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Longitudinal monitoring of turtle trade through Facebook in Vietnam

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Trade of turtles, for both food and pet, represents a substantial business in Vietnam, especially because this country is a cross-bridge for wildlife trade from Indochina to China. Vietnam is also one of the main countries worldwide in terms of the number of Facebook members, and a considerable portion of the business has gone online through Facebook trading, including turtle trade. Here, the advertisements of turtles for sale in Vietnamese Facebook groups were monitored for the period 2013-2018, obtaining a total of 481 advertisement cases concerning 5,758 individuals belonging to 53 species and 12 families. There has been a rapidly rising trade of turtles online, especially in the last two years. Many traded species were allochthonous, but native species accounted for 22 species and over 36 % of the traded individuals. Most allochthonous species were traded as hatchlings and juveniles, whereas most of the native species were traded as subadults and adults, thus suggesting a high frequency of illegal trade in wild caught animals. Five traded native species are considered among the 50 most threatened turtle species in the world. Turtle trade occurred mostly in the two biggest cities of Vietnam (Ho Chi Minh city and Hanoi), which accounted for 68 % of the total trade. Turtle price varied substantially across species and by different life stages (i.e. hatchlings, juveniles, sub-adults and adults), and increased considerably in comparison to 1993 estimates.

Key words: turtle trade, Facebook, Asia, Vietnam

INTRODUCTION

Trade of turtles, for both food and pet, represents a substantial business, both internationally and within several 'mega-biodiverse' tropical and subtropical countries, and has consequently risen considerably through the last decades (Böhm et al., 2013; Auliya et al., 2016; Luiselli et al., 2016). The turtle trade has been especially massive in Asia (Van Dijk et al., 2000; Turtle Conservation Fund, 2002; Cheung & Dudgeon, 2006), thus causing substantial concern among conservation biologists who defined it as the 'Asian turtle crisis' (e.g., see Van Dijk et al., 2000; Ly et al., 2011; Horne et al., 2012). During the 'Asian turtle crisis', there have been an estimated 300 million turtles traded in the Chinese market in the period 1990s-2000s, including wild caught and farmed individuals (Yiming & Dianmo, 1998; Haitao et al., 2008).

The socialist republic of Vietnam, being a "cross-bridge" for wildlife trade from Indochina to China (Yiming & Dianmo, 1998; Van Song, 2008; Ngoc & Wyatt, 2013), has been the main turtle supplier to the Chinese market

(Hendrie, 1998, 2000). Vast amounts of turtles have provided the Chinese market with food, ingredients for traditional medicine, farming and pets (Hendrie, 2000). Conversely, Vietnamese people do not traditionally consume turtles for subsistence and rarely use their parts for traditional medicine (Le Dien Duc & Broad, 1995). The turtle business as a whole is worth USD 750 million annually in China, with more than 300 million turtles sold yearly (Haitao et al., 2008). As a consequence of decades of massive trade, the wild populations of many Vietnamese turtles have been substantially impoverished (Hendrie, 2000; Le, 2007; Ly et al., 2011) with some species on the brink of extinction (Stanford et al., 2018). After decades of overharvesting, the quantity of traded turtles has declined remarkably in Vietnam, presumably due to a massive decline of the wild turtle populations (McCormack & Hendrie, 2007; Van Song, 2008; Linh et al., 2016).

In the last five years, the situation has been changing, whereby increasing numbers of turtles are being imported to Vietnam from China, Thailand and Malaysia to serve the pet market (Thong Pham Van,

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unpublished observations). Before 2010, keeping turtles as pets was rare within Vietnamese households due to the local culture considering any turtle to be a God, thus discouraging any attempt at keeping turtles at home as a source of bad luck to the owners (Espenshade & Le, 2002; Le Thien Duc, 2003). However, there are a few shops, mostly from the tourist areas such as Tam Dao town, Vinh Phuc Province, where turtles were sold as pets, with just few species being kept (i.e. *Geoemyda spengleri*, *Cuora galbinifrons*, *Cuora mouhotii*) (Le Dien Duc & Broad, 1995; Hendrie, 1998). After 2010, young Vietnamese people started to collect turtles as pets, and this trend became a true “fashion” in 2012-2013. Nowadays, there are dozens of turtle species, including native and *allochthonous* species of all ages (hatchlings, juveniles, sub-adults and adults) being traded as pets (Linh et al., 2016). For instance, juvenile turtles (especially *Trachemys scripta*) became frequently traded in animal shops in Hanoi (our unpublished observations). Recently, the online market of wildlife has grown dramatically (e.g., INTERPOL, 2013; Lavorgna, 2014, 2015; Chng & Bouhuys, 2015; Morgan & Chng, 2017), even posing serious issues to biosecurity (Derraik & Phillips, 2010). In Vietnam, turtle trade has also gone online by using social networks such as Facebook (Linh et al., 2016), but this form of trade has not been intensively monitored so far by conservation biologists. To the best of our knowledge, the only study on turtle trade via Facebook was conducted by Linh et al. (2016), who monitored this form of social media for just two months (March to May 2016), recording 346 turtle individuals belonging to 15 different species traded in online markets. Nowadays, Vietnam has about 64 million Facebook users, which account for about two third of the country’s population (Ha Phuong, 2017), with an exponentially increasing amount of people conducting business on Facebook (Nguyen, 2017). Thus, following the increasing demand from Vietnamese people, turtle trade on Facebook started to become popular in the country a few years ago. It is presumed that trade through Facebook may severely influence the turtle market in Vietnam in the years to come (see also Linh et al., 2016). Therefore, in this study, we present a longitudinal monitoring of the turtle trade in Vietnam through Facebook in the years 2013-2018, with the aim contributing to the understanding of this emerging source of threats for wild turtle populations.

