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COPING WITH CRISES I: SUBSISTENCE VARIETY AND RESILIENCE IN THE LATE NEOLITHIC LAKESHORE SETTLEMENT ARBON BLEICHE 3 (SWITZERLAND)

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The site of Arbon Bleiche 3 is located at Lake Constance, canton Thurgau, Switzerland. About half of the original settlement surface was excavated between 1993 and 1995. Due to the waterlogged conditions, the archaeological sediments and the organic remains are very well preserved. Dendrochronological analyses allowed the precise dating of residential structures and the reconstruction of the settlement history in the excavated area. In−depth interdisciplinary analyses of the layer formation processes showed that hardly any horizontal or vertical mixing took place. The settlement is therefore particularly well suited for studying spatial patterns and socio−economic strategies, in both individual houses and the settlement as a whole. Besides excellent preservation conditions, a short, single−phased occupation (3384−3370 BC), which ended in a devastating fire makes the site particularly valuable, as we can contrast the snapshot captured in the burnt remains with the contents of the cultural layer accumulated during the 15−year occupation. Based on the rich faunal remains from Arbon Bleiche 3 we suggest the existence of a broad and resilient subsistence diversity, which allowed the inhabitants to successfully cope with economic difficulties that probably occured during the final years of the settlement.

INTRODUCTION

Research on lakeshore settlements from the 4th and 3rd millennia BC has revealed much about their economy (Gross et al. 1990, Schibler et al. 1997a, Jacomet et al. 2004, Matuschik et al. 2010). There still remain some phases, however, for which the economic basis is unclear. This is mainly due to gaps in the archaeological record resulting from a discontinuous representation of lakeshore dwellings (Arbogast et al. 2006: 409). Our knowledge of how people in the Neolithic reacted to crises, such as times of food scarcity, is rather poor. Thus, it becomes all the more interesting to consider the Late Neolithic site of Arbon Bleiche 3, which is particularly suited to addressing such questions.

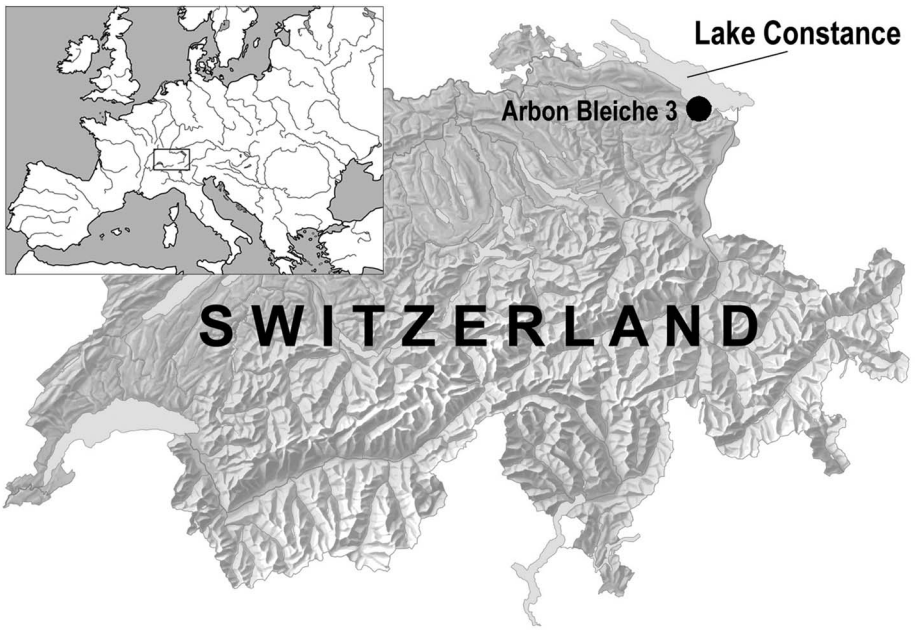

Fig. 1: Location of the Neolithic lakeshore settlement Arbon Bleiche 3 (map of Switzerland: © 2004, swisstopo)

