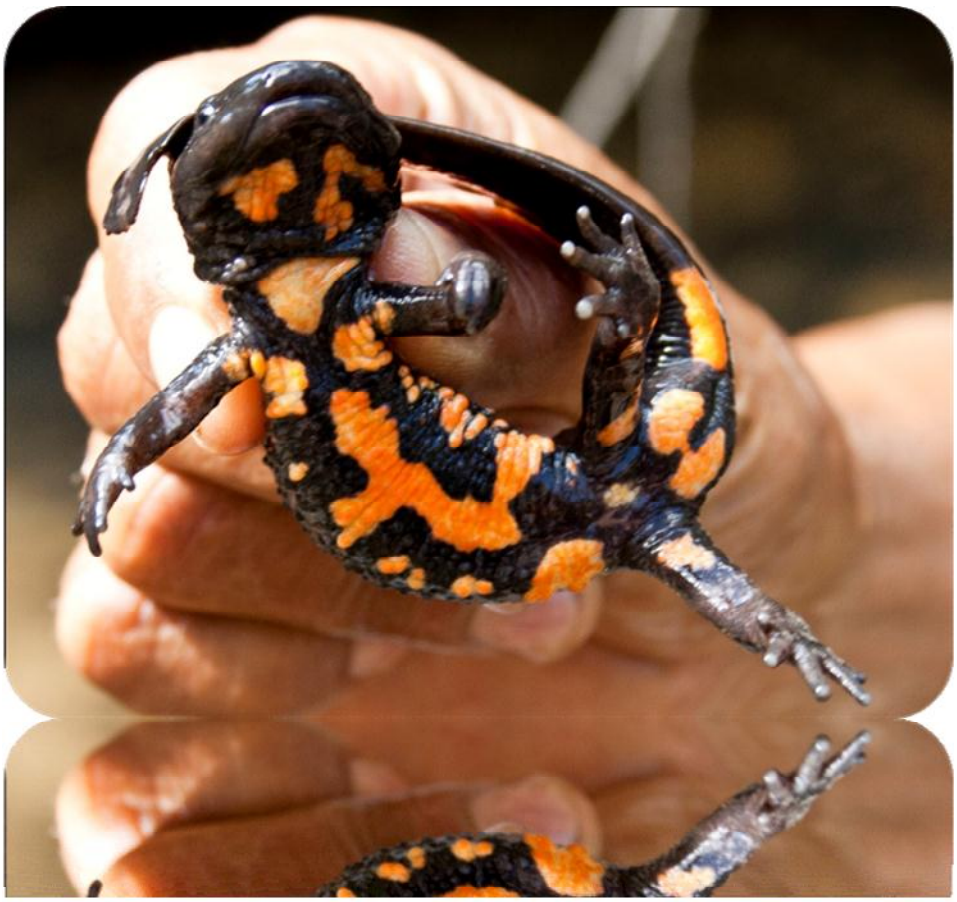
Striking, Vulnerable and in Demand: The Trade in Indochinese Newts



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EXECUTIVE SUMMARY

Newts are remarkable amphibians that play key roles in the structure and function of natural habitats and also act as bio-indicators of environmental change. Relatively few studies have been carrried out and little is known about the ecology of these animals especially in Southeast Asia. According to the Global Amphibian Assessment (GAA) over a third of newt species are threatened with extinction and two thirds of populations are in decline. In conjunction with habitat loss and climate change, over-exploitation for the international pet trade and use in Traditional Medicine (TM) are the major threats facing newts in Indochina.

This study focused on the trade of six species of knobby newts *Tylototriton* spp. and warty newts *Paramesotriton* spp. native to Northern areas of Viet Nam, Lao PDR and Thailand. None of these taxa are listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the international agreement which regulates international trade in wildlife. All six are included in the IUCN *Red List* and have varying degrees of protection in their range states. Here we present the results of market surveys, online surveys and a literature review carried out to highlight the dynamics of trade and conservation threats of these species.

Over one month 17 wildlife markets, six pet shops and 51 TM stores in nine major towns and cities across Cambodia, Viet Nam, Lao PDR and Thailand were surveyed. Information on trade was gathered via personal observations and informal interviews. Field surveys were also conducted in Northern Lao PDR and Viet Nam. No newts or newt derivatives were encountered during market surveys. However, the Lao Newt *P. laoensis* was observed during field surveys in Lao PDR. Although this species is protected locals reported that they occasionally sold them to foreigners for the pet trade.

Internet surveys of over 50 websites were carried out to investigate online trade in these species. These revealed that Indochinese newts are present on websites supplying the international pet market. Specifically, the Guanxi Warty Newt *P. guanxiensis*, Lao Newt and Himalayan Knobby Newt *T. verrucosus* were advertised for sale on five different sites. Sellers originated from Europe, USA and Malaysia. The Lao Newt commanded a particularly high price at USD240 per individual, considerably more than the other study species, suggesting that this rare species is in high demand.

Recent studies indicate that there is a substantial undocumented pet trade in newts. This is due in part to the under representation of amphibians as a whole, but newts in particular, in the CITES Appendices. The results of this study indicate that some trade in these species is occurring. In combination with other known threats trade could potentially endanger wild populations of Indochinese Newts, therefore TRAFFIC recommends the following:

- Listing of the Lao Newt in Appendix II of CITES so that international trade can be monitored. TRAFFIC believes that the restricted range of this species combined with its high value in international pet markets make it particularly susceptible to over-exploitation for the pet trade. Although some of the other Indochinese newt species are sold on the international pet market and are potentially impacted by trade, based on the results from this study we cannot conclude that international trade poses a threat to wild populations. As such, we cannot recommend their inclusion in CITES at this time.

- Legislation in Viet Nam should be amended to protect the Guanxi Warty Newt, Black Knobby Newt and Himalayan Crocodile Newt. Newts are invaluable monitors and regulators of whole ecosystems and their loss from these areas could have habitat wide consequences.

- Greater enforcement effort is required in range states to ensure that exploitation for local and international markets do not endanger wild populations. The collaboration of relevant governments and enforcement authorities with ASEAN-WEN could be an important step in increasing capacity to enforce wildlife laws. Relevant laws and authorities (i.e. aquatic or terrestrial) tasked with protecting these species should be also clarified.

- Internet trade in these species should be monitored and the origin of newts traded online should be investigated to ensure stock was not acquired illegally. Legitimate ex-situ captive breeding programs should be supported so that captive bred stock can supply the pet trade and reduce pressure on wild populations.

- Scientific research needs to be carried out to evaluate sustainable levels of off-take for wild populations of Indochinese newts if any harvest for trade is to be considered. This is most relevant for those species with restricted ranges and small populations who are particularly vulnerable to over-exploitation.

- Improved collaboration and information exchange between TRAFFIC and the Global Amphibian Assessment team. TRAFFIC has extensive knowledge of trade in this region as well as close links to government and law enforcement agencies around the world, attributes which could contribute to the future conservation of these animals if combined with the knowledge generated by the GAA.

INTRODUCTION

Unsustainable trade in wildlife, supplying both local and global appetites for Traditional Medicine (TM), the live pet trade and food, has been increasingly implicated as a major threat to the survival of wild flora and fauna (IUCN, 2010). In recognition of this, the potential impact of trade on endangered species is an area which has received greater attention in recent years from the scientific community, governments, media and public alike. The plight of the Tiger *Panthera tigris*, for example, which is now thought to number less than 3200 in the wild, can be recited by school children in many nations. Such levels of exposure and social infiltration require massive inputs of time and money, two resources which are severely lacking in our fight to conserve endangered species. These resources are even farther out of reach for less marketable taxa which, realistically, are most other floral and faunal species.

Newts, the focal animals of this study, and indeed most amphibians fall into this category. Despite the critical role they play in food webs as well as acting as indicators of environmental health, this group has until recently been largely neglected by the wider scientific community. Due to a combination of deforestation and other biotic and non-biotic factors nearly a third of all amphibian species are threatened with extinction (Stuart *et al*., 2004). In Southeast Asia illicit trade for the international pet market and local harvest for TM are important drivers of threat to amphibians (Stuart *et al*., 2004; TRAFFIC, 2008). In recent years there has been an apparent increase in the demand for several newt species from northern areas of Vietnam, Lao PDR and Thailand for the international pet trade. The extent of this trade is poorly known however without regulation it could have detrimental impacts on wild populations.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) was established in 1973 to regulate the movement of wildlife across international borders. The CITES-WCMC trade database, an open access online resource, is a powerful tool for monitoring legal trade; however, only information of CITES-listed species is recorded. None of the focal species of this project are listed in CITES, as such there are no trade records for these taxa despite the known trade. Indeed, the only newt species listed therein is Kaiser's Spotted Newt *Neurergus kaiseri*. All species in this study are listed in the IUCN Red List and have varying degrees of protection in their range countries.

Project aims

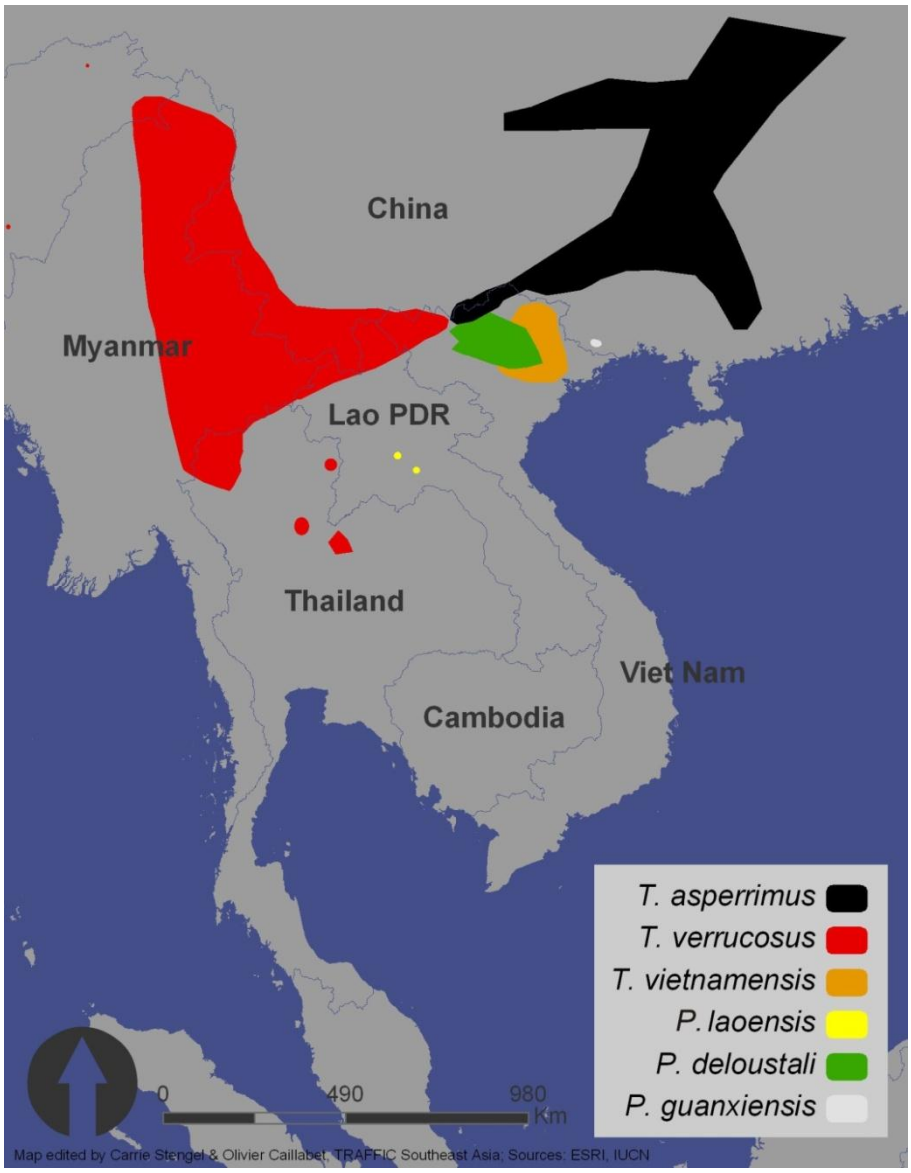
The aim of this study is to determine the dynamics of trade in the six species of Indochinese newts. Several approaches were taken in order to achieve this; 1) surveys were carried out in markets, pet shops and TM establishments throughout Indochina to assess the prevalence of newts in trade, 2) internet surveys were carried out to elucidate trends in demand, price, availability and prevalence of newts on the international market, 3) a literature review was performed in order to gather information on the ecology of newts and amphibians generally as well as the conservation issues facing them and 4) conservation NGO staff and scientists working in the field were consulted throughout the study period to gather information on local trade and conservation issues

