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INTEGRATING ANTHROPOLOGICAL THEORY AND COMPUTATIONAL ARCHAEOLOGY

Abstract

Reconstructing human population dynamics in the past is a key aspect of archaeological research. The archaeological and palaeontological records contain important demographic clues but, whereas the temporal and spatial distribution of morphologically distinct taxa may be relatively easy to establish, identifying the presence of discrete human populations is fraught with difficulty. Drawing a link between patterns in the archaeological record and the existence of *specific* human populations at a given point in time is a major hurdle. It is surprisingly difficult to establish whether archaeologically recognised entities represent discrete biological and social entities. Estimating the size of these entities at a given moment in time is complicated by a combination of chronological uncertainty and relatively small sample sizes. Furthermore, a given population's size, distribution and rate of growth affects its archaeological visibility. This has obvious implications for our ability to interpret patterns in the material culture record in terms of past population dynamics.

Keywords

Hunter-gatherers, foragers, ethnography, computational archaeology, modelling, demography

INTRODUCTION

The size, spatial distribution and chronology of archaeological sites are our only proxies for estimating key demographic parameters of archaeologically recognised groups, or "cultures", in Prehistory. Numerical models have been used to estimate the size and density of Palaeolithic populations on the basis of these data (e.g., Bocquet-Appel et al., 2005; Bocquet-Appel, 2008; Sørensen, 2011; Bocquet-Appel and Degioanni, 2013; Crema et al., 2016). Ecological modelling techniques are increasingly used in archaeology to define and map the distribution of human habitats and, thus, populations in the past (e.g., Banks et al., 2006; Banks et al., 2008; Banks et al., 2011; Gautney and Holliday, 2015; Burke et al., 2017; Ludwig et al., 2018; Tallavaara et al., 2018) and to study the impact of population dynamics on gene flow and patterns of cultural transmission (e.g., Henrich, 2004; Collard et al., 2005; Derex et al., 2013; Derex and Boyd, 2016; Creanza et al., 2017; Wren and Burke, 2019; Sterelny, 2020). Underpinning much of this research, often implicitly rather than explicitly, is a body of anthropological theory and ethnographic observation that should not go unexamined. Questionable stereotypes about the social organisation of foragers persist and continue to colour our interpretation of the Palaeolithic archaeological record. The goal of this paper is to identify some of these stereotypes in the hopes that, if archaeological modellers chose to use them, they will not do so uncritically. Finally, the advantages of a dynamic model of foraging social structure is highlighted.

Most researchers today would agree with Isaac (1968) who points out that direct analogy between historically known hunter-gatherers and prehistoric people is an oversimplification that has no place in archaeological research. Direct analogy has also been criticized for its implicitly racist undertones. In addition, many historically documented foragers were not "pristine" and contemporary foraging societies often occupy

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the margins of what were once richer and far bigger territories (e.g., Leacock, 1978; Clemmer, 2009; Kelly, 2013). However, anthropology has a well-developed body of theory that addresses these problems, as we will see (and as Sahlins points out) even "acculturated" groups provide useful insights into the social mechanisms of foraging societies (Sahlins, 1993).

In what follows, I use the term "forager" to designate people whose subsistence economies are based on the extraction of natural resources, as opposed to people who are engaged in food production. Other terms that have been used to designate foragers include hunter-gatherers, or hunter-gatherer-fishers, or hunter-collectors. I use the term "forager" fully aware that the distinction between foragers and farmers, i.e., between food extraction and food production, is a gross oversimplification of the full spectrum of human/environment interactions implicated in human subsistence practices both past and present. I also skirt the issue of complexity mostly because my focus is on the Palaeolithic and, although complex hunter-gatherer adaptations may have arisen during the Palaeolithic, they did not become widespread until the Mesolithic (Hayden, 2014).

IS THERE A SINGLE MODEL OF THE SOCIAL STRUCTURE OF FORAGING PEOPLE?

Over the years, different "models" (here, the term does not designate a formal model but rather a conceptual model) of foraging social organisation have been proposed. It is worth gaining some historical perspective before reflecting on what these models tell us about identifying cultural entities in the archaeological record and how we can use this knowledge to explore population dynamics in the past using a modelling approach. By the mid 20th century several normative models of band society had been proposed based on ethnographic data. Identifying which model reflected a "pristine" social structure which could serve as a conceptual framework for the evolutionary study of past foraging groups was an active pursuit for many social anthropologists and archaeologists at the time.

