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Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Impacts of the SARS-CoV-2 pandemic on the global demand for exotic pets: An expert elicitation approach

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ARTICLE INFO

Keywords:

Consumer demand

Covid-19

Survey

Wildlife trade

Zoonoses

ABSTRACT

The SARS-CoV-2 pandemic has caused immense social and economic costs worldwide. Most experts endorse the view that the virus has a zoonotic origin with the final spillover being associated with wildlife trade. Besides human consumption, wild animals are also extensively traded as pets. Information on zoonotic diseases has been reported to reduce consumer demand for exotic pets. We conducted a global survey and collected 162 responses from international experts on exotic pet trade (traders, academics, NGOs, enforcement entities) to understand how the legal and illegal trade of exotic pets is expected to be affected by the ongoing coronavirus pandemic. Our results suggest that legal purchase of exotic pets is perceived as decreasing during the first pandemic wave due to: lower availability of animals for trade, suppliers' inability to reach consumers and social distancing measures. The general perception is that in the future (i.e., next five years), both demand and supply of legally traded exotic pets are expected to either remain unchanged or decrease only temporarily. The consumer demand for illegal exotic pets is also expected to remain unchanged following the outbreak. The top two challenges reported by respondents, when considering the consequences of the pandemic for the exotic pet trade, are inadequate enforcement of national regulations and increased illegal trade. Our results suggest that the negative consequences of a zoonotic outbreak may not dissuade consumers of exotic pets. Worldwide, the transit/storing conditions and lack of health screenings of traded live animals are conducive to spreading diseases. Consumer demand is a key driver of trade, and enforcement of trade regulations will remain challenging, unless factors driving consumer demand are adequately incorporated in problem-solving frameworks. We emphasize the complexity of trade dynamics and the need to go beyond bans on wildlife trade. Stronger law enforcement, implemented along with initiatives dissuading consumption of wild exotic pets, are essential to sustainably satisfy the market demand.

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<https://doi.org/10.1016/j.gecco.2022.e02067>

Received 20 December 2021; Received in revised form 15 February 2022; Accepted 15 February 2022

Available online 17 February 2022

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1. Introduction

Wildlife trade refers to the sale or exchange of wild animals, fungi, plants, and their derivatives. It is an extremely diverse, dynamic and profitable economic activity, involving the transportation of billions of living organisms or derived products around the world annually (Jenkins, 2007; Karesh et al., 2005; UNEP-Interpol, 2016). Concerns about the role of wildlife trade and consumption in the SARS-CoV-2 pandemic have been raised since the very beginning of the outbreak, with many cases first reported among vendors of Wuhan (China) wet markets trading live domestic and wild animals for food and as pets (Holmes et al., 2021; Lytras et al., 2021; Xiao et al., 2021).

Although the zoonotic origin of the SARS-CoV-2 virus remains under investigation (Andersen et al., 2020; Li et al., 2020), it is likely to have been transmitted from a wild animal (alive or its derivatives)- probably bats- to humans through an intermediate animal host (Wacharapluesadee et al., 2021). Domesticated animals and wild fauna constitute a reservoir for almost 80% of emerging human diseases (e.g., SARS-CoV, MERS-CoV, Ebola) (de Sadeleer and Godfroid, 2020). Although often overlooked, zoonoses are in fact fairly common. For example, several human salmonellosis cases have been reported following contact with asymptomatic reptiles (Casalino et al., 2021; Gambino-Shirley et al., 2018; Lafuente et al., 2013). Hunting, transporting and consuming wild animals - or the unregulated production and consumption of domestic animals - can thus increase the risk of zoonosis emergence (Swift et al., 2007).

The pet trade is a substantial component of wildlife trade, with billions of wild animals globally traded as pets every year (Smith et al., 2009), ~ 25% of which are traded illegally (Karesh et al., 2007). While captive breeding facilities meet some of the global demand for pets, substantial proportions of exotic pets are still sourced from wild populations (Bush et al., 2014; Haken, 2011). Campaigns focusing on biodiversity and welfare issues have been implemented to reduce demand for exotic pets, with information on zoonotic diseases being reported as the most effective in dissuading consumers (Moorhouse et al., 2017). However the extent to which the coronavirus pandemic is expected to affect wildlife trade is still unclear.

