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# **WILDLIFE MARKETS and COVID-19**

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## Executive Summary

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The emergence and worldwide spread of the COVID-19 pandemic has had an overwhelming effect on both human health and the global economy. Understanding how this disease first arose should be of critical concern to governments around the world. Identifying, and addressing, the source of COVID-19 may be crucial in preventing the next pandemic.

COVID-19 is caused by a virus, SARS-CoV-2, that probably originated in bats. It is unlikely, however, that bats were directly responsible for human infection. Its transference to humans, through an as yet unidentified intermediate host species, has been linked to the sale of wild animals for human consumption in a wildlife market in China. SARS-CoV, a very similar coronavirus responsible for the outbreaks of Severe Acute Respiratory Syndrome (SARS) from 2002 to 2004 which resulted in 774 human fatalities, also originated in bats and is known to have been transmitted to humans through contact in another Chinese wildlife market with an intermediate host species, the Himalayan palm civet (*Paguma larvata*). Had wildlife markets, which were temporarily closed after the SARS outbreak, remained closed, the COVID-19 pandemic might never have occurred.

Animal-based diseases (zoonoses) account for an estimated 73% of all emerging infectious diseases affecting humans. Wildlife markets of the type linked to both SARS and COVID-19, where many species of wild animals are crowded together under unhygienic and stressful conditions and frequently slaughtered on the premises, provide ideal circumstances for the spread of zoonoses. These include diseases caused by coronaviruses transferred to humans through a range of intermediate host species. Large-scale urban wildlife markets in China are a recent phenomenon. Similar markets are widespread in other eastern Asian countries, and the sale of wild meat, with similar associated risks of disease, is widespread in many other parts of the world.

China has already issued a decision banning further sales of wild animals for human consumption, though the terms of the decision remain ambiguous. Humane Society International recommends that all countries with wildlife markets (including those selling live wild animals or their parts for food, pets, or other purposes) permanently ban, or severely limit, wildlife trade, transport and consumption. Any ban or limitation on wildlife trade should, based on the evidence in this white paper, include permanent closure of wildlife markets, particularly those selling wild mammals and birds (including

those that are farmed, such as fur-bearing animals, or captive-bred), the chief sources of coronaviruses and other pathogens transmissible to humans. This ban should also apply to import, export and internal transport of live wildlife or wildlife meat intended for sale in wildlife markets.

Bans on wildlife markets can be put in place immediately, and should be adopted by all relevant governments as part of their strategy to reduce the likelihood of the emergence of further pandemic diseases. We also recommend that these bans be accompanied by support, including technical and financial if needed, for former traders leaving the markets, as well as country-appropriate public education campaigns to reduce the demand for wild animals sold as food. We present survey evidence that buyers in China and elsewhere are already likely to respond favourably to such initiatives.

## Introduction

The emergence and worldwide spread<sup>1</sup> of a new and dangerous respiratory disease, COVID-19, has had an overwhelming effect on both human health<sup>2</sup> and the global economy.<sup>3</sup> Understanding how this disease, now characterized as a pandemic by the World Health Organization, first arose should be of critical concern to governments around the world. Identifying, and addressing, the source of COVID-19 may no longer be of use in preventing its spread, but may be crucial in preventing the next pandemic — and the lesson of recent history is that, if we do not act, the question is not whether another similar pandemic will emerge, but when.<sup>4</sup>

COVID-19 is caused by infection from a coronavirus.<sup>5</sup> The emergence of the virus has been linked to the sale of wild animals for

human consumption in a wildlife market in China. It is not the first such disease. Eighteen years ago, in 2002, Severe Acute Respiratory Syndrome (SARS) spread around the world. SARS, too, was caused by a coronavirus — closely related to SARS-CoV-2<sup>6</sup> — that first appeared in Chinese wildlife markets. COVID-19 may have emerged because the lessons of SARS were not heeded.

If the actions that should have been taken worldwide in 2002 are not taken now, and wildlife markets of the type that has been the probable source of both SARS and COVID-19 are not dealt with — and, as we argue here, permanently closed — by governments on a global scale, the emergence of another coronavirus-based disease in the future is a practical certainty.

## The Emergence of COVID-19

COVID-19 was first reported, as four unexplained cases of pneumonia, on 29 December 2019 in the city of Wuhan, Hubei Province, China.<sup>7</sup> By 31 December the number of identified cases had risen to 27. Most of the patients were stall workers at the Huanan (Southern China) Seafood Wholesale Market, in which one section reportedly sold, in addition to seafood and other items, “animals such as birds (chickens, pheasants), bats, hedgehogs, marmots, tiger frogs, and snakes, as well as organs from rabbits and other animals.”<sup>8</sup> The Wuhan Municipal Government closed the market on 1 January 2020, and as of this writing it has not reopened.

