


Anthropocene

Anthropocene is a term that has been used to refer to the period of time during which humanity has become a planetary force of change. It appears in scientific and social discourse, especially with respect to accelerating geophysical and biochemical changes that characterize the 20th and 21st centuries on Earth. Originally a proposal for a new geological epoch following the Holocene, it was rejected as such in 2024 by the International Commission on Stratigraphy (ICS) and the International Union of Geological Sciences (IUGS).^{[2][3][4]}

The term has been used in sophisticated research relating to Earth's water and salt, geology, geomorphology, landscape, limnology, hydrology, ecosystems and climate.^{[5][6]} The effects of human activities on Earth can be seen, for example, in regards to biodiversity loss, and climate change. Various start dates for the Anthropocene have been proposed, ranging from the beginning of the Neolithic Revolution (12,000–15,000 years ago), to as recently as the 1960s. The biologist Eugene F. Stoermer is credited with first coining and using the term *anthropocene* informally in the 1980s; Paul J. Crutzen re-invented and popularized the term.^[7]

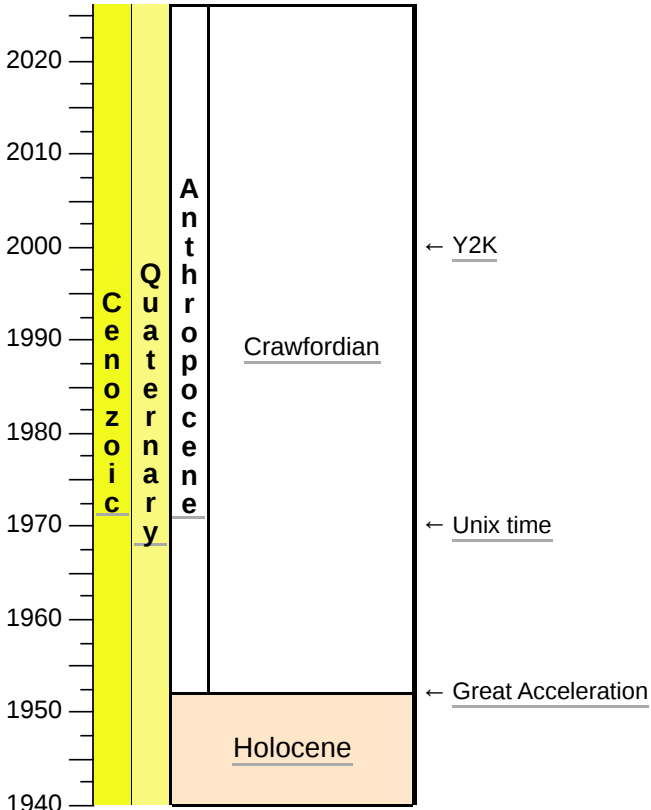
The Anthropocene Working Group (AWG) of the Subcommission on Quaternary Stratigraphy (SQS) of the ICS voted in 2016 to proceed towards a formal golden spike (GSSP) proposal to define an Anthropocene epoch in the geologic

Anthropocene



The invention of electric lights has allowed massive human population centers to be seen from low Earth orbit, demonstrating how humanity's impacts are visible at a global scale.

Chronology



Subdivision of the Anthropocene according to the Anthropocene Working Group, as of 2024.

Vertical axis scale: Gregorian years

Usage information

Celestial body	<u>Earth</u>
-----------------------	--------------

time scale. Later that year, the group presented the proposal to the International Geological Congress.^[8]

In 2019, the AWG voted in favour of submitting a formal proposal to the ICS by 2021.^[9] The proposal located potential stratigraphic markers to the mid-20th century.^{[10][9][11]} This time period coincides with the start of the Great Acceleration, a post-World War II time period during which global population growth, economic growth, pollution and exploitation of natural resources have all increased at a dramatic rate.^[12] The Atomic Age also started around the mid-20th century, when the risks of nuclear wars, nuclear terrorism, and nuclear accidents increased.

Regional usage	Proposed but rejected subdivision of the <u>Quaternary Period</u>
Time scale(s) used	ICS Time Scale
	Definition
Chronological unit	<u>Epoch</u>
Stratigraphic unit	<u>Series</u>
First proposed by	<u>Anthropocene Working Group</u>
Lower boundary definition	<u>Spike in levels of plutonium from hydrogen bomb tests (1952)</u>
Lower boundary GSSP	<u>Crawford Lake, Ontario, Canada</u> <u>43°28'05"N 79°56'55"W</u> ^[1]
Upper boundary definition	<u>Present day</u>
Upper boundary GSSP	N/A
Upper GSSP ratified	N/A

Twelve candidate sites were selected for the GSSP; the sediments of Crawford Lake (Halton Region), Canada were finally proposed, in 2023, to mark the lower boundary of the Anthropocene, starting with the Crawfordian stage/age in 1950.^{[13][14]}

In 2024, after 15 years of deliberation, the Anthropocene Epoch proposal of the AWG was voted down by a wide margin by the SQS, owing largely to its shallow sedimentary record and extremely recent proposed start date.^{[15][16]} The ICS and the IUGS later formally confirmed, by a near unanimous vote, the rejection of the AWG's Anthropocene Epoch proposal for inclusion in the Geologic Time Scale.^{[2][3][4]} The IUGS statement on the rejection concluded: "Despite its rejection as a formal unit of the Geologic Time Scale, Anthropocene will nevertheless continue to be used not only by Earth and environmental scientists, but also by social scientists, politicians and economists, as well as by the public at large. It will remain an invaluable descriptor of human impact on the Earth system."^[4]

Development of the concept

As early as 1873, the Italian geologist Antonio Stoppani acknowledged the increasing power and effect of humanity on the Earth's systems and referred to an 'anthropozoic era'.^[17] From 1877 onward, the term 'Psychozoic' was used by geologists such as Joseph LeConte and Johannes Herman Frederik Umbgrove.^{[18][19]}

An early concept for the Anthropocene was the Noosphere by Vladimir Vernadsky, who in 1938 wrote of "scientific thought as a geological force".^[21] Scientists in the Soviet Union appear to have used the term *Anthropocene* as early as the 1960s to refer to the Quaternary, the most recent geological period.^[22] Ecologist Eugene F. Stoermer subsequently used *Anthropocene* with a different sense in the 1980s.^{[23][24]}

and the term was widely popularised in 2000 by atmospheric chemist Paul J. Crutzen,^{[7][25]} who regarded the influence of human behavior on Earth's atmosphere in recent centuries as so significant as to constitute a new geological epoch.^{[26]:21[27]}

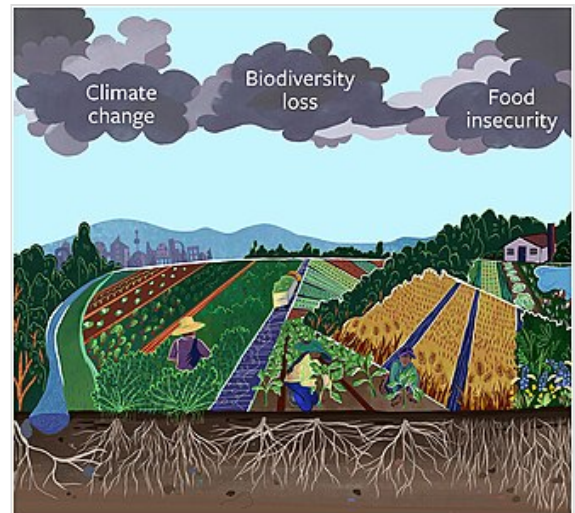
The term *Anthropocene* is informally used in scientific contexts.^[29] The Geological Society of America entitled its 2011 annual meeting: *Archean to Anthropocene: The past is the key to the future.*^[30] The new epoch has no agreed start-date, but one proposal, based on atmospheric evidence, is to fix the start with the Industrial Revolution c.1780, with the invention of the steam engine.^{[31][32]} Other scientists link the new term to earlier events, such as the rise of agriculture and the Neolithic Revolution (around 12,000 years BP).

Evidence of relative human impact – such as the growing human influence on land use, ecosystems, biodiversity, and species extinction – is substantial; scientists think that human impact has significantly changed (or halted) the growth of biodiversity.^{[33][34][35][36]} Those arguing for earlier dates posit that the proposed Anthropocene may have begun as early as 14,000–15,000 years BP, based on geologic evidence; this has led other scientists to suggest that "the onset of the Anthropocene should be extended back many thousand years",^{[37]:1} this would make the Anthropocene essentially synonymous with the current term, *Holocene*.

Anthropocene Working Group

In 2008, the Stratigraphy Commission of the Geological Society of London considered a proposal to make the Anthropocene a formal unit of geological epoch divisions.^{[6][31]} A majority of the commission decided the proposal had merit and should be examined further. Independent working groups of scientists from various geological societies began to determine whether the Anthropocene will be formally accepted into the Geological Time Scale.^[38]

In January 2015, 26 of the 38 members of the International Anthropocene Working Group published a paper suggesting the Trinity test on 16 July 1945 as the starting point of the proposed new epoch.^[39] However, a significant minority supported one of several alternative dates.^[39] A March 2015 report suggested either 1610 or 1964 as the beginning of the Anthropocene.^[40] Other scholars pointed to the diachronous character of the physical strata of the Anthropocene, arguing that onset and impact are spread out over time, not reducible to a single instant or date of start.^[41]



The Anthropocene is characterized by human impacts on their environment, with ramifications for variables such as climate change, biodiversity loss, and global food insecurity.^[20]

The pressures we exert on the planet have become so great that scientists are considering whether the Earth has entered an entirely new geological epoch: the Anthropocene, or the age of humans. It means that we are the first people to live in an age defined by human choice, in which the dominant risk to our survival is ourselves.

—Achim Steiner, UNDP Administrator^[28]

A January 2016 report on the climatic, biological, and geochemical signatures of human activity in sediments and ice cores suggested the era since the mid-20th century should be recognised as a geological epoch distinct from the Holocene.^[42]

The Anthropocene Working Group met in April 2016 to consolidate evidence supporting the argument for the *Anthropocene* as a true geologic epoch.^[43] Evidence was evaluated and the group voted to recommend *Anthropocene* as the new geological epoch in August 2016.^[8]

In April 2019, the Anthropocene Working Group (AWG) announced that they would vote on a formal proposal to the International Commission on Stratigraphy, to continue the process started at the 2016 meeting.^[11] In May 2019, 29 members of the 34 person AWG panel voted in favour of an official proposal to be made by 2021. The AWG also voted with 29 votes in favour of a starting date in the mid 20th century. Ten candidate sites for a Global boundary Stratotype Section and Point have been identified, one of which will be chosen to be included in the final proposal.^{[9][10]} Possible markers include microplastics, heavy metals, or radioactive nuclei left by tests from thermonuclear weapons.^[44]

In November 2021, an alternative proposal that the Anthropocene is a geological event, not an epoch, was published^{[45][46]} and later expanded in 2022.^[47] This challenged the assumption underlying the case for the Anthropocene epoch – the idea that it is possible to accurately assign a precise date of start to highly diachronous processes of human-influenced Earth system change. The argument indicated that finding a single GSSP would be impractical, given human-induced changes in the Earth system occurred at different periods, in different places, and spread under different rates. Under this model, the Anthropocene would have many events marking human-induced impacts on the planet, including the mass extinction of large vertebrates, the development of early farming, land clearance in the Americas, global-scale industrial transformation during the Industrial Revolution, and the start of the Atomic Age. The authors are members of the AWG who had voted against the official proposal of a starting date in the mid-20th century, and sought to reconcile some of the previous models (including Ruddiman and Maslin proposals). They cited Crutzen's original concept,^[48] arguing that the Anthropocene is much better and more usefully conceived of as an unfolding geological event, like other major transformations in Earth's history such as the Great Oxidation Event.

In July 2023, the AWG chose Crawford Lake in Ontario, Canada as a site representing the beginning of the proposed new epoch. The sediment in that lake shows a spike in levels of plutonium from hydrogen bomb tests, a key marker the group chose to place the start of the Anthropocene in the 1950s, along with other elevated markers including carbon particles and nitrates from the burning of fossil fuels and widespread application of chemical fertilizers respectively. Had it been approved, the official declaration of the new Anthropocene epoch would have taken place in August 2024,^[49] and its first age may have been named **Crawfordian** after the lake.^[50]



The Trinity test in July 1945 has been proposed as the start of the Anthropocene.

Rejection in 2024 vote by IUGS

In March 2024, an internal vote was held by the IUGS: After nearly 15 years of debate, the proposal to ratify the Anthropocene had been defeated by a 12-to-4 margin, with 2 abstentions.^[16] These results were not out of a dismissal of human impact on the planet, but rather an inability to constrain the Anthropocene in a geological context. This is because the widely-adopted 1950 start date was found to be prone to recency bias. It also overshadowed earlier examples of human impacts, many of which happened in different parts of the world at different times. Although the proposal could be raised again, this would require the entire process of debate to start from the beginning.^[15] The results of the vote were officially confirmed by the IUGS and upheld as definitive later that month.^[16]

Proposed starting point

Industrial Revolution

Crutzen proposed the Industrial Revolution as the start of Anthropocene.^[17] Lovelock proposes that the Anthropocene began with the first application of the Newcomen steam engine in 1712.^[51] The Intergovernmental Panel on Climate Change takes the pre-industrial era (chosen as the year 1750) as the baseline related to changes in long-lived, well mixed greenhouse gases.^[52] Although it is apparent that the Industrial Revolution ushered in an unprecedented global human impact on the planet,^[53] much of Earth's landscape already had been profoundly modified by human activities.^[54] The human impact on Earth has grown progressively, with few substantial slowdowns. A 2024 scientific perspective paper authored by a group of scientists led by William J. Ripple proposed the start of the Anthropocene around 1850, stating it is a "compelling choice ... from a population, fossil fuel, greenhouse gasses, temperature, and land use perspective."^[55]

Mid-20th century (Great Acceleration)

In May 2019 the twenty-nine members of the Anthropocene Working Group (AWG) proposed a start date for the Epoch in the mid-20th century, as that period saw "a rapidly rising human population accelerated the pace of industrial production, the use of agricultural chemicals and other human activities. At the same time, the first atomic-bomb blasts littered the globe with radioactive debris that became embedded in sediments and glacial ice, becoming part of the geologic record." The official start-dates, according to the panel, would coincide with either the radionuclides released into the atmosphere from bomb detonations in 1945, or with the Limited Nuclear Test Ban Treaty of 1963.^[9]

First atomic bomb (1945)

The peak in radionuclides fallout consequential to atomic bomb testing during the 1950s is another possible date for the beginning of the Anthropocene (the detonation of the first atomic bomb in 1945 or the Partial Nuclear Test Ban Treaty in 1963).^[9]

Minimum atmospheric methane concentration

On 19 June 2025, Vincent Gauci proposed that Anthropocene began in 1592. Ice core records had shown a minimum atmospheric methane concentration at that time.^[56]

Etymology

The name *Anthropocene* is a combination of *anthropo-* from the Ancient Greek ἄνθρωπος (*ánthros*) meaning 'human' and *-cene* from καινός (*kainós*) meaning 'new' or 'recent'.^{[57][58]}

Nature of human effects

Biodiversity loss

The human impact on biodiversity forms one of the primary attributes of the Anthropocene.^[59] Humankind has entered what is sometimes called the Earth's sixth major extinction.^{[60][61][62][63][64]} Most experts agree that human activities have accelerated the rate of species extinction.^{[35][65]} The exact rate remains controversial – perhaps 100 to 1000 times the normal background rate of extinction.^{[66][67]}

Anthropogenic extinctions started as humans migrated out of Africa over 60,000 years ago.^[68] Increases in global rates of extinction have been elevated above background rates since at least 1500, and appear to have accelerated in the 19th century and further since.^[5] Rapid economic growth is considered a primary driver of the contemporary displacement and eradication of other species.^[69]

According to the 2021 *Economics of Biodiversity* review, written by Partha Dasgupta and published by the UK government, "biodiversity is declining faster than at any time in human history."^{[70][71]} A 2022 scientific review published in *Biological Reviews* confirms that an anthropogenic sixth mass extinction event is currently underway.^{[72][73]} A 2022 study published in *Frontiers in Ecology and the Environment*, which surveyed more than 3,000 experts, states that the extinction crisis could be worse than previously thought, and estimates that roughly 30% of species "have been globally threatened or driven extinct since the year 1500."^{[74][75]} According to a 2023 study published in *Biological Reviews* some 48% of 70,000 monitored species are experiencing population declines from human activity, whereas only 3% have increasing populations.^{[76][77][78]}

Biodiversity loss happens when species disappear completely from Earth (extinction) or when there is a decrease or disappearance of species in a specific area. Biodiversity loss means that there is a reduction in biological diversity in a given area. The decrease can be temporary or permanent.^[80] It is temporary if the damage that led to the loss is reversible in time, for example through ecological restoration.^[80] ^[81]If this is not possible, then the decrease is permanent. The cause of most of the biodiversity loss is, generally speaking, human activities that push the planetary boundaries too far.^{[79][82][83]} These activities include habitat destruction^[84] (for example deforestation) and land use intensification (for example monoculture farming).^{[85][86]} Further problem areas are air and water pollution (including nutrient pollution), over-exploitation, invasive species^[87] and climate change.^[84]

