



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Original Article

Illegal wildlife trade in local markets of Feuang and Mad districts of Vientiane Province, Lao People's Democratic Republic

Maniram Banjade^{a,†}, Pradeep Adhikari^{b,†}, Hong-Shik Oh^{c,*}

^a Faculty of Science Education, Jeju National University, Jeju, 63243, Republic of Korea

^b National Institute of Ecology, 1210 Geumgang-ro, Maseo-myeon, Seocheon, Chungcheongnam, 33657, Republic of Korea

^c Interdisciplinary Graduate Programme in Advance Convergence Technology and Science, Faculty of Science Education, Jeju National University, Jeju, 63243, Republic of Korea

ARTICLE INFO

Article history:

Received 11 June 2020

Received in revised form

27 July 2020

Accepted 29 July 2020

Available online 1 September 2020

Keywords:

CITES

IUCN

Lao PDR

Threatened species

Wildlife trade

ABSTRACT

The Lao People's Democratic Republic has emerged as a hub for illegal flora and fauna trade, more specifically, species in protected categories. However, numerous local species are traded and given less consideration despite their importance. Hence, we observed the local markets in the Feuang and Mad districts of Vientiane Province in summer and winter seasons to determine the species for trade, as well as their volume and conservation status. Altogether, 602 specimens corresponding to 23 genera and 22 species were identified. Among them, the highest number of species was mammals, followed by birds, reptiles, amphibians, and insects. Six species are listed in threatened categories according to the International Union for Conservation of Nature and nine under Convention on International Trade in Endangered Species categories. The species in trade varied between seasons, as winter was the main poaching season for mammals and birds and summer was for amphibians, reptiles, and insects. This study revealed that food, traditional medicine, and curio production were the main reasons for wildlife trade. The lack of strong regulations, monitoring and law enforcement, and poverty are the major reasons for wildlife trade. Therefore, strong law enforcement, creating alternate income sources, and participatory conservation programs are required to effectively control wildlife trade in the Lao People's Democratic Republic.

© 2020 National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA), Publishing Services by Elsevier. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The Lao People's Democratic Republic (Lao PDR) is a landlocked country in Southeast Asia surrounded by Myanmar, Thailand, Vietnam, Cambodia, and China that covers 236,800 square kilometers. Because of the heterogeneous habitat, tropical climate, forest, and watershed areas, it is rich in biodiversity. Altogether, 178 species of mammals, 740 species of birds, 189 species of reptiles, and 5,005 species of plants are reported to inhabit the Lao PDR (IUCN 2007; Luu et al 2013; Zhu 2017; Avibase 2018). The biodiversity in the Lao PDR is exposed to several threats that have led to a decline in the native flora and fauna and the extinction of many species. The exploitation of natural resources, expansion of

agriculture and infrastructure, illegal hunting and trapping, and wildlife trade are the major activities threatening biodiversity (Ounchith 2015). Between 1998 and 2015, the flora and fauna in the Lao PDR have been continuously threatened, and the number of threatened and near-threatened species has increased from 100 to 168 species (IUCN 2016). In addition to biodiversity loss, wildlife trapping and trading support the spread of zoonotic diseases. It is estimated that more than 72% of the emerging zoonotic diseases originate from wildlife species, which poses a serious risk to humans and domestic animals (Jones et al 2008).

There is a long tradition of wildlife hunting in the Lao PDR. The majority of the inhabitants live in rural areas and are dependent upon harvesting wild products and hunting wild animals for their livelihood and traditional medicine (Johnson et al 2010; Singh 2010). Hence, numerous wildlife species are in trade at local and international markets, regardless of their conservation status, making the country a hub for illegal trade (Ghos 2010; Schweikhard et al 2019). Various studies have reported that the Lao PDR is part of an international transit system for trading wildlife parts, such as

* Corresponding author. Tel.: +82 64 754-3283; Cell Phone: +82 10 6800-8679.

E-mail address: sciedu@jejunu.ac.kr (H.-S. Oh).

Peer review under responsibility of National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA).

† Both authors are equally contributed.

elephant's ivory, tiger's skin, and rhino's horns from Africa and Asia to supply China, Vietnam, and Thailand. Therefore, the country is being scrutinized for its role in global wildlife trade (CITES 2016; Vigne et al 2017).

