

## Beth Shapiro

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## Curriculum Vitae

University of California Santa Cruz  
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### Education:

DPhil (Zoology) Oxford University, 2003  
MS (Ecology) University of Georgia, 1999  
BS (Ecology) University of Georgia, 1999

### Current Position:

Professor, Ecology and Evolutionary Biology, UC Santa Cruz, (2016- present)  
Director of Evolutionary Genomics, UCSC Genomics Institute, UC Santa Cruz (2015-present)

### Past Positions:

Associate Professor, Ecology and Evolutionary Biology, UC Santa Cruz, (2012- 2016)  
Shaffer Associate Professor, Department of Biology, The Pennsylvania State University (2011-2012)  
Shaffer Assistant Professor, Department of Biology, The Pennsylvania State University (2007- 2011)  
Director, Henry Wellcome Ancient Biomolecules Centre, Oxford University (2004-2007)  
Royal Society University Research Fellow, Oxford University (2006-2007)  
Wellcome Trust Research Fellow, Oxford University (2004-2006)

### Selected Honors and Awards:

Professor, Howard Hughes Medical Institute, 2018  
Member, New York Academy of Sciences, 2016  
National Finalist, Blavatnik Awards for Young Scientists, 2016  
Finalist, LA Times Book Award (for *How to Clone a Mammoth*), 2016  
AAAS/Subaru SB&F Prize for Excellence in Science Books (for *How to Clone a Mammoth*), 2016  
Packard Fellow, 2010  
PopTech Science and Public Leadership Fellow, 2010  
National Geographic Emerging Explorer, 2010  
MacArthur Fellow, 2009  
Searle Scholar, 2009  
Visiting Fellow, Isaac Newton Institute for Mathematical Sciences, University of Cambridge, 2007  
Smithsonian Young Innovator, 2007  
University Research Fellow, The Royal Society, 2006  
Research Fellow, Balliol College, University of Oxford, 2002-2007  
Rhodes Scholar, 1999

### Professional Activities:

Board of Reviewing Editors, *Science* (2018-present).  
Associate Editor, *Journal of Heredity* (2017-present).  
Board of Directors, Revive & Restore (not-for-profit conservation organization) (2017-present)  
American Genetics Association, Council (2016-2019)  
Member: Contamination Control and Planetary Protection Working Group; Mars 2020 Mission; NASA.  
(2015-present)  
Organizing Committee: Advances in Genome Biology and Technology meeting (2015-present)

Editorial Board, *STAR: Science and Technology of Archaeological Research*; <http://www.maneyonline.com/loi/sta> (2014-present)  
Editorial Board, *PaleoAmerica*; <http://www.maneyonline.com/loi/pal> (2014-present).  
Executive Committee Member: *Genome10K/Vertebrate Genome Project*. <https://genome10k.soe.ucsc.edu/> (2013-present)  
Member: Public Interfaces of the Life Sciences Roundtable, The National Academies (2013-2015)  
Panelist: *Molecular Evolution and Genomics* funding panel, Genes and Genome Systems Cluster, Division of Molecular and Cellular Biosciences, The National Science Foundation. 2012  
Panelist: *Public Interfaces of Science*, The National Academies. (2010).  
US Co-Chair: *Indonesian-American Kavli Frontiers of Science*, The National Academy of Science (2010).  
US Session Chair: *German-American Kavli Frontiers of Science*, The National Academy of Science (2009).  
Associate Editor, *Molecular Biology and Evolution*; <http://mbe.oxfordjournals.org/> (2007-present).  
Reviewer for >30 peer-review journals including *Science*, *Nature*, *PLoS Biology*, *Current Biology*, *PNAS*, *Proc Roy Soc B*, *Biology Letters*, *Molecular Ecology*.  
Public Understanding of Science: I am and have been involved with several organizations to promote the public understanding of science. More information and upcoming events can be found on my website and in the "Seminars" section of this document.

### **Professional Memberships:**

American Association for the Advancement of Science  
Society for Molecular Biology and Evolution  
American Genetics Association  
Canadian Quaternary Association  
Society for Vertebrate Paleontology

### **Research Interests:**

Molecular evolution; Genome evolution; Pathogen evolution; The interface of genomics and climate change; Ancient DNA; Paleontology; Human evolution, Extinction and speciation; Reconstructing demographic changes through time; Science communication

### **Selected Invited/plenary talks:**

#### Upcoming Academic Speaking Events

Plenary Speaker, *Advances in Genome Biology and Technology*, Orlando FL. February 2018.  
Schrödinger at 75: What is life? The Future of Biology. Dublin, Ireland, September 2018.

#### Past Public Speaking Events (selected)

*50th Anniversary Celebration plenary speaker, University of Georgia Institute of Ecology, Athens, GA 12 January 2018*  
Northern California Science Writers Association Annual Meeting, Plenary Speaker 6 December 2017.  
Isaac Asimov 2017 Lectures, American Museum of Natural History, New York. 29 March 2017.  
Auckland Museum, Auckland, New Zealand. 12 October 2016.  
Allan Wilson Lecture Series, University of Otago. Dunedin, New Zealand . 10 October 2016.  
Friday Night Seminar, Woods Hole, Mass. 12 August 2016  
Gordon and Betty Moore Foundation, Palo Alto, CA. 10 May 2016,  
Exploratorium, San Francisco, CA. 4 Feb 2016  
California Academy of Sciences, 22 October 2015  
Houston Museum of Natural Sciences, Houston TX, October 2015

Decatur Book Festival. Atlanta, Georgia. September 2015  
Commonwealth Club of San Francisco. 12 June 2015.  
Hay Literary Festival, London. 23 May 2015.  
The Royal Institution, London, 23 May 2015.  
Seminars About Long-Term Thinking (SALT), The Long Now Foundation. April 2015.  
*Ferguson Lecture*. Washington University, St Louis. 31 March 2015.  
*How to Clone a Mammoth*. Phi Beta Kappa annual retreat, Asilomar Conference Center. February 2015.  
Science Speed Dating hosted by the Science and Entertainment Alliance, National Academies of Science. Hollywood, CA. June 2014.  
*Reviving the Passenger Pigeon*. Smith Nature Symposium. Ryerson Woods, Chicago Ill. 17 May 2014.  
Commencement Address. Harvey Mudd College, Claremont CA. 18 May 2014.  
*Extracting DNA: The Power to Restore Life*. City Arts and Lectures Series, with help from the California Academy of Sciences. Nourse Theater, San Francisco, CA. 8 April 2014.  
*Resurrecting the Dead*. Deep Time, Global Change, and You. Vancouver, BC. 6 March 2014.  
Illumina, Inc. San Diego, CA. 27 March 2014.  
*Resurrecting the Dead*. Denver Museum of Nature and Science. September 2013.  
*What makes a species? The twisted tale of brown and white bears*. Illinois Math and Science Academy Great Minds. Chicago (April 2013).  
*Ancient DNA: What it is, and what it could be*. TEDxDeExtinction. National Geographic, Washington DC. March 2013.  
*Frontiers in Biology* Research Series. Princeton University Press. Princeton, NJ. April 2012.  
*Tracing molecular evolution through space and time*. Ideafest. University of South Dakota, Vermillion, SD. April 2011.  
*The Holocene Mass extinction*. Pop!Tech 2010. Camden, Maine. October 2010.  
*Science, Living Systems, and the Edge of Change: A PopTech Salon*. Washington DC, 22 June 2010.  
*Should we care about biodiversity?* SciFoo. Googleplex, Mountain View, CA. July 2010.  
*Understanding extinction*. National Geographic Society. Washington DC. June 2010.  
*How to clone a Dodo*. DNA and Darwin Series, The Chautauqua Institute, Chautauqua, NY. August 2008.

