PRACTICAL ARCHAEOBOTANY 2024 Co-ordinator Mike Charles

Summary and aims

Many current debates in archaeology, ranging from the origins of agriculture to the rise and collapse of urban centres and empires, rely on ideas concerning the production and consumption of plants. This module introduces the theory and methodology that underpin the analysis of macroscopic plant remains from archaeological deposits. Core topics include the identification of charred and waterlogged plant remains, issues of preservation and recovery, analytical approaches to the interpretation of archaeobotanical data and presentation of results.

The tutorials focus on principles underlying analytical techniques and broader issues of interpretation. The practical component of the paper consists of eight laboratory-based classes [normally 2/2.5 hours each] covering the key stages of archaeobotanical investigation, from on-site recovery to sample sorting, identification, quantification and data analysis.

Learning outcomes

You should understand:

- the parameters for the recovery, analysis and interpretation of archaeobotanical remains;
- the role played by archaeobotanical evidence in current - archaeological debates; and
- the potential and limitations of this evidence for understanding past human behaviour.

Transferable skills

You will gain fundamental laboratory skills and develop the skill of evaluating reliability and plausibility of interpretation in published reports. You will also develop your ability to navigate complex and controversial issues, both verbally and in written form.

Tutorial essays:

these have a word limit of 2500 words and should be submitted by 12:00 GMT on the Thursday before the tutorial.

Assessment:

1) 5000-word essay. The topic will be formulated in discussion with the tutors.
2) 5000-word report on an archaeobotanical dataset. The project dataset will be fully presented in week 8.

Schedule:

Wk		***Seminars etc.***		***Practicals***	
1		Module introduction		Cereal chaff identification criteria	
2	ESS	1. Preservation, sampling & recovery Identification & quantification		Cereal grain identification criteria	
3		2. Crop production		Pulse seed identification	
4	ESS	3. Ethnoarchaeology		Wild/weed seed identification	
5		4. Crop processing & storage		Identification of waterlogged plant remains	
6	PRE	5. Plant consumption		Identification of other crops (edible fruits, nuts, oil and fibre plants	
7		Project data I		Mini project, part 1: Flotation, sample scanning and sorting	
8		Project data II		Mini project, part 2: Identification & quantification of sorted material	
		Thursday 10-11:30 Usually IOA seminar room		**Thursday, 14:00 to 16:00 Usually AAWL basement [IOA]**	

A separate session to discuss the project assemblage [see below] will be arranged for week 8.

PRACTICAL ARCHAEOBOTANY RESOURCES

	GENERAL
	Charles, M. and Halstead, P. 2001. Biological Resource Exploitation: Problems of Theory and Method. In Brothwell, D. & Pollard, M. (eds) *Handbook of Archaeological Sciences. London*: Wiley, pp. 365-78.
	R.T.J. Cappers & R. Neef 2021 Handbook of Plant Palaeoecology
	Jacomet, S., and A. Kreuz 1999. *Archäobotanik*. Stuttgart: Eugen Ulmer. [in German]
	Outram, A.K. and Bogaard, A. 2019. *Subsistence and Society in Prehistory: New Directions in Economic Archaeology*. Cambridge: Cambridge University Press.
	Pearsall, D. 2015. *Paleoethnobotany. A Handbook of Procedures,* 3rd Edition. London: Academic Press. [Macro-remains Ch.]
	Wilkinson, K. and Stevens, C. 2003. *Environmental Archaeology. Approaches, Techniques & Applications.* Tempus, Stroud. [see especially Section 3 Palaeoeconomy Ch.]
	Zohary, D., Hopf, M. and Weiss, E. 2012. *Domestication of Plants in the Old World*. Fourth edition. Oxford: Oxford University Press. [available as e-book through SOLO]
	Online sources
	Jacomet, S. et al.2006. Cereal Identification Manual. Online publication: http://arkeobotanika.pbworks.com/f/Jacomet+cereal+ID.pdf
	Historic England; Internet Resources for Archaeobotanists. https://historicengland.org.uk/content/docs/research/awg-links-online-archaeobotanical-resourcespdf/
	Sheffield TOK – Integrated Archaeobotanical Project. https://sites.google.com/sheffield.ac.uk/archaeobotany/seeds/identification
	UCL Prof Dorian Fuller http://www.homepages.ucl.ac.uk/~tcrndfu/archaeobotany.htm
	Dr Naomi Miller, U PENN https://www.sas.upenn.edu/~nmiller0/
	Journals & Groups
	Vegetation History & Archaeobotany
	Environmental Archaeology
	Journal of Archaeological Science
	International Workgroup of Palaeoethnobotanists http://www.archaeobotany.org/
	Term workshop
	ADG University of Oxford
	Seed Atlas series
	Berggren, G. 1969 on-. Atlas of seeds and small fruits of Northwest-European plant species. Swedish Natural Science Research Council
	Cappers R.T.J., Neef R. & Bekker R.M. 2009 Digital atlas of economic plants. Groningen: Barkhuis & Groningen University Library.
	Cappers R.T.J., Bekker R.M. & Jans J.E.A. 2006 Digital seed atlas of the Netherlands. Groningen: Barkhuis & Groningen University Library.
	Bojnanský, V. & Fargašová, A. Atlas of Seeds and Fruits of Central and East-European Flora: The CarpathianMountains Region Hardcover –Illustrated,

