Over-exploitation and illegal trade of reptiles in Indonesia

Vincent Nijman[1], Chris R. Shepherd[1,2], Mumpuni[3] & Kate L. Sanders[4]

[1]*Oxford Wildlife Trade Research Group, Oxford Brookes University, OX3 0BP Oxford, UK*
[2]*TRAFFIC Southeast Asia, Unit 3-2, 1st floor, Jalan SS23/11,Taman SEA, Petaling Jaya, Selangor, Malaysia*
[3]*Herpetology Department, Division of Zoology, Research Centre for Biology-LIPI, Jalan Raya Bogor Km 46, Cibinong 16911, Indonesia*
[4]*University of Adelaide, School of Earth and Environmental Sciences, Darling Building, Adelaide, Australia 5005*

We report on the commercial trade in three reptile species harvested for different purposes in western Indonesia (Sumatra, Java, Kalimantan) for international markets: (1) Tokay geckos, *Gekko gecko*, traded for medicinal uses, (2) Javan filesnakes, *Acrochordus javanicus*, harvested for skins, and (3) Asiatic softshell turtles, *Amyda cartilaginea*, harvested for meat; each species is also exploited for the pet trade, but to a lesser extent. All three species are harvested from wild populations. None of these species are protected by Indonesian law, but there is a national harvest and export quota system in place to prevent overexploitation. For each species, we collected data from catchers, middlemen and exporters on harvest volumes, catching locales, turn-over and prices, and compared these figures with the quota allocated by the Indonesian authorities. The trade in *G. gecko* from Central and East Java (3 traders, 2006) amounts to around 1.2 million individuals annually, greatly exceeding the national quota of 50,000 *G. gecko* for the entire year and representing a monetary value for exporters of around one million USD / year. The annual trade in *A. javanicus* (in five cities in East and South Kalimantan, and North Sumatra, Riau (central Sumatra) and South Sumatra, 2005–6) was estimated at around 300,000 individuals from Kalimantan and 30,000 from Sumatra, exceeding the national quota of 200,000 individuals / year and representing a monetary value for exporters of at least three million USD / year. The trade in *A. cartilaginea* was monitored in three cities in North Sumatra and Riau in 1999: 200–450,000 individuals were traded in 1998 and 1999, greatly exceeding the national quota of 10,000, with a monetary value for exporters in excess of ten million USD / year. We conclude that implementation of wildlife trade regulations by and large are not abided by many reptile traders and are not sufficiently enforced by the Indonesian authorities. We further note that the quota-setting process rarely involves non-detriment findings based on reliable biological information. In order for reptile trade to be sustainable in Indonesia, it is paramount that non-detriment findings are undertaken and existing regulations are sufficiently enforced.

Key words: Biodiversity conservation, CITES, law enforcement, wildlife trade

INTRODUCTION

Wildlife trade is at the heart of the relationship between biodiversity conservation and sustainable development. It is recognized as a major threat to biodiversity, and often acts in concert with habitat loss and hunting (Phelps et al., 2010). Although a significant proportion of wildlife trade is legal, violation of trade regulations and quotas is commonplace (Broad et al., 2003; Nijman et al. 2011). In southeast Asia, unsustainable and illegal trade in wildlife threatens the conservation of numerous species (Nooren & Claridge, 2001; Shepherd et al., 2004; Grieser-Johns & Thomson, 2005; Nijman & Shepherd, 2007, 2011; Shepherd & Nijman, 2007a), with Indonesia being one of the region's major exporters of wildlife (Soehartono & Mardiastuti, 2002; Nijman 2010).

This study provides an overview of the harvest and export of wildlife in Indonesia, focusing on three case studies within reptiles that exemplify different aspects of this trade. Indonesia's laws are sufficient to regulate the trade in wildlife, however the implementation and enforcement of these laws is currently far from effective (e.g. Shepherd & Nijman, 2007b). Indonesia has comprehensive national legislation and quotas to regulate exploitation, and has further committed to the sustainable management of international wildlife trade by becoming a Party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Soehartono & Mardiastuti, 2002). CITES regulates trade in wildlife by including species on one of three appendices: international trade is permitted in species listed on Appendix II and III, albeit regulated, but commercial international trade is prohibited in species listed on Appendix I. Indonesia acceded to CITES in December 1978, which entered into force in March 1979.