METHODS

Protocol

We examined Facebook pages of turtle dealers from 1st December 2017 to 7th August 2018. During this period, while examining all the current posts of these Facebook pages, we also carefully scrutinised their retrospective posts for the period 2013-2018. As Facebook (hereby FB) became popular in Vietnam since 2012, here we present data for the whole period of popularity of this form of social media in the country. Nonetheless, and despite all possible efforts for obtaining a comprehensive dataset, it cannot be excluded that several advertisements for the period 2013-2016 may have been missed, thus making

our estimates on the numbers of traded individuals conservative for that period of time. We also cannot exclude that illegal advertisement might be deleted after the turtles were sold, thus lowering our counts.

Data searches on FB was updated daily, with the main targets being turtle trade groups, personal FB accounts of turtle traders, fanpages of turtle traders, and confiscation news from fanpages of Non-Government Organizations (NGO). The most popular groups that commonly advertised turtles for sale were: Hội Yêu Rùa Việt Nam, Hội nuôi rùa bảo tồn, bán rùa cảnh, Hội rùa Việt Nam, Rùa cạn ba miền, and Hoi san ban thu 3 mien (i.e. groups of wildlife hunters in three regions of Vietnam). It should be noticed that, on each turtle trade group, there are hundreds of turtle buyers and sellers. For example, the most popular groups are Hội Yêu Rùa Việt Nam (with 11,397 members at time of writing), Hội yêu rùa cạn (10,784 members), and Hội yêu rùa kiểng Việt Nam (9,462 members), etc. Thus, it is assumed that most of the online turtle trade business in Vietnam was monitored during the present study.

In several cases, the same advertisement including the same individual turtles for sale was advertised on two or more FB groups. Usually, the traders used the same pictures for advertising a given turtle sample in the various FB groups, thus making very easy to record only one post for our analyses and to ignore the rest. There were some additional cases in which a trader posted the picture to sell, for example, 10 turtles at one time, and then 10 days later they posted different photos of five turtles (same species as in the previous advertisement) that might be a subgroup of the first traded sample. In these cases, we asked him/her whether the turtles belonged to the same sample that was advertised in the first instance, and then recorded the data on the basis of trader’s comments.

For all traded individuals, we identified the species on the basis of the FB pictures (Fig. 1). We did not consider advertisements without appropriate pictures in order to avoid species’ misidentifications or fake announcements. The number of turtles on trade were counted on the basis of the visible number of turtles on the pictures posted in the above-mentioned FB sources. These counts were then confirmed by asking the owner, through private message or comment, on how many turtles of each given species he/she had to sell. This means our counts were on the conservative side. The traded turtles were classified into hatchlings, juveniles, sub-adults and adults on the basis of the appearance of the traded individuals in the FB pictures. We recorded the location of trade to determine where are the ‘hotspots’ of turtle trade within Vietnam. The date of the posts were also recorded, along with the price for each turtle, obtained from the post or by asking privately or in a public comment to the seller.

We also aimed to determine whether a given turtle was legally or illegally traded. In the case of *allochthonous* species, one of us (Thong Pham Van; hereby TPV) privately asked the traders for the legal permits for all the individuals offered for sale. This information was requested using the regular FB account of TPV without hiding his identity. In the case of Vietnam’s native