Past Academic Speaking Events (selected)

*Plant and Animal Genomes, Illumina "Greatest Hits" symposium, 16 January 2018*.  
Cornell University. 25 September 2017.  
Genome10K, Norwich, UK. 30 August 2017.  
Society for Molecular Biology and Evolution annual meeting, invited speaker. 3 July 2017.  
University of Chicago. 7 April 2017.  
Plant and Animal Genomes. San Diego, CA, 14 January 2017.  
James D. Woods Lecture. Butler University, Indianapolis, IN. 30 November 2016.  
Australia Genomics Technologies Association annual meeting 2016. Auckland, NZ. 8 October 2016.  
Spring School in Bioinformatics and Population Genomics, Université de Lausanne, Switzerland. 1 June 2016.  
Ancient DNA. Cold Spring Harbor Lab. 15-17 May 2016.  
University of Alaska Fairbanks, 22 April, 2016.  
USDA Animal Meat Research Center, Clay Center, Nebraska. 17 March 2016.  
Plenary Speaker: The Future of Genomic Medicine, Scripps Institute, San Diego, CA 3-4 Feb 2016.  
Advances in Genome Biology and Technology, 9-14 Feb 2016  
National Academy of Sciences Sackler Colloquium, "In the light of evolution X: Comparative Phytogeography." 8-9 January, 2016.  
Society for Marine Mammals Annual Meeting, San Francisco, CA. 16 December 2015.

Mission Bay Seminar, UCSF, 1 December 2015.

Royal Society Discussion Meeting: *"Dating species divergence using rocks and clocks."* London, UK. 9-10 November, 2015.

California Academy of Sciences, San Francisco, CA, 22 October 2015

Harvard/Radcliffe Science Symposium: "The past, Present, and Future of DNA." Cambridge, MA, 2 October 2015.

Ecological and Evolutionary Genomics Gordon Conference. Biddeford, ME, July 2015

*Ancient DNA*. Korean-American Frontiers of Science. Juju Island, South Korea. June 2014.

Oxford University, Department of Zoology, May 2015

Duke University, Department of Anthropology, 3 April 2015.

*The evolutionary consequences of interspecies hybridization*. AGBT conference, Marco Island, FL. February 2015.

Plenary Speaker: *Plant and Animal Genomes*. San Diego, CA. January 2015.

*Ancient DNA*. Kavli Frontiers of Science. Irvine, CA. November 2014.

*Is de-extinction inevitable? Megafauna and Ecosystem Function: From the Pleistocene to the Anthropocene*. Oxford, UK. March 2014.

*Revealing the past using ancient DNA*. UC Davis. Davis, CA. 28 April 2014.

*Paleogenomes, ice-age megafauna, and rapid warming: How genomes from the past can help predict the consequences of future climate change*. Plenary speaker: Association of Genome Biology and Technology. Marco Island, FL. February 2014.

*The influence of Late Pleistocene climate change on the North American megafauna*. Plenary speaker, Canadian Quaternary Association Annual Meeting. August 2013..

*Sex, lies, and Grolar Bears*. Genome 10K III. Fort Lauderdale, FL. April 2013.

*Inferring population history on a glacial scale from multi-locus genomic data*. Society for Molecular Biology and Evolution Annual Meeting. Dublin, Ireland. July 2012.

*Multiple hybridizations between brown and polar bears during the Late Pleistocene*. CAS-MPG Partner Institute for Computational Biology, Shanghai, China. June 2011.

*Following bears through time using ancient DNA*. Departments of Biology and Biostatistics, University of California Los Angeles and UCLA Medical School. Los Angeles, CA. April 2011.

*Tracing Evolution through space and time*. Department of Genetics, Stanford University Medical School. Palo Alto, CA. January 2011.

*Do we need a true structured coalescent? DNA, Genetics and the History of Mankind*. Banbury Center, Cold Spring Harbor Lab, NY. November 2010.

*Understanding extinction* (Distinguished Lecturer). School of Life Sciences, University of Nevada at Las Vegas, Las Vegas, NV (March 2010).

Measuring evolution through space and time. Boehringer Ingelheim Fonds Fellows Retreat. Cold Spring Harbor Lab, NY. October 2009.

*Several millennia in the lives of polar bears*. Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany. August 2009.

*The rise and the fall of the Beringian megafauna*. Plenary Lecture. Canadian Quaternary Association. Vancouver, Canada. May 2009.

*The rise and the fall of the Beringian megafauna*. 15th Annual German-American Frontiers of Science Symposium. Alexander von Humboldt Foundation and the National Academy of Sciences. Irvine, California. April 2009.

*The rise and the fall of the Beringian megafauna*. Kansas University Museum of Natural History. Lawrence, KS. April 2009.

*Reconstructing demographic change through space and time*. International Biogeography Society, Merida, Mexico. January 2009.

*Did we kill the Megafauna?* Harvard Broad Symposium on the Scientific Study of the Human Past. Harvard University, Cambridge, MA. December 2008.

*Inferring the demographic history of measurably evolving populations using ancient DNA.* Krishnaiah and Katri Lecture Series. Department of Statistics, Penn State University, University Park PA. October 2008.

*Measuring evolution through space and time.* GeoGenetics Interdisciplinary Research Colloquium. Huck Institute of Life Sciences, Penn State University, University Park, PA. February 2008.

*Did we kill the Megafauna?* Special Seminar (University Foundation) University of Georgia, Athens, GA (January 2008).

*Using gene sequences to trace evolution through time and space.* Andrew W Mellon DNA and History seminar series, UCLA. January 2008.

*Ancient DNA: advances in phylogenetic methods.* Fundación Ramon Areces, Madrid, Spain. April 2007.

### **Teaching:**

BIOE 137: *Molecular Ecology*. (2014-present)

BIOE 153A, B, C, *Arctic Ecology and Scientific Communication field quarter*, a 150-unit field course taught every other year beginning 2018.

Biology 110 (PSU) *Basic Concepts and Biodiversity*. I co-taught this large (~720 student) course (2008-2012)

Biology 439 (PSU) *Practical Bioinformatics*. I have developed a combined lecture/practical course to teach students current methods for the analysis of molecular sequence data. (2008-2012)

*International Bioinformatics Workshop on Virus Evolution and Molecular Epidemiology*. I have been part of the core faculty for this annual, week-long workshop in which students are introduced to the latest phylogenetic and genealogic methods to analyze molecular data from viruses.

*Ethics in Genetics* (Oxford University). I developed and taught an intensive four-week course in which students were challenged to tackle ethical dilemmas arising from modern scientific advances.

*Biomolecular Evolution* (Oxford University). I developed and taught a 3-week lecture/discussion course as part of the MSc in Archaeological Science, in which students are introduced to the basic concepts and application of ancient DNA.

### **Supervision:**

My laboratory currently comprises seven PhD students (Nathan Schaffer, Nedda Saremi, Natasha Dudek, Alisa Vershinina, Sabrina Shirazi, Josh Kapp, Nevé Baker) two Postdoctoral Research Associates (Megan Supple, Gemma Murray), four undergraduate researchers and three technicians.

#### Past graduate students:

Ben Novak (MSc, UCSC, 2016; current: graduate student, Canberra University).

James Cahill (PhD, UCSC, 2016; Current: Postdoc, Jarvis lab, Rockefeller University)

James Haile (PhD, Oxford, 2006; Current: Postdoctoral Associate, Oxford University ancient DNA center).

Gabrielle Harrison (PhD, Oxford, 2007; Current: Postdoctoral Associate, Institute for Emerging Infections, Oxford University)

Brandon Letts (PhD, PSU, 2011; Current: FBI forensic scientist)

Logan Kistler (PhD, PSU, 2012, Current: Assistant Professor, University of Warwick)

Conrad Stack 9PhD, PSU, 2013, Current: Research scientist, Mars, Inc.)

Kristine Korzow-Richter (PhD, PSU, 2014, current: ERC fellow, University of York).

#### Past postdoctoral scholars:

Darko Cotoras

Ruth Nichols (current: Senior Scientist, Sirona DX)

Peter Heintzman (current: Tromsø University Museum, Norway)

André Elias Rodrigues Soares (current: Laboratório Nacional de Computação Científica, LNCC, Brasil)  
Dan Chang (Current: Senior Senior Scientist, Merck Research Laboratories)  
Simon Y. W. Ho (Current: Associate Professor, Sydney University).  
Tara Fulton (Current: Canadian Wildlife Service).  
Mathias Stiller (Current: Senior Scientist, DKTK: German Cancer Research Center).  
Andrew Clack (Current: U.S. Army forensic scientist).  
Ryan W. Norris (current: Faculty, Lock Haven University).