The government of the Lao PDR has developed a law called "The Wildlife and Aquatic Law 2007" (WAL 2007) for governing wildlife protection and trade in the Lao PDR. They also developed Penal Law 1990, which describes penalties and the duration of custody for violating the law. However, articles 34, 35, and 36 under the WAL 2007 permit wildlife holding for breeding and business purposes. Articles 38 and 40 define the establishment of farmhouses for breeding and commercial trade and categories of animals that can be farmed and traded after the second generation. Similarly, article 71 of WAL 2007 describes the illegal hunting of rare, nearly extinct animals, as well as the illegal import, export, reexport, and transport of wildlife as criminal activities. Penalties for violating the law range from imprisonment of three months to two years, and the maximum fine for this offense, which applies to repeat offenders, is 600,000 LAK (72 USD).

Several studies have reported that illegal wildlife trade is increasing in the Lao PDR and threatening the native biodiversity (Nooren and Claridge 2001; Foley et al 2011; Singh 2014; Livingstone et al 2018; Rasphone et al 2019). Most of these studies reported that wildlife trade occurred in either the northern border or central parts of the country, focusing on particular seasons. In this study, we reported wildlife trade that occurred in the Feuang and Mad districts of the Vientiane Province in the southwestern part of the country, which are rising as new trade zones for domestic and international trade. This study provided an assessment of local markets and recorded the animals in trade during winter and summer seasons between 2017 and 2018.

Material and methods

This study was conducted in the Feuang and Mad districts of the Vientiane Province of the Lao PDR (Figure 1) from December 2018

to June 2019. The study was performed in the local markets, roadsides of urban areas, and surrounding villages of the Feuang and Mad districts. Direct observation and questionnaire surveys were conducted in the winter and summer seasons to collect data on the wildlife trade, including species names, numbers, sources, and potential use. Three teams with two to five members were involved in the field observations, and questionnaire surveys were performed at each visit. Photos of wild animals were taken for species identification and counting. A questionnaire survey (Supplementary file 1) was conducted among the local people, wildlife harvesters, wildlife traders, government officials, school teachers, and wildlife researchers.

The conservation status of each species was assessed based on the Convention on International Trade in Endangered Species (CITES) and the International Union for Conservation of Nature (IUCN) Red List of Threatened Species categories. The Student *t* test in IBM SPSS 26.0 (IBM Corp. Armonk, NY, USA) was used to assess the significant differences between the two seasons.

Results

Altogether, 23 genera and 22 species (N = 602 specimens) belonging to 21 families were recorded in this study (Table 1). The highest proportion of identified specimens was insects (49.8%), followed by amphibians (23.9%), mammals (15.9%), birds (7.8%), and reptiles (2.4%). Dung beetles, frogs, toads, and rats were the major species sold in the wildlife markets.

The identified species were classified according to the IUCN Red List categories, of which 17 species, such as shrew mouse (*Mus pahari*), brown hawk-owl (*Ninox scutulata*), and green paddy frog (*Hylarana erythraea*), are the least threatened, and three species, including binturong (*Arctictis binturong*), northern pig-tailed macaque (*Macaca leonine*), and black-rayed soft-shelled turtle (*Amyda cartilaginea*), are vulnerable. Similarly, two species, Austen's brown hornbill (*Anorrhinus austeni*) and the blossom-headed parakeet (*Psittacula roseata*) are near threatened, and the keeled box turtle



Figure 1. Study area. Mad and Feuang districts of Vientiane Province of the Lao People's Democratic Republic.

Table 1. List of species in trade and their conservation status.

