

Effects of regional economics on the online sale of protected parrots and turtles in China

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Abstract

The sale of wild animals, including protected species, may relate to regional differences in socio-politics, culture, and economic development. A better understanding of how these factors affect the illegal wildlife trade is therefore necessary to optimize the deployment of conservation resources and policing. To evaluate these factors in relation to the trade-in protected animals as pets, we surveyed China's popular consumer-to-consumer website, Taobao.com (analogous to eBay), and found that over 70,000 individual live parrots and turtles (totaling 46 and 49 protected species, respectively) were sold in just 150 days. Using analyses that attempted to account for species richness estimation and autocorrelation effects, we identified that regional economics promoted the occurrence and extent of pet sales. The provenance of these traded animals was ambiguous, but their vast numbers raise two concerns: if any proportion was sourced illegally from the wild, it is of conservation concern; whereas any bred illegally in captivity raise animal welfare concerns, because this would be unregulated. In the context of rapid economic development in China, it is thus important to reform the legislation that currently allows these commonly traded pet species to slip through the net intended to police animal welfare and illegal animal trading.

KEYWORDS

animal welfare, Asia, conservation, E-commerce, pets, wildlife trade

1 | INTRODUCTION

Any trade in animals (legal or illegal) constitutes an economic activity, and thus the scale and composition of

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wildlife consumption can often be attributed to economic, social, and geographic factors (Brashares, Golden, Weinbaum, Barrett, & Okello, 2011; Dyer et al., 2017; Golden, Fernald, Brashares, Rasolofoniaina, & Kremen, 2011). For example, there is a strong relationship between poverty and illicit activity, such as illegal wildlife hunting (Duffy, St John, Büscher, & Brockington, 2015; Mackenzie, Chapman, & Sengupta, 2011). Conversely, predominantly wealthier consumers purchase exotic pets, as well as other luxury endangered wildlife products (e.g., ivory, rhino horn), and so this trade is more prevalent in areas with greater economic prosperity (Zhou et al., 2015a, 2015b).

Demand for wildlife as pets (defined as species that have not been domesticated or artificially selected from wild types over generations) accounts for 20% of recent inter- and intra-continental wildlife trade reports (combined with animal use in entertainment; Baker et al., 2013). This has both welfare (Baker et al., 2013) and conservation implications (Fernandes-Ferreira, Mendonça, Albano, Ferreira, & Alves, 2012; Tella & Hiraldo, 2014) for various taxa, but predominantly affects birds and reptiles (Bush, Baker, & Macdonald, 2014). Given the significance and scale of the pet trade, it has spurred commentaries on consumer preference (Tella & Hiraldo, 2014), countermeasures (Moorhouse, Balaskas, D'Cruze, & Macdonald, 2017) and the treatment of live seizures (D'Cruze & Macdonald, 2016), where trade has also been linked to the spread of zoonotic disease (e.g., Fogell et al., 2018; Marin, Ingesa-Capaccioni, González-Bodi, Marco-Jiménez, & Vega, 2013). To aid policymakers, it is important to evaluate the full economic and sociological context of the pet trade (Fisher, Turner, & Morling, 2009), especially when it subverts national legislation.

We focus here on China, where exotic pets remain popular with a large consumer base (Bush et al., 2014), despite sales of most species being in contravention of China's Wild Animal Conservation Law (WACL). In major part, this is because those government agencies tasked with reducing illegal animal trafficking (Zhou, Zhou, Newman, & Macdonald, 2014) have focused less on the pet trade, and thus many species are still sold openly, even over mainstream internet sites. To determine the scale of this trade in China we focused on the sale of parrots and turtles, which includes numerous endangered species (raising a red flag for conservation concern). Trade volumes in these taxa were also, regrettably, sufficient to sustain detailed statistical analysis of the seller's location and the economic status of regions where trading was focused. Details of the purchasers' profiles were not available. Many specialist suppliers of turtles and parrots in the United States and Europe sell a range of species, including species protected under the Convention on International

