to have acted as a hub for illegal trade in crab, supplied by Russian poachers and destined for markets in the People's Republic of China (China). Potential North Korean involvement in illegal tiger trade is also of concern, including reports of tiger bone wines of unknown origin and authenticity being sold to tourists (Environmental Investigation Agency, 2019), or being confiscated by Chinese customs officials (Elves-Powell et al., 2024b). In 2012, a Chinese national, subsequently convicted of smuggling, confessed to having entered North Korea on several occasions to obtain 9–10 kg of suspected tiger bone and one tiger skin (ibid). The origin of the bones seized from the defendant and accomplices are unknown, but these were confirmed to have included 0.54 kg of tiger, 2.66 kg of black bear (likely *Ursus thibetanus*) and 2.95 kg of brown bear (*U. arctos*), which are native to North Korea, as well as 0.97 kg of lion (*P. leo*), which is non-native.

Collecting robust data on wildlife trade in North Korea presents substantial challenges. Many conventional techniques, such as market surveys or seizure analyses, cannot be utilised. Local ecological knowledge (LEK)-based techniques, which can provide an alternative source of information on how human communities harvest, use and trade wildlife products, including where such activities may be illegal (Newing, 2011; Nash et al., 2016; Bennett et al., 2017; Aswani et al., 2018), typically rely on the researcher being able to interact with community members in situ, which is impossible. However, one approach that has been used to gain insight into changes to the economic, societal and political functioning of North Korea is the use of interviews with North Korean defectors (Lankov and Kim, 2008; Kirby et al., 2014; Mun and Jung, 2017). The potential for this approach to improve our understanding of socio-ecological systems in North Korea has only just begun to be utilised (Elves-Powell et al., 2024a).

There are a number of important considerations. The verification of research findings based on interviews with North Korean defectors is often challenging, given the difficulty of collecting alternative types of field data (Song and Denney, 2019). Interview sample sizes may be relatively small, due to the challenges associated with identifying and recruiting participants (Fahy, 2015; Elves-Powell et al., 2024a). Conclusions should, therefore, be drawn carefully. However, initial work on environmental change in North Korea has found LEK data from North Korean defectors to be reliable and to show strong concordance with alternative forms of scientific data, such as from satellite-based remote sensing (Elves-Powell et al., 2024a).

In this study, we used interviews with North Korean defectors to investigate the harvesting, consumptive use and trade of wildlife in North Korea. In order to provide baseline information and identify potential trends, we organised our investigation around four lines of inquiry: (i) what species are consumed or traded and why; (ii) how are wildlife products sourced and who is involved; (iii) what is the role of demand from domestic and international markets for wildlife; and (iv) in what circumstances does wildlife trade constitute part of the "first" (i.e. formal, or official) and "second" (i.e. informal) economies of North Korea?

2. Methods

2.1. Data collection

We interviewed 42 North Korean defectors in the Republic of Korea (ROK, or South Korea) and the United Kingdom (UK) in 2021–2022. Participants were recruited using snowball sampling as North Korean defectors are a potentially vulnerable population, whereby trust had to be built between participant and researcher (Goodman, 1961; Faugier and Sargeant, 1997). All participants were over 18 years old and had left North Korea between 1950 and 2020. Specific ethical considerations in the recruitment of participants, arrangement of interviews, and storage and management of data are covered in detail in Elves-Powell et al. (2024a). Importantly, the identities of participants were kept anonymous to the researchers and no personal data that could be used to identify a participant, their acquaintances, or their former place of residence in North Korea were discussed or recorded at any point.

As our interest was in the general use and trade of wildlife in North Korea, which may involve individuals who are not particularly knowledgeable about wild animal taxonomy, behaviour or ecology, participants were not deliberately selected for knowledge of wildlife. However, it became apparent that participants would often recommend participation in the study to individuals they felt were knowledgeable about wildlife. When contact was made by a potential participant and before

conducting an interview, the researchers explained the study's research protocol. If informed written consent was provided, an interview was conducted.

To increase the likelihood of obtaining reliable data and maintaining participant engagement, we restricted the scope of questions to three groups of mammals: large carnivores, their large ungulate prey, and small and medium-sized carnivores. These were chosen because they were directly relevant to our research interests in carnivore populations in North Korea and it was deemed likely that participants would be able to recognise and accurately identify some of these species (Madsen et al., 2020). However, participants were able to provide information about any other species they knew and chose to discuss.

Participants were asked a series of open-ended questions about human interactions with, and use of, wildlife. The use of open-ended questions allowed participants from a wide range of backgrounds to provide information relevant to their individual experience (Lankov and Kim, 2008). As most participants did not have experience of scientific taxonomy, the identification of animals followed the common names and conventions used by participants. We used the information that a participant provided to identify the animal reported to the rank of species, or, if this was not possible, to the lowest taxonomic rank that could be achieved confidently. As our results are based on participant responses, it is important to acknowledge that, as with all such data, these responses may contain inherent inaccuracies such as may result from misidentification of animals and their parts (Royle and Link, 2006).

The study was reviewed and approved by the UCL Research Ethics Committee (Ref 18,841/001).

2.2. Data analysis

Given the deficit of previously published material on wildlife use and trade in North Korea, we employed an exploratory approach to data analysis, as per previous studies that have used the testimony of North Korean defectors (Lankov and Kim, 2008). While a full thematic analysis was not possible, as interviews were not recorded in order to maintain strict anonymity of participants, we followed the principles of a thematic analysis, as outlined by Braun and Clarke (2006). This involved organising and familiarising ourselves with the data, coding the data, and organising codes to identify a number of themes. These were reviewed, combined where appropriate, and named.

To investigate the different uses of wildlife in North Korea, we classified individual records using the IUCN 'use and trade' classification scheme, which categorises consumptive and non-consumptive human use of wildlife, including by end use (for example, for human food) (IUCN, 2020). We recognise concerns that the distinction between medicinal uses of wildlife for traditional Asian medicines (TAMs) and consumption of wildlife for subsistence purposes is not always clear, as many TAMs include practices that involve the consumption of animal or plant materials as medical ingredients (Koo, 1984; Cheung et al., 2020). In some cases, this resulted in classification of purpose of consumption as both 'Traditional medicine' and 'Food - human'. However, participants often identified use of wildlife products as being for a singular purpose and classification was allocated on this basis. We also added an additional category, 'Trade', as participants sometimes identified the harvesting of wildlife as being for the purpose of trade but without knowledge regarding end use.

It is important to note that tallies of different uses of wildlife products represent the number of times they were mentioned and may not necessarily correspond directly to volume of trade. For example, a more well-known species or trade may be identified by a larger number of participants than a hidden trade, or trade in a poorly known species. Another important consideration is that the exact timing of records was sometimes difficult to establish, particularly when participants had left North Korea a relatively long time ago, or reported awareness of trade rather than personal involvement. However, we found that participants often used personally impactful events, such as the hardship of the 1990s or leaving North Korea, to guide their dating of reports. Combined with the use of follow up questions, this allowed us to establish the most recent record of trade, to distinguish between historic and recent reports. To help substantiate information provided in interviews, we compared the responses provided by participants and identified where alternative types of data may exist (for example, reports of North Korea-linked wildlife trade from other countries) to support, or refute, claims made.