Service (1962) proposed that the patrilocal band, which he found evidence for on all continents, was the simplest and therefore oldest form of social structure. Patrilocal bands, as defined by Service, are characterised by low population density (1-50 sq. miles, or ~130 km^2 per person) and small group size (30 to ~100 individuals), male leadership and weakly developed non-kin associations. The key attributes of the patrilocal band, however, are: reciprocal band exogamy, patrilocality and territoriality (Service, 1962).

Birdsell's "dialectical tribe" (Birdsell, 1953; Birdsell et al., 1973), based on the ethnographic record of Australia, adopted many aspects of the patrilocal model. Birdsell promoted the dialectical tribe as the basic demographic unit for "economically simple" groups, which he describes as numbering 500 individuals united by a common dialect (Birdsell et al., 1973: 337). The dialectical tribe, in turn, is composed of one or more "hordes", i.e., local groups equivalent to extended families and numbering roughly 40 individuals each. Hordes are exogamous, patrilineal and patrilocal and are the primary land-owning units. The tribe is assumed to be territorial and the area it occupies is determined by climate conditions (e.g., rainfall) which drive productivity (Birdsell, 1953). It should be pointed out, however, that Birdsell's "optimum number" of 500 individuals glosses over considerable variability in the ethnographic record of Australia, considerably weakening the case for its universality (see Hiatt, 1968: "Discussions, Part V"). Birdsell excluded from analysis smaller or "fragmented" tribes (which he considered to be in a state of disequilibrium as a result of social upheaval) and much larger social units, or "confederacies of tribes" (which numbered in the thousands), which had matrilineal descent systems.

Wobst (1974) uses numerical models, life tables and mating rules to calculate the minimum equilibrium size of "mating networks", or maximum bands, which he equates with Service's patrilocal bands, Birdsell's dialectical tribe and Steward's maximum band (Wobst, 1974: 49). Again, a patrilocal model is explicitly embraced. The rationale behind Wobst's work is that group size should ensure that upon reaching sexual maturity, an individual will find a suitable mate within the network. Wobst assumed that maximum bands are bounded (territorial) and composed of smaller social units, or "minimum bands". Wobst's models suggest maximum band sizes of between 250 to 500 individuals (the upper size limit is similar to Birdsell's empirical calculations) and a minimum band size of roughly 25 people. He also predicted the emergence of network-specific styles as expressions of the social boundaries that were assumed to exist between maximum bands. As Gamble (2000) points out, however, a mating network is not a society; Wobst's approach, which equates the social with the demographic and only deals with the territorial and residential aspects of social organisation, is reductive (Gamble, 2000: 24).

Steward (1955) proposed the composite band model, which he believes results from two factors: the presence of gregarious herd species and the introduction of unrelated families into patrilineal bands (Steward, 1955: 149) – which implies that it was not in contention to be a model for Palaeolithic band structure. The composite band is composed of a group of biologically unrelated families whose constant association results in a level of social integration. In other words, spatial proximity is the mechanism by which these bands are socially integrated, rather than patrilineal descent and a shared language. Other key features of the composite band, according to Steward, are low population density, relatively large band size, the absence of exogamy and post-marriage residence rules, political autonomy and the control of access to resources within a band's territory without implying boundary defense.

The first "Man the Hunter" conference, which gave rise to an ongoing series of international conferences (the Conference on Hunting and Gathering Societies, or "CHAGS" conferences), was held in Chicago in 1966. The conference brought ethnographers, archaeologists, linguists and demographers together to conduct a "state of the art" survey of foraging societies and debate its implications (Lee and DeVore, 1968). By then, Service's patrilocal band (Service, 1962) based on earlier work by Radcliffe-Brown (1931), had already faced several challenges (e. g., contributors to Damas, 1965). The "Man the Hunter" conference would seriously weaken its claim for universality in addition to challenging its core assumptions (see contributions to Lee and DeVore, 1968).