On 7 January 2020, the Chinese Center for Disease Control and Prevention (China CDC) officially announced that the outbreak had been traced to a novel coronavirus.<sup>9</sup> On 26 January, China CDC announced<sup>10</sup> further that it had isolated the new virus (then re-

ferred to as 2019-nCoV but now renamed SARS-CoV-2) from 33 of 585 environmental samples taken on 1 and 12 January at the Wuhan market. Thirty-one of the 33 positive samples were collected from the western end of the market, where booths trading in wildlife were concentrated.

Despite some suggestions to the contrary<sup>11</sup> (including outlandish, and debunked,<sup>12</sup> conspiracy theories that proposed that the virus was a bioweapon), genetic studies have shown that SARS-CoV-2 almost certainly originated in bats.<sup>13</sup> The questions of the exact source of the virus, and the pathway by which it was first transmitted to humans, have, however, not been entirely settled.<sup>14</sup> The virus, or some form of it, may have been circulating in the human population before the first reported cases. Some patients, who apparently had contracted the disease by the beginning of December,<sup>15</sup> had no known association with the Wuhan market.<sup>16</sup> The initial human infection may have happened elsewhere, in November or even earlier.<sup>17</sup> However, the market almost certainly played a role in the subsequent transmission of the disease, even if, as has been suggested,<sup>18</sup> it may have been first contaminated by a human victim who contracted the virus from an animal elsewhere.<sup>19</sup>

As was the case with SARS (see next section), the virus may not have been transmitted directly from bats to humans. By late December most of the bats in the Wuhan area should have been hibernating. No bats were being sold at the time in the Wuhan market (it is unclear if bats were on sale there earlier in the year). The virus is closely related to coronaviruses found in bats (and in particular to Bat/Yunnan/RaTG13 CoV, a virus detected in Yunnan Province, China, in the intermediate horseshoe bat (*Rhinolophus affinis*)<sup>20</sup>). However, it is not identical

to them. This suggests that SARS-CoV-2 is a new virus that arose through a recombination event — that is, an exchange of genetic material between a bat virus and a similar virus from another animal species. Recombination events occur frequently in coronaviruses,<sup>21</sup> and the same process probably occurred during the evolution of SARS.<sup>22</sup> The recombinant virus probably reached humans via transmission from the second species, which was first infected by the bat coronavirus and subsequently served as an intermediate source for human infection.<sup>23</sup>

This intermediate source has not been identified. It has been suggested that it may have been a pangolin (*Manis* sp.),<sup>24</sup> though the scientific evidence for this is still in dispute.<sup>25</sup> Pangolins are the most heavily trafficked mammals in the world, and have been repeatedly smuggled into China where they are valued for food and supposed medicinal purposes. Coronaviruses related to SARS-CoV-2 have been identified from smuggled Sunda pangolins (*Manis javanica*) seized in southern China.<sup>26</sup> A study<sup>27</sup> of amino-acid sequences in coronavirus S-proteins (the proteins that form the distinctive crown-like spikes on the viral surface, and are apparently crucial for transmission between species) showed that the S-proteins in the new virus are extremely similar to those in coronaviruses found in pangolins. It is still not clear, however, whether pangolins are intermediate hosts of SARS-CoV-2 or natural carriers of a closely-related coronavirus, or whether the pangolin coronavirus, whatever its origin, might be transmissible to humans.<sup>28</sup>

Whatever the precise route of the transmission may have been, there seems to be little question that the Wuhan market played an important — and perhaps the primary — role as a common exposure point

in the spread of COVID-19 to humans.<sup>29</sup> The recombination event could presumably not have occurred unless the original bat coronavirus had had an opportunity to infect the intermediate species, whether that species was a pangolin or something else. Its best opportunity to do so may have been in the crowded and unsanitary conditions, such as those the Wuhan market, that prevail where wildlife is butchered and sold. (This could have happened whether bats were actually sold, or if they entered on their own and defecated there<sup>30</sup>). Even if the new, recombinant coronavirus originated elsewhere, the Wuhan market was a place where it was amplified and spread.<sup>31</sup> It was certainly present in the western end of the market — however it arrived there — by the beginning of 2020.

