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1 **The emergence of a commercial trade in pangolins from Gabon**

2

3 **Running title: Emerging trade in pangolins in Gabon**

4 Meine Marie Mambeya*¹, Francesca Baker², Brice Roxan Momboua^{3,4}, Aurélie Flore
5 Koumba Pambo^{4,5}, Martin Hega⁶, V. Joseph Okouyi Okouyi^{4,7}, Martial Onanga⁴,
6 Daniel W.S. Challender^{8,9}, Daniel J. Ingram^{8,10}, Wang Hongyan¹, & Katharine
7 Abernethy^{7,11}

8

9 ¹ North East Agricultural University of Harbin, Harbin, China

10 ² Institute for Conservation Science, Imperial College London, UK

11 ³ Département de Biologie, Faculté des Sciences, University des Sciences et
12 Techniques de Masuku, BP 554, Franceville, Gabon

13 ⁴ Agence Nationale des Parcs Nationaux, BP 20379, Libreville, Gabon

14 ⁵ Centre National de Recherches Scientifiques et Technologies, BP 842, Libreville,
15 Gabon

16 ⁶ Wildlife Conservation Society Gabon, Batterie IV, Libreville, Gabon.

17 ⁷ Institut de Recherche en Ecologie Tropicale, BP 15539, Libreville, Gabon

18 ⁸ IUCN SSC Pangolin Specialist Group, % Zoological Society of London, Regents Park,
19 London NW1 4RY, UK

20 ⁹ Durrell Institute of Conservation & Ecology, School of Anthropology and
21 Conservation, University of Kent, Canterbury, Kent, CT2 7NR, UK

22 ¹⁰ School of Life Sciences, University of Sussex, Brighton, BN1 9QG, UK

23 ¹¹ African Forest Ecology Group, Biological and Environmental Sciences, University of
24 Stirling, Stirling FK9 4LA, UK.

25

26 Meine Marie Mambeya (*submitted posthumously)

27 Francesca Baker :francesca.baker@live.co.uk

28 Brice Roxan MOMBouA: bekouya@outlook.fr

29 Aurelie Flore Koumba Pambo scienceparcsgabon@gmail.com

30 Martin Hega: mhega@wcs.org

31 V.Joseph Okouyi Okouyi: okouyi_joseph@yahoo.fr

32 Martial Onanga: onangamartial@yahoo.fr

33 Dan Challender: dan_pangolin@hotmail.co.uk

34 Daniel Ingram: D.Ingram@sussex.ac.uk

35 Wang Hongyan: why220@126.com

36 Katharine Abernethy: k.a.abernethy@stir.ac.uk

37

38 **Corresponding author: k.a.abernethy@stir.ac.uk**

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59

60

61 **Abstract**

62 Recent seizures of illegally-held wildlife indicate a mounting global trade in pangolins
63 involving all eight species. Seizures of illegally-traded African pangolins are
64 increasing as wild populations of Asian species decline. We investigated trade in
65 pangolins and law enforcement efforts in Gabon; a country likely to have intact wild
66 populations of three of the four species of African pangolin. We compared village
67 sales and trade chains between 2002-3 and 2014. Hunters reported pangolins to be
68 the most frequently requested species in 2014 and the value of pangolins had
69 increased at every point along their trade chain. In Libreville, giant pangolin prices
70 increased 211% and arboreal pangolin prices 73% whilst inflation rose only 4.6%
71 over the same period. We documented a low rate of interception of illegally-traded
72 pangolins despite increased law enforcement. Surveys of potential export routes
73 detected exports across forest borders, in conjunction with ivory, but not through
74 public transport routes. We conclude that whilst there is clear potential and
75 likelihood that a wild pangolin export trade is emerging from Gabon, traditional
76 bushmeat trade chains may not be the primary supply route. We recommend
77 adjusting conservation policies and actions to impede further development of illegal
78 trade within and from Gabon.