The assumption of linguistic and cultural homogeneity, which would potentially have made the patrilocal band visible in the archaeological record, was also challenged by several ethnographers (e. g., Leacock,1969; Owen, 1965; Hiatt, 1968; Lee and DeVore, 1968; and contributors to Damas, 1965). Owen, for example, argued that in ecologically diverse settings with low population densities exogamy would result in the movement of individuals between culturally and linguistically differentiated bands, creating "culturally hybrid" social units (Damas, 1965: 683). The assumed adaptive advantage of virilocality was challenged by Lee (1962) and by Yellen and Harpending (1972). Discussants at the Man the Hunter conference (Lee and DeVore, 1968: Chapter 17) and later publications further argued that patrilocality was maladaptive as it would hinder a group's ability to smooth out demographic variation (e. g., sex ratios), tailor group size to available resources or resolve conflict through fission (Lee and DeVore, 1968; cf. Lee, 1972: 126). As a result of these criticisms and with increased awareness of the diversity of the ethnographic record, the prevailing model of foraging social organisation that would emerge during the second half of the 20th century, which owes a lot to Lee's work in the Kalahari (described below) rejects many of the previous assumptions and features relatively open social groups occupying overlapping shared territories.

THE FLUIDITY OF FORAGING SOCIAL ORGANISATION

Lee's seminal work in the Kalahari among the Ju/'hoansi (previously, and erroneously, labelled the !Kung) describes a flexible social system capable of adapting to fluctuations in the distribution of resources on the landscape at various temporal and spatial scales (Lee, 1968, 1972, 1979). The Ju/'hoansi live in small, highly mobile groups (or "camps") that form part of a larger social unit (Lee, 1972). The "camp" is a noncorporate, bilaterally organised group of individuals living and moving together for at least part of the year. Seasonal rainfall patterns are a limiting feature of life in the Kalahari, and groups aggregate around permanent waterholes during the winter dry season, or when seasonally aggregated resources (such as the mongongo nut) are present. A resident group is composed of a core group of kin (siblings and/or cousins) "generally acknowledged to be owners of the waterhole" (Lee, 1979: 77). The land around the waterhole (the *n!ore*) contains the basic subsistence resources for the group, but access to a larger territory is essential for the survival of the group in order to adjust to long-term patterns of resource scarcity. Associations between specific people and waterholes vary from several years to several decades and Lee estimates the "half-life" of a group's tenure to be between 30 and 50 years (Lee, 1979).

Seasonal mobility and a cycle of population aggregation and dispersal is a central aspect of Lee's concept of the social and spatial organisation of foraging bands. This cycle is driven by resource availability and governed by "rules and practices for allowing reciprocal access to, or joint exploitation of, key resources" (Lee, 1979: 91). Lee emphasises the fluidity of Ju/'hoansi spatial and social boundaries in his ethnography. Both kinship and access to resources are negotiable, and this fluidity ensures that a group's subsistence requirements are satisfied with minimal friction. For example, individuals inherit a *n!ore* from either or both parents, but gain access to other *n!ore* through marriage and "visiting", creating a state of flux in the composition of groups. As Lee notes, this allows for higher population densities than could otherwise be supported under existing conditions of environmental instability. Although Lee describes foragers as finding "a social solution to an environmental problem" his focus is on the adaptiveness of the social system as he invites the reader to "consider a more dynamic model in which interlocking aggregations of persons undergo continual reshuffling of groups in response to short- and long-term environmental fluctuations and to changes in population density." (Lee, 1972: 142).

Myers' ethnography of the Pintupi (Myers, 1982, 1986, 1988) also reflects the dynamic approach to foraging society that developed in the 20th century. Unlike Lee, however, who emphasised the adaptive rationale underlying forager social organisation, Myers describes the Pintupi social system as primarily oriented towards reproducing relations between individuals, i.e., towards social reproduction. The production of "social persons" is described as culturally important to the Pintupi and social networks are inclusive. Individual networks of dyadic relationships are viewed as *constitutive* of social structure at all levels of integration. Finally, Myers emphasises that the formation of groups is a social accomplishment, rather than a given (Myers, 1986: 72).

