

**A Bibliography of Recent Scientific Work
on Population and Biodiversity Conservation**

working paper

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Introduction

Already excessive and still growing human numbers are a leading cause of biodiversity loss in many parts of the world. In researching a paper on this topic last year, we became aware of the large amount of good recent scientific work that has been published on it. In an effort to spur more exploration of this essential topic, we are publishing this annotated bibliography.

We have aimed for comprehensive coverage of peer-reviewed scientific papers published during the past dozen years that deal substantively with the connection between increasing human numbers and decreasing numbers of other organisms. We also include a few books, and select publications from the previous decade which treat this topic. Entries include publication data, a hot link to the source, and a one-sentence description.

In addition to the main listings, we include two addenda: a list of select publications on the connection between population and climate change, and a select list of work on the ethics of biodiversity loss. The recent literature on both topics is large and these addenda only provide an introduction. Nevertheless, we include them as dealing with important adjacent topics that we believe may be of interest.

Readers curious about the main lessons we take from this literature are referred to our publication in *Biological Conservation*, "Overpopulation is a major cause of biodiversity loss and smaller human populations are necessary to preserve what is left." We appreciate any corrections of existing entries and suggestions for additional ones, as well as information about ongoing work in this area. Please send correspondence to philip.cafaro@colostate.edu.

Recent scientific publications on population and biodiversity conservation

Abegão, João. 2019. [Where the Wild Things Were is Where Humans are Now: an Overview](#). Human Ecology 47: 669-679.

The requirements of an expanding human population are strongly linked to wildlife depletion and the increasing difficulties facing biodiversity conservation efforts.

Abell, Robin et al. 2011. [Indicators for Assessing Threats to Freshwater Biodiversity from Humans and Human-Shaped Landscapes](#). In R.P. Cincotta and L.J. Gorenflo (eds.), Human Population: Its Influences on Biological Diversity (Springer), pp. 103-124.

Areas with high human population numbers typically coincide with degraded aquatic ecosystems.

Ahmed, S.E. et al., 2014. [Road networks predict human influence on Amazonian bird communities](#). Proceedings of the Royal Society B Biological Sciences 281: 10.1098/rspb.2014.1742.

Road building leads to significant deleterious effects on birds, in part through encouraging regional population growth.

Albert, James et al. 2021. [Scientists' warning to humanity on the freshwater biodiversity crisis](#). Ambio 50: 85–94.

The rapid rise of human populations and associated food production is increasing pressures on freshwater resources in many regions of the world, driving a rapid loss of freshwater biodiversity.

Attenborough, David. 2011. [Impact of population growth on the planet](#). Lecture to the Royal Society for the Encouragement of Arts, Manufactures and Commerce, London.

More people lead to less wildlife.

Barnosky, Anthony et al. 2013. [Scientific Consensus on Maintaining Humanity's Life Support Systems in the 21st Century: Information for Policy Makers.](#)

Global population growth is driving species extinctions and human over-appropriation of the biosphere; limiting future population growth is key to reversing these trends.

Beebee, Trevor. 2022. [Impacts of Human Population on Wildlife: A British Perspective.](#)

Cambridge University Press.

The reasons usually given for wildlife loss in Britain are real but secondary to a single, primary cause: the attempt to accommodate more people.

Berger, Joel et al. 2020. [Disassembled Food Webs and Messy Projections: Modern Ungulate Communities in the Face of Unabating Human Population Growth.](#) *Frontiers in Ecology and Evolution* 8: 128.

Human population growth has exterminated numerous ungulate and carnivore species and irrevocably changed ecological communities throughout the world.

Boitani, L. and J.D.C. Linnell. 2015. [Bringing large mammals back: large carnivores in Europe.](#) In H. Pereira and L. Navarro (eds.), *Rewilding European Landscapes* (Springer International Publishing, Cham), pp. 67-84.

As rural populations have declined, carnivores have naturally recolonized many former agricultural areas in Europe.

Bradshaw, Corey and Enrico Di Minin. 2019. [Socio-economic predictors of environmental performance among African nations.](#) *Scientific Reports* 9: 9306.

Increasing population density is strongly correlated with greater environmental degradation in Africa, suggesting that reducing population growth is necessary to preserve African biodiversity going forward.

Bradshaw, Corey et al. 2021. [Underestimating the Challenges of Avoiding a Ghastly Future](#). *Frontiers in Conservation Science* 1: 615419.

Excessive human numbers and overconsumption are driving a sixth mass extinction of Earth's biological species.

Brashares, Justin et al. 2002. [Human demography and reserve size predict wildlife extinction in West Africa](#). *Proceedings of the Royal Society B: Biological Sciences* 268: 2473-2478.

Human population and reserve size accounted for 98% of the observed variation in extinction rates between wildlife reserves in West Africa.

Burgess, Neil et al. 2007. [Correlations among species distributions, human density and human infrastructure across the high biodiversity tropical mountains of Africa](#). *Biological Conservation* 134: 164-177.

High rural population densities threaten biodiversity hotspots in Africa.

Cafaro, Philip and Eileen Crist (eds). 2012. [Life on the Brink: Environmentalists Confront Overpopulation](#). University of Georgia Press.

Population policies involve a choice about whether to share the earth with other species or whether to continue to crowd them off the landscape.

Cafaro, Philip and Frank Götmark. 2019. [The potential environmental impacts of EU immigration policy: future population numbers, greenhouse gas emissions and biodiversity preservation](#). *Journal of Population and Sustainability* 4, 71-101.

Population reductions have facilitated major ecological restoration projects in Europe and could help European nations meet their targets for increasing protected area acreage in the future.

Cafaro, Philip et al. 2022. [Overpopulation is a major cause of biodiversity loss and smaller human populations are necessary to preserve what is left](#). *Biological Conservation* 272: 109646.

