
Course Number

ENVIRONMENTAL ARCHAEOLOGY



Proposed for Fall 2019
Joukowsky Institute for Archaeology and the Ancient World
Brown University

Syllabus

Schedule: Tuesdays and Thursdays 10.30-11.50am, Seminar Room 008, Rhode Island Hall

A course with Jennifer Bates, Postdoctoral Research Associate in Archaeology, Joukowsky Institute for Archaeology and the Ancient World.

Jennifer's Office Hours: Monday's 2-4 and (by appointment) Friday 2-4

Office: Room 208, Rhode Island Hall

Email: jennifer_bates@brown.edu

Course Description:

From our earliest ancestors to the recent warming of our planet, the history and future of humans is fundamentally influenced by our relationship with the world around us. This intimate relationship makes it a necessity for us as anthropological archaeologists to understand how humans have used,

adapted to, altered and are in turn affected by our environment. How has climate change affected the development of human society? How have people adapted to their environments in the past and how have they shaped these environments in turn? What does it mean to develop “sustainable” approaches to our environments over the short and long term?

Environmental archaeology is the study of these questions through the use of scientific techniques to analyse landscapes, sites, material culture, soils, plants and animal and human remains from archaeological contexts. The aim is not to come out of this course as an expert in these techniques, but to provide you with a solid foundation on which to build in graduate school or further reading. This course will introduce you to these method with an eye towards how they allow us to interpret human-environment interactions in the past and the present, looking forward to how we may have to change our thinking in the future.

The course will also allow you to gain practical experience in archaeological science techniques, and to debate and discuss their application to wider theoretical questions beyond environmental archaeology. Through active discussion in the lab setting you will gain a critically aware understanding of how these techniques are being applied and developed in ongoing archaeological research.

Learning Outcomes:

Through taking this course you will be able to:

- 1) Describe the natural and cultural mechanisms driving environmental and climatic change
- 2) Interpret the results of archaeological dating methods, calibrate radiocarbon dates, and explain why calibration is necessary and how calibration works
- 3) Identify and describe (on site and from reports) the processes of site formation, landscape formation, soil types and sedimentation processes
- 4) Use archaeobotanical, zooarchaeological, isotopic and geoarchaeological datasets to reconstruct past environmental conditions
- 5) Develop a basic understanding of GIS which can be built on with further courses
- 6) Critically evaluate and model changes in human culture corresponding to and operating within ecological contexts by specifically addressing a) the effects of climatic and environmental change on technology, social organisation and politics, but b) be able to discuss how these aspects of human life have affected the climate and environment.

Class Structure:

Classes will be run twice a week. Tuesdays will be a classroom-based lecture on a theme or technique, and Thursdays will be a lab based session or fieldtrip to put these thematic discussions into action.

Course Texts:

There are two key text books for this course (see below). You do **NOT** have to purchase these for yourself, the relevant chapters for the course have been scanned and uploaded to Canvas. Should you wish to read beyond the chapters selected for the course, copies are available in the Rockefeller Library.

- Dincauze, D.F., 2001. Environmental Archaeology, principles and practice. Cambridge University Press, Cambridge.
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. Case Studies in Environmental Archaeology, 2nd Edition. Plenum Press, London.

As well as the readings for the lectures, an additional reading list of interesting and relevant material has been attached to the back of this syllabus should you wish for a starting place to explore the topic more widely. For extra suggestions pop by my office during my office hours!

Canvas:

The Canvas course page will be the main tool for checking on announcements, view set weekly readings, view assignments, and post and respond to questions. Please make sure you have set yourself

as receiving announcements for the course page and make sure you check it regularly for important information like rooms changes etc.

A Note on Reading and Note-Taking:

Your success in this course will depend in no small part upon completing the assigned readings for the lectures/lab sessions thoroughly and on time, as well as attending the lectures/lab sessions and completing the assignments. Readings for the basis for the course lectures, lab sessions and class discussions, as well as the written assignments (detailed below). Read the papers, make notes and discussion will flow.