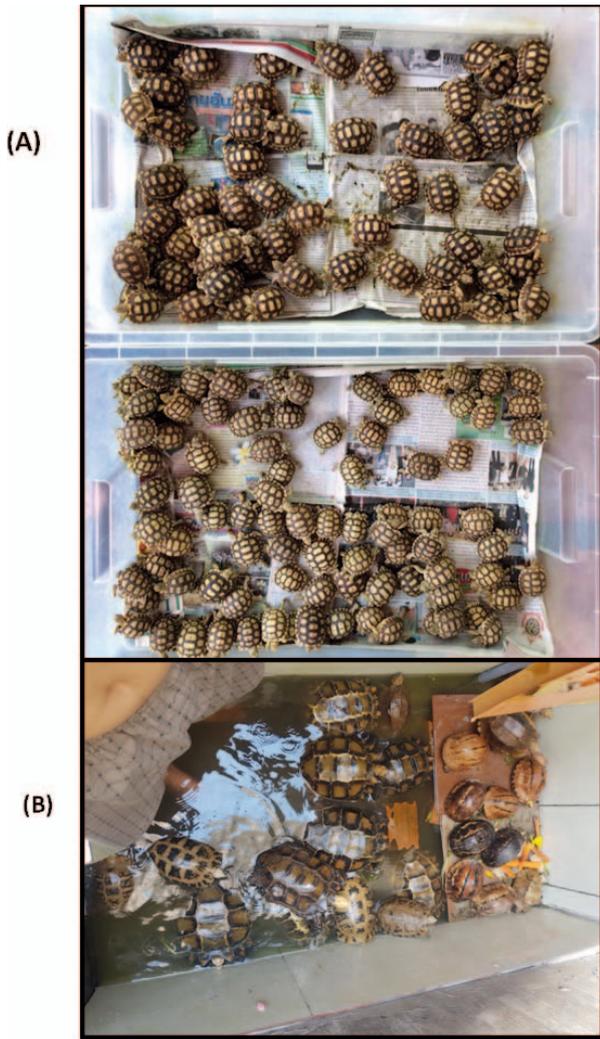


Figure 1. Examples of pictures of Vietnamese turtles on trade through Facebook. **(A)** individuals on legal trade; **(B)** individuals on supposedly illegal trade.

species, when the traders advertised the selling of large numbers of hatchling turtles, mostly aquatic species (i.e. *Mauremys sinensis*, *Heosemys grandis*, *Mauremys mutica*, *Heosemys annandalii*), we assumed that this trade was legal because there were many farms that have legal permits to sell turtles issued by Provincials Forest Protection Department (FPD). These farms normally legally sell hatchling turtles in large numbers (>10 individuals on each occasion; Fig. 1A). When turtles were traded as adults and sub-adults, and usually in small numbers, we classified this trade as illegal as these turtles were most likely wild caught, with no evidence of any legal permit released from competent authorities (Fig. 1B). We also directly asked traders whether they have legal permits for the traded animals. As a general rule, traders explicitly state that an animal is legally traded if they have permit, and they usually sell it for a higher price. In these few cases, the individual was obviously considered ‘legal’, but this situation appeared extremely rare when adult and subadult native turtles were offered for trade.

Statistical analyses

We used parametric tests only after having verified data normality and homoscedasticity in all variables using a Shapiro-Wilk W test. We assessed the correlation between year and number of traded turtles using Pearson’s correlation coefficient, and the correlation between year and yearly number of traders by Spearman’s rank correlation coefficient. Contingency table χ^2 test was used to evaluate the frequency differences in terms of traded individuals (hatchlings + juveniles versus subadults + adults) between native and allochthonous species. In the text, the means are presented ± 1 Standard Deviation. All statistical analyses were performed by Past 3.0 software, with alpha set at 5 %.

RESULTS

General data

We recorded 481 advertisement cases of turtles and tortoises for sale on FB from 2013-2018. Overall, these advertisements concerned 5,758 individuals belonging to 53 species and 12 families, including both allochthonous and native species (Table 1). Overall, 71.9 % of the traded individuals were hatchlings and juveniles, and 28.1 % were subadults and adults. In the period 1st January 2018-30th July 2018, there were an average of 16 individual turtles on trade daily.

Turtle price varied substantially across species and by different lifestages (i.e. hatchlings, juveniles, sub-adults and adults) (Table 1). In addition, the price is also varied hugely in relation to the different coloration morphs of each given species: for example, the normal form of *Malayemys subtrijuga* was traded at \$6.82 while the albino form (white or golden in colour) was sold for up to \$1704.55. The same was true also for *Heosemys annandalii*, with its albino form juvenile being traded at \$4545.45. The price for normally coloured individuals was unknown as the traders did not publish the price in their FB pages.

Although Chelonians originated mostly from Asia and North America, species from Africa (for instance, *Centrochelys sulcata*, *Pelomedusa subrufa*) and Europe (*Testudo hermanni*) were also recorded (Table 1). Among them, 45.3 % of the traded species were Vietnam’s native species and 54.7 % were allochthonous species. 60.4 % of 53 traded species were listed as Threatened in IUCN (2018) Red List. Specifically, 15.1 % were Critically Endangered, 18.9 % were Endangered, and 26.4 % were Vulnerable. In addition, 7.5 % of them were listed on CITES Appendix I and 54.7% were listed on CITES Appendix II (CITES 2017).

Based on answers provided by the sellers, it appeared that the turtle sources outside Vietnam were China (about 80 % of individuals on trade, mostly belonging to freshwater species), whereas the sources of terrestrial species were Malaysia and Cambodia (5 % of individuals on trade), Thailand (5 % of individuals on trade), Madagascar and countries from Africa (especially Mozambique, Tanzania and Sudan, 5 % of individuals on trade), and other countries (roughly 5 % of individuals).

