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GIS project for the spatial analysis of prehistoric occupations in the Casimcea Valley Basin

Abstract:
The objective of the GIS application that we propose is the analysis of the spatial distribution of prehistoric sites and the characterization of the geomorphological parameters of the natural environment near prehistoric settlements, during different periods of habitation. The area of interest is the entire hydrographic basin of the Casimcea Valley, one of the most important hydrographic basins in Dobrogea, presenting an important density of archaeologically researched prehistoric sites, found both in caves and in the open.
The GIS application was made with the aid of the QGIS program, a freeware program that allows viewing, editing, and analyzing geospatial data. This stage of the project integrated data related to the topography and hydrography of the area, as well as the main altitude points, at a scale of 1:25000. The digital terrain model (DTM) was obtained based on the contour lines, with a 5m equidistant. The inventory of prehistoric settlements is based on the National Archaeological Repertoire (RAN), on inventories made within research projects, but also on those found specialized synthesis publications. Some sites were verified in the field, their precise locations recorded with GPS.
From the landscape point of view, the results of this stage of the project show well-individualized occupational patterns for the prehistoric periods under review, suggesting a number of possible scenarios in the relationship between man and the environment. In future, the project will integrate data on the evolution of the paleogeographic environment, and a more detailed analysis will consider the internal chronology of each prehistoric period and culture.

Keywords: *GIS, Casimcea Valley, archaeology, prehistory, geomorphology*

1. The GIS project: main components and features

The Geographic Information System created for the spatial analysis of the archaeological sites in Dobrogea allows the integration of both spatial and interdisciplinary data obtained through sedimentological, geomorphological, petrographic, archaeozoological, physiochemical, chronological (and other) studies. Moreover, the information system allows for spatial analyses querying the database, creating neighborhood areas, overlaying the map layers, and measuring not only geomorphological parameters, but also distances, perimeters, and areas.

Geographical data is represented as a point, line, or a polygon spatial entity, and is rendered on the map in a vector data model[1], well suited for representing a large volume of complex elements.

Quantum GIS (QGIS) is an open-source geographic information system, comprised of a package of programs that allow the visualization, editing and analysis of geospatial information.

2. Geographical and geological characterization of the studied area

Dobrogea is a significant territory in the southeastern extremity of Romania (15,570 km^2), being bounded between the Danube Valley (to the west and north) and the Black Sea coast (to the east). It consists of three geographical units – plateau, delta, and coast, each with specific physical and geographical conditions and resources[2].

The relief descends from north to south and west to east; in general, altitudes are modest. In the north, the heights of a heavily eroded mountain massif determine the highest altitudes of 300-400 m. Further south, altitudes decrease to values of 100-180 m, the hills formed by the fragmentation of the plateau either on rocks that are easier to erode or on the alignments of certain fault lines. In the southern and eastern extremes, the deltaic, littoral, and pediplanar plains appear, featuring the lowest altitudes (below 50 m)[3].

These forms were created through a long evolutionary process, when repeated uplifts and leveling, faulting, and differential erosion processes took place. Today, geomorphological regionalization requires the delimitation of three sub-regional units, with different genetic and

[1] Mihai, 2013, pp.11-12.
[2] Posea *et al.*, 2005, p. 685; Tufescu, 1974, p. 156.
[3] Ielenicz & Săndulescu, 2008, p. 218.

geomorphological features.

From a geological point of view, starting from the Precambrian period Dobrogea was formed by joining three different structural units, which gives the regions a special identity to this day.

The **Northern Dobrogea Plateau**, from the Danube Valley to the Peceneaga – Camena fault, is formed by the remnants of mountains from the Hercynian and Caledonian. Heights range from a few meters in the meadow regions and the coastal plains up to 467 m at the top of Ţuţuiatu (Dobrogea's highest point). The lithological variety of Northern Dobrogea is reflected in the multitude of relief macro- and micro-forms. As such, the relief developed on crystalline schists, with strongly inclined slopes and sharp peaks (Măcin Mountains); on eruptive rocks (granites, porphyries, diabases) with elongated and chamfered heights (Culmea Pricopan), remnants of erosion and wide gravel surfaces; on sedimentary rocks (limestones, sandstones, loess), with forms of karstic relief (valleys, slopes, sinkholes) in the Babadag Plateau and the Tulcea Hills[4].

The **Central Dobrogea Plateau** is framed by two major fault lines: Peceneaga – Camena to the north, and Capidava – Ovidiu to the south; to the west, it is bounded by the Danube Valley, and to the east by the Black Sea coast.

From a geological point of view, greenschists dominate this region, the oldest layers found in all of Romania (dated to the Precambrian). In the upper part, the overlapping loess cover Jurassic and Cretaceous sedimentary deposit surfaces.

The relief has the appearance of a wide and slightly undulating plateau, with altitudes between 100 and 180 m, corresponding to the oldest leveling surface found on the territory of Romania to date. The highest areas can be found on the anticlinal structures (Topolog – Dorobanţu), and the lowest on the synclinal ones (Casimcea Valley)[5].

The *Casimcea Plateau* is the most extensive area in Central Dobrogea. The geological structure of this plateau is represented on the surface mainly by Quaternary deposits, under which are found Upper Mesozoic and Proterozoic formations, mainly greenschists[6]. In some areas, the latter are uplifted to the surface by the intense and long-term action of external agents.

The *Casimcea Plateau* borders the Gârliciului Plateau to the west and the Istriei Plateau to the east. It is shaped as a peneplain, with the

[4] Posea *et al.*, 2005, pp. 688-689.
[5] Posea *et al.*, 2005, pp. 730-733.
[6] Jipa, 1970, p. 40.

highest altitudes towards the north (La Pandele, 395 m), which gradually decrease until the river flows into Lake Taşaul. The 25-30 m thick loess mantle gives the relief its general appearance, cut from north to south by the Casimcea River and its tributaries – Râmnic, Cartal, Grădina, Valea Seacă, Visterna. In the lower basin of the Casimcea Valley, karst relief (sinkholes, slabs, towers) predominates, while an imposing sector of gorges (*Cheile Dobrogei*), which represents a well-known geological reserve and also includes several caves (Cheia – *La izvor*, Cheia – *La Baba*, Cheia – *Peştera Craniilor*, Târguşor – *La Adam*, Gura Dobrogei – *Peştera Liliecilor*)[7], can be found in the vicinity of the towns of Grădina and Gura Dobrogei.

The Casimcea Valley basin covers an area of about 1200 km^2, being the most developed river basin in Dobrogea. The Casimcea River flows for a distance of 60 km, from Beipunar until its mouth to Lake Taşaul. The elevation of the relief decreases from north to south, from 359 m at Ciolpan Hill to below 2 m at the confluence with Taşaul. Viewed at the national level, it is part of the category of medium hydrographic basins within Romania[8]. The Casimcea Plateau represents approximately one-third of central Dobrogea, administratively split between the two Dobrogean counties – Tulcea (approximately one-third of the basin) and Constanţa (the larger part).

The Southern Dobrogea Plateau is bounded to the north by the Capidava – Ovidiu fault, and to the south by a conventional line representing the state border with Bulgaria. To the west and east, its limits have a morpho-hydrographic character, following the course of the Danube and the Black Sea cliff, respectively. It represents a typical platform region, with the lowest altitudes in the entire Dobrogea area (75-100 m). Wide valleys and interfluves that present themselves in the form of long and low plateaus dominate the relief. Limestones, especially of the Sarmatian period, create specific micro-reliefs, with small irregularities caused by sinkholes or poles[9].

Morpho-hydrographic systems – through their characteristics and variables – have conditioned or favored human occupations throughout history. Prehistoric communities were directly influenced by geomorphological conditions, with a continuous exchange of resources and energy taking place between the geophysical backdrop and the human community.

[7] Comănescu, 2004, p. 27.
[8] Pişota & Zaharia, 2001, p. 57.
[9] Ielenicz & Săndulescu, 2008, p. 218

3. Characterization of prehistoric occupations

The prehistoric occupations considered in this study are attributed to the Paleolithic Era, the Neo-Eneolithic Period, the Bronze Age and the Iron Age. Although the Late Iron Age, the *La Téné* period, is generally included in the period of Antiquity, given that there are interactions and continuity with the Hallstatt period occupation, we have integrated the known sites for the entire Iron Age in our analysis, specifying their chronological interval.

The inventory of archaeological sites was based on the national archaeological repertoire (RAN[10]), completed by inventories of prehistoric sites presented in the specialized literature, especially in synthesis studies. Some of these sites were precisely located during field research through GPS.

Paleolithic Era

Classically, the Paleolithic is divided into three sub-periods: Lower or Early, Middle, and Upper. Archaic lithic industries, represented by flint or quartzite pebbles, processed either on the end, on one face, on both (*choppers*, *chopping tools*), but also by chip tools[11] are attributed to the very oldest Paleolithic, chronologically between about 1,000,000 and 600,000 years ago. The Old Paleolithic, which chronologically corresponds to most of the Middle Pleistocene, is characterized by more advanced processing techniques, such as *Levallois* and the technique of *Acheulean* type bifacial pieces, the 'domestication of fire' and the early arrangement of living spaces[12]. These later industries also correspond to the few lithic pieces (including a bifacial flint carver) discovered *in situ* in the aven zone of the *Peştera Liliecilor* cave from Gura Dobrogei (Constanţa County), associated with the bone remains of micro-mammals and chronologically assigned to the final period of, or immediately after, the Cromerian complex[13] (about 700,000 years). On the territory of Dobrogea, a recently attested 'open air' site, OSL dated to the interval ca. 320-392 ka BP and attributed to Lower Paleolithic, has been located at Peştera - *Dealul Guran*[14].

