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Child and adolescent foraging: New directions in evolutionary research

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Abstract

Young children and adolescents in subsistence societies forage for a wide range of resources. They often target child-specific foods, they can be very successful foragers, and they share their produce widely within and outside of their nuclear family. At the same time, while foraging, they face risky situations and are exposed to diseases that can influence their immune development. However, children's foraging has largely been explained in light of their future (adult) behavior. Here, we reinterpret findings from human behavioral ecology, evolutionary medicine and cultural evolution to center foraging children's contributions to life history evolution, community resilience and immune development. We highlight the need to foreground immediate alongside delayed benefits and costs of foraging, including inclusive fitness benefits, when discussing children's food production from an evolutionary perspective. We conclude by recommending that researchers carefully consider children's social and ecological context, develop cross-cultural perspectives, and incorporate children's foraging into Indigenous sovereignty discourse.

KEYWORDS

childhood evolution, children, community resilience, foraging, immune development, inclusive fitness

1 | INTRODUCTION

In this paper, we draw on our collective expertise in human life history theory, cultural evolution, evolutionary medicine, and applied participatory research to outline new and underexplored avenues for future inquiry regarding the ontogeny and evolutionary implications of child and adolescent foraging. Research aimed at understanding the evolution of human subsistence has overwhelmingly conceived of childhood as an extended period for learning, and by extension, a life history phase shaped by selective pressures encountered in

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adulthood.[1] Yet, from an evolutionary perspective, child and adolescent foraging should not only confer delayed adaptive benefits, but immediate ones as well. First, because of their pre-reproductive status, the force of natural selection is expected to be stronger for traits that help children and adolescents reach maturity than for traits that increase fertility.[2,3] Second, the benefits of achieving high adult levels of foraging proficiency is unlikely to come at the cost of adverse behaviors in childhood (i.e., temporal discounting[4]). Together, these perspectives compel us to consider child and adolescent foraging—not only *how much* they collect, but also *what* they target, and with *whom* they share—as ontogenetic adaptations which confer immediate adaptive benefit.[5] To do so, we first summarize main findings from previous research regarding juvenile foraging participation and production. Then, we reinterpret these findings to raise three distinct issues for future evolutionary work: children's contributions to human life history evolution, community resilience, and finally pathogen transmission and immune development. We conclude by recommending that researchers carefully consider children's social and ecological context when characterizing individual immediate and inclusive fitness benefits and costs. We also suggest that children's foraging has implications for Indigenous sovereignty, and for predictive modeling of community resilience and human adaptation to climate change.

2 | JUVENILE FORAGING PARTICIPATION

Cross-cultural studies suggest that in subsistence communities, juveniles are subsidized until their mid- to late-teens.[6,7] Further, foraging returns overall increase with age, with proficiency at the most complex tasks (tuber digging, large game hunting) peaking in adulthood.[8–11] These findings have been interpreted as suggesting that childhood is devoted to acquiring adult subsistence skills. Much less research has focused on how child and adolescent foraging is adapted to immediate environmental, physical, cognitive, and social opportunities and constraints (see references[12–14] for exceptions). For example, children among the Australian Martu and Mikea in Madagascar target lizards and tuber species that are appropriate for their smaller size, lesser strength, and slower walking speed.[15,16] In some societies, such as the Tanzanian Hadza, children aged 3–12 years spend between 5 (girls) and 6.5 (boys) hours a day foraging,[17] and they often produce a surplus of some resources, such as baobab and fig fruit.[18,19] Even in societies where children's subsistence contribution is notably low, such as among the Kalahari !Kung San and the Venezuelan Savannah Pumé, children spend between 1 and 2 h/day foraging.[20,21] Even limited foraging may supplement children's own diets, and that of their families.

Beyond self-provisioning, children and adolescents derive a variety of other immediate benefits from foraging. They learn through play, participation, teaching, and experimentation with adults and peers during foraging excursions.[22–28] They can also acquire social status as successful, albeit young, foragers.[29] Yet, foraging may also carry immediate costs: children risk injury, are exposed to diseases, and expend time and energy which could be invested in somatic growth or social capital acquisition. For example, Savannah Pumé girls invest the energy they save from reduced activity levels into somatic growth.[21] To correctly assess the evolutionary drivers of child and adolescent foraging, in this paper we broaden the spectrum with regard to defining the immediate costs and benefits associated with this activity, to help correctly estimate the (inclusive) fitness benefits that children derive from foraging.

3 | HUMAN LIFE HISTORY EVOLUTION

Most evolutionary explanations for the emergence of modern human life history focus on downward transfers of resources from reproductive or post-reproductive adults to children.[1,30] For example, the Embodied Capital Model[1] outlines how our species' reliance on technologically-assisted hunting and gathering favored long childhoods as a protracted and dedicated period for learning these complex foraging skills. Support for this model emphasizes that adults, particularly men, overproduce food that is transferred to children. In this section, we argue that these models overlook the significant contributions that children make to childcare and resource production, and we chart a path forward for incorporating these observations into human life history research.

While provisioning weaned children is a defining feature of human evolution, an equally derived trait in the hominin lineage is the sharing of resources and labor by children with their mothers, siblings, and others. In subsistence societies, children participate in economic tasks long before they achieve adult return rates.[12,20,21,27,31–33] In hunter-gatherer societies, children commonly forage for fruit, berries, shellfish, insects, honey from stingless bees, small game, birds, and reptiles (Figure 1), which may contribute substantially to their own calorie intake, and to that of others.[15,18] A wealth of ethnographic data also report that children in subsistence societies provide much of the alloparental care to infants and younger children.[34–38]

An additional explanation for the evolution of childhood is the Pooled Energy Model,[39] which can help to explain the constellation of human adult life history traits (short birth intervals, rapid reproduction, high fertility) while accounting for children's productive activities. Within this model, both children and adults draw from and contribute to pooled energy, such that activity budgets are linked across individuals within reproductive units (e.g., families). As a result, the calories that an individual needs to survive and grow as a child, and reproduce as an adult, are not bound by her/his capacity to produce that energy. If a juvenile contributes to the energy pool now, and cooperates to help support her/himself, then s/he receives an immediate fitness benefit rather than having to delay until fully grown. In other words, children can make the best of growing slowly by leveraging their nonreproductive status into a higher reproductive potential for their mothers and, via their siblings, indirectly for

