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## The Department for Bioarchaeology at the Austrian Archaeological Institute (ÖAI), Austrian Academy of Sciences (ÖAW)

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### ABSTRACT

Bioarchaeological research in Austria has largely been characterised by the lack of institutionalisation for nearly a century. In contrast to the long tradition of biological anthropology research facilities, archaeobotanical and archaeozoological positions only became established in a period from the 1970s till the early 1990s. Forming a cornerstone of the Austrian Archaeological Institute's integration process into the Austrian Academy of Sciences, the establishment of ÖAI's Department for Bioarchaeology in 2016 marks the first time in 40 years that such a bioarchaeological research unit has been successfully established as new. The department unites researchers in archaeobotany, archaeozoology and biological anthropology under the same roof, and is embedded into the research infrastructure of the country's largest non-university research institution.

## 1. Introduction

The ÖAI has a strong technical-scientific emphasis, currently represented by the research fields of bioarchaeology and geoarchaeology, as well as material sciences and archaeometry. What distinguishes the ÖAI from other research institutions with biological anthropology, archaeozoology or archaeobotany, is the licenced excavations, which are organised as long-term research platforms, and are open to both national and international cooperation partners. This creates a dynamic relationship between the archaeological sciences and archaeological excavation, permitting archaeologists and specialists the opportunity to integrate their work from the field to the laboratory. After its foundation in 1898 (Kandler and Wlach, 1998), the ÖAI has seen a significant increase in interest in bioarchaeological research, mainly over the last sixty years. This is expressed by a number of co-operations with external researchers and institutions which has been published in detail by M. Binder *et al.* (2018).

## 2. Foundation of the department

Continuing its long tradition of research, and after several changes of affiliations, the ÖAI became an institute of the Austrian Academy of Sciences (ÖAW) in 2016, embedded into the Research Cluster of Archaeology and Classics (CIAC). It was decided that a main focus of the future Academy institute should be the establishment of an in-house bioarchaeology unit, making its foundation one of the core elements of the integration contract. In October 2016, the Department of Bioarchaeology was finally established at the ÖAI (Binder *et al.*, 2018).

Albeit considered a standard constellation in many other countries, in Austria the integration of archaeobotanical, archaeozoological and biological anthropological expertise under the roof of an archaeological research institution has never been established. This is even more surprising as the Austrian traditions of ancient studies and of archaeology have always been based on interdisciplinarity.

The underlying philosophy of the ÖAI's new department is the fostering of a problem-centred approach towards research questions of cultural anthropology: one that transcended

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disciplinary and methodological borders. Aside from the positive effects on communication and cooperation between the Department for Bioarchaeology and all historical-cultural units of the institute, synergies with the Department for Restoration and Conservation have proven to be extremely beneficial, due to the exchange of ideas, the possibility of supporting bioarchaeological work and archiving with the latest material knowledge, and the general optimization of workflows. This fact ensures a high degree of efficiency in the development and implementation of bioarchaeological and prehistorical and historical research aspects and strategies. Cross-disciplinary collaborations within the institute have led to rather unexpected and extremely useful outcomes, one of them being the generation of photogrammetric models of charred organic food remains (Heiss *et al.*, 2019b; 2019c).

The Department for Bioarchaeology encompasses three Research Groups (RG): RG Anthropology and Necropoleis, RG Archaeozoology, and RG Archaeobotany. In contrast to other institutions, the department is decidedly not intended as a mere biosciences service centre (or “Core Facility” as termed in Austrian academia). Quite the contrary, aside from the close integration into the ÖAI’s excavations with a focus on classical archaeology, the department’s three research groups have their own distinct diachronic and interdisciplinary research agendas. While there is more information on the ÖAI website regarding the research groups (see below for links), we will present some of the research underway at the Department for Bioarchaeology by geographical area.

### 3. Geographical areas of research

#### 3.1 Central Europe

A major highlight is the role of the ÖAI in the joint efforts to reinstate the Austrian research of prehistoric lakeshore settlements (UNESCO World Heritage “Prehistoric Pile Dwellings around the Alps”), fostered and directed by the *Kuratorium Pfahlbauten* and the Federal Museum of Upper Austria (Heiss and Jakobitsch, 2018). Within the framework of the projects “*Zeitensprung*” and “*Beyond Lake Villages*” (FWF I-1693), plant remains from underwater excavations and hinterland settlements are being analysed, with the goal of reconstructing settlement activity, economy, nutrition, and land use patterns of the Neolithic settlers (Jakobitsch *et al.*, 2019a). This research is being complemented by the investigation of late Neolithic food remains from Austrian, Swiss and southwest German lakeshore settlements (Heiss, 2017b; Heiss *et al.*, 2017a; Heiss *et al.*, submitted), and extensive studies into Neolithic fishing economies of the same region (Galik, 2009). The latter has been a desideratum for a long time as evidence for prehistoric fishing is still rare, and new data are dearly needed (Galik, 1999; 2008a; 2008b; 2013; Galik *et al.*, 2015; Galik and Küchermann, 2008; Galik *et al.*, 2011; Haidvogel *et al.*, 2013; Ilon *et al.*, 2017; Yurtseva *et al.*, 2013; Yurtseva *et al.*, 2015). A project which has recently started, combines archaeobotanical,

archaeoichthyological and palaeohygienic research in the investigation of dog faeces from pile dwellings in the Neolithic pile dwelling settlements Črnelnik and Stare gmajne in the Slovenian Ljubljansko barje, highlighting the role of fish in domestic dogs’ diet (Tolar and Galik, 2019). The history of fisheries and fishing generally marks a strong research interest in A. Galik’s work. It is a topic that is heavily influenced by methodological choices, as the usually very small fishbones are regularly overlooked when only handpicking is applied in excavations instead of dry- or wet-sieving of sediment samples (Bartosiewicz, 1988; De Cupere *et al.*, 1995; Schmölcke and Heinrich, 2006). As a local research starting point, historical fishing and exploitation behaviour in Austria and other countries can be defined, but the limits are not set to historical areas. Research initiatives into these materials are also being made in all other areas of activity of the ÖAI.

