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CHAPTER

The European Mesolithic in Mountain Landscapes: Comparative Perspectives from Austria, Norway, Scotland, and Switzerland

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Abstract

The use of mountain environments is a recurrent, although not universal, feature of the Mesolithic across Europe. However, synthesis of this material is rare. This means that it is difficult to assess whether regional variation in archaeological evidence is a product of different activities in the past, different research traditions, different post-depositional landscape histories, or—most likely—complex local combinations of all three. To help move past this problem, we provide a comparative approach to the mountain Mesolithic of Western Austria, Southern Norway, Scotland, and the Swiss Alps. For each region, we provide an overview of how sites have been found and what kinds of evidence is present. This allows us to present some comparable and contrasting aspects of the evidence at a European level. In turn, this perspective reinforces the importance of particular kinds of archaeological practice, especially in terms of survey and public engagement, and to highlight potential threats to this archaeological resource.

Keywords: European Mesolithic, mountain environments, comparative archaeology, archaeology of Europe, Mesolithic of Western Austria, Southern Norway, Scotland, Swiss Alps

Subject: Archaeological Methodology and Techniques, Landscape Archaeology, Archaeology

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Introduction

Across Europe, evidence suggests that Mesolithic hunter-gatherers lived in mountain landscapes. Although not exclusive to the Mesolithic period, or continuous in all mountain ranges, the use of mountain landscapes is a common and important feature of the period. The archaeological record of this use is different in different regions of Europe, and it is sometimes hard to understand whether this is because of different traditions of use in the past, variation in the mountain landscapes themselves, or divergent research histories and contemporary socio-economic contexts. The regional structure of research into mountain Mesolithics is unfortunate, as it limits comparative analysis and the sharing of methods. Synthesis at a European level is rare (Warren 2022). This paper initiates a comparative analysis of Mesolithic archaeology in European mountains.

Our paper arises from the virtual workshop 'Finding and Managing Hunter-Gatherer Archaeological Sites in Mountain Landscapes' hosted by UCD in November 2022. At this workshop, commonalities and distinctions between the mountain Mesolithics of different areas became sharply apparent. Here we develop these comparisons, highlighting common problems and potentials. We consider Western Austria, Norway (with a particular focus on South Norway), Scotland, and the Swiss Alps. Our sample is small, but these varied ranges ably highlight the potential of such a comparative approach. Furthermore, these discussions will hopefully prompt others who work in similar environments to engage with the themes outlined.

For each of the regions, we present a brief overview of the character of the mountain landscapes themselves, a consideration of how Mesolithic sites have been found in the area and preliminary statements about the type of evidence that is present. This allows us to identify key comparative themes for discussion. All dates are presented in calibrated years BCE and heights as metres above sea level.

Western Austria

Mountain Landscapes

Austria is an inherently mountainous country, with the Austrian part of the Eastern Alps covering circa 52,600 km^2 or 62.8 percent of the country, reaching heights up to 3,798 m at their highest peak, the Großglockner. Further uplands include the Bohemian Massif (Waldviertel) to the north (max. altitude 1,063 m) and to the east the Outer Western Carpathians (max. altitude 490 m). However, the majority of alpine Mesolithic sites have been found in Western Austria, which will be the focus of this section.

The Eastern Alps are divided into the Central Alps, composed of gneiss and slate with local limestone and granite, and the Northern and Southern Limestone Alps. Depending on the bedrock, the landscape ranges from rugged and rocky areas to overgrown hilly pastures, with ubiquitous traces of various past glacial events. The treeline lies between 1,600 m in the Northern Limestone Alps and 2,300 m along the Main Alpine Divide. The alpine ecosystem is composed of lowland areas (up to 800 m), with dense vegetation (today mainly used for settlements and agriculture); a forested montane and subalpine level reaching up to the treeline; the treeless alpine zone, constituted of shrubbery and dwarf tree vegetation as well as the higher elevated alpine meadows with the typical sour grass vegetation (Nagy and Grabherr 2009); and the *nival* or snow zone, starting at between circa 2,400 and 3,200 m.

How Is Early Prehistoric Archaeology Found?

Mesolithic research in mountainous regions of Austria is quite a young discipline (Figure 1B). Although sites such as Gratkorn (Pittioni 1955), Zigeunerhöhle-Elsbethen (Tichy and Rettenbacher 1994), and Rheinbalme and Krinnenbalme (Laus 2009) were discovered during the first half and middle of the twentieth century through the research excavations of local museums and archaeologists, these first sites were mainly presented in short summaries or remained completely unpublished. Additionally, only little archaeological research was carried out in higher alpine areas. One of the first high-altitude excavations was conducted in the late 1980s at the Hirschbichl open-air site in Eastern Tyrol (Leitner 1998). In the same decade tentative prospection activities were started by local enthusiasts, who collected surface finds from eroded areas on hiking paths (Leitner et al. 2015).

