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Reyes-Garcia, Victoria

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**“Hunting Otherwise”:
Women’s Hunting in Two Contemporary Forager-Horticulturalist Societies**

Victoria Reyes-García^{a, b*}, Isabel Díaz-Reviriego^c, Romain Duda^d,
Álvaro Fernández-Llamazares^{e, f}, Sandrine Gallois^g

^a Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

^b Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

^c Institute of Ecology, Faculty of Sustainability, Leuphana University of Lüneburg, Lüneburg, Germany

^d Unité Anthropologie et Ecologie de l’Emergence des Maladies, Institut Pasteur, Paris

^e Helsinki Institute of Sustainability Science (HELSUS), Faculty of Biological and Environmental Sciences, FI-00014, University of Helsinki, Helsinki, Finland

^f Global Change and Conservation (GCC), Organismal and Evolutionary Biology Research Programme (OEB), Faculty of Biological and Environmental Sciences, FI-00014, University of Helsinki, Helsinki, Finland

^g Faculty of Archaeology, Leiden University, The Netherlands

Abstract Although subsistence hunting is cross-culturally an activity led and practiced mostly by men, a rich body of literature shows that in many small-scale societies women also engage in hunting in varied and often inconspicuous ways. Using data collected among two contemporary forager-horticulturalist societies facing rapid change (the Tsimane’ of Bolivia and the Baka of Cameroon), we compare the technological and social characteristics of hunting trips led by women and men and analyze the specific socioeconomic characteristics that facilitate or constrain women’s engagement in hunting. Results from interviews on daily activities with 121 Tsimane’ (63 women and 58 men) and 159 Baka (83 women and 76 men) show that Tsimane’ and Baka women participate in subsistence hunting, albeit using different techniques and in different social contexts than men. We also found differences in the individual and household socioeconomic profiles of Tsimane’ and Baka women who hunt and those who do not hunt. Moreover, the characteristics that differentiate hunter and non-hunter women vary from one society to the other, suggesting that gender roles in relation to hunting are fluid and likely to change, not only across societies, but also as societies change.

Key words: Baka (Cameroon); gender; small-scale societies; social-ecological transformations; Tsimane’ (Bolivia)

Introduction

Across societies, subsistence hunting is an activity led and practiced mostly by men; nevertheless, a rich body of literature shows that in many small-scale societies women also engage in hunting in many different and sometimes inconspicuous ways, often displaying hunting patterns that differ from those displayed by men (e.g., Biesele and Barclay 2001; Bliege Bird and Bird 2008; Bliege Bird et al. 2012; Noss and Hewlett 2001). However, while there is an increasing acknowledgment of the many ways in which women in small-scale societies participate in subsistence hunting, the characteristics of women's hunting trips as well as the social, cultural, and economic importance of women's hunting continue to be understudied.

In this article, we contribute to research on women's subsistence hunting in small-scale societies in three different ways. First, we compare the characteristics of hunting trips led by women and men in two contemporary forager-horticulturalist societies facing rapid change. Although the ethnographic literature has provided important descriptions of women's hunting, detailed quantitative documentation is sparse (see Estioko-Griffin and Griffin 1985 and Noss and Hewlett 2001 for exceptions). Thus, our analysis enriches the documented ethnographic record of contemporary women's hunting practices. Second, we explore potential differences in the socioeconomic characteristics of women who hunt and women who do not hunt. Ethnographic records have broadly portrayed women as a homogenous category, although there are important intracultural variations in women's realities and livelihood strategies (e.g., Bliege Bird and Bird 2008). We analyze which characteristics might relate to women's differential involvement in hunting, thus contributing to examinations of the fluidity of gender roles, particularly in relation to hunting. Third, we discuss our results regarding women's subsistence hunting in small-scale societies in a context of change. Small-scale societies around the world are facing numerous pressures derived from global change (Reyes-García et al. 2017), which also affect their hunting strategies (e.g., Luz et al. 2017; Ponta et al. 2019). Thus, our research contributes to gender perspectives regarding subsistence hunting in the context of global change (e.g., Ravera et al. 2016).

Women's Hunting in Small-Scale Societies

Much research has examined the various ways in which women have engaged in subsistence hunting in small-scale societies. Ethnographic records across the world have described women's participation in many hunt-supporting activities, including encouraging hunting, performing rituals, tracking wounded prey, butchering carcasses, or carrying meat to camps. For example, a study in eastern Africa showed that women motivated men to hunt through a variety of verbal and nonverbal behaviors (Lowassa et al. 2012). Among the San, the Baka, and the Aka, women had a key role in rituals performed to enhance the success of hunting expeditions (Duda et al. 2017; Joiris 1998; Marshall 1976; Thomas et al. 1991). Women have also been described as important information providers among the Inupiat in Alaska (Burch and Ellanna 1994), the Hadza in northern Tanzania, and the Ju/'hoansi of Botswana, where women track wounded animals (Biesele and Barclay 2001; Lee 1979). Ethnographers have also highlighted the supporting roles of women in helping carry meat from hunting grounds to camps (Biesele and Barclay 2001; Harako 1976; Lee 1979).