ARBON BLEICHE 3: AN EXCEPTIONAL SPOTLIGHT

The site, which lies on the Swiss side of Lake Constance, in canton Thurgau, was excavated by the Archaeological Service of Thurgau (Amt für Archäologie Thurgau) from 1993 to 1995 (Fig. 1). Dendrochronological evidence dates the occupation of the site to 3384 to 3370 BC (Leuzinger 2000: 51–87), a time for which few sites are known (Hafner and Suter 2000). The cause for the lack of lakeshore dwellings during this period probably lies in the unfavourable climatic conditions, which led to higher water levels with subsequent flooding and erosion of lakeshores (Maise 2005). As a consequence, people would have had to leave the lakeshores and settle inland where much less data is available. These dry land settlements are difficult to find and are generally poorly preserved. Furthermore, they have only recently been a topic of interest in Swiss archaeology. This particular research gap should diminish in the near future, and our knowledge of Neolithic landscape management as a whole through time should increase. New research approaches will thus be possible (Doppler et al. 2011).

Arbon Bleiche 3 is of special interest for two reasons. Firstly, it represents a period for which few sites are known. Secondly, it gives an insight into the economy of a settlement for which unfavourable climatic conditions (cold and wet) are presumed to have set in shortly after its establishment (Haas and Magny 2004: 49). The rise of the water level in Lake Constance, shortly after the abandonment of the settlement, can be considered a direct consequence of these conditions (Haas and Magny 2004, Ismail−Meyer and Rentzel 2004, Thew 2004). Fortunately for archaeologists, it is also responsible for the exceptional preservation of the site. The wooden construction elements recovered enabled dendrochronological analysis confirming the short occupation of the settlement.

The good preservation also enabled individual house plans to be recognised on site, facilitating specific sampling strategies for various scientific analyses (Leuzinger and Jacomet 2004: 35−39). A total of 27 houses were completely or partially brought to light, on an area thought to represent about half of the original settlement (Leuzinger 2000: 173; Fig. 2). In comparison to other lakeshore settlements, quite a large portion of the original occupation area was therefore excavated and analysed, emphasising that any results are strongly representative.

On other sites, such inferences are often hindered by the limited size of the excavation area or the mixing of different layers. It was shown for Arbon Bleiche 3 that hardly any horizontal or vertical layer mixing took place (Brombacher and Hadorn 2004, Deschler−Erb and Marti−Grädel 2004a, Haas and Magny 2004, Ismail−Meyer and Rentzel 2004, Thew 2004). The settlement is therefore particularly well suited for studying spatial patterns and socio−economic strategies of individual houses and within the settlement as a whole. This is of special note because Arbon Bleiche 3 is characterised by rich and diverse material remains comprising not only archaeological artefacts but also a wealth of archaeobiological remains. An interesting dimension is added by the fact that the settlement ended in a devastating fire (Leuzinger 2000: 27), a stroke of luck for archaeologists, which will be discussed in more detail later.

A HOUSE AS MANY AGAIN?

A glance at the literature shows that a number of implicit, yet unproven, premises exist in the field of wetland archaeology (Lutz 2010, Doppler et al. 2011). One of these premises states that to each house there belonged, amongst other things, a field and some domestic animals.

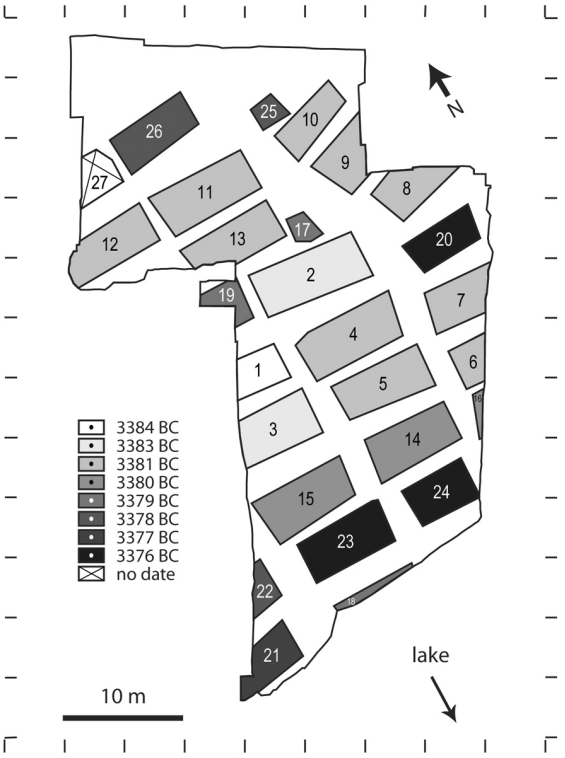

Fig. 2: Dendrochronologically dated house plans with year of construction (modified after de Capitani et al. 2002: 21 Abb. 10)