Reptiles (Squamata, Crocodilia, Testudines) are among the most intensively harvested vertebrates for international export from Indonesia; extremely large volumes are traded both legally and illegally to supply the global demand for pets, traditional medicines, skins and food (cf. Webb & Vardon, 1998; Shepherd, 2000; Soehartono and Mardiastuti, 2002). Here we focus on three reptile species (a lizard, a snake and a turtle) that are traded internationally and to a much lesser extent domestically,

Correspondence: Chris R. Shepherd, TRAFFIC Southeast Asia, Unit 3-2, 1st floor, Jalan SS23/11,Taman SEA, Petaling Jaya, Selangor, Malaysia; *E-mail:* chris.shepherd@traffic.org

to illustrate different aspects of the international demand for wildlife products.

We provide an overview of the regulatory process of the trade in these three species and then present our findings for each case study. For all species, we found that the numbers harvested and exported greatly exceeded the allocated quota, sometimes by several orders of magnitude and to such an extent that it may be detrimental to the survival of the species within their range in Indonesia. While it is impossible to quantify the exact extent of the (international) trade, these case studies provide estimates of trade volumes, illustrate trade dynamics and highlight the failure of exporters to adhere to laws and regulations put in place by the Indonesian government and the lack of enforcement of regulations for the sustainable utilization of wildlife.

Background to quota setting process

Indonesia has an extensive harvest and export quota system for non-protected species to supply both domestic and international markets, regardless of whether they are CITES-listed or not. There are no export quotas for species listed in Appendix I of CITES (all commercial international trade in these species is prohibited) or protected by Indonesia's national legislation. As Indonesia's CITES Scientific Authority, the Indonesian Institute of Sciences (LIPI) sets quotas for harvest and export after consultation with various stakeholders, including reptile traders (Amir et al., 1998), partially due to LIPI having limited expertise and resources (Soehartono & Mardiastuti, 2002). Prior to setting a quota, CITES calls for non-detriment findings (NDF) to be carried out to assess the sustainable off-take for any given species or population in any given area. However, reliable NDF studies require information on population and reproductive biology that are unavailable for most species traded in Indonesia; quotas for many species are instead based on trade figures in previous years and the demands of exporters (cf. Auliya 2010). Harvest quotas are assigned by province or district, with a limited volume allowed from each designated area. Animals are not allowed to be harvested from a province that has not been allocated a quota. Of the entire harvest quota, approximately 10% may be used for domestic purposes and the remainder is designated for export. The quotas clearly state the purpose of export (e.g. pets, consumption, skins) and it is not permitted to export animals for purposes other than those stated in the annual quota.

The CITES Management Authority, i.e., Directorate General of Forest Protection and Nature Conservation (PHKA), enforces the established quota. This is largely carried out via the provincial offices of the Natural Resources Conservation Agency (BKSDA). Companies or individuals wishing to harvest wildlife must obtain a license to do so from the BKSDA office in the province where the harvest is to take place, and may not exceed the allocated harvest quota for each of the provinces. The transport of wildlife from within Indonesia also requires legal documents, whether or not the species concerned is protected by law. Export quotas for reptiles are divided among members of the Indonesian Reptile and Amphibian Trade Association (IRATA), by IRATA itself. Anyone not belonging to IRATA and not having quota may not export reptiles or amphibians, with the exception of those exporting primarily for the meat consumption trade.

In an effort to take pressure off wild populations, captive breeding of wildlife is encouraged by the PHKA in Indonesia (Nijman & Shepherd 2009). All individuals or companies breeding reptiles for export must be registered with the PHKA. Breeders supplying exporters, but not themselves exporting, are registered with the BKSDA offices at a provincial level. Wild parent stock obtained by companies breeding wildlife for commercial purposes remain the property of the government, but since captive bred specimens are not included in the quota, offspring can be exported in unlimited numbers.

METHODS

Data were obtained from the Indonesian CITES Management Authority, through interviews with members of IRATA and from numerous stakeholders in the trade of reptiles in Indonesia, including collectors, middlemen and exporters.

