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Quantifying the global legal trade in live CITES-listed raptors and owls for commercial purposes over a 40-year period

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Abstract – The global wildlife trade poses an increasing threat to the world's biota. One-fifth of the global wildlife trade is fuelled by the demand for animals used as pets and entertainment purposes. The CITES Trade Database contains data on the declared trade of CITES-listed species from 1975 onwards. Previous research has focussed on the commercial trade of heavily persecuted species such as the Saker Falcon *Falco cherrug*. However there has yet to be an extensive review quantifying CITES trade data for live raptors and owls destined for global commercial markets. This study analyses trends in CITES trade data between 1975 and 2015 for live raptors and owls, highlighting key importer and exporter countries and discusses implications for raptor and owl conservation. Our results showed that the number of traded raptor and owl species has increased since 1975. We found that the most traded raptor species included hybrids in the genus *Falco*, the Gyrfalcon *F. rusticolus* and the Saker Falcon. In addition, our analyses revealed that the Eurasian Scops Owl *Otus scops*, Northern White-Faced Owl *Ptilopsis leucotis* and the Little Owl *Athene noctua* were the most commonly traded owl species. Our results suggested that Japan was the largest global importer of raptors and owls contributing to 94% of wild-caught owl imports since 1975, followed by the United Arab Emirates who imported the largest number of captive-bred raptors. Key exporter and re-exporter countries were the United Kingdom, Guinea and Germany. We conclude that the declared, legal commercial trade in live raptors and owls does not currently pose a large conservation concern to many such species. However, at present, there is a lack of quantified evidence highlighting the global extent and impact of the unregulated illegal raptor and owl trade, which is of conservation concern and is a current research gap that must be addressed.

Key-words: bird conservation, CITES, falconry, global wildlife trade, owls, raptors.

INTRODUCTION

The illegal global wildlife trade is a prominent threat to the world's biodiversity (Fernandes-Ferreira *et al*. 2012, Bush *et al*. 2014). A review by Baker *et al*. (2013) highlighted that one-fifth of wildlife trade records were found to be derived by the demand for pets and animals sought-after for entertainment purposes (Baker *et al*. 2013, Bush *et al*. 2014). Overexploitation of wild live animals for commercial purposes is an important factor driving species extinctions due to the removal of large numbers of individuals from natural populations (Rosser & Mainka 2002, Harris *et al*. 2015, Tingley *et al*. 2017, Vall-llosera & Su 2018). According to the International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species, over 13% of bird species are threatened with extinction (IUCN 2019). Overexploitation affects over one-third of all bird species (Harris *et al*. 2015) and is the second most significant threat (after habitat loss) to migratory species (Kirby *et al*. 2008, Brochet *et al*. 2016). Birds are taken from the wild for use as pets or display animals, hunted for food and used in sport (Butchart 2008). At present, there is a lack of quantified data on the global extent of the illegal wildlife trade, however, trade transactions focussing on the declared and legal trade of wildlife and associated wildlife products are readily available.

The Global Trade in Owls

The demand for birds used as pets remains high and as a result the pressure from the international trade on birds is increasing (Li & Jiang 2014). Monitoring of daily bird markets in Indonesia revealed that owl species are frequently offered for sale in nearly every major city (Shepherd 2012). In 2008 two trade consignments collectively containing over 1000 plucked owls destined for Chinese restaurants were intercepted by authorities in Malaysia (Shepherd & Shepherd 2009). Such evidence suggests an increasing demand in owls for consumption in south-east Asia. Despite this, little is known about the ecology of many species and whether the international wildlife trade is negatively impacting their conservation status (Widodo *et al*. 1999, Hutchinson *et al*. 2007).

Falconry

Falconry is commonly practiced as a sport (Knoch 2015), however, it has also been used in attempts to reduce bird strikes at airports (Dolbeer 1998), pest control (Erickson *et al*. 1990), as a response to removing unsolicited unmanned aerial vehicles (Slavimir 2017) and for educational purposes including medieval re-enactments particularly across Italy and central Europe. It is understood that falconry gained global popularity as an aristocratic pastime throughout western Europe during the Middle Ages (Epstein 1943). Archaeological evidence suggests that falconry flourished in Georgia during this time period and consequently the trapping of migratory raptors is deeply rooted in local Georgian tradition (van Maanen *et al*. 2001).

Today, falconry is still widely practiced as a sport in the USA and Eurasia, especially in the Middle East (Wyatt 2009). The United Arab Emirates (UAE) recently identified the preservation of falconry as part of their cultural and sporting heritage providing vital economic and social benefits in the lives of the people of the UAE (Wakefield 2012). Since the 1920s this sport gained popularity in the United States (Millsap & Allen 2006), however, worldwide trade data on live birds remained unavailable until the 1970s with the creation of the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES).

CITES

Since it entered into force in 1975, CITES has played a fundamental role in regulating and monitoring the international trade in wild species (Harfoot *et al*. 2018). Presently CITES is instrumental for biodiversity conservation and preventing overexploitation of wild species for international trade purposes (Harfoot *et al*. 2018). The open-access CITES Trade Database holds over 13 million wildlife trade records for over 34,000 species listed in the CITES Appendices (CITES 2019, www.trade.cites.org). Trade data is collected for species that only cross international borders and do not represent trade within a country.

Numerous papers have utilised CITES trade data and published their results at various taxonomic and geographic levels. Such levels include individual species (McAllister *et al*. 2009), whole genera (Pernetta 2009) and entire taxonomic groups such as reptiles (Carpenter *et al*. 2004, Robinson *et al*. 2015), amphibians (Carpenter *et al*. 2014) and birds (Beissinger 2001). Recent studies have examined CITES trade data focussing on key trading countries such as Japan (Vall-llosera & Su 2018). To date there is no quantitative paper providing a detailed examination of the global trade of live birds in the orders Falconiformes, Accipitriformes and Cathartiformes (for the purposes of this article this includes all diurnal birds of prey, hereafter 'raptors') and Strigiformes (including all nocturnal birds of prey, hereafter 'owls') for commercial purposes. This paper aims to explore trends in the commercial trade of live raptors and owls using the latest trade data since the start of the CITES convention in 1975 until 2015. This paper will reveal whether the overall trade in raptors and owls has increased or decreased since 1975, which species are most traded and which countries are key in the exportation and importation of live raptors and owls. Quantitative data from this paper will be used to determine trends in the legal trade of threatened raptors and owls and their associated population statuses providing evidence for the future conservation of these species.