	Preservation, sampling, recovery, identification and quantification
	From site to spreadsheet: What are the key factors that need to be considered in the recovery and quantification of plant remains from archaeological sites.
	Preservation, sampling, recovery
	Allen, S.E. 2019. Context and contents: Distinguishing variation in archaeobotanical assemblage formation processes at Early Halaf Fistıklı Höyük, Turkey. *Vegetation History and Archaeobotany*, 28: 247–262.
s	Antolín, F., B. L. Steiner and S. Jacomet 2017. The bigger the better? On sample volume and the representativeness of archaeobotanical data in waterlogged deposits. *Journal of Archaeological Science: Reports* 12: 323-333.
	Badham, K., and G. Jones. 1985. An experiment in manual processing of soil samples for plant remains. *Circaea* 3:15-26.
	Bending, J. 2005. An experimental approach to the disaggregation of samples from peat deposits. *Environmental Archaeology*, 10, 81–8.
	Boardman, S. and Jones, G. 1990. Experiments on the effects of charring on cereal plant components. *Journal of Archaeological Science* 17: 1-11.
	Castillo, C.C. 2019. Preservation bias: is rice overrepresented in the archaeological record?. *Arch Anthropol Sci* 11, 6451–6471
	Charles, M. 1998: Fodder from dung: the recognition and interpretation of dung-derived plant material from archaeological sites. *Environmental Archaeology* 1: 111-122.
	Charles, M., Forster, E., Wallace, M. & Jones, G. 2015. "Nor ever lightning char thy grain": establishing archaeologically relevant charring conditions and their effect on glume wheat grain morphology, *STAR* 1:1: 1-6.
p	Dunseth, Z. C., Fuks, D., Langgut, D., Weiss, E., Melamed, Y., Butler, D. H., Yan, X., Boaretto, E., Tepper, Y., Bar-Oz, G., & Shahack-Gross, R. (2019). Archaeobotanical proxies and archaeological interpretation: A comparative study of phytoliths, pollen and seeds in dung pellets and refuse deposits at Early Islamic Shivta, Negev, Israel. *QSR 211*, 166–185.
r	French, D.H. 1971. An experiment in water-sieving. *Anatolian Studies* 21: 59-64.
	Green, F. J. 1982. Problems of interpreting differentially preserved plant remains from excavations of medieval urban sites. In A. Hall and H. Kenward eds *Environmental Archaeology in an Urban Context*. CBA Research Report 23, pp. 40-46.
	Hastorf, C A. "Recent Research in Paleoethnobotany." *Journal of Archaeological Research*, vol. 7, no. 1, 1999, pp. 55–103. *JSTOR*, www.jstor.org/stable/41053165. Accessed 6 Jan. 2021.
	Hubbard, R.N.L.B., and A. al Azm. 1990. Quantifying preservation and distortion in carbonised seeds; and investigating the history of friké production. *Journal of Archaeological Science* 17: 103-106.
