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Toward a Reality-Based Understanding of Hadza Men's Work

A Response to Hawkes et al. (2014)

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Abstract Observations of Hadza men foraging out of camp and sharing food in camp show that men seeking to maximize the flow of calories to their families should pursue large game, and that hunting large game does not pose a collective action problem. These data also show that Hadza men frequently pursued honey, small game, and fruit, and that by doing so, provided a more regular flow of food to their households than would a putative big game specialist. These data support our earlier studies demonstrating that the goal of family provisioning is a robust predictor of Hadza men's behavior. As before, the show-off and costly signaling hypotheses advanced by Hawkes and colleagues fail as both descriptions of and explanations for Hadza men's work.

Keywords Hadza · Hunter-gatherers · Provisioning · Hunting · Costly signaling · Show-off hypothesis

Our 2013 paper (Wood and Marlowe 2013) establishes that the Hadza men we observed were sharing the foods they acquired in ways that strongly advantaged their wives and children, as well as their kin living in other households. According to Hawkes (1991), this is one of the clearest indicators that men's behavior is shaped by the goal of family provisioning:

> If men forage primarily to provision their families, we might expect them to allocate their time to foraging and to choose their foraging strategies so as to

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provide the highest income. They would also direct the resources they acquire to their wives and children (Hawkes 1991:30).

Certainly, Hadza men's sharing meets these criteria. What about the question of whether men chose their foraging strategies so as to provide the highest income? In their current article, Hawkes et al. (2014) attempt to show that this wasn't the case with the Hadza we observed. However, their analyses are based on a demonstrably false premise: that during our study, men were large game specialists, spending 100% of their time out of camp solely hunting large game. This is a bizarre proposition given the fact that Table 4 of our 2013 paper shows that 95% of the food items that men brought to camp were foods other than large game. Nevertheless, it is upon this false claim that they calculate the profitability of large game hunting and construct two ornate, faulty prey choice models (their Tables 4 and 5).

Here, toward developing a more reality-based understanding of Hadza men's work, we provide data collected during 40 focal individual observations ("focal follows") of Hadza men foraging out of camp. We use these data to characterize men's actual foraging behavior, and to calculate the profitabilities of pursuing different food types. These data show that men seeking to maximize the flow of calories to their families should pursue large game, and that hunting large game does not pose a collective action problem. They also show that men frequently pursued honey, small game, and fruit, and that by doing so, they provided a more regular flow of food to their households than would a putative big game specialist. These data support our earlier studies (Wood 2006; Wood and Marlowe 2013) demonstrating that the goal of family provisioning is a robust predictor of Hadza men's behavior. Owing to space constraints, we respond to the points raised by Hawkes et al. regarding methodological differences between our studies in the electronic supplementary materials. In the ESM, we also raise concerns about the evidentiary basis by which Hawkes and colleagues have characterized the Hadza as big game specialists.

Hadza Men's Work

Several lines of evidence establish the fact that foraging for honey, fruit, and small game are major components of Hadza "men's work," and that Hawkes et al. have provided a distorted account of these elements of the Hadza's subsistence economy. Not surprisingly, the biases in their descriptions and analyses create illusory support for their preferred hypothesis.

First consider honey. Hawkes et al. have never published naturalistic[1] focal-follow data describing men's honey acquisitions, or data on how much honey men brought to their households, nor any data describing the sharing or consumption of honey. Our 2013 paper shows that, on average, men brought honey to camp every 2.7 days during the wet season, and every 9.3 days during the dry season. That paper also shows that men's families retained 69% of the honey that men brought into camp in primary distributions, shares that were 14 times heavier than what other households received on average. Our 2013 paper also shows that honey represented 63% of the food calories that men brought to camp

[1] i.e., "non-experimental," in the terminology of Hawkes et al. 2014.