MATERIALS AND METHODS

Following a similar methodology to Pernetta (2009), we obtained trade data for all CITES-listed raptor and owl species (downloaded 7th March 2019) from the open-access CITES Trade Database, using a compiled Comparative Tabulation Table from UNEP/WCMC (CITES 2019, www.cites.org). CITES trade data were obtained by querying the following search terms within the Trade Database: "Year Range" was set to include all trade records from 1975 to 2015, "Source" (see ESM 1 - Appendix A for definitions) was set to "ALL", "Purpose" was set to "COMMERCIAL" denoted by the letter (T) (see ESM 2 - Appendix B for definitions) and "Trade Terms" was set to "LIVE" which retrieved trade records for live birds only. Before downloading the data an additional filter was applied using the "Search by taxon" function. The taxonomic orders "FALCONIFORMES" and "STRIGIFORMES" were used to retrieve trade data for species within these orders. The CITES Trade Database pools all species in the families *Accipitridae*, *Cathartidae*, *Falconidae*, *Pandionidae* and *Sagittariidae* under the searchable order "FALCONIFORMES" and all species in the families *Strigidae* and *Tytonidae* under the order "STRIGIFORMES".

Due to geopolitical changes since 1975, we followed the methodology of Vall-llosera & Su (2018) and pooled data together under the former "Serbia and Montenegro" with data recorded under "Serbia" and "Montenegro", respectively. Other country names that were changed included "Czechoslovakia", "East Germany" and "USSR". Data under these names were pooled with data for "Czech Republic", "Germany" and "Russia" respectively. In addition data for overseas British territories were pooled together along with data from the "United Kingdom".

Importer and exporter reported quantity data were used

for data analyses. The use of import data was preferred compared to export data since it is based on CITES permits that are actually used, whilst export data is calculated based on CITES permits that are issued and some of these may not actually be used (Carpenter *et al*. 2004, Pernetta 2009). Bird taxonomy was standardised for all species using accepted names recognised by the IOC World List version 9.1 (IOC 2019, https://www.worldbirdnames.org/bow/raptors/) and all data management and analyses were conducted using the software package R version 3.5.1. (R Core Team 2018). Simple linear regression analyses were performed to depict trends in trade data using an α value of 0.05. Geospatial analyses and mapping were conducted using the software ArcMap version 10.6.1 (ESRI 2019).

RESULTS

Number of traded species

In total 191 species of raptor (including records for 12 unidentified raptor species) and 86 species of owls (including records for six unidentified owl species) were traded for commercial purposes between 1975 and 2015. Live export records for traded individuals representing all sources totalled 87,837 raptors and 26,035 owls (113,872 in total) and declared wild-caught export data comprised of 19,533 raptors and 18,948 owls (38,481 individual in total) (ESM 3 - Appendix C). Declared wild-caught individuals represented 34% of the total live export trade. Importer recorded quantities of raptors and owls comprised of 33,053 and 20,562 individuals, respectively (53,615 in total) (ESM 3 - Appendix C). Wild-caught individuals represented 42% of the total import trade over the 40-year study period.

Overall, the declared trade in the number of species increased over time for both raptors ($R^2 = 0.5056$, $p < 0.0001$, df = 39) and owls ($R^2 = 0.7859$, $p < 0.0001$, df = 39) with peaks in raptor trade (70 spp.) in 2003 and a peak in owl trade in 2014 (40 spp.). However, the data suggest a rapid decline in raptor trade in 2006 whereby the number of traded raptor species decreased by 53% over a one-year period (Fig. 1). Additionally, gradual declines of up to 49% in the number of traded owl species were observed between 2004 and 2008 (Fig. 1).

Despite the large number of traded raptor species, three species dominated the trade in raptor species, namely hybrids in the genus *Falco*, the Gyrfalcon *Falco rusticolus* and the Saker Falcon *Falco cherrug* (Tab. 1 & Tab. 2). Such species represented 38% of all imported (Tab. 1) and 68% of all exported (Tab. 2) raptor individuals respectively. In addition the three most traded owl species included the Eurasian Scops Owl *Otus scops*, Northern White-faced Owl *Ptilopsis leucotis* and the Little Owl *Athene noctua* (Tab. 1 & Tab. 2). These three species contributed to 43% (Tab. 1) of all imported and 47% (Tab. 2) of all exported owl individuals respectively. However, the Eurasian Scops Owl was found to be the most imported owl species (N = 3,256) (Tab. 1) and the Northern White-faced Owl was the most exported owl species (N = 5,517) (Tab. 2, Fig. 2).

Commercial import and export countries

The CITES trade data recorded 184 countries importing raptor and owl species throughout the 40-year study period from all sources. Raptors were imported by 118 countries and owls were imported by 66 countries. The data revealed a total of 198 countries exporting raptors and owls for commercial purposes, 117 countries exported raptors and 81 countries exported owls during the study period. CITES import data showed that Japan was the largest global im-

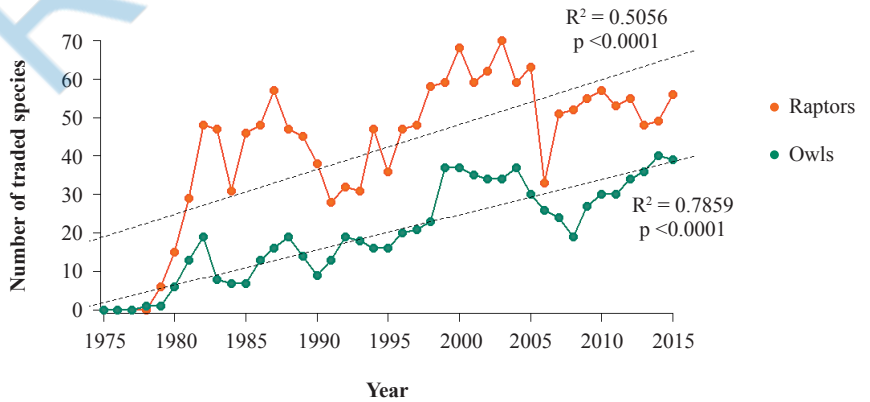

Figure 1. Line graph showing trends in the number of raptor (orange) and owl (green) species traded for commercial purposes over a 40-year period. Simple linear regression lines showing a positive increase in number of species traded since 1975.

