**Living in the mountains. Settlement patterns in Northwestern Iberia during Palaeolithic period**

Mikel Díaz-Rodríguez

**Supplementary Material**

**Archaeological site information for each area**.

Table 1. Archaeological sites of the Northern Mountain ranges included in the study. The established chrono-cultural criteria are as follows: a) Published chrono-cultural attribution; b) Chrono-cultural attribution based on edaphological/palynological data; c) Chrono-cultural attribution based on techno-typological criteria; d) Chrono-cultural attribution based on available dating.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nº | Name | Chrono-cultural sorting | Type | References | Criteria |
| 1 | Abrigo 29 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a, b |
| 2 | Arnela I | Epipalaeolithic | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1996) | a, b |
| 3 | Arnela III | Epipalaeolithic | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1996) | a, b |
| 4 | Arnela IX | Epipalaeolithic | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1996) | a, b |
| 5 | Arnela V | Epipalaeolithic | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1996) | a, b |
| 6 | Arnela VII | Epipalaeolithic | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1996) | a, b |
| 7 | As Penas do Carballido | Epipalaeolithic | Shelter | (López Cordeiro, 2015, 2002) | a |
| 8 | Chan da Cruz | Epipalaeolithic | Shelter | (López Cordeiro, 2003; Ramil Rego, 2014) | a, b, c |
| 9 | Curro do Oso | Epipalaeolithic | Open-air | (Ramil Rego, 2014) | a |
| 10 | Curro Vello 1 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 11 | Curro Vello 2 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 12 | Curro Vello 3 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 13 | Curro Vello 4 | Epipalaeolithic | Open-air | (Ramil Rego, 2014) | a |
| 14 | Curro Vello 5 | Epipalaeolithic | Open-air | (Ramil Rego, 2014) | a |
| 15 | Curro Vello 6 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 16 | Curro Vello 7 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 17 | Curro Vello 8 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 18 | Curro Vello 9 | Epipalaeolithic | Open-air | (Ramil Rego, 2014) | a |
| 19 | Curro Vello 10 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 20 | Curro Vello 11 | Epipalaeolithic | Open-air | (Ramil Rego, 2014) | a |
| 21 | Dos Niñas | Lower-Middle Magdalenian | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1997) | c |
| 22 | Férvedes II | Lower-Middle Magdalenian | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1997) | c |
| 23 | O Xesto | Epipalaeolithic | Open-air | (López Cordeiro, 2015) | a |
| 24 | Pedra Chantada | Magdalenian | Open-air | (López Cordeiro, 2015) | a |
| 25 | Pena Grande | Azilian | Shelter | (Villar Quinteiro, 1997, 1996) | b, c |
| 26 | Pena Vella | Epipalaeolithic | Shelter | (López Cordeiro, 2015, 2002) | a |
| 27 | Prado do Inferno 1 | Azilian | Shelter | (Ramil Rego, 2014; Villar Quinteiro, 1997) | a, b, c |
| 28 | Taller de A Veiga | Lower-Middle Magdalenian | Open-air | (Ramil Rego, 2014; Ramil Rego and Ramil Soneira, 1996) | a |
| 29 | Taller de Piñeiro | Lower-Middle Magdalenian | Open-air | (Ramil Rego, 2014; Ramil Rego and Ramil Soneira, 1996) | a |
| 30 | Taller de Trastoi | Lower-Middle Magdalenian | Open-air | (Ramil Rego, 2014; Ramil Rego and Ramil Soneira, 1996) | a |
| 31 | Valdoinferno 1 | Epipalaeolithic | Shelter | (Ramil Rego, 2014) | a |
| 32 | Xestido I | Epipalaeolithic | Shelter | (López Cordeiro, 2015) | a, b |
| 33 | Xestido II | Epipalaeolithic | Shelter | (López Cordeiro, 2015) | a |
| 34 | Xestido III | Epipalaeolithic | Open-air | (López Cordeiro, 2015) | c, d |

Table 2. Archaeological sites of the Central Mountain ranges included in the study. The established chrono-cultural criteria are as follows: a) Published chrono-cultural attribution; b) Chrono-cultural attribution based on edaphological/palynological data; c) Chrono-cultural attribution based on techno-typological criteria; d) Chrono-cultural attribution based on available dating.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nº | Name | Chrono-cultural sorting | Type | References | Criteria |
| 1 | 67.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991, 1989) | a |
| 2 | 68.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991, 1989) | a |
| 3 | 69.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1989; Criado Boado and Cerqueiro Landín, 1991) | a |
| 4 | 73.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1989) | a |
| 5 | 73.2 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1989) | a |
| 6 | 74.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1989; Criado Boado and Cerqueiro Landín, 1991) | a |
| 7 | 75.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1989) | a |
| 8 | 76.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991, 1989) | a |
| 9 | 76.2 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 10 | 76.3 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 11 | 77.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991; Criado Boado and Cerqueiro Landín, 1991) | a |
| 12 | 78.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 13 | 79.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 14 | 86.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991; Criado Boado and Cerqueiro Landín, 1991) | a |
| 15 | 87.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991; Criado Boado and Cerqueiro Landín, 1991) | a |
| 16 | 88.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado and Cerqueiro Landín, 1991) | a |
| 17 | 90.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 18 | 91.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado and Cerqueiro Landín, 1991) | a |
| 19 | 92.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991; Criado Boado and Cerqueiro Landín, 1991) | a |
| 20 | 95.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 21 | 130.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 22 | 131.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 23 | 132.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 24 | 133.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 25 | 135.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 26 | 135.2 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 27 | 136.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 28 | 141.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 29 | 144.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 30 | 144.2 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 31 | 145.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 32 | 147.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 33 | 148.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 34 | 149.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 35 | 150.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 36 | 151.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 37 | 152.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 38 | 153.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 39 | 154.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 40 | 158.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 41 | 159.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 42 | 164.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Cerqueiro Landín, 1989; Criado Boado et al., 1991) | a |
| 43 | 171.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 44 | 172.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 45 | 173.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 46 | 174.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 47 | 175.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 48 | 178.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 49 | 191.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 50 | 201.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 51 | 204.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 52 | 205.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 53 | 261.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 54 | 262.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 55 | 263.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 56 | 264.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 57 | 265.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 58 | 266.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 59 | 267.1 | Upper Palaeolithic/ Epipalaeolithic | Shelter | (Criado Boado et al., 1991) | a |
| 60 | 268.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |
| 61 | 269.1 | Upper Palaeolithic/ Epipalaeolithic | Open-air | (Criado Boado et al., 1991) | a |