Beyond supporting roles, women's direct engagement in hunting trips as assistants and as independent hunters has also been documented (e.g., Goodale 1994; Lee 1968; Noss and Hewlett 2001). In many different cultures, including the Matsigenka of the Peruvian Amazon (Romanoff 1983), the Ache of Paraguay (Hurtado et al. 1985), the Mbuti of the eastern Congo Basin (Bailey

and Auger 1989), or the Western Desert Australian Aborigines (Goodman et al. 1985), women participated in communal hunting trips for big game. For example, in the Mbuti and the Aka cooperative net hunting expeditions, women frequently helped drive game into nets set in the forest by men (Ichikawa 1987; Thomas et al. 1991).

The role of women as independent hunters has also been documented in societies ranging from the Arctic (Romanoff 1983) to the Tropics (Noss and Hewlett 2001). For example, Brightman (1996) reported that many Woods Cree women trap furbearing animals alone or in groups and that some married and single women hunted moose, caribou, and bear. In a study exploring the sexual division of labor among 36 foragers groups, Marlowe (2007) reported that women engaged in trap hunting in eight of the studied groups, in fowl hunting in five groups, and in big game hunting in four other groups. Among the Agta of the Philippines, some women seem to have been exceptionally good hunters, displaying higher hunting success rates than men, although men brought in twice as much meat as women (Goodman et al. 1985).

A commonality emerging from this body of work is that, in all societies, the ways in which women and men hunt are different. Overall, these differences refer to (i) the extent to which women and men practice hunting; (ii) the techniques used; (iii) the species targeted; (iv) women's and men's contribution to total catch; and (v) women's and men's hunting location and the social context of hunting trips.

First, results from previous research suggest that, while in many societies women engage in subsistence hunting, they often do so to a lesser extent than men (Kelly 2013). For example, Gurven and Kaplan (2006) reported that in the Peruvian Amazon, Matsigenka women devoted about 0.4 min/day to hunting vs. the 48.8 min/day devoted by Matsigenka men. The pattern was similar among the neighboring Piro (4.2 min/day vs. 19.6 min/day). An exception to this pattern are the Agta from the Philippines, where many women, including women with lactating children, hunted, with some women being described as proficient hunters, mastering the use of bows and arrows, machetes, knives, traps, and dogs (Goodman et al. 1985). However, even in this case, Agta women hunted substantially less than Agta men.

Second, the literature also suggests that women and men use different hunting techniques. For example, Wood and Gilby (2019) noticed that among African foragers, no report exists on women hunting in *solo*, with projectiles, or killing large game. Among the Agta, whereas men generally hunted alone, stalking their prey in the forest, women mostly hunted in groups and with dogs, which offered them both protection and assistance (Goodman et al. 1985). In Western Australia, although both Martu men and women used fire to hunt lizards, men also used vehicles to explore large tracts in search of bustards (Bliege Bird et al. 2013). Several researchers have highlighted the prominence of women's roles in net hunting as opposed to hunting with bow and arrow (e.g., Bailey and Auger 1989; Harako 1976; Tanno 1976). There are also reports of Mende women in Sierra Leone avoiding hunting with snare traps because of the danger posed by the powerful spring mechanisms used in such traps (Bonwitt et al. 2017).

Third, given the different hunting techniques used, women and men target different species, with much research suggesting that, overall, women pursue prey that are smaller, less mobile, easier to track, and more abundant than the prey pursued by men (Wood and Gilby 2019). For example, Martu men mostly targeted bustards and kangaroo, whereas women primarily targeted goanna lizards, which are smaller and more predictable (Bliege Bird and Bird 2008). Similarly, Batek women in Malaysia hunted small birds and squirrels (Endicott and Endicott 2008), and Hadza, /Gui, and //Gana women mostly targeted small and relatively

immobile animals, such as tortoises and small mammals, using their hands, clubs, or digging sticks (Tanaka 1980; Wood and Marlowe 2013).

Fourth, although only a few studies systematically evaluate the contributions of women to the overall hunt, available data suggest that such contributions vary widely among groups. For example, Martu women supplied half of the bushmeat consumed in a camp (Bliege Bird and Bird 2008), whereas Hadza women only provided about 3% of the total mass of animals brought to camps (Wood and Marlowe 2013). Among the Mpiemu of the Central African Republic, women made critical contributions to game capture in times of meat scarcity (Giles-Vernick 2002).

Finally, researchers have found differences in the hunting location and social context of hunting trips led by women and men. Basically, women hunt closer to villages and camps and tend to favor cooperative hunting more than men do (e.g., Endicott and Endicott 2008; Goodman et al. 1985). For example, Batek women in Malaysia mostly hunted in short bouts close to their camps (Endicott and Endicott 2008). Regarding the social context of hunting trips, the literature suggests that women hunt in groups more often than men (e.g., Dahlberg 1981; Goodman et al. 1985). Among the Martu, even when both men and women target the same species, men preferred to hunt alone whereas women hunted in groups (Bliege Bird and Bird 2008; Bliege Bird et al. 2012). Such differences in the location and social context of hunting trips arguably make hunting compatible with childcare (Bliege Bird 2007; Crittenden and Marlowe 2008; Noss and Hewlett 2001).