Table 1. Top five most imported species of raptors and owls. Unknown species denoted by * and † values calculated using trade data for all species (ESM 6 & ESM 8).

Scientific name	Common name	Imported individuals	% Total imported individuals †
	RAPTORS		
Falco hybrid*		6180	18.7
Falco rusticolus	Gyrfalcon	3745	11.3
Falco cherrug	Saker Falcon	2464	7.5
Accipiter gentilis	Northern Goshawk	2269	6.9
Falco peregrinus	Peregrine Falcon	2329	7.0
	OWLS		
Otus scops	Eurasian Scops Owl	3256	15.8
Ptilopsis leucotis	Northern White-faced Owl	3153	15.3
Athene noctua	Little Owl	2334	11.4
Tyto alba	Western Barn Owl	1333	6.5
Otus brucei	Pallid Scops Owl	1229	6.0

Table 2. Top five most exported species of raptors and owls. Unknown species denoted by * and † values calculated using trade data for all species (ESM 7 & ESM 9).

Scientific name	Common name	Exported individuals	% Total exported individuals †
	RAPTORS		
Falco hybrid*		29495	33.6
Falco rusticolus	Gyrfalcon	15907	18.1
Falco cherrug	Saker Falcon	14081	16.0
Falco peregrinus	Peregrine Falcon	5131	5.8
Accipiter gentilis	Northern Goshawk	3694	4.2
	OWLS		
Ptilopsis leucotis	Northern White-Faced Owl	5517	21.2
Otus scops	Eurasian Scops Owl	3971	15.3
Athene noctua	Little Owl	2717	10.4
Otus brucei	Pallid Scops Owl	1654	6.4
Athene cunicularia	Burrowing Owl	1302	5.0

porter of live raptors and owls for commercial purposes (N = 28,979), possessing 54% of all global imports (ESM 3 - Appendix C). The data also showed that the United Kingdom was the largest exporter of live commercial raptors and owls (N = 16,534) totalling 15% of global exports (ESM 3 - Appendix C).

Countries supplying Japanese trade

Some 50 countries were found to export live raptors and 43 countries to export live owls to Japan for commercial purposes (see ESM 4 - Appendix D). CITES export data showed that the United Kingdom was the largest exporter of live raptors and owls for the Japanese commercial market and contributed 14.5% (N = 1,566) and 24% (N = 5,333) of all exports to Japan respectively (ESM 4 - Appendix D). In addition to the United Kingdom, CITES export data revealed key Japanese raptor exporter countries also include the United States, Germany and Canada (Fig. 3). Furthermore, key exporter countries supplying the Japanese owl trade included the United Kingdom, Belgium, Russia and the Netherlands (Fig. 4).

Wild-caught trade

The data showed that Japan was the largest importer of wild-caught (WC) raptors and owls. Japan has contributed to approximately 46% of all WC raptor imports (N = 4,472) and dominated WC owl imports (N = 12,147) at 94% (Tab. 3). WC Japanese imports totalled 13% of all

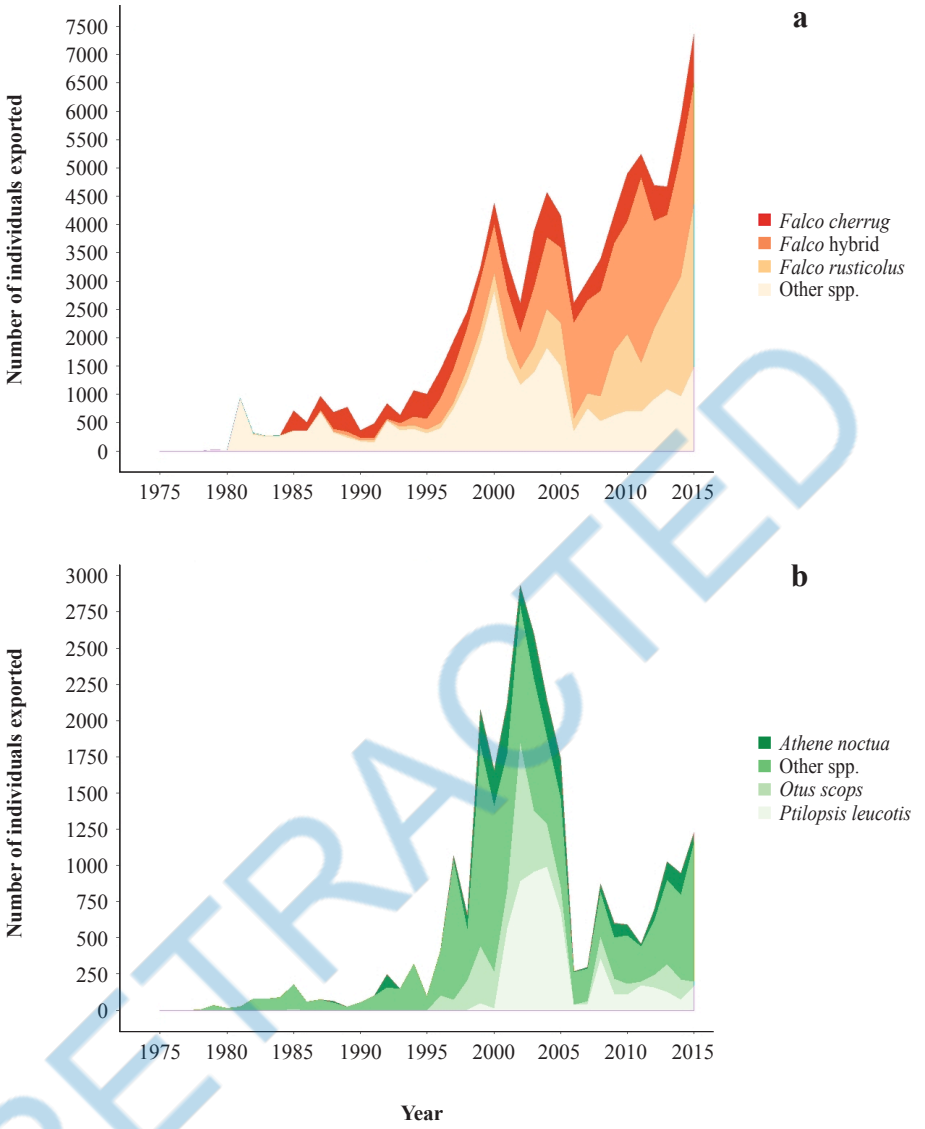

Figure 2. Temporal trends in the trade of the top three most traded raptor and owl species including all other species in each group. a) The number of live individual raptors exported annually for commercial purposes including the three most traded species. b) The number of live individual owls exported annually for commercial purposes including the three most traded species. Exports calculated from exporter reported quantities between 1975-2015.