Background

Newts are tailed amphibians which, together with the "true salamanders", comprise the Salamandridae family of Caudates an assemblage which has a near cosmopolitan distribution in the holarctic region (Duellman and Trueb, 1994). Of the 15 newt genera within this family, six genera (including 25 species) occur in Asia (Anon., 2011a). This report focuses on six species from two genera collectively referred to as the 'warty newts' (*Paramesotriton* spp.) and 'knobby newts' (*Tylototriton* spp.) (Table 1). These taxa are variously distributed in parts of Northern Lao PDR, Viet Nam and Thailand as well as parts of India, Nepal, Myanmar, Bhutan and China (IUCN) (Figure 1). The Lao Newt *P. laoensis* and Guanxi Warty Newt *P. guanxiensis* are the most restricted in terms of geographic distribution while the Black Knobby Newt *T. Aperrimus* and Himalayan Knobby Newt *T. verrucosus* are the most widely ranging. The Viet Nam Crocodile Newt *T. vietnamensis* and Tam Dao Newt *P. deloustali* have small roughly equal distribution extents. [N.B. The species names given for these taxa are following the IUCN Redlist of Endangered Species. *P. Laoensis* has recently been reclassified as *Laotriton laoensis* (Stuart and Papenfuss, 2002)].

Figure 1

Distribution Map of Indochinese Newt Species (NOTE: *T. Asperrimus* has also been recently described in NE Lao PDR)



The ecology of newts can vary considerably between species. Because this subject would encompass a volume unto itself only the general characteristics of this remarkable group of animals will be discussed. Newts are cryptic, medium bodied (~20cm) caudates and have complex life cycles which entail an aquatic larval (tadpole) stage followed by metamorphosis into either terrestrial or aquatic juvenile (eft) and adult forms (Duellman and Trueb, 1994; Davic and Welsh Jr.,

2004; Dodd Jr., 2011).

Table 1

List of relevant laws and agreements protecting Indochinese newt species

Species	Range in Indochina	IUCN	Protective Legislation in Range State(s)
Lao Newt *Paramesotriton laoensis*	LA	DD	Protected
Guanxi Warty Newt *Paramesotriton guanxiensis*	VN*	EN	Not Protected
Tam Dao Newt *Paramesotriton deloustali*	VN	VU	Listed as **Endangered** *Decision 82 /2008/QD-BNN* 17/7/ 2008; **Protected** under *Article 9(1) Decree 32/2006/ND-CP*
Black Knobby Newt *Tylototriton asperrimus*	VN, LA	NT	Not protected
Himalayan Crocodile Newt *Tylotriton verrucosus*	TH, VN**	LC	**TH**- Listed as **Protected**: *Wild Animal Reservation and protection Act - BE. 2535 (1992)*
Vietnam Crocodile Newt *Tylototriton vietnamensis*	VN	NT	Listed as **Endangered:** *Decision 82 /2008/QD-BNN* 17/7/ 2008

Southeast Asian newts tend to be long lived, slow to reproduce and have low mobility (Feng *et al*., 2007). Newts are denizens of a variety of habitats, however the crocodile newts and the warty newts are mostly aquatic and are generally found in or near slow flowing streams within forested mountain areas (Anon., 2011a).

Living in both aquatic and terrestrial landscapes newts are exposed to an array of potentially pathogenic organisms unique to each environment and, as such, require unique adaptations to combat them. Newt skin hosts a variety of potent anti-microbial agents (Clarke, 1997), many of which are the focus of intense scientific research (e.g. Clarke, 1997; Gomes *et al*., 2007). Paratoid glands on the skin (Figure 2) also secrete toxins some of which are extremely harmful, like the taricha toxin found in the North American Rough Skinned Newt *Taricha granulosa* (Brodie *et al*., 1974; Cardall *et al*., 2004). The crocodile newts and warty newts have also been shown to be toxic (Brodie *et al*., 1974; Lai *et al*., 2002). This toxicity, advertised through aposematic colouration (Figure 2), serves as a defence against potential predators. The capacity of amphibian skin, however, is not restricted to defence: this incredibly complex organ also functions in a number of roles including moisture and temperature regulation, (cutaneous) respiration, camouflage and reproduction (Clarke, 1997). A further remarkable characteristic of newts, and one which has also received much attention particularly in the field of developmental biology, is their ability to regenerate damaged tissues and limbs (Singer, 1978; Tsonis, 2000).

Figure 2

Images of the Lao Newt. (Left) image showing the aposematic colouration of the ventral surface. (Right) Image of the dorsal side with arrows pointing to paratoid glands. © O. Caillabet/TRAFFIC Southeast Asia

From a habitat or ecosystem conservation perspective newts, and indeed most amphibians, are of great value. Given the ability of these animals to switch between land and water as well as their sensitivity to environmental change in both mediums, newts are seen as mirrors of ecosystem status reflecting in their own health the vitality of their surroundings (Duellman and Trueb, 1994; Dodd, 2011). Furthermore there is strong evidence that they provide an energetic link between land and water, acting as both predator and prey they play an important part in ecosystem structure and function (Davic and Welsh, 2004; Whiles *et al*., 2006). Therefore, the loss of amphibians from the wild could have drastic consequences for entire ecosystems. Additionally, given their dual role in aquatic and terrestrial systems the loss of a single individual is functionally equivalent to the loss of two, highlighting again the importance of newt conservation (Whiles *et al*., 2006)

An amphibian's skin or rather, its sensitivity is intrinsically linked to the current collapse seen in some wild populations. For example the fungal pathogen *Batrachochytrium dendrobatidis* (Bd), which is decimating many newt and frog populations worldwide, is thought to cause death by interfering with the regular functioning of the skin (Daszak *et al*., 1999) (See Box 1). Similarly, the aesthetically pleasing aposematic colouration of many species' tegument combined with their rarity has likely contributed to some taxa being exploited by international collectors. These threats as well as others facing amphibians and in particular, Southeast Asian newts, are explored in greater detail further on.

Conservation Status

Recent estimates suggest that amphibians are being driven to extinction at least 105 times faster than the natural rate of extinction (McCallum, 2007). According to the Global Amphibian Assessment (GAA) nearly a third of all taxa are threatened with extinction while 43% of populations are in decline, figures which do not include the 23% of species for which we lack data (Stuart *et al*., 2004). Newts are even more at risk with 36% of species threatened and 66% in decline (Anon., 2011a; IUCN, 2010). Recent studies have highlighted how amphibians from certain regions, including

Southeast Asia, have been largely neglected accounting for much of the observed data deficiencies (Gardner *et al*., 2007; Gascon *et al*., 2007). The main threats facing Indochinese Newts are listed below (Table 2).

Table 2

List of major threats facing warty and knobby newts

Species	IUCN Category	Major Threat(s)
Lao Newt	DD	*Pet trade*
Guanxi Warty Newt	EN	*Habitat loss*
Tam Dao Newt	VU	*Habitat loss; Harvesting for food, TM and pet trade*
Black Knobby Newt	NT	*TM; Habitat loss*
Himalayan Knobby Newt	LC	*Habitat loss; Environmental contamination with agrochemicals; Harvesting for pet trade and TM*
Vietnam Crocodile Newt	NT	*Habitat loss*

Source: IUCN 2010

The primary cause of decline is habitat loss and degradation but other factors, working in a complex synergy, are also thought to play important roles (Table 2) (Sodhi *et al*., 2008). Other threats include climate change, disease and overexploitation (Kiesecker *et al*., 2001; Collins and Storfer, 2003; Daszak *et al*., 2003; Schlaepfer *et al*., 2005). Whereas some populations in other areas, Latin America in particular, have been decimated by the fungal disease chytridiomycosis the greatest threats to Southeast Asian amphibians are habitat loss and exploitation (Sodhi *et al*., 2004; Feng *et al*., 2007; Rowley *et al*., 2009; Bickford *et al*., 2010). This disease nonetheless poses a potential threat to Southeast Asian frogs and newts, an issue which is discussed further one (See Box 1).

Protection and legislation

Effective legislation and law enforcement, particularly at the national level, are crucial in regulating trade and protecting endangered species. National laws governing the six newt species of concern in this study, where present, are shown in Table 1. Of the study taxa, only three are protected in their range state: the Lao Newt, Tam Dao Newt and Himalayan Knobby Newt are protected in Lao PDR, Viet Nam and Thailand, respectively, making the collection of wild specimens for commercial trade without appropriate permits illegal. The Himalayan Knobby Newt, which is broadly distributed in the region, is not protected in Viet Nam. The Guanxi Warty Newt is known from Southern China and is also thought to occur in Northern Viet Nam but is not protected here. The Viet Nam Crocodile Newt, which is endemic to Viet Nam (Bohme *et al*., 2005), is listed as an endangered species but is not protected. The Black Knobby Newt occurs in both Viet Nam and Lao PDR where it has only recently been described (Stuart *et al*., 2010) but is not protected in either country.

CITES is a multi-national agreement which aims to ensure that trade in wildlife is sustainable. Established in 1975 there are currently 175 parties to CITES, including the four countries surveyed during this report (UNEP-WCMC,

2011a). Lao PDR was the most recent country to become a Party to CITES, joining in 2004. Viet Nam and Cambodia joined in 1994 and 1997, respectively, while Thailand has been a member since 1987 (UNEP-WCMC, 2011b). Roughly 33 000 species of plants and animals are listed in CITES (UNEP-WCMC, 2011a). Taxa are listed in one of three Appendices according to the degree of threat that international trade poses. The amount of trade permitted for a given species is determined by which Appendix that species is listed in (Table 3). In order to establish *what* level of trade is sustainable parties are required to carry out Non-Detriment Findings (NDF's), ecological studies of the species in question to determine quantifiable levels of off-take that can be absorbed without detriment to wild populations.