Tokay geckos, *Gekko gecko*, are exploited for the pet and traditional Chinese medicinal trades: consuming Tokay geckos is thought to relieve coughs, asthma and symptoms of tuberculosis (Gu et al., 2011). The species is not CITES listed. Data on the *G. gecko* trade were obtained by visiting two collector/exporter locations in East Java in November 2006, and information was gathered on a third visit to exporters in two locations in Central and East Java (Auliya & Shepherd, 2007). While these three traders are considered to be the largest in Indonesia there may be other similar-sized companies active in Indonesia, in addition to numerous smaller traders.

Javan filesnakes, *Acrochordus javanicus*, are harvested for their skins (Shine et al., 1995; Sanders et al., 2010) and to a much lesser extent as pets. Unlike *G. gecko* and *A. cartilaginea*, *A. javanicus* is not always targeted directly by collectors and is often taken opportunistically as by-catch by fishermen (Shine et al., 1995; this study). Filesnakes are not CITES listed. Trade data for *A. javanicus* were collected in November 2005–January 2006 in two cities in East and South Kalimantan (six traders and middlemen) and three cities in north, central (Riau), and south Sumatra (11 traders and middlemen). These surveys included all of the major *A. javanicus* exporters in Indonesia (G. Saputra, personal communication), but omitted numerous minor, unlicensed traders.

Asiatic softshell turtles, *Amyda cartilaginea*, are exploited largely for meat and to a much lesser extent for pets. This species is listed on CITES Appendix II. Data from the trade in softshell turtles (mainly *A. cartilaginea*, but also *Dogania subplana, Pelochelys cantorii*) were obtained largely in September 1999 from traders in Medan (North Sumatra) and Tembilahan and Palembang (Riau), Sumatra, with additional data collected on an *ad hoc* basis up to the time of this writing. Trade statistics for the various species of softshell turtles are often not distinguished; based on information from traders and our own observations we estimate that 90–95% of the

Fig. 1. Asiatic Softshell Turtles *Amyda cartilaginea* in an exporters' warehouse in Indonesia. Photo: Kate Sanders.

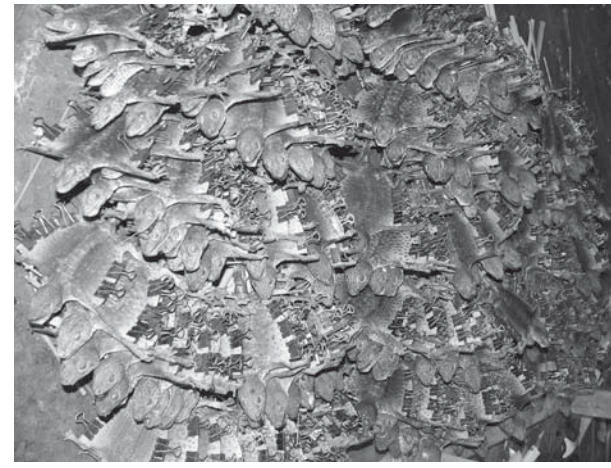

Fig. 2. Dried Tokay Geckos *Gekko gecko* ready for export from Indonesia. Photo: Mark Auliya – TRAFFIC Southeast Asia.

individuals in trade in these areas are *A. cartilaginea*. *Amyda cartilaginea* in the meat-trade are sold by weight, with individuals bought by the kilo and turn-over reported in tonnes. We converted weights to individuals by employing an 'average' weight of live *A. cartilaginea* in trade (~5 kg) as observed at the trader's facilities (Fig. 1).

All interviews were conducted in Bahasa Indonesia and prices were collected in Indonesian Rupiah (IDR) and US Dollar (USD); the former are here converted to USD equivalents using the exchange rate at the time of survey (between 8,025 and 9,470 IDR to one USD). The trade we monitored was carried out openly, and there was no need to resort to undercover techniques to obtain the relevant data; we did not purchase any animals or products during the survey.

RESULTS AND DISCUSSION

Quotas and harvest methods

Traders of *G. gecko* stated that this species is harvested mainly if not exclusively in Java, as this is where the exporters of this species are located - transportation of geckos from other parts of Indonesia to Java is not considered to be economically viable. Within Java there is a strong focus of *G. gecko* harvesting from East Java (Fig. 2). Twenty-four thousand individuals / year are permitted to be harvested from the island of Java, 1,000 from neighbouring Bali, and the total for Indonesia is 50,000 individuals. Of this, 5,000 are intended for local use, while the remaining 45,000 are for export, as live animals for the pet industry. There is no quota for the skin or medicinal trade. The export quota (for pets) is realized every year by 17 registered reptile exporters with quota for *G. gecko*. With the exception of the relatively few captured live for the pet trade (see below), *G. gecko* are hunted using a long bamboo pole with two or three spikes at the end, used for piercing the geckos.