global imports of raptor species and 60% of all global owl imports since 1975 (Tab. 3). Portugal was the second largest importer of WC raptors, representing 10% of the total WC imports and 3% of the global raptor import trade. The CITES import data showed that Spain was the second largest importer of WC owls contributing to 2% of the total WC imports and 1% of the total global import trade in owls (Tab. 3). The data also showed that Guinea and United Kingdom were the largest exporters of WC raptors, each totalling 11% of total WC exports and 2.5% of the total global exports in wild raptors (Tab. 4). Germany was the third largest exporter of WC raptors, whereby German exports constituted 8% of the total WC exports and approximately 2% of the total export trade in raptors (Tab. 4). The United Kingdom was by far the largest exporter of WC owls followed by Russia, comprising 21% and 10% of total WC owl exports and 15% and 7.5% of total global owl exports, respectively (Tab. 4). WC exports from The Netherlands totalled 8% of the total WC owl exports and 6% of global owl exports (Tab. 4).

Captive-bred trade

The United Arab Emirates was the largest importer of captive-bred (CB) raptors and contributed to 23% of all CB imports representing 8% of the global raptor import trade (Tab. 3). The data also showed that Japan was the second largest importer of CB raptors representing 20% of total CB imports and 7% of global raptor imports (Tab. 3). Approximately 90% of the CB owl trade is imported by Ja-

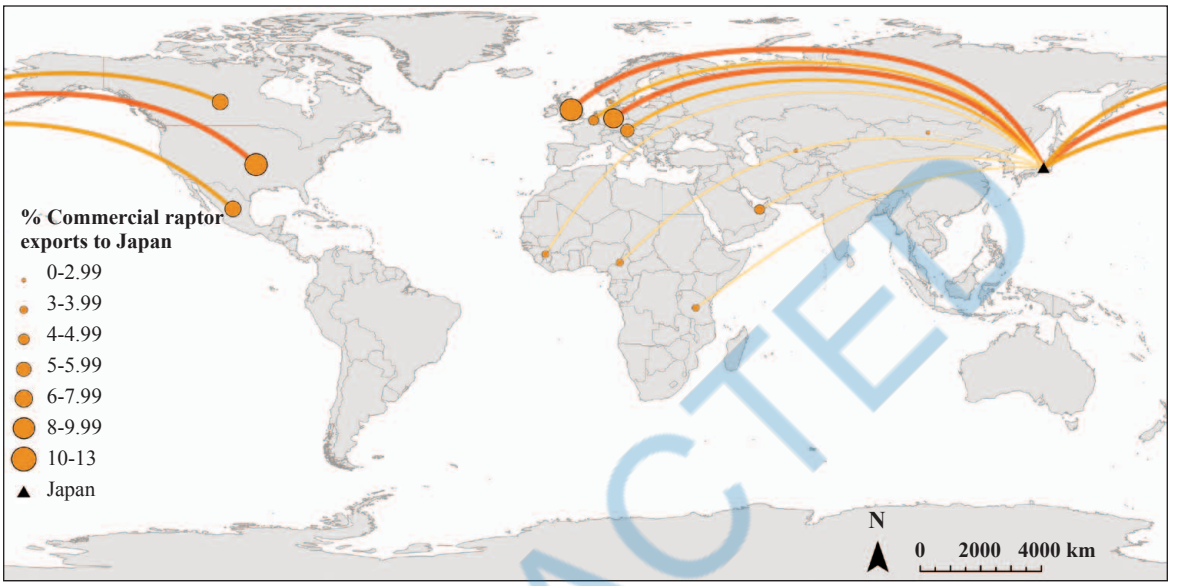

Figure 3. The top 15 exporter countries exporting live raptors for commercial purposes to Japan. Thicker and darker coloured flow lines represent a larger proportion of exports of live raptors to Japan. Graduated symbol sizes also show proportion of each exporter country exporting live raptors to Japan for commercial purposes.

