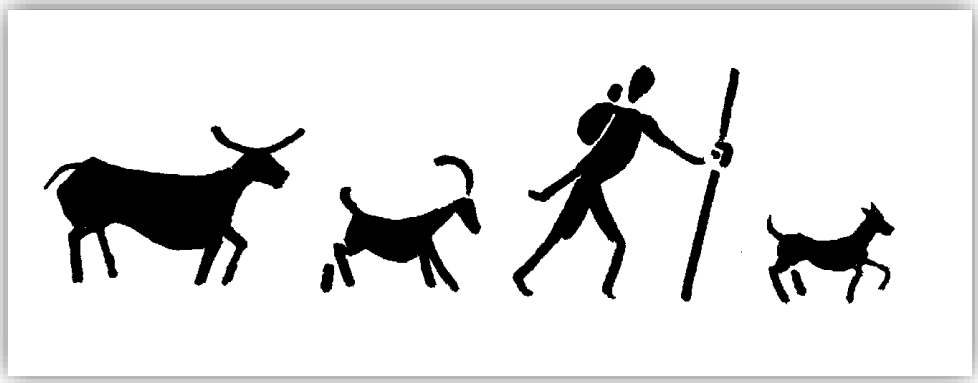
UCL Institute of Archaeology

ARCL 0125
Zooarchaeology in Practice

MSc Option Module, 15 credits

2023-24



Coursework	Deadline	Target for Return
Essay	8 December	8 January 2024
Practical report	22 Jan 2024	22 Feb 2024

Co-ordinator:

Louise Martin

(louise.martin@ucl.ac.uk)

Room 303 IoA; Office hours: Thurs 3-4pm (in-person/online) or by appointment

Or during the Monday 3-4pm practical session

Please refer to the IoA Student Handbook and IoA Study Skills Guide:
https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook
https://www.ucl.ac.uk/archaeology/current-students/ioa-study-skills-guide

for instructions on coursework submission, IoA referencing guidelines and marking criteria, as well as UCL policies on penalties for late submission.

Overview

This Zooarchaeology option module provides specialist postgraduate training in the methods of identification, analysis and interpretation of animal remains from archaeological sites. The module is open to students following MSc and MA degrees at the Institute of Archaeology.

Teaching consists of a **3 hour session (including lectures and practicals) 1-4pm on Mondays in Term 1**. All sessions are held in **Room 308, Institute of Archaeology**. There will be a 10 minute break after the first hour.

Week by Week Summary

1.	2 Oct	Introduction to zooarchaeology: the mammalian skeleton; principles of Identification; taxonomy; terminology Practical: Metapodials and phalanges
2.	9 Oct	Bone: What is bone? Bone development, structure and growth Practical: Upper Limbs /girdle bones (scapula, pelvis, humerus, femur) Unassessed informal Quiz
3.	16 Oct	Ageing I: Epiphyseal fusion and its use in zooarchaeology Practical: Lower limbs (radius, ulna, tibia, fibula, astragalus, calcaneum)
4.	23 Oct	Mammalian Dentition: structure & variation of adult teeth Practical: Skulls, horn cores, antlers, vertebrae
5.	30 Oct	Ageing II: Deciduous dentition and dental ageing in practice Practical: Dental ageing and cull profiles
6. READING WEEK (NO TEACHING)		
7.	13 Nov	Taphonomy and bone surface modifications Practical: Bone surface modifications, Body Part Representation
8.	20 Nov	Biometry (identification, animal size, sexual dimorphism), Practical: Animal palaeopathology, introduction to project
9.	27 Nov	Small mammals in archaeology Practical: Small mammals/project work
10.	5 Dec	Birds in archaeology Practical: Bird bones/project work
11.	12 Dec	Fish in archaeology Practical: Fish bones/work on project

Aims

The aim of the module is to introduce students to the practical and analytical aspects of vertebrate zooarchaeology, to encourage discussion and critique of current approaches, and to explore how zooarchaeological data can be analysed and interpreted. The focus is on **practical and laboratory experience**, where students learn identification and observation skills for a selected range of taxa. The module focuses on vertebrate remains, and students will become particularly familiar with issues and problems of mammalian zooarchaeology, with brief sessions on micro-mammals, birds and fish.

Topics to be included in laboratory sessions include: identification methods, ageing and sexing animal remains (dental eruption and wear, epiphyseal fusion, sexual dimorphism), osteometrics, body part analysis, bone modification/taphonomy, small mammals, birds and fish. Optional discussion of databases and recording systems, analysis and interpretation of data is available for those who will undertake their dissertation in a zooarchaeological topic.

Objectives

On successful completion of this module, students will:

- Have an overview of current approaches to practical zooarchaeology
- Be able to recognize and identify selected Eurasian vertebrate remains
- Be familiar with observational and analytical approaches for assessing taphonomy and potential for assemblage analysis
- Be familiar with biometrical methods in zooarchaeology
- Be familiar with body part analysis, and ageing and sexing methods in zooarchaeology, and the construction of cull profiles
- Have an understanding of the interpretive potential of zooarchaeological data.

Learning Outcomes (and coursework used in assessment)

1. Critical understanding of methods and approaches in practical and analytical Zooarchaeology (essay, practical report and keeping lab book)
2. Critical analysis of laboratory practice
3. Understanding of assessment of site formation/taphonomic processes (practical report and through essay questions)
4. Understanding of the production of zooarchaeological data (essay)
5. Understanding of the analysis of zooarchaeological data (practical report and essay)
6. Development of interpretative abilities (essay)

Teaching Methods

Each week there will be **3 hours of combined lecture and laboratory classes.** During lab classes, students will often work through material independently (or in small groups), under guidance. The emphasis is on students learning not just identification methods, but also how to make observations, and to apply and critique analytical methods.

Prerequisites

Students with a background in archaeology, anthropology or the natural sciences will find this beneficial. For students taking the MSc Environmental Archaeology, the core modules Environmental Archaeology in Practice (ARCL0129) and Resources & Subsistence (ARCL 0128) complement this Zooarchaeology module, but students from other degrees can on occasion take Zooarchaeology as a stand-alone option.

Workload

The total workload for this module is 150 hours, broken down in the following way:

Laboratory/lecture taught	10 hours
Laboratory guided	20
Private reading/preparation	60 hours
Independent Project work	20
Written work/essays	40
TOTAL	**150**

Assessment

This module is assessed by the following:

Type of Assessment	*Percentage of final module mark*
Standard Essay of 2,500 words	**50%**
Practical Report (mainly tables/figures, 1,500 words)	**50%**
TOTAL	**100%**

Students are also strongly encouraged to keep a **lab book**, which is **unassessed**, but guidance will be given on how to structure and use notes and resources for laboratory classes for future reference.

The Standard Essay is based upon a specific question and researched via a range of reading based on the reading lists given in this handbook, and beyond. Credit will be given to essays where there the author has sought sources beyond the reading lists, and where there is evidence of reasoned and critical assessment of multiple sources.

Practical Report – A piece of written work relating to the analysis of a group of animal bone material, on which students have undertaken independent identification, observation and comment. The report should show clear presentation of datasets, including a table and graphics where necessary, and show any recording and analytical methods applied to the data.

Laboratory Notebooks – Notes, observations (written and illustrative) on all aspects of laboratory work, including reflective writing on the lab experience. The lab book is not assessed, but students are encouraged to maintain a record of their lab learning in an easy-to-consult form (whether hard-copy or electronic) for their future reference.

If students are unclear about the nature of an assignment, they should discuss this with the Module Co-ordinator. The nature of the assignment and possible approaches to it will be discussed in class, in advance of the submission deadline.