**Creation process of the variables included in the study**.

1. **Altitude**

The altitude was obtained from the Digital Elevation Model (DEM). In order to do this, a query of the cell in which each archaeological site is located was made. It is possible to obtain this information using the GRASS GIS command *v.what.rast*. The ALT variable was collected at the specific point, while for ALTm the absolute altitude, in meters above sea level, of the four neighbouring cells to the site, was consulted and the average value of those cells was obtained.

To carry out the analysis of topographic prominence there are several possibilities. One option is calculating the relative altitude, based on the altitudinal difference between the site in question and the lowest point in its surroundings (De Reu, 2012). A second option is to obtain the mean difference between a central cell and its adjacent ones (Llobera, 2007, 2001). This can be done, for example, in GRASS GIS with the *r.prominence* extension, created by B. Duke and based on the previously cited works by M. Llobera.

Mapa

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Fig. 1. Example of a map showing the TPI100 calculation with values ranging from dark blue (more prominent areas) to light blue (less prominent areas).

The third option, that was used in this study, consists of using the SAGA GIS software. Its calculation is carried out with the *Topographic Position Index* (TPI) module establishing a 100, 500 and 1000 m radius, which consists of comparing the elevation of each of the DEM cells with the mean of the surrounding elevations. The result is a raster map where the positive values ​​indicate a higher altitude than the average of its surroundings (elevated or prominent areas), the negative values ​​represent locations lower than its surroundings (valleys) and those close to zero flat areas (Guisan et al., 1999; Weiss, 2001, 2000; Wilson and Gallant, 2000) (Fig. 1). The prominence is obtained within the DEM that is established to carry out the analysis and with a given radius. In addition, the average value of the four cells adjacent to each archaeological site was also considered, which allowed obtaining the variables TPI100m, TPI500m and TPI1000m.

Regarding the relative altitude, ALTrA was obtained with the following formula: . It is calculated by dividing the height of the cell in which the site is located (*Aab*) by the cell with the highest altitude within the 20' isochrone (AM). The ALTrB, it is obtained by the formula: . It is calculated by dividing the height of the cell in which the site is located (*Aab*) between the cell with the lowest altitude within the 20' isochrone (*Am*).

To create these variables, the altitude is obtained from a DEM and the isochrone is calculated from the DEM and considering the slope and hydrology as friction surfaces. For this task, another analysis mask was used, but in this case, a limit was obtained based on the cost of moving from the site to the rest of the map. GRASS GIS was employed and within this the *r.watershed* tool in which the DEM of each study area was used and an accumulation map was created using the "positive flow accumulation" option. The map obtained in this step was reclassified with the *r.reclass* tool to make it more manageable when performing cost calculations. Subsequently, *r.walk* was used considering the MDE, a starting point (each site) and the friction map obtained from the previous step. In addition, the “knight move” was selected. This step gives us a cost map in seconds. To establish the different limits of interest for the analysis, the r.*contour* has been used, which establishes lines that mark the threshold that was specify. In this case, 20 minutes have been considered. This step generates a file in which there is a line for each of the established limits. It has been exported and imported it in QGIS, where each of the lines has been individualised and converted into polygons with the *lines to polygons* tool. Finally, each polygon was used to cut the DEM with a *clipper* and thus limit the study area of ​​each site for the different time limits established. Once the 20' isochrone of each site was obtained, it was selected the *AM* and the *Am* values of each site to calculate both variables.

1. **Slope**

The slope was calculated from the DEM. This can be measured in degrees or as a percentage and any GIS can calculate it. The slope values ​​were obtained after applying the nearest neighbour technique to a DEM using a 3x3 pixel mask. As an example, ArcGIS uses an algorithm that calculates the change in height between three adjacent cells by applying a trigonometric formula. The slope is equal to the division between the smaller leg (*l*, difference between the height of the two points) and the larger leg (*L*, horizontal distance between the two points) (Fig. 2) (in degrees).

For the variable SLO, it has been used the value of the slope in the cell in which the site is located. The SLOm was obtained from the four neighbouring cells to that of each archaeological site and calculating its average value. For other slope-related variables, other analyses are needed where more data comes into play. This occurs, for example, with the SLOga, a variable that is analysed because it conditions the biotic resources that can be captured in the immediate environment (Marcos Sáiz, 2006, p. 48). It is calculated from the following formula . It is expressed as the relationship between the subtraction of the maximum height (*MA*) minus the minimum height (*mA*), divided by the distance between them (*D*) and multiplied by 100. The original formula establishes a maximum distance of 1000 m, which has been adapted to the cost of displacement in time, with the isochrone of 20' from the site, because this is a more realistic measure.

Imagen en blanco y negro

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Fig. 2. Schematic representation of the mathematical calculation of α in a triangle.

The SLOt determines the defence and accessibility of the site. It is calculated from the following expression . It is expressed as the relationship between the maximum height (*MA*) minus the minimum height (*mA*), divided by the distance between them (*D*) and multiplied by 100. In the original formula, a maximum distance of 500 m is established, which has been adapted the cost of displacement in time, with the isochrone of 10' from the site.

As for the SLOst, it is the relationship between the maximum and minimum height as a function of the shortest distance between them. This index supposes measuring the slope based on the greatest difference in heights in the shortest distance. It is calculated from the following expression . It is expressed as the relationship between the maximum height (*MA1*) minus the minimum height (*mA2*), divided by the distance between them (*D1-2*) and multiplied by 100. In the original formula, a radius of 500 m was used from each site. However, the 10' isochrone is better suited to reality.