Table 1. Summary of the chelonian species (listed in alphabetical order) offered for sale in Vietnam on Facebook in the period 2013-2018. The traded amounts and the range in prices per individual is also presented.

Species	Quantity	Lowest (\$)	Highest (\$)
<i>Aldabrachelys gigantea</i>	24	2272.73	16000.00
<i>Amyda cartilaginea</i>	10	22.73	
<i>Astrochelys radiata</i>	223	909.09	1818.18
<i>Carettochelys insculpta</i>	35	59.09	204.55
<i>Centrochelys sulcata</i>	334	59.09	2000.00
<i>Chelodina mccordi</i>	5	54.55	136.36
<i>Chelonida novaeguineae</i>	1	90.91	-
<i>Chelonida siebenrocki</i>	1	77.27	-
<i>Chelonoidis carbonaria</i>	11	-	1420.45
<i>Chelus fimbriata</i>	4	72.73	118.18
<i>Chelydra serpentina</i>	1179	5.23	363.64
<i>Chrysemys picta</i>	5	31.82	-
<i>Cuora amboinensis</i>	66	13.64	20.45
<i>Cuora bourreti</i>	134	36.36	109.09
<i>Cuora galbinfrons & Cuora bourreti</i>	100	-	-
<i>Cuora galbinfrons</i>	159	56.82	190.91
<i>Cuora mouhotii</i>	91	6.82	22.73
<i>Cuora picturata</i>	71	70.45	90.91
<i>Cuora 'serata'</i>	1	-	-
<i>Cyclemys oldhamii</i>	2	17.27	-
<i>Cyclemys pulchristriata</i>	19	13.64	15.91
<i>Emydura subglobosa</i>	2	54.55	-
<i>Geochelone elegans</i>	69	90.91	909.09
<i>Geochelone platynota</i>	13	718.18	-
<i>Geoclemys hamiltonii</i>	1	272.73	-
<i>Geoemyda spengleri</i>	197	5.00	15.91
<i>Graptemys geographica</i>	1	-	-
<i>Heosemys annandalii</i>	154	-	4545.45
<i>Heosemys grandis</i>	93	22.73	25.00
<i>Indotestudo elongata</i>	354	15.91	113.64
<i>Macrochelys temminckii</i>	2	250.00	318.18
<i>Malaclemys terrapin</i>	10	77.27	-
<i>Malayemys subtrijuga</i>	31	6.82	1704.55
<i>Manouria impressa</i>	26	15.91	45.45
<i>Mauremys annamensis</i>	4	-	-
<i>Mauremys mutica</i>	263	13.18	40.91
<i>Mauremys reevesii</i>	42	7.27	15.91
<i>Mauremys sinensis</i>	253	3.64	22.73
<i>Pelochelys cantori</i>	2	-	-
<i>Pelomedusa subrufa</i>	1	-	-
<i>Phrynops hilarii</i>	2	113.64	-
<i>Platysternon megacephalum</i>	63	50.00	81.82
<i>Podocnemis unifilis</i>	55	25.91	34.09
<i>Pseudemys peninsularis</i>	1	8.64	-
<i>Sacalia quadriocellata</i>	11	45.45	-
<i>Siebenrockiella crassicollis</i>	1	13.64	-
<i>Staurotypus triporcatus</i>	10	127.27	-
<i>Sternotherus carinatus</i>	4	-	-
<i>Sternotherus odoratus</i>	1	-	-
<i>Stigmochelys pardalis</i>	161	120.45	772.73
<i>Testudo hermanni</i>	2	-	-
<i>Trachemys scripta elegans</i>	1177	0.91	20.45
<i>Trachemys scripta scripta</i>	277	1.82	15.91

For allochthonous species, some big shops in Hanoi and Ho Chi Minh city issued CITES permits. However, most of the turtles traded in Vietnam were illegal: we estimated that the illegal trade outweighed the legal one by 88.4 % versus 11.6 % of traded individuals respectively.

The most frequently traded species belonged to the families *Geoemydidae* and *Testudinidae* (43 % and 39 % respectively) (Fig. 2). Turtle trade occurred mostly in the two biggest cities of Vietnam: Ho Chi Minh City (42 % out of a total of 5,758 traded individuals) and Hanoi (26 %). Thus, these two cities accounted for 68 % of the total trade. Other towns still contributed with considerable numbers of individuals: 6 % of individuals were traded in Da Nang, 3 % in Lang Son and the remaining 23 % in many other smaller towns. Overall, the sources of online turtle trade were widespread within the political territory of Vietnam (Fig. 3).

