

The global magnitude and implications of China's legal and illegal wildlife trade

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SUPPLEMENTARY MATERIAL 1 Criteria for querying and formatting CITES trade data and wildlife seizure data.

CITES trade data

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) is a multilateral treaty that regulates international trade in protected animal and plant species so that the trade does not threaten their survival. It operates mainly through a licensing system through which imports and exports of species listed in one of its three Appendices must be authorized by Parties, who are required to verify the legal acquisition of the traded specimens and the potential impact of the transaction on the species in the wild before issuing permits. States that are parties to CITES, including China, must submit to the CITES Secretariat annual reports of their international trade in specimens and products of CITES-listed species, which are then entered into the CITES trade database (UNEP-WCMC, 2013; CITES, 2016).

In the CITES trade database, mainland China, Hong Kong, Macau and Taiwan (Province of China) are reported separately. In this study we considered imports only by mainland China and treated the other three territories as trading partners. Although CITES requires member states to submit annual reports by October of the year following the one in which the trade occurred, delays in reporting are a common, with reports being added to the database after the deadline (UNEP-WCMC, 2013). As such, the data we analysed for 2016 may not reflect the total trade of that year.

We used importer-reported data where possible; when this was unavailable, we used exporter-reported data. There are two reasons for this: Firstly, exporter-reported data tend to overestimate the scale of trade because exporting countries sometimes report their trade based not on the actual number of traded specimens, but on the quantity for which the permits or certificates were issued. It is not uncommon for the quantity of specimens traded to be considerably lower than that specified on the permits, as in some cases permits are used only partially or remain unused (UNEP-WCMC, 2013). Secondly, several previous studies (e.g. Carpenter et al., 2014; Herrel & van der Meijden, 2014) have shown that reported imports are usually outnumbered by reported exports.

The CITES trade database contains over 70 types of animal-related commodities including live animals, whole dead specimens, body parts (e.g. claws, ears, heads, horns, skeletons, skulls, tails, skins etc.) and processed products (e.g. carvings, garments, leather products, meat, medicinal products, oil etc.). These types of goods traded are being reported in a variety of standard units such as number of individuals, kg, m², l, but also in non-standard units such as bottles, boxes, pairs or sets. We therefore used the conversion terms and ratios provided by Harfoot et al. (2018) to convert the heterogeneous types of animal body parts and products derived from that species into whole-organism equivalents (WOEs), to more accurately estimate the total volume of a species reported in trade. We excluded from the analysis records of body parts and products that we could not convert to WOE, either because they were reported in mass or non-standard units or because there were no conversion coefficients available (e.g. feathers, meat, oil).

In calculating the WOE volume, we assumed that the different body parts or products of a given specimen were sourced from different individuals. For example, we assumed that eight claws of the brown bear *Ursus arctos* reported in trade were taken from two separate individuals and thus corresponded to two WOEs; four brown bear skulls were collected from four other individuals and represent an additional four WOEs. In this case, we assumed that the claws and skulls were extracted from six individual brown bears. This method has limitations in so far as, for example, eight bear claws may come from a range of two to eight brown bears, or the claws and skulls may have been sourced from the same individuals. However, this is inevitable in the absence of information on the accurate origin of the traded goods, and under these circumstances our method provides the best approximation of the quantity animals traded.

We included in this analysis all source and purpose codes as outlined in CITES Notification 2017/006 (CITES Secretariat, 2017). We chose the Comparative Tabulation Report as the form of data output as it contains detailed information on species name; country of origin, export and import; source and purpose of the transaction; product type and quantity of the traded specimens. Each record in the comparative tabulation report does not represent an individual shipment or trade transaction, but a summed result for all records of trade that have the same information in several fields (e.g. year, taxon, type of goods traded, importer, exporter, country of origin, trade purpose, source of specimen; UNEP-WCMC, 2013; Robinson & Sinovas, 2018). Therefore, the count of records cannot be used directly to quantify the scale of the trade.