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FIGURE 1 (a) Mikea child in Madagascar digging for tubers. Courtesy of Bram Tucker. (b) Pemba black bellied starling (*Notopholia corusca* ssp. *vaughan*) captured with the use of sticky traps made with the bungo vine latex (*Saba comorensis*). Note remainings of glue on the feathers. Pemba, Zanzibar. Ilaria Pretelli. (c) Striped grass mouse or zebra mouse (*Lemniscomys striatus*) hunted by Bateke children in the forest-savannah edge using small nets set up on the ground, in Bolobo territory, Mai Ndombe province, Western DRC. Courtesy of Romain Duda. (d) Malaysian Batek children line-fishing. Courtesy of Kirk Endicott and Vivek Venkataraman. (e) Building traps for blue duikers (*Philantomba monticola pembae*) in Pemba, Zanzibar. Ilaria Pretelli.

themselves.[40–42] This time-discounting advantage of contributing to the energy pool may be important in ancestral and contemporary environments where mortality is high, where as many as 35% of children may not live long enough to reproduce, but benefit through indirect reproductive effort.[39]

4 | COMMUNITY RESILIENCE

While previous research has focused on what children *do not* specialize in (i.e., difficult-to-collect resources such as large game or deep tubers), in this section we focus on what children *do* specialize in: fruit, rodents, shallow tubers, and especially, perching and other small birds (Figure 1). We argue that children's foraging helps to maintain knowledge practices which fall outside of everyday use. We suggest that such knowledge may be called upon to help buffer communities against food insecurity during periods of resource scarcity.[43]

Much of children's foraging occurs in the context of play,[18] and as a result, collected food is not always consumed. Among Mikea, children specialize in the collection of *ovy* tubers, which are smaller and shallower than those usually collected by adults,[16] (see Figure 1a). In one instance, children participated in a food fight which destroyed several kilograms of *ovy*[16] conclude that rather than doing so purely to produce food, "children forage for the physical and mental challenge, and because it is an enjoyable social activity." Play, in this context, can be interpreted as an adaptive feature of childhood evolution, as it allows for explorative cognitive patterns that increase novel solutions for behavioral problems, in a period of life when the costs of failure are mitigated by adult provisioning.[44] Exploration and specialization are highlighted by Gallois and colleagues,[45] who, during a free-listing task which asked participants to name all the species they knew, observed that Cameroonian Baka children listed birds, mice, fish, mushrooms, caterpillars, and fruit species that adults never did. This distinct knowledge was intimately related to child-only hunting and collecting strategies, which resulted in distinct ecological knowledge.[15,46] As one adult respondent noted: "Children have their own knowledge about mice. They are always inventing new names!"[45]

Of note is children's special foraging relationship to perching and other small birds. For example, Crittenden[18] describes the production of 'sticky traps' which are used by Tanzanian Hadza children to collect weaver birds (similar sticky traps are used elsewhere in Tanzania, Figure 1b). While these are sometimes eaten, they are also threaded into necklaces, an ultimate example of children 'playing with their food'. Small birds are also often the target of boys' bow-and-arrow

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hunting around camp.[18] Baka and Congolese BaYaka children regularly collect wild rubber and clay to produce slingshots and pellets, which they use to hunt songbirds.[45,47] While adults do hunt larger game birds,[48] small bird hunting is not usually practiced by adults. This is because capturing small birds is time consuming and rarely yields a significant amount of food. Further, in the Congo Basin, small birds are often considered intermediaries between humans and the supernatural world because of their capacity of flight and song, and thus, are usually prohibited food items for adults.[49] Yet, children in this region are not usually subject to these same food taboos. As a result, children tend to be custodians of bird-related knowledge. Considering that birds act as ecological indicators for other species, including elephants, pangolins, snakes, duikers, bees, and culturally-significant plants,[50,51] children's knowledge of perching and other small birds may not only facilitate their own attempts to collect them, but likely has direct implications for ecosystem tracking more generally.

Children's foraging niche specialization gains particular relevance during periods of food shortages, when children's unconstrained food collection easily transitions to exploitation. In the Logone region of Northern Cameroon, for example, a third of the resources consumed by children during periods of resource scarcity are self-provisioned snacks.[52] Crittenden and colleagues[53] similarly highlight the case of two Hadza children, six and ten, who collected 7000 and 10,000 kcals, respectively, of figs, reflecting a unique case in which their parents were unable to routinely provision their household. Children's foraging success during episodes of resource scarcity likely reflects two factors. First, children tend to target fallback foods, that is, "abundant foods of relatively low quality that are used during periods of low overall food availability."[54] Second, children tend to collect resources in zones that adults don't exploit, including rats and squirrels which live in settlements or in gardens.[55] Children not only collect food for themselves, but also share these resources within the peer group.[18,56,57] Further, in some forager communities from the Congo Basin, such as among the Kola of Southern Cameroon, children and elders are not subject to food taboos due to their pre- and post-reproductive status. As a result, elders receive prey from active hunters that reproductive adults are not allowed to eat, and children frequently join their elders for the consumption of this bushmeat.[58] But, children *also* share their own foraging returns with elders. This highlights the possibility that intergenerational relationships are not solely unidirectional,[30] with grandparents provisioning grandchildren, but bidirectional, with knowledge and resources being mutually exchanged.

In summary, while children's food collection is playful in times of resource plenty, in this section we have argued that it can significantly contribute to food security for themselves, peers, and in some cases, elders. Together, this research suggests that we must move beyond snapshots of food collecting, and toward longitudinal research which tracks children's foraging in the context of fluctuating seasonal variation in resources and during rarer periods of major resource shortfall.

5 | PATHOGEN TRANSMISSION AND IMMUNE DEVELOPMENT

Direct immediate costs can result from foraging, as trapping and hunting exposes hunters (women, men, children) to animal body fluids, a source of zoonotic diseases, through bites, manipulation, transport, and processing.[59,60] As outlined in the previous section, children may specialize in hunting small and ecologically resilient animals. More so than big game, such small prey may be reservoirs of zoonotic disease, thus possibly triggering pathogen transmission.[61–63] In this section, we argue that children's foraging has important implications for zoonotic disease transmission, and in turn, immune development.