Records of trade in CITES–listed species between member states are maintained in the UNEP-WCMC CITES trade database, an online open-access resource. This database contains all records of import, export and re-export as reported by the Parties. This is a powerful tool for monitoring trade in wildlife allowing users to observe trends over time and see how much of which species and products are being traded by which countries. Such information can facilitate early warnings of unsustainable trade levels as well direct us towards areas of illegal or bogus activity. Furthermore, the recently launched CITES Trade Data Dashboard, which gives summary information on trade, makes it even easier for users to visually analyze trade in specific animal and plant groups from member states (UNEP-WCMC, 2008).

There are, however, problems with CITES particularly in its implementation in developing nations where there is often 1) high levels of corruption, 2) a lack of resources for enforcement agencies 3) a lack of political will or desire and 4) large incentive to engage in illegal wildlife trade with lax enforcement, soft penalties and huge monetary gains (Carpenter *et al*., 2007; TRAFFIC, 2008).

Intrinsic limitations of CITES are that records are only kept for those species listed within the Appendices and it does not record domestic trade. This means that unregulated and potentially unsustainable trade in non-listed taxa can go unnoticed. For amphibians as a whole, only 114 out of a total 5743 species (2%) are listed making them the most poorly represented terrestrial vertebrate class in CITES (Stuart *et al*., 2004; IUCN, 2010;UNEP-WCMC, 2011b). A further limitation of CITES is that it has no actual enforcement capacity. Instead, it provides a legislative framework that increases member nations' abilities to legally pursue and prosecute those in violation of wildlife law. For this reason the presence of effective wildlife laws at the national level is critical. Inclusion in CITES is not necessarily synonymous with national protection or vice versa.

In 1992 CITES initiated the National Legislation Project. This was established to analyze how effective member states' national legislation is in implementing CITES. Parties are categorized from 1-3; 'Category 1' means that national legislation meets all the requirements for implementing CITES while 'Category 3' confers that legislation does not meet any of the requirements(*CITES SC59 Doc.11* ,2010). Cambodia, Thailand and Viet Nam's national legislation is Category 1 while Lao PDR's is Category 3.

Table 3

Explanation of and criteria for the different CITES Appendices

CITES Appendix	Criteria	Comments
I	Species threatened with extinction	Trade is **not permitted** in these species except in extraordinary situations
II	Species not necessarily facing extinction but for whom trade needs to be controlled	**Some trade permitted** so long as it does not endanger the species, specimens have been legally obtained and appropriate import and export permits have been issued
III	Species is protected in at least one country which sought assistance from other members to control trade	**Some trade permitted** so long as the specimen has been legally obtained and an appropriate export permit has been issued

In Europe all crocodile and warty newts are listed in Annex D of the *EU Wildlife Trade Regulations EC Reg. No 709/2010* 15/08/10. Species included therein are non-CITES listed taxa which are believed to warrant monitoring. Upon import of said species from outside of the EU an Import Declaration Form must be submitted to the appropriate customs office (UNEP-WCMC, 2009). Movement of Annex D listed species between EU nations requires no further documentation except for those which may be specified by individual governments. In China the Black Knobby Newt and Himalayan Knobby Newt are Schedule II listed species making it illegal to hunt, kill (Article 16) or trade (Article 22) in these animals (*Law of the People's Republic of China on the Protection of Wildlife 1988*). In the USA wildlife is protected under the *Lacey Act* (*United States Code Title 16 §372*). Under this legislation it is illegal to import, export, buy, sell or otherwise acquire wildlife which has been obtained in violation of any international laws.

Country Profiles

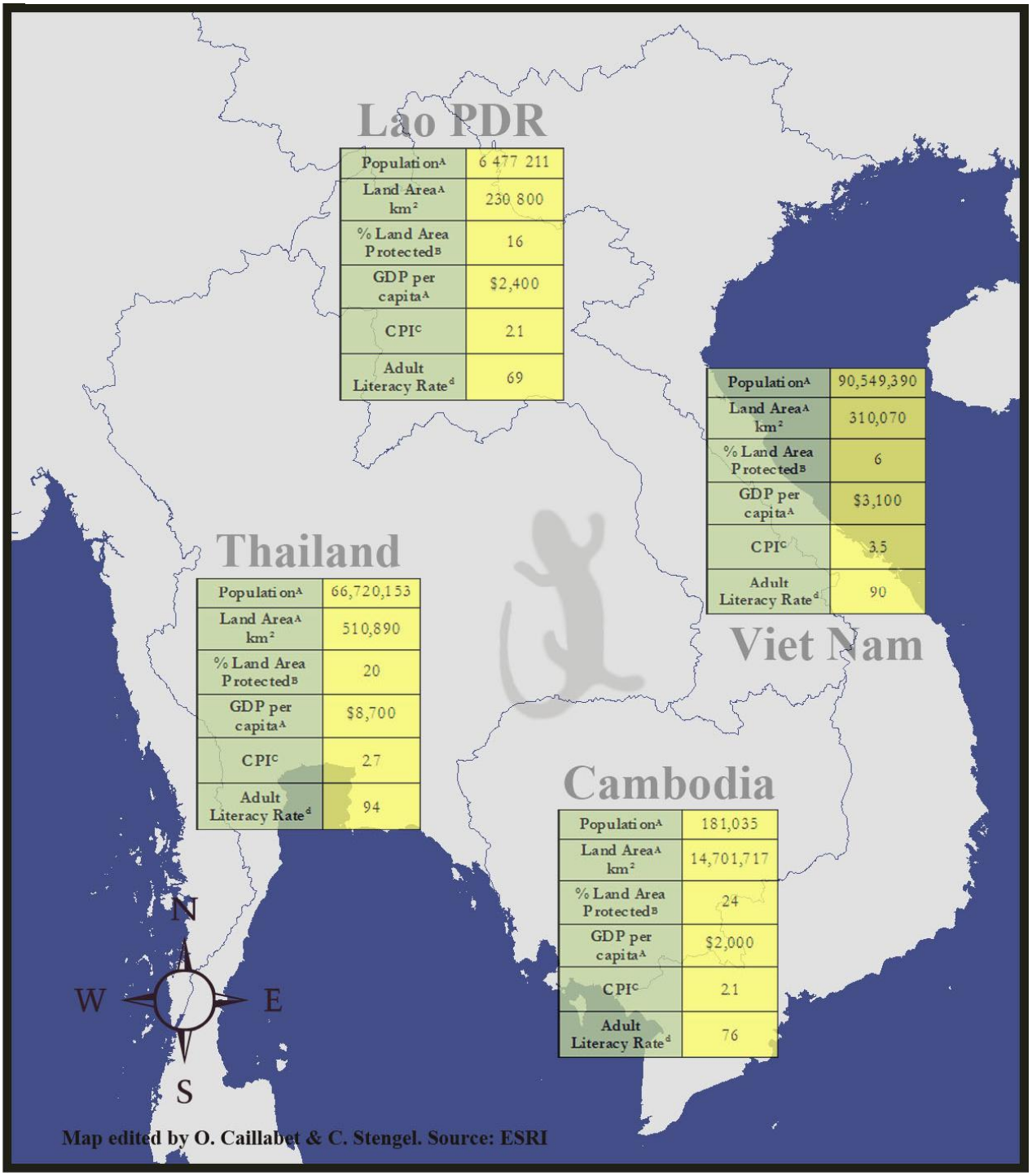
Connected by the Mekong River, Cambodia, Lao PDR, Viet Nam and Thailand have a long history of trading wildlife with each other, not to mention China (Baird, 1993; Nash, 1997). This region is a major source area for the global trade in wildlife (Nijman, 2010). Local consumption is also considerable with a large proportion of people living in rural areas critically dependent on wildlife products for their survival (De Beer and McDermott, 1996; TRAFFIC, 2008). A range of political and geographical statistics pertaining to the four countries surveyed during this report are shown below (Figure 3). Such measures can provide insight into observed patterns in wildlife trade; for example, levels of corruption are often linearly associated with levels of illegal wildlife trade (TRAFFIC, 2008). However, such measures do not universally equate with a particular observed trend and need to be interpreted with caution as each country and each species have a set of parameters driving trade unique to that particular situation. Nonetheless, such statistics are useful in providing an overview of some of the conservation related issues encountered in Indochina.

Geographically Thailand is the largest of the four countries surveyed and is nearly three times the size of Cambodia, which is the smallest country surveyed (The World Factbook, 2009). Looking at protected areas, although proportionally more land is set aside for conservation in Cambodia than the other countries, the greatest extent (km^2) of

protected areas is in Thailand. Viet Nam has both the lowest proportion and lowest total extent of protected areas of all four countries (Anon., 2011b). Viet Nam is the most populous nation with over 90 million inhabitants compared to Lao PDR which is home to just under 6.5 million people (The World Factbook, 2009). Cambodia and Lao PDR are the poorest countries in terms of Gross Domestic Product (GDP). Thailand is the wealthiest nation with a GDP twice that of Viet Nam and four times greater than Cambodia (The World Factbook, 2009). Viet Nam is the least corrupt country of the four considered here while Cambodia and Lao PDR have the highest perceived levels of corruption (Transparency International, 2010). Thailand has the highest rate of adult literacy of the Indochinese countries at 94% compared to an estimated 69% in Lao PDR, the country with the lowest adult literacy rate (UNDP, 2009).

