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10

The Attraction of Home

The Influence of Fire and Ambient Light on Domestic Space among the Dukha Reindeer Herders of Northern Mongolia

MATTHEW J. O'BRIEN, TODD A. SUROVELL, RANDALL HAAS, AND SPENCER PELTON

Since the mid-twentieth century, archaeologists have turned their attention toward the importance of spatial patterning in the archaeological record (e.g., Bamforth et al. 2005; Binford and Binford 1966; Carr 1984; Kintigh 1990; Koetji 1994; Krasinski 2008; Rapson 1991; Rick 1976). In turn, ethnoarchaeological studies sought to provide the crucial link between intrasite patterning and behavior (Kent 1984; O'Connell et al. 1991; Yellen 1977). Previous research emphasizes both the layout of entire campsites (Binford 1978a; Yellen 1977) and the spatial distribution of human behavior within the individual household (Binford 1978b; Janes 1983; Kent 1984; O'Connell et al. 1991; Simms 1988; Yellen 1977). It became clear that behavior was spatially patterned, but in ways that did not correlate cleanly with archaeological expectations or assumptions. Instead of finding discrete locations for particular tasks, certain areas were epicenters of most tasks (O'Connell et al. 1991; although see Lancelotti et al. 2017; Middleton and Price 1996; Milek 2012). In other words, spatial attractors of human activity were apparent.

One attempt to understand ethnographic spatial attractors in the archaeological record comes from Stapert's (1989) spatial analysis of Paleolithic Europe. Given the dearth of clues to the site structure in hunter-gatherer sites, he chose to focus on spatial analysis in relation to hearths, often the only features present in archaeological settings. Building from Binford's (1978b) observations of the Nunamiut hunting camps, Stapert proposed that using a polar grid, as opposed to the traditional square grid, would better provide insight into how activities were structured around hearths. From this proposition, Stapert introduced the ring-and-sector model that looked at the distribution of lithics around the hearth. Despite its self-described simplicity, the model provided a means to distinguish interior versus exterior hearths, which remains a useful tool for archaeologists (Surovell and Waguespack 2007). He further looked at the distribution of tools around the hearth to understand how occupants used the space.

In site-specific critiques of Stapert's (1989) analysis of Barmose I in Denmark, Blankholm (1991/1992) raises concerns about the model itself. Blankholm argues that the model is untested in ethnographic contexts to confirm its validity, that definitions of sector size are arbitrarily defined, and that it ignores the drastic difference in the area of sectors. While we are aware that there are many statistical ways to approach spatial patterning, Stapert's proposition that the hearth serves as an attractor for prehistoric activity is compelling as it references general patterns observed ethnographically. Hearths are just one type of spatial attractor that exists in hunter-gatherer camps. Yellen (1977) found that shady areas between houses drew people. O'Connell and colleagues (1991) pointed to the common area in front of homes. Surovell and O'Brien (2015) demonstrated how doorways shape activities immediately outside of domiciles. The idea of spatial attractors in many ways overlaps with analyses focused on the built environment and household archaeology (Wilk and Rathje 1982), but spatial attractors can also be temporary attractors, like shade or light. Here we employ data collected during the Dukha Ethnoarchaeology Project, an ethnoarchaeological study designed to evaluate the influence of spatial attractors on the use of space in the mobile campsites of reindeer herders living in the taiga of northern Mongolia, to provide a means to interpret spatial patterning observed in the archaeological record.[1]

The Dukha

The Dukha are among the southernmost reindeer herders in Asia residing in Khövsgöl Province of Mongolia, bordering with Russia (Ayush 2009; Inamura 2005; O'Brien and Surovell 2017; Surovell and O'Brien 2015; Wheeler 2000). The Dukha number roughly 200 members split into two separate regions of the taiga found along eastern slopes of the Sayan Mountains. The taiga is a mountainous terrain with a mixture of marshes, boreal forests, and alpine valleys and has received protected status with the establishment of Tengis-Shishged National Park since 2012. While the establishment of an ecological park sought to protect a landscape impacted by mining speculators, it has had a negative impact on Dukha traditional lifeways by banning hunting. Although the Dukha are considered nomadic pastoralists, their economy consists of a balance of foraging, herding, tourism, and participation in the market economy of Tsagaannuur, the closest town (*suum*) (Gauthier and Pravettoni 2016).

The Dukha typically move four to eight times in a year, moving between the alpine valleys in the summer, river valleys in the spring and autumn, and the outskirts of the provincial town of Tsagaannuur in the winter. It is in the winter when only a few men from the group periodically check on the reindeer left in the deep snows of the taiga. Many families who resided in the camp we observed in the summer of 2012 only live in the taiga in the summer and head to town in autumn when their children's school resumes. They return to the mountains when school dismisses at the end of spring. There is always at least one family that cares for all the group's reindeer during this time, and during our time there, it was the family of Bayandalai and Tsetsegmaa, a family we have consistently worked with, among others, over our five visits in five field seasons.