	Jones, M. 1991. Sampling in palaeoethnobotany. In W. van Zeist, K. Wasylikowa and K.-E. Behre [eds] *Progress in Old World Palaeoethnobotany*. Rotterdam: A.A. Balkema, pp. 53-62.
	Jones, J., Heather Tinsley & Richard Brunning (2007) Methodologies for assessment of the state of preservation of pollen and plant macrofossil remains in waterlogged deposits, Environmental Archaeology, 12:1, 71-86, DOI: 10.1179/174963107x172769
R	Kenward HK, Hall AR, Jones AKC (1980) A tested set of techniques for the extraction of plant and animal macrofossils from waterlogged archaeological deposits. Sci Archaeol 22:3–15
P	Letts, J.B. 1999. *Smoke Blackened Thatch. A Unique Source of Late Medieval Plant Remains from Southern England*. English Heritage and University of Reading, London.
s	Maier and Arno Harwath. (2011). Detecting intra-site patterns with systematic sampling strategies. Archaeobotanical grid sampling of the lakeshore settlement Bad Buchau-Torwiesen II, southwest Germany. *Vegetation History and Archaeobot*, *20*(5).
p	Miksicek, C.H. 1987. Formation processes of the archaeobotanical record. *Advances in Arch. Method and Theory* 10: 211-247.
	Rasmussen, P. 1993: Analysis of sheep/goat faeces from Egolzwil 3, Switzerland: evidence for branch and twig foddering of livestock in the Neolithic. *Journal of Archaeological Science* 20, 479-502.
r	Tolar, T., Jacomet, S., Velušček, A., Čufar, K. 2010. Recovery techniques for waterlogged archaeological sediments: a comparison of different treatment methods for samples from Neolithic lake shore settlements. *Vegetation History and Archaeobotany*, 19: 53-67.
	Tomlinson, P. 1985. Use of vegetative remains in the identification of dyeplants from waterlogged 9th & 10th century AD deposits at York. *Journal of Archaeological Science* 12: 269-283.
s	van der Veen, M. 1984. Sampling for seeds. In W. van Zeist and W. A. Casparie [eds] Plants and Ancient Man. Rotterdam: A.A. Balkema, pp. 193-199.
p	van der Veen, M. 2007. Formation processes of desiccated and carbonized plant remains the identification of routine practice *Journal of Archaeological Science* 34: 968-990.
r	Vandorpe, P., & Jacomet, S. 2007. Comparing different pre-treatment methods for strongly compacted organic sediments prior to wet-sieving: A case study on Roman waterlogged deposits *Environmental Archaeology*, 12: 207-214.
	Veen, M. van der, and N. Fieller. 1982. Sampling seeds. *Journal of Archaeological Science* 9:287-298.
	Wagner, G.E. 1988. Comparability among recovery techniques. In C. A. Hastorf and V. S. Popper [eds] *Current Palaeoethnobotany*. Chicago: University of Chicago Press, pp. 17-35.