Trade in Endangered Species of Wild Fauna and Flora (CITES), online (Tella & Hiraldo, 2014). Crucially, such sales are regulated by government authorities to ensure (a) that no animals are taken illegally from the wild, (b) standards are maintained at the breeders' facility, and (c) animals are shipped responsibly and humanely. In contrast, in China, "all" sales of protected parrot and turtle species (and other wildlife), as well as the captive breeding of these taxa, are strictly regulated under Appendix I and II of CITES (valid from November 21, 2016) and/or China's domestic List of Fauna under Special State Protection (LFSSP, 1989). In environmental criminology terms, these circumstances provide both the objective conditions and the temptation (Lavorgna, 2014) that can lead vendors to circumvent regulation and operate illicitly. Consequently, in China because breaking laws intended to protect exotic pets has no consequences, and online trading facilities these sales, this risks emboldening confidence to break other wildlife laws and may provide a "soft entry" into wildlife crime (Brenner, 2002). This is similar to the debate on how failure to enforce marijuana (soft drug) legislation can embolden people to risk using harder drugs (Chu, 2015).

We studied fixed-price classified transactions involving parrots and turtles over Taobao (a subsidiary of the Alibaba group; analogous to "eBay"), which provides the largest domestic consumer-to-consumer (C2C) trading platform in mainland China. Although Taobao has prohibited trade in tiger bone, ivory, rhino horn, bear bile, turtle shell, pangolin scale, and shark fin since 2008 (Wan, 2014) (a year prior to eBay's 2009 ban), it continues to sell various protected species as exotic pets. Having quantified the trade, we then modeled how geographic region and prefectural economics (e.g., prefectural wealth, per capita wealth per prefecture, the level of foreign trade) related to trade. We use these data to formulate a strategic proposal for policy-making.

2 | METHODS

2.1 | Data collection and processing

We extracted transaction information from records obtained from Taobao, which had a gross turnover of RMB 3,093 billion (equiv. US\$ 463 billion) in 2016 (http://www.alibabagroup.com/cn/ir/Alibaba_Financials_and_Metrics_Eng.pdf), accounting for approximately 9.3% of China's *total retail sales of social goods*. Importantly, during our first four survey rounds, Taobao provided no warnings that the sale of protected parrot species was prohibited; however, by our fifth round the site clearly cautioned that such sales of parrots are

banned, coinciding with the conviction of a parrot dealer, sentenced to a 5-year prison sentence in early 2017. As of February 2019, Taobao still does not warn that the sale of any protected turtle species without permit is prohibited. The openness with which sellers publicly shared information on trade strongly suggests that traders are operating in an environment in which they are not restricted by enforcement. The Taobao platform is broadly popular across urban and rural China, with no regional biases in user-ship relative to population density (Wei, Lin, & Zhang, 2019).

We conducted four surveys searching for the terms “parrot, live” (in Chinese) and five for “turtle, live” (in Chinese) (Data S1). The website clearly identified transaction information including “species” (verified from the sellers’ description and photographs), “item location” (i.e., site of origin sale, used to calculate freight charges and presumed to be accurate). The “successful transactions” field provided the volume of individual animals traded and received during the 30 days preceding our survey (here one transaction = one animal traded), and indicated that payment was complete, according to the trading rules, given at <https://rule.taobao.com/detail-14.htm?spm=a2177.7231193.0.0.6P8EIR&tag=self&cId=114>. This transaction report was refreshed in real-time on the webpage for each offer. To ensure data quality, two of the authors trained 10 investigators who conducted duplicate checks of the information extracted from the screenshots.

The number of protected species traded correlated significantly with volume of C2C transactions (individual animals traded) across prefectures (Pearson’s correlation coefficients: parrots: $r = 0.64$, $t = 7.60$, $df = 326$, $p < .001$; turtles: $r = 0.53$, $t = 5.57$, $df = 326$, $p < .001$). We corrected for this, using algorithms to estimate γ diversity (i.e., the prefecture-wide species richness traded) based on the occurrence of species (O’Hara, 2005; Gotelli & Colwell, 2011). We applied the richness estimators Jackknife and Bootstrap (Colwell & Coddington, 1994; Gotelli & Colwell, 2011) to a species-by-location matrix of presences and absences for each survey round per prefecture. From these matrices, we also calculated species-level occupancy for each subset, that is, the number of locations where a species was traded. We applied the site-specific, abundance-based richness estimators of Chao1 and Abundance-Coverage Estimator (ACE) to these occupancy data, treating a prefecture as one site. Values of γ diversity from different estimators were strongly correlated (Data S1). After assessing the consistency of these diversity estimators, and the performance of diversity estimation (Data S1), ACE diversity estimates of parrots/turtles were used thereafter to depict sales in each survey round and the total sales across survey rounds for each