Many scientists, along with the *Global Assessment Report on Biodiversity and Ecosystem Services*, say that the main reason for biodiversity loss is a growing human population because this leads to human overpopulation and excessive consumption.^{[88][89][90][91][92]} Others disagree, saying that loss of habitat is

caused mainly by "the growth of commodities for export" and that population has very little to do with overall consumption. More important are wealth disparities between and within countries.^[93] In any case, all contemporary biodiversity loss has been attributed to human activities.^[94]

Climate change is another threat to global biodiversity.^{[95][96]} For example, coral reefs—which are biodiversity hotspots—will be lost by the year 2100 if global warming continues at the current rate.^{[97][98]} Additionally, the change of temperatures are likely to increase fire activity driving events such as forest fires.^[99] Still, it is the general habitat destruction (often for expansion of agriculture)^[100], not climate change, that is currently the bigger driver of biodiversity loss.^{[101][102]} Invasive species and other disturbances have become more common in forests in the last several decades. These tend to be directly or indirectly connected to climate change and can cause a deterioration of forest ecosystems.^{[103][104]}

Biogeography and nocturnality

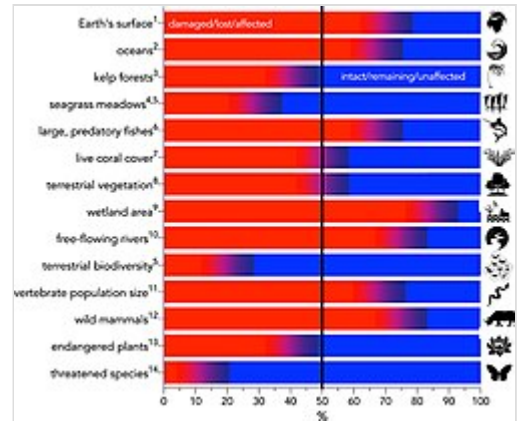
Studies of urban evolution give an indication of how species may respond to stressors such as temperature change and toxicity. Species display varying abilities to respond to altered environments through both phenotypic plasticity and genetic evolution.^{[105][106][107]} Researchers have documented the movement of many species into regions formerly too cold for them, often at rates faster than initially expected.^[108]

Permanent changes in the distribution of organisms from human influence will become identifiable in the geologic record. This has occurred in part as a result of changing climate, but also in response to farming and fishing, and to the accidental introduction of non-native species to new areas through global travel.^[5] The ecosystem of the entire Black Sea may have changed during the last 2000 years as a result of nutrient and silica input from eroding deforested lands along the Danube River.^{[109][110]}

Researchers have found that the growth of the human population and expansion of human activity has resulted in many species of animals that are normally active during the day, such as elephants, tigers and boars, becoming nocturnal to avoid contact with humans, who are largely diurnal.^{[111][110]}

Climate change

One geological symptom resulting from human activity is increasing atmospheric carbon dioxide (CO₂) content. This signal in the Earth's climate system is especially significant because it is occurring much faster,^[112] and to a greater extent, than previously. Most of this increase is due to the combustion of fossil fuels such as coal, oil, and gas.



Summary of major environmental-change categories that cause biodiversity loss. The data is expressed as a percentage of human-driven change (in red) relative to baseline (blue), as of 2021. Red indicates the percentage of the category that is damaged, lost, or otherwise affected, whereas blue indicates the percentage that is intact, remaining, or otherwise unaffected.^[79]

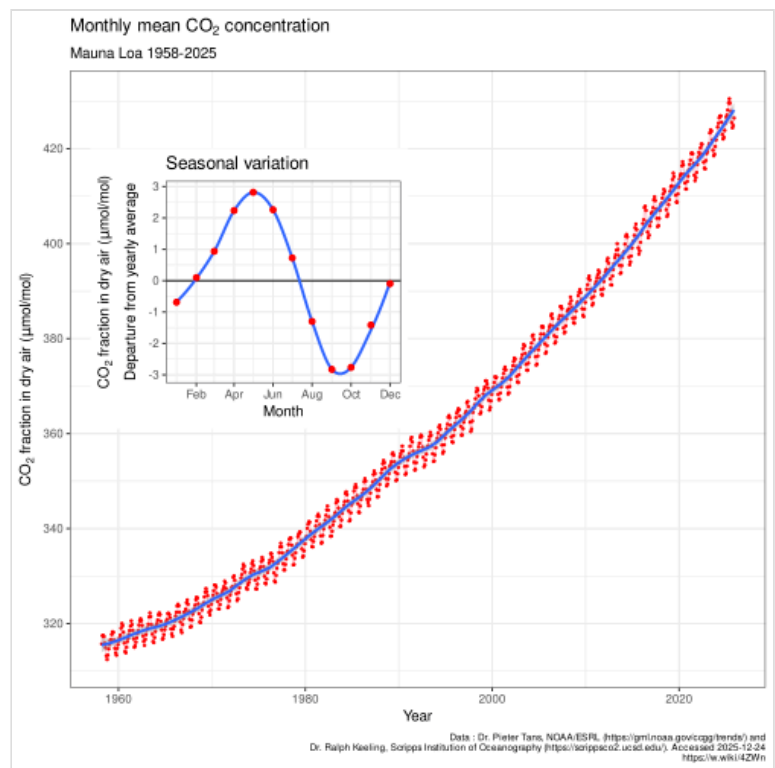
In the atmosphere of Earth, carbon dioxide (CO₂) is a trace gas that plays an integral part in the greenhouse effect, carbon cycle, photosynthesis, and oceanic carbon cycle. It is one of three main greenhouse gases in the atmosphere of Earth. In 2024, the concentration of carbon dioxide in the atmosphere reached 430 ppm or 0.0430% (on a molar basis), representing a mass of 3364 gigatonnes.^[113] This is an increase of 54% since the start of the Industrial Revolution, up from 280 ppm during the 10,000 years prior to the mid-18th century.^{[114][115][116]} The increase is due to human activity.^[117]

Effects of climate change are well documented and growing for Earth's natural environment and human societies. Changes to the climate system include an overall warming trend, changes to precipitation patterns, and more extreme weather. As the climate changes it impacts the natural environment with effects such as more intense forest fires, thawing permafrost, and desertification. These changes impact ecosystems and societies, and can become irreversible once tipping points are crossed. Climate activists are engaged in a range of activities around the world that seek to ameliorate these issues or prevent them from happening.^[118]

The effects of climate change vary in timing and location. Up until now the Arctic has warmed faster than most other regions due to climate change feedbacks.^[119] Surface air temperatures over land have also increased at about twice the rate they do over the ocean, causing intense heat waves. These temperatures would stabilize if greenhouse gas emissions were brought under control. Ice sheets and oceans absorb the vast majority of excess heat in the atmosphere, delaying effects there but causing them to accelerate and then continue after surface temperatures stabilize. Sea level rise is a particular long term concern as a result. The effects of ocean warming also include marine heatwaves, ocean stratification, deoxygenation, and changes to ocean currents.^[120]¹⁰ The ocean is also acidifying as it absorbs carbon dioxide from the atmosphere.^[121]

Geomorphology

Changes in drainage patterns traceable to human activity will persist over geologic time in large parts of the continents where the geologic regime is erosional. This involves, for example, the paths of roads and highways defined by their grading and drainage control. Direct changes to the form of the Earth's surface by human activities (quarrying and landscaping, for example) also record human impacts.



Atmospheric CO₂ concentration measured at Mauna Loa Observatory in Hawaii from 1958 to 2023 (also called the Keeling Curve). The rise in CO₂ over that time period is clearly visible. The concentration is expressed as µmole per mole, or ppm.



Some climate change effects: wildfire caused by heat and dryness, bleached coral caused by ocean acidification and heating, environmental migration caused by desertification, and coastal flooding caused by storms and sea level rise.

It has been suggested that the deposition of calthemite formations exemplify a natural process which has not previously occurred prior to the human modification of the Earth's surface, and which therefore represents a unique process of the Anthropocene.^[122] Calthemite is a secondary deposit, derived from concrete, lime, mortar or other calcareous material *outside the cave environment*.^[123] Calthemites grow on or under man-made structures (including mines and tunnels) and mimic the shapes and forms of cave speleothems, such as stalactites, stalagmites, flowstone *etc.*

Stratigraphy

Sedimentological record

Human activities, including deforestation and road construction, are believed to have elevated average total sediment fluxes across the Earth's surface.^[5] However, construction of dams on many rivers around the world means the rates of sediment deposition in any given place do not always appear to increase in the Anthropocene. For instance, many river deltas around the world are actually currently starved of sediment by such dams, and are subsiding and failing to keep up with sea level rise, rather than growing.^{[5][124]}

Fossil record

Increases in erosion due to farming and other operations will be reflected by changes in sediment composition and increases in deposition rates elsewhere. In land areas with a depositional regime, engineered structures will tend to be buried and preserved, along with litter and debris. Litter and debris thrown from boats or carried by rivers and creeks will accumulate in the marine environment, particularly in coastal areas, but also in mid-ocean garbage patches. Such human-created artifacts preserved in stratigraphy are known as technofossils.^{[5][125]}

Changes in biodiversity will also be reflected in the fossil record, as will species introductions. An example cited is the domestic chicken, originally the red junglefowl *Gallus gallus*, native to south-east Asia but has since become the world's most common bird through human breeding and consumption, with over 60 billion consumed annually and whose bones would become fossilised in landfill sites.^[126] Hence, landfills are important resources to find "technofossils".^[127]

Trace elements

In terms of trace elements, there are a range of distinct signatures left by modern societies. For example, in the Upper Fremont Glacier in Wyoming, there is a layer of chlorine present in ice cores from 1960's atomic weapon testing programs, as well as a layer of mercury associated with coal plants in the 1980s.^{[128][129][130]}

From the late 1940s, nuclear tests have led to local nuclear fallout and severe contamination of test sites both on land and in the surrounding marine environment. Some of the radionuclides that were released during the tests are ^{137}Cs , ^{90}Sr , ^{239}Pu , ^{240}Pu , ^{241}Am , and ^{131}I . These have been found to have had significant impact on the environment and on human beings. In particular, ^{137}Cs and ^{90}Sr have been found to have been released into the marine environment and led to bioaccumulation over a period through food chain cycles. The carbon isotope ^{14}C , commonly released during nuclear tests, has also been found to be integrated into the atmospheric CO_2 , and infiltrating the biosphere, through ocean-atmosphere gas exchange. Increase in thyroid cancer rates around the world is also surmised to be correlated with increasing proportions of the ^{131}I radionuclide.^[131]

The highest global concentration of radionuclides was estimated to have been in 1965, one of the dates which has been proposed as a possible benchmark for the start of the formally defined Anthropocene.^[132]

Human burning of fossil fuels has also left distinctly elevated concentrations of black carbon, inorganic ash, and spherical carbonaceous particles in recent sediments across the world. Concentrations of these components increases markedly and almost simultaneously around the world beginning around 1950.^[5]

Anthropocene markers

A marker that accounts for a substantial global impact of humans on the total environment, comparable in scale to those associated with significant perturbations of the geological past, is needed in place of minor changes in atmosphere composition.^{[133][134]} A range of markers characterizing the period have been identified, such as silicone or aluminium, but most prominently plastic, with plastic, reminiscent of archaeological ages like the Iron Age, marking an archaeological plastic age or the anthropocene even as a geological **plastic epoch**.^[135]

A useful candidate for holding markers in the geologic time record is the pedosphere. Soils retain information about their climatic and geochemical history with features lasting for centuries or millennia.^[136] Human activity is now firmly established as the sixth factor of soil formation.^[137] Humanity affects pedogenesis directly by, for example, land levelling, trenching and embankment building, landscape-scale control of fire by early humans, organic matter enrichment from additions of manure or other waste, organic matter impoverishment due to continued cultivation and compaction from overgrazing. Human activity also affects pedogenesis indirectly by drift of eroded materials or pollutants.



Twentieth-century technofossils in inundated landfill deposits at East Tilbury on the River Thames estuary

Anthropogenic soils are those markedly affected by human activities, such as repeated ploughing, the addition of fertilisers, contamination, sealing, or enrichment with artefacts (in the World Reference Base for Soil Resources they are classified as Anthrosols and Technosols). An example from archaeology would be dark earth phenomena when long-term human habitation enriches^[138] the soil with black carbon.

Anthropogenic soils are recalcitrant repositories of artefacts and properties that testify to the dominance of the human impact, and hence appear to be reliable markers for the Anthropocene. Some anthropogenic soils may be viewed as the 'golden spikes' of geologists (Global Boundary Stratotype Section and Point), which are locations where there are strata successions with clear evidences of a worldwide event, including the appearance of distinctive fossils.^[139] Drilling for fossil fuels has also created holes and tubes which are expected to be detectable for millions of years.^[140] The astrobiologist David Grinspoon has proposed that the site of the Apollo 11 Lunar landing, with the disturbances and artifacts that are so uniquely characteristic of our species' technological activity and which will survive over geological time spans could be considered as the 'golden spike' of the Anthropocene.^[141]

An October 2020 study coordinated by University of Colorado at Boulder found that distinct physical, chemical and biological changes to Earth's rock layers began around the year 1950. The research revealed that since about 1950, humans have doubled the amount of fixed nitrogen on the planet through industrial production for agriculture, created a hole in the ozone layer through the industrial scale release of chlorofluorocarbons (CFCs), released enough greenhouse gasses from fossil fuels to cause planetary level climate change, created tens of thousands of synthetic mineral-like compounds that do not naturally occur on Earth, and caused almost one-fifth of river sediment worldwide to no longer reach the ocean due to dams, reservoirs and diversions. Humans have produced so many millions of tons of plastic each year since the early 1950s that microplastics are "forming a near-ubiquitous and unambiguous marker of Anthropocene".^{[142][143]} The study highlights a strong correlation between global human population size and growth, global productivity and global energy use and that the "extraordinary outburst of consumption and productivity demonstrates how the Earth System has departed from its Holocene state since c. 1950 CE, forcing abrupt physical, chemical and biological changes to the Earth's stratigraphic record that can be used to justify the proposal for naming a new epoch—the Anthropocene."^[143]

A December 2020 study published in Nature found that the total anthropogenic mass, or human-made materials, outweighs all the biomass on earth, and highlighted that "this quantification of the human enterprise gives a mass-based quantitative and symbolic characterization of the human-induced epoch of the Anthropocene."^{[144][145]}

Debates

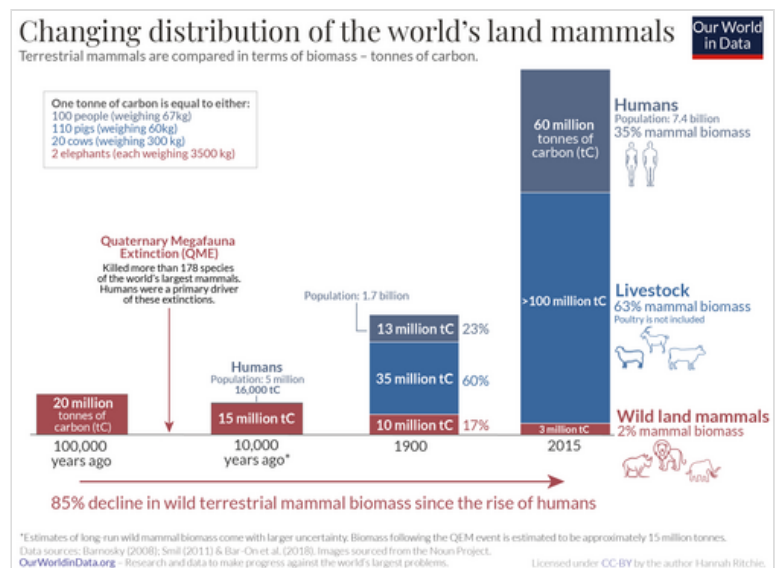
Although the validity of *Anthropocene* as a scientific term remains disputed, its underlying premise, i.e., that humans have become a geological force, or rather, the dominant force shaping the Earth's climate, has found traction among academics and the public. In an opinion piece for *Philosophical Transactions of the Royal Society B*, Rodolfo Dirzo, Gerardo Ceballos, and Paul R. Ehrlich write that the term is "increasingly penetrating the lexicon of not only the academic socio-sphere, but also society more generally", and is now included as an entry in the Oxford English Dictionary.^[147] The University of Cambridge, as another example, offers a degree in Anthropocene Studies.^[148] In the public sphere, the term *Anthropocene* has become increasingly ubiquitous in activist, pundit, and political discourses. Some

who are critical of the term *Anthropocene* nevertheless concede that "For all its problems, [it] carries power."^[149] The popularity and currency of the word has led scholars to label the term a "charismatic meta-category"^[150] or "charismatic mega-concept."^[151] The term, regardless, has been subject to a variety of criticisms from social scientists, philosophers, Indigenous scholars, and others.