Essay topics (50%)

The essay titles below can either be used literally, or can be taken as suggested areas for you to write on. If you want to formulate another essay question to cover a topic which you are particularly interested in, you must discuss this first with Louise Martin; **please do not choose another title yourself without consultation, and please do not alter the titles below.** The titles below are intentionally broad, and designed to make you think across methodological and interpretive issues covered in the module. Ideally, essays will draw on topics covered in the first term of the module. It is expected that you will draw frequently on zooarchaeological/archaeological case studies and examples in your answers. **If you choose essay 4, please confirm the title with the module co-ordinator.**

1) Taphonomic analyses and Body Part Representation play a crucial role in zooarchaeology, not only in aiding understanding of assemblage bias, but in providing evidence for human-animal treatment. Discuss, with reference to experimental/ actualistic studies, and archaeological case-studies.

2) Discuss how zooarchaeologists use 'cull patterns' and interpretative models of hunting strategies and herd management practices. Evaluate both the methodological and theoretical aspects of these approaches to understanding human-animal relations in the past. Use case studies in your answer.

3) In recent decades, zooarchaeologists have increasingly addressed the use of animals in complex societies, and employ zooarchaeological data alongside historical written sources to inform on human-animal interactions. Using case-studies, critically evaluate this approach.

4) Discuss and critique zooarchaeological methods and approaches in an area of your choice, using a good range of case studies. ['Area' can be geographically defined, or thematic e.g. the use of zooarchaeology in animal domestications, or in studies of modes of consumption, or animals in ritual etc]. **Please confirm your chosen title with the Module Co-ordinator.**

Practical Project Report (50%)

In the second half of Term I you will begin identification, observation and recording of a small assemblage of archaeological animal bones. All students will use the same assemblage (which will be kept in lab 308). The aim of this project is to identify, record and make brief comments on the material. The 'write-up' will primarily consist of recording data onto a spreadsheet/table, sketching or photographing specimens to show modifications and making accurate well-reasoned identification and observation and reference-based, well supported interpretative comments.

The project is primarily methodological in scope and aims to assess students' understanding of the practical and analytical aspects of zooarchaeology which they have developed during the module. It is not expected that students will undertake detailed interpretations. Further information on the project will be given at the appropriate stage of the module.

The Lab Book (unassessed)

An important part of learning any laboratory-based discipline is to maintain your own personal record of knowledge acquisition, and to keep it in an easy-to-consult form. This can be hard-copy or in electronic form; increasingly reference manuals and materials are stored electronically, but they still need structure and organization. During the Zooarchaeology module, you will gather a large number of handouts (identification aids, analysis instructions, guidance on methods and approaches), and students are encouraged to keep these handouts, plus other sources that they add themselves, in an organized form for easy reference. It is hoped that this will provide a personal manual that can be used in the field or lab in the student's future career.

The Lab Book is a record of the teaching and student-centred learning during the laboratory classes, and it is strongly recommended that **students keep up their Lab Book on a weekly/class-by-class basis**. Photographs, sketches, hand-written, typed up comments can all be added.

Please bring your Lab Book (whether hard copy or online) to classes, since in many weeks we will be building on material covered in earlier classes.

Please do ask for advice on keeping your lab book. I'm happy to look over it and provide feedback.

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IMPORTANT NOTE on the use of AI Tools in assignments for this module

For assignments in this module, students **are** allowed to use spell-checking and grammar-checking tools (e.g. Grammarly) to check their own written work, and will need to state that they have used this software on the coursework coversheet, and how.

Students are **not** allowed to use ChatGPT or other AI tools which generate text relating to the content of an assignment. Coursework needs to be in a student's own words, reflecting their own research skills. If students have used AI tools (such as ChatGPT) for initial research work, this needs to be clearly stated on the coursework coversheet (what software used, and how it was used).

Please read carefully the section **Information on Assessment**, (section 13.14) in the Online IoA Student Handbook: https://www.ucl.ac.uk/archaeology/current-students/ioa-student-handbook/13-information-assessment

READING AND RESOURCE LIST

The **Online Reading List** for this module can be found here:
https://rl.talis.com/3/ucl/lists/FC82EC80-1FF0-163C-AEDD-A04B8E351EB3.html?lang=en

This includes most of the **essential** and many of the recommended readings as well, plus the links to the online resources.

Essential module textbooks (Online)

Gifford-Gonzales, D., 2018. *An Introduction to Zooarchaeology*. Springer International. Cham, Switzerland. **Available online through library. Essential reading. *I suggest you download the whole volume and use it as a module textbook. We will refer to specific chapters each week.**

Albarella, U., Rizzetto, M., Russ, H., Vickers, K. and Viner-Daniels, S. eds., (2017). *The Oxford Handbook of Zooarchaeology*. Oxford: Oxford University Press **available online. An excellent source for global case studies.**
https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199686476.001.0001/oxfordhb-9780199686476

Baker and Worley (2019) *Animal Bones and Archaeology - Recovery to archive.*

Historic England Guidelines for Best Practice. **Available online. A good introduction to zooarchaeological best practices:**
https://historicengland.org.uk/images-books/publications/animal-bones-and-archaeology/

Recommended additional textbooks

Davis, S. (1987 or 1995). *The Archaeology of Animals*. Batsford: London. **BB 3 DAV**

Evans, J. & O'Connor, T. (1999). *Environmental Archaeology: Principles and Methods*. Sutton: UK. **BB6 EVA** Chapter 6 and Chapter 7

Hesse, B. & Wapnish, P. (1985). *Animal Bone Archaeology: from objectives to analysis*. Washington: Taraxacum. **BB 3 HES**

Klein, R.G. & Cruz-Uribe, K. (1984). *The Analysis of Animal Bones from Archaeological Sites*. Chicago: University of Chicago Press. **BB 3 KLE**

O'Connor, T. (2000). *The Archaeology of Animal Bones*. Sutton. **BB 3 OCO**

Reitz, E. & Wing, E. (1999). *Zooarchaeology*. Cambridge: Cambridge University Press. **BB 3 REI.**

General readings on human-animal relations

Armstrong Oma, K. and Hedeager, L. (2010). *World Archaeology* 42:2 'Humans and Animals'

Mullin, M. 2002 'Animals in Anthropology' *Society and Animals* vol 10 (4) pp 378-393.

Pluskowski, A. (ed) (2005). *Just Skin and Bones? New Perspectives on Human-Animal Relations in the Historic Past,* BAR International Series 1410. **BB 3 Qto PLU**

Russell, N. (2011). *Social zooarchaeology: Humans and Animals in Prehistory*. Cambridge: Cambridge University Press. **BB 3 RUS**

Sykes, N. (2014). *Beastly Questions: Animal Answers to Archaeological Issues*. London: Bloomsbury Publishing. **BB 3 SYK**

FOR PRACTICAL SESSIONS

Identification and laboratory manuals

Cohen, A., & Serjeantson, D. (1996). *A Manual for the Identification of Bird Bones from Archaeological Sites*. Archetype Publications. **BB 3 COH**

France, D. (2008). *Human and Non-Human Bone Identification: A Color Atlas*. CRC Press. **ISSUE DESK IOA CD FRA (*I have requested E-book)**

Hillson, S. (2005 2nd edition). *Teeth*. Cambridge: Cambridge University Press. **BB 2 HIL**

Hillson, S. (1992). *Mammal Bones and Teeth - an Introductory Guide to Methods of Identification*. London: Institute of Archaeology, UCL. **BB 3 Qto HIL**

Schmidt, E. (1972). *Atlas of Animal Bones - for prehistorians, archaeologists and quaternary geologists.* Amsterdam: Elsevier Publishing Company. **BB 3 Qto SCH**

von den Driesch, A. (1976). *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Bulletin No 1. Harvard University. **BB 3 DRI**

ONLINE RESOURCES for PRACTICAL SESSIONS

The following freely available online resources will be used in some Practical sessions, and please browse them for your own independent study, and use them for revision. All resources are available under Creative Commons license.

