

Box S1. Selected examples of recent publications in ecology, biogeography, conservation biology, nature management, and sociology and politics with “extinction” in the title.

Ecology

Smith et al. (1993)	Wake and Vredenburg (2008)	Thomas (2017)
Gaston (2008b)	Wiens (2016)	Rejmánek (2018)
Avise et al. (2008)	Roberts et al. (2017)	

Biogeography

Thomas et al. (2004)	Crisp and Cook (2011)	Kouviri and van der Geer (2018)
Gaston (2006, 2008a)	Eiserhardt et al. (2015)	Humphreys et al. (2019)
de Boeck et al. (2008)	Plotnick et al. (2016)	Ledford (2019)
Turvey (2009b)	Ceballos and Ehrlich (2018)	

Conservation biology

MacPhee (1999)	Cronk (2016)	Brook and Alroy (2017)
Barnosky (2008)	Kosnik and Kowalewski (2016)	

Nature management

Gaston (2005)

Sociology and politics

Barnosky (2014)	Dawson (2016)
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- Avise JC, Hubbell SP, Ayala FJ. 2008. In the light of evolution II: Biodiversity and extinction. *Proceedings of the National Academy of Sciences USA*. 105(supl 1):11453-11457.
- Barnosky AD. 2008. Megafauna biomass tradeoff as a driver of Quaternary and future extinctions. *Proceedings of the National Academy of Sciences USA*. 105(suppl 1):11543-11548.
- Barnosky AD. 2014. *Dodging Extinction: Power, Food, Money, and the Future of Life on Earth*. Oakland, CA: University of California Press.
- Brook BW, Alroy J. 2017. Patterns, process, inference and prediction in extinction biology. *Biology Letters*. 13:20160828.
- Ceballos G, Ehrlich PR. 2018. The misunderstood sixth mass extinction. *Science*. 360(6393):1080-1081.
- Crisp MD, Cook LG. 2011. Cenozoic extinctions account for the low diversity of extant gymnosperms compared with angiosperms. *New Phytologist*. 192(4):997-1009.
- Cronk QCB. 2016. Plant extinctions take time. *Science*. 353(6298):446-447.
- Dawson A. 2016. *Extinction. A Radical History*. New York: OR Books.
- de Boeck HJ, Visscher A, Milbau A, Nijs I. 2008. Quantifying the randomness of extinctions. *Ecography*. 31:327-334.
- Eiserhardt WL, Borchsenius F, Plum CM, Ordonez A, Svenning J-C. 2015. Climate-driven extinctions shape the phylogenetic structure of temperate tree floras. *Ecology Letters*. 18(3):263-272.
- Gaston KJ. 2005. Biodiversity and extinction: species and people. *Progress in Physical Geography*. 29(2):239-247.
- Gaston KJ. 2006. Biodiversity and extinction: macroecological patterns and people. *Progress in Physical Geography*. 30(2):258-269.
- Gaston KJ. 2008a. Biodiversity and extinction: the dynamics of geographic range size. *Progress in Physical Geography*. 32(6):678-683.
- Gaston KJ. 2008b. Biodiversity and extinction: the importance of being common. *Progress in Physical Geography*. 32(1):73-79.
- Humphreys AM, Govaerts R, Ficinski SZ, Lughadha EN, Vorontsova MS. 2019. Global dataset shows geography and life form predict modern plant extinction and rediscovery. *Nature Ecology & Evolution*. 10.1038/s41559-41019-40906-41552.

- Kosnik MA, Kowalewski M. 2016. Understanding modern extinctions in marine ecosystems: the role of palaeoecological data. *Biology Letters*. 12:20150951.
- Kouvari M, van der Geer AAE. 2018. Biogeography of extinction: The demise of insular mammals from the Late Pleistocene till today. *Palaeogeography, Palaeoclimatology, Palaeoecology*.10.1016/j.palaeo.2018.1006.1008.
- Ledford H. 2019. World's largest plant survey reveals alarming extinction rate. *Nature*. 570(7760):148-149.
- MacPhee RDE, editor 1999. *Extinctions in Near Time - Causes, Contexts, and Consequences*. New York: Kluwer/Plenum.
- Plotnick RE, Smith FA, Lyons SK. 2016. The fossil record of the sixth extinction. *Ecology Letters*. 19(5):546-553.
- Rejmánek M. 2018. Vascular plant extinctions in California: A critical assessment. *Diversity and Distributions*. 24(1):129-136.
- Roberts DL, Jarić I, Solow AR. 2017. On the functional extinction of the Passenger Pigeon. *Conservation Biology*. 31(5):1192-1195.
- Smith FDM, May RM, Pellow R, Johnson TH, Walter KR. 1993. How much do we know about the current extinction rate? *Trends in Ecology & Evolution*. 8(10):375-378.
- Thomas CD. 2017. *Inheritors of the Earth - How Nature is Thriving in an Age of Extinction*. London: Allen Lane.
- Thomas CD, Cameron A, Green RE, Bakkenes M, Beaumont LJ, Collingham YC, Erasmus BFN, de Siqueira MF, Grainger A, Hannah L et al. 2004. Extinction risk from climate change. *Nature*. 427(6970):145-148.
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- Wake DB, Vredenburg VT. 2008. Are we in the midst of the sixth mass extinction? A view from the world of amphibians. *Proceedings of the National Academy of Sciences USA*. 105(suppl 1):11466-11473.
- Wiens JJ. 2016. Climate-related local extinctions are already widespread among plant and animal species. *PLoS Biology*. 14(12):e20001104.

