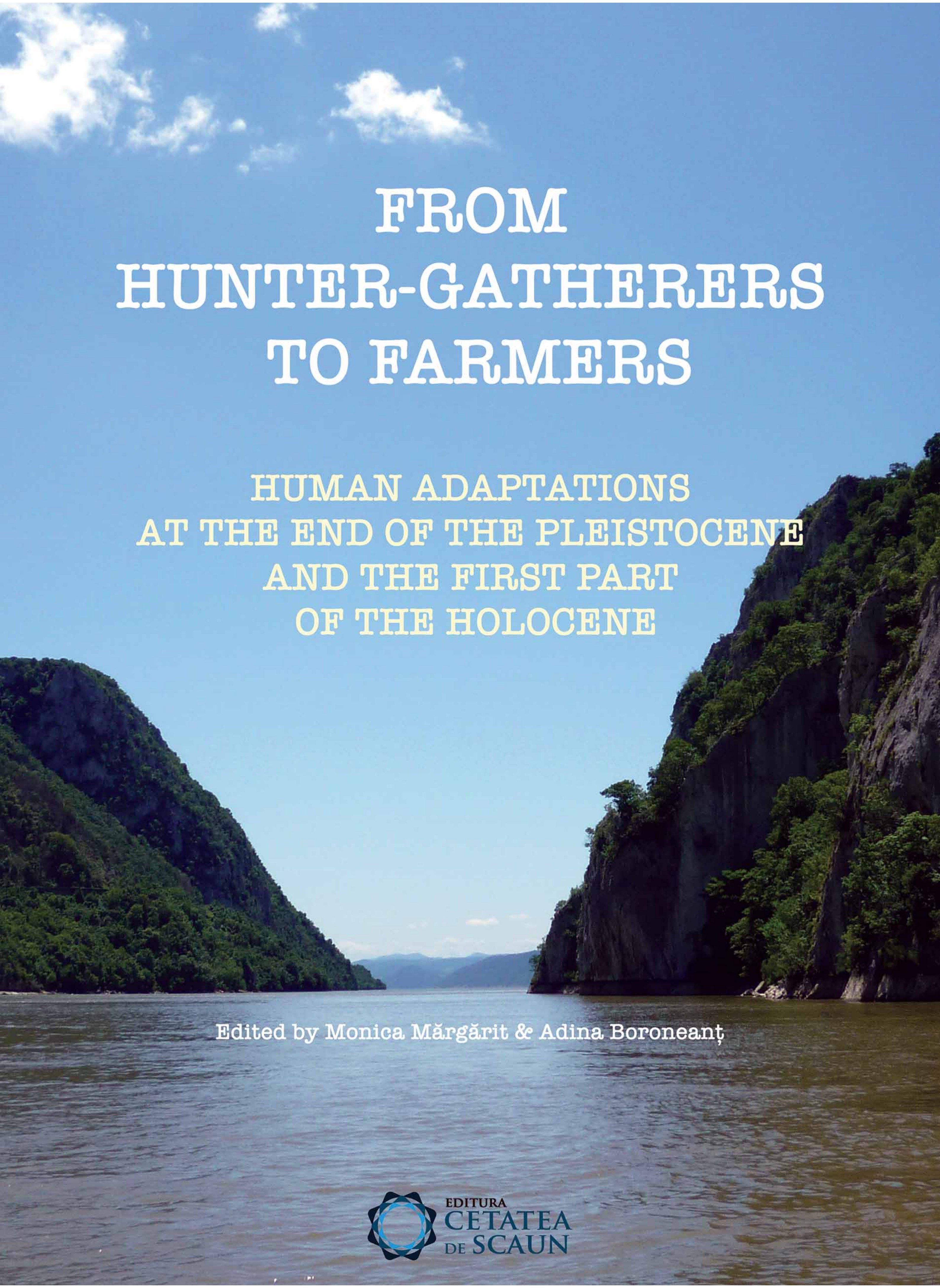

FROM HUNTER-GATHERERS TO FARMERS

HUMAN ADAPTATIONS AT THE END OF THE PLEISTOCENE AND THE FIRST PART OF THE HOLOCENE

Edited by Monica Mărgărit & Adina Boroneanț

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Human adaptations at the end of the Pleistocene and the first part of the Holocene

Papers in Honour of Clive Bonsall

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Photo cover: The Danube at Cazanele Mici (the Smaller Cauldrons) in the Iron Gates (photo Adina Boroneanț).

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PROFESSOR CLIVE BONSALL

EDITORIAL

It is difficult to capture one's life in a few words, a few photographs or even a book. The papers in the present volume will hopefully reflect a part of Clive Bonsall's scientific interests during a career that has started some 45 years ago. Their diversity is impressive: from radiocarbon dating, environmental changes, human–environment interactions, funerary behaviour, to paleogenetics and stable isotopes, reconstruction of ancient diets and obsidian sourcing, most of them in close connection to the hunter-gatherer and first farmer communities of Europe. His studies stretched over a large geographical area, focusing recently mainly around the Balkans and the neighbouring regions. He has conducted fieldwork in Britain, Scotland, Romania and Slovenia, edited 9 books and published over 160 papers, book-chapters, notes, as well as book and paper reviews. His main publications include: "The Mesolithic in Europe" (1989), "The Human Use of Caves" (1997), "The Iron Gates in Prehistory" (2008), "Submerged Prehistory" (2011) and "Not Just for Show: The Archaeology of Beads, Beadwork and Personal Ornaments" (2017).

His substantial work in southeastern Europe is reflected by his long-standing collaboration and friendship with many Romanian and Bulgarian archaeologists, and has received due recognition: Clive Bonsall is an Honorary Member of both the "Vasile Pârvan" Institute of Archaeology in Bucharest and the National Institute of Archaeology with Museum in Sofia. His contribution to the archaeology of the Iron Gates has earned him the recognition of the Serbian archaeologists working in the area. His many other research interests and personal collaborations are also reflected in the present volume.

We are grateful to all our contributors: colleagues and friends, new and old, former students and collaborators whose archaeological interests met Clive's if only briefly. We were happy to see that so many of us were able to mobilize in such a short time. We would like to thank all those who answered our call and at a time when every minute of our professional lives is carefully planned in advance, helped us put together this volume in less than a year. They have endured and complied with our constant deadline reminders and requests, checked and re-checked their manuscripts in record times, gracefully complying with the comments and suggestions from the reviewers, and were most patient with our editorial work.

Each paper was submitted to a double reviewing. We would like to also thank our colleagues from various disciplines who accepted to anonymously review the contributions. Their hard and serious work significantly improved the overall content of the volume.

The outcome has exceeded our most optimistic expectation: a volume that geographically covers almost the entire European continent, from Britain to Russia and Greece and touches on most important issues of hunter-gather adaptions through time. A volume brought together by chronological landmarks (the end of the Pleistocene and the beginning of the Holocene) and geographical areas but also by common approaches to issues such as human-animal interactions, exploitation and use of raw materials, and subsistence strategies.

We chose to organize the papers on three main sections, while within the respective theme they follow in chronological succession. The archaeology of the Iron Gates opens the volume, given Clive Bonsall's substantial contribution to the local early prehistory. The eight contributions cover a large range of subjects, from physical anthropology (Andrei Soficaru), re-interpretation of earlier excavations and the subsequent collections (Adina Boroneanț), stone artefacts (Dragana Antonović, Vidan Dimić, Andrej Starović and Dušan Borić) to the study of faunal remains and subsequent paleo-dietary issues (Adrian Bălășescu, Adina Boroneanț and Valentin Radu; Dragana Filipović, Jelena

Jovanović and Dragana Rančić; Ivana Živaljević, Vesna Dimitrijević and Sofija Stefanović), and osseous industries (Monica Mărgărit and Adina Boroneanț; Selena Vitezović). These studies illustrate the still immense research potential of the Iron Gates region despite the fact that most of the sites have been flooded many decades ago.

During the editing of the volume it became obvious that while some of the contributions focused on the evidence from a certain site, others were more of a regional synthesis. This latter section begins with a most interesting paper bringing together world history and underwater archaeology (Jonathan Benjamin and Geoff Bailey). The following nine articles deal with subjects such as social inequalities seen through the study of burial practices (Judith M. Grünberg), lifeways, adaptations and subsistence strategies of the early prehistoric communities (Agathe Reingruber; Mihael Budja; Annie Brown and Haskel Greenfield; Kenneth Ritchie), raw materials acquisition and exploitation (Tomasz Płonka, Maria Gurova, Eva David), exploitation, management and trade of „exotic” goods (Vassil Nikolov).

The nine papers focusing on individual sites present case studies that illustrate the nature of the current research, the rich opportunities offered by the growing range of scientific techniques and their applications to existing collections. This series of papers starts at Zemunica Cave on the coast of the Eastern Adriatic (Siniša Radović and Ankica Oros Sršen), explores the Mesolithic occupations at Malga Rondenetto (Paolo Biagi, Elisabetta Starnini and Renato Nisbet) and Grotta dell'Edera (Barbara Voytek) in Italy, the Mesolithic ornamented weapons of Motala in Sweden (Lars Larsson and Fredrik Molin), ending this Mesolithic journey among the shell middens on the western coast of Scotland (Catriona Pickard). The transition to the Neolithic happens among the beaver tools at Zamojste 2 in Russia (Olga Lozovskaya, Charlotte Leduc and Louis Chaix). The Neolithic Age finds us further south into Bulgaria, exploring the pitfields of Sarnevo (Krum Bacvarov and John Gorczyk) and the gold of Varna (Tanya Dzhanfezova), while during the Bronze Age roe deer hunting is resurrected at Paks–Gyapa in Hungary (László Bartosiewicz and Erika Gál).

The volume presents altogether new results in recent research and new information resulted from the study of old collections. We also hope it points out directions for future research.

It is with great joy that we present Clive Bonsall this volume, as a token of both our appreciation and friendship, for his contributions to the Early Prehistory of Europe in general, and of Southeastern Europe in special.

The Editors

CLIVE BONSALL – SOME YEARS AFTER

When Clive Bonsall came to Romania in 1991, I was taking an undergraduate degree in computers and wasn't even considering becoming an archaeologist. Together with my mother and brother, I used to accompany my father Vasile Boroneanț every year on his summer digs at Schela Cladovei. It was just over a year after the fall of the communist regime in Romania, and everybody at the site was waiting impatiently the arrival of a team of archaeologists from Great Britain, who were coming to visit the site and perhaps start a joint research project. It must have been past mid-night of the expected day when my father woke us up – because the "English" had arrived…. Four very tired people (Clive Bonsall, Kathleen McSweeney, Sue Stalibrass and Mark Macklin – and not all "English") in a Land Rover but still managing to smile… They had spent 10 hours at the border between Hungary and Romania and their first encounter with Romanian cuisine had been carp-head soup (the only thing available on the menu) in Arad…. I believe Clive still remembers the fish-heads sticking out of the large bowl (obviously a reminder of the Lepenski Vir sculpted boulders…).

The visit at the site went well and the next year the research project commenced, but not unventfully. It must have been sheer passion for archaeology and keen interest for the Iron Gates Mesolithic that made Clive come back the second year, after having (during the previous first year) the minibus tyres slashed several times by the curious and mischievous Schela Cladovei lads, bits of the flotation equipment vanishing into thin air and two pairs of his new Levis jeans (a rarity in Romania in those days) mysteriously disappearing from his room at the youth camp in Gura Văii…..Not to mention the breaking down of the minibus in a country where there were no spare parts for western cars.

Still, here he is, working in Romania, 26 years later…

And following the first four years of the Schela Cladovei project I had switched to a degree in archaeology (and Clive bears much of the blame…). And we are still excavating at Schela Cladovei…and at least Clive looks unchanged… It is his dedication to the archaeology of the area that has made this second research project possible, project going on successfully for over ten years now.

As it was with me, Clive has influenced the lives of many (older and younger) archaeologists and perhaps future archaeologists. He is an inspiration to our students from the Schela Cladovei excavation and a respected professional among Romanian archaeologists. He has always been ready to help my fellow colleagues, whether it was field work, collecting samples, editing or mere professional advice, although such work had rarely anything to do with the archaeology of the Iron Gates. But during his entire activity in this area, he acted as a "human bridge" between Romanian, Bulgarian and Serbian archaeologies, facilitating professional exchanges, easing the access to modern technologies, information and publications.

Clive Bonsall was/is equally interested in other geographical areas and research topics of European (and not only…) archaeology, and the number of people contributing to this volume testify to the impact he had on individuals and archaeologies elsewhere outside Romania.

This may not be the typical introduction to a Festschrift volume… but then, Clive is not a typical person. Rather cynical but warm hearted underneath, with a wonderful (and at times very dry) sense of humour, and great charm (when he wants it…) he makes a great project co-director and fellow-worker.

I can only but hope that our collaboration would go on for many years from now and that we'll get to see the end of the Schela Cladovei trench we started before we both retire!

Bucharest, September 2017

Adina Boroneanț

PUBLICATIONS OF CLIVE BONSALL

Books

- Bar-Yosef Mayer, D.A., Choyke, A. & **Bonsall, C.** (eds). 2017. *Not Just for Show: The Archaeology of Beads, Beadwork and Personal Ornaments*. Oxford, Oxbow Books.
- Waddington, C. & **Bonsall, C.** 2016. *Archaeology and Environment on the North Sea Littoral. A Case Study from Low Hauxley*. Bakewell, Archaeological Research Services/Newcastle upon Tyne, Northumberland Wildlife Trust.
- Comșa, A., **Bonsall, C.** & Nikolova, L. (eds). 2013. *Facets of the Past: The Challenge of the Balkan Neo-Eneolithic*. București, Editura Academiei Române.
- Benjamin, J., **Bonsall, C.**, Pickard, C. & Fischer, A. (eds). 2011. *Submerged Prehistory*. Oxford, Oxbow.
- **Bonsall, C.**, Boroneanț, V. & Radovanović, I. (eds). 2008. *The Iron Gates in Prehistory: New Perspectives.* Oxford, Archaeopress.
- **Bonsall, C.** & Tolan-Smith, C. (eds). 1997. *The Human Use of Caves*. Oxford, Archaeopress.
- **Bonsall, C.** (ed.). 1989. *The Mesolithic in Europe. Papers Presented at the Third International Symposium, Edinburgh 1985*. Edinburgh, John Donald.
- Kinnes, I., **Bonsall, C.**, Jackson, R. & Wilson, G. 1979. *Man Before Metals*. London, British Museum Publications.
- Wymer, J.J. & **Bonsall, C.** 1978. *Gazetteer of Upper Palaeolithic and Mesolithic Sites in England and Wales*. London, Council for British Archaeology.

