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Settling and moving: a biographical approach to interpreting patterns of occupation in LBA Circum-Alpine lake-dwellings

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Abstract

Lake-shore and wetland settlements of the Circum-Alpine region are well known for their excellent preservation of organic remains and their potential for accurate dating through dendrochronology. This settlement tradition spans from the Neolithic to the Early Iron Age, though several hiatuses in lake-dwelling construction are observed. Traditional models for the abandonment of lake-settlements rely upon climatically deterministic models, linking declining climatic conditions to increasing lake-levels, which would have impacted upon settlements and forced the inhabitants to relocate. Recent studies of Neolithic lake-dwellings have indicated that social factors also influenced the development of these settlements, while the 'social biography' of settlements has been an area of increasing interest in terrestrial settlements. A review of selected Late Bronze Age (LBA) lake-settlements illustrates the development sequence seen at many lake-dwellings from across the Circum-Alpine region. The proposal of a biographical model linking cultural influences to the development sequence observed in LBA lake-dwellings, and to the choice to abandon areas and relocate villages, offers further insights into the development of enigmatic settlements.

Introduction

The prehistoric lake-settlements of the Circum-Alpine region are one of the best known and researched settlement groups in central Europe. High levels of organic preservation in waterlogged conditions allow extensive investigation of environmental indicators, agro-economic aspects, and also high-precision dendrochronological dating. However, while many timbers relating to the lower foundations of structures are preserved, e.g. piles, relatively few elements of the higher levels of structures survive.

Although the lake-dwelling tradition in the Circum-Alpine region extends from the Neolithic to the Late Bronze Age (LBA) in the south (i.e. northern Italy) and early Iron Age in the north (Schlichtherle 1997; De Marinis 2006), this apparent 'continuity' is interrupted by several phases of abandonment; for instance north of the Alps during the Bell Beaker period and Early Bronze Age (25th-21st century BC) and the Middle Bronze Age (15th-12th century BC) (Menotti 2001). Traditional models for these phases of abandonment have linked climate proxies to the archaeological and dendrochronological evidence, to suggest climate influences, i.e. climatic deterioration and rising lake-water levels, as a major forcing factor in the decision to abandon the lake-settlements. While these climatic models are based upon well documented climatic changes, as recorded through climatic proxies (see Magny 2004), such a climatically deterministic model does not allow for cultural influences in the social choice to abandon settlements and areas. Furthermore, it must be remembered that lakes are, by their very definition and nature, enclosed bodies of water: they always have a lakeshore. In a model driven by climatic change, and without social change, the lake(shore)-dwelling communities would follow the lake shore as it fluctuates and moves, relocating their settlement when locations become submerged by rising lake water. Such a pattern is not observed.

The research project "The end of the lake-dwelling phenomenon: cultural vs environmental change" run at Basel University (Switzerland) combines material culture studies, archaeozoology archaeobotany, micromorphology and dendrochronology to illuminate cultural and social influences for the decline of the lake-dwelling tradition in the northern Circum-Alpine region. As part of the material culture studies aspect, settlement forms and occupation cycles have been considered as a social expression and 'immovable' material culture. Theoretical approaches hereby applied may provide indications of social impetuses for choices to occupy or abandon settlements.

Settlement abandonment

Dendrochronological analysis from many lake-settlements demonstrates a more complex situation than a one-off building (event, occupation for period of time followed by abandonment) in a single linear sequence, allowing for chain-like sequences of construction, abandonment, and renovation/reconstruction to be observed. Such sequences occur over both short-term periods (with occupation sequences flowing into each other), and longer periods with, possibly, substantial gaps between each settlement phase. For example, the Neolithic settlement of Sutz-Lattrigen - Rütte (Lake Biel, Switzerland) indicates that a settlement phase ended with the destruction of the settlement in a conflagration, to be rebuilt again almost immediately (Hafner and Suter 2004, 23). In contrast, the LBA settlement of Wasserburg-Buchau shows evidence of multiple building and renovation phases, with indications from a perimeter palisade suggesting four events spread over 200 years (Billamboz 2006). Lake-settlements from the west of Switzerland, such as Hauterive-Champréveyres and Grandson-Corcelettes, show indications of extended occupation in their material culture assemblage, but do not necessarily have dendrochronological information to expand upon such hypotheses.

Dendrochronological dating can also provide indications of settlement development. The sequence in which individual structures were built, and renovated, illustrates the development of settlements over time, and suggests that structures may have been constructed and abandoned on an asynchronous scale. These developments have been interpreted as part of a larger system in which multiple settlements formed a "community" around a lake and individuals would re-locate to different settlements at different times, on a rotational basis (the *Siedlungskammer* and *Siedlungsplatz* concepts (Ebersbach 2013; also Bleicher 2009, 159-163). Asynchronous abandonment of dwellings within an individual settlement and the suggestion of immediate reconstruction after abandonment/destruction, are indications that a climatically centred model for the abandonment of lake-settlements does not elucidate the full situation.

