

## Neolithic and Bronze Age lakeside settlements in the Alpine region

### Threatened archaeological heritage under water and possible protection measures – Examples from Switzerland and Southern Germany

#### Neolithic and Bronze Age pile dwellings – a circum-Alpine phenomenon

The lakeside settlements in the Alpine region (most of which date from between 4300 and 700 BC) are among the most important examples of archaeological heritage in Europe. The special conditions under water have led to an exceptionally good preservation of the organic materials. Remarkably well preserved timber-built constructions and numerous artefacts made of wood, bark and textiles as well as copious amounts of plant and animal remains constitute the outstanding scientific significance of the pile dwellings. It is these finds categories which have not been preserved in dry-land sites that provide us with a detailed insight into the everyday life and culture of the early agrarian societies around the Alps. It is of great importance to be able to determine precise dates for finds assemblages and the constructional history of villages by means of dendrochronological analyses.

The wetland settlements in lakes, rivers and bogs throughout the foothills of the Alps have been investigated for over 150 years. Numerous artefacts from the pile dwellings were retrieved from lakes and wetland areas using rather primitive methods as far back as the 19<sup>th</sup> century. While extensive excavations were already carried out in the 1920s, the documentation of the features to modern standards, with few exceptions, was really only introduced after 1970. At the same time, dendrochronological research experienced a breakthrough, although the earliest tentative tree ring dating experiments go back to before 1940.

The pile dwellings can be classified into three types of site, the most numerous being the lakeside settlements, followed by bog settlements, while pile dwelling sites along rivers are only occasionally found. As regards the lakes, one must differentiate between the large lakes in the foothills of the Alps, whose water systems are determined by the Alpine glaciers, and the smaller lakes spread throughout the young moraine landscape. These are often bodies of water largely without effluences, located in the transition area between the mountainous regions and the surrounding fenlands.

Based on the registries of six Alpine countries, approximately 750 sites are today classed as pile dwelling sites. With 450 sites, Switzerland boasts the majority of these. Particularly dense concentrations of settlement sites exist in Western Switzerland (the so-called Three-Lake-Region with Lakes Bièvre, Morat and Neuchâtel), in the Lake Zurich area and at the lakes that form the boundaries between Switzerland and Germany, and Switzerland and France, Lakes Constance and Geneva respectively. These are the two largest inland bodies of water in Central Europe, and, together with the northern foothills of the Alps, they constitute the core area of the pile dwelling phenomenon. This region continues to the north with numerous bog settlements in Upper Swabia, particularly around Lake Federsee, and to the east with sites around the lakes of the Bavarian and Upper Austrian foothills of the Alps. A unique geographical position is represented by the French lakes with sites throughout the Jura Mountains and deep into the Alpine Valleys. There are also similar micro-regions in Northern Italy; however, most of these sites are clustered around the lower area of Lake Garda, the largest of the southern Alpine lakes. The sites located in what is now Slovenia are concentrated in an area limited to the vast bog lands of Ljubljansko Barje.

#### Early research into pile dwellings – chances and consequences

With the Zurich Antiquarian Society and its President Ferdinand Keller, there was an established network of experts as early as the mid 19<sup>th</sup> century, suited to its time and with a great interest in the subject of pile dwellings, not least for political reasons. The main result of this early form of “networking” were the twelve “pile dwelling reports”, published between 1854 and 1930, the primary function of which was to highlight the research and “exploitation” of the Swiss lakeside settlements, while also featuring expertise and developments in neighbouring countries. Reports of pile dwellings discovered in the Baltic were discussed, as were ancient accounts of similar edifices in northern Greece. This early research community also produced the first analyses of prehistoric plant remains and animal bones, whose extraordinary potential in terms of archaeo-biological research had been recognised early on.

In most countries, the advances made by the study of these sites were linked with external circumstances, which brought unexpected possibilities and chances, while also, however, often leading to irreparable damage to the archaeological evidence. In Switzerland these were the two Jura waters correction projects, which, from 1872 onwards, lowered the levels of Lakes Neuchâtel, Bièvre and Morat by a good two metres and exposed the prehistoric settlement sites, thereby making them easily accessible. In Upper Swabia, the construction of the first railway line prompted intensive peat cutting in order to fuel steam locomotives. Numerous remains of settlements were subsequently found and some of them were also badly disturbed during peat cutting around Lake Federsee.