Dukha camps vary in number of families, but the basic structure remains the same. All camps are located close to a reliable stream for access to a steady water supply. Each camp is composed of domestic structures called *ortzen ger*, woodpiles, cache platforms, reindeer staking areas, and corrals. The presence of platforms and corrals varies, and they are more common in camps that are revisited in multiple seasons. In summer camps, there are also large posts for tethering horses, but the difficulty of horseback riding in autumn to spring snows prohibits the need for them at other seasonal camps. The *ortzen ger* is the domestic structure, and each family has their own. In addition, there are woodpiles associated with each family and discrete staking areas for reindeer. In some well-established camps, there can be corrals for deer or other livestock.

The *ortzen ger* is a conical lodge that measures on average 3 m in diameter. There are 18–32 larch poles that are tethered in the middle, and the structure is covered with canvas and sometimes weighed down by cobbles. Prior to setting up the domicile, the Dukha remove rocks from the floor and fill holes with sediment collected from stream gravel bars. Most homes take advantage of plastic tarps along the south facing side of the *ortzen ger*, which is tethered above the door to increase the amount of light into home. The doorway typically faces to the southeast and is a simple canvas flap with a willow pole stretched horizontally across the center of the door flap.

The *ortzen ger* possesses a number of features that serve as spatial attractors that influence where activities take place. The typical interior space consists of a sheet metal collapsible woodstove in the center of the floor space with its metal smokestack rising out through a center aperture. Set right behind the stove to the north is a wooden plank that serves as a shelf for items like a kettle, bowls, and bread set out for residents and guests. The ground surface is typically covered with carpets or linoleum sheets. The kitchen area is along the east wall and often consists of wood plank shelving where most of the cooking equipment resides. Stored food is sometimes found in the kitchen, but many foods set out for drying are lashed to the larch poles using the cordage used to secure the canvas. Raised bed planks lie along the wall and are dependent on the number of occupants. Not every member of the household has a bed as some members sleep on the carpeted ground floor. The bed closest to the kitchen typically belongs to the head of household, whereas the ownership of the remaining beds is less clearly defined. Although not shown in Figure 10.1, there are two remaining features that are fairly common. The first is the Ongod, or family shrine, that is often placed on a high shelf or cabinet and is often covered with a cloth, which is typically located opposite of the doorway to the north. The remaining spatial attractor is the television that is typically in the northwest area of the *ortzen ger*. This is also the location of the solar-charged battery that provides all the power in the house. Television viewing happens at various times of day and is enjoyed by all members of the family.

Studying how the built environment of the *ortzen ger* influences spatial decisions begins with the stove. The stove serves as the source of heat and food preparation, and its central role in domestic space is reinforced by its location in the middle of the *ortzen ger*. In addition, ambient light structures production activities in interior spaces. These spatial attractors serve as an example of how this concept can help understand the spatial patterning among the Dukha and how it can potentially serve as an interpretive tool for the archaeological record.

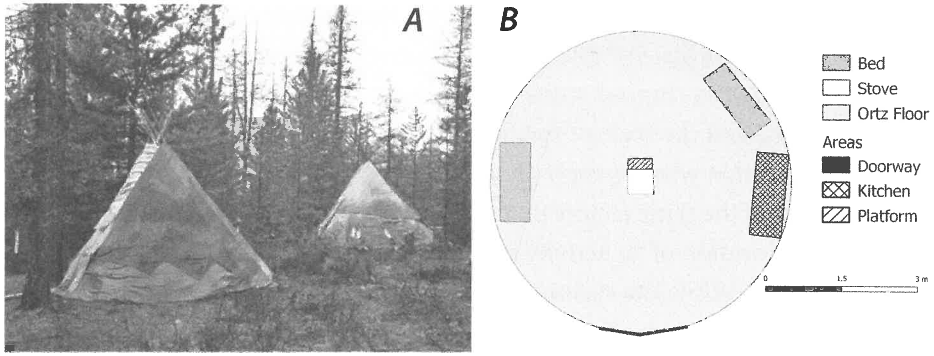

Figure 10.1. Image (*A*) of Dukha *ortzen ger* from spring 2016 and general sketch map (*B*) of the interior space.

The Dukha Ethnoarchaeology Project was a collaboration with Tsetsegjargal Tseden of the Department of Anthropology and Archaeology of the National Museum of Mongolia. It ran from 2012 to 2017 with field excursions occurring in each year. This chapter focuses on the spring 2016 data set, where data collection began on April 19 and concluded by June 4. This field season encompassed four separate camps that varied from two to three households. Each camp represented a slow migration toward the summer camp located in the alpine valley of Mengbulag. We worked closely with the Dukha, who served as our hosts, research subjects, and collaborators. They facilitated and supervised data collection. Dukha collaborators reserved the right to determine when data collection was permissible and to request that any data be deleted. All Dukha requests to modify data collection and methods were accepted without question. We collected spatial data from both exterior and interior spaces, but given the interest in exploring the built environment of the *ortzen ger*, we detail here our household data collection methods.