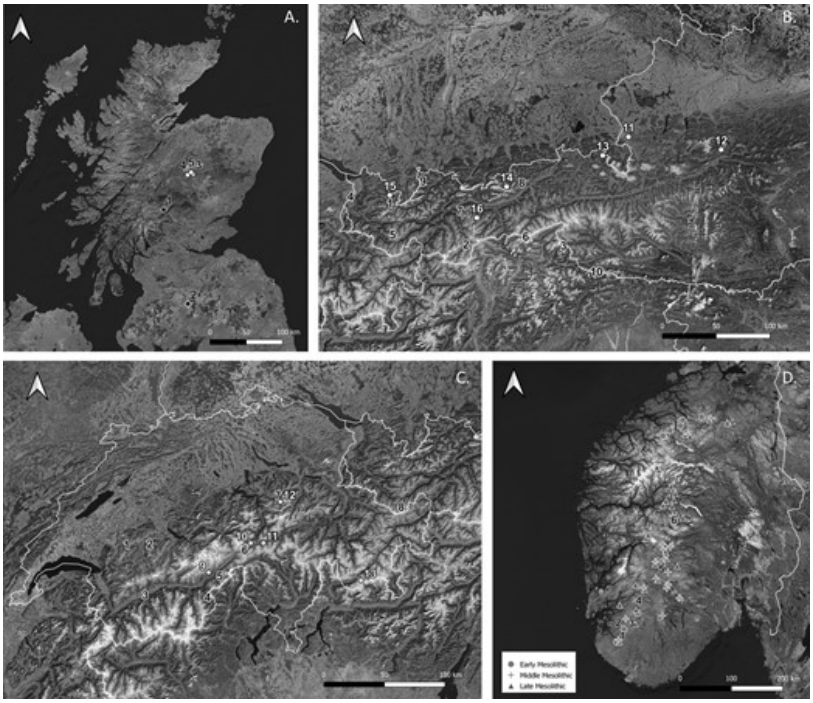

Figure 1. **A**. Distribution of Scottish sites mentioned in the text: white highlights sites in Cairngorms. 1 Edramucky Burn, 2 Coom Rig, 3 Chest of Dee, 4 Caochanan Ruadha, 5 Sgor an Eoin. **B.** Distribution of Mesolithic find regions (black) and sites (white) in Western Austria: 1 Kleinwalsertal, 2 Ötztal, 3 Defreggental, 4 Alpine Rhine valley, 5 Silbertal, 6 Pfitscherjoch/Passo di Vizze, 7 Kühtai, 8 Rofan and Karwendel, 9 Lechtal/Tannheimertal, 10 Carnic Crest, 11 Elsbethen/Zigeunerhöhle, 12 Gamssulzenhöhle, 13 Unken/Oberrainkogel, 14 Laliderer Hochleger, 15 Scheiderküren, 16 Ullafels. **C.** Distribution of key landscape features, and sites (white) in Switzerland: 1 Fribourger Prealps, 2 Simmen valley / Bernese Oberland, 3 Rhone valley (Canton of Valais), 4 Simplonpass, 5 Binn valley, 6 Ursern valley, 7 Muotatal, 8 Silvretta range, 9 Fiescheralp (VS), 10 Hospental-Moos (UR), 11 Tujetsch, Lai Urlan-Avon II Tgiern (GR), 12 Muotathal-Flözerbändli & Muotathal-Berglibalm (SZ), 13 Bregaglia, Val Forno-Plan canin (GR). **D.** Distribution of Mesolithic sites in high and low mountain regions between southeastern and western Norway. key sites and areas: 1 Myrvatnet, 2 Fløyrli, 3 Storhiller, 4 Dyraheio, 5 Hardangervidda, 6 Kjølskarvet.

Alpine archaeology truly started in Western Austria following the discovery of Ötzi, the Ice Man, and has since largely concentrated on the provinces of Vorarlberg and Tyrol. From the 1990s onwards, research with the goal of finding prehistoric sites was and is carried out by research groups from various institutions, such as the University of Innsbruck, including the Forschungsinstitut für Alpine Vorzeit (Schäfer 1997, 2011) and the (S)FB HiMAT—History of Mining Activities in the Tyrol and adjacent areas (see https://www.uibk.ac.at/himat/), as well as by the University of Zurich (see, e.g., Reitmaier 2012). The most recent addition in research activities regarding the Stone Ages in Alpine Austria comes from the association

Archäologisches Forschungsnetzwerk Innsbruck and the Natural History Museum, Vienna. Furthermore, a strong community of citizen scientists has recently developed who, working together with the national authorities (Österreichisches Bundesdenkmalamt) and research institutions, are responsible for many new discoveries of Mesolithic sites. Notable excavation activities took place at sites such as Ullafels (Bertola, Fontana, and Schäfer 2020; Schäfer 2011), Beilstein (Kutschera et al. 2014), Hohle Fels and Rofental (Leitner 2009), the Rofan region (Leitner et al. 2015), the Karwendel region (von Nicolai 2017), the Silvretta region (Reitmaier 2012), and Kleinwalsertal region (Posch 2022). In contrast to other regions, the discovery of Mesolithic sites in advance of development is rare in Western Austria (see, e.g., the Kühtai region (Bachnetzer 2017) and is still linked to specific research projects, such as the Interreg-Project, 'The first prehistoric inhabitants of Eastern Tyrol, the Ladin valleys and the Ladin part of the Belluno Dolomites (ITAT 4145)', in the uplands of the Carnic crest, focused on finding sites related to the prehistoric occupation of this alpine landscape during the Mesolithic, but also subsequent periods. Initial fieldwork has been concentrated in large part on surveys in alpine areas, targeting potentially favourable campsites (flat hills, lake shores, boulders) and/or areas with increased erosion, which were subsequently further investigated through minimal invasive test pitting. First results point towards a beginning of the occupation of the area from the first half of the seventh millennium onwards (Lamprecht, Haas, and Posch 2024).

What Sorts of Evidence and Activity Is Known?

The Austrian Eastern Alps feature a long history of human occupation starting at the end of the Pleistocene (Posch 2022). The activities and evidence subsequently linked to this occupation can be divided in three groups: (1) hunting and/or pastoral activities; (2) mobility (e.g., transhumance, trade, transit), with the Alps functioning as a divide as well as a contact zone; and (3) raw material deposits, be it chert or rock-crystal (see, e.g., Stöllner and Oeggl, 2015).