The calculation of the SLOpi allows to observe the accessibility to the site. It is done using the formula . This is the relationship between the distance of the steepest real slope (DSLOst) divided by the maximum height of said slope (MHSLOst) and multiplied by 100. It has been changed the maximum radius of 500 m, from the original formula, by the 10' isochrone.

To complement the accessibility analysis of each site and find out if this data varies in the transition from the immediate environment (15' isochrone) to the medium environment (45' isochrone), the so-called factor 9 is used. This indicates that, on a surface neutral, the variation between the surface of the isochron of 15 minutes and that of 45 is increased 9 times. If a value greater than 9 is obtained, it would be showing that there is an improvement in accessibility conditions as we move further from the site. However, if this value is less than 9, the accessibility conditions worsen as we move further away (Fábrega Álvarez, 2004, p. 19).

The isochrones tend to the circle, so the principle that follows the calculation is based on the following formula . Where *S* is the area, *r* is the radius and *∆* is the increment of the area. Therefore if ∆15-45 ≥ 9 there is better accessibility. If, on the contrary, ∆15-45 ≤ 9, there is worse accessibility. This variable has been called INCr15-45.

1. **Aspect**

From the DEM, the aspect map can be obtained relatively easily, which can be done with the *aspect* tool in ArcGis. This calculation gives the result in degrees (between 0º and 360º), which has been classified as: North (338º to 22º), Northeast (23º to 67º), East (68º to 112º), Southeast (113º to 157º), South (158º to 202), Southwest (203º to 247º), West (248º to 292º) and Northwest (293º to 337º). The ASP variable has been calculated in the cell in which the site is located, while the ASPm is obtained from the average of the neighbouring four cells to that of the site. The aspect values ​​are obtained after applying a 3x3 cell window to each of the map cells. ArcGIS uses an algorithm that calculates the z-value of the 8 neighbouring cells of the cell in question (Fig. 3).

Tabla, Calendario

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Fig. 3. Diagram showing the calculation of aspect in a GIS.

As seen in Fig. 3, the cells are identified as letters, *a* through *i*. Being the *e* the one that represents the cell in which the aspect is going to be calculated. In such a way that the rates of change of direction in the *x* and in the *y* are calculated with the following formulas and . Taking the rate of change in the *x* and *y* direction of cell, the aspect is calculated with the following formula . Finally, it is converted to compass direction values ​​(from 0º to 360º) according to the following rules: if the orientation is < 0, the cell value = 90.0 – *aspect value*. If the aspect is > 0 the cell value = 360.0 – *aspect value* + 90.0 or 90 – *aspect value* (Burrough and McDonell, 1998, p. 190).

1. **Hydrology**

The present-day hydrological map exhibits anthropogenic modifications and the effects of time on the landscape. In order to approximate the past landscape, a custom hydrographic network was created based on the DEM using a methodology applied in previous studies (García García, 2015). Firstly, ArcGIS software was employed to remove “sinks” from the model. “Sinks” are identified and filled using the *sink* and *fill* tools. These tools assign an average value based on nearby cells. Subsequently, the *Flow Direction* tool calculates the flow direction of hypothetical water masses. Determining the direction of rainfall allows for identifying cells on the map that drain into others using the *Flow Accumulation* tool. Given the high values obtained, the log10 function was applied in the raster calculator to scale values into a more manageable range (0 to 7.12). The next step involves rectifying pixels classified as *NoData*, which lack values, by assigning them the mean value of adjacent cells. A threshold is then set to classify drainage as a watercourse. In comparison with contemporary hydrology, it was verified that the threshold should be above 4. Finally, the hydrological map was hierarchically organized according to its watercourse using the Strahler method, which assigns a numerical order to each river course, increasing in value whenever two streams of the same order converge (Fig. 4).

Diagrama

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Fig. 4. Diagram of the Strahler method in which a numerical order is assigned to each course, the value of which increases when two courses of the same order are joined.

The result is a raster layer with 7 classes, where values range from 1 to 7, representing the watercourses contained in the map. This raster layer is subsequently converted into a vector file for further use. To calculate HYDROE, a query is performed to find the straight-line distance from the archaeological site to the nearest watercourse cell. HYDROEm is calculated in adjacent cells. To obtain HYDROC the river vector layer, initially in line format, is converted to points using GRASS GIS and the *v.to.points* tool, with a 100-meter distance between points. HYDROCm is calculated in the four surrounding cells instead of the archaeological site cell, as in the previous variable. As for HYDROV it involves identifying river cells visible from each archaeological location. This is achieved through an intersection between the river layer and the visibility layer for each site, locating cells where both layers overlap. Surface areas are measured in square meters and converted to hectares.

To calculate the potential wetland areas, SAGA GIS software was utilized, specifically the *Topographic Wetness Index* (TWI), which indicates the topographic wetness index in each map cell used. Once this map is obtained, focusing on areas with higher humidity index values, quartiles are calculated to select cells with values above the third quartile. This selection is performed through reclassification in ArcGIS using the *reclassify* tool. After selecting these cells, data in raster format is converted to polygons using *raster to polygon*. It is important to note that the TWI calculation assigns a high value to cells containing rivers, which is not of interest and could distort the data. To address this, the *buffer* tool was employed in ArcGIS, with a 50-meter distance, to account for river catchments. Subsequently, using QGIS, the *difference* tool was applied to subtract the river map from the previous step from the TWI polygon map. This process retains areas with higher wetness values and excludes areas containing rivers. This results in a polygon layer that must be converted into points using the *fishnet* tool in ArcGIS, with a point distance of 25 meters (equivalent to the resolution of the DEM).

To calculate the variable WET, based on the cost of movement from wetland areas to each of the sites, the point map from the previous step and the *r.walk* tool in GRASS GIS, considering the knight's move option, were used. Also, WETm was calculated in adjacent cells. WETv was obtained by considering those cells that coincide with wetland areas visible from each of the archaeological sites and calculating their surface area in square meters.