prefecture. Analyses were performed using EstimateS 9.1.0 (Colwell, 2013).

We compared trade patterns to data depicting seven economic indices, extracted from statistical bulletins, or yearbooks, collated in the China Knowledge Resource Integrated Database (<http://www.cnki.net/>): *gross domestic product (GDP)*, *total retail sales of social goods*, *per capita GDP*, *per capita consumption expenditure of urban households*, *per capita disposable income of urban households*, *value of goods exported*, and *value of goods imported*. These data were comprehensively available across 328 of 338 prefectures and are regarded as reliable measures of the extent and distribution of economic prosperity across the population. Definitions follow the National Bureau of Statistics of China (see <http://www.stats.gov.cn/english/> for more details). To minimize the effects of outlying values, the average value of each regional economic index, from 2009 to 2014, was \log_{10} -transformed and used as a metric of regional prosperity. Generally, values of these indices were higher in China’s eastern regions. To accommodate multicollinearity within economic indicators across prefectures, a varimax-rotated Principal Component Analysis was performed. Four different factors across prefectures were extracted: PC1 represents prefectural wealth heavily loaded by *GDP* (the correlation coefficient loading on PC1 = 0.86) and *total retail sales of social goods* (0.90); PC2 represents per capita consumption capacity heavily loaded by *per capita consumption expenditure of urban households* (for PC2 = 0.90) and *per capita disposable income of urban households* (0.71); PC3 represents the level of foreign trade heavily loaded by *value of goods exported* (for PC3 = 0.76) and *value of goods imported* (0.84); and PC4 was heavily loaded by *per capita GDP* (for PC4 = 0.82). These four PCs explained 99.9% of total variance (Data S1 and S2).

We analyzed economic and regional patterns using “Prefecture” as the basic administrative unit (Mainland China includes 334 sub-divisions of 34 provinces, and 4 province-level municipalities) to locate the source of items for sale online. A 1:400,000 scale map prefectural boundary layer was obtained from the National Geomatics Center of China (<http://ngcc.sbsm.gov.cn/>).

2.2 | Analyses of impacts on trade presence and extent

To assess regional and economic impacts on the occurrence of trade among prefectures, we used generalized linear regression techniques with binomial error distribution (logistic regression, GLMs). Whether or not the ACE of traded parrots/turtles for each prefecture across the survey was <1 was the dependent variable, and region and PCs

were independent variables. For regional analyses, focal regions were defined and compared against regions where trade was rare, or absent. This was based on five national conurbations: Pearl River Delta (PRD), Yangtze River Delta (YRD), Beijing-Tianjin-Hebei (BTH), Chengdu-Chongqing (CC), and Middle Reaches of Yangtze River (MRYR) (National Development and Reform of China, 2014). These five national conurbations generate approximately half of China's GDP, despite comprising only one-tenth of the territory, demonstrating their importance to China's economy.

To model regional and economic impacts on the extent of trade among prefectures where the ACE of parrots/turtles sales was ≥ 1 , we used multiple regression (ordinary least squares, OLS) (Bailly, Cassemiro, Winemiller, Diniz-Filho, & Agostinho, 2016). We tested all possible model specifications, and established the best (i.e., the most supported) model according to Akaike's Information Criterion (AICc), following standardized protocols (Burnham & Anderson, 2004; Diniz-Filho, Rangel, & Bini, 2008). Economic activities are, however, frequently spatially autocorrelated, which leads to autocorrelated residuals in OLS regression models; consequently, Type I errors may be strongly inflated (Kelejian & Prucha, 1999). To account for this, we assessed autocorrelation in ACE and regression residuals at 15 distance classes, while eigenvector-based spatial filters were further added to the OLS multiple regression (Data S1), using spatial eigenvector mapping (SEVM) (Diniz-Filho & Bini, 2005). We used partial regressions (Legendre & Legendre, 2012) to quantify the relative effects of economic and/or spatial components on explaining ACE. We performed analyses using Spatial Analysis in Macroecology, version 4.0 (Rangel, Diniz-Filho, & Bini, 2010).

