

1 Incentives and social relationships of hunters and traders in a Liberian bushmeat system

2

3 **ABSTRACT**

4

5 Hunting provides livelihoods and food security for a large number of people across the tropics but  
6 endangers wildlife populations. Effective management requires understanding both social and  
7 economic dynamics of local bushmeat systems, yet social elements such as relationships between actors  
8 are often overlooked. We provide the first detailed description of a rural hunting system in Liberia, from  
9 interviews with 205 hunters and 50 traders in the Gola Forest. We found bushmeat contributed  
10 substantially to local livelihoods and earnings from hunting and trading were high relative to local  
11 alternatives (median US\$120 and \$US262/month, hunters and traders respectively). Most of hunters'  
12 catch was sold to traders (85% of harvested biomass) and subsequently transported to urban markets  
13 (65% of all harvested biomass). Local consumption accounted for 27% of total harvest. Financial risks  
14 from meat confiscation were primarily born by traders, many of whom were women, and 60% perceived  
15 this as a motivation to reduce trading. By contrast, the most commonly stated motivation to reduce  
16 hunting was the time demanded by alternative activities such as farming. This discrepancy implies that  
17 livelihood support initiatives and law enforcement tools may play distinct roles across groups.  
18 Relationships between hunters and traders were complex and involved a variety of credit arrangements.  
19 Interpersonal trust played an important role, with mistrust of hunters being cited by 12% of traders as  
20 the principle barrier for profiting from bushmeat trade. Our findings provide context for designing  
21 conservation strategies and suggest that underlying social processes deserve closer attention in  
22 bushmeat research.

23

24 **1. INTRODUCTION**

25

26 Over-harvesting of wildlife for human consumption is a problem for wildlife populations and the humans  
27 who depend on them. Hunting provides a valuable source of income and food for a large number of  
28 people living around tropical forests (Cawthorn and Hoffman, 2015) but is unsustainable at current  
29 levels (Benítez-López et al., 2017) and puts species at risk of extinction (Milner-Gulland et al., 2002;  
30 Oates et al., 2010). A good understanding of both the social and ecological elements of hunting systems  
31 is needed to develop effective tools to address this problem (Dorward, 2014; Milner-Gulland, 2012).  
32 Information about the contribution of bushmeat to local livelihoods, actors in the supply chain, their  
33 motivations and their interpersonal relationships provides valuable context for designing hunting  
34 reduction programmes. Closer attention to social features in this system could reveal barriers and  
35 incentives for behaviour change that are often overlooked by conservationists.

36

37 The role of bushmeat in people's livelihoods varies across sites; in many cases it provides a cheap source  
38 of protein as well as income (Foerster et al. 2012; Golden et al. 2014; Schulte-Herbrüggen et al. 2013).  
39 The commercial supply chain typically involves multiple actors: traders or intermediaries who transport  
40 meat to markets, market-sellers, restaurateurs and consumers (Cowlshaw et al., 2005; Nielsen et al.,  
41 2016). Commercial hunting can be financially rewarding relative to local income alternatives (e.g. Coad  
42 et al. 2010; Nielsen and Meilby 2015), and bushmeat may provide an economic safety net (Enuoh and  
43 Bisong, 2014), help to smooth income across lean seasons (Schulte-Herbrüggen et al., 2013), or generate  
44 social capital (De Merode et al., 2004; Van Vliet et al., 2015). The economic value of bushmeat presents  
45 a challenge of motivating behaviour change in individuals who have strong financial incentives to  
46 continue hunting, while ensuring that conservation efforts do not negatively impact vulnerable people  
47 (Roe, 2008).

48

49 Conservation strategies often aim to influence economic drivers of hunting. Regulatory interventions  
50 introduce financial risks such as fines for non-compliance with hunting restrictions (Tranquilli et al.,  
51 2014), while incentive-based approaches aim to alleviate economic dependence on wildlife resources  
52 (Nielsen et al., 2010; Roe et al., 2015; Wright et al., 2016) or financially motivate behaviour change  
53 (Ferraro and Kiss, 2002). Projects often promote environmentally sustainable income sources (Roe et al.,  
54 2015), such as bee-keeping, while tools from social development, such as micro-credit schemes, are  
55 intended to improve social outcomes of conservation projects (Kaaya and Chapman, 2017). Aiming to  
56 change behaviour, cultural norms, and decision-making infrastructure, such interventions have the  
57 potential to alter social dynamics of local systems, which in turn may influence how natural resources  
58 are used (Miller et al., 2012). However, such feedback mechanisms are poorly understood (Larrosa et  
59 al., 2016), and there is little empirical guidance for conservation managers when it comes to designing  
60 interventions (Wicander and Coad, 2015).