Population growth is a fundamental driver of biodiversity loss and population decrease facilitates ecological restoration efforts.

Cardillo, Marcel et al. 2004. [Human population density and extinction risk in the world's carnivores](#). PLOS Biology 2: 909-914.

Higher levels of exposure to human populations increase the extinction risk to carnivores.

Ceballos, Gerardo et al. 2015. [Accelerated modern human-induced species losses: Entering the sixth mass extinction](#). Science Advances 1: e1400253.

Avoiding a sixth mass extinction will require rapid, greatly intensified efforts to reduce habitat loss, overexploitation, and climate change—all of which are related to human population size and growth.

Ceballos, Gerardo et al. 2017. [Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines](#). PNAS 114: E6089-E6096.

The ultimate drivers of rapid global biodiversity loss are human overpopulation and overconsumption.

Ceballos, Gerardo et al. 2020. [Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction](#). PNAS 117: 13596-13604.

The acceleration of the extinction crisis is certain because of the still fast growth in human numbers and consumption rates.

Chapron, Guillaume et al. 2014. [Recovery of large carnivores in Europe's modern human-dominated landscapes](#). Science 346: 1517–1519.

As rural populations have declined, carnivores have naturally recolonized many former agricultural areas in Europe.

Cheetah Conservation Fund. 2018. [The importance of human reproductive health and rights for cheetah conservation](#). Margaret Pyke Trust, London.

Limiting human population growth is key to cheetah conservation in Namibia, where more than 90% of cheetahs live outside protected areas.

Cincotta, R.P. and L.J. Gorenflo (eds.). 2011. [Human Population: Its Influences on Biological Diversity](#). Springer.

Human population density has a powerful negative influence on the viability of populations for the vast majority of other species.

Colsaet, A. et al. 2018. [What drives land take and urban land expansion? A systematic review](#). Land Use Policy 79: 339–349.

Population growth is positively correlated with wildlife habitat loss at both national and global levels.

Corlett, R.T. 2016. [The role of rewilding in landscape design for conservation](#). Current Landscape Ecology Reports 1: 127–33.

Rural population decreases have facilitated the creation of new protected areas.

Crist, Eileen. 2019. [Abundant Earth: Toward an Ecological Civilization](#). University of Chicago Press.

Justice and prudence both counsel reducing human numbers to 1 or 2 billion and sharing Earth generously with other species.

Crist, Eileen et al. 2017. [The interaction of human population, food production, and biodiversity protection](#). Science 356: 260–264.

Research suggests that the scale of human population and the current pace of its growth contribute substantially to the loss of biological diversity.

Crist, Eileen et al. 2021. [Protecting half the planet and transforming human systems are complementary goals](#). *Frontiers in Conservation Science* 2: 761292.

To limit biodiversity losses, humanity must greatly expand protected areas, which will necessitate much smaller human populations.

Crist, Eileen et al. 2022. [Scientists' Warning on Population](#). *Science of the Total Environment* 845: 157166.

Reducing the human population is necessary to address the collapse of global biodiversity and ensure long-term human wellbeing.

Cunningham, Caitlin and Karen Beazley. 2018. [Changes in Human Population Density and Protected Areas in Terrestrial Global Biodiversity Hotspots, 1995–2015](#). *Land* 7: 136.

Average human population densities in global biodiversity hotspots increased by 36% between 1995 and 2015, double the global average, threatening conservation goals.

Dasgupta, Partha. 2021. [The Economics of Biodiversity: The Dasgupta Review](#). Abridged version. HM Treasury, London.

Lowering future human numbers can directly reduce demands on the natural world and reduce extinction rates.

Defries, Ruth et al. 2010. [Deforestation driven by urban population growth and agricultural trade in the twenty-first century](#). *Nature Geoscience* 3: 178-182.

Urban population growth is a significant driver of tropical forest loss in Africa, Asia and Latin America.

Deinet, S. et al. 2013. [Wildlife comeback in Europe: The recovery of selected mammal and bird species: final report to Rewilding Europe](#). Zoological Society of London.

Between 1960 and 2010, a 28% decline in rural populations facilitated the recovery of many European mammal and bird species.

DeSilvey, C. and N. Bartolini. 2018. [Where horses run free? Autonomy, temporality and rewilding in the Côa valley, Portugal](#). Transactions of the Institute of British Geographers 44: 94-109.

Creation of new protected areas has been facilitated by rural population decreases.

Diaz, Sandra et al. 2019. [Pervasive human-driven decline of life on Earth points to the need for transformative change](#). Science 366: 1327.

The human impact on life on Earth has increased sharply since the 1970s, driven by the demands of a growing population with rising average per capita incomes.

Dinerstein, Eric et al. 2017. [An ecoregion-based approach to protecting half the terrestrial realm](#). BioScience 67: 534-545.

Current trends in rural population decrease facilitate the increased protected area acreages necessary to preserve global biodiversity.

Dinerstein, Eric et al. 2019. [A global deal for nature: guiding principles, milestones, and targets](#). Science Advances 5: p.eaaw2869.

The success of plans to boost food production while protecting biodiversity will depend on limiting human population growth.

D’Odorico, P. et al. 2018. [The global food-energy-water nexus](#). Reviews of Geophysics 56: 456–531.

Human pressure on global water resources is increasing at alarming rates in response to population growth and changes in diet, leading to biodiversity losses in many parts of the world.

Driscoll, D. et al., 2018. [A biodiversity-crisis hierarchy to evaluate and refine conservation indicators](#). Nature: Ecology & Evolution 2: 775–781.

Human population size and resource consumption per capita are the fundamental drivers of biodiversity loss.

Dumont, E. 2012. [Estimated impact of global population growth on future wilderness extent](#). Earth Systems Dynamics Discussions 3: 433–452.

