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The emergence of a commercial trade in pangolins from Gabon

Running title: Emerging trade in pangolins in Gabon

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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.

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

Methods

Village hunting and ‘forestgate’ trade in 2014

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

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

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

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

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

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

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

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

Law enforcement in 2014

One-day surveys at potential export locations in the capital, Libreville (seaport, airport, train station and bus station) were carried out in collaboration with law enforcement agencies and concentrated on current practices used for interception of illegal trade and collation of annual seizures, rather than numbers seized during the survey days. Nationwide data on seizures of pangolins or pangolin products were obtained from all relevant government agencies (Ministry of Forests and Protection of the Environment (*Ministère des Forêts de de la Protection de la Nature*), the 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 \pm 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 \pm 1.67), equivalent to
269 $1,359 \pm 517$ FCFA (US\$2.45 \pm 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

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

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

Law enforcement

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

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

Discussion

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

1. Frequency of sale of pangolins, particularly giant pangolins, may be increasing within the traditional bushmeat market chains, but that these increases are (as yet) small and may not reflect an increase in hunter offtakes for arboreal pangolins. In 2000-2006, although giant pangolins were recorded in trade, the species did not appear in the eighteen most commonly-traded species from a comprehensive survey across Gabon (Abernethy & Ndong Obiang, 2010). Yet in our 2014 study they are the seventh most-traded species. It is likely that their sale frequency has risen overall in our study areas and possibly nationwide.
2. All pangolins have increased in value over time, relative to other species within the existing bushmeat trade structure. Relative value increases are most extreme in most urban areas and smaller in rural areas. This is consistent with absence of a high-value trade developing from within the traditional market 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.

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

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

Specific recommendations are:

1. Improved enforcement and interception efforts in less frequently-used 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 SpeciesTM.
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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

Figure legends

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

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

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

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