Micromorphological analysis of sediment samples from the lake-settlements can provide evidence in support of the inundation = abandonment hypothesis, and can also indicate the functions for which individual buildings were used. For example, analysis of sediments from the Neolithic settlement for Arbon-Bleiche 3 suggest that an individual building was initially used as a dwelling, before being partially destroyed in a fire event and converted/re-used as a herding pen (Ismail-Meyer and Rentzel 2004). A combination of dendrochronological dating and sediment analysis from the LBA lake-settlement Zug-Sumpf (Switzerland) indicate a flooding event around 944 BC, with abandonment of the settlement occurring four years later. This abandonment was not final, and a further phase of occupation occurred on the site between 880 and 860 BC (Bauer *et al.* 2004). Superficially, the example of Zug-Sumpf would appear to corroborate the climatically driven abandonment hypothesis. However it is evident that the settlement was not abandoned due to the direct influence of lake-level rise and settlement inundation; a delay of four years exists between the flooding event and the

abandonment of the settlement. A further example of continued occupation in the face of an increasingly humid, or inundated, environment can be seen in the LBA settlement of Ürschhausen-Horn (Switzerland). The settlement, occupied between 870 and 800 BC, provides indications of changing building techniques over time in order to compensate for increasing ground humidity (Gollnisch-Moos 1999; Nagy 1999). These two examples provide clear indications that Late Bronze Age lake-settlements were not always abandoned due to the threat of rising lake-water, and the inhabitants of some settlements took measures to counteract increasing humidity and continued occupation despite inundation. However, the flooded area could have influenced the economy of the community, which in turn may have led to settlement displacement (Menotti 2003).

Despite the preservation of structural elements, and the potential for highly accurate dating of those elements, other than establishing settlement occupation phases and construction sequences, relatively little theorisation of lake-dwelling biography or development has occurred.

Settlement biographies

In recent years, increasing numbers of studies have attempted to incorporate settlement structure and evolution with the development of the communities constructing and inhabiting those settlements. This has occurred on the scale of both individual buildings (Cutting 2006; Banning and Bird 1987; Gerritsen 2003; 1999) and settlements (Arnoldussen 2013; Brück 1999). While Ethnographic studies clearly demonstrate the social aspects that both influences and structures the construction of settlements and siting of buildings (Herbich and Dietler 2007), and the acceptable use of buildings throughout their history (Kopytoff 1986, 67), these structuring principles are difficult to observe in the archaeological record. Within the Circum-Alpine region Ebersbach (2010a; Ebersbach 2010b; 2010c; see also Claßen *et al.* 2010) has drawn upon the time-depth resolution provided by Neolithic lake-dwellings to suggest social models for the communities inhabiting those settlements, based upon the apparent mobility of households and relocation of dwellings.

Working with upland farmsteads of the Netherlands, Gerritsen (2003, 36) suggested that settlements could be linked to the domestic cycle of its inhabitants and created a model to link significant moments in the inhabitants biography with stages of house development (Gerritsen 2003, Fig 3.1). Working in a dry-land environment, the main evidence with which Gerritsen was able to work with were the post holes of buildings, which indicated the position and size of structures, but provided only limited dating evidence. Given their high temporal resolution and preservation of organic construction materials, wetland settlements of the Circum-Alpine region appear to offer greater potential for considering

the biography of settlements, yet theoretical applications to the lake-settlements are under-represented when compared to economic and environmental studies.

A selection of Late Bronze Age lake-settlements, based upon the extent of excavation with the site boundaries and the available published material, have been examined (through literature review) in order to attempt an understanding of the biographies of lake-dwellings and their inhabitants (Figure 1). While many LBA lake-settlements are known from the northern Circum-Alpine region, only a few of them have been extensively excavated. Most are excavated in small trenches (similar to Zug-Sumpf) providing little indication of the structural development of the entire village, or even entire structures. The four examples discussed here are from the eastern part of Switzerland and southern Germany, none are included from the western part of Switzerland (lakes Neuchâtel, Biel, Murten, and Geneva), though the potential for such studies exists in this area with, for example, the published data from Auvernier (Arnold 1983) and Cortaillod-Est (Arnold 1990).

Of primary importance for the development of lake-dwelling biographies are well researched dendrochronological records for individual sites. These allow an understanding of development sequences, duration of settlement, expansion, and indications of decline. Archaeological evidence, such as traces of fire events, and artefact distribution and density can illustrate planned abandonment and the intentional or accidental destruction of structures and settlements (Ismail-Meyer and Rentzel 2004).