Pet exporters (only pet exporters may obtain quota for this species) apply for permits from the BKSDA to acquire specimens in each of 23 designated areas (distributed throughout Indonesia), pay a fee, and then harvest the animals on Java, regardless of which province their capture permits are designated for. Once the fees are paid to the BKSDA offices, traders indicated that there was no follow-up or monitoring to ensure that the animals are indeed taken from permitted areas, in the allocated quantities.

Acrochordus javanicus is a fully aquatic species harvested primarily in wetland areas of intensive fishing activity. Since at least 1999, the *A. javanicus* annual quota for all of Indonesia has been 200,000 individuals; 180,000 for skin export, 19,100 domestic use and 900 for pet export. In 2005, the quotas for Kalimantan and Sumatra were 80,000 and 20,000 individuals, respectively. Traders in Samarinda (East Kalimantan) source filesnakes from the nearby Mahakam Lakes (Jempang, Melintang and Semayang). Traders in Banjarmasin obtain filesnakes mostly from the Katingan area in Central Kalimantan, but also from the Sungai Negara wetlands in South Kalimantan. At least 80% of the Kalimantan harvest occurs in the wet season, when the main fishing areas are accessible by boat, and (according to collectors) the snakes are most active. Of the filesnakes exported from North Sumatra (Medan), 60% are imported from South and East Kalimantan and 40% are sourced both from throughout Sumatra (Medan area, Jambi, Lampung and Palembang area). Filesnakes exported from South Sumatra (Palembang) are harvested more locally (from south Sumatra, Bangka and Lampung) and mainly in the dry season.

Filesnakes are mainly collected as by-catch in bamboo fish-traps (bubus) and fishing nets, although collectors in Sumatra also report catching filesnakes by electric fishing (Medan area) and baited fishing lines (Palembang area). Most of the harvest is apparently opportunistic; however an exporter in Banjarmasin reported that fishermen will directly target filesnakes when the demand for skins is high, and this dealer gives collectors advance payments to harvest *A. javanicus*. Filesnakes are generally exchanged alive from collectors to one or more middlemen, before reaching the exporters' warehouse where they are skinned (Fig. 3). None of the traders surveyed specialized in *A. javanicus* harvest - most collected a large range of reptiles and amphibians for various trade purposes. The minimum size accepted in the skinnery in Palembang was 1.2 metres neck to vent length; only one other dealer imposed a size

Table 1. Summary statistics of trade in dried Tokay geckos (*Gekko gecko*) from three traders in East and Central Java, Indonesia.

Trader	Staff employed	Reported weekly turn-over dry season	Estimated annual turn-over[1]
Surabaya	40	14,000	550,000
Malang	7	7,000	270,000
Semarang and Kudus	25–40 (at two separate plants)	10,000	390,000

[1] Based on an 8-month dry season, with turn-over halved during the wet season, and a realization of around 90% of

restriction (Banjarmasin), accepting only filesnakes of at least 1 metre in total length.

Amyda cartilaginea are captured mainly using baited fishing lines and traps. Lines or steel traps are placed in the water with a freshly killed animal as bait, with one softshell caught per line and with 5–10 caught per trap. Turtles are captured all over Sumatra, but clearly many individuals are received from areas nearest the exporter's facilities, as well as near to middlemen and collectors that deliver directly to the exporter, as they then pay less for transportation costs. In 1999 the quota for *A. cartilaginea* was 10,000 for Indonesia as a whole. For the harvest from Sumatra (north Sumatra, Riau) the quota was set at 8,000. The harvest of *A. cartilaginea* is allowed for pets and, more recently, for consumption. Export of this species is currently supposed to be regulated by a size limit, but traders claim this is not strictly enforced.

Numbers harvested

Twenty four thousand *G. gecko* are permitted to be exported from Indonesia for use as pets only, as stipulated by the national quota. However, data provided by the traders, and corroborated by our observations during visits to traders, 1.2 million *G. gecko*, kiln-dried, are exported from Indonesia (Table 1). These are shipped completely outside of the quota system to China, dead and dried, to supply the demand for medicinal use (C.R. Shepherd and M. Auliya, unpublished data) (Fig. 4). This species is also in domestic use for various medicinal purposes (Nara, 2000), however the volumes are negligible compared to those involved in the international trade. According to those involved in the trade, the shipments are exported to China.