3 | RESULTS

3.1 | Quantity of transactions

From five survey rounds between July 2016 and July 2017 (each covering a 30-day trade volume; i.e., monitoring, all else being equal, 4–5/12th of total annual commerce), we recorded 5,862 protected parrot transactions (46 species) and 66,927 (49 species) involving protected turtles (Data S1). This extrapolates to annual trade volumes of c. 17,000 and 160,000, respectively. Note, however, in a positive and progressive step, Taobao banned all parrot sales in June 2017, before the fifth round.

The most-traded parrot was the Green-cheeked Parakeet (*Pyrrhura molina*; $n = 2,538$); a South American species of least concern classified by the IUCN Red List of

threatened Species. There were also substantial numbers of endangered parrots traded, most notably the South American Sun Parakeet (*Aratinga solstitialis*; $n = 495$). Among testudines, the most prevalent species was the endangered Yellow Pond Turtle (*Mauremys mutica*; $n = 43,678$) that is indigenous to China and neighboring countries, followed by the vulnerable Yellow-headed Sideneck (*Podocnemis unifilis*; $n = 7,245$) which hails from South America.

3.2 | Regional and economic drivers of trade presence and extent

Geographic patterns of estimated regional diversity of species traded (i.e., of ACE) were distinct between taxa, although transactions occurred only in 146 of 338 prefectures (parrot sales in 100 prefectures; turtles in 109) (Figure 1). Species involved and regional patterns were relatively consistent across surveys (Data S1). Furthermore, throughout China these conurbations accounted, in total, for 80% of all parrot sales and 48% of turtle sales (via Taobao): YRD (11% for parrots and 8% for turtles), BTH (38% for parrots and 1% for turtles), PRD (12% for parrots and 34% for turtles), MRYS (18% for parrots and 5% for turtles), and CC (1% for parrots and 0.2% for turtles).

Regional and economic factors had significant effects on trade patterns (Table 1). For instance, turtle sales were 12.2 times more likely in prefectures within the PRD conurbation when compared to prefectures outside of these top five urban areas. Simultaneously, a 10-unit increase in PC1, PC2, or PC3 was associated with, respectively, a

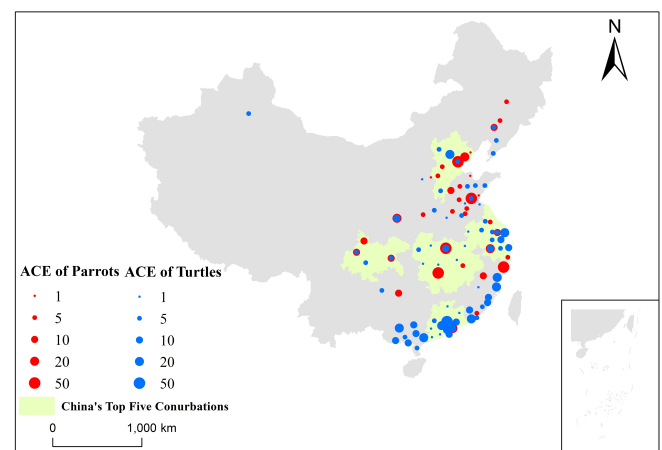


FIGURE 1 Geographical location of the prefectures involved in illegal trade. Dots depict trade locations for parrots (red) and turtles (blue). Dot sizes represent multiple Abundance-Coverage Estimator (ACE) of traded species, as an index of γ diversity

TABLE 1 Coefficient estimates and diagnostics from binary logistic regression explaining presence of parrot/turtle sales online (whether or not ACE was lower than one) among prefectures in mainland China ($n = 338$). p values in bold indicate significant differences ($p < .05$)