Ürschhausen-Horn

The settlement Ürschhausen-Horn was constructed on a peninsula extending into Lake Nussbaum (Switzerland) between 870 and 850 BC, and occupied until around 800 BC (Billamboz and Gollnisch 1998; Nagy 1999; Gollnisch-Moos 1999). Buildings were constructed from a range of methods, including the plank-pillar (using spaced, grooved, vertical posts to retain horizontal timbers in position to form a wall) and *blockbau* (or log – using round timbers stacked sequentially on top of each other to form walls, much the same as a log cabin (Menotti 2012, Fig 4.6)) techniques (Gollnisch-Moos 1999, 21-71; Menotti 2012, 135 for construction definitions). A secondary settlement phase on the site is recorded during the EIA, between 663 and 638 BC, though limited information relating to this occupation was recovered during excavation (Gollnisch-Moos 1999, 122-127). Evolving foundation methods, from construction of loam floors directly on the ground, to creating raised floors on a supporting layer of timbers, have been interpreted as structural management solutions to the dual problem of increasing ground humidity and uneven topography (Gollnisch-Moos 1999, 21-71).

Development of the LBA settlement phase has been proposed by both Nagy (1999) and Gollnisch-Moos (1999) by drawing upon dendrochronological evidence, sedimentological analysis, and pottery typology. While their interpretations are to some extent divergent, the proposal of Gollnisch-Moos (1999, 133-139) provides some interesting insights. Initial settlement of the site began with construction dispersed across the peninsula, with a small cluster of buildings to the northern extent of the settlement (Figure 2). Several of these initially-built dwellings fell into disuse before further structures were built in the southern area of the settlement, increasing the density of buildings in that area, while only limited development occurred in the northern section. Moreover, an area of space in the central-western part of the settlement appears to have been left deliberately un-built. At the height of development, the settlement consisted of over 40 structures, ranging inside between ten and 25 square metres. Not all of these structures were in contemporary use, and particularly during the latter stages of the settlement many of the structures were unutilised. Many of the structures were not simply abandoned or unoccupied, but were physically destroyed by fire. As single structures appear to have been destroyed by fire at different times, it is possible that these were not accidental conflagrations but the deliberate and selective destruction of individual buildings.

The possibility of fire spreading to other structures cannot be excluded, as evidenced by the small cluster of buildings destroyed by fire in the northern extent of the settlement. However, the relatively sparse findings of metal work objects or ceramics from the interior of structures (Gollnisch-Moos 1999) certainly suggest an intentional clearing of buildings before abandonment and destruction. Ceramics stored along the external face of building walls could be storage of pottery outside of the dwelling, or temporary storage of waste (broken) ceramics, which would be left *'in-situ'* in the event of settlement/structure abandonment, as observed in ethnographic studies (Deal 1985).

Wasserburg-Buchau

Wasserburg-Buchau lies in the Lake Feder (Federsee) peat moor of southern Germany, over 2 km from the current lake shore. During the period of settlement occupation, between 1058 and 852 BC (Billamboz 2006), the settlement would have been positioned on the lakeshore or marshland (lake level reconstructions from Bertsch 1931). Excavation of the settlement during the early twentieth century identified two settlement phases; the earliest consisting of rectangular structures, and the later consisting of winged buildings (Reinerth 1928; Kimmig 1992). Excavation in the last decades of the twentieth century disproved the theory of these winged structures in favour of a series of *Packwerk* (foundations/floors of structures made by layering small timbers in a dense grid (Menotti 2012, Fig. 4.3b)) structures built in approximately the same location.

The erection of a perimeter fence, which may have served as a water/wind break, a defensive structure, or a settlement definition, occurred at four times throughout the settlement duration: at 1050, 1000, 930, and 850 BC (Billamboz 2006, 99). Although limited excavation of the site during the last decades of the twentieth century revealed only a small proportion of building structures in the settlement, dendrochronological dating of timbers from the perimeter palisade and buildings indicate that the four distinct construction phases may be linked to possible occupations. Each time the perimeter palisade was reconstructed, the southern edge remained in a relatively constant position, while the north and eastern edge expanded further towards the lake on each occasion (Figure 3).