However, although the inner alpine valleys were ice free from circa 16,000 BCE onwards (Heiri et al. 2014; Ivy-Ochs 2015), the beginning human occupation can only be identified from 13 to 11,000 BCE (e.g., Zigeunerhöhle-Elsbethen: Tichy and Rettenbacher 1994). In the following millennia, occupation activities north of the main Alpine divide remain sparse with only a few sites in valley bottoms, like the rock shelter Oberrainkogel (Windisch 2014), and in subalpine regions, such as the cave Gamssulzenhöhle (Kühtreiber and Kunst 1995) at 1,365 m. During the Preboreal, larger open-air sites appear in Alpine contexts, such as the Ullafels site (Bertola, Fontana, and Schäfer 2020). In the second half of the Boreal, sites became more numerous and reach altitudes of 2,300 m, for example the Pfitscher Joch/Passo di Vizze pass (Leitner and Bachnetzer 2014). The seventh millennium BCE sees a peak in occupation activity that continues into the sixth millennium BCE (Posch 2022). The youngest dates, attributable to a Mesolithic occupation of the area, come from the end of the sixth (see, e.g., Posch 2020b) to the beginning of the fifth millennium BCE (see, e.g., von Nicolai 2017). Interestingly, available data from several regional sediment cores (see von Scheffer et al. 2019; Oeggl and Walde 2007) suggest little to no impact on alpine landscapes in terms of agriculture and/or pastoral activities until well into the middle of the fifth millennium BCE, raising the question of a possible persistence of foraging subsistence strategies alongside the advent of agriculture.

Figure 2. **A:** Chest of Dee excavations, section of alluvial sands (Fraser et al. 2021)(*Scotland*); **B:** Find spots from the site of Sgor an Eoin (*Scotland*); **C:** Excavated early Mesolithic tentrings at Fløyrli (*Norway*). Photo: AM, UiS/S. Bang Andersen; **D:** Hunting pit, Juklevatn, Lærdal 2012 (*Norway*). Photo: J.Gundersen; **E:** Rock-shelter Schneiderküren (*Austria*). Photo: W. Leitner; **F:** Prospection activities Tannheimer Tal (*Austria*). Photo: C. Posch; **G:** The Late Mesolithic and Early Neolithic site Tujetsch, Lai Urlaun-Avon Il Tgiern (GR) during excavation 2022 (*Switzerland*). Photo: Marcel Cornelissen; **H:** The Early Mesolithic rock shelter site Muotathal, Bisisthal-Berglibalm (SZ) during excavation 2015 (*Switzerland*).

Photo: Marcel Cornelissen.

Western Austrian Mesolithic sites are mainly open-air, with only a few rock shelters investigated (Figure 2E, F). Topographically speaking, they appear mainly within the forest-line ecotone (Schäfer 2011; Leitner et al. 2015; Posch 2022), whereas sites in lower altitudes are scarce. This, however, might also be due to conservation issues, with alpine upland areas being less influenced by alluvial and erosive processes as well as settlement and agricultural activities, compared to valley bottoms. Due to preservation conditions in alpine environments, organic remains as well as faunal remains are scarce at most of the sites, which makes reconstructions of diet and site function challenging. There is a strong reliance on locally and regionally available lithic resources, such as radiolarite, chert, or rock crystal (Figure 3B).

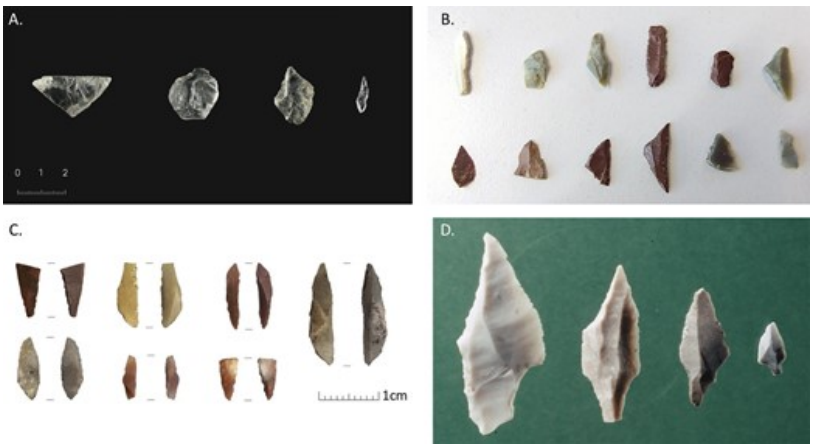

Figure 3. **A:** Mesolithic rock crystal artefacts (*Switzerland*). From left: core, scraper, borer from Silenen, Fuorcla da Strem sut (UR); bi-laterally retouched point from Simplon-PS2 (VS). Photo: Valentin Luthiger/Institut Kulturen der Alpen; right: Valentin Luthiger/Musées cantonaux du Valais, Sion; **B:** Microliths from the site of Egg-Schwarzwasser (Kleinwalsertal, *Austria*). Photo: C. Posch; **C:** Selection of lithics from Caochanan Ruadh (*Scotland*) (Warren et al. 2018); **D:** Early Mesolithic points from Fløyrli; Sf48459 (*Norway*).

Photo: AM, UiS /T.Tvedt.

Supra-regional influences can be seen in the Northern Alps that possess strong ties to Southern Germany, evidenced by exogenous raw materials and microlith types (Posch 2020a), whereas the Central and Southern Alpine regions show Sauveterrian types as well as Southern Alpine raw materials (Leitner 1998; Leitner and Bachnetzer 2014), with the River Inn as a dividing line between the spheres of influence. However, this divide is not impermeable, and we see notable exceptions, such as the Ullafels, where raw materials and microlith types from Bavaria as well as from Southern Alpine contexts are present (Bertola, Fontana, and Schäfer 2020).