| Taxon | Family | Species name | Common name | Status | | Specimen no. | Average price (USD) | |
|------------|-----------------|-----------------------------------|---------------------------------|--------|-------|--------------|---------------------|-------|
| | | | | IUCN | CITES | | Unit | Total |
| Insects | Scarabaeidae | <i>Helicopriss</i> | Dung beetle | LC | NC | ~300 | 0.25 | 75 |
| Amphibians | Ranidae | <i>Hylarana erythraea</i> | Green paddy frog | LC | NC | 72 | 2 | 144 |
| | Dicroglossidae | <i>Fejervarya limnocharis</i> | Boie's wart frog | LC | NC | 49 | 1 | 49 |
| Reptiles | Bufoinae | <i>Duttaphrynus melanostictus</i> | Asian common toad | LC | NC | 23 | 1 | 23 |
| | Trionychidae | <i>Amyda cartilaginea</i> | Black-rayed soft-shelled turtle | VU | II | 4 | 12 | 48 |
| | Gepemydidae | <i>Cuora mouhotii</i> | Keeled box turtle | EN | II | 8 | 84 | 672 |
| | Varanidae | <i>Varanus salvator</i> | Water monitor lizard | LC | II | 3 | 18 | 54 |
| Birds | Strigiformes | <i>Ninox scutulata</i> | Brown hawk-owl | LC | II | 6 | 55 | 330 |
| | Bucerotiformes | <i>Anorrhinus austeni</i> | Austen's brown hornbill | NT | II | 5 | 38 | 190 |
| | Accipiteridae | <i>Accipiter gularis</i> | Japanese sparrow hawk | LC | II | 3 | 15 | 45 |
| | Pittaculidae | <i>Pittacula roseata</i> | Blossom-headed parakeet | NT | II | 11 | 2 | 22 |
| | Anatidae | <i>Tadorna ferruginea</i> | Ruddy shelduck | LC | NC | 12 | 12 | 144 |
| | Phasianidae | <i>Gallus gallus</i> | Jungle fowl | LC | NC | 10 | 8 | 80 |
| Mammals | Viverridae | <i>Arctictis binturong</i> | Binturong/Bear cat | VU | III | 3 | 300 | 900 |
| | Cercopithecidae | <i>Macaca leonina</i> | Northern pig-tailed macaque | VU | II | 4 | 150 | 600 |
| | Spalacidae | <i>Rhizomys sumatrensis</i> | Large bamboo rat | LC | NC | 14 | 10 | 140 |
| | Leporidae | <i>Lepus peguensis</i> | Burmese hare | LC | NC | 6 | 28 | 168 |
| | Rhinolophidae | <i>Rhinolohus thomasi</i> | Thomas's horseshoe bat | LC | NC | 20 | 2 | 40 |
| | Hipposideridae | <i>Hipposideros rotalis</i> | Laotian leaf-nosed bat | LC | NC | 12 | 3 | 36 |
| | Muridae | <i>Mus pahari</i> | Shrew mouse | LC | NC | 18 | 2 | 16 |
| | | <i>Leopoldamyus edwardsi</i> | Edwards's long-tailed giant rat | LC | NC | 5 | 3 | 15 |
| | Sciuridae | <i>Callosciurus inornatus</i> | Inornate squirrel | LC | NC | 9 | 10 | 90 |
| | | <i>Dremomys rufigenis</i> | Asian red-cheeked squirrel | LC | NC | 5 | 8 | 8 |

LC: least concerned; VU: vulnerable; EN, endangered; NT: near threatened; NC: not counted; II: [appendix II](#) ; III: [appendix III](#); USD, United States dollar; IUCN: International Union for Conservation of Nature; CITES: Convention on International Trade in Endangered Species.

**Figure 2.** Wild mammals in trade. The *Arctictis binturong*, *Rhizomys sumatrensis*, and *Macaca leonina* were live and kept inside the cage.

(*Cuora mouhotii*) is an endangered species ([Table 1](#)). Similarly, eight species such as the black-rayed soft-shelled turtle, brown hawk-owl, and northern pig-tailed macaque are listed in [Appendix II](#), one species (binturong) is in [Appendix III](#), and the remaining 14 species, including Boie's wart frog (*Fejervarya limnocharis*), the

ruddy shelduck (*Tadorna ferruginea*), and the large bamboo rat (*Rhizomys sumatrensis*), are considered not counted under the CITES categories ([Table 1](#)).

The wildlife species were found both alive and dead. The live species were kept inside cages, and dead bodies either were found

as whole carcasses or dried parts. Mammalian species such as binturong, the northern pig-tailed macaque, and the large bamboo rat; avian species, such as the brown hawk-owl, blossom-headed parakeet, and Japanese sparrow hawk (*Accipiter gularis*); reptiles such as the keeled box turtle; and amphibian species, such as the green paddy frog, were sold alive. However, Edwards's long-tailed giant rat (*Leopoldamyus edwardsi*), inornate squirrel (*Callosciurus inornatus*), and jungle fowl (*Gallus gallus*) were sold as whole carcasses either cooked or fried. Some representative images of wild species are shown in Figures 2 and 3.

