

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

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Keywords:	consumer demand, covid-19, survey, wildlife trade, zoonoses
Abstract:	<p>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 thus conducted a global survey among 162 international experts on exotic pet trade (traders, academics, NGOs, enforcement entities) to understand how the legal and illegal trade of exotic pets was/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. In the future, 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 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 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 emphasise the complexity of trade dynamics and the need to go beyond bans on wildlife trade. Initiatives dissuading consumption, such as education campaigns are essential to gradually replace wild-caught by controlled captive-bred animals, and sustainably satisfy the market demand.</p>

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29 **Keywords:** consumer demand, covid-19, survey, wildlife trade, zoonoses.

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## 50 **Introduction**

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

58

59 Although the zoonotic origin of the SARS-CoV-2 virus remains under investigation (Andersen  
60 et al., 2020; Li et al., 2020), it is likely to have been transmitted from an original source,  
61 probably bats, to humans through an intermediate animal host (Wacharapluesadee et al., 2021).  
62 Domesticated animals and wild fauna constitute a reservoir for almost 80% of emerging human  
63 diseases (e.g., SARS-CoV, MERS-CoV, Ebola) (de Sadeleer and Godfroid, 2020). Hunting,  
64 transporting and consuming wild animals - or the unregulated production and consumption of  
65 domestic animals - can thus increase the risk of zoonosis emergence (Swift et al., 2007).

66

67 Pet trade is a substantial component of wildlife trade, with billions of wild animals globally  
68 traded as pets every year (Smith et al., 2012), ~ 25% of which illegally (Karesh et al., 2007).  
69 While captive breeding facilities meet some of the global demand for pets, substantial  
70 proportions of exotic pets are still sourced from wild populations (Bush et al., 2014; Haken,  
71 2011). Campaigns focusing on biodiversity and welfare issues have been implemented to  
72 reduce demand for exotic pets, with information on zoonotic diseases being reported as the  
73 most effective in dissuading consumers (Moorhouse et al., 2017). However the extent to which  
74 the coronavirus pandemic is expected to affect wildlife trade is still unclear.

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

84

## 85 **MATERIALS & METHODS**

### 86 **Data collection**

#### 87 **Survey approach**

88 We used expert elicitation to understand potential changes induced by the SARS-CoV-2  
89 pandemic on the exotic pet trade across the world. To identify the experts, we compiled a  
90 relevant contact list through a Google search using the search query: (“trade” OR “sale”) AND  
91 (“exotic pets” OR “reptile pets” OR “amphibian pets” OR “exotic mammals” OR “exotic  
92 birds” OR “pet reptile” OR “pet wildlife” OR “pet amphibian” OR “pet birds” OR “pet  
93 mammals”). The last search was performed on May 21<sup>st</sup> 2020. Each website retrieved during  
94 the search was inspected and every contact available was compiled. Exotic pet trade experts  
95 were selected based on three criteria: (1) being a trader of exotic pets; (2) being a representative  
96 of a non-governmental organization (NGO) targeting wildlife trade with relevant knowledge  
97 about the topic; or (3) being a representative of an environmental governmental organization.  
98 All contacts for CITES (the Convention on International Trade in Endangered Species of Wild

99 Fauna and Flora) offices worldwide were also compiled. Our approach resulted in the  
100 identification of 136 pet traders as well as 1469 NGO and enforcing authorities representatives,  
101 who were invited for the two survey campaigns. To increase the number of respondents and  
102 the country coverage, whilst avoiding potential sampling biases due to respondents' personal  
103 networks and perceptions about the issue (Newing, 2011), we also employed a snowball  
104 sampling, requesting all those directly contacted to recommend additional participants among  
105 colleagues, peers and other organizations that may have relevant knowledge and experience  
106 (Faugier and Sargeant, 1997). This resulted in 69 additional contacts to be approached. Overall,  
107 a total of 1035 invitations were sent (505 in the first wave survey and 530 in the third wave  
108 survey) to experts working in 188 countries.

109

#### 110 **Survey elaboration and implementation**

111 We designed a questionnaire to explore expert perspectives and expectations on the effects of  
112 the SARS-CoV-2 pandemic on the exotic pet trade worldwide (Appendix S1). The first section  
113 of the questionnaire focused on the respondent's professional background. In the second  
114 section, we gathered experts' opinions on the consequences of the coronavirus outbreak for the  
115 legal and illegal trade of exotic pets in their regions. Finally, in the third section we elicited  
116 basic socio-demographic information. In order to gain further insights into the challenges  
117 found, respondents were asked to choose as many options as they found fit for all multiple  
118 option questions that did not follow a Likert scale (Jamieson, 2004). Furthermore, to ensure  
119 that respondents were not coerced to answering questions in order to be able to proceed with  
120 the survey, all questions were optional and could be left unanswered.

