

Isegora Briefs

November/December 2025

Prepared by the Isegora Briefs Team



**“Promoting equal
opportunity in
debate through
accessible resources
for all”**

November/December 2025

Resolved: The United States ought to rewild substantial tracts of land.

Notes

Special thanks to everyone on our team who has contributed to make this possible:

Aalekh Arapalli

Andres Munoz Broder

Elijah Winners

Isaac Dale

Kieran Finnegan (Brief Director)

Neel Shrivastava

Raghav Senthil Kumar

Teshy Jalf

Wareesha Islam

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Topicality

Ought

Morality

Ought indicates a moral obligation

Merriam-Webster [["Ought"](#) Definition & [Meaning](#)." Merriam-Webster. Merriam-Webster, n.d. Web. 05 Oct. 2025.] //Isegora

: [moral obligation](#) : DUTY

Rewild

Generic

Rewilding is the process of replacing places of human activity to its natural state.

Merriam Webster [**Rewild** Definition & **Mean**ing." Merriam-Webster. Merriam-Webster, n.d. Web. 05 Oct. 2025.] //Isegora

transitive + intransitive : **to return to a more natural or wild state** : to make or become natural or wild again Are there garden beds, growing containers or areas under shrubs and trees where you can leave things a little less tidy? If you are able, rewild these places to support hundreds of native pollinators. —Kara Carleton [George] Monbiot's thesis is that to halt and reverse climate change and the global extinction crisis, we must drastically reduce the amount of land we farm, and rewild it with forests and wetlands. —Philippa Jamieson It overlooks what was once part of a golf course, although you would never guess, given how quickly the land has rewilded. —Adam McCulloch

specifically : **to increase biodiversity and restore the natural processes of an ecosystem typically by reducing or ceasing human activity** and reintroducing plant and animal species

Substantial

Ample

Substantial is significant in quantity

Merriam-Webster ["Substantial Definition & Meaning." Merriam-Webster. Merriam-Webster, n.d. Web. 05 Oct. 2025.] //Isegora

considerable in quantity : significantly great

40%

Substantial indicates at least 40% -- Congress agrees.

Superfast CPA[Substantiation and disclosure of tax positions on the CPA exam – SuperfastCPA CPA review. (n.d.). Retrieved October 7, 2025, from <https://www.superfastcpa.com/substantiation-and-disclosure-of-tax-positions-on-the-cpa-exam/>] //Isegora

However, **Congress** is the overriding authority and there is a provision that **says** it needs to be “substantial authority” to take a given tax position. In this case, “substantial” means at least a **40%** chance that the IRS would accept the position. You don’t need to know how to judge the percentage, or how a “40% chance” would be calculated, but **the standard** is a 40% chance that the IRS would agree with the position.

25%

Substantial is 25%

Law Insider 25 [Law Insider (2025, July 6). Substantial or significant portion definition | Law Insider. Law Insider. Retrieved October 6, 2025, from <https://www.lawinsider.com/dictionary/substantial-or-significant-portion>] //lsegora

Substantial or Significant Portion **means 25%** or more.

Greater than 5%

Substantial is at least 5%

AustLII [CORPORATIONS ACT 1989 No. 109 of 1989 - SECT 708 Substantial shareholdings and substantial shareholders. (n.d.). Retrieved October 7, 2025, from https://classic.austlii.edu.au/au/legis/cth/num_act/ca1989172/s708.html] //lsegora

For the purposes of this Part, a person has a **substantial** shareholding in a body corporate if, and only if, the person is entitled to not less than the prescribed percentage of: (a) where the voting shares in the body are not divided into 2 or more classes-those voting shares; or (b) where the voting shares in the body are divided into 2 or more classes-the shares in one of those classes. (2) For the purposes of this Part, the voting shares in a body corporate to which a person is entitled do not include voting shares in which an associate of the person has a relevant interest if a certificate issued by the Commission to that associate under subsection (3) in respect of those shares is in force. (3) The Commission may issue to a person a certificate declaring that specified shares in which that person has a relevant interest are to be disregarded for the purpose of ascertaining the voting shares to which another person specified in the certificate is entitled, and may, by written notice to the first-mentioned person, revoke the certificate. (4) For the purposes of this Part, a person who has a substantial shareholding in a body corporate is a substantial shareholder in that body. (5) In this section: "prescribed percentage" means: (a) subject to paragraph (b), **5%**; or

Tracts of land

General

Tracts of land have legal boundaries

Law Insider 25 ["Tract of Land Definition." Law Insider. Law Insider, 23 July 2025. Web. 06 Oct. 2025.] //Isegora

Tract of land means an expanse of land identified by address legally described with definitive boundaries.

Tract

A tract is a large and indefinite piece of land

Merriam-Webster [[tract](https://www.merriam-webster.com/dictionary/tract)]. (2025). In Merriam-Webster Dictionary. Retrieved October 6, 2025, from <https://www.merriam-webster.com/dictionary/tract> //lsegora

an indefinite stretch of land

Land

Land is only solid parts of the earth.

Merriam-Webster [land. (2025). In Merriam-Webster Dictionary. Retrieved October 6, 2025, from <https://www.merriam-webster.com/dictionary/land>] //Isegora

the **solid** part of the **surface of the earth**

Affirmative Evidence

Climate Change

Warming is real, there is overwhelming agreement in scientific communities.

Herring and Lindsey 22 [Herring, D., & Lindsey, R. (2022, October 12). What evidence exists that earth is warming and that humans are the main cause? NOAA Climate.gov. <https://www.climate.gov/news-features/climate-qa/what-evidence-exists-earth-warming-and-humans-are-main-cause//> Aadit]

We know the world is warming because people have been recording daily high and low temperatures at thousands of weather stations worldwide, over land and ocean, for many decades and, in some locations, for more than a century. When different teams of climate scientists in different agencies (e.g., NOAA and NASA) and in other countries (e.g., the U.K.'s Hadley Centre) average these data together, they all find essentially the same result: Earth's average surface temperature has risen by about 1.8°F (1.0°C) since 1880. [Image and caption omitted] In addition to our surface station data, we have many different lines of evidence that Earth is warming (learn more). Birds are migrating earlier, and their migration patterns are changing. Lobsters and other marine species are moving north. Plants are blooming earlier in the spring. Mountain glaciers are melting worldwide, and snow cover is declining in the Northern Hemisphere (Learn more here and here). Greenland's ice sheet—which holds about 8 percent of Earth's fresh water—is melting at an accelerating rate (learn more). Mean global sea level is rising (learn more). Arctic sea ice is declining rapidly in both thickness and extent (learn more). [Image and caption omitted] We know this warming is largely caused by human activities because the key role that carbon dioxide plays in maintaining Earth's natural greenhouse effect has been understood since the mid-1800s. Unless it is offset by some equally large cooling influence, more atmospheric carbon dioxide will lead to warmer surface temperatures. Since 1800, the amount of carbon dioxide in the atmosphere has increased from about 280 parts per million to 410 ppm in 2019. We know from both its rapid increase and its isotopic "fingerprint" that the source of this new carbon dioxide is fossil fuels, and not natural sources like forest fires, volcanoes, or outgassing from the ocean. [Image and caption omitted] Finally, no other known climate influences have changed enough to account for the observed warming trend. Taken together, these and other lines of evidence point squarely to human activities as the cause of recent global warming.