Wilderness areas around the world are threatened by the environmental impacts of the growing global human population.

Engelman, Robert and David Johnson. 2019. [Removing barriers to family planning, empowering sustainable environmental conservation: A background paper and call for action](#). Margaret Pyke Trust, London.

Conservation organisations can and should build family planning into their efforts to preserve biodiversity.

Engelman, Robert et al. 2016. [Family Planning and Environmental Sustainability: Assessing the Science](#). Worldwatch Institute, Washington, D.C.

Contraceptive availability benefits environmental sustainability, including biodiversity and forest protection.

Estes, Anna et al. 2012. [Land-cover change and human population trends in the greater Serengeti ecosystem from 1984–2003](#). Biological Conservation 147: 255–263.

Agricultural conversion of natural habitats to agriculture was greatest in areas with the highest rates of human population growth.

Estrada, Alejandro et al. 2017. [Impending extinction crisis of the world’s primates: why primates matter](#). Science Advances 3: e1600946.

Human population growth is a major contributor to primate declines around the world, driving increased hunting, deforestation, habitat fragmentation and other direct causes of primate loss.

Fentahun, Tesfahun and Temesgen Gashaw. 2014. [Population Growth and Land Resources Degradation in Bantneka Watershed, Southern Ethiopia](#). Journal of Biology, Agriculture and Healthcare 4: 13–16.

There is a strong correlation between human population growth and deforestation and reductions in wildlife populations.

Figueroa, Fernanda. 2015. [Socioeconomic context of land use and land cover change in Mexican biosphere reserves](#). Environmental Conservation 36: 180-191.

Higher human and cattle populations increased habitat loss in Mexican biosphere reserves.

Foreman, David and Laura Carroll. 2014. [Man Swarm: How Overpopulation is Killing the Wild World](#). Live True Books.

Human overpopulation is the main driver of biodiversity loss and species extinction in the United States and globally.

Gagné, S. et al. 2016. [The effect of human population size on the breeding bird diversity of urban regions](#). Biodiversity Conservation 25: 653–671.

Increasing human population size drives habitat loss, fragmentation and disturbance, and decreases both breeding bird species richness and abundance.

Ganivet, Elias. 2020. [Growth in human population and consumption both need to be addressed to reach an ecologically sustainable future](#). Environment, Development and Sustainability 22: 4979–4998.

Limiting population growth and decreasing per capita consumption are both necessary to preserve global biodiversity.

Gorenflo, L.J. 2011. [Human Demography and Conservation in the Apache Highlands Ecoregion, US-Mexico Borderlands](#). In R.P. Cincotta and L.J. Gorenflo (eds.). Human Population: Its Influences on Biological Diversity (Springer), pp. 153-178.

Beyond a human population density of 10 persons per km², high biodiversity is unlikely in the Apache highlands region.

Gorenflo, L.J. et al. 2011. [Exploring the Association Between People and Deforestation in Madagascar](#). In R.P. Cincotta and L.J. Gorenflo (eds.). Human Population: Its Influences on Biological Diversity (Springer), pp. 197-221.

Human population size is positively correlated with deforestation and species extirpation in Madagascar, although certain activities greatly increase human impacts.

Guerbois, Chloe et al. 2013. [Insights for Integrated Conservation from Attitudes of People toward Protected Areas Near Hwange National Park, Zimbabwe](#). Conservation Biology 27: 844-855.

Migration and rapid population growth into adjacent areas decreased local support for protecting biodiversity in an African national park.

Haberl, Helmut et al. 2014. [Human Appropriation of Net Primary Production: Patterns, Trends, and Planetary Boundaries](#). Annual Review of Environment and Resources 39: 363-391.

Economic growth and population growth result in increasing human appropriation of net primary production, driving biodiversity loss.

Harcourt, A.H. and S.A. Parks. 2003. [Threatened primates experience high human densities: adding an index of threat to the IUCN Red List criteria](#). Biological Conservation 109: 137–149.

Higher human population densities increase the threat of extinction for primates.

Hughes, A. C. 2017. [Understanding the drivers of Southeast Asian biodiversity loss](#). Ecosphere 8: e01624.

While urbanization often is claimed to take pressure off rural areas, it increases deforestation, pollution and the spread of invasive species, hastening biodiversity loss.

Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES). 2019. [Summary for Policymakers. Global Assessment Report on Biodiversity and Ecosystem Services](#). IPBES Secretariat, Bonn, Germany.

Biodiversity loss is underpinned by demographic and economic growth, which have increased in recent decades.

Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) and Intergovernmental Panel on Climate Change (IPCC). 2021. [Co-sponsored Workshop on Biodiversity and Climate Change](#): Scientific Outcome.

Growth of human populations and their increasing wealth forecasts a sharp decline in global biodiversity in the future.

International Union for the Conservation of Nature (IUCN). 2020. [Importance for the conservation of nature of removing barriers to rights-based voluntary family planning. Motion at IUCN World Conservation Congress](#).

Nations should include rights-based voluntary family planning in their national biological strategic action plans to limit the negative the impacts of human population growth on biodiversity.

Keenleyside, C. and G. Tucker. 2010. [Farmland abandonment in the EU: An assessment of trends and prospects](#). World Wildlife Fund and Institute for European Environmental Policy, London.

Europe's rural population decline and its extensive abandonment of less productive farmland have helped restore many formerly rare biological species.

Kolankiewicz, Leon. 2012. [Overpopulation versus biodiversity: how a plethora of people produces a paucity of wildlife](#). In Philip Cafaro and Eileen Crist (eds.), *Life on the Brink: Environmentalists Confront Overpopulation* (University of Georgia Press, Athens), pp. 75-89.

In both tropical and temperate regions, human population increase leads to decreases in native biodiversity.