1. **Geology**

To analyse the potential geology, based on the IGME 1:50000 scale map, areas of potential interest for exploitation by hunter-gatherer communities were identified. These areas encompass abundant quartz, quartzite, and veins of rocks used during the Palaeolithic period. Once identified, each cell of interest on the map was converted into a point based on its centroid. These points were utilized in the GEOLE variable, calculating the straight-line distance from the nearest point to the archaeological site. A similar process was applied to derive GEOLEm but considering the adjacent cells of the archaeological location. Regarding GEOLC distances from these points to each archaeological site were obtained, considering travel cost calculated in time and using slope, and potential hydrology as natural barrier of movement (Fig. 5).

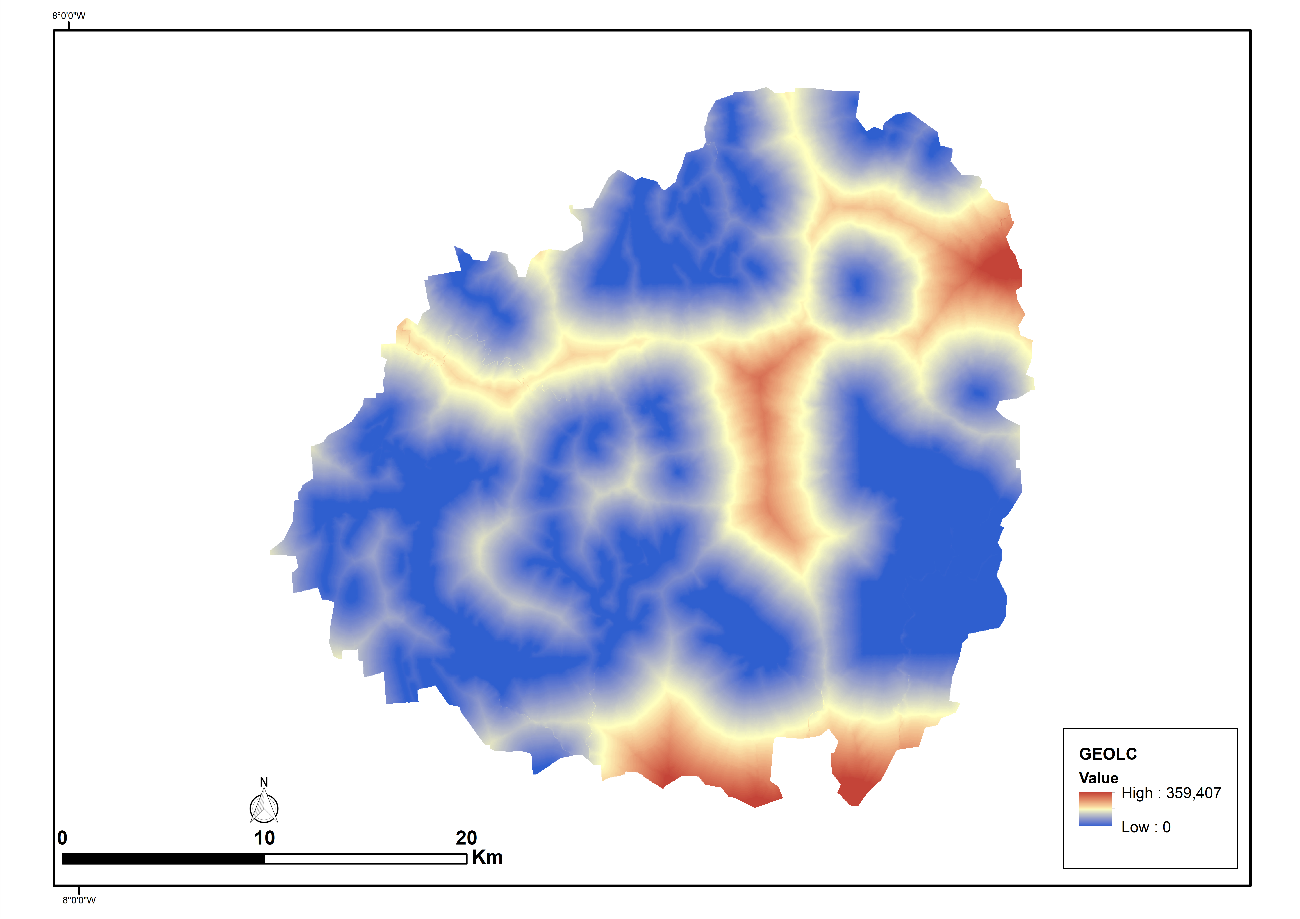


Fig. 5. Map of the GEOLC variable in minutes. Higher values indicate cells further away from the potential geology (in red) while lower values indicate closer proximity (in blue).

The starting point was polygons with potential geological interest, from which it was intended to measure proximity. These polygons were broken down into points in ArcGIS using *Fishnet* establishing regular points at a 100-meter interval between them. These points served as starting points in *r.walk* within GRASS GIS, to calculate travel costs in seconds, incorporating slope and hydrology as friction layers and considering the knight's move option. The same process was used to calculate GEOLCm, although it took into account the average value of adjacent cells. Finally, GEOLv was calculated, based on cells with geological interest that are visible from each of the archaeological sites, and their surface area in square meters was determined and converted to hectares.

1. **CPFPC**

For the calculation of the CPFPC, the Central Place Foraging Prey Choice model was applied with the aim of estimating the maximum productivity threshold associated with each species (deer and goats). Considering an origin point (the archaeological site), the maximum hunting distance for different animals should be related to the energy associated with each species and the costs of processing and transportation (Cannon, 2003).

The result was the establishment of a maximum travel time so that deer hunting would yield maximum productivity, which was determined to be 2.15 hours. The same calculation applied to goat hunting resulted in a value of 1.2 hours. Within this catchment area, it is necessary to determine the surface in which a particular species can live, considering the ecological characteristics of each species. Due to a lack of more precise environmental data corresponding to that period, slope was considered the most determining factor in establishing areas potentially exploitable by flatland-dwelling animals (such as deer) and those from rocky habitats (like goats), as altitude or solar exposure presented a limiting range of validity for each species. Based on slope, it was established that species associated with mountain habitats would be situated above 30° slope, and those associated with flatland areas would be located below 30° slope (Marín Arroyo, 2008, pp. 34–35).