Our study is a shift of emphasis away from mapping debris to mapping individuals. Ethnographic attempts to rely on debris patterning at campsites often reveal patterning at the scale of 10s to 100s of meters, which limits its utility to archaeology, which often operates at scales of meters. For example, O'Connell's study of debris among the Alyawara produced an artifact density of less than one artifact per square meter. A similar parallel study of debris mapping of a 2017 Dukha Fall camp resulted in artifact densities of less than .25 artifacts per square meter. The low frequency of debris in contemporary camps has been attributed in part to the cost of acquiring tools from markets with limited financial means among traditional societies, and that extends the object's use life. The rate of discard between modern and prehistoric technology, such as chipped stone debris, leads to an incongruity in the density of discard and the scale of spatial patterning. As such, we are making an assumption that where people choose to do things in the present is governed by many of the same factors that existed in the past. Furthermore, we assume that the location of an activity in the present is analogous to the similar task in the past. While site cleaning would be expected in the past as we observed in the present, such efforts often leave residual objects that evade sweeping and residues that can be detected from the sediments (Schiffer 1987).

To capture the location of people within the *ortzen ger*, we established random times within daylight hours to perform four to six 20-minute interior observations in our host camp. The times of observations typically spanned 06:00 to 20:00, and all households in camp were included in the study. We would randomly choose the household and time to capture an unbiased sample of daytime activity. Our choice to limit our observations to less than three hours per day was to minimize our influence on Dukha daily activities inside the home.

Observers would first seek permission to enter the house and upon invitation would sit in an unoccupied area. Each observation was recorded using a template with a basic polar grid depicting the *ortzen ger* followed by a table below for data collection (Figure 10.2). The location of each individual was recorded on the template where the center of their body was located. Every minute the observer would record whether the door was open or closed, the location of one individual along with their coded identification, whether they were standing or sitting, what they were doing, and what tools or objects they were using. With each subsequent minute, the observer would move on to the next individual recording the same attribute data, and would cycle back to the first individual once everyone else was recorded. Infants strapped to cradleboards were often mapped as a fixed location as long as they remained so for the duration of the observation. If the house was empty, the observer would remain in the house for a few minutes before departing. After each field season, all observation forms were scanned and digitized using PhotoModeler software to convert hand-plotted locations to a user-defined coordinate system based on a hypothesized 3 m diameter *ortzen ger*. Although there is likely some locational error from using sketch mapping, this technique ensured

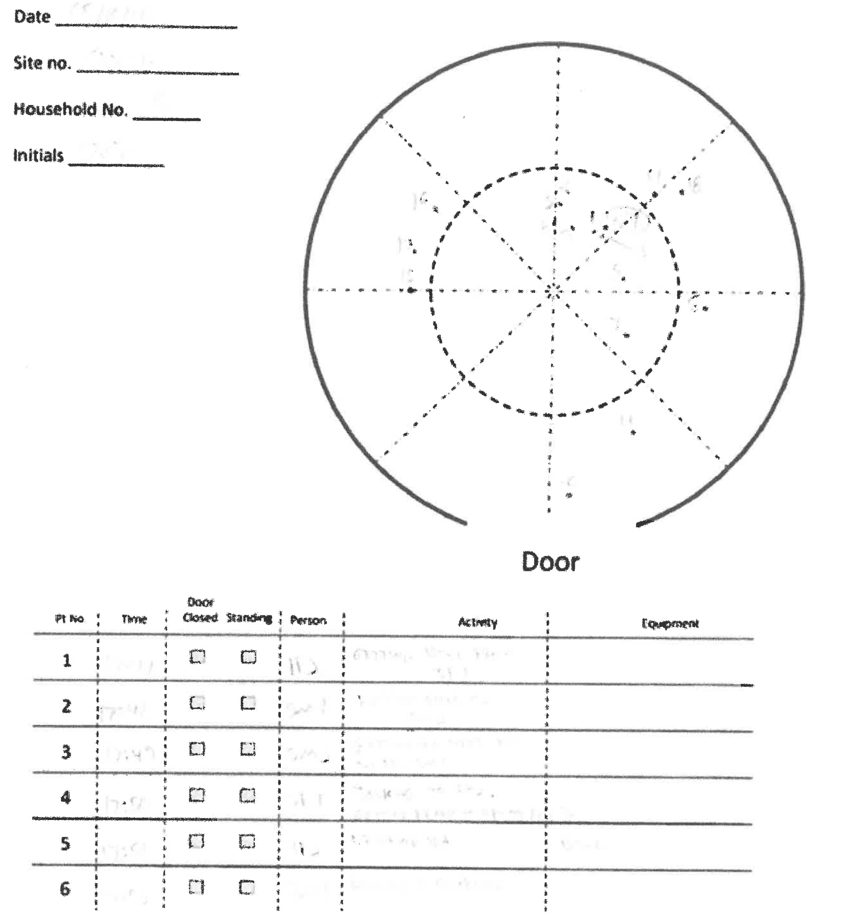

Figure 10.2. Interior observation template used for recording the location and attributes for each observation period.

privacy for the Dukha during observational periods. All spatial queries were performed using Quantum Geographic Information System (QGIS Development Team 2020), and data and statistical analyses were performed using R (R Core Team 2019).