during the wet season, and 14% during the dry season. Marlowe et al. (2014) recently published data collected between 1995 and 2007 showing that approximately 15% of all the food calories brought into 24 Hadza camps was honey; the total contribution of honey to the Hadza diet, including that eaten outside camp, is likely to be higher (Wood et al. 2014). In the "background" section of their current article, Hawkes et al. (2014) describe honey as being pursued by married couples and young, mixed gender groups. In contrast, our long-term data show that men foraging alone or with other men brought 91% of all honey into Hadza camps, by weight, and men foraging with women an additional 2.6% (Marlowe et al. 2014: Table 5). Honey is also the most preferred food in the Hadza diet (Berbesque and Marlowe 2009). All of these data indicate that foraging for honey is a frequent, important, and desired way that Hadza men contribute both to the group's overall diet and especially to the food supply of their families. In their current article, Hawkes et al. wholly ignore men's foraging for honey, or small game, or fruit when they calculate return rates from "men's work," which they falsely equate to hunting large game. Not surprisingly, doing so serves to downplay men's contributions to their families, in line with their preferred hypothesis.

Hunting large game is also very consequential to the diet of the Hadza, and more meat being brought into camps is associated with greater body fat in reproductively aged women (Marlowe and Berbesque 2009). In our 2013 paper, using food sharing and food production data, we estimate that the best hunters provided 4.2 times more food to their family's diet than did the worst hunters. Not surprisingly, Marlowe (2004) reports that 85% of Hadza women stated that a man being a good hunter is a desired trait for a husband. Even though it is very consequential, hunting and sharing large game is only one component of men's work, and ignoring men's other foraging behaviors imperils both descriptions and subsequent analyses.

Hawkes et al. (2014), in their Table 2 (parameter 22), calculate the "expected" pre-sharing profitability of hunting large game during our study period to be 0.46 kg/h, based on the following three assumptions: (1) that men spent 4.1 h per day out of camp, (2) that they produced 1.9 kg of meat per day, and (3) that 100% of their time out of camp was spent searching for and handling large game. We have no qualms with their first two assumptions. The third assumption is impossible in light of men's observed food production, presented in Table 4 of Wood and Marlowe (2013). Hawkes et al. write (in their Table 2, note *c*) that this third assumption is based on time allocation data from Hawkes et al. (1997). What is actually tabulated in Hawkes et al. (1997) *is not how much time men spent handling large game, but the total time men spent outside of camp*, which averaged 4.1 h per day (Hawkes et al. 1997: Table 1). This erroneous calculation is embedded in the prey choice model presented in their Table 5. We are not convinced at all by these analyses and we suggest that readers be more than a little wary.

Men's Time Allocation in 40 Focal Follows

In a sample of 40 focal follows (Wood et al. 2014), Wood observed subjects foraging out of camp for a total of 211.8 h.[2] During this time, men spent 33.7 h (15.9% of their

[2] Marlowe has also carried out a large set of focal follows; a more thorough prey choice analysis incorporating these data will be the subject of a future publication.

time out of camp) extracting honey from 104 bee nests. It is incorrect to code time men spent extracting honey as being spent searching for and handling large game, but that is the method Hawkes and colleagues use in their faulty prey profitability calculations and prey choice models. In fact, when men are extracting honey, hunting is not possible, and not once in these focal follows did a man break from harvesting a bee nest to pursue an animal. The act of chopping open a bee nest and extracting honey is loud and often precarious, and men leave their bows and arrows on the ground when chopping into and climbing trees containing bee nests. To find the 104 harvested bee nests, men spent an additional 2.6 h following greater honeyguide (*Indicator indicator*) birds, and many additional hours searching their woodlands for occupied bee nests, during which they inspected 554 trees for bee colonies (Wood et al. 2014).

We define handling time for each animal prey species as all the time men spent following their tracks, and all the time they spent pursuing visually encountered animals, whether such pursuits were successful or unsuccessful. We define large game as all those animals with average adult body weight over 35 kg, and small game as those weighing less. Conservatively, we include the time men spent atop trees and rock outcroppings scanning the landscape as part of the total handling time for large game. In contrast to the 33.7 h men spent extracting honey from bee nests, they spent only 13.1 h (6.2% of their time) handling large game, which includes time spent following tracks of large game, pursuing visually encountered animals, and processing carcasses. Men also spent 5.9 h handling small game (2.8% of their time) and 3.5 h harvesting fruit (1.6% of their time). When men were not handling food resources, they were usually walking, alert to the presence of small game, large game, honey, and fruit, or resting. In these 40 follows, men spent 132.9 h (62.8% of their time) walking and 15.2 h (7.2% of their time) resting. Table 1 shows that men pursued large game, small game, fruit, and honey; Wood and Marlowe (2013) show that men shared all these foods in ways that advantaged their families.