The selling price of these wild species varied from place to place. Here, we estimated the average selling price of each species based on market surveys in the summer and winter seasons (Table 1). The estimated cost for a dung beetle was 25 cents, amphibians (1–2 USD), reptiles (8–84 USD), birds (2–55 USD), and mammals (2–300 USD). Threatened species such as the keeled box turtle, brown hawk-owl, binturong, and northern pig-tailed macaque had average selling prices of more than 50 USD.

The wildlife market study and questionnaire survey revealed that wild animals were in trade for various purposes, such as food, leather, traditional medicine, curio production, and pets (Figure 4). The highest proportion of wildlife species was traded for food purposes (45.4%), followed by traditional medicine (30.6%), curio production (12.7%), pets (3.6%), and other (7.2%). Wild species, such as the large bamboo rat, the Asian red-cheeked squirrel (*Dremomys rufigenis*), jungle fowl, green paddy frog, and Asian common toad (*Duttaphrynus melanostictus*), were in trade for food. Similarly, the keeled box turtle, Thomas's horseshoe bat (*Rhinolohus thomasi*), and the ruddy shelduck were in trade for medicine. The northern pig-tailed macaque and water monitor lizard (*Varanus salvator*) were in trade for leather, and blossom-headed parakeets were in trade for pets.

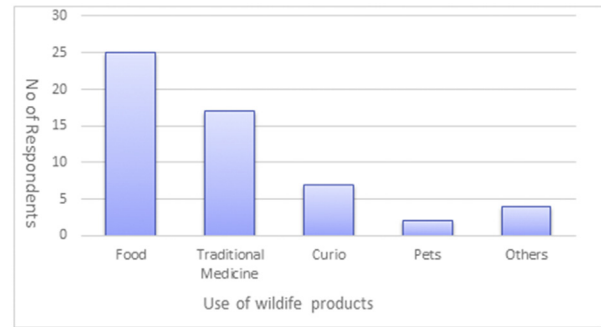


Figure 4. Response of questionnaire survey for using wildlife and their products.

A comparison of individuals in five taxonomic classes recorded in the winter and summer seasons is illustrated in Figure 5. Although mammals and birds were traded at a higher proportion in the winter season and amphibians, reptiles, and insects in the summer season, there were no significant differences in trade between summer and winter (Student *t* test, $p > 0.05$).

Discussion

The wildlife market is expanding due to domestic and international demands for wildlife and their products. Various studies have reported that international trade was closely related to economic benefit (Johnson et al 2010; Singh 2010; Greatorex et al 2016; Krishnasamy et al 2018). The increasing demand and price of wildlife products in other East Asian countries such as China, Thailand, and Vietnam have aggravated wildlife hunting in the Lao PDR. The wildlife trade in the Lao PDR is not only associated with



Dremomys rufigenis in sale with vegetable



Fried *Callosciurus inornatus*



Leopoldamyus edwardsi and *Gallus gallus*



Hylarana erythraea

Figure 3. Wild animals and their products in local market.