2.3. Evaluating the legal status of trade

Where possible, we evaluated whether specific reported examples of the harvesting, use or trade of wildlife are likely to have been legal under domestic and international law. Confidently determining the legality of wildlife trade in North Korea, even when it is part of the formal economy, can be an immensely challenging exercise. Major obstacles include the opaque design of the North Korean legal system and the often-considerable gap between legal rhetoric and political reality (Zook, 2012). However, legal harvesting of wild animals in North Korea would require compliance with various regulations, including both presidential decrees and ordinary laws that grant protected status to specific species. For example, the 16th February 1959 Presidential Decree *About protecting and multiplying useful animals and plants* banned the hunting of sable (*Martes zibellina*) and Eurasian otter (*Lutra lutra*). Legality may be more difficult to determine in examples that concern the private sale or exchange of wildlife products, particularly where the state has tacitly or retrospectively condoned private trade. For example, the *Jangmadang* (in Korean: 장마당) are a form of small-scale, commercial enterprise perhaps best understood as semi-official markets, rather than truly underground "black markets", as they have been increasingly (albeit, unevenly) tolerated by the state since the 1990s (Choe, 2015; Patterson, 2017; Greitens and Silberstein, 2022). These marketplaces may blend semi-official and illegal trade (Patterson, 2017).

3. Results and discussion

3.1. Awareness of, and knowledge about, the consumption and trade of wildlife

We were able to recruit participants from a diverse range of backgrounds, including former soldiers, wildlife professionals, hunters, and brokers or middlemen for illegal wildlife trade, as well as other individuals with first-hand experience (for example, as buyers). However, even those participants without a professional background relating to wildlife, or who otherwise had limited knowledge regarding the fauna and flora of North Korea, proved to be surprisingly knowledgeable about the use and trade of wildlife, often providing detailed answers about the uses or value of different animals. These answers largely conformed with those provided by participants who were more knowledgeable about wildlife, or who had first-hand experience of wildlife trade.

It is difficult to draw conclusions from the number of participants who reported having directly harvested or consumed wildlife, because our sample was non-random. There is also a strong possibility, given that our study involves discussion of potentially illegal activities, that some participants may describe an activity as having involved a 'family member' or 'close friend', in order to avoid self-disclosure (Song and Denney, 2019). However, it is germane to note that 71.4 % of participants reported having personally consumed wildlife or wildlife-derived products in North Korea. 52.4 % of participants reported that they had personally harvested wild animals, or that a close acquaintance (such as a family member or friend) had done so. A further 11.9 % of participants reported that their families had harvested wild plants, without mentioning wild animals.

Details about state-linked trade were scarcer, as with a few exceptions, participants were often only able to provide information based on their observations or the involvement of personal contacts (including

family members), rather than having had direct involvement themselves. This is an important limitation of our study. However, information from individuals without direct involvement may still be valuable for improving our currently limited understanding of this topic. For example, former soldiers who had been stationed at hunting reserves for North Korea's ruling family were able to provide details on the management and harvesting of local wildlife.

3.2. Sourcing of wildlife products and main actors in North Korean wildlife trade

Outside of state-authorised roles, access to firearms in North Korea is heavily restricted, thus limiting their use for the harvesting of wild animals. State-sanctioned hunting occurs in North Korea and participants identified official hunters as one of the primary groups involved in supplying wildlife products. Military personnel on active duty and senior officials are two other groups with potential access to firearms. Senior officials were reported to have occasionally been invited to the aforementioned hunting reserves by the country's leaders. In contrast, hunting by soldiers was described as unsanctioned and opportunistic. However, government-employed field officers (in Korean: 보위원) of the Ministry of State Security, the North Korean secret police agency, were mentioned on several occasions as being involved in the unauthorised procurement of firearms and ammunition for illegal hunting.

Participants also identified widespread deployment of traps and snares in North Korea by official hunters and residents alike, to catch animals for wild meat; protect agricultural crops or livestock from wildlife damage (notably crop raiding by wild boar (*Sus scrofa*) and predation of poultry by small carnivores); or harvest high value species (such as deer) for trade. However, the indiscriminate nature of snares, which are relatively cheap and easy to construct (Noss, 1998; Gray et al., 2017), meant that species not intentionally targeted were reported as bycatch, including leopard cat (*Prionailurus bengalensis*). Other reported sources of wildlife products included captive animals from state-run wildlife farms or zoos, as well as opportunistic discoveries, such as roadkill.

It was reported that wildlife products could be obtained by North Korean residents directly from hunters, from markets, via word-of-mouth, or, in the case of approved products and uses, from the state itself. These sources were understood to be of varying legality. Several participants noted that available products may not always be authentic. For example, one participant described a case of intended deception, where a trader tried to sell wild boar meat as bear; another doubted whether all deer antler-derived products were authentic, given the perceived scarcity of these species in North Korea, and speculated that fake products were sometimes being passed off as deer.

Several participants mentioned a strong gender differentiation among wildlife trade actors in North Korea, a common finding in wildlife trade research across different countries and cultures (McElwee, 2012; Seager et al., 2021). Men were considered more likely to be involved in the harvesting of wildlife, either through hunting or the deployment of traps and snares, while women were more usually reported to be involved in the harvesting of plants or buying of wildlife products. This is in keeping with previous studies on the functioning of the North Korean informal economy (Lankov and Kim, 2008; Tudor and Pearson, 2015).

3.3. Consumption of wild meat in North Korea is non-uniform and impacts a wide range of species

The widespread consumption of wild meat in North Korea for the purpose of subsistence, across an extremely wide range of species, was a major theme in interviews (Tables 1–3). Participants often mentioned domestic food shortages as an important reason why wild meat was consumed as a food resource. However, wild meat was typically not considered to be a major component of participants' diets and several participants noted that obtaining wild meat had been an unusual occurrence.

Large ungulates were the group most regularly identified being consumed or traded as wild meat, specifically deer, wild boar and, less regularly, long-tailed goral. Deer (23.81 % of participants) and wild boar (21.43 %) were far more likely to have been eaten as wild meat by participants than other animals (Fig. 1). Although both were regularly reported to be consumed as wild meat in North Korea, deer of the subfamily Cervinae (potentially referring to *Cervus nippon* or *C. elaphus*) were seen as a luxury wild meat associated with social status and

Table 1
Ungulates reported to be traded, consumed or used in North Korea. (* - Unable to reliably distinguish between the species listed in this category from the record given;? – Participant(s) uncertain; Unknown = Species were recorded from market locations, with source unknown; (n) – Number of mentions, if multiple uses, sources or destinations reported).

Species	Product	Uses	Number of mentions	Source	Destination
Deer spp. (*Cervus nippon*, *Cervus elaphus*, *Capreolus pygargus*, *Hydropotes inermis* and *Moschus moschiferus)**	Antlers	Traditional medicine	19	Wild (5), Farmed (11), China (1)	Local use or consumption (9), North Korean government (5), China (1)
	Meat	Food – human (13), Other (Government submission) (4), Trade (4)	20	Wild (8), Farmed (7), Government hunting reserve (1), Unknown (1)	Local use or consumption (12), North Korean government (6), China (2)
	Blood	Traditional medicine	9	Wild (1), Farmed (5), Unknown (2)	Local use or consumption (7), North Korean government (1)
	Bones	Traditional medicine	1	Wild (1), Farmed (1)	?
	Skin	Wearing apparel, accessories (1), Trade (foreign exchange) (2)	3	Wild	North Korean military (1), Foreign countries (China) (2)
	Body parts & Musk gland	Traditional medicine	4	Wild (3), Farmed (1), Unknown (1), Russia (1)	Local use or consumption
	Bodies	Trade (local in exchange for food)	3	Wild (3), Farmed (2), Unknown (1)	Local use or consumption (1), North Korean government (1), China (2)
Wild boar (*Sus scrofa*)	Meat	Food - human	20	Wild	Local use or consumption
	Heart	Food – human (1), Traditional medicine (1)	1	Wild	Local use or consumption
	Bile	Traditional medicine	4	Wild	Local use or consumption
Long-tailed goral (*Naemorhedus caudatus*)	Meat	Food - human	3	Wild	Local use or consumption
	Skin	Trade (foreign exchange)	1	Wild	China
	Body parts?	Traditional medicine?	1	Wild	Local use or consumption

Table 2
Large carnivores reported to be traded, consumed or used in North Korea. (* - Unable to reliably distinguish between the species listed in this category from the record given; ** - *Ursus thibetanus* and *Ursus arctos* are the native species, but given that trade in bear includes reports of animals from bear farms and zoos, it is not possible to confirm that this does not include other species;? – Participant(s) uncertain; Unknown = Species were recorded from market locations, with source unknown; (n) – Number of mentions, if multiple uses, sources or destinations reported).