The species children tend to hunt are often reservoirs for infectious disease. Descriptions of children's prey are rampant throughout the literature; setting traps for rats in the bush is described as "boy" activities,[64] small animals are repeatedly referred to as "children's meat"[45,60,65] (Figure 1c), and increased consumption of smaller animals (e.g., rodents and small primates) is reported for children in rural settings.[66] Children also tend to rely on a diversity of methods for catching small animals, such as smaller traps, digging burrows, catapults, poison, dogs, fire ant hill/bush, nets, and sticks[8,67–69] (see Figure 1e). While in southern Sierra Leone the smell of insectivorous bats precludes them from consumption, children will still hunt them and use them as playthings.[59] In areas where Lassa fever, a viral illness commonly transmitted by rats, is endemic, children bring home hunted prey and, before butchering, play with the dead animal, often joined by younger siblings.[60] When baby animals are caught, it is sometimes the responsibility of children to rear them to adulthood,[47,59] increasing exposure to highly stressed animals that may have increased viral shedding. As recognized companions, protectors, and hunting partners,[70–72] dogs accompany children and may increase multispecies contact, thus potentially representing a complex pathway for virus transmission.[73–75] Zootherapy treatments for children's specific illnesses, such as use of extracts or mixtures made from animal parts and by-products as enemas to treat weakness or stomach pain in Cross River State, Nigeria, provide additional exposure pathways.[76] While in some settings adults may report not wanting their children to hunt, considering it a low-merit livelihood,[65] for children, hunting is a moment of freedom without supervision from adults and high risk behaviors may thus be done in secret.[59,60,64] For example, in Lassa fever endemic regions, children were more ready to admit eating town and bush rats when interviewed in the absence of an adult.[64]

Despite their participation in hunting, children are usually left out of outbreak investigations of emergent virus spillovers.[62] Yet, data from case investigations in hospitals reported children with Ebola in Democratic Republic of the Congo[77] and Uganda.[78] Studies of Mpox, a zoonotic disease caused by a virus of the same family as smallpox, suggest that younger individuals, and specifically children, play an important role in introducing the animal host to communities,[63,79] for example, through exposure to the virus while interacting with squirrels and mice through playing, dismembering, or eating. In the

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case of Lassa fever, it has not been possible to correlate infection with activity and age, but antibodies against the virus have been detected in children of rodent hunting age.[60] In light of the fact that contact rates may likely increase as human-dominated ecosystems increase small mammalian host diversity,[80] future research should more explicitly explore the role of children's foraging in zoonotic disease emergence.

Infectious disease exposures through hunting practices may also play a key role in immune development for children and communities, underwriting a set of hypotheses for the role of hunting in human health. For example, Lassa virus infection can range from asymptomatic to acute hemorrhagic fever. Variation in the severity of illness may be due selection of genes associated with immunity.[81] The disease's antiquity and continual exposure to the rodent reservoir suggest Lassa infection was an important selective pressure. Repeated exposure to sublethal variants of the virus during childhood or high case numbers and fatality rates in children may help to explain variation in disease outcomes in adults. Behavioral research shows that children are in consistent contact with the rodent reservoir of Lassa fever through hunting[60,64] and seroprevalence studies of Lassa virus show that 5-year-old children already have antibodies to this disease.[82] However, it is unclear whether these were acquired via hunting or in domestic settings, or how long these antibodies last. Future research should explore the role of zoonotic diseases as selection pressures in hunting populations, and the role of children's hunting, and foraging more generally, in immune priming and development, especially in the context of zoonotic disease.

6 | CONCLUSION

In this paper, we foregrounded lesser explored immediate benefits and costs of child and adolescent foraging (Table 1). Specifically, we have highlighted that juvenile foraging can support the acquisition of specialized knowledge and skill, contribute to self-provisioning, and may affect immune development. Juvenile foraging may also be a key asset to communities through their cooperative activities, knowledge stewardship, and resource sharing during periods of scarcity. Finally, we have argued that children's foraging may bring them into contact with zoonotic diseases, thus reflecting the potentially severe risk that such food production entails. These considerations lead us to make three recommendations regarding evolutionary research on child and adolescent foraging.

First, while child and adolescent foraging is usually studied at the individual-level, foraging typically occurs in a social context. Children have heterogeneous opportunities to accompany adults and peers on foraging trips, and these opportunities are contingent not only on the benefits and costs to the children but also to potential foraging partners.[83] Incentives for forming foraging groups are often asymmetric among individuals,[84] and interests of children do not always align with those of other potential members of foraging parties. Moreover, opportunity costs associated with foraging impact children, their families, and their foraging partners, depending on what else a child could do instead of foraging, who benefits from foraging or from alternative activities, who else might be going foraging and so on, as well as on social benefits associated with foraging, such as status. While we have a reasonably clear

TABLE 1 Summary of the current state of the art concerning children foraging and future avenues for research.

Topic	Issue raised	Immediate benefit	Future research
Human life history evolution	Children's foraged products are important contributions to family budgets.	Inclusive fitness benefits, brought by increased parental reproductive success and siblings' survival, could have contributed to the evolution of childhood and interbirth intervals in our species.	Better estimate children's contribution to the family budget across cultural and ecological contexts. Summarize evidence on effect on sibling survival and parental reproduction. Model potential effect of childhood food production on human life history evolution.
Community resilience	Children are holders of specialized knowledge, and often are not subject to the same taboos as adults; they thus have access to a range of resources, many of which are fallback foods.	Children's foraging and resource selection could buffer against food shortages.	Explore the mechanisms by which knowledge of children-specific resources is transmitted. Estimate the relevance of children-specific foods on food security.
Pathogen transmission and immune development	Children's foraging activities create entry points for zoonotic diseases.	Selective pressures on survival may be dependent on the development of immunocompetence via foraging.	Understand the development of the immune system in response to high zoonotic pathogen exposure in relation to food production. Investigate the role of children's hunting in multispecies virus transmission.

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understanding of the processes determining foraging success *during* foraging (optimal foraging theory, individual-level traits,[15] the mechanisms influencing the decision *to go* foraging are much less clear and depend on a plethora of interconnected factors (see Figure 2 for a conceptual summary). In line with the pooled energy budget model, a holistic approach that places children's behaviors in the framework of their families and communities is needed. This is especially relevant in riskier ecologies, where the presence of adults may mitigate against environmental hazards, thus maximizing children's immediate individual (e.g., self-provisioning) and inclusive (e.g., sharing with sibling) benefits while minimizing potential costs (e.g., injury). While it is often difficult to reflect the complexity of foraging in data collection and analytical models, it is important to consider opportunity costs for *both* caregivers *and* children when making inferences concerning the immediate and deferred adaptive value of children foraging activities.

Second, social context shapes the immediate costs and benefits of children's foraging, and by extension, opportunity costs. Yet, the potential heterogeneity of these social dynamics across study sites complicates research into foraging skill and efficiency among children.[10] Diversity in foraging behaviors emerges as a consequence of community ecology and culture, while underlying similarities in cognitive and developmental processes generate generalizable patterns. Researchers aiming at studying children's foraging should, on the one hand, identify shared aspects of this behavior, while, on the other hand, define how this responds to environmental and cultural variation. To do so, it is key to prioritize careful longitudinal data collection and statistical modeling to discount the possibility that observed effects could be the by-product of unaddressed confounds. These longitudinal studies should ideally be carried out in a representative sample of societies, varying in subsistence strategy and ecological setting, and paired with ethnographic observations to contextualize behaviors within their cultural framework.