Figure 3

Map of Indochina showing various statistics for each country (GDP- Gross Domestic Product; CPI- Corruption Perception Index)



Sources: The World Factbook[A], IUCN and UNEP[B], Transparency International[C], UNDP[D], CITES-WCMC[E]

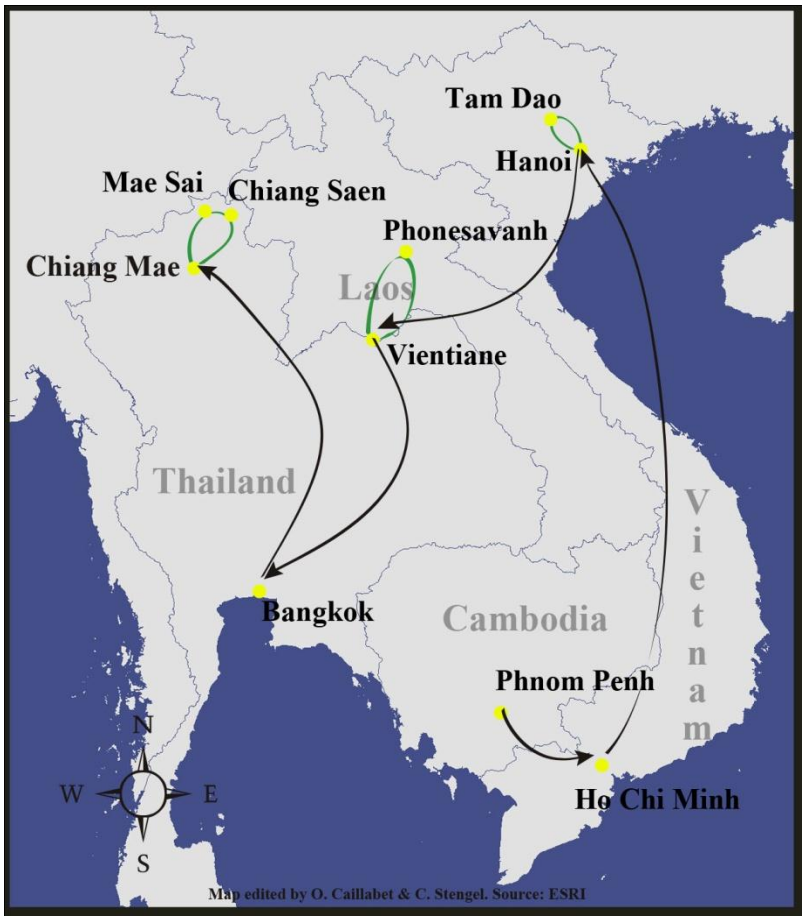
METHODS

In order to assess trade in Indochinese newts this study was carried out on several levels. Surveys were carried out of known wildlife trading locations and areas where it was thought newts are likely to be sold (Figure 4). Surveys were mostly confined to areas within or close to the natural range of Indochinese newts. Phnom Penh, Ho Chi Minh City and Bangkok, which do not fit into this category, are known areas of significant wildlife trade and for this reason were also surveyed. Over the period of one month wildlife markets, pet stores and TM shops across Indochina were visited. On several occasions local translators were hired particularly when surveying TM shops as few of the employees spoke English. The researcher also used photos of the newts to convey to vendors what exactly was wanted. No newts were purchased during this study.

Interviews were held with staff in these establishments to gather information about trade (e.g. supply and demand, cost, uses, origin etc.). However, interviewees were often reluctant to provide much information so this was not always possible. Prior to, during and after these surveys local NGO's, scientists and other experts were consulted to gather species-specific and country-specific information on trade. These correspondences provided valuable information on the wildlife trade in the region as well as areas of potential activity; however, the majority had rarely encountered trade in Indochinese newts.

Figure 4

Map showing survey locations and number of different sites visited during the beginning of 2011



The next stage of this project involved carrying out online surveys of websites selling amphibians as well as blogs and online forums for amphibian enthusiasts. Website surveys were carried out at the beginning of 2011. Each site was surveyed a single time to ensure that species weren't counted more than once. Various search parameters were used including: *Paramesotriton*, *Tylototriton*, *Laotriton*, *laoensis*, newt and salamander. Where possible, information on prevalence, origin and cost were gathered from websites offering these genera for sale. Prices were translated in USD for the sake of ease of comparison.

Finally, a full literature review was performed to gather information on the ecology, status and threats to these species in the wild. As there is a general lack of Indochinese newt-specific publications information on other amphibian species were also referenced. A short review of the UNEP-WCMC CITES Trade Data Dashboard (UNEP-WCMC, 2008) was

subsequently carried out to assess global demand and trends in the international amphibian pet trade. Although none of the focal species of this project are included in the CITES Appendices, the data gathered from the trade database can nonetheless be valuable to highlight the dynamics of trade in newts.

RESULTS

Market surveys

Market surveys were carried out over one month from mid January to mid February 2011. In total 17 markets, 51 TM shops and six pet stores in nine major towns and cities across Cambodia, Vietnam, Lao PDR and Thailand were surveyed (Figure 4). Two other sites, Tam Dao National Park in Northern Viet Nam and a small village near Phonesavanh, Xieng Khouang Province in Lao PDR were also visited. These areas are within the native range of the Tam Dao Newt and Lao Newt and the primary purpose of visiting was to talk to locals and gather information on trade.

Table 3

List of the number of sites surveyed for newts in 2011

	Number of sites visited			
	Market	Pet Store	TM Store	Other
Cambodia	1	0	1	0
Vietnam	7	6	30	1
Lao PDR	6	0	8	1
Thailand	3	0	12	0
Total	17	6	51	2

Of the 17 markets and six pet store which were surveyed during this study, no Indochinese newts were seen for sale. It should be noted that because surveys were conducted in predominantly urban areas it is possible that a rural component to trade exists which was not observed in these surveys. Although frogs were commonly seen for sale in meat markets, the only newt species of any kind observed was the Chinese Fire-bellied Newt *Cynops orientalis* in Jatuchak (aka Chatuchak) market in Bangkok, Thailand (Figure 5). The same vendor was also selling three different species of axolotl *Ambystoma* spp. labelled as Platinum, Black and Green Axolotls for THB650, 650 and 450, respectively (USD21, 21 and 15) (Figure 5). In comparison, the Chinese Fire-bellied Newt cost about USD3. When asked about the possibility of purchasing Himalyan Newts the vendor indicated that the species was protected and that it was illegal to sell it. Another reptile and amphibian dealer in Jatuchak said that this species was not common in Bangkok but that it may be possible to find it in Northern Thailand where the species is found in the wild. Although several other allotments selling herpetofauna in Jatuchak were visited, dealers were extremely cautious and reluctant to give any information perhaps due to recent negative media attention on the wildlife for sale at this market.

Figure 5

Jatujak wildlife market. (Below left) Chinese Fire-bellied Newt. (Middle right) Axolotl species for sale.

Of the 51 TM stores which were surveyed none sold newt products or derivatives. According to the owners of two different establishments in Bangkok, newts are traditionally used to treat skin ailments, asthma and kidney problems but that it was more common in 'older' TM. They are likely prepared in the same way as Tokay Geckos *Gecko gecko* are by first gutting and then drying the animals before consumption. Indeed, when asked for 'newts' most of the TM shops offered Tokays, a species which is extremely prevelant in the medicinal trade and also used to treat skin problems. Personnel in several of the TM stores in Bangkok and one store in Northern Thailand also stated that newts are protected and consequently very difficult to find. This, combined with the widespread availability of an alternative (Tokays) could account for the absence of newts in the medicinal trade in Thailand at least.

In Tam Dao, Northern Vietnam, a local market was visited where the Tam Dao Newt apparently used to be found for sale but no sign was seen of them, live or in any other form. The author also met with wildlife officers working at the nearby National Park, however, they had little information on this species only to say they occasionally saw them in the park but that they were rare.

Figure 6

Photo showing the stream where Lao Newts were found in Xieng Khouang Province, Lao PDR. © O Caillabet/TRAFFIC SE Asia

In Phonesavanh, Lao PDR, a trip was planned to see wild Lao Newts in an effort to gather information on trade from locals. According to a source, around Phonesavanh newts were sometimes kept as pets. Occasionally, some were also sent to Vientiane for export to Japan and Europe. Local guides from a small village ~2 hours drive from Phonesavanh brought the author to a nearby stream where the newts were found (Figure 6, 7). Apparently, the newts had been protected for about one year making it illegal to collect them. One of the guides also said he was paid USD100 by an NGO to conserve them although sometimes Europeans did come to buy them paying USD120 a pair. This, however, did not happen very often. According to the guides locals also eat these newts and, prior to being protected, they could collect "sack full's" from a nearby stream where they are abundant. The newts are prepared by gutting and sun-drying them before being crushed and added to food (Figure 7). Although the guides stated that the newts were protected, the driver later told the researcher that it would be possible to buy some as pets and that the normal asking price of USD60 per animal could be negotiated.

Figure 7 (Left) Sun-dried Lao Newts used for local consumption and (Right) a local guide holding a Laos Newt in its natural habitat in Northern Laos. © O Caillabet/TRAFFIC SE Asia

Online surveys

Online surveys were limited to European, North American and Japanese websites and forums as these areas have been implicated as the major drivers of the international pet trade in newts. Out of approximately 50 different sites 21 were advertising newts for sale (Figure 8 and Appendix I). Of these, 15 had newt species originating from Southeast Asia. Five sites sold warty newts and three sold knobby newts while some sold both (Table 4). Of the study species the Guanxi Warty Newt, Lao Newt and Himalayan Knobby Newt were advertised on five different sites.

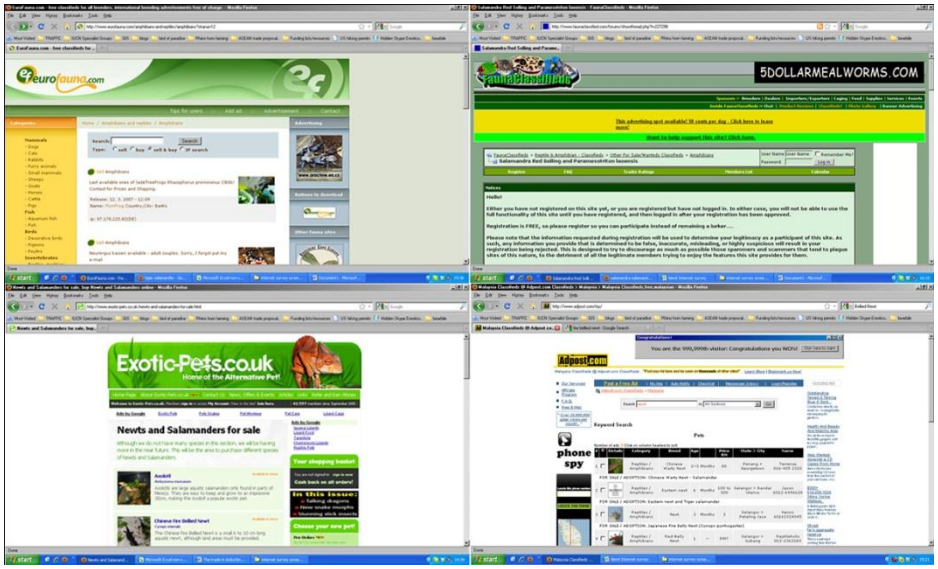


Figure 8

Screen grabs from some of the websites surveyed for Indochinese newts during this study

The Himalayan Knobby Newt was seen most often (4) and the Lao Newt was by far the most expensive species encountered during the survey at USD240. Kaiser's Spotted Newt, which was offered on several different websites, was the only other species which approached this price range at USD120. Sellers of Indochinese newts originated from Europe, the USA, and Malaysia. Online trade is becoming an increasingly important medium for conducting trade in wildlife: given that so little is known about the trade in Indochinese newts the internet proved a valuable source of information.