61

62 The social context in which bushmeat hunting occurs may be central to developing effective  
63 conservation strategies. Social factors have a strong influence on behavioural decisions (Farrow et al.,  
64 2017; Morsello et al., 2015) and are inherent in bushmeat systems which typically involve multiple  
65 stakeholders. Yet components such as inter-personal relationships remain largely overlooked in  
66 conservation research (Robards et al., 2011). The handful of studies examining social features of  
67 bushmeat systems provide valuable insights (Coad et al., 2013; Cowlishaw et al., 2005; Nielsen et al.,  
68 2016; Nielsen and Meilby, 2015; Van Vliet et al., 2015, 2014). For instance, Nielsen *et al.* (2016) describe  
69 an illegal bushmeat trading system built upon long-term relationships between hunters, traders and  
70 consumers, in which access to a trusted network created an entry barrier for hunting. The contrasting  
71 lack of inter-personal relationships with law-enforcers in this system may have contributed to violent  
72 rent-seeking behaviour. In the Amazon basin, Van Vliet *et al.* (2015) revealed substantial non-

73 commercial flows of bushmeat to urban centres via close friendships and family ties, with sharing of  
74 meat linked to cultural identity and norms of reciprocity. Commercial trade meanwhile, was associated  
75 with a distinct socio-economic group who consumed meat as a luxury item. Framing bushmeat as a  
76 problem of common resource governance could also generate helpful insights (Smith et al., 2019) and  
77 adds prominence to factors such as trust and cooperation, which are often overlooked. Social  
78 environments can change rapidly in response to political, economic or technological shifts, which can  
79 have important consequences for resource use (Nackoney et al., 2014; Walters et al., 2015). A better  
80 understanding of the social context in which hunting systems operate provides a basis for designing  
81 appropriate conservation interventions and advances our understanding of behaviour change tools  
82 more generally.

83  
84 Liberia is under-represented in the bushmeat literature (Taylor et al., 2015) despite high levels of  
85 bushmeat consumption and globally threatened wildlife populations. Anstey (1991) estimated that  
86 bushmeat provided 75% of the country's meat, generating \$24 million annually. A survey conducted  
87 after the civil conflict suggested that 80% of Monrovia's population consumed bushmeat, and found  
88 evidence that Liberia supplied a global trade with international exports from the capital (CEEB, 2004).  
89 More recently, a nationwide survey confirmed that hunting and consumption remains widespread  
90 (Junker et al., 2015b), although consumption decreased somewhat among wealthier households during  
91 the Ebola crisis in 2014-15 (Ordaz-Németh et al., 2017). This high level of demand coincides with an  
92 area of high conservation priority: Liberia retains the largest portion of forest in the Upper Guinea  
93 biodiversity hotspot (Mittermeier et al., 2003) and consequently harbours populations which are critical  
94 to the long-term survival of species such as western chimpanzee (*Pan troglodytes verus*) (Kühl et al.,  
95 2017) and pygmy hippopotamus (*Choeropsis liberiensis*) (Hillers et al., 2016). Over-hunting remains one  
96 of the principle threats for wildlife in Liberia and has resulted in local extirpation of large-bodied species

97 (Junker et al., 2015a; Tweh et al., 2014). Financial incentives for hunters are likely to be high. The only  
98 existing study of hunters' incomes found average returns exceeded US\$1500/month for hunters in  
99 commercial camps near Sapo National Park (Greengrass, 2016). The economic role of bushmeat in rural  
100 livelihoods outside of professional hunting camps is largely undescribed and a better understanding of  
101 the economic and social structure of bushmeat systems in Liberia is needed to support conservation  
102 efforts in the region.

103

104 We aim to describe the structure of a bushmeat trading system in Liberia from a social, economic and  
105 livelihood perspective. We use a case-study from the Gola Forest to examine livelihood dependence,  
106 motivations and inter-personal relationships between hunters and traders.

107

## 108 **2. METHODS**

109

### 110 **2.1 Study site**

111 The study was conducted in Kongba District, West Liberia, at the site of the Gola Management  
112 Agreement (GolaMA) conservation project ([www.golarainforest.org/gola-liberia](http://www.golarainforest.org/gola-liberia)). The area covers  
113 approximately 400km<sup>2</sup> of lowland rainforest, bordering Sierra Leone and connecting two protected  
114 areas that together form a transboundary "Peace Park", the Gola Forest National Park in Liberia, and the  
115 Gola Rainforest National Park in Sierra Leone. In Liberia, national laws prohibit hunting within protected  
116 areas and of certain species irrespective of where they are caught (Wildlife Act, 2016).

117

118 GolaMA is a community-based conservation management program that began in 2014, implemented by  
119 the Society for Conservation of Nature of Liberia and the Royal Society for the Protection of Birds. At the  
120 time of data collection, GolaMA's work focused on supporting communities to apply for legal forest

121 management rights and introducing small-scale livelihood support projects such as agricultural training  
122 and bee-keeping initiatives. As in much of rural West Africa, subsistence agriculture forms a major  
123 component of local livelihood strategies, along with commercial crops including oil-palm and cocoa. The  
124 study area is also notable for diamond and gold deposits, and small-scale mining is a locally significant  
125 activity. The site has relatively low population density and high quality of forest resources (Hillers, 2013).  
126 Previous work shows hunting is practiced by about 40% of households, and hunters use shotguns (39%),  
127 snares (24%) or both (37%) (Jones et al., 2019). A more detailed analysis of the demographic, livelihood  
128 and behavioural profiles of hunters in the site is presented by Jones et al (2019).