Within Romania, the Middle Paleolithic is characterized by the

[10] https://map.cimec.ro/Mapserver/
[11] Păunescu, 2001, p. 73.
[12] Păunescu, 2001, p. 73.
[13] Păunescu, 2001, p. 73.
[14] Doboş & Ioviţă, 2015.

development of several Mousterian *facies*, to the formation of which the pre-Mousterian industries also contributed from the beginning of the Riss – Würm interglacial (approx. 100,000 years) until the Middle Würm (33,000-30,000 years)[15]. In Dobrogea, a series of lithic pieces attributed to the Mousterian were discovered, with two *facies* identified: the first including both typical Levallois inventory (such as those from Castelu, Cuza Vodă, Lumina, and from the Cheia – *La izvor* cave) and non-Levallois (such as those from Lumina and Mamaia Sat, all localities in Constanţa County). The second *facies* is denticulate, with weak Levallois debitage, represented by the discoveries from Saligny – *Făclia*, Peştera – *Dealul Peşterica*, Ovidiu (all localities in Constanţa County). The only radiocarbon dating was carried out at the Cheia – *La izvor* cave, returning a value of 36810+790/-720 BP[16].

The Upper Paleolithic corresponds to the Aurignacian and Eastern Gravetian cultures, which evolved during the last glacial period – the middle and upper Würm periods. The Aurignacian is defined by techno-complexes that evolved from the older lithic industries of the Late Middle Paleolithic, such as those of the denticulate Mousterian (with bifacial forms) or of the Acheulean tradition (with numerous scrapers) or of bifacial points and bifacials of different types[17]. On the territory of Dobrogea, the sites of the Cheia – *La izvor* and Târguşor – *La Adam* caves (Constanţa County) are well-known. The Eastern or 'Eastern European' Gravetian is chronologically framed between 24000 and 22000 years BP, with the intervals of 14000-12000 years BP, and 12000-10000 years BP respectively corresponding to the two Epigravetian stages, marked in Dobrogea by the settlements at Tariverde – *Pe izlaz*, and Ţibrinu *III*[18].

The Epipaleolithic is chronologically framed between ca. 13300 and 9500-9000 BP and is characterized by a cultural diversification, respectively by the presence of regional groups with very well-defined territories – such as those in Moldova and Dobrogea, which belonged to the latter Epigravetian and were characterized by lithic industries with accentuated microlithism. In Central Dobrogea, the sites at Castelu and Gherghina (Constanţa County) are known to date from this period, sites that could have been at the origin of the Northwestern Pontic Tardenoisian[19].

[15] Păunescu, 2001, p. 78.
[16] Păunescu, 2001, p. 73.
[17] Păunescu, 2001, pp. 84-87.
[18] Păunescu, 2001, pp. 90-92.
[19] Păunescu, 2001, p. 97.

Neo-Eneolithic Period

In Dobrogea, the Neo-Eneolithic period is represented by the Boian, Gumelniţa, Hamangia and Cernavodă I cultures.

The ***Boian culture*** is considered to have been formed through the synthesis of the Linear ceramic culture and the Dudeşti culture in the central area of Muntenia. It is part of the Boian – Gumelniţa cultural complex, specific to the eastern part of the Lower Danube, as well as to the northeastern part of Bulgaria[20]. The Boian culture spread across south-eastern Transylvania, Dobrogea (the area of the evolution of the Hamangia culture), and north-eastern Bulgaria; but not south of the Balkans, in the area of the Mariţa culture, thought to be related to the Boian culture through the same southern origin[21].

The communities in southern Muntenia evolved in the Vidra phase (classically for Boian), also extending south of the Danube, as far as the Balkans and the shores of the Black Sea. In its last phase, the Spanţov phase, the Boian culture entered Dobrogea as well, where overlaps can be observed in sites of the Hamangia culture[22]. The settlements of these two phases are located on high terraces and structured as *tell*-type settlements, sometimes reinforced with delimitating structures. Moreover, these phases are characterized by rectangular surface dwellings, featuring walls with wooden poles, twigs and and clay plastering, as well as floors of beaten loam.

Based on the radiocarbon data series from Căscioarele – *Ostrovel* for the calibrated and analyzed Boian Spanţov levels, combining the intervals of the maximum probability, Cătălin Bem assigned the period 4900-4550/4525 BC to this phase[23].

The ***Hamangia culture*** is thought to have been developed by a population of southern origin, being most well-known within Dobrogea and isolated on the left bank of the Danube, in the southeastern extremity of Muntenia, with a few discoveries in Bulgaria. According to several researchers[24], the southern origin of this culture is indisputable; at least part of these communities likely arrived in this area by advancing on the western shores of the Black Sea.

Dumitru Berciu states that "... the intimate structure of the Hamangia culture has a very strong Mediterranean, more precisely

[20] Dumitrescu *et al.*, 1983, p. 101.
[21] Petrescu-Dîmboviţa, 2001, p. 150.
[22] Petrescu-Dîmboviţa, 2001, p. 150.
[23] Bem 2000-2001, p. 41.
[24] Dumitrescu *et al.*, 1983, p. 97.

Eastern-Mediterranean, component". Thus, he considers that the first communities belonging to it came by sea and settled in the coastal areas, later penetrating inland[25]. The presence of some materials from an older phase, for example at Cernavodă, could indicate that they also penetrated along the Danube almost simultaneously. The eponymous settlement is represented by Hamangia, today the village of Baia (Tulcea County). In the third phase of the culture, the Mangalia phase, after the occupation of the Danube area by the communities of the Boian culture, the Hamangia culture continued to develop in the south and center of Dobrogea, here preserving itself until the end of its natural evolution when it organically transformed into a Dobrogean variant of the Gumelniţa culture[26].

The settlements of the Hamangia culture are located in coastal areas, on the shores of lakes, on the low or middle terraces of the rivers, or in caves[27]. The main form of housing is the open settlement, located along the coast or on the shores of the lakes, as is the case at Techirghiol, Limanu, and Baia - Goloviţa, or on the lower terraces of the rivers, such as at Ceamurlia de Jos or Tariverde. Some settlements on the lower terraces of the Danube could also extend to the middle terraces, such as those from Cernavodă[28]. The second type of settlement typical of the culture is the cave, such as at *Peştera Liliecilor*, Cheia – *La izvor*, or Târguşor – *La Adam*. Dwellings and hearths were discovered at the entrance of the latter, indicating that these sites were occupied both seasonally and for somewhat longer periods. Sporadically, as in the case of the Hârşova settlement, they were also dwelt in tell-type sites, as can also be found south of the Danube, at Sava and Varna[29].

Regarding the absolute timeline, a radiocarbon dating of a bone taken from the Cheia settlement indicated values of 5020-4797 cal. BC (2 σ), falling within the chronological range established for Hamangia III, 5000-4700 cal. BC[30].

The ***Gumelniţa culture*** represents one of the most brilliant civilizations of the latter half of the 5th millennium BC[31]. This culture gradually developed north and south of the Danube, on the previous background of the Boian, Hamangia, and Mariţa cultures (Karanovo V). It occupied a vast area that includes Muntenia, northeastern Oltenia,

[25] Berciu, 1966, p. 56.
[26] Petrescu-Dîmboviţa, 2001, p. 151.
[27] Dumitrescu *et al.*, 1983, p. 97.
[28] Berciu, 1966, p. 58.
[29] Berciu, 1966, p. 59.
[30] Voinea & Neagu, 2008, p. 16.
[31] Marinescu-Bîlcu, 2001.

Dobrogea, southern Moldova, the neighboring regions of the Republic of Moldova and Ukraine, and eastern Bulgaria, where it is known as Kodjadermen (near Sumen) and Karanovo VI (near Nova Zagora). Some elements have even been reported as far as the Aegean Sea[32]. The Gumelniţa settlements are usually of the tell-type, with deposits several meters thick (Boian, Glina, Hârşova, Tangâru, Vidra, Căscioarele, Gumelniţa, Sultana, Borduşani, etc), but can also be found on terraces (reinforced, in some cases, with boundary structures). Several settlements have also been reported in the caves of Dobrogea. The houses, usually found on the surface, can have a rectangular platform made of split wood or clay; they bear marks of successive plastering, and sometimes feature annexes. The inventory discovered in the settlements of this culture is particularly rich: it includes tools and weapons on flint blades and chips (which stand out for the retouching and carving techniques), flint axes and other types of rocks, antler axes and harpoons, bone points and daggers, as well as numerous copper objects.

In terms of chronology, the A1 phase of the Gumelniţa culture falls within the interval of 4600/4550-4375/4350 BC, with the A2 phase dated to 4350-3950 BC[33].

The *Cernavodă I* culture was first defined in the settlement on Sofia hill in the city of Cernavodă, considered to have been established by the contact between the communities of the Gumelniţa culture in Dobrogea and the shepherd tribes of the northernPontic steppes[34].

Cernavodă I spread throughout Dobrogea and the Danube Plain, to southern Oltenia, northern and northeastern Muntenia and southern Moldova, to northeastern Bulgaria and to the south of the Balkans. Its penetration into the Danube Plain contributed to the movement of the late Gumelniţa communities northward, in the region of the Sub-Carpathian hills[35]. In many cases, the Cernavodă I cultural levels overlap settlements attributed to the Boian and Gumelniţa tell-type sites (Boian, Chirnogi, Hârşova).

It is known that the evolution of the Gumelniţa culture ended, in the majority of its area if distribution, with the penetration of communities attributed to the Cernavodă I phase, with the exception of the hilly areas in northwestern Muntenia[36].

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[32] Petrescu-Dîmboviţa, 2001, p. 155.
[33] Bem, 2000-2001, p. 43.
[34] Petrescu-Dîmboviţa, 2001, p. 168.
[35] Petrescu-Dîmboviţa, 2001, p. 168.
[36] Harţuche, 1971, p. 32.

From a chronological point of view, the Cernavodă I culture, which, in its first stages, evolved alongside the Gumelniţa culture, is framed in the interval of ca. 4000-3400/3300 BC[37].

Bronze Age

The first age of metals also presents a tripartite division into an early period (in which new cultural-historical structures were formed), a middle period (with the establishment of new cultures, stable development and well-defined development areas) and a late period (characterized by the formation of cultural complexes across large areas)[38]. The first period lasted from the middle of the 4th millennium BC, with the appearance of the Baden – Coţofeni cultural block, until the end of the 3rd millennium BC. The second stage is best highlighted around 2200 BC, through the formation of better-established cultures such as those at Monteoru, Periam – Pecica, Wietenberg, Otomani and Tei. The third stage began around 1500 BC, and was characterized by trends of cultural syntheses, such as those in the Carpatho-Dnieper (through the Noua – Sabatinovka cultural complex) or Carpatho-Balkan areas (through the Govora – Fundeni and Zimnicea – Plovdiv cultural complexes)[39].