	Identification and quantification
	Allen, S. 2019 Context and contents: Distinguishing variation in archaeobotanical assemblage formation processes at Early Halaf Fistıklı Höyük, Turkey - Vegetation History and Archaeobotany, 2019 - Springer
	Antolín, F. BL Steiner, S Jacomet - The bigger the better? On sample volume and the representativeness of archaeobotanical data in waterlogged deposits Journal of Archaeological Science ..., 2017 - Elsevier
	Bates, J., Petrie, C. & Singh, R. Cereals, calories and change: exploring approaches to quantification in Indus archaeobotany.*Archaeol Anthropol Sci* 10, 1703–1716 (2018). https://doi.org/10.1007/s12520-017-0489-2
	Bonhomme V, Picq S, Ivorra S, Evin A, Pastor T, Bacilieri R, et al. (2020) Eco-evo-devo implications and archaeobiological perspectives of trait covariance in fruits of wild and domesticated grapevines. PLoS ONE 15(11): e0239863. https://doi.org/10.1371/journal.pone.0239863
	Bonhomme, V, Forster, E, Wallace, M, Stillman E2017 Identification of inter-and intra-species variation in cereal grains through geometric morphometric analysis, and its resilience under experimental charring.
	Brown, T.A. et al. 1994. DNA in wheat seeds from European archaeological sites. *Experientia* 50:571-575.
	Czajkowska, BI.,Bogaard, AM, M Kohler-Schneider, G Jones, M Charles, A Mueller-Bieniek, and TA Brown. 2020. "Ancient DNA Typing Indicates That the 'New' Glume Wheat of Early Eurasian Agriculture Is a Cultivated Member of the Triticum Timopheevii Group." Journal of Archaeological Science 123.
	Dennell, R. 1976. The economic importance of plant resources represented on archaeological sites. *Journal of Archaeological Science* 3: 229-247.
	Dennell, R. W. 1974. Botanical evidence for prehistoric crop processing activities. *Journal of Archaeological Science* 1,275-284
	Hather, J. 1991. The identification of charred archaeological remains of vegetative parenchymous tissue. *Journal of Archaeological Science* 18: 661-675.
	Hendy, J., et al. (2018). Ancient proteins from ceramic vessels at Çatalhöyük West reveal the hidden cuisine of early farmers. *Nature Communications* 9: 4064.
	Hillman, G., S. Mason, D. de Moulins, and M. Nesbitt. 1996. Identification of archaeological remains of wheat: the 1992 London workshop. *Circaea* 12: 195-209.
	Hubbard, R. & Clapham, A.1992 -Quantifying macroscopic plant remains Review of Palaeobotany and Palynology.
	Hubbard, R.N.L.B. 1980. Development of agriculture in Europe and the Near East: evidence from quantitative studies. *Economic Botany* 34: 51-67.
	Jones, G. - The application of present-day cereal processing studies to charred archaeobotanical remains Circaea, 1990 - envarch.net
	Jones, G. 1991. Numerical analysis in archaeobotany. In W. van Zeist, K. Wasylikowa and K.-E. Behre [eds] *Progress in Old World Palaeoethnobotany*. Rotterdam, A.A. Balkema, pp. 63-80
	Jones, G. 1998. Wheat grain identification – why bother? *Environmental Archaeology* 2: 29-34.
	Jones, G., S. Valamoti, and M. Charles. 2000. Early crop diversity: a "new" glume wheat from northern Greece. *Vegetation History and Archaeobotany* 9: 133-146.
	Miller, N.F. 1988. Ratios in palaeoethnobotanical analysis. In C. A. Hastorf and V. S. Popper [eds] *Current Palaeoethnobotany*. Chicago: University of Chicago Press, pp. 72-85.
	Nistelberger, H.M., Smith, O., Wales, N., Star, B., Boessenkool, S., 2016. The efficacy of high-throughput sequencing and target enrichment on charred archaeobotanical remains. Sci. Rep. 6, 37347.
	Tanno, K. and G. Willcox. 2012. Distinguishing wild and domestic wheat and barley spikelets from early Holocene sites in the Near East. *Vegetation History and Archaeobotany* 21: 107-115.
	Tomlinson, P. 1985. Use of vegetative remains in the identification of dyeplants from waterlogged 9th-10th century AD deposits at York. *Journal of Archaeological Science* 12: 269-283.
	Valamoti, S. C Pagnoux, M Ntinou, L Bouby More than meets the eye: new archaeobotanical evidence on Bronze Age viticulture and wine making in the Peloponnese, Greece ... - ... and Archaeobotany, 2019 - Springer
	Veen, M. van der, and N. Fieller. 1982. Sampling seeds. *Journal of Archaeological Science* 9: 287-298.