Edited Journal

Mesolithic Miscellany, 1991-196. vols 12–17 — an international newsletter with subscribers throughout Europe and North America, as well as in Japan and Africa.

Book Chapters

- Gurova, M. & **Bonsall, C.** 2017. Experimental replication of stone, bone and shell beads from Early Neolithic sites in Southeast Europe. In D. Bar-Yosef, C. Bonsall & A. Choyke (eds), *Not Just for Show: The Archaeology of Beads, Beadwork and Personal Ornaments*. Oxford, Oxbow: 161–169.
- Pickard, C., Boroneanț, A. & **Bonsall, C.** 2017. Molluscan remains from Early to Middle Holocene sites in the Iron Gates reach of the Danube, Southeast Europe. In M.J. Allen (ed.), *Molluscs in Archaeology: methods, approaches and applications*. Oxford, Oxbow Books: 179–194.
- Boroneanț, A. & **Bonsall, C.** 2016. The Icoana burials in context. In J.M. Grünberg, B. Gramsch, L. Larsson, J. Orschiedt & H. Meller (eds), *Mesolithic Burials – Rites, Symbols and Social Organisation of Early Postglacial Communities*, vol. II. Halle, Landesmuseum für Vorgeschichte Halle (Saale): 757–780.
- **Bonsall, C.,** Boroneanț, A., Simalcsik, A. & Higham, T. 2016. Radiocarbon dating of Mesolithic burials from Ostrovul Corbului, southwest Romania. In K. Bacvarov and R. Gleser (eds), *Southeast Europe and Anatolia in Prehistory. Essays in Honor of Vassil Nikolov on his 65th Anniversary*. Universitätsforschungen zur Prähistorischen Archäologie 293. Bonn, Habelt: 41–50.
- **Bonsall, C.**, Macklin, M.G., Boroneanț, A., Pickard, C., Bartosiewicz, L., Cook, G. & Higham, T. 2015. Rapid climate change and radiocarbon discontinuities in the Mesolithic–Early Neolithic

settlement record of the Iron Gates: cause or coincidence? In P.F. Biehl & O. Nieuwenhuyse (eds), *Climate and Cultural Change in Prehistoric Europe and the Near East*. Buffalo (New York), SUNY Press: 195–210.

- **Bonsall, C.** & Boroneanţ, A. 2016. Lateglacial hunter-gatherers in the Iron Gates: a brief review of the archaeological and chronological evidence. In Krauß, R. & Floss, H. (eds), *Southeast Europe Before Neolithisation. Proceedings of the International Workshop within the Collaborative Research Centres SFB 1070 "RessourcenKulturen", Schloss Hohentübingen, 9th of May 2014*. Tübingen, University of Tübingen: 149–164.
- McSweeney, K., Bacvarov, K., Nikolov, V., Andreeva, D. & **Bonsall, C.** 2016. Infant burials in Early Bronze Age Bulgaria: a bioarchaeological appraisal of funerary behaviour. In V. Nikolov & W. Schier (eds), *Der Schwarzmeerraum vom Neolithikum bis in die Früheisenzeit (6000–600 v. Chr.)*. Berlin, Marie Leidorf: 383–393.
- Črešnar, M., Koprivnik, V., **Bonsall, C.**, Thomas, J-L. 2014. 16.2. Gračič below Brinjeva Gora. In B. Teržan & M. Črešnar (eds), *Absolute Dating of the Bronze and Iron Ages in Slovenia*. Ljubljana, National Museum of Slovenia: 305–311.
- Črešnar, M., Koprivnik, V., **Bonsall, C.**, Thomas, J-L. 2014. 12. Ruše. In B. Teržan & M. Črešnar (eds), *Absolute Dating of the Bronze and Iron Ages in Slovenia*. Ljubljana, National Museum of Slovenia: 221–223.
- Črešnar, M., **Bonsall, C.**, Thomas, J-L. 2014. 11. Pobrezje near Maribor. In B. Teržan & M. Črešnar, *Absolute Dating of the Bronze and Iron Ages in Slovenia*. Ljubljana, National Museum of Slovenia: 215–219.
- Gurova, M., **Bonsall, C.**, Bradley, B., Anastassova, E. & Cura, P. 2014. An experimental approach to prehistoric drilling and bead manufacturing. In S. Cura, J. Cerezer, M. Gurova, B. Santander, L. Oosterbeek & J. Cristóvão (eds), *Technology and Experimentation in Archaeology*. BAR International Series 2657. Oxford, Archaeopress: 47–56.
- Pickard, C. & **Bonsall, C.**, 2014. Mesolithic and Neolithic shell middens in western Scotland: a comparative analysis of shellfish exploitation patterns. In M. Roksandic, S. Mendonça de Souza, S. Eggers, M. Burchell & D. Klokler (eds), *The Cultural Dynamics of Shell-Matrix Sites*. Albuquerque, University of New Mexico Press: 251–266.
- **Bonsall, C.**, McSweeney, K., Payton, R.W., Pickard, C., Bartosiewicz, L. & Boroneanţ, A., 2013. Death on the Danube: Late Mesolithic burials at Schela Cladovei, Romania. In A. Comşa, C. Bonsall & L. Nikolova (eds), *Facets of the Past: The Challenge of the Balkan Neo-Eneolithic*. Bucureşti, Academia Academiei Române: 55–67.
- **Bonsall, C.**, Mlekuž, D., Bartosiewicz, L. & Pickard, C. 2013. Early farming adaptations of the northeast Adriatic Karst. In S. Colledge, J. Conolly, K. Dobney, K. Manning & S. Shennan (eds), *The Origins and Spread of Domestic Animals in Southwest Asia and Europe*. Walnut Creek (CA), Left Coast Press: 145–160.
- Boroneanţ, A. & **Bonsall, C.** 2013. The 1965–1968 excavations at Schela Cladovei (Romania) revisited. In E. Starnini (ed.), *Unconformist Archaeology. Papers in Honour of Paolo Biagi*. Oxford, Archaeopress: 35–54.
- Schoop, U-D., Pickard, C. & **Bonsall, C.** 2013. Radiocarbon dating Chalcolithic Büyükkaya. In A. Schachner (ed.), 'Die Ausgrabungen in Boğazköy-Ḫattuša 2011'. *Archäologischer Anzeiger* 2012(1): 115–120.
- Pickard, C. & **Bonsall, C.** 2012. The marine molluscs. In A. Saville, K. Hardy, R. Miket & T.B. Ballin (eds), *An Corran, Staffin, Skye: a Rockshelter with Mesolithic & Later Occupation*. SAIR 51: 62–69.
- Boroneanţ, A. & **Bonsall, C.** 2012. Burial practices in the Iron Gates Mesolithic. In R. Kogălniceanu, R. Curcă, M. Gligor & S. Stratton (eds), *HOMINES, FUNERA, ASTRA. Proceedings*

of the International Symposium on Funerary Anthropology 5-8 June 2011 '1 Decembrie 1918' University (Alba Iulia, Romania). Oxford: Archaeopress, 45–56.

- **Bonsall, C.**, Pickard, C. & Ritchie, G.A. 2012. From Assynt to Oban: some observations on prehistoric cave use in western Scotland. In K-A. Bergsvik & R. Skeates (eds), *Caves in Context. The Cultural Significance of Caves and Rockshelters in Europe.* Oxford, Oxbow: 10–21.

- Pickard, C. & **Bonsall, C.** 2012. A different kettle of fish: food diversity in Mesolithic Scotland. In D. Collard, J. Morris & E. Perego (eds), *Food and Drink in Archaeology 3*. Totnes, Prospect Books: 76–88.

- Benjamin, J., Bekić, L., Komšo, D., Koncani Uhač, I. & **Bonsall, C.** 2011. Investigating the submerged prehistory of the eastern Adriatic: progress and prospects. In J. Benjamin, C. Bonsall, C. Pickard & A. Fischer (eds), *Submerged Prehistory*. Oxford, Oxbow: 193–206.

- Bartosiewicz, L., Zapata, L. & **Bonsall, C.** 2010. A tale of two shell middens: the natural *versus* the cultural in 'Obanian' deposits at Carding Mill Bay, Oban, western Scotland. In A.M. Van Derwarker & T.M. Peres (eds), *Integrating Zooarchaeology and Paleoethnobotany: A Consideration of Issues, Methods, and Cases*. New York, Springer: 205–225.

- Pickard C. & **Bonsall C.** 2009. Some observations on the Mesolithic crustacean assemblage from Ulva Cave, Inner Hebrides, Scotland. In J.M. Burdukiewicz, K. Cyrek, P. Dyczek & K. Szymczak (eds), *Understanding the Past. Papers Offered to Stefan K. Kozłowski*. Warsaw, University of Warsaw Center for Research on the Antiquity of Southeastern Europe: 305–313.

- **Bonsall, C.**, Cook, G.T., Pickard, C., McSweeney, K. & Bartosiewicz, L. 2009. Dietary trends at the Mesolithic–Neolithic transition in North-west Europe. In Ph. Crombé, M. Van Strydonck, J. Sergant, M. Bats & M. Boudin (eds), *Chronology and Evolution within the Mesolithic of North-West Europe.* Newcastle upon Tyne, Cambridge Scholars Publishing: 539–562.

- Cook, G.T., **Bonsall, C.**, Pickard, C., McSweeney, K., Bartosiewicz, L. & Boroneanț, A. 2009. The Mesolithic–Neolithic transition in the Iron Gates, Southeast Europe: calibration and dietary issues. In Ph. Crombé, M. Van Strydonck, J. Sergant, M. Bats & M. Boudin (eds), *Chronology and Evolution within the Mesolithic of North-West Europe.* Newcastle upon Tyne, Cambridge Scholars Publishing: 519–537.

- **Bonsall, C.**, Payton, R., Macklin, M.G., & Ritchie, G.A. 2009. A Mesolithic site at Kilmore, near Oban, western Scotland. In N. Finlay, S. McCartan, N. Milner & C. Wickham Jones (eds), *From Bann Flakes to Bushmills: papers in honour of Professor Peter Woodman. Prehistoric Society Research Paper 1.* Oxford, Prehistoric Society/Oxbow Books: 70–77.

- Bartosiewicz, L., **Bonsall, C.** & Șișu, V. 2008. Sturgeon fishing in the Middle and Lower Danube region. In C. Bonsall, V. Boroneanț, & I. Radovanović (eds), *The Iron Gates in Prehistory.* Oxford, Archaeopress: 39–54.

- **Bonsall, C.**, Radovanović, I., Roksandic, M., Cook, G.T., Higham, T. & Pickard, C. 2008. Dating burial practices and architecture at Lepenski Vir. In C. Bonsall, V. Boroneanț & I. Radovanović (eds), *The Iron Gates in Prehistory.* Oxford, Archaeopress: 175–204.

- Bartosiewicz, L. & **Bonsall, C.** 2008. Complementary taphonomies: Medieval sturgeons from Hungary. In P. Béarez, S. Grouard & B. Clavel (eds), *Archéologie du poisson. 30 ans d'archéo-ichtyologie au CNRS. Hommage aux travaux de Jean Desse et de Nathalie Desse-Berset, XXVIIIe rencontres internationales d'archéologie et d'histoire d'Antibes*. Antibes, Éditions APDCA: 35–45.

- **Bonsall, C.** 2008. The Mesolithic of the Iron Gates. In G. Bailey & P. Spikins (eds), *Mesolithic Europe*. Cambridge, Cambridge University Press: 238–279.

- Pickard, C., Pickard, B. & **Bonsall, C.** 2008. Reassessing the mitochondrial DNA evidence for migration at the Mesolithic–Neolithic transition. In Z. Sulgostowska & A.J. Tomaszewski (eds), *Man–Millennia–Environment: Studies in Honour of Romuald Schild*. Warsaw, Polish Academy of Sciences Institute of Archaeology and Ethnology: 53–58.

- **Bonsall, C.** 2007. When was the Neolithic transition in the Iron Gates? In M. Spataro & P. Biagi (eds), *A Short Walk through the Balkans: the First Farmers of the Carpathian Basin and Adjacent Regions*. Trieste, Società per la Preistoria e Protostoria della Regione Friuli-Venezia Giulia: 53–65.

- Cerón-Carrasco, R.N., Stone, D.J.W. & **Bonsall, C.** 2007. Marine Resource Exploitation in Scotland: introducing the *MaRES* database. In Hüster Plogmann, H. (ed.), *The Role of Fish in Ancient Time. Proceedings of the 13th Meeting of the ICAZ Fish Remains Working Group, in October 4th–9th, Basel/August 2005*. Rahden, Leidorf: 163–74.

- **Bonsall, C.** 2007. Human–environment interactions during the Late Mesolithic of the Cumbria coastal plain: the evidence from Eskmeals. In P. Cherry (ed.), *Studies in Northern Prehistory: Essays in Memory of Clare Fell.* Kendal, Cumberland and Westmorland Antiquarian and Archaeological Society: 25–43.

- Pickard, C. & **Bonsall, C.**, 2007. Late Mesolithic coastal fishing practices: the evidence from Tybrind Vig, Denmark. In B. Hårdh, K. Jennbert & D. Olausson (eds), *On the Road. Studies in Honour of Lars Larsson*. Acta Archaeologica Lundensia in 4°, No. 26. Stockholm, Almqvist and Wiksell: 176–183.

- Bartosiewicz, L., Boroneanţ, V., **Bonsall, C.** & Stallibrass, S. 2006. Size ranges of prehistoric cattle and pig at Schela Cladovei (Iron Gates region, Romania). In F. Draşoveanu (ed.), In memoriam Bogdan Brukner. *Analele Banatului, S.N. Archeologie-Istorie* 14(1): 23–42.

- Kitchener, A.C., **Bonsall, C.** & Bartosiewicz, L. 2004. Missing mammals from Mesolithic middens: a comparison of the fossil and archaeological records. In A. Saville (ed.), *Mesolithic Scotland and its Nearest Neighbours: the Early Holocene Prehistory of Scotland, its British and Irish Context, and some Northern European Perspectives*. Edinburgh, Society of Antiquaries of Scotland: 73–82.

