



Deposited via The University of York.

White Rose Research Online URL for this paper:

<https://eprints.whiterose.ac.uk/id/eprint/158948/>

Version: Accepted Version

---

**Article:**

Esmail, Nafeesa, Wintle, Bonnie C, 't Sas-Rolfes, Michael et al. (Accepted: 2020)  
Emerging illegal wildlife trade issues: a global horizon scan. Conservation Letters. ISSN:  
1755-263X (In Press)

---

**Reuse**

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

**Takedown**

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing [eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk) including the URL of the record and the reason for the withdrawal request.

### Emerging illegal wildlife trade issues: a global horizon scan

Journal:	<i>Conservation Letters</i>
Manuscript ID	CONL-19-0089.R3
Wiley - Manuscript type:	Letters
Date Submitted by the Author:	n/a
Complete List of Authors:	<p>Esmail, Nafeesa; University of Oxford; Oxford Martin School, Oxford Martin Programme on the Illegal Wildlife Trade          Wintle, Bonnie; University of Melbourne          't Sas-Rolfes, Michael; Oxford Martin School,          Athanas, Andrea; African Wildlife Foundation          Beale, Colin; University of York          Bending, Zara; The Jane Goodall Institute Global          Dai, Ran; King Mongkut's University of Technology North Bangkok          Fabinyi, Michael; University of Technology Sydney Faculty of Arts and Social Sciences          Gluszek, Sarah; Fauna and Flora International          Haenlein, Cathy; Royal United Services Institute for Defence and Security Studies          Harrington, Lauren; University of Oxford, Wildlife Conservation Research Unit, Department of Zoology          Hinsley, Amy; University of Oxford          Kariuki, Kennedy; Meru Conservation Project          Lam, Jack; City University of Hong Kong College of Humanities and Social Sciences          Markus, Matthew; Pembient, Inc          Paudel, Kumar; Greenhood Nepal,          Shukhova, Sofiya; Animal Concerns Research and Education Society,          Sutherland, William; University of Cambridge          Verissimo, Diogo; University of Oxford, Department of Zoology; San Diego Zoo Institute for Conservation Research,          Wang, Yifu; University of Cambridge          Waugh, John; Integra Government Services International          Wetton, Jon; University of Leicester, Department of Genetics and Genome Biology          Workman, Catherine; National Geographic Society          Wright, Joss; University of Oxford, Oxford Internet Institute          Milner-Gulland, E.J.; University of Oxford, Department of Zoology</p>
Keywords:	Africa, conservation, expanding trade networks, global policy trends, Latin America, misinformation, online platforms, strategic foresight, wildlife trafficking, East Asia
Abstract:	Illegal wildlife trade is gaining prominence as a threat to biodiversity, but addressing it remains challenging. To help inform proactive policy responses in the face of uncertainty, in 2018 we conducted a horizon scan of significant emerging issues. We built upon existing iterative

	<p>horizon scanning methods, using an open and global participatory approach to evaluate and rank issues from a diverse range of sources. Prioritised issues related to three themes: developments in biological, information and financial technologies; changing trends in demand and information; and socio-economic and geopolitical shifts and influences. The issues covered areas ranging from changing demographic and economic factors to innovations in technology and communications that affect IWT markets globally; the top three issues related to China, illustrating its vital role in tackling emerging threats. This analysis can support national governments, international bodies, researchers and non-governmental organisations as they develop strategies for addressing the illegal wildlife trade.</p>

SCHOLARONE™  
Manuscripts

1 **Title:** Emerging illegal wildlife trade issues: a global horizon scan

2 **Full name(s) of all author(s):**

3 Esmail, Nafeesa<sup>1</sup>, Wintle, Bonnie C.<sup>2</sup>, 't Sas-Rolfes, Michael<sup>1</sup>, Athanas, Andrea<sup>3</sup>, Beale,

4 Colin M.<sup>4</sup>, Bending, Zara<sup>5, 6</sup>, Dai, Ran<sup>7</sup>, Fabinyi, Michael<sup>8</sup>, Gluszek, Sarah<sup>9</sup>, Haenlein,

5 Cathy<sup>10</sup>, Harrington, Lauren A.<sup>1</sup>, Hinsley, Amy<sup>1</sup>, Kariuki, Kennedy<sup>11</sup>, Lam, Jack<sup>12</sup>, Markus,

6 Matthew<sup>13</sup>, Paudel, Kumar<sup>14</sup>, Shukhova, Sofiya<sup>15</sup>, Sutherland, William J.<sup>16</sup>, Verissimo,

7 Diogo<sup>1, 17</sup>, Wang, Yifu<sup>16</sup>, Waugh, John<sup>18</sup>, Wetton, Jon H.<sup>19</sup>, Workman, Catherine<sup>20</sup>, Wright,

8 Joss<sup>1</sup>, Milner-Gulland, Eleanor J.<sup>1</sup>

9

10 **Affiliation(s):**

11 <sup>1</sup> University of Oxford

12 <sup>2</sup> University of Melbourne

13 <sup>3</sup> African Wildlife Foundation

14 <sup>4</sup> University of York

15 <sup>5</sup> The Jane Goodall Institute Global

16 <sup>6</sup> Macquarie University

17 <sup>7</sup> King Mongkut's University of Technology Thonburi

18 <sup>8</sup> University of Technology Sydney

19 <sup>9</sup> Fauna & Flora International

20 <sup>10</sup> Royal United Services Institute for Defence and Security Studies

21 <sup>11</sup> Meru Carnivore Project

22 <sup>12</sup> City University of Hong Kong

23 <sup>13</sup> Pembient, Inc.

24 <sup>14</sup> Greenhood Nepal

25 <sup>15</sup> Animal Concerns Research and Education Society

26 <sup>16</sup> University of Cambridge

27 <sup>17</sup> Institute for Conservation Research, San Diego Zoo Global

28 <sup>18</sup> Integra Government Services International

29 <sup>19</sup> University of Leicester

30 <sup>20</sup> National Geographic Society

31

32 **e-mail address(es) of all author(s):**

33 nafeesa.esmail@zoo.ox.ac.uk, bonnie.wintle@unimelb.edu.au, tsas.rolfes@gmail.com,

34 aathanas@awf.org, colin.beale@york.ac.uk, zara@janegoodall.org.au,

35 randaiqq@gmail.com, michael.fabinyi@uts.edu.au, sarah.gluszek@fauna-flora.org,

36 cathy.haenlein@gmail.com, lauren.harrington@zoo.ox.ac.uk, amy.hinsley@zoo.ox.ac.uk,