To calculate the catchment areas for both deer and goats, the cell of the archaeological site was used as the starting point, and isochrones of 2.15 and 1.2 hours were considered. Within these isochrones, cells with slopes greater and less than 30° were selected. Subsequently, the proximity in travel time cost from the cells to each archaeological site was calculated with the variables CPFPCGc (for goats) and CPFPCDc (for deer) (Fig. 6). The exploited surface area in square meters was also calculated with the variables CPFPCGs (for goats) and CPFPCDs (for deer).

Imagen que contiene Gráfico

Descripción generada automáticamente

Fig. 6. Map of the CPFPCGc variable in minutes. Higher values indicate cells further away from the potential goat hunting cells (in purple) while lower values indicate closer proximity (in green).

The first step involves calculating the slope in degrees using the *slope* tool based on the DEM. Then, this file is reclassified according to whether values are greater than 30° or less than 30° using the *reclassify* tool. The next step is to convert each of the files into vectors using the *raster to polygon* tool. To continue, the *clip* tool is used to cut the map obtained in the previous step with the isochrone for either deer or goats for each archaeological site. Finally, a new column is created in the table of the previous layer, and the area is calculated.

1. **Visibility**

In other sections, visibility has been considered in combination with other variables. However, in this section, it will be addressed separately and given importance on its own, without cross-referencing with other data. When visibility calculations are performed, an altitude for the cell from which the observation is made (observer's height) and another for the observed cells (target height) can be established. This process yields the variable VISC, which displays the cells visible from each archaeological site with an observer's height of 1.75 meters. This variable represents visibility. Nevertheless, as Connolly and Lake (2006) indicate, by reversing the heights of the observer and the observed point, visibility from the site is obtained. In this study, this is referred to as VISZ, representing locations on the map from which the archaeological site is visible.

Mapa

Descripción generada automáticamente

Fig. 7. VISPR map showing the higher values in brown and the lowest values in purple.

To calculate visual prominence, an analysis is conducted based on the previously explained method, with some specific details outlined below. For the variable VISPR, points are evenly distributed using *fishnet* tool in ArcGIS, spaced at 500 meters between each point. The point layer is then clipped with the study area polygon using the *clip* tool. In the next step, three columns are created: OFFSETA (with a value of 0), OFFSETB (with a value of 1.75), and RADIUS 2 (with a value of 5000). These data are respectively related to the observer's height, the target height, and the maximum viewing distance. In this case, it is important to invert the positions of the observer and the target to achieve the desired result. This result aims to reproduce total visibility (Fig. 7), where each cell records the number of other cells on the map that are visible from it, summing the visibilities from each potential viewpoint (Conolly and Lake, 2006). The same procedure is used for VISPRm but taking into account the average of the adjacent cells.

1. **Potential Least Cost Path**

In the case of the least cost path calculation, a methodology as neutral as possible was chosen, without considering the location of the archaeological sites when defining the starting and destination points. This is because the aim is not to establish road relationships between the various sites but to observe their proximity to potential transit routes. The sites are analysed in terms of proximity or accessibility once the routes have been obtained.

To model potential transit, the starting point was the model known as FETE (From Everywhere to Everywhere) (White and Barber, 2012), which calculates potential transit routes between all possible locations within a bounded area. In technical terms, this study used an analysis that employed all points in a grid as starting and destination points, enabling the calculation to represent the entire territory by creating the least cost routes for the entire chosen area. However, this analysis requires very powerful computer equipment that was not accessible in this study. Therefore, it was decided to adapt this model using the methodology employed in another study (Rodríguez Rellán and Fábregas Valcarce, 2015).

In each of the study areas, points were generated separated by 2000 meters from each other and located along the contour of each area. From each of these points, the least cost route to the others was sought. To calculate the cost, the accumulation of water and slope were taken into account as the friction surface. This entire process was carried out in GRASS GIS. Accumulation was calculated using *r.watershed* and the DEM was used to account for the slope. In the next step, the cost of movement from each point to the rest was obtained by incorporating the reclassified and adapted accumulation map together with the DEM into the *r.walk* tool. Additionally, knight's move was considered, resulting in slower but more precise movement (Awaida and Westervelt, 2002). This process was repeated for each of the created points. Once each of the layers was obtained, *r.drain* was used to generate the least cost transit routes in this way.

Mapa

Descripción generada automáticamente

Fig. 8. Map of the LCPC variable showing proximity in minutes to potential routes.

To obtain the LCPC variable (Fig. 8), the generated routes were converted to points with *v.to.points*, creating points about 100 meters apart from each other and the cost of movement from each of these points to the rest of the study area was calculated, a process that has been used in previous works (Díaz-Rodríguez et al., 2023, 2021; Díaz Rodríguez, 2017). This provided the cost value in the cell of each of the archaeological sites and the average value of the adjacent cells to obtain the LCPCm variable.

1. **Potential insolation**

In the SAGA GIS software, there is a specific calculation module that allows obtaining the potential insolation received by each cell in the map (Conrad et al., 2015). With this module, three types of radiation can be calculated. The first is direct insolation, which comes directly from the sun's incidence. The second is diffuse radiation, which is received from the atmosphere through the scattering of some of the sun's radiation in the atmosphere. On sunny days, it is not very high, but on cloudy days, it accounts for a higher percentage. Lastly, there is total insolation, which corresponds to the sum of the two previous types. This calculation requires the use of DEM, from which the algorithm obtains the necessary data to calculate potential insolation.

Mapa

Descripción generada automáticamente

Fig. 9. Map of the TOTINS variable. Higher values indicate higher insolation index (in dark brown), while lower values indicate lower insolation index (in green).

Diffuse insolation was obtained with the DIFINS variable for the cell where each site is located and with DIFINSm, which is based on the average of the cells adjacent to the site cell. The DIRINS variable provides direct insolation for the specific cell, and DIRINSm calculates the average of the nearby cells. Finally, total insolation was obtained with TOTINS for each site (Fig. 9) and TOTINSm for the cells adjacent to the site.