## The Lessons of SARS

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We still have much to learn about the origin and spread of COVID-19. However, the best way to understand the risk of a similar pandemic disease occurring again may be to consider the much-better-studied, and extremely similar, case of SARS. SARS, “the first known major pandemic caused by a coronavirus,”<sup>32</sup> caused 774 deaths<sup>33</sup> and cost the global economy more than US \$50 billion in 2003 alone.<sup>34</sup> As a study in the *New England Journal of Medicine* noted, “The parallels between the two SARS viruses are striking, including emergence from bats to infect animals sold in live-animal markets, allowing direct viral access to crowds of humans, which exponentially increases opportunities for host-switching.”<sup>35</sup>

Like COVID-19, SARS was first detected in a patient suffering an unusual form of pneumonia — in this case, in a 45-year-

old man from Foshan, Guangdong Province, China, who developed symptoms on 16 November 2002. According to a 2004 study<sup>36</sup>, “A high proportion (9/23, 39%) of early cases were food handlers ... Of the nine early cases in food handlers, seven were restaurant chefs working in township restaurants (where a variety of animals were slaughtered on the premises), one was a market produce buyer for a restaurant, and one was a snake seller in a produce market (where a variety of live animals were offered for sale).”

It was realized early on<sup>37</sup> that SARS was caused by a novel coronavirus, later named SARS-CoV. It took longer to determine that the virus had an animal origin,<sup>38</sup> almost certainly through a live animal market. A team of researchers taking samples from a live animal market in Shenzhen in April/May 2003 isolated viruses similar to SARS-CoV from six Himalayan palm civets (*Paguma larvata*), a raccoon dog (*Nyctereutes procyonoides*) and a Chinese ferret-badger (*Melogale moschata*). Five out of ten civet dealers at the market were found to have antibodies to the virus. The researchers concluded that “the markets provide a venue for the animal SCoV-like viruses [i.e. SARS-CoV-like viruses] to amplify and to be transmitted to new hosts, including humans, and this is critically important from the point of view of public health.”<sup>39</sup>

In response, Chinese authorities imposed “a temporary ban on the hunting, sale, transportation and export of all wild animals in southern China and also quarantined all civets reared for human consumption in many civet farms across the area.”<sup>40</sup> The Chinese government reportedly confiscated 838,500 wild animals from markets in Guangdong.<sup>41</sup> The ban was, however, lifted in August 2003, only to be followed by a further outbreak of SARS in Decem-

ber 2003 and January 2004. In response, Guangdong provincial officials closed the markets<sup>42</sup> again (though, again, only temporarily) and conducted a massive cull of palm civets and other farm and market animals<sup>43</sup>. However, researchers later failed to detect the coronavirus in wild or farmed civet populations<sup>44</sup>. This failure suggested that civets, like the pangolins implicated in the spread of COVID-19, were only intermediate hosts for the virus<sup>45</sup> and had likely become infected either during transportation or after being brought to market. As mentioned above the civet virus likely arose by recombination, an event that may have happened in 1995<sup>46</sup> or later.<sup>47</sup> The researchers who identified the virus in civets at the Xinyuan Animal Market in Guangdong noted that “It seems that palm civets are extremely susceptible to SARS-CoV and that the Xinyuan animal market was likely the source of infection, where the virus was amplified, circulated, excreted through the respiratory and intestinal tracts of palm civets, and subsequently disseminated to cause sporadic disease in humans,” and concluded that “when SARS-CoV-like virus arrives at an animal market, the majority of palm civets, if not all, will become infected, and that the virus will evolve rapidly in animals to cause disease.”<sup>48</sup>

The hunt for the original carrier — the reservoir species — then expanded to the wild, where a SARS-CoV-related virus was discovered in Chinese horseshoe bats (*Rhinolophus sinicus*) in Hong Kong.<sup>49</sup> Since then, further evidence<sup>50</sup> has supported the conclusion that bats, and in particular horseshoe bats (Rhinolophidae), were the original hosts for SARS-CoV. The closest amino acid match to human and civet viruses was found in the greater horseshoe bat (*R. ferrumequinum*). A five-year study of multiple species of horseshoe bats roosting in a single

cave in Yunnan Province, China, identified all of the building blocks of the SARS virus in anal swabs and fecal samples taken from the bats in the cave. The study, published in 2017, concluded that “While we cannot rule out the possibility that similar gene pools of SARSr-CoVs [SARS-related coronaviruses] exist elsewhere, we have provided sufficient evidence to conclude that SARS-CoV most likely originated from horseshoe bats via recombination events among existing SARSr-CoVs.” Noting that other forms of the virus were also circulating among bats in the region, the authors warned, prophetically, that “the risk of spillover into people and emergence of a disease similar to SARS is possible.”<sup>51</sup>