In other words, this latent premise suggests that each house was a self−sustaining production and consumption unit, and that all houses followed the same subsistence strategy using identical means of production and having the same dietary habits. Essentially, each house within a prehistoric settlement is believed to be economically self−sufficient and to yield identical material remains. Due to the presupposed uniformity of resource use and dietary habits, there should not be any substantial differences in refuse composition and inventories among the houses. Drawing on the example of Arbon Bleiche 3, we shall try to demonstrate that these basic assumptions are to be challenged and that different scenarios can be outlined. The basis for these remarks is our working premise which states that "the archaeobiological remains found within a house reflect the subsistence strategy and dietary habits of the inhabitants of that house".

In the following discussion, our focus will be on the archaeozoological data and results. The basic groundwork of animal bone identification for Arbon Bleiche 3 was done by Deschler−Erb and Marti−Grädel (2004b). Their distribution analyses across the whole settlement yielded truly remarkable results. The analysis of the rich faunal remains – about 70,000 bone fragments – resulted in an interesting division of the settlement. In the northern part, evidence of intense beef consumption was found, whereas in the southern part more pork was consumed. Remarkably, the differentiation of these settlement halves was also visible in the fish remains: while larger amounts of fish caught near the shore were found in the northern part of the settlement, open water species prevailed in the southern half (Hüster Plogmann 2004). Although the database for the fish (as well as for the botanical remains) is somewhat limited by the restricted sampling area (Leuzinger and Jacomet 2004: 35–39), the findings nonetheless support the results obtained from the large animal bones. The systematic recovery and recording of the animal remains during excavation corroborates the validity of these results. We shall not discuss the botanical remains here but it is noted that they also show an uneven distribution so that there are differing spectra of wild and domestic plant species in the individual houses (Hosch and Jacomet 2004). It is evident that there are individual differences between the houses, suggesting an internal pattern within the settlement. The premise that all houses functioned as identical self−sustaining units can therefore be rejected.

IN−DEPTH ANALYSES AT THE HOUSE LEVEL

Based on these results and the exceptional database of the Arbon Bleiche 3 site, we carried out in−depth analyses down to the level of individual houses. In order to simultaneously evaluate several variables and to detect similarities and differences in the multilayered data, we utilised the potential of correspondence analysis (Greenacre 1984, Shennan 1997). Details regarding the methodological approach as well as the complete data used are published elsewhere (Doppler 2013, see also Doppler et al. 2010, 2011).

In terms of the distribution of archaeozoological macroremains, the previously mentioned division of the settlement into a northern and a southern half should be noted (Fig. 3). Further differences also emerge in the distribution of sheep and goats, for example.

A notable number of goat bones are found in three adjoining houses in the northern part of the settlement. In the southern part, one house stands out for its emphasis on sheep bones. The picture becomes even more diverse when game animals are considered. These show marked concentrations in houses number 1, 8 and 20 in the northern part of the settlement (Fig. 3).

It is obvious that the picture becomes quite diverse when the different animal species are considered at the same time. These results indicate a wide mosaic of resources where different subsistence strategies and dietary habits become apparent not only in the northern and southern halves of the settlement, but also in individual houses.

Furthermore, differences not only relate to meat consumption but may also apply to the use of dairy products. Dairying has been established by the age structure of the milking animals and lipid analyses in pottery vessels (Deschler−Erb and Marti−Grädel 2004b, Spangenberg 2004). It is possible that the conspicuous proportions of cattle and goats in the northern sector of the settlement are associated with dairying, which can be considered an additional aspect of a broad subsistence diversity.