1. **Wind**

The final analysis conducted is based on exposure to prevailing winds. Similar to the previous section, SAGA GIS offers a specific analysis module that allows calculating the *Wind Effect Index* for each cell in the study area. The *Wind Effect Index* provides valuable insights: cells with values below 1 are sheltered from the wind, whereas those with values above 1 are exposed to the wind (Böhner and Antonić, 2009). For the variable WIND, the index was obtained for the cell at the archaeological site (Fig. 10), while for WINDm, the average of the cells surrounding the archaeological location was calculated.

Mapa

Descripción generada automáticamente

Fig. 10. Map of the WIND variable. Higher values indicate a higher wind exposure index (in purple), while lower values indicate a lower wind exposure index (in light blue).

Gráfico

Descripción generada automáticamente

Fig. 11. Kernel density plots comparing archaeological sites (red line) and randomly resampled background points (black line) for different variables. The grey areas represent the 95% confidence intervals calculated from the resampling of 999 random samples.

Gráfico, Histograma

Descripción generada automáticamente

Fig. 12. Kernel density plots comparing archaeological sites (red line) and randomly resampled background points (black line) for different variables. The grey areas represent the 95% confidence intervals calculated from the resampling of 999 random samples.

Table 3. Statistical summaries of archaeological and random site samples in each zone.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Area | Type | Variable | Minimum | 1st Quartile | Median | Mean | 3rd Quartile | Maximum |
| Northern | Sites | ALTm | 451 | 608.8 | 688.5 | 654.8 | 733.2 | 765 |
| Northern | Sites | TPI100m | -3.4834 | -1.0528 | 0.3083 | 1.1861 | 2.4028 | 10.1166 |
| Northern | Sites | TPI500m | -3.8826 | -0.9375 | 0.4873 | 1.2722 | 2.5969 | 10.5459 |
| Northern | Sites | TPI1000m | -3.8826 | -0.9375 | 0.4873 | 1.4023 | 3.6071 | 10.5459 |
| Northern | Sites | SLOm | 0.06799 | 4.28487 | 6.93268 | 9.95700 | 14.97825 | 25.25130 |
| Northern | Sites | ASPm | 11.34 | 157.48 | 229.45 | 215.05 | 261.80 | 330.94 |
| Northern | Sites | HYDROEm | 34.42 | 302.30 | 687.89 | 732.61 | 1144.08 | 1783.49 |
| Northern | Sites | HYDROCm | 3.358 | 18.392 | 39.972 | 42.863 | 66.558 | 99.438 |
| Northern | Sites | WETm | 0.1055 | 6.2505 | 10.7202 | 13.6092 | 18.4944 | 44.0393 |
| Northern | Sites | GEOLEm | 0 | 31.19 | 516.52 | 802.42 | 1572.64 | 2975.79 |
| Northern | Sites | GEOLCm | 0 | 1.884 | 25.031 | 42.848 | 86.852 | 152.535 |
| Northern | Sites | VISPRm | 0 | 7.25 | 14.50 | 20.09 | 29 | 75 |
| Northern | Sites | LCPCm | 0.2559 | 10.973 | 20.633 | 30.919 | 43.009 | 99.405 |
| Northern | Sites | TOTINSm | 3.512 | 4.353 | 4.569 | 4.495 | 4.720 | 5.262 |
| Northern | Sites | DIRINSm | 2.604 | 3.464 | 3.659 | 3.595 | 3.821 | 4.418 |
| Northern | Sites | DIFINSm | 0.8438 | 0.8825 | 0.9055 | 0.8998 | 0.9179 | 0.9270 |
| Northern | Sites | WINDm | 0.7763 | 0.9018 | 0.9732 | 1.0048 | 1.1378 | 1.2335 |
| Northern | Random sites | ALTm | 261 | 478.5 | 527 | 533.5 | 574.8 | 866 |
| Northern | Random sites | TPI100m | -9.5558 | -0.7584 | 0.5246 | 0.4413 | 2.0225 | 9.4049 |
| Northern | Random sites | TPI500m | -47.8946 | -7.8932 | -1.2053 | -0.4037 | 5.4049 | 39.9626 |
| Northern | Random sites | TPI1000m | -111.289 | -19.008 | -3.678 | -3.636 | 13.883 | 57.962 |
| Northern | Random sites | SLOm | 0.2156 | 3.1513 | 7.0651 | 8.3807 | 11.4869 | 27.0961 |
| Northern | Random sites | ASPm | 13.01 | 102.10 | 159.44 | 167.95 | 233.27 | 351.37 |
| Northern | Random sites | HYDROEm | 13.94 | 189.18 | 627.03 | 730.79 | 1165.03 | 2100.81 |
| Northern | Random sites | HYDROCm | 3.273 | 13.801 | 36.104 | 44.209 | 70.670 | 118.010 |
| Northern | Random sites | WETm | 2.627 | 6.250 | 12.206 | 18.728 | 23.329 | 85.192 |
| Northern | Random sites | GEOLEm | 0 | 448.5 | 1160.2 | 1526.5 | 2333.7 | 4861.4 |
| Northern | Random sites | GEOLCm | 0 | 26.45 | 61.01 | 78.93 | 122.45 | 240.52 |
| Northern | Random sites | VISPRm | 3 | 8.50 | 16 | 19.65 | 22 | 66 |
| Northern | Random sites | LCPCm | 0.500 | 1.105 | 2.418 | 4.239 | 4.271 | 23.676 |
| Northern | Random sites | TOTINSm | 1.862 | 4.129 | 4.418 | 4.259 | 4.689 | 5.401 |
| Northern | Random sites | DIRINSm | 1.016 | 3.233 | 3.532 | 3.374 | 3.804 | 4.534 |
| Northern | Random sites | DIFINSm | 0.8468 | 0.8765 | 0.8836 | 0.8844 | 0.8917 | 0.9300 |
| Northern | Random sites | WINDm | 0.7739 | 0.8510 | 0.9707 | 1.0111 | 1.1191 | 1.3103 |
| Central | Sites | ALTm | 470 | 706 | 725 | 707.90 | 738 | 758 |
| Central | Sites | TPI100m | -5.63 | -1.23 | -0.22 | -0.05688 | 0.92 | 5.09 |
| Central | Sites | TPI500m | -6.08 | -1.28 | -0.19 | -0.0541 | 1.02 | 5.52 |
| Central | Sites | TPI1000m | -6.08 | -1.28 | -0.19 | -0.0541 | 1.02 | 5.52 |
| Central | Sites | SLOm | 0.8449 | 3.7146 | 5.1415 | 5.8483 | 7.7831 | 15.1934 |
| Central | Sites | ASPm | 11.59 | 111.61 | 165.57 | 178.60 | 242.52 | 346.40 |
| Central | Sites | HYDROEm | 33.25 | 1056.05 | 1247.73 | 1214.36 | 1411.89 | 2018.44 |
| Central | Sites | HYDROCm | 5.273 | 57.275 | 68.533 | 67.443 | 78.161 | 108.135 |
| Central | Sites | WETm | 1.030 | 9.126 | 12.247 | 15.630 | 20.012 | 45.934 |
| Central | Sites | GEOLEm | 5367 | 7914 | 8575 | 8300 | 8914 | 9522 |
| Central | Sites | GEOLCm | 259.3 | 403.9 | 431.6 | 417.9 | 447 | 474.5 |
| Central | Sites | VISPRm | 0 | 4 | 7 | 11.3 | 13 | 68 |
| Central | Sites | LCPCm | 0.3027 | 0.9674 | 1.4631 | 2.1547 | 2.6242 | 13.6262 |
| Central | Sites | TOTINSm | 3.427 | 4.209 | 4.547 | 4.45 | 4.661 | 5.43 |
| Central | Sites | DIRINSm | 2.518 | 3.291 | 3.643 | 3.534 | 3.741 | 4.531 |
| Central | Sites | DIFINSm | 0.8817 | 0.9145 | 0.9194 | 0.9164 | 0.9226 | 0.9265 |
| Central | Sites | WINDm | 0.786 | 1.083 | 1.16 | 1.149 | 1.241 | 1.319 |
| Central | Random sites | ALTm | 307 | 426 | 492 | 499.6 | 562 | 734 |
| Central | Random sites | TPI100m | -5.404096 | -0.821026 | 0.000121 | 0.046318 | 1.217141 | 4.095073 |
| Central | Random sites | TPI500m | -19.008 | -2.052 | 2.137 | 2.094 | 8.058 | 18.938 |
| Central | Random sites | TPI1000m | -31.3832 | -10.9950 | 2.7903 | 0.9093 | 11.0688 | 28.9384 |
| Central | Random sites | SLOm | 0.4758 | 3.4814 | 5.9021 | 6.7163 | 8.8971 | 18.4300 |
| Central | Random sites | ASPm | 22.82 | 112.58 | 202.74 | 186.01 | 259.09 | 335.70 |
| Central | Random sites | HYDROEm | 14.98 | 277.76 | 589.14 | 687.76 | 914.05 | 1959.42 |
| Central | Random sites | HYDROCm | 1.947 | 19.017 | 33.847 | 39.881 | 50.933 | 115.528 |
| Central | Random sites | WETm | 0.9774 | 7.2121 | 12.1440 | 17.5517 | 25.1759 | 82.7502 |
| Central | Random sites | GEOLEm | 0 | 2583 | 5204 | 6202 | 8887 | 16127 |
| Central | Random sites | GEOLCm | 0 | 123.1 | 253.9 | 306.8 | 438.6 | 801.7 |
| Central | Random sites | VISPRm | 0 | 10 | 19 | 19.13 | 27 | 45 |
| Central | Random sites | LCPCm | 0.1143 | 0.7751 | 1.1612 | 1.9530 | 2.2636 | 14.8470 |
| Central | Random sites | TOTINSm | 3.239 | 4.172 | 4.457 | 4.422 | 4.674 | 5.406 |
| Central | Random sites | DIRINSm | 2.393 | 3.296 | 3.567 | 3.539 | 3.799 | 4.540 |
| Central | Random sites | DIFINSm | 0.8459 | 0.8707 | 0.8813 | 0.8826 | 0.8957 | 0.9187 |
| Central | Random sites | WINDm | 0.7866 | 0.8694 | 1.0320 | 1.0196 | 1.1460 | 1.2810 |

