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Q2 Letter

3 Illegal and Legal
4 Wildlife Trade
5 Spreads Zoonotic
6 DiseasesQ4 Q3 Vincent Nijman^{1,*}

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9 Parasites do not read legal documents.
10 They cannot distinguish between animals
11 or animal products that are traded with or
12 without permits. Bezerra-Santos *et al.* [1]
13 discussed the potential risks that the illegal
14 wildlife trade has on the spreading and
15 emergence of zoonotic pathogens. They
16 highlight open wildlife ('wet') markets, the
17 illegal transport of wildlife or their deriva-
18 tives, as well as the illegal importation
19 of exotic pets and the risk of zoonotic
20 pathogens in the spread and introduction
21 of diseases. While they do note that the
22 concerns related to the transmission of
23 zoonotic pathogens and the introduction
24 of exotic infectious agents into a new
25 region may also be applied to the legal
26 wildlife trade, I argue here that the majority
27 of their concerns are applicable to both
28 legal and illegal wildlife trade. Given that,
29 in many instances, the legal wildlife trade
30 is several orders of magnitude larger than
31 the illegal trade (Box 1) it is ineffective and
32 possibly dangerous to focus on the illegal
33 wildlife trade only.

34 In presenting their arguments, Bezerra-
35 Santos *et al.* [1] relied on data collected
36 and interpreted by others. I will use four of
37 these same studies [2–5] to illustrate the
38 point that, in fact, the legal trade poses a
39 larger risk than the illegal wildlife trade.

40 The introduction of exotic ectoparasites
41 through the illicit wildlife trade may result
42 in serious consequences for public health
43 [1]. *Rickettsia* and *Ehrlichia* spp. were
44 detected in ticks on exotic reptiles and
45 amphibians imported into Japan [2]. The

legal import of these animals amounts to
500 000 a year, with 100–200 reptiles
and amphibians seized each year [6].
While illegally imported reptiles and am-
phibians are not subject to any quarantine
regulations neither are legally imported
ones [2]. Hence the risk of introduction of
zoonotic viruses, bacteria, helminths, and
protozoa carried by individual animals is
equal for legal and illegal imports, but in
this case the legal trade is at least three
orders of magnitude larger than the illegal
trade.

Since the spread of covid-19, wildlife mar-
kets are seen as synonymous with the illegal
wildlife trade, but it is important to stress
that, even in the wet market of Wuhan, the
vast majority of nondomesticated animals
(crocodiles, bats, civets, bamboo rats)
were legally offered for sale. The lack of ap-
propriate hygiene conditions (handwashing,
sanitation, separation of wildlife and their
parts) makes wildlife markets important
drivers for the transmission of infections
caused by wildlife-associated pathogens
[1,3]. In Laos 33 752 animals were recorded
in wildlife markets, of which 6452 animals
belonged to species that were protected
under Lao law [3]. There was no indication
that protected species were handled differ-
ently to nonprotected species with regard
to prevention of the spread of diseases.
Given that the legal trade in these markets
is four times larger than the illegal trade,

ceteris paribus, the threat of the legal trade 46
is four times larger. 47

The importation of wild meat or animals 48
intended for slaughter is another route 49
for the spread of zoonotic agents. Animals 50
or meat which were legally or illegally 51
imported into European countries resulted 52
in 3443 *Trichinella* infections in humans; 53
however, only 1% of these cases could 54
be linked to illegally imported meat [4]. 55
The importation of exotic pets may 56
pose public health risks for the transmis- 57
sion of zoonotic pathogens. Based on 58
imports into The Netherlands the five 59
pathogens with the highest perceived 60
risks were *Salmonella* spp., Crimean- 61
Congo haemorrhagic fever virus, West 62
Nile virus, *Yersinia pestis*, and arenaviruses, 63
transmitted by birds, mammals, reptiles, 64
and amphibians [5]. This was the case 65
for legal and illegal imports, but the legal 66
imports far exceeded the illegal ones 67
(490 750 vs 514 animals) [5]. 68