Overwhelming scientific consensus agrees warming is real and anthropogenic

Cook et al. 16 [John Cook, et al, 2016. John Cook^{1,2,3,16}, Naomi Oreskes⁴, Peter T Doran⁵, William R L Anderegg^{6,7}, Bart Verheggen⁸, EdW Maibach⁹, J Stuart Carlton¹⁰, Stephan Lewandowsky^{11,2}, Andrew G Skuce^{12,3}, Sarah A Green¹³, Dana Nuccitelli³, Peter Jacobs⁹, Mark Richardson¹⁴, Bärbel Winkler³, Rob Painting³ and Ken Rice¹⁵ ¹ Global Change Institute, University of Queensland, Australia ² School of Psychology, University of Western Australia, Australia ³ Skeptical Science, Brisbane, Queensland, Australia ⁴ Department of the History of Science, Harvard University, USA ⁵ Geology and Geophysics, Louisiana State University, USA ⁶ Department of Biology, University of Utah, USA ⁷ Princeton Environmental Institute, Princeton University, USA ⁸ Amsterdam University College, The Netherlands ⁹ Department of Environmental Science and Policy, George Mason University, USA ¹⁰ Texas Sea Grant College Program, Texas A&M University, College Station, TX USA ¹¹ University of Bristol, UK ¹² Salt Spring Consulting Ltd, Salt Spring Island, BC, Canada ¹³ Department of Chemistry, Michigan Technological University, USA ¹⁴ University of Reading, Reading, UK, now at Jet Propulsion Lab, California Institute of Technology, Pasadena, USA ¹⁵ Institute for Astronomy, University of Edinburgh, Edinburgh, UK ¹⁶ Author to whom any correspondence should be addressed. Environmental Research Letters. 4/13/16. "Consensus on consensus: a synthesis of consensus estimates on human-caused global warming" DOI: <http://dx.doi.org/10.1088/1748-9326/11/4/048002> Accessed 7/12/18 //WR-NCP]

Abstract The consensus that humans are causing recent global warming is shared by 90%–100% of publishing climate scientists according to six independent studies by co-authors of this paper. Those results are consistent with the 97% consensus reported by Cook et al (Environ. Res. Lett. 8 024024) based on 11,944 abstracts of research papers, of which 4014 took a position on the cause of recent global warming. A survey of authors of those papers (N = 2412 papers) also supported a 97% consensus. Tol (2016 Environ. Res. Lett. 11 048001) comes to a different conclusion using results from surveys of nonexperts such as economic geologists and a self-selected group of those who reject the consensus. We demonstrate that this outcome is not unexpected because the level of consensus correlates with expertise in climate science. At one point, Tol also reduces the apparent consensus by assuming that abstracts that do not explicitly state the cause of global warming ('no position') represent nonendorsement, an approach that if applied elsewhere would reject consensus on well-established theories such as plate tectonics. We examine the available studies and conclude that the finding of 97% consensus in published climate research is robust and consistent with other surveys of climate scientists and peer-reviewed studies.

1. Introduction Climate scientists overwhelmingly agree that humans are causing recent global warming. The consensus position is articulated by the Intergovernmental Panel on Climate Change (IPCC) statement that 'human influence has been the dominant cause of the observed warming since the mid-20th century' (Qin et al 2014, p 17). The National Academies of Science from 80 countries have issued statements endorsing the consensus position (table S2). Nevertheless, the existence of the consensus continues to be questioned. Here we summarize studies that quantify expert views and examine common flaws in criticisms of consensus estimates. In particular, we are responding to a comment by Tol (2016) on Cook et al (2013, referred to as C13). We show that contrary to Tol's claim that the results of C13 differ from earlier studies, the consensus of experts is robust across all the studies conducted by coauthors of this correspondence. Tol's erroneous conclusions stem from conflating the opinions of non-experts with experts and assuming that lack of affirmation equals dissent. A detailed technical response to Tol is provided in (S1) where we specifically address quibbles about abstract ID numbers, timing of ratings, inter-rater communication and agreement, and access to ratings. None of those points raised by Tol affect the calculated

consensus. Most importantly, the 97% consensus derived from abstract ratings is validated by the authors of the papers studied who responded to our survey (N = 2142 papers) and also reported a 97% consensus in papers taking a position. The remainder of this paper shows that a high level of scientific consensus, in agreement with our results, is a robust finding in the scientific literature. This is used to illustrate and address the issues raised by Tol that are relevant to our main conclusion.

Warming real – ocean heat records prove

Abraham 16 [John, professor of thermal and fluid sciences at the University of St. Thomas, “Climate models are accurately predicting ocean and global warming,” 7/27/16, <https://www.theguardian.com/environment/climate-consensus-97-per-cent/2016/jul/27/climate-models-are-accurately-predicting-ocean-and-global-warming>]

For those of us who are concerned about global warming, two of the most critical questions we ask are, “how fast is the Earth warming?” and “how much will it warm in the future?”. The first question can be answered in a number of ways. For instance, we can actually measure the rate of energy increase in the Earth’s system (primarily through measuring changing ocean temperatures). Alternatively, we can measure changes in the net inflow of heat at the top of the atmosphere using satellites. We can also measure the rate of sea-level rise to get an estimate of the warming rate. Since much of sea-level rise is caused by thermal expansion of water, knowledge of the water-level rise allows us to deduce the warming rate. We can also use climate models (which are sophisticated computer calculations of the Earth’s climate) or our knowledge from Earth’s past (paleoclimatology). Many studies use combinations of these study methods to attain estimates and typically the estimates are that the planet is warming at a rate of perhaps 0.5 to 1 Watt per square meter of Earth’s surface area. However, there is some discrepancy among the actual numbers. So assuming we know how much heat is being accumulated by the Earth, how can we predict what the future climate will be? The main tool for this is climate models (although there are other independent ways we can study the future). With climate models, we can play “what-if scenarios” and input either current conditions or hypothetical conditions and watch the Earth’s climate evolve within the simulation. Two incorrect but nevertheless consistent denial arguments are that the Earth isn’t warming and that climate models are inaccurate. A new study, published by Kevin Trenberth, Lijing Cheng, and others (I was also an author) answers these questions. The study was just published in the journal Ocean Sciences; a draft of it is available here. In this study, we did a few new things. First, we presented a new estimate of ocean heating throughout its full depth (most studies only consider the top portion of the ocean). Second, we used a new technique to learn about ocean temperature changes in areas where there are very few measurements. Finally, we used a large group of computer models to predict warming rates, and we found excellent agreement between the predictions and the measurements. According to the measurements, the Earth has gained 0.46 Watts per square meter between 1970 and 2005. Since 1992 the rate is higher (0.75 Watts per square meter) and therefore shows an acceleration of the warming. To put this in perspective, this is the equivalent of 5,400,000,000,000 (or 5,400 billion) 60-watt light bulbs running continuously day and night. In my view, these numbers are the most accurate measurements of the rate at which the Earth is warming. What about the next question – how did the models do? Amazingly well. From 1970 through 2005, the models on average showed a warming of 0.41 Watts per square meter and from 1992-2005 the models gave 0.77 Watts per meter squared. This means that since 1992, the models have been within 3 % of the measurements. In my mind, this agreement is the strongest vindication of the models ever

found, and in fact, in our study we suggest that matches between climate models and ocean warming should be a major test of the models. Despite these excellent results, scientists want to do better. During a conversation with Dr. Trenberth, he told me: Progress is being made on understanding the energy flows through the climate system as datasets are improved and methods of analyzing the data are being revised and rigorously tested. We can never go back and make observations that were missed, but we can still improve knowledge of how the climate has evolved, even in recent (post-2005) data-rich (Argo) times. My other colleague, Dr. Lijing Cheng says: Ocean heat content is a vital climate indicator and is a key metric for global warming. How well ocean heating can be assessed by observations and can be simulated by climate models are a cornerstone of climate studies. By collecting the state-of-the-art observational ocean warming estimates and climate model results, this study gives the current status of our warming world and its future heating. We will continue to work hard to improve both measurements and models to better understand the climate change. Readers should also know that our study isn't the only one of its kind to make these findings. A paper published before ours by a world-class group of scientists came to similar conclusions. So too does another study found here. When multiple and independent studies come to similar conclusions, it suggests that the conclusions are robust.