Due to their easy accessibility, bog settlements became the subject of great public interest mainly in the early 20<sup>th</sup> century, not just in Southern Germany but also in Switzerland and Italy. Sites under water remained out of human reach for a long time until Jacques Cousteau's invention of the aqualung made autonomous diving possible. From around 1970, this led to professional archaeologists going under water and carrying out the earliest studies.

#### The dilemma posed by archaeology as a science – increased insight destroys the sources

Naturally, the past 150 years of research have had an effect on the body of sites. Tentative first steps towards a heritage protection philosophy and an effective “maintenance” of the archaeological sources were only initiated after 1970. Owing to the fact that under water sites were largely inaccessible, one can say that, until the 1950s, systematic destruction – apart from a few exceptions – remained relatively limited. Most of the damage in Switzerland would have been caused by the Jura waters correction projects. This affected three lakes in Western Switzerland (Lakes Neuchâtel, Bièvre and Morat). On the other hand, Canton Berne, for instance, passed the first heritage protection law in an effort to safeguard the

pile dwellings around Lake Bienna as early as 1873. This had been prompted by raids on the lakeside settlements of Lüscherz by local residents, who had started a lucrative business trading in the artefacts. The lakeside settlements of Bodman and Sipplingen on Lake Constance had been exploited in a similar way. Here, a decree issued by the Grand Duchy of Baden put an end to these illicit excavations. However, recent studies have shown that the damage tended to be limited to individual sections and even in settlement sites previously deemed destroyed, the piles driven deep into the lakebed and abundant assemblages of artefacts often still remain intact. The excavators of the 19<sup>th</sup> century had little interest in many of the finds such as broken vessels and other fragmented implements, and left them behind. The bog settlements were also only affected peripherally, because peat cutting only went to a certain depth and the cultural layers were unsuitable as fuel. Until well into the 1950s, large-scale archaeological research excavations were largely limited to the bog settlements of Upper Swabia and Central Switzerland. In the case of the Upper Swabian Federsee bog, these excavations took place between 1920 and 1937, while the Central Swiss Wauwilermoos fenland was the site of extensive bog excavations mainly during the 1950s. The earliest large intrusions at Lake Constance began in the 1960s, when yacht marinas were dredged and pipes laid in the lakebed. Thanks to a phase of economic boom large studies became possible in Switzerland in the 1970s. Large urban development projects were increasingly realised for the first time in raised lakeshore areas and linear constructions such as motorways and later railway lines ran along the lakeshores straight through vast prehistoric settlement sites. While this prompted the first systematic and high-standard rescue excavations along with immense scientific advancement (since 1972, the costs for national projects such as motorways are funded entirely by the parties responsible), these large-scale developments ultimately led to the total destruction of the archaeological evidence. The large development projects of the 1970s made the archaeological dilemma painfully clear for the first time: increased archaeological insight permanently destroys its own non-reproducible sources.

## **Pile dwellings under threat – erosion of lakes, drying out of wetland areas**

Today, the shores of lakes and rivers in all of the Alpine states are considered to be especially ecologically sensitive and are usually subject to particularly rigorous planning legislation. Many of the lacustrine landscapes have, at this stage, been cared for by substantial lobbying for decades and there are numerous NGOs devoted to the protection of “their” lake (Association pour la Sauvegarde du Léman [Association for the Protection of Lake Geneva], Interessengemeinschaft Bielersee [Friends of Lake Bienna], Internationale Bodenseekommission [International Commission for the Protection of Lake Constance], to name but a few). The danger of uncontrolled construction affecting waters has therefore decreased significantly in the past number of years. The capacities of harbours to accommodate amateur captains have been exhausted and bank reinforcements in the form of walls and dams, often practiced before, have completely gone out of fashion thanks to the introduction of lakeshore renaturation projects. Intrusions into bog land areas have also decreased slightly, due to increased environmental awareness and the protection of wetlands (special legislation in Switzerland, identification of new

natural heritage and fauna-flora-habitat areas according to guidelines stipulated in the Habitats Directive in Germany, 1971 Ramsar Convention on Wetlands). However, old drainage systems and sinking groundwater levels still cause problems. It is also entirely unknown, to what extent global warming will affect wetland areas in the future.