To distinguish between and compare trade of wild-caught and captive-bred specimens, we synthesized the categorization methods by Schlaepfer et al. (2005) and Harfoot et al. (2018). We defined the wild-caught category as all records with source code W (wild) or R (ranch). The captive-bred category included all records with source code C (captive-bred), or D (Appendix-I species bred in captivity in registered operations for commercial purposes), or F (born in captivity [F1 and subsequent generations]). Records with all other source codes, including I (confiscation/seizures), O (pre-Convention specimens), U (source unknown) and blank (source unreported), were excluded from this comparison.

In total, we collected from the CITES trade database an aggregate of 22,375 records of imports by mainland China of CITES-listed vertebrate species throughout 1997–2016. Of the total records, only 36% (n = 8090) contained import data and 18% (n = 4025) provided both export and import data. Of the latter, the import and export quantities were identical in only 24% (n = 965), and the export quantity was greater than the import quantity in 57% (n = 2291). The significant and widespread mismatches between the trade quantity reported by exporting and importing sides indicate that there is room for improvement in China's CITES reporting. After removing records reported at the genus level or above (n = 489), those with China as the reported country of export or origin (n = 448), and those that were inconvertible to WOEs (n = 11,992), we obtained 9446 records for final analysis.

Wildlife seizure data

We entered descriptions of wildlife seizure cases into a categorical database that recorded the date of seizure, country of origin, destination or transit, quantity of seized goods, and methods for transport and concealment. In total, we compiled 496 records of China-related wildlife seizures from *TRAFFIC Bulletin* for the period 1997–2016 (see Supplementary Material 3). The majority (n = 475) of the seizure incidents pointed to illegal imports to

China, confirming that the country is primarily a consumer rather than supplier in the illegal international wildlife trade. Only a small number of species and their products were found in illegal exports out of China. These mainly included live saker falcons *Falco cherrug*, wool of the Tibetan antelope *Pantholops hodgsonii* and products used in traditional Chinese medicine containing ingredients of protected fauna and flora such as pangolins, seahorses *Hippocampus* spp. and costus root *Saussurea costus*.

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SUPPLEMENTARY TABLE 1 Most commonly traded species under different taxonomic groups in China's vertebrate imports during 1997–2016 (Data source: CITES trade database; CITES, 2016). Amphibian imports are not included because of their small trade volume.

| Taxa | WOE ¹ vol. (%) | Type of traded goods (%) ² | Source country (%) ³ | Main uses in China |
|---------------------------------|---------------------------|---------------------------------------|---------------------------------|--|
| Mammals | | | | |
| <i>Lontra canadensis</i> | 202,413 (35) | SKI (99) | CA (50), US (44) | Fur products |
| <i>Macaca fascicularis</i> | 113,952 (20) | LIV (100) | KH (45), LA (33) | Biomedical experiment ^a |
| <i>Lycalopex griseus</i> | 75,098 (13) | SKI (100) | AR (97) | Fur products |
| <i>Mustella sibirica</i> | 41,156 (7) | SKI (100) | RU (68), GB (32) | Fur products |
| <i>Arctocephalus pusillus</i> | 37,345 (7) | SKI (95) | NA (94) | Fur products |
| Reptiles | | | | |
| <i>Caiman crocodilus fuscus</i> | 1,146,245 (16) | SKI (98) | CO (98) | Leather products |
| <i>Varanus salvator</i> | 868,724 (12) | SKI (67), LIV (33) | ID (47) | Leather products, food, TCM, ornamental ^b |
| <i>Ptyas mucosus</i> | 787,641 (11) | LIV (99) | LA (74) | Food, TCM, ornamental ^c |
| <i>Crocodylus siamensis</i> | 703,222 (10) | LIV (85) | TH (49), VN (37) | Food, TCM, leather products ^d |
| <i>Python reticulatus</i> | 582,502 (8) | SKI (100) | MY (75) | Leather products |
| Birds | | | | |
| <i>Psittacus erithacus</i> | 18,097 (13) | LIV (100) | ZA (60) | Pet ^e |
| <i>Myiopsitta monachus</i> | 9849 (7) | LIV (100) | UY (60) | Pet ^e |
| <i>Aratinga solstitialis</i> | 7971 (6) | LIV (100) | ZA (93) | Pet ^e |
| <i>Agapornis personatus</i> | 7802 (6) | LIV (100) | NL (61) | Pet ^e |
| <i>Phoenicopterus ruber</i> | 6284 (5) | LIV (100) | CU (70) | Ornamental ^f |
| Fish | | | | |
| <i>Acipenser baerii</i> | 1,828,600 (48) | LIV (100) | FR (100) | Food, leather products ^g |
| <i>Scleropages formosus</i> | 611,672 (16) | LIV (100) | ID (50), MY (44) | Ornamental ^h |
| <i>Polyodon spathula</i> | 427,000 (11) | LIV (99) | US (100) | Food, ornamental, leather products ⁱ |
| <i>Acipenser fulvescens</i> | 400,001 (11) | LIV (100) | CA (100) | Food, leather products ^g |
| <i>Hippocampus ingens</i> | 299,437 (8) | BOD (100) | PE (100) | TCM ^j |