In terms of the number of individual turtles traded by the main FB's groups, *Hội yêu rùa Việt Nam* traded about 45 % of the total followed by *Hội yêu rùa cạn* (20 %) and *Rùa cạn ba miền* (6 %). Other sources (i.e. CLB nuôi rùa bảo tồn, Rùa kiểng Việt Nam, chuyên bán rùa cảnh, Kato pet shop, Viet pet garden and so on) accounted for about 29 % of the total traded turtles.

Native species

22 species and 2,105 traded individuals (36.6 % of the total) belonged to species that are native to Vietnam (Table 2). It is possible that for an undocumented number of individuals, the species is native to Vietnam but the individuals might come from neighbouring countries. Six of these species (i.e. *Indotestudo elongata*, *Mauremys mutica*, *Mauremys sinensis*, *Cuora galbinifrons*, *Geoemyda spengleri*, and *Cuora bourreti*) accounted for the great majority of the traded turtle individuals (Table 2). Among the Vietnamese species, one (*Mauremys annamensis*) is considered among the 25 most endangered turtles in the world, and four species (*Cuora bourreti*, *Cuora galbinifrons*, *Cuora picturata* and *Pelochelys cantori*) are considered among the 50 most endangered turtles in the world (Stanford et al., 2018).

Considering only the species native to Vietnam ($n = 22$), their yearly traded numbers varied from 3 to 1,192 (mean = 350.8 ± 455.3), and increased significantly year-by-year ($r = 0.852$, $r^2 = 0.726$, $n = 6$, $P < 0.05$). In particular, there was an exponential increase in the number of traded individuals in 2017 and 2018 (Fig. 4). In some species, only hatchlings were traded (e.g. *Amyda cartilaginea*) and in others only adults (e.g., *Geoemyda spengleri*). Among the native species, hatchlings accounted for 19.6 ± 36.3 %, juveniles for 9.2 ± 21.6 %, subadults for 13.7 ± 27 %, and adults for 57.5 ± 37.6 % of the traded individuals. Thus, the great majority of the traded individuals from Vietnamese species were adults. If we consider the five most endangered species, all the traded individuals were adults for *Mauremys annamensis* and *Pelochelys cantori*, whereas adults accounted for 88.5 % of traded *Cuora galbinifrons*, 84.7 % of *Cuora bourreti* and 69 % of *Cuora picturata* (Table 2). Therefore, the great majority of the traded individuals of the most threatened species were adults.

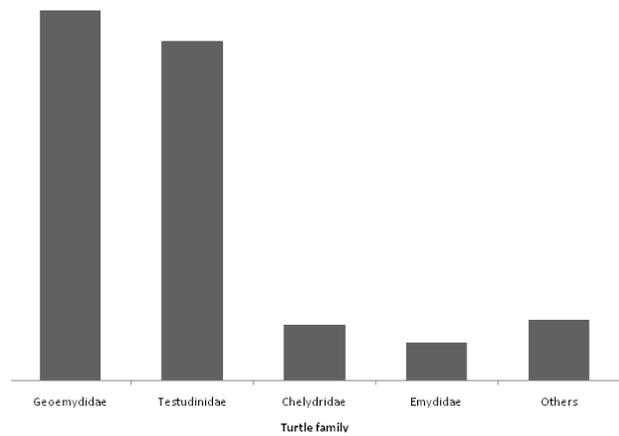


Figure 2. Percentage of turtle individuals on trade through Facebook in Vietnam by family

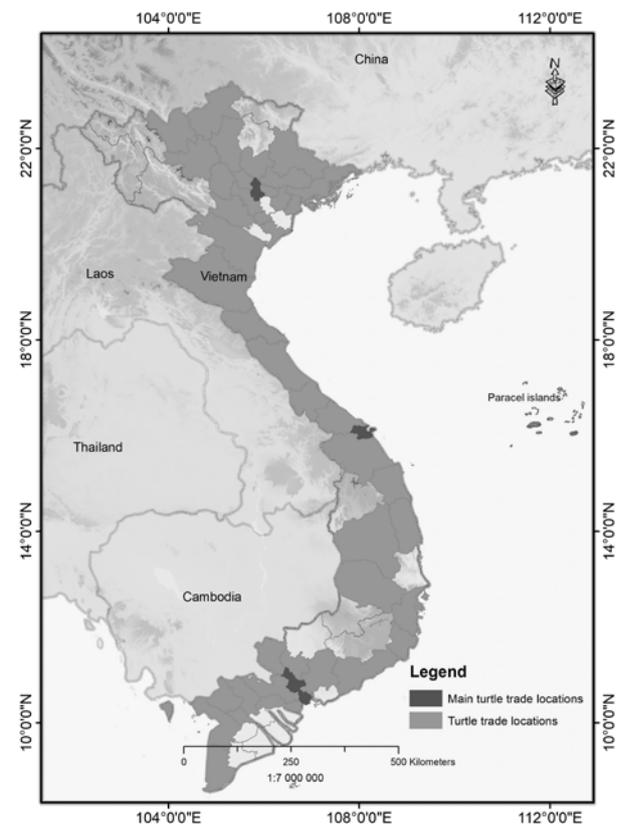


Figure 3. Map of Vietnam showing the areas from which turtle trade originated.