129

130 Familiarity with the study site was obtained by SJ over a period of two years, and AF and ZN are local to  
131 the region. Data were collected by researchers who were local residents and where possible, female  
132 researchers conducted interviews with traders, many of whom were women. Interviews were  
133 conducted in English or local dialects based on respondents' preference. Preliminary results of a study  
134 using specialised techniques for asking sensitive questions (Lau et al. 2011; Nuno and St. John 2014)  
135 confirmed that hunters and traders were comfortable openly discussing hunting and bushmeat trading,  
136 and other potentially sensitive topics such as income sources (Jones et al, unpublished). Ethical approval  
137 was given by Royal Holloway University of London Ethics Committee.

138

## 139 **2.2 Hunters**

140 Interviews were conducted between July 2016 – July 2017 at all villages (n=15) and two semi-permanent  
141 camps in the study site. Hunters were identified through meetings coordinated by chief hunters at each  
142 village, a household survey and snowball sampling. If hunters were not available for interview,  
143 researchers returned a minimum of three times before excluding them from the study. Hunters were  
144 asked general questions about their hunting activity and to provide details of their most recent hunting

145 trip including species killed, the sale or consumption of carcasses, and prices received. To determine  
146 trade routes, hunters were asked the final destination of meat sold to traders. Hunters that could be re-  
147 found were interviewed multiple times giving information for up to three separate hunting trips.  
148 Liberian dollars were converted to US\$ using the local exchange rate in July 2017 (LD100:US\$1). Catch  
149 was converted to raw biomass based on values in Kingdon (2015) and Jones et al (2009). Additional  
150 information relating to hunters' socio-demographic profiles were obtained during the hunter interviews  
151 and are presented in separate study (Jones et al., 2019).

152

153 The perceived contribution of hunting to personal income relative to other activities was assessed by  
154 inviting participants to share a pile of 20 beans among the income generating activities they had profited  
155 from in the past year. This was repeated for the past months' income share. Participants were also  
156 asked to estimate the income each activity generated over an average month and the previous year.  
157 Sample sizes are reported for questions about contribution of hunting to personal income that were  
158 added part way through the study.

159

### 160 **2.3 Traders**

161 Interviews were conducted with all traders identified in ten villages in the study site. We defined  
162 'trader' as anyone who bought meat from one or more hunters and re-sold it. Five villages and two  
163 semi-permanent camps within the study site were not included due to their small size and inaccessibility  
164 (two camps), because no traders were identified or encountered (three villages) or due to time  
165 constraints (two villages). Traders were identified in the same way as hunters. Respondents were asked  
166 about trading behaviour and to provide details of their most recent transaction including species bought  
167 and sold. Contribution of trading to personal income was assessed with the bean-sharing method  
168 described above. Specific information regarding trade routes and customers was not requested as this

169 could have led to targeted law enforcement efforts at road blocks. For this reason, we do not distinguish  
170 traders who acted as intermediaries by transporting meat for resale to market sellers or restaurateurs,  
171 from end-of-chain suppliers selling directly to consumers. However, it is our understanding that sales of  
172 meat transported to urban centres were typically made to market sellers, while local sales were to  
173 consumers.

174

## 175 **2.4 Focus group discussions**

176 Focus group discussions were conducted to generate broader understanding of hunting and trade by  
177 capturing personal perspectives of actors (Nyumba et al., 2018). One discussion per group was  
178 conducted with hunters in six villages and traders in one village. Groups comprised six to nine  
179 participants, recruitment was opportunistic based on availability of individuals encountered by the  
180 facilitator. Hunter discussions were mediated by a facilitator and recorded with a sound recorder. The  
181 trader focus group was restricted to female participants and mediated by a female facilitator with data  
182 recorded by a female note-taker. Topics discussed were: the challenges and benefits of bushmeat  
183 hunting or trade and the role of bushmeat in relation to other livelihood activities.

184

## 185 **3. RESULTS**

186

### 187 **3.1 Socio-economic aspects of the hunting system**

188

#### 189 **3.1.1 Hunters**

190 A total of 213 hunters were identified, of which 205 participated in the study. Of these, 48 hunters were  
191 interviewed on more than one occasion giving a sample of 253 hunting trips, totalling 999 hunting days.