Table 1 tabulates encounters, pursuits, arrow shots, and kills/acquisitions by prey type in our sample of 40 focal follows. Regarding hunting, men pursued large game 25 times and small game 153 times. They shot arrows at large game 9 times and at small game 71 times. The median estimated weight of pursued animals is 5.1 kg, and those shot at with arrows, 1.5 kg. Men killed one large animal, a zebra, during these 40 focal follows, and 23 small game. The top three targeted animals were dik-dik, mourning doves, and guinea fowl. Clearly, men were very interested in pursuing and killing small game. These data show that 68% of dik-dik encounters resulted in pursuits, as did 90% of encounters with guinea fowl, 100% of encounters with klipspringer, 91% of those with baboons, and 81% of those with rock hyrax. Men harvested honey more frequently than any other food type, followed by fruit, small game, and lastly, large game.

These time allocation and food acquisition data, along with the records of what foods men brought to camp provided in our 2013 article, show that it is wrong to describe the Hadza men we observed as large game specialists, and that they certainly did not spend 100% of their time out of camp searching for and pursuing large game. Yet these are the premises of the Hawkes et al. (2014) analyses. Standard methods of optimal prey choice modeling (Hawkes et al. 1982; O'Connell and Hawkes 1981) rank food types according to their expected energetic returns per unit handling time: kcal/h of handling-time, *not* kcal/h that foragers spend out of camp. Hawkes et al. incorrectly adopted this latter method, which inflates the denominator and depresses profitability estimates for large game hunting, in line with their preferred hypothesis. This method does not match the reality

Table 1 Encounters and pursuits in 40 focal follows of men

Food category	Species	Latin	Avg adult wt (kg)	*N* encounters	*N* pursuits	Fraction pursued	*N* arrow shots	*N* kills/ acquisitions
Animal	African mourning dove	*Streptopelia decipiens*	0.13	17+	17	–	12	3
Animal	Baglafecht weaver	*Ploceus baglafecht*	0.03	2+	1	–	1	0
Animal	Bare-faced go-away-bird	*Corythaixoides personatus*	0.26	2+	0	–	1	0
Animal	Buff-crested bustard	*Eupodotis gindiana*	0.79	1	1	1.00	1	0
Animal	Bushbuck	*Tragelaphus scriptus*	48.50	3	1	0.33	1	0
Animal	Caracal	*Felis caracal*	13.00	1	1	1.00	0	0
Animal	Common genet	*Genetta genetta*	1.77	1	1	1.00	2	0
Animal	Crested francolin	*Francolinus sephaaena*	0.29	2+	2	–	2	1
Animal	Dwarf mongoose	*Helogale parvula*	0.28	5	3	0.60	2	1
Animal	Eland	*Taurotragus oryx*	560.50	1	1	1.00	0	0
Animal	Giraffe	*Giraffa camelopardalis*	1340.00	3	1	0.33	0	0
Animal	Greater kudu	*Tragelaphus strepsiceros*	210.00	5	3	0.60	0	0
Animal	Harlequin quail	*Coturnix delegorguei*	0.08	4+	4	–	1	0
Animal	Helmeted guinea fowl	*Numida meleagris*	1.48	21	19	0.90	12	9
Animal	Impala	*Aepyceros melampus*	52.50	22	12	0.55	6	0
Animal	Kirk's dik-dik	*Madoqua kirkii*	5.50	62	42	0.68	14	2
Animal	Klipspringer	*Oreotragus oreotragus*	13.00	3	3	1.00	2	0
Animal	Lesser galago	*Galago senegalensis*	0.21	1	1	1.00	1	1
Animal	Long-crested eagle	*Lophaetus occipitalis*	1.22	2	1	0.50	1	0
Animal	Martial eagle	*Polemaetus bellicosus*	4.60	1	1	1.00	0	0
Animal	Nile monitor lizard	*Varanus niloticus*	2.00	1	0	0.00	0	0
Animal	Ochre bush squirrel	*Paraxerus ochraceus*	0.09	6+	3	–	3	2
Animal	Olive baboon	*Papio anubis*	28.25	11	10	0.91	2	0