Species	Product	Uses	Number of mentions	Source	Destination	Last reported date
Tiger (*Panthera tigris*)	Skin	Wearing apparel, accessories (3), Other household goods (1), Other (Government submission) (1), Trade (3)	11	Wild (4), Unknown (1)	Local use or consumption (4), North Korean government (1), China (3)	After 2009
	Bones	Traditional medicine	3	Wild (1), Zoo (1)	Local use or consumption (2), China (1)	2020 (China) 1970s (local consumption)
	Meat	Food – human (5), Traditional medicine (2)	5	Wild (3), Zoo (1)	Local use or consumption	Mid 2000s
	Scat	Traditional medicine (1), Trade (1)	1	Wild	Local use or consumption	2009–10
	Whiskers	Traditional medicine	1	Wild	Local use or consumption	Early 1980s
Leopard (*Panthera pardus*)	Skin	Trade	4	Wild	China	1999
Bear (*Ursus* spp.)**	Bile	Traditional medicine	18	Wild (11), Farmed (3), Zoo (2)	Local use or consumption (10), North Korean government (4), China (5)	2019 (wild)
	Meat	Food – human (3), Trade (local) (3)	7	Wild	Local use or consumption	2019
	Paws	Traditional medicine	5	Wild (3), Zoo (1)	Local use or consumption (1), North Korean government (3)	2019
	Skin	Other household goods (1), Other (Government submission) (1), Trade (1)	2	Wild	Local use or consumption (1), Foreign countries (China) (1)	–
	Dried organs	Traditional medicine	1	Wild	Local use or consumption	2017
	Bones	Food - human	1	?	Local use or consumption	–
	Oil	Traditional medicine	1	?	?	–
Grey wolf (*Canis lupus*) or Dhole (*Cuon alpinus)**	Skin	Wearing apparel, accessories	1	Wild	North Korean military	–

consumption by government officials, whereas other species of deer and wild boar were described as being opportunistically consumed by individuals of lower status. The meat of carnivores primarily harvested as fur bearers (Table 3), such as Siberian weasel (*Mustela sibirica*) and red fox (*Vulpes vulpes*), was also consumed locally for subsistence purposes (Fig. 2).

3.4. Economic hardship and traditional practices drive medicinal use of wildlife

Another major theme was the use of wildlife in traditional Korean medicine (TKM) in North Korea, occurring across a much wider range of mammal species than TKM in South Korea (Jo et al., 2018). This was stated to occur both due to the observation of traditional practices in North Korea and because of widespread shortages of pharmaceutical products.

Deer antlers were one of the most regularly mentioned items in this context (Table 1). Use of deer antlers in TAMs has a long history (Wu et al., 2013; Jo et al., 2018) and antlers were reported to be a valuable product in North Korea, with use observed to be largely restricted to wealthy individuals or government officials. However, some participants reported that antlers could be obtained illegally from hunters, while one participant suggested that there has also been some inbound trade from China in antler-derived products, specifically pills and powders - the only such report in our data of wildlife products entering North Korea for commercial purposes.

A range of carnivores was also reported being harvested, used, and sometimes traded, for traditional medicine (Table 2–3). For example, Asian badger (*Meles leucurus*) was primarily targeted for production of badger oil (Fig. 3). Unlike South Korea, where badger farms were established in the 1990s (Elves-Powell et al., 2023), the source of badger-derived products in North Korea was always reported as wild animals. By contrast, bear bile, meat, paws, skin, dried organs, bones and oil were all reported being traded (Fig. 4) and these were reportedly sourced from wild animals, bear farms and even zoos, and believed to be destined for local consumption, the North Korean state and government officials, and China. North Korea is believed to have first started farming bears for their bile in the 1970s, before the practice spread to China and South Korea (Li, 2004; Jo et al., 2018).

Numerous other species were reported being used for traditional medicine (Table 4). For example, the spines of the Amur hedgehog (*Erinaceus amurensis*) were reportedly used as a form of acupuncture; as toothpicks; to pierce swellings and skin afflictions; to reduce toothache; and to assist ear piercings. Reported from as recent as 2011–16, hedgehogs were captured in rural areas and their spines kept for personal use, shared among friends, or sold at local markets. While trade in Amur hedgehog for food and traditional medicine has been recorded in China (Guo et al., 1997; Li and Wang, 1999) and the harvesting of hedgehog fat for TKM is suspected to have contributed to population declines in South Korea (NIBR, 2012), this is likely the first report of trade in North Korea (Nijman and Bergin, 2015).

3.5. Economic collapse and the growing importance of international demand to black market trade

3.5.1. Poaching of wild animals for illegal wildlife trade to China

Black market, international trade with buyers in China was reported to be another important form of wildlife trade. During the period of extreme hardship in the 1990s and the corresponding rise of North Korea's informal economy (Lankov and Kim, 2008), wildlife products were reported to be increasingly funnelled towards this form of private sale. Although many of the traded products were also valued locally (Tables 1–3), the reason for this growth in cross-border trade seems to have been the comparatively high prices that certain products could command from buyers in China. For example, one participant who had hunted deer described that in the early 2000s, a pair of antlers from a large wild stag could be sold to buyers in China for more than an average North Korean citizen's expected annual income, noting that this high price reflected consumer preference for wild animal products. While it is difficult to verify the prices given, it is clear that even a conservative

Table 3
Medium- and small-sized carnivores reported to be traded, consumed or used in North Korea. (* = Unable to reliably distinguish between the species listed in this category from the record given;? = Participant(s) uncertain; Unknown = Species were recorded from market locations, with source unknown; (n) – Number of mentions, if multiple uses, sources or destinations reported).

Species	Product	Uses	Number of mentions	Source	Destination	Last reported date
Leopard cat (*Prionailurus bengalensis*)	Bodies	Specimen collecting (1), Trade (foreign exchange) (2)	2	Wild	Local use or consumption (1), China (1)	–
	Bodies	Bycatch - no evidence of use or trade	2	Wild	–	2005
Red fox (*Vulpes vulpes*)	Skin	Wearing apparel, accessories (4), Trade (8)	12	Wild (5), Unknown (3), Word of mouth (1), Russia (1)	Local use or consumption (7), North Korean government (3), China (4)	–
	Meat	Food - human	3	Wild	Local use or consumption	–
	Meat & Brain	Traditional medicine	1	Wild	Local use or consumption	–
Common racoon dog (*Nyctereutes procyonoides*)	Oil	Traditional medicine	1	Wild	Local use or consumption?	–
	Meat	Food - human	3	Wild	Local use or consumption	–
	Skin	Trade	2	Wild	Local use or consumption (1), North Korean government (1), China (2)	2005 (China) 1970s (domestic)
	Bodies	?	1	Wild	?	2018–19
Asian badger (*Meles leucurus*)	Oil	Traditional medicine	17	Wild	Local use or consumption	–
	Meat	Food - human	4	Wild	Local use or consumption	–
	Skin	Wearing apparel, accessories (1), Trade (foreign exchange) (3)	3	Wild	Local use or consumption (2), China (2)	2005 (China)
	Live animal	?	1	Wild	?	–
Eurasian otter (*Lutra lutra*)	Blood	Traditional medicine	1	?	?	–
	Skin	Wearing apparel, accessories (2), Trade (5)	7	Wild (5), Farmed (2)	Local use or consumption (2), China (4)	–
	Bodies	Trade	3	Wild (3), Farmed (1)	Local use or consumption (2), China (2)	–
Yellow-throated marten (*Martes flavigula*) or sable (*Martes zibellina)**	Skin	Trade	3	Wild (3), Farmed? (1)	China	–
	Skin?	Wearing apparel, accessories?	1?	Wild?	Local use or consumption? (1), China? (1)	–
Siberian weasel (*Mustela sibirica*)	Skin	Trade	12	Wild (7), Unknown (2)	Local use or consumption (2), North Korean government (1), Foreign export (1), China (5)	–
	Meat	Food - human (2), Traditional medicine (1)	3	Wild	Local use or consumption	–