In this study, we implemented a global survey among 162 international experts on exotic pet trade (traders, academics, NGOs, enforcement entities) from 55 countries, to understand how the SARS-CoV-2 pandemic has affected the legal and illegal trade of exotic pets worldwide. Specifically, we used experts' perspectives to understand how the legal and illegal demand and supply of exotic pets have been affected by the pandemic, and anticipate how they could evolve in the near future. Respondents' perspectives and expectations were gathered following the initial wave of the outbreak (May-July 2020), and later assessed during the third wave (March-May 2021).

2. Materials and methods

2.1. Data collection

2.1.1. Survey approach

We used expert elicitation to understand potential changes induced by the SARS-CoV-2 pandemic on the exotic pet trade across the world. To identify the experts, we compiled a relevant contact list through a Google search using the search query: ("trade" OR "sale") AND ("exotic pets" OR "reptile pets" OR "amphibian pets" OR "exotic mammals" OR "exotic birds" OR "pet reptile" OR "pet wildlife" OR "pet amphibian" OR "pet birds" OR "pet mammals"). This search began on May 8th and was finalized on May 21st of 2020. Each website retrieved during the search was inspected and every contact available was compiled. Exotic pet trade experts were initially selected based on three criteria: (1) being a trader of exotic pets; (2) being a representative of a non-governmental organization (NGO) targeting wildlife trade with relevant knowledge about the topic; or (3) being a representative of an environmental governmental organization. All contacts for CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) offices worldwide were also compiled. Our approach resulted in the identification of 136 pet traders as well as 1469 NGO and government entities' representatives, who were invited for the two survey campaigns. To increase the number of respondents and country coverage, whilst avoiding potential sampling biases due to respondents' personal networks and perceptions about the issue (Newing, 2011), we also employed a snowball sampling, requesting all those directly contacted to recommend additional participants among colleagues, peers and other organizations that may have relevant knowledge and experience (Faugier and Sargeant, 1997). This resulted in 69 additional experts (from the pet trade, NGOs, government entities and academia) to be approached. Overall, a total of 1035 invitations were sent (505 in the first wave survey and 530 in the third wave survey) to experts working in 188 countries.

2.1.2. Survey elaboration and implementation

We designed a questionnaire to explore experts' perspectives and expectations on the effects of the SARS-CoV-2 pandemic on the exotic pet trade worldwide (Appendix S1). The first section of the questionnaire focused on the respondent's professional background. In the second section, we gathered experts' opinions on the consequences of the coronavirus outbreak for the legal and illegal trade of exotic pets in their regions. Finally, in the third section we elicited basic socio-demographic information. To gain further insights into the challenges found, respondents were asked to choose as many options as they found fit for all multiple option questions that did not follow a Likert scale (i.e., a five (or seven) point rating scale enabling individuals to express how much they agree or disagree with a particular statement; Jamieson, 2004). Furthermore, to ensure that respondents were not coerced to answering questions in order to be able to proceed with the survey, all questions were optional and could be left unanswered.

The questionnaire was pretested using a pilot group composed of 6 international researchers from the authors' own network in order to check if the questions were clear (this group was excluded from the survey). Their responses helped determine the

questionnaire completion time, redefine objectives, broaden the scope of the questions and improve the clarity of the questionnaire. Afterwards, the final version of the questionnaire was sent to all compiled contacts. The online questionnaire was implemented in the Google Forms web platform (<https://www.google.com/forms/>). Invited experts were provided with a general description of the project's aims before deciding to take the survey. Before starting the survey, participants provided written informed consent to participate in this study, authorizing the use of their responses for research purposes. Confidentiality was maintained in data analysis and result presentation to respect participants' privacy.

The survey was first conducted from May 22nd to July 22nd of 2020, loosely coinciding with the end of the first global wave of the outbreak (<https://covid19.who.int/>; here forward referred to as first wave survey). The survey was implemented again, from March 22nd to May 21st of 2021, during the third wave of the pandemic (<https://covid19.who.int/>; here forward referred to as third wave survey). During both periods of survey implementation, weekly reminders were sent to all participants by email.

