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A Short Review of the International Trade of Wild Tortoises and Freshwater Turtles Across the World and Throughout Two Decades

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ABSTRACT. – **The CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) data set for the years 1990–2010 were analyzed to depict the main patterns of trade for tortoises and freshwater turtles of wild origin. About 2 million wild individuals were traded over 20 yrs of monitoring, with 48 species (of 335 turtle species in total) belonging to 10 distinct families being regularly traded and over 100 being at least occasionally traded. Most of the traded specimens belonged to the families Testudinidae, Geoemydidae, Emydidae, and Trionychidae (about 93% of trade). The trade of wild individuals reached its peak in the early 2000s, with this pattern being stronger in the Asian region. After the years 2003–2005, there was a substantial decrease in the number of wild exports from the Asian region, with a remarkable growth in the export numbers from the Nearctic region. It is unknown whether the reduction of exported Asian region turtle numbers depended on 1) CITES regulation and supervision or 2) a collapse of the wild populations. There were uneven frequencies of wild turtles traded by biogeographic region, with a higher amount of traded wild turtles coming from Asian and Palearctic regions. There were 107 exporting countries, with Malaysia, the United States, and Indonesia being the most important countries in the trade (each one responsible for over 20% of trade). Overall, there were 66 importing countries, with the most important being the United States (17%), China (15%), and Hong Kong (12%). The conservation implications of the observed patterns are discussed.**

KEY WORDS. – **chelonians; CITES; wild individuals; conservation**

It has been demonstrated that reptiles currently represent the second-most species-rich vertebrate class after birds in the international pet trade (Bush et al. 2014). Many studies have explored the possible overexploitation of reptiles in the pet trade, with some papers being published since the late 1960s (Lambert 1969; Spellerberg 1976) up to the recent years (Gibbons et al. 2000; Schlaepfer et al. 2005; Luiselli et al. 2012; Auliya et al. 2016). In addition, it appears that harvesting of wild reptile populations is the second largest threat for reptile species worldwide (Böhm et al. 2013). Among reptiles, turtles and tortoises represent the most threatened group of vertebrates worldwide, with over 60% qualifying to be listed as Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) by the International Union for Conservation of Nature (IUCN) (Buhlmann et al. 2009; Turtle Taxonomy Working Group 2014). Turtles and tortoises are also heavily traded; therefore, the international trade in many turtle species is regulated under CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

In the present study, we analyze the patterns of international trade of terrestrial, freshwater, and brackish water chelonian species according to the United Nations Environment Programme–World Conservation Monitoring Centre (UNEP-WCMC) CITES Trade database, by both years of trade and provenance. Sea turtles are not covered here because they have very different ecological characteristics from tortoises and freshwater turtles and because all sea turtles are listed in CITES Appendix I and, thus, banned from commercial trade (Ernst et al. 1997).

METHODS

This study was performed using CITES data sets available at http://trade.cites.org/en/cites_trade/. We extracted all raw data from the Comparative Tabulation Reports (as Gross Imports) available for turtle and tortoise species between 1990 and 2010. We did not consider the

reexports (that can be obtained anyway by comparisons with the Net Imports database). There might be some remarkable differences between gross and net imports in the case of transit countries (like Singapore) and in the case of countries that both import from nearby countries and export the same species from native populations (e.g., *Cuora amboinensis* trade data for Malaysia; P.P. van Dijk, *pers. comm.,* July 2016).

These data accurately report all declared records of legal import/export related to the species and countries per year. Thus, for example, for a given species and for a given trading category, the data source specified the origin (= country of origin), whether the animal had been bred in captivity or taken in the wild, and also the purpose of the exchange (for example commercial, scientific, etc.). It is also indicated in the case of specimens exported/imported whether they were exported dead or alive, whole or just as parts derived from them (such as skins, shells, meat, etc.). It should be noted, however, that the trade database does not list individual transactions, but combines all transactions of a certain species for a certain purpose, from a certain source, in a certain product category, between two countries. Thus, a record of 50 live specimens of the species *X* traded between countries *A* and *B* can be based on a single shipment of 50 animals or 50 different shipments of one animal each.

Among the various available data, we limited our analysis to the import values of individuals registered as coming from the wild (source code "W"), in agreement with what was done by Luiselli et al. (2012) for their analysis of international trade in snakes of the genus *Python*. We did not consider reexports, because they are not relevant from the ecological and conservation points of view, whereas they may be of interest from a more purely economic perspective. It should be noted that *Python* has been included in CITES since 1975; hence, the records are complete and consistent over the years. Many turtle species were added to the CITES Appendices during the time period of this analysis; thus, their trade volumes during the period are only partially recorded in the UNEP-WCMC database.