The Bronze Age settlement in Drasenhofen, Northern Lower Austria, has been recently published (Galik *et al.*, 2019). Incorporated into this was an archaeozoological analysis which demonstrated that animal protein was certainly supplied to the local populace through the slaughtering of domesticated animals, with cattle, sheep and goat the most important. While hunting was obviously less important, exploitation of aquatic resources is evidenced by the presence of fish remains and various freshwater mussel species. It was particularly interesting to observe the frequent presence of so-called “sledge runners”, which are worked animal bones, mainly made of the radii of various mammalian species. Dietary habits, resource management, and spatial organisation of industrial processes are currently under investigation at the Late Bronze Age mining site of Priggglitz-Gasteil in Lower Austria (FWF P 30289). The Department of Bioarchaeology is mainly involved in the investigation of the procurement strategies for timber, fuel wood, and food (Jakobitsch *et al.*, 2019b; Trebsche *et al.*, 2019; Wiesinger *et al.*, 2019).

The large La Tène period lowland settlement of Haselbach is part of the research focus of a long-term research project directed by S. Fichtl (Université de Strasbourg) and P. Trebsche (University of Innsbruck). RG Archaeobotany is involved in the analysis and evaluation of the high resolution microstratigraphical and archaeobotanical sampling (Heiss and Wiesinger, 2018b), and is aimed at elucidating local agricultural economy, and its spatial organisation.

Our anthropological research has begun to contribute to the archaeology of the eastern Alpine region, where it was, until now, rare for cemeteries to be comprehensively studied. The project “*Life in times of change*”, financed by a Hertha-Firnberg scholarship of the FWF, awarded to M. Binder, is dedicated to research on the living conditions in the Eastern Alps at the transition between Late Antiquity and Early Middle Ages (5<sup>th</sup>/6<sup>th</sup> century AD), based on the human skeletal remains from the two neighbouring cemeteries of Hemmaberg and Globasnitz in southern Carinthia. Recording of the osteobiographical data is being carried out by M. Srienc, along with several students in the bioarchaeological

**Figure 1.** Biological anthropologist M. Srienc.  
 Image: ÖAW-ÖAI/N. Gail.



research laboratory of the ÖAI. In correlation to this project, excavations which are being conducted by the ÖAI at Jaunstein/Podjuna in southern Carinthia, are adding to the human skeletal evidence for life and lifeways in the Eastern Alps. The anthropological analysis of the skeletal material from this site will be directly comparable to that from Globasnitz and Hemmaberg, and will form a portion of the PhD research of M. Srienc. In an associated project, the unknown saint excavated at Hemmaberg in 1992, whose skeleton is in a reliquary shrine below the altar of one of the churches of the pilgrimage shrine, was also investigated in a multidisciplinary project. This has now been published in a book (Binder and Ladstätter, 2018). In co-operation with project leader J. Eitler, the project “Cult continuity at the summit of the Hemmaberg” (FWF – 29452-G25) started 2017, and follows the research tradition of the Institute, but

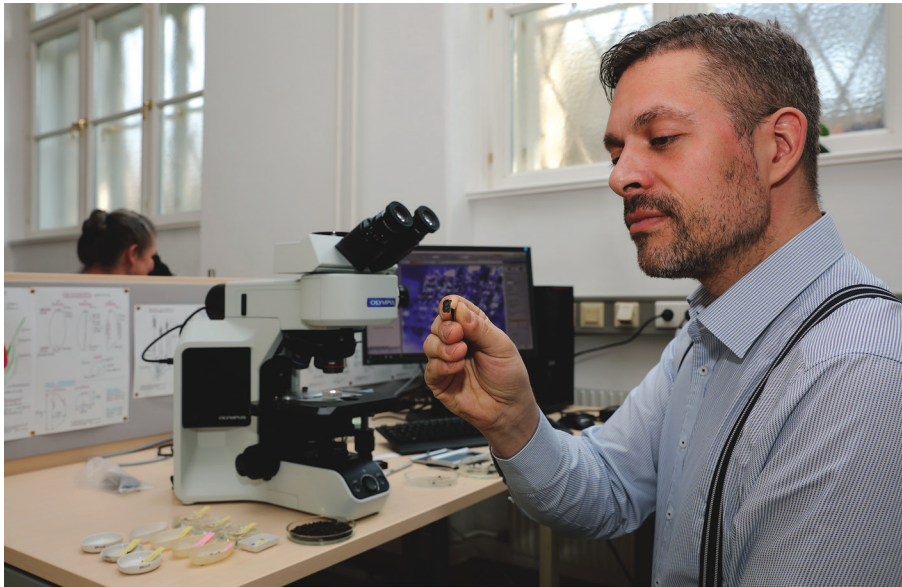
also incorporates significant bioarchaeological research to understanding this complex, multi-period site (Binder *et al.*, 2016; Forstenpointner and Gernot, 1999; Gaggli, 1996; Galik *et al.*, 2018; Heiss, 2018). This integrated research has acquired a unique position in Austria, with a close co-operation with the Federal Monuments Office, as well as with regional museums, and has provided a wealth of new information on this site, from the Bronze Age through the Medieval period. In addition to these site-specific research projects, a joint project between the University of Warsaw and the ÖAI is being developed, which aims to understand the connection between the Roman road system and early medieval migration.

In another “cult project”, the investigation of archaeozoological finds from a Mithras cave at Gradišče,

**Figure 2.** Archaeozoologist A. Galik.  
 Image: ÖAW-ÖAI/N. Gail







**Figure 3.** Archaeobotanists S. Wiesinger and A. G. Heiss. Image: ÖAW-ÖAI/N. Gail.

near St. Egyden, started in 2017 in cooperation with P. Gleirscher (Federal Museum of Carinthia) and C. Hinker (ÖAW-ÖAI). Both the archaeological finds and the archaeozoological remains make the interpretation of the site as a Mithras sanctuary highly probable. The Department of Bioarchaeology is contributing to a number of Roman period projects within Austria; these specifically concern Roman provincial archaeology, and contribute to this often peripheral sphere of research of the wider Roman Empire through time.