2.2. Data processing and analysis

The data retrieved by our questionnaire was used to understand: i) experts' perspectives on how the legal and illegal purchase of exotic pets have been affected by the pandemic and ii) how respondents' professional activity changed following the coronavirus outbreak. We further investigated (iii) experts' expectations for the demand and supply of legally and illegally traded exotic pets for the next 5 years; and iv) the top two challenges encountered when dealing with the consequences of the coronavirus outbreak on the trade of exotic pets. Each of these aspects is explained in the following subsections. All survey questions were coded and analyzed descriptively, by means of counts, relative frequencies and modes. Kruskal-Wallis tests were used to test for significant differences among relative frequencies for different categories of legal/illegal purchase of exotic pets, legal demand and supply of exotic pets, and illegal demand of exotic pets. All statistical analyses were carried out using software R (R Core Team, 2017).

3. Results

3.1. Study participants

The survey collected 162 responses (96 in the first wave and 66 in the third wave survey; response rate of 19% and 12%, respectively). A total of 152 responses answered to all survey questions, while 10 left some questions unanswered.

The respondents showed expertise in issues pertaining exotic pet trade across 67 countries. The modal respondent was a 45–54

Table 1
Summary of survey respondents' characteristics. First and third wave survey results and total count combined.

Aspects	Categories	First wave survey	Third wave survey	Total count
Gender	Female	39	30	69
	Male	57	32	89
	Prefer not to say	0	3	3
Age group	25–34	15	5	20
	35–44	27	23	50
	45–54	30	21	51
	55–64	18	10	28
	65 +	6	1	7
	Prefer not to say	0	5	5
Type of institution	Environmental Governmental Organization	28	41	69
	Environmental Non-governmental Organization	16	17	33
	Animal Welfare Organization	9	13	22
	Academy	3	9	12
	CITES	3	9	12
	Pet Industry	3	6	9
Role in institution	Other	0	3	3
	Managing/Coordination	57	43	100
	Research	17	10	27
	Other	3	7	10
	Commercial	3	1	4
	Enforcement	13	1	14
Geographical scale of work	Animal care/welfare	4	3	7
	National	55	30	85
	Global	46	22	68
	Regional/Local	7	14	21
Number of years of experience in the exotic pet trade	< 5	28	18	46
	5–10	23	12	35
	10–15	19	10	29
	15–20	20	11	31
	> 20	25	15	40

year-old male, working as manager/director of an environmental governmental organization for at least 10 years. Most enquired companies or institutions refer that their activities have remained relatively unchanged by the outbreak (Table S2 from Appendix S2). A summary of the study participants is provided in Table 1.

3.2. Effects of the SARS-CoV-2 pandemic on the exotic pet trade

According to our respondents' perceptions, the legal purchase of exotic pets was mainly decreased after the first SARS-CoV-2 wave. However, most respondents regard it as unchanged following the third pandemic wave (Fig. 2a). The changes reported during the first wave were generally attributed to a lower availability of animals for trade, suppliers being unable to reach consumers and imposed social distancing measures. However, these perceptions appear to have subsided during the third wave (Fig. 2a). Both demand and supply of legally traded exotic pets are expected to mainly decrease temporarily following the pandemic (Fig. 3). The illegal purchase and consumer demand for exotic pets are expected to either remain unchanged or decrease only slightly after the start of the outbreak (Fig. 2b, Fig. 4). The low number of pet traders responding to both surveys (9 in total) impeded testing for significant group differences, but modal perceptions and expectations for legal and illegal purchase of exotic pets were consistent across groups (i.e., NGOs and government entities vs pet traders). Furthermore, modal perceptions and expectations for legal and illegal purchase of exotic pets were also consistent across reported countries of expertise. When considering the consequences of the outbreak for the exotic pet trade, the top two challenges identified were inadequate enforcement of national regulations and increased illegal trade (Table 2).