- **Bonsall, C.** 2004. The 'Obanian' problem: coastal adaptation in the Mesolithic of western Scotland. In M. González Morales & G.A. Clark (eds), *The Mesolithic of the Atlantic Façade: Proceedings of the Santander Symposium*. Anthropological Research Papers No. 55. Tempe (AZ), Arizona State University: 13–22. [reprint]

- **Bonsall, C.** 2003. Iron Gates Mesolithic. In P. Bogucki & P. Crabtree (eds), *Ancient Europe 8000 B.C. to A.D. 1000: Encyclopedia of the Barbarian World*. New York, Scribner: 175–178.

- Cook, G.T., **Bonsall, C.**, Hedges, R.E.M., McSweeney, K., Boroneanţ, V., Bartosiewicz, L. & P. Pettitt. 2002. Problems of dating human bones from the Iron Gates. *Antiquity* 76: 77–85.

- Griffitts, J. & **Bonsall, C.** 2001. Experimental determination of the function of antler and bone 'bevel-ended tools' from prehistoric shell middens in western Scotland. In A. Choyke & L. Bartosiewicz (eds), *Crafting Bone – Skeletal Technologies through Time and Space: Proceedings of the 2nd Meeting of the (ICAZ) Worked Bone Research Group, Budapest, 31 August–5 September 1999*. BAR S937. Oxford, Archaeopress: 209–222.

- Bartosiewicz, L., **Bonsall, C.**, Boroneanţ, V. & Stallibrass, S. 2001. New data on the prehistoric fauna of the Iron Gates: a case study from Schela Cladovei, Romania. In R. Kertés & J. Makkay (eds), *From The Mesolithic to the Neolithic*. Budapest, Archaeolingua (Main Series): 15–21.

- Tolan-Smith, C. & **Bonsall, C.** 1999. Stone Age studies in the British Isles: the impact of accelerator dating. In J. Evin, C. Oberlin, J.P. Daugas & J.F. Salles (eds), *^{14}C et Archéologie. Actes du 3ème congrès international, Lyon, 6–10 avril 1998*. Paris, Mémoires de la Société Préhistorique Française 26, 1999 et Supplément 1999 de la Revue d'Archéometrie: 249–257.

- Boroneanţ, V., **Bonsall, C.**, McSweeney, K., Payton, R.W. & Macklin, M.G. 1999. A Mesolithic burial area at Schela Cladovei, Romania. In A. Thévenin (ed.), *L'Europe des Derniers Chasseurs: Épipaléolithique et Mésolithique.* (Actes du 5e colloque international UISPP, commission XII, Grenoble, 18–23 septembre 1995). Paris, Éditions du Comité des Travaux Historiques et Scientifiques: 385–390.

- **Bonsall, C.**, Kitchener, A.C. & Bartosiewicz, L. 1999. AMS ^{14}C dating and the Mesolithic faunal record. In E. Cziesla, T. Kersting & S. Pratsch (eds), *Den Bogen spannen … Festschrift für Bernhard Gramsch*, vol. 1. Weißbach, Beier and Beran: 99–106.

- Johnson, L.L. & **Bonsall, C.** 1999. Mesolithic adaptations on offshore islands: the Aleutians and western Scotland. In E. Cziesla, T. Kersting & S. Pratsch (eds), *Den Bogen spannen … Festschrift für Bernhard Gramsch*, vol. 1. Weißbach, Beier and Beran: 107–115.

- **Bonsall, C.** 1997. Coastal adaptation in the Mesolithic of Argyll. Rethinking the 'Obanian Problem'. In G. Ritchie (ed.), *The Archaeology of Argyll*. Edinburgh, University Press: 25–37.

- Tolan-Smith, C. & **Bonsall, C.** 1997. The human use of caves. In C. Bonsall & C.A. Tolan-Smith (eds), *The Human Use of Caves*. Oxford, Archaeopress: 217–218.

- **Bonsall, C.** 1996. The 'Obanian' problem: coastal adaptation in the Mesolithic of western Scotland. In A. Pollard & A. Morrison (eds), *The Early Prehistory of Scotland*. Edinburgh, Edinburgh University Press: 183–197.

- Russell, N., **Bonsall, C.** & D. Sutherland. 1995. The role of shellfish-gathering in the Mesolithic of western Scotland: the evidence from Ulva Cave, Inner Hebrides. In A. Fischer (ed.), *Man and Sea in the Mesolithic. Coastal Settlement Above and Below the Present Sea Level*. Oxford, Oxbow Books: 273–288.

- **Bonsall, C.**, Sutherland, D.G. & Payton, R.W. 1994. The Eskmeals coastal foreland: archaeology and shoreline development. In J. Boardman & J. Walden (eds), *The Quaternary of Cumbria: Field Guide*. Oxford, Quaternary Research Association: 90–102.

- Macklin, M.G., Rumsby, B.T., Rhodes, N., Robinson, M.R. & **Bonsall, C.** 1993. Archaeological conservation in Oban, western Scotland. In C. Green, J. Gordon, M.G. Macklin & C. Stevens (eds), *Conserving Our Landscape*. Peterborough, English Nature: 168–175.

- Smith, C. & **Bonsall, C.** 1992. AMS radiocarbon dating of Late Upper Palaeolithic and Mesolithic artefacts: preliminary results. In Mook, W.G. & Waterbolk, H.T. (eds) *Proceedings of the Second International Symposium on ^{14}C and Archaeology, Groningen 1987* (*PACT 29, 1990)*. Strasbourg, Council of Europe: 259–268.

- **Bonsall, C.** & Sutherland, D.G. 1992. The Oban caves. In M.J.C. Walker, J.M. Gray & J.J. Lowe (eds), *The South-West Scottish Highlands: Field Guide*. Cambridge, Quaternary Research Association: 115–121.

- **Bonsall, C.** 1992. Archaeology of the Kilmartin Valley. In M.J.C. Walker, J.M. Gray & J.J. Lowe (eds), *The South-West Scottish Highlands: Field Guide*. Cambridge, Quaternary Research Association: 141–143.

- **Bonsall, C.** 1992. Archaeology of the south-west Scottish Highlands. In M.J.C .Walker, J.M. Gray & J.J. Lowe (eds), *The South-West Scottish Highlands: Field Guide*. Cambridge, Quaternary Research Association: 28–34.

- Smith, C. & **Bonsall, C.** 1991. Late Upper Palaeolithic and Mesolithic chronology: points of interest from recent research. In R.N.E. Barton, A.J. Roberts & D.A. Roe (eds), *The Late Glacial in North-West Europe: Human Adaptation and Environmental Change at the End of the Pleistocene*. London, Council for British Archaeology: 208–212.

- **Bonsall, C.** & Smith, C.A. 1990. Bone and antler technology in the British Late Upper Palaeolithic and Mesolithic: the impact of accelerator dating. In P.M. Vermeersch & P. Van Peer (eds), *Contributions to the Mesolithic in Europe*. Leuven, University Press: 359–368.

- Andersen, S.H., Bietti, A., **Bonsall, C.**, Broadbent, N.D., Clark, G.A., Gramsch, B., Jacobi, R.M., Larsson, L., Morrison, A., Newell, R.R., Rozoy, J.-G., Straus, L.G. & Woodman P.C. 1990. Making cultural ecology relevant to Mesolithic research: I. a data base of 413 Mesolithic fauna assemblages. In P.M. Vermeersch & P. Van Peer (eds), *Contributions to the Mesolithic in Europe*. Leuven, University Press: 23–51.

- **Bonsall, C.**, Sutherland, D.G., Tipping, R.M. & Cherry, J. 1989. The Eskmeals Project: late Mesolithic settlement and environment in north-west England. In C. Bonsall (ed.), *The Mesolithic in Europe*. Edinburgh, John Donald: 175–205.

- Morrison, A. & **Bonsall, C.** 1989. The early post-glacial settlement of Scotland. In C. Bonsall, (ed.), *The Mesolithic in Europe*. Edinburgh, John Donald: 134–142.

- **Bonsall, C.** 1989. Williamson's Moss, Eskmeals. In T. Clare (ed.), *The Prehistoric Society Summer Conference 1989: Field Excursion Guide*. London, Prehistoric Society: 5–7.

- Lawson, T.J. & **Bonsall, C.** 1986. The Palaeolithic in Scotland: a reconsideration of evidence from Reindeer Cave, Assynt. In S.N. Collcutt (ed.), *The Palaeolithic of Britain and its Nearest Neighbours: Recent Trends*. Sheffield, University Department of Archaeology: 85–89.

- **Bonsall, C.** 1981. The coastal factor in the Mesolithic settlement of north-west England. In B. Gramsch (ed.) *Mesolithikum in Europa*. Berlin, Deutscher Verlag: 451–472.

- **Bonsall, C.** 1978. Report on the flint industry. In J. Hedges & D. Buckley (eds), 'Excavations at a new causewayed enclosure, Orsett, Essex, 1975'. *Proceedings of the Prehistoric Society* 44: 219–308.

- **Bonsall, C.**, Mellars, P.A. & Cherry, J. 1977. Cumbrian coast: Williamson's Moss, Monk Moors and Langley Park — archaeology. In M.J. Tooley (ed.), *The Isle of Man, Lancashire Coast and Lake District (Guidebook for Excursion A4, X INQUA Congress)*. Norwich, Geoabstracts: 41–44.

Articles

- Mărgărit, M., Radu, V., Boroneanţ, A. & **Bonsall, C.** 2017. Experimental studies of personal ornaments from the Iron Gates Mesolithic. *Archaeological and Anthropological Sciences*. https://doi.org/10.1007/s12520-017-0522-5.

- **Bonsall, C.**, Gurova, M., Elenski, N., Ivanov, G., Bakamska, A. Ganetsovski, G., Zlateva-Uzunova, R. & Slavchev, V. 2017. Tracing the source of obsidian from prehistoric sites in Bulgaria. *Bulgarian e-Journal of Archaeology* 7: 37–59.

- Gonzalez-Fortes, G., Jones, E.R., Lightfoot, E., **Bonsall, C.**, Lazăr, C., et al. 2017. Paleogenomic evidence for multi-generational mixing between Neolithic farmers and Mesolithic hunter-gatherers in the Lower Danube Basin. *Current Biology*. http://dx.doi.org/10.1016/j.cub.2017.05.023

- **Bonsall, C.**, Elenski, N., Ganecovski, G., Gurova, M., Ivanov, G., Slavchev, V. & Zlateva-Uzanova, R. 2017. Investigating the provenance of obsidian from Neolithic and Chalcolithic sites in Bulgaria. *Antiquity* 91 (Issue 356). https://doi.org/10.15184/aqy.2017.2.

- Dobrescu, R., Ştefan, C.E. & **Bonsall, C.** 2016. Observations sur l'industrie en obsidienne découverte à Şoimuş-La Avicola (Ferma 2). *Materiale şi Cercetări Arheologice* N.S. 12: 45–56.

- Cristiani, E., Radini, A., Borić, D., Mutri, G., Filipović, D., Allué, E., **Bonsall, C.**, Boroneanţ, A., Dalmeri, G., Fontana, F., Lo Vetro, D., Martini, F., Negrino, F., Peresani, M., Riel-Salvatore, J., Sarti, L., Vujević, D. & Vukojicić, S. 2016. The 'Hidden Foods' project: new research into the role of plant foods in Palaeolithic and Mesolithic societies of South-east Europe and Italy. *Antiquity Project Gallery* 352, July 2016, http://antiquity.ac.uk/projgall/572.

- Payton, R.W. & **Bonsall, C.** 2016. Soil paleocatenas, prehistoric land use and coastal landscape dynamics at Druridge Bay, northeast England. *Geoarchaeology: an international journal* 31(5): 388–411. (Online 22/06/2106: doi 10.1002/gea.21551).

- **Bonsall, C.**, Boroneanţ, A., Evatt, A., Soficaru, A., Nica, C., Bartosiewicz, L., Cook, G.T., Higham, T.F.G. & Pickard, C. 2016. The Clisurean finds from Climente II cave, Iron Gates, Romania. *Quaternary International* (2015). http://dx.doi.org/10.1016/j.quaint.2015.12.017.

- Pickard, C., Schoop, U., Dalton, A., Sayle, K.L., Channell, I., Calvey, K., Thomas, J-L., Bartosiewicz, L. & **Bonsall, C.** 2015. Diet at Late Chalcolithic Çamlıbel Tarlası, north-central Anatolia: an isotopic perspective. *Journal of Archaeological Science: Reports* 5: 296–306.

- **Bonsall, C.**, Cook, G., Bartosiewicz, L. & Pickard, C. 2015. Reply to Nehlich & Borić's "Response to Bonsall et al. 'Food for thought: re-assessing Mesolithic diets in the Iron Gates'". *Radiocarbon* 57(4): 705–706.

- **Bonsall, C.**, Cook, G., Pickard, C., McSweeney, K., Sayle, K., Bartosiewicz, L., Radovanović, I., Higham, T., Soficaru, A. & Boroneanț, A. 2015. Food for thought: re-assessing Mesolithic diets in the Iron Gates. *Radiocarbon* 57(4): 689–699.

- Cook, G.T., Ascough, P.L., **Bonsall, C.**, Hamilton, W.D., Russell, N., Sayle, K. & Scott, E.M. 2014. Best practice methodology for 14C calibration of marine and mixed terrestrial/marine samples. *Quaternary Geochronology* 27: 164–171.

- **Bonsall, C.**, Vasić, R., Boroneanț, A., Roksandic, M., Soficaru, A., McSweeney, K., Evatt, A., Aguraiuja, Ü., Pickard, C., Dimitrijević, V., Higham, T., Hamilton, D. & Cook, G. 2015. New AMS 14C dates for human remains from Stone Age sites in the Iron Gates reach of the Danube, Southeast Europe. *Radiocarbon* 57(1): 33–46.

- Evin, A., Girdland Flink, L., Bălășescu, A., Popovici, D., Andreescu, R., Bailey, D., Mirea, P., Lazăr, C., Boroneanț, A., **Bonsall, C.**, Strand Vidarsdottir, U., Brehard, S., Tresset, A., Cucchi, T., Larson, G. & Dobney, K. 2015. Unravelling the complexity of domestication: a case study using morphometrics and ancient DNA analyses of archaeological pigs from Romania. *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 370 20130616. http://dx.doi.org/10.1098/rstb.2013.0616.

- **Bonsall, C.**, Macklin, M.G., Boroneant, A., Pickard, C., Bartosiewicz, L., Cook, G. & Higham, T. 2015. Holocene climate change and prehistoric settlement in the Lower Danube Valley. *Quaternary International* 378: 14–21.