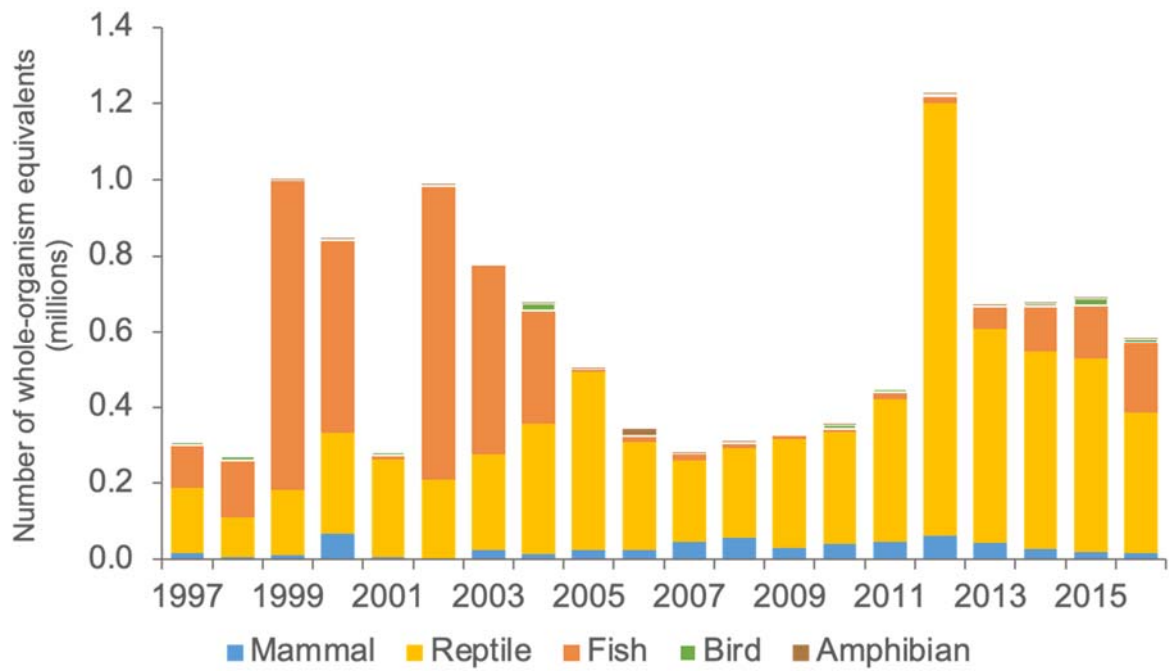
¹WOE, whole-organism equivalent. Numbers in parentheses indicate the proportion of the species reported in trade out of the total WOE imports of the taxonomic class to which the species belongs.

²BOD, whole dead bodies; LIV, live specimens; SKI, whole skins. Numbers in parentheses indicate the per cent of the WOE volume of the species reported in that product type out of the total import volume of that species.