4. Discussion

Here we present a preliminary analysis of the effects of the SARS-CoV-2 pandemic on the legal and illegal trade of exotic pets. Overall, surveyed experts indicated that the purchase and demand for legal and illegal exotic pets have remained unchanged or suffered temporary decreases at best, caused by the restrictions imposed on global transportation of goods following the pandemic. Previous survey-based studies that presented people with direct information on potential zoonotic risks of specific pet species have suggested fear of zoonoses is an effective deterrent for prospective consumers of exotic pets, much more than welfare or conservation concerns (Moorhouse et al., 2021a, 2017). However, according to surveyed wildlife trade experts, fear of zoonoses is not dissuading consumers of exotic pets, even after experiencing an unprecedented global pandemic with severe health and socio-economic consequences. This may be because most press coverage on the origins of SARS-CoV-2 has focused on wildlife consumed as food on so-called 'wet markets' (King, 2020) and/or on specific suspected animal hosts such as bats and pangolins (MacFarlane and Rocha, 2020), possibly leading people not to associate pet keeping to zoonotic risks. Furthermore, authorities such as the U.S. Food and Drug Administration, establishes the risk of pets spreading the virus as low (FDA, 2020). Indeed, a recent large-scale analysis of social media wildlife trade advertisements and discussions found that SARS-CoV-2 was mentioned in less than 1% of conversations (Morcatty et al., 2021). In a follow-up survey assessing citizens' desire to own exotic pets before (2018) and after (2020) the pandemic, Moorhouse et al. (2021b) did report a decrease in the desire to own exotic pets for three out of the four countries studied. This decrease did however not correspond to an increase in surveyed worries about zoonotic diseases, leading the authors to conclude that other factors were at play.

Our study suggests that wildlife trade experts largely expect SARS-CoV-2 pandemic not to increase consumer awareness of the dangers of buying exotic pets, and may in fact have exacerbated people's interest in keeping exotic pets during lockdowns. Indeed, the Pet Food Manufacturers' Association confirmed a staggering rise in pet acquisition, with 3.2 million households in the UK having

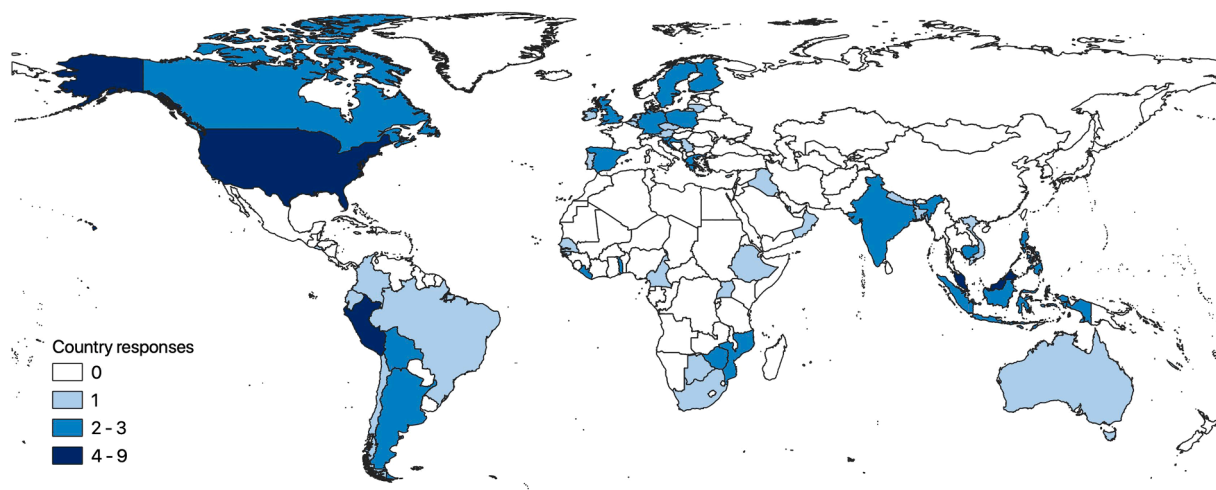


Fig. 1. Map showing number of responses by respondent's country of expertise (i.e. experts' nationality might not coincide with their country or countries of expertise). First and third wave surveys counts combined (see Table S1 from Appendix S2 for more details).

