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**The Ecological and Social Context of Women's  
Hunting in Small-Scale Societies**

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34 **Abstract**

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36 Women participate in hunting in some societies but not in others. To examine the  
37 socioecological factors that are conducive to women's hunting, we conducted an ethnographic  
38 survey using the Human Relations Area Files and other selected sources. Based on life history  
39 theory and behavioral ecology, we predicted that women should engage in hunting when: i) it  
40 poses few conflicts with childcare, ii) it is associated with few cultural restrictions around the use  
41 of hunting technology, iii) it involves low-risk game within range of camp, with the aid of dogs,  
42 and/or in groups, and, iv) women fulfill key logistical or informational roles. We systematically  
43 reviewed ethnographic documents across 64 societies and coded 242 paragraphs for the above  
44 variables. The data largely support theoretical expectations. When women hunted, they did so  
45 in a fundamentally different manner than men, focusing on smaller game and hunting in large  
46 groups near camp, often with the aid of dogs. There was little evidence to suggest that women  
47 only participated in hunting during non-reproductive years; instead, allocate networks were a  
48 prominent strategy for mitigating tradeoffs between hunting and childcare responsibilities.  
49 Women commonly fulfilled crucial informational, logistical, and ritualistic roles. Cultural  
50 restrictions limited women's participation in hunting, but not to the extent commonly assumed.  
51 These data offer a cross-cultural framework for making inferences about whether and how  
52 women's hunting occurred in the past.

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55 Keywords: women; hunting; foraging; hunter-gatherers; dogs; division of labour

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## 68 Introduction

69

70 The emergence of gendered divisions of foraging labour represented a critical shift in human  
71 evolution, improving foraging efficiency and transforming social organization, and contributing to  
72 humans' ecological success (Bird 1999; Kuhn & Stiner 2006; Kraft et al 2021). Whereas  
73 foraging behaviour in the closely-related great apes is similar between the sexes, modern  
74 hunter-gatherer societies evince relatively stable and dichotomous, yet flexible, divisions of  
75 foraging labour: men engage in riskier activities like hunting and women perform lower-risk  
76 tasks like gathering (Bird 1999; Marlowe 2007). As part of this gendered division of labour, it is  
77 rare for women to hunt. One estimate (Gurven & Hill 2009) places the frequency of modern  
78 hunter-gatherer societies in which women hunt at 7.3% (13/179). A more recent estimate places  
79 the value at ~80% (Anderson et al 2023), but there are significant methodological issues with  
80 this estimate that render it unreliable (Venkataraman 2023).

81

82 Though the timing of the origins of the gendered division of labour is unclear, prevailing theories  
83 lie at two extremes. Some scholars suggest that this feature of human socioecology emerged  
84 relatively recently in human evolution, perhaps less than 300 kya (Kuhn & Stiner 2006). If labour  
85 was relatively undifferentiated prior to the emergence of modern *Homo sapiens*, females may  
86 have regularly participated in hunting. In contrast, others believe that sexual divisions of labour  
87 may extend as far back as 2 mya, to *Homo erectus* (Aiello & Key 2002), as indicated by  
88 elevated brain sizes and increased energy budgets associated with humans' cooperative  
89 economy of food (Kraft et al 2021). These changes are plausibly related to the emergence of  
90 cooking, which enabled more time-intensive and risky foraging by males (Wrangham 2009). An  
91 early emergence of a sexual division of labour would suggest that *Homo* females would have  
92 engaged in hunting relatively infrequently, as seen in the modern ethnographic record.

93

94 Questions about the origins of gendered divisions of labour have re-emerged recently, with a  
95 focus on the potential contribution of women to hunting. Haas et al (2020) recently described a  
96 9000-year-old skeleton (WMP6) attributed to a female hunter-gatherer from southern Peru who  
97 was buried alongside a hunter's toolkit. The toolkit contained a full suite of big-game  
98 procurement and processing tools such as projectile points, scrapers, and a backed knife (Haas  
99 et al. 2020). Haas et al (2020) argue that these populations were likely hunting groups of vicuña  
100 with atlatls, or spear throwers, and that women would have been frequent participants. Haas et

101 al (2020) also reviewed burials in the Americas during the Late Pleistocene and Early Holocene.  
102 They identified 27 individuals from 18 sites associated with big-game hunting tools. Of those, 11  
103 were identified as females based on sexing of the skeletal elements. Combining these lines of  
104 evidence, the authors argue that 30-50% of big-game hunters in these populations were female.  
105 If true, this value would exceed levels of female hunting observed in any known modern hunter-  
106 gatherer society.

107  
108 Haas et al (2020) offer a salutary correction to the circular logic that can plague sex assignment  
109 of skeletons and assumptions about divisions of labour. Within burial contexts, gender and  
110 division of labour are often inferred based on preconceived notions of contemporary gender  
111 roles and have little to do with past cultures (Doucette 2001). For example, when archaeologists  
112 discover hunting tools alongside the remains of women, they are often hesitant to conclude that  
113 the women were hunters (Gilchrist 2012); and in cases of ambiguous sexual assignment, an  
114 association with hunting implements can lead to a sex assignment as male (Doucette 2001). For  
115 obvious reasons, this circularity should be avoided; gender roles must be demonstrated, not  
116 assumed.

117  
118 Nevertheless, there are some problematic inferences made by Haas et al (2020). The sample  
119 sizes were very small, and, aside from WMP6, none of the burials were unambiguously female  
120 hunters (Haas et al 2020). One site contained female infants who could not have been hunters.  
121 At one site, only two individuals possess secure stratigraphic association with big-game hunting  
122 tools and were confidently sexed using biomolecular methods (Peacock 1991). When  
123 considering only the unambiguous sex assignments, Kelly (2020) argues that it is more likely  
124 that roughly ten percent of hunters were females. Finally, Haas et al (2020) did not consider  
125 alternative explanations for the grave goods being associated with young women (WMP6 was  
126 17-19 y.o. at time of death). For example, the observed grave goods could have been  
127 associated with a system of bride wealth or child growth payments (Pleger 2000).

128  
129 To evaluate the possibility of women's hunting in the deep past, it is important not to rely solely  
130 on archaeological deposits that are subject to *post-hoc* interpretation; it is also crucial to  
131 understand the broader patterns of costs and benefits that structure behaviour (O'Connell  
132 1995). From the behavioural ecology perspective, it is expected that under certain conditions,  
133 women should, in fact, hunt. Divisions of labour documented among foragers are statistical  
134 patterns, not prescriptive guides to behaviour. Though it may be rare compared to men's

135 hunting, there are nevertheless a number of reports of female hunting (Goodman et al 1985;  
136 Reyes-García et al 2020; Anderson et al. 2023). To aid in the development of a broader  
137 framework for making inferences about women's hunting in the deep past, here we consider the  
138 shared socioecological similarities of the societies in which women hunt.

139  
140 Women's hunting is generally thought to be uncommon due to a host of proximate and ultimate  
141 factors, including reproductive constraints and proximate logistical constraints on the ability to  
142 hunt (Brown 1970). Humans have an energetically demanding life history (Kraft et al 2021):  
143 short interbirth intervals, high fertility, and long periods of childhood dependence require multiple  
144 dependents to be simultaneously cared and provided for (Brown 1970). This often means that  
145 women face trade-offs between childcare and subsistence work during their prime years of life  
146 (Meyer-Rochow 2009). Among foragers, maternal subsistence behaviours decrease during the  
147 early postnatal period and during lactation (Hames 1988; Hill and Magdalena Hurtado 1996;  
148 Ivey 2000; Peregrine 2001). Women's subsistence behaviours are more compatible with  
149 childrearing than men's (Brown 1970; Peregrine 2001). Big-game hunting is thought to be  
150 especially incompatible with childcare. Noisy children can interfere with ambush hunting. Fast  
151 movement can be difficult, if not dangerous, with children. The same is true for close-range  
152 killing. Hunting often requires long-distance travel and time away from home, not to mention the  
153 physical threat of danger from prey animals to mother and child (Wood 2006). To avoid these  
154 costs, when women do participate in hunting, they appear to occupy different roles than men.  
155 For instance, women may observe tracking signs spotted while gathering and relay these to  
156 hunters, carry meat home from hunts, or help to drive game into confined spaces or nets, or  
157 over cliffs (Biesele & Barclay 2001; Nitsch et al 2014; Prall & Scelza 2017).

158  
159 From an evolutionary perspective, the extended human life history pattern, which has its roots in  
160 the human foraging niche (Kaplan et al 2000; Koster et al 2020; Kraft et al 2021), may also  
161 militate against women's hunting. The human foraging niche emphasizes the acquisition of  
162 large-package and nutrient-dense food items that are skill-intensive (Kaplan et al 2000).  
163 Humans acquire greater amounts of energy compared to nonhuman primates, overproducing  
164 for several decades in midlife in order to subsidize non-producing dependents and the elderly  
165 (Kraft et al 2021). Developing such skills, however, requires a long juvenile period (Kaplan et al  
166 2000). In this context, the concept of comparative advantage becomes relevant (Gurven & Hill  
167 2009). Because individuals cannot devote time and energy to multiple skill-demanding tasks, it  
168 pays to specialize in one domain.

169

170 It is important to clarify that gendered divisions of labour can emerge even when skill or ability at  
171 a given task differs little between the genders (Gurven & Hill 2009). For instance, even modest  
172 sex differences in strength and speed can affect the comparative advantage of each sex in  
173 terms of hunting. Men, on average, have significantly greater lean muscle mass compared to  
174 women, resulting in greater overall strength and speed (Lassek & Gaulin 2009; Puts 2010), all  
175 of which would be assets in hunting. On the other hand, success in human hunting is perhaps  
176 better facilitated by cooperation and skill (Kaplan et al 2000) than raw strength *per se*. Sex  
177 differences in strength help to explain, but do not fully explain, why it is uncommon for women to  
178 hunt.

179

180 Finally, social norms may negatively impact optimal female strategies. Discouragement from  
181 hunting may begin in early development, when children begin to learn about subsistence tasks  
182 that they will perform in later life (Lew-Levy et al 2017). Taboos against women eating meat are  
183 very common, and may discourage women from hunting since they would not directly gain  
184 nutritional benefits (Murdock et al 1961; Spielmann 1989). Additionally, hunting taboos generally  
185 focus on preventing women from using specialized big game hunting weapons (White et al  
186 1977). Such taboos may bias young women from taking up hunting. It is important to  
187 understand whether such norms result in full exclusion from hunting, or whether women  
188 participate in more subtle ways.

189

190 Taken together, the differential costs of hunting for men and women at both proximate and  
191 ultimate scales militate against hunting as a frequent behaviour for women (Venkataraman  
192 2021). When hunting requires particularly high levels of skill, it may be expected that women are  
193 less likely to participate due to the principle of comparative advantage (Gurven & Hill 2009).  
194 When hunting is easily mastered at a young age, or involves technological or logistical features  
195 that mitigate tradeoffs with childcare, women's hunting is more likely to occur. Perhaps the most  
196 famous case of women's hunting is that of the Agta hunter-gatherers of the Philippines, who  
197 broadly participate in hunting (Goodman 1985). This pattern was attributable to several factors.  
198 Childcare constraints were alleviated by low ratios of dependent children to adults, reducing the  
199 burden on mothers. Hunts tended to take place close to camps, and with the aid of dogs. Sterile  
200 or post-reproductive women instead took up hunting when carbohydrate roots were sparse and  
201 unprofitable. In other prominent cases of women hunting, such as among the Martu of Australia,  
202 women pursue relatively immobile prey such as lizards (Bird & Bird 2008).