We also analyzed our data by biogeographic region. We defined six main regions: Afrotropical, Australian, Nearctic, Neotropical, Asian, and Palaearctic. Biogeographic region was assigned for each species by considering the distribution reported in the Emys database (available at http://emys.geo.orst.edu/default.html) and in Turtle Taxonomy Working Group (2014). If the distribution of a given species occurs in two or more biogeographical regions, the species was considered cosmopolitan. This proved to be the case, for example, of *Trionyx triunguis*, which has a distribution area including several countries in both the Afrotropical and the Palaearctic regions (e.g., Ernst et al. 1997).

The CITES data set has remarkable biases that should be taken into account when analyzing its entries. For instance, there are serious discrepancies between the numbers of reptiles exported to the European Union that are declared as captive-bred and the numbers of reptiles that breeding facilities are actually producing or have the capacity to produce, including species of turtles such as *Siebenrockiella leytensis* and *Cuora amboinensis* from the Philippines (Auliya et al. 2016).

Table 1. Number of individuals of turtles and tortoises traded between 1990 and 2010, divided by family

Family	No. of traded individuals
Testudinidae	748,008
Geoemydidae	667,469
Emydidae	401,224
Trionychidae	181,015
Pelomedusidae	86,633
Chelydridae	59,705
Podocnemidae	9070
Dermatemydidae	421
Platysternidae	38
Chelidae	37

All statistical analyses were done with a Statistica version 8.0 software. Correlation between progression of years and the yearly number of traded turtles was performed using Pearson's correlation coefficient. Frequencies of wild turtles traded by biogeographic region were assessed by an observed-versus-expected χ^2 test. Alpha was set at 5%, with all tests being 2-tailed.

RESULTS

Specimens traded over the 20-yr study period amounted to 1,997,716 individuals. Of the 335 turtles and tortoise species existing in nature (Turtle Taxonomy Working Group 2014), only 48 species were regularly recorded as traded internationally as CITES species, although over 100 species were recorded at least once in the trade (see Appendix 1). The 48 regularly traded species belonged to 10 distinct families. Obviously, the recorded number of traded turtles is to be considered on the conservative side, as individuals of several recently identified species or of populations just recently elevated to full species rank are traded under old "lumped" criteria. This is the case for instance of *Kinixys nogueyi* that is heavily exported from Ghana, Togo, and Benin under the old name *Kinixys belliana* (G.H.S. and L.L., unpubl. data, 2013–2016).

Most of the traded specimens belonged to the families Testudinidae, Geoemydidae, Emydidae, and Trionychidae (about 93% of trade), with Pelomedusidae and Chelydridae accounting for less than about 7%, and Podocnemidae, Dermatemydidae, Platysternidae, and Chelidae traded in proportionally small numbers (less than 1%; Table 1).

Looking at the trend of the market, over the decades, it appeared that since 1990 the exploitation of wild individuals grew remarkably until reaching its peak in the early 2000s, with this pattern being stronger in the Asian region (Fig. 1). After the years 2003–2005, there was a substantial decrease in the number of wild exports from the Asian region, with a growth in the export numbers from the Nearctic (Fig. 1). It remains an open question

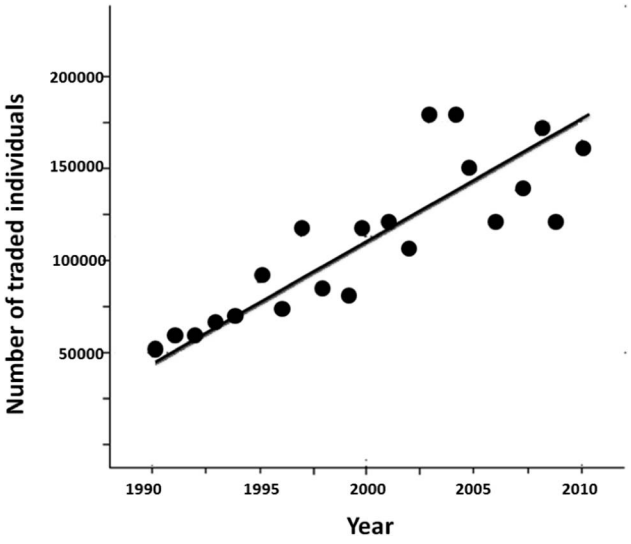

Figure 1. Yearly trend in number of exported wild turtle and tortoises worldwide. For the statistical details, see the text.

whether the reduction of exported numbers from the Asian region is the result of CITES regulation and supervision or because the wild populations have collapsed. Overall, the correlation between time (expressed in years) and number of traded animals was statistically significant (Pearson's $r = 0.849$; $r^2 = 0.720$, $p < 0.00001$), probably because the number of turtle species whose trade is regulated under CITES increased greatly over the study period: from 86 species in 1990 (using 2014 taxonomy; fewer species were recognized at the time) to 180 species at present (Turtle Taxonomy Working Group 2014).