79

80 **Keywords: pangolins, illegal wildlife trade, Gabon, hunting, bushmeat,**

81 **Main text**

82 **Introduction**

83 Although trade in wildlife products is an ancient human endeavor, wild populations
84 of many species are currently suffering declines as demand in global markets drives
85 unsustainable exploitation. Drastic population declines attributed primarily to
86 commercial harvests are reported in diverse terrestrial and marine taxa and IUCN's
87 (International Union for Conservation of Nature) The Red List of Threatened
88 SpeciesTM now lists 8,613 species as threatened by overexploitation worldwide
89 (IUCN, 2014; Ripple et al., 2016). The majority of impacts on terrestrial species are
90 felt in tropical regions (Dirzo et al., 2014) and of these, mammals suffer more than
91 any other species group (Ripple et al., 2016).

92 Commercial exploitation has been the key factor in the rapid decline of wild
93 populations of Asian pangolin species in recent decades (Challender et al., 2015;
94 Challender, 2011). Unsurprisingly, this has led to an overall rise in international trade
95 as well as trafficking of African pangolins, primarily their scales, to Asia (Challender &
96 Waterman, 2017; Challender and Hywood, 2012; Newman et al., 2014; Nijman et al.,
97 2016). Increasing global economic and trade links but particularly new links between
98 African nations and East Asia have possibly facilitated this trade (Challender et al.,
99 2016; Wang and Bio-Tchané, 2008). The vast majority of international demand for
100 pangolins comes from Asia, and in particular China and Vietnam (Challender et al.,
101 2015; Nijman et al., 2016). However, exact countries of origin of traded African
102 pangolins, which are found in many range states, are unattributed for the majority of
103 seizures made (though see Challender & Waterman, 2017). Over the past decade
104 China has developed increasing economic ties with Africa, in particular through

105 direct investment (Abernethy et al., 2016) and Chinese companies now have
106 permanent bases, resident workers and administrative networks in countries across
107 the continent (Wang and Bio-Tchané, 2008; Putzel et al., 2011).

108 Based on available evidence, which is likely to be a partial picture, international
109 seizures of illegally traded products from African pangolins are increasing. Four kg of
110 African pangolin products were seized in 2008, 312 kg in 2012, 4 tonnes of scales
111 were seized in Cameroon in 2016 and another 5.4 tonnes were seized in early 2017
112 (LAGA, 2017), this last representing 10,000 – 20,000 pangolins (see Challender &
113 Waterman, 2017 for a comprehensive overview of global seizures). This is ostensibly
114 an exponential rise which, despite some targeted international law enforcement
115 efforts, may be signalling a mushrooming illegal trade, rather than dramatic
116 improvements in the detection of trafficking.

117 Gabon is home to three of the four African species of pangolin, the fossorial giant
118 pangolin (*Smutsia gigantea*, Illiger 1815); and the arboreal white-bellied pangolin
119 (*Phataginus tricuspis*, Rafinesque 1821) and black-bellied pangolin (*Phataginus*
120 *tetradactyla*, L. 1766) (Kingdon and Hoffman, 2013). Giant pangolins have been
121 integrally protected nationally since 1987 (Republique Gabonaise, décret n°
122 189/PR/MEFCR), but both *Phataginus* (arboreal) species can be legally hunted
123 locally, although hunting methods, catch sizes, seasons and trade are regulated.
124 However, despite regulation, a nationwide six-year survey of sixteen bushmeat
125 markets (2000-2006) recorded arboreal pangolins in all markets in all months,
126 accounting for 10% of all animals traded annually (Abernethy and Ndong Obiang,
127 2010). In two year-long village hunting studies during the same period white-bellied
128 pangolins were caught by village hunters every month and formed approximately 6%

129 of all animals caught annually (Coad, 2007; Van Vliet, 2008). There is no census data
130 for any pangolin species in the wild in Gabon.