Ethnoarchaeology

Discuss the benefits and issues around the use of ethnoarchaeological approaches to the interpretation of archaeological plant remain assemblages.

Applying ethnoarchaeological results:

Halstead P, Jones G. Agrarian ecology in the Greek islands: time stress, scale and risk. The Journal of Hellenic Studies. 1989 Nov;109:41-55.

Ethnoarchaeology Issues:

Gosselain, Olivier. 2016. To Hell with Ethnoarchaeology!. Archaeological Dialogues 23 (2): 215–228.

Lyons, D. & David, N. (2019) To Hell with Ethnoarchaeology ... and Back!, Ethnoarchaeology, 11:2, 99-133, DOI: 10.1080/19442890.2019.1642557

Roux V. Not to throw the baby out with the bathwater. A response to Gosselain's article. Archaeological Dialogues. 2017;24(2):225-229. doi:10.1017/S138020381700023X

Ethnoarchaeology Volume:

WORLD ARCHAEOLOGY 2016 debates edition – Ethnoarchaology

- It's a material world: the critical and on-going value of ethnoarchaeology in understanding variation, change and materiality. Diane Lyons & Joanna Casey, pp. 609-627
- Ethnoarchaeology as slow science. Jerimy J. Cunningham & Scott MacEachern, pp. 628-641
- Sitting in the gap: ethnoarchaeology, rock art and methodological openness. Liam M. Brady & Amanda Kearney, pp. 642-655
- Using the present to interpret the past: the role of ethnographic studies in Andean archaeology. Bill Sillar & Gabriel Ramón Joffré, pp. 656-673
- Ethnoarchaeology: critic, consolidator and contributor. Kathryn A. Kamp & John C. Whittaker, pp. 674-677
- Decolonial archaeologies: from ethnoarchaeology to archaeological ethnography. Yannis Hamilakis, pp. 678-682
- Ethnoarchaeology, epistemology, ethics. Ian J. McNiven, pp. 683-686
- Ethnoarchaeology or simply archaeology? Alfredo González-Ruibal, pp. 687-692
- Article Commentary
- 'Ethno' plus 'archaeology': what's in there for Africa(ns)? Shadreck Chirikure, pp. 693-699
- Debates in ethnoarchaeology today: a new crisis of identity or the expression of a vibrant research strategy? Caroline Hamon, pp. 700-704
- The role and place of ethnoarchaeology in current archaeological debate Gustavo G. Politis, pp. 705-709
- Assessing Ethnoarchaeology's Contemporary Relevance. Ajay Pratap, pp. 710-713

ADDITIONAL READING

Beeley, B. W. (1970). The Turkish Village Coffeehouse as a Social Institution. *Geographical Review*, 60(4), 475–493.

Ebeling, J., & Rogel, M. 2015. The tabun and its misidentification in the archaeological record. Levant, 47(3), 328–349.

Fuller DQ, Stevens C, McClatchie M. 2014 Routine activities, tertiary refuse and labor organization: social inferences from everyday archaeobotany. Ancient plants and people: contemporary trends in archaeobotany. 1:174-217.

Hillman, G. 1973. Crop Husbandry and Food Production: Modern Basis for the Interpretation of Plant Remains. *Anatolian studies* 23 (): 241–244. Web.

Jones G. 1987 A statistical approach to the archaeological identification of crop processing. *Journal of archaeological science.*1;14(3):311-23.

Kamp, K. 2000 From Village to Tell: Household Ethnoarchaeology in Syria. *Near Eastern Archaeology* 63(2):84

Makal, M., Stirling, P. A *Village in Anatolia*. Vallentine: Mitchell; 1954.

Hansen, H.H., 1961. *The Kurdish woman's life.*

Hastorf, C.A., 1988. The use of paleoethnobotanical data in prehistoric studies of crop production, processing, and consumption. *Current paleoethnobotany: Analytical methods and cultural interpretations of archaeological plant remains*, pp.119-144.

Kramer, Carol. 1982 Ethnographic households and archaeological interpretation: a case from Iranian Kurdistan. *American Behavioral Scientist* 25, no. 6: 663-675

Kramer, Carol. 1983. Spatial organization in contemporary southwest Asian villages and archaeological sampling. *TC Young et al*: 347-68.

Kolars,J.F., John F., et al. 1963. Tradition, season and change in a Turkish village. in: *Tradition, season and change in a Turkish village.*,.

Peña-Chocarro L, Zapata L, González Urquijo JE, Ibáñez JJ. 2009. Einkorn (Triticum monococcum L.) cultivation in mountain communities of the western Rif (Morocco): an ethnoarchaeological project. From foragers to farmers. Oxbow. Oxford.:103-11.

Pennington HL, Weber SA. 2004. Paleoethnobotany: modern research connecting ancient plants and ancient peoples. Critical reviews in plant sciences. 1;23(1):13-20.

Portillo M, Belarte MC, Ramon J, Kallala N, Sanmartí J, Albert RM. 2017 An ethnoarchaeological study of livestock dung fuels from cooking installations in northern Tunisia. Quaternary International. 28;431:131-44.