Results

In total, the spring data yielded 1,594 interior observations excluding individuals sleeping. These data reflect patterns common with archaeological backplots, where there is a heterogeneous distribution. Among the Dukha, clustering oc-

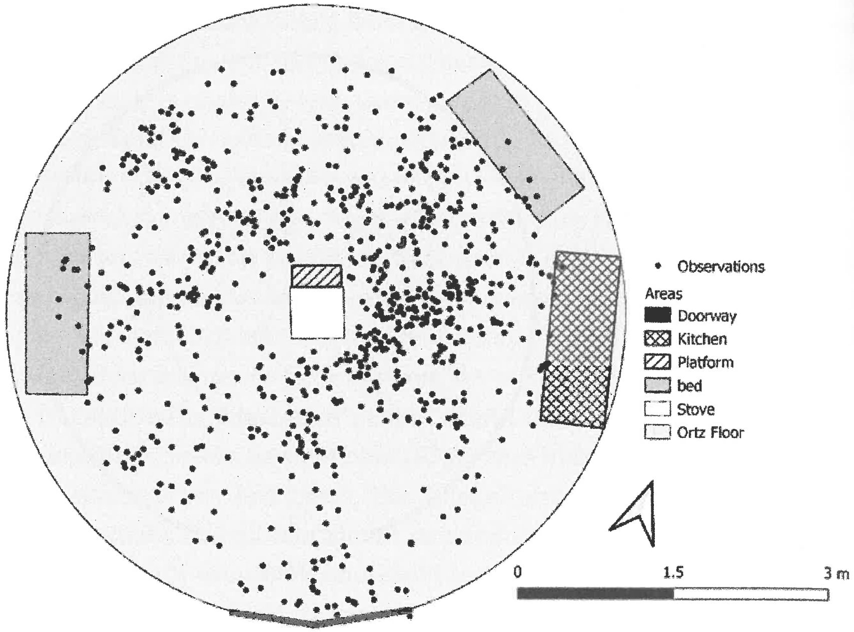

Figure 10.3. The distribution of 1,594 observations of interior observations from April 19 to June 4, 2016.

curs to the east of the stove, near the eastern bed, and to the northwest where the television is most commonly located. Inversely, the western half and, to a greater extent, the space directly adjacent to the door is notably underutilized. In the next section, we examine the first of two spatial attractors: how the woodstove and heat produced influences where activities occur.

Hearth Tethering

Stapert proposed that unimodal distributions in the frequencies of artifacts as a function of hearth distance were indicative of exterior hearths often exhibiting a long right tail. In contrast, an interior hearth would create a bimodal distribution in the frequencies of artifacts as a function of hearth distance, reflecting the dual influences of the hearth and house wall, which prevents further scatter. In other words, both the hearth and house walls are effectively attractors of human activity. Stapert's (1989) prediction holds with all observations with two peaks around 1 m and the second at 2 m from the hearth center. To evaluate this prediction, we examined the distribution of

distances of activity observations to the hearth, looking to determine whether two model distances were present.

To evaluate whether these peaks are significant, we used Hartigan and Hartigan's (1985) dip test, which was developed to determine whether a data set is unimodal or multimodal. The test assumes all data are unimodal with a single mode with a convex distribution less than the mode and a concave distribution greater than the mode. A data set that rejects the null hypothesis of unimodal distribution indicates that there are two or more additional modes. The test statistic is distribution (D), which has a maximum value of 0.25 and minimum value hovering around zero. To visualize the results of the test, we present a generic sample with a single normal distribution with a mode of 1 and a second data set with modes of 1 and 10 (Figure 10.4). The dip test for the normal distribution results supports the null hypothesis for a single mode (D = .0079; $p = .9774$), whereas the bimodal distribution results in significant support for the alternative hypothesis of a multimodal distribution (D = .1362; $p \leq .0001$).

Turning to the data collected in the spring of 2016, we find support for the idea that the use of interior hearth spaces results in a bimodal distribution. The largest peak occurs at 1.25 m and the lower peak 1.84 m, but the Hartigan and Hartigan dip test indicates that the distribution is multimodal (D = .0227; $p \leq .0001$) (Figure 10.5).

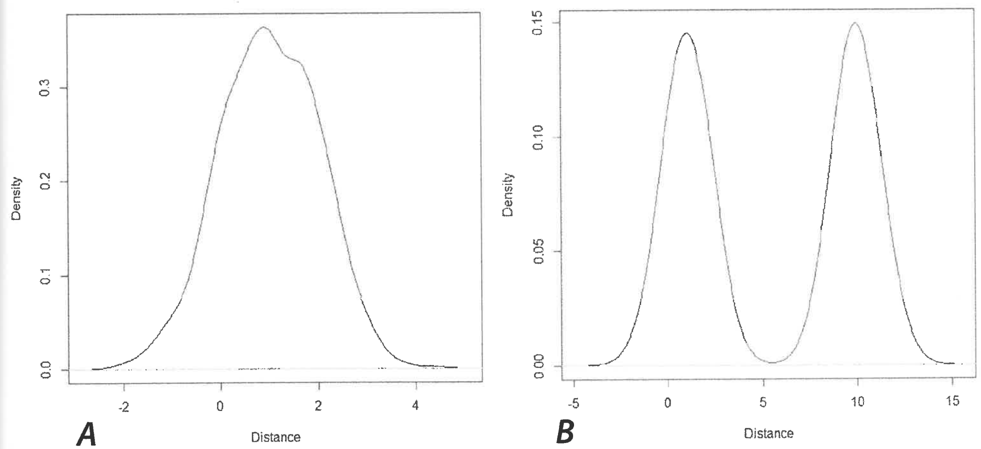

Figure 10.4. Density plot of randomly derived data set with a unimodal distribution (*A*) and bimodal distribution (*B*).