The frequency of hatchlings + juveniles versus subadults + adults on trade was significantly different between allochthonous and native species ($\chi^2 = 37.35$, $df = 1$, $P < 0.0001$), with the two younger categories dominating the allochthonous species sample and the two older categories dominating the native species sample. The yearly number of FB traders (mean = 53.2 ± 46.8 , range = 13-142) increased significantly from 2013 to 2018 (Spearman's $r_s = 0.942$, $n = 6$, $P < 0.005$).

DISCUSSION

The social context of turtle trade in Vietnam

The general economy of Vietnam has grown quickly during the recent decades, and the country is now recognised as a middle income country, with a middle class increasing very rapidly in terms of the number of people (World Bank, 2016). Concurrently, there has also been a much higher interest from people for the pet market. Indeed, other than dogs and cats, which have always been routinely kept as pets in Vietnam, it is now normal that middle class people keep reptiles in captivity, especially freshwater turtles and tortoises. Our study showed that, indeed, keeping turtles in captivity is a growing “fashion” in Vietnam, as indicated by the exponential increase of chelonians offered for sale in FB and the high increase in the yearly number of online turtle traders. In this regard, it is possible that Vietnamese tend to prefer allochthonous species as pets rather than native species due to the difficulty of keeping native species, as most of them die easily in captivity (ATP, 2012, 2014).

We also showed that both allochthonous and native species do enter the online trade. However, allochthonous species were primarily young turtles, whereas native species were primarily adult turtles. Why do allochthonous and native species differ in terms of frequency of age classes of traded individuals? For allochthonous species, young turtles (especially the North American *Trachemys scripta* and *Chelydra serpentina*) come from farms situated in China, and are sought after especially by FB teenagers (TPV unpublished

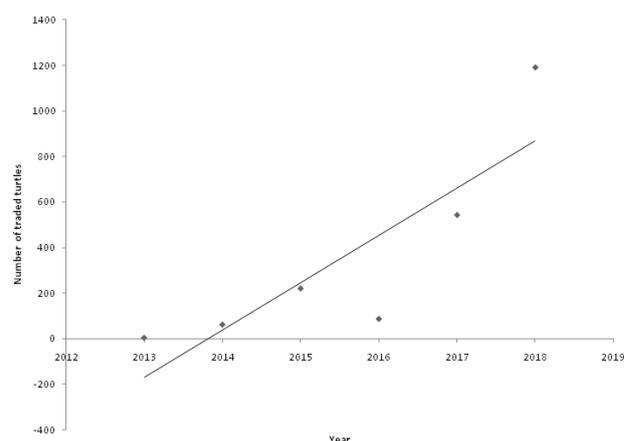


Figure 4. Correlation between year and number of native turtles of Vietnam traded on Facebook. For the statistical details, see the text.

data), who can still afford to buy these animals because of their moderate prices. On the other hand, the highly expensive allochthonous tortoises (*Aldabrachelys gigantea*, *Chelonoidis carbonaria*, etc) are usually bought by rich businessmen looking for animals serving the purpose of ‘Feng Shui’ (bringing good luck on business; TPV unpublished data), but are much less frequently traded than the juvenile farmed turtles. This explains why juvenile turtles dominate the allochthonous sample available for trade on FB. Concerning the native species, the great majority of the traded individuals were certainly wild caught, and often

Table 2. Number of turtle individuals native to Vietnam traded on Facebook in the period 2013-2018 by their age group. *Cuora 'serata'* is a hybrid between *C. galbinifrons* and *C. mouhotii*. The species are listed in alphabetical order.

Species	Number traded	% hatchling	% juvenile	% subadult	% adult
<i>Amyda cartilaginea</i>	10	100.0	0	0	0
<i>Cuora amboinensis</i>	66	27.2	4.5	18.3	50.0
<i>Cuora bourreti</i>	184	0	7.1	8.2	84.7
<i>Cuora galbinifrons</i>	209	0	3.4	7.7	88.5
<i>Cuora mouhotii</i>	91	0	18.7	54.9	26.4
<i>Cuora picturata</i>	71	0	28.2	2.8	69.0
<i>Cuora 'serata'</i>	1	0	0	0	100.0
<i>Cyclemys oldhamii</i>	2	0	100.0	0	0
<i>Cyclemys pulchristriata</i>	19	0	0	26.3	73.7
<i>Geoemyda spengleri</i>	197	0	0	0	100.0
<i>Heosemys annandalii</i>	154	32.5	0	0	67.5
<i>Heosemys grandis</i>	93	84.9	0	1.1	14.0
<i>Indotestudo elongata</i>	354	0	16.1	28.5	55.4
<i>Malayemys subtrijuga</i>	31	0	6.5	29.0	64.5
<i>Manouria impressa</i>	26	0	0	3.9	96.1
<i>Mauremys annamensis</i>	4	0	0	0	100.0
<i>Mauremys mutica</i>	263	94.3	5.7	0	0
<i>Mauremys sinensis</i>	253	90.9	2.4	0.8	5.9
<i>Pelochelys cantori</i>	2	0	0	0	100.0
<i>Platysternon megacephalum</i>	63	1.6	0	19.0	79.4
<i>Sacalia quadriocellata</i>	11	0	9.1	0	90.9
<i>Siebenrockiella crassicolis</i>	1	0	0	100.0	0