This was by no means the first warning that a new coronavirus disease could emerge at any time. However, although market closures “effectively ended”<sup>52</sup> the SARS epidemic, the trade re-emerged and animals that are known to carry coronaviruses, such as civets, continued to be farmed and sold in wildlife markets.<sup>53</sup> In the years since the first outbreak of SARS, one team of researchers after another has warned that controlling or stopping the sale of wild animals in crowded markets was key to preventing another SARS-like outbreak. The authors of a 2007 study<sup>54</sup> of SARS concluded that “The presence of a large reservoir of SARS-CoV-like viruses in horseshoe bats, together with the culture of eating exotic mammals in southern China, is a time bomb. The possibility of the reemergence of SARS and other novel viruses from animals or laboratories and therefore the need for preparedness should not be ignored.”

Today, as COVID-19 continues to spread around the world, the consequences of ignoring such warnings have become plain to see.

## Bats and Disease

The scale of the problem raised by COVID-19 goes well beyond the case of a few wildlife markets in one country.<sup>55</sup> SARS and COVID-19 are just two examples of zoonoses<sup>56</sup> — diseases that have spread to human beings from other animal species. It has been estimated<sup>57</sup> that zoonoses account for 58% of all known human pathogens, and for 73% of all emerging infectious diseases affecting humans, including such serious illnesses as HIV-AIDS and Ebola hemorrhagic fever.<sup>58</sup> A 2008 survey noted that “Pathogens associated with illegally traded wildlife span the gamut of taxonomic origins, affect most vertebrate taxa, and can jump species barriers affecting wildlife, domestic animals (e.g., Newcastle disease), and humans (e.g., psittacosis, salmonellosis, retroviral infections).”<sup>59</sup>

Bats have been identified<sup>60</sup> as the source for a wide range of zoonoses. Bats are regarded as either delicacies or of medicinal value in a number of countries, particularly in East and Southeast Asia, the Pacific Islands and Sub-Saharan Africa including Madagascar.<sup>61</sup> In Ghana, straw-coloured fruit bats (*Eidolon helvum*) are hunted in large numbers (over 128,000 annually in the south of the country alone) despite being potential hosts for a number of pathogens including the Ebola virus.<sup>62</sup> The researchers who first isolated SARS-like coronaviruses in Chinese horseshoe bats noted that bats are a “reservoir of emerging zoonotic viruses, including rabies virus, lyssavirus, Hendra and Nipah viruses, St. Louis encephalitis virus, and fungi such as *Histoplasma* ... The feces of bats (excrementum vespertilionis 夜明砂) are used in traditional Chinese medicine ... The Chinese and Manadonese populations of Malaysia and Indonesia consider bat meat

[to be] a delicacy. Many Chinese [people] also believe that eating bat meat can cure asthma, kidney ailments, and general malaise.”<sup>63</sup> A global survey of bats as bushmeat reported, with respect to bat consumption in China, that “In some areas bats are rarely consumed and always less so than other bushmeat species. In southern China however, bat meat is traded locally and regionally; it appears on some restaurant menus in Guangdong and Guangxi provinces, especially in Wuming County. Bats were seen in markets during surveillance linked to the SARS epidemic in 2003.”<sup>64</sup>

In particular, bats in most of the 18 extant bat families are known repositories for a wide array of coronaviruses.<sup>65</sup> In field studies, coronaviruses have been found in both fecal and respiratory samples from bats of the genus *Miniopterus*, although the bats themselves were asymptomatic.<sup>66</sup> A study of thirteen species of bats in Hong Kong detected eight different coronaviruses in anal, but not in nasopharyngeal, swabs.<sup>67</sup> A 2017 study<sup>68</sup> identified bats “as the major evolutionary reservoirs and ecological drivers of CoV diversity.” This is partly because bats, with over 900 species, are themselves highly diverse. Bat coronaviruses have been identified on every continent but Antarctica, where bats do not occur.<sup>69</sup>

Bats are the putative source of four of the known human coronaviruses, including HCoV-229E, one of the viruses responsible for the common cold.<sup>70</sup> In addition to SARS and COVID-19, bats appear to have been the original source of Middle East Respiratory Syndrome (MERS),<sup>71</sup> a coronavirus disease that emerged in the Middle East in 2012. MERS is thought to have spread to humans through intermediate infection of domestic dromedary camels in the Horn of Africa,<sup>72</sup> rather than through multi-species

wildlife markets.

