



Original Article

Endemic Vietnamese reptiles in commercial trade

Jordi Janssen^{a,*}, Rosa A. Indenbaum^b^a *Emoia Consultancy, Gouda, Netherlands*^b *TRAFFIC, Ha Noi, Vietnam*

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ABSTRACT

Endemic species can be especially vulnerable to overexploitation because of their restricted range, and their trade can quickly become a significant threat. Yet, trade in endemic species is not well documented as many endemic species lack domestic and/or international trade regulations. Vietnam is the home to approximately 470 reptile species, 136 of which are considered endemic. The high number of valuable endemic species makes Vietnam an attractive target for reptile collectors. We analyzed the Convention on International Trade in Endangered Species of Wild Fauna and Flora Trade Database and the Law Enforcement Management Information System database for import and export data of Vietnamese endemic reptile species. Moreover, we added data from an online survey and a physical market survey in Japan. Evidence was found of a minimum of 2054 individuals from seven endemic species in international commercial trade, tied to 10 countries. Only three of the seven endemic species found in trade are currently subjected to international trade regulations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora and domestic trade regulations. This manuscript provides a baseline of the availability of endemic Vietnamese reptiles in international trade and that few endemic species are found on the international market and in trade records. However, those that were found are of concern because of the lack of population assessments and likely laundering of parent stocks.

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Introduction

Rare species and/or those newly discovered by science often become the target of collectors (Lyons and Natusch 2013; Stuart et al 2006). Scientific descriptions that provide locality information can aid collection and, therefore, fuel demand for these species (Lindemayer and Scheele 2017; Stuart et al 2006), resulting in population declines (Kiestler et al 2013; Kuchling 2007; Shepherd and Ibarrondo 2005). Endemic species can be especially vulnerable to overexploitation because of their restricted range (Lyons and Natusch 2013), and international trade can quickly become a significant threat (Grismer et al 2014; Kiestler et al 2013). Many endemic species are only known to occur at their type of location or have not been seen in a long period of time (Meiri et al 2017); some species are now extinct at their type of location because of overexploitation (Lindemayer and Scheele 2017). Vietnam is the home

to approximately 470 reptile species, 136 of which are known to be endemic (Uetz et al 2017), Wang, et al 2018). Many karst outcrops and limestone cave formations harbor endemic species, as these habitats act as mainland “islands” and facilitate speciation (Ngo and Bauer 2008). The high number of valuable endemic species makes Vietnam an attractive target for reptile collectors (Grismer et al 2014). Their desire to collect leads to additional pressure on species that already face challenges such as habitat loss (Meiri et al 2017). After the end of the American war in Vietnam in 1975, biodiversity research increased, and new and endemic species continue to be discovered in Vietnam, e.g., *Cyrtodactylus gialaiensis* (Luu et al 2017) and *Opisthotropis voquyi* (Ziegler et al 2018). For example, 53 of 58 endemic lizard species in Vietnam have been discovered between 2000 and 2017 and are only known to occur in their type of locality (Meiri et al 2017). Meanwhile, recently discovered species are rarely included in trade legislation (e.g., Convention on International Trade in Endangered Species of Wild Fauna and Flora [CITES]) or are subject to trade regulation, making it difficult to document trade levels. Data on trade in non-CITES-listed species often depend on stricter measurements taken by individual countries and is in general confusing, irregular, and far from complete, therefore only able to provide an indication of the

* Corresponding author. Emoia Consultancy, 2806 KC, Gouda, Zuid-Holland, Netherlands. Tel.: +31 6 46638181.

E-mail address: jordi.janssen@mcrsociety.org (J. Janssen).

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actual quantities traded (Janssen and Shepherd 2018). Therefore, limited availability of data on trade in non-CITES-listed species can impede conservation efforts, as the actual level of trade remains unknown and threats can be underestimated.

Vietnamese reptiles are known to be traded domestically (da Nóbrega Alves 2008; Stuart 2004) and are intensively harvested for food and traditional medicine (Compton and Le Hai Quang 1998; Le and Broad 1995; Stuart 2004; Ziegler 2002). The domestic demand for Vietnamese reptile species for human consumption is relatively well studied, whereas international demand is not. This study aims to document the international trade in Vietnamese endemic species in the three largest reptile consumer regions, Europe, Japan, and the United States of America (Auliya et al 2016; Robinson et al 2015), and provide recommendations for Vietnamese decisionmakers, including authorities responsible for the implementation of the CITES.