There were uneven frequencies of wild turtles traded by biogeographic region ($\chi^2 = 787{,}418$, df = 4, $p < 0.00001$). Overall, the higher amount of traded wild turtles were exported from countries in the Asian, Palearctic, and Nearctic regions that represented more than 90% of the total traded turtle amount (Table 2). There were 107 exporting countries, with seven exporting over 50,000 wild turtles during the study period (Table 3). These countries were Malaysia (responsible for 24.4% of global trade), the United States (23%), Indonesia (20.1%), Uzbekistan (17.9%), Tajikistan (4.2%), Togo (3.3%), and Ghana (3.2%). In this regard, it should be mentioned that there were obvious shortcomings associated with the CITES data set. For instance, for a total of 5,799 specimens (equaling to less than 0.3% of the total), it was not possible to determine the country of origin because the original data source was unknown in the CITES database. In addition, some exports were certainly wrongly coded or lacked updating to political changes; for instance, traded wild *Agrionemys* (= *Testudo*) *horsfieldii* were occasionally reported to be of Russian origin despite the fact that this species does not occur at all in the Russian Federation territory (but occurred in the area of the former USSR). The yearly exports of wild turtles were relatively constant in most biogeograpic regions, apart from the Asian and the Nearctic regions that instead revealed remarkable oscillations (Fig. 2). In more detail, Asian turtle exports declined (from regulation or population collapse, after the years 2003–2005), Nearctic turtle exports increased to compensate and peaked in 2007–2010 (Fig. 2). It should also be considered that the United States classifies hatchling turtles produced in turtle farms as "Wild" because it cannot exclude the possibility that wild animals are added as farm brood-stock (hatchlings being not guaranteed captive-born F2 and thus qualifying for source code "C", captive-produced) (P.P. van Dijk, *pers. comm.,* July 2016). Thus, very high numbers of *Graptemys* and *Macrochelys* hatchlings may numerically inflate the Nearctic region data, whereas their impact on wild populations is significantly less

Table 2. Number (and relative percentage) of traded individuals of wild origin by biogeographic region.

Biogeographic region	Total no. of individuals	% of total
Afrotropical	176,314	9.90
Palearctic	553,798	28.31
Oriental	828,350	42.23
Neotropical	8440	0.43
Nearctic	389,447	19.90
Total	1,956,349	

Table 3. List of the main exporting countries of the world, with the number of exported individuals, over the period 1990–2010. Only countries exporting more than 50,000 individuals are listed in this table.

Exporting country	No. of individuals
Malaysia	487,295
USA	460,453
Indonesia	400,986
Uzbekistan	357,277
Tajikistan	83,521
Togo	65,073
Ghana	64,257

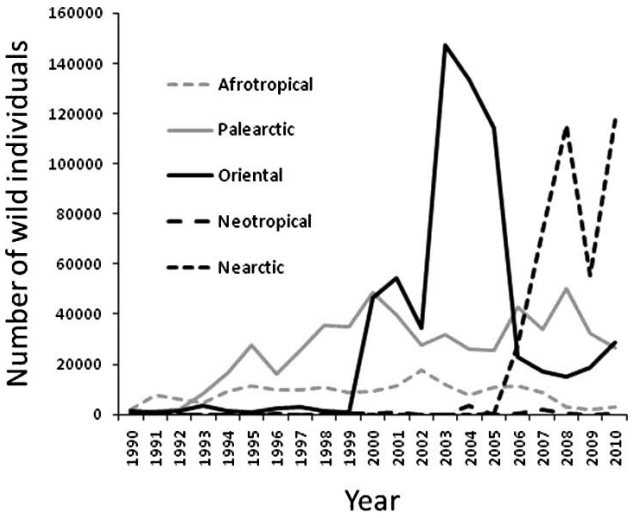

Figure 2. Yearly trend of the number of traded chelonians (wild origin) by biogeographical region.