Table 1 (continued)

Food category	Species	Latin	Avg adult wt (kg)	*N* encounters	*N* pursuits	Fraction pursued	*N* arrow shots	*N* kills/ acquisitions
Animal	Red-billed hornbill	*Tockus erythrorhynchus*	0.16	10+	7	–	7	3
Animal	Rock hyrax	*Procavia capensis*	3.65	16	13	0.81	2	0
Animal	Side-striped jackal	*Canis adustus*	9.65	3	3	1.00	2	0
Animal	Slate-colored boubou	*Laniarius funebris*	0.04	1+	1	–	0	1
Animal	Southern ground hornbill	*Bucorvus leadbeateri*	4.21	1	0	0.00	0	0
Animal	Speckled pigeon	*Columba guinea*	0.30	3+	3	–	1	0
Animal	Spiny mouse	*Acomys wilsoni*	0.02	1	1	1.00	0	0
Animal	Spotted hyena	*Crocuta crocuta*	65.00	2	0	0.00	0	0
Animal	Unknown bird species	Unknown	–	9+	8	–	2	0
Animal	Vervet monkey	*Chlorocebus pygerythrus*	5.12	6	5	0.83	0	0
Animal	Warthog	*Phacochoerus africanus*	82.50	5	4	0.80	2	0
Animal	Wild dog	*Lycaon pictus*	27.00	2	2	1.00	0	0
Animal	Zebra	*Equus quagga*	241.75	5	3	0.60	0	1
Fruit	Baobab	*Adansonia digitata*	–	8+	8	–	0	8
Fruit	Hlukwaiapi berry	*Grewia villosa*	–	4+	3	–	0	3
Fruit	Kongolobi berry	*Grewia bicolor*	–	22+	22	–	0	22
Fruit	Nguilabe berry	*Grewia capitellata*	–	3+	3	–	0	3
Fruit	Pawe	*Sclerocarya birrea*	–	2+	1	–	0	1
Fruit	Tl'atanabe berry	*Grewia pachycalyx*	–	1+	1	–	0	1
Fruit	Undushapi berry	*Cordia sinensis*	–	2+	2	–	0	0
Honey	Ba'alako honey	*Apis mellifera*	–	42	33	0.79	0	42
Honey	Kanowa honey	*Trigona ruspolii*	–	69	64	0.93	0	69
Honey	N!ateko honey	*Trigona erythra*	–	5	5	1.00	0	5

Table 1 (continued)

Food category	Species	Latin	Avg adult wt (kg)	*N* encounters	*N* pursuits	Fraction pursued	*N* arrow shots	*N* kills/ acquisitions
Honey	Tsunako honey	*Trigona gribodoi*	–	3	2	0.67	0	3
Subtotal	All large game		325.09	46	25	0.54	9	1
Subtotal	Small game of known encounters		6.76	139	107	0.77	41	13
Subtotal	All small game		4.56	186+	145	–	69	23
Subtotal	All fruit		NA	40+	40	–	NA	40
Subtotal	All honey		NA	119	104	0.87	NA	104

When we are confident we were able to record every visual encounter, the column "*N* encounters" provides a simple number. For those food types we calculate the fraction of the encounters that resulted in pursuits. When we were unable to record all visual encounters (smallest birds, squirrels, mice, and fruit), we note with a "+" that our tabulated encounters is a minimum number, and for these food types we do not calculate the fraction pursued. Average adult body weights from Estes 1991; Kingdon 2013; Oiseaux.net 2014. Details of how we define encounters and pursuits are provided in the ESM of the Hadza we observed, and it contradicts Hawkes and O'Connell's prior research on prey choice, in which they calculated prey profitabilities based on handling times of prey (Hawkes et al. 1982; O'Connell and Hawkes 1981). Below, we use measures of handling time from our follow data to estimate the time men spent handling resources that they brought to camp, described in our 2013 paper. We also calculate profitabilities of different food types in terms of their camp provisioning rates and household provisioning rates.