Traders of *A. javanicus* from five towns reported a combined annual harvest of between 310,000 and 330,000 individuals (Table 2). This included approximately 100,000 individuals from the Mahakam Lakes in East Kalimantan, >100,000 from the Katingan area in Central Kalimantan, and >50,000 from the Sungai Negara wetlands in South Kalimantan (Table 2). At least 20,000 specimens were reported to be harvested annually from North and South Sumatra; harvest in Riau was minimal, with only the occasional and opportunistic collection of unusually large specimens (Fig. 5). Most traders sent dried skins to Jakarta (Indonesia's capital) for re-export mostly to European (primarily Italy and Spain) and US markets. Two exporters (in Medan and Jakarta) manufacture finished products (mostly handbags, wallets and belts) for international export. Exporters reported that demand (and hence prices paid) for *A. javanicus* skins fluctuates considerably, depending on current fashions in luxury reptile leather. At the time of survey, *A. javanicus* skins were in relatively high demand. Even in years of low demand, full quotas of *A. javanicus* skins are harvested and stockpiled by reptile exporters in Singapore (G. Saputra, personal communication). Most traders reported that neither catch rates nor average body sizes of filesnakes had declined in recent years; however, exporters in South Sumatra stated that they were able to

Table 2. Javan filesnake (*Acrochordus javanicus*) trade in two cities in Kalimantan and three cities in Sumatra, with reported or estimated turn over and capture localities.

Town (traders)	Reported monthly turn-over wet season	Reported monthly turn-over dry season	Reported or *estimated* annual turn-over	Reported capture localities
Kalimantan				
Samarinda 1	13,600	2,500	85,000	East Kalimantan
Samarinda 2			20,000	East Kalimantan
Banjarmasin 1	32,000	60	*160,000*	Central – South Kalimantan
Banjarmasin 2–4	6-800	2–300	*5–6,000*	C, W, E Kalimantan
Sumatra				
Medan 1			40–50,000	S, E Kalimantan (60%), Sumatra
Medan 2–3	160–200	160–200	*2,000–2,500*	North Sumatra
Pekanbaru	<10	<10	*<100*	C. Sumatra
Palembang 1–7	200–250	6–700	*3,500–4,500*	S. Sumatra, Bangka

Fig. 3. Skin being removed from a Filesnake *Acrochordus javanicus*. Photo: Kate Sanders.

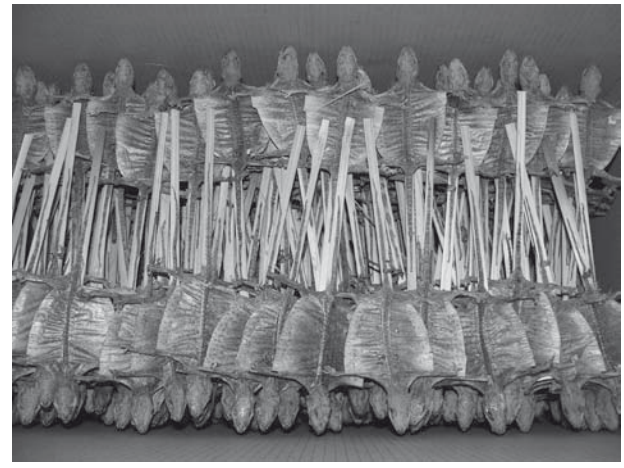

Fig. 4. Tokay Geckos *Gekko gecko* packed for shipment from Java, Indonesia to markets in China. Photo: Mark Auliya – TRAFFIC Southeast Asia.

obtain fewer filesnakes than in previous years and that the average size of harvested filesnakes was smaller.