The date that separates the Bronze Age from the Iron Age is conventionally set at 1150 BC and reflects the generalization of the adoption of the plastic decoration of pottery (especially by grooves and protuberances) and the beginnings of iron metallurgy[40].

With respect to Dobrogea itself, the Coslogeni culture appeared during the Late Bronze Age, , penetrating the plains regions along the Danube, east of Mostiştea, and Dobrogea proper.

Iron Age

The two distinct periods of the Iron Age, both chronologically and culturally, are respectively defined by the *Hallstatt* necropolis and the Celtic fortified settlement (*oppidum*) of La Tène[41]. Chronologically, Hallstatt culture is divided into an early period (approx. 1200/1150-850/800 BC), a middle period (in which the use of iron becomes widespread) around approx. 850/800-650 BC, which roughly corresponds to the evolution of the Basarabi culture, and a late, also known as “Ferigile”, period, approx.

[37] Bem, 2000-2001, p. 50.
[38] Vulpe *et al.*, 2001, p. 222.
[39] Vulpe *et al.*, 2001, pp. 222-223.
[40] Vulpe *et al.*, p. 225.
[41] Vulpe *et al.*, p. 294.

650-450/400 BC[42]. The early Hallstatt is represented by the Babadag culture, found in its first phase in the north of Dobrogea, from where it spread throughout the territory in the second phase and continued its evolution into the third phase. For the middle period, discoveries with Basarabi-type materials have been documented[43].

During the Late Hallstatt period, in the 6th-4th centuries BC, the evolution of civilization in Dacia took place under the influence of important events such as the foundation of Greek colonies on the shores of the Black Sea and the growth of Scythian power in the North Pontic territories[44].

The second Iron Age period, La Tène, was heavily influenced by Celtic communities. However, the Dacians did not immediately assimilate the elements that illustrate the superiority of Celtic culture (wheel-made pottery, the advanced metallurgy of bronze and iron); even so, the settlements and necropolises of the La Tène type bring evidence of the coexistence of the two ethnicities[45].

In Dobrogea, very few typical Getic settlements and burials are known, dated to the 3rd – 1st centuries BC, and, likewise, a single fortified settlement, of 'dava' type, has been found at Satu Nou (Constanţa County)[46].

4. Spatial distribution of sites attributed to the main stages of habitation

Paleolithic Era

Of the seven sites considered in our analysis, most (4) represent cave sites (Cheia - *Peştera Bursucilor*, Cheia – *La izvor*, Gura Dobrogei – *Peştera Liliecilor*, Târguşor - *La Adam*. They are located in the Cheile Dobrogei karstic zone, on the two tributaries of Casimcea – Ghelengicul and Visterna. Among them, two have dwellings attributed to both the Middle and the Upper Paleolithic, one solely to the Upper Paleolithic, and one including, along with the Upper Paleolithic, an occupation level attributed to the Mesolithic.

The two open-air settlements are located in the Târguşor area (on the gentle slope of a hill in the *Sitorman* valley) and, respectively, at *La*

[42] Vulpe *et al.*, pp. 298-299.
[43] Vulpe *et al.*, p. 329.
[44] Vulpe, 2001, p. 467.
[45] Babeş, 2001, p. 503.
[46] Babeş, 2001, p. 503.

Grădină, on a flattened hillock, on the left side of the Visterna valley. They are attributed to the Upper Paleolithic and the Mesolithic, respectively.

An isolated discovery is represented by a single piece, attributed to the Middle Paleolithic, at a point located on the shore of Lake Corbu.

Neo-Eneolithic Period

Of the 24 sites recorded in this GIS application, seven are located in caves. They show levels of associated occupations corresponding to the Hamangia, Boian, and Gumelniţa cultures (three sites, one of which also includes vestiges of habitation attributed to the Cernavodă I culture), Hamagia, Gumelniţa, and Cernavodă I (three sites), and one site showing only traces of Cernavodă I habitation. Almost all known caves in the Cheile Dobrogei area (with the exception of Cheia – *La Soci*) were inhabited in the Neo-Eneolithic period and, broadly speaking, largely overlap its duration.

One settlement attributed to the Gumelniţa culture is considered to be of the tell-type (Taşaul – *La Ostrov*, including two levels of housing, with a total stratigraphic thickness of approx. 1 m, and located on an island of greenschists).

Most Neo-Eneolithic sites (11) represent simple, open settlements with a single occupation level. They are located on small promontories, on the smooth slopes of hills or on the higher terraces of the Casimcea Valley or some of its tributaries or streams, and are attributed to the Hamangia culture (4), Gumelniţa (3), the association of these cultures (3) or to unspecified Neolithic dwellings (1).

Two of the represented sites are burial necropolises, attributed to the Gumelniţa culture, and are located on the shores of Lake Corbul and Taşaul, respectively.

Three other sites represent isolated discoveries of some archaeological materials, attributed to the Gumelniţa culture, located either on the terrace of a tributary of the Casimcea Valley or on the shore of Lake Taşaul.

Bronze Age

Among the seven sites introduced in the application, two dwellings are located in caves, attributed to the unspecified period of Bronze Age (Gura Dobrogei – *Peştera Liliecilor*), and to the Late Bronze Age (Cheia – *La Baba*), respectively.

Two sites, which represent open settlements belonging to the Bronze Age and the Late Bronze Age respectively, are located at the base of the hills on the banks of the Casimcea or near a small river ('derea').

Two other sites represent discoveries of the type of deposits of metal pieces, one attributed to the Early Bronze – Coslogeni culture, and the second to the Final Bronze (D).

A single site represents an inhumation grave, discovered at Casimcea, with a limestone scepter in the shape of a horse's head, attributed to the Yamnaya culture.

Iron Age

Of the 22 sites entered into the GIS application, seven are located in caves, attributed to both Iron Age periods – Hallstatt (Babadag culture) and La Tène (5) or only to the latter (2). Almost all known caves in the Cheile Dobrogei area (with the exception of Cheia – *Grota Călugărului*) were inhabited during the Iron Age.

Of the 12 open settlements, most are attributed to the La Tène period (7), three are attributed to the Hallstatt, and only two to the entire span of the Iron Age. They are located on the slopes of certain hills (such as the one at Casimcea – *Site 15*) or the higher terraces of the Casimcea Valley or its main tributaries, as well as on the shores of Lakes Corbu and Taşaul.

The two burial necropolises (one simple, attributed to the Halstatt period, and the other of the tumulus type, attributed to the La Tène period) are located on the shore of Lake Corbu, and near a high point between two left tributaries of the Casimcea, respectively.

The deposit of metal pieces is attributed to the Hallstatt A period, and is located on a promontory near the locality of Gura Dobrogei.

5. Geomorphological characterization of the prehistoric sites

Geomorphological analysis was carried out on the 60 sites integrated into the GIS application: 7 assigned to the Paleolithic, 24 to the Neo-Eneolithic, 7 to the Bronze Age and 22 to the Iron Age.

The geomorphological analysis considered the hypsometry, hydrology, the slope of the terrain and the exposure (orientation) of said slopes (tab. 1). Maps of these parameters were crafted for each prehistoric period (figs. 2-13).

From a geomorphological point of view, all sites are located in the meadow of the Casimcea Valley, either on the low terraces or its related slopes. Only one site was identified as falling in the interfluve zone (Piatra necropolis).

The sites in the meadow are located in those areas where it is most developed, also considering the fact that one of the valley's geomorphological

characteristics is the floodplain's asymmetric development. This asymmetric character can be observed both in its longitudinal and transverse profile. For example, the Casian and Cheia – *Pazvant II* sites are located in developed meadow areas (with a width of 200-300 m), on the right side of the valley.

An important number of sites are found on the Casimcea river terraces. In general, 3-5 such terraces are notable, with altitudes between 5 m and 90 m. The terraces appear in the form of steps, which gave human communities protection against floods. As in the case of the meadow areas outlined above, these terraces mainly developed on the right side of the valley.

From a hypsometric point of view, most sites (43 out of 60) are located at an altitude no greater than 75 m.

	Subcategory	Values	Paleolithic	Neo-Eneolithic	Bronze Age	Iron Age
Hypsometry	Level 1	>= 75 m	6	15	5	17
	Level 2	75-149 m	1	5	2	3
	Level 3	150-224 m	---	3	---	---
	Level 4	< 224 m	---	1	---	2
Hydrology (Horton-Strahler)	Order 1		2	4	---	4
	Order 2		---	2	2	---
	Order 3		5	8	4	6
	Order 4		---	10	1	6
Slope	Level 1	0-9°	1	6	1	8
	Level 2	10-29°	1	8	3	5
	Level 3	30-59°	2	5	1	4
	Level 4	> 60°	3	5	2	5
Exposure of slopes	North		4	8	3	5
	East		1	4	1	4
	South		1	8	2	9
	West		1	4	1	4

Table 1: Synthetic representation of the geomorphological

characteristics of the prehistoric sites in the Casimcea Valley Basin.

Regarding hydrology, the position of the sites was analyzed with reference to the Horton – Strahler system (fig. 1). Following this analysis, Casimcea is an order 4 basin. Consequently, four levels of hydrographic courses were established. Starting from the idea that the point of confluence causes a change in the dynamics of riverbeds, this ordering system considers tributaries without ramifications as being of order 1; from the confluences of two such courses, a course of order 2 is formed, and in similar fashion up to order 4, representing the Casimcea valley itself.

The distribution of sites according to the order of the hydrographic course was then established. This ordering allows for the determination of existing relationships between the frequency of river courses, the length of channels and drainage surfaces, the perimeter of said surfaces etc., and the establishment of human settlements, through reference to the morphogenetic conditions.