Animal Diversity Web (ADW): https://animaldiversity.org/

Hosted by the University of Michigan University of Zoology, the ADW is really useful for searching information on any animal taxon in the world, and provides photos of species, information on habitats, geographical ranges, and physical, physiological and behavioural descriptions.

The International Union for Conservation of Nature (IUCN) Red List: https://www.iucnredlist.org/

The International Union for Conservation of Nature's Red List of Threatened Species has evolved to become the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species. Very useful for information on wild animals found archaeologically, which often have threatened status.

The Encyclopedia of Life (EOL): http://eol.org/

Smithsonian Institution (Washington) hosted searchable databases of knowledge about all plants and animal species with global coverage.

ArchéoZooThéque: https://www.archeozoo.org/archeozootheque/

A very useful collection of drawings of connected skeletons (showing skeletal structure), exploded skeletons and great labelled photographs of bone elements of many taxa.

ArchéoZoo: https://www.archeozoo.org/

A portal for exchange of zooarchaeological information and links to resources (in French).

Aves 3D: https://www.aves3d.org/

A three-dimensional database of avian (bird) skeletal morphology. The Website is a (USA) National Science Foundation funded database providing bone scans of both living and extinct bird species. You can usefully search on bird common names, scientific names, or skeletal elements. There's a very cool 3-D rotatable model of a Dodo too!

Archaeological Fish Resource: http://fishbone.nottingham.ac.uk/

Hosted by the University of Nottingham, the Archaeological Fish Resource Project created a digital reference collection called 'Fishbone'. This online comparative collection provides images for key skeletal elements for over 90 species of North Atlantic and Mediterranean freshwater and marine fishes.

Virtual Zooarchaeology of the Arctic Project (VZAP): http://vzap.iri.isu.edu/

The VZAP is a virtual, interactive osteological reference collection for the study of northern vertebrates. Funded by NSF.

ARCL0125 Zooarchaeology: Syllabus & Reading List

Online Reading List:
https://rl.talis.com/3/ucl/lists/FC82EC80-1FF0-163C-AEDD-A04B8E351EB3.html?lang=en

1. MODULE INTRODUCTION: AIMS AND SCOPE OF ZOOARCHAEOLOGY; IDENTIFICATION, TAXONOMY, TERMINOLOGY

This lecture introduces the subject of vertebrate zooarchaeology and gives an overview of topics to be covered in the module. The definition of 'vertebrate' and the five classes of vertebrates (fish, amphibians, reptiles, mammals, and birds) are covered, and the module focus on mammals justified. The concepts of 'life assemblage', 'death assemblage', and 'bone assemblage' are introduced. Finally, issues of sampling and retrieval are re-capped. The accompanying practical will introduce the mammalian skeleton and the key terminology used to describe it, including the names of the main bones. The first practical on identification will also be introduced, looking at the bones of the lower limb and foot.

Essential Reading

Gifford-Gonzales, D., 2018. *An Introduction to Zooarchaeology*. Springer International. Cham, Switzerland. **Available online through library. Chapters 1 and 3.**

Carl Linnaeus's Systema Naturae – 3 minute clip to watch by the ***Linnean Society***, explaining how Carl Linnaeus ordered the natural world:
https://www.youtube.com/watch?v=kVD6PP61A28

Please read one of the following:

Douglas, M. (1957). Animals in Lele Religious Symbolism. *Africa: Journal of the International African Institute*. Vol. 27, No. 1 (Jan. 1957), pp. 46-58.

OR

Douglas, M. (1975). *Implicit Meanings*. Routledge: London. **BD DOU or ANTHROPOLOGY D2 DOU** Chapter 2

James, W. (1990). Antelope as self-image among the Uduk, in (ed) R. Willis *Signifying Animals*, 196 -203. London: Unwin Hyman. **BD WIL**

Optional

Davis, S. (1987) *The Archaeology of Animals*. London: Batsford. BB 3 DAV Chapter 1.

Evans, J. and O'Connor, T. (1999). *Environmental Archaeology: Principles and Methods*. Sutton: UK. **BB6 EVA** Chapter 6 and Chapter 7

Hesse, B. and Wapnish, P. (1985). *Animal Bone Archaeology: from objectives to analysis*. Washington: Taraxacum. **BB 3 HES**

O'Connor, T. (2000). *The Archaeology of Animal Bones*. Gloucestershire: Sutton Publishing. **BB3 OCO** Chapters 1, 3, 4

Reitz, E. and Wing, E. (1999). *Zooarchaeology*. Cambridge: Cambridge University Press. **BB3 REI** Chapters 1, 2.

Russell, N. (2011). *Social zooarchaeology: Humans and animals in prehistory*. Cambridge University Press.

Recommended Sources for Animal Classification

https://animaldiversity.org/animal_names/scientific_name/ for an explanation of taxonomy and binomials.

2. WHAT IS BONE? BONE DEVELOPMENT, STRUCTURE & GROWTH

This session gives an overview of what bone is and how it develops and changes as animals grow, and the resulting different types of bone. We consider the importance of understanding bone growth and structure to zooarchaeological analysis.

Essential Reading

Gifford-Gonzales, D., 2018. *An Introduction to Zooarchaeology*. Springer International. Cham, Switzerland. **Available online through library. Chapters 4 on Vertebrate Bone and Bodies, and Chapter 6 on Identifications.**

O'Connor, T (1984). On the structure, chemistry and decay of bone, antler and ivory. In Starling, K and Watkinson, D (Eds.) *Archaeological Bone, Antler and Ivory.* United Kingdom Institute for Conservation Occasional Paper **5** 6-8 **KB STA**

Optional on Bone growth, development and fusion

Alexander, R. (1994). *Bones - The Unity of Form and Function*. New York: Macmillan. **STORE 15-1002**

Davis, S. (1987) *The Archaeology of Animals*. London: Batsford. **BB3 DAV** Chapter 2

Hildebrand, M. (1974). *Analysis of Vertebrate Structure*. New York/London: John Wiley & Sons. **Science ZOOLOGY 25 a HIL**

3. AGEING I: EPIPHYSEAL FUSION AND ITS USE IN ZOOARCHAEOLOGY

Students are introduced to the process of epiphyseal fusion in the skeleton, why and where it occurs and how fusion data is used in zooarchaeology to construct 'age at death' information. The limitations and potentials of the approach are discussed.

Essential Reading

Popkin, P., P. Baker, F. Worley, S. Payne and A. Hammon (2012). The Sheep Project (1): determining skeletal growth, timing of epiphyseal fusion and morphometric variation in unimproved Shetland sheep of known age, sex, castration status and nutrition. *Journal of Archaeological Science*, 39, 1775-1792.