Greifensee-Böschen

The settlement Greifensee-Böschen (Lake Greifen, Switzerland) has a short period of occupation, between 1051 and 1042 BC (Eberschweiler *et al.* 2007, 97-120). Extensive dendrochronological analysis has provided a thorough understanding of the settlement development sequence (Eberschweiler *et al.* 2007, 262). Initial occupation of the site began with the construction of a double structure (Figure 4). Further structures were constructed in 1048 BC, and positioned around the pioneer double building, effectively making that double-structure the centre of the settlement. A perimeter palisade and 'defensive' structure (consisting of piles driven into the ground at an angle and encircling the land-ward side of the settlement only) were constructed during the following year, effectively defining the maximum possible extent of the settlement nucleus. Entrance through the 'defensive' structure was aligned almost directly onto the large double structure, providing further indication that this building formed the effective centre of the settlement. Subsequent construction on the site (from 1047 to 1046 BC) spread lake-wards, and within the area defined by the palisade. However, a number of small buildings constructed between 1045 and 1042 BC spread towards the shore side of the settlement and exceeded the area defined by the palisade. Structures were also constructed in the area of the large double-building for the first time, and obscured the visibility of, and access to, this building from the main settlement entrance. Construction at the site ceased in 1042 BC, before conflagration appears to have consumed the whole settlement.

All of the structures have foundations based around the *blockbau* technique, which was used to raise a platform upon which buildings were constructed (Eberschweiler *et al.* 2007, 38-96). This raised platform construction, and sediment evidence, have been taken as indications that the settlement was constructed in an aquatic environment, though whether the settlement stood in permanent water is currently unknown (Eberschweiler *et al.* 2007, 259-268).

Zug-Sumpf

Excavation and dendro-dating at the site of Zug-Sumpf (Lake Zug, Switzerland) has allowed the definition of various construction stages at the settlement (Seifert 1997, 111-120). Initial development of the site occurred in 1056 BC (Figure 5), with a perimeter fence and small buildings of up to 20m² built in the *Schwellenbau* technique (creating a perimeter 'threshold' of the structure using planks, upon which the walls were built (Benkert *et al.* 1998, Fig 85)). The settlement grew quickly, and by 1050 BC new, pile-built, structures existed over the former perimeter fence. Over the succeeding 50 years, renovations and repairs were made to the existing houses in the settlement, and a new building (or row of buildings) was constructed, before a possible flooding event between 1017 and 1000 BC. This new building (row) was not directly adjacent to the earlier structures, but it was separated by enough space to allow for a pathway, and a further structure was erected between 999 and 974 BC adjacent to building no.5. From 973 to 950 BC further repairs and renovations were carried out on buildings. At the same time, structure no.3 was abandoned, and house 4 was moved to a new location, before a fire event affected much of the settlement. Following the fire, the settlement was rebuilt, with slight rearrangement of the buildings, for instance structures 5 and 6 were replaced by a single building across their former location. Final abandonment of the settlement occurred by 940 BC, following a flooding event after 944 BC (Bauer *et al.* 2004, 182-186). Limited information is available concerning a second occupation of the site that occurred between 880 and 860 BC, with smaller buildings (c. 9m²) built in the *blockbau* technique (Seifert 1996, 128-139).

Biographies from lake-dwellings

From the brief overview of four lake-dwellings from the northern Circum-Alpine region, several stages in the development of settlements are evident. Settlement foundation begins with the construction of one, or several, building(s), in advance (possibly by several years) of other structures. Expansion of the settlement occurs during subsequent years, before abandonment and destruction; after either a relatively short period of time, e.g. Greifensee, or several generations, e.g. Ürschhausen. Such a broad framework can be filled in with other events, such as the definition of the settlement area. Delimitation of the area to be occupied need not occur at the founding of the settlement, but at some point after occupation of the site. By considering events in the biography of communities and households, it may be possible to provide a greater understanding of the biography of their settlements (Figure 6).

Site selection and foundation of settlements

The initial stage of a settlement did not begin with the construction of the first building, but with the choice to create a new settlement, and the selection of a suitable location. Factors influencing the choice to found a new settlement may be based upon demographic and environmental influence. If the settlement had become too large, the settlement territory may have been unable to support the population, causing some parts of a community to leave. Such migration abandonment is not evident in the archaeological record, which indicates more abrupt abandonment events, when the entire population leaves in a short period. Over-exploitation of environmental resources could also reduce the carrying capacity of the settlement territory (Arbogast *et al.* 2006). Extensive off-site sampling would be required to provide an interpretation of the level of environmental degradation within the vicinity of settlements; unfortunately such sampling has not been conducted in LBA lake-dwellings. On-site sampling provides little indication of over-exploitation of environmental resources (though see below), and archaeobotanical investigations at Ürschhausen-Horn suggest that surprisingly little, or low intensity, agricultural activity took place within the vicinity of the settlement (Haas and Hadorn 1998). Evidently, settlements were not entirely focused on agricultural production and could have obtained those resources from other areas, or other settlements and populations, if required. Timber resource levels may have been a factor influencing the choice to move settlements; as the settlements were constructed primarily from timber, their construction would have had a considerable impact on the woodland within the settlement vicinity. At Ürschhausen-Horn a variety of construction techniques are used, some of which consume more timber (*blockbau*) than others (plank-pillar). The change from *blockbau* to plank-pillar techniques at this site may indicate a depletion of the local timber resource. At Greifensee-Böschen an intensive use of timber is seen within a decade of occupation, but the abandonment of the settlement due to depletion of the timber resource would appear unlikely, given that no attempt at timber conservation, through the adoption of modified building techniques of quartering/halving of timbers for use as piles was made. In fact, the use of halved or quartered timber for piles, and the utilisation of recycled timber, is something very rarely seen in the LBA lake-settlements, with the exception of Hauterive-Champréveyres (Lake Neuchâtel, Switzerland) (Pillonel 2007), Conjux Le Port 3 (Lake Bourget, France) (Billaud 2008), and in oak piles at Zug-Sumpf (Seifert 1996, 64-73), suggesting that concerns over timber supply were relatively subdued during the Bronze Age.