Referencing and Resources:

The preferred referencing style is **Harvard**, which is the most common style used in Archaeology and Anthropology. These consist of in text citation (author, date, page numbers) followed by a detailed citation of the publication in the bibliography.

Students are also reminded that using libraries is **essential**. Key readings are listed in the syllabus and will be made available online, but it is also important you expand your reading into other works and scholars. A useful tip is to use the bibliographies of the provided readings but be aware of the dates of publications.

In addition, online resources like JStor and WebofKnowledge for finding articles, academia.edu and researchgate are important repositories of scholarly research. Students are encouraged to use these sites to broaden their reading and familiarize themselves with looking up scholars and their research.

I will be uploading a **pdf entitled 'Useful Resources' on Canvas**. Please look at it as this has a guide to referencing styles, bibliography building and places you can go to look for articles, books and chapters.

Course Requirements and Expectations:

Over 13 weeks, students will spend 3 hours per week in class (39 hours total). Required reading is expected to take up approximately 5 hours per week (65 hours total). In addition, research and writing for the final assessment is estimated at total of approximately 40 hours over the course of the term.

Assessment:

The breakdown of course assessment is as follows:

- **Attendance (10%)**
- **Lab Book (25%)**
- **Display Case Proposals (25%)**
- **Environmental Site Report (40%)**

Lab Book (Due every Tuesday)

It is good practice for anyone working in a lab setting to make notes on what they have done in the lab. You are no exception, and to get you into the habit of taking notes, you will keep a lab journal of everything done on the Thursday sessions. In the first lab session we will talk through the structure of this in detail. This is to be typed up and handed at the following Tuesday lecture.

Display Case Proposals (Due Week 12)

Environmental archaeology rarely gets explained to the public, beyond providing some interesting background images of a changing landscape behind the artefacts. You will (as individuals or small groups, max.4 people, inform me if forming a group by **week 6** please) design a museum display case to explain an aspect of environmental archaeology to the public. I have provided an example taken from my own research, which can be found in Rhode Island Hall. Proposals will be 2 A4 pages, outlining the materials needed, the wording on any signs, and how materials should be laid out to show the

development of the idea. Images can be attached separately if necessary. The aim is that we will put these together in reality and create an actual exhibit before the end of semester so get creative!

Environmental Site Report (Due Week 15)

The final project of this course will be the development of a technical report. This assignment requires each of you (individually) to produce a paper about an archaeological site or region similar to reports developed for example by the Environmental Protection Agency or published site reports. It will have the following sections:

1. Introduction to the site and region
2. The palaeoenvironmental setting
3. The current (and future) and future environment
4. Summary of methods used to reconstruct the environment
5. Recommendations for future archaeological research and preservation

Reports should be between 2500 to 4000 words (no more, no less), excluding references. You can add as many images as you wish.

Formatting: 1.5 spacing, 12 point, Times New Roman font, 1 inch margin.

Assistance:

Please ask questions in class, by email, or in my office hours. I am more than happy to discuss anything with you that will help you to succeed in this class, and if you have a question then doubtless others are also thinking the same thing too. **So please, the most important policy in this class is that if you don't know something or have a question, ask!**

Student and Employee Accessibility Services

Please inform me (after class or during my office hours) if you have a disability or other condition that might require some modification of any of these course procedures. For more information contact Student and Employee Accessibility Service (SEAS) at 401-863-9588 or SEAS@brown.edu

Classroom Policies:

Attendance is mandatory. Tardiness can cause disruptions, please keep it to a minimum, and in the lab sessions it will not be allowed due to the safety procedures.

Turning in late assignments without due reason will not be accepted. You know the due date of your assignments in advance, plan accordingly. If you are worried about handing in an assignment late for a particular reason, talk with me in advance by email, after class or in my office hours, accommodations can and will be made (I am more than happy to do so for due reason). You can hand in a hard copy of an assignment or send a hard copy with another student if you wish (for example if your computer breaks down but you cannot attend a lecture). You can turn assignments in early should you wish.