Pintupi land ownership is the materialisation of social relations rather than the reverse, and land encodes the history of relatedness of people and is a marker of social identity. Ownership does not imply territoriality, rather the "content of ownership […] is the right to be asked." (Myers, 1986: 99) and the emphasis on relatedness makes it difficult to refuse access. Mobility is not only regulated by the distribution of resources but also by the "organizational requirements of a complex regional system of social relations" (Myers 2002: 1). Myers' emphasis on social reproduction does not mean that he negates the importance of the resource base, however, but he cautions against reifying the group:

> "It seems sensible to characterize Pintupi bands as hypothetical entities moving through an optimal pattern of resource-scheduling, with different individuals affiliating themselves to these groups as they move place to place […]. The size of this abstract band may remain relatively constant while the actual composition may vary greatly. The important requirement is that individuals must affiliate with the residential group to use the land. The state of resources determines where people may be, but not necessarily where they actually are, or precisely who is where" (Myers, 1986: 97).

The last point, that groups are not static entities, is important for archaeologists seeking evidence for the existence of distinct "cultures" in the archaeological record. The level of social integration that would be required to create a recurring pattern in the archaeological record cannot be *assumed* to emerge, especially at the regional level where stable networks of social relations are the most difficult to maintain due to social and geographical distance.

THE CASE FOR DIVERSITY AND A NON-PRESCRIPTIVE MODEL

The archaeological vision of foraging society that emerged during the 20th century was largely based on the small-scale, egalitarian society described by Lee, dubbed the "original affluent society", or OAS, by Rowley-Conwy (2001). The OAS incorporates familiar concepts, such as: 1) little personal property and an egalitarian social system; 2) a pattern of fission/fusion; 3) a high level of individual mobility between bands; 4) fluid organisation involving no territorial rights; 5) no strong attachment of a group to a particular area, and 6) a lack of storage technology (Rowley-Conwy, 2001: 40). Explicitly or implicitly, this model was and, to a certain extent still is, widely adopted in archaeology as what Gamble (2000) qualifies as convenient "mental shorthand" for describing the social structure of Palaeolithic groups. The inherent fluidity of the OAS offers a satisfactory explanation for the long-term resilience of human foraging groups but it ignores the power of historical contingency and, more importantly, does not address the diversity of either the ethnographic or archaeological records. Finally, it reifies the group, generating assumptions about group size, mobility, social integration, and the emergence of linguistic and cultural homogeneity that the archaeological record is at pains to support. Clearly, the OAS should be discarded or at least updated to include current anthropological thinking.

The weight of ethnographic evidence accumulated over the course of the 20th century lead anthropologists to emphasise the diversity of social forms among foraging groups (e.g., contributors in Kent, 1996; Kelly, 2013). Settlement patterns vary within linguistic groups, different adaptive strategies are used within the same ecological and social environments, and the social structures of foraging groups vary from forms similar to the one Lee described for the Ju/'hoansi to its diametrical opposite (Guenther, 1996: 71). Clearly, proposing a single normative model of forager band structure is difficult to defend (Guenther, 1996). The emphasis in anthropology shifted accordingly to a more dynamic, agent-centered approach, such as the one adopted by Myers (Lourandos, 1997) and described above. This approach provides an over-arching conceptual structure that can accommodate the diversity of the ethnographic record because it does not prescribe a particular social structure. As Guenther (1996) points out, it is the inherent fluidity and the nested structure of foraging bands that allows them to take on various forms.

IMPLICATIONS FOR THE STUDY OF THE ARCHAEOLOGICAL RECORD

Does a dynamic model of social structure, which considers forager groups to be open with respect to territorial and group affiliation, loosely corporate with respect to land ownership and non-hierarchical, explain the diversity of the archaeological record? What are the archaeological implications of adopting this model?

Firstly, let us consider whether there is archaeological support for the proposed model. Archaeological data suggest that foraging groups share resources, either through trade mechanisms or simply through the existence of overlapping territories. Loring (2002), for example, identifies several different prehistoric groups in Labrador (Canada) who exploited the same chert source, implying overlapping patterns of land use. He suggests that trade in Ramah chert was an important tool for regional integration among early Late Prehistoric communities along Quebec's North Shore and the Straight of Belle Isle, noting that: "the information that accompanied the raw material would serve to define relationships between groups and prevent rigid social and territorial boundaries from forming" (Loring, 2002: 183). Loring's analysis, therefore, supports the proposition that foraging groups would have had mechanisms to limit territoriality. Archaeological modellers have tested some of the key assumptions of the proposed dynamic model. For example, Pearce (2014) created an agent-based model (ABM) designed to test whether foragers carrying out subsistence activities were able to "inadvertently" maintain social integration (contact between groups) without conducting special "visits" or exchanging tokens. The first null hypothesis, i.e., that maintaining social relations is a trivial task, is conclusively rejected. So, too, is the hypothesis that increasing mobility in regions where population density is low counterbalances the "handicap" imposed by physical distance. In other words, as Myers would have predicted, the maintenance of social networks is work and the work increases with distance.