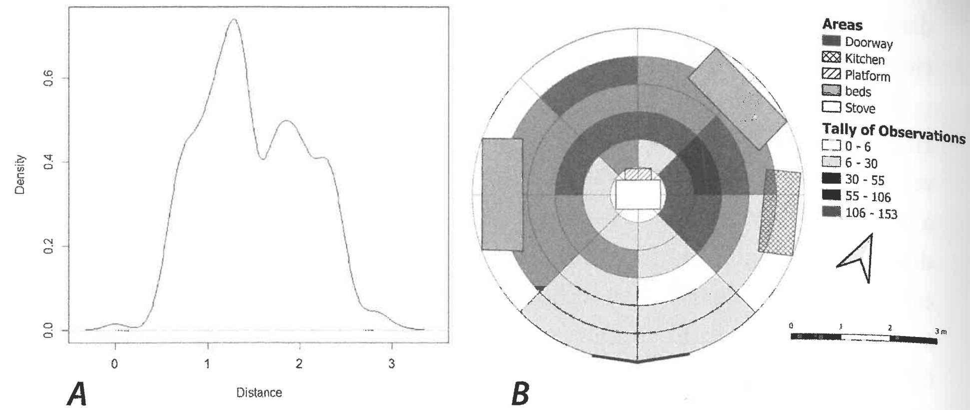

Figure 10.5. The distribution of distances from the stove (*A*) and the intensity of sector use for the 1,594 observations (*B*).

We imposed a polar grid on the *ortzen ger* floorplan and demarcated rings every half meter and subdivided the spokes every 45 degrees. Unlike Stapert's reliance on raw counts that Blankholm (1991/1992) critiqued, we opt to examine the distribution in relation to number of observations divided by the area of the sector. The results show a strongly heterogeneous distribution of activity with the *ortzen ger* where the northern sectors have the greatest density of observations (Figure 10.5). In looking at all of our locational observations, the northern sectors had 1,002 of 1,588 observations (63%). Inversely, the southern sectors have the fewest observations, likely tied to maintaining a clear corridor for people using the doorway. Looking at the distribution in reference to common features within the *ortzen ger*, the stove and kitchen appear to attract the most attention followed by the area commonly adjacent to the television. The only remaining place with a high concentration of occupancy is near the television.

The inclusion of all observations fails to provide an accurate analog to the behaviors that shape the archaeological record. For this reason, we further pare down the observations to include only those that are tied to cooking and production tasks. Observed cooking task locations likely correlate with macrofaunal remains and biochemical signatures in sediments that would indicate the location of the kitchen when no other evidence is present, which would identify the location of the kitchen in the absence of structural remains. Production includes tasks that result in the manipulation or manufacture of materials that would likely result in debris or the use of tools that in prehistoric con-

text would have required rejuvenation. Among the Dukha, these production tasks include cordage production, sewing and garment manufacture, cutting and carving antler, drilling, filing, garment repair, making wooden furniture and bowls, scraping hides, sharpening axes, and chainsaw repair.

Cooking and Production Tasks

Following the previous analysis, we can also look at the distribution of distances from the stove analogous to Stapert's ring-and-sector model. Cooking has a mean distance from the stove of 1.11 m, whereas production averaged 1.41 m, and a Wilcoxon rank-sum test indicates these differences are statistically significant ($W = 7205, p \leq .0001$). The closer proximity of cooking activities toward the stove appears to suggest that this pattern only holds because the stove door opens on this side, and maintaining stove temperature is critical during cooking. We would counter that the tethering to the stove would be reduced when considering a hearth but that the storage of kitchen gear would maintain the biased distribution of cooking locations within the same space between the hearth and kitchen. On the other hand, production tasks do not seem as tethered to the hearth. Stapert (1989) argued that non–fire reliant tasks would occur in the outer area of the floor space, but production tasks are occurring primarily from .5 m to 2.5 m in most sectors, with the exception of the area to the eastern half of the doorway.

Visually, cooking is clearly on the eastern side, whereas production appears skewed toward the western half. More specifically, cooking tasks appear to be concentrated in the area between the kitchen and the stove. To examine angles in relation to the center of the *ortzen ger*, we use the CircStats package in R (Agostinelli and Lund 2018; R Core Team 2019). If we assume the doorway to be to the south (180 degrees), then 88 of 100 cooking locations fall within 45 to 135 degrees. The mean angle of all cooking observations was 84 degrees, and production averaged 329 degrees, which is less informative than the measure of uniformity in the angles of these activities. The spread of observations is best understood with measures of circular dispersion that determines the resultant length and mean resultant length (Jammalamadaka and Sengupta 2001). It is the latter measurement that ranges from 0 to 1 with values approaching 1 indicating little variance in values of angles (Mardia and Jupp 2000). The mean resultant lengths for production and cooking were .213 and .839, respectively, which supports what is visually apparent in Figure 10.6.