Finally, it is increasingly noted that evolutionary models must be applied to current and future adaptive problems.[87] For many Indigenous communities, foraging is not only a means of subsistence, but of resistance, through which access and relationship with traditional territories are maintained,[88] and food collection and

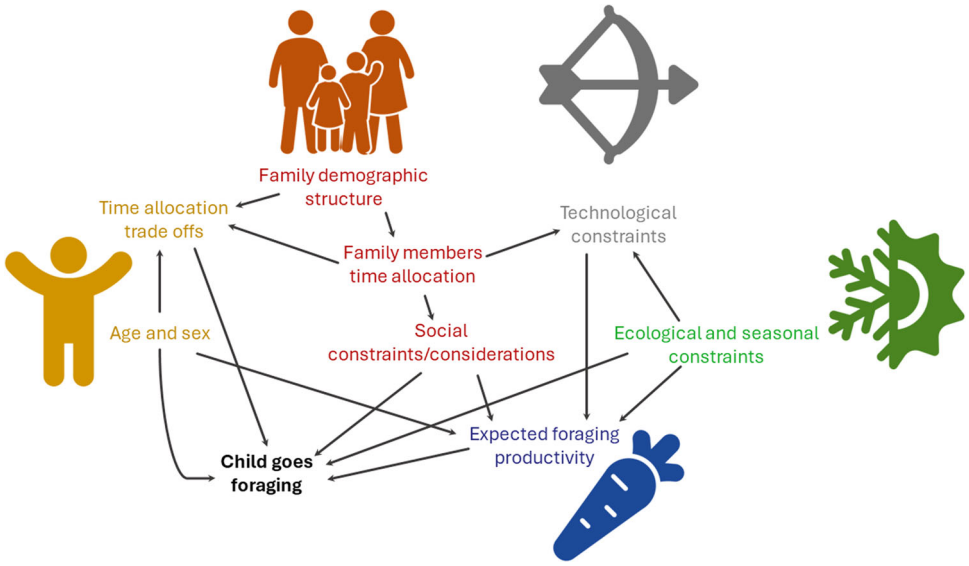

FIGURE 2 The decision making processes that lead to children engaging in foraging involve many different factors. In addition to risks or norms associated with foraging, which limit the participation of children of a certain age or sex to specific forms of foraging, and ecological and seasonal variability that influence expected foraging returns, a large component is represented by the social and familial situation. When considering whether to forage or not, a child will not only take into account whether the activity is age and sex appropriate, or whether the specific resource is available at a specific point in time, but will also weigh foraging against alternative activities that might yield other kinds of benefits to themselves and their families. These activities in turn depend on the demographic structure of their family (e.g. is there someone else who can fetch water? Is there a baby to care for?) and the tradeoffs of not performing them is a limit to the free time a child can dedicate to foraging. Moreover, according to their own cost–benefit considerations, all the other members of the family will decide how to allocate their time, and this has implications for children's likelihood to forage. For example, a boy might decide to go fishing if a boat is available (i.e., no-one else took it), or he may accompany his father, who can paddle him to a good fishing spot, while it will not be in his immediate interest to expend energy finishing for low yields in a spot near home. To complicate things, other individuals, external to a child's family, are relevant too; for example a mixed-age playgroup might decide to go foraging only if a skilled individual joins the party, as the trip will likely yield higher returns for everyone.[85] These factors potentially generate a strong selection bias in sampling, as children who decide not to forage are not going to appear in records of foraging returns, which is something researchers need to consider when analyzing foraging returns data. Overall, to characterize the immediate costs and benefits associated with children and adolescent foraging, researchers must expand their frame of inquiry to account for the social and ecological environment in which children grow up, and short- and long-term changes within these environments. Directed Acyclic Graphs such as this one are useful for illustrating the variables that must be measured to obtain unbiased estimates in subsequent statistical modeling.[86]

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preparation techniques are transmitted.[89,90] Our paper shows that children play a central role in community nutrition, at least at key moments of food scarcity. Further, children's playful foraging may generate new knowledge which may help communities adapt to increasingly radical ecological change.

Diets of almost all contemporary foraging communities are undergoing rapid transition due to myriad factors such as globalization, government policies, land grabbing, and climate change, threatening the relationships between Indigenous communities and their local environment.[91–93] There has been a recent call to study communities in transition, particularly current and formerly foraging communities[94] to better understand the impact of changes on dietary breadth, choice, health, and identity. A changing dietary landscape is necessarily tethered to food sovereignty, defined here as "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agricultural systems."[95] As children are the future stewards of the planet, their activities must be recognized in discourse surrounding climate change, land rights, and Indigenous sovereignty, and incorporated into models aimed at predicting and bolstering food security,[96] and mitigating against zoonotic spillover[97] in the face of climate change.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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REFERENCES