First, we have the archaeozoological analysis of the animal remains from *Brigantium*. The results of this analysis allow the reconstruction of the diet in a Roman military camp and the succeeding civil town of *Brigantium*. The project is carried out in cooperation with G. Grabherr of the Univ. Innsbruck as part of an FWF project (P23777). A second project is dedicated to the animal remains from Amphitheater I in *Carnuntum*. Most of the remains represent domestic animals, which were certainly waste deposits. However, bones of large predators such as bear or big cat could represent remains from animals that were killed during Late Antiquity animal fights in the Amphitheatre. This project is carried out with P. Scherrer from Karl-Franzens-Univ. Graz, and the Archaeological park of *Carnuntum*. A project on the rural economy in the southern part of the Roman province of *Noricum*, in southern Austria, is in preparation (Heiss and Wiesinger, 2018a; Hinker *et al.*, in print). Finally, in southern *Noricum*, at the necropolis of the capital city of *Virunum*, a Roman cemetery is being contrasted with those of Late Antiquity and of the Middle Ages in the same region. Anthropological assessment of the cremations and inhumations of this well-excavated and chronologically-detailed site will provide great potential for the in-depth discussion of provincial Roman research questions. By means of these approaches, fundamental information concerning living conditions, as well as questions regarding

the late Roman-early Medieval migration movements are expected.

Diachronic research is underway at the ÖAI within the framework of the ongoing ERC Project PLANTCULT (PI: S. M. Valamoti, Aristotle University of Thessaloniki; GA 682529; see Valamoti *et al.*, 2017). This wide-reaching and important project is dedicated to the analysis of central European archaeologically-derived finds of processed cereal-based foodstuffs, in order to elucidate their components and the *chaînes opératoires* of their production (Heiss *et al.*, 2019a; Heiss *et al.*, 2017a; Heiss *et al.*, submitted; Heiss and Gail, 2019). Another core research goal of this project is the development of a standardised methodological toolkit for the analysis and interpretation of this often neglected find category (Heiss, 2019a). Another diachronic study underway is the massive archaeobotanical material campaign for 36 archaeological sites in southern Austria, which has recently been finalized in the Interreg-SI-AT PalaeoDiversiStyria (Kiszter *et al.*, 2017). These data will serve as a solid basis for future palaeoenvironmental research initiatives in the region.

### 3.2 Eastern Mediterranean

With on-going excavations and a long research history, Ephesus provides an exceptional opportunity for integrated research from the field to the laboratory for a wide-range of topics, themes, and analyses. Excavations and scientific research have been on-going at the site since 1895, and include an ever-increasing international team of collaborators in association with the Turkish Cultural Assets and Museums Department. The site provides the opportunity for diachronic research, along many avenues, but it is perhaps anthropology which has benefited the most from this *longue durée* of occupation. For the first time, anthropological data from the Bronze Age up to the Ottoman period is available from a key antique site; and further, it can be referenced

**Figure 4.** A look into the botanical reference collection. Image: ÖAW-ÖAI/N. Gail.



with environmental data (see below). The spectrum of the research extends from the creation of individual biographies on the basis of anthropological assessment, to DNA and isotope (carbon, nitrogen, sulphur and strontium) analyses, and the intra- and inter-site comparisons with other central settlements in the ancient world. The comprehensive research strategy at Ephesus represents a key component of understanding the ways of lives of the inhabitants of Ephesus over time, there being three projects presently underway: the analyses of the topography of the necropoleis; tomb architecture and the treatment of the sarcophagi and ostotheke; and studies of nutrition, mobility and living conditions (Steskal *et al.*, 2015).

Essential to understanding the experiences of the Ephesians over time is, of course, research into their diet, consumption, and environment. In these regards, research at the Department of Bioarchaeology is providing key new findings through the on-going archaeozoological and archaeobotanical research. Archaeozoological data has long been collected at Ephesus, to varying degrees, and this provides great research potential for analysis of the diachronic data from the local and wider Ephesian areas, which has evidence of settlement from the Neolithic to the Middle Ages. This metadata offers important information permitting the investigation of cultural-historical and socio-cultural developments, including changes in animal husbandry, and the diet of the inhabitants. The use of domestic animals and the changing environmental conditions are being researched to complement the geoarchaeological and geomorphological investigations (Ehlers *et al.*, 2014; Stock *et al.*, 2016; Stock *et al.*, 2013), which includes investigating the composition of the local wildlife fauna, especially molluscs. Understanding fishing practices at the Mediterranean shores through time is of significant interest, and has already provided highly promising diachronic data, which is especially fascinating in combination with data obtained from Aegean archaeo-ichthyofaunal literature

(Bar-Yosef Mayer and Zohar, 2010; Galik *et al.*, 2010; Mylona, 2008; 2013; Powell, 1996; Theodoropoulou, 2017a; 2017b).

The archaeobotanical research at Ephesus has also benefited from the *longue durée* approach to excavation and analyses at the site. The recently completed project, “Pollen aus Ephesos” (OeNB 17134), has provided high-resolution geoarchaeological and palaeoenvironmental – palynological, palaeoparasitological, chemical – data from the harbour basin in Ephesus, as well as reference data from a less-disturbed habitat in the Ephesus region (Schwaiger *et al.*, 2018). Interdisciplinary integration of these datasets with the archaeological and historical records has just begun (Heiss *et al.*, 2017c; Ladstätter, 2018), but promises to provide further information on the environment of ancient Ephesus and its impact on the inhabitants. On-site plant remains are the major data source for the analysis of the high-resolution sampling carried out at the Late Antique city quarter to the south of St. Mary’s Church. The first results from charcoal analysis suggest new insights into the forestry and timber economy of Ephesus, as well as trade relations (Heiss, 2016; Heiss *et al.*, 2017b).

