

REFERENCES

- [1] Jordi Agustí, Lluís Cabrera, and Miguel Garcés. The Vallesian Mammal Turnover: A Late Miocene record of decoupled land-ocean evolution. *Geobios*, 46(1-2):151–157, jan 2013.
- [2] L B Albright. *Biostratigraphy and Vertebrate Paleontology of the San Timoteo Badlands, Southern California*. University of California Press, Berkeley, 2000.
- [3] Richard R Alexander. Generic longevity of articulate brachiopods in relation to the mode of stabilization on the substrate. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 21:209–226, 1977.
- [4] Linda J S Allen. *An introduction to stochastic processes with applications to biology*. Chapman and Hall/CRC, Boca Raton, FL, 2 edition, 2011.
- [5] John Alroy. Constant extinction, constrained diversification, and uncoordinated stasis in North American mammals. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 127:285–311, 1996.
- [6] John Alroy. Speciation and extinction in the fossil record of North American mammals. In Roger K Butlin, Jon R Bridle, and Dolph Schluter, editors, *Speciation and patterns of diversity*, pages 302–323. Cambridge University Press, Cambridge, 2009.
- [7] John Alroy. Fair sampling of taxonomic richness and unbiased estimation of origination and extinction rates. In John Alroy and Gene Hunt, editors, *Quantitative Methods in Paleobiology*, pages 55–80. The Paleontological Society, 2010.
- [8] John Alroy. The Shifting Balance of Diversity Among Major Marine Animal Groups. *Science*, 329(5996):1191–1194, 2010.
- [9] John Alroy. A simple Bayesian method of inferring extinction. *Paleobiology*, 40(4):584–607, jul 2014.
- [10] John Alroy, Paul L Koch, and James C Zachos. Global climate change and North American mammalian evolution. *Paleobiology*, 26(1981):259–288, 2000.
- [11] Mike Austin. Species distribution models and ecological theory: a critical assessment and some possible new approaches. *Ecological Modelling*, 200:1–19, 2007.
- [12] Catherine Badgley and John A Finarelli. Diversity dynamics of mammals in relation to tectonic and climatic history: comparison of three Neogene records from North America. *Paleobiology*, 39(3):373–399, apr 2013.
- [13] Catherine Badgley, Tara M Smiley, Rebecca Terry, Edward B Davis, Larisa R G Desantis, David L Fox, Samantha S B Hopkins, Tereza Jezkova, Marjorie D Matocq, Nick Matzke, Jenny L McGuire, Andreas Mulch, Brett R Riddle, V Louise Roth,

- Joshua X Samuels, Caroline A E Strömberg, and Brian J Yanites. Biodiversity and Topographic Complexity: Modern and Geohistorical Perspectives. *Trends in Ecology & Evolution*, pages 1–16, 2017.
- [14] Richard K Bambach. Species richness in marine benthic habitats through the Phanerozoic. *Paleobiology*, 3(2):152–167, 1977.
 - [15] Richard K. Bambach, Andrew M. Bush, and Douglas H. Erwin. Autecology and the filling of ecospace: Key metazoan radiations. *Palaeontology*, 50(1):1–22, 2007.
 - [16] Sudipto Banerjee, Bradley P Carlin, and Alan E Gelfand. *Hierarchical modeling and analysis for spatial data*. Chapman and Hall/CRC, 2004.
 - [17] David W Bapst. paleotree: an R package for paleontological and phylogenetic analyses of evolution. *Methods in Ecology and Evolution*, 3:803–807, 2012.
 - [18] David W. Bapst. A stochastic rate-calibrated method for time-scaling phylogenies of fossil taxa. *Methods in Ecology and Evolution*, 4(8):724–733, aug 2013.
 - [19] Jon A Baskin. Bassariscus and Probassariscus (Mammalia, Carnivora, Procyonidae) from the early Barstovian (middle Miocene). *Journal of Vertebrate Paleontology*, 24:709–720, 2004.
 - [20] Jon A Baskin. A new species of Cernictis (Mammalia, Carnivora, Mustelidae) from the late Miocene Bidahochi formation of Arizona, USA. *Palaeontologia Electronica*, 14(3):26A, 2011.
 - [21] Tomasz K Baumiller. Survivorship analysis of Paleozoic Crinoidea: effect of filter morphology on evolutionary rates. *Paleobiology*, 19(3):304–321, 1993.
 - [22] BL Beatty and LD Martin. The earliest North American record of the Antilocapridae (Artiodactyla, Mammalia). *PaleoBios*, 29(1):29–35, 2009.
 - [23] JJ Becker and JA White. Late Cenozoic geomyids (Mammalia: Rodentia) from the Anza-Borrego Desert, southern California. *Journal of Vertebrate Paleontology*, 1(2):211–218, 1981.
 - [24] Gabe S. Bever. New Record of Bassariscus Ogallalae (Carnivora: Procyonidae) From the Ogallala Group (Miocene) of Ellis County, Kansas, With Comments on Variation Within Bassariscus. *The Southwestern Naturalist*, 48(2):249–256, jun 2003.
 - [25] Olaf R P Bininda-Emonds, Marcel Cardillo, Kate E Jones, Ross D E Macphee, Robin M D Beck, Richard Grenyer, Samantha A Price, Rutger A Vos, John L Gittleman, and Andy Purvis. The delayed rise of present-day mammals. *Nature*, 446(7135):507–512, 2007.

- [26] Jonathan I Bloch, Kenneth D Rose, and Philip D Gingerich. New species of *Batodonoides* (Lipotyphla, Geolabididae) from the Early Eocene of Wyoming: smallest known mammal? *Journal of Mammalogy*, 79(3):804–827, 1998.
- [27] Jonathan I Bloch, Mary T Silcox, Doug M Boyer, and Eric J Sargis. New Paleocene skeletons and the relationship of plesiadapiforms to crown-clade primates. *Proceedings of the National Academy of Sciences of the United States of America*, 104(4):1159–64, jan 2007.
- [28] Jessica L Blois and Elizabeth A Hadly. Mammalian Response to Cenozoic Climatic Change. *Annual Review of Earth and Planetary Sciences*, 37(1):181–208, may 2009.
- [29] Fred L Bookstein. Random walk and the existence of evolutionary rates. *Paleobiology*, 13(4):446–464, 1987.
- [30] Barry W. Brook and David M. J. S. Bowman. The uncertain blitzkrieg of Pleistocene megafauna. *Journal of Biogeography*, 31(4):517–523, apr 2004.
- [31] Alexandra M. Brown, David I. Warton, Nigel R. Andrew, Matthew Binns, Gerasimos Cassis, and Heloise Gibb. The fourth-corner solution - using predictive models to understand how species traits interact with the environment. *Methods in Ecology and Evolution*, 5(4):344–352, apr 2014.
- [32] James H Brown and Brian A Maurer. Macroecology: the division of food and space among species on continents. *Science*, 243(4895):1145–1150, 1989.
- [33] James J Brown. *Macroecology*. University of Chicago Press, Chicago, 1995.
- [34] A M Bush and P M Novack-Gottshall. Modelling the ecological-functional diversification of marine Metazoa on geological time scales. *Biology Letters*, 8(1):151–155, 2012.
- [35] Andrew M Bush and Richard K. Bambach. Paleoecologic Megatrends in Marine Metazoa. *Annual Review of Earth and Planetary Sciences*, 39(1):241–269, 2011.
- [36] Andrew M Bush, Richard K Bambach, and Gwen M Daley. Changes in theoretical ecospace utilization in marine fossil assemblages between the mid-Paleozoic and late Cenozoic. *Paleobiology*, 33(1):76–97, 2007.
- [37] J L Cantalapiedra, J L Prado, and M T Alberdi. Decoupled ecomorphological evolution and diversification in Neogene-Quaternary horses. *Science*, 355:627–630, 2017.
- [38] M. T. Carrano. What, if anything, is a cursor? Categories versus continua for determining locomotor habit in mammals and dinosaurs. *Journal of Zoology*, 247(1):29–42, 1999.
- [39] Leslie N Carraway. Fossil History of *Notiosorex* (Soricomorpha: Soricidae) shrews with descriptions of new fossil species. *Western North American Naturalist*, 70(2):144–163, 2010.