Kolankiewicz, Leon et al. 2022. [From Sea to Sprawling Sea: Quantifying the Loss of Open Space in America](#). NumbersUSA, Arlington, VA.

Areas in the United States with rapidly growing populations had higher rates of habitat loss than areas with more slowly growing populations.

Kraussman, Fridolin et al. 2013. [Global human appropriation of net primary production doubled in the 20th century](#). PNAS 110: 10324-10329.

Population growth helped drive increased appropriation of global net primary production in the 20th century and will continue to do so during the 21st.

Krishnadas, M. et al. 2018. [Parks protect forest cover in a tropical biodiversity hotspot, but high human population densities can limit success](#). Biological Conservation 223: 147–155.

In India's Western Ghats, the habitat value of protected areas declined precipitously as local human population densities increased.

Laurance, William et al. 2014. [Agricultural expansion and its impacts on tropical nature](#). Trends in Ecology & Evolution 29: 107-116.

Population growth in the tropics threatens to detonate an “agricultural bomb” that extinguishes numerous species.

Laurance, William et al. 2002. [Predictors of deforestation in the Brazilian Amazon](#). Journal of Biogeography 29: 737–748.

Highways and population growth played a critical role in Amazonian forest destruction in the last four decades of the twentieth century.

Lavides, Margarita et al. 2020. [Patterns of Coral-Reef Finfish Species Disappearances Inferred from Fishers' Knowledge in Global Epicentre of Marine Shorefish Diversity](#). PLoS ONE 11: e0155752.

High Filipino population growth is depleting fish stocks and putting huge pressure on coral reefs.

Leverington, Fiona et al. 2010. [Management effectiveness evaluation in protected areas – a global study](#). Second edition. The University of Queensland, Brisbane.

Increased human population density reduces the effectiveness of protected areas in sustaining native biodiversity.

Lidicker, William. 2020. [A Scientist's Warning to humanity on human population growth](#). Global Ecology and Conservation 24: e01232.

Human-caused extinctions have reached an unprecedented rate, thanks in part to unprecedented human population growth.

Liu, Jianguo et al. 1999. [Changes in human population structure: Implications for biodiversity conservation](#). Population and Environment 21: 45-58.

Rapid population growth in Wolong Nature Reserve led to habitat degradation and biodiversity loss.

López-Carr, David and Jason Burgdorfer. 2013. [Deforestation drivers: population, migration, and tropical land use](#). Environment 55: 10.1080/00139157.2013.748385.

Frontier colonization by small holder farmer migrants may be the main proximate cause of deforestation in Latin America, exceeding forest conversion caused by commercial logging and industrial agriculture.

Lopez-Carr, D. and D. Ervin. 2017. [Population-health-environment \(PHE\) synergies? Evidence from USAID-sponsored programs in African and Asian core conservation areas](#). European Journal of Geography 8: 92–108.

Review of population-health-environment programs in eight developing countries found they achieved substantial improvements in maternal and child health and biodiversity conservation.

Lu, Florence and Richard Bilsborrow. 2011. [A Cross-Cultural Analysis of Human Impacts on the Rainforest Environment in Ecuador](#). In R.P. Cincotta and L.J. Gorenflo (eds.), Human Population: Its Influences on Biological Diversity (Springer), pp. 127-151.

In all cases, for all ethnicities, rapidly growing populations and sedentarization ensure that biodiversity loss and other environmental impacts continue to grow.

Maja, Mengistu and Samuel Ayano. 2021. [The Impact of Population Growth on Natural Resources and Farmers' Capacity to Adapt to Climate Change in Low-Income Countries](#). Earth Systems and Environment 5: 271–283.

Addressing rapid population growth is a crucial step in curbing biodiversity loss, particularly in Sub-Saharan Africa.

Marques, A. et al. 2019. [Increasing impacts of land use on biodiversity and carbon sequestration driven by population and economic growth](#). Nature: Ecology & Evolution 3: 628–637.

Between 2000 and 2011, demographic and economic growth decreased global bird diversity, despite a reduction in land-use impacts per unit of GDP.

Matanle, Peter. 2017. [Towards an Asia-Pacific depopulation dividend in the 21st century: regional growth and shrinkage in Japan and New Zealand](#). The Asia-Pacific Journal: Japan Focus 15: 5018.

Rural population decrease in the Asia-Pacific region is creating opportunities to preserve biodiversity and revive traditional cultural activities.

McKee, Jeffrey. 2003. [Sparing Nature—The Conflict between Human Population Growth and Earth's Biodiversity](#). Rutgers University Press.

Every day, there is a net gain of more than 200,000 people on the planet, leading to the extinction of countless plant and animal species.

McKee, Jeffrey. 2009. [Contemporary Mass Extinction and the Human Population Imperative](#). *Journal of Cosmology* 2: 300–308.

The global pattern of biodiversity loss is clearly linked to the growth of humanity's population's size and density, and losses of plant and animal species will continue if this growth continues.

McKee, Jeffrey and Erica Chambers. 2011. [Behavioral Mediators of the Human Population Effect on Global Biodiversity Losses](#). In R.P. Cincotta and L.J. Gorenflo (eds.), *Human Population: Its Influences on Biological Diversity* (Springer), pps. 47-59.

Human population density, agricultural land use and species richness are the best combined predictors of threats to mammal and bird species.

McKee, Jeffrey et al. 2004. [Forecasting Global Biodiversity Threats Associated with Human Population Growth](#). *Biological Conservation* 115: 161–164.

Multiple regression analysis reveals that two predictor variables, human population density and species richness, account for 88% of the variability in threatened bird and mammal species across 114 continental nations.

McKee, Jeffrey et al. 2013. [Human Population Density and Growth Validated as Extinction Threats to Mammal and Bird Species](#). *Human Ecology* 41: 773–778.

Increased human population density increases the risk of extinction for birds and mammals.