Silver, I.A (1969). 'The Ageing of Domestic Animals' in *Science in Archaeology* (2nd edition) (eds) D. Brothwell and E. Higgs, pp283-302. London: Thames and Hudson. **AJ BRO**

Recommended

Bull, G. and Payne, S. (1982). 'Tooth eruption and epiphyseal fusion in pigs and wild boar' in *Ageing and Sexing Animal Bones from Archaeological Sites* (eds) B. Wilson, C. Grigson and S. Payne. BAR 109, Oxford. **DAA Qto Series BRI 109**

Davis, S.J.M. (2000). The Effect of Castration and Age on the Development of the Shetland Sheep Skeleton and a Metric Comparison Between Bones of Males, Females and Castrates, *Journal of Archaeological Science* 27, 373-390.

Watson, J.P. (1978). 'The interpretation of epiphyseal fusion data' in *Research Problems in Zooarchaeology* (eds) D. Brothwell, K. Thomas and J. Clutton-Brock. Institute of Archaeology, Occasional Publication No 3 pp97-101. **BB Qto BRO**

Zeder, M, Lemione, X and Payne, S (2015). A new system for computing long-bone fusion age profiles in *Sus scrofa*. *Journal of Archaeological Science* **55** 135-150

4.1 MAMMALIAN DENTITION: STRUCTURE & VARIATION OF ADULT TEETH

Teeth often survive very well on archaeological sites and provide good information not only on identification of species, but also for dental ageing (session 5). This lecture provides an overview on the anatomy and variation of mammalian teeth, linking form to function. We introduce the use of dental formulae.

Hillson, S. (2005). *Teeth*. Cambridge: Cambridge University Press. **BB 2 HIL (Available online as an Ebook through the library).**

4.2 PRACTICAL: SKULLS, HORNS, ANTLERS (VERTEBRAE)

This session gives a brief introduction to skull morphology in mammals. We then look at the structure and morphology of horns and antlers. We examine variations in the horns of the main domesticate bovids and consider sexual dimorphism. Students are also introduced to antler growth, variation and morphology in the main European cervids. We discuss the zooarchaeological information gained from the analysis of horncores and antlers. Finally, in this session, we briefly look at different kinds of vertebrae in the mammalian skeleton.

Armitage, P. (1982). 'A system for ageing and sexing the horn cores of cattle from British post-medieval sites' in Wilson et al. *Ageing and Sexing* ...

Goss, R. (1983) *Deer antler: regeneration, function and evolution*. London: Academic Press. **KB GOS** Have a flick through if you are particularly interested in antlers.

Grigson, C. (1982). 'Sexing Neolithic domestic cattle skulls and horn cores' in Wilson et al. *Ageing and Sexing ...*

MacGregor, A. 1985 Bone, Antler, Ivory and Horn. The Technology of Skeletal Materials since the Roman Period. London: Croom Helm. **KB MAC (2 copies)**

Sykes, N. & R.H. Symmons (2007). Sexing cattle horn-cores: problems and progress. *International Journal of Osteoarchaeology*, 17, 514 -523.

Twiss, K.C. & N. Russell (2010). Taking the bull by the horns: ideology, masculinity, and cattle horns at Catalhoyuk. *Paleorient,* 35, 19 -32.

5 DECIDUOUS TEETH & DENTAL AGEING

Dental eruption and wear sequences provide some of the best information on 'age at death' in mammalian zooarchaeology. This session introduces students to the main schemes used to capture, analyse and interpret tooth eruption and wear. We also consider factors affecting variation in tooth development, eruption and wear.

Essential

Gifford-Gonzales, D., 2018. *An Introduction to Zooarchaeology*. Springer International. Cham, Switzerland. **Available online through library** (see Chapter 7 Dental Ageing)

Hillson, S. (2005). *Teeth*. Cambridge: Cambridge University Press. **BB 2 HIL (Available online as an Ebook through the library). Chapter 3 Teeth and Age**

Worley, F, Baker, P, Popkin, P, Hammon, A and Payne, S (2016). The Sheep Project (2): The effects of plane of nutrition, castration and the timing of first breeding in ewes on dental eruption and wear in unimproved Shetland sheep. *Journal of Archaeological Science: Reports*, *6*, pp.862-874

Optional

Grant, A. (1982) 'The use of tooth wear as a guide to the age of domestic ungulates' in (eds) Wilson, B et al. *Ageing and Sexing Animal Bones from Archaeological Sites* pp. 91 -108. Oxford: BAR British Series 109. **DAA Qto Series BRI 109**

Jones, G.G. (2006). Tooth Eruption and Wear Observed in Live Sheep from Butser Hill, the Cotswold Farm Park and Five Farms in the Pentland Hills, UK. In D. Ruscillo (ed), 155 -178, *Recent Advances in Ageing and Sexing Animal Bones*. Oxford: Oxbow. **BB 3 Qto RUS**

Klein, R. et al. (1981). 'The use of dental crown heights for constructing age profiles of Red Deer and similar species in archaeological samples' *Journal of Archaeological Science* 8 pp1 -31.

Klevezal, G. A., Kirillova, I. V., Shishlina, N. I., Sokolov, A. A., & Trunova, Y. E. (2006). Growth layers in tooth dentin and cementum: problems and perspectives of their use in the study of fossil and subfossil mammal remains including humans. *Documenta Archaeobiologica 4*, 113-124.

Levine, M (1982). The use of crown height measurements and eruption-wear sequences to age horse teeth. In Wilson, B, Grigson, C and Payne, S (Eds.) *Ageing and Sexing Animal Bones from Archaeological Sites.* Oxford: Council for British Archaeology **109** 223-243 **DAA Qto Series BRI**

Lieberman, D. (1994) The biological basis for seasonal increments in dental cementum and their application to archaeological research, *Journal of Archaeological Science*, 21, 525 -539.

Payne, S. (1973) 'Kill-off patterns in sheep and goats: the mandibles from Asvan Kale' *Anatolian Studies* 23 pp281 -303.

Ruscillo, D. (2006). *Recent Advances in Ageing and Sexing Animal Bones*. Oxford: Oxbow Books. **BB 3 Qto RUS**

6 READING WEEK – NO TEACHING

7 TAPHONOMY & BONE SURFACE MODIFICATIONS

Taphonomy is one of the most complex yet vital areas of zooarchaeology. It is basic to all subsequent interpretations of an assemblage at site level. This lecture considers some of the most common taphonomic factors affecting an assemblage, what this can tell us about site formation processes, and how it can affect the story of the past. The second session will investigate how the impacts of taphonomy can be visualized.

Essential

Gifford-Gonzales, D., (2018). *An Introduction to Zooarchaeology*. Springer International. Cham, Switzerland. **Available online through library** (Chapter with excellent taphonomy coverage: 11 Bone breakage, 12 Animal action on bone, 13 Taphonomy, 14 Butchery, 15 Processing, 21 Bone density)

Recommended

Lyman, R.L. (1994). *Vertebrate Taphonomy*. Cambridge: Cambridge University Press. **I BB 3 LYM** - Chapters 1 & 2

Madgwick, R. and Mulville, J., (2015). Reconstructing depositional histories through bone taphonomy: extending the potential of faunal data. *Journal of Archaeological Science*, *53*, pp.255-263.

Orton, D. (2012). 'Taphonomy and Interpretation: an analytical framework for social zooarchaeology', *International Journal of Osteoarchaeology*, 22(3): 253-378

Optional

Bar-Oz, G. & N.D. Munro (2004). Beyond cautionary tales: a multivariate taphonomic approach for resolving equifinality in zooarchaeological studies. *Journal of Taphonomy*, 2, 201 -221.

Behrensmeyer, A.K. (1978). Taphonomic and ecological information from bone weathering. *Paleobiology*, 4/2, 150 -162

Binford, L.R. (1981). *Bones - Ancient Men and Modern Myths*. Academic Press. **BB 3 BIN and issue desk.** Have a quick skim through to see what's in here that might be useful.