37 kennedyolekariuki@gmail.com, lam.jykl@gmail.com, matthew@pembient.com,

38 kmrpaudel@gmail.com, s.shukhova@gmail.com, w.sutherland@zoo.cam.ac.uk,

39 verissimodiogo@gmail.com, yifu.wang@mail.mcgill.ca, waugh2k@gmail.com,

40 jon.wetton@gmail.com, cworkman@ngs.org, joss.wright@oii.ox.ac.uk, ej.milner-

41 gulland@zoo.ox.ac.uk

42

43 **Abbreviated form of title:** Horizon scan for illegal wildlife trade

44

45 **Keywords:**

- 46 1. Africa
- 47 2. conservation
- 48 3. East Asia
- 49 4. expanding trade networks
- 50 5. global policy trends
- 51 6. Latin America
- 52 7. misinformation
- 53 8. online platforms
- 54 9. strategic foresight
- 55 10. wildlife trafficking

56

57 **Type of article: *Letters***

58 **Number of words in the abstract: 149**

59 **Number of words in the manuscript: 3,271**

60 **Number of references: 40**

61 **Number of figures and tables: 3**

62

63 **Corresponding name and complete mailing address:**

64 Nafeesa Esmail

65 University of Oxford,

66 Department of Zoology

67 South Parks Road

68 OX1 3PS

69 Oxford, UK

70 nafeesa.esmail@gmail.com

71 +44 (0) 7456 960549

For Peer Review

72 **Abstract:**

73 Illegal wildlife trade is gaining prominence as a threat to biodiversity, but addressing it  
74 remains challenging. To help inform proactive policy responses in the face of  
75 uncertainty, in 2018 we conducted a horizon scan of significant emerging issues. We  
76 built upon existing iterative horizon scanning methods, using an open and global  
77 participatory approach to evaluate and rank issues from a diverse range of sources.  
78 Prioritised issues related to three themes: developments in biological, information and  
79 financial technologies; changing trends in demand and information; and socio-economic  
80 and geopolitical shifts and influences. The issues covered areas ranging from changing  
81 demographic and economic factors to innovations in technology and communications  
82 that affect IWT markets globally; the top three issues related to China, illustrating its vital  
83 role in tackling emerging threats. This analysis can support national governments,  
84 international bodies, researchers and non-governmental organisations as they develop  
85 strategies for addressing the illegal wildlife trade.

86 **Introduction:**

87 Thousands of species are subject to illegal wildlife trade (IWT), defined here as the  
88 unlawful buying or selling of harvested wild species (or derivatives; 't Sas Rolfes et al.  
89 2019). Due to its complexity and typically covert nature, the absolute scale and value of  
90 IWT is challenging to assess, but estimates place it in the top five illegal transnational  
91 trades, alongside arms and drugs. (UNODC, 2016; van Uhm, 2016). Impacts extend  
92 beyond biodiversity, as criminal involvement may destabilize governments and  
93 economies (Felbab-Brown, 2017) and damage livelihoods and security for those living  
94 with wildlife (Riskas et al., 2018). However, IWT also provides income to individuals with  
95 limited alternatives (Harrison et al., 2015) and valued goods, such as bushmeat, to  
96 consumers (Boratto & Gore, 2018).

97

98 Whilst predicting and responding to IWT is challenging, there are growing opportunities  
99 to influence global and national policies. For example, in 2015, the UN General Assembly  
100 adopted its first wildlife trafficking resolutions (UNGA, 2015). In 2014-18, the UK  
101 government led a series of four international conferences and one regional event,  
102 specifically aimed at addressing the topic. At the Convention on Biological Diversity's  
103 thirteenth Conference of the Parties, a decision was made to provide technical guidance  
104 towards a more sustainable bushmeat sector. The direct exploitation of organisms,  
105 including illegal extraction to meet local and global markets, was ranked second of five  
106 key drivers of harmful ecosystem change in the Intergovernmental Science-Policy  
107 Platform on Biodiversity and Ecosystem Services' first global assessment (IPBES 2019).

108

109 Global IWT policy-making involves a range of stakeholders, operating within and  
110 between systems of varying compatibility. Currently, member state compliance with  
111 international agreements, such as CITES (the Convention on International Trade in  
112 Endangered Species of Wild Fauna and Flora), provides the dominant means for  
113 governing wildlife trade to ensure it does not threaten species (’t Sas-Rolfes et al, 2019).  
114 Increasing attention has recently focused on transnational organised crime and related  
115 security dimensions, broadening the scope of IWT policy and action to involve bodies  
116 such as the UN Security Council, Interpol, and the United Nations Office on Drugs and  
117 Crime (UNODC). Regional and global policy initiatives focus on enforcement, technical  
118 assistance, and capacity building, yet effective counter-IWT measures hinge on the  
119 political will of nation states. Such a multifaceted policy-making environment requires  
120 proactive approaches informed by interdisciplinary input, leveraging relevant  
121 innovations in technology, governance and information systems.

122

123 IWT is often unpredictable, involving fluid markets and clandestine crime. In this  
124 complex landscape, appropriate policy responses should be informed by empirical  
125 evidence. While some trends in the *legal* wildlife trade are relatively well-documented  
126 (Harfoot et al., 2018), little has been done to analyse IWT trends and patterns  
127 systematically. Proxy measures of IWT, such as seizure data (Rosen & Smith, 2010),  
128 provide some indication of trade routes and scale, but contain detection and reporting  
129 biases (Underwood et al., 2013). Seizures tend to be biased towards charismatic

130 megafauna (e.g., elephant ivory) and may constitute less than 10% of all illegal trade  
131 (van Uhm, 2016). Information linked to underlying drivers and trends shaping IWT is  
132 even more difficult to obtain. In the face of such uncertainty, poorly informed public  
133 responses may drive politically popular, but ultimately counterproductive, policy  
134 measures.

135  
136 This first global horizon scan of IWT aims to inform proactive policy responses by  
137 governments, international conventions and NGOs to prioritise key IWT issues,  
138 underpinned by emerging empirical evidence. Horizon scanning is particularly useful for  
139 gathering, organising and prioritising new and existing evidence about emerging issues  
140 in a timely, structured and transparent way (Wintle et al, In press). It can be used for  
141 policy and decision-making alongside other strategic foresight tools, such as scenario  
142 planning (Cook et al., 2014).

143  
144 Horizon scanning systematically searches diverse information streams (Amanatidou et  
145 al., 2012), and identifies emerging threats and opportunities (Sutherland & Woodroof,  
146 2009). By helping understand system dynamics and anticipate the future, horizon  
147 scanning can support better coordination of resources, responsive policy or on-the-  
148 ground action to address issues before full impacts are realised (Konnola et al., 2012).  
149 The policy impact of horizon scanning exercises is challenging to gauge, because  
150 decisions typically reflect a blend of inputs (Wintle et al., In press). Nonetheless, other  
151 horizon scans have set a precedent of informing policy and decisions. For example,

152 priorities identified in an Antarctic Science Horizon Scan (Kennicutt et al., 2014) were  
153 used to invoke financial support for joint science programmes on ice sheet research  
154 (National Science Foundation, 2016), and issues identified in annual global conservation  
155 scans (e.g. Sutherland et al., 2018) have informed the U.K.'s Natural Environment  
156 Research Council's 'Forward Look' strategic planning.