valuation would suggest a strong financial incentive for illegally trading wildlife. Despite the economic situation in North Korea possibly having improved since the early 2000s (Kim, 2022), the ability to sell wildlife products to buyers in China, to generate foreign currency or exchange for goods, was regularly reported to remain a major driver of illegal hunting of wildlife in North Korea. Illegal hunting for commercial purposes is a primary threat to many of Asia's large carnivores and ungulates (Gray et al., 2017) and while this has likely provided valuable income for some North Koreans in periods of hardship, it is also a major concern for the sustainability of such important natural resources and the conservation of North Korea's biodiversity.

North Korean wildlife trade to China was reported to involve a multi-step trade chain, due to strict regulation of access to firearms; restrictions on travel; the need for products to cross political and physical borders, including the Amrok (Yalu) or Tumen rivers; and the need to locate and communicate with a buyer in China. Once an animal had been obtained, an individual would contact North Korean middlemen, who would facilitate cross-border smuggling. For example, participants described how residents of South Hamgyong, South Pyongan and Hwanghae provinces who caught Asian badgers and common racoon dogs (*Nyctereutes procyonoides*) would attempt to sell them to residents of Ryanggang or North Hamgyong, North Korean provinces along the Chinese border, who in turn would sell them on to buyers in China. Finding a buyer was not guaranteed and several participants reported products being returned to their original owners after failure to do so.

Wild meat was one product that participants reported being sold to buyers in China in exchange for money or goods. In contrast to most cross-border trade, which was described as largely opportunistic, participants reported that pheasant (*Phasianus colchicus*) and deer would commonly be hunted in the wild and traded across the border with China from early December to late January. This corresponds to the period before the celebration of Lunar New Year, when Chinese families gather for reunion dinners, which typically include a range of different meats. It was suggested that after Lunar New Year, demand from China would decrease and so hunters might consume the animals themselves. We note that UN Security Council Resolution 2397 specifically prohibits the export of food from North Korea.

Concerningly, tiger bone trade to China was reported as recently as 2020 (Fig. 5). This timeline conforms with the aforementioned confiscation of tiger bones, which had supposedly been smuggled from North Korea, by Chinese law enforcement in 2012 (Elves-Powell et al., 2024b). One participant in our study who had been involved in illegal wildlife trade and claimed to have personally traded big cat bones across the border between 2014 and 2020, reported that they had obtained tiger bones from Pyongyang Zoo and North Korean professional hunters. Three other participants independently suggested that highly valued

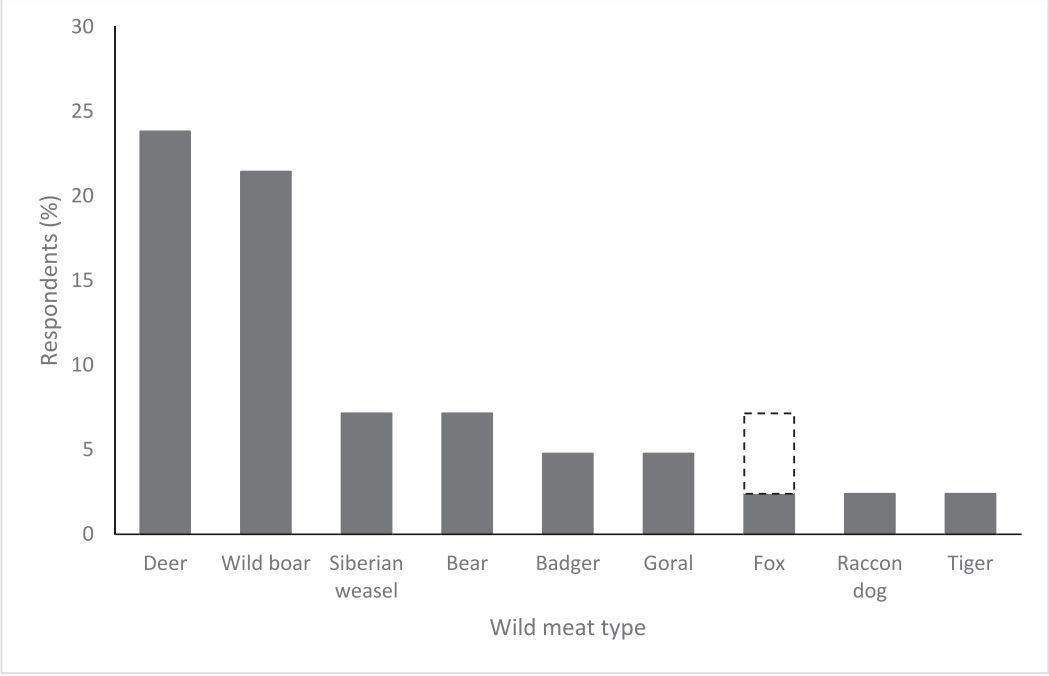

Fig. 1. Percentage of respondents who reported eating each wild meat type (target species only) on at least one occasion. Note, several records of fox (*Vulpes vulpes*) as wild meat were unclear as to whether they involved consumption by the participant.