- Gurova, M. & **Bonsall, C.** 2014. Lithic studies: an alternative approach to Neolithization. *Bulgarian e-Journal of Archaeology* 4: 107–135.

- Gurova, M. & **Bonsall, C.** 2014. 'Pre-Neolithic' in Southeast Europe: a Bulgarian perspective. *Documenta Praehistorica* 41: 95–109.

- Boroneanț, A., McSweeney, K. & **Bonsall, C.** 2014. Schela Cladovei 1982 – supplement to the original excavation report of Vasile Boroneanț. *Analele Banatului* 22: 17–31.

- Vaughn, M., **Bonsall, C.**, Bartosiewicz, L., Schoop, U.-D. & Pickard, C. 2014. Variation in the carbon and nitrogen isotopic signatures of pig remains from prehistoric sites in the Near East and Central Europe. *Archeometriai Műhely* 2013/X./4: 307–312.

- Gurova, M., **Bonsall, C.**, Bradley, B. & Anastassova, E. 2013. Approaching prehistoric skills: experimental drilling in the context of bead manufacturing. *Bulgarian e-Journal of Archaeology* 3(2): 201–221.

- Nalawade-Chavan, S., McCullagh, J., Hedges, R., **Bonsall, C.**, Boroneant, A., Bronk Ramsey, C. & Higham, T. 2013. Compound specific radiocarbon dating of essential and non-essential Amino acids: towards determination of dietary reservoir effects in humans. *Radiocarbon* 55(2–3): 709–719.

- **Bonsall, C.**, Pickard, C. & Groom, P. 2013. Boats and pioneer settlement – the Scottish dimension. *Norwegian Archaeological Review* 46(1): 87–90.

- **Bonsall, C.**, Boroneanț, A., Soficaru, A., McSweeney, K., Higham, T., Mirițoiu, N., Pickard, C. & Cook, G.T. 2012. Interrelationship of age and diet in Romania's oldest human burial. *Naturwissenschaften* 99: 321–325.

- Pickard, C., Pickard, B. & **Bonsall, C.** 2011. Autistic spectrum disorder in prehistory. *Cambridge Archaeological Journal* 21(3): 357–364.

- Cook, M., Ellis, C., Sheridan, A., Barber, J., **Bonsall, C.** [and 16 others] 2010. Excavations at Upper Largie Quarry, Argyll & Bute, Scotland: new light on the prehistoric ritual landscape of the Kilmartin Glen. *Proceedings of the Prehistoric Society* 76: 165–212.

- **Bonsall, C.**, Gurova, M., Hayward, C., Nachev, Ch. & Pearce, N.J.G. 2010. Characterization of ‘Balkan flint’ artefacts from Bulgaria and the Iron Gates using LA-ICP-MS and EPMA. *Интердисциплинарни изследвания* (Interdisciplinary Studies) 22–23: 9–18.
- Benjamin, J. & **Bonsall, C.** 2009. The prehistoric chert dagger from Piran, Slovenia: an underwater find from the northern Adriatic. *Arheološki vestnik* 60: 9–15.
- Benjamin, J. & **Bonsall, C.** 2009. A feasibility study for the investigation of submerged sites along the coast of Slovenia. *International Journal of Nautical Archaeology* 38: 163–172.
- Mlekuž, D., Budja, M., Payton, R.W. & **Bonsall, C.** 2008. 'Mind the gap'. Caves, radiocarbon sequences, and the Mesolithic–Neolithic transition in Europe – lessons from the Mala Triglavca rockshelter site. *Geoarchaeology: an international journal* 23: 398–416.
- Mlekuž, D., Budja, M., Payton, R.W., **Bonsall, C.** & Žibrat Gašparič, A. 2008. Reassessing the Mesolithic/Neolithic ‘gap’ in southeast European cave sequences. *Documenta Praehistorica* 35: 237–251.
- **Bonsall, C.**, Horvat, M., McSweeney, K., Masson, M., Higham, T.F.G., Pickard, C. & Cook, G.T. 2007. Chronological and dietary aspects of the human burials from Ajdovska Cave, Slovenia. *Radiocarbon* 49: 727–740.
- Pickard, C. & **Bonsall, C.** 2004. Deep-sea fishing in the European Mesolithic: fact or fantasy? *European Journal of Archaeology* 7: 273–290.
- **Bonsall, C.**, Cook, G.T., Hedges, R., Higham, T., Pickard, C. & Radovanović, I. 2004. Radiocarbon and stable isotope evidence of dietary change from the Mesolithic to the Middle Ages in the Iron Gates: new results from Lepenski Vir. *Radiocarbon* 46: 293–300.
- Bartosiewicz, L. & **Bonsall, C.** 2004. Prehistoric fishing along the Danube. *Antaeus* 27: 253–272.
- **Bonsall, C.**, Macklin, M.G. Payton, R.W. & Boroneanţ, A. 2002. Climate, floods and river gods: environmental change and the Meso–Neolithic transition in south-east Europe. *Before Farming: the archaeology of Old World hunter-gatherers* 3-4(2): 1–15.
- **Bonsall, C.**, Macklin, M.G., Anderson, D.E. & Payton, R.W. 2002. Climate change and the adoption of agriculture in north-west Europe. *European Journal of Archaeology* 5(1): 7–21.
- Parker, A.G., Goudie, A.S., Anderson, D.E., Robinson, M.A. & **Bonsall, C.** 2002. A review of the mid-Holocene elm decline in the British Isles. *Progress in Physical Geography* 26(1): 1–45.
- Kitchener, A.C. & **Bonsall, C.** 2002. A Woolly Mammoth tusk from Cliftonhall, near Edinburgh, Scotland. *Quaternary Newsletter* 96: 28–31.
- **Bonsall, C.**, Anderson, D.E. & Macklin, M.G. 2002. The Mesolithic–Neolithic transition in western Scotland and its European context. *Documenta Praehistorica* 29: 1–19.
- **Bonsall, C.**, Cook, G.T., Manson, J.A. & Sanderson, D. 2002. Direct dating of Neolithic pottery: progress and prospects. 8th Neolithic Studies. *Documenta Praehistorica* 29: 47–59.
- Cook, G.T., **Bonsall, C.**, Hedges, R.E.M., McSweeney, K., Boroneanţ, V. & Pettitt, P.B. 2001. A freshwater diet-derived ^{14}C reservoir effect at the Stone Age sites in the Iron Gates gorge. *Radiocarbon* 43: 453–460.
- Boroneanţ, V., **Bonsall, C.**, McSweeney, K., Payton, R.W. & Macklin, M.G. 2001. Mormintele Mezolitice din Aria III de la Schela Cladovei. *Apulum (Acta Musei Apulensis)* 28: 1–7.
- Macklin, M.G., **Bonsall, C.**, Davies, F.M. & Robinson, M.R. 2000. Human–environment interactions during the Holocene: new data and interpretations from the Oban area, Argyll, Scotland. *The Holocene* 10(1): 109–121.
- **Bonsall, C.**, Cook, G.T., Lennon, R.J., Harkness, D.D., Scott, M., Bartosiewicz, L. & McSweeney, K. 2000. Stable Isotopes, radiocarbon and the Mesolithic–Neolithic transition in the Iron Gates. *Documenta Praehistorica* 27: 119–132.
- Kitchener, A.C. & **Bonsall, C.** 1999. Further AMS radiocarbon dates for extinct Scottish mammals. *Quaternary Newsletter* 88: 1–10.

- Boroneanţ, V., **Bonsall, C.**, McSweeney, K., Payton, R.W. & Macklin, M.G. 1998. Mormintele mezolitice dîn Aria III de la Schela Cladovei. *Drobeta* 8: 1–10.

- **Bonsall, C.**, Lennon, R.J., McSweeney, K., Stewart, C., Harkness, D.D., Boroneanţ, V., Payton, R.W., Bartosiewicz, L. & Chapman, J.C. 1997. Mesolithic and Early Neolithic in the Iron Gates: a palaeodietary perspective. *Journal of European Archaeology* 5(1): 50–92.

- Kitchener, A.C. & **Bonsall, C.** 1997. AMS radiocarbon dates for some extinct Scottish mammals. *Quaternary Newsletter* 83: 1–11.

- **Bonsall, C.**, Boroneanţ, V. & D. Srejović. 1996. AMS radiocarbon determinations on human bone from Lepenski Vir, Vlasac and Schela Cladovei. *Mesolithic Miscellany* 17(2): 6–10.

- Mason, S., **Bonsall, C.** & Boroneanţ, V. 1996. Plant remains from Schela Cladovei, Romania. *Mesolithic Miscellany* 17(2): 11–14.

- Bartosiewicz, L., **Bonsall, C.**, Boroneanţ, V. & S. Stallibrass. 1995. Schela Cladovei: a review of the prehistoric fauna. *Mesolithic Miscellany* 16(2): 2–19.

- **Bonsall, C.**, Tolan-Smith, C. & Saville, A. 1995. Direct dating of Mesolithic antler and bone artifacts from Great Britain: new results for bevelled tools and red deer antler mattocks. *Mesolithic Miscellany* 16(1): 2–10.

- **Bonsall, C.**, Sutherland, D.G., Russell, N.J., Coles, G., Paul, C., Huntley, J. & Lawson, T.J. 1994. Excavations in Ulva Cave, Western Scotland 1990–91: a preliminary report. *Mesolithic Miscellany* 15(1): 8–21.

- Murray, N., **Bonsall, C.**, Sutherland, D.G., Lawson, T.J. & Kitchener, A. 1993. Further radiocarbon determinations on reindeer remains of Middle and Late Devensian age from the Creag nan Uamh caves, Assynt, north-west Scotland. *Quaternary Newsletter* 70: 1–10.

- **Bonsall, C.** & Smith, C.A. 1992. New AMS ^{14}C dates for antler and bone artifacts from Great Britain. *Mesolithic Miscellany* 13(2): 28–34.

- **Bonsall, C.**, Sutherland, D.G. & Lawson, T.J. 1992. Excavations in Ulva Cave, western Scotland 1989–90: a preliminary report. *Mesolithic Miscellany* 13(1): 7–13.

- **Bonsall, C.**, Sutherland, D.G. & Lawson, T.J. 1991. Excavations in Ulva Cave, western Scotland 1987: a preliminary report. *Mesolithic Miscellany* 12(2): 18–23.

- **Bonsall, C.**, Sutherland, D.G. & Lawson, T.J. 1989. Ulva Cave and the early settlement of northern Britain. *Cave Science* 16(3): 109–111.

- **Bonsall, C.** & C. Smith. 1989. Late Palaeolithic and Mesolithic bone and antler artifacts from Britain: first reactions to accelerator dates. *Mesolithic Miscellany* 10(1): 33–38.

- **Bonsall, C.** 1988. Morton and Lussa Wood: the case for early Flandrian settlement of Scotland. *Scottish Archaeological Review* 5: 30–33.

- Lawson, T.J. & **Bonsall, C.** 1986. Early settlement in Scotland: the evidence from Reindeer Cave, Assynt. *Quaternary Newsletter* 49: 1–7.

- **Bonsall, C.** Sutherland, D.G., Tipping, R.M. & Cherry, J. 1986. The Eskmeals Project 1981–5: an interim report. *Northern Archaeology* 7(1): 3–30.

- Smith, C. & **Bonsall, C.** 1985. A red deer antler mattock from Willington Quay, Wallsend. *Archaeologia Aeliana* 13: 203–211.

- **Bonsall, C.** & Leach, C. 1974. A multidimensional scaling analysis of British microlithic assemblages. *Computer Applications in Archaeology* 1: 5–6.

Research Reports

- **Bonsall, C.** 2002. *The lithic assemblage from Upper Largie Quarry, Kilmartin*. Report for AOC (Scotland) Ltd. Edinburgh: Department of Archaeology.

- Pickard, C. & **Bonsall, C.** 1999. *The marine molluscs from the archaeological site at An Corran, Staffin, Skye*. Report for Historic Scotland. Edinburgh: Department of Archaeology.

- **Bonsall, C.**, McSweeney, K., Boroneanţ, V., Bartosiewicz, L., Chapman, J.C., Mason, S. & Payton, R.W. 1996. *Schela Cladovei (Romania) Project. Fifth Interim Report*. Edinburgh: Department of Archaeology.

- **Bonsall, C.**, McSweeney, K., Boroneanţ, V., Bartosiewicz, L., Chapman, J.C. & Payton, R.W. 1995. *Schela Cladovei (Romania) Project. Fourth Interim Report*. Edinburgh: Department of Archaeology.

- **Bonsall, C.** & Gilmour, S. 1994. *Archaeological Evaluation and Watching Brief of the Former Auction Mart Site, Lochavullin, Oban: report to William Low plc*. Edinburgh: Department of Archaeology.

- **Bonsall, C.**, McSweeney, K., Boroneanţ, V., Bartosiewicz, L. & Stîngă, I. 1994. *Schela Cladovei (Romania) Project. Third Interim Report*. Edinburgh: Department of Archaeology.

- **Bonsall, C.**, Boroneanţ, V., Macklin, M.G., McSweeney, K. & Stallibrass, S. 1993. *Schela Cladovei (Romania) Project. Second Interim Report*. Department of Archaeology.

- **Bonsall, C.**, Boroneanţ, V., Macklin, M.G., McSweeney, K. & Stallibrass, S. 1992. *Schela Cladovei (Romania) Project. First Interim Report*. Department of Archaeology.

- **Bonsall, C.** & Robinson, M.R. 1992. *Archaeological Survey of the Glenshellach Development Area, Oban: Report to Historic Scotland*. Department of Archaeology.

- **Bonsall, C.**, Sutherland, D.G., Lawson, T.J., Russell, N.J. & Coles, G. 1991. *Ulva Cave Excavation: Report No. 3*. Department of Archaeology.

- **Bonsall, C.**, Sutherland, D.G, Lawson, T.J & Russell, N.J. 1989. *Ulva Cave Excavation: Report No. 2*. Department of Archaeology.

- **Bonsall, C.**, Sutherland, D.G. & Lawson, T.J. 1987. *Ulva Cave Excavation: Report No. 1*. Department of Archaeology.

IN SEARCH OF PLANTS IN THE DIET OF MESOLITHIC-NEOLITHIC COMMUNITIES IN THE IRON GATES

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Abstract: There are now several different plant assemblages originating from the Late Mesolithic, Mesolithic-Neolithic (transitional) and Early(/Middle) Neolithic layers of the sites in the Iron Gates area (c. 7400-5500 BC – Borić 2011). To a varied, but also very limited extent, they can be used to glean the availability of plant food sources and the possible components of plant-based human diets over these periods in the region. The botanical archives are, however, beset by problems such as the small size, unclear archaeological and chronological provenance, complex taphonomy and analytical-methodological issues. This paper reviews the, so far available, evidence and highlights the associated problems delimiting the potential for integrating the datasets and the reconstruction of plant-based diets of the Iron Gates Mesolithic and Neolithic communities.