Box S2. Selected European Pliocene or Early Pleistocene tree genera that are absent (exterminated), relictual and rare, or widespread in Europe today.

Regionally exterminated from Europe in Pliocene or Early Pleistocene

Ailanthus
Amenotaxus (Follieri 2010)
Carya (Orain et al. 2013; Magri et al. 2017)
Cedrus (Boyd 2009; Magri 2012; Magri et al. 2017)
Cephalotaxus (Follieri 2010)
Cryptomeria
Diospyros
Engelhardia (Magri et al. 2017)
Eucommia (Magri et al. 2017)
Gleditsia
Halesia
Liquidambar (Boyd 2009)
Liriodendron
Parrotia (Magri et al. 2017)
Platycarya
Pterocarya (Magri et al. 2017)
Robinia
Sassafras
Sciadopitys (Magri et al. 2017)

Sequoia
Swertia
Taxodium (Follieri 2010),
Taxodium-type (Magri et al. 2017), or *Glyptostrobus* (Boyd 2009)
Torreya (Follieri 2010)
Tsuga (Follieri 2010; Magri et al. 2017)

Relictual and rare in southern Europe today

Aesculus
Celtis
Cercis
Cupressus (Follieri 2010)
Ostrya
Rhododendron
Zelkova (Follieri et al. 1986; Kvavadze and Connor 2005; Boyd 2009; Magri et al. 2017)

Widespread in Europe today

Abies
Acer
Alnus
Betula
Buxus (di Domenico et al. 2012)
Carpinus
Corylus (Magri 2010)
Fagus (Magri et al. 2006)
Fraxinus
Juniperus
Larix
Picea (Magri 2010)
Pinus
Quercus
Taxus
Tilia
Ulmus

Boyd A. 2009. Relict conifers from the mid-Pleistocene of Rhodes, Greece. *Historical Biology*. 21(1-2):1-15.

di Domenico F, Lucchese F, Magri D. 2012. *Buxus* in Europe: Late Quaternary dynamics and modern vulnerability. *Perspectives in Plant Ecology, Evolution, and Systematics*. 14:354-362.

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Follieri M, Magri D, Sadori L. 1986. Late Pleistocene *Zelkova* extinctions in central Italy. *New Phytologist*. 103:369-273.

Kvavadze EV, Connor SE. 2005. *Zelkova carpinifolia* (Pallas) K. Koch in Holocene sediments of Georgia—an indicator of climatic optima. *Review of Palaeobotany and Palynology*. 133(1):69-89.

Magri D. 2010. Persistence of tree taxa in Europe and Quaternary climate changes. *Quaternary International*. 219:145-151.

Magri D. 2012. Quaternary history of *Cedrus* in southern Europe. *Annali di Botanica*. 2:57-66.

Magri D, Di Rita F, Aranbarri J, Fletcher W, González-Sampérez P. 2017. Quaternary disappearance of tree taxa from Southern Europe: Timing and trends. *Quaternary Science Reviews*. 163:23-55.

Magri D, Vendramin GG, Comps B, Dupanloup I, Geburek T, Gömöry D, Latałowa M, Litt T, Paule L, Roure JM et al. 2006. A new scenario for the Quaternary history of European beech populations: palaeobotanical evidence and genetic consequences. *New Phytologist*. 171:199-221.

Orain R, Lebreton V, Ermolli ER, Combourieu-Nebout N, Sémah AM. 2013. *Carya* as marker for tree refuges in southern Italy (Boiano basin) at the Middle Pleistocene. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 369:295-302.

