

SHORT COMMUNICATION

Illegal trade on non-native amphibians and reptiles in southeast Brazil: the status of e-commerce

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Legal statutes and associated regulations on the importation of non-native species vary among countries. In Queensland, Australia, toads of the genus *Bombina*, salamanders of the genus *Cynops* and snakes of the genus *Pantherophis*, for example, are considered potential threats to the local fauna and, as a consequence, their importation is forbidden by the Land Protection Act of 2002 (Queensland Government 2012). In Brazil, the pet trade as a vector for amphibian and reptile introduction has received little attention. The Ordinance N° 93 of 1998 was enacted to regulate the management of non-native amphibian and reptiles. This act emphasizes trade regulation of these non-native taxa through vectors such as importation via the pet trade (Brasil 1998).

The introduction of non-native amphibians and reptiles such as the American bullfrog (*Lithobates catesbeianus*) and the red-eared slider (*Trachemys scripta elegans*) through the release of pets has occurred in southeastern and southern regions of Brazil, resulting in the establishment of feral populations (Quintela *et al.* 2006, Afonso *et al.* 2010). Both species are on the list of the 100 world's worst invasive non-indigenous species (Lowe *et al.* 2000). American bullfrogs, in particular, may have caused detrimental effects to native Brazilian frogs (Silva *et al.* 2009), particularly through the introduction of disease (Mazzoni *et al.* 2009, Schloegel *et al.* 2010). In Brazil, all non-native amphibian and reptile species but *L. catesbeianus* were placed on the Ordinance N° 93 of 1998 in order to reduce the likelihood of similar introduction and establishment. The Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) has the responsibility to carry out the enforcement of this ordinance (Brasil 1998).

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Although the Brazilian government has declared the importation of non-native herpetofauna illegal (Brasil 1998), the efficacy of this regulatory policy has not been determined, and data on trade are incomplete and likely inaccurate, especially regarding trade carried out through the Internet (Pistoni and Toledo 2010). The illegal trade in wildlife appears to be increasing on the Internet, as evidenced by the burgeoning number of websites and social media outlets where wildlife goods are offered, often with clearly suspect origins. Although wildlife law enforcement has made gains in policing physical markets, the Internet presents new challenges via virtual markets that have yet to be properly regulated (Wu 2007). In order to understand the extent of potentially illegal trade, we conducted a study of the offerings of non-native amphibians and reptiles that are currently available through Internet and social media outlets in southeastern Brazil.

Species were surveyed in the social network Orkut (<http://www.orkut.com/About.aspx>) from mid-2006 to mid-2012. Seventeen community forums were accessed to determine the availability of species for sale. We calculated the absolute and relative frequencies of non-anonymous dealers selling amphibian and reptile species in three cities of southeastern Brazil (Belo Horizonte, Minas Gerais state, Rio de Janeiro, Rio de Janeiro state, and São Paulo, São Paulo state), as well as anonymous dealers. These cities were chosen because they are the main centers of the Brazilian pet trade (Eterovic and Duarte 2002).

A total of 49 non-native species (three frogs, two salamanders, 16 lizards, 26 snakes, two turtles) were detected during the seven year survey period. Corn snakes (*Pantherophis guttatus*), milk snakes (*Lampropeltis triangulum*), central bearded dragons (*Pogona vitticeps*), ball pythons (*Python regius*), and African clawed frogs (*Xenopus laevis*) comprised the largest percentage of e-commerce trade (43.37, 9.40, 8.67, 6.99 and 4.82%, respectively). Seventeen species identified in our survey are considered

endangered by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). São Paulo was the city with the greatest demand, and anonymous dealers were the ones that most negotiated animals (Table 1).

The Internet has become an invaluable tool for facilitating commerce worldwide. With its popularity, however, the opportunities to trade in live animals have increased and, unfortunately, many of these species are endangered and/or non-native species (Eterovic and Duarte 2002, Henderson and Bomford 2011). Our results suggest that a complete ban on pet-traded species via e-commerce would be ineffective. Because many dealers omit their names, cities, and the origin of specimens offered in community forums, much of this trade is likely illegal, a fact which dealers are no doubt well aware of. Evading the law is a common component of the worldwide amphibian and reptile trade, both through physical and electronic means (Pistoni and Toledo 2010, Natusch and Lyons 2011).