Further work within the region and surrounding areas is focused on tracing one of the most persistent and deadly diseases in human antiquity, malaria. This project, awarded to M. Binder in 2016 and funded by the Innovation Fund of the Austrian Academy of Sciences (IF\_2015\_12), with the title “Tracing 3000 years of Disease History” is currently in its final stages, coordinated by M. Gamble. The project, in cooperation with the Medical University of Vienna and the Institute for Mummy Research, EURAC, Bolzano, selected human tooth and bone samples from Roman to early medieval sites in Lebanon, Cyprus, Egypt, and Austria, to search for the presence of the malaria pathogen *Plasmodium falciparum*. The aim of the project is to improve the biomolecular methods, primarily immunoassays and aDNA,

used to identify malaria in the past, and discuss the contextual investigation of the effects of malaria on historical and cultural processes in Europe and the Mediterranean region.

### 3.3 Balkans peninsula and continental Greece

A project based at the ÖAI since 2018 is dedicated to the question of transformations in the material culture, and also to the issue of burial customs in early Iron Age Greece and their ties to the Balkan region. This project is on-going with existing agreements in place with partners in Serbia, Kosovo and Albania. S. Gimatzidis has led a team examining ‘Death and Burial Between the Aegean and Balkans’ in the Iron Age, funded by the FWF (P 30475). This multi-disciplinary study takes anthropological data as a key element in the interpretations regarding social change and hierarchy during this transitional period. Biological sex, as well as family and other kin relationships of individuals from selected necropoleis, along with strontium isotope analyses are being conducted to understand the social organisation of the local communities.

The long-term research activities of the ÖAI in eastern Achaia (northern Peloponnese) have resulted in immense amounts of available bioarchaeological study materials, in particular at the late Bronze Age coastal site of Aigeira (Forstenpointner *et al.*, 2006; Heiss, 2017a; Schachl, 2006). Together with the inland high-altitude site of Lousoi (Baier *et al.*, 2019; Heiss, 2019b), and the inland river-valley sites of Leontion and Kynaitha/Kalavryta, Aigeira will form one of the focal points of a planned interdisciplinary research project.

## 4. Department facilities

The ÖAI operates the largest archaeological library in Austria, and has extensive archives and collections at its disposal, available to researchers and students. The Department of Bioarchaeology additionally harbours a digital collection of c. 11,000 offprints and books. These resources are available for scholars at the ÖAI, along with the laboratories which have been established at the Institute in the last few years, and are continually growing and improving.

The anthropological laboratory was established in 2015 at the ÖAI in Vienna and provides a well-equipped space for researchers to carry out their macroscopic and microscopic analyses. There is an extensive reference library and comparative material for bone and tooth identification. The laboratory has facilities for cleaning and processing human skeletal material for analysis, aided by the close proximity of the conservation and restoration department. The ÖAI currently curates a large collection of skeletal material from the excavations at Globasnitz and Hemmaberg (Carinthia, Austria), alongside skeletal material from its excavations at Jaunstein in Vienna. The application of more complex analytical methods such as biomolecular investigations (stable isotopes, aDNA) or visualisations (SEM, X-ray, CT) is made possible through co-operations with external institutions.

An archaeozoological research laboratory with broad comparative collections was established at the ÖAI in Vienna in 2016. It is equipped with magnifier lamps and one SZX stereo microscope (magnifications up to 63-fold), which come with a high-resolution digital camera (Olympus UC90). Previously, in 2015, another laboratory and extensive comparative collection was set-up, in cooperation with the Institute of Topographical Anatomy of the University of Veterinary Medicine, Vienna, to aid in faunal identification work at the field laboratory of the ÖAI in Selçuk/Ephesus. Such reference collections are indispensable for the daily archaeozoological identification of animal remains, and they can also be used for the education and training of students. The bone collection at the ÖAI also contains various marine and freshwater fish species which are used for the identification of archaeological fish remains.

In early 2017, a fully-equipped archaeobotanical laboratory was established at the ÖAI in Vienna, embedded within the infrastructure of the Department of Restoration and Conservation. Our in-house faculties cover macrofloral analysis (of various plant materials in charred, mineralised, desiccated, and waterlogged state), as well as histological methods, applied to processed food remains and wood/charcoal analysis. The laboratory working spaces are equipped with a high-resolution digital camera (Olympus UC90), two Olympus SZX stereo microscopes, which are available for macrofossil analysis, and an Olympus BX53 microscope with transmitted and reflected light options (bright field, dark field, magnification up to 50-fold) for histological identifications of wood, charcoal, plant epidermises, and processed foodstuffs. Flotation devices are available for fieldwork, and our wet lab also allows for indoor bucket flotation. Charring experiments can be conducted with a Nabertherm L 5/13/B410 muffle furnace. The botanical reference collection is based on the materials from A. G. Heiss’ collection activities during the past 15 years, supported by close cooperation and exchange agreements with the University of Innsbruck, the University of Vienna, the University of Applied Arts Vienna, BOKU Vienna, the Natural History Museum Vienna (NHM), the University of Hohenheim, and the KU Leuven. The bulk of the collection currently comprises c. 3,400 specimens of seeds and fruits mainly of central European and Mediterranean plants. These are complemented by special collections of woods (c. 200 specimens) and mosses (c. 100 accessions). Archaeobotanical materials from archaeological excavations in central Europe and the Mediterranean are stored at the ÖAI depending on the agreements with the respective excavating institutions.

## 5. Integration, outreach and future interdisciplinary research

While the Department of Bioarchaeology at the ÖAI is still in its infancy, it is already showing the benefits of having an integrated biological sciences department within an



Figure 5. Institute logo.



archaeological research institute. Within this framework, archaeologists and specialists are able to collaborate to improve excavation and sampling which allows for the consideration of complex, problem-oriented research questions, which further elucidate the past. Through the incorporation of anthropology, archaeozoology, and archaeobotany, the ÖAI is discussing a wide-range of socio-cultural, socio-economic, and historical-biological themes relating to diet, environment, trade, social stratification, landscape and land-usage, health, disease, and many other topics in the past. Through the Research Groups' thematic approaches, data from a variety of sources can be integrated to provide a more nuanced understanding of lives, lifeways, and environment in the past.