## **Publication List**

### **In Press:**

- (1) Cahill JA, Heintzman PD, Harris K, Teasdale M, Kapp J, Soares AER, Stirling I, Monaghan N, Edwards CJ, Malev AV, Kisleika AA, Green RE, Shapiro B. 2018. Genomic evidence of globally widespread admixture from polar bears into brown bears during the last ice age. *Molecular Biology and Evolution*
- (2) Novak BJ, Estes Jn Shaw H, Nivak EV, Shapiro B. Experimental investigation of the dietary ecology of the extinct passenger pigeon, *Ectopistes migratorius*

### **Journal articles:**

- (3) Cotoras DD, Murray GGR, Kapp J, Gillespie R, Grosword C, Simison WB, Green RE, Shapiro B. 2017. Ancient DNA resolve the history of *Tetragnatha* spiders on Rapa Nui. *Genes* 8: e43
- (4) Heintzman PD, Zazula GD, MacPhee RDE, Scott E, Cahill JA, McHorse BK, Stiller M, Orlando L, Southon JR, Froese DG, Shapiro B. 2017. A new genus of horse from Pleistocene North America. *eLife* 6:e29944.
- (5) Murray GGR, Soares AER, Novak BJ, Schaefer NK, Cahill JA, Baker AJ, Demboski JR, Doll A, Da Fonseca RR, Fulton TL, Gilbert MTP, Heintzman PD, Letts B, McIntosh G, O'Connell BL, Peck M, Pipes M-L, Rice ES, Santos KM, Sohrweide AG, Vohr SH, Corbett-Detig RB, Green RE, Shapiro B. 2017. Natural selection shaped the rise and fall of passenger pigeon genomic diversity. *Science* 358: 951-954.
- (6) Benazzo A, Trucchi E, Cahill JA, Daisano Delsler P, Mona S, Fumagalli M, Bunnefeld L, Cornetti L, Ghirotto S, Giradi M, Ometto L, Panziera A, Rota-Stabelli O, Zanetti E, Karamanlidis A, Groffi C, Paule L, Gentile L, Vilá C, Vicario S, Boitani L, Orlando L, Fuselli S, Cernesi C, Shapiro B, Ciucci P, Bertorelle G. 2017. Survival and divergence in a small group: the extraordinary genomic history of the endangered Apennine brown bear stragglers. *Proceedings of the National Academy of Sciences USA* 114:E9589-E9597.
- (7) Kirillova IV, Chernova OF, Kukarsih VV, Shapiro B, van der Plischt J, Shidlovskiy FK, Heintzman PD, van Kolfschoten T, Zazina OG. 2017. Discovery of the skull of *Stephanorhinus kirchbergensis* (Jager, 1839) above the Arctic Circle. *Quaternary Research* 88:537-550.
- (8) Zazula GD, Hall E, Hare PG, Thomas C, Matthewes R, La Farge C, Martel AL, Heintzman PD, Shapiro B. 2017. A middle Holocene steppe bison and paleoenvironments from the Versleuce Meadows, Whitehorse, Yukon, Canada. *Canadian Journal of Earth Sciences* 54:1138-1152.
- (9) Maschenko EN, Potapova OR, Vershinina A, Shapiro B, Streletskaya IR, Vasilev AA, Oblogov GE, Kharlamova AS, van der Plicht J, Tikhonov AN, Serdyuk NV, Tarasenko KK. The Zhenya Mammoth (*Mammuthis primigenius* (Blum.)): taphonomy, geology, age, morphology and ancient DNA of a 48,000 year old frozen mummy from Western Taymyr, Russia. *Quaternary International* 445: 104-134.
- (10) vonHoldt BM, Cahill JA, Gronau I, Shapiro B, Wall J, Wayne RK. 2017. Response to *Whole genome data do not support recent hybrid origins of red wolves and eastern wolves*. *Science Advances* 3: e1701233
- (11) Meyer M, Palkopoulou E, Baleka S, Stiller M, Penkman K, Alt KW, Ishida Y, Mania D, Mallick S, Meijer T, Meller T, Nagel S, Nickel B, Ostritz S, Roca AL, Rohland N, Schauer K, Schüler T, Reich D, Shapiro B, Hofreiter M. 2017. Nuclear and mitochondrial genome sequences of the Middle Pleistocene Eurasian straight-tusked elephant rewrite elephant evolutionary history. *eLife* 6: e23413.
- (12) Wang Y, Heintzman P, Newsom L, Bigelow N, Wooller M, Shapiro B, Williams J. 2017. The southern coastal Beringian land bridge: cryptic refugium or pseudo refugium for woody plants during the Last Glacial Maximum? *Journal of Biogeography* 44:1559-1571.
- (13) Froese DG, Stiller M, Heintzman PD, Reyes AV, Zazula GD, Soares AER, Meyer M, Hall E, Jensen

- BKL, Arnold L, MacPhee RDE, Shapiro B. 2017. New fossil and genomic evidence constrains the timing of bison arrival in North America. *Proc Natl Acad Sci USA*. 114:3457-3462.
- (14) Schaefer NK, Shapiro B, Green RE. AD-LIBS: 2017. Inferring ancestry across hybrid genomes using low-coverage sequence data. *BMC Bioinformatics*. 18:203.
- (15) Chang D\*, Knapp M\*, Enk J\*, Lippold S, Kircher M, Lister A, MacPhee RDE, Widga C, Czechowski P, Sommer R, Hodges E, Stümpel N, Barnes I, Dalén L, Derevianko A, Germonpré M, Hillebrand-Voiculescu A, Constantin S, Kuznetsova T, Mol D, Rathgeber R, Rosendahl W, Tikhonov AN, Willerslev E, Hannon G, Lalueza-Fox C, Joger U, Poinar H, Hofreiter M, Shapiro B. 2017. The evolutionary and phylogeographic history of woolly mammoths: a comprehensive mitogenomic analysis. *Scientific Reports* 7:44585
- (16) Węcek K, Hartmann S, Paijmans JLA, Taron U, Xenikoudakis G, Cahill JA, Heintzman PD, Shapiro B, Baryshnikov G, Bunevich AN, Crees JJ, Dobosz R, Manaserian N, Okarma H, Tokarska M, Turvey ST, Wójcik JM, Żyła W, Szymura JM, Hofreiter M, Barlow A. 2017. Complex admixture preceded and followed the extinction of wisent in the wild. *Molecular Biology and Evolution* 34: 598-612.
- (17) Rearden J, Ankeny RA, Bangham J, Darling K, Hilgartner S, Maxson Jones K, Shapiro B, Stevens H, and the Genomic Open workshop group. 2016. Bermuda 2.0: Reflections from Santa Cruz. *GigaScience* 5:1-4.
- (18) Soares AER, Novak B, Haile J, Fjeldså J, Gilbert MTP, Poinar H, Church G, Shapiro B. 2016. Complete mitochondrial genomes of living and extinct pigeons revise the timing of the columbiform radiation. *BMC Evolutionary Biology* 16: 1-9.
- (19) Soubrier J, Gower G, Chen K, Richards S, Llamas B, Mitchell KJ, [35 authors], Shapiro B, Cooper A. 2016. Early cave art and ancient DNA record the origin of European bison. *Nature Communications* 7:13158.
- (20) vonHoldt BM, Cahill JA, Fan Z, Gronau I, Robinson J, Pollinger JP, Shapiro B, Wall J, Wayne RK. 2016. Whole-genome sequence analysis shows that two endemic species of North American wolf are admixtures of the coyote and gray wolf. *Science Advances* 2: e150175.
- (21) Shapiro B. 2016. Pathways to de-extinction: How close can we get to resurrection of an extinct species? *Functional Ecology*. 10.1111/1365-2435.12705 <http://onlinelibrary.wiley.com/doi/10.1111/1365-2435.12705/full>
- (22) Heintzman PD, Froese DG, Ives JW, Soares AER, Zazula GD, Letts B, Andrews TD, Driver JC, Hall E, Hare G, Jass CN, MacKay G, Southon JR, Stiller M, Woywitka R, Suchard MA, Shapiro B. 2016. Bison phylogeography constrains dispersal and viability of the 'Ice Free Corridor' in western Canada. *Proc Natl Acad Sci USA*. Proc 113: 8057-8063. <http://www.pnas.org/content/113/29/8057.full?sid=7b4833d6-a9ea-4887-8123-7ef48f5c26f9>
- (23) Graham RW\*, Belmecheri S, Choy K, Cullerton B, Davies LH, Froese D, Heintzman PD, Hritz C, Kapp JD, Newsom L, Rawcliffe R, Saulnier-Talbot E, Shapiro B, Wang Y, Williams JW, Wooller MJ. 2016. Declining freshwater availability caused the extinction of the last North American mammoth. \*remaining authors are in alphabetical order. *Proc Natl Acad Sci USA* 113: 9310-9314 <http://www.pnas.org/content/113/33/9310.full>
- (24) Schaefer NK, Shapiro B, Green RE. 2016. Detecting hybridization using ancient DNA. *Molecular Ecology* 25: 2398-2412.
- (25) Cahill JA, Soares AER, Green RE, Shapiro B. 2016. Inferring species divergence times using Pairwise Sequential Markovian Coalescent (PSMC) modeling and low coverage genomic data. *Phil Trans Roy Soc B* 371: 20150138.
- (26) Enk J, Devault A, Widga C, Saunders J, Szpak P, Southon JR, Rouillard J-M, Shapiro B, Golding B, Zazula GD, Froese DG, Fisher D, MacPhee RD, Poinar H. 2016. *Mammuthus* population dynamics in Late Pleistocene North America: Divergence, phylogeography and introgression. *Frontiers in Ecology and Evolution* 4:00042. DOI=10.3389/fevo.2016.00042.
- (27) Chernova O, Kirillova I, Shapiro B, Shidlovskiy F, Soares, AER, Levchenko V, Bertuch F. 2016. Morphological and genetic identification and isotopic determinations of the hair of a cave lion (*Panthera spelaea* Goldfuss, 1810) from the Malyy Anyui River (Chukotka, Russia). *Quaternary*