1. Kaplan, H., Hill, K., Lancaster, J., & Hurtado, A. M. (2000). A theory of human life history evolution: Diet, intelligence, and longevity. *Evolutionary Anthropology: Issues, News, and Reviews*, 9(4), 30.
2. Frankenhuis, W. E., & Amir, D. (2022). What is the expected human childhood? Insights from evolutionary anthropology. *Development and Psychopathology*, 34(2), 473–497. https://doi.org/10.1017/S0954579421001401
3. Hamilton, W. D. (1966). The moulding of senescence by natural selection. *Journal of Theoretical Biology*, 12(1), 12–45. https://doi.org/10.1016/0022-5193(66)90184-6
4. Villmoare, B., Klein, D., Lienard, P., & McHale, T. (2023). *The evolutionary origins of temporal discounting: An adaptive peak model shows how time and uncertainty impose constraints on selection for optimal decision-making in a temporal framework*. https://doi.org/10.21203/rs.3.rs-2515272/v1
5. Bjorklund, D. F., & Pellegrini, A. D. (2000). Child development and evolutionary psychology. *Child Development*, 71(6), 1687–1708.
6. Kaplan, H. (1996). A theory of fertility and parental investment in traditional and modern human societies. *American Journal of Physical Anthropology*, 101(S23), 91–135. https://doi.org/10.1002/(sici)1096-8644(1996)23+%3C91::aid-ajpa4%3E3.0.co;2-c
7. Kramer, K. L. (2005). Production and consumption across the life course. In *Maya children* (pp. 123–136). Harvard University Press.
8. Gurven, M., Kaplan, H., & Gutierrez, M. (2006). How long does it take to become a proficient hunter? Implications for the evolution of extended development and long life span. *Journal of Human Evolution*, 51(5), 454–470. https://doi.org/10.1016/j.jhevol.2006.05.003
9. Koster, J., McElreath, R., Hill, K., Yu, D., Shepard, G., Van Vliet, N., Gurven, M., Trumble, B., Bird, R. B., Bird, D., Codding, B., Coad, L., Pacheco-Cobos, L., Winterhalder, B., Lupo, K., Schmitt, D., Sillitoe, P., Franzen, M., Alvard, M., … Ross, C. (2020). The life history of human foraging: Cross-cultural and individual variation. *Science Advances*, 6(26), 1–8. https://doi.org/10.1126/sciadv.aax9070
10. Pretelli, I., Ringen, E., & Lew-Levy, S. (2022). Foraging complexity and the evolution of childhood. *Science Advances*, 8, eabn9889. https://doi.org/10.1126/sciadv.abn9889
11. Walker, R., Hill, K., Kaplan, H., & McMillan, G. (2002). Age-dependency in hunting ability among the Ache of eastern Paraguay. *Journal of Human Evolution*, 42(6), 639–657. https://doi.org/10.1006/jhev.2001.0541
12. Blurton Jones, N. G., Hawkes, K., & O'Connell, J. F. (1989). Modelling and measuring the costs of children in two foraging societies. In V. Staden & R. Foley (Eds.), *Comparative Socioecology, the behavioural ecology of humans and othermammals* (pp. 367–390). Blackwell Scientific Publications.
13. Bock, J. (2002). Learning, life history, and productivity: Children's lives in the Okavango Delta, Botswana. *Human Nature*, 13(2), 161–197. https://doi.org/10.1007/s12110-002-1007-4
14. Lew-Levy, S., Reckin, R., Kissler, S. M., Pretelli, I., Boyette, A. H., Crittenden, A. N., Hagen, R., Haas, R., Kramer, K., Koster, J., O'Brien, M. J., Sonoda, K., Surovell, T. A., Stieglitz, J., Tucker, B., Lavi, N., Ellis-Davies, K., & Davis, H. E. (2022). Socioecology shapes child and adolescent time allocation in twelve hunter-gatherer and mixed-subsistence forager societies. *Scientific Reports*, 12(1), 8054. https://doi.org/10.1038/s41598-022-12217-1
15. Bird, D. W., & Bliege Bird, R. (2005). Mardu children's hunting strategies in the Western Desert, Australia: Foraging and the evolution of human life histories. In B. S. Hewlett (Ed.), *Hunter gatherer childhoods* (pp. 129–146). AldineTransaction.
16. Tucker, B., & Young, A. G. (2005). Growing Up Mikea Children's Time Allocation and Tuber Foraging in Southwestern Madagascar. In B. S. Hewlett & M. E. Lamb (Eds.), *Hunter-gatherer childhoods* (pp. 147–171). AldineTransactions.
17. Hawkes, K., O'Connell, J. F., & Blurton Jones, N. G. (1997). Hadza women's time allocation, offspring provisioning, and the evolution of long postmenopausal life spans. *Current Anthropology*, 38(4), 551–577. https://doi.org/10.1086/204646

15206505, 2024, 2, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/evan.22020 by University Of Utah, Wiley Online Library on [15/06/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