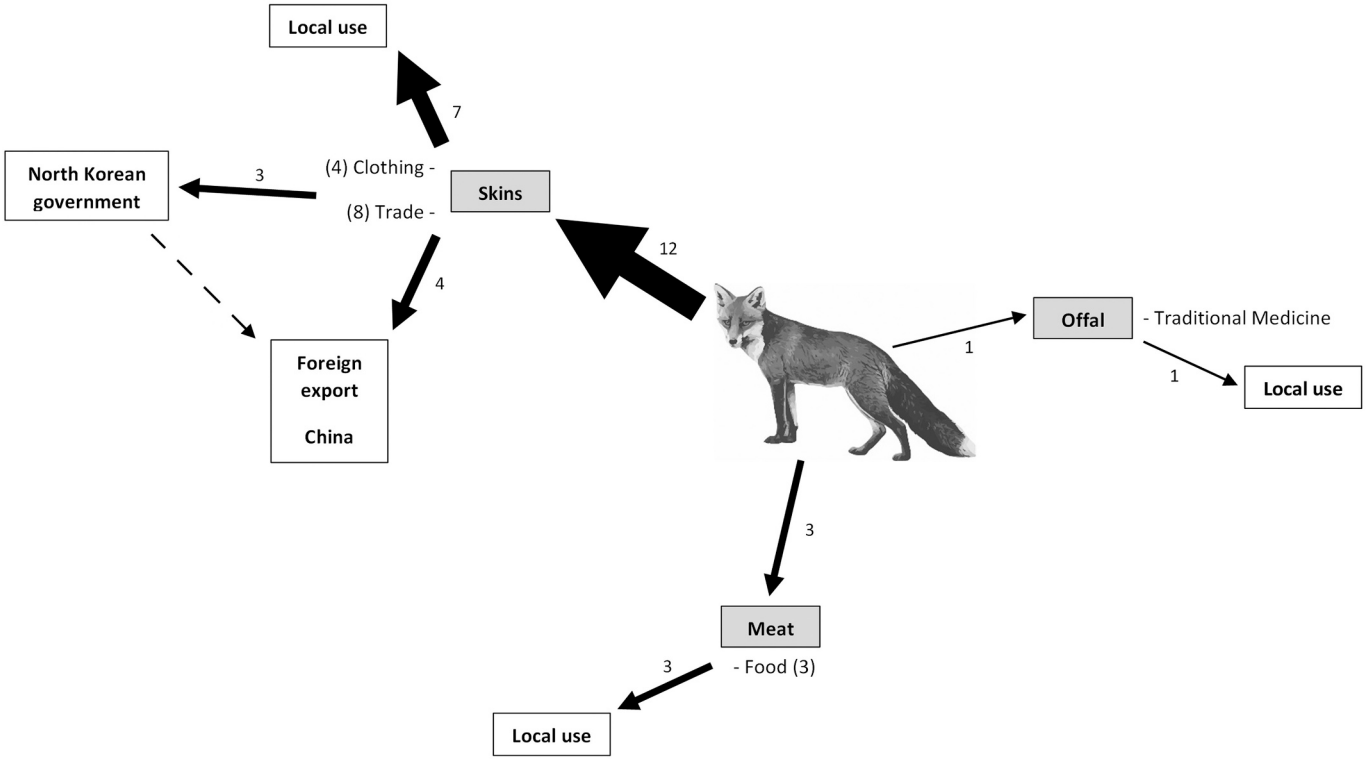

Fig. 2. Red fox (*Vulpes vulpes*) trade in North Korea, by products, use and destination, as reported by North Korean defectors. Weight of arrow and value corresponds to number of participants who mentioned (multiple answers allowed).

wildlife products (tiger meat, bear paws and bile) had been sourced from zoo animals and sold on the black market, or consumed by zoo staff, during or since the economic hardship of the 1990s. For example, one participant whose father had been a wildlife trade middleman, reported that he would be contacted when products were available from "old" zoo bears. We note that participants mentioned that it was rare for products from zoo animals to be available and that these reports may relate to animals that had died natural deaths. Reports of animal body parts being removed from state-run zoos and entering illegal wildlife trade is consistent with previous studies on the North Korean informal economy,

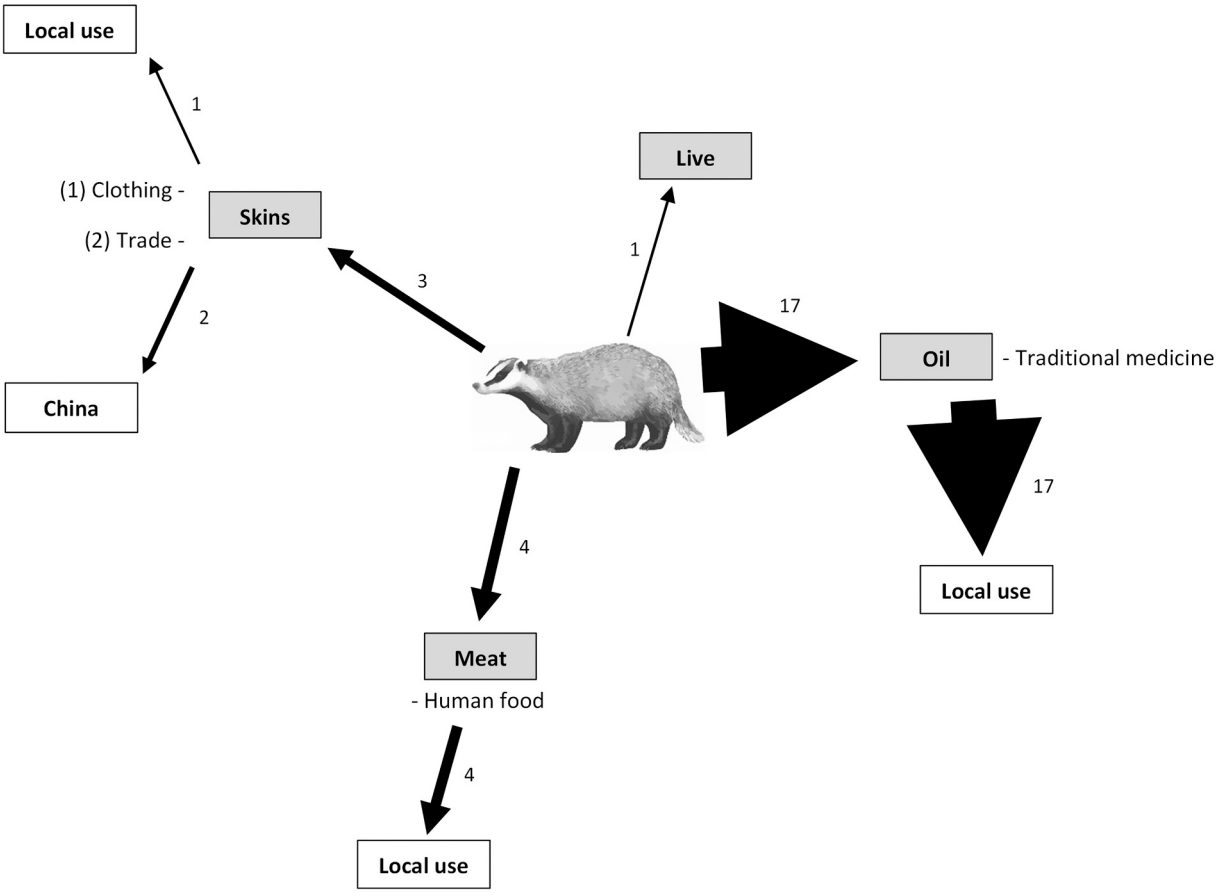

Fig. 3. Asian badger (*Meles leucurus*) trade in North Korea, by products, use and destination, as reported by North Korean defectors. Weight of arrow and value corresponds to number of participants who mentioned (multiple answers allowed).

which have reported that material goods from other North Korean state institutions, such as factories, have been diverted towards underground trade (Chun, 1999). The claim that tiger bones were also obtained from professional hunters lacks corroboration and there is little evidence regarding tiger populations in North Korea (Jo et al., 2018). The importance of confirming that bones were tiger was emphasised, as buyers in China would return any bones that they did not believe were authentic; this observation is supported by testimony from China (Elves-Powell et al., 2024b). Finally, the participant noted that when their father had traded big cat bones (between 2005 and 2009/10), the stock of tiger bones was fairly regular, but that they were now rarer to see in trade.

We did not specifically ask about trade in wild plants. However, several participants provided some limited information on trade in herbal and edible plants with China, which involved similar patterns and motivations as trade in wild animals (see, Supplementary Material).