Variable	β	S.E.	Wald	p value	Exp (β)
Yangtze River Delta	-1.747/0.048	0.747/0.581	-2.340/0.082	.019 /.934	0.174/1.049
Pearl River Delta	0.835/2.502	0.819/0.880	1.021/2.844	.307/ .004	2.306/12.204
Middle Reaches of Yangtze River	-0.637/0.238	0.756/0.550	-0.843/0.432	.399/.666	0.529/1.268
Beijing-Tianjin-Hebei	0.580/-0.508	0.764/0.793	0.758/-0.640	.448/.522	1.786/0.602
Chengdu-Chongqing	0.153/-0.042	0.977/0.884	0.157/-0.048	.875/.962	1.166/0.959
PC1	1.876/1.222	0.343/0.247	5.472/4.954	<.001 / <.001	6.530/3.394
PC2	0.681/0.424	0.229/0.199	2.978/2.125	.003 / .034	1.976/1.527
PC3	1.140/1.265	0.301/0.263	3.792/4.815	<.001 / <.001	3.125/3.542
PC4	0.085/0.009	0.241/0.211	0.352/0.045	.725/.964	1.089/1.010
Constant	-2.602/-2.093	0.318/0.255	-8.174/-8.209	<.001 / <.001	

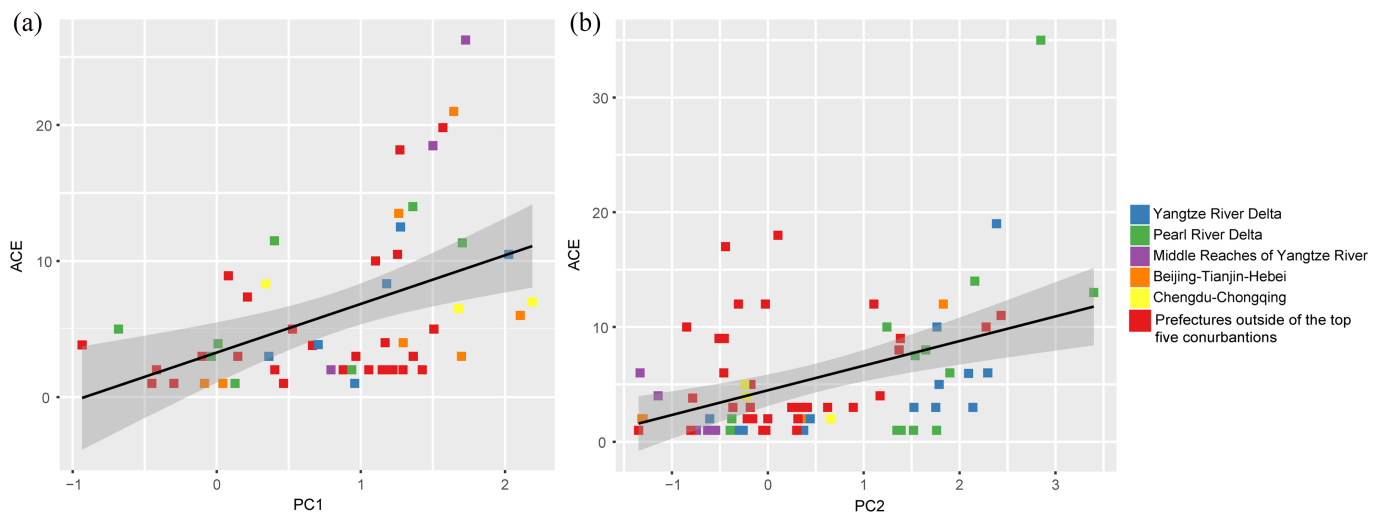


FIGURE 2 Abundance-Coverage Estimator (ACE; ≥ 1) in trade plotted against PC1 for parrots (a) and against PC2 for turtles (b) across prefectures of China (colored symbols). PC1 was heavily loaded by *GDP* and *total retail sales of social goods*, while PC2 by *per capita disposable income of urban households* and *per capita consumption expenditure of urban households* (Data S1 and S2). OLS lines are ACE for parrots = $3.28 + 3.57 \times \text{PC1}$ ($r^2 = 0.20$); ACE for turtles = $4.48 + 2.15 \times \text{PC2}$ ($r^2 = 0.18$). Prefecture was classified and colored according to the region to which it belongs. Gray area indicates a 95% confidence interval for the smoothed lines

55, 10, or 21% greater odds of the sales occurrence for parrots, and 24, 5, or 25% for turtles.