Within each discipline, our current research projects cover the diachronic investigation of subsistence economies, crop choices and agricultural and animal management regimes, likewise of food choices and cuisine in central Europe and the Mediterranean. This explicitly ties in with the analyses of human remains through stable isotope and palaeopathological research, and contributes to a more detailed picture of past populations. Collaborations with external partners in geoarchaeology and palynology provide proxy data on landscape dynamics, climate and vegetation history, and help build the environmental framework of ancient settlements, which in turn impacts on the understanding of the archaeozoological remains of these settlements and land-use, and the lifeways of the people living there. This intersection of biology and culture is key to determining socio-cultural aspects such as socio-economic position, identity, ethnic affiliation, and religious beliefs or cosmology of an individual (or of a community).

A long-term goal is to intensify national and international collaborations in order to establish the department as a scientific hub for bioarchaeological research in ÖAI excavations, as well as in projects of partner institutions. The Department is part of the ÖAI's strategy of disseminating and establishing high-standard interdisciplinary research methods in Austria's classical archaeological research. Our innovative strength is, to a large extent, based on our international networks – resulting in collaborations with experts in palynology, ancient DNA, stable isotopes, biomolecular archaeology, parasitology, geochemistry and geoarchaeology – and on the integration of scientific methods into Prehistoric, Classical and Byzantine archaeology.

The Department of Bioarchaeology at the ÖAI is very keen to support education and training within the respective

disciplines. There is the possibility of internships in the bioarchaeological laboratories of the ÖAI and support for Masters and PhD students undertaking research associated with ÖAI projects. The Department strives for the increased integration of specialists on archaeological excavations as well as a better understanding and awareness of the professional handling of human remains in the field.

## 6. Further reading on the web

### Annual Reports of the Austrian Archaeological Institute:

<https://www.oeaw.ac.at/en/oeai/public-relations/annual-reports/>

### The Department for Bioarchaeology and its Research Groups:

<https://www.oeaw.ac.at/en/oeai/institute/units/bioarchaeology/>

- **Anthropology and Necropoleis:**  
<https://www.oeaw.ac.at/en/oeai/research/anthropology-and-necropoleis/>
- **Archaeozoology:**  
<https://www.oeaw.ac.at/en/oeai/research/archaeozoology/>
- **Archaeobotany:**  
<https://www.oeaw.ac.at/en/oeai/research/archaeobotany/>

### The Department for Bioarchaeology on ResearchGate:

<https://www.researchgate.net/lab/Department-of-Bioarchaeology-Alfred-Galik>

## References

- BAIER, C., UGARKOVIĆ, M., and TRINKS, I., 2019. Neue Forschungen zu der stadträumlichen Organisation von Lousoi. Die Arbeiten der Jahre 2015 bis 2018. *Jahreshefte des Österreichischen Archäologischen Institutes in Wien*, 87, 19–59.
- BAR-YOSEF MAYER, D.E., and ZOHAR, I., 2010. The role of aquatic resources in the Natufian Culture. *Eurasian Prehistory*, 7(1), 29–43.
- BARTOSIEWICZ, L., 1988. Water sieving experiment at Örménykut, Site 54. In: M. Járó and L. Kóltó, eds. *Archaeometrical research in Hungary*. Budapest: National Centre of Museums, pp. 267–273.
- BINDER, M., EITLER, J., DEUTSCHMANN, J., LADSTÄTTER, S., GLASER, F., and FIEDLER, D., 2016. Prosthetics in antiquity – An early medieval wearer of a foot prosthesis (6<sup>th</sup> century AD) from