The anthropologist John Hartigan has argued that due to its status as a charismatic meta-category, the term *Anthropocene* marginalizes competing, but less visible, concepts such as that of "multispecies."^[152] The more salient charge is that the ready acceptance of *Anthropocene* is due to its conceptual proximity to the status quo – that is, to notions of human individuality and centrality.

Other scholars appreciate the way in which the term *Anthropocene* recognizes humanity as a geological force, but take issue with the indiscriminate way in which it does. Not all humans are equally responsible for the climate crisis. To that end, scholars such as the feminist theorist Donna Haraway and sociologist Jason Moore, have suggested naming the Epoch instead as the *Capitalocene*.^{[153][154][155]} Such implies capitalism as the fundamental reason for the ecological crisis, rather than just humans in general.^{[156][157][158]} However, according to philosopher Steven Best, humans have created "hierarchical and growth-addicted societies" and have demonstrated "ecocidal proclivities" long before the emergence of capitalism.^[159] Hartigan, Bould, and Haraway all critique what *Anthropocene* does as a term; however, Hartigan and Bould differ from Haraway in that they criticize the utility or validity of a geological framing of the climate crisis, whereas Haraway embraces it.

In addition to "Capitalocene," other terms have also been proposed by scholars to trace the roots of the Epoch to causes other than the human species broadly. Janae Davis, for example, has suggested the "Plantationocene" as a more appropriate term to call attention to the role that plantation agriculture has played in the formation of the Epoch, alongside Kathryn Yusoff's argument that racism as a whole is foundational to the Epoch. The Plantationocene concept traces "the ways that plantation logics organize modern economies, environments, bodies, and social relations."^{[160][161][162][163]} In a similar vein, environmental humanities scholars like Heather Davis and Indigenous studies scholars such as Métis geographer Zoe Todd have argued that the Epoch must be dated back to the colonization of the Americas, as this "names the problem of colonialism as responsible for contemporary environmental crisis."^[164] Potawatomi philosopher Kyle Powys Whyte has further argued that the Anthropocene has been apparent to Indigenous peoples in the Americas since the inception of colonialism because of "colonialism's role in environmental change."^{[165][166][167]}



"While we often think of ecological damage as a modern problem our impacts date back millennia to the times in which humans lived as hunter-gatherers. Our history with wild animals has been a zero-sum game: either we hunted them to extinction, or we destroyed their habitats with agricultural land."
 – Hannah Ritchie for *Our World in Data*.^[146]

Other critiques of *Anthropocene* have focused on the genealogy of the concept. Todd also provides a phenomenological account, which draws on the work of the philosopher Sara Ahmed, writing: "When discourses and responses to the Anthropocene are being generated within institutions and disciplines which are embedded in broader systems that act as de facto 'white public space,' the academy and its power dynamics must be challenged."^[168] Other aspects which constitute current understandings of the concept of the *Anthropocene* such as the ontological split between nature and society, the assumption of the centrality and individuality of the human, and the framing of environmental discourse in largely scientific terms have been criticized by scholars as concepts rooted in colonialism and which reinforce systems of postcolonial domination.^[169] To that end, Todd makes the case that the concept of *Anthropocene* must be indigenized and decolonized if it is to become a vehicle of justice as opposed to white thought and domination.

Eco-philosopher David Abram, in a book chapter titled 'Interbreathing in the Humilocene', has proposed adoption of the term 'Humilocene' (the Epoch of Humility), which emphasizes an ethical imperative and ecocultural direction that human societies should take. The term plays with the etymological roots of the term 'human', thus connecting it back with terms such as humility, humus (the soil), and even a corrective sense of humiliation that some human societies should feel given their collective destructive impact on the earth.^[170]

"Early anthropocene" model

William Ruddiman has argued that the Anthropocene began approximately 8,000 years ago with the development of farming and sedentary cultures.^[171] At that point, humans were dispersed across all continents except Antarctica, and the Neolithic Revolution was ongoing. During this period, humans developed agriculture and animal husbandry to supplement or replace hunter-gatherer subsistence.^[172] Such innovations were followed by a wave of extinctions, beginning with large mammals and terrestrial birds. This wave was driven by both the direct activity of humans (e.g. hunting) and the indirect consequences of land-use change for agriculture. Landscape-scale burning by prehistoric hunter-gathers may have been an additional early source of anthropogenic atmospheric carbon.^[173] Ruddiman also claims that the greenhouse gas emissions in-part responsible for the Anthropocene began 8,000 years ago when ancient farmers cleared forests to grow crops.^{[174][175][176]}

Ruddiman's work has been challenged with data from an earlier interglaciation ("Stage 11", approximately 400,000 years ago) which suggests that 16,000 more years must elapse before the current Holocene interglaciation comes to an end, and thus the early anthropogenic hypothesis is invalid.^[177] Also, the argument that "something" is needed to explain the differences in the Holocene is challenged by more recent research showing that all interglacials are different.^[178]

Homogenocene

Homogenocene (from old Greek: homo-, *same*; geno-, *kind*; kainos-, *new*;) is a more specific term used to define our current epoch, in which biodiversity is diminishing and biogeography and ecosystems around the globe seem more and more similar to one another mainly due to invasive species that have been introduced around the globe either on purpose (crops, livestock) or inadvertently. This is due to the newfound globalism that humans participate in, as species traveling across the world to another region was not as easily possible in any point of time in history as it is today.^[179]

The term Homogenocene was first used by Michael Samways in his editorial article in the *Journal of Insect Conservation* from 1999 titled "Translocating fauna to foreign lands: Here comes the Homogenocene."^[180]

The term was used again by John L. Curnutt in the year 2000 in *Ecology*, in a short list titled "A Guide to the Homogenocene",^[181] which reviewed *Alien species in North America and Hawaii: impacts on natural ecosystems* by George Cox. Charles C. Mann, in his acclaimed book *1493: Uncovering the New World Columbus Created*, gives a bird's-eye view of the mechanisms and ongoing implications of the homogenocene.^[182]

Society and culture

Humanities

The concept of the Anthropocene has also been approached via humanities such as philosophy, literature and art. In the scholarly world, it has been the subject of increasing attention through special journals,^[183] conferences,^{[184][185]} and disciplinary reports.^[186] The Anthropocene, its attendant timescale, and ecological implications prompt questions about death and the end of civilisation,^[187] memory and archives,^[188] the scope and methods of humanistic inquiry,^[189] and emotional responses to the "end of nature".^[190] Some scholars have posited that the realities of the Anthropocene, including "human-induced biodiversity loss, exponential increases in per-capita resource consumption, and global climate change," have made the goal of environmental sustainability largely unattainable and obsolete.^[191]

Historians have actively engaged the Anthropocene. In 2000, the same year that Paul Crutzen coined the term, world historian John McNeill published *Something New Under the Sun*,^[192] tracing the rise of human societies' unprecedented impact on the planet in the twentieth century.^[192] In 2001, historian of science Naomi Oreskes revealed the systematic efforts to undermine trust in climate change science and went on to detail the corporate interests delaying action on the environmental challenge.^{[193][194]} Both McNeill and Oreskes became members of the Anthropocene Working Group because of their work correlating human activities and planetary transformation.

Bridie Lonie has reflected that the Anthropocene has been a theme for art in New Zealand since the 1970s. Often working outside the art institutions as societally challenging intervention art also "Interrupting the Automatism" in the activation, decision making and ultimate control of especially urban public space^[195]

Popular culture

- In 2019, the English musician Nick Mulvey released a music video on YouTube named "In the Anthropocene".^[196] In cooperation with Sharp's Brewery, the song was recorded on 105 vinyl records made of washed-up plastic from the Cornish coast.^[197]
- *The Anthropocene Reviewed* is a podcast and book by author John Green, where he "reviews different facets of the human-centered planet on a five-star scale".^[198]
- Photographer Edward Burtynsky created "The Anthropocene Project" with Jennifer Baichwal and Nicholas de Pencier, which is a collection of photographs, exhibitions, a film, and a

book. His photographs focus on landscape photography that captures the effects human beings have had on the earth.^{[199][200]}

- In 2015, the American death metal band Cattle Decapitation released its seventh studio album titled *The Anthropocene Extinction*.^[201]
- In 2020, Canadian musician Grimes released her fifth studio album titled *Miss Anthropocene*. The name is also a pun on the feminine title "Miss" and the words "misanthrope" and "Anthropocene."^[202]

See also



- Earth Overshoot Day – Calculated calendar date when humanity's yearly consumption exceeds Earth's replenishment
- Ecological footprint – Individual's or a group's human demand on nature
- Ecological overshoot – Demands on ecosystem exceeding regeneration
- Holocene extinction – Ongoing extinction event caused by human activity
- Novel ecosystem – Human-created ecological niche
- Overconsumption (economics) – Resource use exceeding carrying capacity
- Planetary boundaries – Limits not to be exceeded if humanity is to survive in a safe ecosystem

References

1. "Crawford Lake" (<https://geonames.nrcan.gc.ca/search-place-names/unique?id=FAUAV>). *Geographical Names Data Base*. Natural Resources Canada. Retrieved 20 July 2010.
2. "International Chronostratigraphic Chart" (<https://stratigraphy.org/chart>). *International Commission on Stratigraphy*. Retrieved 7 April 2024.
3. "What is the Anthropocene? – current definition and status" (<http://quaternary.stratigraphy.org/working-groups/anthropocene/>). *quaternary.stratigraphy.org*. Subcommission on Quaternary Stratigraphy, Working Group on the 'Anthropocene'. Retrieved 7 April 2024.
4. The Anthropocene: IUGS-ICS Statement. 20 March 2024. https://www.iugs.org/_files/ugd/f1fc07_ebe2e2b94c35491c8efe570cd2c5a1bf.pdf
5. Waters, C.N.; et al. (8 January 2016). "The Anthropocene is functionally and stratigraphically distinct from the Holocene". *Science*. **351** (6269) aad2622. Bibcode:2016Sci...351.2622W (<https://ui.adsabs.harvard.edu/abs/2016Sci...351.2622W>). doi:10.1126/science.aad2622 (<https://doi.org/10.1126%2Fscience.aad2622>). PMID 26744408 (<https://pubmed.ncbi.nlm.nih.gov/26744408>). S2CID 206642594 (<https://api.semanticscholar.org/CorpusID:206642594>).
6. Edwards, Lucy E. (30 November 2015). "What is the Anthropocene?" (<https://eos.org/opinions/what-is-the-anthropocene>). *Eos*. Vol. 96. doi:10.1029/2015EO040297 (<https://doi.org/10.1029%2F2015EO040297>).
7. Dawson, Ashley (2016). *Extinction: A radical history* (<http://www.orbooks.com/catalog/extinction-by-ashley-dawson/>). OR Books. p. 19. ISBN 978-1-944869-01-4.


8. Carrington, Damian (29 August 2016). "The Anthropocene epoch: Scientists declare dawn of human-influenced age" (<https://www.theguardian.com/environment/2016/aug/29/declare-anthropocene-epoch-experts-urge-geological-congress-human-impact-earth>). *The Guardian*. Retrieved 29 August 2016.
9. Subramanian, Meera (21 May 2019). "Anthropocene now: Influential panel votes to recognize Earth's new epoch" (<https://www.nature.com/articles/d41586-019-01641-5>). *Nature*. doi:10.1038/d41586-019-01641-5 (<https://doi.org/10.1038%2Fd41586-019-01641-5>). PMID 32433629 (<https://pubmed.ncbi.nlm.nih.gov/32433629>). S2CID 182238145 (<https://api.semanticscholar.org/CorpusID:182238145>). Retrieved 5 June 2019.
10. "Results of binding vote by AWG" (<https://web.archive.org/web/20190605091924/http://quaternary.stratigraphy.org/working-groups/anthropocene/>). Anthropocene Working Group. International Commission on Stratigraphy. 21 May 2019. Archived from the original (<http://quaternary.stratigraphy.org/working-groups/anthropocene/>) on 5 June 2019.
11. Meyer, Robinson (16 April 2019). "The cataclysmic break that (maybe) occurred in 1950" (<https://www.theatlantic.com/science/archive/2019/04/great-debate-over-when-anthropocene-started/587194/>). *The Atlantic*. Retrieved 5 June 2019.
12. "The Anthropocene" (<https://www.geolsoc.org.uk/anthropocene>). The Geological Society.
13. Waters, Colin N; Turner, Simon D; Zalasiewicz, Jan; Head, Martin J (April 2023). "Candidate sites and other reference sections for the Global boundary Stratotype Section and Point of the Anthropocene series" (<https://doi.org/10.1177%2F20530196221136422>). *The Anthropocene Review*. **10** (1): 3–24. Bibcode:2023AntRv..10....3W (<https://ui.adsabs.harvard.edu/abs/2023AntRv..10....3W>). doi:10.1177/20530196221136422 (<https://doi.org/10.1177%2F20530196221136422>).
14. Voosen, Paul (11 July 2023). "Pond mud proposed as Anthropocene's 'golden spike,' defining human-altered geological age" (<https://www.science.org/content/article/pond-mud-proposed-anthropocene-s-golden-spike-defining-human-altered-geological-age>). *Science*. **381** (6654): 114–115. doi:10.1126/science.adj6978 (<https://doi.org/10.1126%2Fscience.adj6978>). Retrieved 23 April 2024.
15. Zhong, Raymond (5 March 2024). "Are We in the 'Anthropocene,' the Human Age? Nope, Scientists Say" (<https://www.nytimes.com/2024/03/05/climate/anthropocene-epoch-vote-rejected.html>). *The New York Times*. ISSN 0362-4331 (<https://search.worldcat.org/issn/0362-4331>). Retrieved 5 March 2024.
16. Zhong, Raymond (20 March 2024). "Geologists Make It Official: We're Not in an 'Anthropocene' Epoch" (<https://www.nytimes.com/2024/03/20/climate/anthropocene-vote-upheld.html>). *The New York Times*. ISSN 0362-4331 (<https://search.worldcat.org/issn/0362-4331>). Retrieved 19 April 2024.
17. Crutzen, P. J. (2002). "Geology of mankind" (<https://doi.org/10.1038%2F415023a>). *Nature*. **415** (6867): 23. Bibcode:2002Natur.415...23C (<https://ui.adsabs.harvard.edu/abs/2002Natur.415...23C>). doi:10.1038/415023a (<https://doi.org/10.1038%2F415023a>). PMID 11780095 (<https://pubmed.ncbi.nlm.nih.gov/11780095>). S2CID 9743349 (<https://api.semanticscholar.org/CorpusID:9743349>).
18. Bobbette, Adam (2023). *The pulse of the earth: political geology in Java*. Durham: Duke University Press. p. 134. ISBN 978-1-4780-2708-9.
19. Leconte, Joseph (1877). "On Critical Periods in the History of the Earth, and Their Relation to Evolution; On the Quarternary as Such a Period" (<https://www.jstor.org/stable/2448188>). *The American Naturalist*. **11** (9): 540–557. Bibcode:1877ANat...11..540L (<https://ui.adsabs.harvard.edu/abs/1877ANat...11..540L>). doi:10.1086/271947 (<https://doi.org/10.1086%2F271947>). ISSN 0003-0147 (<https://search.worldcat.org/issn/0003-0147>). JSTOR 2448188 (<https://www.jstor.org/stable/2448188>).