I do not provide copies of the powerpoint presentations, as you will get more out of these classes by attending, taking good notes and interacting with the discussions. Handouts will however be given in the lab sessions as these will form part of the lab notes books. Take careful notes in all lectures and lab sessions and feel free to ask me to pause and go over a point if you need me to, I encourage it!

Interacting with Your Professor:

The best way to get in touch with me is in person, either just after class (before is not so good as I will be in preparation mode and you won't necessarily have my undivided attention) or in office hours. Email (Jennifer_bates@brown.edu) is also a good way to get hold of me. Do not rely on Canvas chat, as I don't have time to login everyday and check it. Also, while many other lecturers may prefer a formal title for interactions, I prefer to be addressed as 'Jennifer'.

Email Policy:

Please email me all questions etc. in one go, rather than bombard me with hundreds of emails in one day. You will receive a far quicker and more eloquent response. If the subject matter is something more

complex, requiring more than a single email reply, come and find me in office hours and we will discuss it in more detail.

I will try to reply to emails within 24 hours, but give me at least 48 hours before sending me a follow up (weekdays – weekends you will NOT get a reply). If it is Urgent, add this in the subject line and I will follow up urgently.

Classroom Civility:

Brown supports the principles of freedom of expression for both faculty and students, and the rights for faculty to teach and students to learn. In order to maintain these rights classroom conditions should not impede the learning process. A disruptive classroom will not be tolerated. Please do not allow cell phones to ring, read magazines, mess about on Facebook, make obnoxious remarks or engage in other rude activities. Sanctions for activities deemed to impinge upon faculty and student rights can be found here: <https://www.brown.edu/offices/student-conduct/code>

Academic Dishonesty:

All students at Brown must abide by the copyright policies standards outlined here: <https://it.brown.edu/computing-policies/copyright-infringement-policy>. Penalties for violating these can be severe, so please familiarize yourselves with them.

Plagiarism is a serious offence and penalties can include a warning, reprimand or grade adjustment, although further penalties at the Dean's discretion can also be applied. A simple guideline is never plagiarize. More information can be found here in the academic code: <https://www.brown.edu/academics/college/degree/index.php?q=policies/academic-code/>

WEEKLY SCHEDULE

Week 1

Thursday

Lecture 1: Course Introduction: Archaeology and the Environment

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Preface and Chapter 1.**
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 1.**

Week 2

Tuesday

Lecture 2: Thinking about environmental change, mechanisms and human (inter)action.

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 3 & 4.**
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 3.**

Thursday

Lab Session 1: Garbology and the Science of Inference

- Reitz, E.J., Shackley, M.L. 2012. *Environmental Archaeology*. Springer, London. Pp.1-39
- Sullivan, A.P., 1978. *Inference and Evidence in Archaeology: A Discussion of the Conceptual Problems*. In *Advances in Archaeological Method and Theory*, 1: 183–222.

Week 3

Tuesday

Lecture 3: Measuring Time and Determining Chronology

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 5.**
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 4.**

Thursday 20th September 2018

Lab Session 2: Trip to the Mass Spectrometers, Dendrochronology Practical and Discussion with DEEPS About Dating Techniques

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 6.**
- Fiedel, S.J., 1999. Older Than We Thought: Implications of Corrected Dates for Paleoindians. *American Antiquity* 64, 95–115.

Week 4

Tuesday

Lecture 4: Sedimentology: introduction to soils and sediments

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 11.**
- French, C.A.I., 2003. *Geoarchaeology in action: studies in soil micromorphology and landscape evolution*. Routledge, London. Pp.1-80

Thursday*Lab Session 3: Geoarchaeology and soil identification*

- Reitz, E.J., Shackley, M.L. 2012. *Environmental Archaeology*. Springer, London. Pp.125-159.

Week 5**Tuesday***Lecture 5: Landscapes, Landforms and Processes for Change*

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 9**.
- French, C.A.I., 2003. *Geoarchaeology in action: studies in soil micromorphology and landscape evolution*. Routledge, London. Pp.198-247.