*Science Reviews* 142: 61-73.

- (28) Simpson JP, Penkman KEH, Demarchi D, Koon H, Collins MJ, Thomas-Oates J, Shapiro B, Stark M, Wilson J. 2016. The effects of demineralisation and sampling point variability on the measurement of glutamine diminution in type I collagen extracted from bone. *Journal of Archaeological Science* 69: 29-38.
- (29) Chang D, Shapiro B. 2016. Using ancient DNA and coalescent-based methods to infer extinction. *Biology Letters* 12: 20150822.
- (30) Tong W, Shapiro B, Rubenstein DI. 2015. Genetic relatedness in two-tiered plains zebra societies suggests that females choose to associate with kin. *Behavior* 152: 2059-2078.
- (31) Rijdsdijk KR, Hume JP, De Louw, PGB, Meijer HJM, Janoo A, De Boer EJ, [18 authors], Shapiro B, [13 authors]. 2015. A review of the dodo and its ecosystem: insights from a vertebrate concentration Lagerstätte in Mauritius. *Journal of Vertebrate Paleontology* 35 (6, Supplement): 3-20.
- (32) Ho SYW, Duchene S, Molak M, Shapiro B. 2015. Time-dependent estimates of molecular evolutionary rates: evidence and causes. *Molecular Ecology* 24: 6007-6012.
- (33) Vohr SH, Buen Abad Najar CF, Shapiro B, Green RE. 2015. A method for positive forensic identification of samples from extremely low coverage. *BMC Genomics* 16:1034 DOI: 10.1186/s12864-015-2241-6.
- (34) Mann DH, Groves P, Reanier RE, Gaglioti BV, Kunz ML, Shapiro B. 2015. Life and extinction of megafauna in the ice-age Arctic. *Proc. Natl. Acad. Sci. USA* 112: 14301-14306.
- (35) Shapiro B. 2015. Mammoth 2.0: Will genome engineering resurrect extinct species? *Genome Biology* 16:228.
- (36) Heintzman PD, Soares AER, Chang D, Shapiro B. 2015. Paleogenomics. *Reviews in Cell Biology and Molecular Medicine* 1: 243-267.
- (37) Kirillova IV, Zamina OG, Chernova OF, Lapteva EG, Trofimova SS, Lebedev VS, Tiunov AV, Soares AER, Shidlovskiy FK, Shapiro B. 2015. An ancient bison from the mouth of the Rauchua River, Chukotka, Russia. *Quaternary Research* 84: 232-245.
- (38) Koepfli K-P, Pollinger J, Godinho R, Robinson J, Lea A, Hendricks S, Schweitzer RM, Thalmann O, Silva P, Fan Z, Yurchenko AA, Dobrynin P, Makunin A, Cahill JA, Shapiro B, Álvares F, Brito JC, Geffen E, Leonard JA, Helgen KM, Johnson WE, O'Brien SJ, Van Valkenburgh B, Wayne RK. 2015. Genome-wide evidence reveals that African and Eurasian Golden Jackals are distinct species. *Current Biology* 17: 2158-2165.
- (39) Heintzman PD, Zazula GD, Cahill JA, MacPhee RDE, Shapiro B. 2015. Genomic data from extinct North American *Camelops* revises camel evolutionary history. *Molecular Biology and Evolution* 32: 2433-2440.
- (40) Seguin-Orlando A, Gamba C, DerSarkissian C, Ermini L, Louvel G, Boulygina E, Sokolov A, Nedoluzhko A, Lorenzen E, Lopez P, McDonald HG, Scott E, Tikhonov A, Stafford TW Jr, Shapiro B, Willerslev E, Prokhortchouk E, Orlando L. 2015. Pros and cons of methylation-based enrichment methods for ancient DNA. *Scientific Reports* 5: 11826.
- (41) Wooller M, Gaglioti B, Fulton TL, Shapiro B. 2015. Post-glacial dispersal of northern pike (*Esox cf. lucius*) in Eastern Beringia inferred using radiocarbon and ancient-DNA results from an 8,800 year old fish skull preserved in Quartz Lake, interior Alaska. *Quaternary Science Reviews* 120: 118-125.
- (42) Seguin-Orlando A, Hoover C, Vasiliev S, Ovodov ND, Shapiro B, Cooper A, Rubin E, Willerslev E, Orlando L. 2015. Amplification bias in TruSeq DNA libraries uncovers ancient methylation signatures. *Science and Technology of Archaeological Research* 1: 112054892315Y. 0000000005.
- (43) Cahill JA, Green RE, Kistler L, Salamzade R, Ersmark E, Fulton TL, Stiller M, Shapiro B. 2015. Genomic evidence of geographically widespread effect of gene flow from polar bears into brown bears. *Molecular Ecology* 24: 1205-1217.
- (44) Alter SE, Meyer M, Post K, Czechowski P, Gravlund P, Gaines C, Rosenbaum HC, Turvey ST van der Plicht H, Shapiro B, Hofreiter M. 2015. Climate impacts on trans-ocean dispersal and