20. Petersen-Rockney, Margiana; Baur, Patrick; Guzman, Aidee; Bender, S. Franz; Calo, Adam; Castillo, Federico; De Master, Kathryn; Dumont, Antoinette; Esquivel, Kenzo; Kremen, Claire; LaChance, James; Mooshammer, Maria; Ory, Joanna; Price, Mindy J.; Socolar, Yvonne (15 March 2021). "Narrow and Brittle or Broad and Nimble? Comparing Adaptive Capacity in Simplifying and Diversifying Farming Systems" (<https://doi.org/10.3389%2Ffsufs.2021.564900>). *Frontiers in Sustainable Food Systems*. **5** 564900. Bibcode:2021FrSFS...564900P (<https://ui.adsabs.harvard.edu/abs/2021FrSFS...564900P>). doi:10.3389/fsufs.2021.564900 (<https://doi.org/10.3389%2Ffsufs.2021.564900>). ISSN 2571-581X (<https://search.worldcat.org/issn/2571-581X>).
21. Ogden, M. (29 February 2016). "'The Anthropocene' viewed from Vernadsky's Noosphere" (http://action.larouchepac.com/_the_anthropocene/). *Promethean Pac*. LaRouche PAC.
22. *Doklady: Biological sciences sections, Volumes 132–135*. Akademiia nauk SSSR.
23. Revkin, Andrew C. (11 May 2011). "Confronting the 'Anthropocene' " (<https://dotearth.blogs.nytimes.com/2011/05/11/confronting-the-anthropocene/>). *The New York Times*. Retrieved 25 March 2014.
24. Badri, Adarsh (5 February 2024). "Feeling for the Anthropocene: affective relations and ecological activism in the global South" (<https://doi.org/10.1093%2Fia%2Fiiae010>). *International Affairs*. **100** (2): 731–749. doi:10.1093/ia/iiae010 (<https://doi.org/10.1093%2Fia%2Fiiae010>). ISSN 0020-5850 (<https://search.worldcat.org/issn/0020-5850>).
25. Crutzen, Paul J.; Stoermer, Eugene F. "The "Anthropocene" ". *IGBP Newsletter*. pp. 17–18.
26. Pearce, Fred (2007). *With Speed and Violence: Why Scientists fear tipping points in Climate Change* (<https://archive.org/details/withspeedviolenc00pear>). Boston, Massachusetts: Beacon Press. ISBN 978-0-8070-8576-9. Retrieved 5 September 2016.
27. "Paul Crutzen died on January 28th" (<https://www.economist.com/obituary/2021/02/13/paul-crutzen-died-on-january-28th>). *The Economist*. 13 February 2021. ISSN 0013-0613 (<https://search.worldcat.org/issn/0013-0613>). Retrieved 21 February 2021.
28. Steiner, Achim (15 December 2020). "The Next Frontier: Human Development and the Anthropocene (Foreword)" (http://hdr.undp.org/sites/default/files/hdr_2020_overview_english.pdf) (PDF). UNDP. Retrieved 16 December 2020.
29. Ehlers, Eckart; Moss, C.; Krafft, Thomas (2006). *Earth System Science in the Anthropocene: Emerging issues and problems* (<https://books.google.com/books?id=ld3Z5XTcOWgC&q=Earth+System+Science+in+the+Anthropocene:+Emerging+Issues+and+Problems>). Springer Science+Business Media. ISBN 978-3-540-26590-0.
30. "2011 GSA Annual Meeting" (<https://web.archive.org/web/20190929144800/http://www.geosociety.org/meetings/2011/>). Geological Society of America. Archived from the original (<http://www.geosociety.org/meetings/2011/>) on 29 September 2019. Retrieved 28 November 2015.
31. Zalasiewicz, Jan; et al. (2008). "Are we now living in the Anthropocene?" (<https://doi.org/10.1130%2FGSAT01802A.1>). *GSA Today*. **18** (2): 4–8. Bibcode:2008GSAT...18b...4Z (<https://ui.adsabs.harvard.edu/abs/2008GSAT...18b...4Z>). doi:10.1130/GSAT01802A.1 (<https://doi.org/10.1130%2FGSAT01802A.1>).
32. Crutzen, P.J. & Stoermer, E.F. (2000). "The 'Anthropocene' ". *Global Change Newsletter*. **41**: 17–18.
33. Sahney, S.; Benton, M. J. & Ferry, P. A. (2010). "Links between global taxonomic diversity, ecological diversity and the expansion of vertebrates on land" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2936204>). *Biology Letters*. **6** (4): 544–547. doi:10.1098/rsbl.2009.1024 (<https://doi.org/10.1098%2Frsl.2009.1024>). PMC 2936204 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2936204>). PMID 20106856 (<https://pubmed.ncbi.nlm.nih.gov/20106856>). "... it could be that without human influence the ecological and taxonomic diversity of tetrapods would continue to increase in an exponential fashion until most or all of the available ecospace is filled."

34. Pimm, S.L.; Jenkins, C.N.; Abell, R.; Brooks, T.M.; Gittleman, J.L.; Joppa, L.N.; Raven, P. H.; Roberts, C.M.; Sexton, J.O. (2014). "The biodiversity of species and their rates of extinction, distribution, and protection" (<http://static.squarespace.com/static/51b078a6e4b0e8d244dd9620/t/538797c3e4b07a163543ea0f/1401395139381/Pimm+et+al.+2014.pdf>) (PDF). *Science*. **344** (6187) 1246752. doi:10.1126/science.1246752 (<https://doi.org/10.1126%2Fscience.1246752>). PMID 24876501 (<https://pubmed.ncbi.nlm.nih.gov/24876501>). S2CID 206552746 (<https://api.semanticscholar.org/CorpusID:206552746>). Retrieved 15 December 2016. "The overarching driver of species extinction is human population growth and increasing per capita consumption."
35. Vignieri, Sacha (2014). "Vanishing fauna" (<https://doi.org/10.1126%2Fscience.345.6195.392>). *Science*. **345** (6195): 392–395. Bibcode:2014Sci...345..392V (<https://ui.adsabs.harvard.edu/abs/2014Sci...345..392V>). doi:10.1126/science.345.6195.392 (<https://doi.org/10.1126%2Fscience.345.6195.392>). PMID 25061199 (<https://pubmed.ncbi.nlm.nih.gov/25061199>).
36. Ceballos, Gerardo; Ehrlich, Paul R.; Barnosky, Anthony D.; García, Andrés; Pringle, Robert M.; Palmer, Todd M. (2015). "Accelerated modern human-induced species losses: Entering the sixth mass extinction" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4640606>). *Science Advances*. **1** (5) e1400253. Bibcode:2015SciA....1E0253C (<https://ui.adsabs.harvard.edu/abs/2015SciA....1E0253C>). doi:10.1126/sciadv.1400253 (<https://doi.org/10.1126%2Fsciadv.1400253>). PMC 4640606 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4640606>). PMID 26601195 (<https://pubmed.ncbi.nlm.nih.gov/26601195>).
37. Doughty, C.E.; Wolf, A.; Field, C.B. (2010). "Biophysical feedbacks between the Pleistocene megafauna extinction and climate: The first human-induced global warming?" (<http://www.agu.org/pubs/crossref/2010/2010GL043985.shtml>). *Geophysical Research Letters*. **37** (L15703): L15703. Bibcode:2010GeoRL..3715703D (<https://ui.adsabs.harvard.edu/abs/2010GeoRL..3715703D>). doi:10.1029/2010GL043985 (<https://doi.org/10.1029%2F2010GL043985>).
38. Zalasiewicz, J.; et al. (2010). "The new world of the Anthropocene". *Environmental Science & Technology*. **44** (7): 2228–2231. Bibcode:2010EnST...44.2228Z (<https://ui.adsabs.harvard.edu/abs/2010EnST...44.2228Z>). doi:10.1021/es903118j (<https://doi.org/10.1021%2Fes903118j>). hdl:1885/36498 (<https://hdl.handle.net/1885%2F36498>). PMID 20184359 (<https://pubmed.ncbi.nlm.nih.gov/20184359>).
39. "Was first nuclear test the start of new human-dominated epoch, the Anthropocene?" (<http://web.archive.org/web/20150414155447/http://newscenter.berkeley.edu/2015/01/16/was-first-nuclear-test-dawn-of-new-human-dominated-epoch-the-anthropocene/>). News Center. University of California, Berkeley. 16 January 2015. Archived from the original (<http://newscenter.berkeley.edu/2015/01/16/was-first-nuclear-test-dawn-of-new-human-dominated-epoch-the-anthropocene/>) on 14 April 2015. Retrieved 29 January 2015.
40. Lewis, Simon L.; Maslin, Mark A. (March 2015). "Defining the Anthropocene" (https://web.archive.org/web/20151224052554/http://www.realtechsupport.org/UB/MCC/Lewis_DefiningAnthropocene_2015.pdf) (PDF). *Nature*. **519** (7542): 171–180. Bibcode:2015Natur.519..171L (<https://ui.adsabs.harvard.edu/abs/2015Natur.519..171L>). doi:10.1038/nature14258 (<https://doi.org/10.1038%2Fnature14258>). PMID 25762280 (<https://pubmed.ncbi.nlm.nih.gov/25762280>). S2CID 205242896 (<https://api.semanticscholar.org/CorpusID:205242896>). Archived from the original (http://www.realtechsupport.org/UB/MCC/Lewis_DefiningAnthropocene_2015.pdf) (PDF) on 24 December 2015.
41. Edgeworth, Matt; Richter, Dan de B.; Waters, Colin; Haff, Peter; Neal, Cath; Price, Simon James (1 April 2015). "Diachronous beginnings of the Anthropocene: The lower bounding surface of anthropogenic deposits" (http://nora.nerc.ac.uk/id/eprint/509573/1/Diachronous%20beginnings%20_for%20NORA.pdf) (PDF). *The Anthropocene Review*. **2** (1): 33–58. Bibcode:2015AntRv...2...33E (<https://ui.adsabs.harvard.edu/abs/2015AntRv...2...33E>). doi:10.1177/2053019614565394 (<https://doi.org/10.1177%2F2053019614565394>). ISSN 2053-0196 (<https://search.worldcat.org/issn/2053-0196>). S2CID 131236197 (<https://api.semanticscholar.org/CorpusID:131236197>).

42. Waters, Colin N.; Zalasiewicz, Jan; Summerhayes, Colin; Barnosky, Anthony D.; Poirier, Clément; Gałuszka, Agnieszka; Cearreta, Alejandro; Edgeworth, Matt; Ellis, Erle C. (8 January 2016). "The Anthropocene is functionally and stratigraphically distinct from the Holocene". *Science*. **351** (6269) aad2622. Bibcode:2016Sci...351.2622W (<https://ui.adsabs.harvard.edu/abs/2016Sci...351.2622W>). doi:10.1126/science.aad2622 (<https://doi.org/10.1126/science.aad2622>). ISSN 0036-8075 (<https://search.worldcat.org/issn/0036-8075>). PMID 26744408 (<https://pubmed.ncbi.nlm.nih.gov/26744408>). S2CID 206642594 (<https://api.semanticscholar.org/CorpusID:206642594>).
43. "Subcommission on Quaternary Stratigraphy – Working Group on the 'Anthropocene' " (<http://quaternary.stratigraphy.org/workinggroups/anthropocene/>). International Commission on Stratigraphy. Retrieved 28 November 2015.
44. Davison, Nicola (30 May 2019). "The Anthropocene epoch: Have we entered a new phase of planetary history?" (<https://www.theguardian.com/environment/2019/may/30/anthropocene-epoch-have-we-entered-a-new-phase-of-planetary-history>). *The Guardian*. Retrieved 5 June 2019.
45. Gibbard, Philip L.; Bauer, Andrew M.; Edgeworth, Matthew; Ruddiman, William F.; Gill, Jacquelyn L.; Merritts, Dorothy J.; Finney, Stanley C.; Edwards, Lucy E.; Walker, Michael J. C.; Maslin, Mark; Ellis, and Erle C. (2021). "A practical solution: the Anthropocene is a geological event, not a formal epoch" (<https://doi.org/10.18814/epiiugs/2021/021029>). *Episodes Journal of International Geoscience*. **45** (4): 349–357. Bibcode:2021Episo..45..349G (<https://ui.adsabs.harvard.edu/abs/2021Episo..45..349G>). doi:10.18814/epiiugs/2021/021029 (<https://doi.org/10.18814/epiiugs/2021/021029>). S2CID 244165877 (<https://api.semanticscholar.org/CorpusID:244165877>).
46. Bauer, Andrew M.; Edgeworth, Matthew; Edwards, Lucy E.; Ellis, Erle C.; Gibbard, Philip; Merritts, Dorothy J. (16 September 2021). "Anthropocene: event or epoch?" (<https://www.nature.com/articles/d41586-021-02448-z>). *Nature*. **597** (7876): 332. Bibcode:2021Natur.597..332B (<https://ui.adsabs.harvard.edu/abs/2021Natur.597..332B>). doi:10.1038/d41586-021-02448-z (<https://doi.org/10.1038/d41586-021-02448-z>). ISSN 0028-0836 (<https://search.worldcat.org/issn/0028-0836>). PMID 34522014 (<https://pubmed.ncbi.nlm.nih.gov/34522014>). S2CID 237515330 (<https://api.semanticscholar.org/CorpusID:237515330>).
47. Gibbard, Philip; Walker, Michael; Bauer, Andrew; Edgeworth, Matthew; Edwards, Lucy; Ellis, Erle; Finney, Stanley; Gill, Jacquelyn L.; Maslin, Mark; Merritts, Dorothy; Ruddiman, William (2022). "The Anthropocene as an Event, not an Epoch" (<https://onlinelibrary.wiley.com/doi/10.1002/jqs.3416>). *Journal of Quaternary Science*. **37** (3): 395–399. Bibcode:2022JQS....37..395G (<https://ui.adsabs.harvard.edu/abs/2022JQS....37..395G>). doi:10.1002/jqs.3416 (<https://doi.org/10.1002/jqs.3416>). ISSN 0267-8179 (<https://search.worldcat.org/issn/0267-8179>). S2CID 247378724 (<https://api.semanticscholar.org/CorpusID:247378724>).
48. Crutzen, Paul J. (2002). "Geology of mankind" (<https://doi.org/10.1038/415023a>). *Nature*. **415** (6867): 23. Bibcode:2002Natur.415...23C (<https://ui.adsabs.harvard.edu/abs/2002Natur.415...23C>). doi:10.1038/415023a (<https://doi.org/10.1038/415023a>). ISSN 1476-4687 (<https://search.worldcat.org/issn/1476-4687>). PMID 11780095 (<https://pubmed.ncbi.nlm.nih.gov/11780095>). S2CID 9743349 (<https://api.semanticscholar.org/CorpusID:9743349>).
49. Carrington, Damian (11 July 2023). "Canadian lake chosen to represent start of Anthropocene" (<https://www.theguardian.com/environment/2023/jul/11/nuclear-bomb-fallout-site-chosen-to-define-start-of-anthropocene>). *The Guardian*. Retrieved 11 July 2023.
50. "The Anthropocene: Canadian lake mud 'symbolic of human changes to Earth' " (<https://www.bbc.com/news/science-environment-66132769>). *BBC News*. 11 July 2023. Retrieved 16 July 2023.

51. Lovelock, James; Appleyard, Bryan (4 July 2019). *Novacene: the coming age of hyperintelligence*. London: Allen Lane. ISBN 978-0-241-39936-1. OCLC 1104037419 (<http://search.worldcat.org/oclc/1104037419>).
52. US Department of Commerce; NOAA; Earth System Research Laboratory. "NOAA/ESRL Global Monitoring Division – The NOAA annual greenhouse gas index (AGGI)" (<https://www.esrl.noaa.gov/gmd/aggi/aggi.html>). *esrl.noaa.gov*. Retrieved 17 May 2017.
53. Douglas, I.; Hodgson, R. & Lawson, N. (2002). "Industry, environment and health through 200 years in Manchester". *Ecological Economics*. **41** (2): 235–255. Bibcode:2002EcoEc..41..235D (<https://ui.adsabs.harvard.edu/abs/2002EcoEc..41..235D>). doi:10.1016/S0921-8009(02)00029-0 (<https://doi.org/10.1016%2FS0921-8009%2802%2900029-0>).
54. Kirch, P.V. (2005). "The Holocene record" (<https://doi.org/10.1146%2Fannurev.energy.29.102403.140700>). *Annual Review of Environment and Resources*. **30** (1): 409–440. doi:10.1146/annurev.energy.29.102403.140700 (<https://doi.org/10.1146%2Fannurev.energy.29.102403.140700>).
55. Ripple, William J.; Wolf, Christopher; van Vuuren, Detlef P.; Gregg, Jillian W.; Lenzen, Manfred (9 January 2024). "An environmental and socially just climate mitigation pathway for a planet in peril" (<https://doi.org/10.1088%2F1748-9326%2Fad059e>). *Environmental Research Letters*. **19** (2): 021001. Bibcode:2024ERL....19b1001R (<https://ui.adsabs.harvard.edu/abs/2024ERL....19b1001R>). doi:10.1088/1748-9326/ad059e (<https://doi.org/10.1088%2F1748-9326%2Fad059e>). "Specifically, our results show a great escalation beginning around 1850 for most variables. If combined with information on carrying capacity or planetary boundaries, these data could be used to explore the possibility that human demands on multiple fronts have greatly accelerated and may have approached or exceeded the biosphere's regenerative capacity. From a population, fossil fuel, greenhouse gasses, temperature, and land use perspective, the mid 19th century (~1850) stands out as a compelling choice among the potential starting points for the Anthropocene."
56. Gauci, Vincent (19 June 2025). "New start date for the Anthropocene proposed – when humans first changed global methane levels" (<https://theconversation.com/new-start-date-for-the-anthropocene-proposed-when-humans-first-changed-global-methane-levels-258834>). *The Conversation*.
57. ἄνθρωπος (<https://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.04.0057:entry=a/nqrwpos>), καινός (<https://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.04.0057:entry=kaino/s>). Liddell, Henry George; Scott, Robert; *A Greek–English Lexicon at the Perseus Project*.
58. Harper, Douglas. "-cene" (<https://www.etymonline.com/word/-cene>). *Online Etymology Dictionary*.
59. McNeill, J.R. (2012). "Global Environmental History: The first 150,000 years" (<https://www.wiley.com/en-gb/A+Companion+to+Global+Environmental+History-p-9781444335347>). In McNeill, J. R.; Mauldin, E.S. (eds.). *A Companion to Global Environmental History*. Wiley-Blackwell. pp. 3–17. ISBN 978-1-444-33534-7.
60. Leakey, Richard; Lewin, Roger (1995). *The Sixth Extinction: Patterns of life and the future of humankind* (<https://archive.org/details/sixthextinctionb00leak>). London: Doubleday. ISBN 978-0-385-42497-4.
61. Dirzo, Rodolfo; Hillary S. Young; Mauro Galetti; Gerardo Ceballos; Nick J. B. Isaac; Ben Collen (2014). "Defaunation in the Anthropocene" (<http://www.uv.mx/personal/tcarmona/files/2010/08/Science-2014-Dirzo-401-6-2.pdf>) (PDF). *Science*. **345** (6195): 401–406. Bibcode:2014Sci...345..401D (<https://ui.adsabs.harvard.edu/abs/2014Sci...345..401D>). doi:10.1126/science.1251817 (<https://doi.org/10.1126%2Fscience.1251817>). PMID 25061202 (<https://pubmed.ncbi.nlm.nih.gov/25061202>). S2CID 206555761 (<https://api.semanticscholar.org/CorpusID:206555761>).