McKinney, M. 2001. [Effects of human population, area, and time on non-native plant and fish diversity in the United States](#). *Biological Conservation* 100: 243-252.

Higher human numbers increase the numbers of invasive plant and fish species, through both planned and inadvertent non-native species introductions.

Molotoks, Amy et al. 2018. [Global projections of future cropland expansion to 2050 and direct impacts on biodiversity and carbon storage](#). *Global Change Biology* 24: 5895–5908.

Global population increase threatens biodiversity, by driving habitat loss to increase cropland.

Mora, Camilo. 2014. [Revisiting the Environmental and Socioeconomic Effects of Population Growth: a Fundamental but Fading Issue in Modern Scientific, Public, and Political Circles](#).

Ecology and Society 19: 38.

Although tackling overpopulation will be difficult, continued neglect of this issue will decrease chances for humanity to reverse rapid biodiversity loss.

Mora, Camilo and Peter Sale. 2011. [Ongoing Global Biodiversity Loss and the Need to Move Beyond Protected Areas: A Review of the Technical and Practical Shortcomings of Protected Areas on Land and Sea](#). *Marine Ecology Progress Series* 434: 251–66.

The only scenarios that end ongoing biodiversity loss require concerted efforts to reduce human population growth and consumption.

Morales-Hidalgo, David et al. 2015. [Status and trends in global primary forest, protected areas, and areas designated for conservation of biodiversity from the Global Forest Resources Assessment](#). *Forest Ecology and Management* 352: 68–77.

A global assessment found a 1% increase in national population density and per capita GDP were associated with a 0.2% decrease in forest area.

Navarro, L. 2014. [Rewilding abandoned landscapes in Europe: biodiversity impact and contribution to human well-being](#). Doctoral thesis, Department of Animal Biology, University of Lisbon.

Nations with decreasing populations have opportunities to expand rewilding efforts and transform marginal agricultural lands into more valuable national parks and protected areas.

Navarro, L. and H. Pereira. 2015. [Rewilding abandoned landscapes in Europe.](#) In H. Pereira and L. Navarro (eds.), *Rewilding European Landscapes* (Springer International), pp. 3-23.
Decreasing human populations reduce hunting pressures on European natural areas.

Ngwira, Susan and Teiji Watanabe. 2019. [An analysis of the causes of deforestation in Malawi: a case of Mwazisi.](#) *Land* 8: 10.3390/land8030048.
The expansion of subsistence agriculture to meet the food needs of a burgeoning population has been one of the main causes of deforestation in Malawi.

Noss, Reed et al. 2012. [Bolder thinking for conservation.](#) *Conservation Biology* 26: 1-4.
Accepting continued population growth and economic growth ensures conservationists will make limited headway in stemming extinction.

Olden, Julian et al. 2006. [Forecasting faunal and floral homogenization associated with human population geography in North America.](#) *Biological Conservation* 27: 261-271.
Increased human population size leads to more homogenized natural communities, across all taxonomic groups.

Oueslati, Walid et al. 2015. [Determinants of urban sprawl in European cities.](#) *Urban Studies* 52: 1594-1614.
Increased population size leads to habitat loss in urban areas in Europe.

Pacheco, Luis et al. 2016. [Conservation as the new paradigm for development.](#) In A. Aguirre and R. Sukumar (eds), *Tropical Conservation: Perspectives on Local and Global Priorities* (Oxford University Press), pp. 390–402.
Development planning should include judgements on how many people ecosystems can sustain without degrading ecosystem services and losing species.

Paradis, Emmanuel. 2018. [Nonlinear relationship between biodiversity and human population density: evidence from Southeast Asia](#). *Biodiversity and Conservation* 27: 2699-712.
Human population pressure on biodiversity increased between 1990 and 2000 throughout Southeast Asia.

Parks, S. and A. Harcourt. 2002. [Reserve size, local human density, and mammalian extinctions in US protected areas](#). *Conservation Biology* 16: 800e808.
In the western United States, extirpation rates of large mammals within national parks increased with human population density outside park boundaries.

Pereira, H. and L. Navarro (eds.). 2015. [Rewilding European landscapes](#). Springer International Publishing, Cham.
Biodiversity restoration projects in Europe often depend on population decrease and land abandonment to succeed.

Pereira, Henrique et al. [Global trends in biodiversity and ecosystem services from 1900 to 2050](#). Preprint.
A growing population and global economy have increased human demands for land and resources, causing habitat conversion and loss through a variety of proximate causes.

Perino, Andrea et al. 2019. [Rewilding Complex Systems](#). *Science* 364: 351.
Evacuation of the entire local population from the Chernobyl Radiation and Ecological Biosphere Reserve has led to one of the most successful rewilding experiments in recent history.

Pimm, Stuart. 2014. [The biodiversity of species and their rates of extinction, distribution, and protection](#). *Science* 344: 1246752.
Large human populations and their continued growth are driving global biodiversity loss.

Potapov, Peter et al. 2012. [Quantifying forest cover loss in Democratic Republic of the Congo, 2000–2010, with Landsat ETM+ data](#). Remote Sensing of Environment 122: 106–116.

Within Congo, forest loss is higher in areas with growing human populations, higher human population densities, and greater mining activity.

Prates, Luciano and S. Ivan Perez. 2021. [Late Pleistocene South American megafaunal extinctions associated with rise of Fishtail points and human population](#). Nature

Communications 12: 2175.

Human population increase and associated hunting pressure drove late Pleistocene extinctions in South America.

Pyšek, Petr et al. 2020. [Scientists' warning on invasive alien species](#). Biological Reviews 95: 1511–1534.

Rising human population size is driving biological invasions around the world, reducing overall global biodiversity.