Indeed, as Myers (1986) notes, social integration should be viewed as an achievement rather than a given. The sum total of individual networks of social relations forms the backbone of foraging social groups and the frequency of interaction determines a sense of common identity and belonging (Bird-David, 2017). Because people find it difficult to maintain social relations over longer distances, the upper-tier of social organisation (the "tribe" or "regional band") is predicted to drop in and out of usage under the influence of interacting variables such as historical contingency, population size, density and the structure of the environment. Cultural differences can be expected to emerge between groups with higher levels of social integration and those without (e.g., Steward, 1938). These differences may or may not include the emergence of archaeologically recognisable expressions of shared culture, although it seems likely that a regionally integrated group has a greater chance of producing a distinct archaeological signature.

Attempts to estimate population size on the basis of site frequencies and radiocarbon dates (Bocquet-Appel et al., 2005; Bocquet-Appel, 2008; Bocquet-Appel and Degioanni, 2013) indicate that Palaeolithic populations in Europe were likely small and highly dispersed. It is quite conceivable that these populations weren't always able to maintain stable social structures at a spatial and temporal scale that would leave a readily discernable pattern in the archaeological record, compounding the problems inherent in cultural taxonomies (Reynolds and Riede, 2019; Sauer and Riede, 2019). Long periods of apparent cultural stasis, for example during the Lower and Middle Palaeolithic in various regions, may well be explained on this basis. Finally, archaeologists encounter difficulties calculating group size when cultural affiliation is unknown or unknowable, but the structure of a population may be just as relevant to the way foragers conducted their lives as its size.

There is not enough space to develop the extensive literature on cumulative culture theory here, but it predicts that connectivity between spatially segregated groups is one of the mechanisms of cultural transformation (Derex and Boyd, 2016). Spatial segregation, especially if groups are poorly integrated at the upper

tier of social organisation, could conceivably produce cultural variants through a process of drift. A dynamic model of social organisation, which places a premium on fluidity, explains why connectivity exists. It also predicts that potential linguistic and cultural barriers arising through a process of differentiation should be permeable, although permeability will decrease with distance and the loosening of social bonds that accompanies it. In other words, the process of cultural differentiation is counter-balanced by an emphasis on permeability and connectivity in foraging societies. The spatial and social limits imposed on this balancing act can be explored in a variety of contexts using a modeling approach.

We can predict one instance when these two processes might have combined to produce cultural change. The archaeological record spans several timeframes when human populations were under significant ecological stress, e.g., during the Last Glacial Maximum (LGM). Ethnographically known foraging groups adopt a more inclusive, open social system when facing ecological risk (Leacock, 1969), allowing people and critical information about resource availability to circulate (Whallon, 2006). On one hand, the archaeological record suggests that climate conditions during the LGM resulted in the creation of spatially segregated refugia. On the other hand, our model suggests that creating connectivity would have been a priority during this event. The creation of cultural variants in spatially separated groups, therefore, would have been counterbalanced by the efforts of people striving to maintain connectivity, resulting in the appearance of new forms of cultural expression at a regional level (the Solutrean).

CONCLUSION

What conclusions can we draw from this brief account of the anthropological theory of foraging social structure? It suggests that, however ingrained they may be in archaeological practice, many of the assumptions inherent in the OAS should be abandoned – or at the very least, they should not be used uncritically. It also suggests that the adoption of a more dynamic approach to social organisation provides a more secure conceptual framework that recognises the role of the individual in building social networks among foraging people and warns us that groups should not be treated as immutable, culturally homogeneous, bounded entities. The dynamic, agent-centred approach described above, with its emphasis on fluidity and a multi-tiered social structure, is adaptive, makes room for the kind of diversity that is present in the archaeological record and has already been successfully integrated (if not always entirely) into computational models aimed at solving important questions regarding the social structure of past human populations (e. g., Grove et al., 2012; Pearce, 2014; Grove and Dunbar, 2015; Wren and Burke, 2019). Further developing this approach in Palaeolithic archaeology should shed light on some of the more puzzling aspects of the material culture record, such as the relatively long periods of apparent cultural "stasis" that have been observed.