121

122 The questionnaire was pretested using a pilot group composed of 6 international researchers  
123 from the authors' own network in order to check if the questions were clear (this group was

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

133

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

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#### 141 **Data processing and analysis**

142 The data retrieved by our questionnaire was used to understand: i) experts' perspectives on  
143 how the legal and illegal purchase of exotic pets have been affected by the pandemic and ii)  
144 how respondents' professional activity changed following the coronavirus outbreak. We  
145 further investigated (iii) experts' expectations for the demand and supply of legally and  
146 illegally traded exotic pets for the next 5 years; and iv) the top two challenges encountered  
147 when dealing with the consequences of the coronavirus outbreak on the trade of exotic pets.  
148 Each of these aspects is explained in the following subsections. All survey questions were

149 coded and analysed descriptively, by means of counts, relative frequencies and modes. Results  
150 shown in the text are illustrated through maps and bar plots.

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## 153 **RESULTS**

### 154 **Study participants**

155 The survey was completed by 162 respondents (96 in the first wave and 66 in the third wave  
156 survey; response rate of 19% and 12%, respectively). A total of 152 participants answered all  
157 survey questions, with some missing responses for the remaining 7 respondents.

158

159 The respondents showed expertise in issues pertaining exotic pet trade across 67 countries. The  
160 modal respondent was a 45 to 54 year-old male, working as manager/director of an  
161 environmental governmental organization for at least 10 years. Most enquired companies or  
162 institutions refer that their activities have remained relatively unchanged by the outbreak (Table  
163 S2 from Appendix S2). A summary of the study participants is provided in Table 1.

164

### 165 **Effects of the SARS-CoV-2 pandemic on the exotic pet trade**

166 According to our respondents, the legal purchase of exotic pets was perceived as mainly  
167 decreasing after the first SARS-CoV-2 wave. However, most respondents regard it as  
168 unchanged following the third pandemic wave (Fig. 2a). The changes reported during the first  
169 wave were generally attributed to a lower availability of animals for trade, suppliers being  
170 unable to reach consumers and imposed social distancing measures. However, these  
171 expectations appear to have subsided during the third wave (Fig. 2a). Both demand and supply  
172 of legally traded exotic pets are expected to mainly decrease temporarily following the  
173 pandemic (Fig. 3). The illegal purchase and consumer demand for exotic pets are expected to



174 either remain unchanged or decrease only slightly after the outbreak (Fig. 2b, Fig. 4). When  
175 considering the consequences of the outbreak for the exotic pet trade, the top two challenges  
176 identified were inadequate enforcement and increased illegal trade (Table 2).

177

## 178 **DISCUSSION**

179 Overall, our surveyed experts indicated that the purchase and demand for legal and illegal  
180 exotic pets have remained unchanged or suffered temporary decreases at best, caused by the  
181 restrictions imposed on global transportation of goods following the pandemic. Previous  
182 survey-based studies that presented people with direct information on potential zoonotic risks  
183 of specific pet species have suggested fear of zoonoses is an effective deterrent for prospective  
184 consumers of exotic pets, much more than welfare or conservation concerns (Moorhouse et al.,  
185 2017, 2021a). However, according to surveyed wildlife trade experts, fear of zoonoses is not  
186 dissuading consumers of exotic pets, even after being confronted by an unprecedented global  
187 pandemic with severe human and economic consequences. This may be because most press  
188 coverage on the origins of SARS-CoV-2 has focused on wildlife consumed as food on so-  
189 called 'wet markets' (King, 2020) and/or on specific suspected animal hosts such as bats and  
190 pangolins (MacFarlane and Rocha, 2020), possibly leading people not to associate pet keeping  
191 to zoonotic risks. Furthermore, authorities such as the U.S. Food and Drug Administration,  
192 establishes the risk of pets spreading the virus as low (FDA, 2020). Indeed, a recent large-scale  
193 analysis of social media wildlife trade advertisements and discussions found that SARS-CoV-  
194 2 was mentioned in less than 1% of conversations (Morcatty et al., 2021). In a follow-up survey  
195 assessing citizen's desire to own exotic pets before (2018) and after (2020) the pandemic,  
196 Moorhouse et al. (2021b) did report a decrease in the desire to own exotic pets for three out of  
197 the four countries studied. This decrease did however not correspond to an increase in surveyed  
198 worries about zoonotic diseases, leading the authors to conclude that other factors were at play.