192 Hunter catch totalled 2088 carcasses from 30 species: 27 mammals, 2 birds and 1 reptile (Appendix A,  
193 Table A.1). Total harvested biomass was approximately 29 metric tonnes.  
194  
195 Hunters sold the majority of catch to traders (Figure 1). Sales to traders for transport to urban markets  
196 included 24 species and accounted for most of the carcasses and harvested biomass. Local consumption  
197 included 23 species. Seven large and infrequently caught species were only recorded as sold to urban  
198 markets (Appendix A, Table A.1), including western chimpanzee (*Pan troglodytes verus*, n=5) and  
199 Jentink's duiker (*Cephalophus jentinki*, n=9). Six mainly small-bodied species were only consumed locally  
200 (Appendix A, Table A.1), including white-breasted guineafowl (*Agelastes meleagrides*, n=16) and greater  
201 cane-rat (*Thryonomys swinderianus*, n=33). Carcasses destined for urban markets were first dried by the  
202 hunters at the time of capture or by traders after purchase. Fresh carcasses were sold in local villages  
203 door-to-door by hunters and traders, either whole or butchered (pers. obs). Long journey times  
204 prevented transport of fresh carcasses to urban markets. The most common destination for meat was  
205 Liberia's capital, Monrovia, followed by markets in Sierra Leone and neighbouring Liberian counties.  
206 Hunters did not know the destination of 8% of carcasses (8% of biomass). Mean sale price reported by  
207 hunters was US\$ 0.82 kg<sup>-1</sup> raw weight (SD=0.37, range=0.05-2.78, n=765 transactions) and did not vary  
208 substantially by species (Appendix B, Figures B.1, B.2). Mean sale price of carcasses destined for urban  
209 consumers was slightly higher than local consumers (US\$ 0.86 kg<sup>-1</sup> SD=0.38, n=495, compared to  
210 US\$0.74 kg<sup>-1</sup>, SD=0.31, n=270). Mean price that traders reported paying hunters was slightly lower than  
211 the price hunters reported receiving from traders (US\$0.70 kg<sup>-1</sup>, SD=0.18, n=114 transactions, compared  
212 to US\$0.83 kg<sup>-1</sup>, SD=0.37, n=622 transactions).  
213  
214 Hunting was the principle income source for most hunters (74%) followed by farming (19%). Hunters  
215 estimated that bushmeat provided 62% of their income during the previous month on average (range=5-

216 100%) and 55% of income for the past year (range=5-100%; Figure 2). Self-estimated monthly earnings  
217 from hunting ranged from \$10-\$900 (median=120, IQR=80-200, n=174; we exclude an unreasonably  
218 large estimate of \$2800). Hunters' average gross revenue per day during their most recent hunting trip  
219 was US\$22 (SD=19, range=0-110; median=\$16, IQR=8-30).

220

### 221 **3.1.2 Traders**

222 A total of 51 traders were identified and 50 participated in the study. Focus groups revealed that  
223 transient, non-resident traders operated in the area but were not identified during this study. We expect  
224 the trader sample therefore to represent only a portion of trading activity, with possible bias toward  
225 residents with a high social profile. Most (80%) of traders were women and 38% came from the same  
226 village. The majority (80%) had emigrated from elsewhere in Liberia between one and 25 years  
227 previously (median=7, IQR=3-12). Among traders interviewed, 57% reported to sell at least some of their  
228 meat locally, 90% sold meat to Monrovia, 4% to Sierra Leone and 8% to the neighbouring Liberian  
229 county of Lofa. The majority (86%) used cars to transport dried meat, and fees paid to commercial car  
230 operators ranged from US\$1.2-6.8 per carcass (mean=US\$3.8, SD=1.5).

231

232 Bushmeat trading was cited as the principle livelihood by the majority (78%) of traders, followed by  
233 trading in other goods (14%) such as foodstuffs, kitchenware or clothing. A majority of traders (73%)  
234 also traded non-bushmeat goods. Traders estimated that bushmeat provided 53% of their income  
235 during the previous month on average (range=0-100%) and 49% of income for the past year (range=20-  
236 100%; Figure 2). Self-estimated maximum monthly earnings ranged from US\$15-\$1600 (median=200,  
237 IQR=88-320) and minimum monthly earnings ranged from US\$10-\$1200 (median=120, IQR=55-155).  
238 Estimates of typical monthly profits were from US\$3-\$600 (median=120, IQR=59-220; n=42, Figure 2).  
239 Traders sold carcasses for an average of 1.9 times the price they paid hunters (SD=0.4; range=0.2-3.4).

240 Mean re-sale prices reported by traders was US\$1.30 kg<sup>-1</sup> (SD=0.54, n=119 sales). Traders often bought  
241 multiple carcasses over a period of time which were transported or sold together in a single  
242 'transaction'. Traders conducted an average of 2.7 transactions per month (SD=2.1, range=0.5-15),  
243 selling an average of 17.9 carcasses per typical transaction (SD=13.90, range=1-60). Mean expenses  
244 were US\$86 per transaction (median=\$60, range=\$2-360). Average net profit was US\$87 per transaction  
245 (median=\$50, range=\$1-440, SD=101.6). However, a lower profit estimate of \$24 (range = \$1-\$243) was  
246 obtained when traders were asked to recall details of species bought and sold, rather than report their  
247 overall expenses and returns. Similarly, the mean number of carcasses recalled from the most recent  
248 transaction was substantially lower than the value reported as 'typical' (mean=8.1, SD=7.0, range=1-38).

249

### 250 **3.2 Motivations and disincentives**

251

252 Confiscation of bushmeat by authorities was perceived as a considerable financial risk among both  
253 hunters and traders and was regularly mentioned in focus group discussions. Among hunters asked  
254 (n=136), 45% had previously had meat confiscated at least once, and 25% had had their meat  
255 confiscated more than once. Median value of confiscated meat was US\$390 (range = US\$50 to 2500,  
256 IQR=225-642, n=58). Among traders, 71% had had their meat confiscated at least once, and 58% on  
257 more than one occasion. Median value of confiscated meat was \$320 (range = US\$22 to 1804, n=36).