Warming is accelerating

Wahlén 18 [Catherine Benson Wahlén [Thematic Expert for Human Development, Human Settlements and Sustainable Development (US)], 11-6-2018, "Study Suggests Global Warming is Faster than Scientists Estimated," IISD's SDG Knowledge Hub, <http://sdg.iisd.org/news/study-suggests-global-warming-is-faster-than-scientists-estimated/> OHS-AT]

31 October 2018: Researchers at Princeton University and the Scripps Institution of Oceanography published a study that warns that global warming may be happening faster than scientists have previously estimated. The study, published in Nature, suggests that these findings may mean that emitted greenhouse (GHG) gases have generated far more heat than scientists originally predicted, meaning that the Earth is more sensitive to carbon dioxide than scientists thought. The study titled, 'Quantification of Ocean Heat Uptake from Changes in Atmospheric Oxygen and Carbon Dioxide Composition', assesses ocean warmth using "a whole-ocean thermometer" to measure carbon dioxide and atmospheric oxygen, both of which increase as the ocean warms and releases gases. In other words, the researchers measured the amount of carbon dioxide and oxygen lost by the oceans, and then calculated the amount of warming needed to explain that change in gases. Previous studies have estimated ocean temperature using hydrographic temperature measurements and data, which the authors argue is an "imperfect ocean dataset." The study estimates that the world's oceans absorbed 60 percent more heat energy between 1991 and 2016 than previous estimates have suggested. Further, the study suggests, GHG emissions generate more heat than scientists originally predicted, which, the authors argue, may make it harder for the world to limit the global average temperature increases to the targets set in the Paris Agreement on climate change. In addition, the findings indicate that extra heat will go into the world's oceans, resulting in implications for marine ecosystems. Laure Resplandy, the Princeton University researcher who led the study, said the study finds that the planet warmed more than researchers had previously thought. "It was just hidden from us because we didn't sample it right," she explained. Resplandy elaborated that the study suggests that achieving the Paris Agreement targets is "even harder because we close the window for those lower pathways" outlined by the Intergovernmental Panel on Climate Change (IPCC) recent Special Report on Global Warming of 1.5°C (SR15). [Ocean Action Hub Story] [WEF News Story] [Nature Abstract]

Warming is accelerating

Nuccitelli '25 [Yale Climate Connections <https://yaleclimateconnections.org/2025/09/climate-change-is-accelerating-scientists-find-in-grim-report/> Nuccitelli, Dana. "Climate change is accelerating, scientists find in 'grim' report » Yale Climate Connections" Yale Climate Connections, 09/15/2025, <https://yaleclimateconnections.org/2025/09/climate-change-is-accelerating-scientists-find-in-grim-report/>. Accessed 10/10/2025.]

The amount of heat trapped by climate-warming pollution in our atmosphere is continuing to increase, the planet's sea levels are rising at an accelerating rate, and the Paris agreement's ambitious 1.5°C target is on the verge of being breached, according to a recent report by the world's top climate scientists. "The news is grim," said study co-author Zeke Hausfather, a former Yale Climate Connections contributor, on Bluesky. A team of over 60 international scientists published the latest edition of an annual report updating key metrics that are used in reports of the Intergovernmental Panel on Climate Change, the leading international scientific authority on climate change. Earth out of balance Climate change is caused by variations in Earth's energy balance – the difference between the planet's incoming and outgoing energy. Nearly all incoming energy originates from the sun. The Earth absorbs that sunlight and sends it back out toward space in the form of infrared light, or heat. Greenhouse gases such as carbon dioxide absorb infrared light, and so increased levels in those gases trap more heat in the atmosphere, warming the planet's surface and oceans. The new report finds that as a result of this increasing greenhouse effect, Earth's energy imbalance has been consistently rising every decade. In fact, the global imbalance has more than doubled just since the 1980s. And from 2020 to 2024, humans exacerbated the problem by adding about 200 billion more tons of carbon dioxide-equivalent greenhouse gases to the atmosphere. This increase in trapped energy has continued to warm Earth's surface temperatures. The new study estimated that at current rates, humans will burn enough fossil fuels and release enough climate pollution to commit the planet to over 1.5°C of global warming above preindustrial temperatures within about three more years, in 2028. The most recent report from the Intergovernmental Panel on Climate Change, published in 2021, concluded that average temperatures had increased 1.09°C since the late 1800s. The new study updates this number to 1.24°C, driven largely by the record-shattering hot years of 2023 and 2024. The paper also finds that global surface temperatures are warming at a rate of about 0.27°C per decade. That's nearly 50% faster than the close to 0.2°C-per-decade warming rate of the 1990s and 2000s, indicating an acceleration of global warming. That warming causes the water in the ocean to expand and land-based ice to melt, both of which contribute to rising sea levels. Since 1900, global sea levels have risen by nine inches, at an average rate of 1.85 millimeters per year. But the rate of sea level rise since 2000 has been twice as fast, at 3.7 millimeters per year. And over the past decade it's risen faster yet, at 4.5 millimeters per year. In other words, sea level rise is also accelerating. "Unfortunately, the unprecedented rates of global warming and accelerating sea-level rise are

as expected from greenhouse emissions being at an all-time high," University of Leeds climate scientist and the study's lead author Piers Forster wrote by email.

Rewilding is the solution to climate change

Introduction The twin crises created by the accelerating pace of climate change and loss of biodiversity (IPBES 2019) have prompted calls for expansion of the terrestrial protected area network. For example, a recent proposal for a Global Deal for Nature suggests that 30% of the terrestrial landscape be formally protected by 2030 and an additional 20% designated as climate stabilization areas, which would maintain or increase the carbon stored in vegetation and soil (Dinerstein et al. 2019). Rather than focusing solely on percentage targets, conservation scientists have also called for more effective placement of new protected areas so that they contribute maximally to reducing biodiversity loss and mitigating climate change (Visconti et al. 2019). Such proposals are not entirely new. The concept of rewilding, a key element underpinning the call for expanded protected area networks, was defined by Soulé and Noss (1998) as restoration and protection of interconnected wilderness landscapes large enough to support wide-ranging mammals, goals the proponents termed the 3Cs (cores, corridors, and carnivores). Reserve network design in the context of rewilding overlaps with conservation planning in the general sense but emphasizes ambitious goals for protection of large connected core areas that suit the needs of focal species with large area requirements. In contrast to most of conventional conservation planning, rewilding attempts to recover the fundamental properties of wilderness landscapes, including complete food webs and natural disturbance regimes (Soulé & Noss 1998). Although elements of the concept can be found in earlier writings by Victor Shelford and others (Croker 1991), rewilding framed this wilderness recovery goal within the context of modern conservation science. The rewilding framework is increasingly relevant given the ambitious targets for expanded protected area networks proposed by scientists, civil organizations, intergovernmental bodies, and some national governments. For example, the Canadian government has endorsed the Convention on Biological Diversity goal of 30% protection by 2030 (CBD 2020), and Bhutan has placed over 42% of its land in protected areas (Locke 2014). While rewilding initially focused on questions concerning landscape structure and reserve design, subsequent development of the concept, especially in Europe, shifted focus toward techniques for restoration of ecosystem processes in formerly human-modified landscapes (e.g., by reestablishing populations of large, usually semidomesticated, herbivores) (Lorimer et al. 2015; Perino et al. 2019, Pettorelli 2019). Ecosystems have structural, functional, and compositional components, all of which interact to determine biodiversity (Noss 1990). Both the structural and process-oriented definitions of rewilding are necessary and complementary because exclusive emphasis on process could result in unacceptable losses of species sensitive to anthropogenic change. We use the term "rewilding" in the original structure-oriented definition throughout the remainder of the article. Although ecologists had begun to consider the implications of climate change for reserve design by the mid-1980s (Peters & Darling 1985), the topic received only passing mention in the initial writings on rewilding (Soulé & Noss 1998; Soulé & Terborgh 1999). The concept's proponents realized that climate change provided additional support for ambitious conservation goals, but

they did not have sufficient information to assess how this increasing threat would influence the design of protected area networks. Although previous reviews have considered climate change within the process-oriented definition of rewilding (Seddon et al. 2014; Corlett 2016; Perino et al. 2019) or in the general context of protected area management (Jones et al. 2016; Reside et al. 2018), we focused on the less-treated question of how climate change can be incorporated within rewilding's structure-oriented focus on design of large interconnected reserve networks. We first explored whether and how the threat to biodiversity from climate change prompts reconsideration of the central concepts of rewilding, the 3Cs framework, and other ambitious strategies for expansion of protected areas. Such a review can serve as the initial element of a three-stage process in which practitioners first evaluate basic reserve design rules and then qualitatively consider the geography of climate change exposure (e.g., spatial patterns created by the interaction of global climate systems with regional topography). This qualitative understanding of threat patterns can inform a final stage in which systematic conservation planning methods are used to identify specific sites for protection (Stralberg et al. 2020b). We considered how practitioners can incorporate such a climate-informed rewilding strategy in regional conservation planning processes with recently developed spatial data projecting future exposure and vulnerability of biodiversity to climate change in the Yellowstone-to-Yukon (Y2Y) region (Fig. 1a) (Carroll et al. 2017; Stralberg et al. 2018, 2020b).