- habitat in gray whales from the Pleistocene to the year 2100. *Molecular Ecology* 24: 1510-1522.
- (45) Koepfli KP- Paten B, The Genome 10K Community of Scientists\*, O'Brien SJ. 2015. The Genome 10K Project: A way forward. *Annual Review of Animal Biosciences* 3: 57-111.
  - (46) Shapiro B, Graham RD, Letts B. 2015. A revised evolutionary history of armadillos (*Dasypus*) in North America based on ancient DNA. *Boreas* 44:14-23.
  - (47) Molak M, Suchard MA, Ho SYW, Beilman D, Shapiro B. 2015. Empirical calibrated radiocarbon sampler: a tool for incorporating radiocarbon-date and calibration error into Bayesian phylogenetic analyses of ancient DNA. *Molecular Ecology Resources* 15: 81-86
  - (48) Schubert M\*, Jónsson H\*, Chang D\*, Der Sarkissian C, Emini Km Ginolhac A, Albrechtsen A, Dupanloup Im Foucal A, Petersen B, Raghavan M, Seguin-Orlando A, Korneliussen TF, Velasquez AMV, Stenderup J, Hoover CA, Rubin CJ, Alfarhan AM, Alquaraisi SA, Al-Rasheid KAS, MacHugh DE, Kalbfleish T, MacLeod JN, Rubin EM, Sicheritz-Ponten T, Andersson L, Hofreiter M, Marques-Bonet T, Gilbert MTP, Nielsen R, Excoffier L, Willerslev E, Shapiro B, Orlando L. 2014. Prehistoric horse genomes reveal the genetic foundation and cost of domestication. *Proc Natl Acad Sci USA* 111: E5661-E5669.
  - (49) Jarvis ED, Mirarab S, and the Avian Phylogenomics Consortium [103 additional authors]. 2014. Whole genome analyses resolve early branches in the tree of life of modern birds. *Science* 346: 1320-1331.
  - (50) Ng TFF, Zhou Y, Chen L-F, Shapiro B, Stiller M, Heintzman PD, Varsani A, Kondov NO, Wong W, Deng X, Andrews TD, Moorman BJ, Meulendyk R, MacJay G, Gilbertson RL, Delwart E. 2014. Preservation of viral genomes in 700-year-old caribou feces from a subarctic ice patch. *Proc Natl Acad Sci USA* 111:16842-16847.
  - (51) Johnson KR, Miller IM, Pigati JS, Ager T, Anderson S, Carrara P, [9 authors], Shapiro B, [43 authors] Troll, C. 2014. Introduction to the Snowmastodon Project Special Volume The Snowmastodon Project. *Quaternary Research*, 82(3), 473-476.
  - (52) Kistler L, Montenegro A, Smith BD, Gifford JA, Green RE, Newsom LA, Shapiro B. 2014. Transoceanic drift and the domestication of African bottle gourds in the Americas. *Proc Natl Acad Sci USA*. 111:2937-2941.
  - (53) Shapiro B, Hofreiter M. 2014. A paleogenomic perspective on evolution and gene function: New insights from ancient DNA (invited review). *Science* 343: 1236573.
  - (54) Horn S, Prost S, Stiller M, Makowiecki D, Kusnetsova T, Benecke N, Pucher E, Hufthammer AK, Schouwenburg C, Shapiro B, Hofreiter M. 2014. Ancient mitochondrial DNA and the genetic history of Eurasian beavers *Castor fiber*. *Molecular Ecology* 23: 1717-1729.
  - (55) Der Sarkissian C, Emini L, Jónsson H, Alekseev A, Crubézy E, Shapiro B, Orlando L. 2014. Shotgun profiling of fossil remains. *Molecular Ecology* 23: 1780-1798.
  - (56) Barnett R, Yamaguchi N, Shapiro B, Ho, SYW, Barnes I, Burger J, Sabin R, Werdelin L, Cuisin J, Larson G. 2014. Revealing the maternal demographic history of *Panthera leo* using ancient DNA and a spatially explicit genealogical analysis. *BMC Evolutionary Biology* 14: 80.
  - (57) Harington CR, Cournoyer M, Chartier M, Fulton TL, Shapiro B. 2014. Brown bear (*Ursus arctos*) (9880±35 BP) from Late-glacial Champlain Sea deposits of Saint-Nicolas, Québec, Canada, and the dispersal history of bears. *Canadian Journal of Zoology* 51: 527-535.
  - (58) Shapiro B, Ho SYW. 2014. Ancient hyaenas highlight the old problem of estimating evolutionary rates (Invited perspective). *Molecular Ecology* 23:499-501.
  - (59) Thalmann O, Shapiro B, Schuenemann VJ, Sawyer SK, Greenfield DL, Germonpre MB, [23 others] Wayne RK. 2013. Complete mitochondrial genomes of ancient canids suggests a European origin of domestic dogs. *Science*. 342: 871-874.
  - (60) Orlando L, Finolhac A, Zhang G, Froese D, [49 authors], Shapiro B, Jun W, Willerslev E. 2013. Recalibrating *Equus* evolution using the genome sequence of an early Middle Pleistocene horse. *Nature* 499: 74-78.
  - (61) Green RE, Shapiro B. Human evolution: turning back the clock. 2013. *Current Biology* 23:R286-288.

- (62) Fulton TL, Norris RW, Graham RE, Semken HA Jr, Shapiro B. 2013. Ancient DNA supports southern survival of Richardson's collared lemming (*Dicrostonyx richardsoni*) during the Last Glacial Maximum. *Molecular Ecology* 22:2540-2548.
- (63) Cahill JA, Green RE, Fulton TL, Stiller M, Jay F, Ovsyanikov N, Salamzade R, St John J, Stirling I, Slatkin M, Shapiro B. 2013. Genomic evidence for island population conversion resolves conflicting theories of polar bear evolution. *PLoS Genetics* 9: e1003345.
- (64) Vilstrup JT, Sengouin-Orlando Am Stiller M, Ginolhac A, Raghavan M, Nielsen SCA, Weinstock J Friese D, Vasiliev SK, Ovodov ND, Clary J, Helgen KM, Fleischer RC, Cooper A, Shapiro B, Orlando L. 2013. Mitochondrial phylogenomics of modern and ancient equids. *PLoS ONE* 8: e55950.
- (65) Gill MS, Lemey P, Faria NR, Rambuat A, Shapiro B, Suchard M. 2013. Improving Bayesian population dynamics inference: a coalescent-based model for multiple loci. *Molecular Biology and Evolution* 30: 713-724.
- (66) Molak M, Lorenzen ED, Shapiro B, Ho SYW. 2013. Phylogenetic estimation of timescales using ancient DNA: the effects of temporal sampling scheme and uncertainty in sample ages. *Molecular Biology and Evolution* 30: 253-262.
- (67) Ginolhac A, Vilstrup J, Stenderup J, Rasmussen M, Stiller M, Shapiro B, Zazula G, Froese D, Steinmann KE, Thompson JD, Al-Rasheid KAS, Gilbert MTP, Willerslev E, Orlando L. 2012. Improving the performance of true single-molecule sequencing for ancient DNA. *BMC Genomics* 13:177.
- (68) Fischer A, Shapiro B, Muriuki C, Heller M, Schnee C, Bongcam-Rudloff E, Frey J, Jores J. 2012. The origin of the '*Mycoplasma mycoides* cluster' coincides with domestication of ruminants. *PLoS ONE* 7:e36150.
- (69) Widga C, Fulton TL, Martin LD, Shapiro B. 2012. *Homotherium* and *Cervalces* from the Great Lakes region, USA: geochronology, morphology and ancient DNA. *Boreas* 41: 546-556.
- (70) Dalén L, Orlando L, Shapiro B, Durling MB, Quam R, Gilbert MTP, Fernández-Lomana JCD, Willerslev E, Arsuaga JL, Götherström 2012. A. Partial genetic turnover in Neandertal: continuity in the east and population replacement in the west. *Molecular Biology and Evolution* 29: 1893-1897.
- (71) Letts B, Shapiro B. 2012. Case study: ancient DNA recovered from Pleistocene-age remains of a Florida armadillo. *Methods in Molecular Biology* 840: 87-92.
- (72) Fulton TL, Wagner SM, Shapiro B. 2012. Case study: recovery of ancient nuclear DNA from toe pads of the extinct passenger pigeon. *Methods in Molecular Biology* 840: 29-35.
- (73) MacDonald GM, Beilman DW, Kuzmin YV, Orlova LA, Kremenetski KV, Shapiro B, Wayne RK, Van Valkenburgh B. 2012. Pattern of extinction of the woolly mammoth in Beringia. *Nature Communications* 3: 893.
- (74) Letts B, Fulton TL, Stiller M, Andrews T, MacKay G, Popkp R, Shapiro B. 2012. Ancient DNA reveals genetic continuity in woodland caribou of the Central Mackenzie Mountains, Northwest Territories, Canada. *Arctic* 65, Suppl 1: 80-94.
- (75) Fulton TL, Wagner SM (PSU undergrad), Fisher C, Shapiro B. 2012. Nuclear DNA from the extinct passenger pigeon (*Ectopistes migratorius*) confirms its phylogenetic placement within the Columbinae. *Annals of Anatomy* 194: 52-57.
- (76) Fulton T, Letts B, Shapiro B. 2012. Multiple losses of flight and recent speciation in steamer ducks. *Proceedings of the Royal Society B* 279: 2339-2346.
- (77) Higham T, Compton T, Stringer C, Jacobi R, Shapiro B, Trinkaus E, Chandler B, Gröning F, Collins C, Hillson S, O'Higgins P, Fagan M. 2011. The earliest evidence for anatomically modern humans in northwestern Europe. *Nature* 479: 521-524.
- (78) Orlando L, Ginolhac A, Raghavan M, Vilstrup J, Rasmussen M, Magnussen K, Steinmann K, Kapranov P, Thompson JF, Shapiro B, Zazula G, Froese D, Hofreiter M, Al-Rasheid KAS, Mundy J, Gilbert MTP, Willerslev E. 2011. Single-molecule ancient DNA sequencing of a Pleistocene horse bone. *Genome Research* 21: 1705-1719.
- (79) Lorenzen ED, Noguees-Bravo D, Orlando L, Weinstock J, Binladen J, Marske KA, 52 additional