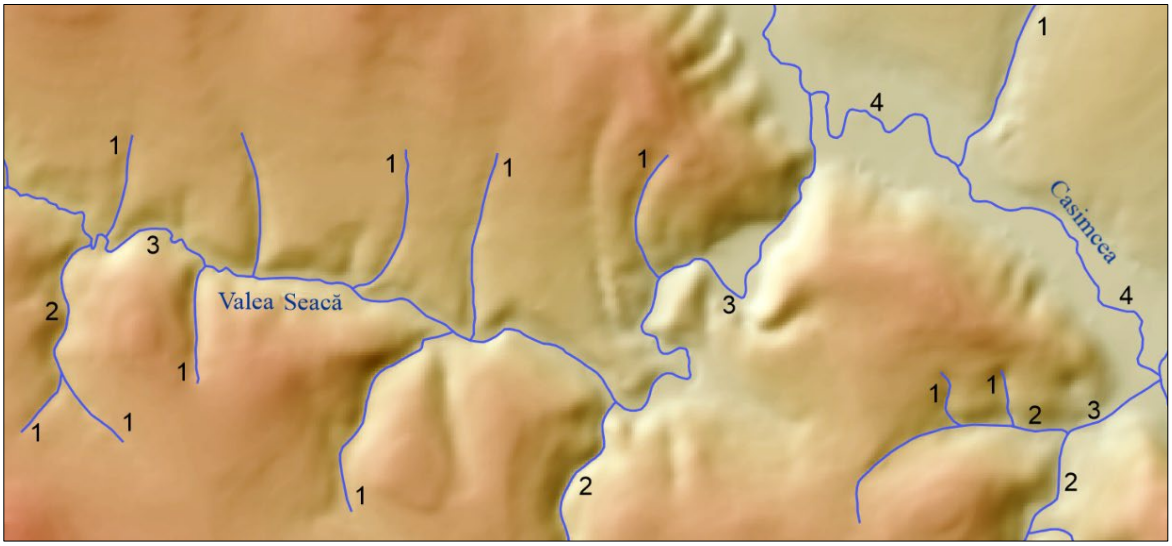

Figure 1: Representation of the Horton - Strahler system in the Casimcea Valley Basin.

The Paleolithic sites are located on the 3rd order valleys, direct tributaries of the Casimcea River. However, we must also take into account the fact that most of these sites are located in the caves of the Cheile Dobrogei area. The Neo-Eneolithic sites are, likewise, located in valleys of orders 4 and 3, but also in those of orders 1 and 2, which suggests their gradual advance towards the upper part of the basin. The Bronze Age sites are located in valleys of order 3, but also of orders 2 and 4, while the Iron Age sites are found in valleys of orders 4, 3 and 1.

Regarding the slope, higher values are specific to Paleolithic sites (over 60°), which is evident for the karstic area. The majority of Neo-Eneolithic sites are located on much lower slopes (68.4% of the sites on slopes below 30°). Bronze Age sites are also located on lower slopes, while the Iron Age sites are more homogeneously distributed, with a slight preference for lower slopes.

Relative to the orientation of the slopes, the majority of settlements are located on the northern slopes (66.6% of Paleolithic sites and 33.3% of Neo-Eneolithic ones), followed by the southern slopes (42.8% of Iron Age, 38.8% of Neo-Eneolithic and 16.6% of Paleolithic sites). The western slopes were used for Iron Age and Neo-Eneolithic sites (16.6%).

Conclusions

Firstly, our geomorphological analysis has highlighted the importance of cave dwellings. As mentioned above, the majority of dwellings from the Paleolithic Era are concentrated in caves, which is mainly explained by the climatic variations experienced during the Ice Age. Moreover, almost all of this domestic potential was employed in the Neo-Eneolithic and Iron Age periods, which sheds an entirely new light on the special area that is Cheile Dobrogei.

Even though in most cases these were considered sporadic dwellings, there are also instances of stable settlements with carefully built homes, such as those featuring hearth areas in the Cheia region.

Also of note, perhaps surprisingly, Bronze Age settlements have a very sporadic presence throughout the entire basin.

Regarding the values of the geomorphological parameters under review, these highlighted some similarities, but also some specific preferences, such as the lower values of the slopes in the case of the Neo-Eneolithic sites, and their southern exposure, in the case of Neo-Eneolithic and Iron Age sites.

With particular, but not exclusive, regard for these two periods, the existing geomorphological analysis must bear further and separate elaboration in the future for each culture and each chronological interval, respectively.

We appreciate the proposed GIS as being highly appropriate for the spatial analysis of prehistoric occupations in the Casimcea Valley Basin.

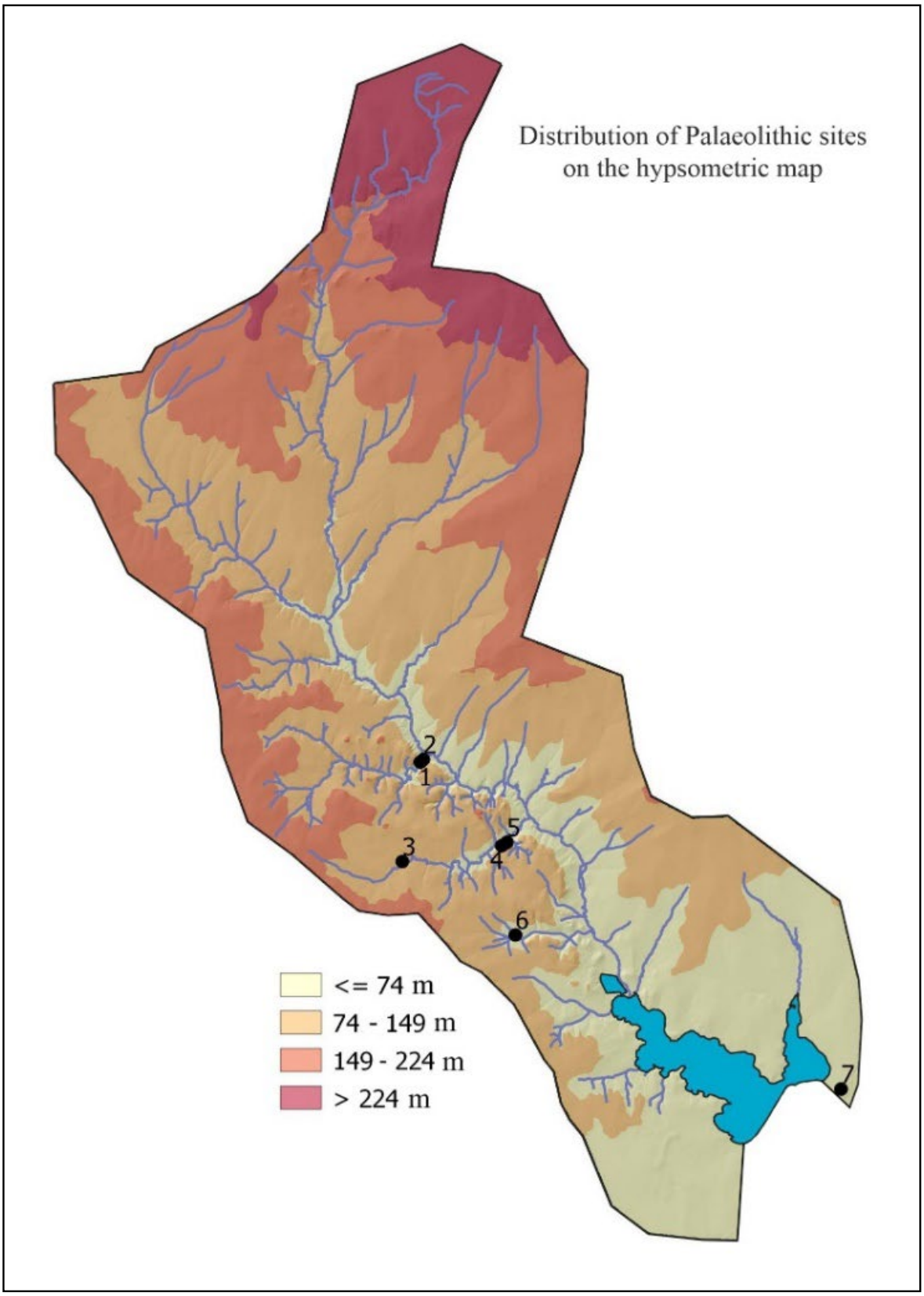

Figure 2: Distribution of Paleolithic sites on the hypsometric map.