- Hemmaberg/Austria. *International Journal of Paleopathology*, 12, 29–40. doi:10.1016/j.ijpp.2015.11.003.
- BINDER, M., GALIK, A., and HEISS, A.G., 2018. Bioarchäologie am Österreichischen Archäologischen Institut. Neue Wege in der interdisziplinären Erforschung archäologischer Stätten. *Jahreshefte des Österreichischen Archäologischen Institutes in Wien*, 86, 11–31.
- BINDER, M., and LADSTÄTTER, S., eds., 2018. *Die Heilige vom Hemmaberg – Cold Case einer Reliquie*. Wien: Holzhausen.
- De CUPERE, B., LENTACKER, A., and WAELKENS, M., 1995. Sieving experiments in the Lower Agora and their implications for the interpretation of archaeozoological data from Sagalassos. In: M. Waelkens and J. Poblome, eds. *Sagalassos III. Report on the fourth excavation campaign of 1993*. Leuven: Leuven University Press, pp. 367–377.
- EHLERS, L., STOCK, F., HOREJS, B., and BRÜCKNER, H., 2014. Reconstructing the Palaeogeographies of a Neolithic – Bronze Age Settlement Mound at Ephesos, Turkey. *Geophysical Research Abstracts*, 16, 2014-2692-2011.
- FORSTENPOINTNER, G., and GERNOT, G., 1999. Rinderzucht am Beispiel des Hemmaberges. *Beiträge zur Mittelalterarchäologie in Österreich*, 15, 123–137.
- FORSTENPOINTNER, G., PUCHER, E., WEISSENGRUBER, G., and GALIK, A., 2006. Tierreste aus dem bronzezeitlichen Aigeira – Befunde und funktionelle Interpretationen. In: E. Alram-Stern and S. Deger-Jalkotzy, eds. *Aigeira I. Die mykenische Akropolis. Faszikel 3*. Wien: Österreichische Akademie der Wissenschaften, pp. 171–188.
- GAGGL, G., 1996. *Tierknochenfunde aus dem spätantiken Pilgerheiligtum auf dem Hemmaberg*. Unpublished thesis (PhD.), Veterinärmedizinische Universität Wien.
- GALIK, A., 1999. Fischreste aus mittelalterlichen bis neuzeitlichen Fundstellen: Bedeutung und Aussagekraft dieser kleinen archäozoologischen Funde. *Beiträge zur Mittelalterarchäologie in Österreich*, 15, 197–206.
- GALIK, A., 2008a. Die Fischreste. In: P. Trebsche, ed. *Die Höhengiedlung "Burgwiese" in Ansfelden (Oberösterreich). Ergebnisse der Ausgrabungen von 1999–2002*. Linz, pp. 307–315.
- GALIK, A., 2008b. Fischreste. In: E. Cichy, ed. *Der Siedlungsplatz Hamm-Westhafen*. Mainz: Philipp von Zabern, pp. 185–191.
- GALIK, A., 2009. Die Bedeutung des Fischfangs in der Horgener Seeufersiedlung Wallhausen-Ziegelhütte am Überlinger See. In: *Tauchsondagen und Rettungsgrabungen unter Wasser in der jung- und endneolithischen Seeufersiedlung Wallhausen-Ziegelhütte, Kreis Konstanz. Archäologische und naturwissenschaftliche Beiträge*. Freiburg im Breisgau: Janus, pp. 138–144.
- GALIK, A., 2013. Die frühkaiserzeitlichen Fischreste von der Keplerwiese in Linz. In: E.M. Ruprechtsberger and O.H. Urban, eds. *Vom Keltenschatz zum frühen Linze. Begleitband zur Ausstellung "Vom Keltenschatz zum Frühen Linze" im NORDICO Stadtmuseum Linz, 8.2.–20.5.2013*. Linz: NORDICO Museum der Stadt Linz, pp. 79–82.
- GALIK, A., EMRA, S., and PACHER, M., 2019. Die tierischen Überreste aus der frühbronzezeitlichen Siedlung bei Drasenhofen. In: K. Fiebig and A. Csaplaros, eds. *Trassenarchäologie 3*. Pöttelsdorf: Eigenverlag, pp. 60–69.
- GALIK, A., FORSTENPOINTNER, G., and WEISSENGRUBER, G.E., 2010. The expression of demand for particular fish food implied by aquatic facilities in living areas of noble households. In: S. Ladstätter and V. Scheibelreiter, eds. *Städtisches Wohnen im östlichen Mittelmeerraum 4. Jh. v. Chr. – 1. Jh. n. Chr. Akten des internationalen Kolloquiums vom 24.–27. Oktober 2007 an der Österreichischen Akademie der Wissenschaften*. Wien: Österreichische Akademie der Wissenschaften, pp. 667–674.
- GALIK, A., HAIDVOGL, G., BARTOSIEWICZ, L., GUTI, G., and JUNGWIRTH, M., 2015. Fish remains as a source to reconstruct long-term changes of fish communities in the Austrian and Hungarian Danube. *Aquatic Sciences*, 77(3), 337–354. doi:10.1007/s00027-015-0393-8
- GALIK, A., HEISS, A.G., and LADSTÄTTER, S., 2018. Das Holzkästchen. In: M. Binder and S. Ladstätter, eds. *Die Heilige vom Hemmaberg – Cold Case einer Reliquie*. Wien: Holzhausen, pp. 115–121.
- GALIK, A., and KÜCHELMANN, H.C., 2008. Fischreste aus der mittelalterlichen Bremer Altstadt. *Bremer Archäologische Blätter – Neue Folge*, 7, 215–231.