It may appear that simply banning the sale and consumption of bats would be sufficient to prevent further outbreaks. There have already been misguided calls to eliminate bat populations in the wake of COVID-19. These must be resisted, and information about the critical ecosystem roles that bats fulfill should be a part of public education programmes.<sup>73</sup> Bats play an important ecological role,<sup>74</sup> particularly in tropical forests,<sup>75</sup> and are essential for the pollination of crops, such as durian.<sup>76</sup> Bats are important controllers of insect pests, and their value to agriculture in the United States alone has been estimated at 22.9 billion USD a year.<sup>77</sup> Noting that “The exaggeration of bats’ negative traits without regard for their positive ones could ultimately lead to their needless and intentional elimination”, one Wuhan-based researcher concerned about negative image of bats in China following the COVID-19 outbreak warned that “The need for public education about bats, including their positive and negative impacts, is urgent and vital to their conservation.”<sup>78</sup>

Such views, in addition, ignore the findings that in all three coronavirus-based epidemics in this century — SARS, MERS and COVID-19 — the infection was probably passed to humans through an intermediate species; that the intermediate host was a different mammal, only distantly related to the others, in each case; that we do not know when and how the infection of the intermediate species occurred; and that bats could have transferred the virus without being on sale in markets themselves. Any action taken against wildlife markets that does not apply to all mammal and bird species sold there (as these taxa are the known hosts of coronaviruses) risks missing the potential intermediate host for the next epidemic.

Not all viruses are equally able to adapt to a wide range of host species (that is, to have a high host plasticity). This adaptability is probably necessary for a virus to transfer from a bat or some other reservoir species to an intermediate host. A 2015 study<sup>79</sup> found that viruses with high host plasticity were more likely to be transmissible from one human to another, and that viruses transmitted to humans from places that confined different species of animals in close proximity were more likely to have high host plasticity. In other words, the kinds of viruses transmitted to humans in a mixed-species market are more likely to be able to infect other humans than are viruses from other sources.

Intermediate hosts may, in fact, be necessary for successful transfer of at least some bat coronaviruses to human beings. A 2008 study suggested that the SARS-related coronaviruses in bats may not be able to infect humans directly, but may require mutation of the spike protein in an intermediate host before they can interact with receptor enzymes in human tissue.<sup>80</sup> More recently, other bat coronaviruses have been identified that are able to infect human cells.<sup>81</sup> However, this ability apparently varies among bat coronaviruses and the identity of a future intermediate host for a new coronavirus is impossible to predict. The major focus of control should therefore be on places where the greatest range of potential intermediate host species is likely to occur and where the greatest opportunity exists for transfer of any viruses they may carry to human recipients. Mixed-species wildlife markets fit this description exactly.



## Wildlife Markets

Large-scale wildlife markets of the type involved in the spread of SARS and COVID-19 are a comparatively recent phenomenon. Wildlife markets spread rapidly in the 1990s as China increased in affluence.<sup>82</sup> They cater, according to a survey<sup>83</sup> published in 2008, mostly to a young, well-educated and recently affluent urban clientele that sees the use of wild animals as a status symbol and as part of a fashionable lifestyle. More than 50% of wildlife consumers interviewed for this study “said they consume wildlife because they find the taste delicious. Those who tried wild animals because they felt they were rare represent 23.3% of the surveyed, while 20.9% of people indicated they tried wildlife out of curiosity. Those who tried wild animals for nutritional and nourishment purposes accounted for 19.3%.”

Another 2008 study noted that “Wildlife is expensive (US\$30 per kg, compared to US\$1 for chicken), and there is evidence that demand and consumption have increased in recent years as economic conditions in China have improved. Why do people eat wildlife? Usually it is for perceived health benefits. For example, *Paguma larvata* is typically eaten in winter when fresh fruit is often unavailable. It is believed that eating the animal (also known colloquially as the fruit fox or flower fox because of its dietary preferences) provides the same health benefits as eating fruit. In markets, wild-caught *P. larvata* meat attracts a price premium because people believe it is more health-giving and tastes better than its grain-fed farmed counterpart.”<sup>84</sup>

A 2014 survey of markets in seven cities in Guangdong and Guanxi provinces documented sales of more than 7,000

individuals of 97 animal species.<sup>85</sup> The researchers who first identified coronaviruses in palm civets at the Xinyuan animal market reported that “The zoological biodiversity of the Xinyuan animal market was large, including live donkeys, calves, goats, sheep, piglets, American minks, raccoon dogs, farmed foxes, hog badgers, porcupines, nutria, guinea pigs, rabbits, and birds. Animals were presented in small wire cages piled atop one another, which highly favors the transmission of any pathogens present. The mixing of wild and domestic animals of various species and geographic origins likely further increased the probability of pathogen transmission.”<sup>86</sup>