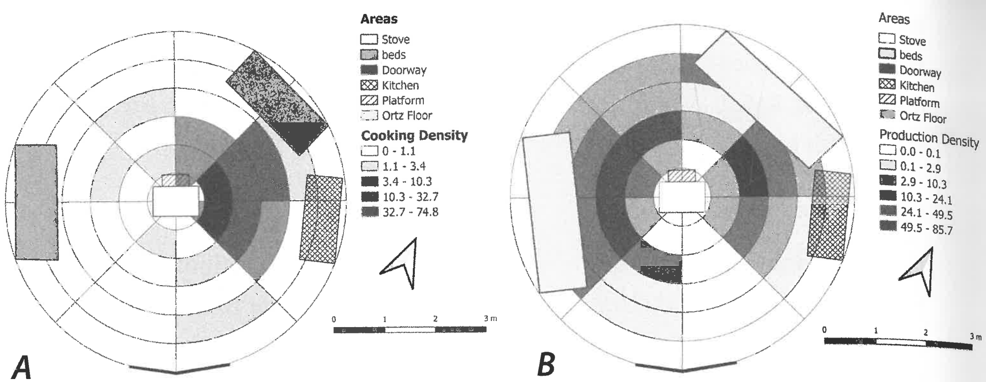

Figure 10.6. Density of cooking (*A*) and production (*B*) per sector.

Ambient Light

In the previous section the tethering effects of the hearth provided an explanation for the skewed spatial distribution of cooking tasks, but the relatively dispersed nature of production tasks suggests an alternative factor is at play. One variable to consider is how the opening at the top of the structure and occasionally open doorway create an uneven distribution of light within the *ortzen ger*. Over the course of five years, we collected lux readings from the interior of the *ortzen ger* at different times of day. Since our production observation times span 9:41 to 20:57, we combined spring readings at 13:55 and 15:10, summer at 9:45, and fall at 11:00. These values were taken at increments of 45 degrees from the center to the wall at intervals of 50 cm. Casual observations indicated the drastic difference in the amount of light hinged on whether the door was left open or closed, which led us to capture light in both settings. Although the door was occasionally open in the spring of 2016, we focus solely on door-closed lux readings.

The location of each reading was then used to establish Voronoi diagrams to subdivide the floor into discrete polygons. The division of space was not based on the actual lux values, but simply on a unique value collected in that space. This method simply subdivides space based on lines being drawn perpendicular between any two points at the midpoint. With the floor subdivided in this manner, we can then count the number of production locations that fall within that space (Figure 10.7). Using the average values from the four lux readings, ambient light with the door closed ranged from 61.3 to 7,886 with all of the light originating from the opening at the top as well

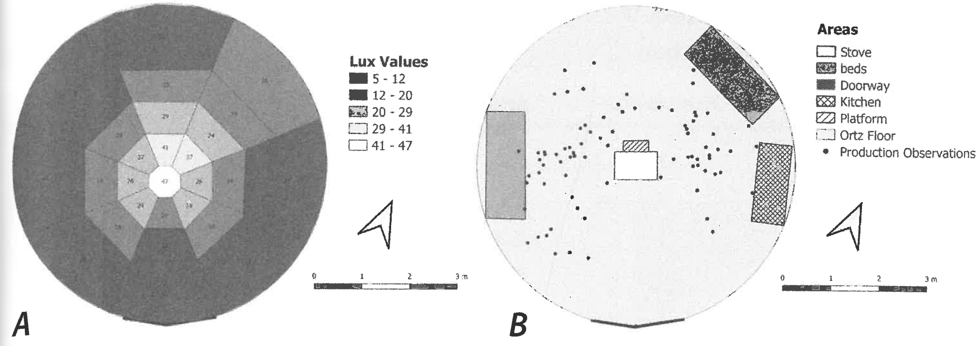

Figure 10.7. The measure of light in lumens with the door closed (*A*) and the distribution of production observations (*B*).

as the semitransparent tarp stretched across the upper portion of the south wall. Light was brightest around the hearth up to 1.5 m and greater toward the north. If ambient light was a significant factor inside the structure, we would expect production tasks to be correlated with the distribution of lumens.

To accurately identify the relationship between light and production, the production tasks were also subdivided into those taken with the door open or closed, which results in a breakdown of 270 production locations into 227 door-closed and 43 door-open observations. Due to the colder temperatures during the spring, the shortage of door-open observations precludes further analysis, so we focus on 227 door-closed observations (Figure 10.7).

Logic would suggest that ambient light plays a critical role in where production tasks take place. The distribution of production tasks tends to occupy a band spanning 1 m to 1.5 m around the center of the *ortzen ger*, which also has higher lux values. When we look at all lux sectors with at least one production observation, we find a moderate correlation between the amount of light and the density of production ($r_s = .424$; $p = .039$) (Figure 10.8; Table 10.1). The fit of the Spearman's Rank Correlation is impacted by highest lux reading located 1.5 m from the center and an angle of 0 degrees that only had six observations, and equally critical was the highest frequency of production that coincided with fourth-lowest lux average. This location falls within the sector between the stove and the kitchen where cooking dominates. These results confirm our preliminary field observations that ambient light is a spatial attractor, affecting Dukha spatial decision-making, but it also suggests that ambient light alone does not dictate positioning of production tasks.