157  
158 Scans for global conservation issues have been conducted for ten years (e.g., Sutherland  
159 et al., 2018) and topics thus identified have had widespread salience. Illustrating this, in  
160 2009, only 23% of respondents had heard of microplastic pollution, 46% of synthetic  
161 meat, and 69% of mobile sensing technology; today, these are mainstream issues  
162 (Sutherland et al., 2019). Our horizon scan provides insights into how complex  
163 economic, socio-political, financial, and ecological systems relate to IWT. Building on  
164 existing structured methods, but using an open and inclusive approach to participation,  
165 it highlights a diverse range of emerging topics to consider when formulating policy and  
166 coordinating resources.

167

168 **Methods:**

169 We adapted the Delphi-like method used in other horizon scans (Mukherjee et al., 2015;  
170 Sutherland et al., 2018). Through anonymity, iteration, facilitated discussion, structured  
171 elicitation, and aggregation of individual judgments, the method is designed to  
172 democratically incorporate a range of perspectives, and mitigate psychological biases  
173 that typically befall individuals and groups (Burgman, 2016).

174

175 Many scans solicit direct input from an invited expert group and require participants to  
176 meet in person. There is always a risk that particular topics may be more likely to be  
177 suggested when they closely align with the person's own research interests, and that  
178 more senior people, seen as "experts", may have particular worldviews and experiences,  
179 that limit their perspectives. To help mitigate this potential source of bias, we cast a  
180 wide net to solicit the first round of ideas from as many different contributors as  
181 possible, to capture diverse interests from around the world. To do so, we used an open  
182 online platform, which accommodated 29 languages and remotely engaged  
183 contributors who might not otherwise be able to participate (Hemming et al., 2017;  
184 McBride et al., 2012). An online call for participation was disseminated via targeted  
185 individuals and approximately 45 networks, groups and organisations, encompassing a  
186 range of relevant disciplines and institution types. The call reached a minimum of 5,000  
187 people. Supplementary Material 1 provides specific methodological details.

188

189 The study followed a stepwise procedure, with all stages remotely facilitated, to identify  
190 and prioritise emerging issues with the potential to have substantial positive and/or  
191 negative impacts on IWT over the next 5-10 years (Figure 1). Ultimately the usefulness  
192 of Horizon Scanning can only be judged retrospectively based on whether the issues  
193 have come to pass within the specified time-frame and how the scan has informed  
194 proactive responses (Sutherland et al. 2019).

195

196 <Figure 1>

197

198 Up to five issues were elicited from each contributor (**Stage 1**), who were asked to think  
199 widely, consult their networks, and conduct their own research. Thirty-nine nationalities  
200 and wide expertise (including biomedical engineering, conservation, criminology, earth  
201 sciences, ecology, economics, geography, law, political science and sociology) were  
202 represented in the initial contributor group (139 individuals). Eighty-seven percent of  
203 contributors were affiliated with institutions. Of those, sixty-five percent were affiliated  
204 with academia, 50% NGOs, 17% consultancy, 13% government, 10% multilateral  
205 organisations, and 7% private sector. Contributors worked in multiple regions: 55%  
206 Africa, 50% Asia-Pacific, 26% Europe, 17% North America, 11% Latin America.

207

208 The initial list was thematically organised and anonymised by the facilitators (NE, BW).  
209 Unsuitable material (which conveyed a perceived need, knowledge gap, opinion or  
210 promotion) was removed. A consolidated list was circulated to 'assessors', a subset of  
211 contributors who had submitted well-researched contributions accompanied by links to  
212 evidence (i.e. papers, reports etc.), chosen to balance background, expertise and  
213 geographical diversity (the remaining authors). Six of 139 people submitted issues in a  
214 language other than English; among the 25 authors there was fluency in at least 10  
215 languages, allowing evidence from a range of sources to be assessed.

216

217 In **Stage 2**, the assessors independently and anonymously scored (on a scale of 0-1000)  
218 each issue based on novelty, plausibility, and potential future impact on IWT. Raw scores  
219 were converted to z-scores, ranked (Wintle et al., 2017), and the top 45 were shortlisted.  
220 Assessors reported whether they had previously heard of each issue; the least known  
221 reflecting some of the most novel issues. Before **Stage 3**, the opportunity was given to  
222 'save' any of the originally assessed 128 issues not shortlisted through scoring, if  
223 substantiated with well-justified reasoning. Eight additional issues were saved, meaning  
224 53 issues moved to **Stage 3**. Here, each assessor was randomly assigned 4-5 issues to  
225 investigate, ensuring that each issue was closely examined by 2-3 people and equally  
226 considered before discussion. This helped mitigate potential biases from people  
227 focussing solely on their own 'pet' topics, or eye-catching topics. In **Stage 4**, authors  
228 discussed insights into each issue from their investigations and experiences via an online  
229 forum. This culminated with a second scoring round to produce a final ranked list of 20.  
230 Again, scoring was independently completed by each assessor with scores aggregated,  
231 so decisions on the final list were not dominated by the loudest voice. The facilitators  
232 then reworked final issue descriptions and grouped them into overarching themes. We  
233 cross-validated these groupings and links between themes by conducting topic  
234 modelling, based on the descriptive text, using Latent Dirichlet Allocation (Blei et al.,  
235 2003; Supplementary Material 4). To clarify the policy relevance of issues and refine their  
236 descriptions, we drew upon issue-specific expertise from an additional 12 external  
237 reviewers (Stage 5).

238

239

240 **Results:**

241 The top 20 issues fell under three overarching themes: (i) *Geographic (political,*  
242 *demographic and socio-economic) shifts and influences;* (ii) *Scientific and technological*  
243 *innovation,* and (iii) *Changing trends in demand and information* (Fig. 2). Topics identified  
244 through the Latent Dirichlet Allocation analysis largely complemented our qualitative  
245 analysis of overarching themes; results are presented in Supplementary Material 4. In  
246 Supplementary Material 2, we provide details of the top 20 issues, with brief  
247 descriptions of the following 40. Policy directions are mapped out for all top issues in  
248 Supplementary Material 3, intended as a platform for further discussion and decision-  
249 making.

250

251 **<Figure 2>**

252

253 Issues under the first theme, '*Geographic shifts and influences*' include changing  
254 geopolitical processes and the rising global influence of East Asia. Authors noted  
255 political, demographic and economical changes, which could facilitate greater access to  
256 wildlife, and stimulate growing demand (but also sustainable opportunities) for IWT  
257 products. These issues were the top three ranked: **Issue 1**- the political support and  
258 cultural revival of Traditional Chinese Medicine (Zheng, 2016; Table 1); **Issue 2**- the  
259 increasing role of China in developing countries, through international aid, investment,  
260 and diaspora; and **Issue 3**- the rapid expansion of new international trade routes,

261 particularly in the context of the Belt and Road Initiative (Chinese State Information  
262 Centre, 2019).