199

200 Our study suggests that wildlife trade experts largely expect SARS-CoV-2 pandemic not to  
201 increase consumer awareness of the dangers of buying exotic pets, and may in fact have  
202 exacerbated people's interest in keeping exotic pets during lockdowns. Indeed, the Pet Food  
203 Manufacturers' Association confirmed that 3.2 million households in the UK acquired a pet  
204 since the start of the pandemic (PFMA, 2021). Owning a pet has often been associated with  
205 improved mental health among owners, better quality of life, and decreased levels of  
206 depression and loneliness (Bao and Schreer, 2016), which might become especially alluring  
207 during lockdowns, to help deal with forced social isolation. However, restrictions imposed on  
208 legal suppliers might have boosted the illegal trade. Scarcity of a desired item is known to  
209 increase its value and stimulate its demand among consumers (Krishna et al., 2019). Hence, if  
210 legal suppliers were unable to satisfy consumers' demand for exotic pets, illegal traders could  
211 be a viable option. Indeed, our results show that the top two challenges found by respondents  
212 when considering the consequences of the outbreak for the exotic pet trade was inadequate  
213 enforcement and increased illegal trade.

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215 Here we present a preliminary analysis of the effects of the SARS-CoV-2 pandemic on the  
216 legal and illegal trade of exotic pets. The results of the survey undertaken with wildlife trade  
217 experts suggest that the global pandemic has not and will likely not decrease demand and  
218 supply of wildlife products. We acknowledge the questionnaires were implemented in English  
219 thus likely excluding many relevant non-English speakers. Nonetheless, the coverage of  
220 countries represented in our study (N = 67, Fig. 1) and the considerable expertise reported by  
221 the respondents gives credence to our results. Since we focused on perceptions of experts rather  
222 than on actual quantitative trends, additional studies investigating how trade patterns might  
223 have been changed by the pandemic will be needed.

224

225 Wild animal transit and storage conditions, coupled with insufficient health screenings, gives  
226 the exotic pet trade the potential to spread diseases (Dobson et al., 2020). Given that demand  
227 drives trade, it is only a matter of time before the next pandemic emerges (Douceff, 2021).  
228 Our results are thus especially worrying and highlight the need to radically curb the global  
229 demand for wildlife items. This is a complex issue, which will hardly be solved through the  
230 implementation of bans on wildlife trade (Ribeiro et al., 2020), not least because they are highly  
231 volatile, adjusting easily to changes in patterns of demand (e.g. Reino et al., 2017). Initiatives  
232 dissuading consumption, such as well-organized and wisely directed education campaigns are  
233 essential to gradually replace wild-caught by controlled captive-bred animals, and sustainably  
234 satisfy the market demand.

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### 236 **Supporting Information:**

237 Additional information is available online in the Supporting Information section at the end of  
238 the online article. The authors are solely responsible for the content and functionality of these  
239 materials. Queries (other than absence of the material) should be directed to the corresponding  
240 author.

241 Appendix S1 – Full questionnaire sent to experts.

242 Appendix S2 – Contains Table S1 and Table S2.

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

<b>Aspects</b>	<b>Categories</b>	<b>First wave survey</b>	<b>Third wave survey</b>	<b>Total count</b>
<b>Gender</b>	Female	39	30	69
	Male	57	32	89
	Prefer not to say	0	3	3
<b>Age group</b>	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
<b>Type of institution</b>	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
	Other	0	3	3
<b>Role in institution</b>	Managing/Coordination	57	43	100
	Research	17	10	27
	Other	3	7	10
	Commercial	3	1	4
	Enforcement	13	1	14
	Animal care/welfare	4	3	7
<b>Geographical scale of work</b>	National	55	30	85
	Global	46	22	68
	Regional/Local	7	14	21
<b>Number of years of experience in the exotic pet trade</b>	<5	28	18	46
	5 - 10	23	12	35
	10 - 15	19	10	29
	15 - 20	20	11	31

>20	25	15	40
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366 **Table 2.** Main challenges when dealing with the consequences of the coronavirus outbreak  
 367 for the trade of exotic pets, reported by respondents to first and third wave surveys, and total  
 368 count combined.