Case Studies

We collected data among two contemporary forager-horticulturalist societies facing rapid socioeconomic changes: the Tsimane' in the Amazon Basin (Bolivia) and the Baka in the Congo Basin (Cameroon).

The Tsimane' are an Indigenous society living in the Department of Beni, in Bolivian Amazonia. The Tsimane' number about 14,000 people living in 125 villages of around 20 households per village, located primarily along the Maniqui and Quiquibey riverbanks (Reyes-García et al. 2014). Traditionally, Tsimane' depended on hunting, gathering, and fishing, but nowadays the Tsimane' also practice small-scale shifting agriculture. Furthermore, some Tsimane' (particularly those in villages close to market towns) also engage in cash-generating activities such as the sale of crops (mostly rice and plantain), non-timber forest products (e.g., thatch palm), and wage labor in logging camps and cattle ranches (Fernández-Llamazares et al. 2016). Despite these new sources of income, hunting remains a main component in Tsimane' livelihood (Luz et al. 2017; Reyes-García et al. 2019).

The Tsimane' traditionally hunted for subsistence, and today bushmeat continues to be one of the main sources of animal protein in their diet (Reyes-García et al. 2019). Moreover, the consumption of bushmeat is also associated with wellbeing and happiness (Reyes-García and TAPS 2012). The most common hunting technique among the Tsimane' is tracking and stalking with dogs, although trapping is also common (Luz et al. 2015). Traditionally, the Tsimane' hunted with bows and arrows, but these are increasingly being replaced by rifles and shotguns (Luz et al. 2017). Besides technology, hunting rituals and taboos are also inherent to Tsimane' hunting practices (Fernández-Llamazares et al. 2017).

As among other Amazonian Indigenous groups (e.g., Århem 1996), hunting is an essential component of the Tsimane' worldview (Fernández-Llamazares et al. 2017), articulating—with other productive activities—the division of labor and gender roles in the society (Díaz-Reviriego et al. 2017; Gurven and Hill 2009). Tsimane' social organization is largely kinship based, and gender relations are one of the central axes of social life and the

division of hunting labor (Daillant 2003). Hunting is normatively recognized as a male activity, although there are few explicit restrictions on female hunting, (Hooper et al. 2015). Excellence in hunting is a status symbol for Tsimane' men (Gurven and von Rueden 2006). Nevertheless, recent changes in the area (e.g., access to school, paid jobs) are altering Tsimane' activities, with men allocating more time to wage labor (Díaz-Reviriego et al. 2017; Luz et al. 2015).

Our second society are the Baka, a traditionally highly mobile group of about 40,000 individuals living in southeastern Cameroon, northwestern Republic of Congo, and Gabon (Leclerc 2012). Dependent on hunting, gathering, and barter for their livelihood, the Baka traditionally lived in close economic, social, and ritual association with other ethnolinguistic groups practicing slash-and-burn agriculture. The Baka traditionally displayed a marked gendered division of labor (Bahuchet 1992; Joiris 1992) inscribed in their mythology (Brisson 1999). However, Baka mobility patterns and gendered division of labor have been largely altered since the 1950s, basically due to the adoption of subsistence agriculture and the sedentarization process promoted by the national government (Joiris 1992; Leclerc 2012).

Among the Baka, hunting practices are dynamic and dependent on relations with neighboring groups and weapon availability. Known primarily as spear hunters (Bahuchet 1992), the Baka have also used, and continue to use, a wide variety of other hunting techniques. Nowadays, common hunting techniques include hunting with spears, snare traps, shotguns, and digging out rodents with fire or dogs (Duda et al. 2017). "Big hunts," or long expeditions targeting large mammals, have been described as a male activity, although their success is dependent on women's collective and ritual power (Lewis 2002). In contrast, "small hunts," or the hunting of small animals, can involve a solitary male hunter, a couple, a group of men, a group of women, or even a group of adolescents or children accompanied (or not) by adults (Bahuchet 1992; Joiris 1992; Lewis 2002). Overall, Baka women's hunting practices are strongly regulated by beliefs and social norms referring to the type of animal to be hunted and women's stage in the reproductive cycle (Duda et al. 2018).

Methods

Data were collected within the framework of a larger research project for which we conducted 18 months of fieldwork between 2012 and 2014 in two villages in each of the studied societies (Reyes-García, Guèze et al. 2016). During the first six months of fieldwork, researchers learned the local languages, adapted to the local mores, built up trust with participants, collected background information, and developed the research tools. Basic sociodemographic data were collected at the beginning of fieldwork and updated later. Data collection on women's and men's hunting behavior took place over the course of 12 consecutive months during which researchers repeatedly visited each household. All interviews were done in the local language, with the support of trained field assistants.

We obtained Free, Prior, and Informed Consent from each village and individual participating in this study. To work in the Tsimane' territory, we obtained written permission from the Great Tsimane' Council. No specific permissions were required to work in the area where the Baka live. The ethics committee of the Autonomous University of Barcelona approved the protocol for this research, including obtaining oral consent (CEEAH-04102010).

Sampling

In each of the four study villages we worked with all people >16 years of age willing to participate. Participation rate was over 90%. Overall, our sample comprises 121 Tsimane' (63 women and 58 men) and 159 Baka (83 women and 76 men).