Table 3. List of turtle species fully protected by Vietnam national law.

Species	Decree 160/ NĐ-CP/2013	Decree 32/ NĐ-CP/2006
<i>Amyda cartilaginea</i>		
<i>Cuora amboinensis</i>		
<i>Cuora bourreti</i>		
<i>Cuora galbinifrons</i>	x	
<i>Cuora mouhotii</i>		
<i>Cuora picturata</i>		
<i>Cuora 'serata'</i>		
<i>Cyclemys oldhamii</i>		
<i>Cyclemys pulchristriata</i>		
<i>Geoemyda spengleri</i>		
<i>Heosemys annandalii</i>		x
<i>Heosemys grandis</i>		x
<i>Indotestudo elongata</i>		x
<i>Malayemys subtrijuga</i>		
<i>Manouria impressa</i>		x
<i>Mauremys annamensis</i>		x
<i>Mauremys mutica</i>		
<i>Mauremys sinensis</i>		
<i>Pelochelys cantori</i>	x	
<i>Platysternon megacephalum</i>		x
<i>Sacalia quadriocellata</i>		
<i>Siebenrockiella crassicollis</i>		

Table 4. Comparison of the price of turtles offered for sale on Facebook in the past (Le Dien Duc & Broad, 1995) and now (this study)

Species	1993 (\$/kg)*	2018 (\$/individual)**
<i>Amyda cartilaginea</i>	6.82	22.73
<i>Cuora amboinensis</i>	3.91	20.45
<i>Cuora galbinifrons</i>	3.91	19.09
<i>Cuora mouhotii</i>	1.82	22.73
<i>Cyclemys oldhamii</i>	1.82	17.27
<i>Geoemyda spengleri</i>	0.23	15.91
<i>Heosemys grandis</i>	1.50	25.00
<i>Indotestudo elongata</i>	1.82	113.64
<i>Manouria impressa</i>	2.27	45.45
<i>Mauremys mutica</i>	1.18	40.91
<i>Platysternon megacephalum</i>	1.82	81.82

of relatively big size likely because they are easier for hunters and hunting dogs to find in the wild. Thus, the shortage of juvenile individuals from native species is an evidence that FB trade of Vietnamese turtles is based on wild caught animals. This result also indirectly indicates that the breeding of many species at local farms might not very successful. By contrast, because captive breeding is more successful for *Mauremys mutica*, *Mauremys sinensis*, *Amyda cartilaginea* and *Heosemys grandis*, the juvenile and hatchling individuals dominate the traded turtles belonging to these four species.

The trade of native turtles

A total of 32 chelonian species (including five marine species) are naturally occurring in Vietnam (Turtle Taxonomy Working Group, 2017). Our study revealed that, through FB, 68.9 % (or 81.5 % if we exclude the marine species from the count) of the native chelonian species of Vietnam were traded online. Our estimates of the numbers of native turtles traded through FB are likely conservative, and more individuals would have been traded but escaped our monitoring. For instance, Linh et al. (2016) considered also Google trade exchanges (which we did not monitor), and their recorded numbers were therefore higher than ours for the same short study period in which our two respective studies overlapped (2013 to 2015).

As mentioned above, the native turtles mostly came from the wild, with individuals being caught not only in Vietnam but also in neighbouring countries such as Laos and Cambodia (Hendrie, 1998). In Vietnam, viable turtle populations can still be found in protected areas (e.g. Le, 2007), but rarely outside (Thong Pham Van & Leprince, unpublished data). Therefore, it is presumed that almost all the native turtles on trade come from protected areas due to the lack of attention from rangers and relevant agencies. Nowadays, poachers still operate in the surroundings of the protected areas (TPV et al., unpublished data), and they routinely enter the protected forest to hunt wildlife with hunting dogs. Le (2007) reported, for instance, that turtle trade around Cat Tien National Park was still high despite populations of six turtle species being viable (see also Morris et al., 2004). It is likely that turtle populations may have declined substantially inside protected areas, but sound data are lacking in this respect. This hypothesis is indirectly supported by the TPV's interviews of some poachers in 2017 and 2018, who said that they were able to collect bags of 10-20 kg of turtles per day in the 1980s-1990s, but that now they only can find one or two turtles per week.