Norway

Mountain Landscapes

Statistics Norway records that 7.4 percent, or circa 24 000 km^2, of Norway is defined as bare rock, gravel, and blockfields, and 0.8 percent is permanently covered by glaciers and snow patches. In comparison, 5.3 percent are bogs, 3.5 percent is farmable quality land, and only 1.7 percent is settled (https://www.ssb.no/en). A national reference-classification system for different types of landscapes has been developed (Puschmann 2005), which divides the mountain regions into Høgfjell (high mountains), Lågfjell (low mountains), and Fjellskog (mountain forests). The *low mountain* region comprises bare mountains up to 1,500 m, but also good pastures for livestock and game—the region includes large high-altitude plains in South Norway, like Hardangervidda and Dovre. The *high mountain* region is defined as continuous areas above 1,500 m, containing glaciers and snow patches. In the south and southeastern half of Norway, the glaciers have rounded the high mountains, whereas farther west and north, the high mountains can have alpine, nunatak-like peaks. The *mountain forests* are areas forested by pine, mountain birch, or other low bushes, as well as some scattered spruce. Its rich summer pastures and wetlands were traditionally exploited by transhumance. To access the mountains from the coastal and fjord regions, people moved through the mountain forests, via broad glacier- or steep river-valleys as natural passages. Archaeological sites found along lakes and waterways in these valleys also attest to the time depth of utilization of the mountain regions (e.g., Bang-Andersen 1996, 2008; Boaz 1998; Gundersen 2013).

How Is Early Prehistoric Archaeology Found?

The interest in prehistoric montane exploitation started in the mid-nineteenth to early twentieth century. Yet, systematic recording and surveying programs did not pick up until the 1950s, when large-scale survey projects were sparked by the rise in hydro-power developments post–World War II (Indrelid 2009). Since then, several hundreds of mountain lake shores and waterways have been surveyed[1] (Figure 1D).

During the upsurge in hydro-power surveyance, so-called intuitive test-pitting (Bang-Andersen 2008, 18), where landscape and topography look suitable for prehistoric settlement, was primarily undertaken in up to 500 m broad zones around lakes and rivers, although the most intensively surveyed areas were those up to 100 m from the shores. To give an idea of the intensity with which areas were surveyed, one example is 'Dyraheio' covering an area of about 4500 km^2 in southwest Norway (Bang-Andersen 1983, 2008). In just one section of Dyraheio, around two lakes, 6,320 excavated test pits led to the identification of 13 Stone Age sites (Bang-Andersen 2008, 21). Ten of these sites were excavated, and nine were typologically and/or radiocarbon dated to the Late Mesolithic.

Other applied field methods involve surface surveys at exposed beaches when the water level is low. Shorelines are searched for lithic scatters, clusters of fire-cracked rocks, or other types of structures, like circular tent rings of stones (Figure 2C). Today, large-scale hydro-power development surveys have become rare. Still, hydro-power companies are obliged to pay a set fee to finance archaeological surveys and excavations around, or in, impacted lakes. The fee is collected when concessions given prior to the 1960s are revised or renewed. The Norwegian Directorate for Cultural Heritage allocates the money for proposed projects. Between 2009 and 2021 about NOK42,000,000 (approximately €3,500,000) was distributed for archaeological surveys and excavations.

Although imparting to Norwegian archaeology a relatively extensive knowledge of mountain activities, concerns have been raised as to whether the focus on lakes and rivers is at the expense of sites representing a wider spectrum of activities. Prioritizing surveying where one expects to find something can become a 'self-confirming practice'. However, this bias is countered somewhat by recent development-led projects in the mountains, which do not necessarily focus on lakes and waterways. These include the establishment or extension of new gateways for power cables between regions, roads leading between regulated lakes and dams (e.g., Årskog and Åstveit 2014; Dahl 2016), avalanche/erosion shelters for railway and roads, fences to keep game away from roads or within certain regions, or the clearing of areas for building holiday homes and cabins. This provides a balance to the earlier lake-/river-focussed surveys. Reports of sites and surface finds collected from eroded trails or patches in the terrain, detected and reported by hikers, hunters, or archaeologists (Gundersen 2013; Nyland 2019), also supplement the lake/river side surveys.

Lidar-generated maps are also increasingly used as a survey tool by both professional archaeologists and the interested public. Aided by lidar images, larger structures like hunting pits (Figure 2D), especially in wood covered areas, can be found. Potential features can then be ground-proofed. In 2016, a national project to increase the percentage of lidar coverage in the mountain region was started by The Norwegian Mapping Authority (www.kartverket.no/en) cooperating with various municipalities, the Norwegian Public Roads Administration, and Norwegian Water Resources and Energy Directorate.

What Sorts of Evidence and Activity Are Known?

Dated both typologically and through radiocarbon, Mesolithic people started seasonally exploiting mountain resources around 9000 BCE (e.g., Callanan 2008; Bang-Andersen 2012). In addition to sites being located along lake and/or river shores, they were also sited in strategic places for hunting or trapping, or along-established paths taking one across the mountains.