263

264 <**Table 1**>

265

266 In key wildlife source countries, especially in Africa and Latin America, recent  
267 developments create conditions that may exacerbate IWT. This includes freer trade and  
268 migration policies, with aspirations for rapid economic growth and prosperity across  
269 Africa (African Union, 2018; **Issue 7**). Rapid human population growth, alongside  
270 continued agricultural land conversion and natural habitat encroachment, also affects  
271 sub-Saharan Africa (**Issue 8**), leading to increased human-wildlife conflict, resource  
272 pressure, and wildlife crime (Kideghesho, 2016). Indicated by expanding Asian-  
273 influenced demand for its range of commodities and species, Latin America was also  
274 considered increasingly prominent in IWT activities, with trade often passing undetected  
275 through established smuggling routes (Issue 20). Political and socio-economic instability  
276 in the region was highlighted, with the current crisis in Venezuela identified as a  
277 significant potential catalyst for IWT, facilitating both extraction and transit (Sánchez-  
278 Mercado, 2017) and impacting neighbouring countries (Issue 9).

279

280 Issues under the second theme, '*Scientific and technological innovation*', fell into two  
281 broad categories: 1) biotechnology and 2) information technology (IT), including  
282 financial technology. The most highly-ranked biotechnology issue was **Issue 4**: genetic

283 technological advancements (e.g. Parker et al., 2018), enabling rapid, cost-effective  
284 assessments and traceability of product identity and source at the species and individual  
285 levels. Such advances can provide critical evidence to penalise and deter wildlife  
286 traffickers. Increased availability of portable devices also offers the potential to increase  
287 legal trade monitoring.

288  
289 Three recent IT developments were deemed significant. **Issue 17** concerns the shift of  
290 IWT operations and transactions onto and between digital platforms, such as closed  
291 social media groups (Xiao et al., 2017), with trade aided by the convergence of online  
292 and mobile payment systems, and cryptocurrencies (**Issue 12**). Both reflect the  
293 increasing exploitation of digital platforms for advertising and IWT-related transactions,  
294 by sellers and buyers. Closely related is **Issue 13**: the role of social media as a  
295 marketplace and forum that can either stimulate or deter IWT (e.g. Nekaris et al., 2013).  
296 Relatedly, **Issue 16** highlights the emerging use of financial analysis and investigation  
297 tools to help track and disrupt IWT-related transactions (Haenlein & Keatinge, 2017),  
298 enabling law enforcement to incorporate this into their broader IWT responses.

299  
300 Our third theme, *'Changing trends in demand and information'*, encompasses a range of  
301 issues around specific products and markets. Markets for certain taxa and wildlife-  
302 derived products are growing, with threats underappreciated. These include demand for  
303 *Haiwei*, dried seafood (**Issue 10**), medicinal plants (**Issue 19**) and cave beetles in Eastern  
304 Europe's karst landscapes (**Issue 18**) which are at risk of extinction before being

305 scientifically described. **Issue 14** highlights the general concern that newly discovered  
306 species (desired by collectors for their novelty) may quickly become targets due to  
307 easier-to-access locational information (Lindenmayer & Scheele, 2017).

308  
309 Linked to themes two and three, public-private collaborations help identify and disrupt  
310 illicit financial flows by using financial institutions' anti-money laundering technology  
311 and infrastructure, and information exchange to facilitate investigations and  
312 prosecutions (**Issue 15**, APG & UNODC, 2017). Another cross-thematic issue is that, in  
313 the modern age of networked communication, misinformation (from market  
314 participants, intergovernmental bodies, NGOs, policymakers and/or the media) can  
315 rapidly influence policy and practice (**Issue 5**). This can be difficult to correct and can  
316 undermine conservation efforts by skewing policy responses and potentially  
317 misdirecting scarce resources.

318  
319 Finally, and linking back to our first theme, two additional cross-thematic issues were  
320 identified. **Issue 6** highlights how urbanisation (across Africa and Asia) may change the  
321 dynamics of wild meat markets (Boratto & Gore, 2018). As supplies diminish and  
322 restrictions on harvesting certain species intensify, substitutes for wildlife products (such  
323 as tiger parts, timber, orchids) are increasingly sought, with globalisation facilitating this  
324 shift towards analogue species (**Issue 11**).

325

326 **Discussion:**

327 Through an inclusive and democratic horizon scanning strategy, we prioritised 20 issues,  
328 from which three interlinked themes emerged. Many are double-edged; for instance, a  
329 more networked world allows both illegal traders and conservationists to form new  
330 alliances and influence public opinion and behaviour. Rapidly emerging technologies are  
331 changing the speed and ways people react to newly opened markets and information  
332 sources. In particular, the growing reach of mobile technology and physical access into  
333 new areas (including remote rural and marine locations) presents opportunities for both  
334 IWT perpetrators and conservationists. This dynamic IWT environment presents a  
335 challenge as mitigation efforts are inherently reactive to trafficking activities and  
336 thwarted by jurisdictional boundaries.

337  
338 Many issues relate to changing social, economic, political and governance regimes, with  
339 the potential to both enable and limit IWT. Major initiatives, such as China's Belt and  
340 Road Initiative and African economic growth strategies, may bring prosperity but also  
341 biodiversity loss. A number of issues (relating to agricultural conversion, urbanisation,  
342 TCM promotion, East Asia's influencing role, African growth strategies, skewed African  
343 demographics towards younger people and a rising Asian middle-class) circle back to  
344 underlying topics of human population growth and overconsumption; major and  
345 contentious causes of current and future conservation challenges.

346

347 Given a key aim of addressing IWT is to conserve biodiversity (IPBES, 2019), a broader  
348 perspective is needed, requiring integrated responses across sectors. Policy and funding  
349 currently tend to focus on large, charismatic species, predominantly traded from Africa  
350 to Asia, with wider ecological values sometimes overlooked. Additionally, it can be  
351 difficult to predict which species and areas will become the next targets, especially if  
352 they are lesser known. Of the taxonomically-focused issues captured, we prioritised  
353 those we believed to be most neglected in IWT discourse (i.e. cave invertebrates,  
354 medicinal plants, *Haiwei*, seabirds), while acknowledging prioritising one taxon over  
355 another is a value judgment. We also recognise that the issues identified were informed  
356 by the expertise of scan participants, who were predominantly sourced through the  
357 Oxford Martin Programme on the Illegal Wildlife Trade mailing list. A different group of  
358 people might have identified and prioritised different specific issues. Similarly, limiting  
359 participants to those with more horizon scanning experience might have yielded a  
360 different balance between issues that are truly novel and those that are already well-  
361 evidenced. However, this would have reduced contributor diversity, thereby potentially  
362 also limiting the range of issues considered. This doesn't negate the issues selected, but  
363 highlights the need for regular scans and wide consultation. Future scans should  
364 incorporate all relevant voices even more actively, ensuring local community  
365 perspectives are heard as well as those sourced through international-level processes.  
366  
367 IWT dialogues are often perceived as 'western'-led. But as local and national voices seek  
368 more authority over natural patrimony, sovereignty and self-determination, this is

369 changing. Notably, our scan identifies greater commitment to tackling IWT from African  
370 political leaders, particularly through peer-to-peer dialogues (**Issue 34**) and initiatives  
371 that support recognition of and engagement with local communities (**Issue 38**).