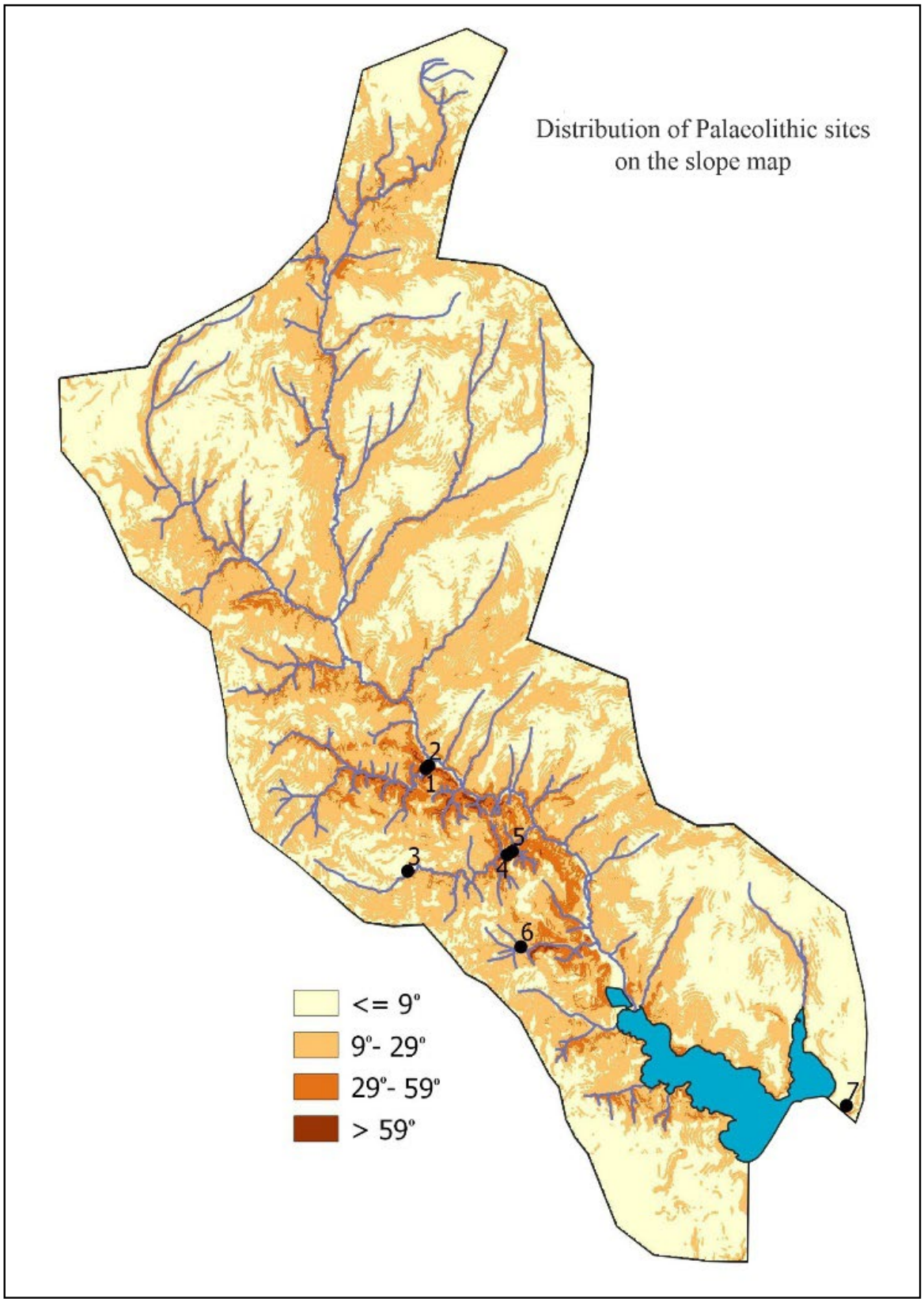

Figure 3: Distribution of Paleolithic sites on the slope map.

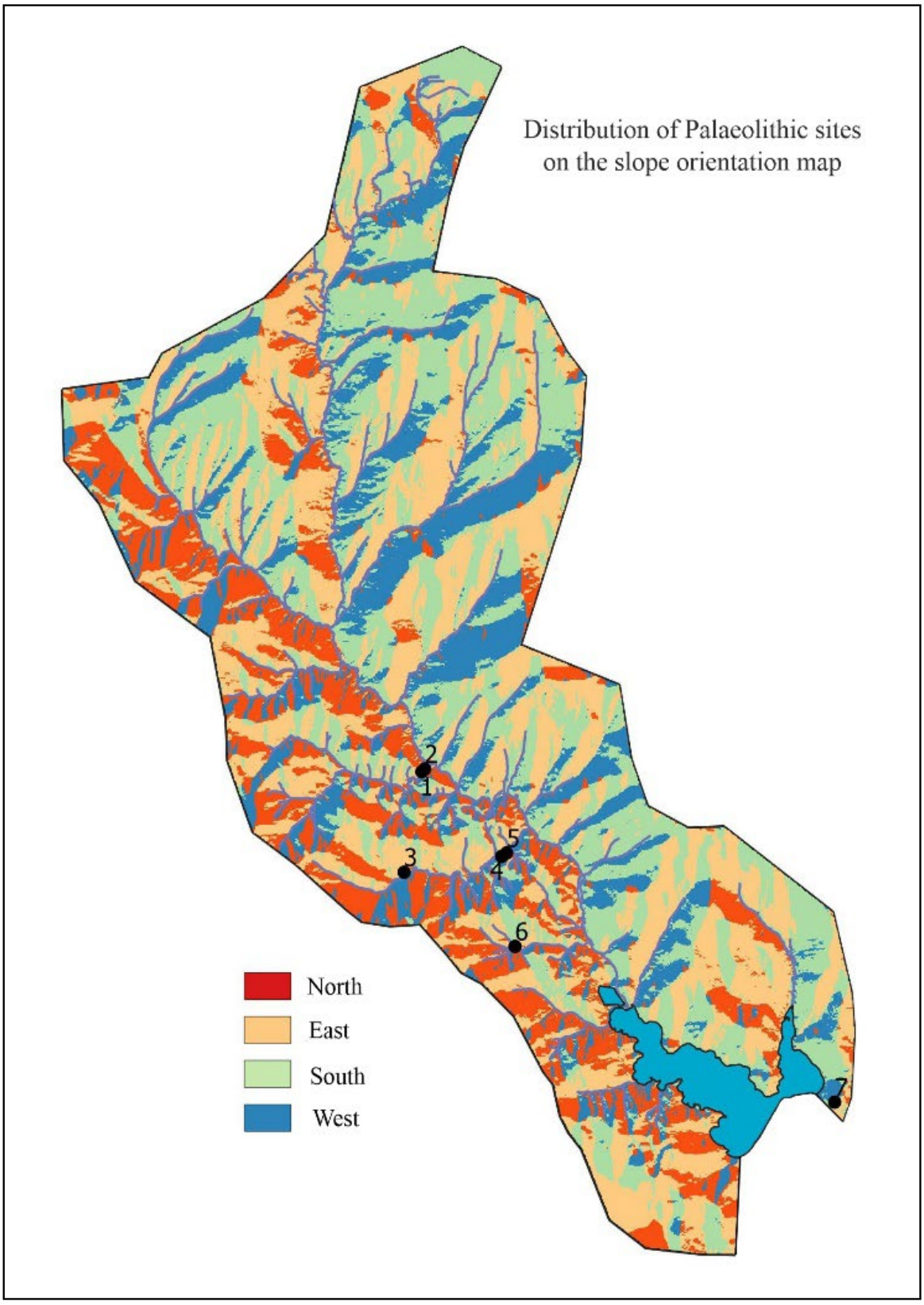

Figure 4: Distribution of Paleolithic sites on the slope orientation map.

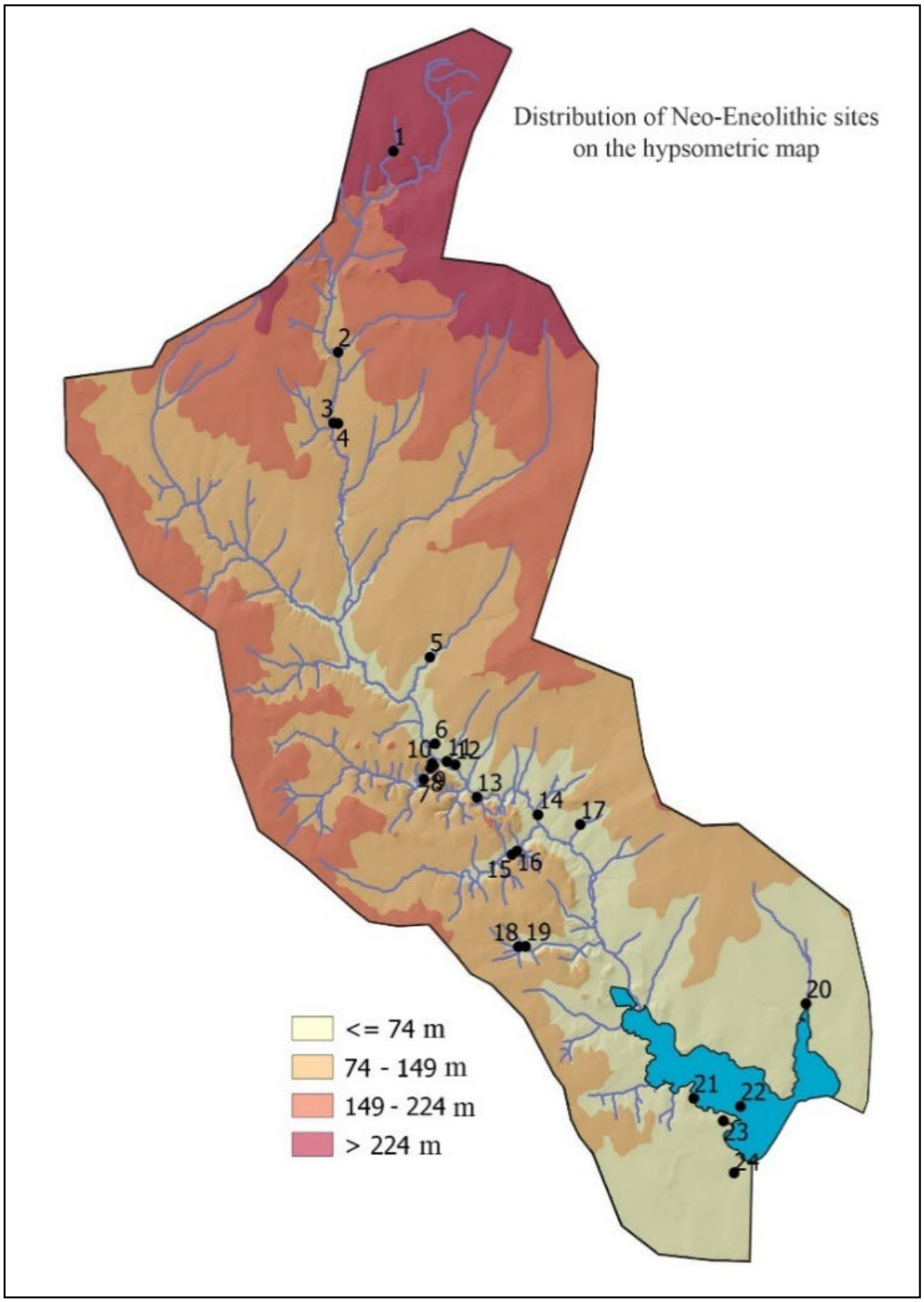

Figure 5: Distribution of Neo-Eneolithic sites on the hypsometric map.