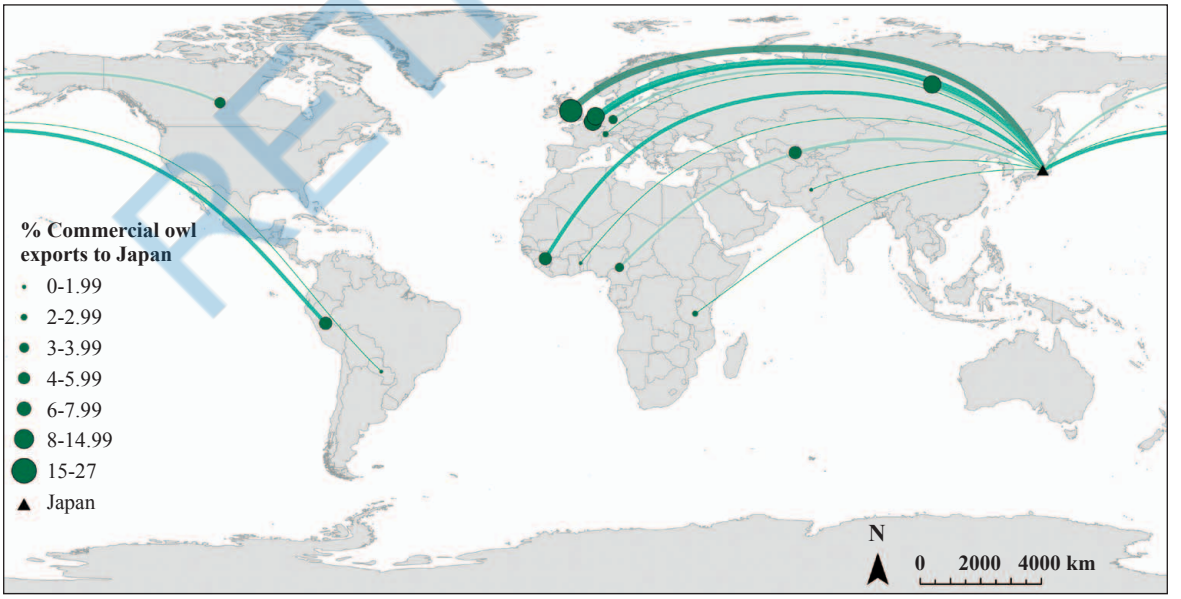

Figure 4. The top 15 exporter countries exporting live owls for commercial purposes to Japan. Thicker and darker coloured flow lines represent a larger proportion of exports of live owls to Japan. Graduated symbol sizes also show proportion of each exporter country exporting live owls to Japan for commercial purposes.

Table 3. Top five global import countries for wild-caught (WC) and captive-bred (CB) raptors and owls for commercial purposes, with percentage of total global imports. Data derived from importer recorded quantities.

	Importer (WC)	**Imported individuals** (WC)	**% Total imports** (WC)	**% Total global imports**	**Importer** (CB)	**Imported individuals** (WC)	**% Total imports** (WC)	**% Total global imports**
RAPTORS								
	Japan	4472	45.8	13.4	United Arab Emirates	2599	22.6	7.8
	Portugal	1024	10.5	3.1	Japan	2314	20.1	6.9
	Spain	875	9.0	2.6	Qatar	1998	17.4	6.0
	The Netherlands	623	6.4	1.9	Kuwait	812	7.1	2.4
	Saudi Arabia	459	4.7	1.4	Saudi Arabia	726	6.3	2.2
Total		**9756**	-	33503		**11491**	-	**33503**
OWLS								
	Japan	12147	93.9	**59.1**	Japan	5498	89.3	26.7
	Spain	271	2.1	**1.3**	United Kingdom	91	1.5	0.4
	Canada	100	0.8	**0.5**	Thailand	78	1.3	0.4
	The Netherlands	77	0.6	**0.4**	Italy	69	1.1	0.3
	South Africa	61	0.5	**0.3**	United States	66	1.1	0.3
Total		**12932**	-	**20562**		**6155**	-	**20562**

pan, contributing to 27% of the global import trade for owl species (Tab. 3). The United Kingdom was the second largest importer of CB owl species contributing 1% of the CB owl imports and 0.4% of global owl imports altogether (Tab. 3).

CITES export data indicated that Germany was the largest exporter of CB raptors since 1975, contributing 19% of total CB raptor exports and 8% of all global raptor exports (Tab. 4). The United Kingdom and Spain were the second and third largest exporters of CB raptors, totalling 14% and 12% of total CB raptor exports respectively (Tab. 4). British and Spanish exports represent 6% and 5% of all CB raptor exports respectively (Tab. 4).

Temporal trends in CB and wild-caught trade

The trade in both CB and WC raptors significantly increased over the 40-year study period (CB: $R^2 = 0.856$, $p < 0.0001$, df = 39; WC: $R^2 = 0.142$, $p < 0.01$, df = 39). The results showed that the increase in trade for CB raptors was more significant than declared WC raptors (Fig. 5a). Trade data for owls showed a similar pattern (CB: $R^2 = 0.573$, $p < 0.0001$, df = 39; WC: $R^2 = 0.089$, $p > 0.01$, df = 39) whereby the trade for both CB and WC individuals increased over time (Fig. 5b). The increase in the number of CB owls traded over the 40-year study period was more significant than the increase in WC owls (Fig. 5b).

IUCN Red List categories and population trends

According to data from the IUCN Red List of Threatened Species the majority of traded bird species were of least concern (LC) (Fig. 6). However, there were more threatened species (vulnerable (VU), endangered (EN) and critically endangered (CR)) derived from declared WC sources compared to the data from the CB trade (Fig. 6). In summary, 67% of WC raptors and 64% of WC owl species were LC (see ESM 5 - Appendix E). Threatened raptor and owl species comprised of 19% of the WC trade and approximately 8% and 2% of the CB trade respectively (see ESM 5 - Appendix E).

The largest proportions of raptor and owl species within the WC trade had decreasing global population trends in the wild, comprising 44% and 53% respectively (Fig. 7; ESM 5 - Appendix E). In addition 16% of raptors and 18% of owl species had increasing wild population trends. Population trends within the majority of CB raptors and owls were stable representing 52% and 59% respectively (Fig. 7, ESM 5 - Appendix E). However, 42% of raptors and 37% of CB owl species had decreasing wild population trends. CB species of both raptors and owls showed the lowest proportion of species under the increasing wild population trend category, comprising 6% and 4% respectively (Fig. 7, ESM 5 - Appendix E).

DISCUSSION

For the first time, this study used import data from the open-access CITES Trade Database to quantify and exam-

Table 4. Top five global export countries for wild-caught (WC) and captive-bred (CB) raptors and owls for commercial purposes, with percentage of total global exports. Data derived from exporter recorded quantities.

	Exporter (WC)	**Exported individuals** (WC)	**% Total exports** (WC)	**% Total global exports**	**Exporter** (CB)	**Exported individuals** (CB)	**% Total exports** (CB)	**% Total global exports**
RAPTORS								
	Guinea	2242	11.5	2.6	Germany	7262	19.1	8.3
	United Kingdom	2196	11.2	2.5	United Kingdom	5329	14.0	6.1
	Germany	1563	8.0	1.8	Spain	4625	12.2	5.3
	Russia	1439	7.4	1.6	Belgium	2986	7.9	3.4
	United States	1436	7.4	1.6	Czech Republic	2474	6.5	2.8
Total		**19533**	-	**87846**		**37981**	-	**87846**
OWLS								
	United Kingdom	4028	21.3	15.5	Belgium	1761	29.1	6.8
	Russia	1970	10.4	7.6	United Kingdom	1560	25.8	6.0
	The Netherlands	1593	8.4	6.1	The Netherlands	368	6.1	1.4
	Peru	1508	8.0	5.8	Uzbekistan	215	3.6	0.8
	Guinea	1306	6.9	5.0	Austria	208	3.4	0.8
Total		**18948**	-	**26035**		**6047**	-	**26035**

ine trends in the legal trade of live raptors and owls for the global commercial market. Results from this study found that the commercial trade in live raptors and owls has increased over time since 1975. The magnitude of the trade in raptors increased more than the trade in owls. We found that Japan was the largest global importer of live raptors and owls with the United Kingdom being the largest global exporter/re-exporter country of live raptors and owls. Since 2005, the overall trade in CB individuals increased more than the trade of WC individuals, likely a response to global trade restrictions.