203  
204 To obtain a broader ethnographic perspective on the issue of women's hunting, we conducted a  
205 survey using the Human Relations Area Files (eHRAF) and complemented the resulting dataset  
206 with other select sources. Based on prevailing models of life history and behavioral ecology, and  
207 similar to the approach of Noss & Hewlett (2001), we generated four hypotheses about the  
208 context in which women's hunting should occur. These are relevant to five domains: conflict with  
209 childcare, life history, cultural restrictions, hunting behaviour, and logistical roles. More  
210 specifically, women's hunting should:

211  
212 (H1) Pose few conflicts with childcare (i.e. performed by pre- or post-reproductive women and/or  
213 opportunities for allocare);

214 (H2) Be associated with few cultural restrictions around the use of hunting technology;

215 (H3) Involve the pursuit of low-risk game (i.e. smaller, more reliable game) within range of  
216 camp, with the aid of dogs, and/or in groups;

217 (H4) Involve women fulfilling key logistical or informational roles

218 .

219 For each hypothesis, we created several variables corresponding to specific aspects of hunting  
220 behaviour. In total, we produced 21 variables (Table 1).

221

222

## 223 Methods

### 224 Modern ethnographic data

225 We conducted a cross-cultural analysis of women's hunting using the Human Relations Area  
226 Files (HRAF), a comprehensive digital collection of ethnographic documents that serve as an  
227 essential repository of human diversity in traditional, subsistence-level societies. The Standard  
228 Cross-Cultural Sample (SCCS), a subset of the HRAF, uses a systematic sampling method to  
229 control for historical intercultural relationships (Meyer 1994). The SCCS consists of 186  
230 societies with varying social organization, subsistence patterns, and cultural, economic,  
231 linguistic, and geographical backgrounds. We also complemented these data with reports of  
232 women's hunting that we found independently or were referenced in Anderson et al (2023).

233

234 Societies were categorized by their predominant subsistence style. Hunter-gatherers obtained  
235 their food by hunting wild animals, fishing, and gathering wild plant resources. Horticulturalists  
236 cultivated crops in small garden plots using simple tools and also gather wild plant resources.  
237 Agriculturalists farmed using more advanced techniques such as plows, irrigation, and  
238 domesticated animals for labor. Pastoralists raised domesticated animals for food, clothing, and  
239 transportation, and move their herds to different grazing areas depending on the season. Some  
240 societies have a mix of subsistence strategies. Societies labeled as 'primarily hunter-gatherers'  
241 obtain the majority of their food through hunting and gathering but may also engage in other  
242 subsistence strategies such as horticulture or fishing.

243  
244 Our search of HRAF focused on five Outline of Cultural Materials (OCM) codes ("division of  
245 labor by gender", "gender roles and issues", "child care", "infancy and childhood", and "food  
246 quest") and three keywords (hunt\*, women, and beater\*) related to women's hunting in the  
247 SCCS subset of the eHRAF (Kraft et al 2021). There were 1,116 paragraphs returned in this  
248 search. Due to the general nature of OCM topics (e.g., "gender roles and issues"), most  
249 returned paragraphs did not address women's hunting specifically. Consequently, we examined  
250 each paragraph for information specific to women's hunting. Information relevant to women's  
251 hunting was found in 242 paragraphs ("text records") from 69 documents and 40 journal  
252 publications, across 64 societies, published between 1829 and 2020; the mean year of  
253 publication for our ethnographic sources was 1972 (Figure S1). Out of the 139 total authors  
254 contributing to the examined documents, we found that 94 (67.6%) of authors identified as male,  
255 while 45 (32.4%) of authors identified as female. We did document some differences in the  
256 ways that male and female authors reported aspects of women's hunting (Figure S2 & S3).

257  
258 Our 21 variables consisted of unambiguous propositions (Table 1). For each of these variables,  
259 each text record was read and coded by the first author (JH) and verified by the second author  
260 (KF) and senior author (VV). A variable was coded as 1 when there was evidence for its  
261 corresponding proposition, -1 if there was evidence against its corresponding proposition, and 0  
262 if there was no evidence at all. We considered the occurrence (1) and nonoccurrence (-1) of  
263 traits in relation to the total number of societies that had any evidence for a given prediction (i.e.  
264 data coded as zero were not included in the denominator of the calculated percentages). To  
265 arrive at a society-level coding for each variable, we analyzed the coding decisions within the  
266 relevant paragraphs and identified the most frequent coding outcome (either 1 or -1). We then  
267 reported the majority outcome in our overall calculations. In instances where the coding

268 decisions were evenly split between positive and negative for a variable, we regarded this as  
269 positive evidence for both.

270

271 Data used in the analysis may be accessed at the following website:

272 [https://github.com/vivekvasi/womens\\_hunting](https://github.com/vivekvasi/womens_hunting).

273

## 274 Results

275 The geographic distribution of societies with women's hunting is shown in Figure 1, with  
276 societies labeled by circles whose sizes are proportional to the number of documents from that  
277 society. In total, our sample comprised 64 cultures. The majority of the sample is comprised of  
278 hunter-gatherers (n=54). There was a far smaller sample of horticulturalists (n=4),  
279 agriculturalists (n=3), pastoralists (n=1), and primarily hunter-gatherer (n=2) societies  
280 represented in the sample. Additionally, the representation of various subsistence categories  
281 differs by the number of paragraphs referenced. Paragraph extracts ("n") were categorized by  
282 subsistence type: hunter-gatherers (n=221), horticulturalists (n=5), agriculturalists (n=8),  
283 pastoralists (n=3), and primarily hunter-gatherers (n=5). Figure 2 shows for each variable the  
284 extent to which the data were consistent with our predictions. The most commonly-mentioned  
285 aspects of women's hunting were the following: var3.4: women hunting small game (<15 kg),  
286 var1.1: children coming on hunts, var2.3: women using different hunting technology than men,  
287 var3.2: women hunting in a group, var3.6: collective hunting of medium-large game, var4.1:  
288 participation in game drives and var4.2: carrying the hunted game (Table 1). In the following, we  
289 discuss our findings regarding each prediction falling under the four main hypotheses (Figure 2).

290

### 291 *H1. Conflicts with childcare*

292 We found that it was common for children to attend hunts, typically communal hunts of small  
293 game (var1.1; 26/28 societies). In such instances, they either participated in hunting or were  
294 carried by hunters. For example, among the Mbuti, net hunters used a special skin that formed  
295 a sling for carrying babies on their backs (Turnbull 1965). In some cases, older children may  
296 help out with logistical tasks related to hunting. For instance, Slavey children assist women in  
297 collecting small game when they go out to hunt (Asch 1986). Additionally, since most land  
298 animals in the Tiwi islands of Australia could be caught with minimal strength, skill, and  
299 equipment, children were often taught to aid women in collecting these foods (Goodale 1971).

300

301 It was also common for children to be left at home with other family members (var1.2; 9/10  
302 societies). !Kung women left all children except nursing infants and toddlers at the base camp  
303 while mothers gathered or hunted (Kent 1993). Due to the collaborative nature of collective  
304 hunting, women in Mbuti net-hunting bands practiced more cooperative strategies than women  
305 in archer bands, such as leaving their children with sisters or close friends for short periods of  
306 time (Turnbull 1965).

307

308 Nulliparous women accompanied men, often their husbands, on hunting trips (var1.4; 4/8  
309 societies); we also found evidence of post-child-bearing women (var1.3; 4/8 societies) doing so.  
310 The Slavey of Canada exhibited both of these behaviours. Slavey women would accompany  
311 their husbands to assist on hunting and trapping trips prior to the birth of their first child. Slavey  
312 widows, because they lacked a regular supply of meat, took it upon themselves to learn to shoot  
313 rifles to hunt rabbits for subsistence (Helm 1961).

314

315 *H2. There are few cultural restrictions on access to hunting technology*

316

317 Cultural restrictions on women's hunting were found in roughly half of the societies for which  
318 evidence was available (var2.1; 12/28 societies). Restrictions typically took the form of exclusion  
319 from using certain hunting tools or pursuing certain prey animals (Ohnuki-Tierney 1984; Lye  
320 2004). However, restricting women's access to hunting technology such as bows, nets, and  
321 guns (var2.2; 9/18 societies) did not necessarily mean women do not hunt, as women could  
322 instead use a different hunting technology that was not proscribed (var2.3; 21/26 societies). In  
323 terms of technology used by women, snares were the most common (Figure S4). The second  
324 most common was the digging stick, which is typically used to exploit underground storage  
325 organs (Figure S4). Among the !Kung, women employ their digging sticks, traditionally utilized  
326 for excavating the ground to uncover roots, as makeshift clubs to strike small animals (Kent  
327 1993). In line with religious beliefs, Ainu women are only allowed to hunt nondeified animals  
328 with instruments separate from the male use of bows and arrows (Nitsch et al 2014). However,  
329 restrictions were not always tool based. Tiwi women were not allowed to hunt turtles or geese,  
330 and while they may accompany men during turtle hunts or goose-killing expeditions, they did not  
331 take part in the actual hunt (Goodale 1971)1971:154). However, when they hunted non-tabooed  
332 small game animals such as opossums and bandicoots, both men and women made and used  
333 ground steel axes (Goodale 1971) 1971:154).

334

335 Women's hunting practices were often mundane rather than prized within their communities  
336 (var2.4; 5/7 societies). For instance, among the Ojibwa of Ontario, myths or ceremonies, male  
337 activities and leadership were glorified, and women's roles were considered inferior and thus,  
338 not celebrated. Unlike Ojibwa boys, girls did not receive a feast after their first hunting kill  
339 (Vecsey 1983). However, women's efforts in hunting were sometimes commended. Among the  
340 Ju/'hoansi (!Kung) people recognize women's skill, judgment, and strength on hunting trips, and  
341 their contributions are genuinely appreciated (Biesele 1978; Biesele & Barclay 2001).

342

343 Finally, women were believed to contribute positively to hunting indirectly through various  
344 ceremonies, institutions, or rituals (var2.5; 4/4 societies). In Iñupiaq culture, it was thought that  
345 women's involvement in such rituals contributes to improved hunting success (Bodenhorn  
346 1990). According to this belief system, the respect shown by women towards the animals killed  
347 during hunting trips, as well as their meticulous care during the butchering process, was thought  
348 vital in ensuring future successful hunts. In contrast, evidence suggesting that women are  
349 believed to have a negative impact on hunting success was reported in certain cultural contexts  
350 (var2.6; 7/8 societies). Among the Northern Paiute, men, women, and children participated in  
351 antelope-drives. However, women who were pregnant or menstruating were excluded from  
352 participating because it is believed that the presence of a woman in either of these conditions  
353 would cause the antelope to break through the corral fence and escape (Park, 1938).