Thursday*Lab Session 4: Study of a River Valley*

- French, C.A.I., 2003. *Geoarchaeology in action: studies in soil micromorphology and landscape evolution*. Routledge, London. Pp.81-158.
- French, C., Sulas, F., Petrie, C., 2017. Expanding the research parameters of geoarchaeology: case studies from Aksum in Ethiopia and Haryana in India. *Archaeological and Anthropological Sciences* 9, 1613–1626.

Week 6**Tuesday***Lecture 6: Site Formation Processes*

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 12**.
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 5**.

Thursday*Lab Session 5: Field Trip to the College Hill Excavation Site*

- Goldberg, P., Macphail, R., 2006. *Practical and theoretical geoarchaeology*. Blackwell Publishing, Malden, MA ; Oxford. Pp.28-41; 211-224; 299-334.

Week 7**Tuesday***Lecture 7: Palaeoenvironmental Reconstruction I – Archaeobotany at the Macrolevel*

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 13**.
- Pearsall, D.M., 1989. *Palaeoethnobotany: a handbook of procedures*. Academic Press, San Diego. Pp.1-10.

Thursday*Lab Session 6: What we can see with the naked eye: seeds charcoal and other large vegetal matter*

- Asouti, E., Austin, P., 2005. Reconstructing Woodland Vegetation and its Exploitation by Past Societies, based on the Analysis and Interpretation of Archaeological Wood Charcoal Macro-Remains. *Environmental Archaeology* 10, 1–18.
- Miller, N.F., 1988. *Ratios in Palaeoethnobotanical Analysis*, in: Hastorf, C.A., Popper, V.S. (Eds.), *Current Palaeoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*. Chicago University Press, Chicago, pp. 72–85.

Week 8**Tuesday**

Lecture 8: Palaeoenvironmental Reconstruction II – Archaeobotany at the Microlevel

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 14.**
- Madella, M., García-Granero, J.J., Out, W.A., Ryan, P., Usai, D., 2014. Microbotanical Evidence of Domestic Cereals in Africa 7000 Years Ago. *PLoS ONE* 9, e110177.

Thursday

Lab Session 7: Life under the microscope: phytoliths, pollen and starch.

- Piperno, D.R., 2006. *Phytoliths*. AltaMira Press, Oxford. Pp.23-80.
- Hesse, M. (Ed.), 2009. *Pollen terminology: an illustrated handbook*. Springer, New York. **Chapter 4.**

Week 9**Tuesday**

Lecture 9: Palaeoenvironmental Reconstruction III – Zooarchaeology

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 15 & 16.**
- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 21.**

Thursday

Lab Session 8: Using Fauna to Reconstruct the Environment

- Carter, R.J., 1998. Reassessment of Seasonality at the Early Mesolithic Site of Star Carr, Yorkshire Based on Radiographs of Mandibular Tooth Development in Red Deer (*Cervus elaphus*). *Journal of Archaeological Science* 25, 851–856.
- Pringle, H., 1998. Reading the Signs of Ancient Animal Domestication. *Science* 282, 1448–1448.

Week 10**Tuesday**

Lecture 10: Palaeoenvironmental Reconstruction IV – Global Isotopic Approaches

- Dincauze, D.F., 2001. *Environmental Archaeology, principles and practice*. Cambridge University Press, Cambridge. **Chapter 8.**
- Madella, M., Fuller, D.Q., 2006. Palaeoecology and the Harappan Civilisation of South Asia: a reconsideration. *Quaternary Science Reviews* 25, 1283–1301.

Thursday

Lab Session 9: Isotopes on hair practical I – preparing and processing samples

- O'Connell, T.C., Hedges, R.E.M., 1999. Investigations into the effect of diet on modern human hair isotopic values. *American Journal of Physical Anthropology* 108, 409–425.