Potapov, P.V. et al. 2012. [Quantifying forest cover loss in Democratic Republic of the Congo, 2000-2010, with Landsat ETM+ data](#). Remote Sensing of Environment 122: 106–116.

In the Democratic Republic of the Congo, forest loss intensity was associated with areas of high population density, including within formally protected areas.

Qiu, C. et al. 2018. [Human pressures on natural reserves in Yunnan province and management implications](#). Scientific Reports 8: 3260.

Reducing human population density and encouraging residents' outmigration can help preserve biodiversity in Yunnan, China.

Radeloff, V. et al., 2015. [Housing growth in and near United States protected areas limits their conservation value](#). PNAS 107: 940–945.

Housing growth poses the main threat to protected areas in the United States, directly linking population growth to biodiversity loss.

Raven, P.H. and D.L. Wagner. 2021. [Agricultural intensification and climate change are rapidly decreasing insect biodiversity](#). PNAS 118: e2002548117.

To limit the mass extinction of invertebrates, a lower human population and sustainable consumption levels will be necessary.

Rees, William. 2023. [The human eco-predicament: Overshoot and the population conundrum](#). Vienna Yearbook of Population Research 21: 1–19.

Increasing human numbers on a finite planet necessarily competitively displaces wild species.

Reid, Walter et al. 2005. [Millennium Ecosystem Assessment: Ecosystems and Human Well-Being: Biodiversity Synthesis](#). World Resources Institute, Washington, D.C.

The growth of agriculture is the primary driver of habitat loss in all human-dominated landscapes, and the primary threat to biodiversity worldwide.

Rewilding Charter Working Group. 2020. [Global Charter for Rewilding the Earth](#). The Ecological Citizen 4 (Suppl A): 6–21.

Nations should enact laws and policies to lower human numbers in order to stem plummeting wildlife populations.

Rewilding Europe. 2021. [Our rewilding areas](#). Nijmegen, Netherlands.

Major ecological restoration sites in Europe correspond closely to areas experiencing declining populations and reduced agricultural activity.

Ripple, William et al. 2015. [Collapse of the world's largest herbivores](#). Science Advances 1: e1400103.

Human population growth drives the habitat loss and overhunting decimating large herbivore populations throughout the world.

Ripple, William et al. 2017. [World scientists' warning to humanity: A second notice](#). *BioScience* 67: 1026–1028.

Rapid population growth is a primary driver of biodiversity loss and other ecological threats.

Robson, L. and F. Rakotozafy. 2015. [The freedom to choose: integrating community-based reproductive health services with locally led marine conservation initiatives in southwest Madagascar](#). *Madagascar Conservation & Development* 10: 6-12.

Through integrating community-based reproductive health services and marine conservation initiatives, more than 800 unintended pregnancies were averted and a community-managed marine protected area was created.

Rust, N. and L. Kehoe. 2017. [A call for conservation scientists to empirically study the effects of human population policies on biodiversity loss](#). *Journal of Population and Sustainability* 1: 53-66.

High human population density and large size are linked with biodiversity loss, so conservation biologists should study the connections between them.

Sánchez-Bayo, Francisco and Kris Wyckhuys. 2019. [Worldwide decline of the entomofauna: A review of its drivers](#). *Biological Conservation* 232: 8–27.

One-third of the world's insect species are threatened with extinction due primarily to population-driven agricultural intensification.

Scharlemann, J. 2005. [The level of threat to restricted-range bird species can be predicted from mapped data on land use and human population](#). *Biological Conservation* 123: 317–326.

Increasing rural populations lead to agricultural habitat conversion and loss of biodiversity.

Schnitzler, A. 2014. [Towards a new European wilderness: embracing unmanaged forest growth and the decolonisation of nature](#). *Landscape & Urban Planning* 126: 74–80.

Accepting depopulation and the spontaneous rewilding of former agricultural lands can help preserve Europe's biodiversity.

Secretariat of the Convention on Biological Diversity. 2020. [Global Biodiversity Outlook 5](#). Montreal.

Unsustainable population growth is helping drive rapid biodiversity loss.

Seto K.C. 2011. [A meta-analysis of global urban land expansion](#). *PLoS One* 6: e23777.

A direct correlation exists between increased population densities and loss of species and natural areas to development.

Seto, K.C. 2012. [Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools](#). *PNAS* 109: 16083–16088.

If current trends in population density continue, by 2030 urban land cover will nearly triple compared to 2000, resulting in considerable losses in key biodiversity hotspots.

Shahabuddin, G. and M. Rao. 2010. [Do community-conserved areas effectively conserve biological diversity? Global insights and the Indian context](#). *Biological Conservation* 143: 2926-2936.

Population growth may undermine biodiversity protection under customary management institutions, while declining populations help preserve stable forest cover.

Shi, Hua et al. 2005. [Integrating Habitat Status, Human Population Pressure, and Protection Status into Biodiversity Conservation Priority Setting](#). *Conservation Biology* 19: 1273-1285.

Areas with growing human populations should be prioritized for protection efforts, since more people increase demand for land and resources and threaten natural habitats.

Shragg, Karen. 2022. [On the wrong track: Why the endangered species act isn't enough](#).
Negative Population Growth.

Population growth undermines legal efforts to protect endangered species.

Sisay, Getahun and Ginjo Gitima. 2020. [Forest cover change in Ethiopia: extent, driving factors, environmental implication and management strategies, systematic review](#). Journal of Resources Development and Management 67: 10.7176/JRDM/67-01.

Forest loss in Ethiopia is closely linked to ongoing population growth.

Smil, Vaclav. 2011. [Harvesting the biosphere: The human impact](#). Population and Development Review 37: 613–636.

Wild vertebrate biomass is vanishingly small, having been largely replaced by human and domesticated animal biomass.

Stanford, C. 2012. [Planet Without Apes](#). Harvard University Press, Cambridge.