131 In the face of the global rise in illegal wildlife trade in recent years and in particular
132 the threat to African mammals (London Declaration, 2014; Kasane Statement, 2015),
133 anti-poaching efforts have been increased in Gabon and in particular for species
134 likely to be at highest risk. Sniffer dogs trained for the detection of ivory, ape and
135 pangolin products have been working at roadblocks, railway stations, airports and
136 seaports since 2013, in an effort to intercept wildlife being traded illegally.

137 In this first evaluation of trade risk to Gabonese pangolins, our specific objectives
138 were to:

- 139 a) describe the current trade of pangolins in rural areas and rural-to-urban
140 scenarios;
- 141 b) evaluate the extent of change over the past decade in the species and
142 relative value of species involved this trade, with particular attention to
143 change in the value of pangolins relative to other species;
- 144 c) assess the extent to which rural hunting communities may be the source of
145 pangolins for export or whether the species are potentially sourced outwith
146 the traditional bushmeat trade;
- 147 d) evaluate the trade routes for pangolins within and from Gabon,
- 148 e) evaluate the current control of trade; and using the data we acquire for
149 points a-e;
- 150 f) propose actions to more effectively combat any emerging high-value trade in
151 these species outside the traditional subsistence economy.

152 To address these objectives, we collected data in traditional subsistence villages on
153 hunter sales; trade prices at the 'forestgate'; in the provincial town markets supplied
154 and in the capital; and law enforcement efforts in 2014. We compared our results to
155 existing data collected variously between 2000 and 2006.

156 **Methods**

157 *Village hunting and 'forestgate' trade in 2014*

158 Pangolin offtake and sales were assessed in local communities living in rural
159 subsistence economies (which include hunting for meat and income). The hunted
160 areas were not protected areas and arboreal pangolins could be legally hunted
161 under traditional customary rights. We assessed the numbers of pangolins traded in
162 2014 from villages in the Ogooué-Ivindo and the Nyanga provinces in Gabon both to
163 local clients and, via roadside sales to traders, into larger markets. The two key
164 provinces were chosen for the following reasons: a) comparative data were available
165 from the previous decade (Okouyi Okouyi, 2006; Abernethy and Ndong Obiang,
166 2010); b) both provinces have relatively recently seen the arrival of populations of
167 migrant Asian workers, specifically in the construction, agro-industrial and logging
168 industries (Oxford Business Group, 2015); and (c) these areas broadly represent the
169 two major catchment habitats of completely forested (Ogooué Ivindo) and
170 savannah/forest mosaic (Nyanga) found in Gabon. Surveys of village hunters were
171 made in the dry season during a 43-day study period in the Ogooué-Ivindo (June-July
172 2014), and a 10-day period in the Nyanga (early August 2014). During these studies,
173 24 villages were surveyed (Figure 1). Surveys comprised data collection on village
174 characteristics (questionnaires filled by the village chief or elder hunter) and semi-
175 structured interviews with hunters on hunting activity, client requests, sales and

176 revenues from the past month. Examples of the questionnaires are given in
177 Supplementary Materials and can also be found in Baker, (2014) and Mambeya,
178 (2015).

179 A total of 138 villagers participated in the research. Of these initial survey
180 respondents, 69 villagers in ten villages in the Ogooué Ivindo and 34 villagers in ten
181 villages in the Nyanga (total 103) reported hunting actively and were further
182 interviewed. Villages ranged from 64-800 people (median 200) with between one
183 and fifteen hunters (median 4). All interviewed hunters were men, aged between 16
184 and 70 years, with the majority in the 31-50 year-old age class (57. 3%). Over 90% of
185 interviewees were native to the village (born there or living with family born there)
186 and gave subsistence as their primary reason for hunting. Culture, protection of
187 plantations and supplementary income were also reasons (9.3%), but no hunter
188 reported even legitimate local commercial trade as their primary motivation for
189 hunting. Hunters used guns (47.6%) or snares (28.1%) or both (24.3%) and all
190 hunters reported hunting within one day's walk from their village without using
191 camps. Comparison with available literature shows that these village hunting
192 communities conform to previously established profiles for subsistence communities
193 in Gabon in terms of hunter ages, hunter numbers per village, hunting catchment
194 distances from the village (one day's walk or max 10 km), species caught,
195 percentages traded and price equivalency between species (Coad, 2007; Foerster et
196 al., 2011; Okouyi Okouyi, 2006; Starkey, 2004; Van Vliet, 2008).