Week 11**Tuesday**

Lecture 11: Palaeoenvironmental Reconstruction V – Localised Isotopic Approaches

- Dixit, Y., Hodell, D.A., Petrie, C.A., 2014. Abrupt weakening of the summer monsoon in northwest India 4100 yr ago. *Geology* 42, 339–342.
- Sealy, J.C., van der Merwe, N.J., Thorp, J.A.L., Lanham, J.L., 1987. Nitrogen isotopic ecology in southern Africa: Implications for environmental and dietary tracing. *Geochimica et Cosmochimica Acta* 51, 2707–2717.

Thursday

Lab Session 10: Isotopes on hair practical II – interpreting the data

- Cadwallader, L., Beresford-Jones, D.G., Whaley, O.Q., O’Connell, T.C., 2012. The Signs of Maize? A Reconsideration of What $\delta^{13}\text{C}$ Values Say about Palaeodiet in the Andean Region. *Human Ecology* 40, 487–509.

Week 12**Tuesday**

Lecture 12: Hunter-Gatherers and Agriculture, the Impacts of Changing Lifestyles

- Prendergast, A.L., Stevens, R.E., O’Connell, T.C., Hill, E.A., Hunt, C.O., Barker, G.W., 2016. A late Pleistocene refugium in Mediterranean North Africa? Palaeoenvironmental reconstruction from stable isotope analyses of land snail shells (Haua Fteah, Libya). *Quaternary Science Reviews* 139, 94–109.
- Richerson, P. J., Boyd, R., & Bettinger, R. L. (2001). Was agriculture impossible during the Pleistocene but mandatory during the Holocene? A climate change hypothesis. *American Antiquity*, 66(3), 387-411.

Thursday

Lab Session 11: GIS, using computers to map changes in time, space and landscapes

- No readings, pick a region of the world you are interested in and have a look for suitable base maps from this resource (if you find you cannot do so, don’t worry, we will walk through it in class with a case study):
<https://www.arcgis.com/home/group.html?content=all&id=34ca4e3505f24c1f90ac559ea23a5bed#overview>

Week 13**Tuesday**

Lecture 13: Ancient Ecology of Individual People

- Larsen, C.S., 2002. Bioarchaeology: the lives and lifestyles of past people. *Journal of Archaeological Research* 10(2):119-166.
- Warinner, C., Speller, C., Collins, M.J., Lewis, C.M., 2015. Ancient human microbiomes. *Journal of Human Evolution* 79, 125–136.

Thursday

Lab Session 12: Analysing a body in detail, looking at Otzi (cf. skype session with Otzi museum)

- Kutschera, W., Rom, W., 2000. Ötzi, the prehistoric Iceman. *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms* 164–165, 12–22.
- Rollo, F., Ubaldi, M., Ermini, L., Marota, I., 2002. Otzi’s last meals: DNA analysis of the intestinal content of the Neolithic glacier mummy from the Alps. *Proceedings of the National Academy of Sciences* 99, 12594–12599.

Week 14**Tuesday**

Lecture 14: Environmental Change, Climate Change and Their Impacts

- Morgan, C., 2009. Climate change, uncertainty and prehistoric hunter–gatherer mobility. *Journal of Anthropological Archaeology* 28, 382–396.
- Newby, P., Bradley, J., Spiess, A., Shuman, B., Leduc, P., 2005. A Paleoindian response to Younger Dryas climate change. *Quaternary Science Reviews* 24, 141–154.

Thursday

Lab Session 13: Discussion of how environments shape humans and humans shape environments

- Reitz, E.J., Newson, L.A., Scudder, S.J., 2008. *Case Studies in Environmental Archaeology*, 2nd Edition. Plenum Press, London. **Chapter 14.**
- Murray, T. 2010, *The power of the past: environment, aborigines, archaeology and a sustainable Australian society*. In P. McAnany and N.Yoffee (eds) *The choices and fates of human societies: an anthropological and environmental reader*, pp. 229-328. Cambridge University Press: New York.
- Green, A.& Bates, J. et al. In press. How to last a Millennium; Or A Global Perspective on Environmental Variability and the Long-Term Dynamics of Social Human Sustainability. *Nature Sustainability*.