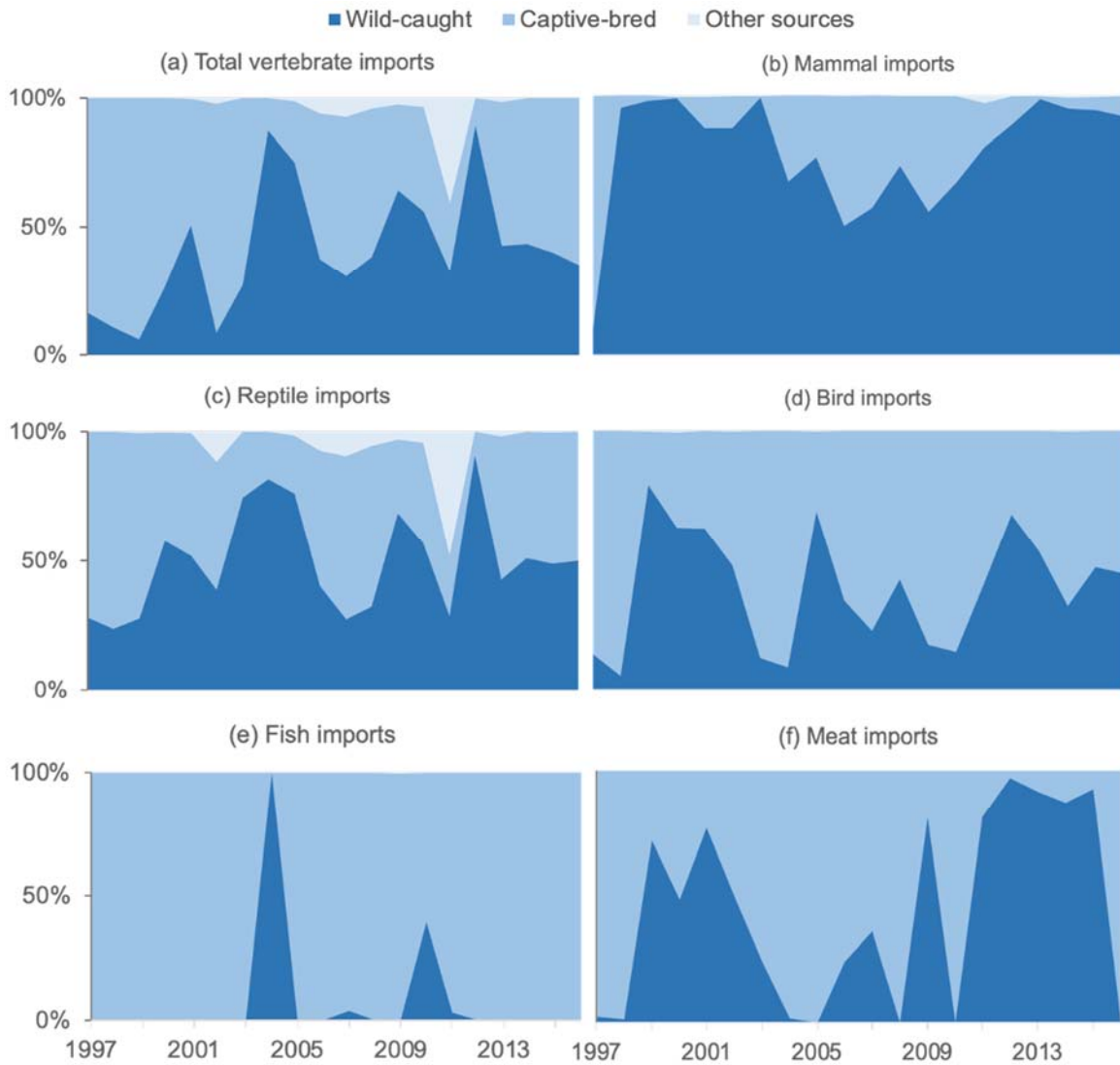
³AR, Argentina; CA, Canada; CO, Colombia; CU, Cuba; FR, France; GB, United Kingdom; ID, Indonesia; KH, Cambodia; LA, Laos PDR; MY, Malaysia; NA, Namibia; NL, The Netherlands; PE, Peru; RU, Russia; TH, Thailand; US, USA; UY, Uruguay; VN, Viet Nam; ZA, South Africa. Numbers in parentheses indicate the per cent of the WOE volume of the species reported from that source country out of the total import volume of that species.