- [40] M. Cassiliano. A new genus and species of Stenomylinae (Camelidae, Artiodactyla) from the Moonstone Formation (late Barstovian-early Hemphillian) of central Wyoming. *Rocky Mountain Geology*, 43(1):41–110, may 2008.
- [41] Scott Chamberlain and Eduard Szocs. taxize - taxonomic search and retrieval in r. *F1000Research*, 2013.
- [42] Anne Chao, T. C. Hsieh, Robin L. Chazdon, Robert K. Colwell, Nicholas J. Gotelli, and B. D. Inouye. Unveiling the species-rank abundance distribution by generalizing the Good-Turing sample coverage theory. *Ecology*, 96(5):1189–1201, 2015.
- [43] Stephen G. B. Chester and K. Christopher Beard. New Micromomyid Plesiadapiforms (Mammalia, Euarchonta) from the Late Paleocene of Big Multi Quarry, Washakie Basin, Wyoming. *Annals of Carnegie Museum*, 80(2):159–172, mar 2012.
- [44] William A Clemens. Eoconodon (“Triisodontidae,” Mammalia) from the Early Paleocene (Puercan) of northeastern Montana, USA. *Palaeontologica Electronica*, 14(3):22A, 2011.
- [45] William A Clemens and Thomas E Williamson. A new species of Eoconodon (Triisodontidae, Mammalia) from the San Juan Basin, New Mexico. *Journal of Vertebrate Paleontology*, 25(1):208–213, 2005.
- [46] William C Clyde and Philip D Gingerich. Mammalian community response to the latest Paleocene thermal maximum: an isotaphonomic study in the northern Bighorn Basin, Wyoming. *Geology*, 26(11):1011–1014, 1998.
- [47] K M Cohen, S C Finney, P L Gibbard, and J-X Fan. The ICS International Chronostratigraphic Chart, 2015.
- [48] Margery Chalifoux Coombs. Tylocephanolyx, a new genus of North American dome-skulled Chalicoteres (Mammalia, Perissodactyla). *Bulletin of the American Museum of Natural History*, 164:1–64, 1979.
- [49] William S Cooper. Expected time to extinction and the concept of fundamental fitness. *Journal of Theoretical Biology*, 107:603–629, 1984.
- [50] E D Cope. On the dentition of Metalophodon. *Proceedings of the American Philosophical Society*, 12(86):542–545, 1871.
- [51] Karl Cottenie. Integrating environmental and spatial processes in ecological community dynamics. *Ecology Letters*, 8(11):1175–1182, 2005.
- [52] Jerry A Coyne and H Allen Orr. *Speciation*. Sinauer Associates, Sunderland, MA, 2004.
- [53] Benjamin S. Cramer, K.G. Miller, P.J. Barrett, and J.D. Wright. Late Cretaceous-Neogene trends in deep ocean temperature and continental ice volume: Reconciling records of benthic foraminiferal geochemistry ($\delta^{18}\text{O}$ and Mg/Ca) with sea level history. *Journal of Geophysical Research: Oceans*, 116(12):1–23, 2011.

- [54] James S. Crampton, Roger A. Cooper, Peter M. Sadler, and Michael Foote. Greenhouse–icehouse transition in the Late Ordovician marks a step change in extinction regime in the marine plankton. *Proceedings of the National Academy of Sciences*, 113(6):1498–1503, 2016.
- [55] James S Crampton, Roger A Cooper, Peter M Sadler, and Michael Foote. Greenhouse–icehouse transition in the Late Ordovician marks a step change in extinction regime in the marine plankton. *Proceedings of the National Academy of Sciences*, 113(6):1498–1503, 2016.
- [56] Gabor Csardi and Tamas Nepusz. The igraph software package for complex network research. *InterJournal*, Complex Systems:1695, 2006.
- [57] Walter W Dalquest. Early Blaccan mammals of the Beck Ranch local fauna of Texas. *Journal of Mammalogy*, 59(2):269–298, 1978.
- [58] John Damuth and Christine M Janis. On the relationship between hypsodonty and feeding ecology in ungulate mammals, and its utility in palaeoecology. *Biological Reviews*, 86:733–758, 2011.
- [59] Mary R. Dawson. Coryphodon, the northernmost Holarctic Paleogene pantodont (Mammalia), and its global wanderings. *Swiss Journal of Palaeontology*, 131(1):11–22, nov 2012.
- [60] Mary R. Dawson and K. Christopher Beard. Rodents of the Family Cylindrodontidae (Mammalia) From the Earliest Eocene of the Tuscahoma Formation, Mississippi. *Annals of Carnegie Museum*, 76(3):135–144, oct 2007.
- [61] Stéphane Dray and Pierre Legendre. Testing the species traits–environment relationships: the fourth–corner problem revisited. *Ecology*, 89(12):3400–3412, 2008.
- [62] Dianne Edwards and Una Fanning. Evolution and environment in the late Silurian–early Devonian: the rise of pteridophytes. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 309:147–165, 1985.
- [63] N Egi. Body mass estimates in extinct mammals from limb bone dimensions: the case of North American hyaenodontids. *Palaeontology*, 44(1990), 2001.
- [64] Jane Elith and John R Leathwick. Species distribution models: ecological explanation and prediction across space and time. *Annual Review of Ecology, Evolution, and Systematics*, 40:677–697, 2009.
- [65] Jussi T Eronen, Alistair R Evans, Mikael Fortelius, and Jukka Jernvall. The impact of regional climate on the evolution of mammals: a case study using fossil horses. *Evolution*, 64(2):398–408, 2009.

- [66] Jussi T Eronen, Christine M Janis, C Page Chamberlain, and Andreas Mulch. Mountain uplift explains differences in Palaeogene patterns of mammalian evolution and extinction between North America and Europe. *Proceedings of the Royal Society B: Biological Sciences*, 282:20150136, 2015.
- [67] Jussi T Eronen, P David Polly, Marianne FRED, John Damuth, David C FRANK, Volker Mosbrugger, Christoph SCHEIDEGGER, Nils Chr Stenseth, and Mikael Fortelius. Ecometrics: The traits that bind the past and present together. *Integrative Zoology*, 5(2):88–101, 2010.
- [68] Thomas H G Ezard, Paul N Pearson, Tracy Aze, and Andy Purvis. The meaning of birth and death (in macroevolutionary birth-death models). *Biology Letters*, 8(1):139–42, mar 2012.
- [69] Thomas H G Ezard, Andy Purvis, and Helene Morlon. Environmental changes define ecological limits to species richness and reveal the mode of macroevolutionary competition. *Ecology Letters*, 19(8):899–906, 2016.
- [70] J Felsenstein. Phylogenies and the comparative method. *The American Naturalist*, 125(1):1–15, 1985.
- [71] I Ferrusquía-Villafranca. The first Paleogene mammal record of middle America: *Simojovelhyus pocitosense* (Helohyidae, Artiodactyla). *Journal of Vertebrate Paleontology*, 26(4):989–1001, 2006.
- [72] Borja Figueirido, Christine M Janis, Juan A Pérez-Claros, Miquel De Renzi, and Paul Palmqvist. Cenozoic climate change influences mammalian evolutionary dynamics. *Proceedings of the National Academy of Sciences*, 109(3):722–727, jan 2012.
- [73] S. Finnegan, N. A. Heim, S. E. Peters, and W. W. Fischer. Climate change and the selective signature of the Late Ordovician mass extinction. *Proceedings of the National Academy of Sciences*, 109:6829–6834, 2012.
- [74] Seth Finnegan, Jonathan L. Payne, and Steve C. Wang. The Red Queen revisited: reevaluating the age selectivity of Phanerozoic marine genus extinctions. *Paleobiology*, 34(3):318–341, sep 2008.
- [75] R G Fitzjohn. Quantitative Traits and Diversification. *Systematic Biology*, 59(6):619–633, 2010.
- [76] M Foote and J J Sepkoski. Absolute measures of the completeness of the fossil record. *Nature*, 398(6726):415–7, apr 1999.
- [77] Michael Foote. Survivorship analysis of Cambrian and Ordovician Trilobites. *Paleobiology*, 14(3):258–271, 1988.
- [78] Michael Foote. Estimating taxonomic durations and preservation probability. *Paleobiology*, 23(3):278–300, 1997.

- [79] Michael Foote. Inferring temporal patterns of preservation, origination, and extinction from taxonomic survivorship analysis. *Paleobiology*, 27(4):602–630, dec 2001.
- [80] Michael Foote. Origination and extinction through the Phanerozoic: a new approach. *Journal of Geology*, 111:125–148, 2003.
- [81] Michael Foote. Substrate affinity and diversity dynamics of Paleozoic marine animals. *Paleobiology*, 32(3):345–366, sep 2006.
- [82] Michael Foote. The geologic history of biodiversity. In M A Bell, Douglas J Futuyma, W F Eanes, and Jeffery S Levinton, editors, *Evolution since Darwin: the first 150 years*, pages 479–510. Sinauer Associates, Sunderland, MA, 2010.
- [83] Michael Foote. Environmental controls on geographic range size in marine animal genera. *Paleobiology*, 40(3):440–458, 2014.
- [84] Michael Foote, James S Crampton, Alan G Beu, and Campbell S Nelson. Aragonite bias, and lack of bias, in the fossil record: lithological, environmental, and ecological controls. *Paleobiology*, 41(2):245–265, 2015.
- [85] Michael Foote and Arnold I Miller. *Principles of Paleontology*. Freeman, New York, third edition, 2007.
- [86] Michael Foote and Arnold I. Miller. Determinants of early survival in marine animal genera. *Paleobiology*, 39(2):171–192, mar 2013.
- [87] Michael Foote and DM Raup. Fossil preservation and the stratigraphic ranges of taxa. *Paleobiology*, 22(2):121–140, 1996.
- [88] Mike Foote. Origination and extinction components of taxonomic diversity: general problems. *Paleobiology*, 26(sp4):74–102, dec 2000.
- [89] Mike Foote. Origination and extinction components of taxonomic diversity: Paleozoic and post-Paleozoic dynamics. *Paleobiology*, 26(4):578–605, dec 2000.
- [90] Mikael Fortelius, Jussi Eronen, Jukka Jernvall, Liping Liu, Diana Pushkina, Juhani Rinne, Alexey Tesakov, Inesa Vislobokova, Zhaoqun Zhang, and Liping Zhou. Fossil mammals resolve regional patterns of Eurasian climate change over 20 million years. *Evolutionary Ecology Research*, 4:1005–1016, 2002.
- [91] John R Foster. Preliminary body mass estimates for mammalian genera of the Morrison Formation (Upper Jurassic, North America). *PaleoBios*, 28:114–122, 2009.
- [92] Richard C. Fox and Craig S. Scott. A New, Early Puercan (Earliest Paleocene) Species of *Purgatorius* (Plesiadapiformes, Primates) from Saskatchewan, Canada. *Journal of Paleontology*, 85(3):537–548, may 2011.