Table 4. Results of statistic tests in Northern area.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Normality | Homoscedasticity | | Independent means | |  |
| Variable | **Shapiro-Wilk** | **F Test** | **Wilcoxon** | **T Student** | **T Welch** | **Same population** |
| ALTm | 0.04185 | NA | 0.00001762 | NA | 0.00001234 | No |
| TPI100m | 0.008938 | NA | 0.468 | 0.1943 | NA | Yes |
| TPI500m | 0.09752 | 0.463 | NA | 0.5105 | NA | Yes |
| TPI1000m | 0.02265 | NA | 0.7839 | 0.5793 | NA | Yes |
| SLOm | 0.00005112 | NA | 0.3567 | 0.3596 | NA | Yes |
| ASPm | 0.1197 | 0.5768 | NA | 0.02261 | NA | No |
| HYDROEm | 0.003188 | NA | 0.9079 | 0.9887 | NA | Yes |
| HYDROCm | 0.002521 | NA | 0.8407 | 0.8503 | NA | Yes |
| WETm | 0.000000006833 | NA | 0.538 | 0.1682 | NA | Yes |
| GEOLEm | 0.000006409 | NA | 0.01154 | NA | 0.01003 | No |
| GEOLCm | 0.000007255 | NA | 0.01469 | NA | 0.01332 | No |
| VISPRm | 0.000001251 | NA | 0.8443 | 0.9161 | NA | Yes |
| LCPCm | 0.0000002778 | NA | 0.7839 | 0.2453 | NA | Yes |
| TOTINSm | 0.0000001963 | NA | 0.2146 | 0.1367 | NA | Yes |
| DIRINSm | 0.0000003559 | NA | 0.2797 | 0.1618 | NA | Yes |
| DIFINSm | 0.04847 | NA | 0.005377 | NA | 0.003053 | No |
| WINDm | 0.006604 | NA | 0.9854 | 0.8687 | NA | Yes |

Gráfico

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Fig. 13. Kernel density plots comparing archaeological sites (red line) and randomly resampled background points (black line) for different variables. The grey areas represent the 95% confidence intervals calculated from the resampling of 999 random samples.