354

355 *H3. Women pursue low-risk game within range of camp with the aid of dogs and/or in groups*  
356 Women often participated in game drives (var3.6; 26/28 societies). These game drives are  
357 characterized by a hunting strategy in which one type of game is targeted and herded into  
358 confined or precarious place where it can be more easily killed. The methods employed to guide  
359 the game differ, ranging from individuals acting as beaters who employ sound or tools to initiate  
360 game movement, to utilizing environmental elements like fire. For Ovimbundu women of central  
361 Angola, involvement in hunting is typically limited to assisting in peripheral tasks during  
362 communal fire hunts. Communal hunts occur during the dry season when the grass can be  
363 trodden down, after which fires are started, and animals are killed as they flee (Hambly 1934).

364

365 Women's hunting also commonly involved the pursuit of low-risk game which was relatively  
366 reliably acquired (var3.4; 38/38 societies). These hunts were usually composed of groups of  
367 women (var3.2; 26/30 societies) and took place close to camp (var3.7; 7/7 societies).

368 Additionally, dogs were shown to be valued hunting companions for women as they would be  
369 used to locate and drive game or pull sleds (var3.1; 10/11 societies). Tiwi women had well-  
370 trained hunting dogs that are given unique names and referred to using the same kinship terms  
371 women use for their own children. After these dogs passed away, they were buried and  
372 mourned by their Tiwi family (Goodale 1971).

373

#### 374 *H4. Women fulfill key logistical or informational roles during hunting*

375 We found that carrying meat back to camp was the most common logistical role of women  
376 during hunting (var4.2; 18/20 societies). This load-bearing behaviour presented in various ways.  
377 In some cases, women would carry game into camp from the kill site, such as among the  
378 Kimam, where the possibility of surprise attacks from neighbouring villages made it necessary  
379 for women to transport the slain game to camp, allowing men to focus on external threats. In  
380 other cases, men would bring the meat closer to camp, and women would carry it the rest of the  
381 way. Warao men would carry the slain game from the kill site and leave it some distance from  
382 the house for women to collect and bring home (Kirchhoff 1948). This behavior is believed to  
383 stem from the general cultural expectation that women were responsible for carrying loads,  
384 even when it may have been more convenient for men to do it themselves (White et al 1977).

385

386 There were also instances where women would assist in hunting by rowing boats while men  
387 searched for and pursued medium-large game, such as seals. Ainu women were forbidden from  
388 directly participating in sea mammal hunting, as the sea was considered sacred residence of the  
389 sea deities, and it is believed that the smell of menstrual and parturient blood is offensive to the  
390 deities. However, Ainu women would still attend hunts to help men by rowing boats and  
391 transporting killed game (Nitsch et al 2014).

392

393 Women commonly served as beaters during collective hunting (var4.1; 17/20 societies). In  
394 Central Africa, Mbuti women made beaters from twigs and branches and spread out in a  
395 semicircle in the forest. Men set up nets across from them to complete the circle. The women  
396 would beat the ground and shout to drive game toward the nets. Slow game was caught by  
397 women with their hands and placed in baskets while men remained motionless, waiting to seize  
398 any animals captured in their nets. Once caught, the net owner killed the animal with a knife or  
399 spear, signaling success to his companions by clapping his armpit. The women's shouting and  
400 the men's arm-clapping indicated not only when and where game is caught but also the type of  
401 game (Turnbull 1965).

402  
403 Women were also crucial in providing information about prey animals to male hunters (var4.3;  
404 8/9 societies). Among the Ju/'hoansi (!Kung), women accompany their husbands on about half  
405 of their hunting trips. Some women brought nursing infants along while hunting, as they did  
406 when gathering. While gathering, women often discovered prime hunting tracks which they  
407 relayed to male hunting parties. Sometimes women would lead the hunt, tracking or stalking the  
408 game until it was close, or using baby animals to lure in larger prey, at which point men took  
409 over. Biesele & Barclay (2001) report that while the women were skilled trackers and shared  
410 signals, the men ultimately carried the weapons and were considered to be in control. However,  
411 cross-culturally, women's contributions via spotting and chasing game, retrieving arrows,  
412 carrying water to flood holes to flush prey, encouraging hunting dogs, striking animals with  
413 sticks or machetes, guiding the party, and carrying meat home, are culturally well-respected and  
414 considered vital to hunting success (Biesele & Barclay 2001).

415  
416

## 417 Discussion

418 We sought to understand the conditions that promote women's hunting in small-scale societies.  
419 In making inferences about past populations of foragers, the goal is not to identify specific  
420 populations of modern foragers that most resemble some ancestral condition. Rather, the goal  
421 is to identify the general set of conditions under which women hunt, and to investigate how  
422 reproductive and other logistical constraints - which, it stands to reason, would have also been  
423 important in the past - are overcome. Overall, our results aligned well with our predictions, which  
424 were derived from theory in behavioral ecology and life history, indicating that women's hunting  
425 is determined by a dynamic profile of costs and benefits throughout the life course (Kaplan et al  
426 2000; Noss & Hewlett 2001; Gurven & Hill 2009). Below we discuss our findings for each  
427 hypothesis.

428

### 429 H1. Women's hunting poses few conflicts with childcare

430 The demands of childcare are considered to militate against women's hunting (Brown 1970).  
431 Our results suggest this is the case in the sense that lone big-game hunting, which poses  
432 numerous incompatibilities with parenting, is not performed by women. But our analysis also

433 reveals that women's hunting can be facilitated in diverse ways by allocate networks, whether at  
434 the hunting site or back at camp. Sometimes children do attend hunts and provide important  
435 labour. For instance, Jang et al (2022) showed that girls in early childhood (ages 4-7) facilitated  
436 adult women's foraging by attending to young children. Although it may not be necessarily  
437 beneficial to have children present from the foraging perspective, there may be longer-term  
438 benefits. For example, participation in hunting could be an important opportunity for vertical  
439 transmission of social learning from parent to child (Hewlett et al 2011). Social learning and  
440 gender play a significant role in understanding cultural practices related to big game hunting.  
441 Generally speaking, social learning by children in hunter-gatherer societies reflects adult  
442 divisions of labour (Gallois et al 2015; Lew-Levy et al 2018). As part of communal hunting,  
443 children can act as beaters or capture small game, tasks that encourage child interest in  
444 subsistence strategies and teach them skills that can be built upon as they grow older. For  
445 instance, Nisa, a !Kung woman, described a role-playing game related to hunting she  
446 participated in as a child (Shostak 1976; Shostak 1981). She and her friends followed tracks  
447 and shot pretend arrows at prey when they spotted them. They then carried back to the village  
448 leaves on sticks, pretending they were meat. For the Tiwi, all land animals except wallabies  
449 were easy to hunt with minimal physical strength, skill, and equipment. This allowed women and  
450 even children to contribute to the daily food supply. Children could learn the necessary  
451 techniques early, and since physical strength and energy were not major requirements for these  
452 prey types, children could contribute to the larder early on (Goodale 1971). Finally, the  
453 hypothesis that women engage in hunting during pre- or post-reproductive stages received  
454 limited evidence compared to other hypotheses, suggesting that age-related limitations on  
455 women's hunting may be overstated in the literature.

456

## 457 H2. Women's hunting is associated with few cultural restrictions 458 around the use of hunting technology.

459 Although it is commonly stated that social factors determine whether or not women hunt  
460 (Brightman 1996), we found that social norms restrict women's hunting in half of the reports for  
461 which evidence was available. Therefore, explanations such as patriarchy or male dominance  
462 do not fully capture the complexity of the factors that influence women's hunting decisions.  
463 Women were rarely completely excluded from hunting practices; even when they were, they  
464 found ways to be involved in hunting. Frequently, they fulfilled alternative roles that contributed

465 importantly to hunting success. Whether women hunt or not is not primarily imposed on them by  
466 others, though sometimes it is. More generally, the decision is shaped by the experiences and  
467 tradeoffs faced by women themselves. However, we did find evidence that women's hunting  
468 was very rare in non-hunter-gatherer societies. This may be linked to the gender inequality that  
469 generally accompanies increases in sociopolitical complexity; further work is needed to examine  
470 this possibility.

471  
472 We suggest that future research should focus on how social norms and belief systems influence  
473 women's role in hunting. In our review, we came across few instances in which female hunters  
474 were asked about how they made the decision to hunt or not. However, a unique case was  
475 observed among the Kutse, among whom both men and women were questioned about why  
476 women did not participate in hunting with bows and poison arrows, as men did. In response,  
477 both genders stated that women were unable to hunt with bows and poison arrows due to their  
478 lack of knowledge and skill in shooting arrows and safely extracting poison without risking harm  
479 or fatality to themselves. Some individuals said that if women possessed the knowledge and  
480 ability to safely handle poison and use it effectively, there would be no reason to prevent them  
481 from using bows and arrows. Future research would benefit from consideration of emic  
482 viewpoints, such as the interviews employed among the Kutse or among the Hadza by Stibbard-  
483 Hawkes et al. (2022), to better understand why women choose to hunt or not.

484

485

### 486 **H3. Women's hunting involve the pursuit of low-risk game (i.e.** 487 **smaller game) within range of camp, with the aid of dogs, and/or** 488 **in groups**

489 Our study confirmed that women's hunting in foraging societies tends to focus on relatively  
490 small-sized game; big-game hunting by women is uncommon and only done in groups (Figure  
491 S5). We found two societies in which solo big-game hunting was described for women: the  
492 Alyawara, in which women hunted kangaroos (with guns), and the Woodland Cree, in which  
493 certain women pursued moose, caribou, and bear (with guns) (Devitt 1989; Brightman 1996).  
494 Bugir et al (2021) surveyed 161 study sites associated with hunter-gatherer populations to  
495 assess which kinds of fauna hunter-gatherers prefer as prey. They found that foragers'  
496 preferred species ranged in body mass from 17.4 kg to 535 kg, with a mean of 128.5 kg. The

497 authors suggest that hunter-gatherers prefer larger, more threatening herbivores, largely within  
498 the order Artiodactyla. Based on their preference index, they also suggest that, at a global level,  
499 animals less than 2.5 kg are generally avoided, likely because acquisition costs outweigh  
500 energetic gain. Combining these results with ours, the consensus view is supported that  
501 women's hunting focuses on smaller prey compared to men's hunting.

502

503 Our results confirmed that women's hunting was often associated with game being close to  
504 camp. Less time spent traveling may reduce tradeoffs with childcare. Women's hunting typically  
505 occurred in large groups, with women serving prominent roles as beaters and helping to carry  
506 game back to camp. This may be a way of not only increasing hunting efficiency through  
507 cooperative gains, but also pooling labour to facilitate childcare, as noted above. Moreover, the  
508 use of dogs is often crucial to women's hunting. Dogs help to haul objects and items, reducing  
509 transport costs (Lupo 2019; Lupo 2021). And in the case of direct involvement with hunting,  
510 dogs lower search and handling costs of prey items (Lupo 2017). Dogs therefore increase the  
511 efficiency and ease of women's work and decrease the costs of women's participation in  
512 hunting. It is important to note, however, that there are many societies with dogs in which  
513 women do not hunt. Dogs should be considered a contributing, but not sufficient, condition for  
514 women's regular participation in hunting.