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<b>Total challenges</b>	<b>First wave survey</b>	<b>Third wave survey</b>	<b>Total count</b>
<b>Enforcement</b>	27	20	47
<b>Increased illegal trade</b>	14	9	23
<b>Lack of campaigns</b>	10	5	15
<b>Low supply</b>	9	4	13
<b>Lack of knowledge</b>	7	4	11
<b>Lack of hygiene/public health measures</b>	7	1	8
<b>Low demand</b>	7	1	8
<b>Increased demand</b>	1	5	6
<b>Increased online trade</b>	2	4	6
<b>Lack of laws and government regulation</b>	4	1	5
<b>Lack of funding</b>	3	1	4
<b>Monitoring</b>	1	3	4

<b>Decreased trade</b>	3	0	3
<b>Increase fear of exotic pets</b>	2	0	2
<b>Increased regulation</b>	1	1	2
<b>Increased release/eradication of pets</b>	2	0	2
<b>Increased supply following restriction lifting</b>	0	2	2
<b>None</b>	2	0	2
<b>Less research</b>	1	0	1
<b>Price of pets</b>	0	1	1

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383 **Figure legends**

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385 **Figure 1.** Map showing number of responses by respondent's country of expertise. First and  
386 third wave surveys counts combined (see Table S1 from Appendix S2 for more details).

387

388 **Figure 2.** Prevalence of respondents' perceptions of the variation of the legal (a) and illegal  
389 purchase (b) of exotic pets in their geographical scale of work, as a consequence of the  
390 coronavirus outbreak. Relative frequency shown for both surveys implemented after the first  
391 wave and during the third wave of the pandemic.

392

393 **Figure 3.** Prevalence of respondents' expectations for the change in consumer demand (a) and  
394 supply (b) for legally traded exotic pets, considering their geographical scale of work and the  
395 next 5 years. Relative frequency shown for both surveys implemented after the first wave and  
396 during the third wave of the pandemic.

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399 **Figure 4.** Prevalence of respondents' expectations for the change in consumer demand for  
400 illegally traded exotic pets, considering their geographical scale of work and the next 5 years.  
401 Relative frequency shown for both surveys implemented after the first wave and during the  
402 third wave of the pandemic.