Keywords: Danube Gorges/Iron Gates, Mesolithic-Neolithic, pollen, seed/fruit, starch.

Introduction

It was the investigations led by Vasile Boroneanț and Clive Bonsall at Schela Cladovei (1992 to 1996) on the Romanian side of the Danube in the Iron Gates area that were the first to encompass systematic sampling for plant remains in this region. The excavations at the site of Schela Cladovei included thorough sieving and flotation of soil removed from the Mesolithic and Neolithic contexts, and they yielded the first remains of plant parts potentially consumed by humans (root/tuber and seed/fruit remains – Mason *et al.* 1996). Flotation and archaeobotanical analysis at this site continue (Đ. Obradović, pers. comm.) and will add to the gradually emerging general picture of plant use in this uniquely important part of the Balkans. Of the highest interest is probably the role of plants in the diets of the Mesolithic and Neolithic communities of the Danube Gorges, especially given the likely shift in dietary habits at the time of/after the introduction of domestic food sources in the region. Indeed, the composition of the diets of these communities has been a central topic of both earlier and more recent papers dealing with the Mesolithic-Neolithic of the area (e.g., Bonsall *et al.* 1997, 2004, 2015; Nehlich *et al.* 2010; Nehlich and Borić 2015; Cristiani *et al.* 2016; Dimitrijević *et al.* 2016). Most of these and the associated studies focus on faunal remains and stable isotopes from human and animal bone as evidence of diet – understandably so, given the scarcity of plant remains indicating plant food consumption (see below). Nonetheless, some recent botanical work offered a few hints as to the potential components of plant-based diets in the Iron Gates, and we review them here. First, however, we discuss at length the methodological issues that define or, rather, constrain the quality of the available datasets. The discussion on the reliance on plants for food has, to some extent, featured in the work of C. Bonsall and other scholars focusing on the Danube Gorges. The benefit of having different researchers/teams investigating a similar set of questions (and materials) in a single micro-region lies in the opportunity to scrutinise and combine each other's work and to use the results of one as a control for the other. We attempt a similar approach here and we hope our contribution adds to the ongoing research.

The available datasets and the issues that surround them

There are now several different botanical datasets that derived from the Mesolithic and Neolithic contexts/layers in the Iron Gates. Not only are they different in the content and the questions they can address, but they are also of markedly different resolution and thus of varied usefulness for the study of plant procurement and consumption. We examine them here and highlight the issues that undermine their interpretative potential.

Pollen in archaeological deposits and in coprolites

The first botanical remains reported for the Mesolithic and Neolithic periods in the Iron Gates/Danube Gorges were pollen grains from Lepenski Vir (Gigov 1969). Table 1 summarizes the published data. In his report, Gigov mostly discusses the dominance of birch (*Betula*) pollen in the sample from underneath Building 54, and compares it with the presence of birch pollen in other post-glacial pollen records from the central Balkans. He suggests that birch pollen from Lepenski Vir indicates the "birch" phase, which he sees as characteristic of the cold Preboreal geo-climatological period. In reference to the human diet, he wonders whether the inhabitants of Lepenski Vir used to make cuts in birch trunks in order to extract its sweet juice available in spring (Gigov 1969. 206). If the birch pollen indeed derives from the Preboreal stage, it would perhaps be relevant to the earliest occupation of the site, dated to the Early Mesolithic period of the region (9500-7400 – Borić 2011. Table 2). However, the presence in the same deposit of pollen of less cold-tolerant tree taxa (e.g. *Celtis*, *Fagus*, *Tsuga*) shows that the (local) climatic conditions at the time were not harsh (Mišić *et al.* 1969). Without absolute dates, it is impossible to determine the age of this pollen assemblage, but it may be assumed that it reflects the time before, or the time of, construction of the floor of Building 54, which was in use prior to the beginning of the 6th millennium BC (Borić 2011. Footnote 117). The other pollen sample was obtained from inside a ceramic vessel, and is perhaps contemporary with it; based on the association with phase LV IIIb, the vessel comes from the Early/ Middle Neolithic level (cf. Borić 2008. Table 1). It is possible that the pollen grains date from the Neolithic, in which case the difference between the two samples in the taxa represented could be meaningful (e.g. in terms of the vegetation composition).

Pollen was also extracted from coprolites (fossilised human faeces) discovered at the sites of Icoana and Vlasac (Cârciumaru 1973, 1978). The age of these remains was determined based on their find position in the stratigraphic sequence at the respective sites, i.e. they were not dated using an absolute dating method; thus their age is uncertain. Consequently, their connection with the Mesolithic or Neolithic levels cannot be confirmed (cf. Kozlowsky and Kozlowsky 1986. 97), but could perhaps be inferred based on the relative depth at which they were found: in different layers between 90 cm and 210 cm at Icoana, and in layers between c. 100 cm and 320 cm at Vlasac (Cârciumaru 1973, 1978). In an ideal situation – the lower the layer, the older – but there is no evidence that this applies to the fossilised faeces in question. Moreover, the method by which it was established that these finds represent coprolites has not been described; also, it remains unclear if they are of human origin. Identification of the origin of coprolites can be complicated and requires an elaborate analytical procedure (cf. Reinhard and Bryant 1992), which adds another level of uncertainty to this strand of evidence. The matrix surrounding the pollen-yielding finds has not been checked for pollen and so it cannot be ascertained whether the identified pollen grains indicate plant (parts) that were actually ingested and defecated, or if they represent "background pollen" (Reinhard and Bryant 1992. 251) or pollen rain, which would, perhaps, also leave traces within the excavated layers. A combination of the two categories of pollen in the coprolites – food-derived and general (e.g. airborne) pollen – is also possible and may explain the highly diverse pollen assemblage, as the one from Vlasac (see Table 2).

Table 1. List of taxa identified from the pollen recovered from archaeological deposits at Lepenski Vir (after Gigov 1969).

Sample	2	1
Soil	sandy loess	clayey
Quadrant		C/XII
Layer		IV
Context	10 cm below floor of Bldg. 54	content of an overturned pot
Reported phase	LV I	LV IIIb
TAXA	total grain	percentage
Abies	3	3
Betula	400	
Carpinus		15
Celtis	5	
Corylus		4
Fagus	2	15
Juniperus	20	
Pinus	5	10
Quercus		44
Salix		3
Tsuga	10	
Ulmus		4
Amaranthaceae		x
Caryophyllaceae		x
Compositae		x
Poaceae	15	x
ferns and moss	47	x
fungal spores		x
AP		*78*
NAP		*20*
spores		2

Assuming that the pollen records from Icoana and Vlasac indeed derive from the Mesolithic-Neolithic layers, and from fossilised human faeces, the alleged occurrence of pollen of domesticated cereals at Icoana and Vlasac must be evaluated. At these two sites, Cârciumaru recognises grass pollen of different sizes and, using the size-based criterion proposed by Erdtman (1943. 58), distinguishes between pollen of wild and cultivated grasses, whereby he attributes pollen grains of up to 38.5 μ in diameter to wild grasses (Gramineae) and the larger ones to cultivated grasses (Cerealia) (Cârciumaru 1978. 32, Table 1-2). He then observes that 'small' grass pollen occurs in greater proportions in the lower (deeper) layers at Icoana and Vlasac, whereas upper layers contain more of the 'large' grass pollen. He sees this as an indicator of the presence of cultivated cereals in the (presumably) later occupation levels at these sites and suggests a possible local cereal cultivation at these locations (Cârciumaru 1973. 173; 1978. 32).

The overall quantities/proportions of grass pollen recovered from Icoana[1] and Vlasac are likely too low to account for the natural variation in the pollen grain size (e.g., Erdtman 1943. 56-62; also Behre 2007, 2008. 205). Likewise, the proportions of grain of different size classes proposed are very small and inadequate for offering conclusions based on their quantity (see Table 2). Even if the datasets are considered representative, the argued trend – from more wild grass to more cereal-type pollen up the stratigraphic sequence – is not discernible. As shown in Table 3, 'small' grass pollen occurs throughout the sequence at Icoana, whilst 'large' grass pollen is, in fact, more visible at the greater depths. At Vlasac, the wild grass and the assumed cereal-type pollen were present in both the lower and the upper layers. In sum, this evidence is thin and as such should not be used to claim, or support other potential evidence of, the presence of domesticated cereals at the two sites (such as in Cristiani *et al.* 2016. 10299, 10301, see below).

A further problem with the 'cereal' pollen evidence from the Iron Gates is the use of pollen grain size, and only the size, as the determinant in distinguishing between the wild and the domesticated Poaceae pollen. There are several other criteria that need to be satisfied in terms of the grain morphology (e.g., shape and size of the pollen grain elements), and some specific microscopy methods that can be applied, in order to come close to accurate identification of cereal pollen, which may be questionable even then, depending on the grain preservation and the level of the analyst's experience (Erdtman 1943. 58-59; Behre 2008. 204-205). Thus, much more convincing data are needed on the grass pollen from Icoana and Vlasac prior to accepting the identification of some as possibly belonging to domesticated cereals.

The presence of cereal pollen could, perhaps, be expected in the top levels/latest phases of these two sites, since they date from the Mesolithic-Neolithic transitional period and the Early(/Middle) Neolithic (Borić 2011. Table 2) – the time when other elements associated with the Neolithic arrive in the region (Borić *et al.* 2008, 2009). The potential traces of cultivated cereals in the form of starch grains have recently been discovered in dental calculus scraped off the teeth of selected human occupants of Vlasac and Lepenski Vir; we review this line of evidence below.

Seed/fruit archives and their limited potential due to size and taphonomy

Two Mesolithic-Neolithic sites in the Iron Gates produced charred macro-botanical (non-charcoal) remains – Vlasac and Schela Cladovei – largely thanks to extensive sampling of the excavated deposits and flotation[2]. At both sites, 0.3 mm mesh was used to capture the floating material (Mason *et al.* 1996; Filipović *et al.* 2010). Still, quantities of the discovered remains are desperately low. In the Mesolithic samples from Schela Cladovei, few fragments of possible root/tuber tissue (parenchyma) were found, a couple of seed/fruit remains and some wood charcoal. The post-Mesolithic contexts (Neolithic and Iron Age deposits, combined in the available report) yielded wood charcoal, a small number of seeds (including cereal? grain) and a part of probable sloe/plum-type fruit stone (Mason *et al.* 1996).

Table 2. List of taxa identified from pollen extracted from supposed human coprolites encountered at Vlasac (after Cârciumaru 1978).

Trench/Quadrant	d/9	b/17	b/13	A/17.18	d/9	A	a/6
Excavation layer	XXIV	XVI	XV	XI	XII	VIII	IV
Relative depth (cm)	320	268	197	197	193	172	103
Period	Late Mesolithic						Neolithic
Phase *	Vlasac II	Vlasac II	Vlasac II/III	Vlasac II/III	Vlasac II/III	Vlasac II/III	Neolithic
Context		Burial 34		Burial 51			
TAXA	%	%	%	%	%	%	%
Abies						1.2	
Acer		2.4	4.6				1.8
Alnus	3.4	3.6	1.8	1.5	6.6	8.4	4.6
Betula	0.7			0.1	1.7	0.4	0.5
Carpinus					0.3		?0.5
Corylus	61.4	40	15.1	5.4	41	36.7	41.2
Fagus	9.2	1.2			0.7	0.8	
Fraxinus		2.4	1.4				
Juglans					0.3		
Picea	0.7		1	0.1		5	2.3
Pinus	4	4.9	4.3	0.3	2.8	7.1	8.1
Quercus	9.5	3.6	13	1.3	12.6	7	18
Quercus/Ulmus/Tibia	28.5	40.3	69.2	92	43.1	38.2	40.1
Salix	1	4.8	2.8	0.3	3.1	2.1	2.3
Tilia	1	20.7	45.8	1.4	5.6	20.2	10.5
Ulmus	18	16	10.4	89.3	24.9	11	11
AP	*55.2*	*29.6*	*58*	*82.9*	*38.4*	*44*	*20.8*
Poaceae	6.6	20.5	16.3	17	11	10	7.6
Cerealia	2.6		1.8		0.6	2.5	1.4
Artemisia	3.6	17.2	10	7.4	3	16	4
Aster	2	2.4	9.5	7.4	1.3	6	3.5
Ephedra		3.2	0.9	2.8	1.7	1	0.8
Rhamnus	2.3	0.8	4.5	9.3	28.1		0.2
Urtica			0.2	1		0.5	0.4
Carduaceae			0.9	1		0.5	0.5
Caryophyllaceae	1		3	1	2.3		1.1
Centaniaceae	0.6						
Chenopodiaceae	22.3	17.2	5.8	9.3	2.6	17.5	65.6
Compositae	3.6	2.4	4	1	3.3	7.5	10.3
Cyperaceae	4	3.2	3.4	3.7	3.3	2	3
Elaeagnaceae	1		1.4			3	4.8
Geraniaceae	6.6		4.5	4.7		0.5	4.6
Labiateae	0.6		2		0.3	0.5	
Leguminosae			3		0.6	1.5	
Linaceae	31	10.6	5.4	7.4	27.8	15.5	5.5
Malvaceae			0.2			0.5	0.4
Plantaginaceae	0.3	0.8	0.4	1			0.2
Polygonaceae	10	16.4	16.7	24.3	11	13	7.3
Polypodiaceae	96.7	98.5	97.2	100	100	91.2	100
Ranunculaceae			0.9				1.1
Rosaceae	0.3	0.8	2.5	1	2	0.5	0.5
Saxifragaceae		2.4	0.9				0.5
Umbeliferae		1.6	0.6	1	0.3	0.5	0.2
Lycopodium	3.3	1.5	2.8			8.8	
NAP	*40.6*	*44.3*	*37.2*	*13*	*40.1*	*37*	*64.1*
spores	4.2	26.1	4.8	4.1	21.5	19	15.1
total pollen grains	*738*	*275*	*739*	*823*	*743*	*540*	*805*
Cerealia pollen. count	13	11	14	19	4	0	0

** according to Marković-Marjanović 1978. Table 6 (Сл. 6)

Table 3. Distribution of grass pollen of different sizes through the stratigraphic sequences at Icoana and Vlasac (after Cârciumaru 1973, 1978, 1996).