3.5.2. Trade in furbearing carnivores reveals complex relationships between legal and illegal wildlife trade from North Korea to China

A particularly important category of North Korean wildlife trade to China, both black market and state-sanctioned, was trade in furbearing carnivores. Two individuals who had been involved in wildlife trade in North Korea, as an illegal hunter and as a middleman respectively, independently volunteered assessments of the comparative value of different furbearing carnivores. These two assessments largely concurred (Table 5). The animal most valued as a furbearer was a creature referred to as '*Geomeundon*' (in Korean: 검은돈), which, following further inquiry, was identified to be sable. There is a long tradition of trade in sable skins in Korea and they were historically considered highly desirable (Jo et al., 2018). Although globally classified as Least Concern (LC) on the IUCN Red List (Monakhov, 2016), sable are officially classified as Endangered in North Korea and hunting of the species is banned by presidential decree. Despite their legal protection, participants believed that hunters would still attempt to capture sable if they were observed. However, while participants who were involved in wildlife trade in North Korea collectively knew of sable and how they would distinguish between a sable skin and that of other native mustelids, no-one had ever personally seen a sable skin and it was regarded as an almost mythical animal. On this basis, it seems likely that if sable is still present in North Korea at all, it is extremely rare.

Reports of trade in fur and skins further highlighted the complex relationship between formal and black market wildlife trade in North Korea and provided additional insight into wildlife trade supply chains. Two furbearers, red fox and Siberian weasel (Table 3), were regularly described as staples of North Korean fur trade, but participants also described similar patterns of trade in other small- and medium-sized furbearing carnivores, such as Asian badger and common racoon dog: skins could either be submitted by hunters to the North Korean state, or sold to middlemen for black market trade, either locally or with China. It was noted that a hunter may engage in both forms of trade in order to retain their official status and maximise their profits, potentially directing different body parts or different animals to state submission and private sale, either local or cross-border. The stated importance of red fox is notable, as the species has been considered to be rare in North Korea (Jo et al., 2018). Asian badger skins are known to have been exported from northern Korea since the 19th century (Imperial Maritime Customs, 1888), with North Korea officially exporting 13,000 badger skins in 1953 alone (Jo et al., 2018). One species that was not reported from trade was Eurasian lynx (*Lynx lynx*), despite being historically valued as a furbearer in other range countries (Raye, 2017). However,

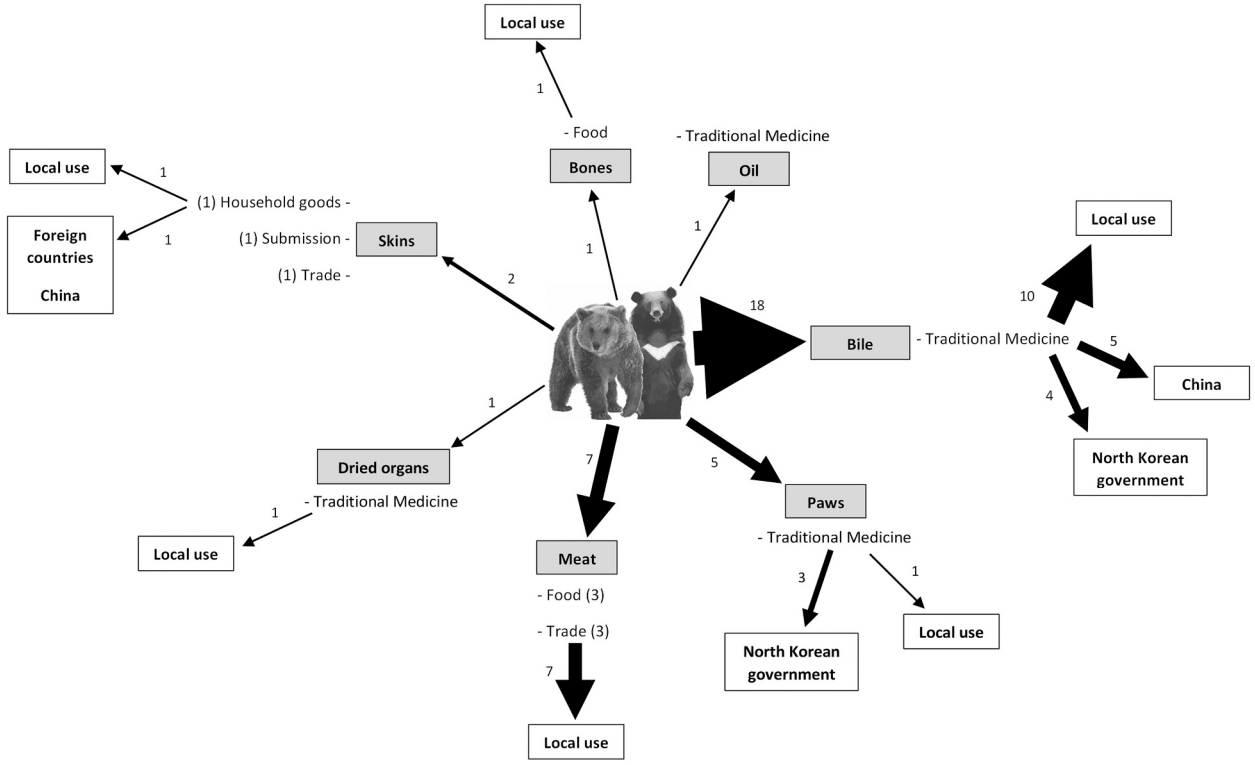

Fig. 4. Bear (*Ursus* spp.) trade in North Korea, by products, use and destination, as reported by North Korean defectors. Weight of arrow and value corresponds to number of participants who mentioned (multiple answers allowed).

Table 4
Non-target species reported to be traded, consumed or used in North Korea. (* - Unable to reliably distinguish between the species listed in this category from the record given; **Wild animals likely refer to native *Lepus coreanus* or *Lepus mandshuricus*, but farmed animals may refer to *Oryctolagus cuniculus*;? – Participant(s) uncertain; (n) – Number of mentions, if multiple uses, sources or destinations reported).

Species	Product	Uses	Number of mentions	Source	Destination
Amur hedgehog (*Erinaceus amurensis*)	Spines	Traditional medicine	5	Wild	Local use or consumption
	Meat	Food - human	3	Wild	Local use or consumption
	Live animal	Pets/display animals (4), ? (1)	5	Wild	Local households
Pheasant (*Phasianus colchicus*)	Meat	Food - human (4), Trade (foreign exchange) (5)	6	Wild (5), Farmed (1)	Local use or consumption (4), China (5)
Ducks and geese (Suborder: Anseres*)	Bodies & Feathers	Trade	2	Wild	?
Hawks, vultures and other birds of prey (Family: Accipitridae*)	Meat	Food - human	2	Wild	Local use or consumption
	Bodies	Trade (foreign exchange)	1	Wild	China
	Bodies	Specimen collecting	1	Wild	Local use or consumption (wealthy individuals)
Owls (Family: Strigidae*), including Eurasian eagle-owl (*Bubo bubo*)	Meat	Food – human	1	Wild	Local use or consumption
	Bodies	Specimen collecting	1	Wild	Local use or consumption (wealthy individuals)
Snake (Suborder: Serpentes*)	Snake liquor	Traditional medicine	3	Wild	Local use or consumption
	Powder	Traditional medicine	1	?	Local use or consumption
	Meat	Food - human	1	Wild	Local use or consumption
Rabbits or Hares (Family: Leporidae)**	Skin	Wearing apparel, accessories	7	Wild (1), Farmed (5)	Local use or consumption (3), North Korean government (military) (3)
	Meat	Food - human	7	Wild (4), Farmed (2)	Local use or consumption
	Live animal	Pets/display animals	2	Wild	Local households
Coypu (nutria) (*Myocastor coypus*)	Skin	Wearing apparel, accessories	3	Farmed	North Korean government
Domestic cat (*Felis catus*)	Meat	Food - human	3	Domestic	Local use or consumption
Domestic dog (*Canis familiaris*)	Skin	Wearing apparel, accessories (1), Other (Government submission) (1), Trade (local) (2), Trade (foreign exchange) (1)	3	Domestic	Local use or consumption (2), Foreign export (China) (1)
	Meat	Food - human	3	Domestic	Local use or consumption