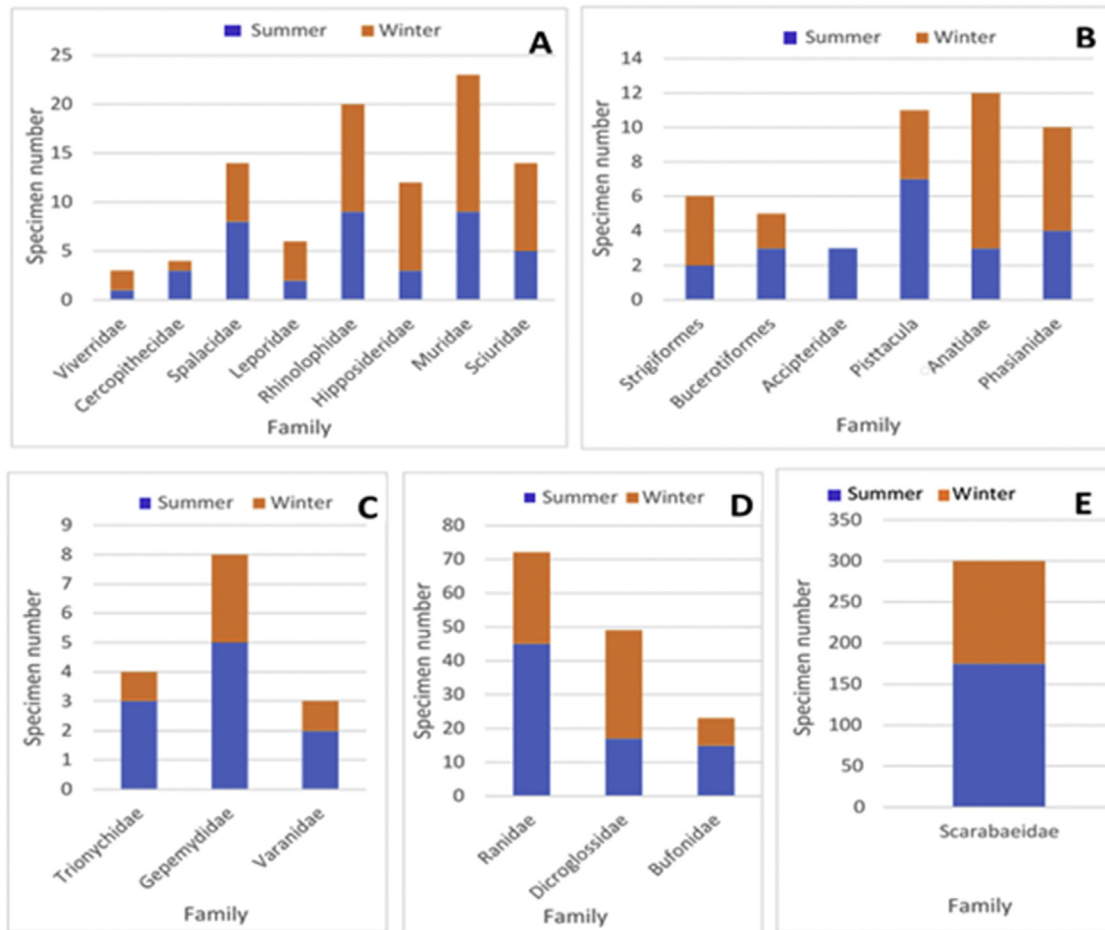


Figure 5. Comparison of wildlife trade in summer and winter season. The graph shows the number of specimens corresponding to each family: A, mammals; B, birds; C, reptiles; D, amphibians; E, Insects.

the livelihood of the local people but also closely related to culture and tradition. People believe that consuming wildlife products increases virility, social status, luck, and health (Due and Broad 1995). Many traditional medicines use wildlife parts such as liver, skin, gall bladder, and muscles as ingredients, and this practice is still in place (Table 2).

Globally, the disease implications of wildlife trade have received less attention over the decade. However, it is a significant threat to human health (Greatorex et al 2016). Open markets and poor biosafety enhance the transfer of zoonotic diseases or pathogens from wildlife to humans. Our observation of local markets

correlated risk with the presence of wildlife known to carry globally significant zoonotic agents. The higher volumes of Muridae (rats), Sciuridae (squirrels), and Hipposideridae (bats) are of special concern as these families are reservoir hosts of several zoonotic pathogens ranging from hantavirus and Nipah virus to SARS (Severe Acute Respiratory Syndrome) and Ebola (Chua et al 2002; Lau et al 2005; Kim et al 2009; Olival et al 2013). Different from mammals, most birds and reptiles act as intermediate hosts rather than definitive hosts (Mendoza-Roldan et al 2020). Approximately, 2.7 million human deaths and 2.5 billion human illnesses are attributable to zoonotic diseases globally (Gebreyes et al 2014).