	Trench/		Relative	% of grass pollen of different diameter (within all grasses)									
Sample	Quadrant	Layer	depth (cm)	c. 27 μ	c. 36 μ	38.5 μ	41 μ	43 μ	45.5 μ	47.5 μ	50 μ	52.5 μ	54.5 μ
Icoana-4	V		90	0.6	0.2	0.4					0.2		
Icoana-5	V		100	2.5	1.3	0.5							
Icoana-6	V		140	3.7	2.6	1	2		0.2				
Icoana-8	VI		160	2.3	0.9	0.9	0.9	0.5	0.1				0.3
Icoana-7	V		165	3.4	1	0.6	0.3			0.3			0.3
Icoana-1	IV		180	0.2	1.1	0.5	1.1	0.2	0.5				
Icoana-2	IV		190		0.7	0.7	0.2	0.2	0.2	0.2			0.2
Icoana-3	IV		210	1.5	1.7	0.1	0.2	0.2					
Vlasac-6	a/6	IV	103			0.8	0.4	0.2					
Vlasac-5	a/6	VIII	172			1		0.5		0.5		0.5	
Vlasac-3	d/9	XII	193			0.3					0.3		
Vlasac-7	b/13	XV	197			1.8							
Vlasac-4	d/9	XXIV	320			1.6	0.3	0.3			0.3		

At Vlasac, macro-plant remains were somewhat more visible, especially in the samples from the Late Mesolithic layers (Filipović *et al.* 2010; Allué *et al.* in press a; Filipović. in press). The most commonly occurring are remains of Cornelian cherry (*Cornus mas* L.) fruit stones, the majority of which derived from the (cremation) burials (Table 4). The non-burial Mesolithic deposits at Vlasac produced very little plant material – a few fragments of Cornelian cherry fruit stones and some unidentifiable vegetal matter. Further, the sampled contexts attributed to the transitional Mesolithic-Neolithic phase at Vlasac, all but one representing burial fills, contained about a dozen remains of Cornelian cherry, common dogwood, hazelnut, dwarf elder and indeterminate plant tissue (possibly parenchyma). Finally, in the few samples from the Early Neolithic occupation layer, several more fragments of Cornelian cherry fruit stones were discovered (Filipović. *in press*).

The available seed/fruit assemblage from the Iron Gates is small and, at Vlasac, largely composed of the remains of a single plant (Cornelian cherry). The majority of the archaeobotanically-sampled contexts at Vlasac are burials (for the results of the renewed excavations at Vlasac see Borić *et al.* 2014), and the largest portion of them are cremations. These deposits are less likely to contain charred residues from day-to-day plant processing and consumption than are the deposits in the domestic areas (e.g. in and around fire-related features and dwellings). It is plausible that the discovered charred remains, certainly the wood charcoal, mixed in with burnt bone fragments, represent traces of the vegetal material burnt along with the deceased. The relatively frequent and numerous finds of Cornelian cherry in the cremations suggest that the fruit may have served as an element of the ritual.

The rest of the analysed deposits at Vlasac include the infills of inhumation burials, pit infills and general occupation layers (Filipović. in press). These lack the evidence of local (*in situ*) burning and are, therefore, of lower resolution in terms of indicating possible sources of the charred remains. In other words, their botanical component likely derives from different activities, such as food preparation/consumption or other plant-related practices, but it could (also) simply represent random, accidentally charred inclusions from the surrounding flora. This ambiguity, combined with the small quantity of the remains, limits the usefulness of this assemblage in the reconstruction of a plant-based diet at Vlasac. Nevertheless, the presence of various plant taxa in the archaeological layers at Vlasac and Schela Cladovei at least shows their availability in the surroundings of the sites at the time, as also signalled by the charcoal assemblage from

Vlasac (Filipović *et al.* 2010; Allué *et al.* in press; Allué and Filipović. in press); some of these taxa have edible fruits or other parts and could have represented food sources.

Table 4. List of taxa identified from charred seed/fruit remains collected at Vlasac.

TAXA	total remains	ubiquity (%) across 38 contexts
Cornus mas, stone fragment	154	26
Cornus mas, complete stone	15	8
cf. *Cornus sanguinea,* stone fragment	1	3
Corylus avellana, shell fragment	3	8
Fruit stone/nutshell fragment, indeterminate	2	5
Eleocharis type, seed	1	3
Sambucus ebulus, seed	5	5
Solanum nigrum /dulcamara, seed	3	8
wild seed, indeterminate	1	3
indeterminate plant matter (fragment)	5	13
cf. parenchyma (ml)	0.05	3
burnt oily matter (ml)	0.01	3

Starch in dental calculus and doubtful identifications

The initial extraction and study of starch grains trapped in dental calculus on the teeth of individuals buried in the Iron Gates was carried out within a PhD project (during 2015) that looked at the diet and health status of the Mesolithic and Neolithic communities of this region (Jovanović 2017). Altogether, dental calculus found in 53 human individuals from five of the sites on the Serbian side of the Danube was examined for starch. ^{14}C dates were obtained directly on 22 of the selected individuals (see Table 5); the rest of the samples are chronologically characterised based on their archaeologically determined stratigraphic position and their spatial association with the dated burials. Following the periodization by Borić (2011. Table 2), the sampled humans date to two main periods in the local development: 12 to the Mesolithic (9500-6300 BC) and 41 to the Mesolithic-Neolithic and the Neolithic (6300-5500 BC).

The starch extraction was performed at the Histology Laboratory of the Crop Science Department at the Faculty of Agriculture, University of Belgrade (in the period between December 2014 and October 2015). This environment offered adequate equipment – fume hood, sterile tools, laboratory chemicals, consumables (Eppendorf tubes, glass slides and cover slips, disposable pipettes, micro-pestle) micro-scale, vortex mixer and centrifuge. Inside the fume hood, the surfaces[3] with dental calculus accumulations were gently brushed, the calculus removed with a dental pick, placed into aluminium foil pans and its weight measured. The residue was then placed in 1.5 ml tubes and subjected to demineralisation. The demineralisation and starch extraction procedure followed the steps taken by Tromp (2012. 105), which represent a modified protocol used by Hardy *et al.* (2009). The samples were mounted on glass slides by placing 30 µl of the pellet and adding a small amount of paraffin oil. They were observed using Olympus BX51 compound polarising microscope with magnifications of x100, x500 and x1000 (routinely, magnifications of at least x400 are used in starch analysis – e.g. Piperno *et al.* 2004). The total area of the slides was examined in horizontal transects, under bright-field illumination. The suspected starch grains were confirmed by the presence/visibility of the extinction cross under cross-polarising light. All recovered grains were counted and photographed. In general, the possibility of laboratory contamination of the material is excluded as it was ensured that the conditions in which the samples were processed and the analysis conducted replicate those described in the relevant literature.

A total of 35 starch grains were retrieved: five from the calculus of four Mesolithic individuals and 30 from the calculus of 17 (Mesolithic/)Neolithic individuals (Table 5, Fig. 1/a-d). In another strand of this study, dental calculus from humans found in Early Neolithic burials (dated to 5600-5400 cal. BC) at the sites of Vinča and Golokut (central and northern Serbia) was also analysed for starch grains; 131 starch grains were detected in the calculus from nine individuals.

The remarkable difference in the number of starches between the Neolithic populations that resided in and outside the Danube Gorges may reflect the differential preservation of starch, variations in the diet, and/or beginnings of/increase in the consumption of starch-rich food, such as domesticated cereals, in the regions outside the Iron Gates. The latter is in full agreement with the earliest evidence of domesticated cereals in the wider region – recorded, for example, at Early Neolithic/Starčevo-Criș sites in Serbia and Romania (Cârciumaru 1996; Bogaard and Walker 2011; Filipović and Obradović 2013), and perhaps as early as c. 6400 cal BC at the site of Blagotin in central Serbia (Whittle et al. 2002. 113 – 14C dates on human and animal remains from pits in which einkorn grains were also present, see Jezik 1998). As regards the starch evidence, this form of reasoning is valid only under the assumption that the retrieved Neolithic starch grains belong to domesticated cereals and that they come from consumed food. Within the described study, archaeological starches were compared with a set of modern examples extracted from seeds of some of the taxa documented at Early Neolithic sites in the wider region (primarily crops, e.g. einkorn, emmer, barley, lentil, pea) as well as from some wild, starch-rich edible fruit (e.g. sweet chestnut and acorns). Modern specimens were crushed to fine powder and mounted on a slide using (double-distilled) water or mineral oil. A portion of the material was soaked in boiling water or boiled for five minutes. Some of the modern samples were stained with Lugol's iodine reagent. The modern starch grains from different sources and in different states were observed and their characteristics compared with those of the archaeological starches and the relevant examples from the literature. Unfortunately, the available microscopy (adapted for Raman spectroscopy) did not offer a sufficiently clear and detailed view of the grains and their key features (e.g. lamellae, hilum, fissures, etc.), which are the basis of botanical determination. Further, this was the first ever attempt at extracting and examining archaeological starch in Serbia, and was carried out in collaboration with specialists who deal with modern starch derived from known sources (i.e. not requiring identification). Thus, it was felt that the expertise of an experienced specialist is necessary in order to pursue botanical determination of the grains. Based on the size and shape, most of the starches could broadly (and preliminary) be identified as belonging to species of Poaceae family. No major differences were observed between archaeological grains from different sites and periods, but this could again be due to the resolution and quality of the microscope image being too low to allow for discerning key characteristics of the material. A much more careful examination is needed to evaluate similarities/differences between the sites/periods; indeed, the starch extracted will, in the near future, be examined using appropriate microscopy.

Overall, major contribution offered by this initial analysis is the discovery of starch grains in dental calculus of the inhabitants of the Iron Gates and beyond, and the indication of a greater presence of starch grains in the calculus of Neolithic individuals from outside the Danube Gorges. As a sort of an adjunct to this work, a test-study was carried out in 2016 within the ERC-funded BIRTH project and in collaboration with Amanda Henry, at the time leader of the research group 'Plant Foods in Hominin Dietary Ecology' at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany (MPI EVA). The analysis was conducted at the MPI EVA under Henry's supervision and following the starch extraction protocol used by her team (which includes fewer steps and requires less time than the one used in the above-described study). Prior to this work, water-traps for modern starch contamination were set up in two locations at the Department of Archaeology in Belgrade where the skeletal material from the Iron Gates is stored. These were later checked for starch; no starch was detected. Dental calculus from two sites was tested for starch: Mesolithic infant burial at Hajdučka Vodenica (Burial 18(3), tooth 26 – Fig. 2) and two individuals from the Mesolithic-Neolithic (transitional) level at Lepenski Vir from which other teeth were previously examined (Burial 11, tooth 41 and Burial 61, tooth 32 – Fig. 3, 4). In some cases, control samples were taken from the surface of jaw bones, the wrapping in which the material was stored, the masking tape used to keep fragments of jaws together and the soil trapped in the alveolus of the tested teeth.

One of the jaws from Lepenski Vir (LV61) produced starch grains; the other two specimens did not yield starch. In the calculus from the lingual surface of a tooth in LV61, two starch grains (Fig. 5/a-b) were registered whose characteristics are consistent with those seen in modern and archaeological starch of Triticae (large-seeded grasses including domesticated cereals). Single bell-shaped grain was also present. A control sample from the outer surface of the jaw contained another Triticae-looking starch, though smaller than the other two (Fig. 6/a), and a grain of compound, polyhedral form also coming from a grass seed (e.g. of Paniceae tribe or perhaps *Avena*) (Fig. 6/b). It is probably safe to consider the starch granules in the calculus as 'authentic', based also on the finds of starches in the above-described study (and the one that followed – see below). They may be indicative of plant (possibly cereal) consumption over this period at Lepenski Vir, but there are a number of other possible routes for the inclusion of starch into dental calculus (e.g. Radini *et al.* 2016). The granules found on the jaw most likely represent contamination, the sources of which could be many (e.g. the matrix in which the bones were found, the packaging in which they were stored over the years since the excavation). The other control samples did not contain starch, although the sample of soil from jaw LV61 was not examined.

The most recently conducted analysis of starches preserved in dental calculus of Mesolithic and Neolithic inhabitants of the Iron Gates area (Cristiani *et al.* 2016) was much more successful in terms of the number of recovered grains and the level of identification. Hundreds of starch granules were recovered from the teeth of the individuals from Vlasac dated to the Late Mesolithic (c. 7400-6300 cal BC) and Mesolithic-Neolithic transitional occupation (c. 6300-5900 cal BC), as well as from Lepenski Vir individuals dated to its Early Neolithic occupation (c. 5950-5700 cal BC) (Cristiani *et al.* 2016. 1-2, Table 1). The starches were attributed to the tribes of Triticeae, Paniceae, Aveneae and Fabeae. An overlap in morphology is reported for the granules ascribed to the same taxa coming from different periods/sites – e.g. Triticeae starch from Vlasac and Lepenski Vir, although the number of Triticeae starches found in the Neolithic samples is significantly lower than that detected in the Mesolithic samples and perhaps does not account for possible variations in the form and structure of the grains.