Amyda cartilaginea is traded for the international pet trade, but these numbers are dwarfed by those exported for the meat trade. Of all the turtles traded for the meat trade, *A. cartilaginea* was valued highest in Sumatra. Exporters in Medan, and from smaller centres in Riau, export large quantities of *A. cartilaginea* largely as to supply the demand in China and Hong Kong. At the time of the survey, exporters in Medan send off daily shipments of 3–5 tonnes each of live specimens on flights to China, whereas exporters in Tembilahan shipped them by sea to Singapore from where the majority were re-exported. *Amyda cartilaginea* were observed up to weights of 40 kg but exporters have a clear preference for the smaller individuals, with the highest prices (per kg) paid for individuals <5kg (Table 3). At the time of the survey, traders from Tembilahan did not take in large specimens, as according to the traders, these were not accepted by Hong Kong. At the time of the survey, collectors, middlemen and exporters all indicated a decrease in numbers, allegedly due to the increasing scarcity of the turtles, but, at the same time, reported a decrease in prices paid. More recent observations suggest that this trend has continued and that volumes have significantly dropped due to over-exploitation.

Assuming a price of USD 1.00 for *G. gecko*, USD 10.00 for *A. javanicus* and USD 10.00 for a kg of *A. cartilaginea*, the export values are in excess of one million USD / year for *G. gecko*, three million USD / year for *A. javanicus* and 10 million USD / year for *A. cartilaginea*. The real value of *G. gecko* and *A. cartilaginea* trade must be considerably higher as only a small number of traders were visited.

Numbers quota versus actual harvest

Our estimates of actual harvest and export quantities far exceeded quotas for all three species. Surveys of just three *G. gecko* exporters revealed that approximately 31,000 individuals are harvested per week. In total, some 1.2 million *G. gecko* are exported per annum, exceeding Indonesia's quota of 50,000 by an order of magnitude. The annual quota for *A. javanicus* was 200,000 in 2005,

Table 3. Asiatic softshell turtles (*Amyda cartilaginea*) trade in Sumatra in 1999 based on our total weight conversions (see Methods).

Town	Turn-over weight week[1] (tones)	Turn-over individuals week (average 5 kg)	Turn-over individuals week (average 3 kg)	Annual turn-over (individuals)	Reported export[2] (individuals)
North Sumatra					
Medan 1–2	14	2,800	4,700	140,000–240,000	120,000–150,405
Riau					
Tembilahan 1–2	2	400	700	20,000–30,000	40,000–47,795
Palembang	4	800	1,300	40,000–70,000	

[1]For Medan turn-over is based on what is reported for *A. cartilaginea* by one trader, whereas for Tembilahan and Palembang it is based on the notion, as reported by traders, that *A. cartilaginea* comprise 40% of the volume of trade.
[2] The Directorate General of Fisheries report on export of *A.cartilaginea*; it appears however that other species are included in this total and the lower estimate is based on information supplied by traders in Medan assuming that some 80% of the softshell turtle trade comprises *A. cartilaginea*

Table 4. Approximate selling prices (in US dollar) of Tokay geckos (*Gekko gecko*) Javan filesnakes (*Acrochordus javanicus*) and Asiatic softshell turtles (*Amyda cartilaginea*) in Indonesia; prices from exporters and retailers were quoted in US dollars, whereas the other prices were quoted in Indonesian Rupiah and are here converted to US dollars at the exchange rate at the time.

	G. gecko (2006)	*A. javanicus* (2005)	*A. cartilaginea* (1999)
Trapper	0.05–0.07	No data	1.25–4.98
Middlemen	0.08–0.11	2.15–2.69	2.49–11.21
Collectors	0.13–0.26	2.70–6.80	2.49–24.92
Exporters (Indonesia)	1.00–1.15	10.00–17.00 (alive)	16.00 (small, alive)
Retailer (abroad)	10.00 (USA, alive), 2.00 (China, dead)	No data	No data

with 180,000 intended for international export (900 live for pets, the remainder as skins) and this was exceeded by a factor of two in the facilities surveyed alone. This trend is not new. In 1999, annual quotas for *A. cartilaginea* for the entire country were greatly exceeded in just two provinces. For some species, such as *A. javanicus*, specimens are mostly collected as by-catch, in significant quantities, and therefore it is very likely that they are harvested and traded without the appropriate permits.

We have no indication that the seven provinces included in our study are exceptional in volume of reptile trade, with Samedi & Iskandar (2000), for instance, listing East Kalimantan and Riau as having the provinces with the least amount of trade in turtles and tortoises in 1997 (with 518 and 20,628 individuals exported, respectively), and South Kalimantan (69,320 individuals) and North Sumatra (238,912 individuals) as the most. Hence we fear that the trade dynamics we describe may be typical, and that the lack of enforcement of wildlife trade regulations is symptomatic for the situation in Indonesia.