515

#### 516 H4. Women fulfill key logistical or informational roles

517 Much work of hauling and carrying falls to women when they are involved in hunting. This can  
518 be energetically costly, with potentially negative fitness consequences (Lupo 2021). It is curious  
519 that the highly physical task of carrying so often falls to women across cultures, even though  
520 they are sometimes said to be excluded from hunting due to strength limitations. A potential  
521 cultural explanation for this comes from Róheim (1933:217), who, writing of Australian  
522 Aborigines, noted that "woman bears the child and carries him in her womb, and then on her  
523 body. By extension, therefore, it is a natural tendency to make her carry things."

524

525 Even when women did not directly participate in hunting, they were observed to play important  
526 roles in providing information to hunters. Unsurprisingly, women in hunter-gatherer societies  
527 appear to have rich knowledge of animal behaviour that may influence hunting success (Biesele  
528 & Barclay 2001). In considering these contributions by women, we call attention to the rich  
529 cultural texture behind hunting behaviour, including that of women. As in any element of hunter-

530 gatherer life, hunting is nested within the broader spheres of competition and cooperation. In  
531 highlighting the diverse roles in hunting served by women, any interpretation of women's  
532 hunting - and, indeed, men's hunting - must be viewed through the lens of gendered  
533 interdependence. As (Burch & Ellanna 1994) write: *"In a few societies, females have hunted big  
534 game, in others they have cooperated with males in the pursuit of big game, and in quite a few  
535 they have hunted small game and have fished, with or without male assistance. Even where  
536 they have not actively participated in hunting, females often have played a major part in the  
537 rituals that have helped to ensure hunting success...One cannot really make sense of the  
538 division of labor along gender lines in a given society without reference to the allocation of  
539 power and responsibility, ritual, symbolism, communication, and emotional expression. The  
540 straightforward focus of many early gender studies on the amount of time males and females  
541 spent in different activities is no longer sufficient."* (Burch & Ellanna 1994:12)

542

## 543 Summary of women's hunting

544 Taken together, our results show that women's participation in hunting is not a static feature of  
545 a society. Instead, it is a dynamic behaviour shaped by a complex calculus of costs and benefits  
546 at proximate and ultimate scales. Agta hunter-gatherers, a canonical example of a society in  
547 which women hunt (Goodman et al 1985), offer an illustration of this dynamism. Kuhn & Stiner  
548 (2006) write that 'there is no widely accepted explanation' for why Agta women hunt, but it is  
549 quite clear from Goodman et al (1985) that the socioecological conditions faced by the Agta in  
550 the 1970s and 1980s incentivized this behaviour. But things appear to have changed over the  
551 past decades. As documented by Hagen et al (2016), Agta informants in recent years stated  
552 that increased logging in the area had detrimentally affected the forest vegetation and reduced  
553 animal populations. Additionally, fewer hunting dogs were available. With these changes, it  
554 became harder for women to hunt. Hagen et al (2016) mentions that two older women had  
555 claimed they had hunted when they were younger but state that no Agta women under the age  
556 of 45 have ever participated in hunting. Two recent ethnographers of the Agta note they had  
557 never seen women hunters or heard people talk about them, and they believe women's hunting  
558 is no longer practiced (D Smith, M Dyble, *pers comm*). In light of increasing levels of market  
559 integration, it seems that women's hunting has been increasingly disincentivized among the  
560 Agta.

561

562

563 Estimating the frequency of women's hunting among modern  
564 foragers

565 Although our primary goal was not to estimate the frequency of women's hunting, our results do  
566 enable an estimate that can be compared with those of Gurven & Hill (2009) and Anderson et al  
567 (2023). Before doing so, it is important to acknowledge at least two pitfalls of attempting such an  
568 estimate. First, whether hunting occurs by women sometimes or rarely is different from the  
569 question of whether it occurs frequently enough to constitute a female foraging strategy. For  
570 example, in the western Australian desert Martu women do hunt kangaroos on rare occasions,  
571 but this behaviour is typically performed by male hunters (Bird & Bird 2008). Despite the  
572 presence of occasional kangaroo hunting by women, it would be a stretch to say that kangaroo  
573 hunting is a female foraging strategy among the Martu (Bird & Bird 2008). With HRAF reports, it  
574 is generally difficult to assess the frequency of women's hunting within a population. In most  
575 cases, rare events of women hunting are coded the same as habitual women's hunting. This is  
576 a shortcoming of virtually all studies of women's hunting, including our own.

577  
578 Second, there is a common assumption that male ethnographers will tend to overlook instances  
579 of women's hunting, resulting in systematic underestimates of the frequency of the behaviour.  
580 This is an important consideration, as male ethnographers often face challenges interacting with  
581 women during fieldwork, and the vast majority of traditional ethnographers were men. However,  
582 our results do not necessarily support this idea, as over two-thirds of the ethnographic  
583 documents used in our analysis came from male authors. This does not mean that there are no  
584 biases. Ethnographers commonly assumed hunting was a male activity. For example, in his  
585 ethnography of the Slavey, Honigmann stated: "Hunting was of course the work of men  
586 although women trapped for smaller mammals such as rabbits"(Honigmann 1946).  
587 Ethnographies should be scrutinized for such biases, and inferences adjusted accordingly.

588  
589 With this in mind, our HRAF survey showed that reports of women's hunting were uncommon.  
590 Our analysis uncovered only 125 paragraphs across 26 societies in the SCCS database; we  
591 arrived at a total of 64 societies after including other sources, some of which were derived from  
592 Anderson et al (2023). If we consider only our SCCS sample, the estimated frequency of  
593 societies in which women participate in hunting is 15.5% (26/186). We also conducted a search  
594 on the D-PLACE database, focusing on the "Sex Difference: Hunting" variable. Out of 965  
595 societies, 14 (1.4%) were coded for the presence of women's hunting. Of those 14 groups, 12 of

596 them were hunter-gatherers, and the other two were agriculturalists. If we treat 965 as a  
597 reasonable denominator for the number of societies, this gives an estimate for the frequency of  
598 women's hunting as 6.6% (64/965). If we consider only hunter-gatherers, the frequency would  
599 be 16.4% (64/391). Finally, Koster et al (2020) synthesized data on hunting across 40 small-  
600 scale societies. The dataset contained little data on hunting by women. Though the authors  
601 caution against generalizing about sex differences based on low female sample sizes, many  
602 data came from very well-studied populations (e.g. Ache, Batek, Pume), suggesting the  
603 behaviour is indeed uncommon. Our findings of the rarity of female hunting in modern  
604 ethnographic contexts confirms previous cross-cultural work on the topic (Gurven & Hill 2009)  
605 and contrast starkly with the 80% estimate of Anderson et al (2023). However, as noted  
606 previously, there is reason to be skeptical about the majority of findings presented in Anderson  
607 et al (2023) (Venkataraman 2023).

608

## 609 Women's hunting in the Pleistocene

610 Among modern foragers, whether women hunt or not is largely a function of specific  
611 socioecological conditions. This should have been true in the past as well. In light of our results,  
612 we now return to consideration of the possibility of women's hunting in the Pleistocene. A full  
613 account of the possibility of female hunting across human evolution is complicated by complex  
614 ecological and technological change across great timescales. Nevertheless, some  
615 generalizations are possible.

616

617 Prey size, type, and abundance changed over the past several hundred thousand years, which  
618 would have influenced female participation in hunting. By the Late Quaternary period, due in  
619 part to hominin influence, 90 genera of animals >44 kg went extinct globally (Ben-Dor & Barkai  
620 2021). As a result, subsequent human ancestors subsisted on smaller prey than their  
621 predecessors, necessitating a broadening of diet breadth (Ben-Dor & Barkai 2021; Dembitzer et  
622 al 2022). These macroevolutionary trends suggest that human ancestors were quite successful  
623 in killing big game for hundreds of thousands of years. Such hunting sometimes required large-  
624 scale cooperation to drive, corner, and run prey, and may have led to the formation of large  
625 groups on a temporary basis (Boyd & Richerson 2022). We expect such large-game communal  
626 hunting to result in widespread female participation, an inference supported by the review of  
627 Boyd & Richerson (2022). If we extrapolate from ethnographic trends, women would have  
628 participated primarily in terms of providing logistical support, including carrying and processing

629 game, and serving in ritualistic and symbolic roles; women also likely participated in finding  
630 game and acting as beaters.

631  
632 Any consideration of women's hunting in the past must consider the technologies available at a  
633 given time period, as any given technology is associated with unique profiles of failure  
634 probability and danger, as well as requirements of cooperation with others. Broadly speaking,  
635 and admittedly oversimplifying, technological evolution throughout the human lineage is thought  
636 to have progressed from hand-wielded spears to throwing spears, followed by spear throwers  
637 and bows and arrows (O'Driscoll & Thompson 2018; Milks 2020). As stated by O'Driscoll &  
638 Thompson (2018: 34; Lombard 2016), although these technologies appear to increase in  
639 complexity over time, the adaptation of these technologies should be understood as  
640 "independent solutions that each operated within its own environmental and cultural contexts."  
641 Based on the evidence of early points, throwing and thrusting spears were first used ~500 kya,  
642 with earliest evidence being found in South Africa (O'Driscoll & Thompson 2018). Some of the  
643 earliest and direct evidence for the emergence of spear throwers are found in Europe at ~17.5  
644 kya (O'Driscoll & Thompson 2018). Possible fragments of a bow have been recovered from  
645 sites in Europe, dating back to ~18 kya. However, the earliest evidence of complete armatures  
646 dates back to ~8 kya in Denmark (O'Driscoll & Thompson 2018). It is important to consider that  
647 wooden clubs and throwing sticks also make for potent weapons but are challenging to detect  
648 archaeologically (Hrnčič 2023). On the whole, it seems that relatively complex technologies  
649 emerged rather recently in human evolution.

650  
651 We first consider hand-wielded spears, which would have necessitated close-range killing.  
652 Archaeological evidence suggests this may have been the most common type of hunting, up to  
653 500 kya. Our ethnographic review revealed spears to be the fourth-most common type of  
654 weapon used by women during hunting. Extrapolating from these reports, we suspect hunting  
655 large game at close range may have posed unacceptably dangerous risks to female  
656 participants. It is unlikely that children would be brought into close range of large and dangerous  
657 animals. But, on the other hand, if communal hunting necessitates large gatherings (Boyd &  
658 Richerson 2022), numerous opportunities for allocare would also be available. We suggest that  
659 women would likely have participated in this kind of hunting in the same way it is observed  
660 among modern foragers: not necessarily close-range killing, but by serving as beaters and  
661 being involved in ritualistic practices, butchery, sharing, and serving other key logistical roles.