- [93] Danielle Fraser, Root Gorelick, and Natalia Rybczynski. Macroevolution and climate change influence phylogenetic community assembly of North American hoofed mammals. *Biological Journal of the Linnean Society*, 114(3):485–494, 2015.
- [94] Matthijs Freudenthal and Elvira Martín-Suárez. Estimating body mass of fossil rodents. *Scripta Geologica*, 145:1–130, 2013.
- [95] Susanne A Fritz, Olaf R P Bininda-Emonds, and Andy Purvis. Geographical variation in predictors of mammalian extinction risk: big is bad, but only in the tropics. *Ecology Letters*, 12(6):538–49, jun 2009.
- [96] Susanne A Fritz and Andy Purvis. Selectivity in mammalian extinction risk and threat types: a new measure of phylogenetic signal strength in binary traits. *Conservation Biology*, 24(4):1042–51, aug 2010.
- [97] Susanne A Fritz, Jan Schnitzler, Jussi T Eronen, Christian Hof, Katrin Böhning-Gaese, and Catherine H Graham. Diversity in time and space: wanted dead and alive. *Trends in Ecology & Evolution*, 28(9):509–16, sep 2013.
- [98] C L Gazin. A Tertiary vertebrate fauna from the upper Cuyama drainage basin, California. *Carnegie Institution of Washington*, 404:55–76, 1930.
- [99] Andrew Gelman. Prior distributions for variance parameters in hierarchical models. *Bayesian Analysis*, 1(3):515–533, 2006.
- [100] Andrew Gelman. Scaling regression inputs by dividing by two standard deviations. *Statistics in Medicine*, pages 2865–2873, 2008.
- [101] Andrew Gelman, John B Carlin, Hal S Stern, David B Dunson, Aki Vehtari, and Donald B Rubin. *Bayesian data analysis*. Chapman and Hall, Boca Raton, FL, 3 edition, 2013.
- [102] Andrew Gelman and Jennifer Hill. *Data Analysis using Regression and Multi-level/Hierarchical Models*. Cambridge University Press, New York, NY, 2007.
- [103] James Williams Gidley. Pleistocene peccaries from the Cumberland Cave deposit. *Proceedings of the United States National Museum*, 57(2324):651–678, 1920.
- [104] PD Gingerich. Quantification and comparison of evolutionary rates. *American Journal of Science*, 293:453–478, 1993.
- [105] Emma E Goldberg, Lesley T Lancaster, and Richard H Ree. Phylogenetic inference of reciprocal effects between geographic range evolution and diversification. *Systematic Biology*, 60(4):451–65, jul 2011.
- [106] Emma E Goldberg, Kaustuv Roy, Russell Lande, and David Jablonski. Diversity, endemism, and age distributions in macroevolutionary sources and sinks. *The American Naturalist*, 165(6):623–33, jun 2005.

- [107] Harvey Goldstein, William Browne, and Jon Rasbash. Partitioning variation in multi-level models. *Understanding Statistics*, 1(4):1–12, 2002.
- [108] Cynthia L Gordon. A First Look at Estimating Body Size in Dentally Conservative Marsupials. *Journal of Mammalian Evolution*, page 21, 2003.
- [109] Alan Graham. *A natural history of the New World: the ecology and evolution of plants in the Americas*. University of Chicago Press, Chicago, 2011.
- [110] Camille Grohé, Yaowalak Chaimanee, Louis de Bonis, Chotima Yamee, Cécile Blondel, and Jean-Jacques Jaeger. New data on Mustelidae (Carnivora) from Southeast Asia: *Siamogale thailandica*, a peculiar otter-like mustelid from the late middle Miocene Mae Moh Basin, northern Thailand. *Die Naturwissenschaften*, 97(11):1003–15, nov 2010.
- [111] E R Hall. Three new genera of Mustelidae from the later Tertiary of North America. *Journal of Mammalogy*, 11(2):146–155, 1930.
- [112] Bjarte Hannisdal and Shanan E Peters. Phanerozoic Earth system evolution and marine biodiversity. *Science*, 334:1121–1124, nov 2011.
- [113] Luke J. Harmon and Susan Harrison. Species Diversity Is Dynamic and Unbounded at Local and Continental Scales. *The American Naturalist*, 185(5):000–000, mar 2015.
- [114] P. G. Harnik, C. Simpson, and J. L. Payne. Long-term differences in extinction risk among the seven forms of rarity. *Proceedings of the Royal Society B: Biological Sciences*, 279(1749):4969–4976, oct 2012.
- [115] Paul G Harnik. Direct and indirect effects of biological factors on extinction risk in fossil bivalves. *Proceedings of the National Academy of Sciences*, 108(33):13594–13599, aug 2011.
- [116] Paul G. Harnik, Paul C. Fitzgerald, Jonathan L. Payne, and Sandra J. Carlson. Phylogenetic signal in extinction selectivity in Devonian terebratulide brachiopods. *Paleobiology*, 40(4):675–692, jun 2014.
- [117] Susan Harrison and Howard Cornell. Toward a better understanding of the regional causes of local community richness. *Ecology Letters*, 11:969–979, 2008.
- [118] OP Hay. Descriptions of some fossil vertebrates found in Texas. *Bulletin of the University of Texas*, 71:2–24, 1916.
- [119] OP Hay. Notes on Some Fossil Horses, with Descriptions of Four New Species. *Proceedings of The United States National Museum*, 44:569–594, 1969.
- [120] Matthew M Hedman. Constraints on clade ages from fossil outgroups. *Paleobiology*, 36(1):16–31, 2010.

- [121] Noel A Heim and Shanan E Peters. Regional environmental breadth predicts geographic range and longevity in fossil marine genera. *PloS one*, 6(5):e18946, jan 2011.
- [122] Robert J. Hijmans. *raster: Geographic data analysis and modeling*, 2015. R package version 2.3-24.
- [123] Kenneth B. Hoehn, Paul G. Harnik, and V. Louise Roth. A framework for detecting natural selection on traits above the species level. *Methods in Ecology and Evolution*, pages doi: 10.1111/2041-210X.12461, 2015.
- [124] Matthew D. Hoffman and Andrew Gelman. The no-U-turn sampler: Adaptively setting path lengths in Hamiltonian Monte Carlo. *arXiv*, 1111(4246), 2011.
- [125] Matthew D Hoffman and Andrew Gelman. The No-U-Turn Sampler: Adaptively Setting Path Lengths in Hamiltonian Monte Carlo. *Journal of Machine Learning Research*, 15:1351–1381, 2014.
- [126] Robert D. Holt. Emergent neutrality. *Trends in Ecology and Evolution*, 21(10):531–533, 2006.
- [127] Melanie J. Hopkins, Carl Simpson, and Wolfgang Kiessling. Differential niche dynamics among major marine invertebrate clades. *Ecology Letters*, 17(3):314–323, 2014.
- [128] Elizabeth A Housworth, P Martins, and Michael Lynch. The Phylogenetic Mixed Model. *The American Naturalist*, 163(1):84–96, 2004.
- [129] G Hunt. The relative importance of directional change, random walks, and stasis in the evolution of fossil lineages. *Proceedings of the National Academy of Sciences*, 104:18404–18408, 2007.
- [130] Gene Hunt. Fitting and comparing models of phyletic evolution: random walks and beyond. *Paleobiology*, 32(4):578–601, 2006.
- [131] Gene Hunt and Daniel L Rabosky. Phenotypic Evolution in Fossil Species: Pattern and Process. *Annual Review of Earth and Planetary Sciences*, 42(1):421–441, 2014.
- [132] Gene Hunt, Kaustuv Roy, and David Jablonski. Species-level heritability reaffirmed: a comment on "on the heritability of geographic range sizes". *The American naturalist*, 166(1):129–35; discussion 136–43, jul 2005.
- [133] Joseph G Ibrahim, Ming-Hui Chen, and Debajyoti Sinha. *Bayesian Survival Analysis*. Springer, New York, 2001.
- [134] D Jablonski. Heritability at the species level: analysis of geographic ranges of cretaceous mollusks. *Science*, 238(4825):360–363, oct 1987.
- [135] David Jablonski. Background and mass extinctions: the alternation of macroevolutionary regimes. *Science*, 231(4734):129–133, 1986.