- GALIK, A., SCHNEIDER, M.T., and FORSTENPOINTNER, G., 2011. Die tierischen Überreste aus einer spätmittelalterlichen Latrine im Augustiner Chorherrenstift in St. Pölten. In: R. Risy, ed. *Da steh i drauf! St. Pölten Domplatz 2010. Eine archäologische Zwischenbilanz*. St. Pölten: Stadtmuseum St. Pölten, pp. 91–103.
- HAIDVOGL, G., GALIK, A., and PONT, D., 2013. Vers une histoire de la biodiversité piscicole du Danube autrichien: apports croisés des sources archéologiques et écrites. In: F. Guizard, J. Heude, and C. Beck, eds. *Eaux de la vie : pour une histoire de la biodiversité des cours d'eau (13<sup>e</sup> rencontres internationales de Liessies)*. Villeneuve-d'Ascq: Université de Lille, pp. 131–142.
- HEISS, A.G., 2016. Auf dem Holzweg durch die Spätantike? Erkenntnisse zu den Nutzhölzern in der Residenz in Ephesos / Woodworking Ways in Late Antiquity – Insights on Timber Use in the Residence in Ephesus. *Forum Archaeologiae*, 78(3).
- HEISS, A.G., 2017a. *Internes Working Paper zur archäobotanischen Bearbeitung der spätbronzezeitlichen Siedlung von Aigeira, Achaia*. Wien.
- HEISS, A.G., 2017b. Vom "Urknödel" zur "Ursemmel"? Annäherung an ein museales Brotobjekt. *Mitteilungen des Heimatbundes Mondseeland*, 207, 4–5.
- HEISS, A.G., 2018. Die Holzkohlen aus der Reliquiengrube. In: M. Binder and S. Ladstätter, eds. *Die Heilige vom Hemmaberg – Cold Case einer Reliquie*. Wien: Holzhausen, 109–114.
- HEISS, A.G., 2019a. *Fifty Shapes of Grain. New archaeobotanical approaches towards charred finds of processed cereal-based foods. I. Rahmenschrift und Original Papers*. Unpublished habilitation thesis, Universität für Bodenkultur Wien.
- HEISS, A.G., 2019b. *Vorbericht zu den archäobotanischen Materialien aus der Grabung Lousoi, Achaia*. Wien.
- HEISS, A.G., ANTOLÍN, F., BERIHUETE AZORÍN, M., BIEDERER, B., ERLACH, R., GAIL, N., GRIEBEL, M., LINKE, R., LOCHNER, M., MARINOVA, E., OBERNDORFER, D., STIKA, H.-P., and VALAMOTI, S.M., 2019a. The Hoard of the Rings. "Odd" annular bread-like objects as a case study for cereal-product diversity at the Late Bronze Age hillfort site of Stillfried (Lower Austria). *PLoS ONE*, 14(6), e0216907. doi:10.1371/journal.pone.0216907
- HEISS, A.G., ANTOLÍN, F., BLEICHER, N., HARB, C., JACOMET, S., KÜHN, M., MARINOVA, E., STIKA, H.-P., and VALAMOTI, S.M., 2017a. State of the (t)art. Analytical approaches in the investigation of components and production traits of archaeological bread-like objects, applied to two finds from the Neolithic lakeshore settlement Parkhaus Opéra (Zürich, Switzerland). *PLoS ONE*, 12(8), e0182401. doi:10.1371/journal.pone.0182401
- HEISS, A.G., BERIHUETE AZORÍN, M., ANTOLÍN, F., KUBIAK-MARTENS, L., MARINOVA, E., ARENDT, E.K., BILIADERIS, C.G., KRETSCHMER, H., LAZARIDOU, A., STIKA, H.-P., ZANKOW, M., BABA, M., BLEICHER, N., CIAŁOWICZ, K.M., CHŁODNICKI, M., MATUSCHIK, I., SCHLICHTERLE, H., and VALAMOTI, S.M., submitted. Mashies to Mashies, Crust to Crust. Presenting a novel microstructural marker for malting in the archaeological record. *PLoS ONE*.
- HEISS, A.G., and GAIL, N., 2019. Brot oder nicht Brot – keine einfache Frage. Methodische Überlegungen zu verkohlten archäologischen Speiseresten und die Neubearbeitung von Funden aus dem gallorömischen Gräberfeld von Wederath-Belginum. In: R. Cordie, N. Haßlinger, and J. Wiethold, eds. *Was aßen Kelten und Römer? Umwelt, Landwirtschaft und Ernährung westlich des Rheins*. Morbach: Archäologiepark Belginum, pp. 73–88.
- HEISS, A.G., and JAKOBITSCH, T., 2018. "Zeitensprung": Umwelt und Landwirtschaft der Seeufersiedlungen am Attersee. In: S. Ladstätter, ed. *Wissenschaftlicher Jahresbericht des Österreichischen Archäologischen Instituts 2018*. Wien: Österreichisches Archäologisches Institut, pp. 128–129.
- HEISS, A.G., KURTZE, C., and GAIL, N., producer, 2019b. 24.07.2019. Hornstaad Hörnle IA | Charred bread-like object. [3D model] Retrieved from <https://sketchfab.com/3d-models/hornstaad-hornle-ia-charred-bread-like-object-b96ab3c0db0d41978e0adf7f92de54c1>
- HEISS, A.G., KURTZE, C., and GAIL, N., producer, 2019c. 24.07.2019. Sipplingen Osthafen | Charred bread-like object. [3D model] Retrieved from <https://sketchfab.com/3d-models/sipplingen-osthafen-charred>