Selection of a 'new' settlement location may also have been influenced by environmental factors, topography, and the quantity of available surrounding land for agriculture. In

addition, social factors would have influenced site choice, not only by guiding site location through the socially constructed landscape, but also through social memory (Arnoldussen 2013). Many sites show more than a single occupation phase, such as Ürschhausen-Horn (Lake Nussbaum, Switzerland), Wasserburg-Buchau (Lake Feder, Germany), Hauterive-Champréveyres (Lake Neuchâtel, Switzerland), Zurich-Alpenquai (Lake Zurich, Switzerland), and Zug Sumpf (Lake Zug, Switzerland). At these sites with temporary abandonment, communities may have returned after a generational gap (Wasserburg construction phases), guided to the site not only through the potentially still visible physical remains of the previous settlement (timber piles, palisade), but also through the social memory of successfully inhabiting that area. Whether the same communities were returning to their previous sites is unknown, but material culture from the region indicates local development rather than incoming populations to the area, and so this should be considered more than likely.

With the selection of a new site, the settlement would have been founded by a small number of 'pioneer' inhabitants, constructing only one or two buildings (e.g. Greifensee-Böschen), and preparing other areas of the site in readiness for other settlers (for a Neolithic perspective see Bleicher 2009, 72-73). Who were these pioneer settlers, and where did they come from? These questions are difficult to answer from the archaeological record, though some indications may be provided by material culture studies. In a study of sickles from Switzerland, Margarita Primas (1986) identified a number of sickles as being cast in the same mould. These 'sibling' sickles may, for instance, provide indications of exchange links in the region of Lake Neuchâtel (Figure 7), but may also hint at individual/household mobility in the area, with persons moving between settlements and taking their personal equipment and possessions. How the pioneer settlers were selected is also difficult to understand, and concepts under which young adults were sent off to found their own settlement should be avoided; many settlements were not 'new', but simply reoccupations of a previous site concurrent with the abandonment and decline of the present settlement. However, age linked social status has been interpreted as a motivating factor for individual mobility in African societies (Kopytoff 1987), as high status attribution to senior social members limited the potential for younger members of groups, who are thus 'forced' to migrate to new locations in order to create new communities and attain higher personal status. It has to be pointed out though that such a migration would create new settlements as opposed to the rotation of whole communities between sites.

Settlement expansion and maturity

Expansion of settlements occurred primarily due to the relocation of individuals and households from other settlements. This increase occurs too rapidly to be caused purely by demographic growth. Structures of varying sizes would have been constructed, providing both dwelling and storage or workshop spaces. Besides size variation (generally into two groups – large structures = dwelling; and small = storage, though small structures may also be used as dwellings, e.g. second occupation of Zug-Sumpf and the Neolithic settlement Torwiesen 2 (Bleicher 2009)), the structures are relatively similar and provide little indication of social hierarchy or 'chiefs houses'. Two exceptions are: the large double-structure at Greifensee-Böschen, which also formed the apparent settlement centre for much of the settlements brief florescence, and a building constructed on top of an artificial mound at the end of a 100m-long causeway at the Neolithic site of Marin les Piécettes (Lake Neuchâtel, Switzerland) (Honegger 2001).

Definition of settlement boundaries would have occurred relatively quickly after the initial founding, using either previous boundaries as guidelines (e.g. Wasserburg-Buchau), or creating new boundaries (Greifensee-Böschen). Although no perimeter fence has been found at Ürschhausen-Horn, there are indications of breakwater structures around the settlement (Gollnisch-Moos 1999, 188). These perimeters may have served a defensive purpose, from humans, animals, wind, and water, and also symbolic functions, creating barriers between those individuals who were members of the community and those who were not, and also effectively limiting the possible size of the settlement and numbers of 'immigrants' who could enter.