The most supported OLS model for parrots included exclusively PC1, which explained 20.2% of the variation in ACE ($\text{AICc} = 338.89$, $\text{DAICc} = 0.0$, $F = 13.18$, $p < .001$; Figure 2a). PC1 was positively related to ACE, and increased by 3.6 (CI 95% = 1.64; 5.50) species for each 1-unit increase in PC1. Autocorrelation was detected for ACE only in the sixth distance class (737–863 km) of the spatial correlogram (negative autocorrelation: Moran's $I = -0.26$, $p = .009$), while autocorrelation was detected for the residuals of the OLS regression in the seventh class (863–979 km; positive autocorrelation: Moran's

$I = 0.21$, $p = .029$). After applying the SEVM filters (truncation distance of 382 km), the most supported AICc model was the same as the OLS model, including exclusively PC1. This enhanced model increased the value of r^2 to 43.6 ($F = 2.38$, $p = .018$) and reduced autocorrelation in the regression residuals in the seventh distance class (Moran's $I = 0.18$, $p = .075$). Among exclusive effects, region explained the greatest proportion of variance in ACE (23.3%), followed by PC1 (15.7%).

The most supported OLS model for turtles included exclusively PC2, which explained 18.4% of the variation in ACE ($\text{AICc} = 441.77$, $\text{DAICc} = 0.0$, $F = 15.60$, $p < .001$; Figure 2b). PC2 was positively related to ACE,

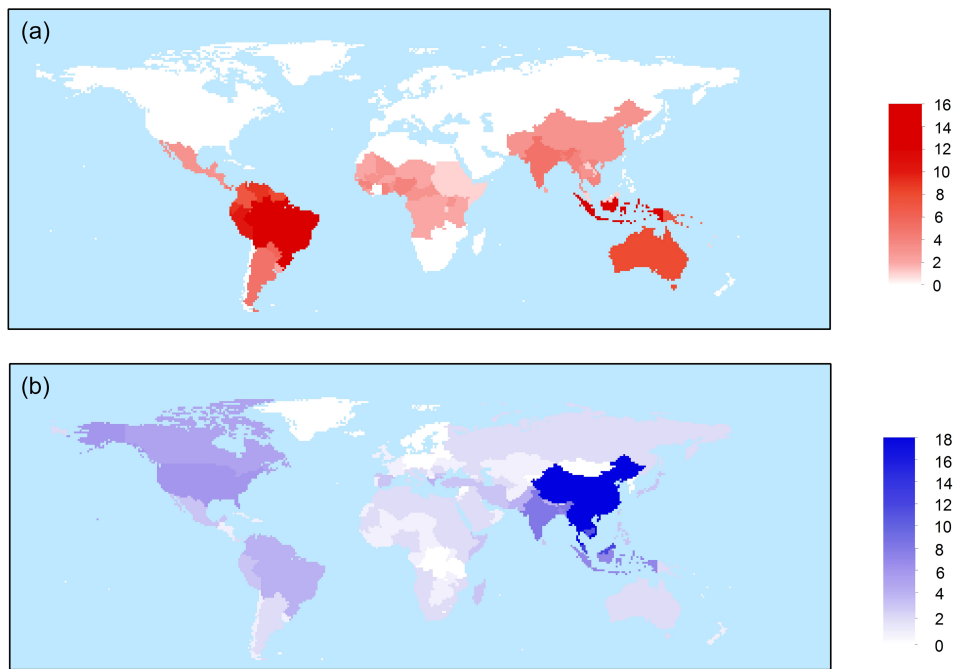


FIGURE 3 Indigenous areas of protected parrots (a) and turtles (b) traded as pets in China