Table 4. List of the 10 main importing countries of the world, with the number of imported individuals, over the period 1990–2010.

Importing country	No. of individuals
USA	474,048
China	332,704
Hong Kong	295,542
Japan	229,660
Portugal	122,773
Spain	106,118
Belgium	69,057
Mexico	67,982
Czech Republic	64,934
Germany	57,653

than the export of wild-collected adult turtles from Asian countries (Shi et al. 2007, 2008).

Overall, there were 66 importing countries, with the most important being the United States (17%), China (15%), Hong Kong (12%), Japan (6%), and Portugal (5%) (Table 4).

DISCUSSION

Our study confirmed previous studies revealing that that the international trade of CITES turtles is certainly very large (IUCN Tortoise and Freshwater Turtle Specialist Group [TFTSG] 2011; CITES 2016), with almost 2 million individuals taken from the wild and traded in the 2 decades considered for our study. In this regard, it should also be considered that the annual trade data are not equivalent year to year but include shifting baselines of additional species of turtles being added or subtracted over time.

For this trade, all the continents (and all the biogeographical regions) except Australia and Antarctica proved to be affected by the phenomenon, although with a heavily uneven distribution of traded numbers (much higher in the Asian, Palearctic, and Nearctic regions). Nonetheless, the range of species involved was apparently relatively low (about 13.7% of the total number of species). However, it should be mentioned that many species with freshwater lifestyles are not listed by CITES, and their export numbers are, therefore, largely unknown. In addition, it should be mentioned that 32 nonmarine turtle species are listed in CITES Appendix I, about 126 in Appendix II, and about 22 in Appendix III, whereas the remaining 140 species are not included in the CITES Appendices and, therefore, not included in UNEP-WCMC CITES trade records. Trade records are further incomplete because many/most of the listed species were added to the CITES Appendices by 2000 or later; hence, even if they were traded internationally before their date of inclusion, those records would not show up in the database (IUCN TFTSG 2011). An analysis of the most traded species showed that the "pet trade" is an important reason for the marketing, with *C. amboinensis*, *A.* (= *Testudo*) *horsfieldii*, and *Graptemys pseudogeographica* being 3 key species in the international trade of live animals (Yuwono 1998; CITES 2016). However, these 3 species are not only traded as pets. Indeed, the great majority of *C. amboinensis* exported from Indonesia and Malaysia were exported to China and Hong Kong for the consumption trade (IUCN TFTSG 2011). Similarly, large volumes of *A.* (= *Testudo*) *horsfieldii* were exported for consumption in China, not as pets, and even *Graptemys* may be used in Chinese aquaculture to rear for consumption (IUCN TFTSG 2011). In this regard, it is interesting to note that the demand for having the greatest possible diversity of species by individual keepers is crucial in this kind of trade, because it has recently been demonstrated for lizards (Kolbe et al. 2013). This type of demand may also favor potential problems related to the introduction of nonnative animals. In fact, Kolbe et al. (2013) demonstrated that the genetic origin of the lizard populations introduced in the United States from Europe have different origins.

As mentioned above, there were significant differences in the amount of wild individuals (and numbers of species) exported from the various biogeographic regions, with species of the Asian and the Palearctic regions that dominate in commercial exchanges. The reasons for these differences between biogeographic regions could be as follows.

1. The largest importers are in Europe (Auliya et al. 2016) and North America, where the climatic conditions greatly favor the breeding (even outdoors) of species of temperate areas (Palearctic) and/or subtropical (part of the Asian region) rather than of tropical areas.
2. As already demonstrated for pythons (Luiselli et al. 2012), the economies of some exporting countries are linked to the US dollar or the Euro, such that the exchanged amounts are updated from year to year in relation to the indices of Euro–Dollar exchange. Indeed, CITES (2016) showed that, by analysis of the illegal trade, there was a decline in trade during the economic recession years of 2008–2010. Exactly the same trend was observed comparing the yearly changes in the international traffic of *Python* spp. (Luiselli et al. 2012). Additional reasons can be (2.1) the uneven reporting by importing and exporting countries (China apparently does not report all its imports); (2.2) the effects of different species from different areas being listed in CITES at different times; (2.3) new and developing trade trends, like many thousands of hatchlings *Podocnemis unifilis* being exported from Peru in the past few years with numbers increasing after 2012 (CITES AC27 Doc 12.4, p. 133; available at http://cites.org/sites/default/files/eng/com/ac/27/E-AC27-12-04.pdf); (2.4) different trade demand for turtle species from different regions, with softshells being in high consumption demand, Chelids and Pelomedusids in low trade demand for food or pets; and (2.5) different infrastructure development and transport links impeding export trade from certain countries and regions (Afrotropical, Neotropics) (P.P. van Dijk, *pers. comm.,* July 2016).