Expansion of the settlement occurred in a structured manner, with areas left unoccupied for communal meeting spaces or other activities (e.g. Ürschhausen-Horn). Such open spaces may have been essential in settlements with high population and building density (Harding and Locker 2004, 181-185). An open space is also known from the Early Bronze Age settlement at Zurich-Mozartstrasse, though a platform was constructed on this area, which has been interpreted as a communal space or structure (Gross *et al.* 1987, 70-74). At Greifensee-Böschen the building sequence clearly illustrates that specific areas were intended for construction; the lake-side of the settlement area was built upon before the land-ward side, and construction adjacent to the large double building was avoided for the majority of the settlement duration, though full maturity of this site may not have been reached during its brief decade of occupation.

Ürschhausen-Horn may be considered as a mature settlement before its abandonment, with a relatively stable settlement size, and fluctuation of individual buildings in states of occupation or abandonment. Minor fluctuations would have been caused by household growth and decline, and the relocation of households to other settlements. Household growth may have created new buildings as members reached maturity and began new households (Doppler *et al.* 2010). There are few indications for the expansion of individual

buildings during their period of occupancy (though some extended structures are known from Auvernier-Nord (Arnold 1990)), indicating that households could not expand indefinitely within the same building. The death of members may have caused buildings to become redundant. Micromorphological analysis from many settlements indicates that burning events may have been the last action at individual buildings. Instead of buildings simply being left to decay, which may have occurred fairly rapidly following abandonment (Schöbel 2011), they were destroyed through conflagration. That specific buildings were deliberately destroyed can be seen at Ürschhausen-Horn, individual buildings were destroyed without fire spreading to adjacent buildings, despite the close proximity of structures (see above).

How long it took for settlements to reach maturity varies from site to site. Greifensee-Böschen displays a very brief period of occupation, while Ürschhausen-Horn appears to have been inhabited for circa 50 years, or two generations. Dendrochronological evidence from Wasserburg-Buchau indicates occupation over 200 years, though it is not clear if the site was continuously occupied for the whole of this period. Extended periods of occupation have been proposed for lake-settlements in western Switzerland, such as Hauterive-Champréveyres, where settlement occurred in multiple phases over two centuries (Pillonel 2007) and may have become central places in the human landscape (Maute-Wolf 2004). However, structures would have required maintenance and repair during their period of occupation, with experimental reconstructions indicating a period of good structural condition lasting up to 20 years (Monnier *et al.* 1991).

Structures indicating social hierarchy and the status of individual households are uncommon in lake-dwelling settlements of the Late Bronze Age (and also earlier periods). An exception may be the double structure from Greifensee-Böschen, which was not only different in its size, but also contained fragments of exceptionally large pottery, indicating that it may have been used as a central storage location (Primas 2004, 119). More frequent, though still not common, are open areas, deliberately left un-built, which may have served as communal spaces for meetings, animal herding, etc. (e.g. Ürschhausen-Horn). The regularity of site plan and structure size has often been used to support suggestion of egalitarian communities in the lake-dwellings (Hasenfratz and Gross-Klee 1995). These arguments are further supported by the lack of evidence relating to burial practices within the lake-dwelling communities. However, artefactual evidence (e.g. the quantity of swords, amber and glass beads, and arm-/leg-rings recovered from lake-settlements) indicates that different social identities and statuses existed within the communities. When these items, and particularly swords, are examined in communities outside of the lake-dwelling region they can be seen as indicators, and constructors, of elevated social status (e.g. Sperber 1996).

Comparison of the lake-dwellings to other settlements in the northern Circum-Alpine region is difficult, not only in terms of archaeological remains, but also population density. The lake-dwellings appear to have a significantly higher population density than other contemporary settlements from the region (Arnold 1990). It is only during the Iron Age that densely populated sites with identifiably high(er) status structures (for the living) begin to be constructed (e.g. the *Herrnhauser* at the Heuneburg fortified hilltop settlement, Germany (Gersbach 1995; Arnold 2010)). Comparable sites to the lake-dwellings from the Bronze Age may be found in northern Italy, such as the large manufacturing and exchange centre of Frattesina (Bietti Sestieri 1984) and the *Terramare* settlements (Cardarelli 1997). High population density is known from both of these examples, though the surviving structural evidence provides little indication of elaboration or the status of inhabitants. However, cemeteries associated with these settlements clearly illustrate levels of social stratification and hierarchy (Salzani and Colonna 2010; Cardarelli and Tirabassi 1997). The burial practices of the lake-dwelling communities north of the Alps are relatively unknown (though some cemeteries may occur in more inland locations (Beeching 1977; Moinat and David-Elbiali 2003)), making the identification of social elites difficult, even though social stratification is known in the region from the Neolithic (Moinat and Gally 1998).