Our data show that men spent only 6.2% of their time out of camp handling large game. Using these data, the profitability of large game hunting, in terms of the total kilograms of flesh brought to camp (which we call "pre-sharing profitability"), can be more accurately estimated as follows:

- 0.46 kg of animal flesh brought to camp per hour spent out of camp (1.9 kg/4.1 h)
- 0.062 h spent handling large game per hour spent out of camp

Therefore, the expected pre-sharing profitability from pursuing large game is 7.4 kg/handling-hour (0.46 kg/0.062 handling-hour). This estimate of the pre-sharing profitability of large game hunting is more than 15 times higher than the rate Hawkes et al. compute under the incorrect assumption that men spent 100% of their time out of camp only searching for and handling large game. We can compare our profitability estimate, which is based on the weight of large game brought back to camp over 2,297 person-days of food returns, to the profitability of large game hunting observed solely within our much smaller sample of 40 focal follows. During our focal follows, subjects killed one large animal, a zebra, and 23 small animals (Table 1). At the zebra kill site, men ate approximately 3 kg of flesh from the head and ribs, and the rest of the carcass was carried back to the hunters' camp. The carcass weighed 152 kg at its arrival at camp. In terms of foods delivered to camp, the profitability of large game hunting can thus be calculated as 152 total kg/13.1 total hours of large game handling, or 11.6 kg/handling-hour. This value observed within our focal follows corresponds reasonably well to our estimate of 7.4 kg/handling-hour based on food returns. For large game, the post-sharing household provisioning rate can be calculated using food sharing data in Wood and Marlowe (2013) to be 1.33 kg/handling-hour (i.e., 7.4 kg * 0.18). In Table 2 we similarly calculate to-camp and to-household profitabilities for large game, small game, honey, and fruit.

Our estimate of the profitability of large game hunting for men's families is conservative. It does not include the food men consumed out of camp, which is the subject of a manuscript in preparation. It also does not include nutritional benefits that men's families may accrue by sharing with others. Hawkes et al. contest evidence for reciprocity in the meat sharing data they collected (Hawkes, O'Connell, and Blurton Jones 2001), but this issue is not yet settled (see Jaeggi and Gurven 2013). The fact that Hadza camps usually contain close relatives of the hunter means that men also accrue inclusive fitness benefits by sharing large game with their neighbors. We will take up these issues in greater detail in a subsequent publication.

Does Large Game Hunting Pose a Collective Action Problem?

Hawkes et al. (2014) repeatedly note that large game hunters provide benefits to people outside their household because of their meat sharing. Such patterns are not a sufficient

Table 2 Prey profitabilities

	Large game	Small game	Honey	Fruit
% of time out of camp men spent handling [food] in our follow data	6.2%	2.8%	15.9%	1.6%
Handling cost[a] (hours/day)	0.25	0.11	0.65	0.06
Men's acquisitions brought to camp (kcal/day) [b]	2,907	274	1,081	185
Pre-sharing profitability (kcal brought to camp/handling-hour)	11,436	2,387	1,658	2,820
Fraction of what is brought to camp consumed by men's households[b]	0.18	0.47	0.61	0.71
Profitability to men's households (kcal eaten in men's households/handling-hour)	2,058	1,121	1,011	2,002

[a] We assume here, as do Hawkes et al. (2014), that foragers spent on average 4.1 h per day out of camp

[b] From Wood and Marlowe 2013

basis upon which to claim that hunting large game poses a collective action problem. For the pursuit of large game to pose a collective action problem, it must provide a net benefit to other group members *and* it must impose a net cost upon the individual who pursues large game. For this to be true, from the standpoint of nuclear family provisioning, the pursuit of large game must lower the rate at which men deliver food to their households. Is this the case among the Hadza we observed? Certainly not. According to our estimates in Table 2, the pursuit of large game provides the highest expected rate of food delivery to men's households among the four resource types examined. Because of this, men seeking to maximize the flow of calories to their nuclear families should pursue large game. Hawkes et al. go to great lengths to argue that the Hadza men we observed were big game specialists, ignoring small game, and thus were lowering the rate at which they delivered food to their households in order to share more meat with others. Men's actual behavior, including their frequent pursuits of honey, small game, and fruit tabulated in Table 1, demonstrate that such a description doesn't match the reality we observed.