62. Kolbert, Elizabeth (2014). *The Sixth Extinction: An Unnatural History*. New York City: Henry Holt and Company. ISBN 978-0-8050-9299-8.
63. Ripple WJ, Wolf C, Newsome TM, Galetti M, Alamgir M, Crist E, Mahmoud MI, Laurance WF (13 November 2017). "World Scientists' Warning to Humanity: A Second Notice". *BioScience*. **67** (12): 1026–1028. doi:10.1093/biosci/bix125 (<https://doi.org/10.1093%2Fbiosci%2Fbix125>). hdl:1808/25687 (<https://hdl.handle.net/1808%2F25687>). "Moreover, we have unleashed a mass extinction event, the sixth in roughly 540 million years, wherein many current life forms could be annihilated or at least committed to extinction by the end of this century."
64. Ceballos, Gerardo; Ehrlich, Paul R.; Raven, Peter H. (1 June 2020). "Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7306750>). *PNAS*. **117** (24): 13596–13602. Bibcode:2020PNAS..11713596C (<https://ui.adsabs.harvard.edu/abs/2020PNAS..11713596C>). doi:10.1073/pnas.1922686117 (<https://doi.org/10.1073%2Fpnas.1922686117>). PMC 7306750 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7306750>). PMID 32482862 (<https://pubmed.ncbi.nlm.nih.gov/32482862>).
65. Andermann, Tobias; Faurby, Søren; Turvey, Samuel T.; Antonelli, Alexandre; Silvestro, Daniele (1 September 2020). "The past and future human impact on mammalian diversity" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7473673>). *Science Advances*. **6** (36) eabb2313. Bibcode:2020SciA....6.2313A (<https://ui.adsabs.harvard.edu/abs/2020SciA....6.2313A>). doi:10.1126/sciadv.abb2313 (<https://doi.org/10.1126%2Fsciadv.abb2313>). ISSN 2375-2548 (<https://search.worldcat.org/issn/2375-2548>). PMC 7473673 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7473673>). PMID 32917612 (<https://pubmed.ncbi.nlm.nih.gov/32917612>). S2CID 221498762 (<https://api.semanticscholar.org/CorpusID:221498762>).  Text and images are available under a Creative Commons Attribution 4.0 International License (<https://creativecommons.org/licenses/by/4.0/>).
66. "Anthropocene: Have humans created a new geological age?" (<https://www.bbc.co.uk/news/science-environment-13335683>). *BBC News*. 10 May 2011.
67. Pimm, S. L.; Jenkins, C. N.; Abell, R.; Brooks, T. M.; Gittleman, J. L.; Joppa, L. N.; Raven, P. H.; Roberts, C. M.; Sexton, J. O. (30 May 2014). "The biodiversity of species and their rates of extinction, distribution, and protection" (<http://static.squarespace.com/static/51b078a6e4b0e8d244dd9620/t/538797c3e4b07a163543ea0f/1401395139381/Pimm+et+al.+2014.pdf>) (PDF). *Science*. **344** (6187) 1246752. doi:10.1126/science.1246752 (<https://doi.org/10.1126%2Fscience.1246752>). PMID 24876501 (<https://pubmed.ncbi.nlm.nih.gov/24876501>). S2CID 206552746 (<https://api.semanticscholar.org/CorpusID:206552746>).
68. Johns, David; Crist, Eileen; Sahgal, Bittu, eds. (2022). "Ending the Colonization of the Non-Human World" (<https://www.sciencedirect.com/journal/biological-conservation/special-issue/10574WDL8SQ>). *Biological Conservation*.
69. 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" (<https://www.researchgate.net/publication/359182950>). *Philosophia*. **50** (5): 2263–2282. doi:10.1007/s11406-022-00497-w (<https://doi.org/10.1007%2Fs11406-022-00497-w>). S2CID 247433264 (<https://api.semanticscholar.org/CorpusID:247433264>).
70. Dasgupta, Partha (2021). "The Economics of Biodiversity: The Dasgupta Review Headline Messages" (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957629/Dasgupta_Review_-_Headline_Messages.pdf) (PDF). UK government. p. 1. Retrieved 15 December 2021. "Biodiversity is declining faster than at any time in human history. Current extinction rates, for example, are around 100 to 1,000 times higher than the baseline rate, and they are increasing."
71. Carrington, Damian (2 February 2021). "Economics of biodiversity review: what are the recommendations?" (<https://www.theguardian.com/environment/2021/feb/02/economics-of-biodiversity-review-what-are-the-recommendations>). *The Guardian*. Retrieved 16 December 2021.

72. Cowie, Robert H.; Bouchet, Philippe; Fontaine, Benoît (2022). "The Sixth Mass Extinction: fact, fiction or speculation?" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9786292>). *Biological Reviews*. **97** (2): 640–663. doi:10.1111/brv.12816 (<https://doi.org/10.1111%2Fbrv.12816>). PMC 9786292 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9786292>). PMID 35014169 (<https://pubmed.ncbi.nlm.nih.gov/35014169>). S2CID 245889833 (<https://api.semanticscholar.org/CorpusID:245889833>).
73. Sankaran, Vishwam (17 January 2022). "Study confirms sixth mass extinction is currently underway, caused by humans" (<https://www.independent.co.uk/climate-change/news/sixth-mass-extinction-global-biodiversity-b1994346.html>). *The Independent*. Archived (<https://gho.starchive.org/archive/20220507/https://www.independent.co.uk/climate-change/news/sixth-mass-extinction-global-biodiversity-b1994346.html>) from the original on 7 May 2022. Retrieved 18 January 2022.
74. Melillo, Gianna (19 July 2022). "Threat of global extinction may be greater than previously thought, study finds" (<https://thehill.com/changing-america/sustainability/environment/3565945-threat-of-global-extinction-may-be-greater-than-previously-thought-study-finds/>). *The Hill*. Retrieved 20 July 2022.
75. Isbell, Forest; Balvanera, Patricia; et al. (2022). "Expert perspectives on global biodiversity loss and its drivers and impacts on people" (<https://doi.org/10.1002%2Ffee.2536>). *Frontiers in Ecology and the Environment*. **21** (2): 94–103. doi:10.1002/fee.2536 (<https://doi.org/10.1002%2Ffee.2536>). hdl:10852/101242 (<https://hdl.handle.net/10852%2F101242>). S2CID 250659953 (<https://api.semanticscholar.org/CorpusID:250659953>).
76. "Biodiversity: Almost half of animals in decline, research shows" (<https://www.bbc.com/news/uk-northern-ireland-65681648>). *BBC*. 23 May 2023. Retrieved 23 May 2023.
77. Finn, Catherine; Grattarola, Florencia; Pincheira-Donoso, Daniel (2023). "More losers than winners: investigating Anthropocene defaunation through the diversity of population trends" (<https://doi.org/10.1111%2Fbrv.12974>). *Biological Reviews*. **98** (5): 1732–1748. doi:10.1111/brv.12974 (<https://doi.org/10.1111%2Fbrv.12974>). PMID 37189305 (<https://pubmed.ncbi.nlm.nih.gov/37189305>). S2CID 258717720 (<https://api.semanticscholar.org/CorpusID:258717720>).
78. Paddison, Laura (22 May 2023). "Global loss of wildlife is 'significantly more alarming' than previously thought, according to a new study" (<https://www.cnn.com/2023/05/22/world/wildlife-crisis-biodiversity-scn-climate-intl/index.html>). *CNN*. Retrieved 23 May 2023.
79. Bradshaw, Corey J. A.; Ehrlich, Paul R.; Beattie, Andrew; Ceballos, Gerardo; Crist, Eileen; Diamond, Joan; Dirzo, Rodolfo; Ehrlich, Anne H.; Harte, John; Harte, Mary Ellen; Pyke, Graham; Raven, Peter H.; Ripple, William J.; Saltré, Frédéric; Turnbull, Christine; Wackernagel, Mathis; Blumstein, Daniel T. (2021). "Underestimating the Challenges of Avoiding a Ghastly Future" (<https://doi.org/10.3389%2Ffcosc.2020.615419>). *Frontiers in Conservation Science*. **1** 615419. Bibcode:2021FrCS....1.5419B (<https://ui.adsabs.harvard.edu/abs/2021FrCS....1.5419B>). doi:10.3389/fcosc.2020.615419 (<https://doi.org/10.3389%2Ffcosc.2020.615419>).
80. IPBES (2019). S. Díaz; J. Settele; E. S. Brondízio; H. T. Ngo; M. Guèze; J. Agard; A. Arneth; P. Balvanera; K. A. Brauman; S. H. M. Butchart; K. M. A. Chan; L. A. Garibaldi; K. Ichii J. Liu; S. M. Subramanian; G. F. Midgley; P. Miloslavich; Z. Molnár; D. Obura; A. Pfaff; S. Polasky; A. Purvis; J. Razzaque; B. Reyers; R. Roy Chowdhury; Y. J. Shin; I. J. Visseren-Hamakers; K. J. Willis; C. N. Zayas (eds.). Summary for policymakers of the global assessment report on biodiversity and ecosystem services (<https://zenodo.org/doi/10.5281/zenodo.3553579>) (Report). doi:10.5281/zenodo.3553579 (<https://doi.org/10.5281%2Fzenodo.3553579>).
81. Bongaarts, John (2019). "IPBES, 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services" (<https://onlinelibrary.wiley.com/doi/10.1111/padr.12283>). *Population and Development Review*. **45** (3): 680–681. doi:10.1111/padr.12283 (<https://doi.org/10.1111%2Fpadr.12283>). ISSN 0098-7921 (<https://search.worldcat.org/issn/0098-7921>).

82. Ripple WJ, Wolf C, Newsome TM, Galetti M, Alamgir M, Crist E, Mahmoud MI, Laurance WF (13 November 2017). "World Scientists' Warning to Humanity: A Second Notice" (<https://doi.org/10.1093%2Fbiosci%2Fbix125>). *BioScience*. **67** (12): 1026–1028. doi:10.1093/biosci/bix125 (<https://doi.org/10.1093%2Fbiosci%2Fbix125>). hdl:11336/71342 (<https://hdl.handle.net/11336%2F71342>). "Moreover, we have unleashed a mass extinction event, the sixth in roughly 540 million years, wherein many current life forms could be annihilated or at least committed to extinction by the end of this century."
83. Cowie RH, Bouchet P, Fontaine B (April 2022). "The Sixth Mass Extinction: fact, fiction or speculation?" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9786292>). *Biological Reviews of the Cambridge Philosophical Society*. **97** (2): 640–663. doi:10.1111/brv.12816 (<https://doi.org/10.1111%2Fbrv.12816>). PMC 9786292 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9786292>). PMID 35014169 (<https://pubmed.ncbi.nlm.nih.gov/35014169>). S2CID 245889833 (<https://api.semanticscholar.org/CorpusID:245889833>).
84. "Global Biodiversity Outlook 3" (<https://www.cbd.int/gbo3/>). Convention on Biological Diversity. 2010. Archived (<https://web.archive.org/web/20220519223227/https://www.cbd.int/gbo3/>) from the original on 19 May 2022. Retrieved 24 January 2017.
85. Kehoe L, Romero-Muñoz A, Polaina E, Estes L, Kreft H, Kuemmerle T (August 2017). "Biodiversity at risk under future cropland expansion and intensification" (<http://www.nature.com/articles/s41559-017-0234-3>). *Nature Ecology & Evolution*. **1** (8): 1129–1135. Bibcode:2017NatEE...1.1129K (<https://ui.adsabs.harvard.edu/abs/2017NatEE...1.1129K>). doi:10.1038/s41559-017-0234-3 (<https://doi.org/10.1038%2Fs41559-017-0234-3>). ISSN 2397-334X (<https://search.worldcat.org/issn/2397-334X>). PMID 29046577 (<https://pubmed.ncbi.nlm.nih.gov/29046577>). S2CID 3642597 (<https://api.semanticscholar.org/CorpusID:3642597>). Archived (<https://web.archive.org/web/20220423232132/https://www.nature.com/articles/s41559-017-0234-3>) from the original on 23 April 2022. Retrieved 28 March 2022.
86. Allan E, Manning P, Alt F, Binkenstein J, Blaser S, Blüthgen N, Böhm S, Grassein F, Hölzel N, Klaus VH, Kleinebecker T, Morris EK, Oelmann Y, Prati D, Renner SC, Rillig MC, Schaefer M, Schloter M, Schmitt B, Schöning I, Schrupf M, Solly E, Sorkau E, Steckel J, Steffen-Dewenter I, Stempfhuber B, Tschapka M, Weiner CN, Weisser WW, Werner M, Westphal C, Wilcke W, Fischer M (August 2015). "Land use intensification alters ecosystem multifunctionality via loss of biodiversity and changes to functional composition" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4744976>). *Ecology Letters*. **18** (8): 834–843. Bibcode:2015EcolL..18..834A (<https://ui.adsabs.harvard.edu/abs/2015EcolL..18..834A>). doi:10.1111/ele.12469 (<https://doi.org/10.1111%2Fele.12469>). PMC 4744976 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4744976>). PMID 26096863 (<https://pubmed.ncbi.nlm.nih.gov/26096863>).
87. Walsh JR, Carpenter SR, Vander Zanden MJ (April 2016). "Invasive species triggers a massive loss of ecosystem services through a trophic cascade" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4839401>). *Proceedings of the National Academy of Sciences of the United States of America*. **113** (15): 4081–5. Bibcode:2016PNAS..113.4081W (<https://ui.adsabs.harvard.edu/abs/2016PNAS..113.4081W>). doi:10.1073/pnas.1600366113 (<https://doi.org/10.1073%2Fpnas.1600366113>). PMC 4839401 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4839401>). PMID 27001838 (<https://pubmed.ncbi.nlm.nih.gov/27001838>).
88. Stokstad, Erik (6 May 2019). "Landmark analysis documents the alarming global decline of nature" (<https://doi.org/10.1126%2Fscience.aax9287>). *Science*. doi:10.1126/science.aax9287 (<https://doi.org/10.1126%2Fscience.aax9287>). "For the first time at a global scale, the report has ranked the causes of damage. Topping the list, changes in land use—principally agriculture—that have destroyed habitat. Second, hunting and other kinds of exploitation. These are followed by climate change, pollution, and invasive species, which are being spread by trade and other activities. Climate change will likely overtake the other threats in the next decades, the authors note. Driving these threats are the growing human population, which has doubled since 1970 to 7.6 billion, and consumption. (Per capita of use of materials is up 15% over the past 5 decades.)"