In contrast to Middle Eastern countries, the demand for mammals is high in Laos compared with birds and herpetofauna (Eid et al 2011; Abi-Said et al 2018). This is consistent with results obtained from neighboring countries such as China, Vietnam, Thailand, and Mongolia, where mammals constitute the majority of species in trade (Schweikhard et al 2019). Most species in trade were of local origin and a few of them were carried from long distances, which fall under IUCN and CITES categories. Rats, squirrels, lizards, and frogs were the most common species observed in the market and were selling at low prices. The price of binturong and northern pig-tailed macaque was relatively high compared with small mammals, birds, amphibians, and reptiles. We did not see the large and charismatic species, such as bears, tigers, and elephants, and their products (skin, horns, antlers, and tusks) in the market as reported by Krishnasamy et al (2018) and Schweikhard

Table 2. Some medical uses of animals products.

| Species | Derivative/parts used | Applications |
|-----------------|----------------------------|--|
| Primates | Balm made from bones | For lack of appetite, insomnia, anemia, and so on. |
| Birds | Stomach and liver membrane | Improve body strength. |
| Snakes | Gall bladder and meat | Relieve cough and pain, headache, cure paralysis. |
| Monitor lizards | Gall bladder | Cure asthma. |
| Turtles | Plastron | Heal joints problems |
| Toads | Mucus from dorsal glands | To relieve pain, treat skin inflammation, and boils. |

Source: CRES (1993)

et al (2019). Low populations, difficulties in capturing, and high cost could be the possible reasons. Previous studies revealed that the CITES-listed species had high selling prices compared with the non-CITES species (Courchamp et al 2006).

Although our study was performed in two seasons, we visited local markets and covered only two districts. Therefore, we could not record large mammals. The border areas of China, Vietnam, and Thailand and express highways connecting to neighboring countries are popular sites for wildlife trade (Johnson et al 2010; Krishnasamy et al 2018). This suggests that trade is not limited to certain periods but continues year-round. A case study in Laos reported that hunting frequency varied due to seasonal differences in labor, such as planting or harvesting of crops (Johnson et al 2010). The trade of herpetofauna was higher in the summer season than in the winter season, which was related to their abundance. As summer is accompanied by rain, the availability of groundwater creates a suitable habitat for their metabolic activity (Pradhan et al 2014), making them easily accessed by hunters.

A trade chain encompasses flexible distribution lines that are often highly creative. Trafficking is facilitated both by domestic and international specialists involved in stockpiling, handling, transporting, marketing, and retailing wildlife products. The hunting scenario starts with harvesters, who predominantly inhabit rural areas and have economically weak livelihoods. Harvesters are usually active at night and use local and traditional weapons, such as snares, and bows and arrows for hunting small mammals and birds but use modern firearms for hunting large mammals (Nash 1997). Usually, youth and adult men are involved in hunting and the transportation of wild animals and selling to local dealers and wildlife traders coming from other districts. They sell either live animals or dry meat, carcasses, skin, and horns. The traders transport wildlife products to other markets inside the country or border areas for exporting to other countries. In local markets, we observed young children and adult women involved in trade, selling small mammals, amphibians, and reptiles on a small scale, where their earnings were used for purchasing daily needs such as food, clothing, and other grocery items.

Wildlife traders change their routes of transportation continuously to take advantage of new infrastructures, reduce costs, or avoid detection by authorities. Open borders, accessible markets, and better transportation and communication have led to a situation where wildlife moves almost unimpeded across the borders of Laos and Thailand (Chong Mek), Laos and Cambodia (Veun Kham), Laos and Vietnam (Namcan), and Laos and China (Boten Mohan). Krishnasamy et al (2018) and Srikosamatara et al (1992) reported Boten and Yunan, respectively, for trading wildlife. With its booming economy, China is the biggest market for wildlife products (Butler 2009), followed by Hong Kong, Taiwan, South Korea, and Thailand (Kemf 1994). Most of the species exported to Vietnam are further exported to China (Jenkins 1995).