372 Furthermore, the pivotal role of China in tackling IWT is highlighted. However,  
373 expanding demand for wildlife products due to rising prosperity is not unique to China  
374 and its neighbours. Future agendas for tackling IWT would benefit from coordinated  
375 efforts linking major centres of supply, demand and trade across the world.

376  
377 Many issues cut across several policy arenas and stakeholders. Conducting in-depth  
378 stakeholder and policy-gap analyses for each issue can highlight those in need of cross-  
379 sectoral input and help inform appropriate action, by identifying other relevant  
380 individuals, groups, policies or legislation, considering their relationships, and  
381 prioritising their involvement in the decision-making process (see Supplementary  
382 Material 3 as a starting point). It would also be useful to further 'roadmap' the path to a  
383 *particular* policy impact by carrying out feasibility assessments of different options,  
384 informed by filling necessary knowledge gaps. Techniques to support evidence-based  
385 decision-making in uncertain conditions (e.g. scenario planning) can also assist in  
386 assessing the most relevant possible futures and policies.

387  
388 Our findings underpin policy briefing documents, presented at the 2018 London IWT  
389 Conference and the 18th CITES Conference of the Parties in August 2019 (Esmail et al., 2019).  
390 This scan might be similarly useful to large-scale funders (such as governments and

391 international NGOs) as a guide for prioritising strategic funding programmes, and for  
392 highlighting issues to raise during inter-governmental discussions on strategic  
393 approaches to tackling IWT. We recommend regular systematic IWT horizon scanning,  
394 both nationally and globally, as a pro-active management tool to detect issues before  
395 they become urgent, ubiquitous, and thus unmanageable. This could be integrated into  
396 strategic planning by donors, regulatory bodies and international partnerships  
397 addressing transnational crime, to better coordinate resources and interventions, pre-  
398 emptively addressing challenges while solutions are achievable. We hope that future-  
399 orientated exercises such as this may help conservation shift its focus from responding  
400 to crises to preparing for what is to come.

401

#### 402 **Acknowledgements and Data:**

403 We thank all those involved in this project (see Supplementary Material 5 for complete  
404 contributor lists). Special thanks to the numerous external reviewers who contributed at  
405 various stages, including peer-review. We gratefully acknowledge the financial support  
406 of the Oxford Martin Programme on the Illegal Wildlife Trade. WJS is funded by Arcadia.  
407 Research ethical approval was received from the University of Oxford (CUREC 1A  
408 Approval Ref: R56377/RE001).

409 **References:**

410 African Union. (2018). Assembly of the Union: Tenth Extraordinary Session. Retrieved

411 from <https://au.int/sites/default/files/decisions/34055->

412 [ext\\_assembly\\_dec\\_1x\\_e26\\_march.pdf](https://au.int/sites/default/files/decisions/34055-ext_assembly_dec_1x_e26_march.pdf).

413

414 Amanatidou, E., Butter, M., Carabias, V., Konnola, T., Leis, M., Saritas, O., ... Rij, V.V. (2012).

415 On concepts and methods in horizon scanning: Lessons from initiating policy dialogues

416 on emerging issues. *Science and Public Policy*, 39(2), 208-221. doi:10.1093/scipol/scs017.

417

418 Asia Pacific Group on Money Laundering (APG) & United Nations Office on Drugs and

419 Crime (UNODC). (2017). *Enhancing the Detection, Investigation and Disruption of Illicit*

420 *Financial Flows from Wildlife Crime*. Retrieved from

421 [https://www.unodc.org/documents/southeastasiaandpacific/Publications/2017/FINAL\\_-](https://www.unodc.org/documents/southeastasiaandpacific/Publications/2017/FINAL_-)

422 [\\_UNODC\\_APG\\_Wildlife\\_Crime\\_report.pdf](https://www.unodc.org/documents/southeastasiaandpacific/Publications/2017/FINAL_-_UNODC_APG_Wildlife_Crime_report.pdf).

423

424 Blei, D.M., Ng, A.Y., & Jordan, M.I. (2003). Latent Dirichlet Allocation. In: Lafferty, J. (Ed.).

425 *Journal of Machine Learning Research*, 3(4–5): 993–1022. doi:10.1162/jmlr.2003.3.4-5.993.

426

427 Boratto, R., & Gore, M.L. (2018). *The Bushmeat Supply Chain in Pointe Noire, Republic of*

428 *the Congo: A Conservation Criminology Analysis June 2016 - January 2017*.

429 doi:10.13140/RG.2.2.18391.37284.

430

431 Burgman, M.A. (2016). *Trusting judgements: How to get the best out of experts.*

432 Cambridge, United Kingdom: Cambridge University Press.

433

434 Chinese State Information Centre. (2019). Belt & Road Portal. Retrieved from

435 <https://www.yidaiyilu.gov.cn>

436

437 Cook, C.N., Inayatullah, S., Burgman, M.A., Sutherland, W.J. and Wintle, B.A. (2014).

438 Strategic foresight: how planning for the unpredictable can improve environmental

439 decision-making. *Trends in Ecology & Evolution*, 29, 531–541.

440

441 Esmail, N. Harrington, L. Lam, J. Malsch, K. Milner-Gulland, E.J., Bending, Z. 't Sas-Rolfes,

442 M. (2019). Horizon Scanning for Illegal Wildlife Trade: A Strategic Approach to Inform

443 Future CITES Policy Decisions. [https://www.oxfordmartin.ox.ac.uk/publications/cites-](https://www.oxfordmartin.ox.ac.uk/publications/cites-briefing-2019/)

444 [briefing-2019/](https://www.oxfordmartin.ox.ac.uk/publications/cites-briefing-2019/)

445

446 Felbab-Brown, V.F. (2017). *The Extinction Market Wildlife Trafficking and How to Counter*

447 *It*. London: C. Hurst & Company.