Table 5. List of individuals from the Mesolithic-Neolithic Iron Gates sites sampled for dental calculus and examined for starch as part of the doctoral project (Jovanović 2017)

	Site	Burial No.	Period/ phase	Absolute dating (cal BC)		Sex	Age	Tooth No.	Total starch
1	Hajdučka Vodenica	14	Mesolithic (c. 9500-6300 BC)			ND	5-9	32	1
2		18				ND	10-14	16	
3	Lepenski Vir	60		9175-8635	Bonsall *et al* . 2015	M	Middle aged adult	46	1
4		50		8310-7970	Borić and Price 2013	M	Middle aged adult	47	
5		69		7940-7590	Bonsall *et al* . 2015	M	Middle aged adult	48	
6		22		7580-7190	Borić 2011	M?	Adult size	16	
8		64				M	Middle aged adult	18	1
7		21				ND	Adult size	46	
9		105				ND	Adult size	36	2
10	Padina	11		8616-8296	Borić 2011	ND	5-9	46	
11	Vlasac	18c(2)				ND	5-9	I(incisor)	
12		64b				ND	5-9	32	
									5
1	Ajmana	7	Neolithic (c. 6300-5500 BC)	6214-6008	Borić 2011	ND	Middle aged adult	16	1
2		6		6030-5824	Borić 2011	M?	Young adult	23	
3		12				ND	1-4	85	8
4		14				ND	5-9	42	1
5		15				ND	5-9	41	
6		3				ND	10-14	11	
7		13				ND	10-14	22	2
8		11				F	Middle aged adult	44	1
9		9				F	Old adult	34	5
10	Lepenski Vir	61 *		6225-5915	Bonsall *et al* . 2015	ND	5-9	11	1
11		54e		6210-5930	Bonsall *et al* . 2015	F	Young adult	47	
12		122		6208-5987	Borić 2011	ND	15-19	16	
13		32b		6080-5720	Borić 2011	F?	Middle aged adult	46	
14		32a **		6076-5731	Bonsall *et al* . 1997; Borić 2011	F	Old adult	33	1
15		89a		6060-5780	Bonsall *et al* . 2015	ND	Adult size	37	
16		26		6025-5890	Bonsall *et al* . 2015	M	Young adult	47	
17		79a		6020-5890	Bonsall *et al* . 2015	M?	Old adult	37	
18		73		6005-5845	Borić and Price 2013	M	Middle aged adult	26	
19		19		5984-5752	Borić 2011	F	Middle aged adult	31	
20		88		5984-5644	Bonsall *et al* . 1997; Borić 2011	F	Middle aged adult	45	
21		9		5980-5740	Bonsall *et al* . 2015	ND	Adult size	26	
22		17		5776-5575	Borić 2011	ND	Young adult	32	1
23		14		5235-5990	Bonsall *et al* . 2015	F	Adult size	33	1
24		7/I		5230-5985	Bonsall *et al* . 2015	M	Old adult	27	1
25		56				ND	5-9	17	1
26		11 *				ND	10-14	42	1
27		6				F?	15-19	45	
28		37				ND	15-19	41	1
29		57				ND	15-19	16	
30		48				ND	Young adult	41	
31		27a				F?	Middle aged adult	16	
32		13				F?	Adult size	27	
33		16				F?	Adult size	41	
34		20 **				F	Adult size	17	
35		28				M	Adult size	48	1
36		47				F	Adult size	38	
37		57(1)				ND	Adult size	47	2
38		74				M?	Adult size	23	
39		82				ND	Adult size	17	
40		83a				ND	Adult size	31	
41		91				ND	Adult size	27	1
									30

* individuals also analysed at MPI EVA

** individuals also analysed by Cristiani *et al* . (2016)

Cristiani *et al.* attempted a more precise identification of the starch grains they recovered. In the process, they used extensive collections of modern reference material, including starch from plants native to the central Balkans, and compared the grains with the archaeological specimens. They also consulted the relevant literature and considered the presence/distribution of candidate species in the region (Cristiani *et al.* 2016. SI2-3). There are, however, certain methodological problems and uncertainties in this aspect of their work that bring into question the proposed taxonomic determination of starches, thus undermining the conclusions and ideas expressed in the paper.

For instance, the authors did not provide a comprehensive list of species from which modern starch was extracted and compared against the archaeological examples (though they do seem to list all of the observed species within the *Aegilops* genus – Cristiani *et al.* 2016. SI2). Further, there is no information in the paper on the: number of examined individuals within the species; whether they were collected in different ecological settings (especially since the effect of plant growing conditions on starch formation and morphology is acknowledged by the authors); how many starch grains from how many seeds per individual plant/species were inspected; if unripe seeds were also examined (given that those could have also been consumed). It remains unclear why the size of starch grains of *Aegilops* species was used to support the exclusion of this genus as a potential source of the archaeological starches when, at least following the description of the modern reference material examined by the authors, this size seems to be comparable to the size of starch granules of domesticated Triticeae (Cristiani *et al.* 2016. SI2). Also, the fact that *Aegilops* seeds have not been discovered within, the generally very small, charred seed assemblages from the Mesolithic and Early Neolithic sites in the region is no argument against its possible contribution to the starch assemblage from the Iron Gates (Cristiani *et al.* 2016. 4). The characteristics of the structure and shape, and the number and distribution of A- and B-type starch granules, as used in the paper, appear to be better criteria for differentiation in this and other described cases. The exclusion as potential candidates of all wild *Hordeum* species nowadays growing in the region based on the results of the inspection of modern starches from only one of them (*Hordeum murinum*) requires explanation/justification. These are some of the matters of concern in relation to the narrowing-down of the possible sources of Triticeae starch to domesticated cereals, as attempted by Cristiani *et al.* The support for their conclusions the authors find in the pollen records from Vlasac and Icoana where, purportedly, pollen grains of domesticated Cerealia were encountered (see above). As argued in the relevant section above, this claim is problematic and unconfirmed, and remains disputable.

Several other types of starch were identified by Cristiani *et al.* and they suggest potential use of different (wild) plant sources. *Aveneae* tribe includes many of the most abundant grasses in temperate ecosystems, growing in both disturbed and in natural conditions. Some of them have large seeds (e.g. *Avena* species) that could have represented a food source, but one should not forget other edible parts. Here, of high relevance could be *Arrhenatherum elatius* var. *bulbosum* that produces edible, starch-rich bulbs of up to ca. 1 cm in diameter and which were found (as charred macro-remains) at a number of sites in central and north-western Europe (Roehrs *et al.* 2013). For the Paniceae starch they discovered, Cristiani *et al.* think it could have originated from *Setaria* genus (Cristiani *et al.* 2016. 4). Most of the Paniceae nowadays found in the area are allochthonous (Vrbničanin *et al.* 2004), but some *Setaria* species have a cosmopolitan distribution (e.g. *Setaria pumila*, widespread in the region). *Setaria* species are C4 plants, which is, perhaps, of interest in light of the elevated $\delta^{13}C$

values in the human bones from the Iron Gates (Bonsall *et al.* 2015). Cristiani *et al.* further recovered a small number of starch grains that may belong to species of the *Vicia* genus which includes pulses whose seeds are, due to their natural toxicity, edible to humans only if properly treated prior to consumption (e.g. soaking in water, prolonged cooking). A number of plant parts that would not be considered edible to humans (e.g. fibre, wood) were present in the dental calculus analysed by Cristiani *et al.*, along with some animal remains (Cristiani *et al.* 2016. 4, SI4); this was also the case in the calculus analysed within the other two starch-related studies described above. This may reflect the variety of possible routes via which the material became entrapped in the calculus, as well as the diversity of sources from which the starch and non-starch remains could have originated (see Radini *et al.* 2016). Thus resolving the taphonomy of the inclusions in the dental plaque should precede and inform conclusions on the composition of diet and dietary habits based on calculus-derived starch.

The study by Cristiani *et al.* included two individuals from Lepenski Vir that have also been examined within one of the above-mentioned projects (Jovanović 2017); different teeth were targeted for dental calculus (see Table 4 here and Table 1 in Cristiani *et al.* 2016). The two sets of results for one of the individuals (LV20) are similar – no or very few granules were discovered in the examined teeth. The results for the other individual (LV32a), however, are very different: only one grain was detected on the tooth tested in the previous study, whereas the three teeth analysed by Cristiani *et al.* yielded over 200 starches. This may relate to the different starch recovery methods applied, but also to the possible variation among teeth in the rate of starch deposition, and the calculus build-up and microenvironment that can affect calculus formation (Radini *et al.* 2016. 73). Cristiani *et al.* state that the grains deriving from LV32a were retrieved in dense clusters, but they do not specify whether this was the case for all three teeth they examined for this individual (Cristiani *et al.* 2016. Fig. 3, SI). In this sense, it would also be interesting to know approximately how many starch grains per tooth were detected in other individuals for which multiple teeth were sampled within this study and which also produced a relatively large number of granules (i.e. the three individuals from Vlasac that yielded 50 or more starch grains – Cristiani *et al.* 2016. Table 1). Very tentatively, perhaps there are similarities in e.g. the pathways of inclusion and deposition of starch in the cases where it was found in abundance, such as in the calculus of two female individuals of about the same age at death (and with largely overlapping absolute dates) – H53 from Vlasac and 32a from Lepenski Vir. Cristiani *et al.* 2016 suggest that, other than the consumption of starchy seeds, another route could be the inhalation of starch produced during their processing (prior to cooking) that could have included grinding. It remains to be seen whether the grinding stones found at the two sites were used for plant processing.

Strontium isotope analysis of LV32a (and of two other individuals from Lepenski Vir examined for starch – Cristiani *et al.* 2016. 2) indicated a non-local origin and a possible connection with the farming groups that were, at the time, settling in the Danube hinterlands and beyond (Borić and Price 2013). Interestingly, the dental calculus from the teeth of LV32a did not contain starch granules of the Triticeae type, but the other two individuals did produce this category of starch (Cristiani *et al.* 2016. Table 1). Macro-remains of domesticated cereals were not encountered in the so far analysed archaeobotanical samples from Lepenski Vir (Allué *et al.* in press b) and they were, likewise, absent from (all of) the occupation phases at Vlasac. They were, on the other hand, noted in the Early Neolithic layers at Schela Cladovei (Mason et al. 1996; Đ. Obradović, pers. comm.), thus indicating the presence of domesticated cereals in this period within the Iron Gates. Inter- and intrasite variations in the presence/absence and degree of use of cereals, and the possible cultivation of cereals, may have been features of the Early Neolithic food acquisition in this region.

Plants in the diet of the Iron Gates Mesolithic-Neolithic inhabitants – a summary of the discussion

The evidence is, so far, limited to a) the possibly human coprolite-derived pollen record; b) the modest collection of charred seed/fruit remains; and c) the starch grains preserved in human dental calculus. Each of the three datasets are in some ways problematic, which limits their interpretative potential.

It has not been explicitly shown that pollen grains from Vlasac and Icoana derived indeed from fossilised human faeces. Their stratigraphic and chronological characterisation is also insecure due to the lack of direct absolute dating. Further, identification of some pollen grains as belonging to domesticated cereals is shrouded by problems relating to, for instance, the criterion used for the taxonomic determination – the size of pollen grains – in the context of the naturally wide range of sizes of grass pollen. These issues render futile the available pollen assemblages from Vlasac and Icoana as regards their contribution to the reconstruction of plant-based diets in the Mesolithic-Neolithic Iron Gates.

Seed/fruit remains have so far been retrieved only from two sites in the Iron Gates. The assemblages are very small and reveal little of the potential array of plants procured for food or for other purposes. In the case of Vlasac, most of the analysed deposits represent burial infills, whilst only a few samples come from contexts likely containing detritus from every-day activities that may have encompassed plant processing and consumption. This could partly explain the small number of the remains. They do, nonetheless, offer some idea of the type of plants that may have been gathered for food – wild fruit and nut which would have been available in the immediate surroundings, as also indicated by the much larger and more diverse charcoal record from Vlasac.

The extraction of starch grains from the dental calculus was successful and this approach emerged as a promising venue in the investigations of plant-based diets of the Mesolithic and Neolithic communities of the Danube Gorges. This especially, given that flotation and archaeobotanical analysis continue only at Schela Cladovei, whilst the osteological material is abundant and available for further examinations. So far, the starch analysis has provided some information on the potential sources of food among herbaceous plants, mainly grasses, and this nicely complements the data provided by the charred seed/fruit (and wood) assemblage largely composed of the remains of woody plants. The highly diverse pollen record also offers some idea on the range and availability of the potential plant foods in the region as it appears to contain pollen from different vegetation formations (e.g. high- and mid-altitude woodland, grassland, ruderal and wetland flora).

Some of the recovered starch grains (i.e. those placed in the Triticeae category) may have derived from domesticated cereals. The presence/use of cereals could indeed be expected from around the time when the earliest groups using domesticated crops are detected in the region, such as the possibly c. 6400 cal BC-settlers of the site of Blagotin in central Serbia. Or perhaps even earlier, as argued by Cristiani *et al.* based on their identification of Triticeae starch grains and referring to the AMS-dates on emmer grain from the Franchthi cave which confirm that domesticated cereals reached southern Greece (likely via maritime route) during the first half of the 7th millennium BC (Perlès *et al.* 2013). A refinement of the identification procedures is essential in order to test and further explore this possibility, as well as detailed consideration of the taphonomy and the use of a dataset that includes more samples from more sites.

[1] For Icoana, only proportions of grass pollen within NAP were provided (Cârciumaru 1973, 1996. Table 30); for Vlasac, the total number of pollen and spores per sample were supplied (Cârciumaru 1978. Table 1).

[2] Flotation and analysis of the sediment collected for unspecified analysis at Lepenski Vir in the 1960's is ongoing (Allué *et al.* in press b).

[3] By rule, calculus from supragingival surfaces was always targeted for sampling.

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References

Allué, E., Filipović, D. in press. Chapter 14. Charcoal remains. In Borić, D. (ed.), *Vlasac: A Mesolithic Site in the Danube Gorges Revisited, vol. I.* McDonald Institute for Archaeological Research, Cambridge.

Allué, E., Filipović, D., Borić, D. in press a. Archaeobotanical record from the site of Vlasac in the Danube Gorges (Serbia). In Arias, P. (ed.) *Proceedings of the 10th Conference on the Mesolithic in Europe*. Oxbow Books, Oxford.

Allué, E., Filipović, D., Cristiani, E., Borić, D. in press b. Late Glacial to early Holocene environs and wood use at Lepenski Vir. In Borić, D. *et al.* (eds.), *Title TBA (Proceedings of the MESO2015)*. Publisher TBC.

Behre, K.-E. 2007. Evidence for Mesolithic agriculture in and around central Europe?. *Vegetation History and Archaeobotany* 16: 203-219.

Behre, K-E. 2008. Wo sind die Nachweise für mesolithischen Ackerbau in Mitteleuropa? *Archäologische Informationen* 30(2): 53-57.

Bogaard, A., Walker, A. 2011. Preliminary Archaeobotanical Results from Teleor 003/Măgura 'Buduiasca'. In: Mills, S.F., Mirea, P. (eds.) *The Lower Danube in Prehistory. Landscape Changes and Human-Environment Interactions*. Editura Renaissance, București: 151-160.

Bonsall, C., Lennon, R., McSweeney, K., Stewart, C., Harkness, D., Boroneant, V., Bartosiewicz, L., Payton, R., Chapman, J. 1997. Mesolithic and Early Neolithic in the Iron Gates: a paleodietary perspective. *Journal of European Archaeology* 5(1): 50-92.