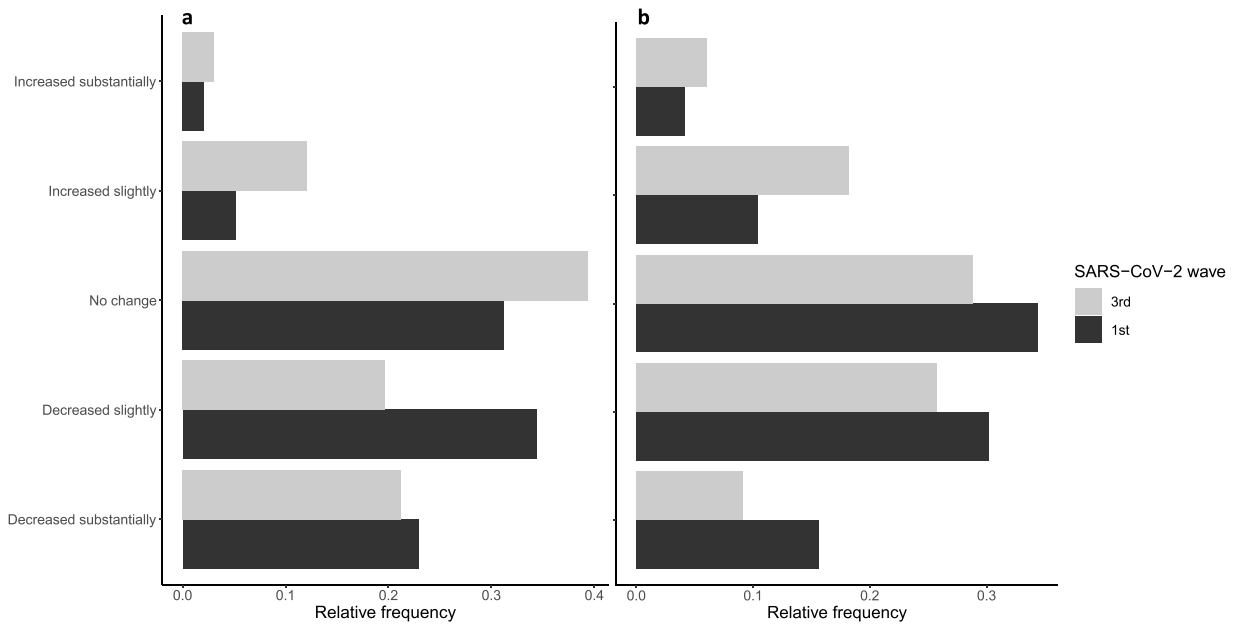


Fig. 2. Prevalence of respondents' perceptions of the variation of the legal (a) and illegal purchase (b) of exotic pets in their geographical scale of work, as a consequence of the coronavirus outbreak. Relative frequency is shown for both surveys implemented after the first wave and during the third wave of the pandemic. No significant differences were found among relative frequencies for different categories of perceptions of legal (Chi square = 9, df = 9, p-value=0.437) and illegal (Chi square = 9, df = 9, p-value=0.435) purchase of exotic pets.