448

449 Haenlein, C., & Keatinge, T. (2017). *Follow the Money: Using Financial Investigation to*

450 *Combat Wildlife Crime* (Occasional Paper). Royal United Service Institute for Defence

451 and Security Studies. Retrieved from

452 [https://rusi.org/sites/default/files/201709\\_rusi\\_follow\\_the\\_money\\_haenlein.keatinge.pdf](https://rusi.org/sites/default/files/201709_rusi_follow_the_money_haenlein.keatinge.pdf).

453

454 Harfoot, M., Glaser, S.A.M., Tittensor, D.P., Britten, G.L., McLardy, C., Malsch, K., &  
455 Burgess, N.D. (2018). Unveiling the patterns and trends in 40 years of global trade in  
456 CITES-listed wildlife. *Biological Conservation*, 223, 47–57.  
457 doi:10.1016/j.biocon.2018.04.017.

458

459 Harrison, M., Baker, J., Twinamatsiko, M., & Milner-Gulland, E.J. (2015). Profiling  
460 unauthorized natural resource users for better targeting of conservation interventions.  
461 *Conservation Biology*, 29, 1636-1646. doi:10.1111/cobi.12575.

462

463 Hemming, V., Burgman, M.A., Hanea, A.M., McBride, M.F., & Wintle, B.C. (2017). A  
464 practical guide to structured expert elicitation using the IDEA protocol. *Methods in*  
465 *Ecology and Evolution*, 9(1), 169-180. doi:10.1111/2041-210x.12857.

466

467 IPBES. (2019). Intergovernmental Platform on Biodiversity and Ecosystem Services -  
468 Summary for policymakers of the global assessment report. Retrieved from  
469 [https://www.ipbes.net/sites/default/files/downloads/spm\\_unedited\\_advance\\_for\\_posting](https://www.ipbes.net/sites/default/files/downloads/spm_unedited_advance_for_posting_hn.pdf)  
470 [\\_htn.pdf](https://www.ipbes.net/sites/default/files/downloads/spm_unedited_advance_for_posting_hn.pdf)

471

472 Kennicutt, M., Chown, S., Cassano, J., Liggett, D., Massom, R., Peck, L. ... Sutherland, W.J.  
473 (2014). Polar research: Six priorities for Antarctic science. *Nature*, 512, 23-25.  
474 doi:10.1038/512023a.

- 475
- 476 Kideghesho, J. (2016). Reversing the trend of wildlife crime in Tanzania: challenges and  
477 opportunities. *Biodiversity and Conservation*, 25, 427-449. doi:10.1007/s10531-016-1069-  
478 y.
- 479
- 480 Konnola, T., Salo, A., Cagnin, C., Carabias, V., & Vilkkumaa, E. (2012). Facing the future:  
481 Scanning, synthesizing and sense-making in horizon scanning. *Science and Public Policy*,  
482 39, 222-231. doi:10.1093/scipol/scs021.
- 483
- 484 Lindenmayer, L., & Scheele, B. (2017). Do not publish. *Science*, 356, 800-801.  
485 doi:10.1126/science.aan1362.
- 486
- 487 McBride, M., Garnett, S.T., Szabo, J.K., Burbidge, A.H., Butchart, S.H.M., Christidis, L.,  
488 Dutson, G., Ford, H.A., Loyn, R.H., Watson, D.M. & Burgman, M.A. (2012) Structured  
489 elicitation of expert judgments for threatened species assessment: a case study on a continental  
490 scale using email. *Methods in Ecology and Evolution*, 3, 906–920.
- 491
- 492 Mukherjee, N., Hugé, J., Sutherland, W.J., Mcneill, J., Opstal, M.V., Dahdouh-Guebas, F., &  
493 Koedam, N. (2015). The Delphi technique in ecology and biological conservation:  
494 Applications and guidelines. *Methods in Ecology and Evolution*, 6, 1097-1109.  
495 doi:10.1111/2041-210x.12387.
- 496

497 National Science Foundation. (2016, October 20) Thwaites: The Future of Thwaites  
498 Glacier and its Contribution to Sea-level Rise. Polar Programs. Retrieved from  
499 [https://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=505320&org=OPP&from=home](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505320&org=OPP&from=home)  
500

501 Nekaris, K.A., Campbell, N., Coggins, T.G., Rode, E.J., & Nijman, V. (2013). Tickled to  
502 Death: Analysing Public Perceptions of 'Cute' Videos of Threatened Species (Slow Lorises  
503 – *Nycticebus* spp.) on Web 2.0 Sites. *PLoS One*, 8(7): e69215  
504 doi:10.1371/journal.pone.0069215.  
505

506 Parker, J., Helmstetter, A.J., & Papadopoulos, A.S. (2018). Rapid, raw-read reference and  
507 identification (R4IDs): A flexible platform for rapid generic species ID using long-read  
508 sequencing technology. doi:10.1101/281048  
509

510 Riskas, K.A., Tobin, R.C., Fuentes, M.M., & Hamann, M. (2018). Evaluating the threat of  
511 IUU fishing to sea turtles in the Indian Ocean and Southeast Asia using expert elicitation.  
512 *Biological Conservation*, 217, 232-239. doi:10.1016/j.biocon.2017.10.011.  
513

514 Rosen, G., & Smith, K. (2010). Summarizing the Evidence on the International Trade in  
515 Illegal Wildlife. *Ecohealth*, 7, 24-32. doi:10.1007/s10393-010-0317-y.  
516

517 Sánchez-Mercado, A., Asmussen, M., Rodríguez, J.P., Moran, L., Cardozo-Urdaneta, A., &  
518 Morales, L.I. (2017). Illegal trade of the Psittacidae in Venezuela. *Oryx*, 1-7.  
519 doi:10.1017/S003060531700120X.  
520  
521 Sutherland, W.J., & Woodroof, H. (2009). The need for environmental horizon scanning.  
522 *Trends in Ecology & Evolution*, 24, 523-527. doi:10.1016/j.tree.2009.04.008.  
523  
524 Sutherland, W.J., Broad, S., Butchart, S.H., Clarke, S.J., Collins, A.M., Dicks, L.V., ...  
525 Ockendon, N. (2018). A horizon scan of emerging issues for global conservation in 2019.  
526 *Trends in Ecology & Evolution*, 34, 83-94. doi:10.1016/j.tree.2018.11.001.  
527  
528 Sutherland, W.J., Fleishman, E., Clout, M., Gibbons, D.W., Lickorish, F., Peck, L.S., Pretty, J.,  
529 Spalding, M. & Ockendon, N. (2019). Ten years on: a review of the first global conservation  
530 horizon scan. *Trends in Ecology & Evolution*, 34, 139-153. doi:10.1016/j.tree.2018.12.003.  
531  
532 't Sas-Rolfes, M., Challender, D.W., Hinsley, A., Veríssimo, D., Milner-Gulland, E.J., 2019.  
533 Illegal Wildlife Trade: Scale, Processes and Governance. *Annual Review of Environment and*  
534 *Resources* 44:1. doi.org/10.1146/annurev-environ-101718-033253  
535  
536 UK Government. (2018, October 12) IWT Conference 2018: Declaration commits over 50  
537 countries to action for endangered species. Retrieved from  
538 [https://www.gov.uk/government/news/iwt-conference-2018-declaration-commits-over-50-](https://www.gov.uk/government/news/iwt-conference-2018-declaration-commits-over-50-countries-to-action-for-endangered-species)  
539 [countries-to-action-for-endangered-species.](https://www.gov.uk/government/news/iwt-conference-2018-declaration-commits-over-50-countries-to-action-for-endangered-species)

540

541 Underwood, F.M., Burn, R.W., & Milliken, T. (2013). Dissecting the Illegal Ivory Trade: An  
542 Analysis of Ivory Seizures Data. *PLoS ONE*, 8(10). doi:10.1371/journal.pone.0076539.