REFERENCES

Banks, W.E., Aubry, T., d'Errico, F., Zilhão, J., Lira-Noriega, A., Townsend Peterson, A., 2011. Eco-cultural niches of the Badegoulian: Unraveling links between cultural adaptation and ecology during the Last Glacial Maximum in France. *Journal of Anthropological Archaeology* 30, 359-374.

Banks, W.E., d'Errico, F., Peterson, A.T., Vanhaeren, M., Kageyama, M., Sepulchre, P., Ramstein, G., Jost, A., Lunt, D., 2008. Human ecological niches and ranges during the LGM in Europe derived from an application of eco-cultural niche modeling. *Journal of Archaeological Science* 35, 481-491.

Banks, W.E., d'Errico, F., Dibble, H., Krishtalka, L., West, D., Olszewski, D.I., Townsend Peterson, A., Anderson, D.G., Gillam, J.C., Montet-White, A., Crucifix, M., Marean, C.W., Sánchez-Goñi, M.F., Wohlfarth, B., Vanhaeran, M., 2006. Eco-Cultural Niche Modeling: New Tools for Reconstructing the Geography and Ecology of Past Human Populations. *Paleoanthropology* 2006, 68-83.

Bird-David, N., 2017. Before Nation: Scale-Blind Anthropology and Foragers' Worlds of Relatives. *Current Anthropology* 58, 209-226.

Birdsell, J.B., 1953. Some environmental and cultural factors influencing the structuring of Australian Aboriginal populations. *The American Naturalist* 87, 171-207.

Birdsell, J.B., Bennett, J.W., Bicchieri, M., Claessen, H., Gropper, R.C., Hart, C., Kileff, C., Posinsky, S., Thompson, L., 1973. A basic demographic unit [and comments and reply]. *Current Anthropology* 14, 337-356.

Bocquet-Appel, J.-P., 2008. *Recent Advances in Palaeodemography*. Springer, Dordrecht.

Bocquet-Appel, J.-P., Degioanni, A., 2013. Neanderthal Demographic Estimates. *Current Anthropology* 54, 202-213.

Bocquet-Appel, J.-P., Demars, P.-Y., Noiret, L., Dobrowsky, D., 2005. Estimates of Upper Palaeolithic meta-population size in Europe from archaeological data. *Journal of Archaeological Science* 32, 1656-1668.

Burke, A., Kageyama, M., Latombe, G., Fasel, M., Vrac, M., Ramstein, G., James, P.M.A., 2017. Risky business: The impact of climate and climate variability on human population dynamics in Western Europe during the Last Glacial Maximum. *Quaternary Science Reviews* 164, 217-229.

Clemmer, R.O., 2009. Pristine Aborigines or Victims of Progress? The Western Shoshones in the Anthropological Imagination. *Current Anthropology* 50, 849-881.

Collard, M., Kemery, M., Banks, S., 2005. Causes of Toolkit Variation Among Hunter-Gatherers: A Test of Four Competing Hypotheses. *Canadian Journal of Archaeology* 29, 1-19.

Creanza, N., Kolodny, O., Feldman, M.W., 2017. Greater than the sum of its parts? Modelling population contact and interaction of cultural repertoires. *Journal of The Royal Society Interface* 14, 20170171.

Crema, E.R., Habu, J., Kobayashi, K., Madella, M., 2016. Summed Probability Distribution of ^{14}C Dates Suggests Regional Divergences in the Population Dynamics of the Jomon Period in Eastern Japan. *PLOS ONE* 11, e0154809.

Damas, D., 1965. *Contributions to Anthropology – Band Societies.* Proceedings of the Conference on Band Organization, Ottawa, Canada, August 30 to September 2, 1965. Anthropological Series. Bulletin 228. National Museums of Canada, Ottawa, Canada.