Table 4

List of warty and knobby newts observed for sale during internet surveys 2011

Common Name	Latin Name	Seller Origin	Cost USD
Chinese Warty Newt	*P. chinensis*	Malaysia	26
Chinese Warty Newt	*P. chinensis*	USA	25
Chinese Warty Newt	*P. chinensis*	USA	20
Guanxi Warty Newt	*P. guanxiensis*	Czech Rep.	-
Hong Kong Newt	*P. hongkongensis*	Ireland	21
Hong Kong Newt	*P. hongkongensis*	Holland	-
Lao Newt	*P. laoensis*	USA	240
Warty Newt sp.	*Paramesotriton sp.*	UK	-
Warty Newt sp.	*Paramesotriton sp.*	Japan	-
Mandarin Newt	*T. shanjing*	Portugal	28
Knobby Newt sp.	*Tylototriton sp.*	Hong Kong	-
Taliang Knobby Newt	*T. taliangensis*	Germany	-
Himalayan Knobby Newt	*T. verrucosus*	Malaysia	39
Himalayan Knobby Newt	*T. verrucosus*	Austria	-
Himalayan Knobby Newt	*T. verrucosus*	USA	-
Himalayan Knobby Newt	*T. verrucosus*	Germany	-

DISCUSSION

Threats: pet trade

The amphibian pet trade, like that of mammals, birds and reptiles, is often fad-driven with rare and endangered species arousing particular interest among collectors (Schlaepfer *et al*., 2005). The majority of frogs and salamanders listed in CITES resulted from pressure from the pet trade, for example, Kaiser's Spotted Newt (Gratwicke *et al*., 2009). Endemic to Iran, less than one thousand of these Critically Endangered newts are thought to survive in the wild (Sharifi *et al*., 2008). The root causes of population declines are habitat loss and climate change, however, a study by Cooper (2006) found that there was also a significant illegal trade for the international pet market. In 2005, 200 wild specimens were illegally exported from Iran and sold on the international pet market, a single individual fetching up to CA$350 (USD~280 @2005 rate). Although this is an acute example it demonstrates how the pet trade can act in synergy with and compound other threats endangering newts.

The pet trade is listed as the primary threat to the Lao Newt and as a major threat to both the Tam Dao Newt and Himalayan Knobby Newt (Van Dijk, 2004a; Van Dijk, 2004b; Van Dijk and Stuart, 2004). The Lao Newt was first described in 2002 and subsequently became popular in the international pet trade appearing for sale in Germany and Japan in 2006 (Stuart and Papenfuss, 2002; Chang, 2006; Stuart *et al*., 2006). In Japan, a journalist investigating trade there found that a single dealer had imported around 100 Lao Newts and began selling them around the country (Masumitsu, 2006). Surveys of Japanese websites at the time found the newts on sale for around USD170 each (Chang, 2006; B. Stuart, pers. comm.). Today, these newts are apparently selling for USD400 per animal most likely being transported to Japan via China (Nishikawa, pers.comm.).

Similarly, in Germany this species began to appear in online forums and websites with information on how to buy, breed and keep these animals in captivity. Using distribution information from a publication on the species, dealers apparently collected these species in Lao PDR and brought them back to Europe and Japan (Stuart *et al*., 2006).

Less is known again about the trade in the other two species. The Tam Dao Newt is said to be kept for 'ornamental purposes' in Viet Nam (Nguyen, 2000) and can also be found on many of the same websites offering Lao newts for sale, as can the Himalayan Knobby Newt. Members of the knobby and warty newt genera have a lot of similar physical characteristics and can be difficult to discern from one another. China apparently regularly exports 'mountain newts' (knobby and warty newt spp.) to Europe for the pet trade (M. Auliya, pers. comm.) via Hong Kong (Lau *et al*., 1995). Given the trade links between China and its neighbours (Zhang *et al*., 2007), the similarity of species and their close geographical distributions it is possible that some Indochinese newts enter trade this way.

Records from the CITES Trade Data Dashboard 2004-2008 (UNEP-WCMC, 2008) and other sources were used to highlight the dynamics of the amphibian pet trade. Averaging data from importers and exporters, roughly equal proportions of captive-bred and wild-caught amphibians supply the pet trade. The USA is the largest consumer importing over ten times the volume of the second largest importer, Canada (8553) (Table 5). The USA is also the largest importer of wild caught amphibians followed by Canada, Japan, the Netherlands and Germany (Table 5). Madagascar supplied over 90 000 pet amphibians (mostly Malagasy poison frogs *Mantella* spp.) to the market from

2004-2008, 99% of which were wild-caught. Panama is the second largest supplier of amphibians exporting nearly 50 000 captive bred poison-arrow frogs (*Dendrobates* spp.) in four years.

Table 5.

Top importers of amphibians in global pet trade

Country	No. Of Imports (all sources)	No. Of Imports (wild sourced)	% of Total Imports Wild-Sourced
Canada	8553	6375	75
Germany	1612	1606	99
Japan	7069	3859	54
Netherlands	5966	1869	31
USA	93 202	48 689	52

A study by Schaepfer *et al*. (2005) highlighted that one of the major obstacles to conserving wild amphibians is that massive unregulated exploitation can go unnoticed because so few species are listed in CITES and other trade monitoring systems.

Using information from the Law Enforcement Management and Information System (LEMIS), they found that 22% of salamandrids imported into the USA between 1998 and 2002 were not identified to the species level accounting for nearly 600 000 individuals. Overall, 2 611 251 amphibians imported during this period lacked identification. Considering animals just supplying the pet trade, the authors revealed that over 5 000 000 amphibians including 1 635 362 Chinese Fire-bellied Newts were also imported during this time (Schlaepfer *et al*., 2005).

CITES Trade Data Dashboard records show that somewhere in the region of 140 000 amphibians were traded globally from 1999-2003. Doing a rough comparison of this data to the figures published by Schlaepfer *et al.* shows that the number of non-CITES listed amphibians imported as pets into the USA was 35 times the volume recorded by CITES for all trade in amphibians, including meat. Including the two million plus unidentified individuals in Schlaepfer *et al.*'s study, somewhere in the region of 50 times more amphibians are imported into the USA compared to what is recorded in global trade by CITES. Although these figures are incredible, the true extent of unregulated trade in amphibians is likely to be even larger given that import records from Europe and Japan, two major consumers, are not included and neither are data from illegal trade and animals which perish in transit which could also be significant (Schlaepfer *et al*., 2005; Rowley *et al*., 2010).

Threats: traditional medicine

The use of animals and plants in TM, particularly in China, dates back thousands of years. The IUCN lists this trade as a main threat to the Black Knobby Newt, Tam Dao Newt and the Himalayan Knobby Newt. Unlike the questionable medical application of derivatives from other species such as Tiger and Rhino, there may be actual medicinal value in newt products (Ye *et al*., 1993; Clarke, 1997). According to Gomes *et al*. (2007) in some Asian cultures newts are torched and used as aphrodisiacs and newt skin is used to treat various maladies.

Knobby newts are apparently common in TM markets in China (M. Lau, pers. comm.). Xie *et al*., (2007) reported that local exploitation for TM has caused rapid declines in populations of the Black Knobby Newt as well as the Shanjing

Newt *Tylototriton shanjing* which is also seen in the pet trade. In Yunnan province, Southwest China, Himalayan Knobby Newts are sometimes sold in small quantities for about CNY1 (USD0.15) each and given to young children to "improve appetite" (Xu, L. pers. Comm.).

Although not listed as a threat by the IUCN several other sources suggest that the Lao Newt is used in TM. For example, in 2008 the arrest of two Lao PDR nationals living in Minnesota, USA, for smuggling wildlife uncovered among a host of animals 120 dried Lao Newt carcasses apparently destined for use in TM (Spielman, 2009). More recently, a newspaper article in the Vientiane Times highlighted local collection of these newts in Xieng Khouang for TM as the major threat to this species. The article also mentioned that the construction workers on a new road (Figure 8) being built through the Lao Newt's habitat were collecting hundreds of animals which were sold for TM (Anon., 2010).

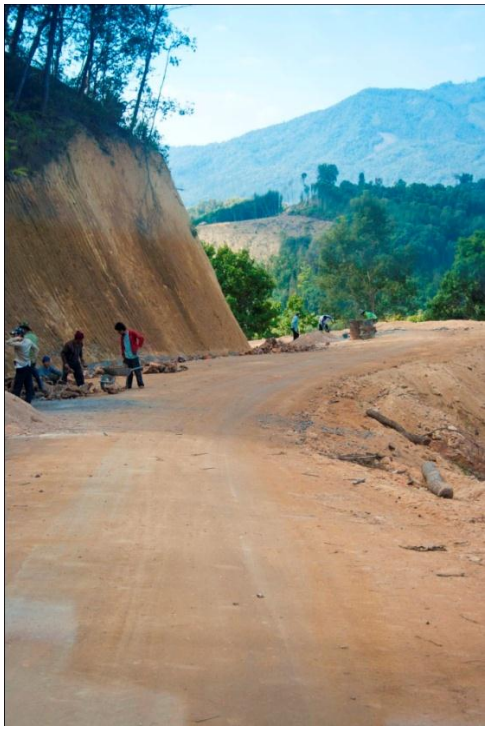


Figure 8 Photo of a new road being built through Laos Newt habitat in Xieng Khouang Province, Laos.© O Caillabet/TRAFFIC SE Asia

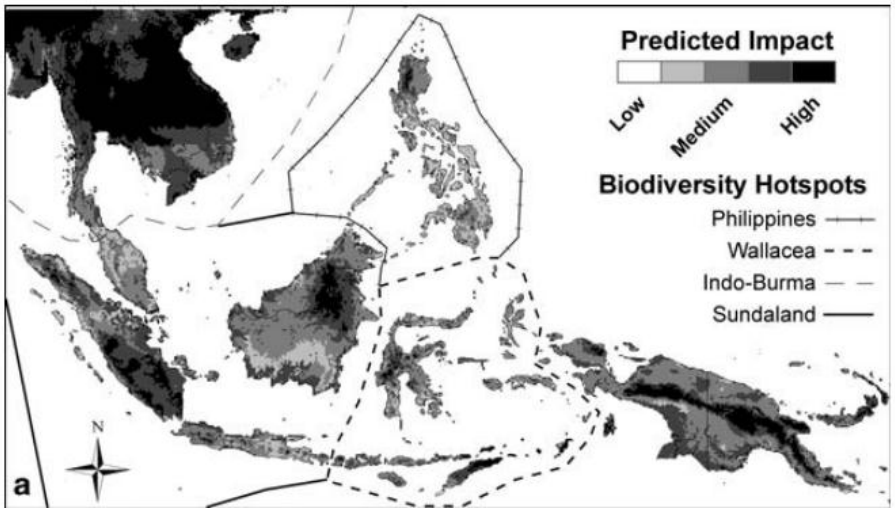
Threats: other

As previously mentioned habitat loss and degradation is the greatest threat to wild amphibian populations, including Indochinese newts. Deforestation in Southeast Asia, an area which encompasses four different biodiversity hotspots, has been more severe than in most of the tropics (Brooks *et al*., 2000; Achard *et al*., 2002). Lao PDR, Cambodia, Thailand and Vietnam are found within the Indo-Burma hotspot which is home to 286 species of amphibians over half of which are endemic (Bickford *et al*., 2010; Conservation International, 2010). Southern parts of China which border these four countries, also within the Indo-Burma hotspot, are particularly rich in newt diversity (Feng *et al*., 2007).