Box S3. References to selected studies that attempt to provide an evidence-based framework for ecological restoration, rewilding, wilding, translocation, and de-extinction.

Restoration

Sutherland (2002)	Burney (2010)	Henne et al. (2015)
Bradshaw (2004)	Gell (2010)	Perring et al. (2015)
Burney and Burney (2007)	Davies (2011)	Corlett (2016)
Lindbladh et al. (2007)	Jiang et al. (2013)	Hilt et al. (2018)
Jackson and Hobbs (2009)	Rotherham (2013)	
Marris (2009)	Tinner et al. (2013)	

Rewilding

Donlan et al. (2005, 2006)	Rubenstein and Rubenstein (2016)	Jepson et al. (2018)
Taylor P (2005, 2011, 2016)		Johnson et al. (2018)
Caro (2007)	Svenning et al. (2016a, 2016b)	Olofsson and Post (2018)
Oliveira-Santos and Fernandez (2010)	Palazón (2017)	Pennisi (2018)
Bekoff (2014)	Thompson et al. (2017)	Pettorelli et al. (2018, 2019)
Monbiot (2014)	Bakker and Svenning (2018)	Torres et al. (2018)
Carey (2016)	Cromsigt et al. (2018)	Willby et al. (2018)
Malhi et al. (2016)	Derham et al. (2018)	Perino et al. (2019)
	Fuhlendorf et al. (2018)	Schweiger et al. (2019)
	Jarvie and Svenning (2018)	

Wilding

Vera (2000)	Oliveira-Santos and Fernandez (2010)	Tree (2018)
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Translocation

Hodder and Bullock (1997)	Schwartz et al. (2012)	Taylor G et al. (2017)
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De-extinction

Anthony (1979)	Seddon (2017)
Shapiro (2015, 2017)	Wood et al. (2017)

Anthony P. 1979. *The Source of Magic*. New York: Ballantine Books.

Bakker ES, Svenning J-C. 2018. Trophic rewilding: impact on ecosystems under global change. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 373(1761):20170432.

Bekoff M. 2014. *Rewilding our Hearts: Building pathways of compassion and coexistence*. Novato, California: New World Library.

Bradshaw RHW. 2004. Past anthropogenic influence on European forests and some possible genetic consequences. *Forest Ecology and Management*. 197(1):203-212.

Burney DA. 2010. *Back to the Future in the Caves of Kaua'i: a scientist's adventures in the dark*. New Haven: Yale University Press.

Burney DA, Burney LP. 2007. Paleoeecology and "inter-situ" restoration on Kaua'i, Hawaii. *Frontiers in Ecology and the Environment*. 5(9):483-490.

Carey J. 2016. Rewilding. *Proceedings of the National Academy of Sciences USA*. 113(4):806-808.

Caro T. 2007. The Pleistocene re-wilding gambit. *Trends in Ecology & Evolution*. 22(6):281-283.

Corlett RT. 2016. Restoration, reintroduction, and rewilding in a changing world. *Trends in Ecology & Evolution*. 31(6):453-462.

Cromsigt JPGM, te Beest M, Kerley GIH, Landman M, le Roux E, Smith FA. 2018. Trophic rewilding as a climate change mitigation strategy? *Philosophical Transactions of the Royal Society B: Biological Sciences*. 373(1761):20170440.

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- Derham TT, Duncan RP, Johnson CN, Jones ME. 2018. Hope and caution: rewilding to mitigate the impacts of biological invasions. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 373(1761):20180127.
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Box S4. References to selected studies of past events (“historical legacies”) that appear to influence present-day ecology or biogeography.

Short-term (<100 years)

Magnuson (1990)	Dalsgaard et al. (2013)	Faurby and Araújo (2018)
Padisák (1992)	Ogle et al. (2015)	Janssen et al. (2018)
Vellend et al. (2000)	Becker and Pollard (2016)	Ryo et al. (2018)
Bossuyt and Hermy (2001)	Hoffman et al. (2017)	Clark et al. (2019)
Bengtsson et al. (2003)	Neumann et al. (2017)	Hughes et al. (2019)
Golinski et al. (2008)	Schweiger and Beierkuhnlein (2017)	
Schaefer (2009)		
Fukami and Nakajima (2011)	Egelkraut et al. (2018)	

Medium-term (100–1000 years)