- [136] David Jablonski. Scale and hierarchy in macroevolution. *Palaeontology*, 50(September 2006):87–109, 2007.
- [137] David Jablonski. Species Selection: Theory and Data. *Annual Review of Ecology, Evolution, and Systematics*, 39(1):501–524, dec 2008.
- [138] David Jablonski and Kaustuv Roy. Geographical range and speciation in fossil and living molluscs. *Proceedings of the Royal Society B: Biological Sciences*, 270(1513):401–406, feb 2003.
- [139] Tahira Jamil, Wim A. Ozinga, Michael Kleyer, and Cajo J F Ter Braak. Selecting traits that explain species-environment relationships: A generalized linear mixed model approach. *Journal of Vegetation Science*, 24(6):988–1000, 2013.
- [140] C Janis, J Damuth, and J M Theodor. The species richness of Miocene browsers, and implications for habitat type and primary productivity in the North American grassland biome. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 207(3-4):371–398, may 2004.
- [141] C M Janis, J Damuth, and J M Theodor. Miocene ungulates and terrestrial primary productivity: where have all the browsers gone? *Proceedings of the National Academy of Sciences*, 97(14):7899–904, jul 2000.
- [142] Christine M Janis. Tertiary mammal evolution in the context of changing climates, vegetation, and tectonic events. *Annual Review of Ecology and Systematics*, 24:467–500, 1993.
- [143] Christine M Janis. Tertiary mammal evolution in the context of changing climates, vegetation, and tectonic events. *Annual Review of Ecology and Systematics*, 24:467–500, 1993.
- [144] Christine M. Janis. An evolutionary history of browsing and grazing ungulates. In Iain J Gordon and Herbert H T Prins, editors, *The Ecology of Browsing and Grazing*, pages 21–45. Springer-Verlag, 2008.
- [145] Christine M Janis, Gregg F Gunnell, and Mark D Uhen. *Evolution of Tertiary mammals of North America. Vol. 2. Small mammals, xenarthrans, and marine mammals*. Cambridge University Press, Cambridge, 2008.
- [146] Christine M Janis, K M Scott, and L L Jacobs. *Evolution of Tertiary mammals of North America. Vol. 1. Terrestrial carnivores, ungulates, and ungulatelike mammals*. Cambridge University Press, Cambridge, 1998.
- [147] Christine M. Janis and Patricia Brady Wilhelm. Were there mammalian pursuit predators in the tertiary? Dances with wolf avatars. *Journal of Mammalian Evolution*, 1(2):103–125, jun 1993.

- [148] Phillip E Jardine, Christine M Janis, Sarda Sahney, and Michael J Benton. Grit not grass: concordant patterns of early origin of hyposdonty in Great Plains ungulates and Glires. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 365-366:1–10, 2012.
- [149] Edwin T Jaynes. *Probability theory: the logic of science*. Cambridge Univ Press, Cambridge, 2003.
- [150] G L Jepsen. *Rubulodon taylori*, a Wind River Eocene Tubulidentate from Wyoming. *Proceedings of the American Ph*, 71(5):255–274, 1932.
- [151] Jukka Jernvall and Mikael Fortelius. Common mammals drive the evolutionary increase of hypsodonty in the Neogene. *Nature*, 417(6888):538–40, may 2002.
- [152] Jukka Jernvall and Mikael Fortelius. Maintenance of trophic structure in fossil mammal communities: site occupancy and taxon resilience. *The American Naturalist*, 164(5):614–624, nov 2004.
- [153] M. M. Joachimski, S. Breisig, W. Buggisch, J. A. Talent, R. Mawson, M. Gereke, J. R. Morrow, J. Day, and K. Weddige. Devonian climate and reef evolution: Insights from oxygen isotopes in apatite. *Earth and Planetary Science Letters*, 284(3-4):599–609, 2009.
- [154] Zerina Johanson. New marsupial from the Fort Union Formation, Swain Quarry, Wyoming. *Journal of Paleontology*, 70(6):1023–1031, 1996.
- [155] J G Johnson. Extinction of Perched Faunas. *Geology*, 2:479–482, 1974.
- [156] Kate E Jones, Jon Bielby, Marcel Cardillo, Susanne A Fritz, Justin O’Dell, C David L Orme, Kamran Safi, Wes Sechrest, E Boakes, C Carbone, C Connolly, M J Cutts, J K Foster, R Grenyer, M Habib, C A Plaster, S A Price, E A Rigby, J Rist, Amber Teacher, Olaf R P Bininda-Emonds, John L Gittleman, Georgina M Mace, and Andy Purvis. PanTHERIA : a species-level database of life history , ecology , and geography of extant and recently extinct mammals. *Ecology*, 90(9):2648, 2009.
- [157] DR Kelley and AE Wood. The Eocene mammals from the Lysite member, Wind River Formation of Wyoming. *Journal of Paleontology*, 28(3):337–366, 1954.
- [158] Wolfgang Kiessling and Martin Aberhan. Environmental determinants of marine benthic biodiversity dynamics through Triassic Jurassic time. *Paleobiology*, 33(3):414–434, 2007.
- [159] E Christopher Kirk and Blythe a Williams. New adapiform primate of Old World affinities from the Devil’s Graveyard Formation of Texas. *Journal of human evolution*, 61(2):156–68, aug 2011.
- [160] John P Klein and Melvin L Moeschberger. *Survival Analysis: Techniques for Censored and Truncated Data*. Springer, New York, 2nd edition, 2003.

- [161] D G Kleinbaum and M Klein. *Survival analysis: a self-learning text*. Springer, New York, NY, 2 edition, 2005.
- [162] WW Korth. Miosicista angulus, a new sicistine rodent (Zapodidae, Rodentia) from the Barstovian (Miocene) of Nebraska. *Transactions of the Nebraska Academy of Sciences*, 20:97–101, 1993.
- [163] Alp Kucukelbir, Rajesh Ranganath, Andrew Gelman, and David M Blei. Automatic Variational Inference in Stan. In *NIPS*, volume 28, pages 568–576, 2015.
- [164] Pierre Legendre, René Galzin, and Mireille L Harmelin-Vivien. Relating behavior to habitat: solutions to the fourth-corner problem. *Ecology*, 78(2):547–562, 1997.
- [165] Serge Legendre. Analysis of mammalian communities from the Late Eocene and Oligocene of Southern France. *Paleovertebrata*, 16(4):191–212, 1986.
- [166] Daniel Lewandowski, Dorota Kurowicka, and Harry Joe. Generating random correlation matrices based on vines and extended onion method. *Journal of Multivariate Analysis*, 100(9):1989–2001, oct 2009.
- [167] Jason A Lillegraven. Small rodents (Mammalia) from Eocene deposits of San Diego County, California. *Bulletin of the American Museum of Natural History*, 158:223–260, 1977.
- [168] JD Lim, LD Martin, and RW Wilson. A new species of Leptarctus (Carnivora, Mustelidae) from the late Miocene of Texas. *Journal of Paleontology*, 75(5):1043–1046, 2001.
- [169] L H Liow, Mikael Fortelius, E Bingham, K Lintulaakso, H Mannila, L Flynn, and N C Stenseth. Higher origination and extinction rates in larger mammals. *Proceedings of the National Academy of Sciences*, 105(16):6097–6102, 2008.
- [170] Lee Hsiang Liow. A test of Simpson’s ”rule of the survival of the relatively unspecialized” using fossil crinoids. *The American Naturalist*, 164(4):431–43, oct 2004.
- [171] Lee Hsiang Liow. Does versatility as measured by geographic range, bathymetric range and morphological variability contribute to taxon longevity? *Global Ecology and Biogeography*, 16(1):117–128, 2007.
- [172] Lee Hsiang Liow, Mikael Fortelius, Kari Lintulaakso, Heikki Mannila, and Nils Chr Stenseth. Lower Extinction Risk in SleeporHide Mammals. *The American Naturalist*, 173(2):264–272, 2009.
- [173] Lee Hsiang Liow and James D Nichols. Estimating rates and probabilities of origination and extinction using taxonomic occurrence data: Capture-mark-recapture (CMR) approaches. In John Alroy and Gene Hunt, editors, *Quantitative Methods in Paleobiology*, pages 81–94. The Paleontological Society, 2010.

- [174] Lee Hsiang Liow, Tiago B Quental, and Charles R Marshall. When can decreasing diversification rates be detected with molecular phylogenies and the fossil record? *Systematic biology*, 59(6):646–59, dec 2010.
- [175] Lee Hsiang Liow, Leigh Van Valen, and Nils Chr Stenseth. Red Queen: from populations to taxa and communities. *Trends in Ecology & Evolution*, 26(7):349–358, jul 2011.
- [176] Elisabeth A Lloyd and Stephen J Gould. Species selection on variability. *Proceedings of the National Academy of Sciences*, 90:595–599, 1993.
- [177] G T Lloyd, J R Young, and A B Smith. Taxonomic Structure of the Fossil Record is Shaped by Sampling Bias. *Systematic Biology*, 61(1):80–89, 2011.
- [178] Nicolas Loeuille and Mathew a Leibold. Evolution in metacommunities: on the relative importance of species sorting and monopolization in structuring communities. *The American naturalist*, 171(6):788–99, 2008.
- [179] FB Loomis. The camels of the Harrison beds, with three new species. *American Journal of Science*, 31:65–70, 1911.
- [180] FB Loomis. Two new Miocene entelodonts. *Journal of Mammalogy*, 13(4):358–362, 1932.
- [181] Jonathan B Losos. Adaptive radiation, ecological opportunity, and evolutionary determinism. *The American naturalist*, 175(6):623–39, jun 2010.
- [182] Jonathan B Losos and D Luke Mahler. Adaptive radiation: the interaction of ecological opportunity, adaptation, and speciation. In M. A. Bell, D. J. Futuyma, W. F. Eanes, and J. S. Levinton, editors, *Evolution since Darwin: the first 150 years*, chapter 15, pages 381–420. Sinauer Associates, Sunderland, MA, 2010.
- [183] Zhe-Xi Luo, Alfred W Crompton, and Ai-Lin Sun. A New Mammaliaform from the Early Jurassic and Evolution of Mammalian Characteristics. *Science*, 292:1535–1540, 2001.
- [184] Michael Lynch. Methods for the analysis of comparative data in evolutionary biology. *Evolution*, 45(5):1065–1080, 1991.
- [185] Giles TERNAN Mac Intyre. The Miacidae (Mammalia, Carnivora) Part 1. The systematics of Ictidopappus and Protictis. *Bulletin of the American Museum of Natural History*, 131:115–210, 1966.
- [186] J R Macdonald. Additions to the Whitneyan fauna of South Dakota. *Journal of Paleontology*, 25(3):257–265, 1951.
- [187] J R Macdonald. The North American Antracotheres. *Journal of Paleontology*, 30(3):615–645, 1956.