Greenfield, H. 1988. Bone consumption by pigs in a contemporary Serbian village: Implications for the interpretation of prehistoric faunal assemblages, *Journal of Field Archaeology* vol 15, 473 -479

Huntley, J. and Stallibrass, S. (2000). *Taphonomy and Interpretation*, Symposia of the Association for Environmental Archaeology No.14. Oxford: Oxbow Books.

Lam, Y.M., O.M. Pearson, C.W. Marean & X. Chen (2003). Bone density studies in zooarchaeology. *Journal of Archaeological Science*, 30, 1701-1708.

Marean, C.W. (1991). Measuring the postdepositional destruction of bone in archaeological assemblages. *Journal of Archaeological Science,* 18, 677 694.

Marean, C.W. and Spencer, L.M. (1991). 'Impact of carnivore ravaging on zooarchaeological measures of element abundance', *American Antiquity* 56 (4), 645 -658.

Mee, C. and Renard, J. (2007) Cooking up the Past - Food and Culinary Practices in the Neolithic and Bronze Age Aegean. Oxford: Oxbow Books. **DAG 100 MEE** - especially Chapter2 (Isaakidou) & Chapter 3 (Halstead)

Miracle, P. & N. Milner (2002) *Consuming passions and patterns of consumption.* Cambridge: McDonald Institute of Archaeological Research **Issue Desk IOA MIR**

Munson. P. (2000). Age-Correlated Differential Destruction of Bones and its Effect on Archaeological Mortality Profiles of Domestic Sheep and Goats, *Journal of Archaeological Science* 27, 391 -407.

O'Connor, T. (2000). *The Archaeology of Animal Bones*. Stroud: Sutton. **BB 3 OCO** - Chapter 3

O'Connor, T. (2005). Biosphere to Lithosphere: new studies in vertebrate taphonomy. Oxford: Oxbow. **BB 3 Qto OCO**

Outram, A (2002). Bone fracture and within-bone nutrients: An experimentally based method for investigating levels of marrow extraction. In Miracle, P and Milner, N (Eds.) *Consuming Passions and Patterns of Consumption.* Cambridge: McDonald Institute for Archaeological Research 51-64 **Issue Desk IOA MIR.**

Payne, S. and Munson, P.J. (1985). 'Ruby and how many squirrels? The destruction of bones by dogs' in *Palaeobiological Investigations - research design, methods and data analysis* (eds) N. Fieller, D. Gilbertson & N. Ralph. Oxford: BAR International Series 266, 31 -39. **BB Qto FIE**

Russell, N., Martin, L.A. (2012). Cooking Meat and Bones at Neolithic Çatalhöyük, Turkey. In S. R. Graff and E. Rodríguez-Alegría (eds) *The Menial Art of Cooking: Archaeological Studies of Cooking and Food Preparation*, 87-97. Boulder: University Press of Colorado. **Online access through the library**

Speth, J.D. (2000). Boiling vs baking and roasting: a taphonomic approach to the recognition of cooking techniques in small mammals, in Rowley -Conwy, P. (ed), 89 -105. *Animal Bones, Human Societies*. Oxford: Oxbow. **Issue Desk**

Symmons, R (2005). Bone density variation between similar animals and density variation in early life: implications for future taphonomic analysis. In O'Connor, T (Ed.) *Biosphere to Lithosphere. New Studies in Vertebrate Taphonomy.* Oxford: Oxbow 87-94 **BB 3 Qto OCO**

Diagenesis

Conard, N., Walker, S. and Kandel, A. (2008). How heating and cooling and wetting and drying can destroy dense faunal elements and lead to differential preservation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 266(3-4), pp.236-245.

Jans, M., Nielsen-Marsh, C., Smith, C., Collins, M. and Kars, H. (2004). Characterisation of microbial attack on archaeological bone. *Journal of Archaeological Science* 31, 87-95.

Koon, J., Nicholson, R. and Collins, M. (2003). A practical approach to the identification of low temperature heated bone using TEM. *Journal of Archaeological Science* 31, 1393-1399.

Smith, C., Nielsen-Marsh, C., Jans, M. and Collins, M. (2007). Bone diagenesis in the European Holocene I: patterns and mechanisms, *Journal of Archaeological Science* 34(9), 1485-1493.

Nielsen-March, C., Smith, C., Jans, M. Nord, A., Kars, H. and Collins, M. (2007). Bone diagenesis in the European Holocene II: taphonomic and environmental considerations. *Journal of Archaeological Science* 34: 1523-1531.

Week 8: BIOMETRICAL ANALYSIS, PATHOLOGY & BODY PARTS

Emphasis this week is on biometrical analysis – the use of bone measurements to discern aspects of past animals such as size, shape, sex (male, female or castrate) and age. The second part of the session will incorporate an introduction to palaeopathology – how disease and trauma can be observed on animal bone. Following this is a seminar on how quantification of the skeleton is calculated.

Essential

Albarella, U (2002). Size matters: how and why biometry is still important in zooarchaeology. In Dobney, K and O'Connor, T (Eds.) *Bones and the Man: Studies in honour of Don Brothwell.* Oxford: Oxbow 51-62 **BB 3 Qto DOB**

Payne, S and Bull, G (1988). Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archaeozoologia* **2** 27-65

Optional: Biometrical Analysis

Albarella, U, Johnstone, C and Vickers, K (2008). The development of animal husbandry from the Late Iron Age to the end of the Roman period: a case study from South-East Britain. *Journal of Archaeological Science* **35(7)** 1828-1848

Arbuckle, B. (2013). The late adoption of cattle and pig husbandry in Neolithic Central Turkey. *Journal of Archaeological Science*, 40, 1805-1815.

Davis, S (1996). Measurements of a group of adult female shetland sheep skeletons from a single flock: a baseline for zooarchaeologists. *Journal of Archaeological Science* **23** 593-612

von den Driesch, A. (1976). *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Bulletin No 1. Harvard University. **BB 3 DRI plus Issue Desk**

Evin, A., Cucchi, T., Cardini, A., Strand Vidarsdottir, U., Larson, G. and Dobney, K. (2013). The long and winding road: identifying pig domestication through molar size and shape. *Journal of Archaeological Science*, 40, 735-743.

Evin, A, Cucchi, T, Escarguel, G, Owen, J, Larson, G, Strand Vidarsdottir, U and Dobney, K (2014). Using traditional biometrical data to distinguish West Palearctic wild boar and domestic pigs in the archaeological record: new methods and standards. *Journal of Archaeological Science* **43** 1-8

Holmes, M (2014). Does Size Matter? Changes in the size and shape of animals throughout the English Saxon period (AD 450-1066). *Journal of Archaeological Science* **43** 77-90

Johnstone, C (1999). Looking a gift horse in the mouth: the problems of using archived and published biometrical data. *Current and Recent Research in Osteoarchaeology* **2** 48-50

Meadow, R. (1999). The use of size index scaling techniques for research on archaeozological collections from the Middle East, in *Historia Animalium ex Ossibus, Beitrage zur Palaeoanatomie, Archaeologie, Agyptologie, Ethnologie und Geschichte der Tiermedizin*, (eds) C. Becker, H. Manhart, J. Peters, and J. Schibler. Rahden: Verlag Marie Leidorf. **BB 3 Qto BEC** [See for an explanation of the Standard Animal scaling technique].