Census

At the beginning of the study, we conducted a census to collect information on household composition including the age, biological sex, and maximum school grade of all household members. Since most people in the sample did not know their birthdate, to estimate people's age we traced the kinship relations of neighboring households. Level of schooling was coded from 0 to 5, depending on the maximum school grade completed.

Economic Survey

We also collected individual information on four variables used to measure variation in levels of integration into the market economy (Godoy et al. 2005): (i) wealth, defined as the monetary value of a set of commercial items owned by the person; (ii) income from sales of agricultural and forest products; (iii) income from wage labor; and (iv) number of visits to the market town in the previous year. For the two measures of income (sales and wage labor), we asked for all sources of income during the 15 days prior to the survey. We considered both cash and in-kind income, which was converted to its monetary equivalent (see Reyes-García et al. 2016 for details). We converted local currencies to USD values calculated the Purchasing Power Parity (PPP) value of all economic information using World Development Indicators (<https://datacatalog.worldbank.org/dataset/world-development-indicators>). Since income data and frequency of visits to the market town were collected every three months, we averaged information provided by an individual to obtain a single individual measure, expressed in USD (PPP)/fortnight.

Weekly Interviews

Information from hunting trips was collected through weekly visits. Each week, on a day chosen at random, we visited each household and asked all adults in the household to report the main activities they had performed during the two previous days. If hunting was not mentioned, we specifically asked whether the person went hunting during the two previous days. For each hunting trip reported, we recorded the local name of the animal killed (if any), the estimated time of the hunting trip, the names and roles of people participating in the hunting trip, and the weapons used. We also asked the name of the person who killed the animal and, to avoid double counting, we attributed each prey only to one hunter. Informants estimated hunting trip duration using as a benchmark the sun's position or events that occurred during the interview day, with an assigned maximum duration of 48 hours.

Data Analysis

To assess the extent to which Tsimane' and Baka women hunt, we used data from our weekly interviews. We classified all the adults in the sample as hunter, assistant, or not a hunter. Under the category "hunter" we included any adult who reported leading at least one hunting trip. We defined "assistants" as adults who reported participating but not leading a hunting trip. A person acting as an assistant on one trip could act as the hunter on another trip, so we only categorized people who never led a hunting trip as assistants. The last category, "not a hunter," includes people who did not report participating in hunting trips at all. We compared the number and percentage of Tsimane' and Baka women and men in each of the categories.

To examine whether hunting trips led by women differ from hunting trips led by men, we compared the following characteristics: total and average number of hunting trips per person, main weapon used, trip duration, hunting trips without harvest, average harvest across hunting trips, number of assistants and number of children under 6 years of age participating in the trip,

harvest pooling, and level of cooperation in the trip. For trips in which informants reported more than one weapon, we only considered the main weapon used. To assess harvest pooling, we created a variable that captures whether the harvested animal could be unambiguously credited to an individual hunter (=0) or not (=1). To measure the level of cooperation in a trip, hunting trips were classified as *alone* if the hunter reported hunting alone, *cooperative* if the hunter coordinated with other hunters to catch a prey, and *loose* if the hunter mostly remained in loose contact with other hunters during the trip (Koster et al. 2019). We used a *t*-test to assess statistically significant differences in the mean of these variables for women and men.

We also used information from weekly interviews to compare species killed by women and men. To assign a scientific name to the prey types reported, we used Luz et al. (2017) for the Tsimane' and Brisson (2010) for the Baka. We also used published data to classify the species reported according to their body size (adapted from Peres 2000) and across families (mostly Myers et al. 2006 for species reported by the Tsimane' and Kingdon 1997 and Gautier-Hion 1999 for species reported by the Baka). Then, we compared the frequency and percentage of animals of each species killed by Tsimane' and Baka women and men.

We also compared the socioeconomic characteristics of women in the categories of hunter and not-hunter (i.e., excluding assistants). Since individual activities are often conditioned by the closest affinity group (i.e., the household), and particularly by the activities of other household members, we performed the comparison across different levels. Specifically, we compared (1) the individual socioeconomic profile (i.e., age, schooling, wealth, wage income, income from sales, and trips to town) of women who hunt and women who do not, (2) the socioeconomic profile of hunter/non-hunter women's households (i.e., household size, wealth, wage income, and income from sales), and (3) the socioeconomic profile of the male household head (i.e., male household head wealth, wage income, and income from sales) in households of women who hunt and women who do not. To obtain household measures, we averaged the information from all adults within a same household. To compare whether socioeconomic profiles varied between hunter and not-hunter women, we ran a series of two-sample *t*-test with equal variance comparing characteristics across two groups (i.e., hunter and not-hunter). We used STATA 13 for statistical analyses.

Results

To What Extent Do Tsimane' and Baka Women Hunt?

Over the course of one year, we conducted weekly interviews with a total of 58 Tsimane' women and 63 Tsimane' men and with 83 Baka women and 76 Baka men, with an average of 19.2 reports per person (SD = 6.9). These interviews provided information on 968 hunting trips: 266 among the Tsimane' and 702 among the Baka.