Table 10.1. Lumen values, the frequency of production tasks, and density of production

Mean Lux	Observations	Area	Density
61.3	17	2.25	7.56
78.3	2	2.32	0.86
84.0	7	2.20	3.18
106.8	26	0.62	42.07
119.3	3	0.62	4.85
136.0	9	0.41	21.85
169.7	14	0.78	17.95
179.0	2	0.41	4.85
192.7	10	0.82	12.14
230.0	2	1.37	1.46
234.3	18	0.62	29.13
236.3	6	0.62	9.71
242.5	19	0.82	23.06
296.0	1	0.21	4.85
317.5	1	0.21	4.85
322.0	13	0.62	21.04
343.3	9	0.41	21.85
381.3	11	0.41	26.70
423.5	1	0.21	4.85
454.0	3	0.21	14.56
471.0	12	0.41	29.13
843.3	15	0.41	36.41
2741.8	18	0.62	29.13
7886.0	6	0.62	9.71

Discussion

We developed this study with the specific goal of examining Dukha spatial behavior within a framework that provides analogs for archaeological interpretation. Our use of Stapert's ring-and-sector model highlights the importance of establishing units that correlate spatial clustering with behavior. We

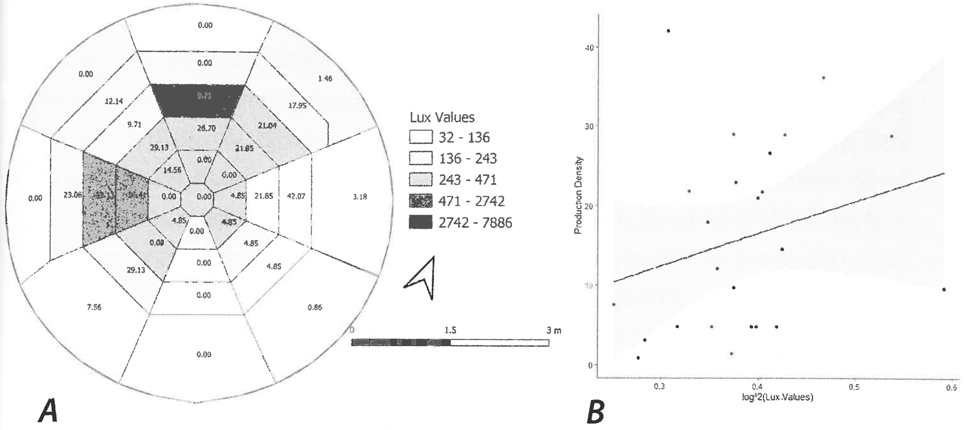

Figure 10.8. Density plot (*A*) of light values (Lx) shaded by average values and the numerical value per sector is the production density. (*B*) is a scatterplot of log2 of lux values and production density.

would argue that Stapert's model implicitly reflects an approach we have incorporated into our ethnoarchaeological project—one that focuses on spatial attractors (Surovell and O'Brien 2015). Attractors are natural and cultural features that attract individuals seeking greater efficiency when performing certain tasks, and each attractor caters to different tasks and different contexts. Spatial attractors can be ephemeral, such as ambient light or heat, or fixed, such as the organization of materials within a structure. In some cases attractors are nested within each other, such as with the built environment pertaining to the home. It is the organization of the domestic structure that impacts where people situate themselves to perform certain tasks. Our Dukha study focused on the influence of hearths and households on spatial decision-making.

Archaeological analysis of patterning within households and interior space first requires that one can identify the presence of a domestic structure, and the ring-and-sector model provides a means to accomplish this task. Using ethnoarchaeological observations to construct methodological approaches should not be seen as a bias but instead an informed prediction that can then be tested empirically. Blankholm (1991/1992) critiqued the model for using arbitrary divisions of site space, but one could argue excavating archaeological sites and the variation in how this is done is equally arbitrary. Clearly, using the model in archaeological contexts requires knowledge of the location of a hearth, but even in the absence of clear signs of a thermal feature, it is possible to discern its location by the distribution of burned artifacts and bone (Mackie et al. 2021; Surovell and Waguespack 2007).

We first examined whether Stapert's (1989) distinction between interior and exterior hearths holds in an ethnographic setting. While the Dukha rarely use exterior hearths in base camps, we could examine interior hearths and the distribution of people placement. The bimodal distribution of the active observations supports Stapert's interior hearth distinction of artifact patterning. The cold temperatures in northern Mongolia place an emphasis on occupying spaces close to the hearth more so than areas farther toward the outer walls. This pattern may be reversed in warmer seasons or latitudes. The bimodal distribution holds when the sample only includes cooking or production activities. As would be expected, cooking activities occur closer to the stove compared to all nonsleeping observations. Production activities did not result in differences in the average distances of all observations, suggesting that the stove was not a critical factor in spatial decisions. This reinforces Stapert's argument that fire-dependent tasks would be more closely tethered to the hearth and that other production tasks would be spaced out in locations to accommodate the need for more space.