Settlement decline and abandonment

At a certain point during the occupancy of a village, the decision to abandon it was made, though the factors influencing such a decision are unknown. As previously mentioned, these could have been environmental-economic, though evidence to support their relocation as a result of environmental over-exploitation is scarce. However, demographic pressure and the over use of environmental resources have been suggested as influencing factors for the abandonment of settlements around Lake Chalain (France) during the Neolithic (Arbogast *et al.* 2006). The abandonment of a settlement does not imply movement away from the site, but could simply involve the destruction of an individual site to be quickly rebuilt in the same location, as seen at the Neolithic settlement of Sutz-Lattrigen - Rütte (Hafner and Suter 2004). The decision to renovate a site provides a clear indication that over-exploitation of environmental resources was unlikely to have been a significant factor in the choice to abandon settlements, and that social influences played a more relevant role in the choice to abandon villages.

Social factors may have included the death of prominent social members or households; the foundation of a 'new' settlement (settlement relocation) may have been the responsibility of newly emerging elites. Delays between the construction of pioneer buildings and subsequent settlement expansion may argue against the role of elite succession in the choice to relocate, as individuals would still reside in the former 'chiefs' village. However,

the act of sending pioneers to found a 'new' settlement may have symbolised the succession of elites, and marked an intention to relocate; in this case minor delays would be expected due to the preparation of an area. Alternatively, the timing of settlement abandonment and relocation or renovation may have been influenced by the age of inhabitants, agricultural productivity, community beliefs, unusual events, or the structural condition of buildings (Ebersbach 2010b, 152). Dendrochronological analysis has indicated that repairs were made to buildings almost immediately after their construction, and that repairs continued throughout their use-life (Bleicher 2009; Ebersbach 2010b). Eventually, a point at which it was no longer feasible to repair structures may have been reached, and so they were abandoned in favour of new buildings.

Just as the founding of a settlement was a cumulative process, so were its decline and abandonment. The first community members to leave (in a final abandonment) would have been those 'selected' to begin the initial construction of the new site, and begin the settlement cycle again. Once the new site was chosen and initial preparation works completed more households would abandon their dwellings, leave the former settlement and begin expansion at the new site. Again, the apparent destruction of many buildings in fire events is noted, and could be seen as the deliberate destruction of dwellings and households (Bönisch 2005) as opposed to accidents or 'catastrophes' afflicting the village (Leuzinger 2000, 165). Such events may have marked the end of a life or household stage, or simply provided an easy method to clear a site in advance of fresh construction, or been a method to ensure that incoming groups could not utilise previous household structures.

Conclusion

Traditional models of lake-settlement dynamics in the northern Circum-Alpine region are dominated by climatically-deterministic models, reliant upon assumptions of climatic decline causing higher lake-water levels, which would have directly, and adversely, affected the lake-dwellers and their settlements. A study of several lake-dwellings from Switzerland and southern Germany has illustrated that such a situation does not account for possible cultural influences in the abandonment and relocation of settlements. Not only do settlements indicate continued occupation despite flooding events (e.g. Zug-Sumpf), but also display internally asynchronous occupational patterns. If flooding were the prime cause for abandonment, then it would be logical to expect the abandonment of large sections of settlements at the same time. Furthermore, the number, and distribution, of artefacts recovered from the studied lake-dwellings, and many others, do not suggest a hurried abandonment of settlements due to inundation.

The settlement biography detailed here, based upon periodic settlement relocation, is similar to the system detailed for the Neolithic, particularly in the Federsee region, by Bleicher (2009, 139-163). Reasons for the initiation of settlement rotation patterns may have included efforts to ensure sustained resource exploitation, which would require the maintenance of former dwelling places at the same time as inhabiting new areas to reduce the levels of effort required to clear spaces when re-occupying former village sites (Bleicher and Herbig 2010). Such a system corresponds well to the possible site duration of 10-20 years during the Neolithic (Bleicher 2009; Maute-Wolf 2004), but does not fit so well with the LBA system where longer settlement durations are observed (with the exception of Greifensee-Böschen). Place maintenance would also represent as a continued, albeit small, occupation of a site, as the individuals sent to maintain a site would have needed dwellings and utilised material objects.