Material and methods

As trade records do not necessarily include information on non-regulated species, physical and online market surveys were used as sources of data. In February 2017, TRAFFIC conducted a physical market survey across a total of 16 reptile shops in Tokyo, Kanagawa, and Osaka and a reptile exposition in Osaka (Wakao et al 2018). In September 2017 to October 2017, one European classifieds website was surveyed for live reptile advertisements with endemic Vietnamese reptiles present in both surveys. The survey data were then supplemented by international trade data to obtain an overview of regulated endemic Vietnamese reptiles in international trade. Two trade databases were analyzed for both import and export of Vietnamese endemic reptiles between 2000 and 2015 to contextualize the presence of this trade: the CITES Trade Database and the United States Law Enforcement Management Information System (LEMIS). The CITES Trade Database was analyzed for export of Vietnamese endemic reptiles from Vietnam. The LEMIS was analyzed for the import and export of Vietnamese endemic reptiles to and from the USA. We tested for a monotonic trend in the quantities of endemic reptiles imported by the United States using a Mann-Kendall Rank Correlation Test with Sen's Slope estimator using the package *trend* conducted using R Studio, Version 1.1.456.

Law and policy

In Vietnam, the Law on Forest Protection and Development (No. 29/2004/QH11) protects all animals found in forests from hunting, catching, caging, slaughtering, purchasing, selling, trading, and transporting, except with an appropriate permit. Presumably, endemic reptiles found in forests would be covered by this law, but no clear definition of “forest animal” is given, and this law is rarely, if ever, used to prosecute offenders. However, three endemic reptiles are explicitly regulated by the Vietnamese law: the Southern Vietnamese box turtle (*Cuora picturata*), Vietnamese pond turtle (*Mauremys annamensis*), and psychedelic rock gecko (*Cnemaspis psychedelica*). All three species are subject to trade regulations (import/export, transit, breeding, rearing, and artificial propagation) under Decree 82/2006/ND-CP, Vietnam's CITES implementing legislation. The Vietnamese pond turtle (*Mauremys annamensis*) is also listed in Decree 32/2006/ND-CP Group IIB, a list of species for which domestic commercial exploitation is restricted, except under certain circumstances.

Results

This analysis found evidence of a minimum of 2054 individuals from seven endemic species in international commercial trade,

with ties to 10 countries: Austria, Canada, Czech Republic, Germany, Italy, Japan, Malaysia, Poland, Slovenia, and the USA. Only three of the seven endemic species found in trade are currently subjected to international trade regulations under CITES and domestic trade regulations under Decree 82 and/or Decree 32.

Market survey

Four of the 606 reptile taxa observed for sale on the Japanese market (Wakao et al 2018) were endemic to Vietnam: the Southern Vietnamese box turtle, Cattien bent-toed gecko, Huu-Lien Cave gecko, and Vietnamese pond turtle (Table 1). These species comprised a total of 23 individuals of four species, of which 14 were observed at the reptile exposition in Osaka and the remaining nine in two reptile shops in Tokyo and Osaka. The Vietnamese pond turtle was the most commonly observed species, with 12 individuals recorded. This observation is of particular interest because although Japan reportedly imported a total of 36 captive born and/or captive-bred specimens between 2005 and 2016, none were for commercial purposes. In fact, there is no record of live specimens being exported from Vietnam for commercial purposes since the species were listed in the CITES in 2003. This suggests that the specimens observed on the market in Japan were either illegally imported or originated from illegal parent stock.

Classifieds website

A total of 12 advertisements were observed on the largest European reptile classifieds website, offering a total of 37 individuals from five endemic species: the psychedelic rock gecko (*Cnemaspis psychedelica*), Southern Vietnamese box turtle, Cattien bent-toed gecko, Cat Ba tiger gecko (*Goniurosaurus catbaensis*), and Vietnamese pond turtle (Table 1). The advertisements originated from five countries: those from Germany (n=4, 15 specimens) and Austria (n=2, 11 specimens) offered the highest number of specimens, followed by the Czech Republic (n=2, five specimens), Slovenia (n=2, three specimens), and Italy (n=1, two specimens).