Figure 1 Open in figure viewerPowerPoint (a) Yellowstone-to-Yukon region showing the 7 largest protected areas (or protected-area planning region for Peel watershed, 1) and (b) comparison of values of the 8 climate adaptation metrics for these protected areas. All data are scaled to equal-area quantiles for comparability. Data sources are in Supporting Information.

Cores, Corridors, and Carnivores in the Context of Climate Change Effects of core reserve size on carnivores and other focal species Design of protected area networks has historically been informed by principles inspired by the theory of island biogeography (Wilson & MacArthur 1967). Diamond (1975) summarized these principles as implying that the effectiveness of protected areas in conserving biodiversity increases as they became bigger, more connected, and more circular (i.e., with less edge). Large carnivores are among the species with the largest area requirements to sustain viable populations (Shaffer 1981). Soulé and Noss (1998) proposed that protected area networks large enough to sustain focal carnivore species will also be of sufficient size to conserve species with smaller area requirements (Table 1); this is the familiar umbrella species strategy (Roberge & Angelstam 2004). Table 1. Four central concepts underlying reserve design and potential challenges to application of these concepts due to climate change The 3Cs refers to use of Cores, Corridors, and Carnivores as a conservation planning framework. In addition to their role as umbrella species, intact assemblages of carnivores may help buffer the effects of climate change on other species, for example by maintaining availability of carrion despite a shift towards shorter seasonal duration of snow cover, which preserves carrion (Wilmers & Getz 2005). Trophic cascades determined by the abundance of large carnivores may also influence net ecosystem productivity and hence carbon cycling, although the direction and magnitude of this effect varies between ecosystems (Wilmers & Schmitz 2016). The 3Cs approach is not invalidated by projections that even the

largest reserves may not retain carnivore species such as the wolverine (*Gulo gulo*), a species highly vulnerable to climate change via loss of snow-covered denning habitat (McKelvey et al. 2011). Given adequate broad-scale connectivity, large protected areas can sustain other area-dependent focal species adapted to their future climates as well as species with broader climatic tolerances such as the gray wolf (*Canis lupus*) (Carroll et al. 2001). Although the 3Cs approach uses carnivore area requirements to inform reserve proposals, in more developed ecoregions that lack sufficiently large natural areas to sustain large carnivores, the focal species element of the 3Cs strategy can be informed by area requirements of smaller focal species that are also vulnerable to changes in habitat configuration (Noss & Cooperrider 1994). More recent reviews have concluded that a group of small reserves may be more effective than a large single reserve under changing climates if the former encompasses broader climatic and elevational gradients (Table 1) (Pearson & Dawson 2005; Araújo 2009). Because the best option between a single large and several small reserves will largely depend on the specific planning context and species of concern, this argument, like the single large or several small debate as a whole, may have limited practical relevance. One aspect of the question, however, is uniquely relevant under climate change: the necessity of including both macro- and microrefugia within reserve networks. Microrefugia (small areas with locally favorable environments within otherwise unsuitable climates) may be important to persistence of species with modest area requirements under climate change, especially in topographically complex landscapes (Dobrowski 2011). The North American protected area network is predominantly located in low productivity areas (Scott et al. 2001), which are often at high elevations, so existing protected areas may have higher microrefugia potential than expected by chance (Oldfather et al. 2020). However, many microrefugia form holdout or stepping-stone habitat (Hannah et al. 2014), which has only transient value before being overwhelmed by broad-scale climate shifts. Therefore, a robust conservation network should include both microrefugia and large reserves that capture macrorefugia (areas where broad-scale climate is relatively stable and suitable for persistence) (Carroll et al. 2017) (Table 1). Area requirements for capturing macro- and microrefugia and broad environmental gradients may equal or exceed the area required to maintain focal species populations in the absence of climate change (Carroll et al. 2017; Stralberg et al. 2020b). Effects of reserve shape The effect of increased edge on persistence of species and ecosystem processes has been documented in many systems (Ries et al. 2004), leading to the principle that compact (circular) reserves are more effective at retaining elements of biodiversity of conservation concern (e.g., species associated with interior forest or vulnerable to human exploitation) (Diamond 1975) (Table 1). Nevertheless, subsequent reviews suggested that under climate change, a more linear reserve that spans climatic and elevational gradients may be more effective than a compact reserve (Table 1) (Pearson & Dawson 2005; Araújo 2009). Proponents of rewilding also proposed protection of intact elevational and latitudinal gradients to facilitate upslope or poleward migration of species in response to climate change (Noss & Cooperrider 1994). The contrast between the two perspectives hinges on the fact that rewilding proponents viewed novel stressors such as climate change as altering the role, but confirming the value of large core reserves (including those spanning climatic

gradients) as anchors of regional protected area networks. This latter perspective is supported by evidence that edge effects in small or linear reserves may be accentuated by the projected increase in extreme events such as droughts or megafires under climate change and the increased sensitivity of areas of forest near edges to these changes (Noss 2001) (Table 1). In regions where fire frequency or severity is projected to increase with climate change, fire refugia (areas in the landscape that remain unburned or less affected by fire) will become essential to the persistence of fire-sensitive species (Meddens et al. 2018). The role of corridors and connectivity Because even the largest core areas are of insufficient size to sustain populations of wide-ranging carnivore species, ensuring habitat connectivity between protected areas is a major element of rewilding (Soulé & Noss 1998) (Table 1). Connectivity conservation has also been identified as a key strategy for enhancing species dispersal and hence persistence under climate change (Heller & Zavaleta 2009). Many species and populations will need to shift their locations to track suitable climatic conditions (Chen et al. 2011). Pearson and Dawson (2005) note that because dispersal to newly suitable habitat may be difficult or impossible under climate change for certain species (especially the plant taxa they focused on), assisted colonization may become a more relevant strategy than conservation of habitat linkages (Table 1). The relative importance of these two strategies depends on the dispersal ability of particular taxa of concern. Climate velocity, a measure of the rate of dispersal necessary to track climate (Loarie 2009), varies widely across most regions of North America (Carroll et al. 2017). Many species in locations with low climate velocity will be able to disperse to external refugia (newly suitable areas within their dispersal range [Reside et al. 2018]) if connectivity can be maintained between current and future habitat (Table 1) (Keeley et al. 2018). Restoration of ecological processes Although not directly emphasized in the original 3Cs approach, restoration of ecological and evolutionary processes is an inherent element of rewilding because a wild ecosystem is one that maintains natural regimes of stress, disturbance, and stabilizing positive feedbacks (Table 1). Nevertheless, conservation goals based on process restoration have a more complex meaning under climate change (Lorimer et al. 2015). The original proposal for rewilding did not address the fundamental challenge of restoring wildness – or even determining what wildness means – for ecosystems undergoing rapid change toward likely novel states (Soulé & Noss 1998) (Table 1). Although historical baselines will become less relevant as templates for restoration, webs of positive feedbacks remain important for stabilizing composition and structure of communities (Bowman et al. 2015) (Table 1). Restoration of ecological processes may be a key factor in avoiding transition of ecosystems to degraded states due to the interaction of climate change with anthropogenic stressors, such as grazing, logging, and alteration of fire regimes (Noss 2001; Hanberry et al. 2015). Example from Yellowstone-to-Yukon Region of Integration of Climate Resilience and Rewilding Our review of the concepts underpinning rewilding suggests that the conservation value of large, connected protected areas persists under climate change but that this unprecedented threat may alter guidelines for the optimal design and placement of reserves. Because a key challenge of climate change exposure stems from its novel geographic patterns, we addressed the question of what planners might do differently when considering climate

resilience by summarizing these patterns and their implications for conservation planning in the Y2Y region. The Y2Y region, which spans the mountain ranges stretching from Yellowstone National Park in the United States to the Yukon in Canada, is an iconic example of a broad-scale conservation proposal impelled by the need to conserve a community of wide-ranging carnivore species (Fig. 1a) (Locke 1994; Carroll et al. 2001). The Y2Y region represents the southernmost extension of intact native assemblages of large carnivores such as the grizzly bear (*Ursus arctos*), wolf, and wolverine (Laliberte & Ripple 2004) for two reasons. First, it encompasses much of the Rocky Mountains, North America's largest north-south cordillera, which facilitates connectivity with larger boreal carnivore populations. Second, key core areas in the region were protected, primarily for their scenic beauty, before much of the surrounding landscape was modified by Euroamerican settlement (Fig. 1a & 2a) (Locke 1994).