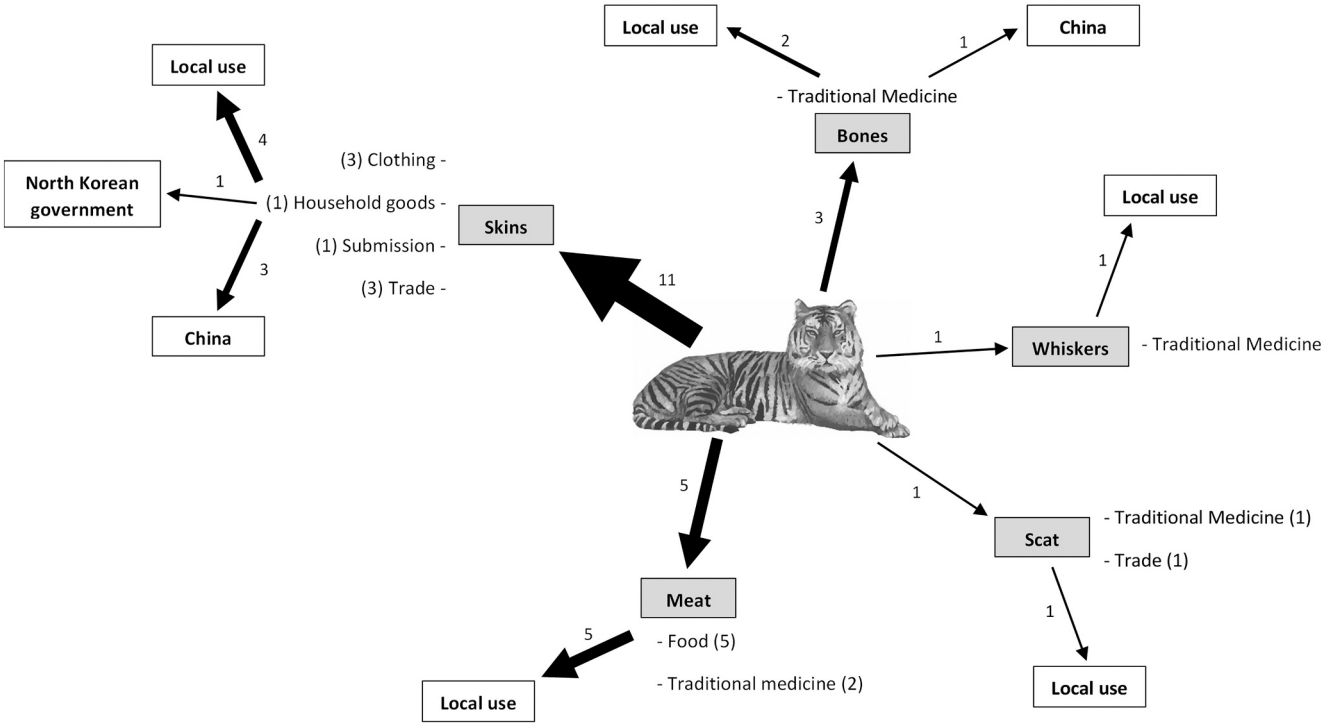

Fig. 5. Tiger (*Panthera tigris*) trade in North Korea, by products, use and destination, as reported by North Korean defectors. Weight of arrow and value corresponds to number of participants who mentioned (multiple answers allowed).

Table 5
Participant assessments of comparative value of furbearing carnivores in wildlife trade.

	Assessment 1	Assessment 2
1 (Highest)	Sable (*Martes zibellina*)	Sable (*Martes zibellina*)
2	Eurasian otter (*Lutra lutra*)	Yellow-throated marten (*Martes flavigula*)
3	Red fox (*Vulpes vulpes*)	Eurasian Otter (*Lutra lutra*)
4	Asian badger (*Meles leucurus*) & common raccoon dog (*Nyctereutes procyonoides*)	Siberian weasel (*Mustela sibirica*)
5 (Lowest)	Siberian weasel (*Mustela sibirica*)	

the species has been considered rare in Korea (Jo et al., 2018) and the few participants who reported having unsuccessfully tried to hunt lynx in North Korea described that it was elusive and difficult to capture.

3.6. State-sanctioned wildlife trade as part of the formal economy

Interview responses indicated the importance of wildlife as a natural resource for the North Korean state, both to supply raw materials (for example, skins for the manufacture of winter clothing) and to generate foreign currency, specifically through trade with buyers from its main economic partner, the People's Republic of China (China). Foreign currency is particularly important for the North Korean regime because the country has limited financial reserves and restricted access to international trade in order to obtain key resources and goods, due to its diplomatic and economic isolation (Lee, 2018; Lukin and Zakharova, 2018). China plays a particularly important role for North Korean trade as it shares a land border with North Korea; is one of Pyongyang's few diplomatic allies; and has only enforced sanctions against North Korea intermittently and unevenly (Lee, 2018). Previous reports on the North Korean economy have discussed the state's use of its limited natural resources to generate foreign currency, specifically coal and raw minerals (Thompson, 2011; Mah, 2018) and timber (Liu and Sheng, 2023), but our results show that wildlife is also considered a potentially valuable resource to be exploited for this purpose. It is important to note that while we discuss wildlife trade by the North Korean state to China, this does not necessarily imply involvement by the Chinese state or its agents (including government owned companies), as information on buyers or end users for this trade is currently opaque.

Animal body parts appear to be supplied to the North Korean state through three principle mechanisms: first, the tribute of wildlife products to the state or its leaders, either from state-sanctioned hunters or local communities; second, a quota-based system, whereby residents submitted animal skins to a government agency (these were ostensibly wild animals, although it was mentioned that some families would kill and skin domestic dogs to meet their allocated number); and third, state-run wildlife farms. Concerningly, species reported to be targeted in the wild for the purpose of trade included animals with domestic and international protected status. For example, although designated a Natural Monument in North Korea since 1980 (Jo et al., 2018), long-tailed goral was identified as a species specifically targeted by state-registered hunters for skins. Goral skins were historically used on the Korean Peninsula to make winter clothes for hunters (Jo et al., 2018), but the participant who was most knowledgeable about recent goral trade in North Korea did not mention local use and instead reported that skins

were sold to China. Long-tailed gorals are a CITES Appendix I-listed species and as China is a Party to CITES, commercial trade to buyers in China is illegal. This trade was reported as having had negative impacts for wildlife populations in North Korea and goral populations were reported to have been heavily reduced, which is corroborated by Kim et al. (2015).

3.6.1. *Wildlife farming as a source of products for the North Korean state*

State-owned wildlife farms were regularly identified as a source of certain products, including bear bile; deer antlers, meat, blood, bones and other body parts; otter skins; and pheasant meat. Some of these products were intended for domestic use and consumption, as a food resource, for use in TKM, or in the creation of clothing. Wildlife farms were also reported to supply international trade with China. In addition to native species, participants described a movement in the 1980s to farm non-native coypu (nutria) (*Myocastor coypus*) for their skins. Participant responses suggested some of these animals may have escaped into the wild, a concern for the potential impact on native ecosystems (Kil et al., 2015).