O'Connor, T (2007). Wild or domestic? Biometric variation in the cat Felis silvestris schreber. *International Journal of Osteoarchaeology* **17** 581-595

Popkin, P, Baker, P, Worley, F, Payne, S and Hammon, A (2012). The sheep project (1): determining skeletal growth, timing of epiphyseal fusion and morphomentric variation in unimproved Shetland sheep of known age, sex, castration status and nutrition. *Journal of Archaeological Science* **39** 1775-1792

Ruscillo, D. (2006). *Recent Advances in Ageing and Sexing Animal Bones*. Proceedings of the 9th ICAZ Conference, Durham 2002. Oxford: Oxbow Books. **BB 3 Qto RUS**

Sykes, N and Symmons, R (2007). Sexing cattle horn-cores: problems and progress. *International Journal of Osteoarchaeology* **17** 514-523

Thomas, R., M. Holmes and J. Morris (2012). "So bigge as bigge may be": tracking size and shape change in domestic livestock in London (AD 1220-1900). *Journal of Archaeological Science*, 40, 3309-3325.

Zeder, M (2001). A metrical analysis of a collection of modern goats from Iran and Iraq: Implications for the study of caprine domestication. *Journal of Archaeological Science* **28** 61-79

Palaeopathology

Albarella, U. (1995). Depressions on Sheep Horncores. *Journal of Archaeological Science*, 22, 699-704.

Baker, J. (1984). 'The study of animal diseases with regard to agricultural practices and man's attitude to his animals'. *Animals in Archaeology: 4. Husbandry in Europe*, (eds) C. Grigson and J. Clutton-Brock. BAR is 277, 253-257. **BB 3 Qto GRI**

Baker, J. and Brothwell, D. (1980). *Animal diseases in archaeology*. London, New York: Academic Press. **Issue Desk.**

Bartosiewicz, L and Gál, E (2013). *Shuffling Nags, Lame Ducks: The Archaeology of Animal Disease.* Oxford: Oxbow **BB 3 BAR**

Bartosiewicz, L., van Neer, W. and Lentacker, A. (1997). *Draught Cattle: their osteological identification and history.* Koninklijk Museum Voor Midden-Afrika Tervuren, Belgie, Annalen Zoologische Wetenschappen vol 281. **BB 3 Qto BAR**

Clark, K (2009). Pathologies of the sheep. In Serjeantson, D and Rees, H (Eds.) Food, Craft and Status in Medieval Winchester: The Plant and Animal Remains from the Suburbs and City Defences. Winchester: Winchester Museums 158-165 **DAA 410 Qto SER**

Davies, J, Fabis, M, Richards, M and Thomas, R (Eds.) (2005). Diet and Health in Past Animal Populations. Current Research and Future Directions. Oxford: Oxbow **BB 3 Qto DAV**

Dobney, K. and Ervynck, A. (2000). Interpreting Developmental Stress in Archaeological Pigs: the Chronology of Linear Enamel Hypoplasia, *Journal of Archaeological Science* 27, 597-607.
OR

Ervynck, A. and Dobney, K. (1999). Lining up on the M1: a Tooth Defect as a Bio-indicator for Environment and Husbandry in Ancient Pigs, *Environmental Archaeology*, 4, 1-8.

Groot, M (2008). Understanding past human-animal relationships through the analysis of fractures: A case study from a Roman site in The Netherlands In Miklíková, Z and Thomas, R (Eds.) *Current Research in Animal Palaeopathology.* Oxford: British Archaeological Reports International Series **1844** 40-50 **BB 3 Qto MIK**

Isaakidou, V. (2007). Ploughing with Cows: Knossos and the Secondary Products Revolution, in Serjeantson, D. and Field, D. (eds) Animals in the Neolithic of Britain and Europe, Neolithic Studies Group Seminar Papers 7, 95-112. Oxford: Oxbow Books **DA 140 SER**

Miklíková, Z and Thomas, R (Eds.) (2008). *Current Research in Animal Palaeopathology.* Oxford: British Archaeological Reports International Series **1844 BB 3 Qto MIK**

Noddle, B (1999). Bone defects in joint surfaces of intensively farmed livestock. In Anderson, S (Ed.) *Current and Recent Research in Osteoarchaeology 2.* Oxford: Oxbow 1-3 **JF Qto AND**

Noe-Nygaard, N. (1974). 'Mesolithic hunting in Denmark illustrated by bone injuries caused by human weapons', *Journal of Archaeological Science* 1, 217-248.

Vann, S and Thomas, R (2006). Humans, other animals and disease: A comparative approach towards the development of a standardised recording protocol for animal palaeopathology. *Internet Archaeology* **20**

Waldron, T (2008). Palaeopathology. Cambridge: Cambridge University Press. **Available online through the library**

Body part representation

Lyman, L (2008). *Quantitative Paleozoology.* Cambridge: Cambridge University Press **BB 3 LYM and online through the library.**

Marshall, F and Pilgram, T (1991). Meat versus within-bone nutrients: another look at the meaning of body part representation in archaeological sites. *Journal of Archaeological Science* **18** 149-163

Sexual dimorphism

Clutton-Brock, T., Guiness, F. and Albon, S. (1982). *Red Deer: Behaviour and Ecology of Two Sexes*. Edinburgh: Edinburgh University Press. (see chapters 5, 6 and especially 7). **Science library ZOOLOGY 25 d CLU**

Davis, S (2000). The effect of castration and age on the development of the shetland sheep skeleton and a metric comparison between bones. *Journal of Archaeological Science* **27(5)** 373-390

Greenfield, H. 2006. Sexing Fragmentary Ungulate Acetabulae, in D. Ruscillo (ed), 68-86. *Recent Advances in Ageing and Sexing Animal Bones*. Proceedings of the 9th ICAZ Conference, Durham 2002. Oxford: Oxbow Books **BB 3 Qto RUS**

Hatting, T. (1975) 'The influence of castration on sheep horns', *Archaeozoological Studies* (ed) A.T. Clason. Amsterdam: N Holland Publishing Company. **BB 3 CLA**

Horwitz, L.K., Cope, C. and Tchernov, E. (1990). 'Sexing the bones of mountain-gazelle (*Gazella gazella*) from prehistoric sites in the southern Levant', *Paléorient*, 16/2, 1-12.

Grigson, C. (1982). 'Sexing Neolithic domestic cattle skulls and horn cores' in Wilson *et al. Ageing and Sexing ...* **DAA Qto Series BRI 109**

Mayer, J J and Brisbin, I L (1988). Sex identification of Sus scrofa based on canine morphology. *Journal of Mammalogy* **69(2)** 408-412

Wilson, B., Grigson, C. & Payne, S. (1982). *Ageing and sexing animal bones from archaeological sites*. BAR British Series 109. **DAA Qto Series BRI 109**

9: SMALL MAMMALS IN ARCHAEOLOGY

Micromammals from archaeological sites provide very different kinds of information to larger mammals, since they are often not deposited by humans but by other agents. They can provide good information on micro-habits around sites, but their deposition needs first understanding. This session introduced students to the categories of small mammals, methods for unraveling how they arrives in assemblages, and interpretative approaches.

Essential

Andrews, P., 1990. *Owls, Caves and Fossils: Predation, Preservation, and Accumulation of Small Mammal Bones in Caves*. London: The Natural History Museum. **DAA 410 S.4**

Hillson, S. (2005). *Teeth*. Cambridge: Cambridge University Press. **BB 2 HIL (Available online as an Ebook through the library).**

Optional

Fernandez-Jalvo, Y., Denys, C., Andrews, P., Williams, T., Dauphin, Y. & Humphrey, L. (1998). 'Taphonomy and palaeoecology of Olduvai Bed-1 (Pleistocene, Tanzania)'. *Journal of Human Evolution* **34**, 137-172.