Week 15**Tuesday**

Lecture 15: Human Responses to Climate Change, a Case Study from Dr Bates' (and Colleagues) Research

- Petrie, C.A., Singh, R.N., Bates, J., Dixit, Y., French, C.A.I., Hodell, D.A., Jones, P.J., Lancelotti, C., Lynam, F., Neogi, S., Pandey, A.K., Parikh, D., Pawar, V., Redhouse, D.I., Singh, D.P., 2017. Adaptation to Variable Environments, Resilience to Climate Change: Investigating Land, Water and Settlement in Indus Northwest India. *Current Anthropology* 58, 1–30.
- Bates, J., Petrie, C.A., Singh, R.N., 2017. Approaching rice domestication in South Asia: New evidence from Indus settlements in northern India. *Journal of Archaeological Science* 78, 193–201.



Additional Readings

Adams, R.E.W. 2000. *Introduction to a Survey of the Native Prehistoric Cultures of Mesoamerica*. In Adams R.E.W., MacLeod M. J., ed., 2000. *The Cambridge History of the Native Peoples of the Americas, Volume II: Mesoamerica, Part 1*. Cambridge: Cambridge University Press.

Ames, K.M., Maschner, H.D.G. 1999. *Peoples of the Northwest Coast: Their Archaeology and Prehistory*. London: Thames & Hudson.

Angel, L.J. 1984. *Health as a Crucial Factor in the Changes from Hunting to Developed Farming in the Eastern Mediterranean*. In Cohen M.N., Armelagos G.J., eds. 1984. *Paleopathology at the Origins of Agriculture*. Florida: University Press of Florida.

Bathurst, R.R., Davide Z., Byock J. 2010. Diatoms as Bioindicators of Site Use: Locating Turf Structures from the Viking Age. *Journal of Archaeological Science* 37(11): 2920–2928.

Boas, F. 1966. *Kwakiutl Ethnography*. University of Chicago Press.

Bolt, H.M. 2012. Arsenic: an Ancient Toxicant of Continuous Public Health Impact, from Iceman Ötzi until now. *Archives of Toxicology* 286 (866).

Branch, N., Canti, M., Clark, P., Turney, C. 2014. *Environmental Archaeology: Theoretical and Practical Approaches*. London: Routledge.

Butler, V.L. 1993. Natural versus cultural salmonid remains: origin of the Dalles Roadcut bones, Columbia River, Oregon, USA. *Journal of Archaeological Science* 20:1-24.

Butzer, K.W. 1983. Human Response to Environmental Change in the Perspective of Future, Global Climate. *Quaternary Research* 19(3): 279–292.

Butzer, K.W., Endfield, G.H.. 2012. Critical Perspectives on Historical Collapse. *Proceedings of the National Academy of Sciences* 109 (10):3628-31.

Byock, J. 2001. *Viking Age Iceland*. Penguin UK.

Carson, R. 1962. *Silent Spring*. Boston: A Marine Book.

Diamond, J. 2005. *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.

Diamond, J. 1997. *Guns, Germs, and Steel: The Fate of Human Societies*. New York: Norton.

Dickson, J.H., Mudie, P.J. 2008. The Life and Death of Kwäday Dän Ts'ınchi, an Ancient Frozen Body from British Columbia: Clues from Remains of Plants and Animals. *The Northern Review* 28:27-50.

Di Cosmo, N. 1994. Ancient inner Asian nomads: their economic basis and its significance in Chinese history. *The Journal of Asian Studies*, 53:1092-1126.

Dillehay, T.D., Kolata A.L. 2004. Long-Term Human Response to Uncertain Environmental Conditions in the Andes. *Proceedings of the National Academy of Sciences of the United States of America* 101(12): 4325–4330.