Bonsall, C., Cook, G.T., Hedges, R.E.M., Higham, T.F.G., Pickard, C., Radovanović, I. 2004. Radiocarbon and Stable Isotope Evidence of Dietary Change from the Mesolithic to the Middle Ages in the Iron Gates: New Results from Lepenski Vir. *Radiocarbon* 46 (1): 293-300.

Bonsall, C., Cook, G., Pickard, C., McSweeney, K., Sayle, K., Bartosiewicz, L., Radovanović, I., Higham, T., Soficaru, A., Boroneant, A. 2015. Food for Thought: Re-Assessing Mesolithic Diets in the Iron Gates. *Radiocarbon* 57 (4): 1-11.

Borić, D. 2008. First households and 'house societies' in European prehistory. In Jones, A. (ed.), *Prehistoric Europe: theory and practice*. Wiley-Blackwell, Chichester: 109-142.

Borić, D. 2011. Adaptations and Transformations of the Danube Gorges Foragers (c. 13,000–5500 cal. BC): An Overview. In Krauß, R. (ed.), *Beginnings – New Research in the Appearance of the Neolithic Between Northwest Anatolia and the Carpathian Basin*. Verlag Marie Leidorf GmbH, Rahden/Westf.: 157-203.

Borić, D., Price, T.D. 2013. Strontium isotopes document greater human mobility at the start of the Balkan Neolithic. *Proceedings of the National Academy of Sciences of the United States of America* 110 (9): 3298-3303.

Borić, D., French, C.A.I., Dimitrijević, V. 2008. Vlasac revisited: Formation processes, stratigraphy and dating. *Documenta Praehistorica* 35: 293-320.

Borić, D., Raičević, J., Stefanović, S. 2009. Mesolithic cremations as elements of secondary mortuary rites at Vlasac (Serbia). *Documenta Praehistorica* 36: 247-282.

Borić, D., French, C.A.I., Stefanović, S., Dimitrijević, V., Cristiani, E., Gurova, M., Antonović, D., Allué, E.A., Filipović, D. 2014. Late Mesolithic Lifeways and Deathways at Vlasac (Serbia). *Journal of Field Archaeology* 39(1): 4-31.

Cârciumaru, M. 1973. Compte rendu de l'analyse pollinique des coprolithes d'Icoana – Portes de Fier. *Actes du VIII^{e} Congrès International des Sciences Préhistoriques et Protohostoriques,* Beograd 9-15 septembre 1971, Tome deuxième, Raports et Corapports. Union internationale des Sciences préhistoriques et protohistoriques, Beograd: 172-173.

Cârciumaru, M. 1978. L'analyse pollinique des coprolithes de la station archéologique de Vlasac. In Garašanin, M. (ed.), *Vlasac. A Mesolithic Settlement in the Iron Gates* (II Geology – Biology – Anthropology). Srpska akademija nauka i umetnosti, Beograd: 31-34.

Cârciumaru, M. 1996. *Paleoetnobotanica*. Studii în Preistoria și Protoistoria României. Editura Glasul Bucovinei - Helios, Iași.

Cristiani, E., Radini, A., Edinborough, M., Borić, D. 2016. Dental calculus reveals Mesolithic foragers in the Balkans consumed domesticated plant foods. *Proceedings of the National Academy of Sciences of the United States of America* 113: 10298-10303.

Dimitrijević, V., Živaljević, I., Stefanović, S. 2016. Becoming sedentary? The seasonality of food resource exploitation in the Mesolithic-Neolithic Danube Gorges. *Documenta Praehistorica* 43: 103-122.

Erdtman, G. 1943. *An Introduction to Pollen Analysis*. Chronica Botanica Company, Waltham.

Filipović, D., Allué, E., Borić, D. 2010. Integrated Carpological and Anthracological Analysis of Plant Record from the Mesolithic Site of Vlasac, Serbia. *Glasnik Srpskog Arheološkog Društva* 26: 145-161.

Filipović D., Obradović, Đ. 2013. Archaeobotany at Neolithic sites in Serbia: a critical overview of the methods and results. In Miladinović-Radmilović, N., Vitezović, S. (eds.), *Bioarheologija na Balkanu: bilans i perspektive / Bioarchaeology in the Balkans. Balance and perspectives*. Srpsko arheološko društvo, Beograd – Sremska Mitrovica: 25-55.

Filipović, D. in press. Chapter 13: Charred Seed and Fruit Remains. In Borić, D. (ed.) *Vlasac: A Mesolithic Site in the Danube Gorges Revisited, vol. I.* McDonald Institute for Archaeological Research, Cambridge.

Gigov, A. 1969. Analiza polena. In Srejović, D. (ed.), *Lepenski vir*. Srpska književna zadruga, Beograd: 203-206.

Hardy, K., Blakeney, T., Copeland, L., Kirkham, J., Wrangham, R., Collins, M. 2009. Starch granules, dental calculus and new perspectives on ancient diet. *Journal of Archaeological Science* 36: 248-255.

Jezik, S. 1998. *The origins of agriculture in temperate Europe: An exploration into the subsistence strategies of two early Neolithic groups in the Central Balkans, Foeni-Salaș and Blagotin*. Master thesis. University of Manitoba, Winnipeg.

Jovanović, J. 2017. *The Diet and Health Status of the Early Neolithic Communities of the Central Balkans (6200-5200 BC).* Doctoral Dissertation. University of Belgrade, Belgrade.

Kozlowski, J.K., Kozlowski, S.K. 1986. Foragers of Central Europe and their acculturation. In Zvelebil, M. (ed.), *Hunters in Transition*. Cambridge University Press, Cambridge: 95-108.

Marković-Marjanović, J. 1978. Geologija i stratigrafija. In Garašanin, M. (ed.), *Vlasac. A Mesolithic Settlement in the Iron Gates* (II

Geology – Biology – Anthropology). Srpska akademija nauka i umetnosti, Beograd: 11-27.

Mason, S.L.R., Boroneanţ, V., Bonsall, C. 1996. Plant remains from Schela Cladovei, Romania. *Mesolithic Miscellany* 17: 11-14.

Mišić, B., Čolić, D., Dinić, D. 1969. Ekološka-fitocenološka istraživanja. In Srejović, D. (ed.), *Lepenski vir, nova praistorijska kultura u Podunavlju*. Srpska književna zadruga, Beograd: 207-223.

Nehlich, O., Borić, D., Stefanović, S., Richards, M.P. 2010. Sulphur isotope evidence for freshwater fish consumption: a case study from the Danube Gorges, SE Europe. *Journal of Archaeological Science* 37(5): 1131-1139.

Nehlich, O., Borić, D. 2015. Response to B onsall et al. "Food for thought: reassessing Mesolithic diets in the Iron Gates". *Radiocarbon* 57(4): 701-703.

Perlès, C., Quiles, A., Valladas, H. 2013. Early seventh-millennium AMS dates from domestic seeds in the Initial Neolithic at Franchthi Cave (Argolid, Greece). *Antiquity* 87(338): 1001-1015.

Piperno, R.D., Weiss, E., Holst, I., Nadel, D. 2004 Processing of wild cereal grains in the Upper Palaeolithic revealed by starch grain analysis. *Nature* 430: 670-673.

Radini, A., Nikita, E., Buckley, S., Copeland, L., Hardy, K. 2016. Beyond food: The multiple pathways for inclusion *of* materials into ancient dental calculus. *American Journal of Physical Anthropology* 162(63): 71-83.

Reinhard, K.J., Bryant, V.M. Jr. 1992. Coprolite Analysis. A Biological Perspective on Archaeology. *Papers in Natural Resources* 46: 245-288.

Roehrs, H., Klooss. S., Kirleis, W. 2013. Evaluating prehistoric finds of Arrhenatherum elatius var. bulbosum in north-western and central Europe with an emphasis on the first Neolithic finds in Northern Germany. *Archaeological and Anthropological Sciences* 5: 1-15.

Tromp, M. 2012. *Large-scale Analysis of Microfossils Extracted from Human Rapanui Dental Calculus: a Dual-Method Approach Using SEM-EDS and Light Microscopy to Address Ancient Dietary Hypotheses*. Master thesis. Idaho State University, Pocatello.

Vrbničanin, S, Karadžić, B. Dajić-Stevanović, Z. 2004. Adventivne i invazivne korovske vrste na području Srbije. *Acta Herbologica* 13(1): 1-12.

Whittle, A., Bartosiewicz, L., Borić, D., Pettitt, P.B., Richards, M. 2002. In the Beginning: New Radiocarbon Dates for the Early Neolithic in Northern Serbia and South-East Hungary. *Antaeus* 25: 63-117.

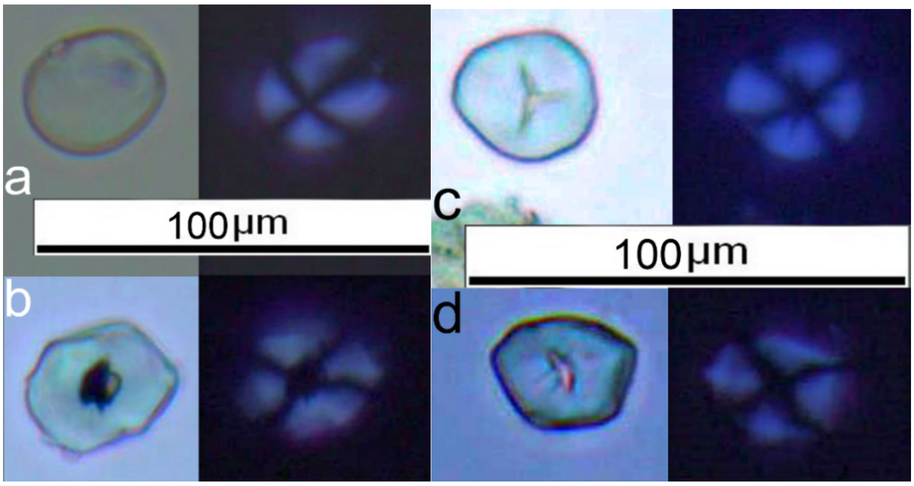

Figure 1. Some of the starch grains retrieved from the dental calculus of individuals dated to the Neolithic from the sites of Ajmana and Lepenski Vir (views under bright field and cross-polarised light): a) Ajmana, grave 13; b) Ajmana, grave 9; c) Lepenski Vir, grave 57(1); d) Lepenski Vir, grave 7/I.

Figure 2. The indicated sampled area of the calculus on the tooth of the individual from the Mesolithic grave 18(3) at the site of Hajdučka Vodenica.

Figure 3. The marked sampled area of the calculus on the tooth of the individual from the Mesolithic/Neolithic grave 11 at the site of Lepenski Vir. The control-sampled piece of masking tape also indicated.

Figure 4. The surface of a tooth after the removal of the calculus of the individual from the Mesolithic/Neolithic grave 61 at the site of Lepenski Vir.

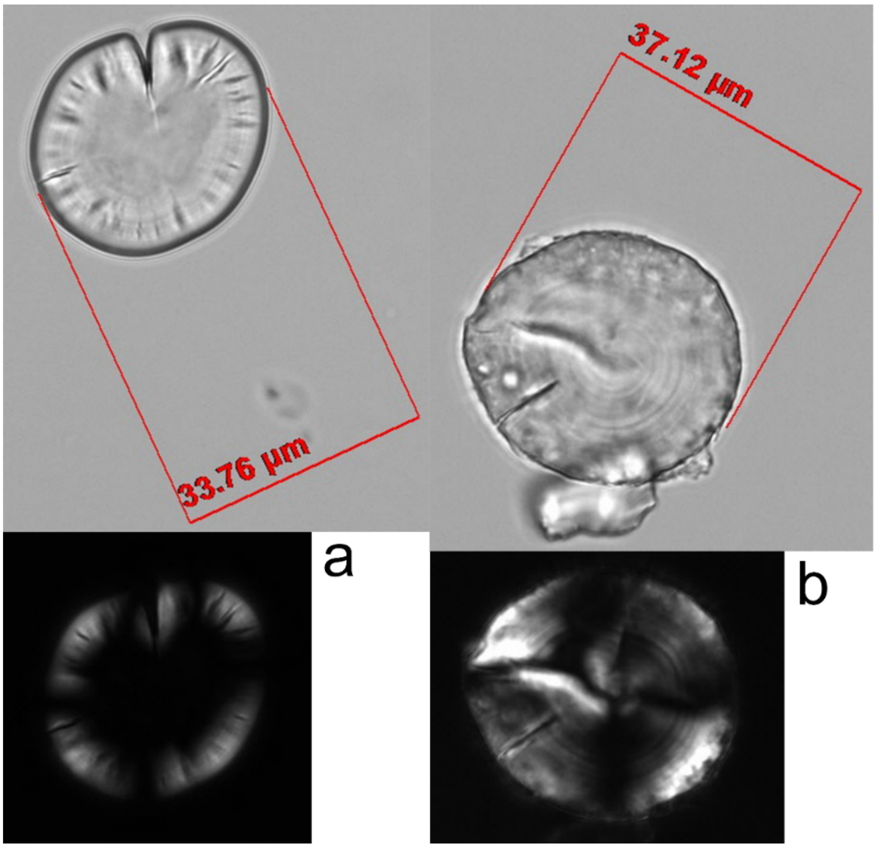

Figure 5. Starch grains recovered from the calculus from the individual buried in grave 61 at Lepenski Vir.

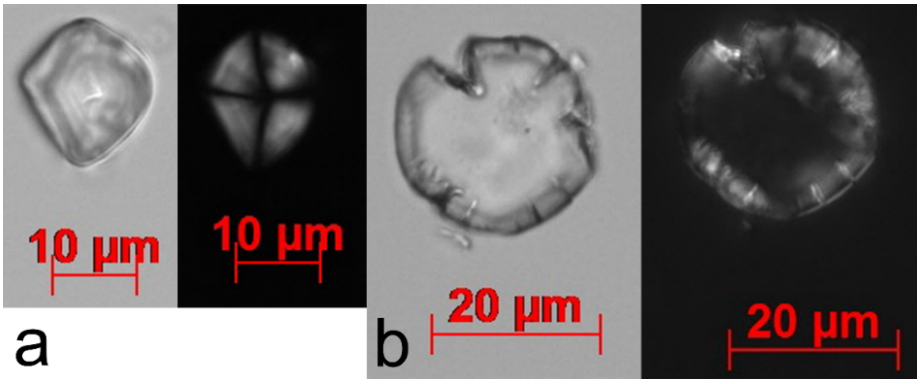

Figure 6. Starch grains recovered from the control sample taken from the surface of the jaw bone of the individual buried in grave 61 at Lepenski Vir.