Stahl, P. (1996). The recovery and interpretation of microvertebrate bone assemblages from archaeological contexts. *Journal of Archaeological Method and Theory*, 3/1, 31-75.

Pleistocene Small Mammals and Dating the Earliest Occupation of Europe

Roebroeks W. & van Kolfschoten T. (1994). 'The earliest occupation of Europe: a short chronology'. *Antiquity* **68**(260), 489-503.

Stringer, C.B., Andrews, P. & Currant, A.P. (1996). 'Palaeoclimatic significance of mammalian faunas from Westbury Cave, Somerset, England'. In *The early Middle Pleistocene in Europe.* C. Turner (ed.). Balkema, Rotterdam. 135-143. **DA 4 TUR**

Commensalism, human impacts

Armitage P.L. (1985). 'Small mammal faunas in later mediaeval towns. A preliminary study in British urban biogeography'. *Biologist* **32**(3), 65-71. (Journal in DMS Watson library)

Armitage P.L. (1994). 'Unwelcome companions: ancient rats reviewed', *Antiquity* **68**(259), 231-240.

OR

Armitage P.L. (1993). 'Commensal rats in the New World, 1492-1992'. *Biologist* **40**(4), 174-178.

Cucchi T. (2008). 'Uluburun shipwreck stowaway house mouse: molar shape analysis and indirect clues about the vessel's last journey'. *Journal of Archaeological Science* **35**(11), 2953-9

Cucchi, T., Vigne, J., Auffray, J., Croft, P., & Peltenburg, E. (2002). Passive transport of the house mouse (Mus musculus domesticus) to Cyprus at the Early Preceramic Neolithic (late 9th and 8th millennia cal. BC). *Comptes Rendus Palevol*, ***1***(4), 235-241.

O'Connor, T (2013). *Animals as Neighbors: The Past and Present of Commensal animals.* East Lansing (Mi): Michigan State University Press **BB 3 OCO and online through the library**

Vigne, J -D. and Valladas, H.E. (1996). Small mammal Fossil Assemblages as indicators of Environmental Change in Northern Corsica during the last 2500 years. *Journal of Archaeological Science*, 23, 199 -215.

Weissbrod L, Malkinson D, Cucchi T, Gadot Y, Finkelstein I, et al. (2014) Ancient Urban Ecology Reconstructed from Archaeozoological Remains of Small Mammals in the Near East. *PLoS ONE* 9(3): e91795.

10 BIRDS IN ARCHAEOLOGY

This session considers particular methods of identification and analysis that affect our understanding and interpretation of avian remains from archaeological sites. We look at case studies concerning taphonomy, ageing and sexing of bird remains, and research on bird hunting and management. The practical session introduces the structures of the avian skeleton.

Essential

https://aves3d.org/ A good resource to understand the bird skeleton

Albarella, U., Baker, P., Browaeys, E., Corbino, C.A., Mulville, J., Poland, G. and Worley, F., (2020). The Archaeology of Human-Bird Interactions: Essays in Honour of Dale Serjeantson Volume 1. *Quaternary International* Volume 543, p1-148, March 2020.

Optional

Albarella, U. (2005) 'Alternate fortunes? The role of domestic ducks and geese from Roman to Medieval times in Britain.' *Documenta Archaeobiologiae* pp.249-258.

Blasco, R., and Peris, J. F. (2009). Middle Pleistocene bird consumption at level XI of Bolomor cave (Valencia, Spain). *Journal of Archaeological Science*, *36*(10), 22132223.

Bovy, K. M. (2012). Why so many wings? A re-examination of avian skeletal part representation in the south-central Northwest Coast, USA. *Journal of Archaeological Science*, *39*(7), 2049-2059.

Brothwell, D. (1993). 'Avian osteopathology and its evaluation' in *Archaeofauna* 2, pp.33-43.

Cruz, I. (2007). Avian taphonomy: observations at two Magellanic penguin (Spheniscus magellanicus) breeding colonies and their implications for the fossil record. *Journal of Archaeological Science*, *34*(8), 1252-1261.

Davis, S. J. (2002). The mammals and birds from the Gruta do Caldeirão, Portugal. *Revista Portuguesa de Arqueologia*, *5*(2), 29-98.

Driver, J.C. (1982). 'Medullary bone as an indicator of sex in bird remains from archaeological sites'. in (eds) B. Wilson, C. Grigson and S. Payne *Ageing and Sexing animal Bones from Archaeological Sites*. Oxford: BAR British Series 109, pp.251254. **DAA Qto Series BRI 109**

Ericson, P.G.P. (1987). 'Interpretation of archaeological bird remains: a taphonomic approach', *Journal of Archaeological Science*, 14, pp.65 -75.

Ervynck, A. (1993). 'The role of birds in the economy of Medieval and post-Medieval Flanders: a diversity of interpretational problems' in *Archaeofauna* 2, 107 -119.

Evershed, R. P., Dudd, S. N., Copley, M. S., & Mukherjee, A. J. (2002). Identification of animal fats via compound specific δ13C values of individual fatty acids: assessments of results for reference fats and lipid extracts of archaeological pottery vessels. *Documenta praehistorica*, *21*, 73-96.

Fothergill, B. T. (2014). The husbandry, perception and 'improvement'of turkeys in Britain, 1500–1900. *Post-Medieval Archaeology*, *48*(1), 207-228.

Livingston, S.D. (1989). 'The Taphonomic Interpretation of Avian Skeletal Part Frequencies'. *Journal of Archaeological Science*, 16, pp.537 -547.

ICAZ Bird Working Group (1993). 'Archaeornithology: Birds and the Archaeological Record', *Archaeofauna* 2. The proceedings of the first meeting of the ICAZ Bird Working Group in 1992 - lots of interesting papers ... some listed separately here under author. **BB 3 ARC**

MacDonald, R.H., MacDonald, K.C. and Ryan, K. (1993). 'Domestic geese from medieval Dublin', *Archaeofauna* Vol 2, pp.205 -218.

Martin, L., Edwards, Y., and Garrard, A. (2013). Broad Spectrum or Specialized Activity? Birds and tortoises at the Epipalaeolithic site of Wadi Jilat 22 in the eastern Jordan steppe, *Antiquity,* Volume 87, Issue 337, 649-665.

Overton, N. J., & Hamilakis, Y. (2013). A manifesto for a social zooarchaeology. Swans and other beings in the Mesolithic. *Archaeological Dialogues*, *20*(02), 111-136.

Poole, K. (2010). Bird introductions. *Extinctions and Invasions: A Social History of British Fauna*, 156-65. **ZOOLOGY 22 f OCO**

Serjeantson, D. (1998). Birds: a seasonal resource, *Environmental Archaeology* 3, 23-33.

Serjeantson, D. (2001). The great auk and the gannet: a prehistoric perspective on the extinction of the great auk. *International Journal of Osteoarchaeology* 11: 43 -55.

Serjeantson, D., Irving, B. and Hamilton-Dyer, S. (1993). 'Bird bone taphonomy from the inside out: the evidence of full predation on the Manx shearwater *Puffinus puffinus'* in *Archaeofauna* Vol 2, pp.191 -204.

Serjeantson, D. and J. Morris (2011). Ravens and crows in Iron Age and Roman Britain. *Oxford Journal of Archaeology*, 30, 85 -107.

Thomas, R., Sadler, P., & Cooper, J. (2014). Developmental Osteology of Cross_bred Red Junglefowl (Gallus gallus L. 1758) and the Implications for Ageing Chickens from Archaeological Sites. *International Journal of Osteoarchaeology*.