	Kandiyoti, D., 1975. Social change and social stratification in a Turkish village. *The Journal of Peasant Studies*, *2*(2), pp.206-219.
	Stirling, P., 1953. Social ranking in a Turkish village. *The British Journal of Sociology*, *4*(1), pp.31-44.
	Portillo Ramirez, M. and Matthews, W. (2020) Investigating use of space and human-animal interactions in agricultural built environments: the geo-ethnoarchaeology of livestock dung. In: Otto, A., Herles, M. and Kaniuth, K. (eds.) Proceedings of the 11th International Congress on the Archaeology of the Ancient Near East. Harrassowitz, Wiesbaden, Germany, pp. 497-508
	Portillo M, Dudgeon K, Allistone G, Raeuf Aziz K, Matthews W. 2021 The taphonomy of plant and livestock dung microfossils: an ethnoarchaeological and experimental approach. Environmental Archaeology. 4;26(4):439-54.
	Sweet, R. 1960 Tell Toqaan: A Syrian Village. Anthropological Papers of the Museum of Anthropology, University of Michigan 14. Ann Arbor: Univer- sity of Michiga

	Crop production
	Using case studies, assess (1) the social significance of farming methods for understanding past agricultural societies and (2) the potential and limitations of contrasting archaeobotanical approaches to the inference of crop production
2	Aguilera, M., Zech-Matterne, V., Lepetz, S. & Balasse, M. 2018. Crop Fertility Conditions in North-Eastern Gaul During the La Tène and Roman Periods: A Combined Stable Isotope Analysis of Archaeobotanical and Archaeozoological Remains, Environmental Archaeology, 23:4, 323-337.
2	Baum, T., Mainberger, M., Taylor, T. *et al.* How many, how far? Quantitative models of Neolithic land use for six wetland sites on the northern Alpine forelands between 4300 and 3700 BC. *Veget Hist Archaeobot* 29, 621–639 (2020).
2	Bogaard, A., A. Styring, M. Ater, Y. Hmimsa, L. Green, E. Stroud, J. Whitlam, C. Diffey, E. Nitsch, M. Charles, G. Jones and J. Hodgson (2018). From traditional farming in Morocco to early urban agroecology in northern Mesopotamia: combining present-day arable weed surveys and crop isotope analysis to reconstruct past agrosystems in (semi-)arid regions. *Environmental Archaeology* 23(4): 303-322.
1	Bogaard, A., Krause, R. and Strien, H.-C. 2011. Towards a social geography of cultivation and plant use in an early farming community: Vaihingen an der Enz, south-west Germany. *Antiquity* 85: 395-416.
2	Colledge, S. 1998. Identifying pre-domestication cultivation using multivariate analysis. In A. B. Damania, J. Valkoun, G. Willcox, and C. O. Qualset [eds] *The Origins of Agriculture and Crop Domestication*. Aleppo: ICARDA, pp. 121-131.
1	Colledge, S., and J. Conolly. 2010. Reassessing the evidence for the cultivation of wild crops during the Younger Dryas at Tell Abu Hureyra, Syria. *Environmental Archaeology* 15: 124-138.
2	Fiorentino, G., Ferrio, J.P., Bogaard, A., Araus, J.L. and Riehl, S. 2015. Stable isotopes in archaeobotanical research. *Vegetation History and Archaeobotany* 24: 215-227.
2	Fraser, R. et al. 2011. Manuring and stable nitrogen isotope ratios in cereals and pulses: towards a new archaeobotanical approach to the inference of land use and dietary practices. *Journal of Archaeological Science* 38: 2790-2804.
2	Fuller, D.Q., G. Willcox and R.G. Allaby. 2011. Early agricultural pathways: moving outside the 'core area' hypothesis in Southwest Asia. *Journal of Experimental Botany* Advance Access: 628-652.
2	Guttman, E.B.A. 2005. Midden cultivation in prehistoric Britain: arable crops in gardens. *World Archaeology* 37:224-239.
2	Heier, A., J. A. Evans, and J. Montgomery. 2009. The potential of carbonized grain to preserve biogenic 87Sr/86Sr signatures within the burial environment. *Archaeometry* 51: 277-291.
2	Jacomet S, Ebersbach R, Akeret Ö, et al. On-site data cast doubts on the hypothesis of shifting cultivation in the late Neolithic (c. 4300–2400 cal. BC): Landscape management as an alternative paradigm. The Holocene. 2016;26(11):1858-1874.