The wildlife trade in the Lao PDR depends upon two factors, supply and demand. Trade will not end until the demand from consuming countries is reduced. Rapid development and growing affluence creates demand from China, Thailand, and Vietnam, and addressing them to control trade seems ineffective. Similarly, the supply side is more critical as trade restrictions eliminate a source of income for the rural poor. Since 2004, the Lao PDR has become a party to CITES (Nijman and Shepherd 2012). However, the capacity and resources to implement CITES are often inadequate. Cross-border trade has continued, with the Lao PDR being a country of origin for traded species. This effectively means that the Lao PDR is unable to implement CITES, despite being a party to the convention (CITES 2016; Krishnasamy et al 2016). The lack of regulations, monitoring, and law enforcement at border towns has made it a popular hub for cross-border wildlife trade. Although complex, the

Laotian government needs to address the supply by clarifying laws and strengthening enforcement through the training of wildlife authorities and costume authority. The government of the Lao PDR should develop wildlife policies for the sustainable harvesting of wildlife based on their conservation status. There is an urgent need to close the loopholes in wildlife law increasing wildlife trade and implement effective law enforcement to prevent the exploitation of natural resources. In addition, alternative income sources are required for the citizens who are completely dependent upon wildlife products for their livelihood. Public awareness and community-based participatory conservation programs could be effective for controlling illegal wildlife trade in the Lao PDR.

Conflict of interest

The authors declare that there is no conflict of interest.

Acknowledgments

This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2019R1A6A1A10072987).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.japb.2020.07.006>.

References

- Abi-Said MR, Outa NT, Makhlof H, et al. 2018. Illegal trade in wildlife species in Beirut, Lebanon. *Vertebrate Zoology* 68 (1):1–4.
- Avibase. 2018. *Loas bird checklist, referencing the world bird database*. Retrieved from, <https://avibase.bsc-eoc.org>.
- Butler R. 2009. *Laos emerges as key source in Asia's illicit wildlife trade*, vol. 360. Yale Environment.
- Chua KB, Lek Koh C, Hooi PS, et al. 2002. Isolation of Nipah virus from Malaysian Island flying-foxes. *Microbes and Infection* 4 (2):145–151.
- CITES. 2016. Application of Article XIII in the Lao People's democratic republic by Sixty-sixth Meeting of the Standing Committee (Johannesburg (South Africa)), 23 September 2016. Gland, Switzerland.
- Courchamp F, Angulo E, Rivalan P, et al. 2006. Rarity value and species extinction: The anthropogenic allee effect. *PLoS Biology* 4 (12):2405–2410.
- Due LD, Broad S. 1995. *Investigations into Tortoise and Freshwater Turtle Trade in Vietnam*. NWF/IUCN/WWF Programme for Endangered Species in Asia in collaboration with TRAFFIC Southeast Asia. pp. 1–144.
- Eid E, Hasani I Al, Share T Al, et al. 2011. Animal Trade in Amman Local Market, Jordan. *Jordan Journal of Biological Sciences* 4 (2):101–108.
- Foley KE, Stengel CJ, Shepherd CR. 2011. Pills, Powders, Vials and Flakes: the bear bile trade in Asia. *TRAFFIC Southeast Asia*:1–79.
- Gebreyes WA, Dupouy-Camet J, Newport MJ, et al. 2014. The Global One Health Paradigm: Challenges and Opportunities for Tackling Infectious Diseases at the Human, Animal, and Environment Interface in Low-Resource Settings. *PLoS Neglected Tropical Diseases* 8 (11):e3257. <https://doi.org/10.1371/journal.pntd.0003257>.
- Ghos N. 2010. *Bearing the brunt of illegal wildlife trade*. *The Straits Times*. 2 October. Retrieved from, <https://wildsingaporenews.blogspot.com>.
- Greatorex ZF, Olson SH, Singhalath S, et al. 2016. Wildlife trade and human health in Lao PDR: An assessment of the zoonotic disease risk in markets. *PLoS One* 11 (3): e0150666.
- IUCN. 2007. *The IUCN Red List of Threatened Species: Mammals of Laos*.
- IUCN. 2016. *Fifth national report to the united nations convention on biological diversity – DFRM-MoNRE and Technical support*. Vientiane, Lao PDR: IUCN. Retrieved from, <https://www.cbd.int/doc/world/la/la-nr-05-en.pdf>.
- Jenkins MD. 1995. Tortoises and Freshwater Turtles: the trade in south east Asia. *TRAFFIC International*:1–49.
- Johnson A, Krahn J, Seateun S. 2010. *Finding the Linkages between Wildlife Management and Household Food Consumption in the Uplands of Lao People's Democratic Republic: a case study from the Nam Et-Phou Louey National Protected Area*. USAID. pp. 1–80.
- Jones KE, Patel NG, Levy MA, et al. 2008. Global trends in emerging infectious diseases. *Nature* 451 (7181):990–993.
- Kemf E. 1994. Vietnam stamps out illegal wildlife trade. *TRAFFIC Dispatches*:1–200.
- Kim B, Vincent H, Heikki H, et al. 2009. Rodent-borne zoonotic viruses in Southeast Asia. *Kasetsart Journal - Natural Science* 43 (1):94–105.