Currently, circum-Alpine pile dwellings around the large lakes are threatened by the aggressive erosion of the shallow water zone, which can extend up to 300 metres into the lake. This erosion is caused by various overriding factors largely beyond our control. Some of these factors are the numerous regulating intrusions into the regime of tributaries and effluences of the waters since the mid 19<sup>th</sup> century, wave reflection and changes in currents due to bank reinforcements, declining lakeshore vegetation caused by the eutrophication of the lakes, decreased sedimentation due to barrages in the headwaters of the tributaries, and the intensive traffic of motor-driven boats and ships.

The erosion of the shallow water zone usually leads to the large-scale ablation of sediments covering the archaeological layers. In absence of the protecting sediments, the organic components and finds made of wood, bark or plant fibres are destroyed very quickly. Harder artefacts such as pottery may well survive for some years but will also erode rather fast and will lose their archaeological potential, leaving just rounded sherds. After a few decades, all that will be left of the 5000 year old settlements, extraordinarily well preserved up to a short while ago, will be the hardest objects such as stone and bronze artefacts. Compared to the archaeological layers still intact, such eroded layers, having been reduced to “hard ware” only, have lost most of their archaeological evidence. However, compared to “dry-land sites” these sites are still valuable cultural witnesses thanks to the thousands of piles that were driven deep into the lakebed, still possessing a last scientific potential in terms of dendrochronological, and maybe in future also climatological studies.

Completely different processes occur in the dried up areas of small lakes and in bogs. In order to gain more farm land, many of the small bodies of water were “ameliorated” in the past, i.e. lakes without outlets were provided with artificial outlets, the sills of existing outlets were lowered and wetlands were drained using large-scale drainage systems. Ultimately, all these measures have the same effect: Groundwater levels sink and the archaeological sites, preserved in water-saturated conditions for millennia, subsequently dry out. Atmospheric oxygen penetrates the originally waterlogged sediments and micro-organisms commence their destructive work on the organic material. They are extremely efficient: It only takes a few decades for the entire organic material to be totally decayed. To put it simply, they systematically turn valuable archaeological artefacts into simple humus. It goes without saying that this represents a grave loss of archaeological potential.

At this moment in time, one can say that the “pile dwellings” around all the lakes throughout the foothills of the Alps are threatened by erosion to a greater or lesser extent. Decreasing groundwater levels are witnessed all across Europe, which effectively threatens all bog settlements. To date, however, this scenario has usually only concerned parts of the sites. As a rule, they show a succession of already badly eroded peripheral areas to sections at the centre of the settlements that are still intact. Bog settlements, in turn, show the opposite, i.e. the central areas are often located at higher levels and are therefore dried up more than the edges located lower down and are thus often still below the groundwater level.

## Erosion protection measures and future possibilities

Because of the situation described above, numerous rescue excavations were carried out over the past 25 years in order to document acutely threatened settlement sites, while pure research excavations took a back seat. This strategy is basically in accord with the European Convention on the protection of archaeological heritage. The treaty document, ratified in 1992 is also called the 'Malta or Valletta Convention' and puts it plainly: the *in situ* conservation of archaeological cultural goods takes priority over an excavation. First experiments in actively protecting archaeological sites under water have also been carried out over the past approximately 25 years. The first methods have been developed almost simultaneously in Western Switzerland and Southern Germany. Initial experiments consisted of securing lakeshore sections by installing "rigid" reinforcements and coverings with sand bags, sand deposits and similar methods. For the past number of years, geotextiles covered with gravel deposits have proven successful. Various heritage protection agencies have developed specially designed floating implements in order to carry out this work and to put in place efficient and cost-effective erosion protection measures. The experiences with this method gathered over the past approximately ten years have been extremely positive. At the outset, the performance of the gravel coverings on top of the geotextile was viewed as the main critical aspect. It was feared that currents on the lakebed, for instance during storms, would shift the gravel and uncover the geotextile. So far, this has not occurred; however, empirical data on the most advantageous gravel mixtures and range of geotextiles is still incomplete. One must also ensure that any intrusions into the shallow water zone are ecologically viable and comply with legislation such as the Habitats Directive guidelines.