18. Crittenden, A. N. (2016). Children's foraging and play among the Hadza. In C. L. Meehan & A. N. Crittenden (Eds.), *Origins and implications of the evolution of childhood* (pp. 155–172). University of New Mexico Press. https://books.google.it/books?hl=en&lr=&id=pC2yCwAAQBAJ&oi=fnd&pg=PA155&dq=%5B18%5D%09Alyssa+N.+Crittenden.++Children%27s+foraging+and+play+among+the+Hadza.++Origins++and++implications+of+the+evolution+of+childhood,&ots=hO56qosGTD&sig=sknTo_OI9P-1yv82FjnX-x
19. Froehle, A. W., Kilian Wells, G., Pollom, T. R., Mabulla, A. Z. P., Lew-Levy, S., & Crittenden, A. N. (2019). Physical activity and time budgets of Hadza forager children: Implications for self-provisioning and the ontogeny of the sexual division of labor. *American Journal of Human Biology*, 31(1), e23209. https://doi.org/10.1002/ajhb.23209
20. Draper, P., & Cashdan, E. (1988). Technological change and child behavior among the!Kung. *Ethnology*, 27(4), 339. https://doi.org/10.2307/3773398
21. Kramer, K. L., & Greaves, R. D. (2011). Juvenile subsistence effort, activity levels, and growth patterns. *Human Nature*, 22(3), 303. https://doi.org/10.1007/s12110-011-9122-8
22. Bock, J., & Johnson, S. E. (2004). Subsistence ecology and play among the okavango delta peoples of botswana. *Human Nature*, 15(1), 63–81. https://doi.org/10.1007/s12110-004-1004-x
23. Boyette, A. H. (2016). Children's play and culture learning in an Egalitarian foraging society. *Child Development*, 87(3), 759–769. https://doi.org/10.1111/cdev.12496
24. Fouts, H. N., Neitzel, C. L., & Bader, L. R. (2016). Work-themed play among young children in foraging and farming communities in Central Africa. *Behaviour*, 153(6–7), 663–691.
25. Hewlett, B. S., Fouts, H. N., Boyette, A. H., & Hewlett, B. L. (2011). Social learning among Congo Basin hunter–gatherers. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 366(1567), 1168–1178. https://doi.org/10.1098/rstb.2010.0373
26. Kline, M. A., Boyd, R., & Henrich, J. (2013). Teaching and the life history of cultural transmission in Fijian villages. *Human Nature*, 24(4), 351–374. https://doi.org/10.1007/s12110-013-9180-1
27. Kramer, K. L. (2021). Childhood teaching and learning among Savanna Pumé hunter-gatherers mismatch between foraging and postindustrial societies. *Human Nature*, 32(1), 87–114. https://doi.org/10.1007/s12110-021-09392-x
28. Lew-Levy, S., Reckin, R., Lavi, N., Cristóbal-Azkarate, J., & Ellis-Davies, K. (2017). How do hunter-gatherer children learn subsistence skills? *Human Nature*, 28(4), 367–394. https://doi.org/10.1007/s12110-017-9302-2
29. Gurven, M., & von Rueden, C. (2006). Hunting, social status and biological fitness. *Social Biology*, 53(1–2), 81–99. https://doi.org/10.1080/19485565.2006.9989118
30. Hawkes, K., O'Connell, J. F., Blurton Jones, N., Alvarez, H., & Charnov, E. L. (1998). Grandmothering, menopause, and the evolution of human life histories. *Proceedings of the National Academy of Sciences of the United States of America*, 95(3), 1336–1339. https://doi.org/10.1073/pnas.95.3.1336
31. Hawkes, K., O'Connell, J. F., & Blurton Jones, N. (1995). Hadza children's foraging: Juvenile dependency, social arrangements, and mobility among hunter-gatherers. *Current Anthropology*, 36(4), 688–700. https://doi.org/10.1086/204420
32. Lee, R. B. (1979). *The! Kung San: Men, women and work in a foraging society*. Cambridge University Press.
33. Blurton Jones, N. G., Hawkes, K., & OConnell, J. F. (1997). Why do Hazda children forage? In N. L. Segal, G. E. Weisfeld, & C. C. Weisfeld (Eds.), *Uniting psychology and biology: Integrative perspectives on human development* (pp. 279–313). American Psychological Association.
34. Crittenden, A. N., & Marlowe, F. W. (2008). Allomaternal care among the Hadza of Tanzania. *Human Nature*, 19(3), 249–262. https://doi.org/10.1007/s12110-008-9043-3
35. Jang, H., Janmaat, K. R. L., Kandza, V., & Boyette, A. H. (2022). Girls in early childhood increase food returns of nursing women during subsistence activities of the BaYaka in the Republic of Congo. *Proceedings of the Royal Society B: Biological Sciences*, *289*(1987), 20221407. https://doi.org/10.1098/rspb.2022.1407
36. Kramer, K. L., & Veile, A. (2018). Infant allocare in traditional societies. *Physiology & Behavior*, 193, 117–126. https://doi.org/10.1016/j.physbeh.2018.02.054
37. Page, A. E., Emmott, E. H., Dyble, M., Smith, D., Chaudhary, N., Viguier, S., & Migliano, A. B. (2021). Children are important too: Juvenile playgroups and maternal childcare in a foraging population, the Agta. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 376(1827), 37620200026. https://doi.org/10.1098/rstb.2020.0026
38. Weisner, T. S., & Gallimore, R. (1977). My brother's keeper: Child and sibling caretaking. *Current Anthropology*, 18(2), 169–190. https://doi.org/10.1086/201883
39. Kramer, K. L., & Ellison, P. T. (2010). Pooled energy budgets: Resituating human energy-allocation trade-offs. *Evolutionary Anthropology*, 19(4), 136–147. https://doi.org/10.1002/evan.20265
40. Kramer, K. L. (2009). Does it take a family to raise a child? Cooperative breeding and the contributions of maya siblings, parents and older adults in raising children. In G. Bentley & R. Mace (Eds.), *Substitute parents* (pp. 77–99). Berghahn Books. https://books.google.it/books?hl=en&lr=&id=QppIIXDCnTcC&oi=fnd&pg=PA77&dq=%5B72%5D%09Karen+L.+Kramer.+Does+It+Take+a+Family+to+Raise+a+Child%3F+Cooperative+Breeding+and+the+Contributions+of+Maya+Siblings,+Parents+and+Older+Adults+in+Raising+Children.+&ots
41. Kramer, K. L., & Russell, A. F. (2014). Kin-selected cooperation without lifetime monogamy: Human insights and animal implications. *Trends in Ecology & Evolution*, 29(11), 600–606. https://doi.org/10.1016/j.tree.2014.09.001
42. Reiches, M. W., Ellison, P. T., Lipson, S. F., Sharrock, K. C., Gardiner, E., & Duncan, L. G. (2009). Pooled energy budget and human life history. *American Journal of Human Biology*, 21(4), 421–429. https://doi.org/10.1002/ajhb.20906
43. Dounias, E., & Aumeeruddy-Thomas, Y. (2017). Children's ethno-biological knowledge: An introduction. *AnthropoChildren*, 7. https://doi.org/10.25518/2034-8517.2799
44. Gopnik, A. (2020). Childhood as a solution to explore–exploit tensions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1803), 20190502. https://doi.org/10.1098/rstb.2019.0502
45. Gallois, S., Duda, R., & Reyes-Garcia, V. (2017). Local ecological knowledge among Baka children: A case of "children's culture"? *Journal of Ethnobiology*, 37(1), 60.
46. Porcher, V., Li, X., Carrière, S. M., Alvarez-Fernandez, S., Cresson, D., Reyes-García, V., & Gallois, S. (2023). *As proficient as adults: Distribution of children's knowledge of wild edible plants in the arid Mahafaly region, Madagascar*.
47. Lew-Levy, S., & Boyette, A. H. (n.d.). *Learning to walk in the forest*. Ethos, Revisions requested.
48. Alvard, M. S. (1993). Testing the "ecologically noble savage" hypothesis: Interspecific prey choice by Piro hunters of Amazonian Peru. *Human Ecology*, 21, 355–387.
49. Terashima, H. (2007). The status of birds in the natural world of the Ituri forest hunter-gatherers. *Animal Symbolism: The "Keystone" Animal in Oral Tradition and Interactions between Humans and Nature. IRD, Paris*, 147–162.
50. Ichikawa, M. (1998). The birds as indicators of the invisible world: Ethno-ornithology of the Mbuti hunter-gatherers. *African Study Monographs*, 25, 105–121. https://doi.org/10.14989/68390
51. van der Wal, J. E., Gedi, I. I., & Spottiswoode, C. N. (2022). Awer honey-hunting culture with greater honeyguides in coastal Kenya. *Frontiers in Conservation Science*, 2, 727479.