Of the 58 Tsimane' women interviewed, 20.7% ($n=12$) reported having led at least one hunting trip and 10.3% ($n=6$) reported having assisted on a hunting trip at least once (Table 1). Few Tsimane' women (31.0%) participated in hunting, either as hunter or as assistant. These numbers contrast with reports by Tsimane' men, among whom only 20.6% ($n=13$) had not participated in a hunting trip during the sampled days.

Hunting was more frequent among the Baka: 59.4% ($n=49$) of Baka women had led at least one hunting trip, 6.0% ($n=5$) had assisted in hunting trips, and only 34.9% ($n=29$) had not participated in hunting during the sampled days. All Baka men fell within our category of hunter.

Are Hunting Trips Led by Tsimane' and Baka Women and Men Different?

Tsimane' women were the lead hunters in 8.3% of the hunting trips documented, with men leading the remaining 91.7%. On average, Tsimane' hunter women led fewer hunting trips than men (1.8 vs. 4.5 hunting trips, $p < .001$; Table 2). Tsimane' hunter women also used different weapons than men. Dogs and machetes were the main weapons in hunting trips led by Tsimane' women (76.4%), but these weapons were less preferred by men (23.8%), who favored firearms (66.5%). In comparison to trips led by men, hunting trips led by Tsimane' women were shorter (4.0 vs. 8.0 hours, $p < .001$), more often unsuccessful (24.1% vs. 18.1%), and resulted in lower yields (1.9 vs. 9.6 kg, $p < .01$). Hunting trips led by Tsimane' women included more assistants (0.1 vs. 0.05 assistants, not statistically significant), and more children under 6 years of age (0.6 vs. 0.06 children, $p < .001$).

Two other important characteristics differentiate hunting trips led by Tsimane' women and men. First, the harvest was pooled among participants in 17.5% of the trips led by women but only in 6.0% of the trips led by men ($p < .1$). Second, 80.6% of hunting trips led by women but only 24.9% of the hunting trips led by men were cooperative ($p < .001$). In contrast, Tsimane' men led more individual (56.3% vs. 19.4%) and loose (18.8% vs. 0) hunting trips than women ($p < .001$ for both).

We also found differences in the characteristics of hunting trips led by Baka women and men. Baka women led 15.4% of the hunting trips documented and Baka men led the remaining 84.6%. Thus, on average, Baka women led fewer hunting trips than men (1.8 vs 5.9 trips, $p < .001$). Baka women and men also used different weapons: women mostly hunted with fire (72.8%, $p < .001$) and occasionally with snares (11.5%), whereas men mostly hunted with snares (55.4%, $p < .001$), although they also used fire (20.1%) and occasionally firearms (14.7%, $p < .001$). As with the Tsimane', Baka women's hunting trips were shorter (3.3 vs. 6.2 hours, $p < .001$) and resulted in lower yields (2.1 vs. 7.9 kg, $p < .001$) than men's hunting trips. Differently than for the Tsimane', hunting trips led by Baka women were not less successful than hunting trips led by men (29.5% vs. 27.2%). Hunting trips led by women had fewer assistants than those led by men (0.02 vs. 0.18 assistants, $p < .001$), but they included more children under 6 years of age (0.4 vs. 0.1 children, $p < .001$).

As among the Tsimane', the Baka harvest was more often pooled in hunting trips led by women (57.6% vs. 22.8%, $p < .001$). Similarly, more hunting trips were cooperative among women (71.2% vs. 35.2 %, $p < .001$), although about a quarter of the trips led by Baka women were individual (28.8% vs. 52.9%, $p < .001$).

We also found gendered differences in species frequency catch. Tsimane' and Baka women killed a smaller diversity of species and from fewer biological families than men (see Electronic Supplementary Material). Moreover, in both societies, women killed fewer animals than men (Tsimane' and Baka women killed 8.3% and 17.5% of the animals reported), which also represented a lower yield (3.8 vs. 12.5kg/prey for Tsimane' women vs. men; 3.7 vs. 7.7kg/prey for Baka women vs. men) (See ESM Tables S1 and S2). In particular, although Tsimane' men and women mostly killed medium-body-size animal species (i.e., 1–5 kg), 81.7% of Tsimane' men's harvests came from very large species (>15 kg), while most women's harvests (73.7%) came from medium-sized species (Table 3). A large share of Baka men's kills came from medium-sized (40.1%) and large species (44.4%), although in terms of harvest, very large species made 50% of Baka men's yields. In contrast, medium-sized species predominated in Baka women's harvests, in terms of both number of animals killed (65.9%) and yields (50%).

Do Hunter Women Have Different Socioeconomic Characteristics Than Women Who Do Not Hunt?

Among the Tsimane', the only characteristic differentiating women who hunt and women who do not was the number of trips to the market town (Table 4). Tsimane' women who hunt traveled more often to the market town than Tsimane' women who do not hunt (3.9 vs. 2.8 trips, $p < 0.1$). In contrast, several characteristics differentiate Baka women who hunt and those who do not. Baka women who hunt were younger (33.4 vs. 41.7 years of age, $p = 0.01$), had higher levels of education (0.84 vs. 0.36 school grade, $p = 0.01$), and traveled less often to town (0.6 vs. 1 trip, $p = 0.07$) than Baka women who do not. Additionally, Baka women who hunt had higher wage income than those who do not hunt (1.5 vs. 0.9 USD (PPP)/fortnight, $p < 0.1$).