- [188] BJ MacFadden. Fossil horses from "Eohippus" (Hyracotherium) to Equus: scaling, Cope's Law, and the evolution of body size. *Paleobiology*, 12(4):355–369, 1986.
- [189] Cary T. Madden and John E. Storer. The Proboscidea from the Middle Miocene Wood Mountain Formation, Saskatchewan. *Canadian Journal of Earth Sciences*, 22(9):1345–1350, sep 1985.
- [190] W P Maddison, P E Midford, and S P Otto. Estimating a binary character's effect on speciation and extinction. *Systematic Biology*, 56(5):701, 2007.
- [191] Jonathan D. Marcot. The fossil record and macroevolutionary history of North American ungulate mammals: standardizing variation in intensity and geography of sampling. *Paleobiology*, 40(2):237–254, feb 2014.
- [192] RA Martin, HT Goodwin, and JO Farlow. Late Neogene (Late Hemphillian) rodents from the Pipe Creek Sinkhole, Grant County, Indiana. *Journal of Vertebrate Paleontology*, 22:137–151, 2002.
- [193] W D Matthew. Additional observations on the Creodonta. *Bulletin of the American Museum of Natural History*, 14:1–38, 1901.
- [194] HG McDonald. Paleoecology of extinct xenarthrans and the Great American Biotic Interchange. *Bulletin of the Florida Museum of Natural History*, 45:313–333, 2005.
- [195] Richard McElreath. *Statistical rethinking: a Bayesian course with examples in R and Stan*. CRC Press, Boca Raton, FL, 2016.
- [196] Brian J McGill, Brian J Enquist, Evan Weiher, and Mark Westoby. Rebuilding community ecology from functional traits. *TRENDS in Ecology and Evolution*, 21(4):178–185, 2006.
- [197] Paul O McGrew. A new Amphicyon from the Deep River Miocene. *Geological Series of Field Museum of Natural History*, 6(23):341–350, 1939.
- [198] Ryan Thomas McKenna. *Potential for Speciation in Mammals Following Vast , Late Miocene Volcanic Interruptions in the Pacific Northwest*. Masters, Portland State University, 2011.
- [199] Daniel W McShea. Mechanisms of Large-Scale Evolutionary Trends. *Evolution*, 48(6):1747–1763, 1994.
- [200] James S Mellett. A skull of Hemipsalodon (Mammalia, Deltatheridia) from the Clarno Formation of Oregon. *American Museum Novitates*, 2387:1–19, 1969.
- [201] M. Mendoza, C. M. Janis, and P. Palmqvist. Estimating the body mass of extinct ungulates: a study on the use of multiple regression. *Journal of Zoology*, 270:90–101, may 2006.

- [202] Matthew C. Mhlbachler and Nikos Solounias. Coevolution of Tooth Crown Height and Diet in Oreodonts (Merycoidodontidae, Artiodactyla) Examined with Phylogenetically Independent Contrasts. *Journal of Mammalian Evolution*, 13(1):11–36, mar 2006.
- [203] Arnold I Miller and Michael Foote. Epicontinental seas versus open-ocean settings: the kinetics of mass extinction and origination. *Science*, 326(5956):1106–9, nov 2009.
- [204] Gary G. Mittelbach and Douglas W. Schemske. Ecological and evolutionary perspectives on community assembly. *Trends in Ecology and Evolution*, 30(5):241–247, 2015.
- [205] Cesar Alberto Laurito Mora and Ana Lucia Valerio Zamora. First record of Rhynchotherium blicki (Frick, 1933) for the late Cenozoic of Costa Rica. *Revista Geologica de America Central*, 33:75–82, 2005.
- [206] Isaac Casanovas-Vilar Salvador Moyà-Solà, Jordi Agustí, and Meike Kohler. 9 The geography of a faunal turnover : tracking the Vallesian Crisis. In Ashraf M T Elewa, editor, *Migration of Organisms: Climate, geography, ecology*, pages 247–300. Springer, Berlin, 2005.
- [207] Axel Munnecke, Mikael Calner, David A T Harper, and Thomas Servais. Ordovician and Silurian sea-water chemistry, sea level, and climate: A synopsis. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 296(3-4):389–413, 2010.
- [208] S Nee. Inferring speciation rates from phylogenies. *Evolution*, 55(4):661–8, apr 2001.
- [209] S Nee, a O Mooers, and P H Harvey. Tempo and mode of evolution revealed from molecular phylogenies. *Proceedings of the National Academy of Sciences of the United States of America*, 89(17):8322–6, sep 1992.
- [210] Sean Nee. Birth-Death Models in Macroevolution. *Annual Review of Ecology, Evolution, and Systematics*, 37(1):1–17, dec 2006.
- [211] Sean Nee, RM May, and PH Harvey. The reconstructed evolutionary process. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 344:305–311, 1994.
- [212] Michael J Novacek. A review of Paleocene and Eocene Leptictidae (Eutheria: Mammalia) from North America. *PaleoBios*, 24:1–42, 1977.
- [213] Philip M Novack-Gottshall. Using a theoretical ecospace to quantify the ecological diversity of Paleozoic and modern marine biotas Using a theoretical ecospace to quantify the ecological diversity of Paleozoic and modern marine biotas. *Paleobiology*, 33(2):273–294, 2007.
- [214] Sabine Nürnberg and Martin Aberhan. Habitat breadth and geographic range predict diversity dynamics in marine Mesozoic bivalves. *Paleobiology*, 39(3):360–372, apr 2013.

- [215] Sabine Nürnberg and Martin Aberhan. Interdependence of specialization and biodiversity in Phanerozoic marine invertebrates. *Nature Communications*, 6:6602, jan 2015.
- [216] Henry Fairfield Osborn. *Sebelodon burnhami*, a new shovel-tusker from California. *American Museum Novitates*, 639:1–5, 1933.
- [217] Michael E Palmer and Marcus W Feldman. Survivability is more fundamental than evolvability. *PloS one*, 7(6):e38025, jan 2012.
- [218] Thomas Hudson Patton and Beryl E Taylor. The Protoceratinae (Mammalia, Tylopoda, Protoceratidae) and the systematics of the Protoceratidae. *Bulletin of the American Museum of Natural History*, 150:347–414, 1973.
- [219] Jonathan L Payne and Seth Finnegan. The effect of geographic range on extinction risk during background and mass extinction. *Proceedings of the National Academy of Sciences*, 104:10506–11, jun 2007.
- [220] Jonathan L Payne, Noel A Heim, Matthew L Knope, and Craig R McClain. Metabolic dominance of bivalves predates brachiopod diversity decline by more than 150 million years. *Proceedings of the Royal Society B: Biological Sciences*, 281:20133122, 2014.
- [221] Matthew W Pennell, Luke J Harmon, and Josef C Uyeda. Is there room for punctuated equilibrium in macroevolution? *Trends in ecology & evolution*, 29(1):23–32, jan 2014.
- [222] Shanan E. Peters. The problem with the Paleozoic. *Paleobiology*, 33(2):165–181, 2007.
- [223] Shanan E Peters. Environmental determinants of extinction selectivity in the fossil record. *Nature*, 454(7204):626–629, jul 2008.
- [224] Shanan E Peters and Michael Foote. Determinants of extinction in the fossil record. *Nature*, 416(6879):420–4, mar 2002.
- [225] Shanan E Peters and Noel A Heim. The geological completeness of paleontological sampling in North America. *Paleobiology*, 36(1):61–79, 2010.
- [226] Steven J Phillips, Robert P Anderson, and Robert E Schapire. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190:231–259, 2006.
- [227] Mathias M Pires, Daniele Silvestro, and Tiago B Quental. Continental faunal exchange and the asymmetrical radiation of carnivores. *Proceedings of the Royal Society B: Biological Sciences*, 282:20151952, 2015.
- [228] Laura J. Pollock, Michael J. Bayly, and Peter a. Vesk. The Roles of Ecological and Evolutionary Processes in Plant Community Assembly: The Environment, Hybridization, and Introgression Influence Co-occurrence of *Eucalyptus*. *The American Naturalist*, pages 000–000, mar 2015.