197

198 *Village surveys in 2002-2003 and change over time 2002-2014*

199 Detailed studies of village hunting had been carried out in 2002-2003 in the Ogooué-
200 Ivindo (Okouyi Okouyi, 2006) which allowed us to analyze changes over time in local
201 farmgate, or rather 'forestgate', sale prices for the Ogooué Ivindo. Data on date,
202 time and location of sale, species sold, carcass state (whole or butchered parts, fresh
203 or smoked) and price obtained were collected over fourteen months in 2002-2003 in
204 six villages around Makokou (detailed methods in Okouyi Okouyi, 2006) and
205 Makokou market itself. Comprehensive surveys of sixteen town and village markets
206 in Gabon from 2000-2006 showed that prices did not fluctuate significantly between
207 seasons of a year (Abernethy & Ndong Obiang, 2010), however hunter offtake rates
208 could alter between seasons (Coad, 2007). We limited the hunter sales data analysed
209 from 2002-2003 to the months of May – August (dry season) to limit any potential
210 bias of offtake volume or composition on hunter trade decisions between the
211 compared study periods.

212

213 *Change in relative value of species, within and along the traditional trade chain*

214 To investigate change over time in the relative value of traded bushmeats we looked
215 specifically at the Ogooué-Ivindo market chain, from which we had comparable data
216 from 2002-2003 and 2014. Market surveys in Makokou and surrounding villages
217 were carried out for all sales in six markets on one day per week during 2002-2003
218 and one to three days per location during three months May-July in 2014. Data from
219 Libreville Mont Bouët market, also collected from 2002-2003 allowed analysis of the
220 evolution of relative value of species over the past twelve years for these locations.
221 We included the five most common other species groups recorded in our national
222 surveys in both 2002-2003 and 2014 (blue duiker (*Philantomba monticola*, Thunberg

223 1822), brush-tailed porcupine (*Atherurus africanus*, Gray 1842), red duikers
224 (*Cephalophus* spp.), red river hog (*Potamochoerus porcus*, L. 1758) and guenons
225 (*Cercopithecus* spp.) and both pangolin types (Table 1). Prices were standardized to
226 per kg prices for comparisons between species, using mean weights of hunted
227 animals recorded directly in villages in Gabon (Coad, 2007; Abernethy & Ndong
228 Obiang, 2010). For comparison of the price of the same species over space and time,
229 we used sales of whole animals only to reduce inherent noise from standardizing
230 weights of butchered animals. We did not use a purchasing power parity or
231 Consumer Price Index (CPI) correction between years, as inferences were drawn
232 from the relative rank value of traded species across space, rather than from their
233 absolute values. However, between the start of 2002 and the end of 2014, Gabon's
234 inflation (percentage change in CPI) was approximately 4.6% (World Bank, 2017),
235 thus a rise of up to 5% in absolute value of products, may not indicate any real
236 change over time in value relative to other products.

237

238 *Law enforcement in 2014*

239 One-day surveys at potential export locations in the capital, Libreville (seaport,
240 airport, train station and bus station) were carried out in collaboration with law
241 enforcement agencies and concentrated on current practices used for interception
242 of illegal trade and collation of annual seizures, rather than numbers seized during
243 the survey days. Nationwide data on seizures of pangolins or pangolin products were
244 obtained from all relevant government agencies (Ministry of Forests and Protection
245 of the Environment (*Ministère des Forêts de de la Protection de la Nature*), the
246 Convention on International Trade in Endangered Species (CITES) Management

247 Authority for Gabon, National Police Force (*Gendarmerie Nationale*), the Border
248 Police (*Police des Aires et Frontières*), Customs (*Douanes Nationales*) and National
249 Parks Agency (*Agence Nationale des Parcs Nationaux; ANPN*) for assessment of law
250 enforcement efforts (2012-2015) and potential export routes.