- bread-like-object-db37ab7cae4c46288b5912c2ae7e49c6
- HEISS, A.G., OBERNDORFER, D., and SCHWAIGER, H., 2017b. *Brandspuren. Vorläufige Ergebnisse zu den Holzkohlenanalysen an den Brandschichten des spätantik-mittelalterlichen Stadtquartiers südlich der Marienkirche in Ephesos*. Paper presented at the 9<sup>th</sup> Deutscher Archäologiekongress des Deutschen Verbandes für Archäologie und der Deutschen Altertumsverbände, Mainz.
- HEISS, A.G., STOCK, F., BRÜCKNER, H., DSIKOWITZKY, L., HASSL, A., KNIPPING, M., LAERMANN, H., PICHLER, B., PINT, A., SAUER, R., and LADSTÄTTER, S., 2017c. *Siltation, contamination, legislation – approaching the management of environmental and anthropogenic hazards in the antique harbor of Ephesos*. Paper presented at the International Conference “New Technologies, Hazards and Geoarchaeology”, Athen.
- HEISS, A.G., and WIESINGER, S., 2018a. *Abschlussbericht zur archäobotanischen Grundlagenforschung im Rahmen des Projekts Interreg-SI-AT “PalaeoDiversiStyria”, und Überblick über archäobotanische Großbestandsanalysen in Steiermark und Kärnten*. Wien.
- HEISS, A.G., and WIESINGER, S., 2018b. *Kurzbericht zur archäobotanischen Analyse spätneolithischer und latènezeitlicher Siedlungsbefunde aus Haselbach (Flur “Im äußeren Urban”, Grabungskampagne 2016) in Niederösterreich*. Wien.
- HINKER, C., HEISS, A.G., LAMM, S., and DRESCHER-SCHNEIDER, R., in print. Drei römische Brunnenverfüllungen im Laßnitztal (Steiermark). Beiträge zur Siedlungs- und Landwirtschaftsgeschichte im südöstlichen Noricum. *Jahreshefte des Österreichischen Archäologischen Institutes in Wien*.
- ILON, G., BARTOSIEWICZ, L., and GALIK, A., 2017. Research tradition and the archaeological reconstruction of fishing in the small Hungarian plain. *Hungarian Archaeology, E-Journal*, 2016, 1–13.
- JAKOBITSCH, T., HEISS, A.G., KOWARIK, K., MAURER, J., TREBSCH, P., WIETHOLD, J., and TAYLOR, T., 2019a. *Food and Farming beyond Alpine Lake Dwellings – Archaeobotanical Evidence from the Late Neolithic Settlements Lenzing-Burgstall and Ansfelden-Burgwiese (both Upper Austria)*. Paper presented at the 18<sup>th</sup> Conference of the International Workgroup for Palaeoethnobotany, Lecce.
- JAKOBITSCH, T., HEISS, A.G., WIESINGER, S., and TREBSCH, P., 2019b. *Plant-based resources of a Late Bronze Age copper mining site in the eastern Alps – Archaeobotany at Prigglitz-Gasteil (Lower Austria)*. Paper presented at the International Mountain Conference, Innsbruck.
- KANDLER, M., and WLACH, G., eds., 1998. *100 Jahre Österreichisches Archäologisches Institut. 1898–1998*.
- KISZTER, S., ČREŠNAR, M., HEISS, A.G., RABENSTEINER, J., and MELE, M., 2017. PalaeoDiversiStyria – Mensch, Ernährung und Umwelt im Wechselspiel. *Mitteilungen der Anthropologischen Gesellschaft in Wien*, 147, 1–12.
- LADSTÄTTER, S., 2018. *The more research, the more confusion. No clear water in the harbour basin of Ephesos*. Paper presented at the LARS-seminar, Leuven.
- MYLONA, D., 2008. *Fish-Eating in Greece from the Fifth Century B.C. to the Seventh Century A.D.: A story of impoverished fishermen or luxurious fish banquets?* Oxford.
- MYLONA, D., 2013. Dealing with the unexpected. Unusual animals in an Early Roman cistern fill in the Sanctuary of Poseidon at Kalaureia, Poros. In: G. Ekroth, and J. Wallenstein, eds. *Bones, Behaviour and Belief. The Zooarchaeological Evidence As a Source for Ritual Practice in Ancient Greece & Beyond*. Stockholm: Svenska Institutet i Athen, pp. 149–166.
- POWELL, J., 1996. *Fishing in the Prehistoric Aegean*. Jonsred: Paul Åströms Förlag.
- SCHACHL, R., 2006. Die archäobotanischen Reste. In: E. Alram-Stern and S. Deger-Jalkotzy, eds. *Aigeira I. Die mykenische Akropolis. Faszikel 3*. Wien: Österreichische Akademie der Wissenschaften, pp. 189–201.
- SCHMÖLCKE, U., and HEINRICH, D., 2006. Die Tierknochen aus dem Hafen von Haithabu – Schlammfunde. In: D. Heinrich, H. Hüster-Plogmann, U. Schmölcke, and K.J. Hüser, eds. *Untersuchungen an Skelettresten von Tieren aus dem Hafen von Haithabu*. Neumünster: Wachholtz, pp. 195–239.
- SCHWAIGER, H., HEISS, A.G., and LADSTÄTTER, S., 2018. *Pollen aus Ephesos: Ein Beitrag zur Umwelt- und Vegetationsgeschichte Kleinasien. Abschlussbericht*. Wien.
- STESKAL, M., REMBART, L., PÜLZ, A., and BINDER, M., 2015. Die Bestattungen im sogenannten Serapeion von Ephesos. *Jahreshefte des Österreichischen Archäologischen Institutes in Wien*, 84, 259–299.
- STOCK, F., KNIPPING, M., PINT, A., LADSTÄTTER, S., DELILE, H., HEISS, A.G., LAERMANN, H., MITCHELL, P.D., PLOYER, R., STESKAL, M., THANHEISER, U., URZ, R., WENNRICH, V., and BRÜCKNER, H., 2016. Human impact on Holocene sediment dynamics in the Eastern Mediterranean – the example of the Roman harbour of Ephesus. *Earth Surface Processes and Landforms*, 41(7), 980–996. doi:10.1002/esp.3914
- STOCK, F., PINT, A., HOREJS, B., LADSTÄTTER, S., and BRÜCKNER, H., 2013. In search of the harbours: New evidence of Late Roman and Byzantine harbours of Ephesus. *Quaternary International*, 312, 57–69. doi:10.1016/j.quaint.2013.03.002
- THEODOROPOULOU, T., 2017a. Regional stories, one sea: towards reconstructing the history/ies of fishing and marine animal exploitation in the early Greek world. In: A. Mazarakis Ainian, A. Alexandriou, and X. Charalambidou, eds. *Regional stories towards a new perception of the early Greek world. Acts of an international symposium in honour of Professor Jan Bouzek. Volos 18–21 June 2015*. Volos: University of Thessaly Press, pp. 669–680.
- THEODOROPOULOU, T., 2017b. A sea of luxury: luxury items and dyes of marine origin in the Aegean during the seventh century BC. In: X. Charalambidou, and C. Morgan, eds. *Interpreting the Seventh Century B.C. Tradition and Innovation*. Oxford: Archaeopress, pp. 80–92.
- TOLAR, T., and GALIK, A., 2019. A Study of Dog Coprolite from Late Neolithic Pile-Dwelling Site in Slovenia. *Archaeological Discovery*, 7, 20–29. doi:10.4236/ad.2019.71002
- TREBSCH, P., FEHLMANN, D., FLORES-OROZCO, A., HEISS, A.G., JAKOBITSCH, T., KONRAD, M., LÄNGAUER, J., MÖDLINGER, M., SALISBURY, R., SCHLÖGEL, I., WEIXELBERGER, G., and WIESINGER, S., 2019. *Leben und Arbeit im bronzezeitlichen Bergbau von Prigglitz – Vorstellung des Projektes, der Fragestellungen und erster Ergebnisse*. Paper presented at the FZ HiMAT – 13. Milestone-Meeting, Innsbruck.
- VALAMOTI, S.M., JACOMET, S., STIKA, H.-P., and HEISS, A.G., 2017. The PLANTCULT Project: identifying the plant food cultures of ancient Europe. *Antiquity*, 91(358), e9. doi:10.15184/aqy.2017.130
- WIESINGER, S., HEISS, A.G., JAKOBITSCH, T., and TREBSCH, P., 2019. *Supplies for the Miners – Investigating Food and Wood Resource Management at the Late Bronze Age Mining Site of Prigglitz-Gasteil (Lower Austria)*. Paper presented at the 18<sup>th</sup> Conference of the International Workgroup for Palaeoethnobotany, Lecce.
- YURTSEVA, A., SALMINA, E., and GALIK, A., 2013. Long-term changes in fish populations of the Pskov land (IV–XX Centuries). In: I.V. Askeyev, and D.V. Ivanov, eds. *Dinamika sovremenn'ih ekosistem v golocene*. Kazan: Otechestvo, pp. 350–353.
- YURTSEVA, A., SALMINA, E., GALIK, A., and LAJUS, D., 2015. How a millennium of fishing changed fish populations: a case study of Lake Peipus and the Velikaya River (NW Russia). *Aquatic Sciences*, 77(3), 325–336. doi:10.1007/s00027-014-0381-4