89. Pimm SL, Jenkins CN, Abell R, Brooks TM, Gittleman JL, Joppa LN, Raven PH, Roberts CM, Sexton JO (May 2014). "The biodiversity of species and their rates of extinction, distribution, and protection". *Science*. **344** (6187) 1246752. doi:10.1126/science.1246752 (<https://doi.org/10.1126%2Fscience.1246752>). PMID 24876501 (<https://pubmed.ncbi.nlm.nih.gov/24876501>). S2CID 206552746 (<https://api.semanticscholar.org/CorpusID:206552746>). "The overarching driver of species extinction is human population growth and increasing per capita consumption."
90. Cafaro, Philip; Hansson, Pernilla; Götmark, Frank (August 2022). "Overpopulation is a major cause of biodiversity loss and smaller human populations are necessary to preserve what is left" ([https://www.sustainable.soltechdesigns.com/Overpopulation-and-biodiversity-loss\(2022\).pdf](https://www.sustainable.soltechdesigns.com/Overpopulation-and-biodiversity-loss(2022).pdf)) (PDF). *Biological Conservation*. **272** 109646. Bibcode:2022BCons.27209646C (<http://ui.adsabs.harvard.edu/abs/2022BCons.27209646C>). doi:10.1016/j.biocon.2022.109646 (<https://doi.org/10.1016%2Fj.biocon.2022.109646>). ISSN 0006-3207 (<https://search.worldcat.org/issn/0006-3207>). S2CID 250185617 (<https://api.semanticscholar.org/CorpusID:250185617>). Archived ([https://web.archive.org/web/20231208055537/https://www.sustainable.soltechdesigns.com/Overpopulation-and-biodiversity-loss\(2022\).pdf](https://web.archive.org/web/20231208055537/https://www.sustainable.soltechdesigns.com/Overpopulation-and-biodiversity-loss(2022).pdf)) (PDF) from the original on 8 December 2023. Retrieved 25 December 2022. "Conservation biologists standardly list five main direct drivers of biodiversity loss: habitat loss, overexploitation of species, pollution, invasive species, and climate change. The *Global Assessment Report on Biodiversity and Ecosystem Services* found that in recent decades habitat loss was the leading cause of terrestrial biodiversity loss, while overexploitation (overfishing) was the most important cause of marine losses (IPBES, 2019). All five direct drivers are important, on land and at sea, and all are made worse by larger and denser human populations."
91. Crist, Eileen; Mora, Camilo; Engelman, Robert (21 April 2017). "The interaction of human population, food production, and biodiversity protection" (<https://www.researchgate.net/publication/316286860>). *Science*. **356** (6335): 260–264. Bibcode:2017Sci...356..260C (<https://ui.adsabs.harvard.edu/abs/2017Sci...356..260C>). doi:10.1126/science.aal2011 (<https://doi.org/10.1126%2Fscience.aal2011>). PMID 28428391 (<https://pubmed.ncbi.nlm.nih.gov/28428391>). S2CID 12770178 (<https://api.semanticscholar.org/CorpusID:12770178>). Retrieved 2 January 2023. "Research suggests that the scale of human population and the current pace of its growth contribute substantially to the loss of biological diversity. Although technological change and unequal consumption inextricably mingle with demographic impacts on the environment, the needs of all human beings—especially for food—imply that projected population growth will undermine protection of the natural world."
92. Ceballos, Gerardo; Ehrlich, Paul R. (2023). "Mutilation of the tree of life via mass extinction of animal genera" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10523489>). *Proceedings of the National Academy of Sciences of the United States of America*. **120** (39) e2306987120. Bibcode:2023PNAS..12006987C (<https://ui.adsabs.harvard.edu/abs/2023PNAS..12006987C>). doi:10.1073/pnas.2306987120 (<https://doi.org/10.1073%2Fpnas.2306987120>). PMC 10523489 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10523489>). PMID 37722053 (<https://pubmed.ncbi.nlm.nih.gov/37722053>). "Current generic extinction rates will likely greatly accelerate in the next few decades due to drivers accompanying the growth and consumption of the human enterprise such as habitat destruction, illegal trade, and climate disruption."

93. Hughes, Alice C.; Tougeron, Kévin; Martin, Dominic A.; Menga, Filippo; Rosado, Bruno H. P.; Villasante, Sebastian; Madgulkar, Shweta; Gonçalves, Fernando; Geneletti, Davide; Diele-Viegas, Luisa Maria; Berger, Sebastian; Colla, Sheila R.; de Andrade Kamimura, Vitor; Caggiano, Holly; Melo, Felipe (1 January 2023). "Smaller human populations are neither a necessary nor sufficient condition for biodiversity conservation" (<https://doi.org/10.1016%2Fj.biocon.2022.109841>). *Biological Conservation*. **277** 109841. Bibcode:2023BCons.27709841H (<https://ui.adsabs.harvard.edu/abs/2023BCons.27709841H>). doi:10.1016/j.biocon.2022.109841 (<https://doi.org/10.1016%2Fj.biocon.2022.109841>). ISSN 0006-3207 (<https://search.worldcat.org/issn/0006-3207>). "Through examining the drivers of biodiversity loss in highly biodiverse countries, we show that it is not population driving the loss of habitats, but rather the growth of commodities for export, particularly soybean and oil-palm, primarily for livestock feed or biofuel consumption in higher income economies."
94. Weston, Phoebe (26 March 2025). "Biodiversity loss in all species and every ecosystem linked to humans – report" (<https://www.theguardian.com/environment/2025/mar/26/human-ink-biodiversity-loss-species-ecosystems-climate-pollution-eawag-study-nature-aoe>). *The Guardian*. Retrieved 3 April 2025.
95. "Climate change and biodiversity" (<https://web.archive.org/web/20180205010427/http://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf>) (PDF). Intergovernmental Panel on Climate Change. 2005. Archived from the original (<http://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf>) (PDF) on 5 February 2018. Retrieved 12 June 2012.
96. Kannan, R.; James, D. A. (2009). "Effects of climate change on global biodiversity: a review of key literature" (https://web.archive.org/web/20210415065220/http://www.tropecol.com/pdf/open/PDF_50_1/05Kannan.pdf) (PDF). *Tropical Ecology*. **50** (1): 31–39. Archived from the original on 15 April 2021. Retrieved 21 May 2014.
97. "Climate change, reefs and the Coral Triangle" (http://wwf.panda.org/what_we_do/where_we_work/coraltriangle/problems/climatechangecoraltriangle/). *wwf.panda.org*. Archived (https://web.archive.org/web/20180502200544/http://wwf.panda.org/what_we_do/where_we_work/coraltriangle/problems/climatechangecoraltriangle/) from the original on 2 May 2018. Retrieved 9 November 2015.
98. Aldred, Jessica (2 July 2014). "Caribbean coral reefs 'will be lost within 20 years' without protection" (<https://www.theguardian.com/environment/2014/jul/02/caribbean-coral-reef-lost-fishing-pollution-report>). *The Guardian*. Archived (<https://web.archive.org/web/20221020130421/https://www.theguardian.com/environment/2014/jul/02/caribbean-coral-reef-lost-fishing-pollution-report>) from the original on 20 October 2022. Retrieved 9 November 2015.
99. Byrne B, Liu J, Bowman KW, Pascolini-Campbell M, Chatterjee A, Pandey S, Miyazaki K, Van Der Werf GR, Wunch D, Wennberg PO, Roehl CM, Sinha S (28 August 2024). "Carbon emissions from the 2023 Canadian wildfires" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11424480>). *Nature*. **633** (8031): 835–839. Bibcode:2024Natur.633..835B (<https://ui.adsabs.harvard.edu/abs/2024Natur.633..835B>). doi:10.1038/s41586-024-07878-z (<https://doi.org/10.1038%2Fs41586-024-07878-z>). PMC 11424480 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11424480>). PMID 39198654 (<https://pubmed.ncbi.nlm.nih.gov/39198654>).
100. Campbell, Bruce; Beare, Douglas; Bennett, Elena; Hall-Spencer, Jason; Ingram, John; Jaramillo, Fernando; Ortiz, Rodomiro; Ramankutty, Navin; Sayer, Jeffrey; Shindell, Drew (12 October 2017). "Ecology and Society: Agriculture production as a major driver of the Earth system exceeding planetary boundaries" (<https://www.ecologyandsociety.org/vol22/iss4/art8/>). *Ecology and Society*. **22** (4). doi:10.5751/ES-09595-220408 (<https://doi.org/10.5751%2FES-09595-220408>). ISSN 1708-3087 (<https://search.worldcat.org/issn/1708-3087>).

101. Ketcham, Christopher (3 December 2022). "Addressing Climate Change Will Not "Save the Planet" " (<https://theintercept.com/2022/12/03/climate-biodiversity-green-energy/>). *The Intercept*. Archived (<https://web.archive.org/web/20240218153423/https://theintercept.com/2022/12/03/climate-biodiversity-green-energy/>) from the original on 18 February 2024. Retrieved 8 December 2022.
102. Caro, Tim; Rowe, Zeke (2022). "An inconvenient misconception: Climate change is not the principal driver of biodiversity loss" (<https://doi.org/10.1111%2Fconl.12868>). *Conservation Letters*. **15** (3) e12868. Bibcode:2022ConL...15E2868C (<https://ui.adsabs.harvard.edu/abs/2022ConL...15E2868C>). doi:10.1111/conl.12868 (<https://doi.org/10.1111%2Fconl.12868>). S2CID 246172852 (<https://api.semanticscholar.org/CorpusID:246172852>).
103. Bank, European Investment (8 December 2022). *Forests at the heart of sustainable development: Investing in forests to meet biodiversity and climate goals* (<https://www.eib.org/en/publications/20220173-forests-at-the-heart-of-sustainable-development>). European Investment Bank. ISBN 978-92-861-5403-4. Archived (<https://web.archive.org/web/20230321101636/https://www.eib.org/en/publications/20220173-forests-at-the-heart-of-sustainable-development>) from the original on 21 March 2023. Retrieved 9 March 2023.
104. Finch, Deborah M.; Butler, Jack L.; Runyon, Justin B.; Fettig, Christopher J.; Kilkenny, Francis F.; Jose, Shibu; Frankel, Susan J.; Cushman, Samuel A.; Cobb, Richard C. (2021). "Effects of Climate Change on Invasive Species". In Poland, Therese M.; Patel-Weynand, Toral; Finch, Deborah M.; Miniati, Chelcy Ford (eds.). *Invasive Species in Forests and Rangelands of the United States: A Comprehensive Science Synthesis for the United States Forest Sector*. Cham: Springer International Publishing. pp. 57–83. doi:10.1007/978-3-030-45367-1_4 (https://doi.org/10.1007%2F978-3-030-45367-1_4). ISBN 978-3-030-45367-1. S2CID 234260720 (<https://api.semanticscholar.org/CorpusID:234260720>).
105. Bender, Eric (21 March 2022). "Urban evolution: How species adapt to survive in cities" (<https://knowablemagazine.org/article/living-world/2022/urban-evolution-species-adapt-survive-cities>). *Knowable Magazine*. Annual Reviews. doi:10.1146/knowable-031822-1 (<https://doi.org/10.1146%2Fknowable-031822-1>). Retrieved 31 March 2022.
106. Diamond, Sarah E.; Martin, Ryan A. (2 November 2021). "Evolution in Cities" (<https://web.archive.org/web/20220331205605/https://www.annualreviews.org/doi/pdf/10.1146/annurev-ecolsys-012021-021402>). *Annual Review of Ecology, Evolution, and Systematics*. **52** (1): 519–540. doi:10.1146/annurev-ecolsys-012021-021402 (<https://doi.org/10.1146%2Fannurev-ecolsys-012021-021402>). ISSN 1543-592X (<https://search.worldcat.org/issn/1543-592X>). S2CID 239646134 (<https://api.semanticscholar.org/CorpusID:239646134>). Archived from the original (<https://www.annualreviews.org/doi/pdf/10.1146/annurev-ecolsys-012021-021402>) on 31 March 2022. Retrieved 1 April 2022.
107. Diamond, Sarah E.; Chick, Lacy D.; Perez, Abe; Strickler, Stephanie A.; Zhao, Crystal (14 June 2018). "Evolution of plasticity in the city: urban acorn ants can better tolerate more rapid increases in environmental temperature" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6007456>). *Conservation Physiology*. **6** (1) coy030. doi:10.1093/conphys/coy030 (<https://doi.org/10.1093%2Fconphys%2Fcoy030>). ISSN 2051-1434 (<https://search.worldcat.org/issn/2051-1434>). PMC 6007456 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6007456>). PMID 29977563 (<https://pubmed.ncbi.nlm.nih.gov/29977563>).
108. Harvey, Fiona (18 August 2011). "Climate change driving species out of habitats much faster than expected" (<https://www.theguardian.com/environment/2011/aug/18/climate-change-species-habitats>). *The Guardian*. Retrieved 8 November 2015.
109. Nuwer, Rachel (14 September 2012). "From Ancient Deforestation, a Delta Is Born" (<https://green.blogs.nytimes.com/2012/09/14/from-ancient-deforestation-a-delta-is-born/>). *The New York Times*. Retrieved 14 June 2018.

110. Gaynor, Kaitlyn M.; et al. (2018). "The influence of human disturbance on wildlife nocturnality" (<https://doi.org/10.1126%2Fscience.aar7121>). *Science*. **360** (6394): 1232–1235. Bibcode:2018Sci...360.1232G (<https://ui.adsabs.harvard.edu/abs/2018Sci...360.1232G>). doi:10.1126/science.aar7121 (<https://doi.org/10.1126%2Fscience.aar7121>). PMID 29903973 (<https://pubmed.ncbi.nlm.nih.gov/29903973>).
111. Brennan, William (1 October 2018). "When Animals Take the Night Shift" (<https://www.theatlantic.com/magazine/archive/2018/10/up-all-night/568291/>). *The Atlantic*. Retrieved 16 February 2019.
112. "Deep ice tells long climate story" (<https://news.bbc.co.uk/2/hi/science/nature/5314592.stm>). *BBC News*. 4 September 2006. Retrieved 28 November 2015. "The 'scary thing', [Dr. Wolff] added, was the rate of change now occurring in CO₂ concentrations. In the core, the fastest increase seen was of the order of 30 parts per million (ppm) by volume over a period of roughly 1,000 years. The last 30 ppm of increase has occurred in just 17 years. We really are in the situation where we don't have an analogue in our records."
113. Division, NASA Earth Science kip. "Carbon Dioxide - Earth Indicator | NASA Earth Science Division" (<https://science.nasa.gov/earth/explore/earth-indicators/carbon-dioxide/>). *Carbon Dioxide - Earth Indicator*. Retrieved 16 March 2026.
114. Eggleton, Tony (2013). *A Short Introduction to Climate Change* (https://books.google.com/books?id=jeSwRly2M_cC&q=280&pg=PA52). Cambridge University Press. p. 52. ISBN 978-1-107-61876-3. Archived (https://web.archive.org/web/20230314104202/https://books.google.com/books?id=jeSwRly2M_cC&q=280&pg=PA52) from the original on 14 March 2023. Retrieved 14 March 2023.
115. "Carbon dioxide now more than 50% higher than pre-industrial levels" (<https://www.noaa.gov/news-release/carbon-dioxide-now-more-than-50-higher-than-pre-industrial-levels>). National Oceanic and Atmospheric Administration. 3 June 2022. Archived (<https://web.archive.org/web/20220605004925/https://www.noaa.gov/news-release/carbon-dioxide-now-more-than-50-higher-than-pre-industrial-levels>) from the original on 5 June 2022. Retrieved 14 June 2022.
116. "The NOAA Annual Greenhouse Gas Index (AGGI) – An Introduction" (<https://www.esrl.noaa.gov/gmd/aggi/>). NOAA Global Monitoring Laboratory/Earth System Research Laboratories. Archived (<https://web.archive.org/web/20201127013113/https://www.esrl.noaa.gov/gmd/aggi/>) from the original on 27 November 2020. Retrieved 18 December 2020.
117. Etheridge, D.M.; L.P. Steele; R.L. Langenfelds; R.J. Francey; J.-M. Barnola; V.I. Morgan (1996). "Natural and anthropogenic changes in atmospheric CO₂ over the last 1000 years from air in Antarctic ice and firn". *Journal of Geophysical Research*. **101** (D2): 4115–28. Bibcode:1996JGR...101.4115E (<https://ui.adsabs.harvard.edu/abs/1996JGR...101.4115E>). doi:10.1029/95JD03410 (<https://doi.org/10.1029%2F95JD03410>). ISSN 0148-0227 (<https://search.worldcat.org/issn/0148-0227>). S2CID 19674607 (<https://api.semanticscholar.org/CorpusID:19674607>).
118. CounterAct; Women's Climate Justice Collective (4 May 2020). "Climate Justice and Feminism Resource Collection" (<https://commonslibrary.org/climate-justice-feminism/>). *The Commons Social Change Library*. Retrieved 8 July 2024.
119. Lindsey, Rebecca; Dahlman, Luann (28 June 2022). "Climate Change: Global Temperature" (<https://web.archive.org/web/20220917101830/https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>). *climate.gov*. National Oceanic and Atmospheric Administration. Archived from the original (<http://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature>) on 17 September 2022.