The most common species observed for sale was the Cat Ba tiger gecko (16 specimens), followed by the Vietnamese pond turtle (15 specimens) and psychedelic rock gecko (five specimens). Only one Southern Vietnamese box turtle was recorded. For 25 of the 37 animals, the advertisements claimed the animals had been bred in captivity.

CITES database

Over the period of 2000–2015, the CITES Trade Database does not contain any records of trade in endemic Vietnamese reptiles. As the psychedelic rock gecko was only listed in 2017, no trade records were available for the study period. However, the CITES Trade Database does contain trade records for 68 native Vietnamese reptile species. Vietnam reported the export of 1921 730 individual nonendemic live reptiles during this period, whereas importing parties reported the import of 360 454 non-endemic individuals from Vietnam.

LEMIS database

Over the period of 2000–2015, the LEMIS database contains import and export records for three endemic Vietnamese reptile species (the Cat Ba tiger gecko, Huu-Lien tiger gecko, and giant butterfly lizard), comprising a total of 1979 animals (Table 1).

The quantity of endemic reptiles imported per shipment (Figure 1) decreased over time ($\tau = -0.362$, $p = <0.01$), suggesting a reduction in quantities imported. Yet, the Cat Ba tiger gecko and Huu-Lien tiger gecko were only imported in 2012 and 2015. This

Table 1. Combined overview of Vietnamese endemic reptiles observed for sale in Europe, Japan, and the USA and their corresponding status in the CITES, Vietnamese legislation, and IUCN.

Scientific name	Common name	CITES	Vietnamese legislation	IUCN	CITES database	LEMIS	Market survey	Classified website	Countries involved
<i>Cnemaspis psychedelica</i>	Psychedelic Rock Gecko	I	Decree 82	EN	–	–	–	5	CZ, SI
<i>Cuora picturata</i>	Southern Vietnamese Box Turtle	II	Decree 82	CR	–	–	3	1	JP, SI
<i>Cyrtodactylus cattienensis</i>	Cattien Bent-toed Gecko	–	–	–	–	–	2	16	DE, CZ, JP
<i>Goniurosaurus catbaensis</i>	Cat Ba Tiger Gecko	–	–	EN	–	4	–	16	DE, CZ, US
<i>Goniurosaurus huulienensis</i>	Huulien Tiger Gecko	–	–	–	–	10	5	–	DE, JP
<i>Leiolepis guttata</i>	Giant Butterfly Lizard	–	–	–	–	1965	–	–	VN, CA, PL, MY
<i>Mauremys annamensis</i>	Vietnamese Pond Turtle	II	Decree 32 + 82	CR	–	–	12	15	JP, AT, IT

EN: endangered; CR: critically endangered; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; LEMIS, Law Enforcement Management Information System; I: CITES Appendix I; II: CITES Appendix II; CZ: Czech Republic; SI: Slovenia; JP: Japan; DE: Germany; VN: Vietnam; CA: Canada; PL: Poland; MY: Malaysia; IT: Italy; AT: Austria; US, United States.

suggests that the negative trend is mostly applicable to the giant butterfly lizard, which was also the most commonly imported species with 1827 specimens. The species giant butterfly lizard was mostly imported from Vietnam, with only eight individuals originating from other countries (Germany: $n=6$, Poland: $n=2$). The USA also exported 138 giant butterfly lizards to Canada ($n=12$) and Germany ($n=126$). Of the imported giant butterfly lizards, 1825 were said to have been wild caught in Vietnam. The two others were reported as captive-bred and imported from Poland. Of the 138 exported animals, 126 were reportedly wild-caught animals from Vietnam that were exported from the USA to Germany. The remaining 12 were reported as wild-caught animals imported from Malaysia and exported from the USA to Canada. Imports to the USA of 10 Huu-Lien tiger geckos and four Cat Ba tiger geckos were recorded during the survey period, all of which were said to have been bred in captivity in Germany.

Discussion

The giant butterfly lizard had the highest quantities of individuals in trade, with 1965 individuals. Neither the international nor domestic trade in this species is currently regulated, meaning there are few mechanisms or incentives for monitoring and recording the trade. In addition, the population status has not yet been assessed for this species, and thus, little information is known about how trade may be impacting their populations.