662

663 With the advent of direct spear-throwing and spear-throwing technology such as atlatls, killing at  
664 a distance became possible. It has been theorized that atlatls were used for hunting large  
665 terrestrial mammals, though this would have varied by geographic location (Lombard & Shea  
666 2021). This is the kind of hunting inferred by Haas et al (2020) to have occurred in the case of  
667 the Peruvian female hunters. Spear-throwing technologies are notable for their potential use by  
668 a wide demographic of people during group hunting (Bettinger 2013; Grund 2017). Grund  
669 (2017) constructed learning curves for self-bows and atlatls based on modern amateur  
670 practitioners, concluding that spear throwers are relatively easy to learn compared to archery  
671 (but see Whittaker 2013; Whittaker et al 2017). Though the atlatl is considered to have relatively  
672 low accuracy, this may be offset by marginal gains in overall success rates due to larger group  
673 size (Grund 2017). Given the cooperative structure of atlatl hunts, the reduced danger of  
674 hunting-at-a-distance, and the relative ease of use of this technology, it is quite possible that  
675 women regularly participated in atlatl hunting in diverse ways.

676

677 With the emergence of bow and arrow technology at ~18 kya (at the latest), foragers would  
678 have realized several benefits: a greater maximum striking range, higher accuracy, and a faster  
679 reload rate (Bettinger 2013). These technological differences have led scholars to conclude that  
680 bows are more conducive to more individualistic or small-group hunting compared to atlatls, and  
681 that they potentially downgraded the scale of cooperation in Western North America after their  
682 introduction (Bettinger 2013). There is little evidence from the modern ethnographic record to  
683 suggest that women would have regularly engaged in hunting with the bow in the past,  
684 particularly if this form of hunting is individualistic and necessitates long periods of time away  
685 from camp.

686

687 Finally, we consider the antiquity of dogs' involvement in women's hunting. Dogs are considered  
688 to be one of the first species to enter a domesticate relationship with humans (Chambers et al  
689 2020; Perri et al 2021). Researchers debate the timing(s) of dog domestication. Some scholars  
690 place dog domestication as early as ~20-40 kya (e.g. Galibert et al 2011 and their discussion on  
691 proto-domestication), however these cases of earlier "Pleistocene dogs" have been met with  
692 skepticism (Irving-Pease et al 2019; Thalmann & Perri 2018). Currently, strong evidence of  
693 domestication has been found for dates ranging ~13.5-15 kya (Chambers et al 2020; Irving-  
694 Pease et al 2019; Lupo 2017; Thalmann & Perri 2018). If we conservatively accept these more  
695 recent estimates, this leaves a long period of time during which dogs were not available to aid  
696 modern *Homo sapiens* women in hunting. For most of the Pleistocene, involvement in game

697 drives and other forms of collective hunting were probably the most common kinds of  
698 participation by women in hunting.  
699

## 700 Revisiting the origins of divisions of labour in foragers

701 Our study may shed some light on the emergence of gendered divisions of labour among  
702 foragers. As noted in the Introduction, one prominent theory (Kuhn & Stiner 2006) suggests that  
703 gendered divisions of labour characteristic of modern foragers 'did not appear in Eurasia until  
704 the beginning of the Upper Paleolithic.' According to this view, the undifferentiated economies of  
705 Middle Paleolithic populations were at a competitive disadvantage due to lower foraging  
706 efficiency compared to the differentiated economies of Upper Paleolithic populations that  
707 eventually replaced them. This hypothesis is based on the principle of comparative advantage,  
708 from which it follows that complementary gender roles yield foraging benefits (Bird 1999).

709  
710 However, it is important to be specific about what is meant by undifferentiated economies.  
711 Women's participation in hunting need not imply undifferentiated economies. As we see in  
712 modern foragers, divisions of labour can still exist and yet be flexible according to circumstance,  
713 being undifferentiated in some seasons or contexts but stricter in others. For example,  
714 Indigenous hunting behaviour at buffalo jumps in the Northern Plains of North America was  
715 highly seasonal due to the grouping patterns and reproductive patterns of buffalo, with the  
716 largest drives occurring only in the autumn, when buffalo fat reserves were at high levels (Brink  
717 2008; Lee et al 2022). Women in these societies would have participated in hunting, but large  
718 buffalo drives likely only happened every few years. Women may have participated in hunting  
719 frequently on a seasonal basis, but this doesn't necessarily imply frequent hunting on larger  
720 timescales, nor specialization on hunting. Given that atlatl and spear use are relatively easy to  
721 learn (Grund 2017) and the fact that big-game cooperative hunting was seasonal, ancient  
722 women may have experienced minimal tradeoffs between involvement in hunting and acquiring  
723 skills that are more typically in the female domain, such as plant foraging. This idea is supported  
724 by the fact that digging sticks are one of the most commonly used hunting weapons by modern  
725 female foragers. The idea of undifferentiated economies may need revision in light of these  
726 points.

## 727 Conclusion

728 Our ethnographic analysis identified several socioecological similarities observed in modern  
729 foraging societies in which women participate in hunting. Based on contemporary ethnography it  
730 seems probable that the following factors would have promoted women's involvement in hunting  
731 in the past: opportunity to collectively hunt abundant small game; mitigation of tradeoffs with  
732 childcare through allocare networks; opportunities to act as beaters and drivers of game;  
733 opportunities to serve logistical, informational, and ritualistic roles; and the use of hunting  
734 technology requiring low expertise. The extent to which women's hunting occurred would have  
735 been a result of these various factors interacting in complex ways. In the case of Middle  
736 Paleolithic modern humans, prevailing technologies and socioecological settings suggest that  
737 female hunting may have been relatively common under the right circumstances.

738

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742

743

## 744 References

745

- 746 1. Aiello LC, Key C. 2002. Energetic consequences of being a Homo erectus female. *Am J*  
747 *Hum Biol.* 14(5):551–565.
- 748 2. Anderson A, Chilczuk S, Nelson K, Ruther R, Wall-Scheffler C. 2023. The Myth of Man  
749 the Hunter: Women's contribution to the hunt across ethnographic contexts. *PLoS One.*  
750 18(6):e0287101.
- 751 3. Asch M. 1986. The Slavey indians: the relevance of ethnohistory to development. In:  
752 native peoples: the canadian experience. [place unknown]: McClelland and Stewart; p.  
753 271–296.
- 754 4. Ben-Dor M, Barkai R. 2021. Prey Size Decline as a Unifying Ecological Selecting Agent  
755 in Pleistocene Human Evolution. *Quaternary.* 4(1):7.
- 756 5. Bettinger RL. 2013. Effects of the bow on social organization in Western North America.  
757 *Evol Anthropol.* 22(3):118–123.
- 758 6. Biesele M. 1978. Sapience and scarce resources: Communication systems of the !Kung  
759 and other foragers. *Soc Sci Inf.* 17(6):921–947.
- 760 7. Biesele M, Barclay S. 2001. Ju/'hoan women's tracking knowledge and its contribution to  
761 their husbands' hunting success. *Afr Study Monogr.* 26:67–84.

- 762 8. Bird R. 1999. Cooperation and conflict: The behavioral ecology of the sexual division of  
763 labor. *Evol Anthropol.* 8(2):65–75.
- 764 9. Bird RB, Bird DW. 2008. Why women hunt: risk and contemporary foraging in a Western  
765 Desert aboriginal community. *Curr Anthropol.* 49(4):655–693.
- 766 10. Bodenhorn B. 1990. I'm Not the Great Hunter, My Wife Is": Iñupiat and anthropological  
767 models of gender. *Études/Inuit/Studies.*:55–74.
- 768 11. Boyd R, Richerson PJ. 2022. Large-scale cooperation in small-scale foraging societies.  
769 *Evol Anthropol.* 31(4):175–198.
- 770 12. Brightman R. 1996. The Sexual Division of Foraging Labor: Biology, Taboo, and Gender  
771 Politics. *Comp Stud Soc Hist.* 38(4):687–729.
- 772 13. Brink JW. 2008. *Imagining Head-Smashed-in*. Athabasca University Press.
- 773 14. Brown JK. 1970. A note on the division of labor by sex. *Am Anthropol.* 72(5):1073–1078.
- 774 15. Bugir CK, Peres CA, White KS, Montgomery RA, Griffin AS, Rippon P, Clulow J,  
775 Hayward MW. 2021. Prey preferences of modern human hunter-gatherers. *Food Webs.*  
776 26:e00183.
- 777 16. Burch ES, Ellanna LJ. 1994. *Key Issues in Hunter-Gatherer Research*. London, England:  
778 Routledge Cavendish.
- 779 17. Chambers J, Quinlan MB, Evans A, Quinlan RJ. 2020. Dog-human coevolution: Cross-  
780 cultural analysis of multiple hypotheses. *J Ethnobiol.* 40(4). [https://doi.org/10.2993/0278-](https://doi.org/10.2993/0278-0771-40.4.414)  
781 [0771-40.4.414](https://doi.org/10.2993/0278-0771-40.4.414)
- 782 18. Dembitzer J, Barkai R, Ben-Dor M, Meiri S. 2022. Levantine overkill: 1.5 million years of  
783 hunting down the body size distribution. *Quat Sci Rev.* 276:107316.
- 784 19. Devitt J. 1989. *Contemporary Aboriginal women and subsistence in remote, arid*  
785 *Australia [PhD]: The University of Queensland.* <https://doi.org/10.14264/uql.2020.223>
- 786 20. Doucette DL. 2001. Decoding the gender bias: inferences of atlatls in female mortuary  
787 contexts. *Gender and the Archaeology of Death.*:159–177.
- 788 21. Galibert F, Quignon P, Hitte C, André C. 2011. Toward understanding dog evolutionary  
789 and domestication history. *C R Biol.* 334(3):190–196.
- 790 22. Gallois S, Duda R, Hewlett B, Reyes-García V. 2015. Children's daily activities and  
791 knowledge acquisition: A case study among the Baka from southeastern Cameroon. *J*  
792 *Ethnobiol Ethnomed.* 11:86.
- 793 23. Gilchrist R. 2012. *Gender and Archaeology: Contesting the Past*. Routledge.
- 794 24. Goodale JC. 1971. *Tiwi wives : a study of the women of Melville Island, North Australia*.  
795 Seattle: University of Washington press.
- 796 25. Goodman MJ, Griffin PB, Estioko-Griffin AA, Grove JS. 1985. The compatibility of  
797 hunting and mothering among the agta hunter-gatherers of the Philippines. *Sex Roles.*  
798 12(11):1199–1209.
- 799 26. Grund BS. 2017. Behavioral ecology, technology, and the organization of labor: How a  
800 shift from spear thrower to self bow exacerbates social disparities. *Am Anthropol.*  
801 119(1):104–119.
- 802 27. Gurven M, Hill K. 2009. Why Do Men Hunt? A Reevaluation of "Man the Hunter" and the  
803 Sexual Division of Labor. *Curr Anthropol.* 50(1):51–74.