543

544 United Nations General Assembly (UNGA). (2015). Tackling illicit trafficking in wildlife.  
545 Retrieved from <https://undocs.org/en/A/RES/69/314>.

546

547 United Nations Office for Drugs and Crime (UNODC). (2016). *World wildlife crime report:  
548 Trafficking in protected species*. Retrieved from [https://www.unodc.org/documents/data-](https://www.unodc.org/documents/data-and-analysis/wildlife/World_Wildlife_Crime_Report_2016_final.pdf)  
549 [and-analysis/wildlife/World\\_Wildlife\\_Crime\\_Report\\_2016\\_final.pdf](https://www.unodc.org/documents/data-and-analysis/wildlife/World_Wildlife_Crime_Report_2016_final.pdf).

550

551 van Uhm, D.P. (2016). *The illegal wildlife trade: Inside the world of poachers, smugglers  
552 and traders*. Switzerland: Springer International Publishing.

553

554 Wintle, B.C., Kennicutt II, M.C., & Sutherland, W.J. (In Press). *Scanning horizons in  
555 research, policy and practice*. In Sutherland, W. J., Brotherton, P., Davies, Z., Pettorelli, N.,  
556 Vira, B., & Vickery, J. (Eds). *Conservation Research, Policy and Practice*. Cambridge:  
557 Cambridge University Press.

558

559 Wintle, B.C., Boehm C. R., Rhodes C., Molloy J. C., Millett P., Adam L., Breitling R., Carlson  
560 R., Casagrande R., Dando M., Doubleday R., Drexler E., Edwards B., Ellis T., Evans N. G.,  
561 Hammond R., Haseloff J., Kahl L., Kuiken T., Lichman B. R., Matthewman C. A., Napier J. A.,

562 ÓhÉigeartaigh S. S., Patron N. J., Perello E., Shapira P., Tait J., Takano E. and Sutherland W. J.  
563 (2017). A transatlantic perspective on 20 emerging issues in biological engineering. *eLife*.  
564 Feature article. 6: e30247.  
565  
566 Xiao, Y., Guan, J., & Xu, L. (2017). *Wildlife Cybercrime in China: E-commerce and social*  
567 *media monitoring in 2016*. TRAFFIC Briefing Paper. Retrieved from  
568 [www.trafficj.org/publication/17\\_Briefing\\_Wildlife\\_Cybercrime\\_in\\_China.pdf](http://www.trafficj.org/publication/17_Briefing_Wildlife_Cybercrime_in_China.pdf)  
569  
570 Zheng, C. J. (2016). 《中国的中医药》白皮书(全文). The State Council Information Office  
571 of the People's Republic of China. Retrieved from  
572 <https://www.scio.gov.cn/37236/38180/Document/1626694/1626694.htm>

573 *Figure 1: Methodological stages illustrating the number of people involved and treatment of issues*  
574 *at each stage. Assessors and facilitators are the paper's authors.*

575

576 *Figure 2: The top 20 issues with linkages drawn between them. Numbering represents the rank*  
577 *order of the issues. Those outlined in black are cross-thematic issues. See Supplementary*  
578 *Material 2 for descriptions of all issues.*

579

580 *Table 1: Policy relevance of issue 1, as an example of how the issues can be related to policy. Other*  
581 *issues are discussed in Supplementary Material 3.*

582

For Peer Review

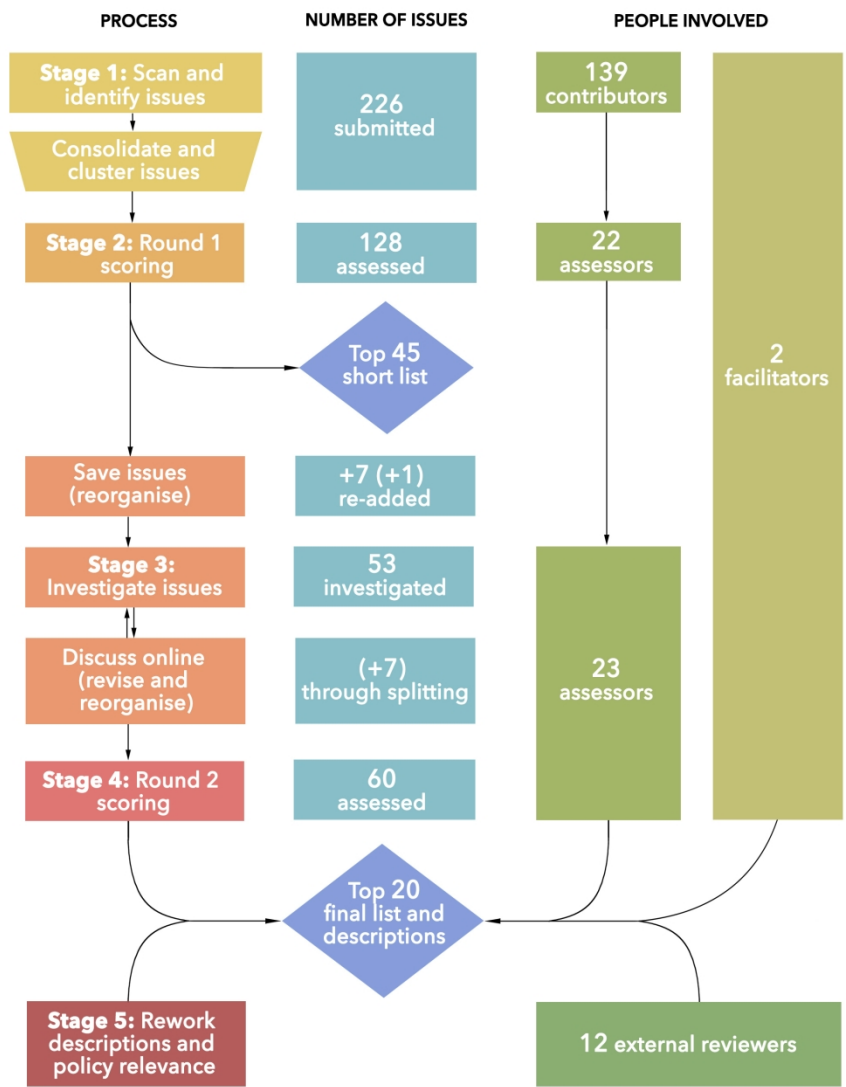


Figure 1: Methodological stages illustrating the number of people involved and treatment of issues at each stage. Assessors and facilitators are the paper's authors.