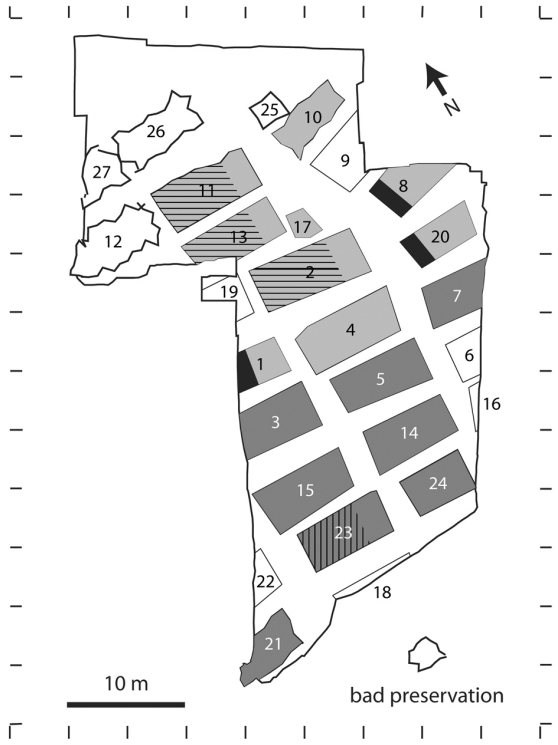

Fig. 3: Summarised results of correspondence analyses based on house units and large animal bones. The different shading indicates high amounts of bones from specific animals and illustrates the manifold mosaic of resources. Light grey = domestic cattle, dark grey = domestic pig, horizontal hatching = goat, vertical hatching = sheep, black = game animals. Calculations are based on fragment numbers published in Doppler 2013

THE BURNT LAYER: A VALUABLE SNAPSHOT

After highlighting this diverse resource use we would like to come back to the previously mentioned burnt layer that has been identified in Arbon Bleiche 3. This layer is the result of a fire which marked the end of the settlement. We can therefore distinguish two layers within the short, single−phase occupation (Leuzinger 2000: 153; 157). The burnt layer stretches over the whole of the excavated area suggesting, along with the abundance of the material recovered, that an accidental conflagration destroyed the entire settlement (Leuzinger 2000: 27). Even though the burnt layer cannot be precisely dated, we presume that it coincides with the period directly preceding the fire. This offers the possibility to contrast two phases, namely the snapshot captured in the burnt remains with the contents of the cultural layer accumulated during the 15−year occupation. This comparison is of special interest in light of the previously mentioned climatic situation in Arbon Bleiche 3, supposed to have deteriorated towards the final period of the settlement (Haas and Magny 2004, Maise 2005, Arbogast et al. 2006). By opposing the occupation layer and the burnt layer it becomes possible to investigate potential differences in animal bone spectra for the two periods. In an archaeological case study from Lake Zurich, Schibler et al. (1997c) were able to show that climatic stress may be a cause of intensified hunting activities. We tested this hypothesis for Arbon Bleiche 3, as a general increase of wild game was already noticed for the later phase of the cultural layer (Fig. 4). In order to visualise the results clearly, we utilise a variant of correspondence analysis which enables the use of passive variables (Thiessen et al. 1994, Greenacre 2007). This type of analysis makes it possible to illustrate two phases in the same profile space and search it for changes (Fig. 5).

In our case, we can investigate whether any changes occurred in the animal bone spectra in individual houses between the cultural layer (white boxes) and the burnt layer (black boxes). In the profile space such changes become visible by the changing positions of houses, hinting at changing strategies of food supply.

ANALYSES AND RESULTS

The comparison between the occupation layer and the burnt layer (Fig. 5) shows an obvious tendency towards a left shift of the houses, which indicates an obvious shift towards red deer (CerE) but also towards wild boar (SusS) and domestic pig (SusD).