This region has a unique geological history which effectively resulted in the formation of a network of islands partly accounting for the observed levels of endemicity (Sodhi *et al*., 2004; Bickford *et al*, 2010). Islands tend to have restricted geographic ranges and consequently resident species can be more susceptible to extinction through stochastic events, such as those brought on by climate change (Payne and Finnegan, 2007). A recent paper by Bickford *et al*. (2010) highlighted the knobby and warty newts as genera which, owing to their distribution and habitat requirements, could be severely affected by predicted climate change and are in urgent need of conservation action (Figure 9).

Figure 9

Map showing the predicted areas of impact of climate change on Southeast Asian amphibians (Reproduced from Bickford *et al*., 2010)



Like most of the tropics growing human populations in Southeast Asia are placing increased pressure on wild areas and creating greater demand for natural resources (Gallant *et al*., 2006). The clear felling of large swathes of productive forest for agriculture, such as oil palm and rice plantations, is widespread. Increased levels of agriculture often bring with it a concomitant rise in environmental contamination through the leakage of agrochemicals, one of the main threats to the Himalayan Knobby Newt (Kiesecker, 2002; Van Dijk *et al*., 2004a). Additionally, recent growth in many Asian economies has meant that more people have disposable income. Expensive forest products like timber and wild animals used in the food, pet and TM trades which were previously out of reach are being increasingly exploited often at non-sustainable levels (TRAFFIC, 2008).

Box 1. Wildlife Trade and Disease Introduction

The deliberate relocation of animals between different geographical zones for trade is a pathway through which novel pathogens can be introduced (Daszak *et al*., 2007). This can have devastating effects on immunologically naive populations (Warkentin *et al*., 2008; Gratwicke *et al*., 2009).

The international trade in amphibians is a multinational, multi-million dollar industry involving the transport of millions of individuals around the globe. Between 1996 and 2006 France and Belgium combined consumed ~70 000 t of frog legs, most of which originated from Indonesia (Kusrini and Alford, 2006; Schloegel *et al*., 2009). From 1998-2004 the USA imported over 5 000 000 pet newts and frogs from Africa and Asia not including imports of CITES listed species (Schlaepfer *et al*., 2005).

In recent years the emergence of Chytridiomycosis, a disease caused by the fungus *Batrachochytrium dendrobatidis*, has caused the catastrophic decline of amphibian populations in Europe, North America and Australia (Stuart *et al*., 2004). This disease has recently been discovered in wild populations of Asian amphibians introduced for the meat trade (Bai *et al*., 2010). Experts now believe that international trade is the prime culprit in the spread of this disease (Fisher and Garner, 2007; Schloegel *et al*., 2009) and that without tighter regulation this fungus poses a greater threat to wild populations than over-exploitation (Gratwicke *et al*., 2010)

CONCLUSION

As no newts were found during market surveys it is conceivable that their presence is minimal in local markets and TM stores. Anecdotal information from informal interviews with staff and personnel from these establishments would further suggest that Indochinese newts are not commonly kept as pets, eaten or used in TM in range states. However, as this study focused on major towns and cities it is possible that there is an unknown rural component to trade. Furthermore, these results only represent a snapshot of trade at a particular moment and do not take into account seasonal trends and other factors which can influence trade. The only location where newts were seen was during field surveys in Northern Lao PDR where they occur in the wild. Although this species is protected locals reported that they occasionally sold them to foreigners.

The trade for the international pet market is a known threat to these species. Internet surveys carried out to assess the extent of this trade revealed that Indochinese newts are present on websites supplying the international pet market. The Himalayan Knobby Newt, Guanxi Warty Newt and Lao Newt were observed for sale on five different websites of approximately 50 surveyed. The Lao Newt in particular commanded a high price being sold at USD240 per individual. As far as the authors are aware, this is the first recorded instance of this species being sold in the USA. The high price tag for the Lao Newt illustrates that there is a demand for rare species and that collectors are willing to pay high prices for them.

Amphibians are the most endangered terrestrial vertebrate class. A review of relevant literature highlighted habitat loss as well as the international pet trade and climate change as the main threats to the future persistence of wild Indochinese newts. Although any one of these factors may independently cause population declines they often work in a complex synergy. Over-exploitation of newts for the pet trade, particularly those with restricted ranges, can compound these other factors. Lack of basic information on species biology makes it difficult to assess the sustainability of this trade but acting in synergy with these other threats it could potentially endanger wild populations.

Recent studies indicate that there is a substantial undocumented pet trade in newts. This is due in part to the under representation of amphibians as a whole, but newts in particular, in the CITES Appendices. The results of this study indicate that some trade in these species is occurring. In combination with other known threats TRAFFIC believes that trade could potentially endanger wild populations of Indochinese Newts.

RECOMMENDATIONS

- Listing of the Lao Newt in Appendix II of CITES so that international trade can be monitored. TRAFFIC believes that the restricted range of this species combined with its high value in international pet markets make it particularly susceptible to over-exploitation for the pet trade. Although some of the other Indochinese newt species are sold on the international pet market, based on the results from this study we cannot conclude that international trade poses a threat to wild populations. As such, we cannot recommend their inclusion in CITES at this time.

- Legislation in Viet Nam should be amended to protect the Guanxi Warty Newt, Black Knobby Newt and Himalayan Crocodile Newt. Newts are invaluable monitors and regulators of whole ecosystems and their loss from these areas could have habitat wide consequences.

- Greater enforcement effort is required in range states to ensure that exploitation for local and international markets do not endanger wild populations. The collaboration of relevant governments and enforcement authorities with ASEAN-WEN could be an important step in increasing capacity to enforce wildlife laws. Relevant laws and authorities (i.e. aquatic or terrestrial) tasked with protecting these species should be also clarified.

- Internet trade in these species should be monitored and the origin of newts traded online should be investigated to ensure stock was not acquired illegally. Legitimate ex-situ captive breeding programs should be supported so that captive bred stock can supply the pet trade and reduce pressure on wild populations.

- Scientific research needs to be carried out to evaluate sustainable levels of off-take for wild populations of Indochinese newts if any harvest for trade is to be considered. This is most relevant for those species with restricted ranges and small populations who are particularly vulnerable to over-exploitation.

- Improved collaboration and information exchange between TRAFFIC and the Global Amphibian Assessment team. TRAFFIC has extensive knowledge of trade in this region as well as close links to government and law enforcement agencies around the world, attributes which could contribute to the future conservation of these animals if combined with the knowledge generated by the GAA.

REFERENCES

Achard, F., Eva, H.D., Stibig, H-J., Mayaux, P., Gallego, J., Richards, T. and Malingreau, J-P. (2002). Determination of Deforestation Rates of the Worlds Humid Tropical Forests. *Science* 297(5583):999-1002.

Anon (2010). New research aims to halt salamander trade. *Vientiane Times*. http://laovoices.com/2010/01/16/new-research-aims-to-halt-salamander-trade/. Viewed 16 January 2010.

Anon. (2011a). *Information on amphibian biology and conservation*. AmbibiaWeb http://amphibiaweb.org/index.html Viewed 1st March.

Anon. (2011b). *Biodiversity Hotspots*. Conservation International. http://www.biodiversityhotspots.org/xp/hotspots/indo_burma/Pages/default.aspx. Viewed 12 March.

Bai, C., Garner, T.W.J. and Li, Y. (2010). First evidence of Batrachochytrium dendrobatidis in China: discovery of chytridiomycosis in introduced American bullfrogs and native amphibians in the Yunnan Province, China. *EcoHealth* 7(1):127-134.

Baird, I.G. (1993). *Wildlife Trade Between the Southern Lao PDR Provinces of Champasak, Sekong, and Attepeu, and Thailand, Cambodia, and Vietnam*. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.

Bickford, D., Howard, S.D., Ng, D.J.J. and Sheridan, J.A. (2010). Impacts of climate change on the amphibians and reptiles of Southeast Asia. *Biodiversity Conservation* 19(4):1043-1062.

Brooks, T.M., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B., Rylands, A.B., Konstant, W.R., Flick, P., Pilgrim, J., Oldfield, S., Magin, G. and Hilton-Taylor, C. (2001). Habitat Loss and Extinction in the Hotspots of Biodiversity. *Conservation Biology* 16(4):909-923.

Carpenter, A.I., Dublin, H., Syed, G., McKay, J.E. and Morre, R.D. (2007). Over-harvesting. In: Gascon, C., Collins, J., Moore, R.D., Church, D.R., McKay, J.E. and Mendelson, J.R. (Eds), *Amphibian Conservation Action Plan*. IUCN/SSC Amphibian Specialist Group. Gland, Switzerland and Cambridge, UK.

Chang, K. (2006). Scientists Discover a Salamander; Now Profiteers Have Found It Too. *The New York Times* (USA), 25 April.

CIA. (2011). *The World Factbook (2009)*. Washington, DC: Central Intelligence Agency. https://www.cia.gov/library/publications/the-world.factbook/index.html. Viewed 16 March 2011.

Collins, J.P. and Storfer, A. (2003). Global amphibian declines: sorting the hypotheses. *Diversity and Distributions* 9:89-98.

Cooper, E. (2006). The Kaiser's Spotted Newt- Traded to the Brink of Extinction. *TRAFFIC Report* 5(1):6.

Daszak, P., Berger, L., Cunningham, A.A., Hyatt, A.D., Green, D.E. and Speare, R. (1999). Emerging infectious diseases and amphibian population declines. *Emerging Infectious Diseases* 5:735-748.

Daszak, P., Lips, K., Alford, R., Carey, C., Collins, J.P., Cunningham, A., Harris, R. and Ron, S. (2007). Infectious Diseases. In: Gascon, C., Collins, J., Moore, R.D., Church, D.R., McKay, J.E. and Mendelson, J.R. (Eds), *Amphibian Conservation Action Plan*. IUCN/SSC Amphibian Specialist Group. Gland, Switzerland and Cambridge, UK.

Daszak, P., Schloegel, L., Maranda, L., Cronin, A., Pokras, M., Smith, K. And Picco, A. (2006). The Global Trade in Amphibians: Summary Interim Report of a CCM Study. *Report of the Consortium for Conservation Medicine*. Consortium for Conservation Medicine, New York.

Davic, R.D. and Welsh Jr., H.H. (2004). On the Ecological Roles of Salamanders. *Annual Review of Ecology, Evolution, and Systematics* 35:405-434.

Duellman, W.E. and Trueb, L. (1994). *Biology of Amphibians*. John Hopkins University Press, USA. 635 pp.

Fisher, M.C. and Rarner, T.W.J. (2007). The relationship between the emergence of Batrachochytrium dendrobatidis, the international trade in amphibians and introduced amphibian species. *Fungal Biology Reviews* 21:2-9.

Gallant, A.L., Klaver, R.W., Casper, G.S. and Lannoo, M.J. (2006). Global rates of habitat loss and implications for amphibian conservation. *Copeia* 4:967-979.

Gardner, T.A., Barlow, J. and Peres, C.A. (2007). Paradox, presumption and pitfalls in conservation biology: The importance of habitat change for amphibians and reptiles. *Biological Conservation* 138:166-179.