Figure 2 Open in figure viewer

PowerPoint Comparison of 8 metrics relevant to regional climate adaptation planning in the Yellowstone-to-Yukon region of western Canada and the United States: (a) intactness (inverse of anthropogenic land use intensity), (b) topodiversity (topographic or elevational diversity), (c) refugia based on forward climatic velocity, (d) refugia based on backward climatic velocity, (e) bird species refugia, (f) tree species refugia, (g) aboveground forest carbon, and (h) soil carbon. As in Fig. 1, all data are scaled to equal-area quantiles for comparability. Sources of data in (a–h) are in Supporting Information. Even a protected area network as extensive as that within Y2Y will experience novel threats to its biota from climate change. Shifts in species distributions due to climate change are already evident in the Y2Y region (Dawe & Boutin 2016), as are ecosystem responses such as landcover change (Wang et al. 2020), including permafrost thaw-induced boreal forest loss (Carpino et al. 2018). The magnitude of the threat to species and ecosystems from climate change is a function of both climate exposure (how much change in climate a species is likely to experience at a site) and the species' sensitivity and capacity to adapt to changing climate via evolution, behavioral changes, phenotypic plasticity, or dispersal to new areas (McCarthy et al. 2001). Climate exposure and adaptive capacity can be measured for ecosystems and landscapes as well as for species. Landscape-scale conservation, by protecting key areas such as climate refugia (Keppel et al. 2015), can increase the adaptive capacity or resilience of a landscape and its ability to retain native species and ecosystems.

Latitudinal gradients The key latitudinal gradients influencing climate adaptation planning in the Y2Y region involve climate dissimilarity, microrefugia potential, species diversity, soil carbon, and the human footprint. The most fundamental measure of climate exposure is climate dissimilarity (i.e., how different will the future climate at a location be from its current climate?). A strong latitudinal gradient in dissimilarity is evident, with more rapid warming in boreal regions than at mid-latitudes (Wang et al. 2020) (Table 2). Table 2. Spatial gradients of climate exposure and related metrics in the Yellowstone-to-Yukon region and their implications for conservation planning *Level of generality: +, high; -, low; ~, intermediate. Within Y2Y, both elevation and topographic diversity generally increase from north to south (Fig. 2b & Table 2) (See Supporting Information for spatial data references and Beckers and Carroll [2020] to view and download data.) The relatively low local topographic diversity (and hence low potential for topographic

microrefugia) in much of boreal Y2Y compounds the effect of high climate dissimilarity and exposure there. A gradient of decreasing species diversity with latitude is also evident within the Y2Y region (Table 2). Metrics based on climatic-niche models for individual species therefore project that midlatitude areas will provide refugia for a greater number of species than will boreal regions (Stralberg et al. 2018). The several latitudinal gradients collectively imply several guidelines for climate adaptation planning. Topographically complex boreal landscapes such as the Mackenzie Mountains assume importance due to their rarity, as do ecologically driven refugia, such as peatland complexes and lake margins (Stralberg et al. 2020a). Recent conservation proposals suggest that protected area networks be expanded to include areas that hold large reserves of aboveground (biomass) and belowground (soil and biomass) carbon, with the aim of reducing disturbances that accelerate release of stored carbon (Dinerstein et al. 2019). Soil carbon is highest in large boreal peatlands, implying that protection of large boreal landscapes in Y2Y and elsewhere is critical for capturing areas of high soil carbon as well as conserving area-dependent species such as caribou (Rangifer tarandus) (Fig. 2b & Table 2) (Hengl et al. 2017; Stralberg et al. 2020a). Anthropogenic pressure, as represented here by the human modification index (Kennedy et al. 2019), forms another fundamental latitudinal gradient in North America, decreasing in intensity from mid-latitude portions of Y2Y to the boreal region (Fig. 2a & Table 2) (Carroll 2006). The diverse patterns of threat from anthropogenic stressors, such as oil and gas development and forestry, are incompletely represented in the global data set used here and would require further analysis in regional-scale planning processes. The rapid increase in anthropogenic development, especially in boreal Y2Y, prompts the question as to whether land-use change is so immediate a threat that priorities based on climate adaptation goals (e.g., restoration of potential climate refugia in already transformed landscapes) divert resources that would be better spent to protect undeveloped areas irrespective of their climate adaptation value. Although the relative pace of climate versus land-use change deserves consideration by planners, climate change is projected to alter conservation values even within otherwise undeveloped landscapes and will typically interact with land-use change to affect biodiversity (Brook et al. 2008). Evidence also suggests that incorporating climate change, adaptation, and mitigation goals into conservation planning strengthens societal support for protected area expansion (Wright et al., 2019). Longitudinal (maritime to continental) gradients The key longitudinal gradients influencing planning in the Y2Y region involve connectivity under climate change, species diversity, and aboveground carbon. The north–south trending axis of the Rocky Mountains and most other North American ranges allows montane protected area networks, such as Y2Y, to incidentally support latitudinal climate-driven range shifts. Because organisms will need to avoid hostile climates, dispersal routes between current climate types and where those climates will occur in the future will often be circuitous (Dobrowski & Parks 2016). Thus, the distribution of climate corridors (i.e., areas that support climate-driven dispersal) is driven by complex factors at a range of spatial scales and is not limited to north–south or elevational gradients (Supporting Information) (Carroll et al. 2018). In the Y2Y region, climate corridors occur along the eastern slopes of the central Canadian Rocky Mountains (areas that also served as ice-free dispersal corridors during

the Pleistocene [McDevitt et al. 2009]) and in the valleys of the Mackenzie Mountains and British Columbia's Inland Temperate Rainforest (Table 2 & Supporting Information). A strong longitudinal precipitation gradient is produced by predominantly west-to-east atmospheric circulation interacting with the north–south Rocky Mountain cordillera. The distribution of the taxonomic groups we examined, particularly tree species, shows a longitudinal gradient driven by precipitation patterns, with western, mesic areas supporting higher species diversity (Stralberg et al. 2018) (Fig. 2g & Table 2). These mesic forested areas also support the region's highest levels of aboveground carbon (Table 2) (Santoro 2018). In other regions, such as the Pacific coast of Canada, areas with high levels of below- and aboveground carbon may overlap to a greater degree than is seen within Y2Y (Buotte et al. 2020). Elevational gradients Montane ecosystems of Y2Y show elevational gradients in climate exposure, with rapid change predicted in alpine areas when a full suite of temperature and precipitation metrics are considered (Carroll et al. 2017). The high elevational and topographic diversity of the southern and central Y2Y region, however, should allow microrefugia to play a role in buffering such changes (Keppel et al. 2015) (Table 2). Although some populations will be able to persist in microrefugia because of their capacity to tolerate expected climatic shifts via genetic or behavioral adaptation, many populations will need to shift broadly in space. Climate velocity, the speed at which an organism needs to travel to keep pace with climate, can be measured by categorizing climate into types and measuring the straight-line distance between a site and the nearest site with the same climate type in a different period (Hamann et al. 2015). Forward climatic velocity, based on the distance between a site's current climate type and the nearest site with the same climate type under future climates, represents the rate at which an organism currently at a location must move to find future suitable climate (Hamann et al. 2015). Backward climate velocity, based on the distance between a site's future climate type and the nearest site with the same climate type under current climates, represents the rate at which organisms adapted to a location's future climate will need to move to colonize that location (Hamann et al. 2015). Forward velocity, which provides information on the ability of resident species and ecosystems to persist regionally, will often be high in alpine areas because reaching the nearest analogous future climate may require dispersal to distant mountaintops (Fig. 2c & Table 2). The high forward velocity of Y2Y's upper montane areas, especially high latitude ranges such as the Mackenzie Mountains, suggests these areas will experience substantial species turnover and ecosystem shifts. Backward velocity, which reflects a location's ability to serve as a refugium for species, is often high in valley bottoms because organisms must travel longer distances to colonize these locally new habitats (Fig. 2d & Table 3). Conversely, the low backward velocity of Y2Y's alpine and upper montane areas suggests their role as refugia for species from adjacent downslope areas. Nevertheless, an effective climate resilience strategy built around high-elevation protected areas must also encompass complete elevational gradients, including low-elevation areas currently underrepresented in the protected area network (Scott et al. 2001). Patterns of species range shifts under climate change are complex (Rapacciuolo et al. 2014; Lenoir & Svenning 2015). Because climate velocity is influenced by processes operating at multiple scales (e.g., a site's local and regional topographic position and its location in relation