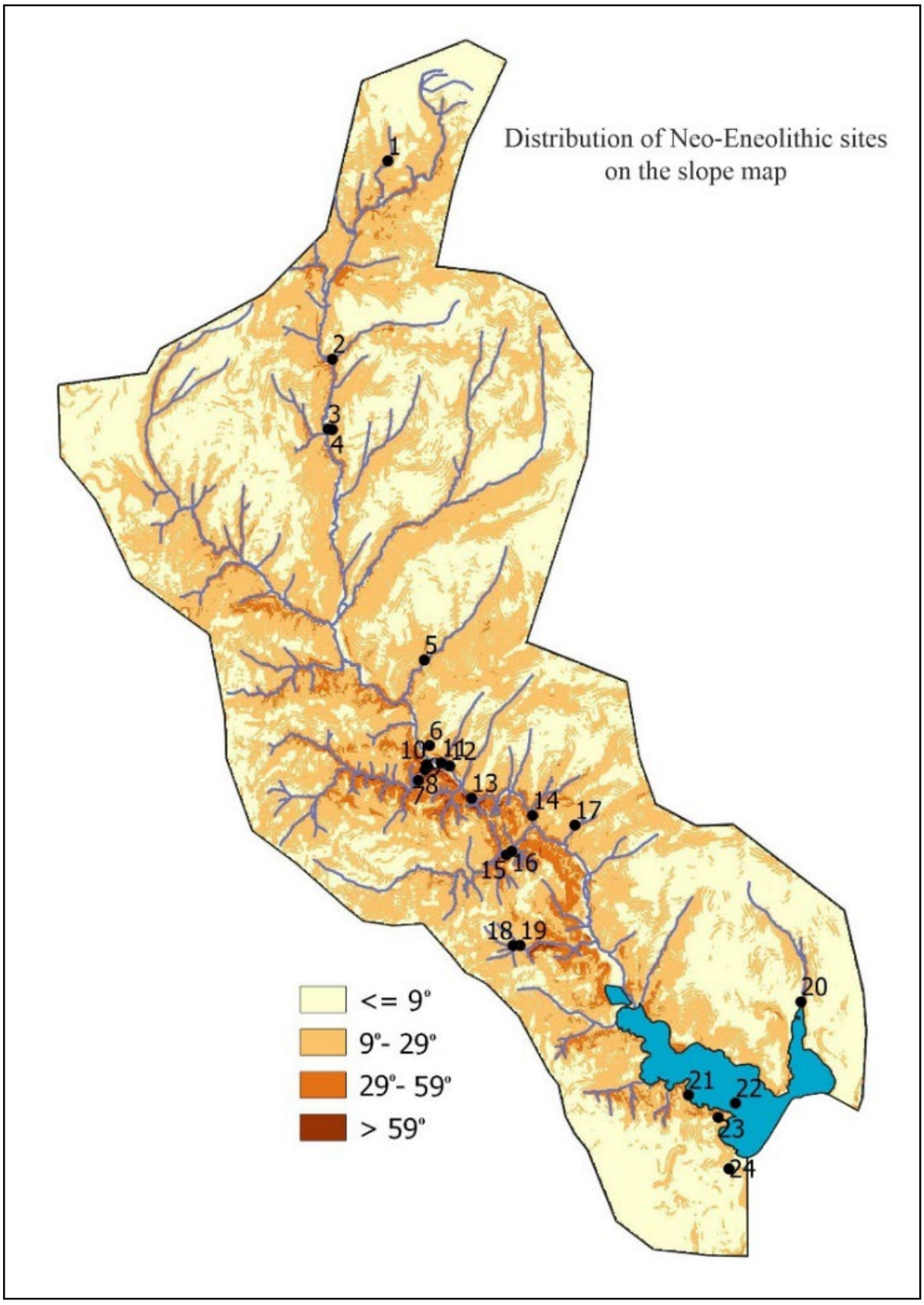

Figure 6: Distribution of Neo-Eneolithic sites on the slope map.

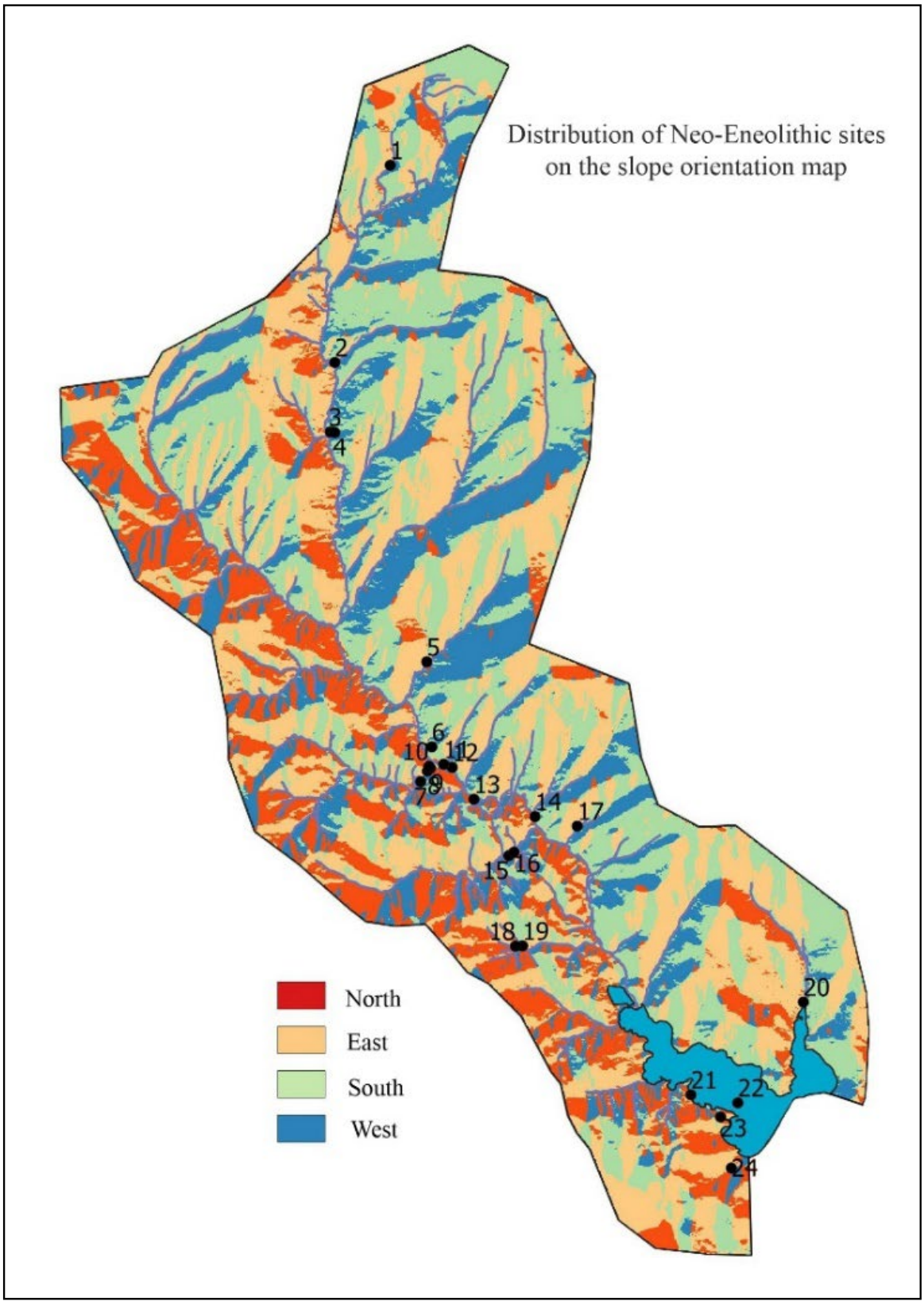

Figure 7: Distribution of Neo-Eneolithic sites on the slope orientation map.

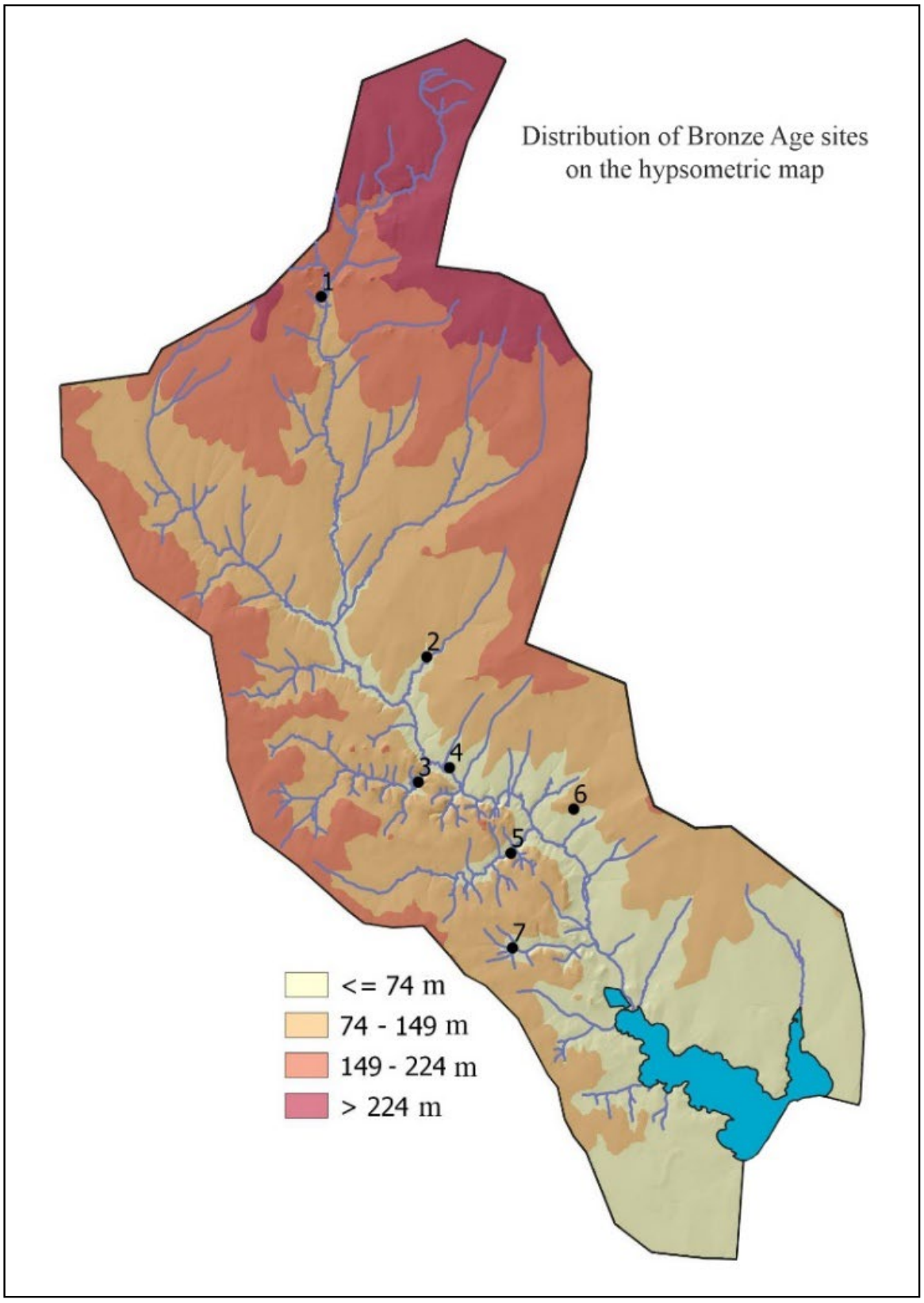

Figure 8: Distribution of Bronze Age sites on the hypsometric map.