120. Intergovernmental Panel on Climate Change (IPCC), ed. (2022), "Summary for Policymakers" (<https://www.cambridge.org/core/books/ocean-and-cryosphere-in-a-changing-climate/summary-for-policymakers/097A895553D86981DFE6195ADFD3DDA4>), *The Ocean and Cryosphere in a Changing Climate: Special Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press, pp. 3–36, doi:10.1017/9781009157964.001 (<https://doi.org/10.1017%2F9781009157964.001>), ISBN 978-1-009-15796-4, retrieved 24 April 2023
121. Doney, Scott C.; Busch, D. Shalin; Cooley, Sarah R.; Kroeker, Kristy J. (17 October 2020). "The Impacts of Ocean Acidification on Marine Ecosystems and Reliant Human Communities" (<https://doi.org/10.1146%2Fannurev-environ-012320-083019>). *Annual Review of Environment and Resources*. **45** (1): 83–112. doi:10.1146/annurev-environ-012320-083019 (<https://doi.org/10.1146%2Fannurev-environ-012320-083019>). ISSN 1543-5938 (<https://search.worldcat.org/issn/1543-5938>). S2CID 225741986 (<https://api.semanticscholar.org/CorpusID:225741986>).
122. Dixon, Simon J.; Viles, Heather A.; Garrett, Bradley L. (2018). "Ozymandias in the Anthropocene: The city as an emerging landform" (<https://doi.org/10.1111%2Farea.12358>). *Area*. **50** (1): 117–125. Bibcode:2018Area...50..117D (<https://ui.adsabs.harvard.edu/abs/2018Area...50..117D>). doi:10.1111/area.12358 (<https://doi.org/10.1111%2Farea.12358>). ISSN 1475-4762 (<https://search.worldcat.org/issn/1475-4762>).
123. Smith, G.K. (April 2016). "Calcite straw stalactites growing from concrete structures" (<http://bcra.org.uk/pub/candks/index.html>). *Cave and Karst Science*. **43** (1): 4–10. Retrieved 14 June 2018.
124. Giosan, L.; Syvitski, J.P.M.; Constantinescu, S.; Day, J. (3 December 2014). "Climate change: Protect the world's deltas" (<https://doi.org/10.1038%2F516031a>). *Nature*. **516** (7529): 31–33. Bibcode:2014Natur.516...31G (<https://ui.adsabs.harvard.edu/abs/2014Natur.516...31G>). doi:10.1038/516031a (<https://doi.org/10.1038%2F516031a>). PMID 25471866 (<https://pubmed.ncbi.nlm.nih.gov/25471866>). S2CID 1970583 (<https://api.semanticscholar.org/CorpusID:1970583>).
125. Cabadas-Báez, H.V.; Sedov, S.; Jiménez-Álvarez, S; Leonard, D.; Lailson-Tinoco, B.; García-Moll, R.; Ancona-Aragón, I.; Hernández, L. (2017). "Soils as a source of raw materials for ancient ceramic production in the Maya region of Mexico: Micromorphological insight" (<https://doi.org/10.18268%2FBSGM2018v70n1a2>). *Boletín de la Sociedad Geológica Mexicana*. **70** (1): 21–48. doi:10.18268/BSGM2018v70n1a2 (<https://doi.org/10.18268%2FBSGM2018v70n1a2>).
126. Carrington, Damian (31 August 2016). "How the domestic chicken rose to define the Anthropocene" (<https://www.theguardian.com/environment/2016/aug/31/domestic-chicken-anthropocene-humanity-influenced-epoch>). *The Guardian*.
127. Achmon, Yigal; Achmon, Moshe; Dowdy, F. Ryan; Spiegel, Orr; Claypool, Joshua T.; Toniato, Juliano; Simmons, Christopher W. (2018). "Understanding the Anthropocene through the lens of landfill microbiomes". *Frontiers in Ecology and the Environment*. **16** (6): 354–360. Bibcode:2018FrEE...16..354A (<https://ui.adsabs.harvard.edu/abs/2018FrEE...16..354A>). doi:10.1002/fee.1819 (<https://doi.org/10.1002%2Ffee.1819>). ISSN 1540-9309 (<https://search.worldcat.org/issn/1540-9309>). S2CID 89937817 (<https://api.semanticscholar.org/CorpusID:89937817>).
128. Sousa, Matthew; Benson, Bryce; Welty, Connor; Price, Dylan; Thirkill, Ruth; Erickson, William; et al. (February 2020). "Atmospheric Deposition of Coal-Related Pollutants in the Pacific Northwest of the United States from 1950 to 2016". *Environmental Toxicology and Chemistry*. **39** (2): 335–342. Bibcode:2020EnvTC..39..335S (<https://ui.adsabs.harvard.edu/abs/2020EnvTC..39..335S>). doi:10.1002/etc.4635 (<https://doi.org/10.1002%2Fetc.4635>). PMID 31743941 (<https://pubmed.ncbi.nlm.nih.gov/31743941>). S2CID 208186469 (<https://api.semanticscholar.org/CorpusID:208186469>).

129. Cecil, L. DeWayne; David L. Naftz; Paul F. Schuster; David D. Susong; Jaromy R. Green (2010). *The Paleoenvironmental Record Preserved in Middle Latitude, High-Mountain Glaciers – An Overview of U.S. Geological Survey Experience in Central Asia and the United States* (https://pubs.usgs.gov/pp/p1386f/pdf/F8_PaleoRecord.pdf) (PDF) (Report). United States Geological Survey. Retrieved 14 May 2022.
130. Krabbenhoft, David; Paul Schuster. *Glacial Ice Cores Reveal a Record of Natural and Anthropogenic Atmospheric Mercury Deposition for the Last 270 Years* (<https://web.archive.org/web/20220308171512/https://toxics.usgs.gov/pubs/FS-051-02/pdf/fs-051-02.pdf>) (PDF) (Report). USGS Fact Sheet. Vol. FS-051-02. U.S. Geological Survey. Archived from the original (<https://toxics.usgs.gov/pubs/FS-051-02/pdf/fs-051-02.pdf>) (PDF) on 8 March 2022. Retrieved 14 May 2022.
131. Právělie, Remus (October 2014). "Nuclear weapons tests and environmental consequences: A global perspective" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4165831>). *Ambio*. **43** (6): 729–744. Bibcode:2014Ambio..43..729P (<https://ui.adsabs.harvard.edu/abs/2014Ambio..43..729P>). doi:10.1007/s13280-014-0491-1 (<https://doi.org/10.1007%2Fs13280-014-0491-1>). PMC 4165831 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4165831>). PMID 24563393 (<https://pubmed.ncbi.nlm.nih.gov/24563393>).
132. Turney, Chris S.M.; Palmer, Jonathan; Maslin, Mark A.; Hogg, Alan; Fogwill, Christopher J.; Southon, John; et al. (2018). "Global peak in atmospheric radiocarbon provides a potential definition for the onset of the Anthropocene Epoch in 1965" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5818508>). *Scientific Reports*. **8** (1): 3293. Bibcode:2018NatSR...8.3293T (<https://ui.adsabs.harvard.edu/abs/2018NatSR...8.3293T>). doi:10.1038/s41598-018-20970-5 (<https://doi.org/10.1038%2Fs41598-018-20970-5>). PMC 5818508 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5818508>). PMID 29459648 (<https://pubmed.ncbi.nlm.nih.gov/29459648>).
133. Zalasiewicz, J.; Williams, M.; Steffen, W. & Crutzen, P.J. (2010). "Response to 'The Anthropocene forces us to reconsider adaptationist models of human-environment interactions' ". *Environmental Science & Technology*. **44** (16): 6008. Bibcode:2010EnST...44.6008Z (<https://ui.adsabs.harvard.edu/abs/2010EnST...44.6008Z>). doi:10.1021/es102062w (<https://doi.org/10.1021%2Fes102062w>).
134. Zalasiewicz, J.; et al. (2011). "Stratigraphy of the Anthropocene" (<https://doi.org/10.1098%2Fsta.2010.0315>). *Philosophical Transactions of the Royal Society A*. **369** (1938): 1036–1055. Bibcode:2011RSPTA.369.1036Z (<https://ui.adsabs.harvard.edu/abs/2011RSPTA.369.1036Z>). doi:10.1098/rsta.2010.0315 (<https://doi.org/10.1098%2Fsta.2010.0315>). PMID 21282159 (<https://pubmed.ncbi.nlm.nih.gov/21282159>).
135. Giaimo, Cara (13 January 2016). "Stone Age, Bronze Age... Plastic Age? The Race to Define Our Epoch" (<https://www.atlasobscura.com/articles/stone-age-bronze-age-plastic-age-the-race-to-define-our-epoch>). *Atlas Obscura*. Retrieved 4 May 2025.
136. Richter, D. deB. (2007). "Humanity's transformation of Earth's soil: Pedology's new frontier". *Soil Science*. **172** (12): 957–967. Bibcode:2007SoilS.172..957R (<https://ui.adsabs.harvard.edu/abs/2007SoilS.172..957R>). doi:10.1097/ss.0b013e3181586bb7 (<https://doi.org/10.1097%2Fss.0b013e3181586bb7>). S2CID 15921701 (<https://api.semanticscholar.org/CorpusID:15921701>).
137. Amundson, R. & Jenny, H. (1991). "The place of humans in the state factor theory of ecosystems and their soils". *Soil Science*. **151** (1): 99–109. Bibcode:1991SoilS.151...99A (<https://ui.adsabs.harvard.edu/abs/1991SoilS.151...99A>). doi:10.1097/00010694-199101000-00012 (<https://doi.org/10.1097%2F00010694-199101000-00012>). S2CID 95061311 (<https://api.semanticscholar.org/CorpusID:95061311>).

138. Janovský, Martin (2024). "Stable isotope analysis in soil prospection reveals the type of historic land - use under contemporary temperate forests in Europe" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11208554>). *Scientific Reports*. **14** (1) 14746. Bibcode:2024NatSR..1414746J (<https://ui.adsabs.harvard.edu/abs/2024NatSR..1414746J>). doi:10.1038/s41598-024-63563-1 (<https://doi.org/10.1038%2Fs41598-024-63563-1>). PMC 11208554 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11208554>). PMID 38926400 (<https://pubmed.ncbi.nlm.nih.gov/38926400>).
139. Certini, G. & Scalenghe, R. (2011). "Anthropogenic soils are the golden spikes for the Anthropocene". *The Holocene*. **21** (8): 1269–1274. Bibcode:2011Holoc..21.1269C (<https://ui.adsabs.harvard.edu/abs/2011Holoc..21.1269C>). doi:10.1177/0959683611408454 (<https://doi.org/10.1177%2F0959683611408454>). S2CID 128818837 (<https://api.semanticscholar.org/CorpusID:128818837>).
140. "The Advent of the Anthropocene: Was that the big story of the 20th century?" (<https://web.archive.org/web/20160304072916/http://worldofideas.wbur.org/2015/03/29/mcneill>). *World of Ideas, Boston U. Radio*. Archived from the original (<http://worldofideas.wbur.org/2015/03/29/mcneill>) on 4 March 2016. Retrieved 28 November 2015.
141. Grinspoon, D. (28 June 2016). "The golden spike of Tranquility Base" (<https://www.skyandtelescope.com/astronomy-blogs/the-golden-spike-of-tranquility-base/>). *Sky & Telescope*.
142. Simpkins, Kelsey (16 October 2020). "Unprecedented energy use since 1950 has transformed humanity's geologic footprint" (<https://phys.org/news/2020-10-unprecedented-energy-humanity-geologic-footprint.html>). *phys.org*. University of Colorado at Boulder. Retrieved 17 October 2020.
143. Syvitski, Jaia; Waters, Colin N.; Day, John; et al. (2020). "Extraordinary human energy consumption and resultant geological impacts beginning around 1950 CE initiated the proposed Anthropocene Epoch" (<https://doi.org/10.1038%2Fs43247-020-00029-y>). *Communications Earth & Environment*. **1** (32): 32. Bibcode:2020ComEE...1...32S (<https://ui.adsabs.harvard.edu/abs/2020ComEE...1...32S>). doi:10.1038/s43247-020-00029-y (<https://doi.org/10.1038%2Fs43247-020-00029-y>). hdl:10810/51932 (<https://hdl.handle.net/10810%2F51932>). S2CID 222415797 (<https://api.semanticscholar.org/CorpusID:222415797>).
144. Laville, Sandra (9 December 2020). "Human-made materials now outweigh Earth's entire biomass – study" (<https://www.theguardian.com/environment/2020/dec/09/human-made-materials-now-outweigh-earths-entire-biomass-study>). *The Guardian*. Retrieved 10 December 2020.
145. Elhacham, Emily; Ben-Uri, Liad; et al. (2020). "Global human-made mass exceeds all living biomass". *Nature*. **588** (7838): 442–444. Bibcode:2020Natur.588..442E (<https://ui.adsabs.harvard.edu/abs/2020Natur.588..442E>). doi:10.1038/s41586-020-3010-5 (<https://doi.org/10.1038%2Fs41586-020-3010-5>). PMID 33299177 (<https://pubmed.ncbi.nlm.nih.gov/33299177>). S2CID 228077506 (<https://api.semanticscholar.org/CorpusID:228077506>).
146. Ritchie, Hannah (20 April 2021). "Wild mammals have declined by 85% since the rise of humans, but there is a possible future where they flourish" (<https://ourworldindata.org/wild-mammal-decline>). *Our World in Data*. Retrieved 18 April 2023.
147. Dirzo, Rodolfo; Ceballos, Gerardo; Ehrlich, Paul R. (2022). "Circling the drain: the extinction crisis and the future of humanity" (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9237743>). *Philosophical Transactions of the Royal Society B*. **377** (1857) 20210378. doi:10.1098/rstb.2021.0378 (<https://doi.org/10.1098%2Frstb.2021.0378>). PMC 9237743 (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9237743>). PMID 35757873 (<https://pubmed.ncbi.nlm.nih.gov/35757873>).
148. "MPhil in Anthropocene Studies" (<https://www.geog.cam.ac.uk/graduate/mphil/anthropocene/>).

149. Sutoris, Peter (20 October 2021). "The term 'Anthropocene' isn't perfect – but it shows us the scale of the environmental crisis we've caused" (<https://theconversation.com/the-term-anthropocene-isnt-perfect-but-it-shows-us-the-scale-of-the-environmental-crisis-weve-caused-169301>). *The Conversation*. Archived (<https://web.archive.org/web/20211020162931/http://theconversation.com/the-term-anthropocene-isnt-perfect-but-it-shows-us-the-scale-of-the-environmental-crisis-weve-caused-169301>) from the original on 20 October 2021.
150. Reddy, Elizabeth (8 April 2014). "What Does it Mean to do Anthropology in the Anthropocene?" (<https://blog.castac.org/2014/04/what-does-it-mean-to-do-anthropology-in-the-anthropocene/>). *Platypus*. Archived (<https://web.archive.org/web/20140531064303/http://blog.castac.org:80/2014/04/what-does-it-mean-to-do-anthropology-in-the-anthropocene/>) from the original on 31 May 2014.
151. Davis, Heather; Turpin, Etienne (2014). *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environments and Epistemologies* (<http://www.openhumanitiespress.org/books/titles/art-in-the-anthropocene/>). Open Humanities Press. pp. 3–30. ISBN 978-1-78542-008-5.
152. Hartigan, John (12 December 2014). "Multispecies vs Anthropocene" (<http://somatosphere.net/2014/multispecies-vs-anthropocene.html/>). *Somatosphere*. Archived (<https://web.archive.org/web/20200921163424/http://somatosphere.net/2014/multispecies-vs-anthropocene.html/>) from the original on 21 September 2020.
153. Haraway, Donna (2014). Davis, Heather; Turpin, Etienne (eds.). *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environments and Epistemologies* (<http://www.openhumanitiespress.org/books/titles/art-in-the-anthropocene/>). Open Humanities Press. pp. 255–270. ISBN 978-1-78542-008-5.
154. Moore, Jason W., ed. (2016). *Anthropocene or Capitalocene? Nature, history, and the crisis of capitalism*. Oakland, CA: PM Press. ISBN 978-1-62963-148-6.
155. Davies, Jeremy (24 May 2016). *The Birth of the Anthropocene* (<https://books.google.com/books?id=-VkiDQAAQBAJ&pg=PA94>) (1st, hardcover ed.). Oakland: University of California Press. pp. 94–95. ISBN 978-0-520-28997-0. LCCN 2015043076 (<https://lccn.loc.gov/2015043076>). OCLC 926061257 (<https://search.worldcat.org/oclc/926061257>). OL 27210120M (<https://openlibrary.org/books/OL27210120M>). Wikidata Q114630752.
156. Hickel, Jason (2021). *Less is More: How Degrowth Will Save the World*. Windmill Books. pp. 39–40. ISBN 978-1-78609-121-5. "It was only with the rise of capitalism over the past few hundred years, and the breathtaking acceleration of industrialization from the 1950s, that on a planetary scale things began to tip out of balance."
157. Foster, John Bellamy (2022). *Capitalism in the Anthropocene: Ecological Ruin or Ecological Revolution* (<https://books.google.com/books?id=wY5IEAAAQBAJ&pg=PT7location=>). Monthly Review Press. p. 1. ISBN 978-1-58367-974-6. "The advent of the Anthropocene coincided with a planetary rift, as the human economy under capitalism heedlessly crossed, or began to cross, Earth System boundaries, fouling its own nest and threatening the destruction of the planet as a safe home for humanity."
158. Derber, Charles; Moodliar, Suren (2023). *Dying for Capitalism: How Big Money Fuels Extinction and What We Can Do About It*. Routledge. ISBN 978-1-032-51258-7.