- 804 28. Haas R, Watson J, Buonasera T, Southon J, Chen JC, Noe S, Smith K, Llave CV,  
805 Eerkens J, Parker G. 2020. Female hunters of the early Americas. *Sci Adv.* 6(45).  
806 <https://doi.org/10.1126/sciadv.abd0310>
- 807 29. Hagen R, van der Ploeg J, Minter T. 2016. How do hunter-gatherers learn? The  
808 transmission of indigenous knowledge among the Agta of The Philippines. *Hunter*  
809 *Gatherer Research.*
- 810 30. Hambly WD. 1934. *The Ovimbundu of Angola.* Chicago.
- 811 31. Hames RB. 1988. *The Allocation of Parental Care among the Ye'kwana.* L. Betzig  
812 MBMAPT, editor. Cambridge University Press.
- 813 32. Helm J. 1961. *The Lynx Point People: The Dynamics of a Northern Athapaskan Band.*  
814 National Museum of Canada, Department of Northern Affairs and National Resources.
- 815 33. Hewlett BS, Fouts HN, Boyette AH, Hewlett BL. 2011. Social learning among Congo  
816 Basin hunter-gatherers. *Philos Trans R Soc Lond B Biol Sci.* 366(1567):1168–1178.
- 817 34. Hill K, Magdalena Hurtado A. 1996. *Aché Life History: The Ecology and Demography of*  
818 *a Foraging People.* Routledge.
- 819 35. Honigmann JJ. 1946. *Ethnography and acculturation of the Fort Nelson Slave.* In: Yale  
820 University Publications in Anthropology. New Haven: Pub. For the Dept. of anthropology,  
821 Yale University, Yale University Press ; H. Milford, Oxford University Press; p. 169.
- 822 36. Hrnčič V. 2023. The Use of Wooden Clubs and Throwing Sticks among Recent  
823 Foragers. *Hum Nat.* 34(1):122–152.
- 824 37. Irving-Pease EK, Ryan H, Jamieson A, Dimopoulos EA, Larson G, Frantz LAF. 2019.  
825 Paleogenomics of Animal Domestication. In: Lindqvist C, Rajora OP, editors.  
826 Paleogenomics: Genome-Scale Analysis of Ancient DNA. Cham: Springer International  
827 Publishing; p. 225–272.
- 828 38. Ivey PK. 2000. Cooperative reproduction in Ituri Forest hunter-gatherers: Who cares for  
829 Efe infants? *Curr Anthropol.* 41(5):856–866.
- 830 39. Jang H, Janmaat KRL, Kandza V, Boyette AH. 2022. Girls in early childhood increase  
831 food returns of nursing women during subsistence activities of the BaYaka in the  
832 Republic of Congo. *Proc Biol Sci.* 289(1987):20221407.
- 833 40. Kaplan H, Hill K, Lancaster J, Hurtado AM. 2000. A theory of human life history  
834 evolution: Diet, intelligence, and longevity. *Evol Anthropol.* 9(4):156–185.
- 835 41. Kelly RL. 2020. Newly discovered remains reveal 9,000-year-old big-game hunting  
836 female. *Outsider.* [accessed 2023 May 11]. [https://outsider.com/outdoors/newly-](https://outsider.com/outdoors/newly-discovered-human-remains-reveal-9000-year-old-ancient-big-game-hunter-woman/)  
837 [discovered-human-remains-reveal-9000-year-old-ancient-big-game-hunter-woman/](https://outsider.com/outdoors/newly-discovered-human-remains-reveal-9000-year-old-ancient-big-game-hunter-woman/)
- 838 42. Kent S. 1993. Sharing in an Egalitarian Kalahari Community. *Man.* 28(3):479–514.
- 839 43. Kirchhoff P. 1948. The Warrau. In: Steward JH, editor. *Handbook of South American*  
840 *Indians: Volume 3 The Tropical Forest Tribes.* Smithsonian Institution Bureau of  
841 American Ethnology Bulletin 143; p. 861–881.
- 842 44. Koster J, McElreath R, Hill K, Yu D, Shepard G, van Vliet N, Gurven M, Trumble B, Bird  
843 RB, Bird D, et al. 2020. The life history of human foraging: Cross-cultural and individual  
844 variation. *Science Advances.* 6(26). <https://doi.org/10.1126/sciadv.aax9070>
- 845 45. Kraft TS, Venkataraman VV, Wallace IJ, Crittenden AN, Holowka NB, Stieglitz J, Harris  
846 J, Raichlen DA, Wood B, Gurven M, Pontzer H. 2021. The energetics of uniquely human  
847 subsistence strategies. *Science.* 374(6575):eabf0130.

- 848 46. Kuhn SL, Stiner MC. 2006. What's a mother to do? The Division of Labor among  
849 Neandertals and Modern Humans in Eurasia. *Curr Anthropol.* 47(6):953–981.
- 850 47. Lassek WD, Gaulin SJC. 2009. Costs and benefits of fat-free muscle mass in men:  
851 Relationship to mating success, dietary requirements, and native immunity. *Evol Hum*  
852 *Behav.* 30(5):322–328.
- 853 48. Lee CM, Neeley M, Horton E, McWethy DB. 2022. Drivelines, hunting blinds, effigies  
854 and intercept hunting strategies in the Greater Yellowstone Ecosystem, USA. *Hunter*  
855 *Gatherer Research.* 5(3–4):187–205.
- 856 49. Lew-Levy S, Lavi N, Reckin R, Cristóbal-Azkarate J, Ellis-Davies K. 2018. How do  
857 hunter-gatherer children learn social and gender norms? A meta-ethnographic review.  
858 *Cross-Cultural Research: The Journal of Comparative Social Science.* 52(2):213–255.
- 859 50. Lew-Levy S, Reckin R, Lavi N, Cristóbal-Azkarate J, Ellis-Davies K. 2017. How Do  
860 Hunter-Gatherer Children Learn Subsistence Skills? *Hum Nat.* 28(4):367–394.
- 861 51. Lombard M. 2016. Mountaineering or Ratcheting? Stone Age Hunting Weapons as  
862 Proxy for the Evolution of Human Technological, Behavioral and Cognitive Flexibility. In:  
863 Haidle MN, Conard NJ, Bolus M, editors. *The Nature of Culture: Based on an*  
864 *Interdisciplinary Symposium 'The Nature of Culture', Tübingen, Germany.* Dordrecht:  
865 Springer Netherlands; p. 135–146.
- 866 52. Lombard M, Shea JJ. 2021. Did Pleistocene Africans use the spearthrower-and-dart?  
867 *Evolutionary Anthropology: Issues*  
868 <https://onlinelibrary.wiley.com/doi/abs/10.1002/evan.21912>
- 869 53. Lupo KD. 2017. When and where do dogs improve hunting productivity? The empirical  
870 record and some implications for early Upper Paleolithic prey acquisition. *Journal of*  
871 *Anthropological Archaeology.* 47:139–151.
- 872 54. Lupo KD. 2019. Hounds follow those who feed them: What can the ethnographic record  
873 of hunter-gatherers reveal about early human-canid partnerships? *Journal of*  
874 *Anthropological Archaeology.* 55:101081.
- 875 55. Lupo KD. 2021. Hunters Who Haul with Dogs: Man's Best-Friend or Woman's Little  
876 Helper? *Hum Ecol.* 49(6):707–719.
- 877 56. Lye T-P. 2004. *Changing Pathways: Forest Degradation and the Batek of Pahang,*  
878 *Malaysia.* Lexington Books.
- 879 57. Marlowe FW. 2007. Hunting and Gathering: The Human Sexual Division of Foraging  
880 Labor. *Cross Cult Res.* 41(2):170–195.
- 881 58. Meyer ML. 1994. *The White Earth tragedy; Ethnicity and dispossession among the*  
882 *White Earth Anishinaabeg, 1889-1920.* University of Nebraska Press.
- 883 59. Meyer-Rochow VB. 2009. Food taboos: their origins and purposes. *J Ethnobiol*  
884 *Ethnomed.* 5:18.
- 885 60. Milks A. 2020. A review of ethnographic use of wooden spears and implications for  
886 Pleistocene hominin hunting. *Open Quat.* 6. <https://doi.org/10.5334/oq.85>
- 887 61. Murdock GP, Ford CS, Hudson AE, Kenney R, Simmons LW, Whiting JWM. 1961.  
888 *Outline of Cultural Materials.* [accessed 2023 May 10]. <https://eric.ed.gov/?id=ED044998>
- 889 62. Nitsch A, Faurie C, Lummaa V. 2014. Alloparenting in humans: fitness consequences of  
890 aunts and uncles on survival in historical Finland. *Behav Ecol.* 25(2):424–433.

- 891 63. Noss AJ, Hewlett BS. 2001. The Contexts of Female Hunting in Central Africa. *Am*  
892 *Anthropol.* 103(4):1024–1040.
- 893 64. O’Connell JF. 1995. Ethnoarchaeology needs a general theory of behavior. *Journal of*  
894 *Archaeological Research.* 3(3):205–255.
- 895 65. O’Driscoll CA, Thompson JC. 2018. The origins and early elaboration of projectile  
896 technology. *Evol Anthropol.* 27(1):30–45.
- 897 66. Ohnuki-Tierney E. 1984. *The Ainu of the northwest coast of southern Sakhalin.*  
898 Waveland Press.
- 899 67. Park WZ. 1938. *Shamanism in western North America: A study in cultural relationships.*
- 900 68. Peacock NR. 1991. Rethinking the Sexual Division of Labor: Reproduction and Women’s  
901 Work among the Efe. In: di Leonardo M, editor. *Gender at the Crossroads of Knowledge.*  
902 University of California Press; p. 339–360.
- 903 69. Peregrine P. 2001. Outline of archaeological traditions. [https://hraf.yale.edu/wp-](https://hraf.yale.edu/wp-content/uploads/2020/12/Outline-of-Archaeological-Traditions-Intro.pdf)  
904 [content/uploads/2020/12/Outline-of-Archaeological-Traditions-Intro.pdf](https://hraf.yale.edu/wp-content/uploads/2020/12/Outline-of-Archaeological-Traditions-Intro.pdf)
- 905 70. Perri AR, Feuerborn TR, Frantz LAF, Larson G, Malhi RS, Meltzer DJ, Witt KE. 2021.  
906 Dog domestication and the dual dispersal of people and dogs into the Americas. *Proc*  
907 *Natl Acad Sci U S A.* 118(6):e2010083118.
- 908 71. Pleger TC. 2000. Old Copper And Red Ocher Social Complexity. *MidCont J Archaeol.*  
909 25(2):169–190.
- 910 72. Prall SP, Scelza BA. 2017. Child fosterage and sex-biased nutritional outcomes among  
911 Namibian pastoralists. *Am J Hum Biol.* 29(6). <https://doi.org/10.1002/ajhb.23058>
- 912 73. Puts DA. 2010. Beauty and the beast: Mechanisms of sexual selection in humans. *Evol*  
913 *Hum Behav.* <https://www.sciencedirect.com/science/article/pii/S1090513810000279>
- 914 74. Reyes-García V, Díaz-Reviriego I, Duda R, Fernández-Llamazares Á, Gallois S. 2020.  
915 “hunting otherwise” : Women’s hunting in two contemporary forager-horticulturalist  
916 societies. *Hum Nat.* 31(3):203–221.
- 917 75. Róheim G. 1933. *Women and Their Life in Central Australia.* *The Journal of the Royal*  
918 *Anthropological Institute of Great Britain and Ireland.* 63:207–265.
- 919 76. Shostak M. 1976. *!Kung Woman” s Memories of Childhood” in Kalahari Hunters and*  
920 *Gatherers.* Edited by Richard Lee & Irven DeVore.
- 921 77. Shostak M. 1981. *Nisa: The Life and Words of a !Kung Woman.* [place unknown]: New  
922 York: Vintage Books.
- 923 78. Spielmann KA. 1989. A Review: Dietary Restrictions on Hunter-Gatherer Women and  
924 the Implications for Fertility and Infant Mortality. *Hum Ecol.* 17(3):321–345.
- 925 79. Stibbard-Hawkes, D. N., Smith, K., & Apicella, C. L. 2022. Why hunt? Why gather? Why  
926 share? Hadza assessments of foraging and food-sharing motive. *Evol and Hum*  
927 *Behavior.* 43(3): 257-272.
- 928 80. Thalmann O, Perri AR. 2018. Paleogenomic Inferences of Dog Domestication. In:  
929 Lindqvist C, Rajora OP, editors. *Paleogenomics: Genome-Scale Analysis of Ancient*  
930 *DNA.* Cham: Springer International Publishing; p. 273–306.
- 931 81. Turnbull CM. 1965. The Mbuti Pygmies: an ethnographic survey. [accessed 2023 May  
932 11] (50). <https://ehrafworldcultures.yale.edu/document?id=fo04-001>
- 933 82. Vecsey C. 1983. *Traditional Ojibwa religion and its historical changes.* Philadelphia, PA:  
934 American Philosophical Society.