- authors, Shapiro B, Rahbek C, Willerslev E. 2011. Species-specific responses of Late Quaternary megafauna to climate and humans. *Nature* 479: 359-364.
- (80) Edwards CJE, Suchard MA, Lemey P, Welch JJ, Barnes I, Fulton TL, Barnett R, O'Connell TC, Coxon P, Monaghan N, Valdiosera C, Lorenzen ED, Willerslev E, Baryshnikov GF, Rambaut A, Thomas MG, Bradley DG, Shapiro B. 2011. Ancient hybridization and a recent Irish origin for the modern polar bear matriline. *Current Biology* 21: 1-8.
- (81) Kistler L, Shapiro B. 2011. Ancient DNA confirms a local origin of domesticated chenopod in Eastern North America. *J. Arch. Sci.* 38: 3459-3554.
- (82) Lippold S, Knapp M, Kuznetsova T, Leonard JA, Benecke N, Ludwig A, Rasmussen M, Weinstock J, Willerslev E, Shapiro B, Hofreiter M. 2011. Discovery of lost diversity of paternal horse lineages using ancient DNA. *Nature Comm.* 2:450.
- (83) Workman C, Dalen L, Vartanyan S, Shapiro B, Kosintev P, Sher A, Gotherstrom A, Barnes I. 2011. Population-level genotyping of coat colour polymorphism in woolly mammoth (*Mammuthus primigenius*). *Quat. Sci. Rev.* 30: 2304-2308.
- (84) Ho SYW, Lanfear R, Phillips MJ, Barnes I, Thomas JA, Kolokotronis S-O, Shapiro B. 2011. Bayesian estimation of substitution rates from ancient DNA sequences with low information content. *Syst. Biol.* 60: 366-375.
- (85) Ho SYW, Shapiro B. 2011. Skyline-plot methods for estimating demographic history from nucleotide sequences *Mol. Ecol. Res.* 11: 423-434.
- (86) Harrison GL, Lemey P, Hurler M, Moyes C, Horn S, Pryor J, Malani J, Supuri M, Masta A, Teriboriki B, Toatu T, Penny D, Rambaut A, Shapiro B. 2011. Genomic analysis of Hepatitis B Virus reveals antigen state and genotype as source of evolutionary rate variation. *Viruses* 3: 83-101.
- (87) Shapiro B, Ho SYW, Drummond AJ, Suchard MA, Pybus O, Rambaut A. 2011. A Bayesian phylogenetic method to estimate unknown sequence ages. *Mol. Biol. Evol.* 28: 879-887.
- (88) Firth C, Kitchen A, Shapiro B, Suchard MA, Holmes EC, Rambaut A. 2010. Using time-structured data to estimate evolutionary rates of double-stranded DNA viruses. *Mol. Biol. Evol.* 27: 2038-2051.
- (89) Shapiro B, Hofreiter M. 2010. The analysis of ancient human genomes: using next generation sequencing, 20-fold coverage of the genome of a 4,000-year-old human from Greenland has been obtained. *Bioessays* 32: 388-391.
- (90) Stack JC, Welch D, Ferrari MJ, Shapiro B, Grenfell BT. 2010. Protocols for sampling viral sequences to study epidemic dynamics. *J. Roy. Soc. Interface* 7: 1119-1127.
- (91) Campos P, Willerslev E, Sher A, Axelsson E, Tikhonov A, Aaris-Sørensen K, Greenwood A, Kahlke R-D, Kosintsev P, Krakhmalnaya T, Kuznetsova T, Lemey P, MacPhee RD, Norris CA, Shepherd K, Suchard MA, Zazula GD, Shapiro B, Gilbert MTP. 2010. Ancient DNA analysis excludes humans as the driving force behind late Pleistocene musk ox (*Ovibos moschatus*) population dynamics. *Proc. Natl. Acad. Sci. USA* 107: 5675-5680.
- (92) Kuhn TS, McFarlane K, Groves P, Moers AO, Shapiro B. 2010. Modern and ancient DNA reveal recent partial replacement of caribou in the southwest Yukon. *Mol. Ecol.* 19: 1312-1318.
- (93) Haile J, Larson G, Owens K, Dobney K, Shapiro B. 2010. Ancient DNA typing of Archaeological Pig Remains Corroborates Historical Records. *J. Arch. Sci.* 37:174-177.
- (94) Edwards CJ, Magee DA, Park SD, McGettigan PA, Lohan AJ, Murphy A, Finlay EK, Shapiro B, Chamberlain AT, Richards MB, Bradley DG, Loftus BJ, Machugh DE. 2010. A complete mitochondrial genome sequence from a mesolithic wild aurochs (*Bos primigenius*). *PLoS One* 5:e9255.
- (95) Magiorkinis G, Magiorkinis E, Paraskevis D, Ho SYW, Shapiro B, Pybus O, Allain JP, Hatzakis A. 2009. The global spread of Hepatitis C Virus 1a and 1b: a phylodynamic and phylogeographic analysis *PLoS Med.* 6:e1000198.
- (96) Cordingly JE, Sundaresan SR, Larison BJ, Shapiro B, Rubenstein DI. 2009. Grevy's zebra conservation: overcoming threats of isolation, genetic hybridization and demographic instability. *Anim. Conserv.* 12 520-521.