Site types vary but most consist of flint scatters or finds of other lithic raw materials (Figure 3D). Some settlement sites contain hearths, and cleared areas encircled by stones used to secure tents. Other common features are stone-built lookouts and bowman hides, that is, half-circle-shaped low stone walls, and sometimes stone lined-hunting pits (Figure 2D) with and without associated stone-built fences. There are also quarries for stone (e.g., very fine-grained quartzites or mylonites) from the Mesolithic onwards (Johansen 1978; Nyland 2020). Settled rock shelters are another common category of site. The utilization of these starts at the end of the Middle Mesolithic in both coastal and montane areas. At Storhiller, approximately 750 m, Rogaland County in southwest Norway, triangular microliths were found with burned bones from large game (species undetermined) radiocarbon dated to the end of the Middle Mesolithic.

Scotland

Mountain Landscapes

Although Scotland is widely understood to be a mountainous country, no single Scottish government definition of a mountain landscape exists, and there are no agreed assessments of how much of Scotland is mountainous. Scotland's mountains are not high in absolute terms, with the tallest peaks circa 1200 to 1300 m. But they encompass very significant altitudinal variation across small areas. Scotland's mountains are topographically varied. All have been shaped by repeated, and recent, glaciation. Some ranges are elevated upland plateaus, deeply dissected by glaciers. Others are more Alpine in character.

Montane habitats, dominated by moorland or upland heath developed on peats of varying depth, are often seen to start at 600 m asl, around the 'natural' treeline, giving way to moss dominated communities by circa 900 m (Wrightham 2002). Complex histories of land use, especially long-standing forest clearance, lie behind the dominance of upland moorland in these landscapes, which are not 'natural' mountain landscapes, but in any case, they are a distinctive feature of Scottish mountains, with many European landscapes comparatively more heavily forested, covered with arable grassland or bare of vegetation (Gløersen et al. 2004, iii). Although Scotland's mountains form the 'interior' of the country, many are still close to the coast, and, especially in the west, fjord landscapes bring the mountains and sea together. In the east, major river systems provide natural axes of communication into high mountain landscapes.

How Is Early Prehistoric Archaeology Found?

The majority of evidence for Mesolithic activity in Scottish mountain landscapes has come through the identification of lithics in erosive contexts including footpaths, riverbanks, and reservoir edges (Figure 1A, 2A). Much of this material was initially identified by vocational archaeologists or members of the public. This includes volunteers working on footpath maintenance projects who identified two significant locations on Mar Lodge Estate, Cairngorms (Fraser et al. 2021). The Biggar Archaeological Group recovered significant numbers of Mesolithic sites at the shore of Daer Reservoir (c. 350 m), with excavations revealing pits, fire settings, and other structural features (Ward 2017). Some survey work in commercial forestry has been undertaken, often after damage caused by initial ploughing, as for example by Biggar Archaeological Group at Coom Rig, with many Mesolithic sites identified.

Most of these findspots are dominated by flint, which is not naturally present in mountain landscapes in Scotland and is relatively easily recognisable (Figure 3C). Worked vein quartz—which is known to be used in mountain environments (e.g., Edramucky Burn, Ben Lawers; Atkinson 2016)—would be very challenging to identify in erosive contexts for non-specialists. No sites have been solely identified by the presence of charcoal in erosive contexts.

More rarely, early prehistoric activity has been identified through excavation of post-Mesolithic archaeological features, such as late Medieval huts at Ben Lawers that had Mesolithic activity present dating to circa 7000 BCE (Atkinson 2016). Such coincidences may indicate something of the long-term potential of key locations in mountain environments. Small numbers of sites have also been identified in advance of infrastructural development. The latter includes locations of prehistoric activity without artefacts such as at Fallago Rigo excavations in advance of wind-farm development where a complex of pits dating to circa 6200 BCE was discovered, with no associated artefacts, at circa 400–450 m at the head of upland streams (Savory 2013).

What Sorts of Evidence and Activity Are Known?

In terms of chronology, evidence from mountain landscapes spans much of the Scottish Mesolithic. Late Upper Palaeolithic finds are known from circa 70 km away from the high mountains, well inland on the River Dee (Wickham-Jones et al. 2021), but have not yet been identified in higher terrain. No radiocarbon-dated evidence of the Early Mesolithic is known, and most evidence post-dates 8000 BCE. This is broadly in keeping with Scotland as a whole. Dated Mesolithic activity in the mountains runs throughout the period, although with a small number of sites it is not possible to assess change over time in any meaningful way. The expansion of activity into the mountains in the Middle Mesolithic is very much in keeping with Conneller's models of diversification and expansion of Mesolithic activity at this time (Conneller 2021). Mesolithic activity in mountain and upland environments runs to the very end of the Mesolithic period and may overlap with the presence of culturally 'Neolithic' activity in lowland areas.

Our evidence base is limited by the comparatively small number of findspots that have been excavated but features present include pits and fire-settings, although highly podsolized soils mean that subtle features can be hard to identify. The location of structures, including tents, has been identified on the basis of artefact distributions (Warren et al. 2018; Wickham-Jones et al. 2020). Mesolithic chert quarry sites are known in the Southern Uplands (Warren 2001).

Some locations were used over the long term, although not continuously. At Chest of Dee, for example (Wickham-Jones et al. 2020; Figure 2A), major episodes of activity take place shortly after 7000 BCE, about 6000 BCE and again in the mid-sixth millennium. This is a large site, with a diverse lithic assemblage, and seems likely to have been a focal point for activity over long periods of time. Still within Mar Lodge, excavations at Caochanan Ruadha identified a tent, occupied for perhaps only a couple of days, and with a highly specialized lithic assemblage (Warren et al. 2018). This sits within a very low-density artefact scatter on low slopes, including some concentrations that are not contemporary with the use of the tent. It is possible that the general location was visited over a longer period of time. The excavators of sites at Daer and Coom Rig also propose repeated short-term uses (Ward 2017).