Captive breeding

At least two companies have licenses for captive breeding and export of *G. gecko*. Whether equivalent licenses are held for *A. cartilaginea* is unknown and should be a priority for future investigations. No captive-breeding licenses have been issued for *A. javanicus*; however, captive breeding is unlikely to be commercially viable for Acrochordids given their low growth rates and delayed maturation (e.g. Houston & Shine, 1994). Those involved in the trade question whether (commercial) captive-breeding takes place of *G. gecko* and *A. cartilaginea*. According to reptile traders in Indonesia, prices are far too low to make captive breeding of these species an economically viable option, as the investment and scale is far too large compared to the return and, as a result, there is likely no commercial captive breeding of this species in Indonesia. This was further confirmed by exporters in Java, who stated to TRAFFIC researchers that all the Tokay geckos are wild-caught (C.R. Shepherd and M. Auliya, unpublished data). At about a dollar a head this species is amongst the cheapest reptiles to be exported from Indonesia, and with a purchasing price of a few dollar cents for a wild-caught individual there is no financial incentive to captive breed geckos.

With slow growth rates, and a low purchasing price of USD 2.15 for a 10–15 cm long wild-caught individual (note that under optimal conditions it takes close to a year to attain this size, cf. Saad et al., 2003), commercial breeding of *A. cartilaginea* in Indonesia is not an economically viable option. Dealers involved in the trade of reptiles in Indonesia state that this species is not captive bred and have suggested that exporters often claim wild-caught species as captive bred to avoid quantity restrictions imposed by the quota - there are no limits on the numbers of captive bred specimens that may be exported.

Fig. 5. Filesnakes *Acrochordus javanicus* filled with water before the skin is removed. Photo: Kate Sanders.

Enforcement of wildlife trade regulations

It is clear that the majority of the trade in the three species examined in this study is not carried out in accordance with Indonesia's national legislation. Although there are several regulations and guidelines in place in Indonesia to regulate the trade in freshwater turtles, snakes and geckos, few of the collectors, middlemen, and especially the smaller traders, abide by these rules. Our observations suggest that certainly the exporters in these species are fully aware of the law and CITES regulations, and as such we consider the trade to be illegal. Despite its illegality, trade is carried out in an open manner, with blatant disregard for the law, clearly demonstrating a serious lack of enforcement, and hence little deterrent for illegal activity.

As a result, harvest and export continue to greatly exceed quotas, and according to many individuals involved, this has resulted in significant local declines in traded species, indicating that harvest levels are unsustainable. Although

for meaningful quota-setting, non-detriment findings are required to be carried out, this has not been done for many reptile species in Indonesia and as such, there is no sound scientific evidence for any of the species in trade regarding a numerical limit for harvest that would be considered sustainable without affecting the survival of populations in the wild. Non-detriment findings should be carried out and take into consideration the levels of illegal trade. It is clear that if reptile trade is to be sustainable in Indonesia, existing regulations must be sufficiently enforced by the relevant authorities and by the reptile trade industry itself.

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REFERENCES

Amir, M., Sugardjito, J. & Boeadi (1998). The Scientific Authority of CITES, the Indonesian Institute of Sciences, LIPI. *Mertensiella* 9, 17–20.

Auliya, M (2010) *The conservation status and impacts of trade on the Oriental Rat Snake* Ptyas mucosa *in Java, Indonesia*. Petaling Jaya: TRAFFIC Southeast Asia.

Auliya, M. & Shepherd, C.R. (2007). Verhängnisvoll - der Ruf des Tokehs. *Terraria* 4, 100–101.

Broad, S., Mulliken, T. & Roe, D. (2003). The nature and extent of legal and illegal trade in wildlife. In *The trade in wildlife. Regulation for conservation*, pp. 3–22. Oldfield, S., (ed). London, Flora and Fauna International, Resource Africa and TRAFFIC International.

Grieser-Johns, A. & Thomson, J. (2005). Going, going, gone: The illegal trade in wildlife in East and Southeast Asia. Washington, D.C.: World Bank.

Gu, H.F., Xia, Y., Peng, R., Mo, B.H., Li, L. & Zeng, X.M. (2011). Authentication of Chinese crude drug gecko by DNA barcoding. *Natural Product Communications* 6, 67–71.