Tomek, T., & Bocheński, Z. M. (2000). The comparative osteology of European corvids (Aves: Corvidae), with a key to the identification of their skeletal elements. Instytutu Systematyki i Ewolucji Zwierząt PAN.

West, B. and Zhou, B -X. (1988). 'Did Chickens Go North? New Evidence for Domestication' in *Journal of Archaeological Science*, 15, pp.515 -533.

PRACTICAL https://aves3d.org/ A good resource to understand the bird skeleton

Cohen, A. & Serjeantson, D. (1996). *A Manual for the Identification of Bird Bones from Archaeological Sites*. London: Archetype. **BB 3 COH**

Gilbert, B.M., Martin, L.D. and Savage, H.G. (1985) *Avian Osteology*. Arizona: B. Miles Gilbert Publisher. **BB 3 GIL** An identification key to American bird species.

Serjeantson, D (2009) *Birds*. Cambridge University Press, Cambridge. **BB 3 SER**

Eggshell

Best, J. and Mulville, J., 2013. Between the sea and sky: the archaeology of avian resource exploitation in Scottish island environments. In Daire, Dupont, Baudry, Billard, Large, Lespez, Normand and Scarre, *Ancient Maritime Communities and the Relationship between People and Environment along the European Atlantic Coasts*. Oxford: BAR Int Ser 2570, 417-426 **DA 100 Qto DAI**

Keepax, C.A. (1981). 'Avian Egg-shell from Archaeological Sites' in *Journal of Archaeological Science*, 8, pp.315-335.

Presslee, S., Wilson, J., Woolley, J., Best, J., Russell, D., Radini, A., Fischer, R., Kessler, B., Boano, R., Collins, M. and Demarchi, B., 2017. The identification of archaeological eggshell using peptide markers. *STAR: Science & Technology of Archaeological Research*, *3*(1), pp.89-99.

Sidell, E.J. (1993). A methodology for the identification of archaeological eggshell. *Archaeofauna* 2, 45-51 **BB 3 SID**

11 FISH IN ARCHAEOLOGY

The final week of the module considers particular methods of identification and analysis that affects our understanding of fish from archaeological sites. The lecture introduces case studies which discuss fishing methods, fish trade and processing. In the practical, we examine the elements of bony fish which zooarchaeologists select to identify and use, which provide identification, ageing and seasonality information.

Essential

Orton, D. J. Morris, A. Locker & J.H. Barrett (2014). 'Fish for the city: meta-analysis of archaeological cod remains and the growth of London's northern trade', *Antiquity*, 88: 516 -530

Wheeler, A. and Jones, A. (1989). *Fishes*. Cambridge: Cambridge University Press**. BB 3 WHE**. Best general text book.

Optional

Casteel, R. (1976). Fish Remains in Archaeology and Palaeo-environmental *Studies*. London: Academic Press. **BB 3 CAS**

Barrett, J. (1997). Fish trade in Norse Orkney and Caithness: a zooarchaeological approach, *Antiquity* 71, 616 -38.

Barrett, J., A. Locker and C. Roberts (2004). 'Dark Age Economics' revisited: the English fish bone evidence AD 600 -1600. *Antiquity* 78, 618 -636.

Brewer, D. (1991). 'Temperatures in Predynastic Egypt inferred from the remains of the Nile perch', *World Archaeology* 22, 287 -303.

Brinkhuizen, D. & Clason, A. (eds) (1986). *Fish and Archaeology*. Oxford: BAR International Series 294. **BB 3 Qto BRI**. A useful compilation of case studies and taphonomic studies; see especially Jones, Van Neer.

Butler, V. (1994). The role of bone density in structuring prehistoric salmon bone assemblages. *Journal of Archaeological Science*, 21, 413 -424.

Carder, N. & Crock, J.G. (2012). A pre-Columbian fisheries baseline from the Caribbean. *Journal of Archaeological Science* 39: 3115 -3124.

Colley, S. (1990). 'The analysis and interpretation of archaeological fish remains', *Advances in Archaeological Method and Theory* 2, 207 -253.

Enghoff, I.B. (1996). A medieval herring industry in Denmark - the importance of herring in Eastern Denmark. *Archaeofauna* 5: 43 -47.

Erlandson, J.M. & Rick, T.C. (2010). Archaeology Meets Marine Ecology: The Antiquity of Maritime Cultures and Human Impacts on Marine Fisheries and Ecosystems. *Annual Review of Marine Science* 2: 231 -251.

Jones, A. (1986). Fish bone survival in the digestive systems of the pig, dog and man: some experiments. In D. Brinkhuizen and A. Clason (eds) *Fish in Archaeology*, 53-61 **BB 3 Qto BRI**

Kettle, A.J., Heinrich, D., Barrett, J.H., Benecke, N. & Locker, A. (2008). Past distributions of the European freshwater eel from archaeological and palaeontological evidence. *Quaternary Science Reviews* 27: 1309 -1334.

Lauwerier, R.C.G.M. & Laarman, F.J. (2008). Relics of 16th-century gutted herring from a Dutch vessel. *Environmental Archaeology* 13: 135 -142.

Limburg, K.E., Walther, Y., Hong, B., Olson, C. & Stork J. (2008). Prehistoric versus modern Baltic Sea cod fisheries: selectivity across the millennia. *Proceedings of the Royal Society B: Biological Sciences* 275: 2659 -2665.

Mellars, P. and Wilkinson, M. (1980). 'Fish otoliths as indicators of seasonality in prehistoric shell middens: the evidence from Oronsay (Inner Hebrides)', *Proceedings of the Prehistoric Society* 46, 19 -44.

Orton, D. and 20 others, (2011). 'Stable isotope evidence for late medieval (14th-15th C) origins of the eastern Baltic cod (*Gadus morhua*) fishery', *PLoS ONE*, 6(11)e27568

Orton, D. J. Morris, A. Locker & J.H.Barrett (2014). 'Fish for the city: meta-analysis of archaeological cod remains and the growth of London's northern trade', *Antiquity*, 88: 516 -530.

Reitz, E.J. (2004). "Fishing down the Food Web": A Case Study from St. Augustine, Florida, USA. *American Antiquity* 69: 63 -83.

Smith, I.W.G. (2013). Pre-European Maori exploitation of marine resources in two New Zealand case study areas: species range and temporal change. *Journal of the Royal Society of New Zealand* 43: 1 -37.

Thieren, E., Wouters, W., Van Neer, W. & Ervynck, A. (2012). Body length estimation of the European eel Anguilla anguilla on the basis of isolated skeletal elements. *Cybium* 36: 551 -562.

Van Neer, W., Lougas, L. & Rijnsdorp, A. (1999). Reconstructing Age Distribution, Season of Capture and Growth Rate of Fish from Archaeological Sites Based on Otoliths and Vertebrae, *International Journal of Osteoarchaeology* 9, 116 -130.

Van Neer, W., Ervynck, A., Bolle, L. J., & Millner, R. S. (2004). Seasonality only works in certain parts of the year: the reconstruction of fishing seasons through otolith analysis. *International Journal of Osteoarchaeology*, *14*(6), 457-474.

Wheeler, A. (1978). 'Problems of identification and interpretation of archaeological fish remains', *Research Problems in Zooarchaeology* (eds D. Brothwell, K. Thomas, J. Clutton -Brock), 69 -75. London: Institute of Archaeology. **BB Qto BRO**

PRACTICAL Archaeological Fish Resource: http://fishbone.nottingham.ac.uk/