IUCN. (2011). *IUCN Redlist of Threatened Species*. IUCN Version 2010.4. http://www.iucnredlist.org. Viewed 12 March.

Gratwicke, B., Evans, M.J., Jenkins, P.T., Kusrini, M.D., Moore, R.D., Sevin J. and Wildt, D.E. (2009). Is the international frog legs trade a potential vector for deadly amphibian pathogens? *Frontiers in Ecology and the Environment* 8:438–442.

Kiesecker, J.M. (2002). Synergism between trematode infection and pesticide exposure: a link to amphibian limb deformities in nature? *Proceeding of the National Academy of Sciences of the United States of America* 99:9900-9904.

Kuzrini, M.D. and Alford, A.A. (2006). Indonesia's exports of Frogs Legs. *TRAFFIC Bulletin* 21(1):13-24.

Lau, M.W-N., Ades, G., Goodyer, N. and Zou, F-S. (1995). *Wildlife Trade in Southern China including Hong Kong and Macau.* Report to China Council for International Cooperation on Environment and Development.

Masumitsu, H. (2006). Pet dealers target new found newt. *Yomiuri Shimbun* (Japan), 24 April.

McCallum, M.L. (2007). Amphibian Decline or Extinction? Current Declines Dwarf Background Extinction Rate. *Journal of Herpetology* 41(3):483-491.

Mohneke, M., Onadeko, A.B., Hirschfield, M. and Rodel, M.-O. (2010). Dried or Fried: Amphibians in Local and Regional Food Markets in West Africa. *TRAFFIC Bulletin* 22(3):117-128.

Nash, S.V. (1997). *Fin, Feather, Scale of Skin: Observations on the Wildlife Trade in Lao PDR and Vietnam*. TRAFFIC Southeast Asia, Petaling Jaya, Malaysia.

Sharifi, M., Papenfuss, T., Rastegar-Pouyani, N., Anderson, S. and Kuzmin, S. (2008). *Neurergus kaiseri*. In: IUCN 2010. IUCN Red List of Threatened Species Version 2010.4. www.iucnredlist.org. Viewed 16 March 2011.

Nijman, V. (2010). An overview of international wildlife trade from Southeast Asia. *Biodiversity Conservation* 19:1101-1114.

Payne, J.L. and Finnegan, S. (2007). The effect of geographic range on extinction risks during background and mass extinctions. *Proceedings of the National Academy of Science of the United States of America* 104(25):10506-10511.

Rowley, J.J.L., Chan, S.K.F., Tang, W.S., Speare, R., Skerratt, L.F., Alford, R.A., Cheung, K.S., Ho, C.Y. and Campbell, R. (2007). Survey for the amphibian chytrid *Batrachochytrium dendrobatidis* in Hong Kong in Native amphibians and in the international amphibian trade. *Diseases of Aquatic Organisms* 78:87-95.

Rowley, J., Brown, R, Bain, R., Kusrini, M., Inger, B., Styart, B., Wogan, G., Thy, N., Chan-ard, T., Trung, C.T., Diesmos, A., Iskandar, D.T., Lau, M., Ming, T., Makchai., S., Truong, N.Q. and Phimmachak., S. (2010). Impending conservation crisis for Southeast Asian amphibians. *Biology Letters* 6:336-338.

Schlaepfer, M.M, Hoover, C. and Dodd Jr., C.K. (2005). Challenges in Evaluating the Impact of the Trade in Amphibians and Reptiles on Wild Populations. *BioScience* 55(3):256-264.

Schloegel, L. Picco, A., Kilpatrick, A., Davies, A.J., Hyatt, A.D. and Daszak, P. (2009). Magnitude of the US trade in amphibians and presence of *Batrachochytrium dendrobatidis* and ranavirus infection in imported North American Bullfrogs(*Rana catesbeiana*). *Biological Conservation* 142**:**1420-1426.

Singer, M. (1978). On the Nature of the Neurotrophic Phenomenon in Urodele Limb Regeneration. *American Zoologist* 18(4):829-841.

Sodhi, N.S., Koh, L.P., Brook, B.W. and Ng, P.K.L. (2004). Southeast Asian Biodiversity: an impending disaster. *Trends in Ecology and Evolution* 19(12):654-660.

Sodhi, N.S., Bickford, A.C., Diesmos, T.M., Lee., L.P., Koh., B.W., Brook, C.H., Sekercioglu and Bradshaw, C.J.A. (2008). Measuring the meltdown: drivers of global amphibian extinction and decline. *Public Library of Science One* 3(2):e1636.

Speilman, T. (2009). Women sentenced in case of smuggled Laos Wildlife. *Outdoornews*. http://outdoornews.com/minnesota/article_10c6f15c-e434-552f-b48f-c54b8be9a4a3.html. 16 March.

Stuart, B.L. and Papenfuss, T.J. (2002). A new Salamander of the Genus Paramesotriton (Caudata: Salamandridae) from Laos. *Journal of Herpetology* 36(2):145-148.

Stuart, B.L., Rhodin, A.G.J., Grismer, L.L. and Hansel, T. (2006). Scientific Description Can Imperil Species. *Science* 312:1137.

Stuart, B.L., Phimmachak, S., Sivongxay, N. And Robichaud, W. (2010). A new species in the *Tylototriton asperrimus* group (Caudata: Salamandridae) from central Laos. *Zootaxa* 2650:19-32.

Stuart, S.N., Chanson, J.C., Cox, N.A., Young, B.E., Rodriges, A.S.L., Fischman, D.L. and Waller, R.W. (2004). Status and Trends of Amphibian Declines and Extinctions Worldwide. *Science* 3061:783-1786.

Tsonis, P.A. (2000). Regeneration in Vertebrates. *Developmental Biology* 221(2):73-284.

TRAFFIC (2008). *Whats Driving the Wildlife Trade? A review of Expert Opinion on Economic Social Drivers of the Wildlife Trade Control Efforts in Cambodia, Indonesia, Lao PDR and Vietnam*. East Asia and Pacific Region Sustainable Development Department, World Bank, Washington, DC.

Transparency International. (2011). *Corruption Perception Index*. Transparency International. http://www.transparency.org/policy_research/surveys_indices/cpi/2010/results. Viewed 16 March 2011.

UNEP-WCMC. (2008). *CITES Trade Data Dashboard*. UNEP-WCMC CITES. http://cites-dashboards.unep-wcmc.org/. Viewed 12 March.

UNEP-WCMC. (2009). *UNEP-WCMC EU Wildlife Trade Regulation Database*. UNEP-WCMC CITES. http://quin.unep-wcmc.org/eu/taxonomy/index.cfm. Viewed 12 March.

UNEP-WCMC (2011a). *CITES List of Contracting Parties*. http://www.cites.org/eng/disc/parties/chronolo.shtml. Viewed 12 March.

UNEP-WCMC (2011b). *CITES listed species database*. http://www.cites.org/eng/disc/species.shtml Viewed 12 March.

UNDP (2010). *UNDP in Asia-Pacific: 2009 Results Report*. United Nations Development Programme. http://undp.org/asia. Viewed 16 March.

van Dijk, P.P., Wogan, G., Lau, M. W-N., Dutta, S., Shrestha, T.K., Roy, D. & Nguyen Q.T. (2004a). *Tylototriton verrucosus*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 16 March 2011.

van Dijk, P.P., Nguyen Q.T. and Wallays, H (2004b). *Paramesotriton deloustali*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 16 March 2011.

van Dijk, P.P. and Stuart, B. (2004). *Paramesotriton laoensis*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 16 March 2011.

Warkentin, I.G., Bickford, D., Sodhi, N.S. and Bradshaw, C.J.A. (2009). Eating frogs to Extinction. *Conservation Biology* 23:1056-1059.

IUCN and UNEP (2009). *World Database on Protected Areas*. www.protecteedplanet.org. Viewed 16 March.

Whiles, M.R., Lips, K.R., Pringle, C.M., Kilham, S.S., Bixby, R.J., Brenes, R., Connelly, S., Colon-Gaud, J.C., Hunte-Brown, M, Huryn, A.D., Montgomery, C. and Peterson, S. (2006). The effects of amphibian population declines on the structure and function of Neotropical stream systems. *Frontiers in Ecology and the Environment* 4(1):27-34.

Xie, F., Lau, M.W.N., Stuart, S.N., Chanson, J.S., Cox., N.A. and Fischman, D.L. (2007). Conservation needs of amphibians in China: A review. *Science in China Series C: Life Sciences* 50(2):265-276.

Zhang,L., Ning, H and Sun, S. (2007). Wildlife trade, consumption and conservation awareness southwest China. *Biodiversity Conservation* 17(6):1493-1516.

APPENDICES

Appendix I

List of websites selling salamandrids observed during online surveys including seller origin and price.

Common Name	Latin Name	Origin of site/seller	Website	Price
Kaiser's Spotted Newt	*Neurergus kaiseri*	USA	http://market.kingsnake.com	$120
Kaiser's Spotted Newt	*Neurergus kaiseri*	USA	http://market.kingsnake.com	$120
Turkish Salamander	*Ommatriton vittatus*	Holland	http://members.chello.nl	-
Danube Crested Newt	*Triturus dobrogicus*	Holland	http://members.chello.nl	$17
Southern Crested Newt	*Triturus karelinii*	Holland	http://members.chello.nl	-
Italian Crested Newt	*Triturus carnifex*	Holland	http://members.chello.nl	$21-$49
European Marbled Newt	*Triturus marmoratus*	Holland	http://members.chello.nl	-
Hong Kong Newt	*Paramesotriton hongkongensis*	Ireland	http://www.adpost.com/ie/	$21
Japanese Fire Bellied Newt	*Cynops pyrrhogaster*	Malaysia	http://www.adpost.com/my/	$1
Eastern Red Spotted Newt	*Notophthalmus viridescens*	Malaysia	http://www.adpost.com/my/	$33-$99
Chinese Warty Newt	*Paramesotriton chinensis*	Malaysia	http://www.adpost.com/my/	$26
Red-Belly Newt	*Taricha rivularis*	Malaysia	http://www.adpost.com/my/	$2
Himalayan Knobby Newt	*Tylototriton verrucosus*	Malaysia	http://www.adpost.com/my/	$39
Chinese Fire Belly Newt	*Cynops orientalis*	UK	http://www.adpost.com/uk	$9
Axolotl	*Ambystoma mexicanum*	USA	http://www.adpost.com/us/	$50
Marbled Salamander	*Ambystoma opacum*	USA	http://www.adpost.com/us	$32
Tiger salamander	*Ambystoma tigrinum*	USA	http://www.adpost.com/us	$25
Axolotl	*Ambystoma mexicanum*	-	http://www.angelfire.com/	$35
Tiger Salamander	*Ambystoma tigrinum*	-	http://www.angelfire.com/	$40
Chinese Fire Belly Newt	*Cynops orientalis*	-	http://www.angelfire.com/	$6
Fire Salamander	*Salamandra salamandra*	-	http://www.angelfire.com/	$30
Axolotl	*Ambystoma mexicanum*	Czech Rep	http://www.animalfarm.cz/	$48
Tiger Salamander	*Ambystoma tigrinum*	Czech Rep	http://www.animalfarm.cz/	$24
Eastern Red Spotted Newt	*Notophthalmus viridescens*	Czech Rep	http://www.animalfarm.cz/	$24
Axolotl	*Ambystoma mexicanum*	Holland	http://www.dierenhandelexotica.nl	-

