Over hill and dale. Reconstructing patterns of movement in alpine landscapes for Early Holocene hunter-gatherer-groups

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Introduction: Patterns of mobility in non-sedentary communities

Mobility is perceived as one of the main characteristics of non-sedentary hunter-gatherer-fisher (HGF) communities during prehistory, history and modern times. Their campsites 'live' in the sense that they are constantly transformed in the way they interact and connect to each other, resulting in a connection or concatenation of time, place, people, meaning and different events. For these groups living is a part of a constant flow of places (David et al., 2018). HGF communities create and formulate their specific taskscapes, in which every activity, every type of movement and every adaptive strategy is part of a greater historical and social context, but also interlaced with considerations regarding ongoing adaptations to changing environmental conditions and subsequently changing modes of subsistence. The understanding, quantification and reconstruction of this inherently mobile world is an important aspect in the study of prehistoric HGF communities. In these studies, methods originating in anthropological research are of interest and frequently applied. They enable us to reflect and discuss the possibilities and restrictions on landscape usage and mobility faced by prehistoric communities of the Pleistocene and early Holocene. In the presented paper, an attempt has been made to reconstruct hypothetical patterns of movement for Early Holocene or Mesolithic HGF in alpine environments. As case study, the *Kleinwalsertal* was chosen.

The *Kleinwalsertal* during the Mesolithic

The *Kleinwalsertal* is located in the north-eastern corner of the province of Vorarlberg (Austria). It encompasses an area of ~97km^2, faces northeast and is enclosed to the west, south and east by mountain ridges with summit heights ranging from 1,982m (*Steinmandl*) to 2,533m a.s.l. (*Großer Widderstein*). The valley bottom lies between 920m and 1,200m a. s. l. The adjacent valleys to the south can be accessed on foot via passes at the valley heads.

Analyses of pollen cores suggest that after the last glacial maximum and with the gradually warming climate, the *Kleinwalsertal* region was ice free and accessible from 13,000 BCE onwards. However, human occupation can only be traced to the turn of the 9th to the 8th millennium BCE. Subsequently, there is a peak in occupation from the end of the 8th and all the way through the 7th and 6th millennium BCE, continuing possibly into the initial Neolithic period. Various sites show a persistent and repeated frequentation. This indicates a regular usage of the region over a considerable time span by Mesolithic HGF, frequenting similar routes and campsites (Posch & Brandl, 2022).

Background to construction of mobility patterns

Regarding the mobile lifestyle of Mesolithic communities, several models are proposed in literature. For example Kompatscher and Kompatscher (Kompatscher et al., 2016) argue that the location of alpine Mesolithic sites is linked to the preferred routes through the landscape. Along these ‘central paths’ lateral movements from the sites to the surrounding ‘activity zones’ are hypothesised. These direct activity areas around the respective site are calculated in terms of proposed walking time: A radius of 2 hours for collecting and of 4 hours for hunting activities. These values originated among other considerations from ethnoarchaeological observations and where a radius of 4 hours represents the distance that could also be walked there and back again on the same day. Areas without sufficient archaeological evidence should be in turn offside these preferred routes and outside the proposed activity areas.