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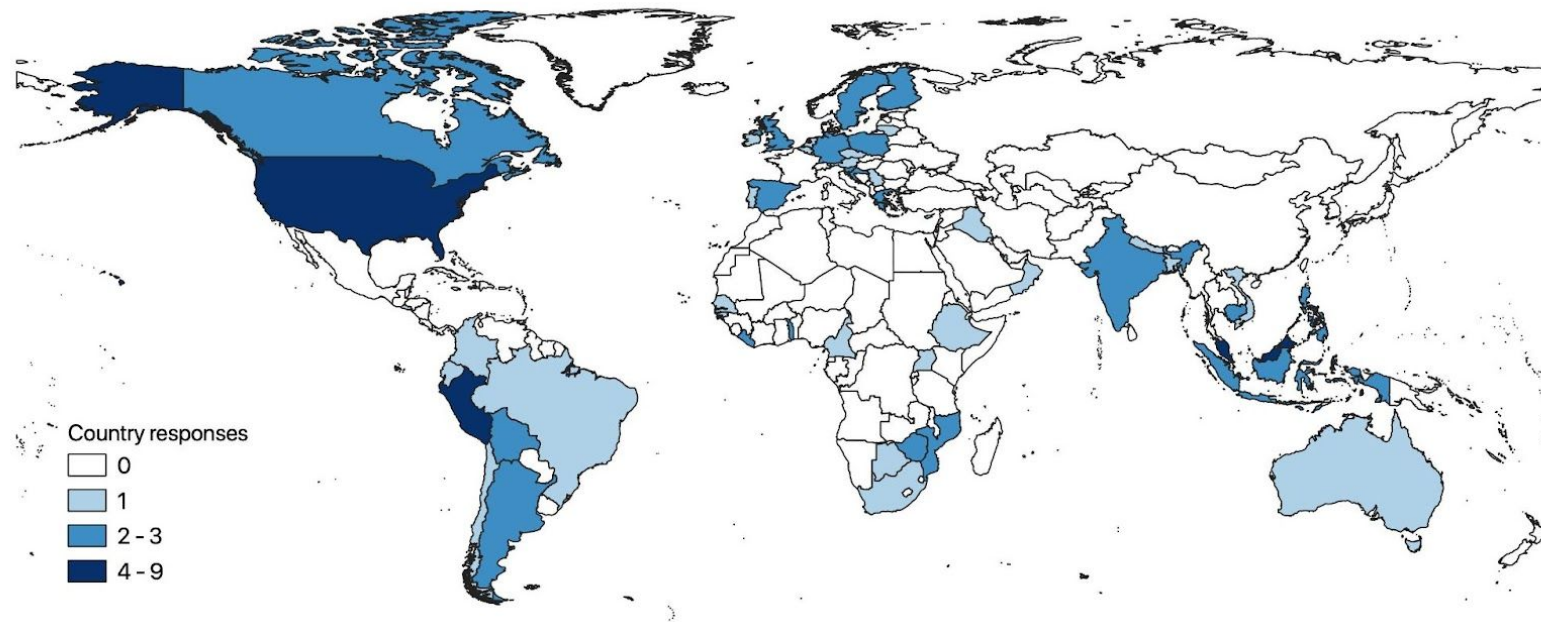
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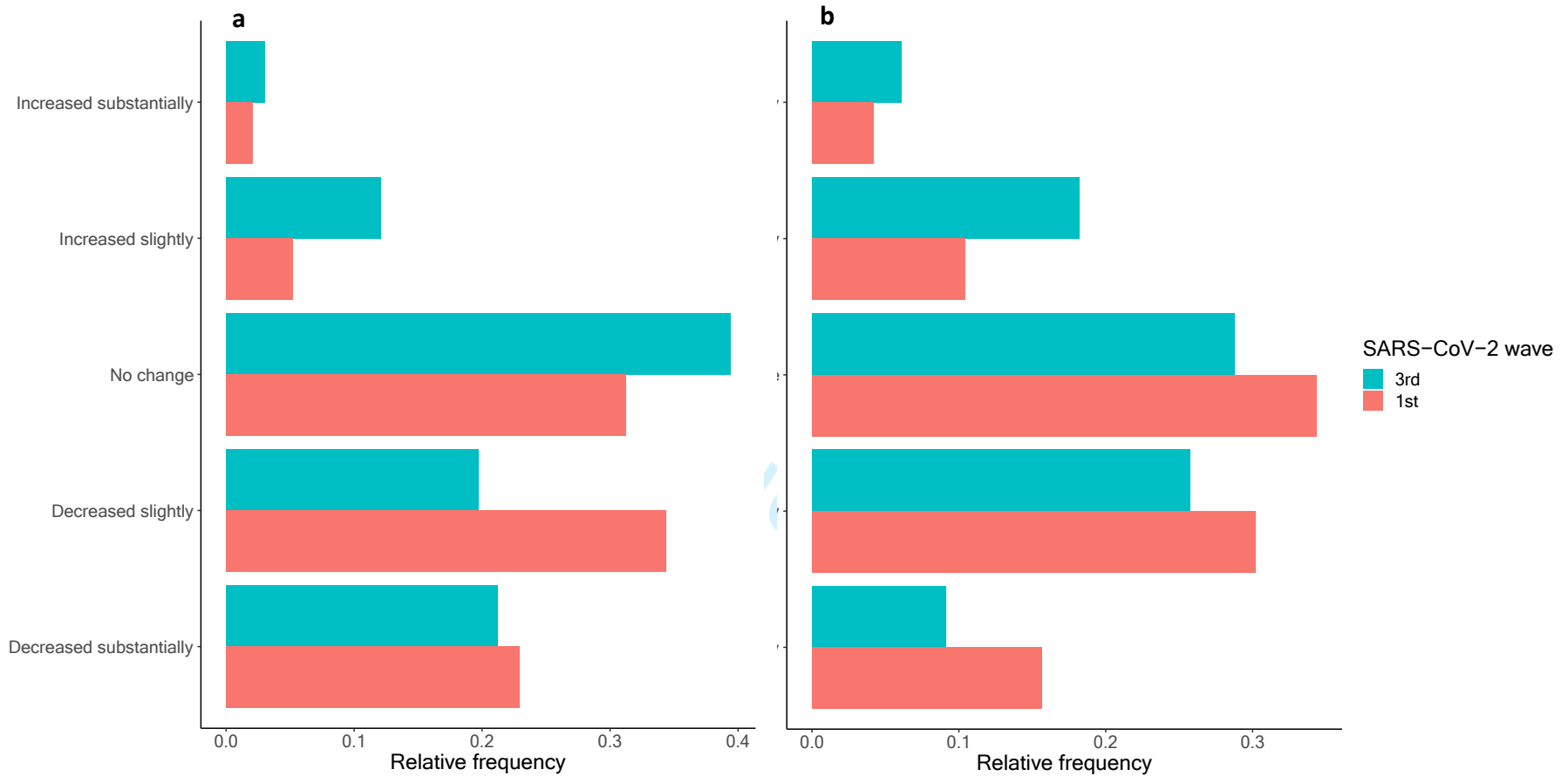
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422 **Figure 1.** Map showing number of responses by respondent's country of expertise. First and third wave surveys counts combined (see Table S1