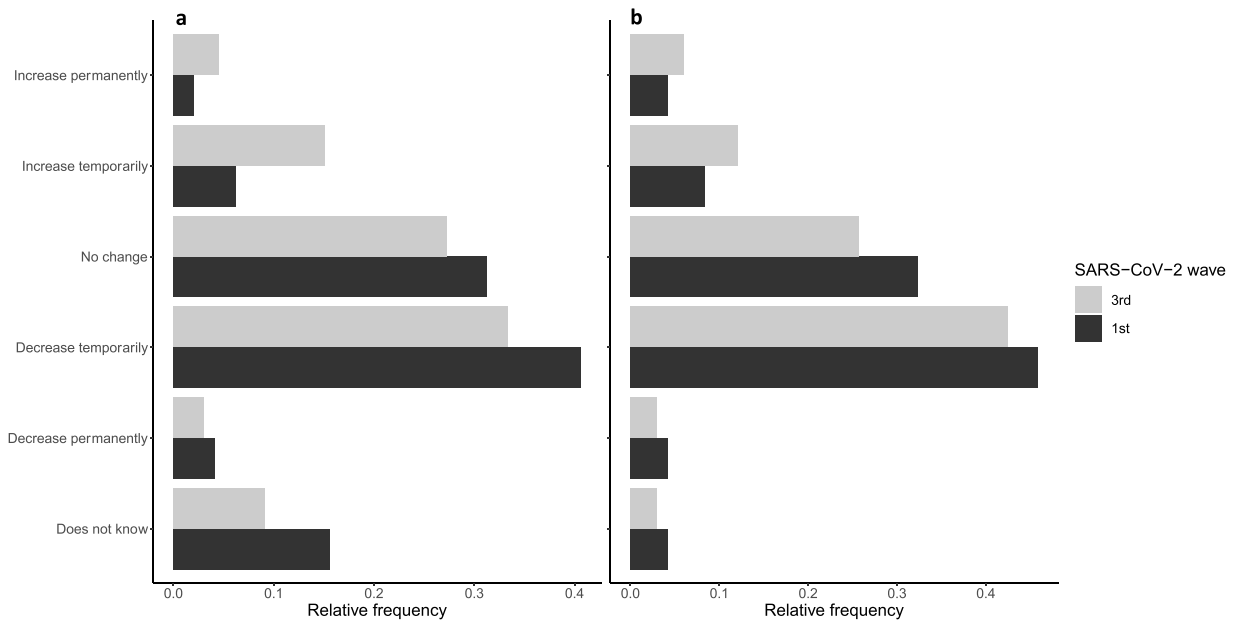


Fig. 3. Prevalence of respondents' expectations for the change in consumer demand (a) and supply (b) for legally traded exotic pets, considering their geographical scale of work and the next 5 years. Relative frequency is shown for both surveys implemented after the first wave and during the third wave of the pandemic. No significant differences were found among relative frequencies for different categories of legal demand (Chi square = 11, df = 11, p-value=0.443) and supply (Chi square = 6.44, df = 8, p-value=0.597) of exotic pets.

acquired a pet since the start of the pandemic (PFMA, 2021). Owning a pet has often been associated with improved mental health among owners, better quality of life, and decreased levels of depression and loneliness (Bao and Schreer, 2016), which might become especially alluring during lockdowns, to help deal with forced social isolation. However, restrictions imposed on legal suppliers might have boosted the illegal trade. Scarcity of a desired item is known to increase its value and stimulate its demand among consumers

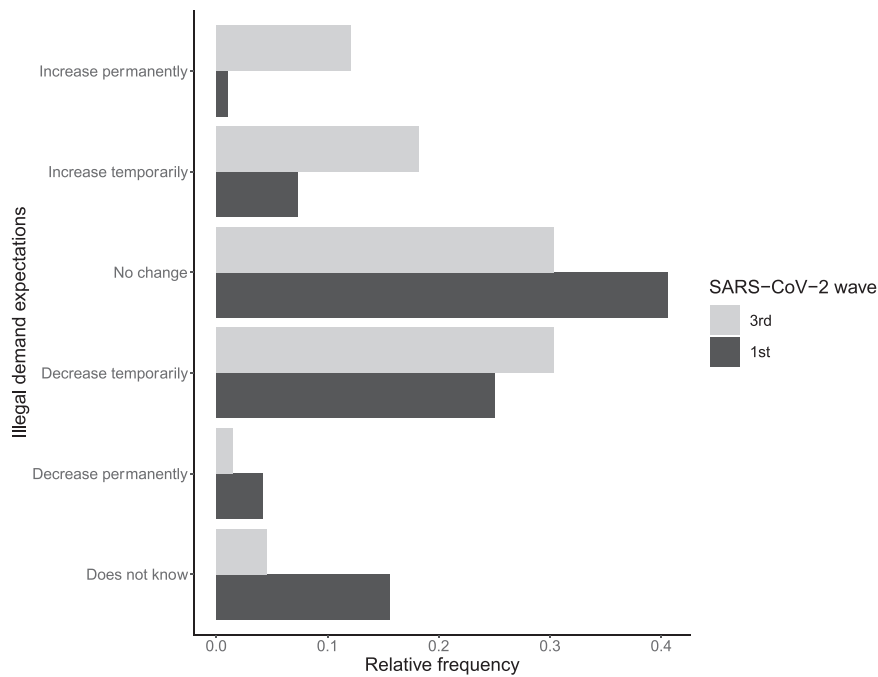


Fig. 4. Prevalence of respondents' expectations for the change in consumer demand for illegally traded exotic pets, considering their geographical scale of work and the next 5 years. Relative frequency is shown for both surveys implemented after the first wave and during the third wave of the pandemic. No significant differences were found among relative frequencies for different categories of illegal demand (Chi square = 10.843, df = 10, p-value=0.369) of exotic pets.