The comparison of household socioeconomic characteristics suggests that Tsimane' women who hunt lived in households with lower income from sales than women who do not hunt (12.8 vs. 82.1 USD (PPP)/fortnight, $p < 0.1$) (Table 4). In contrast, there were no differences in the household socioeconomic profile of Baka women who hunt and Baka women who do not hunt.

Finally, the comparison of differences in the socioeconomic profile of the male household head shows that Tsimane' women who hunt lived in households where the male household head has less wealth (1599 vs. 2376 USD (PPP), $p = 0.1$) and lower income from sales (34 vs. 210 USD (PPP)/fortnight, $p < 0.1$) than male household heads in households of women who do not hunt. In contrast, among the Baka, we did not find any differences in the characteristics of the male household head between the sample of women who hunt and those who do not hunt (Table 4).

Discussion

Three important findings emerge from our analysis. First, we found strong evidence of women's participation in hunting in the two studied societies, although we also found differences in the technologies and outcomes of hunting trips led by Tsimane' and Baka women and men. Second, we found that the social contexts of Tsimane' and Baka women's and men's hunting trips differ. The finding is important because its potential implications in our understanding of social processes embedded in hunting, such as knowledge transmission or sharing. Finally, we also found differences in the socioeconomic profiles of Tsimane' and Baka women who hunt and those who do not hunt. Although these characteristics differ between the two societies, we relate them to the variability of livelihood strategies particularly in a fast-changing context. We devote this section to discussion and interpretation of each of these findings.

Our first important finding is that Tsimane' and Baka women unequivocally engage in hunting, both as lead hunters and as assistants, with about one third of Tsimane' and two thirds of Baka women leading or assisting in hunting trips. The share is likely higher, as our ethnographic information suggests that in both societies people underreport the catch of small and medium-sized species (<5 kg), which constitute the largest share of women's harvests (73.6% and 52.5% for Tsimane' and Baka women, respectively).

The finding that Tsimane' and Baka women participate in hunting aligns well with previous research showing that, in many small-scale societies, women do engage in subsistence hunting, although they often do so in ways that differ substantially from those of men (e.g., Biesele and Barclay 2001; Bliege Bird and Bird 2008; Bliege Bird et al. 2012; Noss and Hewlett 2001). Our results also complement previous research on hunting in the two societies, which had mostly focused on men (see Gurven and Hill 2009 and Luz et al. 2015 for the Tsimane'; Bahuchet 1992 and Leclerc 2012 for the Baka). Put in context, our finding suggests that, although women participation in subsistence hunting has been acknowledged in the academic literature, the characteristics of women's hunting trips (i.e., short), and the resulting yields (i.e.,

small, less diverse preys) might have contributed to researchers overlooking the social, cultural, and economic importance of women's hunting. Thus, a greater emphasis on the study of women's subsistence hunting remains needed.

Our second finding relates to differences on the social contexts of hunting trips led by Tsimane' and Baka women and men. We found that hunting trips led by women include more children (>6 years of age), are more often cooperative, and result in the sharing of harvests more frequently than hunting trips led by men. Previous work provided evidence that, in some societies, women hunt with children and engage in cooperative hunting more often than men (e.g., Estioko-Griffin and Griffin 1985; Goodman et al. 1985). For example, Hooper and colleagues (2015) found that, among the Tsimane', women participated in larger and more heterogeneous hunting groups than men. Moreover, researchers had suggested that the two characteristics are probably linked, as cooperation makes hunting and childcare compatible (Bliege Bird 2007; Crittenden and Marlowe 2008; Noss and Hewlett 2001).

Beyond the division of labour, the different social contexts of women's and men's hunting trips have implications for our understanding of social processes embedded in hunting, such as knowledge transmission and sharing. It is typically assumed that hunting knowledge, as other aspects of traditional knowledge, is passed from one generation to another, often following male or female lines (Acerbi and Bentley 2014). Our results point to a more complex and nuanced picture. Acquiring hunting skills is a long-term process (Gurven et al. 2006; Koster et al. 2019) which begins early in life and builds through a scaffolding process (Reyes-García, Gallois, and Demps 2016). Same-sex parents and peers have been identified as the principal source of hunting knowledge for children above 6 years of age (Gallois et al. 2018; Hewlett et al. 2011; Lew-Levy et al. 2017; MacDonald 2007). Results presented here suggest that women might play an important role in the transmission of hunting knowledge during early childhood (<6 years old). Although the nature of our data does not allow exploring this issue in depth, it brings attention to the importance of women in the transmission of hunting knowledge, especially during early childhood.