Figure 3. A cage containing several wild individuals of *Kinixys homeana*, captured in the surroundings of Calabar (Cross River State, Nigeria). According to the traders, forest tortoises are dispatched illegally to Benin and then exported "legally" with CITES certificates. (Color version is available online.)

We also showed that that the international trade of CITES-listed turtles has grown tremendously over the years, increasing over about 2 decades from about 50,000 to over 150,000 individuals annually traded. Consistently with our estimates, CITES (2016) reported, for the years 2011–2014, an average of 138,000 live wild-collected CITES-listed tortoises and freshwater turtles per year. In the same period, the total estimated turtle trade (either CITES-listed or nonlisted, both wild-collected and farmed) is over 8 million turtles annually, thus revealing the huge size of the turtle trade across the earth. Also in this case, the data concerning turtles are in agreement with patterns observed on the pythons, with an overall tripling of trade volume in the most frequently traded species (such as *Python reticulatus*; Luiselli et al. 2012). We suggest that further studies should be carried out to understand whether noticeable declines of wild turtles are attributable to the international pet trade (as well as for consumption purposes), especially in the Asian region where the consumption of turtle meat has already been demonstrated to be unsustainable (van Dijk et al. 2000; Turtle Conservation Fund 2002; Gong et al. 2009).

In addition, it must be mentioned that several wild species captured in a given country are then exported from another country where they have been imported illegally. For instance, this is the case of the West African turtles and tortoises that are usually exported from Ghana, Togo, and Benin even if not captured in any of these countries (Fig. 3). The potential impact of the illegal trading from one country to another, to circumvent CITES quotas and/or domestic export restrictions, should be carefully monitored in the years to come. More importantly, enforcement of such illegal trade should happen, and the CITES authorities of these countries should investigate more into the legal origin of the animals for which they issue export permits.

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Appendix 1. List of the analyzed species, as presented in the CITES database.

Agrionemys (= *Testudo*) *horsfieldii*
Amyda cartilaginea
Apalone ater
Batagur baska
B. borneoensis
Chelodina mccordi
Chelonoidis carbonaria
C. chilensis
C. denticulata
Chersina angulata
Chinemys (= *Mauremys*) *nigricans*
Chitra chitra
Chrysemys picta
Cuora amboinensis
C. aurocapitata
C. flavomarginata
C. galbinifrons
C. mccordi
C. pani
C. trifasciata
C. zhoui
Cuora spp.
Dermatemys mawii
Erymnochelys madagascariensis
Geochelone elegans
G. platynota
G. sulcata
Geochelone spp.
Geoclemys hamiltonii
Geoemyda spengleri
Gopherus agassizii
G. berlandieri
G. flavomarginatus
Gopherus spp.
Graptemys geographica
G. ouachitensis
G. pseudogeographica
Heosemys annandalii
H. depressa
H. grandis
H. spinosa
Homopus areolatus
H. boulengeri
H. femoralis
H. signatus
Homopus spp.
Indotestudo elongata
I. forstenii
Indotestudo spp.
Kachuga spp.
Kinixys belliana
K. erosa
K. homeana
K. lobatsiana
K. natalensis
K. spekii
Kinixys spp.
Leucocephalon yuwonoi
Lissemys punctata
Macrochelys temminckii
Malaclemys terrapin
Mauremys mutica
Notochelys platynota
Pelochelys spp.
Pelodiscus axenaria
P. maackii
Pelomedusa subrufa
Peltocephalus dumerilianus
Pelusios adansonii
P. castaneus
P. gabonensis
P. niger
Pelusios spp.
Platysternon megacephalum
Podocnemis erythrocephala
P. expansa
P. lewyana
P. sextuberculata
P. unifilis
P. vogli
Podocnemis spp.
Psammobates geometricus
P. oculiferus
P. tentorius
Psammobates spp.
Pyxidea (= *Cuora*) *mouhotii*
Pyxis arachnoides brygooi
P. arachnoides oblonga
P. arachnoids
P. planicauda
Pyxis spp.
Siebenrockiella crassicollis
Testudo graeca
T. hermanni
T. kleinmanni
T. marginata
Testudo spp.
Trionyx triunguis