196x250mm (300 x 300 DPI)

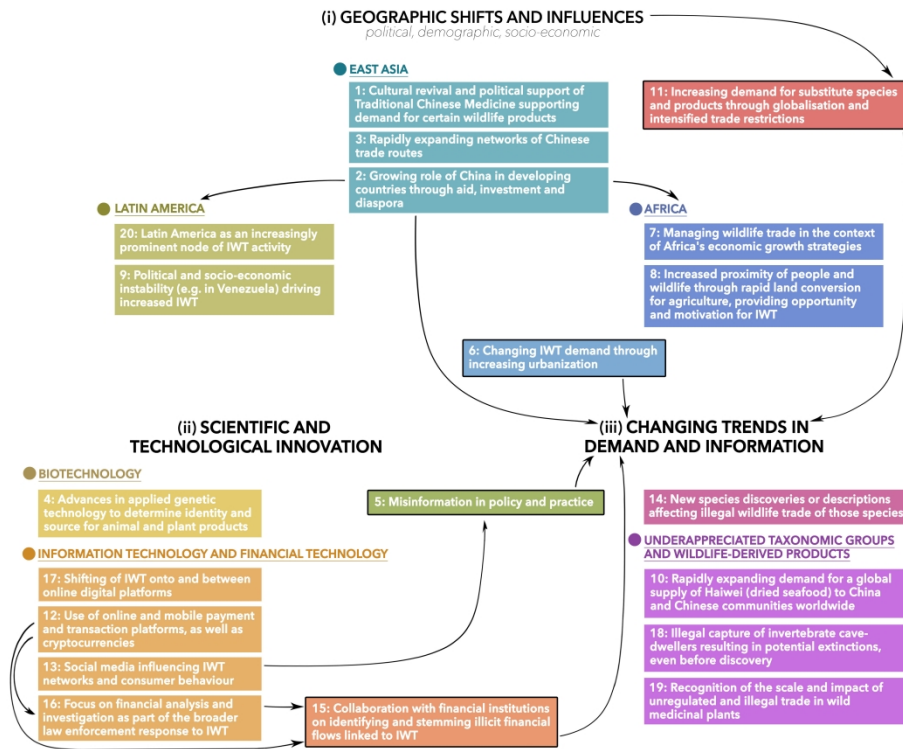


Figure 2: The top 20 issues with linkages drawn between them. Numbering represents the rank order of the issues. Those outlined in black are cross-thematic issues. See Supplementary Material 2 for descriptions of all issues.

365x307mm (300 x 300 DPI)

Table 1: Policy perspective of the top ranked horizon scan issue. This table is not exhaustive, (e.g. it largely omits local and national processes and stakeholders) but represents a starting point to inform policy and management and guide strategic responses. See Supplementary Material 3 for Acronym List and perspectives for other issues.

<i>1: Cultural revival and political support of Traditional Chinese Medicine supporting demand for certain wildlife products</i>			
<b>Current policy context</b>	<b>Relevant actors and institutions: stakeholders to consider</b>	<b>Knowledge gaps</b>	<b>Potential policy and management approaches: ideas for discussion</b>
<p>Section 4.2 of Traditional Chinese Medicine Could Make ‘Health for One’ True, states: “In order to ensure sustainable supplies of natural produce, planting and farming endangered species of wildlife are encouraged by the government, community, and the international organization.”<sup>1</sup></p> <p>Strategic objective 1 of WHO Traditional Medicine Strategy, states: “Member States should strengthen their own knowledge generation, collaboration and sustainable use of T&amp;CM resources. It is important that Member States and stakeholders are mindful</p>	<p>TCM associations (e.g. China’s National Administration of TCM), regional hospitals and local medicinal marketplaces.</p> <p>Pharmaceutical industries and TCM education sectors.</p> <p>National and regional pharmaceutical market and labeling regulators (e.g. State Administration for</p>	<p>What pharmacopoeia is being promoted?</p> <p>Where do the wildlife-related ingredients for the medicines in the pharmacopoeia originate?</p> <p>How are these ingredients currently sourced?</p> <p>Are these ingredients</p>	<p>Implement evidence-based regulation of unsustainably sourced products (alongside monitoring of medicines over a certain quantity).</p> <p>Raise awareness of all stakeholders of issues of biodiversity and conservation. Conduct targeted consumer / practitioner behaviour change interventions.</p> <p>Create an open-access online platform to integrate policy</p>

<sup>1</sup> World Health Organisation Commission on Intellectual Property Rights, Innovation and Public Health. Traditional Chinese Medicine Could Make ‘Health for One’ True, 2007. Retrieved from: <https://www.who.int/intellectualproperty/studies/jia.pdf>

<p>of biodiversity and international treaties concerning endangered species.”<sup>2</sup></p> <p>China's National Regulation on Protection of Wild Medicinal Resources (1987), Law of the People's Republic of China on TCM (2017), Pharmaceutical Administration Law of the People's Republic of China (2015 Amendment).</p> <p>Existing CITES measures to regulate trade of wildlife products derived from listed species.</p> <p>SDG 3: Good Health and Well-being (However there is no mention of traditional medicines).</p>	<p>Market Regulation).</p> <p>National importation regulators, CITES management authorities and customs agencies.</p> <p>International development agencies, multilaterals and intergovernmental bodies (e.g. WB, WTO, WHO, FAO, UNDP, UNEP).</p> <p>General public, particularly users/consumers.</p>	<p>sustainable now? In the future, given predicted demand?</p> <p>What acceptable substitutes exist for unsustainable ingredients?</p> <p>Will TCM practitioners adhere to the pharmacopoeia? If not, what other species may be affected?</p>	<p>transparency and accountability.<sup>3</sup></p> <p>Integrate issue into intergovernmental regulatory platforms and institutions (e.g. FAO food safety regulations; WHO pharmaceutical safety regulations).</p> <p>Strengthen control and screening at customs ports. Particularly because TCM may expand rapidly outside of China due to the BRI and other similar plans.</p>
---	--	---	---

<sup>2</sup> World Health Organisation. WHO Traditional Medicine Strategy: 2014-2023, 2013. Retrieved from: <https://apps.who.int/iris/handle/10665/92455>

<sup>3</sup> See the Institute for Policy Integrity Government Transparency and Accountability project, as an example: <https://policyintegrity.org/projects/transparency-and-accountability>