Trends in the legal trade of raptors and owls

Overall the data showed an increase in the number of bird species traded for commercial purposes over the 40-year study period. Our data follow a similar pattern to that observed by Vall-llosera & Su (2018). Initially the trade in raptors and owls was low and started to increase in 1979, after this period there was a positive trend in the number of species traded between 1979 and 2005. We report a notable decline in the number of species traded between 2005-2006, however, the trade in raptors and owls has stabilised since then.

The number of raptor species traded for commercial purposes remained higher than the number of owl species throughout the 40-year study period. This is likely due to the fact that there were nearly double the number of raptor species (N = 191) compared to owls (N = 86) represented in our trade data. Additionally, the falconry trade and its associated historical prominence is arguably more popular in human society than the more recent demand for owls destined for the pet trade. Owls are poorly represented within falconry literature which is dominated by raptors. Training raptors (commonly referred to as 'hawks' in the literature) for use in falconry is different to that of owls and requires the use of visual cues. Owls frequently rely on sound to locate prey (Knudson 1981) whereas many raptors hunt relying on sight making them more suitable for falconry. Furthermore, the diurnal behaviour of raptors as opposed to the nocturnal behavioural characteristics of owls may be more desirable for falconers.

Peaks in WC imports were observed in 2000 for both raptors and owls. In 2005 an indefinite wild bird trade ban was issued by the European Union (EU) to counter the spread of avian influenza (Cardador *et al*. 2019). In the years before the band was issued the trade in WC birds declined gradually whereas the trade in CB birds increased. Our data showed a sizeable increase in the trade of CB raptors from 2006 onwards, likely a response to the implementation of the EU's trade ban in 2005. A paper published by Vall-llosera & Cassey (2017) discussed that many major European exporters may have large-scale captive breeding facilities capable of contributing to the global commercial demand for birds (Vall-llosera & Cassey 2017). Although it is unlikely that such facilities are capable of supplying the entire trade network as the illegal trade in raptors and owls remains a prominent conservation issue (Iqbal 2016). These findings correlate with ours, whereby key exporter countries mostly comprised of European countries possibly explaining why the United King-

dom was found to be the largest exporter/re-exporter of live birds globally and to Japan. Furthermore, a substantial increase in the numbers of CB Peregrine Falcons and other falcon species throughout the United Kingdom driven by the international demand for falcon hybrids occurred between 1983-2008 (Fleming *et al*. 2011).

The CITES import data showed the WC trade in raptors and owls never recovered after the trade ban imposed

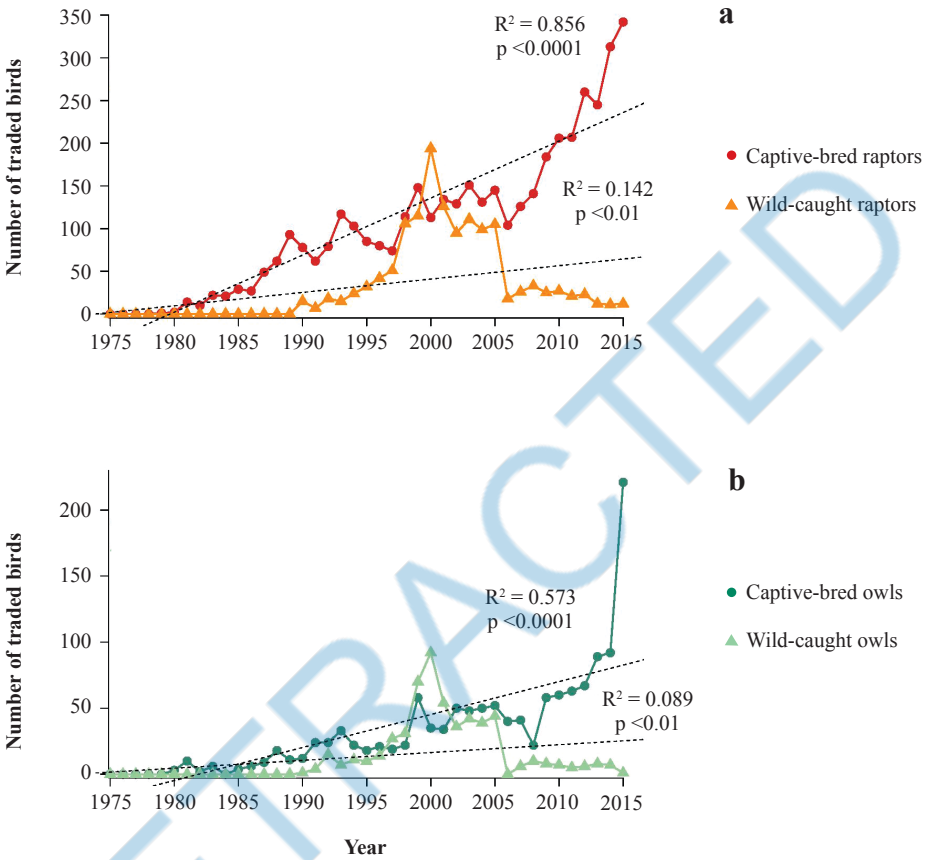

Figure 5. Trends in the trade of declared CB and WC individuals since 1975 represented by linear regression lines. a) Trends in the declared trade of CB and WC raptors. b) Trends in the declared trade of CB and WC owls.