On Men's Foraging for Small Game, Honey, and Fruit

Given Hadza men's frequent pursuits of small game, honey, and fruit during our study period, it is worth reevaluating the basis for Hawkes et al.'s claims that both the men we observed and those they observed were large game specialists. Concerning our study period, the data we have provided here and in our 2013 paper clearly refute this idea. We agree with Hawkes et al. that because men frequently pursued foods other than large game, they provided a more reliable flow of calories to their households than they would have if they had specialized in just hunting large game. The behavior we observed was thus in line with the goal of family provisioning, as specified by Hawkes et al. (2014):

men would bring more to their own households—but less for the collective—if they regularly pursued small game.

Indeed they did. What about their claim that men during *their* study period were large game specialists? On closer inspection, the empirical basis for this claim is weak. Hawkes et al. have never published quantitative data such as that provided here, tabulating all the food types that men encountered, or pursued, or shot at with arrows during their naturalistic focal follows, nor quantitative data describing how men acquired and shared small game, honey, or fruit. Nor have they provided quantitative data comparable to that in our 2013 paper, describing all the foods men brought back to the camps they observed. Publishing such data would be helpful for understanding whether and possibly why Hadza men's foraging behavior has changed between our two studies. In our 2013 paper we proposed the hypothesis that large game depletion might have led to a shift in men's prey choice decisions. We suggest again that Hawkes et al. should publish their data describing all the foods men encountered, pursued, acquired, and brought to their households if these data exist. Providing these basic quantitative data would be much more useful than providing yet more elaborate "models" of men's behavior. Doing so would allow the large game depletion hypothesis to be tested, and would more generally help establish what Hadza men were doing during their study period.

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Methodological Differences in the Measurement of Household Shares

Hawkes et al. (2014) describe a few differences between our methods of tallying household shares of large game and theirs. The primary differences are that in our (2013) article we report the gross weight of all shares, whereas Hawkes et al. (2001) report estimated “flesh weights,” which are more precisely the estimated weights of muscle and fat. Their system of accounting excludes many parts of carcasses that the Hadza eagerly consume, including skin, organs, marrow, and grease. They also note that they reported only those shares received by houses containing married couples, whereas we reported shares retained by all households. They neglect to mention another difference in our methods, which is that *they did not in fact weigh 36% (38/105) of the household shares in their meat sharing sample* (Hawkes et al. 2001:136) but instead estimated these share weights. They write that they used values in Blumenschine and Caro (1986) to estimate both the gross and flesh weights of their unweighed shares of impala and eland, and that they used a still-unpublished manuscript to estimate weights of their unweighed zebra shares. They have never explained how they estimated the weights of their unweighed warthog shares (carcass #29), nor have they explained how they estimated flesh weights of their eland (carcass #37) by applying values from the study of Blumenschine and Caro (1986), which did not include estimates of eland flesh weights. This is an important concern because Blumenschine and Caro caution that there are significant differences in element flesh weights/fractions between species. Eland are morphologically quite distinct from both impala and Thompson’s gazelle, the species that appear in Blumenschine and Caro's study. Because Hawkes et al. did not weigh many of their household shares, it is incorrect for them to write in their current article that they have recalculated producer’s household’s shares as proportions of the “total **weighed** at all hunters’ households.” In fact, their methods introduced error in two ways: (1) estimating the original gross weight of shares and (2) estimating what the “flesh weight” for that estimated gross weight was. To avoid such errors we used spring scales to weigh every share of large game and analyzed these gross weights. Of course, different carcass elements do vary in caloric value per kilogram, so we investigated in our 2013 paper the value of elements kept by hunters. We found that (successful) hunter’s households were much more likely to keep high-value parts, including the hind limbs, which have the highest fractions of edible weight among carcass elements. So not only did hunters keep heavier shares for their households, they also kept better shares.

When Hawkes et al. (2014) attempt to reconstruct the gross weights of their household shares, it is notable that producers in their camps in fact were keeping heavier shares than what other men in camp were receiving, which runs contrary to their notion that large game kills were distributed like “collective goods.”