935 83. Venkataraman VV. 2021. Women were successful big-game hunters, challenging beliefs  
936 about ancient gender roles. *The Conversation*. [accessed 2023 May 10].  
937 [http://theconversation.com/women-were-successful-big-game-hunters-challenging-](http://theconversation.com/women-were-successful-big-game-hunters-challenging-beliefs-about-ancient-gender-roles-153772)  
938 [beliefs-about-ancient-gender-roles-153772](http://theconversation.com/women-were-successful-big-game-hunters-challenging-beliefs-about-ancient-gender-roles-153772)  
939 84. Venkataraman VV. 2023. Debunking a debunking: A Critique Of Anderson et al.'s  
940 (2023) Plos One Paper On Women's Hunting.  
941 85. White DR, Burton ML, Brudner LA. 1977. Entailment Theory and Method: A Cross-  
942 Cultural Analysis of the Sexual Division of Labor. *Behav Sci Res*. 12(1):1–24.  
943 86. Whittaker JC. 2013. Comparing Atlatls and Bows: Accuracy and Learning Curve.  
944 *Ethnoarchaeology*. 5(2):100–111.  
945 87. Whittaker JC, Cao Y, Leverich A. 2017. Atlatls Are Not Easier Than Bows: Rebuttal To  
946 Grund.  
947 88. Wood B. 2006. Prestige or Provisioning? A Test of Foraging Goals among the Hadza.  
948 *Curr Anthropol*. 47(2):383–387.  
949 89. Wrangham R. 2009. *Catching fire: How cooking made us human*. Profile Books.

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958 **Tables**

959 **Table 1.** Hypotheses and corresponding predictions about the socioecological context of  
960 women's hunting.

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| Hypothesis                                  | Prediction                                | Proposition  |
|---|---|--|
| 1. There is minimal conflict with childcare | 1.1 Children attend hunts                 | Evidence that children attend hunting excursions along with women                              |
|   | 1.2 Allocarers attend to children at camp | Evidence that children stay at camp with other care takers when women go on hunting excursions |

|  |   |   |
|--|---|---|
|  | 1.3 Post-child bearing women hunt (or hunt more often)              | Evidence that women hunt post-child bearing                                       |
|  | 1.4 Nulliparous (pre-child bearing) women hunt (or hunt more often) | Evidence that women hunt before they reach reproductive age                       |
| 2. There are few cultural restrictions on access to hunting technology | 2.1 Exclusion or taboo on women's hunting                           | Evidence that women are socially forbidden from hunting-related practices         |
|  | 2.2 Women have limited access to hunting technology                 | Evidence that women are socially forbidden from using certain hunting technology  |
|  | 2.3 Women use different technology than men                         | Evidence that women use a different technology than men when they hunt            |
|  | 2.4 Women's hunting unceremonious compared to men's                 | Evidence that women are not celebrated when they hunt successfully                |
|  | 2.5 Ritualistic role  | Evidence that women are involved in rituals believed to improve hunting success   |
|  | 2.6 Negative impact on hunting                                      | Evidence that women are believed to negatively impact hunting success in some way |

|  |   |   |
|--|---|---|
| 3. Women pursue low-risk game within range of camp, with the aid of dogs, and/or in groups | 3.1 Use of dogs by women                    | Evidence that women are aided by dogs when they hunt                    |
|  | 3.2 Women hunt in a group                   | Evidence that women hunt in association with other adults               |
|  | 3.3 Women hunt alone                        | Evidence that women hunt unaided by other adults                        |
|  | 3.4 Women hunt small game (<15 kg)          | Evidence that women hunt game <15 kg                                    |
|  | 3.5 Women hunt medium-large game ( ≥15kg)   | Evidence that women hunt game ≥ 15 kg                                   |
|  | 3.6 Participation in game drives            | Evidence that women communally hunt medium-large game in drives         |
|  | 3.7 Close to camp                           | Evidence that women hunt game close to camp                             |
|  | 3.8 Far from camp                           | Evidence that women hunt game far from camp                             |
| 4. Women fulfill key logistical or informational roles                                     | 4.1 Women act in collective hunt as beaters | Evidence that women act as beaters to drive game during communal drives |

|  |                      |   |
|--|----------------------|---|
|  | 4.2 Carrying role    | Evidence that women carry meat back to camp or aid male hunters with the hunting load       |
|  | 4.3 Information role | Evidence that women track and relay information about hunting opportunities to male hunters |

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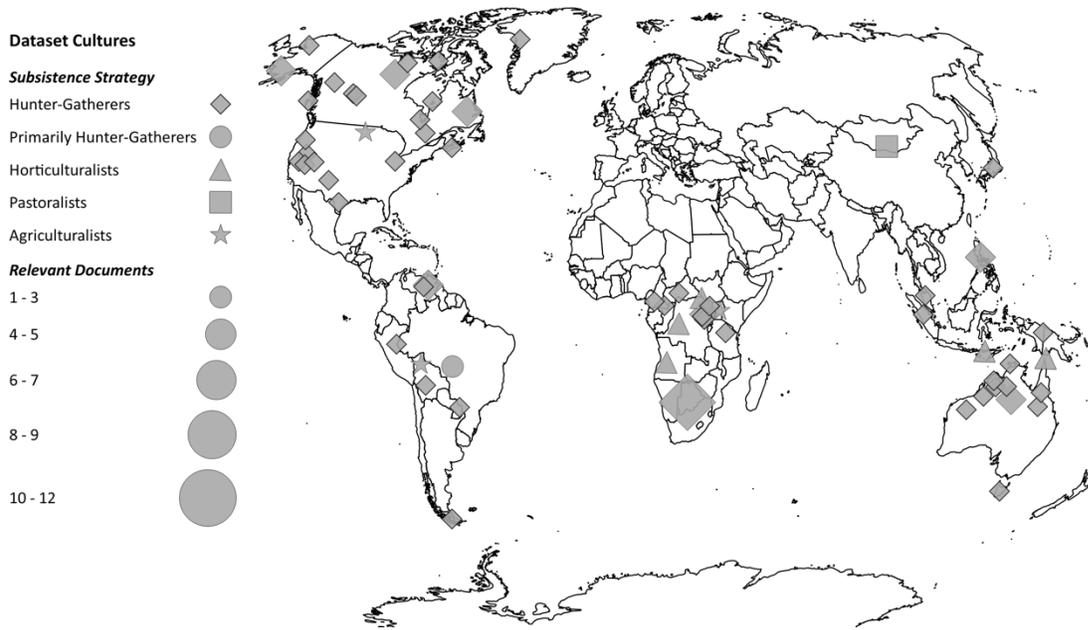
971 **Figures**

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973 **Figure 1.** Geographic locations of ethnographic instances of women's hunting. Circle sizes are  
974 proportional to the number of relevant documents from each society. Subsistence strategy is  
975 denoted by symbol type.

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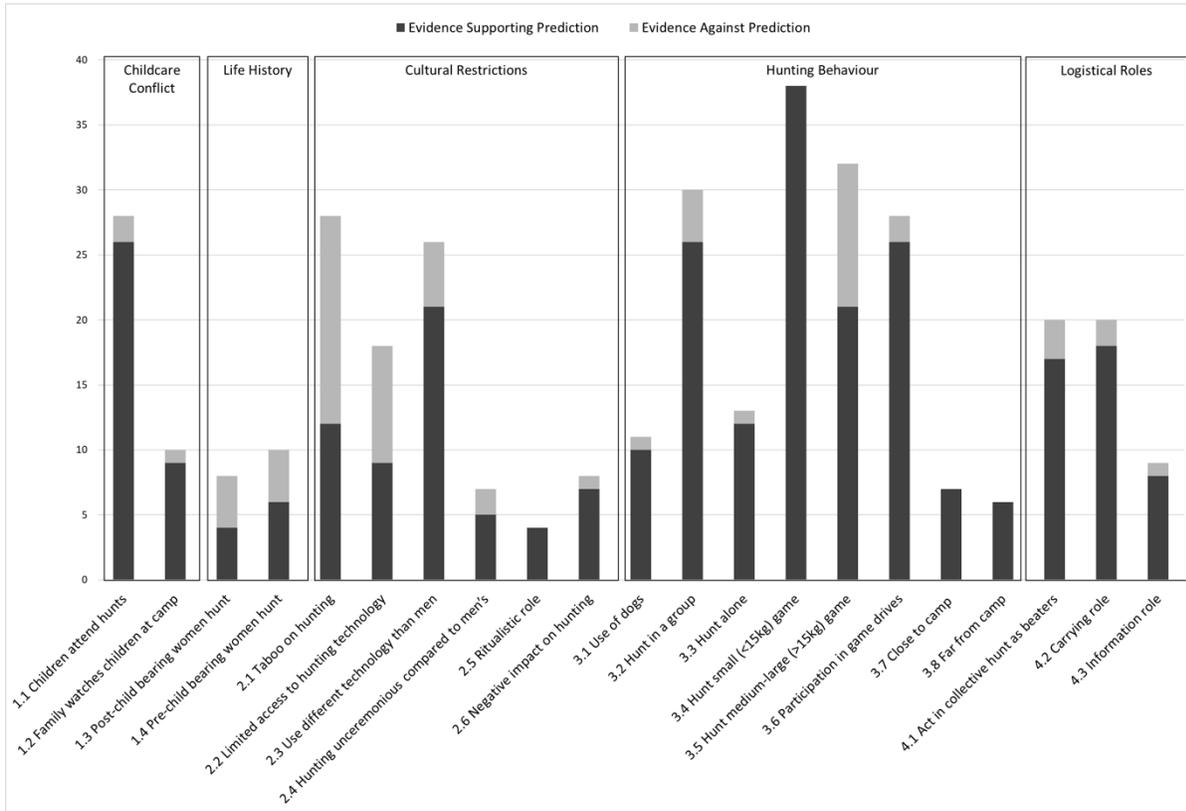
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992 **Figure 2.** Bar graphs displaying evidence for (black) and against (grey) predictions regarding  
 993 the socioecological context of women’s hunting across five domains.