2	Jones, G. 1992: Weed phytosociology and crop husbandry: identifying a contrast between ancient and modern practice. *Review of Palaeobotany and Palynology* 73: 133-143.
2	Jones, G. 2002. Weed ecology as a method for the archaeobotanical recognition of crop husbandry practices. *Acta Palaeobotanica*. 42: 185-193.
2	Jones, G., A. Bogaard, P. Halstead, M. Charles, and H. Smith. 1999. Identifying the intensity of crop husbandry practices on the basis of weed floras. *Annual of the British School at Athens* 94:167-189.
2	Nitsch, E. K., Charles, M. and Bogaard, A. Calculating a statistically robust $\delta^{13}C$ and $\delta^{15}N$ offset for charred cereal and pulse seeds. *STAR* 2015; 1(1).
2	Styring, A., Manning, H., Fraser, R., Wallace, M., Jones, G., Charles, M., Heaton, T.H.E., Bogaard, A. and Evershed, R.P. 2013. The effect of charring and burial on the biochemical composition of cereal grains: investigating the integrity of archaeological plant material. *Journal of Archaeological Science* 40 (12): 4767-4779.
2	Styring, A., Rösch, M., Stephan, E., Stika, H.-P., Fischer, E., Sillmann, M., Bogaard, A. 2017. Centralisation and long-term change in farming regimes: comparing agricultural practice in Neolithic and Iron Age south-west Germany. *Proceedings of the Prehistoric Society* 83: 357-381, doi: 10.1017/ppr.2017.3.
2	Styring, A.K., Evans, J.A., Nitsch, E.K., Lee-Thorp, J.A. and Bogaard, A. 2018. Revisiting the potential of carbonized grain to preserve biogenic $^{87}Sr/^{86}Sr$ signatures within the burial environment. *Archaeometry*.
1	Styring, A.K., M. Charles, F. Fantone, M.M. Hald, A. McMahon, R.H. Meadow, G.K. Nicholls, A.K. Patel, M.C. Pitre, A. Smith, A. Sołtysiak, G. Stein, J.A. Weber, H. Weiss, and A. Bogaard. 2017. Isotope evidence for agricultural extensification reveals how the world's first cities were fed. *Nature Plants* 3, Article number 17076, doi: 10.1038/nplants.2017.76
2	Van der Veen, M. 1992. *Crop Husbandry Regimes: An archaeobotanical study of farming in northern England*. Sheffield: J.R. Collis Publications. Ch.s 9-11.
2	VanDerwarker, A. M. 2005. Field cultivation and tree management in tropical agriculture: a view from Gulf Coastal Mexico. *World Archaeology* 37: 275-289.
2	Wallace, G Jones, M Charles, E Forster. 2019 –Re-analysis of archaeobotanical remains from pre-and early agricultural sites provides no evidence for a narrowing of the wild plant food spectrum during the …
2	Whitlam, J., A. Bogaard, R. Matthews, W. Matthews, Y. Mohammadifar, H. Ilkhani and M. Charles (2018). Pre-agricultural plant management in the uplands of the central Zagros: the archaeobotanical evidence from Sheikh-e Abad. *Vegetation History and Archaeobotany* 27(6): 817-831.
2	Willcox, G., S. Fornite and L. Herveux. 2008. Early Holocene cultivation before domestication in northern Syria. *Vegetation History and Archaeobotany* 17: 313-325.

	Crop processing & storage
	Using case studies, assess archaeobotanical approaches to the inference of 1) crop processing and 2) storage
2	Angourakis, A., José Ignacio Santos, José Manuel Galán & Andrea L. Balbo Food for all: An agent-based model to explore the emergence and implications of cooperation for food storage
2	Antolín, F. & Schäfer, M. (2020) Insect Pests of Pulse Crops and their Management in Neolithic Europe, Env. Arch.
2	Balbo, A. (2015) Storage: Introduction to the special issue, Environmental Archaeology, 20:4, 305-313,
	Bates, J., Singh, R.N. and Petrie, C.A., 2017. Exploring Indus crop processing: combining phytolith and macrobotanical analyses to consider the organisation of agriculture in northwest India c. 3200–1500 BC. *Vegetation History and Archaeobotany*, *26*, pp.25-41.
2	Bogaard, A., et al. 2009. Private pantries and celebrated surplus: storing and sharing food at Neolithic Çatalhöyük. *Antiquity* 83: 649-668.
1	Cartwright, C.R. 2003. Grapes or raisins? An Early Bronze Age larder under the microscope. *Antiquity* 77: 345-348.
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	Plant consumption
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