The increase in the yearly number of FB traders throughout the years was essentially due to a change in the policy of the FB groups trading turtles in Vietnam. Indeed, in 2013 there were only 13 turtle traders actively selling online. However, due to conflict of interest, the administrators of the FB group "CLB nuôi rùa bảo tồn" decided to shift towards becoming a conservation group instead of a trading turtle group, and that was why some traders established their own group to be free to continue their online trade of turtles. Thus, the number of traders increased up to 142 in 2018.

Most sellers of turtles on FB are not the hunters. Indeed, the wild-caught turtles were bought by local traders from poachers and then sold to the provincial traders before joining the big traders, usually operating in the China's market. Although Vietnam's market of turtles is growing quickly, the overall number of turtles being kept within the country is certainly still very small compared to China. Thus, the online market is based on a few intermediate clients (Linh et al., 2016; TPV & Linh, unpublished data). The price of turtles traded in the traditional way was remarkably lower than those

advertised on FB: for example, the market price of *Geoemyda spengleri* is approximately \$5/individual in the traditional way (TPV & Linh, unpublished data) whereas it is about \$15.91 per individual on FB. This fact is also due to the fact that most FB clients are middle-class people in relatively good wealth.

The average turtle price has increased considerably in the last 15 years (Table 4; but notice that the data are not directly comparable because in 1993 it was a cost per kg and in 2018 it is a cost per individual), with a trend that was general across species. In this regard, *Indotestudo elongata* and *Platysternon megacephalum* were the species whose prices increased the most (Table 4). Exchange rates in 1993 were about 13,000 VND per US dollar, whereas currently is 22,000VND per US dollar. These differences in the exchange rate should also be considered when comparing the increases in price of the traded turtles. Either way, the considerable increase in turtle prices over the years was also noted by Linh et al. (2016), who showed how prices of six species increased considerably even within short time intervals, i.e. between 2013 and 2015. According to Linh et al. (2016), prices of turtles are not affected by weight but only by the size of the animals. We did not collect data in this regard, and thus we could not confirm this otherwise noteworthy remark.

Our study also documented that, although eight native species are fully protected by Vietnam National Laws Decree 160/NĐ-CP/2013 and Decree 32/NĐ-CP/2006 (Table 3), these species still appeared on online trade. Decree 32/NĐ-CP/2006, enforced by the Forest Protection Department (FPD) of the Ministry of Agriculture and Rural Development (MARD) of Vietnam, lists seven turtle species as protected. Six of these protected species, however, appeared regularly on FB. For instance, *Indotestudo elongata*, although fully protected by law, was one of the most commonly traded native species (n = 354 individuals).

Criminal Law modified in 2015 has served as the background to fine the wildlife traders involved in trading wildlife species listed in the Decree 160/2013/NĐ-CP and Decree 32/2006/NĐ-CP. For instance *Cuora galbinifrons* traders may be sentenced for up to three years in jail. Environment police are more equipped to gather evidence online, whereas forest rangers focus more on patrolling and monitoring violations in the field. Decree 160 was recently revised and submitted to the central government for approval. Four new turtle species have been proposed to be added in the revised version. Indeed, this law had substantially reduced the number of individual turtles traded on FB for the species it specifically protected (*Cuora galbinifrons*) and traders may be sentenced to jail for up to three years, thus certainly discouraging the trade. However, since only a few species were protected under this law (i.e. *Cuora galbinifrons*, *Cuora trifasciata*, *Mauremys annamensis*, *Pelochelys cantorii* and *Rafetus swinhoei*), this law is still irrelevant for the protection of all other species from trade. Therefore, lack of legislation still remains a big issue in native turtle conservation within the country, and the same is also true for the allochthonous species

as there are no effective laws to control the turtle trade (Amanda et al., 2016).

In conclusion, our study revealed a rapidly rising trade of turtles, including threatened native species, via FB in Vietnam. Although the total number of traded individuals, as detected in this study, is much smaller than the number that was documented during the 1990s-2000s (Haitao et al., 2008), nonetheless the documented rise of the FB trade of turtles is worrying, especially because it concerns also some of the most threatened turtle species in the world (Stanford et al., 2018) and wild populations are already very much reduced (Hendrie, 2000). It is strongly recommended that Vietnamese police should quickly implement a rigorous control system for the online trade of turtles, in cooperation with rangers, as well as new regulations for online trading of wildlife in CITES and in the countries (Morgan & Chng, 2017) and awareness campaigns to the population (Linh et al., 2016).

We also agree with Amanda et al. (2016) that, also for Vietnamese species, it is imperative that (i) a multipronged approach should be used to combat the growing global turtle trade (for instance, with wild-caught individuals imported to China being now often sourced from South America and Africa as supply from South-east Asia decreases), and that (ii) alternative ways to meet end market demand should be studied in the long-term.

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