Similarly, our results also show that hunting trips led by women result in the sharing of the harvest more frequently than hunting trips led by men. This is so despite the fact that women predominantly hunt small and medium-sized species. The finding is troublesome because it challenges the argument that men typically target large animals that are then widely shared outside the household, whereas women pursue small targets that are mostly consumed within the household (e.g., Gurven and Hill 2009). Indeed, the cooperative nature of hunting trips led by women might naturally lead to the sharing of harvest among trip participants, with the sharing likely occurring during the trip itself. The spontaneous and less visible distribution of small and medium size preys during a trip contrasts with the way in which big animals are shared, a process often highly regulated and subject to strong social scrutiny (Bliege Bird 1999). Overall, our finding suggests that the level to which women share their harvest outside the household might have been previously underestimated.

The third important finding of this work is that there are significant differences in the socioeconomic profiles of Tsimane' and Baka women who hunt and those who do not hunt, and—importantly—that the characteristics that differentiate the two groups of women vary from one society to the other. For the Tsimane', household integration into the market economy relates to women's engagement in hunting; for the Baka, individual characteristics seem more important. Thus, among the Tsimane', household characteristics explain women's engagement in hunting (i.e., women who hunt live in households with less wealth and income than women who

do not hunt). Tsimane' women complain that—nowadays—men do not fulfill their roles as meat and fish providers, as they increasingly spend more time in income-generating activities outside the village (Díaz-Reviriego et al. 2017). Thus, in households where men leave the village in search of income-generating activities, women might feel compelled to engage in hunting, as has also been reported for fishing (Díaz-Reviriego et al. 2017). For Baka women, engagement in hunting seems to be much more common (with 60% of women being categorized as hunters), although several individual-level factors differentiate women who hunt from those who do not hunt. In comparison to women who do not hunt, Baka women who hunt are generally younger, have more schooling, and engage more in wage labor. In fact, during our time in the field, we often found the villages empty during the day, with the exception of elders in charge of childcare. In that sense, our findings suggest that, by outsourcing childcare to elder women, Baka social organization facilitates adult women's engagement in productive activities, including foraging and, more recently, wage labor. This finding is in line with previous research highlighting the crucial role of elders, and notably grandmothers, in human societies (e.g., Crittenden and Marlowe 2008).

While results reflect cultural specificities, overall, our analysis dovetails with scholarship emphasizing that women are not a homogenous category (Díaz-Reviriego et al. 2016; Shaughnessy and Krogman 2011). Rather, across and within societies, women have multiple socioeconomic characteristics and fulfill a diversity of roles and tasks, resulting in different levels of participation in subsistence activities. Moreover, this engagement changes along with socioeconomic and environmental changes (Ravera et al. 2016), making gender roles much more fluid than previously acknowledged in ethnographic accounts of forager-horticulturalist societies.

Conclusion

Our findings add to growing evidence that, across the globe, access to and use of natural resources is largely mediated by gender relations (Rocheleau et al. 1996; Shaughnessy and Krogman 2011; Sunderland et al. 2014). We found that Tsimane' and Baka women engage in hunting, although they hunt using different techniques and in different social contexts than men in the same societies. We also found differences in the household and individual socioeconomic profiles of Tsimane' and Baka women who hunt and those who do not hunt. Moreover, the characteristics that differentiate women who hunt and women who do not hunt vary from one society to another, which indicates that gender roles are multidimensional, fluid, and likely to change not only cross-culturally, but also along with socioeconomic characteristics and current global changes.

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Victoria Reyes-García (PhD in Anthropology, 2001, University of Florida) is ICREA Research Professor at the Institut of Environmental Science and Technology, Universitat Autònoma de Barcelona (ICTA-UAB) where she coordinates the Laboratory for the Analysis of Social-Ecological Systems in a Global World (<http://www.laseg.cat/en>). In her current research she studies the potential contribution of Indigenous and local knowledge to climate change impacts research (www.licci.eu).

Isabel Díaz-Reviriego (PhD in Environmental Sciences, 2015) is a postdoctoral researcher at Leuphana University of Lüneburg, Germany. Her research focuses on understanding the multiplicity of human-nature relationships, including Indigenous people's and local communities' worldviews, knowledge, and practices, and particularly how gender relations shape the access, use, and management of biodiversity. She has conducted extensive work with Indigenous peoples in Bolivia and has also worked in Costa Rica, Norway and Spain. Her research interests also include participation and inclusiveness issues in global environmental governance and science-policy interfaces.

Romain Duda (PhD in Environmental Sciences, 2017) is leading ethnoecological research in central Africa. As a postdoctoral researcher at the Pasteur Institute (Paris), he is currently working on human-animal contacts at the interface of anthropology, history and ecology of emerging diseases (ebola, monkeypox). Since 2012 he has conducted several long-term fieldworks in Cameroon, Congo and DRC among different groups (Baka, Aka, Twa, Teke) to investigate knowledge, practices and engagements between humans and non-humans in the Congo basin rainforests.

Álvaro Fernández-Llamazares (PhD in Environmental Sciences, 2015) is a postdoctoral research fellow at the Helsinki Institute of Sustainability Science (HELSUS) of the University of Helsinki, in Finland. An ethnoecologist by training, he has more than 27 months of in-depth ethnographic field experience with Indigenous communities in the Global South, most notably in Bolivian Amazonia. His work spans from advanced geospatial analyses of Indigenous land tenure at regional and global scales to field-based ethnoecological studies of local biocultural systems, including also hands-on action for documenting, revitalizing and honouring Indigenous and Local Knowledge.