The risk of transfer of infectious diseases in such a market, already high due to significant stress compromising the animals’ immune systems and because of the number of species being maintained in close proximity to each other, is further increased by often unhygienic conditions. Wildlife markets “are traditionally places that sold dead and live animals out in the open and where blood and other body fluids originating from different animal species represent an exceptional source for the spread of infectious diseases and the jump of species barriers by pathogens.”<sup>87</sup> Prior to government action after the SARS outbreak, “animals were often housed together, exposed to one another’s waste, and sometimes even fed to one another. For a virus or bacteria capable of jumping between species, the markets had provided the perfect place to reproduce.”<sup>88</sup> One observer visiting the wildlife market in Foshan City in March 2015 observed that “All of the animals are mixed together in each stall. There was blood and faeces everywhere. Some of the animals looked quite sick, with the exception of the goats. ... Shops seemed to specialize in hav-

ing as large a variety as possible. Turtles and snakes were mixed in with poultry, boars, pigs, civets, nutria, bamboo rats, regular rats (that looked particularly ill). ...There were 6 civets in the market. One in a stall with chickens, ducks, pigs, cats and snakes. Its fur looked matted and dirty.”<sup>89</sup>

It is little wonder that the authors of a review of SARS-CoV-2 concluded that “live-animal markets such as in China could provide chances to animal CoVs to get transmitted to humans and these markets may act as critical places for the origin<sup>90</sup> of novel zoonotic pathogens and pose high public health risks during an outbreak.”<sup>91</sup>

Markets in other Asian countries present similar problems. According to a 2005 review, the wildlife markets of Asia “are a mixing bowl of domestic animals, wildlife from near and far, and people. Most often, sanitation and hygiene are very poor to nonexistent, and both people and animals are under a tremendous amount of stress, lowering immuno-competency. Those in the marketplace are handling live birds and butchering others without any personal protection and often live, eat, and sleep in their shops amongst their animals for sale. This serves as an excellent environment in which pathogens can mutate and jump into novel species.”<sup>92</sup> Wild bird markets in Vietnam have been implicated in the spread of the Highly Pathogenic Avian Influenza (HPAI H5N1) virus.<sup>93</sup> Surveys of seven wildlife markets in Lao PDR, where wildlife markets first appeared in the 1980s, between 2010 and 2013 identified mammals on sale known to be capable of hosting 36 zoonotic pathogens.<sup>94</sup> A recent literature analysis using TRAFFIC survey data from wild meat restaurants, roadside stalls and markets in

Malaysia<sup>95</sup> identified 51 zoonotic pathogens (16 viruses, 19 bacteria and 16 parasites) that could be hosted by wild species found on sale.

## The Need for a Ban

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If SARS, COVID-19 and other zoonoses, and the warnings that epidemiologists have been issuing for years<sup>96</sup> have taught us anything, it should be that the existence of wildlife markets in their current form — particularly the large, unhygienic, mixed-species markets associated with both SARS and COVID-19 — is a serious threat to human health on a global scale. That is why Humane Society International supports banning or severely limiting all trade, transport and consumption of wildlife, and why this paper recommends that governments around the world take immediate action to close wildlife markets selling wild mammals and birds, the chief sources of coronaviruses and other pathogens transmissible to humans, within their borders. This ban should also apply to import, export and internal transport of live wildlife or wildlife meat intended for sale in wildlife markets.

Closing wildlife markets is not the only action that needs to be taken to prevent another zoonotic disease from developing into a global pandemic.<sup>97</sup> Medical and veterinary practitioners have been urged to adopt a “one health” approach that considers human and animal health as a single issue.<sup>98</sup> Calls to control the massive domestic and international trade in wild animals for food and medicine have been issued since the emergence of SARS and even earlier.<sup>99</sup> Recently John Scanlon, former Secre-

tary-General of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), has called<sup>100</sup> for a new global agreement on wildlife crime as an essential step in preventing the spread of future zoonoses, such as HIV AIDS, Ebola, SARS, MERS and COVID-19.

Important as these measures are, however, none of them can be put into place immediately or have an immediate effect. The most effective step that can be taken right now, across the board and in every applicable country in the world, is to shut down markets that sell wild animals, particularly mammals or birds that can be infected by coronaviruses, whether captured in the wild or farmed, for food or medicine or any other purpose.