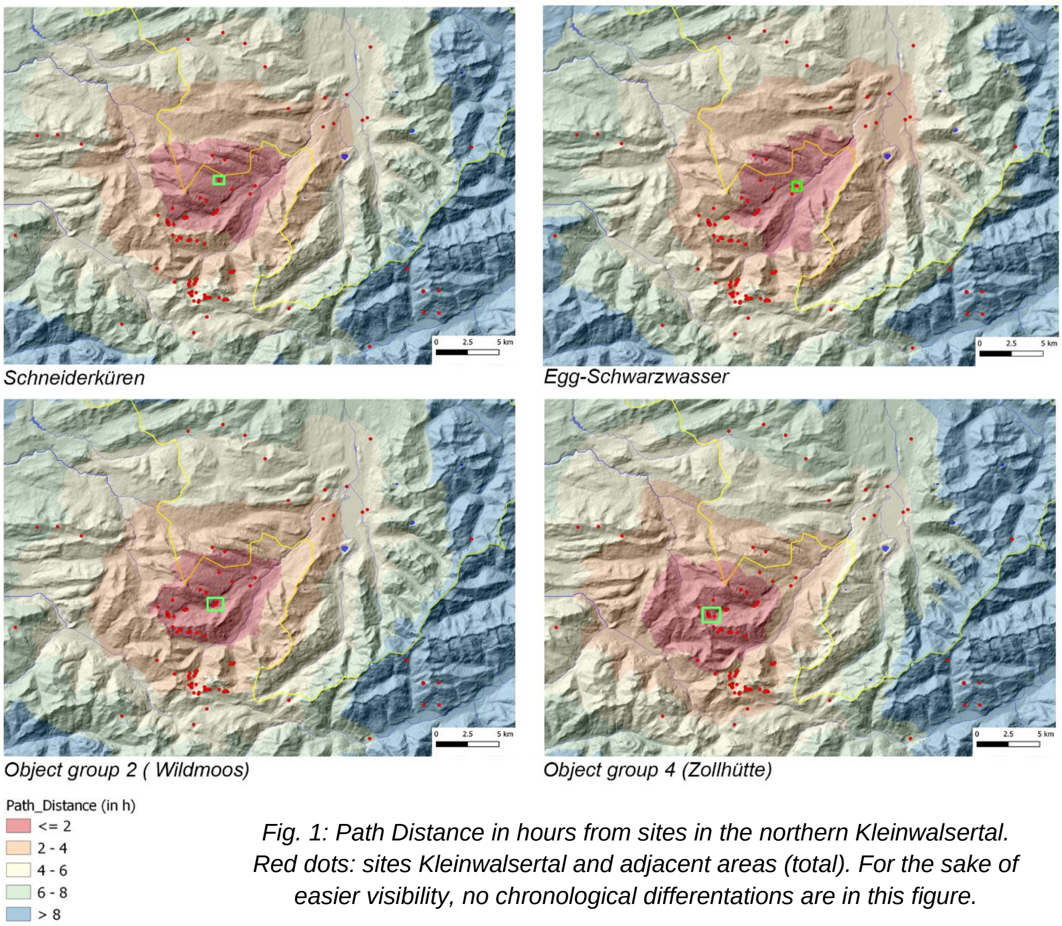

Fig. 1: Path Distance in hours from sites in the northern Kleinwalsertal. Red dots: sites Kleinwalsertal and adjacent areas (total). For the sake of easier visibility, no chronological differentations are in this figure.

In order to test these hypotheses, GIS-based analyses were conducted to reconstruct hypothetical patterns of movement through the landscape, using least cost path (LCP) and site catchment analysis (SCA) (Herzog, 2020). Here, several questions were of interest: i) What are the ideal paths through the *Kleinwalsertal* and are the Mesolithic sites located along these paths? ii) How far extend the 2- and 4-hour radii around the sites in topographic terms? iii) Which sites are located within each other's activity zones and what possible relationships do these sites have with each other?

GIS-Analysis

GIS-analysis were performed between sites i) including an inventory of more than 40 lithic artefacts, ii) classifiable as roughly contemporaneous, and/or iii) positioned at the outermost borders of the region. This procedure was chosen to counteract a possible distortion due to temporal inequalities and to show general paths and corridors of movement through the *Kleinwalsertal*. The calculations were purposefully kept on a basic level and represent the ideal paths in a purely topographical landscape whose only obstacle is slope. It does not include the complexity of mobility, where components such as wetlands, vegetation, erosion potential, etc. are also vital aspects. In the present case, however, it was decided to use only basic calculations, as these are suitable for answering the general working questions proposed above.

For the activity zones, a 25m Digital Elevation Model (DEM) was used for the calculation of the activity zones around the campsites. In order to include how much time it takes to overcome a certain slope, the data table "Tobler's Hiking Function" (Tobler, 1993) was included in the calculations. It should be noted at this point that Tobler's Hiking Function provides a good indication of how fast a certain slope can be traversed, but these values are based on today's habits and speeds. It can be hypothesised that Mesolithic people possibly moved faster and that the results of the analyses are rather minimum action radii then Stone Age reality.

Using the DEM and Tobler's Hiking Function as well as the vector points as starting points, a cost surface was calculated for each campsite using the algorithm "Path Distance" of ArcGIS, which shows how long it takes from the starting point to cross the corresponding grid cell.