251

252 **Results**

253 Hunters and traders did not reliably differentiate between the two *Phataginus*
254 species of pangolin in either the 2014 surveys or the 2002-2003 village studies, thus
255 data are given collectively for 'arboreal pangolins'.

256

257 ***Village hunting and 'forestgate' trade in 2014***

258 Of village hunters who gave information on sales (90/103), all hunters reported
259 catching an arboreal pangolin 'commonly' and 89% of hunters reported sale of an
260 arboreal pangolin in the past three months.

261 The average price per kg for all bushmeat carcasses recorded as sold at the roadside
262 in villages was not significantly different between the two provinces. Mean 2014
263 roadside price for all bushmeat was 1008 ± 400 FCFA (US\$ 1.81 ± 0.72) per kg for 514
264 records from hunter sales. Figure 3 shows mean price per kg for all sales reported by
265 hunters in 2014. Both types of pangolin sold at a higher price per kg than the mean
266 price of all bushmeat: whole arboreal pangolins (estimated at 1.8kg from a sample of
267 93 hunted animals weighed in Gabon; Coad, 2007, Hymas, unpublished data) were
268 sold at a mean roadside price of $2,447 \pm 930$ FCFA (US\$ 4.40 ± 1.67), equivalent to
269 $1,359 \pm 517$ FCFA (US\$ 2.45 ± 0.93) per kg (n=65 sales observed during field study).

270 Giant pangolins (estimated at 28.75kg) sold at the roadside at a mean price of

271 38,100 ± 17,822 FCFA (US\$68.39 ±32.07) equivalent to 1,325 FCFA (US\$2.38±1.28)
272 per kg (n=25).

273

274 **Expressed demand for pangolins in rural areas in 2014**

275 The majority (70%) of hunters reported only selling their meat opportunistically. Of
276 the 30% of hunters that took orders for meat before hunting, 34% of their customer
277 base (by number of clients) were Asian immigrants, although hunters did not know
278 the particular nationality of individual clients. All hunters that took orders for meat
279 before hunting were from the Ogooué Ivindo. Meat orders placed by Asian clients
280 were heavily biased to pangolins (Figure 2). Hunters and village chiefs reported no
281 knowledge of hunting in the forest by immigrant workers themselves, in either
282 province.

283

284 **Change in rank position of pangolin species within the traditional bushmeat trade**

285 Sixteen species were recorded in the markets in 2014. The top five species, or
286 species groups, sold by total number of carcasses in all markets were, in rank order;
287 blue duiker (26.1% carcasses), brush-tailed porcupine (20.3%), red duikers (18.8%),
288 red river hog (9.4%) and guenons (7.2%). Arboreal pangolins were the sixth most-
289 traded species, forming 4.3% of all carcasses and giant pangolins were the seventh
290 most-traded species, forming 3.6% of all carcasses sold.

291 **Change over time and space in market value**

292 The price of any bushmeat at the forestgate in Ogooué Ivindo had risen from a mean
293 761±236 FCFA (US\$1.31±0.42) per kg in 2002-2003 to 1008±400 FCFA (US\$1.81±
294 0.72) in 2014; an increase of 32% of the 2002 price. Pangolins were traded at above

295 average per kg prices in both 2002 and 2014, but the relative price increase was far
296 greater for giant pangolins, which sold in 2014 for 52% more than their 2002 price,
297 whilst the price of arboreal pangolins had only risen by 9% on the 2002 forestgate
298 value.