159. Best, Steven (2021). "Failed Species: The Rise and Fall of the Human Empire" (<https://addletonacademicpublishers.com/contents-rjac/2241-volume-9-2-2021/4078-failed-species-the-rise-and-fall-of-the-human-empire>). *Romanian Journal of Artistic Creativity*. **9** (2). "Today we call this planetary monolith "global capitalism," but humans became global animals tens of thousands of years before the onset of capitalism. Humans created hierarchical and growth-addicted societies some ten thousand years ago and their ecocidal proclivities stretch back millennia more into prehistory. And just like every political empire of the past, the human empire has possibly reached its zenith and begun its downward spiral toward collapse. This empire's peak and slide into catastrophe marks a new epoch not only in human history, but also the history of the earth. Debates over whether advanced societies have entered into a new "postmodernity" pale in significance to the scientifically-based proposition that human activity has created a new epoch in geological history—the age of the Anthropocene. This epoch characterized by the dominance of human influence over earth's systems and has led to, among other colossal events, a sixth mass extinction crisis and runaway climate change."
160. "What is the Plantationocene?" (<https://edgeeffects.net/plantationocene-series-plantation-worlds/>). *Edge Effects Magazine*. c. 2020.
161. Haraway, Donna (2015). "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making kin" (<https://web.archive.org/web/20150714061851/http://environmentalhumanities.org/arch/vol6/6.7.pdf>) (PDF). *Environmental Humanities*. **6**: 159–165. doi:10.1215/22011919-3615934 (<https://doi.org/10.1215%2F22011919-3615934>). Archived from the original (<https://environmentalhumanities.org/arch/vol6/6.7.pdf>) (PDF) on 14 July 2015.
162. Yusoff, Kathryn. *A Billion Black Anthropocenes or None*. University of Minnesota Press.
163. Davis, Janae; Moulton, Alex A.; Sant, Levi Van; Williams, Brian (2019). "Anthropocene, Capitalocene, ... Plantationocene?: A Manifesto for Ecological Justice in an Age of Global Crises" (<https://onlinelibrary.wiley.com/doi/abs/10.1111/gec3.12438>). *Geography Compass*. **13** (5) e12438. Bibcode:2019GComp..13E2438D (<https://ui.adsabs.harvard.edu/abs/2019GComp..13E2438D>). doi:10.1111/gec3.12438 (<https://doi.org/10.1111%2Fgec3.12438>). ISSN 1749-8198 (<https://search.worldcat.org/issn/1749-8198>). S2CID 155374232 (<https://api.semanticscholar.org/CorpusID:155374232>).
164. Davis, Heather; Todd, Zoe (20 December 2017). "On the Importance of a Date, or, Decolonizing the Anthropocene" (<https://acme-journal.org/index.php/acme/article/view/1539>). *ACME: An International Journal for Critical Geographies*. **16** (4): 761–780. ISSN 1492-9732 (<https://search.worldcat.org/issn/1492-9732>).
165. Whyte, Kyle (2017). "Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing the Anthropocene" (<https://muse.jhu.edu/article/711473>). *English Language Notes*. **55** (1): 153–162. doi:10.1215/00138282-55.1-2.153 (<https://doi.org/10.1215%2F00138282-55.1-2.153>). ISSN 2573-3575 (<https://search.worldcat.org/issn/2573-3575>). S2CID 132153346 (<https://api.semanticscholar.org/CorpusID:132153346>).
166. Whyte, Kyle (2016). "Is it Colonial Déjà Vu? Indigenous Peoples and Climate Injustice". In Adamson, Joni (ed.). *Humanities for the Environment: Integrating Knowledges, Forging New Constellations of Practice*. Routledge. pp. 88–104. doi:10.2139/ssrn.2925277 (<https://doi.org/10.2139%2Fssrn.2925277>). SSRN 2925277 (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2925277).
167. Whyte, Kyle P. (1 March 2018). "Indigenous science (fiction) for the Anthropocene: Ancestral dystopias and fantasies of climate change crises". *Environment and Planning E: Nature and Space*. **1** (1–2): 224–242. Bibcode:2018EnPIE...1..224W (<https://ui.adsabs.harvard.edu/abs/2018EnPIE...1..224W>). doi:10.1177/2514848618777621 (<https://doi.org/10.1177%2F2514848618777621>). ISSN 2514-8486 (<https://search.worldcat.org/issn/2514-8486>). S2CID 158298529 (<https://api.semanticscholar.org/CorpusID:158298529>).

168. Todd, Zoe (2014). Davis, Heather; Turpin, Etienne (eds.). *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environments and Epistemologies* (<http://www.openhumanitiespress.org/books/titles/art-in-the-anthropocene/>). Open Humanities Press. pp. 241–254. ISBN 978-1-78542-008-5.
169. Hacıgüzeller, Piraye (December 2021). "On critical hope and the anthropos of non-anthropocentric discourses. Some thoughts on archaeology in the Anthropocene" (<https://doi.org/10.1017%2FS1380203821000192>). *Archaeological Dialogues*. **28** (2): 163–170. doi:10.1017/S1380203821000192 (<https://doi.org/10.1017%2FS1380203821000192>). hdl:10067/1836770151162165141 (<https://hdl.handle.net/10067%2F1836770151162165141>). S2CID 244775395 (<https://api.semanticscholar.org/CorpusID:244775395>).
170. Milstein, Tema; Castro-Sotomayor, José, eds. (1 May 2020). *Routledge Handbook of Ecocultural Identity* (<https://www.taylorfrancis.com/books/9781351068833>) (1 ed.). Abingdon, Oxon; New York, NY : Routledge, 2020. |: Routledge. doi:10.4324/9781351068840 (<https://doi.org/10.4324%2F9781351068840>). ISBN 978-1-351-06884-0.
171. Certini, Giacomo; Scalenghe, Riccardo (April 2015). "Is the Anthropocene really worthy of a formal geologic definition?". *The Anthropocene Review*. **2** (1): 77–80. Bibcode:2015AntRv...2...77C (<https://ui.adsabs.harvard.edu/abs/2015AntRv...2...77C>). doi:10.1177/2053019614563840 (<https://doi.org/10.1177%2F2053019614563840>). ISSN 2053-0196 (<https://search.worldcat.org/issn/2053-0196>). S2CID 130059700 (<https://api.semanticscholar.org/CorpusID:130059700>).
172. Ellis, Erle; Goldewijk, Kees Klein; Gaillard, Marie-José; Kaplan, Jed O.; Thornton, Alexa; Powell, Jeremy; et al. (30 August 2019). "Archaeological assessment reveals Earth's early transformation through land use". *Science*. **365** (6456): 897–902. Bibcode:2019Sci...365..897S (<https://ui.adsabs.harvard.edu/abs/2019Sci...365..897S>). doi:10.1126/science.aax1192 (<https://doi.org/10.1126%2Fscience.aax1192>). hdl:10150/634688 (<https://hdl.handle.net/10150%2F634688>). ISSN 0036-8075 (<https://search.worldcat.org/issn/0036-8075>). PMID 31467217 (<https://pubmed.ncbi.nlm.nih.gov/31467217>). S2CID 201674203 (<https://api.semanticscholar.org/CorpusID:201674203>).
173. Lightfoot, Kent G.; Cuthrell, Rob Q. (29 May 2015). "Anthropogenic burning and the Anthropocene in late-Holocene California". *The Holocene*. **25** (10): 1581–1587. Bibcode:2015Holoc..25.1581L (<https://ui.adsabs.harvard.edu/abs/2015Holoc..25.1581L>). doi:10.1177/0959683615588376 (<https://doi.org/10.1177%2F0959683615588376>). ISSN 0959-6836 (<https://search.worldcat.org/issn/0959-6836>). S2CID 130614921 (<https://api.semanticscholar.org/CorpusID:130614921>).
174. Mason, Betsy (2003). "Man has been changing climate for 8,000 years". *Nature*. doi:10.1038/news031208-7 (<https://doi.org/10.1038%2Fnews031208-7>).
175. Robert, Adler (11 December 2003). "Early farmers warmed Earth's climate" (<https://www.newscientist.com/article/dn4464-early-farmers-warmed-earths-climate/>). *New Scientist*. Retrieved 4 February 2008.
176. Ruddiman, William F. (2003). "The anthropogenic greenhouse era began thousands of years ago" (https://web.archive.org/web/20140416132256/http://earth.geology.yale.edu/~avf5/teaching/Files_pdf/Ruddiman2003.pdf) (PDF). *Climatic Change*. **61** (3): 261–293. Bibcode:2003ClCh...61..261R (<https://ui.adsabs.harvard.edu/abs/2003ClCh...61..261R>). CiteSeerX 10.1.1.651.2119 (<https://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.651.2119>). doi:10.1023/B:CLIM.0000004577.17928.fa (<https://doi.org/10.1023%2FB%3ACLIM.0000004577.17928.fa>). S2CID 2501894 (<https://api.semanticscholar.org/CorpusID:2501894>). Archived from the original (http://earth.geology.yale.edu/~avf5/teaching/Files_pdf/Ruddiman2003.pdf) (PDF) on 16 April 2014.

177. Broecker, Wallace S.; Stocker, Thomas F. (2006). "The Holocene CO₂ rise: Anthropogenic or natural?" (<https://doi.org/10.1029%2F2006EO030002>). *Eos, Transactions American Geophysical Union*. **87** (3): 27. Bibcode:2006EOSTr..87...27B (<https://ui.adsabs.harvard.edu/abs/2006EOSTr..87...27B>). doi:10.1029/2006EO030002 (<https://doi.org/10.1029%2F2006EO030002>). ISSN 2324-9250 (<https://search.worldcat.org/issn/2324-9250>).
178. Tzedakis, P.C.; Raynaud, D.; McManus, J.F.; Berger, A.; Brovkin, V.; Kiefer, T. (2009). "Interglacial diversity". *Nature Geoscience*. **2** (11): 751–755. Bibcode:2009NatGe...2..751T (<https://ui.adsabs.harvard.edu/abs/2009NatGe...2..751T>). doi:10.1038/ngeo660 (<https://doi.org/10.1038%2Fng660>).
179. Crawley MJ. 1989. Chance and timing in biological invasions. In: Drake JA, Mooney HJ, DiCatri F, et al. (Eds). *Biological invasions: a global perspective*. Chichester, UK: John Wiley.
180. Michael, Samways (1999). "Translocating fauna to foreign lands: Here comes the Homogenocene". *Journal of Insect Conservation*. **3** (2): 65–66. doi:10.1023/A:1017267807870 (<https://doi.org/10.1023%2FA%3A1017267807870>). S2CID 263987331 (<https://api.semanticscholar.org/CorpusID:263987331>).
181. Curnutt, John L. (2000). "AA Guide to the Homogenocene". *Ecology*. **81** (6): 1756–1757. doi:10.1890/0012-9658(2000)081[1756:AGTTH]2.0.CO;2 (<https://doi.org/10.1890%2F0012-9658%282000%29081%5B1756%3AAGTTH%5D2.0.CO%3B2>).
182. Mann, Charles C. (2011). *1493: Uncovering the New World Columbus Created* (<https://archive.org/details/1493uncoveringne00mann>). New York: Knopf. ISBN 978-0-307-26572-2.
183. Clark, Timothy (1 December 2012). Clark, Timothy (ed.). "Special Issue: Deconstruction in the Anthropocene". *Oxford Literary Review*. **34** (2): v–vi. doi:10.3366/olr.2012.0039 (<https://doi.org/10.3366%2Folr.2012.0039>).
184. Humanities Research Centre, Australian National University (13 June 2012). *Anthropocene Humanities: The 2012 Annual Meeting of the Consortium of Humanities Centers and Institutes* (<https://web.archive.org/web/20140831221523/http://chcnetwork.org/anthropocene-humanities/>). Canberra, Australia. Archived from the original (<http://chcnetwork.org/anthropocene-humanities/>) on 31 August 2014. Retrieved 21 July 2014.
185. Rachel Carson; Alexander von Humboldt (14 June 2013). *Culture and the Anthropocene* (http://www.carsoncenter.uni-muenchen.de/events_conf_seminars/event_history/2013/2013_conf_ws_sem/130614_cult_anthrop/index.html). Munich, Germany. Retrieved 21 July 2014.
186. Wenzel, Jennifer (13 March 2014). "Climate Change" (<http://stateofthediscipline.acla.org/entry/climate-change>). *State of the Discipline Report: Ideas of the Decade*. American Comparative Literature Association.
187. Scranton, Roy (10 November 2013). "Learning how to die in the Anthropocene" (<https://opinionator.blogs.nytimes.com/2013/11/10/learning-how-to-die-in-the-anthropocene/>). Opinionator. *The New York Times*. Retrieved 17 July 2014.
188. Colebrook, Claire (27 January 2014). "The Anthropocene and the Archive" (<https://web.archive.org/web/20160303205338/http://thememorynetwork.net/the-anthropocene-and-the-archive/>). *The Memory Network: Exchanges*. Archived from the original (<http://thememorynetwork.net/the-anthropocene-and-the-archive/>) on 3 March 2016. Retrieved 21 July 2014.
189. Nowviskie, Bethany (10 July 2014). "Digital humanities in the anthropocene" (<http://nowviskie.org/2014/anthropocene/>). *nowviskie.org*. Retrieved 10 July 2014.
190. Ronda, Margaret (10 June 2013). "Mourning and Melancholia in the Anthropocene" (<https://post45.org/2013/06/mourning-and-melancholia-in-the-anthropocene/>). *Post45*. Retrieved 21 July 2014.

191. Benson, Melinda Harm; Craig, Robin Kundis (2014). "The End of Sustainability" (<http://www.tandfonline.com/doi/abs/10.1080/08941920.2014.901467>). *Society & Natural Resources*. **27** (7): 777–782. Bibcode:2014SNatR..27..777B (<https://ui.adsabs.harvard.edu/abs/2014SNatR..27..777B>). doi:10.1080/08941920.2014.901467 (<https://doi.org/10.1080%2F08941920.2014.901467>). ISSN 0894-1920 (<https://search.worldcat.org/issn/0894-1920>). S2CID 67783261 (<https://api.semanticscholar.org/CorpusID:67783261>).
192. McNeill, John (2000). *Something New Under the Sun: An Environmental History of the Twentieth-Century World*. New York: W. W. Norton & Company.
193. Oreskes, Naomi; Eric, Conway (2010). *Merchants of Doubt: How a handful of scientists obscured the truth on issues from tobacco smoke to climate change*.
194. Oreskes, Naomi (3 December 2004). "The Scientific Consensus on Climate Change" (<https://doi.org/10.1126%2Fscience.1103618>). *Science*. **306** (5702): 1686. doi:10.1126/science.1103618 (<https://doi.org/10.1126%2Fscience.1103618>). PMID 15576594 (<https://pubmed.ncbi.nlm.nih.gov/15576594>). S2CID 153792099 (<https://api.semanticscholar.org/CorpusID:153792099>).
195. Lonie, Bridie (10 September 2024). "Cabbages, Crumble and Sky Talk: Environmental and Planetary Issues in Art – Aotearoa New Zealand" (<https://ojs.victoria.ac.nz/jnzs/article/view/9589>). *The Journal of New Zealand Studies* (NS38). doi:10.26686/jnzs.iNS38.9589 (<https://doi.org/10.26686%2Fjnzs.iNS38.9589>). ISSN 2324-3740 (<https://search.worldcat.org/issn/2324-3740>).
196. Mulvey, Nick (1 October 2019). *Nick Mulvey – In the Anthropocene* (<https://www.youtube.com/watch?v=OYnaQlvBRAE>). Retrieved 27 June 2024 – via YouTube.
197. CMU: Nick Mulvey releases vinyl made from recycled plastic washed up on Cornish beaches (<https://completemusicupdate.com/article/nick-mulvey-releases-vinyl-made-from-recycled-plastic-washed-up-on-cornish-beaches/>)
198. "The Anthropocene Reviewed – WNYC Studios and Complexly" (<https://open.spotify.com/show/3scirzcuaGm02MQ4FUZydq>). *Spotify*. Retrieved 13 May 2020.
199. Kenigsberg, Ben (24 September 2019). "'Anthropocene: The Human Epoch' Review: Global Warnings" (<https://www.nytimes.com/2019/09/24/movies/anthropocene-the-human-epoch-review.html>). *The New York Times*.
200. Davison, Nicola. "The devastating environmental impact of human progress like you've never seen it before" (<https://www.wired.com/story/ed-burtynsky-anthropocene/>). *Wired*. ISSN 1059-1028 (<https://search.worldcat.org/issn/1059-1028>). Retrieved 5 April 2024.
201. "Cattle Decapitation – To Release 'The Anthropocene Extinction' This August Via Metal Blade Records" (<http://www.metalblade.com/us/news/cattle-decapitation-to-release-the-anthropocene-extinction/>) (Press release). *Metal Blade Records*. 20 May 2015. Retrieved 20 October 2020.
202. "The 25 Best Pop Albums of 2020: Staff Picks" (<https://www.billboard.com/media/lists/best-pop-albums-2020-9498901/>). *Billboard*. 15 November 2019. Retrieved 5 May 2024.

External links

- The Anthropocene epoch: have we entered a new phase of planetary history? (<https://www.theguardian.com/environment/2019/may/30/anthropocene-epoch-have-we-entered-a-new-phase-of-planetary-history>), *The Guardian*, 2019
- Drawing A Line In The Mud: Scientists Debate When 'Age Of Humans' Began (<https://www.npr.org/2021/03/17/974774461/drawing-a-line-in-the-mud-scientists-debate-when-age-of-humans-began>). NPR. 17 March 2021.
- "The Anthropocene: Where on Earth are we Going? [Full]" (<https://www.youtube.com/watch?v=HvD0TgE34HA>). *YouTube*. The Royal Society of Victoria. 15 April 2021. (lecture given by Professor Will Steffen in Melbourne, Australia)

- 8 billion humans: How population growth and climate change are connected as the 'Anthropocene engine' transforms the planet (<https://theconversation.com/8-billion-humans-how-population-growth-and-climate-change-are-connected-as-the-anthropocene-engine-transforms-the-planet-193075>). *The Conversation*. 3 November 2022.
-

Retrieved from "<https://en.wikipedia.org/w/index.php?title=Anthropocene&oldid=1354601236>"