15206505, 2024, 2, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/evan.22020 by University Of Utah, Wiley Online Library on [15/06/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

52. Dounias, E. (2014). From foraging to… foraging. Non-wood forest products newsletter of FAO, 4.
53. Crittenden, A. N., Conklin-Brittain, N. L., Zes, D. A., Schoeninger, M. J., & Marlowe, F. W. (2013). Juvenile foraging among the Hadza: Implications for human life history. *Evolution and Human Behavior*, 34(4), 299–304. https://doi.org/10.1016/j.evolhumbehav.2013.04.004
54. Marshall, A. J., Boyko, C. M., Feilen, K. L., Boyko, R. H., & Leighton, M. (2009). Defining fallback foods and assessing their importance in primate ecology and evolution. *American Journal of Physical Anthropology*, 140(4), 603–614. https://doi.org/10.1002/ajpa.21082
55. Dounias, E. (2016). From subsistence to commercial hunting: Technical shift in cynegetic practices among southern Cameroon forest dwellers during the 20th century. *Ecology and Society*, 21(1), 23. https://doi.org/10.5751/ES-07946-210123
56. Boyette, A. H. (2019). Autonomy, cognitive development, and the socialisation of cooperation in foragers. *Hunter Gatherer Research*, 3(3), 475–500. https://doi.org/10.3828/hgr.2017.23
57. Crittenden, A. N., & Zes, D. A. (2015). Food sharing among Hadza hunter-gatherer children. *PLOS ONE*, 10(7), e0131996. https://doi.org/10.1371/journal.pone.0131996
58. Dounias, E. (1993). Dynamique et gestion différentielles du système de production à dominante agricole des Mvae du Sud-Cameroun forestier. *Montpellier, Thèse de Doctorat, Université Des Sciences et Techniques Du Languedoc, Miméograph*, 2.
59. Bonwitt, J., Kandeh, M., Dawson, M., Ansumana, R., Sahr, F., Kelly, A. H., & Brown, H. (2017). Participation of women and children in hunting activities in Sierra Leone and implications for control of zoonotic infections. *PLoS Neglected Tropical Diseases*, 11(7), e0005699.
60. Douno, M., Asampong, E., Magassouba, N., Fichet-Calvet, E., & Almudena, M. S. (2021). Hunting and consumption of rodents by children in the Lassa fever endemic area of Faranah, Guinea. *PLoS Neglected Tropical Diseases*, 15(3), e0009212.
61. Baize, S., Pannetier, D., Oestereich, L., Rieger, T., Koivogui, L., Magassouba, N., Soropogui, B., Sow, M. S., Keïta, S., & De Clerck, H. (2014). Emergence of Zaire Ebola virus disease in Guinea. *New England Journal of Medicine*, 371(15), 1418–1425.
62. Marí Saéz, A., Weiss, S., Nowak, K., Lapeyre, V., Zimmermann, F., Düx, A., Kühl, H. S., Kaba, M., Regnaut, S., Merkel, K., Sachse, A., Thiesen, U., Villányi, L., Boesch, C., Dabrowski, P. W., Radonić, A., Nitsche, A., Leendertz, S. A. J., Petterson, S., … Leendertz, F. H. (2015). Investigating the zoonotic origin of the West African Ebola epidemic. *EMBO Molecular Medicine*, 7(1), 17–23. https://doi.org/10.15252/emmm.201404792
63. Nolen, L. D., Osadebe, L., Katomba, J., Likofata, J., Mukadi, D., Monroe, B., Doty, J., Kalemba, L., Malekani, J., Kabamba, J., Bomponda, P. L., Lokota, J. I., Balilo, M. P., Likafi, T., Lushima, R. S., Tamfum, J.-J. M., Okitolonda, E. W., McCollum, A. M., & Reynolds, M. G. (2015). Introduction of monkeypox into a community and household: Risk factors and zoonotic reservoirs in the Democratic Republic of the Congo. *The American Journal of Tropical Medicine and Hygiene*, 93(2), 410–415. https://doi.org/10.4269/ajtmh.15-0168
64. Bonwitt, J., Kelly, A. H., Ansumana, R., Agbla, S., Sahr, F., Saez, A. M., Borchert, M., Kock, R., & Fichet-Calvet, E. (2016). Rat-atouille: A mixed method study to characterize rodent hunting and consumption in the context of Lassa fever. *Ecohealth*, 13, 234–247.
65. Friant, S., Paige, S. B., & Goldberg, T. L. (2015). Drivers of bushmeat hunting and perceptions of zoonoses in Nigerian hunting communities. *PLoS Neglected Tropical Diseases*, 9(5), e0003792.
66. van Vliet, N., Nebesse, C., & Nasi, R. (2015). Bushmeat consumption among rural and urban children from Province Orientale, Democratic Republic of Congo. *Oryx*, 49(1), 165–174. https://doi.org/10.1017/S0030605313000549
67. Bird, D. W., & Bliege Bird, R. (2002). Children on the reef: Slow learning or strategic foraging? *Human Nature*, 13(2), 269–297.
68. Kawabe, T. (1983). Development of hunting and fishing skills among boys of the Gidra in lowland Papua New Guinea. *J. Human Ergol*. 12, 65–74.
69. Ilaria, P., Monique, B. M., Bakar, M. K., & Richard, M. (2023). Foraging and the importance of knowledge in Pemba, Tanzania: Implications for childhood evolution. *Proceedings of the Royal Society B: Biological Sciences*. 290, 20231505. https://doi.org/10.1098/rspb.2023.1505
70. Duda, R., Gallois, S., & Reyes-Garcia, V. (2017). Hunting techniques, wildlife offtake and market integration. A perspective from individual variations among the Baka (Cameroon). *African Study Monographs*, 38(2), 97–118.
71. Goodman, M. J., Estioko-Griffin, A., Griffin, P. B., & Grove, J. S. (1985). Menarche, pregnancy, birth spacing and menopause among the Agta women foragers of Cagayan Province, Luzon, the Philippines. *Annals of Human Biology*, 12(2), 169–177. https://doi.org/10.1080/03014468500007661
72. Koster, J., & Noss, A. (2014). Hunting dogs and the extraction of wildlife as a resource. In M. E. Gompper (Ed.), *Free-ranging dogs and wildlife conservation* (pp. 265–285). Oxford Academic.
73. Haun, B. K., Kamara, V., Dweh, A. S., Garalde-Machida, K., Forkay, S. S., Takaaze, M., Namekar, M., Wong, T. A. S., Bell-Gam Woto, A. E., & Humphreys, P. (2019). Serological evidence of Ebola virus exposure in dogs from affected communities in Liberia: A preliminary report. *PLoS Neglected Tropical Diseases*, 13(7), e0007614.
74. Milstein, M. S., Shaffer, C. A., Suse, P., Marawanaru, E., Gillespie, T. R., Terio, K. A., Wolf, T. M., & Travis, D. A. (2020). An ethnographic approach to characterizing potential pathways of zoonotic disease transmission from wild meat in Guyana. *EcoHealth*, 17(4), 424–436. https://doi.org/10.1007/s10393-021-01513-3
75. Seang, S., Burrel, S., Todesco, E., Leducq, V., Monsel, G., Le Pluart, D., Cordevant, C., Pourcher, V., & Palich, R. (2022). Evidence of human-to-dog transmission of monkeypox virus. *The Lancet*, 400(10353), 658–659.
76. Friant, S., Bonwitt, J., Ayambem, W. A., Ifebueme, N. M., Alobi, A. O., Otukpa, O. M., Bennett, A. J., Shea, C., Rothman, J. M., & Goldberg, T. L. (2022). Zootherapy as a potential pathway for zoonotic spillover: A mixed-methods study of the use of animal products in medicinal and cultural practices in Nigeria. *One Health Outlook*, 4(1), 1–21.
77. Heymann, D. L., Weisfeld, J. S., Webb, P. A., Johnson, K. M., Cairns, T., & Berquist, H. (1980). Ebola hemorrhagic fever: Tandala, Zaire, 1977–1978. *Journal of Infectious Diseases*, 142(3), 372–376.
78. Shoemaker, T., MacNeil, A., Balinandi, S., Campbell, S., Wamala, J. F., McMullan, L. K., Downing, R., Lutwama, J., Mbidde, E., & Ströher, U. (2012). Reemerging Sudan ebola virus disease in Uganda, 2011. *Emerging Infectious Diseases*, 18(9), 1480.
79. Duda, R., Betoulet, M. J., Besombes, C., Mbrenga, F., Borzykh, Y., Nakoune, E., & Giles-Vernick, T. (2023). *A time of decline: An eco-anthropological and ethnohistorical investigation of mpox in the Central African Republic*. SocArXiv. https://doi.org/10.31235/osf.io/sv89a
80. Gibb, R., Redding, D. W., Chin, K. Q., Donnelly, C. A., Blackburn, T. M., Newbold, T., & Jones, K. E. (2020). Zoonotic host diversity increases in human-dominated ecosystems. *Nature*, 584(7821), 398–402.
81. Andersen, K. G., Shylakhter, I., Tabrizi, S., Grossman, S. R., Happi, C. T., & Sabeti, P. C. (2012). Genome-wide scans provide evidence for positive selection of genes implicated in Lassa fever. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 367(1590), 868–877.