423 from Appendix S2 for more details).



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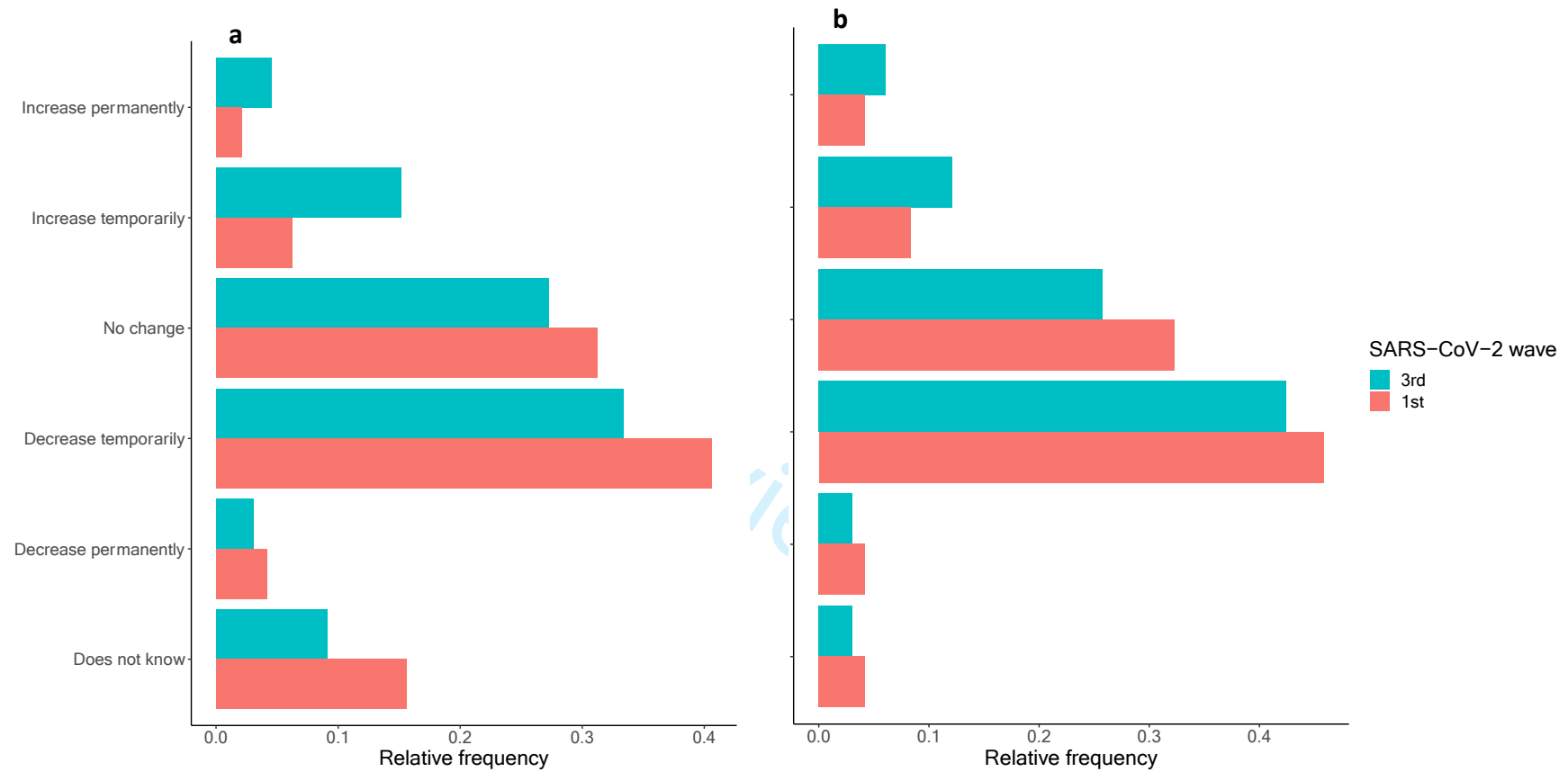
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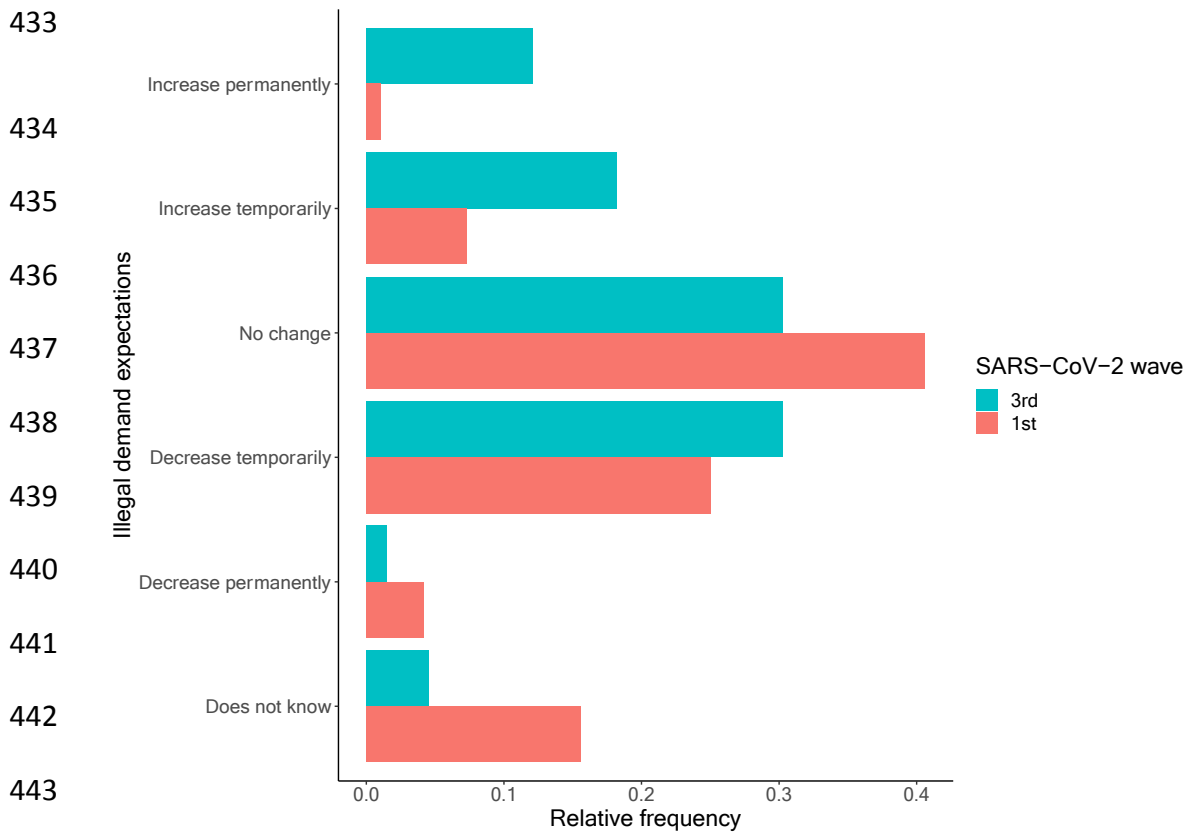
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428 of work, as a consequence of the coronavirus outbreak. Relative frequency shown for both surveys implemented after the first wave and during  
429 the third wave of the pandemic.

For review only





430 **Figure 3.** Prevalence of respondents' expectations for the change in consumer demand (a) and supply (b) for legally traded exotic pets,  
431 considering their geographical scale of work and the next 5 years. Relative frequency shown for both surveys implemented after the first wave  
432 and during the third wave of the pandemic.



446 **Figure 4.** Prevalence of respondents' expectations for the change in consumer demand for  
447 illegally traded exotic pets, considering their geographical scale of work and the next 5 years.  
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449 third wave of the pandemic.

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