The reasons for a lack of compliance with existing Brazilian law are probably related to (1) a lack of enforcement by IBAMA on wildlife e-commerce and (2) ignorance of the law by most people involved in the pet trade, especially pet owners. IBAMA simply lacks the staff needed to monitor and regulate the pet trade (both physical pet stores and e-commerce); a lack of resources and manpower is a recurring problem in this Federal agency, as in many around the world (Lacava *et al.* 1995). The great commercial potential of the Internet is that it allows individuals to readily find information about products and sales. The Internet can also be a powerful tool for educating dealers and pet owners about regulations and the ethics of releasing non-native species into native habitats, but IBAMA and others in the herpetological community need to develop more effective methods to harness the power of the Internet to inform those involved in on-line transactions about their responsibilities (Kikillus and Hatley 2012).

Before a non-native species has been introduced to a new country, the possibility of a

Table 1. Number of internet dealers selling prohibited amphibians and reptiles in southeast Brazil (2006–2012). BH: Belo Horizonte, RJ: Rio de Janeiro, SP: São Paulo.

Non-native species	CITES	BH	RJ	SP	Anonymous dealers	Total	% dealers
FROGS/TOADS							
Bombinatoridae							
<i>Bombina orientalis</i>	–	–	–	2	1	3	0.72
Ceratophryidae							
<i>Ceratophrys cranwelli</i>	–	–	–	1	–	1	0.24
Pipidae							
<i>Xenopus laevis</i>	–	4	4	11	1	20	4.82
SALAMANDERS							
Ambystomatidae							
<i>Ambystoma mexicanum</i>	Appendix II	–	1	14	1	16	3.85
Salamandridae							
<i>Pleurodeles waltl</i>	–	–	–	1	–	1	0.24
LIZARDS							
Agamidae							
<i>Hydrosaurus amboinensis</i>	–	–	–	1	–	1	0.24
<i>Pogona vitticeps</i>	–	1	–	5	30	36	8.67
<i>Uromastyx</i> sp.	Appendix II	–	–	1	–	1	0.24
Anguidae							
<i>Abronia graminea</i>	–	–	–	–	1	1	0.24
<i>Abronia taeniata</i>	–	–	–	–	1	1	0.24
Chamaeleonidae							
<i>Chamaeleo calytratus</i>	Appendix II	–	1	1	3	5	1.20
<i>Trioceros jacksonii</i>	Appendix II	–	–	–	1	1	0.24
Diplodactylidae							
<i>Rhacodactylus auriculatus</i>	–	–	–	–	1	1	0.24
<i>Rhacodactylus ciliatus</i>	–	–	–	–	1	1	0.24
Eublepharidae							
<i>Eublepharis macularius</i>	–	–	2	7	5	14	3.37
<i>Hemitheconyx caudicinctus</i>	–	–	–	1	–	1	0.24
Scincidae							
<i>Tiliqua scincoides chimaerea</i>	–	–	–	–	2	2	0.48
Varanidae							
<i>Varanus exanthematicus</i>	Appendix II	–	–	1	–	1	0.24
<i>Varanus niloticus</i>	Appendix II	–	–	1	–	1	0.24
<i>Varanus salvator</i>	Appendix II	–	–	1	–	1	0.24
<i>Varanus timorensis</i>	Appendix II	–	–	1	–	1	0.24

Table 1. Continued.