299 Using prices of whole animals of the most common and comparable species; blue
300 duikers and brush-tailed porcupines account for around 50% of all sales, Makokou
301 town prices for whole, fresh animals had risen from 3631±1177 FCFA (US\$6.53±2.12)
302 to 5453±1297 FCFA (US\$9.81± 2.33) per carcass, and Libreville prices had risen from
303 8455±1716 FCFA (US\$15.22±3.09) to 15700±4461FCFA (US\$28.26±8.03), relative
304 rises of 50% and 87% on 2002 prices. During the same period, the average price of
305 giant and arboreal pangolins in Libreville rose by 212% and 74% respectively (Figure
306 4).

307

308 **Law enforcement**

309 During 2014, government wildlife law enforcement teams with sniffer dogs carried
310 out 209 control missions on potential export routes at the Libreville seaport and
311 airport, the N1 major road artery into and out of Libreville and the train station.
312 Daily controls without dogs also operated at five roadblocks on major road arteries
313 across the country. Standard customs controls not specialized to wildlife issues also
314 operated on all flights departing the international airport and ships departing the
315 seaport. Illegally held pangolins were located and seized on only four occasions:
316 three on the N1 road and one at the train station, recovering in total twelve arboreal
317 pangolins, equivalent to approximately 21 kg total weight. In 2015 (January-June)
318 teams working at the same locations made one seizure of scales in the town of

319 Oyem. These scales were reportedly destined for a Chinese buyer in Equatorial
320 Guinea who regularly placed orders with Gabonese hunters and were associated
321 with a seizure of ivory. No seizures of pangolins or products were made at the
322 international transport hubs.

323

324 **Discussion**

325 We set out to describe the current position of pangolins within the traditional
326 subsistence trade chain, to evaluate the extent of change over the past decade in the
327 trade from forestgate to city, and to assess the extent to which rural hunting
328 communities may be a source of pangolins for international trade, and how and
329 where illegal trade maybe emerging. We have found that

330 1. Frequency of sale of pangolins, particularly giant pangolins, may be increasing
331 within the traditional bushmeat market chains, but that these increases are (as
332 yet) small and may not reflect an increase in hunter offtakes for arboreal
333 pangolins. In 2000-2006, although giant pangolins were recorded in trade, the
334 species did not appear in the eighteen most commonly-traded species from a
335 comprehensive survey across Gabon (Abernethy & Ndong Obiang, 2010). Yet in
336 our 2014 study they are the seventh most-traded species. It is likely that their
337 sale frequency has risen overall in our study areas and possibly nationwide.

338 2. All pangolins have increased in value over time, relative to other species within
339 the existing bushmeat trade structure. Relative value increases are most
340 extreme in most urban areas and smaller in rural areas. This is consistent with
341 absence of a high-value trade developing from within the traditional market
342 trade and otherwise primarily involving village hunters.

343 3. Specific demand for pangolins expressed to village hunters is high in certain
344 areas relative to expressed demand for other species, and particularly for
345 consumption by the immigrant Asian population.

346 4. Giant pangolins have become relatively more valuable than arboreal pangolins,
347 which is in line with their much higher weight of scales, if scale price is a
348 determinant of value.

349 5. Despite an intensification of law enforcement effort to detect pangolin
350 trafficking, no movement through public international or domestic transport
351 hubs has been detected. Instead, a very small number of informal trade routes
352 have been found across forest borders where no enforcement is routinely made.
353 It is probable that clients within established illegal trade chains for ivory may
354 also be expressing a demand for pangolin scales.

355 There is little evidence from our surveys of village hunters that they are engaging at
356 present in hunting pangolins for more commercial purposes, nor in greater numbers,
357 than in 2002-3. The top five species reported by hunters in this study as most
358 frequently caught are very similar to those found by hunter studies a decade ago
359 (the top five species in 2014 village catches were also found in the top eight species
360 in all 2002-2006 studies: Okouyi Okouyi, 2006, Coad 2007, van Vliet, 2008). These
361 results suggest that this hunting is still primarily oriented towards subsistence, rather
362 than newer commercial possibilities associated with intercontinental trafficking.