to global climate circulation patterns), patterns shown by velocity metrics are more informative than simpler rules of thumb, such as movement upslope or to higher latitudes. Multivariate velocity metrics, such as we considered here, also reflect the understanding that future climate projections suggest low alignment between shifts in temperature and precipitation, with consequent challenges for species attempting to track climatic niches (Oldfather et al. 2020). Biogeographic patterns and gradients Climate velocity and similar metrics based on nonspecies-specific data represent a coarse-filter surrogate used to inform conservation of the vast majority of taxa for which detailed information is lacking (Noss & Cooperrider 1994). Ideally, however, such data should be complemented with fine-filter metrics focused on individual species, where that information is available (Tingley et al. 2014). Biotic velocity is a fine-filter metric based on correlations between species distributions and current climatic conditions, which are then projected forward to predict distribution under future climates (Carroll et al. 2015). Biotic velocity represents the distance between a site and the nearest site projected to be climatically suitable for the species under projected future climates. In comparison with refugia defined solely on the basis of climatic data, the distribution of biotic refugia in Y2Y is additionally influenced by biogeographic factors that have made certain regions more biodiverse than expected based on climate alone. Macrorefugia for tree species are primarily found in the Greater Yellowstone Ecosystem, the Central Canadian Rockies, and the western edge of the Y2Y region in British Columbia, which receives relatively more maritime influence (Fig. 2g) (Stralberg et al. 2018). Important songbird refugia occur in montane southern Y2Y and northern areas such as the Mackenzie Mountains (Fig. 2f). Future research is needed to expand available data on biotic velocity in Y2Y beyond the two major taxonomic groups (trees and songbirds) we reviewed (Stralberg et al. 2018). In temperate and boreal latitudes, the biased placement of existing protected areas in low-productivity areas often reduces their overlap with hotspots of species diversity and endemism (Scott et al. 2001). Biotic-velocity-based refugia metrics, because they assign additional weight to biodiverse areas, prioritize areas with a broad elevational range (Stralberg et al. 2018). Coarse-filter goals based on protection of climatic-velocity-based refugia and corridors, by aiming to represent all climate types, also distribute conservation priorities beyond the montane and arid regions that hold many existing protected areas. Starplots provide a useful tool for comparing the relative intensities of climate exposure in different subregions or protected areas (Garcia et al. 2014; Beckers & Carroll 2020). Comparison of starplot patterns for 7 of Y2Y's major protected area complexes illustrates the combined effect of the gradients described above (Fig. 1b). The contrast in starplot patterns between southern and northern protected areas within Y2Y (Fig. 1b) reflects the long-noted dichotomy between centers of species diversity (hotspots) and wild landscapes (coldspots) (Kareiva & Marvier 2003). Northern protected areas within Y2Y score highly in intactness and protection of soil carbon, whereas southerly protected areas play a greater role in providing macrorefugia as defined by both species models and climate velocity (Fig. 1b). Generality of gradients The specific spatial gradients we identify within Y2Y vary in their generality to other regions globally (Table 2). For example, a large proportion of the arid southwestern United States lies within protected areas that hold centers of species diversity and endemism that are

expected to transition to novel climates in the coming decades (Carroll et al. 2017). Many of these, such as Grand Canyon National Park, encompass substantial elevational gradients but not the broad latitudinal gradients in the Y2Y protected area network, which may heighten the vulnerability of their biota to climate change. The generality of lessons from Y2Y may also be reduced in regions of low topographic relief, such as the boreal and mid-latitude plains of North America, where broad-scale connectivity initiatives to enhance climate resilience may focus on ecologically driven refugia such as peatland complexes rather than topographic features (Stralberg et al. 2020a). Patterns of projected climate change suggest that many megadiverse regions in North America that served as paleorefugia under past cooling, such as upper montane areas at the southern end of major north–south ranges (e.g., southern Appalachians and Sierra Madre Occidental), are projected to experience extremely high climate exposure (i.e., forward velocity) under future warming (Carroll et al. 2017). An expanded view of rewilding that gives explicit recognition to maintenance of intact ecosystem processes and stabilizing feedbacks, such as fire-vegetation loops, will be critical in helping increase the resilience of these regions to climate change. Although Y2Y's patterns of climate exposure are not universal, a key aspect of climate change is that relatively consistent spatial patterns characterize the geography of climate exposure. A qualitative understanding of these patterns, in addition to the high-level planning concepts reviewed earlier and place-specific priorities derived from detailed mapping (Stralberg et al. 2020b), can help planners craft conservation strategies that are more resilient to uncertainty regarding the future intensity of climate change.

Planning under uncertainty Because the rate at which humanity will reduce future emissions of greenhouse gasses is unknown, the pace and magnitude of climate change is inherently uncertain. Therefore, resilient strategies are needed for conserving conservation targets under a range of potential future climate change trajectories. At broad regional and continental extents, conservation prioritizations based on the location of climate connectivity areas have proved relatively robust to alternate future climate scenarios (Carroll et al. 2018). However, regional and local conservation planning processes benefit from incorporating quantitative methods that explicitly account for uncertainty (Moilanen et al. 2006), as well as qualitative guidelines for factoring uncertainty into site-level management strategies (Belote et al. 2017). More generally, the establishment and restoration of protected areas and connectivity to facilitate adaptive dispersal and protect climatic refugia is in large part a no-regrets strategy that serves other societal goals beyond ameliorating the effects of climate change.

Conclusion Conservation scientists have called for expansion of the global protected area network and more effective placement of new protected areas as critical measures to counter threats arising from the twin crises of accelerating climate change and species extinctions (Dinerstein et al. 2019). A key step in increasing the effectiveness of such expansion is a better understanding of how threats to biodiversity from climate change alter the conceptual underpinnings of rewilding and other ambitious goals for large interconnected natural areas. We found that previous critiques of the relevance of protected area design principles under climate change (Pearson & Dawson 2005; Araújo 2009) were partially supported (e.g., in recommending an increased focus on environmental gradients), but that key

design principles, such as the importance of large core reserves, remain valid. The Y2Y conservation initiative provides an example of how practitioners can use conceptual rules based on broad-scale spatial patterns and drivers of threat to inform regional conservation priorities under climate change. Climate-exposure metrics, such as we describe here, can be key information sources for prioritizing of protection areas that have been identified as macrorefugia, especially in boreal landscapes where climate exposure is greatest (Fig. 1). Many of these areas are currently the focus of conservation planning processes involving the Canadian government and indigenous First Nations. In more developed landscapes with fewer remaining options for new protected areas, climate resilience can nonetheless be enhanced by expanding existing protection to better represent elevational, latitudinal, and ecosystem gradients. The data on climate exposure we reviewed suggest several rules of thumb regarding the vulnerability of existing protected areas based on their landscape position. Alpine and upper montane areas may experience high levels of climate exposure and loss of native species; montane areas at the southern end of major ranges will be especially affected. Nevertheless, these areas in turn will provide refugia for foothill and lowland species shifting upward in elevation. The eastern slopes of the Rocky Mountains provide an example of a key area for north–south climate connectivity that is poorly represented within existing parks. Additionally, interior basins of western North America are projected to experience high climate exposure and velocity and merit greater conservation attention. The complexity and uncertainty inherent in projecting future climates has created barriers to consideration of climate change in conservation planning. However, an increasing volume of freely accessible information, applied within "communities of practice" (Wenger 1999) that bring together researchers and practitioners (e.g., staff from governmental agencies, First Nations, and nongovernmental organizations), promises to lower barriers to integrating climate resilience within regional planning processes. Our findings suggest that the unique patterns of threat associated with climate change merit consideration as an additional component of the rewilding within a 4Cs framework for conservation of cores, corridors, carnivores, and climate resilience. Although previous reviews propose that planning for climate adaptation should favor small dispersed reserves, we conclude that climate change strengthens the rationale for networks of large protected areas that represent all landscape types and species, protect intact environmental gradients, and maintain ecological and evolutionary processes, including natural disturbance regimes and stabilizing feedbacks (Noss & Cooperrider 1994).