- (97) Bunce M, Worthy T, Phillips M, Holdaway R, Willerslev E, Haile J, Shapiro B, Scofield P, Drummond A, Kamp P, Cooper A. 2009. The evolutionary history of the extinct ratite moa and New Zealand Neogene paleogeography. *Proc. Natl. Acad. Sci. USA* 106: 20646-20651.
- (98) Firth C, Charleston MA, Duffy S, Shapiro B, Holmes EC. 2009. Insights into the evolutionary history of an emerging livestock pathogen: Porcine Circovirus 2. *J. Virol.* 83: 12813-12821.
- (99) Cordingly JE, Sundarisan SR, Fischhoff IR, Shapiro B, Ruskey J, Rubenstein DI. 2009. Is the endangered Grevy's zebra threatened by hybridization? *Anim. Conserv.* 12: 505-513.
- (100) Zazula GD, MacKay G, Andrews TD, Shapiro B, Letts B, Brock F. 2009. A Late Pleistocene steppe bison (*Bison priscus*) partial carcass from Tsiigehtchic, Northwest Territories, Canada. *Quat. Sci. Rev.* 28: 2734-2742.
- (101) Collins MJ, Penkman KEH, Rohalnd N, Shapiro B, Dobberstein RC, Rotz-Timme A, Hofretier M. 2009. Is amino acid racemization a useful tool for screening for ancient DNA in bone? *Proc. Roy. Soc. B* 276: 2971-2977.
- (102) Weinstock J, Shapiro B, Prieto A, Martin JC, Gonzáles BA, Gilbert MPT, Willerslev E. 2009. The Late Pleistocene distribution of vicuñas (*Vicugna vicugna*) and the "extinction" of the gracile llama (*Lama gracilis*): new molecular data. *Quat. Sci. Rev.* 28: 15-16.
- (103) Barnett R, Shapiro B, Ho SYW, Barnes I, Burger J, Yamaguchi N, Higham T, Wheeler, HT, Rosendhal W, Sher AV, Baryshnikov G, Cooper A. 2009. Phylogeography of lions (*Panthera leo*) reveals three distinct taxa and a Late Pleistocene reduction in genetic diversity. *Mol. Ecol.* 18: 1668-1677.
- (104) Rambaut A, Drummond AJ, Ho SYW, Shapiro B. 2009. Accommodating the effect of ancient DNA damage on inferences of demographic histories. *Mol. Biol. Evol.* 26: 245-248.
- (105) Rijdsdijk KF, Hume JP, Bunnik F, Florens V, Baider C, Shapiro B, et al. 2009. Mid-Holocene vertebrate bone Concentration Lagerstätte on oceanic island Mauritius provides a window into the ecosystem of the dodo (*Raphus cucullatus*). *Quat. Sci. Rev.* 28: 14-24.
- (106) Wilson M, Shapiro B, Hills LV. 2008. Late Pleistocene northward-dispersing *Bison antiquus* from the Bighill Creek Formation, Gallelli Gravel Pit, Alberta, Canada, and the fate of *Bison occidentalis*. *Can. J. Earth Sci.* 45: 827-859.
- (107) Dalén L, Götherström A, Shapiro B. 2008. Recovery of DNA from footprints in the snow. *Can. Field Nat.* 12: 321-324.
- (108) Shapiro B. 2008. Engineered polymerases amplify the potential of ancient DNA. *Trends Biotech.* 26: 285-287.
- (109) Ho SYW, Larson G, Edwards CJ, Heupink TH, Lain KE, Holland PWH, Shapiro B. 2008. Correlating Bayesian date estimates with climatic events and domestication using a bovine case study. *Biol. Lett.* 274: 1377-1385.
- (110) Ho SYW, Saarma U, Barnett R, Haile J, Shapiro B. T 2008. The effect of inappropriate calibration: three case studies in molecular ecology *PLoS ONE* 3: e1615.
- (111) Barnett R, Yamaguchi N, Shapiro B, Sabin R. 2008. Ancient DNA analysis indicates the first English lions originated from North Africa, *Contrib. Zool.* 77: 7-16.
- (112) Kapoor A, Shapiro B, Shafer RW, Rhee S-Y, Delwart EL. 2008. Multiple independent origins of protease inhibitor resistance mutation in salvage therapy patients. *Retrovirology* 5: 7.
- (113) Buckley M, Walker A, Ho SYW, Yang Y, Smith C, Ashton P, Oates JT, Cappellini E, Koonn H, Penkman K, Elsworth B, Ashford D, Solazzo C., Andrews P, Strahler J, Shapiro B, Ostrom P, Gandhi H, Miller W, Raney B, Zylber MI, Gilbert MTP, Prigodich RV, Ryan M, Rijdsdijk KF, Janoo A, Collins M. 2008. Comment on "Protein sequences from Mastodon and *Tyrannosaurus rex* revealed by mass spectrometry" *Science* 319: 33.
- (114) Barnett R, Yamaguchi N, Shapiro B, Nijman V. 2007. Using ancient DNA techniques to identify the origin of an unprovenanced museum specimen, as illustrated by the identification of a 19th century lion from Amsterdam, *Contrib. Zool.* 76: 87-94.
- (115) Deforche K, Camacho, R., Laethem, KV, Shapiro B., Moreau Y, Rambaut A, Vandamme, AM, Lemey P. 2007. Estimating the relative contribution of dNTP pool imbalance and APOBEC3G/

- 3F editing to HIV evolution in vivo. *J. Comp. Biol.* 14: 1105-1114.
- (116) Abecasis AB, Lemey P, Vidal N, de Oliveira T, Peeters M, Camacho R, Shapiro B, Rambaut A, Vandamme A-M. 2007. Recombination is confounding the early evolutionary history of HIV-1: subtype G is a recombinant. *J. Virol.* 81: 8543-51.
- (117) Ho SYW, Shapiro B, Phillips MJ, Cooper A, Drummond AJ. 2007. Evidence for time dependency of molecular rate estimates. *Sys. Biol.* 56: 515-522.
- (118) Barnes I, Shapiro B, Kuznetsova T, Sher A, Guthrie D, Lister A, Thomas MG. 2007. Genetic structure and extinction of the woolly mammoth. *Curr. Biol.* 17: 1072-1075.
- (119) Ho SYW, Heupink TH, Rambaut A, Shapiro B. 2007. Bayesian estimation of sequence damage in ancient DNA. *Mol. Biol. Evol.* 24:1416-1422.
- (120) Edwards CJ, Bollongino R, Scheu A, Chamberlain A, Tresset A, Vigne J-D, Baird JF, Larson G, Ho SYW, Heupink TH, Shapiro B, Freeman AR, *et al.* 2007. Mitochondrial DNA analysis shows a Near Eastern Neolithic origin for domestic cattle and no indication of domestication of European aurochs. *Proc. Roy. Soc B.* 274: 1377-1385.
- (121) Rector A, Lemey P, Tachezy R, Mostmans S, Ghim S, Van Doorslaer K, Roelke M, Bush M, Montali RJ, Joslin J, Burk R, Jenson A, Sundberg JP, Shapiro B, Van Ranst M. 2007. Ancient papillomavirus-host co-speciation in Felidae. *Genome Biol.* 8:R57.
- (122) Haile J, Holdaway R, Oliver K, Bunce M, Gilbert MTP, Nielsen R, Munch K, Ho, SYW, Shapiro B, Willerslev E. 2007. Ancient DNA chronology within sediment deposits: is DNA leaching a factor? *Mol. Biol. Evol.* 24: 982-989.
- (123) Lemey P, Kosakovsky-Pond SL, Drummond A, Pybus O, Shapiro B, Barroso H, Taveira N, Rambaut A. 2007. Synonymous substitution rates predict HIV disease progression as a result of underlying replication dynamics. *PLoS Comp. Biol.* 3:e29.
- (124) Shapiro B, Rambaut A, Gilbert MTP. 2006. No proof that typhoid caused the Plague of Athens. *Int. J. Infect. Dis.* 10:334-335.
- (125) Shapiro B, Rambaut A, Drummond AJ. 2006. Choosing appropriate substitution models for the phylogenetic analysis of protein-coding sequences *Mol. Biol. Evol.* 23: 7-9.
- (126) Poinar HN, Schwartz C, Qi J, Shapiro B, MacPhee RD, Buiges B, Tikhonov A, Huson D, Tonsho L, Auch A, Rapp M, Miller W, Schuster SC. 2006. Metagenomics to paleo-genomics: large scale sequencing of mammoth DNA. *Science* 311: 392-394.
- (127) Shapiro B, Drummond AJ, Rambaut A, Pybus OJ, Holmes EC. 2006. A phylogenetic method for detecting positive epistasis in gene sequences and its application to RNA virus evolution. *Mol. Biol. Evol.* 23:1724-1730.
- (128) Gilbert MTP, Shapiro B, Drummond A, Cooper A. 2005. Post-mortem DNA damage hotspots in Bison (*Bison bison*) provide supporting evidence for mutational hotspots in human mitochondria. *J. Arch. Sci.* 32:1053-1060.
- (129) Drummond AJ, Pybus OG, Shapiro B, Rambaut A. 2005. Bayesian coalescent inference of past population dynamics from molecular sequences. *Mol. Biol. Evol.* 22:1185-1192.
- (130) Bunce M, Szulkin M, Lerner HRL, Barnes I, Shapiro B, Cooper A, Holdaway RN. 2005. Ancient DNA provides new insights into the evolutionary history of New Zealand's extinct giant eagle. *PLoS Biol.* 3(1) e20.
- (131) Shapiro B, Drummond AJ, Rambaut A, Wilson MC, Matheus P, Sher AV, Pybus OG, *et al.* 2004. Rise and fall of the Beringian steppe bison. *Science* 306: 1561-1565.
- (132) Gilbert MTP, Wilson AS, Bunce M, Hansen AJ, Willerslev E, Shapiro B, Higham TFG, Richards MP, O'Connell TC, Tobin DJ, Janaway RC, Cooper A. 2004. Ancient mitochondrial DNA from hair. *Curr. Biol.* 14: R463-464.
- (133) Shapiro B, Cooper A. 2003. Beringia as an Ice Age genetic museum. *Quat. Res.* 60: 94- 100.
- (134) Willerslev E, Hansen AJ, Binladen J, Brand TB, Gilbert MTP, Shapiro B, Bunce M, Wiuf C, Gilichinsky DA, Cooper A. 2003. Diverse plant and animal genetic records from Holocene and Pleistocene sediments. *Science* 300: 791-795.
- (135) Nielsen-Marsh, CM, Ostrom PH, Gandhi H, Shapiro B, Cooper A, Collins MJ. 2002. Sequence

preservation of osteocalcin protein and mitochondrial DNA in bison bones older than 55 ka. *Geology* 30: 1099-1102 .