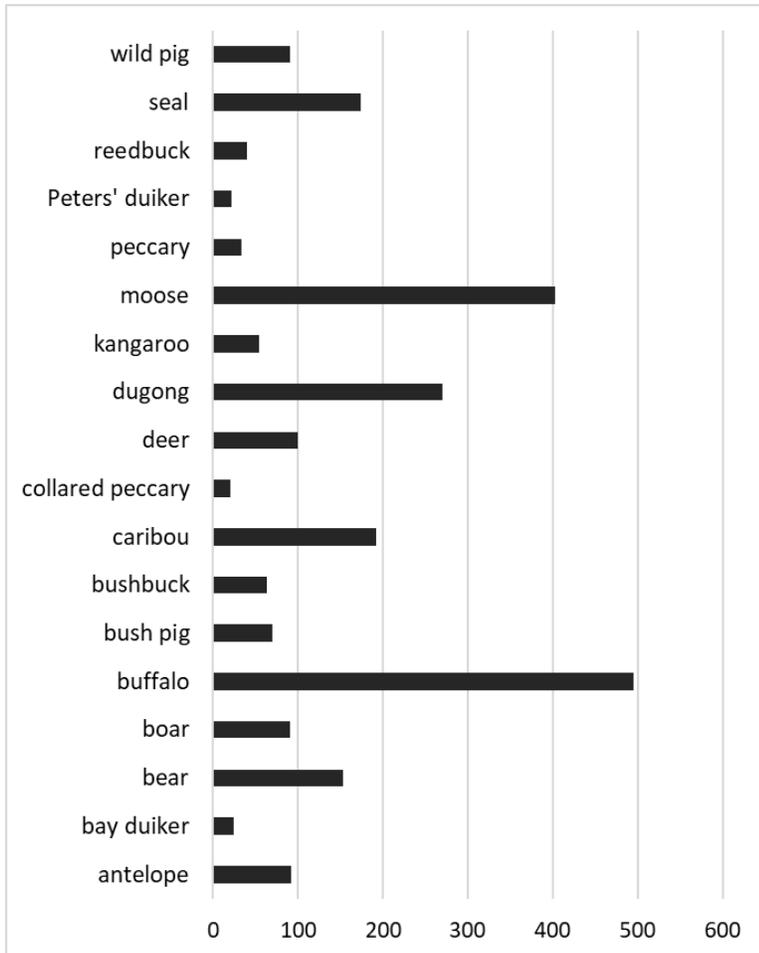


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1011 **Supplemental Information**

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1013 **Figure S1.** Bar graph of weights (kg) of medium-large game hunted by women.



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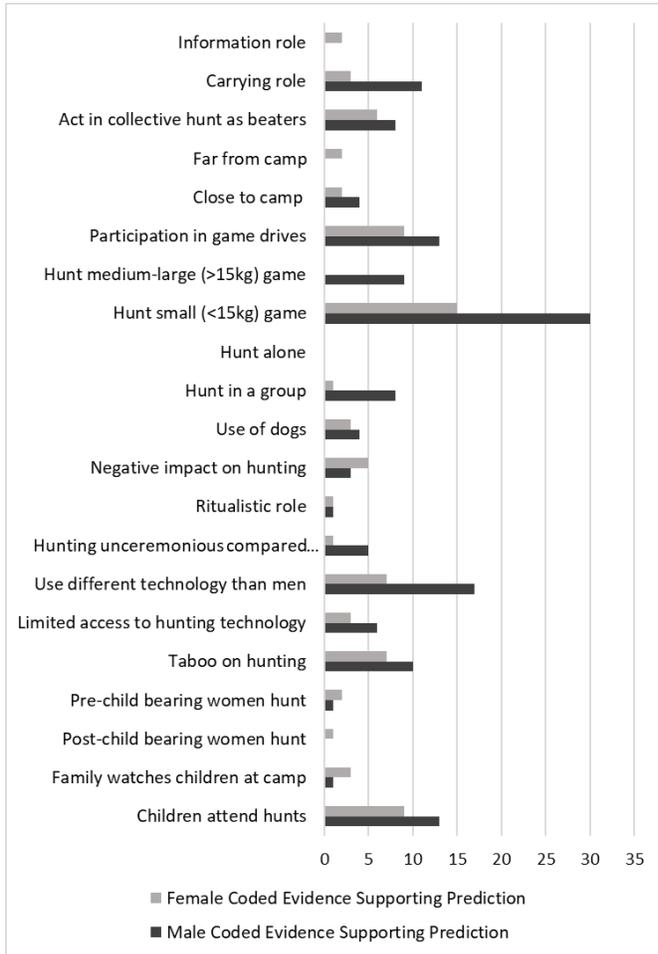
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1028 **Figure S2.** Clustered bar chart of behaviours as recorded in male versus female authored  
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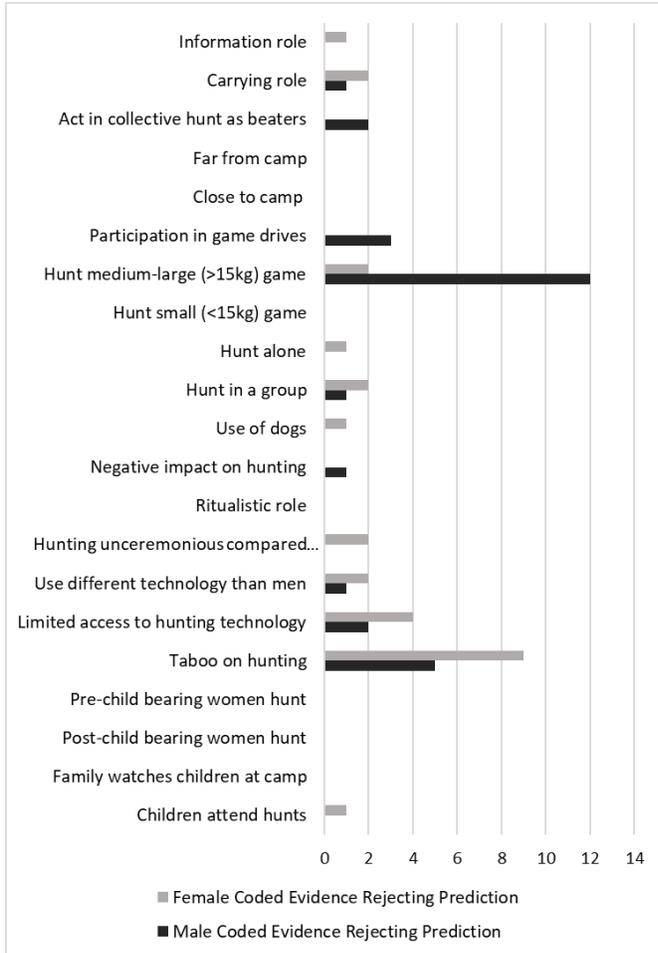
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1042 **Figure S3.** Clustered bar chart of behaviours as rejected in male versus female authored  
 1043 ethnographies.

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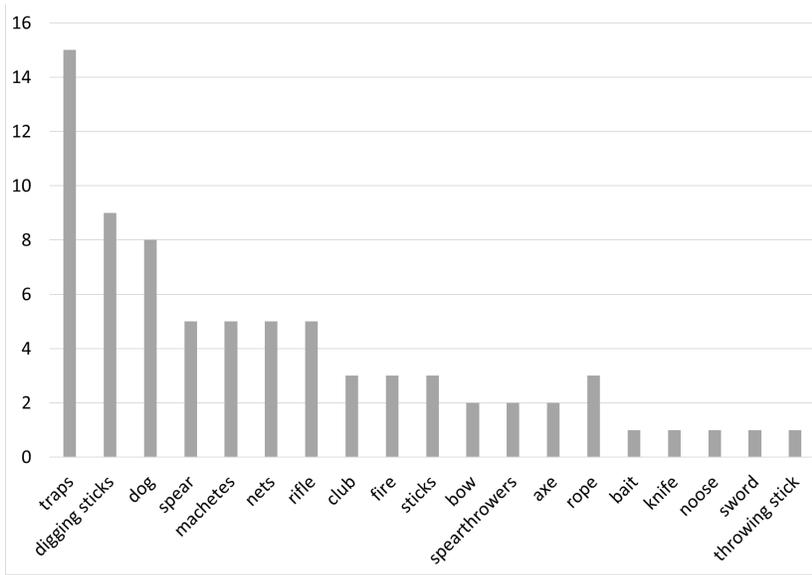
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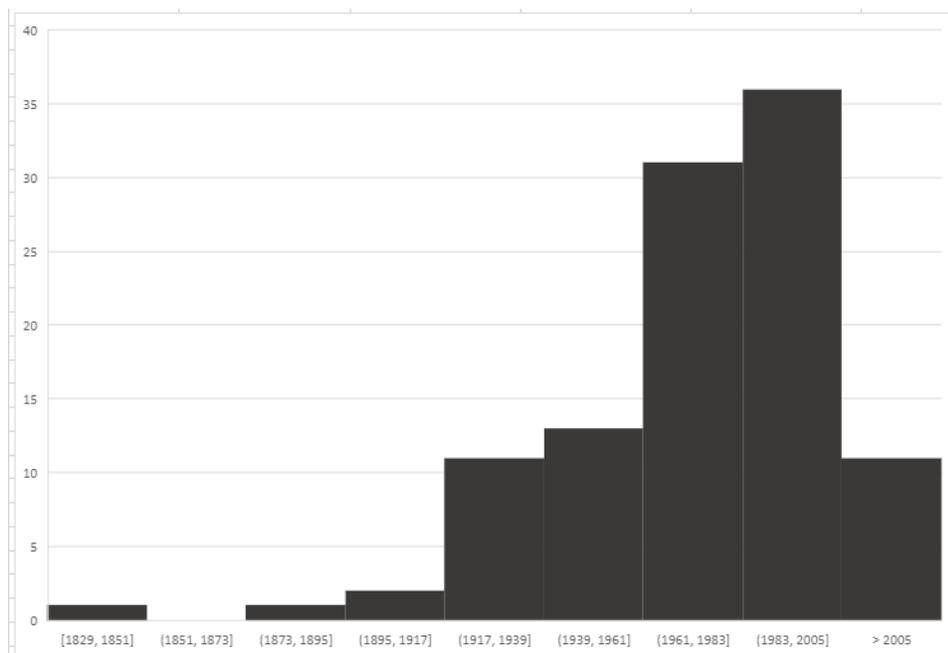
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1051 **Figure S4.** Bar graph of ethnographic reports of women's hunting technology use.



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1074 **Figure S5.** Histogram of ethnographic reports of women's hunting across time.



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