- Krishnasamy K, Boyd L, Or OC. 2016. Observations of the Helmeted Hornbill Trade in Lao PDR. *Traffic Report*:1–15.
- Krishnasamy K, Shepherd CR, Or OC. 2018. Observations of illegal wildlife trade in Boten, a Chinese border town within a Specific Economic Zone in northern Lao PDR. *Global Ecology and Conservation* 14:e00390.
- Lau SKP, Woo PCY, Li KSM, et al. 2005. Severe acute respiratory syndrome coronavirus-like virus in Chinese horseshoe bats. *Proceedings of the National Academy of Sciences of the United States of America* 102 (39):14040–14045.
- Livingstone E, Gomez L, Bouhuys J. 2018. A review of bear farming and bear trade in Lao People's Democratic Republic. *Global Ecology and Conservation* 13:e00380.
- Luu VQ, Nguyen TQ, Calame T, et al. 2013. New country records of reptiles from Laos. *Biodiversity Data Journal* 1 (1):1–14.
- Mendoza-Roldan JA, Modry D, Otranto D. 2020. Zoonotic parasites of reptiles: a crawling threat. *Trends in Parasitology* 36 (8):677–688.
- Nash S. 1997. Fin, Feather, Scale and Skin: Observations on the Wildlife Trade in LAO PDR and Vietnam. *TRAFFIC Southeast Asia*:1–52.
- Nijman V, Shepherd CR. 2012. The Role of Lao PDR in the Ivory Trade. *TRAFFIC Bulletin* 24 (1):35–40.
- Nooren H, Claridge G. 2001. *Wildlife trade in Laos: the end of the game*. Amsterdam: Netherlands Committee for IUCN. Retrieved from, <https://www.cabdirect.org>.
- Olival KJ, Islam A, Yu M, et al. 2013. Ebola virus antibodies in fruit bats, Bangladesh. *Emerging Infectious Diseases* 19 (2):270–273.
- Ounchith P. 2015. *Threats to biodiversity: Implications for socio-economic well-being in Lao PDR, Vientiane*.
- Pradhan S, Mishra D, Sahu KR. 2014. Seasonal variation and abundance of herpetofauna in the Gandhamardan hills. *International Journal of Research in Zoology* 4 (2):51–54.
- Rasphone A, Kéry M, Kamler JF, et al. 2019. Documenting the demise of tiger and leopard, and the status of other carnivores and prey, in Lao PDR's most prized protected area: Nam Et - Phou Louey. *Global Ecology and Conservation* 20:e00766.
- Schweikhard J, Kasper K, Ebert CL, et al. 2019. Investigations into the illegal wildlife trade in central Lao PDR. *TRAFFIC Bulletin* 31 (1):19–25.
- Singh S. 2010. Appetites and aspirations: Consuming wildlife in Laos. *Australian Journal of Anthropology* 21 (3):315–331.
- Singh S. 2014. Borderland practices and narratives: Illegal cross-border logging in northeastern Cambodia. *Ethnography* 15 (2):135–159.
- Srikosamatara S, Siripholdej B, Suteethorn V. 1992. Wildlife trade in Lao PDR and between Lao PDR and Thailand. *Natural History Bulletin of the Siam Society* 40: 1–47.
- Vigne L, Martin E, Frederick J. 2017. The ivory trade of Laos: now the fastest growing in the world. *Save the Elephants*:119–121.
- WAL. 2007. *Wildlife and Aquatic Law: Lao People's Democratic Republic Peace Independence Democracy Unity Prosperity*. pp. 1–20.
- Zhu H. 2017. Floristic characteristics and affinities in Lao PDR, with a reference to the biogeography of the Indochina peninsula. *PLoS One* 12 (6):e0179966.