The limited evidence base restricts any assessment of findspot locations and is compounded by problems of circularity caused by a reliance on erosion as a means of identifying findspots. Some locations have prominent views (e.g., Edramucky), are located on well-drained high terraces (e.g., Sgòr an Eoin), or lie next to pools below waterfalls and proximate to major river junctions (e.g., Chest of Dee). Many of these are locations are intuitively 'good' for hunter-gatherer activity, and, in some cases, survey has targeted them because of this. River valleys within mountain landscapes appear important rather than the mountain tops, but further survey work is needed to assess this. At Coom Rig a dry hillside away from water sources appears to have been significant and is not intuitively a good location for settlement.

Lithic assemblages include a range of local and non-local raw materials. Flint is certainly imported into mountain landscapes from the coast. In keeping with the Scottish Mesolithic as a whole, none of this material is necessarily moving very far in absolute terms. In some places, local raw materials are also used,

for example a poorly understood rhyolite at Chest of Dee, or—assumedly—quartz at Ben Lawers. As noted above, chert was quarried from mountain landscapes in the latest parts of the Mesolithic.

Switzerland

Mountain Landscapes

Over two-thirds of Switzerland is mountainous. The Jura Mountains (11% of Switzerland) are a 'mittelgebirge', or low mountain range, in this case up to 1,679 m, straddling the northern Swiss border and mostly in the montane ecozone. A number of Mesolithic sites have been excavated here, mainly during the first half of the twentieth century. The focus for this discussion though is the Alps. These are separated from the Jura by the Swiss Plateau (c. 400–800 m). The Alps and Prealps, situated north of the main alpine ridge, cover 58 percent of the country, reaching up to 4,634 m (the height of Dufourspitze). Switzerland's lowest point is the Lago Maggiore at 193 m, but a staggering 20 percent of the country is located above the timberline. The natural timberline is situated at circa 1800–2300 m, the treeline 50–200 m lower (Irniger 2013), with both somewhat higher in the southern Alps due to the warmer climate. However, due to geology, exposure, and elevation, these and other climatic and environmental aspects can vary greatly within short distances.

How Is Early Prehistoric Archaeology Found?

The twenty-six cantons of Switzerland are responsible for the protection of archaeological heritage. The resources the cantons apply to cultural- and archaeological-heritage management varies greatly. Especially in smaller mountainous cantons these resources are limited, and the archaeological heritage is sometimes managed by heritage specialists without an archaeological background. This also means that the available archaeological data vary per canton and are quite scattered.

The early twentieth-century discovery of Palaeolithic artefacts in caves in the Prealps, dating to circa 40–30,000 years ago, was the first indication that hunter-gatherer societies had lived in the Swiss mountains (Pignaz and Crotti 2002). Magdalenian and Epigravettian finds are so far limited to the Prealps and are found up to 1,410 m (Jagher, Fischer, and Morel 2000; Leuzinger-Piccand et al. 1996).

Mesolithic finds have been known from the Prealps and the Alps since the 1930s (Figure 1C, Figure 2G, H). The first finds were made by amateur archaeologists in caves and rock shelters in the Simmen valley of the Bernese Oberland (Andrist, Fluckiger, and Andrist 1964). Since 2000 increased research activity in the subalpine and alpine zones has shown that Mesolithic hunter-gatherers used much of the Swiss Alps (Cornelissen et al. 2016; Curdy 2015). All vegetation zones up into the nival zone and near what would have been glaciated regions were visited. Research projects seldom targeted only hunter-gatherer archaeology (Curdy et al. 2010; Crotti, Curdy, and Leuzinger 2004; Hess, Della Casa, and Ballmer 2010; Reitmaier 2012). Similarly, the ongoing fieldwork in the Muotathal by Walter Imhof and Urs Leuzinger and colleagues have, besides one Late Palaeolithic and seven Mesolithic sites, resulted in the discovery of circa eighty younger sites (Imhof and Leuzinger 2021). Sites have also been discovered by chance by members of the public or, rarely, during archaeological investigations in advance of development work, for example, Hospental-Moos (Auf der Maur, Cornelissen, and Brönnimann 2014).

Many sites are only known from surface finds made in exposed soil along hiking paths or animal tracks or in the spoil of animal burrows. These are often located in regions with either significant leisure activity or pastoralism. Fieldwalking of exposed deposits is the most common form of surveying, combined with auguring and test-trenching, especially in caves and rock shelters. Test-trenching is done by hand: test-

trenches rarely measure more than 50 x 50 cm. Charcoal is an important indicator of past human presence and is found in erosive contexts, auguring cores, or small test-trenches.

Finds consist mainly of lithic artefacts. Flint can be gathered in the Jura and near the Alps. Other raw materials such as fine-grained quartzites, radiolarites, and rock crystal (Figure 3A) can be found regionally within the Prealps and Alps. In sheltered conditions such as caves and rock shelters—especially in limestone regions—or in ice patches and glaciers, organic materials and botanic remains can survive (e.g., Flözerbändli rock shelter; Leuzinger et al. 2022). These finds provide valuable and rare insights into the environment and lifeways of Mesolithic people in the Alps.

What Sorts of Evidence and Activity Are Known?

Currently the quality of our knowledge of Mesolithic use of the Swiss Alps is extremely varied and determined by research biases. We know of several sites in parts of the Silvretta range, in the Muotathal, in sections of the central Swiss Alps and the Bernese Oberland, and in the Binn valley and around the Simplonpass, but in other regions we know very little.