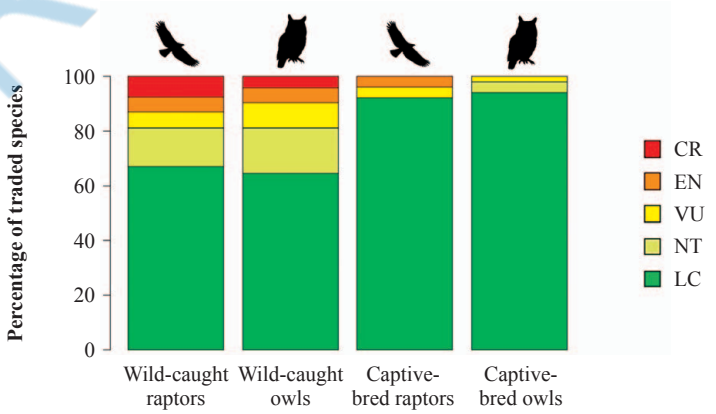

Figure 6. Percentages of number of traded species within global IUCN Red List categories (CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened and LC = least concern).

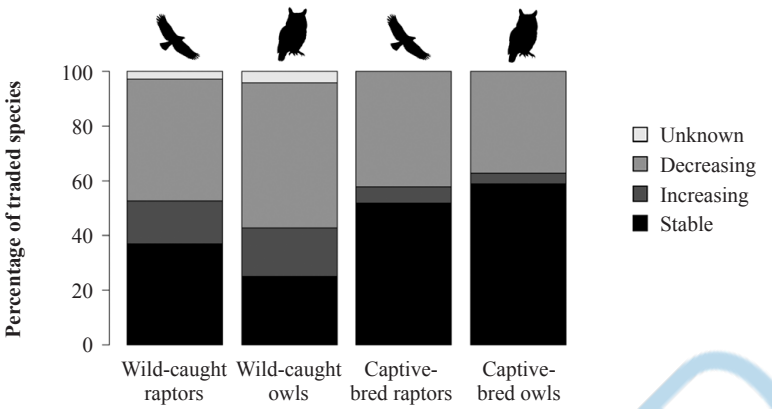

Figure 7. Percentages of number of traded species within global IUCN reported population trends.

in 2005, suggesting a long-term reduction in the extent of the declared WC trade. However, the extent of the benefits of the trade ban have been argued, others suggest the criminalisation of the wild bird trade will encourage and further stimulate illegal activity and effectively push it "underground" (Cooney & Jepson 2006).

Japanese trade

From our import data Japan was the largest global importer of WC raptors and owls contributing to 94% of WC owl imports. Owls are displayed in "bird cafes" along with some raptor species for entertainment purposes (Vall-llosera & Su 2018). Such practices also pose extensive animal welfare concerns as unhealthy levels of interaction stress are imposed onto animals in these conditions (Parry-Jones & Ferguson 2003). Japanese law states that only CB animals are allowed to be displayed in "bird cafes" (Vall-llosera & Su 2018) which may explain the increase in global trade of CB raptors and owls to Japan and its current status as the largest global importer of these species for commercial purposes.

The "Kawaii" trend has also been referred to as Japan's "cute culture" (Vall-llosera & Su 2018) and has dominated Japanese mainstream culture since the 1980s (Kinsella 1995). The "Kawaii" trend celebrates morphological traits that are deemed "infantile" and "adorable" (Kinsella 1995) and is a likely explanatory factor as to why Japan imports the highest number of owl species for commercial purposes. Humans are more commonly attracted to animals which retain infantile characteristics deriving from features of a human baby, for example, a large head and big eyes (Estren 2012). Owls possess morphological features that may appeal to the "Kawaii" trend including large head to body size, short beak in relation to head size and large eyes. Owls are considered a lucky animal in Japanese culture (Daniels 2012) and are known to be attractive to people because of these characteristics (Lorenz 1971, Stokes 2007, Vall-llosera & Su 2018). Our data showed that one of the most traded global owl species was the Northern White-Faced Owl, a sub-Saharan species which possess facial characteristics desired by Japan's "Kawaii" culture. The species is currently listed as LC by the IUCN Red List of Threatened Species. However, the demand by the international pet trade is recognised as a threat to this species and therefore it is currently protected under CITES legislation (Appendix II) (CITES 2019, https://www.cites.org).

A smaller proportion of raptors are destined for "bird cafes" although most are likely destined for the falconry trade. The ancestral tradition of falconry is known as "Takagari" in Japan (Jameson 1962, Otsuka 2006), despite losing popularity over the years it is still practiced by a small number of followers and still contributes to a large volume of Japanese raptor imports (Vall-llosera & Su 2018). We found the most traded raptor species included Falcon hybrids, the Gyfalcon and the Saker Falcon. Our findings complement those of Dixon (2012) who discussed the use of hybrid falcons destined for the falconry trade. Hybrid birds typically consisting of hierofalcon taxa, possess phenotypic and behavioural traits desirable to falconers including high agility, husbandry and aesthetical appeal (Dixon 2012). Additionally, our results correlate with that of Dixon *et al*. (2011) who identified the Saker Falcon as one of the most sought-after raptor species for the falconry trade (Dixon *et al*. 2011). This species is unsustainably harvested across central Asia along with wild Gyrfalcons and as a result, is listed as EN on the IUCN Red List of Threatened Species. We highlight a continuing commercial demand for live Saker Falcons, although, did not find an increase in the trade of declared WC individuals. Despite this, illegal collection of wild Saker Falcon eggs and chicks is a nota-

ble driver of population declines across central and eastern Europe and is likely to occur underground (Horák 2000, Levin 2000, Moseikin 2000, Galushin *et al*. 2001, Karyakin 2001, ERWDA 2003, Karyakin 2005, Karyakin 2008, Levin *et al*. 2010).

The influence of the media on wildlife trade

In recent years the media has played a key role in the increase of international wildlife trade. For example, the release of the first *Jurassic Park* film in 1993 resulted in a delayed increase in the global trade of green iguanas *Iguana iguana* (Christy 2008, Nijman & Shepherd 2011, Nijman & Nekaris 2017). Similarly, the release of the Disney Film *Finding Nemo* prompted a spike in the number of species of clownfish entering the US marine aquarium fish trade (Rhyne *et al*. 2012, Nijman & Shepherd 2011, Militz & Foale 2017).