Sandrine Gallois (PhD in Environmental Science, 2016) is a post-doctoral research fellow at Leiden University, Netherlands. Her research focuses mostly on human-environment relations including the acquisition of Indigenous and local knowledge in a context of global change. Taking an interdisciplinary approach, her areas of interest are biocultural diversity, cultural transmission, childhood, ethnobotany, social-ecological systems and science-policy interface.

Table 1. Tsimane' and Baka women's participation in hunting

	Tsimane'		Baka	
	Women (N=58)	Men (N=63)	Women (N=83)	Men (N=76)
Hunter	12 (20.7%)	49 (77.8%)	49 (59.4%)	76 (100%)
Assistant	6 (10.3%)	1 (1.6%)	5 (6.0%)	0
Did not hunt	40 (69.0%)	13 (20.6%)	29 (34.9%)	0

Table 2. Characteristics of hunting trips (N=968) by sex of hunter

	Tsimane'		Baka	
	Women	Men	Women	Men
Total number of trips	22	244	108	594
(%)	(8.3)	(91.7)	(15.4)	(84.6)
Average number of trips	1.8	4.5***	1.8	5.9***
(SD)	(1.2)	(3.3)	(1.6)	(4.2)
% of trips in which main weapon was:				
Firearm	0	66.5***	0	14.7***
Dogs and machete	76.4***	23.8	1.3	2.6
Fire	^	^	72.8***	20.1
Snare	^	^	11.5	55.4***
Other	15.3	8.4	14.2**	7.2
Trip duration, in hours	4.0	8.0***	3.3	6.2***
(SD)	(1.6)	(4.9)	(2.8)	(3.5)
Number of unsuccessful trips	7	54	54	225
(%)	(24.1)	(18.1)	(29.5)	(27.2)
Average harvest, in kg	1.9	9.6**	2.1	7.9***
(SD)	(1.4)	(12.5)	(1.2)	(15.9)
Number of assistants $\geq$ 6 years old	0.10	0.05	0.02	0.18***
(SD)	(0.29)	(0.12)	(0.14)	(0.23)
Number of children <6 years old	0.63***	0.06	0.4***	0.1
(SD)	(0.8)	(0.2)	(0.9)	
Number of trips in which harvest was pooled	17.5*	6.05	57.6***	22.8
% of trips in which hunting was:				
Individual	19.4	56.3***	28.8	52.9***
Cooperative	80.6***	24.9	71.2***	35.2
Loose	0	18.8***	0	11.9***

^ Indicates that the hunting technique is not practiced by this society.

Statistically significant at * 0.1, ** 0.05, and *** 0.01 confidence level in a *t*-test.

Table 3. Species killed by Tsimane' and Baka by sex of hunter and body size of animal (N=968 trips)

	Men				Women			
	Animals killed		Harvest		Animals killed		Harvest	
	N	%	kg	%	N	%	kg	%
Tsimane'								
Small species (<1 kg)	1	0.41	0.84	0.03	0	0	0	0
Medium-size species (1–5 kg)	163	67.63	453.76	14.93	21	95.45	61.48	73.65
Large species (5–15 kg)	15	6.22	101.93	3.35	0	0.00	0	0.00
Very large species (>15 kg)	62	25.73	2482.7	81.69	1	4.55	22	26.35
Total	241		3039.23		22		83.48	
Baka								
Small species (<1 kg)	40	6.66	28.03	0.61	16	12.40	12.00	2.52
Medium-size species (1–5 kg)	241	40.10	702.10	15.23	85	65.89	238.23	50.00
Large species (5–15 kg)	267	44.43	1575.80	34.19	24	18.60	133.50	28.02
Very large species (>15 kg)	53	8.82	2303.30	49.97	4	3.10	92.70	19.46
Total	601		4609.23		129		476.43	

Table 4. Comparison of individual and household characteristics between Tsimane' and Baka women who hunt and women who do not

	Tsimane'		Baka	
	Hunter	Non-hunter	Hunter	Non-hunter
	<i>N</i> =12	<i>N</i> =40	<i>N</i> =49	<i>N</i> =29
Individual Characteristics				
Age, in years	41.6	36.6	33.4	41.7**
Years of school	1.0	1.5	0.84**	0.36
Individual wealth, in PPP US\$	237	193	59	56
Individual wage income, in PPP US\$	0	2.3	1.5*	0.9
Individual sales income, in PPP US\$	2.0	2.7	1.4	1.2
Trips to town	3.9*	2.8	0.6	1.0*
Household Characteristics				
Household size	7.4	6.8	6.4	6.9
Household wealth, in PPP US\$	2691	3387	119	126
Household wage income, in PPP US\$	13.3	16.3	4.5	3.5
Household sales income, in PPP US\$	12.8	82.1*	2.1	2.0
Characteristics of Male Household Head				
Male household head wealth, in PPP US\$	1599	2376*	50	56
Male household head wage income, in PPP US\$	33	35	8.4	7.4
Male household head sales income, in PPP US\$	34	210*	3.4	3.2

Statistically significant at * 0.1, ** 0.05, and *** 0.01 confidence level in a *t*-test.