Houston, D. & Shine, R. (1994). Low growth rates and delayed maturation in arafura filesnakes (Serpentes: Acrochordidae) in tropical Australia. *Copeia* 1994, 726–731.

Nara, N. (2000). Kediri punya Sate Bekicot dan Semur Kobra. *Kompas*, 26 June, 34.

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

Nijman, V. & Shepherd, C.R. (2007). Trade in non-native, CITES-listed, wildlife in Asia, as exemplified by the trade in freshwater turtles and tortoises (Chelonidae) in Thailand. *Contributions to Zoology* 76, 207–211.

Nijman, V. & Shepherd, C.R. (2009). Wildlife trade from ASEAN to the EU: Issues with the trade in captive-bred reptiles from Indonesia. Brussels: TRAFFIC Europe Report for the European Commission.

Nijman, V. & Shepherd, C.R. (2011). The role of Thailand in the international trade in live CITES-listed reptiles and amphibians. *PLoS One* 6(3): e17825.

Nijman, V., Todd, M. & Shepherd, C.R. (2011). Wildlife trade as an impediment to conservation as exemplified by the trade in reptiles in Asia. In *Biotic evolution and environmental change in southeast Asia*. Gower, D.J., Richardson, J.E., Rosen, B.R., Rüber, L. & Williams, S.T. (eds). Cambridge: Cambridge University Press (in press).

Nooren, H. & Claridge, G. (2001). *Wildlife trade in Laos: the end of the game*. Amsterdam: NC-IUCN.

Phelps, J., Webb, E.L., Bickford, D., Nijman, V. & Sodhi, N.S. (2010). Boosting CITES. *Science* 330, 1752–1753.

Saad, C.R., Alimon, A.R., Tong, H.H. & Roustaian, P. (2003). Practical diet evaluation with hatchlings of soft-shell turtle, *Trionyx sinensis* Wiegmann, in the tropics. Journal of Applied Ichthyology 19, 62–63.

Samedi & Iskandar, D.T. (2000). Freshwater turtle and tortoise conservation and utilization in Indonesia. In *Asian turtle trade: Proceedings of a workshop on conservation and trade of freshwater turtles and tortoises in Asia*, 106–111. Van Dijk, P.P., Stuart, B.L. & Rhodin, A.G.J. (eds). Chelonian Research Monographs No. 2.

Sanders, K.L., Mumpuni, Hamidy, A., Head, J.J. & Gower, D.J. (2010). Phylogeny and divergence times of filesnakes (*Acrochordus*): Inferences from morphology, fossils and three molecular loci. *Molecular Phylogenetics and Evolution* 56, 857–867.

Shepherd, C.R. (2000). Export of live freshwater turtles and tortoises from North Sumatra and Riau, Indonesia: a case study. In *Asian turtle trade: Proceedings of a workshop on conservation and trade of freshwater turtles and tortoises in Asia*, 106–111. Van Dijk, P.P., Stuart, B.L. & Rhodin, A.G.J. (eds). Chelonian Research Monographs No. 2.

Shepherd, C.R., Sukumaran, J. & Wich, S.A. (2004). *Open season: An analysis of the pet trade in Medan, Sumatra 1997–2001*. Petaling Jaya: TRAFFIC Southeast Asia.

Shepherd, C.R. & Nijman, V. (2007a). The trade in bear parts from Myanmar: an illustration of the ineffectiveness of enforcement of international wildlife trade regulations. *Biodiversity and Conservation* 17, 35–42.

Shepherd, C.R. & Nijman, V. (2007b). *An overview of the regulation of the freshwater turtle and tortoise pet trade in Jakarta, Indonesia*. Petaling Jaya: TRAFFIC Southeast Asia.

Shine, R., Harlow, P., Keogh, J.S. & Boeadi (1995). Biology and commercial utilization of Acrochordid snakes, with special reference to karung (*Achrochordus javanicus*). Journal of Herpetology 29, 352–360.

Soehartono, T. & Mardiastuti, A. (2002). *CITES–Implementation in Indonesia*. Jakarta: Nagao NEF.

Webb, G.J.W. & Vardon, M.J. (1998). Reptile harvests, sustainable use and trade. *Mertensiella* 9, 45–60.

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