The lack of basic information on a species' population status or ecology can seriously impede efforts to quantify the sustainability of trade. The Sapa Japalure, *Japalura chapaensis*, was thought to be endemic to Vietnam until March 2018, when this species was found

in China (Wang et al 2018) and subsequently had to be removed from the dataset. Yet, 4312 specimens were still documented in trade (Janssen and Indenbaum, unpublished). Impact of these trade levels can differ significantly if the species is endemic or has a wider distribution. The lack of basic population information and known trade levels combined can further impede efforts for an accurate International Union for Conservation of Nature (IUCN) Red List assessment (Janssen and Shepherd 2018).

Both the Southern Vietnamese box turtle and the Vietnamese pond turtle were found to be offered for sale in Japan and Europe. However, no export records from Vietnam were found for these specimens, and their presence in international trade raises questions about the legal origin of these animals. Both species are bred in captivity by herpetoculturists around the world, but without export records of these species from Vietnam to breeding countries, a legal gray area has emerged in which the parent stock may have been acquired illegally, but the trade in new generations of specimens is considered legal because they have been bred in captivity.

Using data from a physical market, online market, and two trade databases focusing on the three major live reptile consumer regions (Europe, Japan, and the USA), this analysis provides a baseline of the availability of endemic Vietnamese reptiles in international trade. This analysis revealed that few endemic species are found on the international market and in trade records. However, those that were found are of concern because of lack of population assessments and likely laundering of parent stocks.

Where available, trade records can be used to anticipate and detect the overexploitation of range-restricted species. However, the trade records for unregulated species are irregular and confusing and incomplete at best (Janssen and Shepherd 2018).

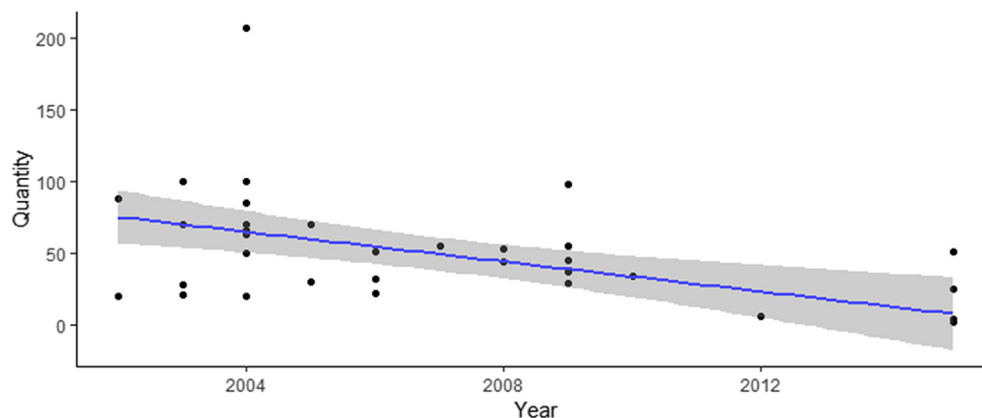


Figure 1. Quantity of endemic reptiles imported per shipment over the period of 2000–2015. Fitted line displayed constitutes of Sen's Slope estimator ($S = -1.515$, $z = -2.9074$, $n = 37$, $p = <0.01$). Source: USFWS LEMIS database.

Without regulation, there is often no requirement and little incentive to record the trade, which creates difficulty in accurately documenting the number of specimens traded. This analysis showed that only three endemic species are explicitly regulated by domestic and/or international trade regulations, likely meaning that most endemic species are not accurately or thoroughly captured by trade records. Without trade records and, in some cases, population estimates, it is difficult to estimate the impact of trade on these endemic species (Janssen and Shepherd 2018). Therefore, it is imperative that trade in these species is documented to preemptively detect and determine if trade can negatively affect a species.

It is recommended that the Vietnamese government consider the following actions to protect and preserve its endemic reptile species: first, include new or updated assessments for all endemic reptile species in the next version of the Vietnam Red Data Book to better understand population estimates and impacts of current trade offtake levels; second, add all endemic reptile species to the Decree 32 IIB's list of species to regulate domestic commercial trade and promote the gathering of trade data; third, consider CITES Appendix III listings for endemic reptile species found in high numbers in international trade, namely the Sapa Jalapure and the Giant Butterfly Lizard.

Conflict of interest

The authors declare that there is no conflict of interest.

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