and increased by 2.1 (CI 95% = 1.08; 3.21) species for each 1-unit increase in PC2. Autocorrelation for ACE was detected in the second distance class (214–361 km) of the spatial correlogram (positive autocorrelation: Moran's $I = 0.28$, $p < .001$), while autocorrelation was also detected for the residuals of the OLS regression in the second class (positive autocorrelation: Moran's $I = 0.26$, $p = .001$). After applying the SEVM filters (truncation distance of 2,022 km), the most supported model was similar to the OLS model, including PC1 and PC2. This enhanced model increased the value of r^2 to 30.7 ($F = 5.76$, $p < .001$) and reduced the autocorrelation in the regression residuals in the second distance class (Moran's $I = 0.15$, $p = .043$). Among exclusive effects, PC2 explained the greatest proportion of variance in ACE (13.1%), followed by region (9.8%) and PC1 (7.6%).

4 | DISCUSSION

We documented the sale of 5,862 individual parrots (46 protected species) and 66,927 turtles (49 protected species) over four and five 30-day surveys, respectively. These involved 396 vendors of parrots and 976 selling turtles. This extrapolates to annual trade volumes of c. 17,000 parrots and 160,000 turtles. Our results further revealed significant impacts of regional and economic factors on the occurrence and extent of pet trade, depending on the specific taxon. These prefectures predominantly represented the wealthier regions of China, in accord with the *normal goods hypothesis* (Brashares,

Golden, Weinbaum, Barrett, & Okello, 2011), which states that purchasing power drives sales. Given that possession of protected wild animals and derived products is generally the prerogative of more affluent purchasers (see also Zhou et al., 2015a, 2015b), ownership is more likely to be esteemed than criticized in China; a phenomenon known as the *anthropogenic Allee effect* (Courchamp et al., 2006; Tella & Hiraldo, 2014), linking rarity, desirability, and value (Fernandes-Ferreira et al., 2012).

We limited our search to a single (although the largest e-commerce platform in China) internet marketplace, Taobao.com, because data requests were not restricted on this site, and these data were presented in a well-structured and consistent way. Parrots and turtles are also sold through other online forums and social media platforms (e.g., WeChat) (Wong, 2017) and our data, therefore, are, but, a sub-sample of the total e-commerce in these species. Furthermore, we emphasize that when greater trade volumes (individuals) are transacted over more platforms there is a greater likelihood of observing an even broader range of species involved. We also recognize that despite the prominence of online trade in China's retail market, purchasing goods online involves a bias toward younger and better-educated consumers. Additional retail figures, detailing conventional high street sales of parrots and turtles would be needed to give a more complete estimate of total sales. In the future, it would also be informative to profile the buyers of these illegal exotic pets, to reveal the complete flow in traded species. Ultimately, however, these caveats serve to illustrate that the true number and diversity of parrots and

turtles traded in China per year would be even more staggering.

Interestingly, transactions occurred only in one-third of mainland China's prefectures despite the generally even use of the Taobao platform, where, importantly, we used unbiased sampling, without weighting intensity of investigation between prefectures, enabling a comprehensive assessment of the economic drivers of trade at a national scale. Significantly, patterns of pet sales were incongruent with the deployment of, inevitably limited, policing and educational resources intended to thwart illegal animal trading in China (Meng, 2013). Most efforts are currently focused on wildlife outflows from Southwest China's regional biodiversity hotspots (Li, Gao, Li, Wang, & Niemelä, 2000; Li & Li, 1998; Myers, Mittermeier, Mittermeier, Da Fonseca, & Kent, 2000), and/or on addressing subsistence-based consumption among China's large, typically poorer, rural population (Li & Wilcove, 2005), rather than on illegal pet trading in urban settings. From our results, we would caution that if new economic prosperity comes to a region, an increase in the sale and ownership of exotic pets is likely to follow, enabling the pre-emptive redeployment of enforcement resources.