Our data showed an increase in the trade of owls towards the end of the 1990s and is similar to findings by Nijman & Nekaris (2017) who investigated whether the release of the popular book and film series *Harry Potter* influenced the extent of the owl trade in Indonesia (Nijman & Nekaris 2017). Their study found a potential delayed "*Harry Potter effect*" but along with our data the time period coincided with the global expansion of the internet and subsequently social media, potentially contributing to the increase in owl trade. Furthermore, a study by Megias et al. (2017) found no evidence of such media-derived effect on the commercial trade of owls, despite investigating potential lag-time effects (Megias *et al*. 2017). Social media has been identified as a key conservation concern due to the exploitation of threatened species kept as pets (Kitson & Nekaris 2017). Our data also showed a similar positive trend in traded raptor species during this time period. However, no media influence targeting raptors has been identified as a key factor influencing the commercial trade between 1990-2000. Nevertheless, the rise of the internet and social media are likely to facilitate both the legal and illegal trade in raptors and owls providing direct contact between sellers and buyers. However, there is a lack of quantitative data on the extent of the illegal trade although recent studies have started investigating the role of social media in the illegal trade of raptors and owls (Iqbal 2016).

Data limitations

This study has solely relied on data made available in the CITES Trade Database and all figures are likely to underestimate the total global trade in live animals. Data from countries that are not signatories of the CITES convention are also not included and data from the illegal trade are unavailable. Additionally, data gaps are present for specimens traded within a country as the CITES Trade Database only includes data on trade crossing international borders. However the wealth of trade data held in the CITES Trade Database provides suitable baselines for analyses of global trade trends which other studies have expanded upon (e.g. Vall-llosera & Su 2018).

Unlike Vall-llosera & Su (2018), we chose not to use quantified transaction data during our analyses as many transactions involved the trade of multiple individuals at once. Instead, we used importer and exporter reported quantity data for our data analysis adopting a similar method to that of Pernetta (2009). These data provided more detail into the number of individual birds traded per transaction as opposed to the number of overall transactions per species. Despite this there were gaps in our dataset where the importer and/or exporter reported quantities were unknown, underestimating the extent of the legal trade in raptors and owls. Further inconsistencies in the declared trade of raptors and owls may be explained by the number of participating countries ratified within the CITES convention at any given time (Vall-llosera & Su 2018). For example Tajikistan ratified into the CITES convention in 2016 and full trade data for this country may not be included in the dataset prior to the date of ratification, subsequently underrepresenting the extent of the declared trade during our analyses. On the contrary, the United Kingdom joined the CITES convention in 1976 and as a result may contribute a larger proportion of trade data post-1976. This may explain why the United Kingdom was found to be the largest re-exporter of WC birds in this study. Furthermore, prior to 1991 the CITES Trade Database did not record source data for the traded specimens unless specified as CB (UNEP-WCMC 2013, Vall-llosera & Su 2018), therefore, it is highly likely that more WC specimens were traded before 1991 than our data show. It is recommended that our findings are interpreted with caution due to a lack of updated population trends for many species in different countries. For example in 2010, the illegal collection and overexploitation of Bonelli's Eagle *Aquila fasciata* chicks in Italy was identified, however, intervention from conservationists and police authorities resulted in a significant increase in the population (Di Vittorio *et al*. 2018). In the years prior to 2010, the illegal harvesting of chicks remained unknown in the country.

Finally, the CITES Trade Database contains only declared, legal trade data and may not be wholly representative with real world conditions as it does not contain data on the unregulated and illegal trade of CITES-listed species. It is important to note that figures within this study only represent wild-caught transactions declared to the CITES authorities and do not represent the extent of the

illegal trade. External regulation of the CITES Trade Database does not exist and the system relies heavily on self-reporting by participating parties. As a result submission biases including fake data may occur for various political or economic reasons (Ginsberg 2002, Phelps 2011, Li & Jiang 2014). Inconsistencies in the reported importer and exporter quantities present in this study may be a result of the self-reporting system CITES has in place.

Implications for raptor and owl conservation

We found more threatened species were traded as WC individuals compared to CB. Our data showed that temporal increases in the number of traded WC individuals were not as extensive as CB individuals, namely due to the EU's ban on WC bird trade in 2005. Analyses of our data showed that the majority of WC raptors and owls had decreasing global population trends, whereas the majority of CB birds had stable wild population trends. The results from our study show a reduction in the trade of declared WC individuals and an increase of CB individuals after 2005, suggesting a reduction in the trade of more threatened species. However, it is more likely that the illegal trade of such species continues unmonitored and poses a conservation concern (e.g. Levin 2000, Karyakin 2005).

Forgery of trade documentation has been found to occur within the declared global trade network, whereby WC birds are falsely labelled as CB (Shepherd *et al*. 2012). Furthermore, the trafficking of raptors and owls using falsified CITES-certificates and other documentation for Annex A listed species was reported in 2014. Consignments of birds of prey eggs and chicks stolen from the wild and traded under falsified documentation were also seized by the authorities (EU ERA Seminar 2016, http://ec.europa.eu/environment/legal/law/4/pdf/illegal_trade_of_birds_of_prey.pdf).

The illegal trapping of owls for the pet trade has been identified as a crucial conservation issue (Shepherd & Shepherd 2009) and data from this study suggests the global commercial demand for owl species is increasing, especially in Japan. Results from our study suggest similar increases in the global demand for raptors. A paper published by Dixon et al. (2011) argue that as a consequence of the increased demand, the illegal and unregulated trade in Saker Falcons, Gyrfalcons and Peregrine Falcons persists across central Asia (Dixon et al. 2011). Illegal smuggling of birds drives false reporting of traded animals and remains a prominent issue in avian conservation (Shepherd *et al*. 2012).

Future research

It is assumed that the majority of illegal wildlife trade will move online as it provides sellers with almost instant access to global wildlife markets. The internet and with it, the dark web and social media (Iqbal 2015, 2016) pose a substantial threat to wildlife allowing overexploitation of threatened species on a global scale. It is recommended that future monitoring of the declared global commercial trade in raptors and owls along with novel research into the extent of the illegal trade of such species both online and on-the-ground is continued.

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