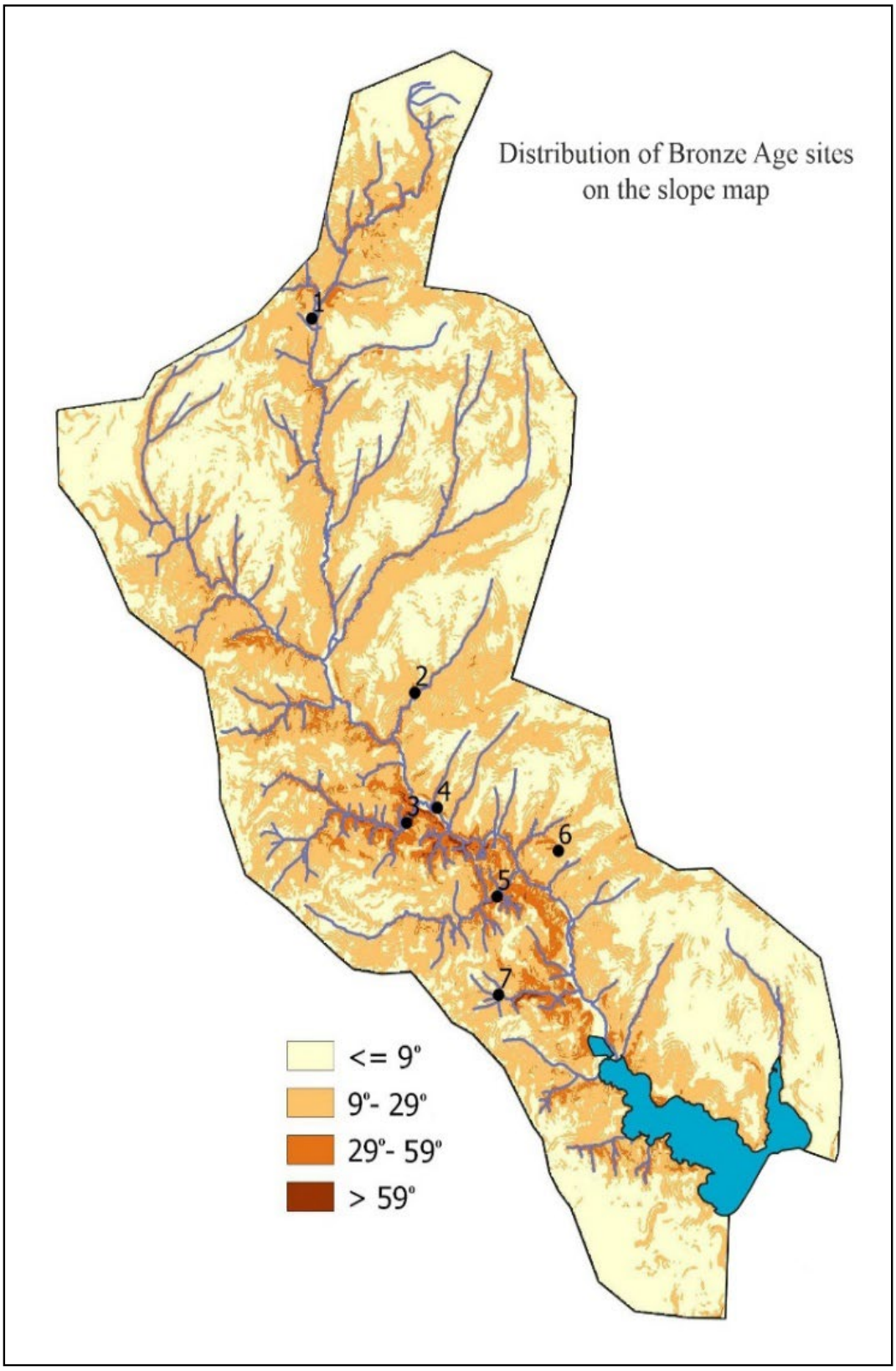

Figure 9: Distribution of Bronze Age sites on the slope map.

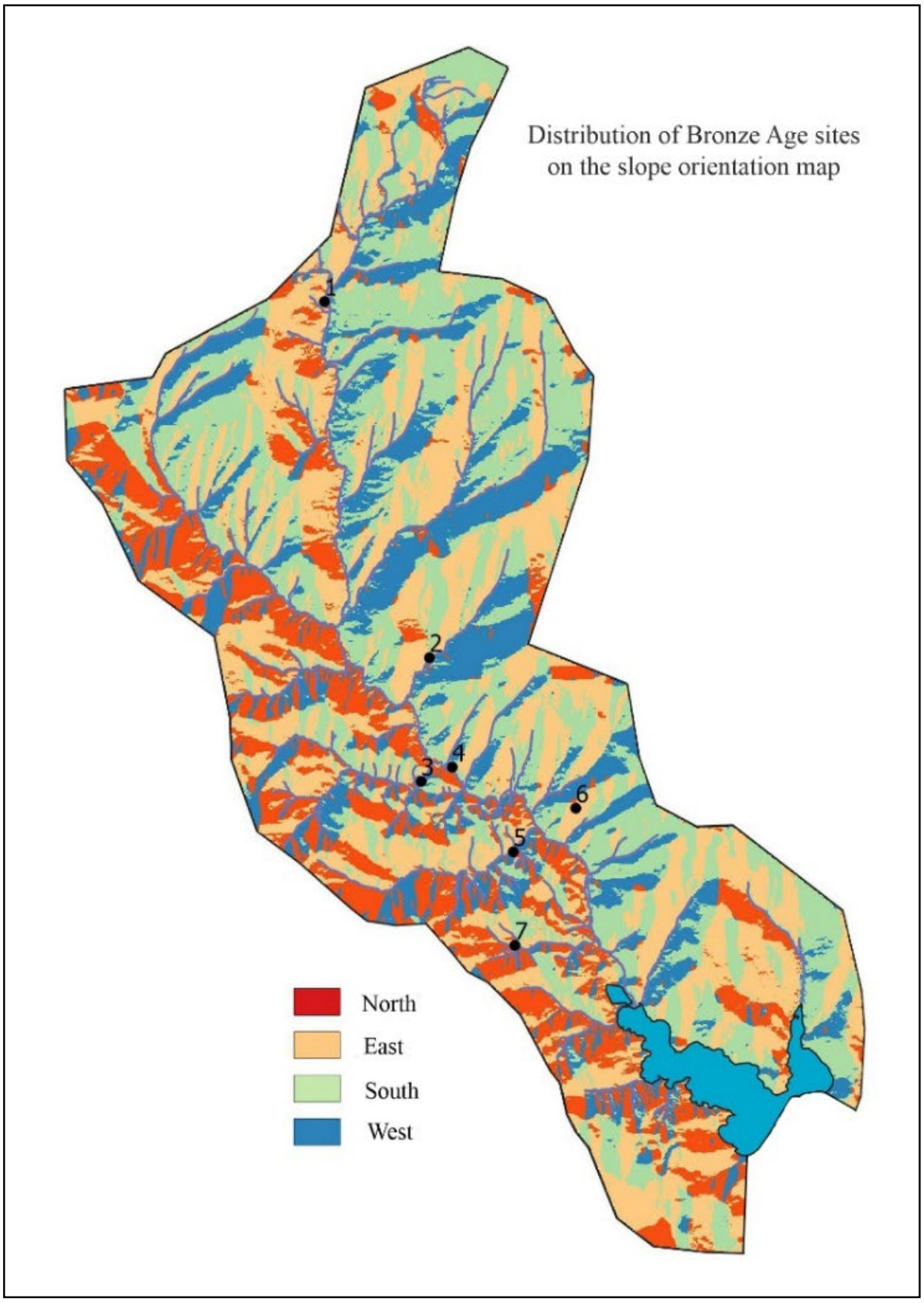

Figure 10: Distribution of Bronze Age sites on the slope orientation map.