Closing markets is a strategy that is known to work. In 2013, respiratory disease experts in China noted, in reference to the renewed outbreak of SARS in late 2003, that “The strong enactment of Guangdong government against rearing, sales, slaughter and transport of wildlife proved effective for the crackdown of wildlife markets and spread of SARS. Unfortunately, following remission of epidemics, the wildlife markets resumed to thrive, a consequence possibly stemming from the lack of subsequent governance and reduced public health awareness.”<sup>101</sup> Noting that “the potential pathogenicity of SARS-CoV mutants arisen from gene recombination should not be underestimated”, they recommended that “Wildlife markets, in conjunction with the personnel involving in transaction, slaughter and transportation, should be made illegal and are subjected to punishment and serious warning. The laws are strongly recommended to be enforced periodically under stringent supervision.”

Some of the strongest calls for the elimination of wildlife markets have come, and are coming, from infectious disease experts within China. One recent study called for, among other actions, “completely eradicating wildlife trading.”<sup>102</sup> An open letter from “a group of 19 prominent researchers from the Chinese Academy of Sciences, the Wuhan Institute of Virology and the nation’s top universities,”<sup>103</sup> issued in the wake of COVID-19, called on the Chinese government to ban “the illegal consumption of wild animals.”<sup>104</sup> Chinese researchers have called on their government to “seize this opportunity and permanently ban wildlife consumption,”<sup>105</sup> close loopholes in existing laws and increase penalties for illegal activity, and provide financial support “to facilitate the transformation of the wildlife farming industry required by the ban, as well as made available to help transition away from the production of traditional Chinese medicine.”<sup>106</sup>

On February 4, 2020, the Standing Committee of the Thirteenth National People’s Congress issued an open-ended “Complete Ban of Illegal Wildlife Trade and the Elimination of the Unhealthy Habit of Indiscriminate Wild Animal Meat Consumption.”<sup>107</sup> Among other things, this decision bans “Hunting, trading or transporting for meat terrestrial wild animals that grow and reproduce naturally in the wild,” and decrees that “Illegal business premises and operations shall be shut down, sealed off or ordered to close in accordance with the law.” There have been criticisms<sup>108</sup> that the coverage of the ban is not always clear. We believe that the ban should be expanded to cover all potential coronavirus-carrying mammals and birds, including those cur-

rently excluded as ‘livestock’. At the moment the exempted animals even include the raccoon dog, one of the species that is known to have carried the SARS virus.

Enforcement of the ban remains an issue. There are recent reports that wildlife markets in some cities are still operating, or have reopened, despite the ban.<sup>109</sup> However, the decision is welcome and, we believe, necessary. We urge the Chinese government to close any loopholes that the decision may contain, and to make the ban permanent. The example of SARS, which re-emerged after a ban on wildlife markets was lifted, should be good evidence that temporary closures will not do. Nonetheless, we urge other all governments to follow China’s example and ban all wildlife markets, and to do so indefinitely.

There have been warnings that closing legal markets will not end the trade but drive it underground.<sup>110</sup> These warnings ignore that fact that much of the trade is underground already, and that banning wildlife markets will likely reduce it.<sup>111</sup> All pangolin species, for example, are listed on Appendix I of CITES, making any transfer of pangolins across borders for sale in markets — legal or illegal — already in violation of the law in every, or almost every, country where it takes place (noting that a few countries, such as North Korea, remain out of CITES).

Critics argue that regulation, with the imposition of hygiene standards and other measures, would be a better way to proceed. However, attempts to establish well-regulated markets have failed in the past. One of the largest, if not the largest, wildlife wholesale markets in China was relocated from Guangzhou to Taiping in 2006, funded “by the Guangzhou City Forestry Department, Conghua City Forestry Bureau, and the Taiping Township Forestry Station

with an investment of RMB 30 million...The purpose of the new market was to permit the wholesale selling of licensed wildlife, and it would be under strict inspection and checks.” Despite these conditions, the market reportedly became “a major centre for illegal wildlife trade”, subject to repeated raids and closures.<sup>112</sup>

Truly effective regulations would take time and care to design and put into place, which might not be effective in preventing a disease that has yet to emerge. Permanently enforcing them would require a considerable investment of time and resources, and would, as the experience of the Taiping market strongly suggests, probably be unsuccessful. If we are to avoid being caught by the emergence of a new pandemic, therefore, an immediate ban is an essential first step. Effective long-term measures, appropriate to the socio-economic and cultural realities in each country, can be put into place at a later date (bearing in mind, for example, that bushmeat markets in Africa are not identical to wildlife markets in China<sup>113</sup> and may require a different approach).