258

259 The majority of hunters and traders reported doing less hunting or trade in the previous year than the  
260 preceding one (70% of hunters, 90% of traders; Table 1). The most common reason given by hunters  
261 was involvement in other activities such as farming, followed by enforcement of government restrictions  
262 and fewer animals. Most traders cited government restrictions, followed by reduction in animal  
263 populations (Table 1). Traders asked about factors that made meat trade challenging most frequently

264 cited confiscation of meat at roadblocks (31 respondents, 62%; Appendix C, Table C.1), followed by the  
265 costs of transportation (6 respondents, 12%) and issues relating to mistrust with hunters such as paying  
266 hunters in advance without receiving meat in return (6 respondents, 12%).

267

268 Trader focus group discussion indicated transportation costs were a key factor perceived to limit  
269 bushmeat profitability and that these were exacerbated both by poorly maintained roads and a local  
270 monopoly of commercial vehicle operators. Participants noted that transportation barriers were  
271 reduced when companies (such as logging or mining companies) were active in the area. However, high  
272 costs of transporting goods simultaneously created a motivation for increased involvement in bushmeat  
273 trade. This was because traders taking bushmeat to urban centres had the opportunity to purchase  
274 goods with cash from bushmeat sales. Profit margins for non-bushmeat goods were reportedly low and  
275 more severely impacted by transport prices, motivating traders to compensate by increasing bushmeat  
276 sales to make up the shortfall. Purchase of goods and gun cartridges in urban markets using cash from  
277 bushmeat sales may have helped offset the cost of return journeys. Traders also minimised transport  
278 fares by sending meat via trusted third parties, such as vehicle operators, to known urban buyers  
279 without travelling themselves. Traders rarely transported non-bushmeat goods, such as non-timber  
280 forest products or agricultural produce, to urban centres due prohibitively expensive fares.

281

### 282 **3.3 Hunter trader relations**

283

284 Partnerships between hunters and traders were frequently mentioned during focus group discussions,  
285 and 28% of hunters had a specific “business partner”. Two thirds of partnerships were with female  
286 traders, and 13% were with spouses or family members. Mean duration of partnerships was 2.7 years  
287 (SD=3.4, n=39). Typically, trading partners offered hunters financial support of some kind, to be repaid

288 with a regular supply of meat. In 68% of such arrangements, trading partners provided gun cartridges,  
289 but exchanges also included food (42%), cash advances (11%), wire for snares (8%) or other items such  
290 as batteries (5%). The most frequent agreement was that hunters provide the equivalent of two  
291 medium-sized duiker carcasses (totalling 30-40 kg in raw weight) in exchange for a box of 25 gun  
292 cartridges (39% of agreements). Other common arrangements were that hunters provide the trader  
293 with a minimum number of carcasses per month (31% of agreements), or that hunters agree to  
294 exclusively sell their catch to the partner (8%). Agreements were similar for partnerships with male or  
295 female traders. Informal discussions indicated that relationships between hunters and traders were  
296 complex and varied. For instance, traders who owned small businesses offered hunters credit for goods  
297 such as food, cigarettes and alcohol, to be repaid with meat from their next hunting trip. Reports  
298 suggested some hunters followed a predictable pattern of generating debt in the village, followed by  
299 hunting trips to repay creditors – a cycle which made it hard to generate capital to pursue alternative  
300 income sources. Traders who were not local residents were reported to travel into the study site from  
301 urban centres with goods such as clothing to exchange for meat from hunters. A popular narrative was  
302 of hunters cheating traders who provided gun cartridges and food for hunting trips, by secretly selling  
303 meat in the forest and claiming not to have caught anything. Romantic relationships between hunters  
304 and traders of different gender were also alluded to as somewhat common. It was noted that hunters  
305 were able to help girlfriends or wives by providing them with bushmeat to sell, as well as off-cuts to eat  
306 and direct financial support. Informal conversations with hunters, traders and other local citizens  
307 suggested that a majority of traders selling meat in Monrovia had close ties with a single trusted buyer.  
308 This buyer could be relied upon to safeguard traders' money until it was needed, much like a bank or  
309 savings group, and offered credit or financial support in times of crisis to both hunters and traders.  
310 Taken together, such anecdotes implied that interpersonal relationships were important components of  
311 the hunting-trading system.

312

313 **4. DISCUSSION**

314

315 This study provides the first detailed description of the social and economic structure of a rural Liberian  
316 bushmeat system. The results reveal substantial livelihood dependence on bushmeat with high financial  
317 incentives for both hunters and traders. Bushmeat demand came from both local and urban markets  
318 with a high proportion of meat destined for Monrovia. Hunters and traders each had different  
319 motivations to reduce effort, suggesting that conservation programmes need to operate across multiple  
320 groups in order to be effective. Such programmes also need to take into account the complex social  
321 contexts within which hunting and trade operate. We found evidence that inter-personal relationships  
322 between hunters and traders, characterised by credit arrangements based on mutual trust, were  
323 influential components of the system, yet these are often overlooked.