- [229] Laura J. Pollock, William K. Morris, and Peter A. Vesk. The role of functional traits in species distributions revealed through a hierarchical model. *Ecography*, 35(8):716–725, 2012.
- [230] P. David Polly, A. Michelle Lawing, Jussi T. Eronen, and Jan Schnitzler. Processes of ecometric patterning: modelling functional traits, environments, and clade dynamics in deep time. *Biological Journal of the Linnean Society*, pages n/a–n/a, 2015.
- [231] PD Polly, JT Eronen, Marianne Fred, Gregory P Dietl, Volker Mosbrugger, Christoph Scheidegger, David C Frank, John Damuth, Nils C Stenseth, and Mikael Fortelius. History matters: ecometrics and integrative climate change biology. *Proceedings of the Royal Society B: Biological Sciences*, 278(1709):1131–1140, 2011.
- [232] S A Price and L Schmitz. A promising future for integrative biodiversity research: an increased role of scale-dependency and functional biology. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371:20150228, 2016.
- [233] Samantha A Price, Samantha S B Hopkins, Kathleen K Smith, and V Louise Roth. Tempo of trophic evolution and its impact on mammalian diversification. *Proceedings of the National Academy of Sciences*, 109(18):7008–12, may 2012.
- [234] A Purvis, J L Gittleman, G Cowlishaw, and G M Mace. Predicting extinction risk in declining species. *Proceedings of the Royal Society B: Biological Sciences*, 267(1456):1947–52, oct 2000.
- [235] Tiago B Quental and Charles R Marshall. Extinction during evolutionary radiations: reconciling the fossil record with molecular phylogenies. *Evolution*, 63(12):3158–3167, dec 2009.
- [236] Tiago B Quental and Charles R Marshall. How the Red Queen Drives Terrestrial Mammals to Extinction. *Science*, 341(6143):290–292, sep 2013.
- [237] Daniel L Rabosky. Extinction rates should not be estimated from molecular phylogenies. *Evolution*, 64(6):1816–1824, jun 2010.
- [238] Daniel L Rabosky. Diversity-Dependence, Ecological Speciation, and the Role of Competition in Macroevolution. *Annual Review of Ecology, Evolution, and Systematics*, 44:1–22, 2013.
- [239] Daniel L. Rabosky. Reproductive isolation and the causes of speciation rate variation in nature. *Biological Journal of the Linnean Society*, 2015.
- [240] Daniel L. Rabosky and Allen H. Hurlbert. Species Richness at Continental Scales Is Dominated by Ecological Limits. *The American Naturalist*, 185(5):000–000, mar 2015.
- [241] Daniel L Rabosky and Daniel R Matute. Macroevolutionary speciation rates are decoupled from the evolution of intrinsic reproductive isolation in *Drosophila* and birds. *Proceedings of the National Academy of Sciences*, 110(38):15354–15359, 2013.

- [242] Daniel L Rabosky and Amy R McCune. Reinventing species selection with molecular phylogenies. *Trends in Ecology & Evolution*, 25(2):68–74, feb 2010.
- [243] Daniel L. Rabosky, Francesco Santini, Jonathan Eastman, Stephen a. Smith, Brian Sidlauskas, Jonathan Chang, and Michael E. Alfaro. Rates of speciation and morphological evolution are correlated across the largest vertebrate radiation. *Nature Communications*, 4:1–8, jun 2013.
- [244] P Raia, F Carotenuto, F Passaro, D Fulgione, and M Fortelius. Ecological specialization in fossil mammals explains Cope’s rule. *The American Naturalist*, 179(3):328–37, mar 2012.
- [245] P. Raia, F. Carotenuto, F. Passaro, P. Piras, D. Fulgione, L. Werdelin, J. Saarinen, and Mikael Fortelius. Rapid action in the Palaeogene, the relationship between phenotypic and taxonomic diversification in Coenozoic mammals. *Proceedings of the Royal Society B: Biological Sciences*, 280:20122244, nov 2013.
- [246] Pasquale Raia, Francesco Carotenuto, A Mondanaro, S Castiglione, F Passaro, F Saggese, M Melchionna, C Seiro, L Alessio, D Silvestro, and M Fortelius. Progress to extinction: increased specialisation causes the demise of animal clades. *Scientific Reports*, 6:30965, 2016.
- [247] David M Raup. Taxonomic survivorship curves and Van Valen’s Law. *Paleobiology*, 1(1):82–96, jan 1975.
- [248] David M Raup. Cohort Analysis of generic survivorship. *Paleobiology*, 4(1):1–15, 1978.
- [249] David M Raup. Mathematical models of cladogenesis. *Paleobiology*, 11(1):42–52, 1985.
- [250] David M Raup. *Extinction: Bad Genes or Bad Luck?* Norton, New York, 1991.
- [251] David M Raup. The role of extinction in evolution. *Proceedings of the National Academy of Sciences*, 91(July):6758–6763, 1994.
- [252] David M Raup and Stephen Jay Gould. Stochastic simulation and evolution of morphology – towards a nomothetic paleontology. *Systematic Zoology*, 23(3):305–322, 1974.
- [253] David M Raup, Stephen Jay Gould, Thomas J M Schopf, and Daniel S Simberloff. Stochastic models of phylogeny and the evolution of diversity. *The Journal of Geology*, 81(5):525–542, 1973.
- [254] David M Raup and J John Sepkoski. Mass Extinctions in the Marine Fossil Record. *Science*, 215(4539):1501–1503, 1982.
- [255] Liam J. Revell. phytools: An r package for phylogenetic comparative biology (and other things). *Methods in Ecology and Evolution*, 3:217–223, 2012.

- [256] P Robinson. Fossil Mammalia of the Huerfano Formation, Eocene, of Colorado. *Peabody Museum of Natural History Bulletin*, 21:1–95, 1966.
- [257] Peter D Roopnarine. The description and classification of evolutionary mode: a computational approach. *Paleobiology*, 27(3):446–465, 2001.
- [258] Peter D Roopnarine. Analysis of rates of morphologic evolution. *Annual Review of Ecology, Evolution, and Systematics*, 34:605–632, 2003.
- [259] Peter D Roopnarine, Gabe Byars, and Paul Fitzgerald. Anagenetic evolution, stratophenetic patterns, and random walk models. *Paleobiology*, 25(1):41–57, 1999.
- [260] KD Rose and DW Krause. Cyriacotheriidae, a new family of early Tertiary pantodonts from western North America. *Proceedings of the American Philosophical Society*, 126(1):26–50, 1982.
- [261] Kenneth D Rose, Stephen G B Chester, Rachel H Dunn, Doug M Boyer, and Jonathan I Bloch. New fossils of the oldest North American euprimate Teilhardina brandti (Omomyidae) from the paleocene-eocene thermal maximum. *American journal of physical anthropology*, 146(2):281–305, oct 2011.
- [262] Kenneth D. Rose, Kishor Kumar, Rajendra S. Rana, Ashok Sahni, and Thierry Smith. New Hypsodont Tillodont (Mammalia, Tillodontia) from the Early Eocene of India. *Journal of Paleontology*, 87(5):842–853, sep 2013.
- [263] James Rosindell, Luke J Harmon, and Rampal S Etienne. Unifying ecology and macroevolution with individual-based theory. *Ecology Letters*, 18(5):472–482, may 2015.
- [264] Martin Rosvall, D Axelsson, and CT Bergstrom. The map equation. *The European Physical Journal Special Topics*, 178(14):13–24, 2009.
- [265] Martin Rosvall and Carl T Bergstrom. Maps of random walks on complex networks reveal community structure. *Proceedings of the National Academy of Sciences*, 105(4):1118–23, jan 2008.
- [266] Kaustuv Roy, Gene Hunt, David Jablonski, Andrew Z Krug, and James W Valentine. A macroevolutionary perspective on species range limits. *Proceedings of the Royal Society B: Biological Sciences*, 276:1485–1493, apr 2009.
- [267] J. Andrew Royle and Robert M Dorazio. *Hierarchical modeling and inference in ecology: the analysis of data from populations, metapopulations and communities*. Elsevier, London, 2008.
- [268] J Andrew Royle, James D Nichols, and Marc Kéry. Modelling occurrence and abundance of species when detection is imperfect. *Oikos*, 110(January):353–359, 2005.
- [269] Donald B Rubin. Multiple imputation after 18+ years. *Journal of the American Statistical Association*, 91(434):473–489, 1996.

- [270] Marten Scheffer and Egbert H van Nes. Self-organized similarity, the evolutionary emergence of groups of similar species. *Proceedings of the National Academy of Sciences*, 103(16):6230–6235, 2006.
- [271] Holger Schielzeth. Simple means to improve the interpretability of regression coefficients. *Methods in Ecology and Evolution*, 1(2):103–113, feb 2010.
- [272] Craig S Scott. Late Torrejonian (Middle Paleocene) mammals from South Central Alberta, Canada. *Journal of Paleontology*, 77(4):745–768, 2003.
- [273] Craig S. Scott, Daniel N. Spivak, Arthur R. Sweet, and Hans Sues. First mammals from the Paleocene Porcupine Hills Formation of southwestern Alberta, Canada 1. *Canadian Journal of Earth Sciences*, 50(3):355–378, mar 2013.
- [274] CS Scott. A new species of the ptilodontid multituberculate Prochetodon (Mammalia, Altheria) from the Paleocene Paskapoo Formation of Alberta, Canada. *Canadian Journal of Earth Sciences*, 41:237–246, 2004.
- [275] William Berryman Scott and Glenn Lowell Jepsen. The mammalian fauna of the White River Oligocene: Part IV. Artiodactyla. *Transactions of the American Philosophical Society*, 28(4):363–746, 1940.
- [276] William Berryman Scott, Glenn Lowell Jepsen, and Albert Elmer Wood. The mammalian fauna of the White River Oligocene: Part II. Rodentia. *Transactions of the American Philosophical Society*, 28(2):155–269, 1937.
- [277] Ross Secord. *The Tiffanian Land-Mammal Age (Middle and Late Paleocene) in the Northern Bighorn Basin , Wyoming*. University of Michicagn, 2008.
- [278] David Sepkoski. *Rereading the fossil record: the growth of paleobiology as an evolutionary discipline*. University of Chicago Press, Chicago, 2015.
- [279] David Sepkoski and Michael Ruse. *The paleobiological revolution: essays on the growth of modern paleontology*. University of Chicago Press, Chicago, 2009.
- [280] J John Sepkoski. Stratigraphic biases in the analysis of taxonomic survivorship. *Paleobiology*, 1(4):343–355, 1975.
- [281] J John Sepkoski. A factor analytic description of the Phanerozoic marine fossil record. *Paleobiology*, 7(1):36–53, 1981.
- [282] PM Sheehan. The late Ordovician mass extinction. *Annual Review of Earth and Planetary Sciences*, 29:331–364, 2001.
- [283] H David Sheets and Charles E Mitchell. Uncorrelated change produces the apparent dependence of evolutionary rate on interval. *Paleobiology*, 27(3):429–445, 2001.