Rapid population growth has played an important role in driving Africa's commercial bushmeat trade and the extirpation of chimpanzees and gorillas from large areas.

Sterling, E.J. et al. 2006. [Vietnam: A Natural History](#). Yale University Press, New Haven.

Overhunting, driven partly by rising populations, has led to "empty forest syndrome" throughout Vietnam.

Symes, W. et al., 2016. [Why do we lose protected areas? Factors influencing protected area downgrading, downsizing and degazettement in the tropics and subtropics](#). Global Change Biology 22: 656–665.

Increased human population densities within or near protected areas is an important cause of their being downgraded or downsized, leading to habitat loss and degradation.

Thompson, K. and A. Jones 1999. [Human population density and prediction of local plant extinction in Britain](#). Conservation Biology 13: 185-189.

Increases in human population density increase plant species extinction at the local level.

Tucker, Marlee et al. 2018. [Moving in the Anthropocene: Global reductions in terrestrial mammalian movements](#). Science 359: 466–469.

Increased human population density interferes with feeding, mating and migration of wild mammals.

Vincent, A.C.J. 2008. [Reconciling fisheries with conservation on coral reefs: The world as an onion](#). 4th World Fisheries Congress. Reconciling Fisheries with Conservation volumes I and II 49: 1435-1467.

Unconstrained human demands, whether from overconsumption or overpopulation, threaten to overwhelm coral reef conservation and management efforts.

Visconti, Piero et al. [Future hotspots of terrestrial mammal loss](#). 2011. Philosophical Transactions of the Royal Society B 366: 2693–2702.

Expected growth in human populations and consumption in biodiversity hotspots threatens future mammal loss despite conservation efforts.

Wade, Alisa and David Theobald. 2010. [Residential development encroachment on U.S. protected areas](#). Conservation Biology 24: 151e161.

Population growth-driven housing development is reducing biological connectivity around protected areas in the United States.

Weisman, Alan. 2007. [The World Without Us](#). Thomas Dunne Books.

Areas depopulated by war, nuclear meltdown and other anthropogenic debacles show how quickly wild nature returns when human beings leave.

Weber, H. and J. Sciubba. 2018. [The effect of population growth on the environment: evidence from European regions](#). European Journal of Population 35: 379-402.

Higher population growth rates lead to increased habitat loss at the regional level in Europe.

Whitmee, Sarah et al. 2015. [Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health](#). Lancet 386: 1973–2028.

Population growth is an important driver of deforestation and biodiversity loss, particularly in tropical hotspots.

Williams, John. 2013. [Humans and biodiversity: Population and demographic trends in the hotspots](#). Population and Environment 34: 510–523.

Global biodiversity hotspots have rapidly growing human populations, boding ill for their ability to preserve biodiversity long-term.

Wilson, E.O. 2010. [The diversity of life](#). Harvard University Press, Cambridge.

Population growth drives species extinctions in synergy with other factors in the “HIPPO” causal model of biodiversity loss.

Wilson, E. O. 2016. [Half Earth: Our Planet's Fight for Life](#). WW Norton & Company, New York.

Population growth has driven biodiversity loss in the Anthropocene epoch and ending population growth will be necessary to share Earth generously with other species.

Wittemyer, George et al. 2008. [Accelerated Human Population Growth at Protected Area Edges](#). Science 321: 123-126.

Rates of deforestation are highest around protected areas where human population growth is greatest, linking population growth to habitat loss and fragmentation.

Wood, Alexander et al. (eds.). 2000. [The Root Causes of Biodiversity Loss](#). Earthscan Publications, London.

Increased population density has been a major cause of biodiversity loss in numerous countries on all inhabited continents.

World Wildlife Fund. 2020. [Bringing life to the lower Danube – a real success story for WWF in Ukraine.](#)

Dike removal, species reintroductions and other ecological restoration activities have been facilitated by population decline and agricultural abandonment.

World Wildlife Fund. 2022. [Living Planet Report 2022.](#)

Global vertebrate populations have declined 69% since 1970, driven by increased human numbers and economic activity, particularly the expansion of agriculture.

Wright, Joseph and Helene Muller-Landau. 2006. [The Future of Tropical Forest Species.](#)

Biotropica 38: 287–301.

Remaining forest cover is closely correlated with human population density among countries in both the tropics and the temperate zone.

Yi, Yoonjung and Amaël Borzée. 2021. [Human population and efficient conservation: Are humans playing ostriches and rabbits?](#) *Journal of Asia-Pacific Biodiversity* 14: 144e145.

Current societies need to reject outmoded taboos against discussing overpopulation, which is the main cause of biodiversity loss and other global environmental problems.

Young, Hillary et al. 2016. [Patterns, Causes, and Consequences of Anthropocene Defaunation.](#)

Annual Review of Ecology, Evolution, and Systematics 47: 333–358.

Stabilizing the human population and decreasing overconsumption are essential to halt current rapid decreases in animal populations.

Addendum: Population and climate change

Global climate change is a growing threat to biodiversity. Here is a sampling from the recent scientific literature affirming that addressing population can help limit climate change.

Bongaarts, J. and B. O’Neill. 2018. [Global warming policy: is population left out in the cold?](#) *Science* 361: 650–52.

The potential carbon emissions reductions of reducing global population growth are large, with significant co-benefits for women’s rights and economic development in poorer countries.

Das Gupta, Monica. 2013. [Population, Poverty, and Climate Change](#). Policy research working paper 6631. The World Bank.

Lowering fertility rates in the developing world could greatly aid their climate adaptation efforts, as well as contribute to climate change mitigation.

Dodson, Jenna et al. 2020. [Population growth and climate change: addressing the overlooked threat multiplier](#). *Science of the Total Environment* 748: 141346.

Demographic trends will play a large role in determining the magnitude of climate disruption in the 21st century and how well societies adapt to it.