- (136) Lalueza-Fox, C, Shapiro B, Bover P, Alcover JA, Bertranpetit J. 2002. Molecular phylogeny and evolution of the extinct bovid *Myotragus*. *Mol. Phyl. Evol.* 25 (3): 501-510.
- (137) Shapiro B, Sibthorpe D, Austin J, Wragg G, Lee PLM, Bininda-Emonds ORP, Cooper A. 2002. Flight of the Dodo. *Science* 295: 1683.
- (138) Barnes I, Matheus P, Shapiro B, Jensen D, Cooper A. 2002. Dynamics of mammal population extinctions in eastern Beringia during the last glaciation. *Science* 295: 2267-2270.
- (139) Beck CW, Shapiro B, Choksi S, Promislow DEL. 2002. A genetic algorithm approach to study the evolution of female preference based on male age. *Evol. Ecol. Res* 4: 275-292.
- (140) Shapiro BA, Pickering J. 2000. Rainfall and parasitic wasp (Hymenoptera: Ichneumonoidea) activity in successional forest stages at Barro Colorado Nature Monument, Panama and La Selva Biological Station, Costa Rica. *Agr. For. Ent.* 2: 39-47.

#### **Book reviews:**

- (1) Shapiro, B. Book review: Reading the story in DNA by Lindell Bromham. 2010. *Quart. Rev. Biol.* 85: 223.
- (2) Shapiro B. Book review: Return of the Crazy Bird: the Sad, Strange Tale of the Dodo by Clara Pinto-Correia. 2004. *Quart. Rev. Biol.* 79: 197-198.

#### **Book chapters:**

- (1) Heintzman P, Soares AER, Shapiro B. Paleogenomics. Reviews in Cell Biology and Molecular Medicine 1: 243-267.
- (2) Shapiro B. 2013. Ancient DNA. Pp 475-481 in Princeton Guide to Evolution. Losos, J. Ed. Princeton University Press.
- (3) Pybus OG, Shapiro B. 2009. Natural selection and adaptation of molecular sequences. In Lemey P, Salemi N, Vandamme A-M. *The Phylogenetics Handbook*. Cambridge Univ. Press.
- (4) Shapiro B, Gilbert MTP, Barnes I. 2008. Using DNA to investigate the human past. Pp 207-242 in H Schutkowski, *Between Biology and Culture*. No. 56 in series: Cambridge Studies in Biological and Evolutionary Anthropology Cambridge University Press.
- (5) Barnett R, Shapiro B, Barnes I. 2003. Ancient DNA from vertebrate fossils. In Elias SA, Ed. *Encyclopedia of Quaternary Science*. Elsevier.

#### **Books:**

- (1) Forthcoming (2019): Shapiro B. Wild(ish) Life. Basic Books, New York.
- (2) Shapiro B, Hofreiter M (Eds). 2012. Ancient DNA. Methods and Protocols. Methods in Molecular Biology vol 840. Springer, New York. DOI 10.1007/978-1-61779-516-9\_1
- (3) Shapiro, B. 2015. How to Clone a Mammoth: The Science of De-Extinction. Princeton University Press, Princeton, NJ. ISBN 978-0-691-15705-4.

#### **Newspaper and Magazine Articles:**

- (1) Shapiro B, 2015. Long Live the Mammoth. *Popular Science*, May 2015 <http://www.popsci.com/de-extinction-long-live-mammoth>.
- (2) Shapiro, B. 2015. Should we clone a mammoth? *The Chronicle of Higher Education*, April 27 2015. <http://chronicle.com/article/Should-We-Clone-a-Mammoth-/229575>
- (3) Shapiro, B. 2015. Could we “de-extinctify” a mammoth? *The Observer* 26 April 2015. <http://www.theguardian.com/science/2015/apr/26/woolly-mammoth-normal-for-norfolk-de-extinction>

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## Past External Research Support

- NASA Astrobiology (Supplement to Alfonso Davila, SETI). The isolation of ancient biomolecules from ancient dry deserts in Chile and Antarctica. \$30,000 (09/01/2015-08/31/16).
- Revealing virus origins using ancient DNA. \$875,000. David and Lucille Packard Foundation. (10/13/10-10/12/15).
- NSF ARC-1203990 Collaborative Research: Paleoclimate, Paleoenvironment and Other Potential Drivers of Extinction of *Mammuthus primigenius*, St. Paul Island, Pribilof Islands, Alaska.. \$287,846. National Science Foundation. Co-PIs: R Graham (PSU); M Wooller (UAF); J Williams (UWisc-Mad). (02/01/13-01/31/16).
- PSARCI: Signatures of life from Earth and beyond. \$2.8M. Role: Co-I (one of 17). NASA Astrobiology Institute. C House (PSU) PI. (02/01/09-01/31/14).
- DNA from ancient fecal pellets: Using rapidly evolving markers to reconstruct recent evolutionary dynamics of pathogens and their hosts. \$300,000. Searle Scholars Program. (07/01/09-06/30/13).
- NSF ARC-0909456. Collaborative research: Understanding the role of environmental change on the long-term population dynamics of two extinct and one surviving arctic species. \$267,758. National Science Foundation. CO-Is: R Wayne (UCLA) E Post (PSU) M Wooller (UAF). (08/01/09-07/31/12)
- Assessing the role of the changing arctic environment on the genetic structure and temporal stability of polar bears. NASA; Pennsylvania Space Grant Consortium. \$5000. (2009-2010).
- NIH R01 GM083983-01. Synthesizing the evolution and ecological dynamics of acute RNA viruses: Comparative analyses and methods development. Role: Co-I. B. Grenfell (Princeton) PI. (2006-2011).
- NIH R01 GM083601-01. Novel statistical models for synthesizing social networks and epidemic dynamics. Role: Co-I. David Hunter (PSU) PI (2007-2012).
- Melting treasure: Recovering 700,000 years of evolutionary history from melting permafrost in the Yukon. (2010) \$20,300 National Geographic. Role: PI.



## Videos and interviews available online:

### A short video take on what I do:

[http://poptech.org/popcasts/  
quick\\_takes\\_beth\\_shapiro](http://poptech.org/popcasts/quick_takes_beth_shapiro)

### And how I “live curious”:

[http://video.nationalgeographic.com/video/specials/  
in-the-field-specials/curiosity-beth-shapiro/](http://video.nationalgeographic.com/video/specials/in-the-field-specials/curiosity-beth-shapiro/)

### Longer talks/seminars

TEDxDeExtinction:

Ancient DNA: What it is, and what it could be  
National Geographic Society, Washington D.C.

<http://longnow.org/revive/tedxdeextinction/ancient-dna-what-it-is-and-what-it-could-be/>

Pop!Tech:

Understanding Extinction

Swedish Embassy, Washington D.C

[http://poptech.org/popcasts/beth\\_shapiro\\_species\\_extinction](http://poptech.org/popcasts/beth_shapiro_species_extinction)

Pop!Tech:

What goes extinct?

Pop!Tech annual meeting

[http://poptech.org/popcasts/beth\\_shapiro\\_what\\_goes\\_extinct](http://poptech.org/popcasts/beth_shapiro_what_goes_extinct)

World Science Festival:

Cool Jobs

[http://worldsciencefestival.com/participants/beth\\_shapiro](http://worldsciencefestival.com/participants/beth_shapiro)

### Radio, TV, and documentaries:

Dateline: On Assignment. The Clone Zone. May 2016. <http://www.nbcnews.com/dateline/video/the-de-extinction-download-688897603654>

*Die Trying: Hunt for the Superbear*. 90 Miles Productions for National Geographic TV. Release Date: 12 July 2014.

*Undoing Forever*. CBC Radio One IDEAS. Release date: 19 June 2014.

*Reawakening Extinct Species*. KQED QUEST. Release date: 23 April 2014.

*The Dodo's Guide to Surviving Extinction*. BBC. Release date: 4 November 2007.

*Extinct*. Wall to Wall TV. Release date: 25 September 2001.