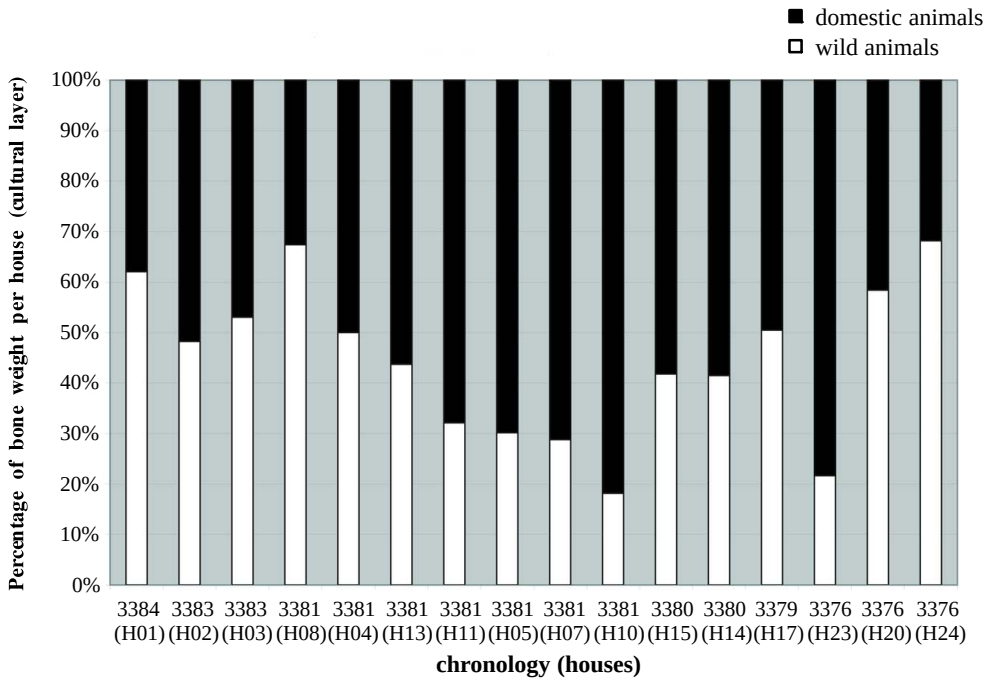

Fig. 4: Proportions by bone weight of domestic and wild animals per house in occupation layer. Houses are arranged chronologically, resulting in a wave pattern with increased proportions of game animals in the initial and terminal phases of the occupation. Game proportions in initial phase supposedly due to pioneer phase at time of settlement foundation (Doppler et al. 2010: 131). Analysis based on data published in Doppler 2013

This leads us to the conclusion that in some houses, intensification in hunting activities did occur during the last settlement period. Furthermore, it shows that red deer played an important role during this shift. There are, however, further conspicuous phenomena. Instead of an intensification in deer hunting, a few houses show a tendency towards an increase in wild boar hunting and possibly an intensification of pig breeding. Yet, other houses show neither of these reactions. This is most noticeable in houses 8, 11, 13 and 23. The fact that these houses seem to be, in part, associated with red deer or pigs in the profile space represents a problem of perspective, caused by the two−dimensional re−presentation of a multi−dimensional space (Fig. 5). Detailed analyses of the key statistical figures, which are central criteria for the evaluation of such analyses, show that these associations are non−existent. These conclusions can be interpreted further, in light of the aforementioned postulate that the climate deteriorated towards the end of the occupation phase (Haas and Magny 2004: 49), to see whether the results are compatible with or contradict such a scenario.

In order to explain our findings we shall return to the above noted mosaic of resource use and dietary strategies (Fig. 3). If we compare our observations with the settlement plan it becomes obvious that the houses exhibiting intensified red deer hunting are almost all found in the northern part of the settlement and are, therefore, houses with high proportions of cattle bones. One explanation might be that cattle are labour−intensive animals, the keeping of which requires favourable conditions and a lot of workpower (Schibler et al. 1997b: 347–49; Ebersbach 2002: 161–62; Deschler−Erb and Marti−Grädel 2004b: 245–46; Schibler and Jacomet 2010: 179). It is possible that these prerequisites were no longer given in the final period of the settlement and that those cattle resources had to be augmented by deer hunting.