Derex, M., Beugin, M.-P., Godelle, B., Raymond, M., 2013. Experimental evidence for the influence of group size on cultural complexity. *Nature* 503, 389-391.

Derex, M., Boyd, R., 2016. Partial connectivity increases cultural accumulation within groups. *Proceedings of the National Academy of Sciences* 113, 2982-2987.

Gamble, C S., 2000. *The Paleolithic Societies of Europe*. Cambridge University Press, Cambridge.

Gautney, J.R., Holliday, T.W., 2015. New estimations of habitable land area and human population size at the Last Glacial Maximum. *Journal of Archaeological Science* 58, 103-112.

Grove, M., Dunbar, R.I.M., 2015. Local objects, distant symbols: fission-fusion social systems and the evolution of human cognition. In: Coward, F., Hosfield, R., Pope, M., Wenban-Smith, F. (Eds.), *Settlement, Society and Cognition in Human Evolution: Landscapes in Mind*. Cambridge University Press, Cambridge, pp. 15-30.

Grove, M., Pearce, E., Dunbar, R.I.M., 2012. Fission-fusion and the evolution of hominin social systems. *Journal of Human Evolution* 62, 191-200.

Guenther, M.G., 1996. Diversity & flexibility: the case of the Bushmen of southern Africa. In: Kent, S. (Ed.), 1996. *Cultural Diversity among Twentieth-Century Foragers. An African perspective*. Cambridge University Press, Cambridge, pp. 65-86.

Hayden, B., 2014. Social Complexity. In: Cummings, V., Jordan, P., Zvelebil, M. (Eds.), *The Oxford Handbook of the Archaeology and Anthropology of Hunter-Gatherers.* Oxford University Press, Oxford.

Henrich, J., 2004. Demography and Cultural Evolution: How Adaptive Cultural Processes can Produce Maladaptive Losses: The Tasmanian Case. *American Antiquity* 69, 197-214.

Hiatt, L.R., 1968. Ownership and Use of Land among the Australian Aborigines. In: Lee, R.B., DeVore, I. (Eds.), *Man the Hunter*. Routledge, New York, pp. 99-102.

Isaac, G., 1968. Traces of Pleistocene hunters: an East African example. In: Lee, R.B., DeVore, I. (Eds.), *Man the Hunter*. Routledge, New York, pp. 253-261.

Kelly, R.L., 2013. *The Lifeways of Hunter-Gatherers*. *The Foraging Spectrum*. Cambridge University Press, Cambridge.

Kent, S., 1996. *Cultural Diversity among Twentieth-Century Foragers. An African perspective*. Cambridge University Press, Cambridge.

Leacock, E., 1969. The Montagnais-Naskapi Band. In: Damas, D. (Ed.), *Contributions to Anthropology – Band Societies.* Proceedings of the Conference on Band Organization, Ottawa, Canada, August 30 to September 2, 1965. Anthropological Series. Bulletin 228. National Museums of Canada, Ottawa, Canada, pp. 1-17.

Leacock, E., 1978. The Montagnais-Naskapi Band. In: Cox, B. (Ed.), 1978. Cultural Ecology: Readings on the Canadian Indians and Eskimos. McClelland & Stewart, Toronto, Canada, pp. 81-100.

Lee, R.B., 1968. What Hunters Do for a Living, or, How to Make Out on Scarce Resources. In: Lee, R.B., DeVore, I. (Eds.), *Man the Hunter*. Routledge, New York, pp. 30-45.

Lee, R.B., 1972. !Kung spatial organization: An ecological and historical perspective. *Human Ecology* 1, 125-147.

Lee, R.B., 1979. *The !Kung San: Men, Women, and. Work in a Foraging Society*. Cambridge University Press, Cambridge.

Lee, R.B. and I. DeVore (1968). Problems in the study of hunters and gatherers. In: Lee, R.B., DeVore, I. (Eds.), *Man the Hunter*. Routledge, New York, pp. 3-12.

Lee, R.B., DeVore, I., 1968. *Man the Hunter*. Routledge, New York.

Loring, P., 2002. And They Took Away the Stones from Ramah: Lithic Raw Material Sourcing and Eastern Arctic Archaeology. In: Fitzhugh, W., Loring, S., Odess, D. (Eds.), *Honouring our Elders: a history of eastern Arctic archaeology*. Contributions to Circumpolar Anthropology 2. Arctic Studies Center, Smithonian Institution, Washington D.C., pp. 163-185.