Table 2

Main challenges when dealing with the consequences of the coronavirus outbreak for the trade of exotic pets, reported by respondents to first and third wave surveys, and total count combined.

Total challenges	First wave survey	Third wave survey	Total count
Enforcement	27	20	47
Increased illegal trade	14	9	23
Lack of campaigns	10	5	15
Low supply	9	4	13
Lack of knowledge	7	4	11
Lack of hygiene/public health measures	7	1	8
Low demand	7	1	8
Increased demand	1	5	6
Increased online trade	2	4	6
Lack of laws and government regulation	4	1	5
Lack of funding	3	1	4
Monitoring	1	3	4
Decreased trade	3	0	3
Increase fear of exotic pets	2	0	2
Increased regulation	1	1	2
Increased release/eradication of pets	2	0	2
Increased supply following restriction lifting	0	2	2
None	2	0	2
Less research	1	0	1
Price of pets	0	1	1

(Krishna et al., 2019). Hence, if legal suppliers were unable to satisfy consumers' demand for exotic pets, illegal traders could be a viable option. Indeed, our results show that the top two challenges found by respondents when considering the consequences of the outbreak for the exotic pet trade was inadequate enforcement and increased illegal trade.

The questionnaires were implemented in English, thus likely excluding potentially relevant non-English speakers. Nonetheless, the coverage of countries represented in our study (N = 67, Fig. 1) and the considerable expertise reported by the respondents gives credence to our results. Since we focused on perceptions of experts rather than on actual quantitative trends, additional studies investigating how trade patterns might have been changed by the pandemic will be needed.

5. Conclusions

Wild animal transit and storage conditions, coupled with insufficient health screenings, gives the exotic pet trade the potential to spread diseases (Dobson et al., 2020). Given that demand drives trade, it is only a matter of time before the next pandemic emerges (Doucleff, 2021). Our results, suggesting that the global SARS-CoV-2 pandemic has not reduced consumer demand for exotic pets, are thus especially worrying and highlight the need to radically curb the global demand for wildlife. This is a complex issue, which will hardly be solved through the implementation of bans on wildlife trade (Ribeiro et al., 2020), not least because they are highly volatile and adjust easily to changes in patterns of demand (e.g. Reino et al., 2017). Initiatives dissuading consumption, such as well-organized and wisely directed education campaigns are clearly needed to reduce market demand for exotic pets. However, as such behavioral change is often difficult to achieve (Thomas-Walters et al., 2020), we recommend the gradual replacement of wild-caught by controlled captive-bred animals to satisfy remaining market demand, and the investment in more effective law-enforcement to minimize fraud and laundering of wild animals as captive ones (Hogg et al., 2018).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank all the experts who kindly shared their time and participated in our survey. This study received funding from FEDER Funds through the Operational Competitiveness Factors Program “COMPETE”, and by National Funds through the Foundation for Science and Technology (FCT) within the framework of project ‘PTDC/BIA-ECO/30931/2017-POCI-01-0145-FEDER-030931’. Joana Ribeiro acknowledges the support from INTERREG Europe through a post-doc grant within project INTERREG Europe INVALIDIS - Protecting European Biodiversity from Invasive Alien Species “PGI05271”, funded by the European Union and through project UNRAVEL (PTDC/BIA-ECO/0207/2020), financed by National Funds through FCT - Foundation for Science and Technology, IP. Joana Santana was supported by project ALIENRADE (PTDC/BIA-ECO/30931/2017). Ana Sofia Vaz acknowledges support from FCT - Portuguese Foundation for Science and Technology through the program Stimulus for Scientific Employment - Individual Support [contract reference 2020.01175. CEECIND]. Luís Reino was supported by Portuguese National Funds through FCT, I.P., under the “Stimulus of Scientific Employment—Individual Support” contract “CEECIND/00445/2017”.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.gecco.2022.e02067](https://doi.org/10.1016/j.gecco.2022.e02067).

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