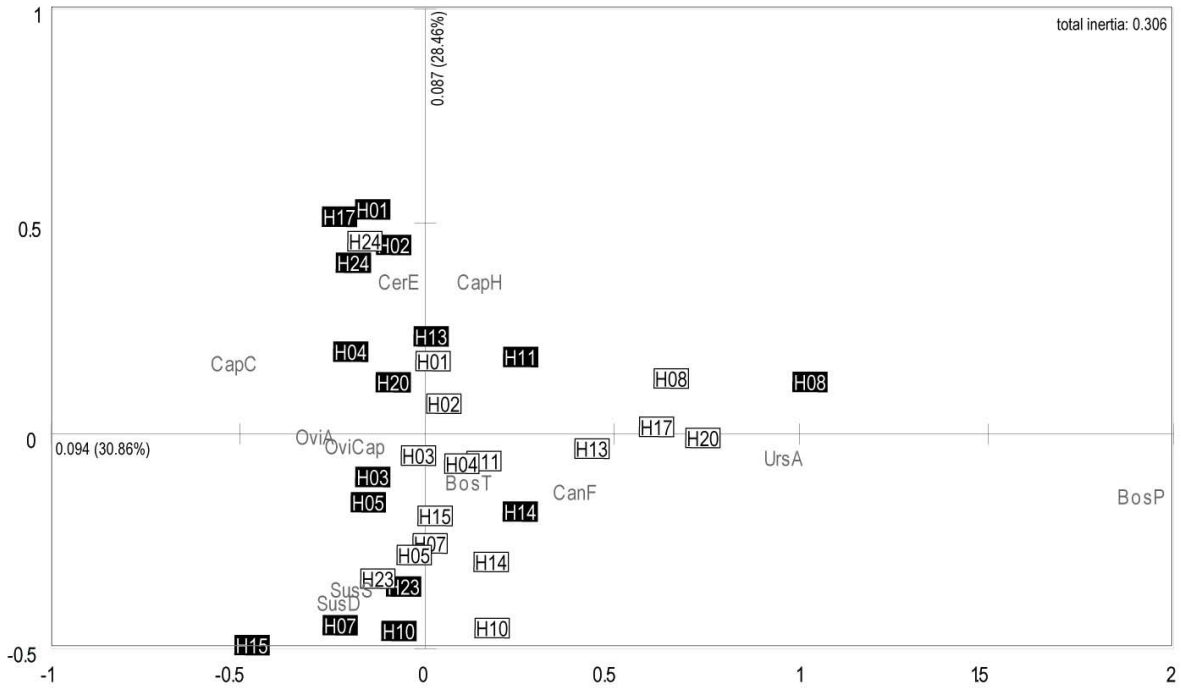

Fig. 5: Comparison by correspondence analysis of houses from burnt layer (black boxes) and occupation layer (white boxes) based on bone weight of domestic and selected wild animal species. Symmetric representation with houses of the occupation layer set as passive elements. BosT = domestic cattle, SusD = domestic pig, OviA = sheep, OviCap = sheep/goat, CapH = goat, CanF = dog, BosP = wild cattle, CerE = red deer, CapC = roe deer, SusS = wild boar, UrsA = brown bear. Total inertia: 0.306. The profile space illustrates the first and the second dimension which explain 59.3% of the variance in the data. Analysis based on data published in Doppler 2013

Interestingly, the houses without conspicuous red deer hunting activities are those which exhibit high proportions of sheep and goat bones – low maintenance animals that reproduce more quickly than cattle (Ebersbach 2002: 157–58). Our findings suggest that the houses with high amounts of ovicaprids could have been more resilient in the face of climatically induced problems and compensation by intensification of hunting might therefore have been unnecessary. In addition to the houses with the ovicaprids, house 8 in the north−eastern part of the settlement also does not show an increase in red deer hunting. This house has high proportions of wild animal bones throughout the duration of the settlement and has therefore already been identified as specialising in hunting (Deschler−Erb and Marti−Grädel 2004b: 251–52). During the last settlement phase, this house stands out for its brown bear and wild cattle remains (Fig. 5). Hunting these two rather dangerous species required skills the well−experienced inhabitants of house 8 must have certainly had. This correlates with the hypothesis put forward by Schibler and Jacomet (2010: 181), that hunting large game offered a way to compensate for low crop yields in periods of unfavourable weather conditions. Last but not least, one must mention the houses with high proportions of pig bones (Fig. 3). All of these houses in the southern part of the settlement do not exhibit a conspicuous increase in red deer hunting. Such an activity is, however, totally unnecessary, because pigs do not require strong labour efforts and reproduce quickly and in great numbers, so that climatically induced deficits may be compensated for relatively easily by an intensification of breeding efforts (Schibler et al. 1997b: 349–50; Ebersbach 2002: 158; Deschler−Erb and Marti−Grädel 2004b: 232; 246).

These results let us to conclude that there was a change in subsistence behaviour towards the end of the settlement. These changes seem, in our opinion, to concur with a period of unfavourable weather conditions which probably had an impact on crop yields (Schibler et al. 1997c: 568). Since cereal was assumedly the major calorie source during the Neolithic, it would have been necessary to compensate for crop failures. Ethnographic sources have already shown that turning towards an intensification of hunting and gathering is one possible alternative in such situations (Schibler and Jacomet 2010: 178–79). What is particular in the case of Arbon Bleiche 3, is that different changes can be observed in individual houses, which we have interpreted as different reactions to deteriorating climatic conditions: while a number of houses complemented or secured their subsistence bases by an intensification of red deer hunting, a few houses did so by intensifying wild boar hunting or pig breeding instead, with other houses exhibiting no changes at all.