The method of using a combination of geotextiles and gravel deposits has proven so successful in Lake Bienne that, for instance, breakwater systems using timber palisades and fascines, which were still being installed until the late 1990s, no longer seem viable today.

While great strides have been made over the past twenty years in terms of protecting archaeological sites from erosion, efforts made with regard to the *in situ* conservation of archaeological sites in wetland areas have not evolved much. An exception to this rule is the Federsee region in Southwestern Germany, where new nature reserves have been identified in close collaboration with nature conservation organisations, and where large areas of land have been bought and withdrawn from intensive farming by reallocation procedures. In some areas, the groundwater levels could be raised again and the fluctuations in groundwater tables are now being closely monitored by numerous measuring stations. For the pile dwellings in other bogs throughout the Alpine region, however, there is no systematic monitoring, which would enable us to observe the long-term development of the state of organic wetland sediments. Changing to extensive farming in the proximity of small lakes and wetland areas is a first step. Extensive agriculture, however, involves a change in farming practices and limited use of fertilizers and manure. Such efforts clash with the wishes of the landowners concerned and can sometimes lead to conflicts.

Over the past number of years, a rich pool of practical knowledge has been amassed through international exchange of information and close collaboration. A network of experts dealing with the subject has evolved over the years, and there have been two round table talks to date (Archéologie et Erosion, Lons-le-Saunier

1994/Neuchâtel 2004), the results of which have been published. We aim, in future, to link up with other existing networks dealing with the same topics throughout the Anglophone and Nordic regions (Preserving Archaeological Remains *in situ* PARIS1-3, London 1996 and 2001/Amsterdam 2006). Focal points of the discourse would mainly be the protection of archaeological sites in wetland areas. In terms of pile dwelling bog settlements, the collaboration between heritage protection and nature conservation authorities and NGOs, and the consistent enforcement of treaties like the Ramsar Convention has, to date, only occurred in isolated instances; however, it must be demanded for the future.

The project initiated by Switzerland in 2004 to include the circum-Alpine pile dwellings in the list of UNESCO World Heritage sites primarily intended to protect the archaeological sites from further destruction. The UNESCO label provides invaluable support because archaeological sites such as pile dwellings attract public attention (and along with it financial assistance) and protection from other interests only if their scientific value is acknowledged at the highest level. The pile dwellings need dedicated lawyers who are fully committed to the fight for the protection of the archaeological heritage under water and in wetland areas.

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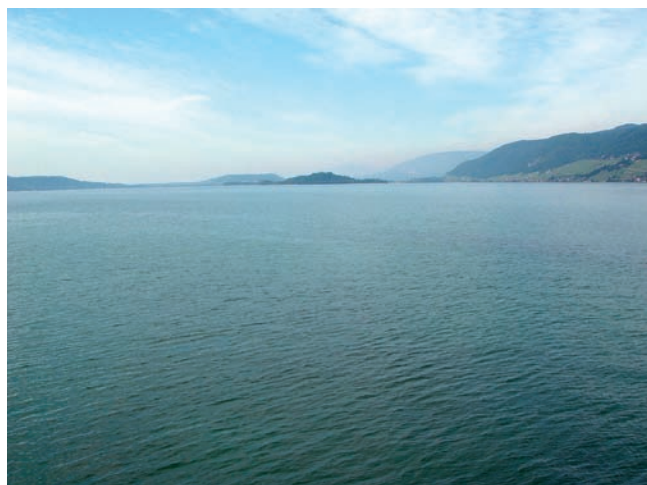
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Lake Federsee (foreground), situated 60 km north of the Alps (background) in the state of Baden-Württemberg, is a classic example of a dried up lake in the foothills of the Alps with a rich body of preserved settlements, plank ways and dugouts dating from the Stone Age to the Metal Ages. Nature conservation and heritage protection work hand in hand to create reserves and to raise groundwater levels. Photograph: Stuttgart Regional Council, O. Braasch.