- [284] Bill Shipley, Denis Vile, and Eric Garnier. From plant traits to plant communities: a statistical mechanistic approach to biodiversity. *Science*, 314:812–814, 2006.
- [285] Christian A Sidor, Daril A Vilhena, Kenneth D Angielczyk, Adam K Huttenlocker, Sterling J Nesbitt, Brandon R Peacock, J Sébastien Steyer, Roger M H Smith, and Linda A Tsuji. Provincialization of terrestrial faunas following the end-Permian mass extinction. *Proceedings of the National Academy of Sciences*, 110(20):8129–33, may 2013.
- [286] Daniele Silvestro, Alexandre Antonelli, Nicolas Salamin, and Tiago B Quental. The role of clade competition in the diversification of North American canids. *Proceedings of the National Academy of Sciences of the United States of America*, 112(28):8684–9, jul 2015.
- [287] Daniele Silvestro, Jan Schnitzler, Lee Hsiang Liow, Alexandre Antonelli, and Nicolas Salamin. Bayesian estimation of speciation and extinction from incomplete fossil occurrence data. *Systematic biology*, 63(3):349–67, may 2014.
- [288] Daniel Simberloff and Tamar Dayan. The Guild Concept and the Structure of Ecological Communities. *Annual Review of Ecology and Systematics*, 22:115–143, 1991.
- [289] Elwyn L Simons. The Paleocene Pantodonta. *Transactions of the American Philosophical Society*, 50(6):3–99, 1960.
- [290] Carl Simpson. *Levels of selection and large-scale morphological trends*. PhD thesis, University of Chicago, 2006.
- [291] Carl Simpson. The case for species selection. *bioRxiv*, 2016.
- [292] Carl Simpson and Paul G. Harnik. Assessing the role of abundance in marine bivalve extinction over the post-Paleozoic. *Paleobiology*, 35(4):631–647, dec 2009.
- [293] Carl Simpson, Wolfgang Kiessling, Heike Mewis, Rosemarie C Baron-Szabo, and Johannes Müller. Evolutionary diversification of reef corals: a comparison of the molecular and fossil records. *Evolution*, 65(11):3274–3284, nov 2011.
- [294] George Gaylord Simpson. *Tempo and Mode in Evolution*. Columbia University Press, New York, 1944.
- [295] George Gaylord Simpson. *The Major Features of Evolution*. Columbia University Press, New York, 1953.
- [296] WJ Sinclair. Additions to the fauna of the lower Pliocene Snake Creek beds (results of the Princeton University 1914 expedition to Nebraska). *Proceedings of the American Philosophical Society*, 54(217):73–95, 1915.

- [297] Morris F Skinner and Claude W Hibbard. Early Pleistocene pre-glacial and glacial rocks and faunas of North-Central Nebraska. *Bulletin of the American Museum of Natural History*, 148:1–148, 1972.
- [298] GJ Slater, LJ Harmon, and ME Alfaro. Integrating fossils with molecular phylogenies improves inference of trait evolution. *Evolution*, 66(12):3931–3944, 2012.
- [299] Graham J. Slater. Phylogenetic evidence for a shift in the mode of mammalian body size evolution at the Cretaceous-Palaeogene boundary. *Methods in Ecology and Evolution*, 4(8):734–744, aug 2013.
- [300] Graham J. Slater. Iterative adaptive radiations of fossil canids show no evidence for diversity-dependent trait evolution. *Proceedings of the National Academy of Sciences*, 112(16):4897–4902, 2015.
- [301] F A Smith, J Brown, J Haskell, and S Lyons. Similarity of mammalian body size across the taxonomic hierarchy and across space and time. *The American Naturalist*, 163:672–691, 2004.
- [302] F. A. Smith, S. K. Lyons, S.K. Morgan Ernest, and J. H. Brown. Macroecology: more than the division of food and space among species on continents. *Progress in Physical Geography*, 32(2):115–138, apr 2008.
- [303] Felisa A Smith, James H Brown, John P Haskell, S Kathleen Lyons, John Alroy, Eric L Charnov, Tamar Dayan, Brian J Enquist, S K Morgan Ernest, Elizabeth A Hadly, Kate E Jones, Dawn M Kaufman, Pablo A Marquet, Brian A Maurer, Karl J Niklas, Warren P Porter, Bruce Tiffney, and Michael R Willig. Similarity of Mammalian Body Size across the Taxonomic Hierarchy and across Space and Time. *The American Naturalist*, 163(5):672–691, 2004.
- [304] Michael Smithson and Jay Verkuilen. A better lemon squeezer? Maximum-likelihood regression with beta-distributed dependent variables. *Psychological Methods*, 11(1):54–71, 2006.
- [305] Peter D. Smits. Expected time-invariant effects of biological traits on mammal species duration. *Proceedings of the National Academy of Sciences*, 112(42):13015–13020, 2015.
- [306] Janne Soininen. A quantitative analysis of species sorting across organisms and ecosystems. *Ecology*, 95(12):3284–3292, 2014.
- [307] R R Sokal and F J Rohlf. *Biometry*. W. H. Freeman, New York, 4 edition, 2011.
- [308] Christophe Soligo and Robert D Martin. Adaptive origins of primates revisited. *Journal of human evolution*, 50(4):414–30, apr 2006.
- [309] AR Solow and Woollcott Smith. On fossil preservation and the stratigraphic ranges of taxa. *Paleobiology*, 23(3):271–277, 1997.

- [310] Boris Sorkin. A biomechanical constraint on body mass in terrestrial mammalian predators. *Lethaia*, 41(4):333–347, dec 2008.
- [311] T Stadler. Mammalian phylogeny reveals recent diversification rate shifts. *Proceedings of the National Academy of Sciences*, 108(15):6187–6192, 2011.
- [312] T Stadler. Recovering speciation and extinction dynamics based on phylogenies. *Journal of Evolutionary Biology*, 26:1203–1219, may 2013.
- [313] Tanja Stadler and Folmer Bokma. Estimating speciation and extinction rates for phylogenies of higher taxa. *Systematic biology*, 62(2):220–30, mar 2013.
- [314] Stan Development Team. Stan: A c++ library for probability and sampling, version 2.5.0, 2014.
- [315] Stan Development Team. Stan Modeling Language Users Guide and Reference Manual, 2016.
- [316] S M Stanley. A theory of evolution above the species level. *Proceedings of the National Academy of Sciences*, 72(2):646–650, 1975.
- [317] S M Stanley. *Macroevolution: pattern and process*. W. H. Freeman, San Francisco, 1979.
- [318] RA Stirton. An association of horn cores and upper molars of the antelope *Sphenophalos nevadanus* from the lower Pliocene of Nevada. *American Journal of Science*, 24:46–51, 1932.
- [319] C Stock. An Eocene titanotherium from San Diego County, California, with remarks on the age of the Poway Conglomerate. *Proceedings of the National Academy of Sciences*, 23:48–53, 1937.
- [320] Chester Stock. Restos de Tejon (Taxidea) Pliocenoico del Occidente de Chihuahua. *Boletín de la Sociedad Geológica Mexicana*, 13:69–76, 1948.
- [321] SG Strait. Dietary reconstruction of small-bodied omomyoid primates. *Journal of Vertebrate Paleontology*, 21:322–334, 2001.
- [322] Caroline A E Strömberg. Decoupled taxonomic radiation and ecological expansion of open-habitat grasses in the Cenozoic of North America. *Proceedings of the National Academy of Sciences of the United States of America*, 102(34):11980–4, aug 2005.
- [323] Beryl E Taylor and S David Webb. Miocene Leptomerycidae (Artiodactyla, Ruminantia) and their relationships. *American Museum Novitates*, 2596:1–22, 1976.
- [324] Richard H Tedford, L G Barnes, and C E Ray. The early Miocene littoral ursoid carnivorous *Kolponomos*: systematics and mode of life. *Proceedings of the San Diego Society of Natural History*, 29:11–32, 1994.