Foster (1992, 2002)	Foster et al. (2003)	Vellend et al. (2007)
Motzkin et al. (1996, 1999)	Heckenberger et al. (2003, 2007)	Plue et al. (2008)
Delcourt and Delcourt (1997)		Rhemtulla et al. (2009)
Koerner et al. (1997)	Rackham (2003, 2006)	Junqueira et al. (2010)
Wulf (1997)	Lindborg and Eriksson (2004)	Purschke et al. (2014)
Foster and Motzkin (1998)	Turetsky (2004)	Fraterrigo (2016)
Foster et al. (1998)	Vellend (2004)	Johnstone et al. (2016)
Moorhead et al. (1999)	Willis et al. (2004)	Jonason et al. (2016)
Camill and Clark (2000)	Flinn and Vellend (2005)	Levis et al. (2017)
McLachlan et al. (2000)	Graham et al. (2006)	Whitney and Cárdenas (2017)
Bellemare et al. (2002)	Dambrine et al. (2007)	Feckler et al. (2018)
Dupouey et al. (2002)	Glaser (2007)	Perring et al. (2018)
Peterson (2002)	Rowe (2007)	Schweiger et al. (2019)

Long-term (>1000 years)

Davis (1976, 1981a)	Pärtel et al. (2007)	Herzschuh et al. (2016)
Nilsson et al. (1991)	Svenning and Skov (2007a)	Ordonez and Svenning (2016)
Latham and Ricklefs (1993)	Jackson et al. (2009b)	Blonder et al. (2018)
Tzedakis and Bennett (1995)	Booth et al. (2012)	Correll et al. (2018)
Lindbladh (1999)	Kissling et al. (2012)	Douda et al. (2018)
Ricklefs (1999)	Pederson et al. (2014)	Pinto-Ledezma et al. (2018)
Willis and Birks (2006)	Svenning et al. (2015)	Sandel (2019)

Becker MS, Pollard WH. 2016. Sixty-year legacy of human impacts on a high Arctic ecosystem. *Journal of Applied Ecology*. 53(3):876-884.

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Blonder B, Enquist BJ, Graae BJ, Kattge J, Maitner BS, Morueta-Holme N, Ordonez A, Šimová I, Singarayer J, Svenning J-C et al. 2018. Late Quaternary climate legacies in contemporary plant functional composition. *Global Change Biology*. 24(10):4827-4840.

Booth RK, Jackson ST, Sousa VA, Sullivan ME, Minckley TA, Clifford MJ. 2012. Multi-decadal drought and amplified moisture variability drove rapid forest community change in a humid region. *Ecology*. 93(2):219-226.

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Box S5. Selected examples of approaches to studying the possible impacts of future climate change on biodiversity.

Palaeoecology and “lessons from the past”

Bush (2002)	Willis and Bhagwat (2010)	Barnosky et al. (2017)
Willis and Birks (2006)	Willis and MacDonald (2011)	Cuesta et al. (2019)
Botkin et al. (2007)	Nogués-Bravo et al. (2016)	Lovejoy and Hannah (2019)

Ecological modelling

Botkin et al. (2007)	Tovar et al. (2013)	Graae et al. (2018)
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Conservation studies

Willis and Bhagwat (2009)	McGeoch et al. (2013)	Urban et al. (2016)
Araújo et al. (2011)	Watson and Segan (2013)	Pecl et al. (2017)
Groves et al. (2012)	Garcia et al. (2014)	Lovejoy and Hannah (2019)
Gillson et al. (2013)	Urban (2015)	

Ecological or biogeographical studies

Walther et al. (2002)	Moritz and Agudo (2013)	Nadeau et al. (2017)
Nogués-Bravo and Rahbek (2011)	Scheffers et al. (2016)	Lovejoy and Hannah (2019)

Integrated studies

Botkin et al. (2007)	Dawson et al. (2011)	Lovejoy and Hannah (2019)
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Box S6. Different types of non-analogous communities (based on Keith et al. 2009).

Type	Features	Examples
Recombinant communities	“Cities provide habitats for a rich and diverse range of plant and animals, which occur sometimes in unlikely recombinant communities”	Angold et al. (2006)
Invasive communities	Community where each new invader facilitates invasion by another species and so on, resulting in “invasion meltdown”	Sutherland et al. (2008)
Highly modified community	Heavily altered community based on the arriver and leaver concepts in modelling	Masters and Ward (2005)
Emerging community	“An ecosystem whose species composition and relative abundance have not previously occurred within a given biome”	Milton (2003)
Novel ecosystem	An alternative name for an emerging community. Now widely used in conservation biology and management. Also used in palaeoecology and called “no-analogue” assemblages	Jackson and Williams (2004); Hobbs et al. (2006, 2013); Williams and Jackson (2007)

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