324

325 We found bushmeat was a significant cash-generating component of local livelihoods: more than half of  
326 hunters and traders estimated that bushmeat provided at least 50% of annual income, and almost three  
327 quarters of hunters considered hunting their principle profession. This reinforces the need for livelihood  
328 support tools to be integrated into conservation strategies. Financial incentives of individuals were also  
329 considerable. Typical earnings of hunters and traders were variable and generally high relative to local  
330 opportunities; a pattern that has been observed at other sites across Africa (Coad et al., 2010; Grande-  
331 Vega et al., 2013; Olupot and Plumpre, 2009). Hunters reported earning \$120/month, whereas monthly  
332 earnings for local teachers range from \$40 - \$100, unskilled company employees (e.g. security guards)  
333 receive \$70-\$80, and small-holder cocoa farmers can generate approximately \$300/year on 3ha (S.  
334 Kamara, personal communication). Standard rates for manual labour are \$5/day (pers. obs) while  
335 hunters were able to earn \$10-\$20/day. Traders' incomes were slightly higher, with average self-

336 estimated monthly earnings between \$120 - \$260. Self-reported incomes should be interpreted  
337 cautiously since they are prone to error and reporting bias (Krumpal 2013, Mathiowetz et al, 2002).  
338 Nevertheless, values from this study fall within the range recorded for similar settings (e.g. Coad et al.  
339 2010; Kümpel et al. 2009; De Merode, Homewood, and Cowlshaw 2004; Vega et al. 2013) and provide a  
340 benchmark to inform conservation efforts.

341

342 Bushmeat incomes were an order of magnitude lower than those previously recorded by Greengrass  
343 (2016) at commercial camps near Liberia’s Sapu National Park. This is unsurprising as our study  
344 describes a village hunting system, rather than a camp of professional hunters. However, the upper  
345 range of estimates in our study exceeded \$1000/month, suggesting that even in a village context, a  
346 minority of hunters may have considerable financial incentives. Effective conservation may depend on  
347 clearly identifying and defining target groups for behaviour change interventions (Jones et al., 2019). In  
348 Gola, a small number of ‘high-impact’ hunters likely capture a disproportionate share of harvest and  
349 profit – a pattern that is commonly reported (e.g. Abernethy and Ndong Obiang, 2010; Luz et al., 2017).  
350 In such systems, altering behaviour of a majority of hunters may have less impact than influencing the  
351 group of highest earning individuals using a more targeted approach.

352

353 Hunters and traders gave different reasons for reducing effort in bushmeat trade. Traders most  
354 frequently cited the risk of financial losses due to checkpoint confiscations, whereas most hunters cited  
355 increased involvement in activities such as farming. Checkpoints operate across Liberia and are  
356 relatively cheap to maintain. We found meat confiscation generated substantial financial risks,  
357 particularly for traders, many of whom had lost assets reaching hundreds of dollars. Most traders cited  
358 confiscation of meat alongside transportation costs as a major barrier to generating income from trade.  
359 While confiscation risk may act as a deterrent, it was insufficient to motivate hunters or traders to

360 completely abandon their activities. A principle reason given for this was lack of alternative, equivalent,  
361 income sources. In contrast to traders, hunters most frequently cited doing other activities as a reason  
362 for reduced hunting effort. This implies that promotion of non-hunting activities which are time-  
363 demanding, but profitable, could be a successful conservation tool. As with the traders' responses,  
364 stated motivations do not constitute evidence of genuine behaviour change, and should be interpreted  
365 as factors which are perceived to influence choices. Nevertheless, the difference between hunters' and  
366 traders' responses provides useful hypotheses that could be formally tested: that traders are influenced  
367 by interventions to increase financial risks, while hunters respond best to increased demands on their  
368 time from alternative activities.

369

370 Our case-study demonstrates the need to consider the wider social context of hunting in order to obtain  
371 an accurate picture of bushmeat systems. For instance, the use of cash from bushmeat sales to boost  
372 other income sources merits further attention since this implies that simple models may not capture the  
373 true economic contribution of bushmeat. Nearly a third of hunters in this study maintained specific  
374 business partnerships with traders, and credit arrangements between the two groups were varied and  
375 complex. This underlying structure has implications for the design of interventions such as small loans  
376 schemes which are likely to influence hunter-trader relations. Trust and cooperation between actors  
377 may also be influential. Untrustworthiness of hunters was seen by traders as a significant barrier for  
378 generating profit, while a small number of hunters mentioned break-down of trading partnerships as  
379 motivation for decreasing their hunting effort. The nature of hunter-trader relationships may be  
380 revealing and could be influenced by conservation actions. For instance, Nielsen et al (2016) report a  
381 system in Tanzania in which hunters advanced credit to traders – the reverse of what was observed in  
382 our study. This difference may be linked to differences in the risk and profit experienced by hunters and  
383 traders, with the implication that hunter-trader dynamics may be sensitive to interventions such as law



384 enforcement. Trust can promote sustainable management of resources such as bushmeat by facilitating  
385 cooperative behaviour (Bouma et al., 2017; Vollan et al., 2013). However, our results imply that higher  
386 trust and cooperation in hunter and trader partnerships may promote over-hunting by minimising the  
387 financial risks and uncertainty faced by both parties. More generally, one-to-one relationships could  
388 make hunting systems more resistant to interventions by creating social expectations and obligations. A  
389 clearer understanding of social dynamics in bushmeat systems, and the way these are affected by  
390 conservation actions, could improve the design of interventions.