All of these species were traded in contravention of China's WACL, and, if trafficked internationally, also in violation of CITES (unless specifically permitted, for example, for research, domestication or exhibition). Therefore, under China's criminal law, any seller/buyer convicted of trading in these species, could face up to 15 years fixed-term imprisonment accompanied by fines and/or the confiscation of property (see Zhou et al., 2016 for the detailed cascade of legal jurisdiction and penalties). Despite massive trade volumes, prosecutions remain few (notwithstanding the parrot dealer sentenced to a five-year prison sentence early in 2017 [subsequently reduced to 2-year upon appeal in 2018] for trading two green-cheeked parakeets, *Pyrhura molinae*, over Taobao), which highlights that entry-level illegal wildlife trade is not being prosecuted consistently. As for those pets sold over Taobao, before this was banned, their fate is unknown, but confiscation by enforcement authorities presents a further dilemma, because these tens of thousands of live, protected animals would vastly exceed the capacity of China's animal rehabilitation facilities, while euthanizing them would be illegal under Chinese law (Zhou, Newman, Buesching, Macdonald, & Zhou, 2016).

Clearly, it is important to establish the provenance of these animals sold as exotic pets. According to CITES Species+ (<http://www.speciesplus.net/>), 43 of these nationally and internationally protected parrot species (5,798 of the 5,862 individuals) and 32 protected turtle species (19,725 of 66,926 individuals) are not native to China, or even to Asia; with exotic parrots being indigenous to South America (18 species), Australia, and

eastern Indonesia (14 species), while 14 exotic turtle species were native to Indo-Malayan regions (Figure 3). We further queried the United Nations' Environment Program World Conservation Monitoring Centre (UNEP-WCMC) CITES trade database (<http://trade.cites.org/>) for all live wild animal seizures in China for the years 1976–2015, to include long-lived individuals and founder animals used for (illegal) captive breeding. We specifically selected data using only the “live” trade term, the country and territory code of the importer “CN” (China), and the CITES source code “I”, which refers to illegal trade seizure records as outlined in Notification 2002/022. Data were collated up to February 17, 2017—see UNEP-WCMC (2014) for a detailed explanation of these data. Perhaps significantly, our investigation revealed that only 292 parrots (eight species) and 3,900 turtles (11 species) were seized by border authorities during the period 1976–2015, arriving from Hong Kong, Ukraine, the United States, and Russia (Data S1). If border controls had intercepted illegal, wild-caught, imports efficiently, these recorded confiscations could account for only a small fraction of the C2C trades we report. We therefore deduce that the majority of the C2C trade we documented was supplied from captive-bred sources, while the minority from wild-caught. Clearly, the crucial question is to what extent was this captive-bred supply chain supplemented by individuals laundered into breeding stock from the wild. The balance of these two unknown scenarios determines the extent to which concerns principally hinge on conservation or welfare. Either way, this unlawful exotic pet trade illustrates that laws protecting wild species in China are being contravened by this pet trade.

Tackling this huge trade in protected exotic pets in China requires a thorough reappraisal of legislative policies. One option would be to permit legitimate commercial captive breeding and trade to supply demand for exotic pets, while enforcing good welfare standards for captive stock. This would be an approach similar to that adopted in the United States and the EU, where, paradoxically, the ownership of parrots and turtles can often foster interest and concern for the conservation status and continued protection of these species. Furthermore, given the massive volume of online trade in protected species, not just parrots/turtles but also other animals (Bergin, Atoussi, & Waters, 2018; Sung & Fong, 2018) and plants (Hinsley, Verissimo, & Roberts, 2015; Olmos-Lau & Mandujano, 2016), we recommend that it should henceforth be compulsory for online trading platforms to demonstrate legal compliance (to expose noncompliance) by appending specific permits to all sales advertising protected taxa. This should be enforced through amendments to Advertising Laws and/or through self-regulation codes of conduct implemented across the internet industry.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Z.M.Z. designed research; Y.C.Y. and X.X. undertook the data gathering while Y.C.Y., W.H.Y. and Y.X. led on the analysis, C.N., C.D.B., D.W.M., and Z.M.Z. interpreted the findings and wrote the paper. Y.C.Y. and W.H.Y. contributed equally.

ETHICS STATEMENT

No ethics approval was required for this research. The Taobao.com customers were anonymous and there was no invasion of personal privacy.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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