They tell an imaginative story about why hunters in their sample who killed game larger than 180 kg were observed to retain larger shares than others. According to their story, news of a kill spread to other camps and was “usually identified by the name of the successful hunter,” which led visitors to arrive in camp and put pressure solely on the successful hunter to share. Hunters are portrayed as anticipating such behavior, and then amassing larger shares ahead of time in order to share with the expected visitors. They provide no data to back up this “arguable” scenario. They also provide no reason why hunters could in such situations wrest larger shares from their neighbors, whereas in all other circumstances, the dynamic of tolerated theft is said to have prevailed. In our experience, kills in neighboring camps have not been identified by the hunter but simply by the word *manako* (meat) and perhaps the name of the camp or the species of animal killed. For visitors traveling to a camp known to have meat, it takes less than a minute for them to walk around from house to house and see who has meat and ask those who do to share. We had Hawkes's imaginative story in mind when we collected our data, and thus we noted whenever visitors arrived in camp and took away raw meat from recent kills. Our results show that even after adjusting for this sharing with visitors, successful hunters retained much more of their kill than they gave to other households in the camp.

The Importance of Skins

The second reason they provide for why our studies might differ has to do with accounting for skins. We learn that during their periods of observation, hunters who killed large game often kept the skins, just as we found. It is remarkable that they never reported this fact in their prior writings, given that such data strike at the core of determining whether men are capable of exerting any control over large game distributions, and for understanding what benefits good hunters deliver to their families. Interestingly, Kalahari foragers are reported to practice this same norm, in which successful hunters keep the skins of large game (Tanaka 1980). Carrying devices and clothing—which many foragers make from animal skins—are two of the most important developments in human technological evolution. The Hadza today continue to use skins for carrying devices, clothing, sleeping surfaces, work surfaces, and for the manufacture of various leather tools. Without a doubt, skins are a highly valuable part of animal carcasses for the Hadza today, and probably were even more so in the past. Our interest in the distribution of skins was rooted in trying to understanding how access to valuable parts of an animal carcass is organized among the Hadza. The fact that hunters keep skins much more frequently than others is a clear indication that men are privileged in their rights to the spoils of their own kills. Hawkes et al. (2014) acknowledge that a similar pattern occurred during their period of study, although they never mentioned this fact in their previous articles. Concerning this omission, Hawkes et al. write that they were only interested in tallying and reporting "edible portions" of large game kills. We are skeptical. First, if they were focused on edible portions, why did they exclude from all their analyses the weights of organs, marrow, and grease, which the Hadza certainly eat? Second, O'Connell, Hawkes, and Blurton Jones (1988) note in great detail the importance of skins to the Hadza, and the fact that *skins are edible*—they wrote that skins of many large game are "pounded with rocks, lightly roasted, and eaten" (1988:120). That impala and kudu skins are edible but are in practice seldom consumed *simply indicates that they are more valuable as leather than as food*.

Household Size

The third reason they provide for why our studies might differ is "household size." This is an odd claim because their analysis of meat sharing and ours treated household size in exactly the same manner: we both ignored it. None of our analyses, nor theirs, controls for or tests for effects of variation in household size. Therefore this cannot be why our results differ. This is not to say that household size did not affect sharing outcomes in each of our studies, but for this to be a mediating factor for why our studies differ, we would have needed to have treated this variable differently in our analyses. When we exclude non-nuclear-family households from our analyses, and thus analyze the same set of household types as they included in their analyses, evidence for a producer advantage remains clear: hunters kept shares that were eight times heavier than what other nuclear family households in camp received (Wood and Marlowe 2013:310-311).

Big Game Specialists?

Hawkes et al. claim that *we* have not provided sufficient data to know whether the men we observed generally ignored small game or not, when in fact the food returns data in Table 4 of Wood and Marlowe (2013) exceeds in detail any data their team has provided covering their periods of research. Based on their less-comprehensive data, their team has had no qualms about claiming that the Hadza men they observed were big game specialists. The data in Table 1 provided in this article confirms that the men we observed regularly pursued foods other than large game and should put this question to rest.