Closing markets will undoubtedly have an economic effect on market traders, many of whom may have no other opportunities to earn income. Closures should therefore be accompanied by remedial actions such as financial support for those transitioning away from trading and training for alternative livelihoods.<sup>114</sup> The Decision establishing the current ban in China states that “Relevant local people’s governments shall provide support and guidance to affected farmers to help them change their production and business activities, and provide them with compensation accordingly.”

It is not only national governments that can take action to ban wildlife trade and consumption. Shenzhen, China’s fourth

largest city, will reportedly ban wildlife consumption starting May 1, 2020, according to a regulation passed by the Shenzhen Municipal People's Congress, the city's legislature. A resolution of the Guangdong provincial government stiffening punishments for poaching, trading and consuming wildlife will go into effect on the same day.<sup>115</sup>

Such measures may be welcomed by the traders themselves. A survey of traders selling wildlife in markets in Indonesia found that a number of those interviewed felt that their limited education levels gave them no other option, and some stated that they would leave the business if alternatives were available. None wanted their children or grandchildren to continue trading rather than pursuing their education and seeking better opportunities.<sup>116</sup>

## Public Support for a Ban

The best way to prevent further black-market trade is to accompany any ban in markets with a public education campaign focused on the need to prevent new diseases<sup>117</sup> by reducing demand for wildlife products. Campaigns will vary from country to country as appropriate, but should be science-based, respectful of local perceptions, and should avoid unfairly singling out minority communities with particular dietary preferences.<sup>118</sup>

The potential for success of a properly-focused, country-appropriate campaign is considerable. Consumers of wildlife are already aware of the risks. A research team surveying 1,596 rural residents in Yunnan, Guanxi and Guangdong districts in southern China between 2015 and 2017 reported<sup>119</sup> that “When asked about animals and disease transmission, more than half of

the study participants believed that animals could spread disease (n=871, 56%) and were worried about disease emergence from animals at wet [wildlife] markets (n=810, 52%). Of those worried about disease emergence, 46% (n=370) purchased animals from wet [wildlife] markets in the past 12 months.”

Support in China for closure of potentially dangerous wildlife markets is already broader than critics may realize. A belief that wildlife should be protected has existed in China for some time. A 2008 survey found that “61.7% of Chinese urban residents believe all wild animals should be protected ... 52.6% think wild animals are equal to human beings and both deserve protection and respect ... [and] nearly 60% of urban respondents think improved animal welfare is related to societal development.”<sup>120</sup> 37.5% “hold that the sanctions imposed by law are not stern enough, which is why the law does not truly play its role of prohibiting unlawful behavior.”

An online survey, conducted from 15 December 2015 to 15 January 2016, assessed 2,238 Chinese millennials' attitudes about wildlife consumption and perceived health-risks. It indicated “that although this population is currently the primary driver of demand for wildlife trade in China, it may also be the most effectively targeted with campaigns to educate about zoonotic emergence from wildlife reservoirs.” The survey report concluded that “Utilising social networks as a means of distributing public health or public service messages about the health risks of wildlife trade and consumption could yield positive results and begin to effect change around consumption of wildlife in China.”<sup>121</sup>

The opportunity to influence public opinion in China (and elsewhere) may have grown even greater with the emergence of

COVID-19<sup>122</sup>. A telephone survey conducted between 1 and 10 February 2020 in Shanghai and Wuhan found that “79.0% (403) of respondents in Wuhan and 66.9% (335) of respondents in Shanghai supported permanent closure of wet [wildlife] markets ( $P < 0.001$ ). 95% and 92% of respondents supported banning wild animal trade and quarantining Wuhan, and 75% were confident towards containment measures. Females and the more educated were more supportive for the above containment measures.”<sup>123</sup>

China is not the only country in which a public education programme could influence buyer opinion. Wildlife consumers surveyed at markets in Lao PDR in 2016 and 2017 “indicated they would stop consuming wildlife if they knew the animal was near extinction (74% of respondents), if they knew it could transmit a pathogen (71.5%), and if they knew police would fine them (92.5%).”<sup>124</sup> Their consumption of bushmeat “was motivated by dietary preference and tradition rather than nutritional needs.”

Results such as these suggest that critics may be underestimating the willingness of wildlife consumers — and in particular younger, more affluent and well-educated consumers in China and elsewhere — to accept a total closure of wildlife markets in the interest of protecting human health. Had such action been taken years ago, COVID-19 might never have emerged. We should not be afraid to do so now.

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