391

## 392 **5. CONCLUSIONS**

393

394 Bushmeat hunting in Liberia has received little research attention but is a major threat for endangered  
395 species in the region (Greengrass, 2016; Taylor et al., 2015). Our case-study illustrates the challenge of  
396 sustainable management of bushmeat resources in the face of large financial incentives and high  
397 livelihood dependence on wildlife. We found that motivations differed between hunters and traders,  
398 suggesting a promising direction for future work lies in determining whether livelihood support and law  
399 enforcement may be more effectively targeted. Social structures and processes such as interpersonal  
400 trust, were seen to be influential and merit closer attention in bushmeat research.

401

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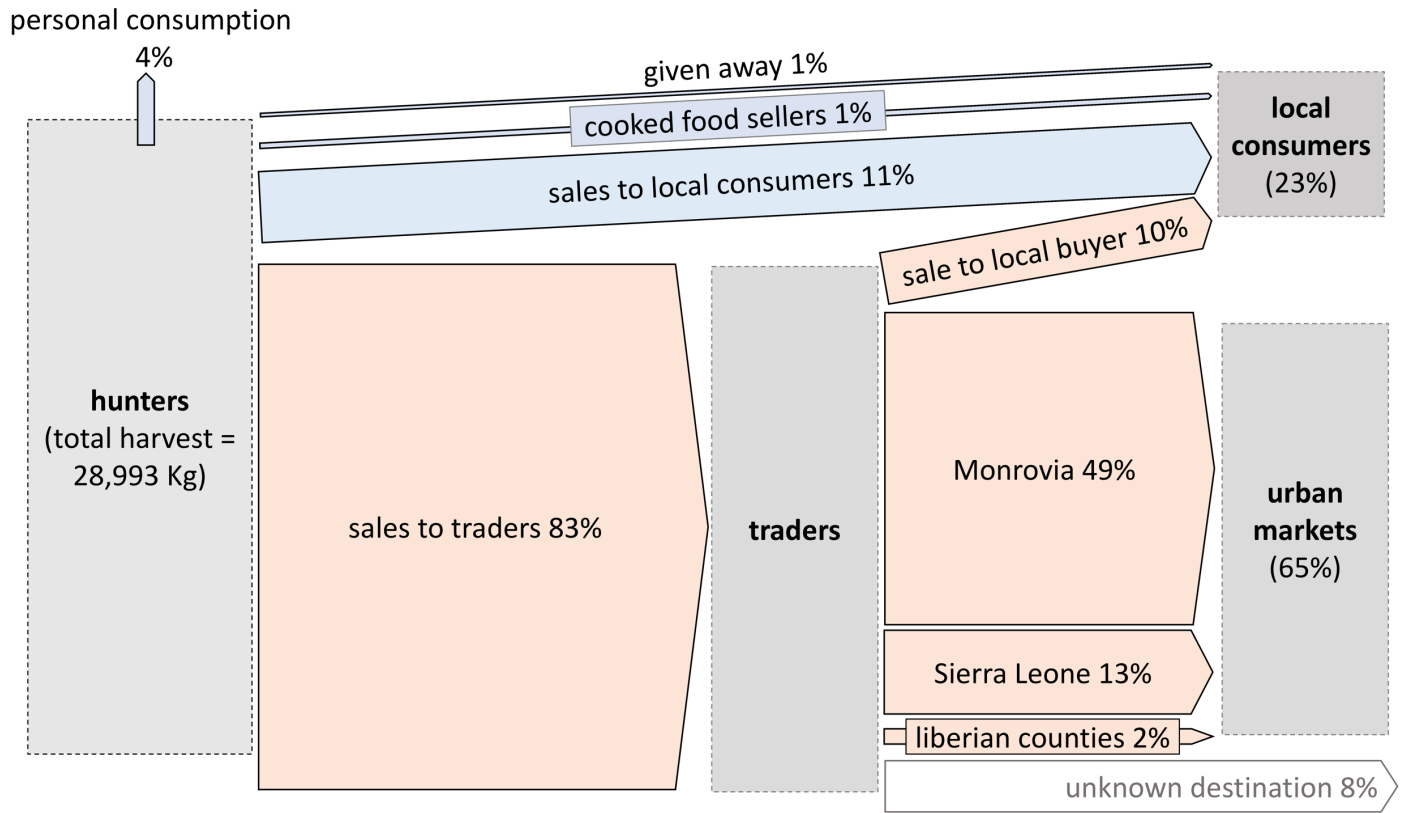
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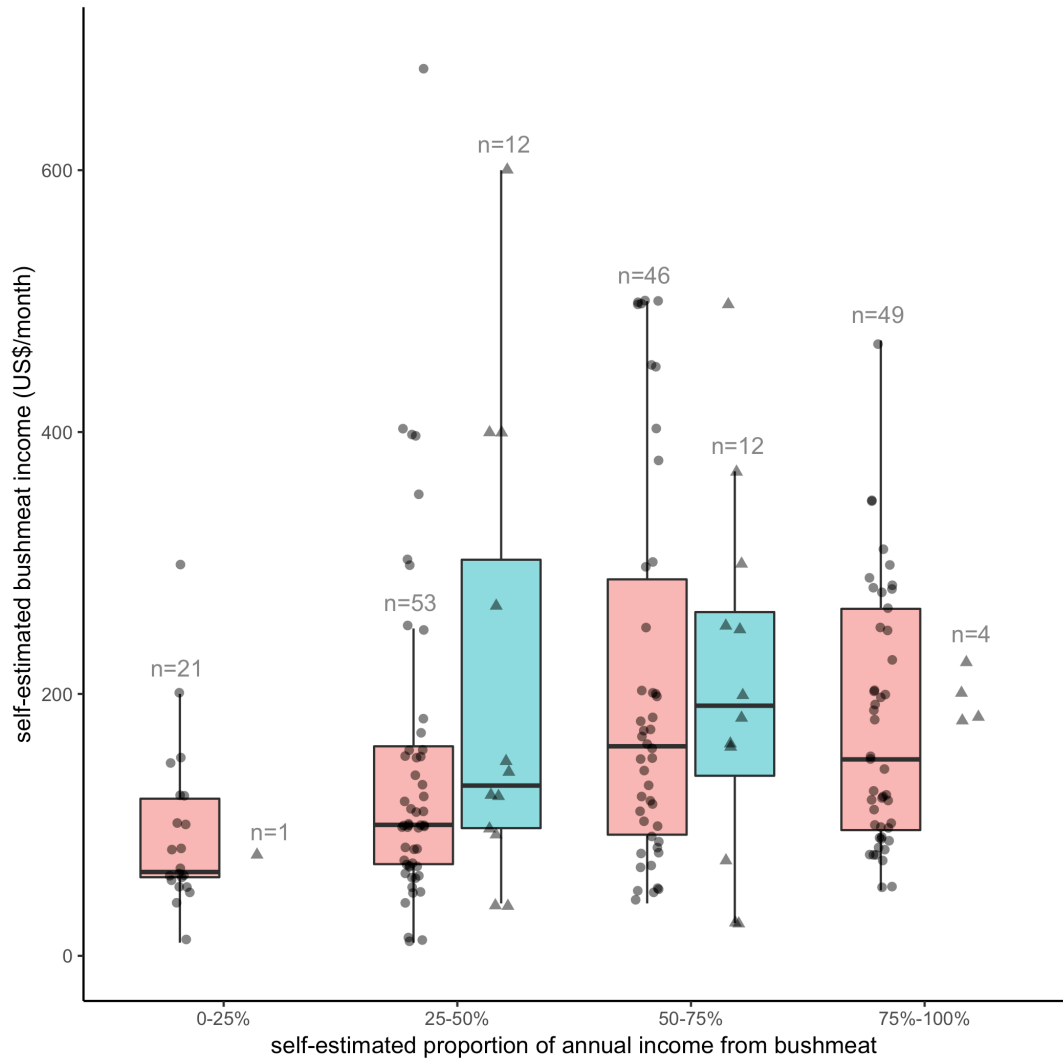
585