Both the Simmental and Muotathal have a limestone geology, and not surprisingly, Mesolithic archaeology here is known mostly from rock shelters and caves, although open-air sites have been found in the Fribourg Prealps (Mauvilly, Braillard, and Kramer 2006). In other regions, such as the Silvretta range, the cantons of the Grisons, Uri, and the Valais, most known sites are situated in the upper subalpine and alpine zones, typically just above the treeline between 1,900 and 2,400 m (Cornelissen et al. 2016; Curdy 2015). Whether these ecotones were preferred camp locations and provided specific resources or whether field survey is easier here because of a mostly artificially lowered treeline is unclear. In these ecotones, open-air sites are often situated near small lakes or moors.

Some sites are known from the Rhone valley floor (375–700 m) and from the high inner alpine Ursern valley floor (1,475 m). However, alluvium may have buried sites on valley floors deeply, meaning they are rarely discovered during building work. In the Valais, the relatively steep slopes between the current treeline and the valley floor are often forested, which makes surveying difficult (Curdy 2015). Mesolithic land use thus remains hard to understand. Moreover, few sites in the Swiss Alps are excavated fully, and many are not completely analysed and published. As a result, most sites are known either from single surface finds or small assemblages of surface finds, or they come from test-trenches (typically 30 x 30 cm to 1.5 m^2). Therefore, little is known about the intra-site organization of individual sites beyond the occasional presence of hearths. However, bones with cut marks from Muotathal-sites and lithic (rock crystal) extraction sites at Fiescheralp and the Fuorcla da Strem Sut show that perhaps unsurprisingly, hunting and raw-material procurement took place in the Swiss Alps (Hess et al. 2021; Cornelissen, Auf der Maur, and Reitmaier 2022; Imhof et al. 2021). The high proportion of projectile points from the Simplonpass sites might also point to hunting having been important here (Cornelissen and Curdy, forthcoming).

Although we only have evidence for human presence during part of the Mesolithic in some regions, humans were present in the Swiss Alps throughout the period, from 9500 to 5500 BCE, with some sites being visited repeatedly. Site functions are largely unknown for most sites dating to any part of the Mesolithic. It thus remains impossible to reconstruct settlement systems with certainty. Lithic raw-material analyses indicate a variety of procurement strategies, which focus solely on local material as, for example, in the Binn valley and the Simplon region (Cornelissen and Curdy, forthcoming; Curdy et al. 2010) or depend on a wide variety of materials from sources located up to 400 km apart. The small ensemble from Bregaglia, Val Forno-Plan Canin is a good example of this (Cornelissen et al. 2013). Other sites depend largely on a combination of local material and small quantities of exotic material.

Discussion: Comparing Regions and Looking Forward

The regions reviewed in this comparative study provide a snapshot of the diversity of mountain landscapes in the European Mesolithic. In part, this diversity is a product of the physical characteristics of the landscapes in question, which provide both varied challenges in our ability to identify sites, and different affordances during the Mesolithic. It is also clear that research traditions are varied, although there are strong commonalities.

How Are Sites Found?

The ways in which sites have been found across our comparative regions are relatively consistent, however, research culture and landscape-development goals present variability in the emphasis of these across the regions. Chance finds by the public, citizen scientists, and professional archaeologists alike play an important role. This material is often found in areas of high erosion, for example, pathways or exposed areas resulting from animal grazing, or artificially regulated lake shores. The majority of these finds are lithics, sometimes consisting of single or very few artefacts in each instance. In Western Austria and Switzerland, individuals have made substantial contributions over the long term to knowledge of the Mesolithic in mountain environments. Often living 'locally' and being able to repeatedly visit areas and monitor them over time, this form of archaeological prospection and knowledge is vital in mountain landscapes. This is a type of archaeological observation that is not usually available to research and heritage-management teams who might only spend short periods of time in the field. Collaboration is essential, as is awareness raising of the importance of material that might be found by the public. In part, this relates directly to the need to expand the knowledge base and raise awareness of the potential of these landscapes.

In most areas, archaeological work in advance of infrastructural development has identified important Mesolithic archaeology. But there is also significant variation in the nature of this development and the archaeological responses to it. The scale of archaeological work in advance of hydroelectric developments in Norway, for example, is not replicated in other regions. Furthermore, it is also important to note differences in regional practice in advance of common infrastructural development such as road schemes and those related to leisure activities and the energy transition—the latter with substantial landscape impacts. Given that combined climate and socio-economic change will lead to the further transformation of our mountain landscapes, providing appropriate mitigations in advance of development is an important challenge.

What Is Found?

Across our case-study areas, the primary evidence comes from the presence of stone tools, found in larger site settings, and as single finds. This demonstrates the use of locally sourced and imported raw materials. In some regions, such as Scotland, Switzerland, and Norway, quarries are known in upland locations (e.g., Nyland 2020), whereas in Austria evidence for actual quarrying activities during the Mesolithic remains ambiguous. But in many cases, locally sourced materials are poorly understood, and can sometimes present challenges in terms of identification of struck materials—a problem especially acute for quartz. In contrast, imported materials, often flint, can be easier to identify, although the careful curation of scarce raw materials in prehistory means that artefacts can be very small.

Organic preservation across all regions is poor, with rare faunal assemblages, such rock shelters and caves, in, for example, Switzerland or Norway. These are very important for understanding resource exploitation and the associated practices undertaken. Structural evidence is also present, for example hearths with burnt material, and structures reconstructed on the basis of artefact distribution or the location of stones in

Scotland and Norway. Whereas rock shelters and some caves form an important site category in some areas, for example Switzerland, these have seen little investigation in others, such as Scotland.