15206505, 2024, 2, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/evan.22020 by University Of Utah, Wiley Online Library on [15/06/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

82. Jankhöfer, C. H., Saez, M. A., Magassouba, N., Soropogui, B., Camara, A., Günther, S., Gabriel, M., Fichet-Calvet, E., & Borchert, M. (2019). Lassa-seroprevalence and its predictors in Faranah prefecture, Guinea: A cross-sectional survey. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 113, S111.
83. Koster, J., Grote, M. N., & Winterhalder, B. (2013). Effects on household labor of temporary out-migration by male household heads in Nicaragua and Peru: An analysis of spot-check time allocation data using mixed-effects models. *Human Ecology*, 41, 221–237.
84. Smith, E. A. (1985). Inuit foraging groups: Some simple models incorporating conflicts of interest, relatedness, and central-place sharing. *Ethology and Sociobiology*, 6(1), 27–47.
85. Kandza, V. (2020). *Selection of food species by indigenous BaYaka children in the tropical dense forest*. Marien Ngouabi University.
86. Cinelli, C., Forney, A., & Pearl, J. (2022). A crash course in good and bad controls. *Sociological Methods & Research*, 004912412210995. https://doi.org/10.1177/00491241221099552
87. Gibson, M. A., & Lawson, D. W. (2015). Applying Evolutionary Anthropology. *Evolutionary Anthropology*, 24(1), 3–14. https://doi.org/10.1002/evan.21432
88. Coté, C. (2016). "Indigenizing" food sovereignty. Revitalizing indigenous food practices and ecological knowledges in Canada and the United States. *Humanities*, 5(3), 57.
89. Budowle, R., Arthur, M. L., & Porter, C. M. (2019). Growing intergenerational resilience for Indigenous food sovereignty through home gardening. *Journal of Agriculture, Food Systems, and Community Development*, 9(B), 145.
90. Hoover, E. (2017). "You can't say you're sovereign if you can't feed yourself": Defining and enacting food sovereignty in American Indian community gardening. *American Indian Culture and Research Journal*, 41(3), 31–70.
91. Fernández-Llamazares, Á., Lepofsky, D., Lertzman, K., Armstrong, C. G., Brondizio, E. S., Gavin, M. C., Lyver, P. O., Nicholas, G. P., Pascua, P., Reo, N. J., Reyes-García, V., Turner, N. J., Yletyinen, J., Anderson, E. N., Balée, W., Cariño, J., David-Chavez, D. M., Dunn, C. P., Garnett, S. C., … Vaughan, M. B. (2021). Scientists' warning to humanity on threats to indigenous and local knowledge systems. *Journal of Ethnobiology*, 41(2), 144–169. https://doi.org/10.2993/0278-0771-41.2.144
92. Reyes-García, V., Powell, B., Díaz-Reviriego, I., Fernández-Llamazares, Á., Gallois, S., & Gueze, M. (2019). Dietary transitions among three contemporary hunter-gatherers across the tropics. *Food Security*, 11(1), 109–122. https://doi.org/10.1007/s12571-018-0882-4
93. Scheidel, A., Fernández-Llamazares, Á., Bara, A. H., Del Bene, D., David-Chavez, D. M., Fanari, E., Garba, I., Hanaček, K., Liu, J., Martínez-Alier, J., Navas, G., Reyes-García, V., Roy, B., Temper, L., Thiri, M. A., Tran, D., Walter, M., & Whyte, K. P. (2023). Global impacts of extractive and industrial development projects on Indigenous Peoples' lifeways, lands, and rights. *Science Advances*, 9(23), eade9557. https://doi.org/10.1126/sciadv.ade9557
94. Pollom, T. R., Herlosky, K. N., Mabulla, I. A., & Crittenden, A. N. (2020). Changes in juvenile foraging behavior among the Hadza of Tanzania during early transition to a mixed-subsistence economy. *Human Nature*, 31(2), 123–140. https://doi.org/10.1007/s12110-020-09364-7
95. Patel, R. (2009). Food sovereignty. *The Journal of Peasant Studies*, 36(3), 663–706. https://doi.org/10.1080/03066150903143079
96. Cidro, J., Adekunle, B., Peters, E., & Martens, T. (2015). Beyond food security: Understanding access to cultural food for urban Indigenous people in Winnipeg as Indigenous food sovereignty. *Canadian Journal of Urban Research*, 24(1), 24–43.
97. Carlson, C. J., Albery, G. F., Merow, C., Trisos, C. H., Zipfel, C. M., Eskew, E. A., Olival, K. J., Ross, N., & Bansal, S. (2022). Climate change increases cross-species viral transmission risk. *Nature*, 607(7919), Article 7919. https://doi.org/10.1038/s41586-022-04788-w

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