Interfaz de usuario gráfica, Gráfico, Histograma

Descripción generada automáticamente

Fig. 14. Kernel density plots comparing archaeological sites (red line) and randomly resampled background points (black line) for different variables. The grey areas represent the 95% confidence intervals calculated from the resampling of 999 random samples.

Table 5. Results of statistic tests in Central area.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Normality | Homoscedasticity | | Independent means | |  |
| Variable | **Shapiro-Wilk** | **F Test** | **Wilcoxon** | **T Student** | **T Welch** | **Same population** |
| ALTm | 0.000000007778 | NA | < 2.2e-16 | NA | < 2.2e-16 | No |
| TPI100m | 0.1544 | 0.3478 | NA | 0.7598 | NA | Yes |
| TPI500m | 0.2957 | 0.02653 | NA | NA | 0.945 | Yes |
| TPI1000m | 0.0131 | NA | 0.03906 | NA | 0.03107 | No |
| SLOm | 0.000009964 | NA | 0.3702 | 0.2006 | NA | Yes |
| ASPm | 0.04993 | NA | 0.5155 | 0.6325 | NA | Yes |
| HYDROEm | 0.003927 | NA | 0.00000003019 | NA | 0.000000002273 | No |
| HYDROCm | 0.01832 | NA | 0.00000002122 | NA | 0.000000003962 | No |
| WETm | 2.332e-10 | NA | 0.8417 | 0.4089 | NA | Yes |
| GEOLEm | 0.0003715 | NA | 0.00003436 | NA | 0.0004325 | No |
| GEOLCm | 0.0002549 | NA | 0.00002684 | NA | 0.0001813 | No |
| VISPRm | 0.0000000288 | NA | 0.000002453 | NA | 0.0004423 | No |
| LCPCm | 3.324e-16 | NA | 0.09815 | 0.6297 | NA | Yes |
| TOTINSm | 0.0178 | NA | 0.6486 | 0.6973 | NA | Yes |
| DIRINSm | 0.02601 | NA | 0.9918 | 0.9409 | NA | Yes |
| DIFINSm | 0.000000192 | NA | < 2.2e-16 | NA | < 2.2e-16 | No |
| WINDm | 0.00002514 | NA | 0.000007451 | NA | 0.000001081 | No |

Diagrama, Esquemático

Descripción generada automáticamente

Fig. 15. Boxplots comparing the results of both areas for different variables.

Diagrama, Esquemático

Descripción generada automáticamente

Fig. 16. Boxplots comparing the results of both areas for different variables.

Diagrama

Descripción generada automáticamente

Fig. 17. Boxplots comparing the results of both areas for different variables.

Diagrama, Esquemático

Descripción generada automáticamente

Fig. 18. Boxplots comparing the results of both areas for different variables.

Table 6. Summary of trends for each variable studied in each zone.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ID Number | Variable | Central Mountain Ranges | | Northern Mountain Ranges | |
| v1 | ALTA | High | Medium | |
| v2 | ALTm | High | Medium | |
| v3 | TPI100 | Low | Medium | |
| v4 | TPI100m | Low | Medium | |
| v5 | TPI500 | Medium | Medium | |
| v6 | TPI500m | Medium | Medium | |
| v7 | TPI1000 | Medium | Medium | |
| v8 | TPI1000m | Medium | Medium | |
| v9 | ALTrA | High | High | |
| v10 | ALTrB | Medium | Medium | |
| v11 | SLO | Low | Low | |
| v12 | SLOm | Low | Low | |
| v13 | SLOga | Low | Medium | |
| v14 | SLOt | Low | Low | |
| v15 | SLOst | Low | Medium | |
| v16 | SLOpi | Low | Low | |
| v17 | INCr15-45 | Medium-Low | Low | |
| v18 | ASP | SE | SW | |
| v19 | ASPm | SE | SW | |
| v20 | HYDROE | Medium | Low | |
| v21 | HYDROEm | Medium | Low | |
| v22 | HYDROC | Medium | Medium | |
| v23 | HYDROCm | Medium | Medium | |
| v24 | HYDROV | Low | Low | |
| v25 | WET | Low | Low | |
| v26 | WETm | Low | Low | |
| v27 | WETv | Low | Low | |
| v28 | GEOLE | Medium | Low | |
| v29 | GEOLEm | Medium | Low | |
| v30 | GEOLC | Medium | Low | |
| v31 | GEOLCm | Medium | Low | |
| v32 | GEOLV | Low | Low | |
| v33 | CPFPCGs | Medium-Low | Low | |
| v34 | CPFPCGc | Low | Low | |
| v35 | CPFPCDs | High | Medium | |
| v36 | CPFPCDc | Low | Low | |
| v37 | VISC | Low | Low | |
| v38 | VISZ | Low | Low | |
| v39 | VISPR | Low | Low | |
| v40 | VISPRm | Low | Low | |
| v41 | LCPC | Low | Low | |
| v42 | LCPCm | Low | Low | |
| v43 | TOTINS | Medium-High | Medium | |
| v44 | TOTINSm | Medium-High | Medium | |
| v45 | DIRINS | Medium-High | Medium | |
| v46 | DIRINSm | Medium-High | Medium | |
| v47 | DIFINS | High | Medium-High | |
| v48 | DIFINSm | High | Medium-High | |
| v49 | WIND | Medium-High | Medium-Low | |
| v50 | WINDm | Medium-High | Medium-Low | |

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