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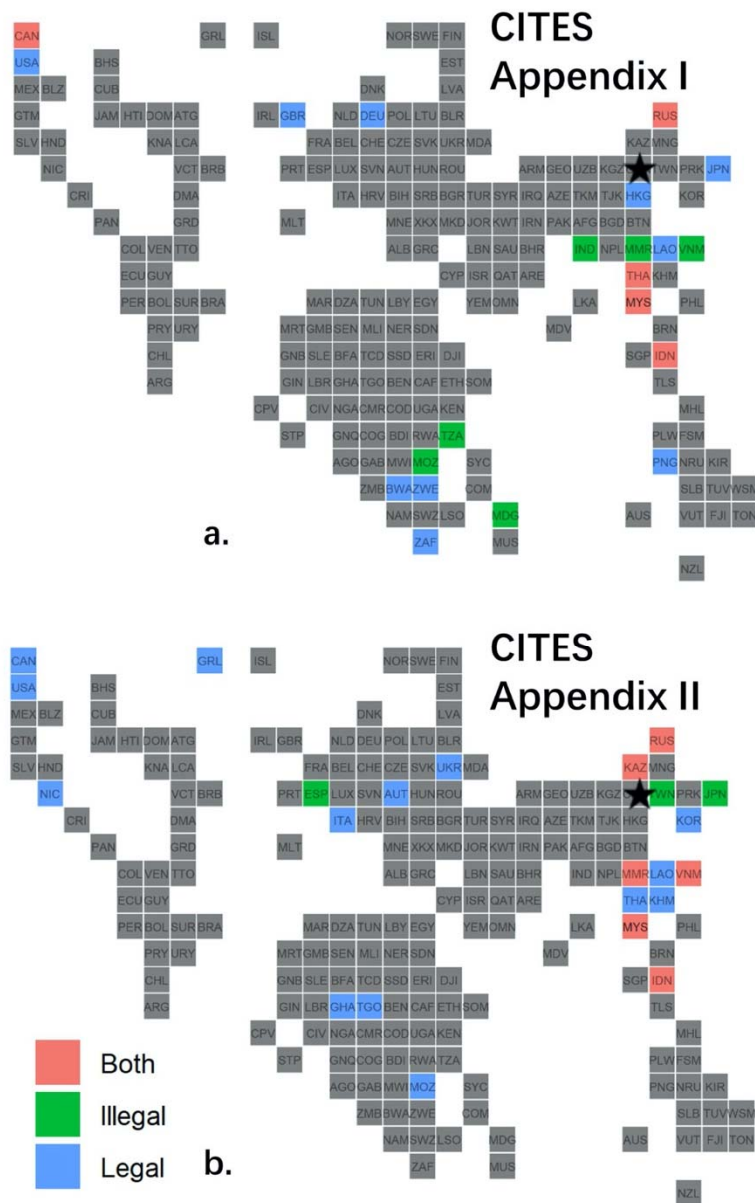
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SUPPLEMENTARY FIG. 1 China's legal wildlife imports in whole-organism equivalents during 1997–2016, by taxonomic groups (Data source: CITES trade database; CITES, 2016).



SUPPLEMENTARY FIG. 2 Per cent of whole-organism equivalent imports from wild-caught (source codes W, R), captive-bred (source codes C, D, F) and other sources (source codes I, O, U or blank) in China's total wildlife imports during 1997–2016, by taxonomic groups. Because relatively few amphibians were imported to China (< 20,000 whole-organism equivalents), they are not included here (see also Supplementary Material 2).



SUPPLEMENTARY FIG. 3 Source countries of 54 species listed on (a) CITES Appendix I and (b) CITES Appendix II that were legally and illegally traded to China during 1997–2016. Countries and territories are represented by their ISO code in the tile grid, in their approximate geographical location. China is marked by the black star. The colour of each tile represents whether the country or territory was source of legally and/or illegally traded wildlife. Countries and territories for which no data were available are coloured in grey (see also Supplementary Material 3).

SUPPLEMENTARY MATERIAL 2 Data on China's legal wildlife trade.

The data are available in a separate spreadsheet at doi.org/10.1017/S0030605320000800.

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