Trophic Rewilding to Animate the Carbon Cycle (TRACC) solves climate change.

Burak et al. 24 [Burak, M. K., Ferraro, K. M., Orrick, K. D., Sommer, N. R., Ellis-Soto, D., & Schmitz, O. J. (2024). Context matters when rewilding for climate change. *People and Nature*, 6, 507–518. <https://doi.org/10.1002/pan3.10609>]

One burgeoning climate change mitigation strategy is animating the carbon cycle through trophic rewilding. Animating the carbon cycle recognizes that animals, particularly large vertebrates, can have important effects on ecosystem carbon capture despite their smaller total biomass relative to other biological drivers of carbon cycling (e.g. plants or microbes; Schmitz et al., 2014, 2023). Trophic rewilding rebuilds ecosystems by restoring intact animal communities, the trophic structure of food webs, and natural ecosystem processes and services for both humans and wildlife (Carver et al., 2021; Svenning et al., 2016). Thus, Trophic Rewilding to Animate the Carbon Cycle (TRACC) leverages both animating the carbon cycle and trophic rewilding frameworks, positing that rewilding animals' functional roles in ecosystems can simultaneously further biodiversity conservation and increase carbon capture and storage in ecosystems. Although all rewilding initiatives involve species restoration and therefore restoration within a trophic level of an ecological community, trophic rewilding specifically assesses all subsequent top-down and bottom-up effects that arise following restoration. Estimates derived from a subset of animals across diverse ecosystems reveal that animals could substantially alter an ecosystem's carbon budget by 60%–95%, relative to cases where these focal animals are absent (Schmitz & Leroux, 2020). Therefore, restoring animal populations can potentially enhance ecosystem carbon capture and storage globally by at least 6.4 billion tonnes per year (Schmitz et al., 2023). By comparison, this amount rivals that of each of the IPCC top five steps for reducing net emissions expeditiously, including a rapid transition to solar and wind technology (IPCC, 2022). Hence, the high potential of TRACC to add to the portfolio of nature-based solutions makes it an appealing way to promote wildlife conservation to overcome the dual challenges of mitigating climate change and biodiversity loss. However, we are at a juncture where careful examination is warranted for ecologically accurate biodiversity protection using TRACC. The few studies that quantify animal effects on ecosystem carbon cycling show promise; however, they also demonstrate the importance of considering ecological context. This is because animal effects on carbon capture and storage can vary with ecosystem type and the functional role of wildlife species in that ecosystem (Table 1; Figure 1), and the uncertainty around estimates can be high (Schmitz et al., 2023; Supporting Information). TRACC also inherently requires increasing the abundance of wildlife species on the landscape, potentially in competition with people who already live there. Therefore, as a nature-based solution, TRACC requires including human communities as part of the solution (Schmitz & Sylvén, 2023; Seddon et al., 2021).

TABLE 1. Effects of animal species on ecosystem carbon uptake and storage driven by trophic impacts, illustrating context-dependency in animal effects. Orange, green, and grey squares represent net negative, positive, and neutral animal effects on ecosystem carbon budgets, respectively. Note: → = trophic interaction, ↑ = increase in ecosystem effect, ↓ = decrease in ecosystem effect, – = neutral ecosystem effect. a

References for case studies are presented in Supplemental Information. **FIGURE 1** The consideration of a full trophic cascade disentangling the assumption that organismal biomass or abundance equates to the cumulative effect of carbon storage mechanisms. Demonstrating using a wolf-deer system (Wilmsers & Schmitz, 2016), the greatest carbon uptake is yielded through indirect effects, disproportionate to biomass. From top to bottom and beginning with bare soil, increasing the number of trophic levels in a grassland system and in a boreal system increases soil carbon storage through indirect effects. Arrows represent direct effects (solid line), indirect effects (dashed line), negative effects (red), positive effects (black), and magnitude of effect (arrow thickness). We discuss key considerations when designing and monitoring TRACC programmes. This includes assessing and balancing social and ecological dependencies to produce ethical and scientifically defensible nature-based solutions using TRACC. We begin by (1) highlighting the context of species and of ecosystems features and (2) outlining a series of social contexts which need to be considered. We then (3) address the kinds of ethical considerations that are needed, given the potential impacts of TRACC on people and the value that rewilding projects place on wildlife. We conclude with (4) suggestions and directions for conservationists interested in trophic rewilding schemes for carbon storage. We also discuss how to optimize available technologies for appropriate monitoring strategies to better understand how a species impacts the carbon storage of a specific ecosystem. Trophic Rewilding to Animate the Carbon Cycle is a subset of rewilding initiatives, with the deliberate aim of restoring animal populations and communities to enhance carbon capture and storage. We focus here on TRACC examples involving terrestrial megafauna (e.g., >45 kg; Martin & Klein, 1989) because they are among the most studied and most vulnerable animals to human activities (Belote et al., 2020; Dirzo et al., 2014; Ripple et al., 2014). Consequently, conservationists have heightened their investment in the rewilding of large and charismatic species. Moreover, given their biomass, density and role in ecosystem function, they often have significant impacts on carbon cycling (Kristensen et al., 2022; Malhi et al., 2022; Schmitz et al., 2018). This is not to diminish the critical importance of considering marine wildlife (Durfort et al., 2022; Saba et al., 2021), large reptiles and invertebrates (e.g. arthropods; de Miranda, 2017) for similar purposes. To that end, the concepts and principles we derive from terrestrial case studies should apply to other taxa. We recognize that rewilding is a growing, multifaceted strategy with many different goals and socio-ecological benefits and challenges. Within such a breadth, some rewilding efforts primarily try to restore ecological function through the management and conservation of habitat and landscape connectivity, acknowledging that such efforts may have ancillary benefits of increasing carbon storage (Goswami, 2023; Lamba et al., 2023). Other rewilding programmes aim to reintroduce or promote animal populations for other socio-economic and ecological contributions; however, these are beyond the scope of this paper.

2 CONTEXT DEPENDENCY IN REWILDING THE CARBON CYCLE

Determining whether trophic rewilding as a nature-based solution—that is, TRACC—will work largely depends on understanding whether such efforts are ecologically and socially feasible. Here, we highlight some contexts necessary to consider for successful TRACC projects so that conservationists may be able to use this as an initial means to identify the context dependencies that are most

relevant in their system. 2.1 The species context In the intricate web of ecological relationships, the success of TRACC efforts hinges on a nuanced understanding of the unique roles that individual species play within ecosystems. While most TRACC initiatives focus on wildlife species, some TRACC initiatives may use domestic animals to mimic the role of wild animals in cases where wild counterparts have gone extinct (e.g. introducing cattle to mimic extinct aurochs). This is a legitimate TRACC approach if these animals are managed differently from herded livestock by allowing them to functionally mimic the movement and foraging ecology of their extinct wild counterparts, even if in some context, they are still legally treated as livestock (e.g. required vaccinations; Gordon, Manning, et al., 2021; Gordon, Pérez-Barbería, et al., 2021; Hempson et al., 2017). As such, it is an important prerequisite to consider a species not just in terms of its taxonomic identity but more importantly in terms of its functional traits, population demographics and density, and the resident animal community assemblage to which it will be restored. (Figure 2).