363 Although village hunters are experiencing high local demand for pangolins from
364 Asian immigrant workers, and are providing supply, it would be possible to achieve
365 more pangolin sales in 2014 than in 2002-3 without initially increasing offtakes. Coad
366 (2007) found village hunters traded only 10% of the pangolins they hunted,

367 consuming the rest at home. Thus, there is significant potential for increased trade
368 to be recorded without necessarily increased offtakes, simply by hunters deciding to
369 sell, rather than consume, their catch.

370 Arboreal pangolins were only the tenth and twelfth most traded species in markets
371 nationally between 2000-2006 (Abernethy and Obiang Ndong, 2010), yet in this
372 study were the sixth most-traded species (by number of carcasses sold). The large
373 difference in sample size and period means that this result must be interpreted with
374 caution, however it supports the conclusion that arboreal pangolins may be traded
375 more often in 2014 than they were in 2002-2003, whether or not offtakes from the
376 forest are higher. Sustained demand and high value will be almost certain to create
377 increased offtakes from the village hunting grounds over time.

378 The 2015 seizure of 2kg of scales in Oyem was the first domestic interception of
379 scale trade, despite considerable efforts since 2012 dedicated to controlling major
380 transport hubs and focusing search efforts on pangolins and their derivatives. The
381 trader intercepted was also dealing in ivory and reported having regularly supplied
382 the Chinese client involved for the past two years, exporting scales informally across
383 a forest border to a specific recipient, rather than using established bushmeat
384 traders within the country to offer the product for general sale alongside meat. In
385 2016 a second ivory trader was also intercepted in the Minkébé region of Gabon,
386 with 2 sacks of pangolin scales associated with a seizure of raw ivory (ANPN, 2016).
387 Although these are small pieces of evidence, combined with the lack of seizures of
388 pangolins in major domestic transport hubs and the traditional bushmeat trade
389 network, even these anecdotes provide some insight into the possible mechanisms
390 of new illegal trade emergence.

391 We conclude that the beginnings of higher value trade chains are possible and
392 indeed probable for each species of pangolin. both within and from Gabon, and that
393 pathways for increasing the trade of pangolins hunted in villages are already evident,
394 even if this trade is not yet fully realised. The value of giant pangolins in domestic
395 trade has increased greatly in urban markets, despite the species' fully protected
396 status, which is an indicator that pressure on this species may be higher and
397 expressed more rapidly than demand for arboreal pangolins. Whilst we demonstrate
398 that illegal trade networks for pangolins may evolve outside of the traditional
399 bushmeat market structure and be 'invisible' to traditional meat market surveys and
400 controls, evolution of pangolin trade both within *and* outside the traditional
401 bushmeat supply is of course possible.

402 If the international pangolin trade is not sourcing animals from the traditional
403 bushmeat markets, then it may be difficult to detect a parallel trade structure using
404 the current conservation strategies. We see an immediate need for pro-active
405 monitoring of the hunting and trade of pangolins in villages and a diversification of
406 pangolin-focused law enforcement activities. Such actions will require innovation on
407 the part of government agencies and NGOs supporting such efforts, an increase of
408 resources dedicated to combatting the illegal wildlife trade in and from Gabon, and
409 strengthening of multiple international collaborations. However, we feel it is useful
410 to all future partners to set out a road map for conservation action for pangolins in
411 Gabon from this point forwards.

412 Specific recommendations are:

- 413 1. Improved enforcement and interception efforts in less frequently-used
414 domestic trade and potential export routes, to complement current efforts

415 on larger transport hubs, including paying particular attention to detecting
416 and recording concurrent seizures of pangolins and ivory.

417 2. Improved traceability of seizures involving pangolins and their derivatives,
418 through

419 a. improved national capacity for tracing origins of domestic illegal trade
420 (giant pangolins) to source, for example by monitoring transport links;

421 b. improved collaboration and participation of the Gabonese State
422 agencies in international enforcement tools for all pangolins (i.e.
423 CITES permits and trade monitoring; Heinrich et al., 2016, Challender
424 & Waterman, 2017); and

425 c. mapping of genotypic variation of wild Gabonese pangolin
426 populations to enable differentiation of origin within the country, as
427 well as across the species' global range (i.e. Gaubert et al., 2016).