The second concerned the most suitable path between different camps. In order to take small-scale conditions into account, these analyses were carried out on the basis of a 5m DEM. Again, Tobler's Hiking Function was applied as a guide to the walking speed in different terrain. Starting from the cost surface of a given location, the algorithm Cost Path was used to calculate the respective costs to the corresponding end points. In order to get not only a single narrow path, but also to take into account the fact that the terrain at that time might have been slightly different, or that people had to take a slightly different route due to conditions not visible in the terrain, a cost surface was calculated for each path, which was converted into minutes. In doing so for each path also the areas were calculated deviating up to 4 minutes left and right from the ideal line of movement. The result is not so much a least cost path as a least cost corridor within which people could move from one campsite to another with the least effort.

Results

Regarding the proximity of the sites, which lie within a 2-hour walking radius of each other, interesting results were obtained: The sites clustering respectively in the north (Fig. 1) and south of the *Kleinwalsertal* are mainly located within a radius of 2 hours to each other and are thus located in two clusters of common close range. If one considers in a next step their 4-hour walking radius, it becomes evident that all the sites of the *Kleinwalsertal* lie in the same larger catchment area. Thus, from the sites in the north as well as in the south, the entire region can be used within a single 4-hour radius. This would subsequently allow the hypothesis of the *Kleinwalsertal* region as one common activity zone.

During LCP-analysis, corridors with a minimum width of 70m and a maximum width of 500m were created through the landscape. These routes show the broad possibilities of the mobility patterns in the region. Interestingly, they also follow partly the ideal course of historically recorded mule trails or still used hunter's tracks and routes of cattle crossings. This holds true e.g. for the ideal movement corridors of site 80 (*Egg-Schwarzwasser*) to the recorded find spots at the extreme periphery of the *Kleinwalsertal* (Fig. 2).

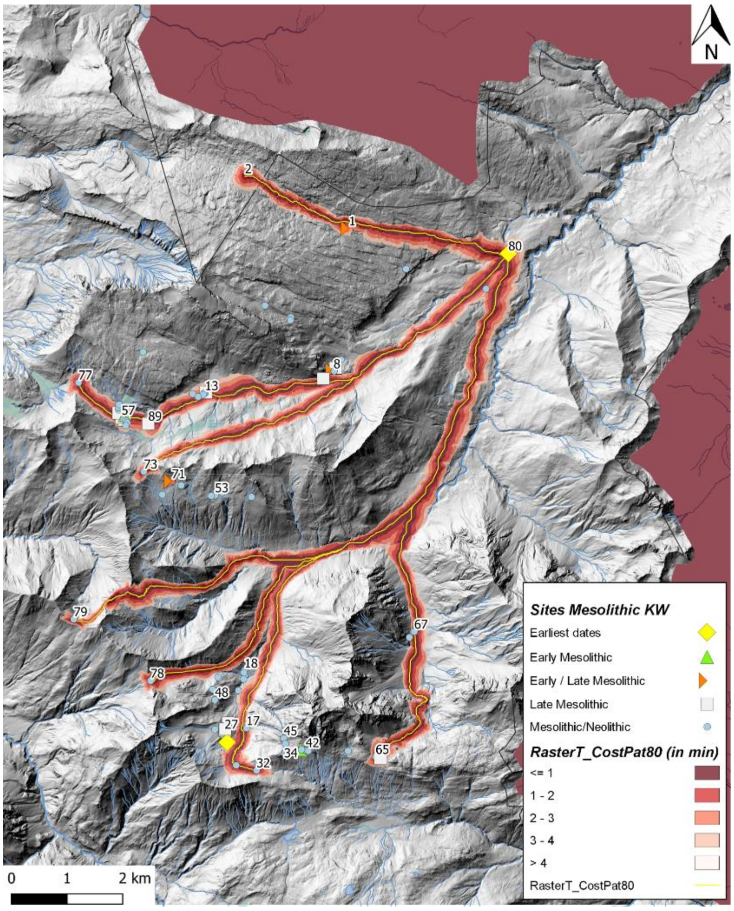

Fig. 2: Least Cost Corridor from site 80.

These observations highlight interesting possibilities regarding the various potential patterns of movement through the landscape. The positions of sites from various chronological contexts along the ideal paths through the landscape seem to strengthen the assumption that prehistoric path networks were not created by a one-time walking event, but their course might be based on rational principles underlying their course and on a long-term and repeated use of a certain route.

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Conflict of Interests Disclosure

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