Future Challenges and Opportunities

We close our discussion by considering three key areas that will shape the future of Mesolithic sites in mountain landscapes: (1) expanding and consolidating our knowledge base, (2) landscape change, and (3) archaeological mitigation and public engagement. With the exception of Norway, in our other three case-study areas, the knowledge base is limited. A comparatively small number of sites are known, fewer have been excavated, and fewer still published. As such, it is difficult to be certain about the extent and character of the Mesolithic use of mountain landscapes. This in turn creates significant challenges for managing the cultural heritage of these areas. For most of our case-study areas, there is a pressing need to both formally assess the data we do have, and provide the means and guidance to properly report new discoveries. A first step is the dissemination of what we do know to those who engage with these landscapes, across all levels of stakeholder (see below). Providing guidance at all levels about how to act when Mesolithic material is identified by chance will further promote the archaeological potential of these landscapes.

Alongside the assessment of the data present, it is important that new methodologies to expand this knowledge base are developed. This is especially significant in terms of site prospection where the basic problem of finding small sites in large landscapes, often with significant post-Mesolithic landscape change, remain fundamental. The development and rigorous testing of predictive models offer some potential in this regard. Furthermore, increased understanding of the geomorphological history of mountain landscapes, to better understand the context of archaeological material, is important. This includes the assessment of the landscape contemporary with past human activity, but also the preservation potential for areas as well as potential threats and destruction.

The dynamism of mountain landscapes remains a fundamental challenge to our ability to record and protect this cultural heritage, and in many cases provides direct threats to the archaeology that is present. This dynamism is driven by interrelated climate and socio-economic drivers. This problem is especially marked in glacial landscapes. For example, the Swiss Alps are warming up twice as fast as the global average (Zubler, Schleger, and Bader 2019). This changes soil conditions whilst glaciers retreat and permafrost melts. As a result, pastoralism and forestry practices change, touristic use of the Alps becomes more reliant on infrastructure. Currently (2023), the Swiss parliament is discussing various legislative amendments to simplify and accelerate the construction of solar- or wind-power plants as well as the expansion of hydropower plants, particularly in the Alps. Here, the interests of renewable-energy production are given priority over environmental and heritage protection. In contrast, in Norway hydro-power companies pay a fee related to concessions. These threats can also be subtle, and a side effect of an unregulated power market in Europe is that businesses are more prone to increase production when prices are high, meaning that dams are draining and filling more frequently than before. This in turn accelerates the erosion of lake shores with detrimental effects on preservation of cultural heritage.

The threats facing ephemeral cultural heritage in these areas are substantial, and providing adequate protection will require careful negotiation. In Scotland, for example, protecting cultural heritage in mountain landscapes often sits alongside protection of natural heritage. In the face of climate change, changing public visions of how landscapes might be ‘rewilded’ as well as traditional land-use values such as upland hunting are coming into existence. Hunter-gatherer archaeology is only one of many landscape resources that has value. Given these competing value systems, one of the most important forms of protection for mountain Mesolithic archaeology is to ensure an increased awareness amongst policy makers, the general public, and archaeological authorities of the potential of hunter-gatherer archaeology in mountainous landscapes. Outreach work to communicate the value of this material is essential.

Fortunately, there are some grounds for optimism in this regard, and the authors' experience is of significant public interest in mountain hunter-gatherer archaeology. And as we find more sites it will be easier to tell stories and engage the public. Our early prehistoric cultural heritage can enhance how these landscapes are experienced and engaged with beyond typical recreational activities. Recent experiences by two of the authors have shown that artistic engagement with the archaeology and scientific process can enable communication with non-specialist audiences. A collaboration with poet and composer Richard Skelton resulted in a piece of music (Plateau) and poetry (*an Càrn Gorm / am Monadh Ruadh)* directly informed by the scientific process (Skelton 2023). Drawing artist Sarah Casey's *Emergency!* project includes glacial archaeological finds from the Fuorcla da Strem sut (Casey 2023).

Both projects speak to non-archaeological audiences and place the fragile archaeological evidence within the context of the changing landscape of Mesolithic mountain archaeology. Collaborating with documentary photographer Valentin Luthiger as is practiced in mountains sports, has also proven to be successful, reaching new non-specialist audiences in Switzerland. Engaging the public can, in turn, help provide a body of citizen scientists who know and value the archaeology of prehistoric hunter-gatherers in mountain landscapes, thus directly feeding into the generation of new data. In Scotland, for example, promotional literature has been developed showing 'How you can help find prehistoric hunter-gatherers in the Scottish mountains' (https://www.digitscotland.com/how-you-can-help-find-prehistoric-hunter-gatherers-in-the-scottish-mountains/).

Conclusion

We have compared the Mesolithic mountain archaeology of (Western) Austria, (Southern) Norway, Scotland, and Switzerland. To our knowledge, this is one of the first attempts to make this kind of comparison within Europe. Despite these being very different mountain landscapes, there are many similarities among the regions, with Norway perhaps appearing slightly different to the others. The database for most regions is small, and chance finds—often by vocational archaeologists or members of the public—are a significant source of data. An in-depth understanding of the extent and character of the heritage resource is not always present. This, in turn, creates significant challenges in managing and preserving this material in the face of very significant landscape change. Much has, undoubtedly, been lost. But there is also significant potential in using our prehistoric mountain hunter-gatherer archaeology to engage broader publics and raise awareness of the potential and significance of the remarkable archaeology in Europe's highest landscapes, and to tell the story of how humans have lived in, travelled through, and experienced these places in the deep time past.

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Notes

1 Norway has today 1,700 hydro power plants, and more than 1,400 lakes are regulated, water providing 90 percent of the country’s power: https://atlas.nve.no/Html5Viewer/index.html?viewer=nveatlas.