Non-native species	CITES	BH	RJ	SP	Anonymous dealers	Total	% dealers
SNAKES							
Boidae							
<i>Acrantophis dumerili</i>	Appendix I	–	–	1	–	1	0.24
Colubridae							
<i>Heterodon nasicus</i>	–	–	–	1	–	1	0.24
<i>Lampropeltis californiae</i>	–	–	2	1	1–	13	3.13
<i>L. californiae</i> × <i>L. triangulum</i> hybrid	–	–	–	–	1	1	0.24
<i>Lampropeltis mexicana</i>	–	–	–	1	–	1	0.24
<i>Lampropeltis nigra</i>	–	–	–	1	2	3	0.72
<i>Lampropeltis triangulum</i>	–	–	4	20	15	39	9.40
<i>Pantherophis guttatus</i>	–	3	12	67	98	180	43.37
<i>Philodryas baroni</i>	–	–	–	1	–	1	0.24
<i>Pituophis catenifer sayi</i>	–	–	–	1	–	1	0.24
<i>Thamnophis marcianus</i>	–	–	–	1	–	1	0.24
Pythonidae							
<i>Broghammerus reticulatus</i>	Appendix II	–	–	1	1	2	0.48
<i>Morelia spilota cheynei</i>	Appendix II	–	–	–	1	1	0.24
<i>Morelia spilota mcdowelli</i>	Appendix II	–	–	–	1	1	0.24
<i>Morelia viridis</i>	Appendix II	–	–	1	–	1	0.24
<i>Python brongersmai</i>	Appendix II	–	–	–	1	1	0.24
<i>Python molurus</i>	Appendixes I and II	–	–	1	11	12	2.89
<i>Python regius</i>	Appendix II	1	1	16	11	29	6.99
Viperidae							
<i>Agkistrodon contortrix laticinctus</i>	–	–	–	–	1	1	0.24
<i>Atropoides olmec</i>	–	–	–	–	1	1	0.24
<i>Bothriechis schlegelii</i>	Appendix II	–	–	–	1	1	0.24
<i>Crotalus triseriatus</i>	–	–	–	–	1	1	0.24
<i>Deinagkistrodon acutus</i>	–	–	–	–	1	1	0.24
<i>Trimeresurus trigonocephalus</i>	–	–	–	–	1	1	0.24
<i>Trimeresurus vogeli</i>	–	–	–	–	1	1	0.24
<i>Trimeresurus venustus</i>	–	–	–	–	1	1	0.24
TURTLES							
Chelydridae							
<i>Chelydra serpentina</i>	–	–	–	2	–	2	0.48
Emydidae							
<i>Trachemys scripta elegans</i>	–	1	–	4	1	6	1.44
	17	10	27	169	209	415	

successful invasion must be considered. Establishment risk resulting via an individual pet owner who may keep a few animals of any species likely will be minimal. However, when this risk is multiplied by hundreds of pet owners, releases are inevitable (Henderson and Bomford 2011). If this occurs, extremely detrimental consequences can result, such as biological competition for space and food (e.g., Chamaeleonidae species impacting Brazilian bush anoles, *Polychrus acutirostris*; *T. scripta elegans* competing with D'Orbigny's sliders, *T. dorsibigni*), hybridization (e.g., Mexican dusky rattlesnakes, *Crotalus triseriatus*, hybridizing with South American rattlesnakes, *Crotalus durissus*), predation on native species by pythons (e.g., *Acrantophis*, *Morelia*, *Python*), and the spread of emerging infectious diseases (e.g., as has occurred involving *Xenopus laevis* and other species; Fischer and Garner 2007).

The introduction of non-native species may have unforeseen consequences beyond direct ecological effects. Recent attention has been given to the problem of secondary invaders, such as fungi and viruses, which hitchhike along with individuals in the live animal trade. Amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) and *Ranavirus* (Iridoviridae) are pathogens responsible for mass amphibian mortality and population declines and exemplify the dangers of un-checked trade in non-native species (Robert *et al.* 2007).

Another particular feature of the live animal trade is the potential release of venomous snakes, such as adders and cobras, which could lead to public health concerns (Eterovic and Duarte 2002). A number of species found in our survey of trade are highly venomous (e.g., Agkistrodon, Atropoides, Bothriechis, Crotalus, Deinagkistrodon, *Philodryas*, Trimeresurus), and no antiserum for non-native species is available in Brazil.

Brazil has been signatory of CITES since 1975 (Brasil 1975). Each nation that is party to CITES must make efforts to monitor wildlife trade (Hemley 1994). An effective inspection protocol monitoring the sales of amphibians and

reptiles via e-commerce is necessary in order to combat illegal trade and to avoid the potential establishment of non-native species mediated through the pet trade. We strongly suggest two measures: (1) IBAMA should work with Brazilian web administrators, such as Google and Yahoo, to provide warnings to dealers and enthusiasts about Brazilian law regarding non-native wildlife trade, as well as the dangers of releasing amphibians and reptiles into native habitats; (2) Orkut and other social media must intensify their educational campaigns concerning the illegal pet trade and popularize the goals of CITES to ensure that the international trade of animals and plants does not threaten native species survival in the wild.

Finally, our study examined only a small portion of the extent of the Brazilian Internet pet trade. For example, there are other non-native taxa included in Appendix II of CITES, such as plants (e.g., blue orchid *Vanda coerulea*), invertebrates (e.g., emperor scorpion *Pandinus imperator*, Mexican red-kneed tarantula *Brachypelma smithi*), and vertebrates (e.g., grey parrot *Psittacus erithacus*) that are also sold by anonymous dealers in Orkut. Indeed, the problem seems to be much larger than we can imagine, a situation similar to that in other countries when trying to monitor the impacts of international wildlife trade (Schlapfer *et al.* 2005).

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