Sword-tail Newt	*Cynops encicauda*	Holland	http://www.dierenhandelexotica.nl	-
Hong Kong Newt	*Paramesotriton hongkongensis*	Holland	http://www.dierenhandelexotica.nl	-
Algerian Ribbed Newt	*Pleurodeles poireti*	Holland	http://www.dierenhandelexotica.nl	-
Guanxi Warty Newt	*Paramesotriton guanxiensis*	Czech Rep.	http://www.eurofauna.com	-
Mandarin Newt	*Tylototriton shanjing*	Portugal	http://www.eurofauna.com	$28
Crocodile Newt sp.	*Tylototriton sp.*	Hong Kong	http://www.eurofauna.com	-
Taliang Knobby Newt	*Tylototriton taliangensis*	Germany	http://www.eurofauna.com	-
Himalayan Knobby Newt	*Tylototriton verrucosus*	Austria	http://www.eurofauna.com	-
Kaiser's Spotted Newt	*Neurergus kaiseri*	Czech Rep.	http://www.eurofauna.com	-
Fire Salamander	*Salamandra salamandra bernardezi*	Germany	http://www.eurofauna.com	-
Spotted Salamander	*Ambystoma maculatum*	UK	http://www.exotic-pets.co.uk	-
Barred Tiger Salamander	*Ambystoma manortium*	UK	http://www.exotic-pets.co.uk	-
Axolotl	*Ambystoma mexicanum*	UK	http://www.exotic-pets.co.uk	-
Marbled Salamander	*Ambystoma opacum*	UK	http://www.exotic-pets.co.uk	-
Small Mouthed Salamander	*Ambystoma texanum*	UK	http://www.exotic-pets.co.uk	-
Tiger Salamander	*Ambystoma tigrinum*	UK	http://www.exotic-pets.co.uk	$30
Chinese Fire Belly Newt	*Cynops orientalis*	UK	http://www.exotic-pets.co.uk	-
Japanese Fire Bellied Newt	*Cynops pyrrhogaster*	UK	http://www.exotic-pets.co.uk	-
Southern Two lined Salamander	*Eurycea cirregera*	UK	http://www.exotic-pets.co.uk	-
Common Mudpuppy	*Necturus maculosus*	UK	http://www.exotic-pets.co.uk	-
Paddled Tailed Newt	*Pachtriton labiatus*	UK	http://www.exotic-pets.co.uk	-
Red Backed Salamander	*Plethodon cinereus*	UK	http://www.exotic-pets.co.uk	-
Slimy Salamander	*Plethodon glutinosus*	UK	http://www.exotic-pets.co.uk	-
Sharp Ribbed Newt	*Pleurodeles waltl*	UK	http://www.exotic-pets.co.uk	-
Cantabrian Fire Salamander	*Salamandra s. bernaderi*	UK	http://www.exotic-pets.co.uk	-
Fire Salamander	*Salamandra salamandra*	UK	http://www.exotic-pets.co.uk	-
Italian Alpine Newt	*Trituris alpestris apuanus*	UK	http://www.exotic-pets.co.uk	-
Italian Crested Newt	*Trituris carnifex*	UK	http://www.exotic-pets.co.uk	-
Southern Pygmy Marbled Newt	*Trituris pygmaeus*	UK	http://www.exotic-pets.co.uk	-
Laotriton laoensis	*Laotriton laoensis*	USA	http://www.faunaclassified.com	$240
Fire Salamander	*Salamandra salamandra*	USA	http://www.faunaclassified.com	$40

Paddled Tailed Newt	*Pachtriton labiatus*	USA	http://www.faunaclassified.com	$10
Kaiser's Spotted Newt	*Neurergus kaiseri*	USA	http://www.faunaclassified.com	$120
Andersoni Salamander	*Ambystoma andersoni*	USA	http://www.generalexotics.com	-
Blue Spotted Salamander	*Ambystoma laterale*	USA	http://www.generalexotics.com	-
Spotted Salamander	*Ambystoma maculatum*	USA	http://www.generalexotics.com	$30
Marbled Salamander	*Ambystoma opacum*	USA	http://www.generalexotics.com	$30
Barred Tiger Salamander	*Ambystoma tigrinum mavortium*	USA	http://www.generalexotics.com	-
Dusky Salamander	*Desmognathus fuscus*	USA	http://www.generalexotics.com	-
Black Bellied Salamander	*Desmognathus quadramaculatus*	USA	http://www.generalexotics.com	-
Four-toed Salamander	*Hemidactylium scutatum*	USA	http://www.generalexotics.com	-
Common Mudpuppy	*Necturus maculosus*	USA	http://www.generalexotics.com	$50
Chinese Warty Newt	*Paramesotriton chinensis*	USA	http://www.generalexotics.com	$25
Alpine Salamander	*Salamandra atra*	USA	http://www.generalexotics.com	-
Fire Salamander-Yellow	*Salamandra giglioli*	USA	http://www.generalexotics.com	-
Fire Salamander	*Salamandra salamandra*	USA	http://www.generalexotics.com	-
Fire Salamander- Red	*Salamandra terrestris*	USA	http://www.generalexotics.com	-
Japanese Fire Bellied Newt	*Cynops pyrrhogaster*	UK	http://www.gumtree.com	$40
Chinese Fire Belly Newt	*Cynops orientalis*	UK	http://www.pets-classifieds.co.uk	$9
Warty Newt sp.	*Paramesotriton sp.*	UK	http://www.pets-classifieds.co.uk	-
Chinese Fire Belly Newt	*Cynops orientalis*	UK	http://www.preloved.co.uk	$12
Warty Newt sp.	*Paramesotriton sp.*	Japan	http://www.rainforest.co.jp	-
Sharp Ribbed Newts	*Pleurodeles waltl*	UK	http://www.reptileclassifieds.co.uk	$8
Paddled Tailed Newt	*Pachtriton labiatus*	UK	http://www.reptileforums.co.uk	$8
Rough-skinned Paddletail Newt	*Taricha granulosa*	UK	http://www.reptileforums.co.uk	$8
Chinese Fire Belly Newt	*Cynops orientalis*	UK	http://www.reptileforums.co.uk	$8
Alpine Newt	*Trituris inexpectatus*	UK	http://www.reptileforums.co.uk	$8
Marbled Salamander	*Ambystoma opacum*	USA	http://www.reptilesncritters.com	$20
Common Mudpuppy	*Necturus maculosus*	USA	http://www.reptilesncritters.com	$45
Eastern Red Spotted Newt	*Notophthalmus viridescens*	USA	http://www.reptilesncritters.com	$13
Rough-skinned Paddletail Newt	*Taricha granulosa*	USA	http://www.reptilesncritters.com	$20
Chinese Fire Belly Newt	*Cynops orientalis*	USA	http://www.reptilestogo.com	-
Kaiser's Spotted Newt	*Neurergus kaiseri*	USA	http://www.reptilestogo.com	-

Eastern Red Spotted Newt	*Notophthalmus viridescens*	USA	http://www.reptilestogo.com	-
Paddled Tailed Newt	*Pachtriton labiatus*	USA	http://www.reptilestogo.com	-
Himalayan Knobby Newt	*Tylototriton verrucosus*	USA	http://www.reptilestogo.com	-
Alpine Newt	*Trituris alpestris*	UK	http://www.reptiletrader.co.uk	-
Spotted Salamander	*Ambystoma maculatum*	USA	http://www.reptmart.com	-
Spotted Salamander	*Ambystoma maculatum*	USA	http://www.salamandersandnewts.info	$25
Marbled Salamander	*Ambystoma opacum*	USA	http://www.salamandersandnewts.info	$30
Tiger Salamander	*Ambystoma tigrinum*	USA	http://www.salamandersandnewts.info	$50
Common Mudpuppy	*Necturus maculosus*	USA	http://www.salamandersandnewts.info	$26
Eastern Red Spotted Newt	*Notophthalmus viridescens*	USA	http://www.salamandersandnewts.info	$15
Paddled Tailed Newt	*Pachtriton labiatus*	USA	http://www.salamandersandnewts.info	$20
Chinese Warty Newt	*Paramesotriton chinensis*	USA	http://www.salamandersandnewts.info	$20
Slimy Salamander	*Plethodon glutinosus*	USA	http://www.salamandersandnewts.info	$15
Black Bellied Salamander	*Desmognathus quadramaculatus*	USA	http://www.salamandersandnewts.info	-
California Newt	*Taricha torosa*	USA	http://www.salamandersandnewts.info	-
Chinese Black Spotted Stout Newt	*Pachytriton brevipes*	USA	http://www.salamandersandnewts.info	-
Dusky Salamander	*Desmognathus fuscus*	USA	http://www.salamandersandnewts.info	-
Fire Salamander	*Salamandra salamandra*	USA	http://www.salamandersandnewts.info	-
Chinese Fire Belly Newt	*Cynops orientalis*	USA	http://www.salamandersandnewts.info	-
Axolotl	*Ambystoma mexicanum*	USA	http://www.salamandridae.com	$15
Hynobius salamander	*Hynobius quelpartensis*	USA	http://www.salamandridae.com	$60
Danube Crested Newt	*Triturus dobrogicus*	USA	http://www.salamandridae.com	$20
Marbled Salamander	*Ambystoma opacum*	UK	http://www.southcoastexotics.com	$64
Paddled Tailed Newt	*Pachtriton labiatus*	UK	http://www.southcoastexotics.com	$6
Northwestern Salamander	*Ambystoma gracile*	Germany	http://www.tropenparadies.org	-
Marble Salamander	*Ambystoma opacum*	Germany	http://www.tropenparadies.org	-
Blue Fire Belly Newt	*Cynops cyanurus*	Germany	http://www.tropenparadies.org	-
Japanese Fire Bellied Newt	*Cynops pyrrhogaster*	Germany	http://www.tropenparadies.org	-
Dark Mountain Salamander	*Desmogonathus fuscus*	Germany	http://www.tropenparadies.org	-
Tokyo Salamander	*Hynobius tokyoensis*	Germany	http://www.tropenparadies.org	-
Common Mudpuppy	*Necturus maculosus*	Germany	http://www.tropenparadies.org	-
Eastern Red Spotted Newt	*Notophthalmus viridescens*	Germany	http://www.tropenparadies.org	-

Mucus Salamander	*Plethodon glutinosus*	Germany	http://www.tropenparadies.org	-
Italian Alpine Newt	*Triturus a. apuanus*	Germany	http://www.tropenparadies.org	-
Himalayan Knobby Newt	*Tylototriton verrucosus*	Germany	http://www.tropenparadies.org	-