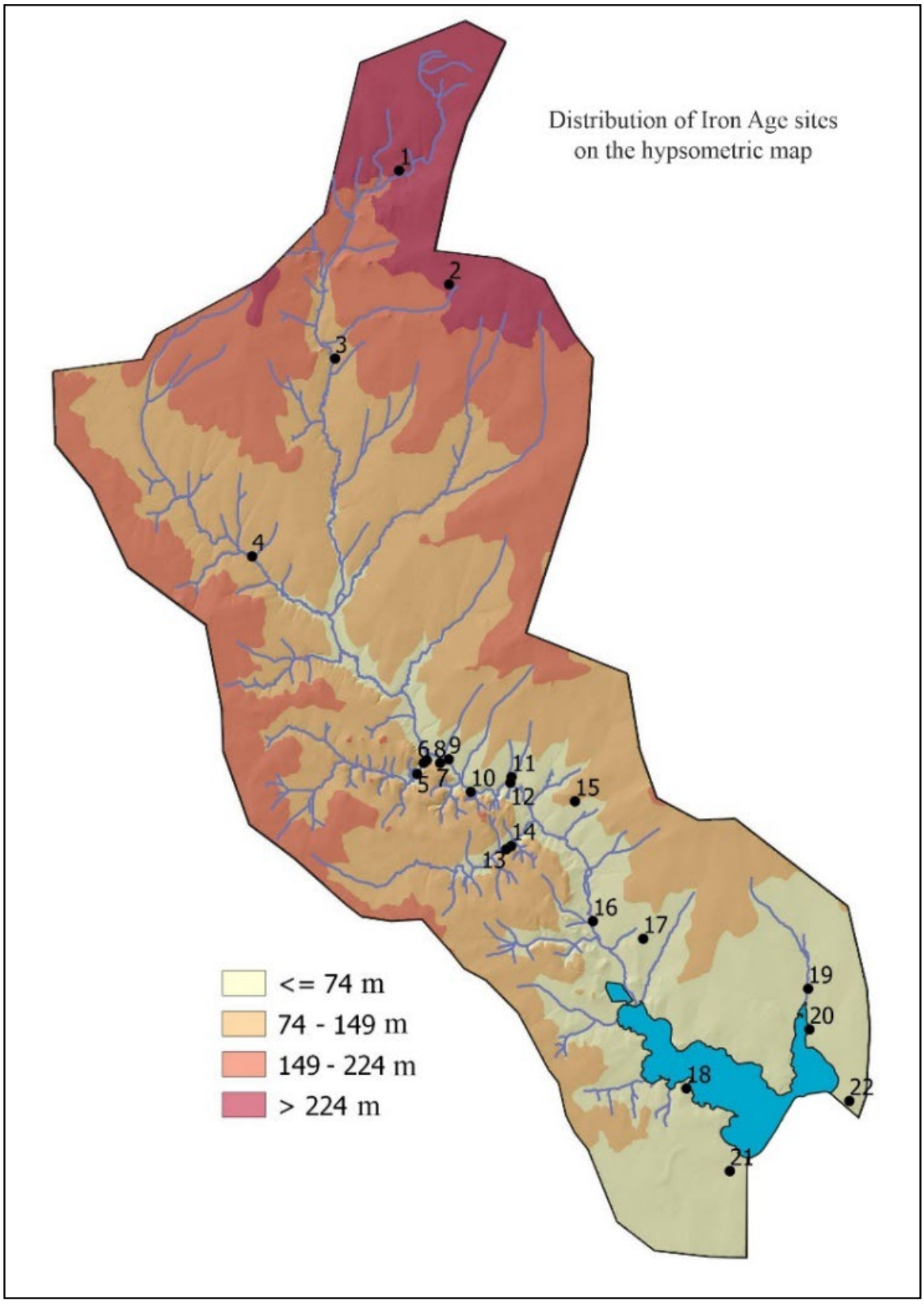

Figure 11: Distribution of Iron Age sites on the hypsometric map.

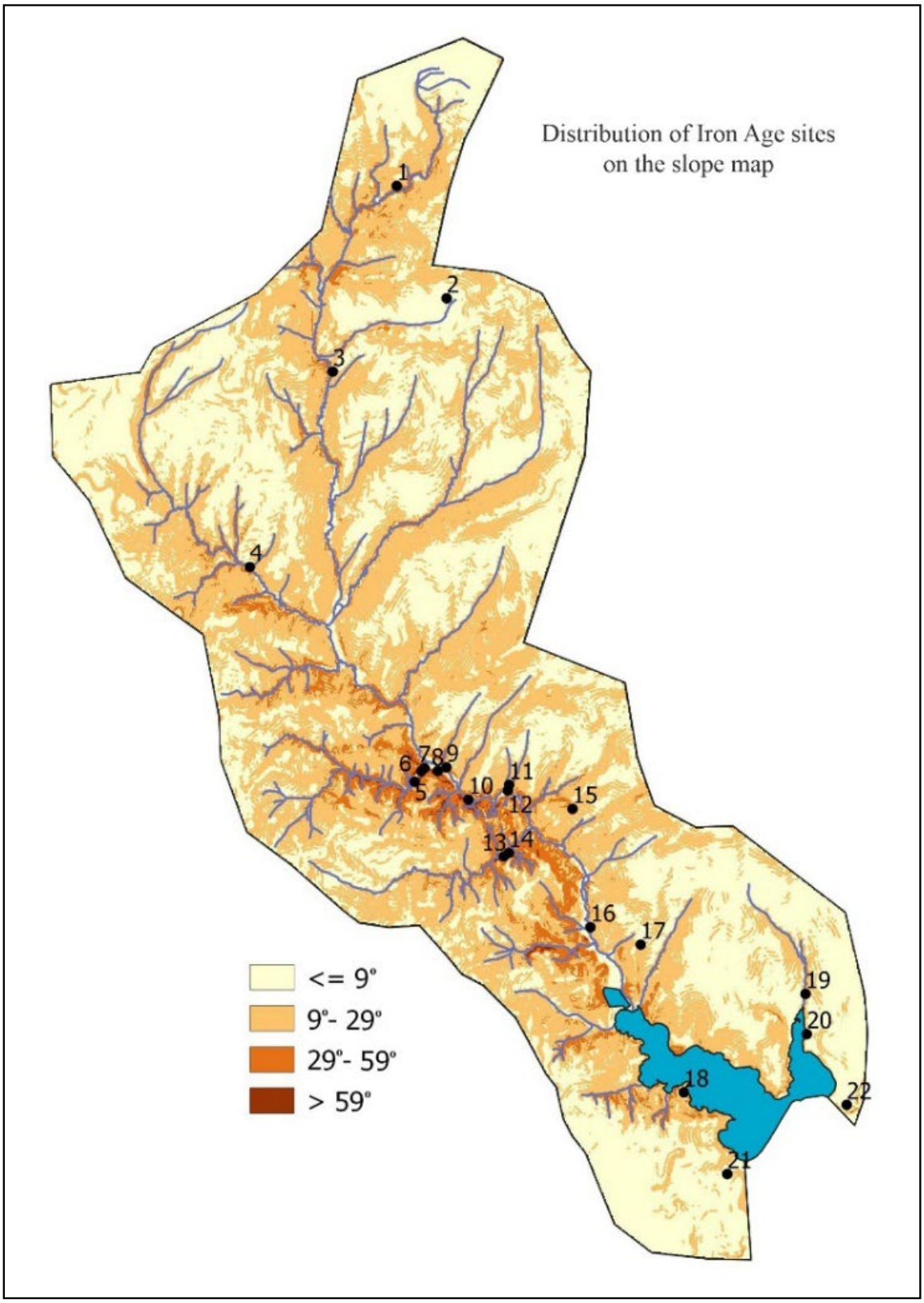

Figure 12: Distribution of Iron Age sites on the slope map.

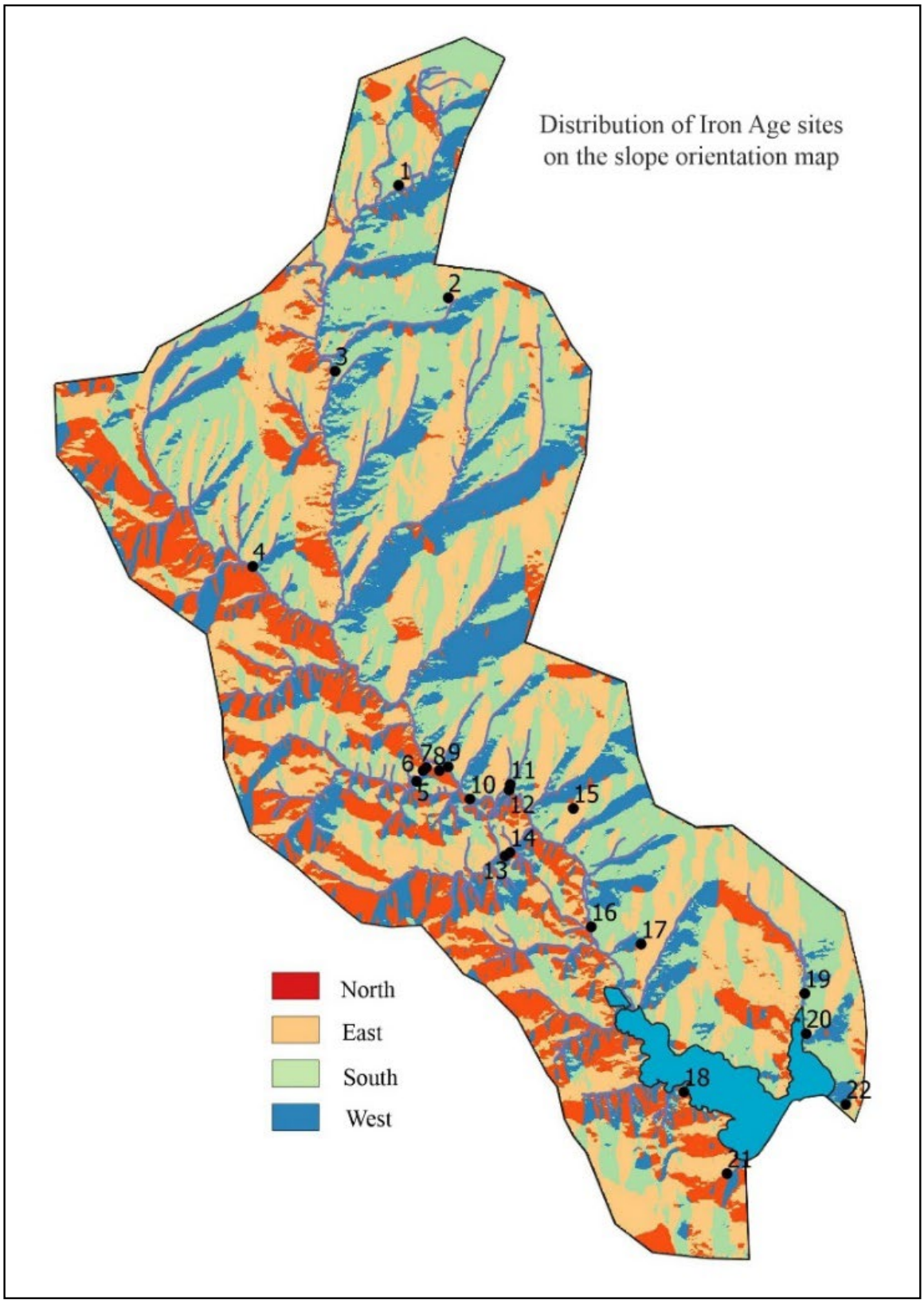

Figure 13: Distribution of Iron Age sites on the slope orientation map.

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