Moving beyond the hearth, we also observed how the organization of gear in the house plays a significant role in shaping spatial decisions by occupants as demonstrated by the stove and kitchen area. It was unsurprising to find an overwhelming percentage of the cooking tasks were performed in the area between the stove and the kitchen. With the stove door only opening to the east, the Dukha's use of a woodstove plays a role in the high concentration of cooking locations to the east as one needs to continuously maintain the fire. We would argue that cooking implements would serve as a spatial attractor in cases with an open hearth, and cooking activities would still be clustered as seen with the Dukha activities. In other words, we observe an interactive effect between two spatial attractors biasing human activity to a single space. Therefore, we believe that the archaeological and geochemical signature of cooking space should be visible within interior spaces.

A second organizational feature is that of the doorway and the near absence of observations near the front, or south side, of the structure relative to the back area. As Surovell and O'Brien (2015) point out in their analysis of exterior areas adjacent to the doorway, there is a conscious or unconscious awareness that the free flow of entry and exit has priority over other activities in these spaces. The absence of activity combined with the tendency to use the exterior areas adjacent to the doorway for production tasks would also make this archaeologically visible not as attractor spaces but as repulsion spaces—thoroughfares where the main activity is movement among other activity areas.

In what is likely the most analogous data set to that of the archaeological record, we examined the spatial patterning of production tasks. The locations of these tasks maintained the bimodal patterning seen with the composite and cooking data set, but the peak density fell farther from the stove compared to cooking. This may correlate with Stapert's suggestion that some production tasks need more space than others, and moving away from the stove may have afforded the individual with needed floor space. Yet production activities were dispersed across nearly all spaces except for the doorway area, which is similar to the results of Haas and colleagues (2018). While production tasks tend to fall in areas with more light, there is no correlation linking more light to more activity. There are likely other factors that have an equal or greater influence on production locations that stem from the need for space, storage of tools or equipment, comfort provided from furniture, and the actual tasks performed. Surovell and colleagues (in press) have shown that interior space is highly gendered, with women dominating interior space predominantly in the eastern half of the home. Women also performed 97.8 percent of the food preparation and all the fire maintenance observed during our field studies, which coincides with the eastern side of the *ortzen ger*. If food preparation is considered primary, then we may be seeing some supporting evidence that production tasks happen in locations and times that do not conflict with cooking.

Given the incongruity between Stapert's lengthy discussion of tool type distributions and our limited sample size, we chose to deviate from his model and examine how light alters the suitability of interior space. The construction of the *ortzen ger* frame and cover alters the distribution of interior light, and the subarctic latitudes force the Dukha to perform many production tasks from within their households to avoid the harsh weather conditions. Our observations show a moderately positive correlation between the amount of light and the frequency of Dukha production when accounting for differences in area. The amount of light is still predicated on the required roof aperture for the chimney, so production locations are indirectly influenced by the stove as it dictates the distribution of ambient light. Variation in the location of production tasks also suggests that there is variance unaccounted for by the spatial attractors of the hearth and light. In part, it is likely the location of necessary gear needed to tackle specific tasks and the need for sufficient space. In respect to the archaeological significance of these results, our analysis of light requires archaeologists to have a basic understanding of the design of the prehistoric dwelling.

Conclusion

Archaeology has long identified spatial patterning in the artifact assemblage provenience that requires explanation, but linking those patterns to behavior has remained difficult. Spatial statistics have drastically improved the reliability of identifying often complex patterns, but they have not provided a means to interpret those patterns. Through ethnoarchaeology, Stapert (1989) proposed looking at provenience from a hearth-centric perspective that drew from Binford's (1978b) Mask Site. Admittedly, the application of the model was criticized for its application and its design, but it did promote the concept of spatial attractor without actually using this term. All archaeologists would agree that a camp has particular areas that attract people and activity. These might be private or public spaces, but there are a myriad of them that range from culturally specific to cross-cultural. It is logical to assume that the hearth represents a cross-cultural attractor due to its role as a source of heat, light, and food preparation (Clark and Ranlett, Chapter 2, this volume). Adhering to Stapert's approach of focusing on spatial attractors, we examined the role of the hearth and home among the Dukha and found the ring-and-sector model an appropriate platform to explore spatial patterning of fire-dependent activities.

By transitioning to the spatial positioning of individuals as opposed to debris, we have generated a robust data set to examine patterning at levels analogous to that of archaeological investigation. By focusing on mundane factors such as heat and light, we believe that the conclusions we draw in this chapter provide insight into factors that shape spatial decisions and are germane to archaeological interpretation of intrasite spatial patterning and inquiries into the effects of the built environment. Yet distinguishing differences between cultural idiosyncrasies or traditions of the Dukha from those that generally apply to other cultures will require similar studies done elsewhere, and we encourage such endeavors.

Note

1. All Dukha individuals who participated in the project did so willingly and voluntarily under an informed consent procedure approved by the University of Wyoming Institutional Review Board in 2010 and renewed annually through 2017.

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