Although the focus of this article has been to argue that climatically deterministic models should not be relied upon in considerations of the abandonment of lakeshore settlements of the northern Circum-Alpine region, climatic influences should not be totally discarded. In some cases the initial triggering factors might be climatic, but they always need to be considered in tandem with socio-cultural factors, as has been proposed by Menotti for the MBA abandonment of lake-settlements north of the Alps (Menotti 2001). Considering the fluctuation and abandonment of settlements through the concept of a social biography provides a more complete understanding of settlement and community dynamics, and suggests directions for future research. For example, combining intra-site artefact distribution maps with dendrochronological dating of individual structures may enable an understanding of the social structure dictating settlement form. An understanding of social structures would in turn privilege a greater conception of the individual households and community members, their position within settlements, and their role in the decision to select, found, and abandon settlements. To address hierarchical structures within the communities, indicators other than building size or form should be sought, for example in the distribution of portable material culture and food consumption practices, and attempts to link lake-dwelling communities into local burial practices should be pursued.

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Captions

Figure 1. Lake-dwelling sites from the Circum-Alpine region mentioned in the text. 1) Arbon Bleiche 3; 2) Auvernier-Nord; 3) Conjux le Port 3; 4) Cortaillod-Est; 5) Grandson-Corcelettes; 6) Greifensee-Böschen; 7) Hauterive-Champréveyres; 8) Marin-Les Piécettes; 9) Sutz-Lattrigen Rütte; 10) Torwiesen II; 11) Ürschhausen-Horn; 12) Wasserburg-Buchau; 13) Zug-

Sumpf; 14) Zurich-Alpenquai & Zurich-Mozartstrasse. (Map created using SRTM Shaded Relief data, Water Bodies and Country Borders overlay from ESRI Map Data 3).

Figure 2. Ürschhausen-Horn development over 10 phases proposed by Gollnisch-Moos (1999). Construction initially began dispersed across the settlement (a), and some buildings were abandoned shortly after (b). The southern half of the settlement was more densely built than the northern half (c-e), with some buildings destroyed or cleared by fire. The northern half of the settlement appears to have remained relatively stable until the latter stages of the settlement, when most of the buildings were abandoned before being burned (f-j), though some minor rebuilding may have occurred (g, i). A similar pattern, though considerably more dynamic, is visible in the southern half of the settlement, with buildings being abandoned, renovated and reoccupied, or destroyed by fire. (Redrawn from Gollnisch-Moos, 1999: Figures 222-224).

Figure 3. Development of the pallisade surrounding Wasserburg-Buchau. The perimeter palisade of the settlement remains in a relatively stable position along most of its length throughout phases of reconstruction, apart from the North-East quarter, which expands with each phase of re-establishment. (Redrawn from Billamboz, 2006: Figure 2).

Figure 4. Development of Greifensee-Böschen between 1051 and 1042 BC. A pioneer double structure marked the foundation of the site (a, 1051 BC), with rapid expansion to the left and right (b, 1048 BC). Definition of the settlement area occurred with the construction of a perimeter fence and defensive structure (c, 1047 BC), before new structures were built on the either side of the settlement (d, 1047-1046 BC), which also exceeded the area defined by the perimeter fence (e, 1045-1043 BC). A final structure was constructed on the lake side of the settlement (f, 1042 BC), before abandonment and apparent destruction of the settlement in a conflagration. (Redrawn from Eberschweiler *et al*, 2007: Figure 9).

Figure 5. Development of the settlement Zug-Sumpf. Dendro-dating provides an accurate development sequence for structures observed in the northern trench, and a general sequence for those from the southern trenches. Initial development of the settlement began in the southern area, with a perimeter palisade visible in the northern trench. Over the following century new buildings were constructed and repaired. Occasionally houses were abandoned (no. 3) or moved (no. 4). Dating: a) 1056 BC; b) 1051-1034 BC; c) 1033-1020 BC; d) 1019-1000 BC; e) 999-973 BC; f) 973-950 BC; g) 949-940 BC. (Redrawn from Seifert, 1996: Figures 141 & 146).

Figure 6. A potential biographical model for the development of lake-dwellings, linking social events to the founding and abandonment of structures and settlements.

Figure 7. Sickles manufactured in the same mould found at different sites in western Switzerland. Connections between sites are represented by dashed lines, sickles cast in the same mould from the same site (i) are also known. 1) Auvernier (i); 2) Chevroux (i); 3)

Colombier; 4) Concise; 5) Cortaillod; 6) Estavayer-le-Lac; 7) Gletterens; 8) Grandson-Corcelettes (i); 9) Guevaux; 10) Hauterive-Champréveyres (i); 11) Haut-Vully; 12) Montilier; 13) Mörigen (i); 14) Neuchâtel Le-Crêt (i); 15) Nidau; 16) Sissach; 17) Twann-Petersinsel; 18) Vallamand. (Data from Primas, 1986).