Lourandos, H., 1997. *Continent of Hunter Gatherers*. Cambridge University Press, Cambridge.

Ludwig, P., Shao, Y.P., Kehl, M., Weniger, G.C., 2018. The Last Glacial Maximum and Heinrich event I on the Iberian Peninsula: A regional climate modelling study for understanding human settlement patterns. *Global and Planetary Change* 170, 34-47.

Myers, F.R., 1982. Always Ask: Resource Use and Landownership among the Pintupi of Central Australia. In: Williams, N.M., Hunn, E.S. (Eds.), *Resource Managers: North American and Australian Hunter-Gatherers*. Westview Press for the American Association for the Advancement of Science, Boulder (CO), USA, pp. 173-195.

Myers, F.R., 1986. *Pintupi Country, Pintupi Self*. *Sentiment, Place, and Politics Among Western Desert Aborigines.* Smithonian Institution Press, Washington D.C.

Myers, F.R., 1988. Burning the Truck and Holding the Country: Pintupi Forms of Property and Identity. In: Wilmsen, E.N. (Ed.), *We Are Here: Politics of Aboriginal Land Tenure.* University of California Press, Berkeley, Los Angeles, pp. 15-42.

Myers, F.R., 2002. *Painting culture: the making of an aboriginal high art*. Duke University Press, Durham NC; https://doi.org/10.1525/aa.2004.106.2.422.

Owen, R.C., 1965. The Patrilocal Band: A Linguistically and Culturally Hybrid Social Unit. *American Anthropologist* 67, 675-690.

Pearce, E., 2014. Modelling mechanisms of social network maintenance in hunter-gatherers. *Journal of Archaeological Science* 50, 403-413.

Radcliffe-Brown, A.R., 1931. *The Social Organization of Australian Tribes.* Macmillan, Melbourne.

Reynolds, N., Riede, F., 2019. Reject or revive? The crisis of cultural taxonomy in the European Upper Palaeolithic and beyond. *Antiquity* 93, 1368-1370.

Rowley-Conwy, P., 2001. Time, change and the archaeology of hunter-gatherers. In: Panter-Brick, C., Layton, R.H., Rowley-Conwy, P. (Eds.), *Hunter-Gatherers: An Interdisciplinary Perspective*. Cambridge University Press, Cambridge, pp. 39-72.

Sahlins, M., 1993. Goodbye to Tristes Tropes – Ethnography in the Context of Modern World History. *Journal of Modern History* 65, 1-25.

Sauer, F., Riede, F., 2019. A Critical Reassessment of Cultural Taxonomies in the Central European Late Palaeolithic. *Journal of Archaeological Method and Theory* 26, 155-184.

Service, E.R., 1962. *Primitive social organization: an evolutionary perspective*. Random House, New York.

Sørensen, B., 2011. Demography and the extinction of European Neanderthals. *Journal of Anthropological Archaeology* 30, 17-29.

Sterelny, K., 2020. Demography and cultural complexity. *Synthese* (2020); https://doi.org/10.1007/s11229-020-02587-2.

Steward, J.H., 1938. *Basin-Plateau Aboriginal Sociopolitical Groups*. U.S. Government Printing Office, Washington.

Steward, J., 1955. *Theories of Culture Change*. University of Illinois, Urbana. Tallavaara, M., Eronen, J.T., Luoto, M., 2018. Productivity, biodiversity, and pathogens influence the global hunter-gatherer population density. *PNAS Proceedings of the National Academy of Sciences* 115, 1232-1237.

Whallon, R., 2006. Social networks and information: Non-utilitarian mobility among hunter-gatherers. *Journal of Anthropological Archaeology* 25, 259-270.

Wobst, H.M., 1974. Boundary conditions for Paleolithic Social Systems: A Simulation Approach. *American Antiquity* 39, 147-178.

Wren, C.D., Burke, A., 2019. Habitat suitability and the genetic structure of human populations during the Last Glacial Maximum (LGM) in Western Europe. *PLOS ONE* 14, e0217996.

Yellen, J., Harpending, H., 1972. Hunter-gatherer populations and archaeological inference. *World Archaeology* 4, 244-253.

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