587 Figure 1. Destination of wildlife harvest based on hunters' reports (n=253 hunting trips). All values  
588 shown are percentages of original total harvested biomass and width of arrows is proportional to  
589 volume in Kg.

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592

593 Figure 2. Bushmeat income estimated by hunters (red, circles, n=169) and traders (blue, triangles, n=29),

594 grouped according to perceived proportion of annual income from bushmeat. Four high hunter

595 estimates are omitted for clarity, from income proportion categories 25-50% (\$800/month), 50-75%

596 (\$800 and \$900/month) and 75-100% (\$2800/month). Boxes indicate median and 25% - 75% quartile

597 range for cases with at least 10 values, whiskers extend to 1.5xIQR beyond boxes.

598

599 Table 1. Reasons given by hunters (n=92) and traders (n=45) who stated during interviews they had  
600 reduced their effort in bushmeat activities in the previous year compared to the preceding one. Values  
601 are the percentage and number of total respondents giving each reason.

Reasons for reduction in hunting / trading effort in the previous year ( <i>example statements</i> )	Hunters	Traders
<b>Government restrictions and law enforcement</b> <i>"the arresting of meat on the road"</i> <i>"because they're taking the meat from us"</i>	21% (19)	60% (27)
<b>Replacement with a different income generating activity</b> <i>"farming is now my focus point"</i> <i>"because I went to gold mining"</i> <i>"busy with farming"</i> <i>"I have more activities this year than hunting"</i>	32% (29)	(0)
<b>Fewer animals</b> <i>"the animals are not as many compared to last year"</i> <i>"I travel far distance in hunting and get less animals"</i>	21% (19)	16% (8)
<b>Awareness about conservation, GolaMA project activities</b> <i>"conservation message"</i> <i>"golama say no hunting"</i>	13% (12)	7% (3)
<b>Personal / health issues</b>	8% (7)	4% (2)
<b>Financial barriers, lack of gun</b> <i>"bullets are expensive"</i> <i>"someone go with my gun"</i>	5% (5)	2% (1)
<b>Limited by supply from hunters, or support from traders</b> <i>"more hunters leaving their hunting tent"</i> <i>"because the hunters are not doing any hunting"</i> <i>"I did more hunting[before] because of my partner help"</i>	1% (1)	4% (2)
<b>Transportation issues</b> <i>"poor road condition"</i>	(0)	2% (1)

602