Although they critique the data in our 2013 paper for *underestimating* men's small game acquisition rates, to the degree that this bias is present, it only strengthens our claim that the Hadza men we observed were not big game specialists. Hawkes and O'Connell (1992:63) define specializing on a particular resource as "searching for and handling only that resource." In their current article, in responding to the data we published in 2013 showing that men did not just search for and handle large game, Hawkes et al. now provide a revised definition of what they mean by "big game specialist." They now claim that the Hadza we observed in fact *were* big game specialists because they "did not hunt as much small game as possible." This is not the definition that they employed in prior writings:

> Hadza hunters disregard small prey in favour of larger forms (mean adult mass ~40 kg) (Hawkes et al. 1991:243).
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> [Hadza] take big game to the virtual exclusion of small-bodied prey" (Hawkes et al. 1991:243).
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> Unlike the !Kung, Hadza men are also specialized big-game hunters, taking prey ranging in size from impala to giraffe with bows and metal-tipped poisoned arrows (Hawkes 1993:344).

Our data certainly do not "echo" these characterizations of the Hadza. Hawkes and colleagues have contrasted the Hadza (as big game specialists) with the !Kung, who were depicted as generalist foragers who frequently killed small game (Hawkes 1993; Hawkes et al. 1991). If one were to apply their new definition of a big game specialist, the !Kung would now also be considered big game specialists because they did not "hunt as much small game as possible."

Rather than redefining the qualitative terms of their analyses, a more useful response by their team would have been to provide quantitative data, comparable to what we provided in our 2013 paper, and what we provide here. For these discussions to be useful, Hawkes et al. should provide the data necessary to establish the reality of what men were actually doing during their period of observation. How often did men encounter or pursue large game, small game, fruit, and honey? How often did they bring all these foods back to their camp, and households? How were all these foods shared? In the 30 years since their research began, Hawkes et al. have yet to provide the basic data needed to answer these questions.

How We Define Encounters, Pursuits, and Handling Times

An encounter is here defined as a direct visual encounter with a potential food item. In the case of encounters with animals, a pursuit is a change in the forager's behavior indicating a goal of killing the prey. At its most subtle and brief, this can take the form of a forager freezing in his tracks, staring in the direction of the prey item, remaining still and quiet, readying his weapon. Readying his weapon means shifting his bow in his hand to facilitate shooting—including selecting an arrow, lifting the bow, knocking an arrow, and drawing his bow. Pursuits nearly always cause a sudden shift in the hunter's style of travel—from a simple walking gait to a frozen stance or a crouched, quieter stalking gait to facilitate getting closer to the prey item. The briefest pursuits are often of dik-dik and birds—they can occur within a few seconds. In these cases, a typical sequence involves the hunter spotting a dik-dik, which immediately causes the hunter to focus on the animal, stop in his tracks, and ready his weapon. If the dik-dik spots the forager, it will race away out of the hunter's visual range. When dik-diks run away, hunters abandon their pursuits. In discussions with BW, Hadza men have told him that pursuits of alerted dik-dik are futile—and that after spotting a hunter, dik-dik run faster and farther away than larger ungulates do. Likewise, when birds (helmeted guinea fowl, doves, quails, etc.) detect hunters and fly away, pursuits are abandoned. In other cases, if a hunter is able to spot a prey item but the animal is still unaware of the hunter's presence, the pursuit will continue until either the prey detects the hunter or the hunter shoots an arrow at the animal. If the shot misses, the animal is usually spooked by the arrow and flees. Very rarely, a second shot might be possible.

Handling times for species include the duration of both unsuccessful and successful pursuits, and in the case of successful pursuits, processing times. The duration of a (failed) pursuit is from the time the initial visual contact occurred to the time the hunter resumes his other activities; the duration of a successful pursuit is the time from the first visual contact to the killing and thereafter to processing the prey item for transport. Often the first visual contact that a hunter has with a prey item is when the animal is already fleeing—having sensed the hunter before the hunter spotted the prey item. In these cases, the first thing the hunter sees or hears is of an animal running or flying away. These are tallied as encounters, but such encounters of fleeing prey items very rarely result a pursuit by the hunter. Instead, in these cases the hunter often takes note of the prey item but does not alter his travel behavior or ready his weapon with an intent to kill. When men return to camps, they often tell other men of such encounters, noting the location and species of animal, and thus share information that might be useful to other hunters at later times.

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