In summary, one can state that changes in resource use should not only be analysed on a settlement level but must also be made on the level of individual houses. Using this approach, we can observe that the houses in Arbon Bleiche 3 exhibit a rich and diverse mosaic in resource use and dietary habits based on different subsistence strategies. This statement is in direct contradiction to a common paradigm declaring that all the houses within a given settlement follow uniform and identical subsistence strategies. For now, it is impossible to say whether the observed mosaic of resources in Arbon Bleiche 3 represents a general tendency in Neolithic lakeshore settlements, or whether this phenomenon only set in during the second half of the 4th millennium BC. Due to the limited areas excavated in settlements pre−dating Arbon Bleiche 3, the diversity of specific subsistence strategies may be difficult to assess. In spite of these difficulties, the results for our case study persist. If we presume a heterogeneous subsistence strategy, and if we further abandon the key concept of each house as an autarkic unit and postulate exchange among the houses instead – for which there is evidence in Arbon Bleiche 3 (Deschler−Erb and Marti−Grädel 2004a: 92; 2004b: 231), we can widen our view and formulate alternative hypotheses. One such hypothesis may state that the mosaic of resources presented here is characteristic of a broad−based subsistence which may have prevented the collapse of the entire settlement in times of distress.

Whether this resource mosaic is the result of a specific strategy to increase resilience in times of crises, or whether it is a chance development arising from the coexistence of different groups of people with different economies (Deschler−Erb and Marti−Grädel 2004b: 251), is yet to be discovered. The fact is that in either case, vulnerability during crises linked to food shortages would have been considerably reduced.

CONCLUDING REMARKS

When different, geographically separated sites synchronically show an increase in hunting activities during periods of unfavourable climate, it constitutes a strong argument for hunting being used to mitigate low crop yields (Arbogast et al. 2006). Of course, changes in subsistence strategies, especially an increase in hunting, do not necessarily have to be the result of climate alone. Crises, such as the one assumed for Arbon Bleiche 3, are in general a result of various factors, with climate being just one of them (Pétrequin et al. 2003: 61–62).

Demographic and social factors such as population increase, disease, settlement relocation and increased social competition can all result in an intensified use of wild resources (Hachem 2001: 96; Pétrequin et al. 2005: 165; Arbogast et al. 2006: 414; Billamboz et al. 2010: 281; Doppler et al.

2010: 131; Jeunesse 2010: 135; Schibler and Jacomet 2010: 173). Finally, religious or ideological aspects should also be considered (Politis and Saunders 2002: 125; Albarella 2006: 171–72; Pollard 2006: 136; Serjeantson 2006: 120–21). Each case study must therefore be considered and evaluated individually and carefully, especially since we are dealing with regional as well as temporal differences. We must anticipate complex and multifaceted objectives dependent on settlement locations, economic resilience, or even the strength of social networks (Arbogast et al. 2006: 404; Röder et al., this volume). The broad based subsistence strategy discussed in this paper and its ensuing resilience to climatically induced food shortages partly illustrates such a multifaceted system. Based on the animal remains, we also see that any economic strategy is imbedded in, and thus influenced by, a social and cultural context. Taking these aspects into account can stimulate research, as was the case when climate began to be considered as a decisive historical factor. This development has considerably enriched and furthered wetland archaeology. Indeed, the way in which this changed our perspective of prehistoric subsistence strategies must certainly be emphasised. The previously accepted picture of a static subsistence strategy was put aside, as archaeologists realised that past populations evolved in a dynamic environment, where measures could be consciously taken to manipulate existing strategies, and adapt to varying needs and situations. We may therefore corroborate the statement of Arbogast et al. (2006: 415) that "the extraordinarily good preservation of the Neolithic lake dwellings, together with the possibility of precise dendrochronological dating is one of the most powerful instruments with which the relationship between climate, economy, environment and human culture can be highlighted." In this sense, Arbon Bleiche 3 can be considered a model case for such analyses.

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