428 3. to ensure robust monitoring of subsistence hunter pressure by working with
429 local hunters and villages in order to:

430 a. detect changes in offtake, including to better understand the
431 sustainability of current harvests (Coad et al., 2013; Ingram et al;
432 2017); and

433 b. to enable early reactivity to increased commercial trade and/or
434 trafficking.

435 4. to support and encourage robust scientific research on wild pangolin
436 populations in Gabon, with a particular focus on determining the status of
437 populations in quantitative terms and temporal trends, such that baselines
438 can be established to properly underpin national conservation measures and

439 international decision-making, including within CITES, and re-assessment of
440 African pangolins for The IUCN Red List of Threatened Species™.
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550

551 **Tables.**

552 Table 1. Hunter sale 'forestgate' price changes over 12 years from 2002-2014 in the
 553 Ogooué Ivindo villages. Data from the 2002-2003 sample were limited to records
 554 from May-September for comparison to the 2014 sampling period. The lines for
 555 pangolin records are shaded.
 556

Species group	Body Weight (kg)	2002			2014			price increase (% 2002)
		Price/kg FCFA (SD)	Equivalent Price/kg US\$ (SD)	N	Price/kg FCFA (SD)	Price/kg US\$ (SD)	N	
Red duiker	16.2	661 (126)	1.19 (0.23)	347	715 (239)	1.29 (0.43)	72	8
Arboreal pangolin	1.8	1,252 (209)	2.25 (0.38)	16	1,359 (334)	2.45 (0.60)	57	9
Blue duiker	4.2	744 (182)	1.34 (0.33)	34	879 (312)	1.58 (0.56)	56	18
Brush tailed porcupine	3.4	1,013 (175)	1.82 (0.31)	63	1,240 (257)	2.23 (0.46)	58	22
All species		761 (236)	1.37 (0.42)	966	1,008 (400)	1.81 (0.72)	515	32
Red river hog	55.0	569 (97)	1.02 (0.17)	73	765 (301)	1.38 (0.54)	91	34
Guenon	4.0	676 (204)	1.22 (0.37)	36	945 (619)	1.70 (1.11)	25	40
Giant pangolin	28.8	874 (598)	1.57 (1.08)	53	1,325 (517)	2.38 (0.93)	66	52

557

558 **Figure legends**

559 Figure 1. The study sites in Gabon. Libreville is the national capital city and Makokou
560 and Tchibanga are provincial capitals. Hunters were interviewed in the villages
561 (shown as black dots) supplying these two provincial town markets. Villages in
562 Gabon are generally situated along the road network, in similar densities to those
563 shown around the two provincial towns studied.

564

565 Figure 2. Requests received from locally based Asian industrial workers between
566 March and May 2014 by hunters from surveyed Ogooué-Ivindo villages, for supply of
567 particular species (N=34 specific requests recorded).

568

569 Figure 3. Mean price per kg FCFA (\$1USD = 555 FCFA) for species sold by hunters at
570 the forestgate in 2014 (N sales). Error bars represent the SE of prices. Bodyweights
571 were taken from empirical data for weighed carcasses in Gabon (Coad, 2007 &
572 Abernethy & Ndong Obiang, 2010). At equal meat value, by bodyweight, giant
573 pangolins would be expected to sell for a similar price to red duikers and red river
574 hog, approximately half their actual sale price. The bar for the mean of all species is
575 shown in white and bars for pangolin species in brown.

576

577 Figure 4. Percentage (of earlier price) rise in mean price between 2002-2003 and
578 2014 for whole animal sales of a) most commonly sold taxa under 5kg (palm civet,
579 blue duiker, brush-tailed porcupine, arboreal pangolins and guenons) b) arboreal
580 pangolins c) Giant pangolins recorded from forestgate villages, Makokou town and in
581 Libreville's largest market (Mont Bouët).