- [325] Susumu Tomiya. Body Size and Extinction Risk in Terrestrial Mammals Above the Species Level. *The American Naturalist*, 182:196–214, sep 2013.
- [326] Zhijie J Tseng, Jingmai K O’Connor, Xiaoming Wang, and Donald R Prothero. The first Old World occurrence of the North American mustelid *Sthenictis* (Mammalia, Carnivora). *Geodiversitas*, 31(4):743–751, 2009.
- [327] Mark C. Urban, Mathew A. Leibold, Priyanga Amarasekare, Luc De Meester, Richard Gomulkiewicz, Michael E. Hochberg, Christopher A. Klausmeier, Nicolas Loeuille, Claire de Mazancourt, Jon Norberg, Jelena H. Pantel, Sharon Y. Strauss, Mark Vellend, and Michael J. Wade. The evolutionary ecology of metacommunities. *Trends in Ecology and Evolution*, 23(6):311–317, 2008.
- [328] J C Uyeda, T F Hansen, S J Arnold, and J Pienaar. The million-year wait for macroevolutionary bursts. *Proceedings of the National Academy of Sciences*, 108(38):15908–15913, 2011.
- [329] James W Valentine. Patterns of taxonomic and ecological structure of the shelf benthos during Phanerozoic time. *Paleontology*, 12(4):684–709, 1969.
- [330] Katleen Van der Gucht, Karl Cottenie, Koenraad Muylaert, Nele Vloemans, Sylvie Cousin, Steven Declerck, Erik Jeppesen, Jose-Maria Conde-Porcuna, Klaus Schwenk, Gabriel Zwart, Hanne Degans, Wim Vyverman, and Luc De Meester. The power of species sorting: local factors drive bacterial community composition over a wide range of spatial scales. *Proceedings of the National Academy of Sciences of the United States of America*, 104(51):20404–20409, 2007.
- [331] Leigh Van Valen. A new evolutionary law. *Evolutionary Theory*, 1:1–30, 1973.
- [332] Leigh Van Valen. Taxonomic survivorship curves. *Evolutionary Theory*, 4:129–142, 1979.
- [333] Blair Van Valkenburgh. Skeletal and dental predictors of body mass in carnivores. In John Damuth and Bruce J Macfadden, editors, *Body size in mammalian paleobiology: estimation and biological implications*, pages 181–205. Cambridge University Press, Cambridge, 1990.
- [334] Blaire Van Valkenburgh. Major patterns in the history of carnivorous mammals. *Annual Review of Earth and Planetary Sciences*, 27:463–493, 1999.
- [335] Blaire Van Valkenburgh. Deja vu: the evolution of feeding morphologies in the Carnivora. *Integrative and comparative biology*, 47(1):147–63, jul 2007.
- [336] Daril A Vilhena. *Boundaries and dynamics of biomes*. PhD thesis, University of Washington, 2013.

- [337] Daril A Vilhena, Elisha B Harris, Carl T Bergstrom, Max E Maliska, Peter D Ward, Christian A Sidor, Caroline A E Strömberg, and Gregory P Wilson. Bivalve network reveals latitudinal selectivity gradient at the end-Cretaceous mass extinction. *Scientific Reports*, 3:1790, may 2013.
- [338] Sébastien Villéger, Philip M Novack-Gottshall, and David Mouillot. The multidimensionality of the niche reveals functional diversity changes in benthic marine biotas across geological time. *Ecology letters*, 14(6):561–8, jun 2011.
- [339] Elisabeth S Vrba. What is species selection? *Systematic Zoology*, 33(3):318–328, 1984.
- [340] Elisabeth S Vrba and Stephen Jay Gould. The hierarchical expansion of sorting and selection: sorting and selection cannot be equated. *Paleobiology*, 12(2):217–228, 1986.
- [341] P J Wagner, M Aberhan, A Hendy, and W Kiessling. The effects of taxonomic standardization on sampling-standardized estimates of historical diversity. *Proceedings of the Royal Society B: Biological Sciences*, 274(1608):439, 2007.
- [342] Peter J Wagner and George F Estabrook. Trait-based diversification shifts reflect differential extinction among fossil taxa. *Proceedings of the National Academy of Sciences*, 111:16419–16424, oct 2014.
- [343] Peter J. Wagner and Jonathan D. Marcot. Modelling distributions of fossil sampling rates over time, space and taxa: assessment and implications for macroevolutionary studies. *Methods in Ecology and Evolution*, 4(8):703–713, aug 2013.
- [344] Steve C. Wang. On the continuity of background and mass extinction. *Paleobiology*, 29(4):455–467, dec 2003.
- [345] Steve C Wang, Philip J Everson, Heather Jianan Zhou, Dasol Park, and David J Chudzicki. Adaptive credible intervals on stratigraphic ranges when recovery potential is unknown. *Paleobiology*, 42(2):240–256, 2016.
- [346] Steve C Wang and C R Marshall. Improved confidence intervals for estimating the position of a mass extinction boundary. *Paleobiology*, 30(1):5–18, 2004.
- [347] Steve C Wang and Charles R Marshall. Estimating times of extinction in the fossil record. *Biology Letters*, 12(4):20150989, 2016.
- [348] Xiaoming Wang. Phylogenetic systematics of the Hesperocyoninae (Carnivora: Canidae). *Bulletin of the American Museum of Natural History*, 221:1–207, 1994.
- [349] Xiaoming Wang, Óscar Carranza-Castañeda, and José Jorge Aranda-Gómez. A transitional skunk, *Buisnietis metabatos* sp. nov. (Mephitidae, Carnivora), from Baja California Sur and the role of southern refugia in skunk evolution. *Journal of Systematic Palaeontology*, 12(3):291–302, apr 2014.

- [350] Xiaoming Wang, Richard H Tedford, and Beryl E Taylor. Phylogenetic systematics of the Borophaginae (Carnivora, Canidae). *Bulletin of the American Museum of Natural History*, 243:2–391, 1999.
- [351] David I. Warton, Bill Shipley, and Trevor Hastie. CATS regression - a model-based approach to studying trait-based community assembly. *Methods in Ecology and Evolution*, 6(4):389–398, apr 2015.
- [352] Sumio Watanabe. Asymptotic Equivalence of Bayes Cross Validation and Widely Applicable Information Criterion in Singular Learning Theory. *Journal of Machine Learning Research*, 11:3571–3594, 2010.
- [353] Marjorie G Weber, Catherine E Wagner, Rebecca J Best, Luke J Harmon, and Blake Matthews. Evolution in a Community Context: On Integrating Ecological Interactions and Macroevolution. *Trends in Ecology & Evolution*, xx:1–14, 2017.
- [354] C Williams, C H C Brunton, and S J Carlson. *Treatise on invertebrate paleontology. Part H, Brachiopoda*. Geological Society of America, Boulder, Colorado, 2007.
- [355] Thomas E Williamson and Stephen L Brusatte. New specimens of the rare taeniodont Wortmania (Mammalia: Eutheria) from the San Juan Basin of New Mexico and comments on the phylogeny and functional morphology of "archaic" mammals. *PloS one*, 8(9):e75886, jan 2013.
- [356] Thomas E. Williamson, Stephen L. Brusatte, Thomas D. Carr, Anne Weil, and Barbara R. Standhardt. The phylogeny and evolution of CretaceousPalaeogene metatherians: cladistic analysis and description of new early Palaeocene specimens from the Nacimiento Formation, New Mexico. *Journal of Systematic Palaeontology*, 10(4):625–651, dec 2012.
- [357] Gregory P Wilson, Alistair R Evans, Ian J Corfe, Peter D Smits, Mikael Fortelius, and Jukka Jernvall. Adaptive radiation of multituberculate mammals before the extinction of dinosaurs. *Nature*, 483:457–460, 2012.
- [358] J Bastow Wilson. Guilds, functional types and ecological groups. *Oikos*, 86(3):507–522, 1999.
- [359] AE Wood. The early Tertiary rodents of the family Paramyidae. *Transactions of the American Philosophical Society*, 52(1):3–261, 1962.
- [360] J L Wortman and C Earle. Ancestors of the tapir from the lower Miocene of Dakota. *Bulletin of the American Museum of Natural History*, 5:159–180, 1893.
- [361] J B Yoder, E Clancey, S Des Riches, J M Eastman, L Gentry, W Godsoe, T J Hagey, D Jochimsen, B P Oswald, J Robertson, B A J Sarver, J J Schenk, S F Spear, and L J Harmon. Ecological opportunity and the origin of adaptive radiations. *Journal of Evolutionary Biology*, 23:1581–1596, 2010.

- [362] James C Zachos, Gerald R Dickens, and Richard E Zeebe. An early Cenozoic perspective on greenhouse warming and carbon-cycle dynamics. *Nature*, 451(7176):279–283, jan 2008.
- [363] James C Zachos, M Pagani, L Sloan, E Thomas, and K Billups. Trends, rhythms, and aberrations in global climate 65 Ma to present. *Science*, 292:686–693, 2001.
- [364] SP Zack, TA Penkrot, D W Krause, and M C Maas. A new apheliscine ”condylarth” mammal from the late Paleocene of Montana and Alberta and the phylogeny of ”hyopsodontids”. *Acta Palaeontologica Polonica*, 50:809–830, 2005.
- [365] RJ Zakrzewski. New species of Blanford’s woodrat (Cricetidae) from north-central Kansas. *Journal of Mammalogy*, 72(1):104–109, 1991.
- [366] John-Paul Zonneveld and Gregg F. Gunnell. A new species of cf. *Dilophodon* (Mammalia; Perissodactyla) from the early Bridgerian of southwestern Wyoming. *Journal of Vertebrate Paleontology*, 23(3):652–658, sep 2003.