Bezerra-Santos *et al.* [1] state that 69
the monetary value of the illegal wildlife 70
trade could be worth up to US\$23 billion 71
annually; this is an upper estimate and 72
includes illegal trade in timber, charcoal, 73
and fisheries [7]. While this is an impressive 74
amount it is dwarfed by the monetary value 75
of the legal wildlife trade, with estimates 76
of both legal fisheries and legal timber 77
exports alone approaching US\$400 billion Q5

Box 1. Live Wildlife Imported into the USA

The USA is one of the three largest importers of wildlife, alongside the EU and China. Despite this, with few exceptions, it has no laws specifically requiring disease surveillance for imported wildlife. Taxa that are tested – as they could present a significant public health concern – include certain salamanders and rodents, primates, and bats. So the vast majority of nondomesticated animals entering the country are not tested. In recent years the US Fish and Wildlife Services inspected over 150 000 shipments of wildlife a year (live, dead, and derivatives), resulting in ~10 000 investigative cases being opened (~85% because of suspected violation of the Endangered Species Act and the Lacey Act[®]). While this is an impressive number, the legal import of live animals into the USA, primarily from Asia, numbers in the tens of millions annually [8], including:

Molluscs: 1.75 million
Fish: 40.43 million
Amphibians: 1.02 million
Reptiles: 0.27 million
Mammals: 0.96 million
Birds: 0.63 million
Miscellaneous (mixed species): 0.60 million

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79 (US\$151 and US\$244 billion^{i,ii}). With
80 95–99% of the (value of) wildlife trade
81 being legal, it is imprudent to focus on
82 the illegal part of it alone when trying to
83 lessen the risk of the introduction of
84 zoonotic pathogens. This is true even
85 when taking into account that only a
86 proportion of the illegal trade will be
87 intercepted and acknowledging that, in
88 some cases, the (unknown) health status
89 of illegally imported animals may pose a
90 higher risk for public health than legally
91 imported animals. By emphasising the
92 illegal wildlife trade as a gateway to zoo-
93 notic infectious diseases one runs the
94 risk of creating a misplaced feeling of
95 safety when considering the legal trade,
96 and this may lead to lapses in surveillance
97 and attention.

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Declaration of Interests

There are no interests to declare.

Resources

ⁱ www.fao.org/documents/card/en/c/ca9229en

ⁱⁱ www.fao.org/forestry/statistics/80938/en/

ⁱⁱⁱ www.fws.gov/le/pdf/LE-at-a-Glance.pdf

¹Oxford Wildlife Trade Research Group, Oxford Brookes University, Oxford, UK

*Correspondence:
vnijman@brookes.ac.uk (V. Nijman).
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References

1. Bezerra-Santos, M.A. *et al.* (2021) Illegal wildlife trade: a gateway to zoonotic infectious diseases. *Trends Parasitol.* Published online February 10, 2021. <https://doi.org/10.1016/j.pt.2020.12.005>
2. Andoh, M. *et al.* (2015) Detection of *Rickettsia* and *Ehrlichia* spp. in ticks associated with exotic reptiles and amphibians imported into Japan. *PLoS One* 10, e01337007
3. Grestorex, Z.F. *et al.* (2016) Wildlife trade and human health in Lao PDR: An assessment of the zoonotic disease risk in markets. *PLoS One* 11, e01506663
4. Pozio, E. (2015) *Trichinella* spp. imported with live animals and meat. *Vet. Parasitol.* 213, 46–55
5. Roon, A.V. *et al.* (2019) Live exotic animals legally and illegally imported via the main Dutch airport and considerations for public health. *PLoS One* 14, e02201229
6. Kitade, T. and Naruse, Y. (2020) *Crossing the red line: Japan's exotic pet trade*, TRAFFIC, Japan Office, Tokyo, Japan
7. Nellemann *et al.* (2014) *The Environmental Crime Crisis: Threats to Sustainable Development from Illegal Exploitation and Trade in Wildlife and Forest Resources*, UN Environment Programme
8. Eskew, E.A. *et al.* (2020) United States wildlife and wildlife product imports from 2000–2014. *Sci. Data* 7, 22

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