Lake Bienna (Canton Berne) is one of the smaller bodies of water in the Swiss Midlands, which in turn are located between Lakes Geneva and Constance, the two largest European inland lakes. While there are 35 'pile dwelling' sites on the 17 km long Lake Bienna, Switzerland boasts a total of approximately 450 sites. Around 750 pile dwelling sites are known throughout the circum-Alpine region. Photograph: Archaeological Service of Canton Berne.



Aerial photograph of the pile dwelling site of Unteruhldingen on Lake Constance. The erosion of the shallow water zone is ongoing, palisades and ground plans of houses are constantly being exposed. Photograph: Stuttgart Regional Council, O. Braasch.

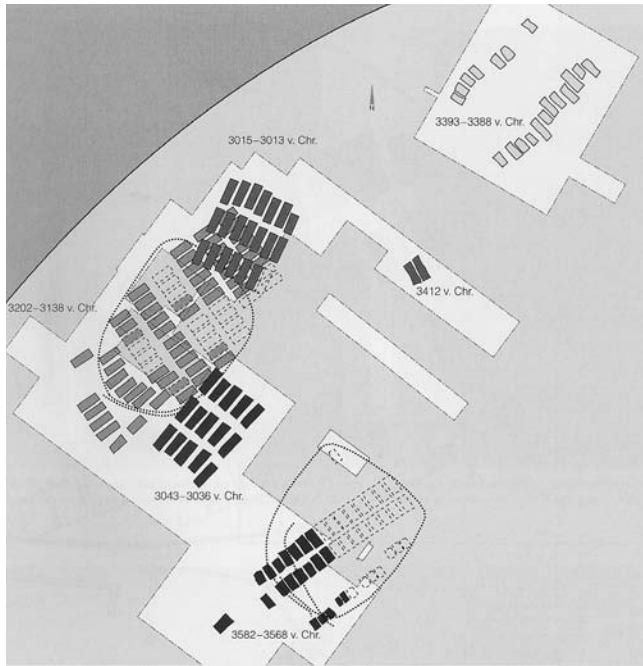


Excavation of the timber structures of a Late Stone Age house (dated dendrochronologically to 3279 BC) on Lake Federsee. For thousands of years, the preservation conditions in the peat were ideal; today, drainage systems and decreasing groundwater levels are threatening the archaeological evidence. Photograph: Stuttgart Regional Council, W. Hohl.

Divers among the piles at a site in Lake Bienne, which were exposed by the erosion of the lakebed. The situation pictured here is an extreme form of destruction caused by waves and wind and also by human intrusion into the natural balance of the body of water. Photograph: Archaeological Service of Canton Berne.

Situation of a pile dwelling site on Lake Bienne, the archaeological layer of which is in the process of disintegrating. Crabs are already burrowing into the archaeological layer – it looks like Swiss cheese. Jutting out of the lakebed are the stumps of piles from a settlement that was destroyed by a conflagration in 2704 BC.





Example of a Neolithic settlement sequence (Sutz-Lattrigen on Lake Biene) between 3600 and 3000 BC. During the rescue excavations, samples were taken from thousands of piles, which will be analysed by dendrochronological means and will provide exact dates. Figure: Archaeological Service of Canton Berne



Groundwater level measuring stations monitor the groundwater tables in an area of the Federsee bog, which has undergone wetland restoration. The archaeological evidence remains preserved beneath the peat cover. Photograph: Stuttgart Regional Council, H. Schlichtherle.



Erosion protection measures at Lake Biene, Switzerland (2003-2004). 'ROBOR' catamaran in action with geotextile mats. 6,000 m2 of the settlement site in the bay of Sutz-Lattrigen have been covered over and 30,000 m2 have been excavated archaeologically. Photograph: Archaeological Service Canton Berne.

Artefacts made of organic materials survived thousands of years in the wetland settlements throughout the foothills of the Alps in exceptional states of preservation. Textiles, wooden vessels, a comb and a knife dating from the Late Stone Age found at the lakeside settlements of Vinelz and Lattrigen on Lake Biene. Figure: Archaeological Service of Canton Berne/Stuttgart Regional Council, A. Kalkowski.



Divers recording exposed and eroded timbers. Rescue excavations often provide the last pieces of information before they are destroyed forever. Photograph: Archaeological Service Canton Berne.