Dugmore, A.J., McGovern, T.H., Vésteinsson, O., Arneborg, J., Streeter, R., Keller, C. 2012. Cultural Adaptation, Compounding Vulnerabilities and Conjunctions in Norse Greenland. *Proceedings of the National Academy of Sciences* 109 (10):3658-63.

Dugmore, A.J., Newton, A.J., Larsen, G., Cook, G.T., 2000. Tephrochronology, Environmental Change and the Norse Settlement of Iceland. *Environmental Archaeology* 5(1): 21–34.

Dunning, N.P., Beach, T.P., Luzzadder-Beach, S.. 2012. Kax and Kol: Collapse and Resilience in Lowland Maya Civilization. *Proceedings of the National Academy of Sciences* 109 (10):3652-7.

Eastman, A. 1997. The potential of bird remains for environmental reconstruction *International Journal of Osteoarchaeology* 7: 422-429.

Erlandson, J.M., 2010. As the World Warms: Rising Seas, Coastal Archaeology, and the Erosion of Maritime History. *Journal of Coastal Conservation* 16(2): 137–142.

Erlandson, J.M., Rick, T.C., Braje, T.J., Steinberg, A., Vellanoweth, R.L., 2008 Human Impacts on Ancient Shellfish: A 10,000 Year Record from San Miguel Island, California. *Journal of Archaeological Science* 35(8): 2144–2152.

Fitzhugh, B., Gjesfjeld, E.W., Brown, W.A., Hudson, M.J., Shaw, J.D., 2016. Resilience and the population history of the Kuril Islands, Northwest Pacific: A study in complex human ecodynamics. *Quaternary International* 419, 165–193.

Fritz, G. 2005, *Paleoethnobotanical Methods and Applications*. In Maschner, H.D.G., Chippindale, C. eds. 2005. *Handbook of Archaeological Methods*. Rowman Altamira. Pp. 773–833.

Gardner, A., Cochrane, E.E. 2011. *Evolutionary and Interpretive Archaeologies: A Dialogue*. In Cochrane, E.E., Gardner, A., eds. 2011. *Evolutionary and Interpretive Archaeologies: A Dialogue*. Walnut Creek, CA: Left Coast Press.

Hardesty, D.L. 1977. *Ecological Anthropology*. John Wiley & Sons.

Jazwa, C.S., Braje, T.J., Erlandson, J.M., Kennett, D.J., 2015 Central Place Foraging and Shellfish Processing on California's Northern Channel Islands. *Journal of Anthropological Archaeology* 40: 33–47.

Lear, L. 2002. *Introduction*. In Carson, R., *Silent Spring*. Boston: A Marine Book.

Legge, T. 1996. *The beginning of caprine domestication in Southwest Asia*. In Harris, D.R., ed., 1996. *The Origins and Spread of Agriculture and Pastoralism in Eurasia*. London: UCL Press. Pp. 238-262.

Lightfoot, K.G., Martinez, A., Schiff, A.M. 1998. Daily practice and material culture in pluralistic social settings: an archaeological study of culture change and persistence from Fort Ross, California. *American Antiquity* 63:199-222.

Liritzis, I., Singhvi, A.K., Feathers, J.K., et al. 2013. Luminescence Dating of Archaeological Materials. In *Luminescence Dating in Archaeology, Anthropology, and Geoarchaeology* Pp. 25–40. Springer Briefs in Earth System Sciences. Springer International Publishing.

Marston, J.M., Warinner, C., d'Alpoim Guedes, J. 2014. *Paleoethnobotanical Method and Theory in the Twenty-First Century*. In Marston, J.M., D'Alpoim Guedes, Warinner, C., eds. 2014. *Method and Theory in Paleoethnobotany*. University Press of Colorado.

- Martin-Benito, D., Pederson, N., McDonald, M., et al. 2014. Dendrochronological Dating of the World Trade Center Ship, Lower Manhattan, New York City. *Tree-Ring Research* 70(2): 65–77.
- McElory, A., Townsend, P.K. 2015. *Medical Anthropology in Ecological Perspective*, Sixth Edition: Westview Press.
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