Hickey, Colin. 2016. [Population engineering and the fight against climate change](#). *Social Theory and Practice* 42: 845–870.

The threats posed by climate change justify policies to reduce human populations, including incentivizing small families.

Intergovernmental Panel on Climate Change (IPCC). 2022. [Climate Change 2022: Mitigation of Climate Change](#). Contribution of Working Group III to the Sixth Assessment Report of the IPCC.

Over the past three decades, population growth and economic growth have been the fundamental drivers of increased greenhouse gas emissions.

Mitchell, R. B. 2012. [Technology is not enough: Climate change, population, affluence, and consumption](#). *The Journal of Environment & Development* 21: 24–27.

To meet the challenge of climate change, humanity will have to address our excessive numbers and economic demands.

O'Neill, Brian et al. 2015. [Plausible reductions in future population growth and implications for the environment](#). *Proceedings of the National Academy of Sciences* 112: E506.

Limiting population growth can play a substantial role in mitigating global climate change.

O'Sullivan, Jane. 2018. [Synergy between population policy, climate adaptation and mitigation](#).

In M. Hossain et al. (eds.), *Pathways to a Sustainable Economy* (Springer International), pp. 103–127.

Voluntary family planning programs could significantly reduce global greenhouse gas emissions and increase the adaptability of poorer nations for the climate change that is coming.

Ripple, William et al. 2020. [World scientists' warning of a climate emergency](#). *Bioscience* 70: 8–12.

Population growth is among the most important drivers of increases in carbon emissions and nations reduce their populations to fight climate change.

Ripple, William et al., 2021. [World scientists' warning of a climate emergency 2021](#). *Bioscience* 71: 894-898.

Ending population growth and gradually reducing the human population by providing voluntary family planning, improving education and supporting women's rights is necessary to limit global climate change.

Spears, D. 2015. [Smaller human population in 2100 could importantly reduce the risk of climate catastrophe](#). *Proceedings of the National Academy of Sciences* 112: E2270.

Limiting population growth can play a substantial role in mitigating global climate change.

Wynes, S. and K. Nicholas. 2017. [The climate mitigation gap: Education and government recommendations miss the most effective individual actions](#). Environmental Research Letters 12: 074024.

By more than an order of magnitude, having fewer children is the most effective action citizens in the developed world can perform to reduce their personal greenhouse gas emissions.

Addendum: The ethics of biodiversity loss

Preserving biodiversity depends on good ethics as well as accurate science. Here are some recent legal and philosophical publications affirming that human beings have a duty to preserve Earth's species.

Borràs, Susana. 2016. [New Transitions from Human Rights to the Environment to the Rights of Nature](#). *Transnational Environmental Law* 5: 113–143.

We must reject legal systems that treat the natural world solely as property to be exploited, rather than as an integral ecological partner with its own rights to exist and thrive.

Bradshaw, Karen. 2018. [Animal Property Rights](#). *University of Colorado Law Review* 89: 809-61.

Securing traditional property rights for wild animals could be an effective response to population growth-driven habitat loss.

Cafaro, Philip. 2022. [Reducing human numbers and the size of our economies is necessary to avoid a mass extinction and share Earth justly with other species](#). *Philosophia* 50: doi 10.1007/s11406-022-00497-w.

The moral case for reducing excessive human numbers rests on duties to avoid exterminating other species or seriously harming future human generations.

Cafaro, Philip and Jane O'Sullivan. 2019. [How should ecological citizens think about immigration?](#) *Ecological Citizen* 3: 85-92.

Sharing Earth justly with other species demands that overpopulated countries, such as the United Kingdom and the United States, reduce current fertility and immigration levels.

Chapron, Guillaume et al. 2019. [A rights revolution for nature: Introduction of legal rights for nature could protect natural systems from destruction](#). *Science* 363: 1392-1393.

Securing legal rights to exist and flourish can level the playing field between people and other species, slowing biodiversity loss.

Donaldson, Sue and Will Kymlicka. 2011. [Zoopolis: A Political Theory of Animal Rights](#). Oxford University Press.

Because wild animals have a right to the habitats they occupy, human beings should not increase their numbers to levels which make securing that habitat impossible.

Hedberg, Trevor. 2020. [The Environmental Impact of Overpopulation](#). Routledge.

If we extend moral consideration to other species, the incentives to reduce our numbers increase significantly.

Pope Francis. 2015. [Laudato Si': On Care for Our Common Home](#). Vatican Press.

If we approach nature with awe and wonder, then we will preserve biodiversity and refuse to turn reality into an object simply to be used and controlled.

Rolston, Holmes III. 2020. [Wonderland Earth in the Anthropocene Epoch](#). In Brian Henning and Zack Walsh (eds), *Climate Change Ethics and the Non-Human World* (Routledge), pp. 196-210.

Humans should right-size our population in order to share Earth fairly with other species.

Staples, Winthrop and Philip Cafaro. 2012. [For a Species Right to Exist](#). In Philip Cafaro and Eileen Crist (eds.), *Life on the Brink: Environmentalists Confront Overpopulation* (University of Georgia Press), pp. 283-300.

Nonhuman species have a right against untimely anthropogenic extinction, grounded in their intrinsic value and their beauty, complexity and unique genealogies.

Washington, Haydn et al. 2018. [Foregrounding ecojustice in conservation](#). *Biological Conservation* 228: 367–374.

Justice demands a fair distribution of Earth's limited habitat among people and nonhuman species, which in turn demands people curb our numbers.

Wienhues, Anna. 2020. [Ecological Justice and the Extinction Crisis: Giving Living Beings Their Due](#). Bristol University Press.

All living beings are morally considerable, hence human numbers and economic demands must be limited as part of a compromise between human and nonhuman demands on the natural world.