The widespread keeping of "rabbits", introduced under Kim Il Sung (1948–94), represents a distinct component of "wildlife" farming. The Korean hare (*Lepus coreanus*) and Manchurian hare (*L. mandshuricus*) are native and while reports of wild animals being hunted presumably refer to these species, reports of captive animals may be non-native, domesticated European rabbits (*Oryctolagus cuniculus*). Rabbits were reportedly kept by schools and households, with schoolteachers responsible for checking that pupils had submitted the correct number of skins. This provided a regular supply of skins for the state for the manufacture of winter clothing. Households were allowed to keep the leftover meat for food, which state propaganda portrayed as a gift from Kim Il Sung. The occurrence of government campaigns to encourage rabbit farming and the involvement of schools (and other state-owned enterprises) is corroborated by reports from North Korean state media (*Rodong Sinmun, 7 April* 2023, p.5). Directives since 2021 to expand rabbit farming to boost food production (ibid) are potentially a response to North Korea's suspected recent food shortages (Noland, 2022).

4. Conclusion and recommendations

While North Korean use and trade of wildlife is often based on traditional practices, it is shaped by the extreme hardship experienced by the majority of the country's citizens and the economic limitations of the state, and illegal and unsustainable exploitation of wildlife is likely widespread. In order to address long-term shortages of food and basic goods and to generate foreign currency, an extremely wide range of species, across diverse taxonomic groups and including globally threatened species, are opportunistically harvested and consumed as wild meat or traditional medicine by North Korea's citizens, or are utilised or traded by the North Korean state. The severe socioeconomic shocks caused by the collapse of the North Korean economy in the early 1990s had important ramifications and resulted in the growth of illegal cross-border trade in animals and plants with buyers in China. Up until 2020, which is the latest data we were able to obtain and which coincides with North Korea's closure of its borders as part of a zero-COVID policy, the smuggling of wildlife products across the North Korea-China border remained a distinctive component of North Korean wildlife trade.

Participants identified the overexploitation of wildlife for the purpose of consumption or trade to be one of two major drivers of terrestrial biodiversity declines in North Korea, along with deforestation (Elves-Powell et al., 2024a). While it is difficult to provide conclusive assessments on a species-by-species basis, our results suggest that at least one native mammal that is highly desirable to traders, sable, is likely now extremely rare or extirpated in North Korea, and there are concerns regarding the status of several other native mammals, including the tiger and Amur leopard (*P. pardus orientalis*) (Jo et al., 2018). In other examples, individuals who were involved in the harvesting or trade of wildlife in North Korea reported that the availability of wildlife products, or the populations of the species the products were obtained from, seemed to have declined. For example, a participant who had illegally hunted and traded deer noted that populations had reduced heavily in North Hamgyong province, which they believed was due to hunting pressure. Given the number of rare and protected species identified from harvesting and trade, and perceived trends of associated populations, there is clearly a serious risk that the unsustainable exploitation of wildlife in North Korea has severe consequences, including the extirpation of key species and potential defaunation of North Korean landscapes. This has important implications for the conservation of biodiversity and other natural resources in other locations which suffer from severe human deprivation and economic inequality (Lindsey et al., 2011; Harrison et al., 2015; Lunstrum and Givá, 2020), particularly during periods of extreme hardship. North Korea illustrates how this may occur within industrialised societies, despite legal protections and potentially draconian penalties. While attention usually focusses on black market trade, operating outside of government-sanctioned channels (Bragina et al., 2015; Lunstrum and Givá, 2020), North Korea also highlights the risks presented by illegal wildlife trade as state crime.

Developing effective policies to combat the identified trends is fraught with difficulty, given the extreme economic and political circumstances that underpin hardship in North Korea. For example, researchers have previously focused on the potential unintended consequences of economic sanctions on the environment (Khalatbari et al., 2018; Madani, 2020). International sanctions are clearly an important limitation on the North Korean economy. Of particular importance would seem to be restrictions that impact North Korea's agricultural sector, given the food shortages that have defined economic hardship in North Korea and the reportedly widespread, though irregular, consumption of wild meat for subsistence purposes. However, our results show that a focus on international sanctions alone provides an insufficient explanatory mechanism for patterns of wildlife trade in North Korea and is unlikely to yield effective solutions. The economic collapse of the 1990s and subsequent growth of black market wildlife trade occurred prior to the current UN Security Council sanctions regime (introduced in 2006 and broadened in 2016 in response to North Korea's nuclear weapons programme), at a time when United States government sanctions were actually beginning to ease (Niksch, 2006). Instead, the collapse of the North Korean economy was underpinned by long-term issues, many of which persist. For example, economic mismanagement remains a major issue (Schortgen, 2017; Noland, 2022), with defence spending believed to consume up to 26 % of gross domestic product (GDP) (Lee, 2019; U.S. Department of State, 2021). Furthermore, while the economic situation and food availability in North Korea likely improved between the 1990s and 2016 (Koen and Beom, 2020), our results find no evidence that the harvesting and exchange of wildlife for black market trade (including international trade to China) has reduced. While we retain hope that improved living standards and increased food security could contribute to decreased domestic demand for wild meat in North Korea, we acknowledge the serious challenges that exist (Lee and Tan, 2020) and caution that there is no guarantee that illegal cross-border trade in wildlife, now established, would disappear.

Recent patterns of consumptive use of wildlife in North Korea have importance not only for local biodiversity, but the recovery of metapopulations in these species across the Korean Peninsula (Jo et al., 2018) and the conservation goals of Russia and China in their shared border areas (Wang et al., 2018). For example, North Korea borders an area of China where tigers are returning (Wang et al., 2016; Ning et al., 2019; Li et al., 2022) and individual animals are suspected to have occasionally crossed the border. Our investigation shows that tigers which disperse into North Korea are at risk of being killed for their body parts, which may negatively impact the region's recovering tiger population. In turn, illegal North Korean trade of wildlife across its border with China breaches, in some cases, China's CITES commitments and UN Security Council Resolution 2397. China can counter this threat by continuing to

reduce domestic demand for illegal wildlife and putting diplomatic pressure on its economically dependent neighbour to disengage from state-sanctioned illegal wildlife trade. If North Korea acts as a future sink for mammal populations, rather than a dispersal route between mainland Asia and the Korean Peninsula, it also presents a major challenge for current South Korean biodiversity policy, which anticipates natural recolonisation. Instead, South Korea must advance its national biodiversity agenda on the understanding that the dispersal of terrestrial wildlife via North Korea may not be a short-term reality. Continuing to utilise conservation translocations and reintroductions (Lee et al., 2013; Powell and Choi, 2022) is likely to be a more realistic strategy to achieve species restorations.

There are limited opportunities for direct engagement with biodiversity conservation in North Korea by the global conservation community and we caution that efforts to do so should be aware of the potential for any conservation or scientific initiative, however well intentioned, to have unintended consequences. For example, efforts to identify routes used to smuggle wildlife products into China should be conscious that these routes may also be used by North Korean refugees seeking to reach South Korea, often being subject in China to arrest and forced repatriation (Chang et al., 2006; Yoon, 2019). Further research on the use and trade of wildlife by the North Korean state would be beneficial, as while participants in our study reported the occurrence of trade and how wildlife products were supplied to the state, we are only able to provide limited further details.

There may be the potential for future co-operation on issues of biodiversity conservation between North Korea and its neighbours, with particular attention having been given to environmental peacebuilding as a way to achieve common ground on the Korean Peninsula (Barquet et al., 2014; Kim and Ali, 2016; Lim and Choi, 2022). However, the North Korean state's failure to enforce and abide by its own wildlife protection laws currently presents a major obstacle to co-operation. In light of this, we urgently recommend that the North Korean state ceases trading protected species with immediate effect. While CITES accession would likely be a beneficial long-term goal, compliance with domestic protected species legislation should be an immediate priority.

CRediT authorship contribution statement

Joshua Elves-Powell: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jan C. Axmacher:** Writing – review & editing, Supervision. **John D.C. Linnell:** Writing – review & editing, Supervision. **Sarah M. Durant:** Writing – review & editing, Supervision.

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Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2025.111102.

Data availability

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

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