FIGURE 2 Open in figure viewer PowerPoint Known and potential discrepancies in carbon storage, based on system-specific contexts: (a) Species' functional traits, in which grazing or browsing could alter carbon stored in plant biomass; (b) Population demographics, in which species' sex can differentially alter the amount of plant carbon stored (Davies & Asner, 2019); (c) Animal density, where the number of animals can alter soil and tree carbon stored (Holdo et al., 2009); (d) Community composition, in which presence or absence of certain herbivore or plant species can directly affect plant carbon storage (Metcalf & Olofsson, 2015); (e) Trophic role, where presence or absence of a predator can indirectly affect soil and plant carbon storage (Cromsigt et al., 2018); (f) Ecosystem characteristics, where system-specific effects, such as habitat type, will determine whether a species has a positive or negative impact on carbon storage (Wilmers & Schmitz, 2016); (g) Ecological composition, where soil animal communities have known effect on carbon storage in soil and in the plants (Andriuzzi & Wall, 2018; Filser et al., 2016); (h) Human behaviour, where the presence or absence of humans, as well as the type of activity occurring on the landscape, will indirectly impact plant carbon storage ecosystem characteristics. Understanding species' functional traits is critical to understanding their impacts on carbon cycling (Figure 2). Varied hunting or foraging styles determine how individuals impact their community and ecosystem, primarily by modulating the vegetative structure of the landscape (Bakker et al., 2016), which has carbon implications. For example, grazers generally consume fast-growing grasses, which can promote shoot production, thereby increasing carbon capture (Wilson et al., 2018). In contrast, browsers consume slow-growing shrubs and trees, which, in some systems, may limit carbon capture (Salisbury et al., 2023). Additionally, functional traits such as digestion capabilities may shape the quality and quantity of plants that are eaten and the subsequent amount of methane released (Clauss et al., 2020). Activity such as trampling may compact soil and reduce soil respiration (Schmitz et al., 2018), while wallowing can create natural fire breaks (Malhi et al., 2022), and migration across landscapes may translocate nutrients essential to plant production (Subalusky et al., 2017). The demographics of a rewilded population can also differentially affect carbon sequestration even within the same system (Figure 2b). For example, in Kruger National Park, male elephants decreased above-ground carbon storage, while breeding herds

had a nonsignificant impact (Davies & Asner, 2019). In deer species, males are known to consume more woody vegetation (Garcia et al., 2023); hence, populations with higher proportions of males could ultimately reduce carbon storage and uptake. Other demographics (e.g. age, social status) that also alter consumption rates and preferences may also have carbon capture implications. One of the most important decisions to make in trophic rewilding efforts is how densely populated a rewilded species should be. Different population densities of rewilded animals can have negative, positive or negligible effects on ecosystem carbon storage (Figure 2c; Berzaghi et al., 2019; Holdo et al., 2009), notwithstanding potential density-dependent risk of human–wildlife conflict. For example, forest elephants (*Loxodonta cyclotis*) in the Congo can have negative overconsumption and trampling effects on tree production at high densities, negligible effects at low densities and positive effects at intermediate densities due to their enhancement of forest canopy tree production via reducing competition with understorey vegetation and promoting seed dispersal and germination (Berzaghi et al., 2019). In the Serengeti, a 20% reduction in the wildebeest population shifted the savanna from being a carbon sink to a source because reduced grazing led to more frequent and intense wildfires (Holdo et al., 2009). Thus, maximizing carbon capture using rewilded animal populations could require population control for both carbon storage and conflict mitigation, which may be antithetical to the goals of merely conserving wildlife biodiversity (e.g. prioritizing species richness). Effective TRACC solutions require deciding which species to rewild, what density is needed to balance carbon capture and other determined targets and the kind of management or stewardship needed to maintain the population at this density. Of course, species do not exist or act alone in ecosystems, and the resident plant and animal community assemblage must also be considered (Figure 1). For instance, different mammalian herbivore assemblages can have varying impacts on carbon storage and CO₂ fluxes via herbivory that alters plant communities (Olofsson & Post, 2018), above-ground biomass (Metcalf & Olofsson, 2015) and soil mixing (Kristensen et al., 2022). Further research is needed to untangle how differing community assemblages, and changes in assemblages, may impact carbon sequestration. Not all animal traits and characteristics can be addressed or managed in a rewilding or TRACC intervention. We add the caveat that applying this ecological understanding nearly always relies on estimating average species contribution to the carbon cycle, which neglects to account for intraspecific variation (Bolnick et al., 2011; Sommer & Schmitz, 2020). The species and individual contexts provided here are not an insurmountable hurdle to successful TRACC intervention, but rather emphasize the importance of local knowledge and application.

2.2_The ecological context Implementing trophic rewilding as a nature-based climate solution must also account for the ecological characteristics within ecosystems and their relationship to the candidate species for rewilding (Table 1). These characteristics include trophic cascades, community composition and ecosystem or habitat type. Wild animals can have top-down feedback effects on ecosystem functions via trophic cascades (Figures 1 and 2e), in which density and trait-mediated effects at upper trophic levels can alter the amount of carbon exchanged between plants, soils and the atmosphere (Schmitz & Leroux, 2020). As described above, such roles include foraging and space use by carnivores and herbivores that,

respectively, control animal and plant productivity and abundance; redistributing seeds and nutrients over vast spatial extents; and trampling, burrowing, and wallowing causing disturbance and compaction. Other ecosystem characteristics such as climate, topography, seasonality and rainfall gradient can influence the carbon storage potential of animals. For extensive reviews on how ecosystem context can impact rewilding and/or the carbon cycle, see Malhi et al. (2022) and Kristensen et al. (2022). The effects of these ecosystem characteristics are magnified by trophic interactions that can alter the diversity, abundance and carbon density of plant communities, fire regimes, methane release from permafrost, carbon inputs to soil from faecal and carcass deposition, and microbial processes and chemical reactions that mediate the retention of soil carbon. Herbivores themselves can influence ecosystem fire frequency and severity by determining the quantity and quality of fuels on the landscape, thereby affecting carbon source or sink potential. As a result, trophic rewilding has been proposed as a potential tool for regulating fire and carbon loss, as climate change renders fire seasons longer and more severe (Johnson et al., 2018). The ecosystem effects of herbivores can be further mediated by predators. Predator-driven reduction in herbivore abundances and altered herbivore behaviour and physiology can have indirect effects on plant biomass, photosynthesis and respiration, ultimately affecting fluxes of CO₂ and CH₄ between ecosystems and the atmosphere. Even a species' role itself can differ across longitude, habitats or ecosystem types (Figure 2f; Berzaghi et al., 2019; Davies & Asner, 2019). For example, savanna elephants (*Loxodonta africana*) in savanna ecosystems appear to have neutral or negative effects on carbon storage (Davies & Asner, 2019; Pellegrini et al., 2017; Sandhage-Hofmann et al., 2021), whereas forest elephants (*L. cyclotis*) in the central African rainforest play a significant role in seed dispersal, above-ground biomass and thus above-ground carbon storage (Berzaghi et al., 2019). Regional differences are not only limited to the effects of large animals or plant communities but also extend to intra-annual weather patterns and interannual changes in climate. Carbon-relevant processes are highly dependent on local contexts, which necessitates longitudinal, holistic, regional assessments of how rewilding will impact carbon storage. It is also noteworthy to consider that animals selectively move across the landscape, therefore stratifying nutrient subsidies (Ferraro et al., 2021), shaping plant diversity (Ellis-Soto et al., 2021) and altering the carbon density of standing vegetation within a region. Resolving such zoogeochemistry mechanisms and climate fluctuations is key for predicting the feedback between animals and elemental cycling, and become increasingly important under continued climate change (e.g. changes in seasonality, droughts and floods). Such feedbacks could be large enough that, if animal effects are ignored, conventional natural climate solutions may either miss opportunities to enhance carbon capture or fail to meet carbon capture targets. Ecological community composition is diverse and complex; therefore, it is also necessary to consider the impacts of carbon beyond the direct management action of large animals (Figure 2g). For example, soil animal communities are rarely considered in conservation or rewilding projects despite their known effect on soil carbon turnover and storage (Andriuzzi & Wall, 2018; Filser et al., 2016). Relatedly, management to improve carbon storage might result in unintended consequences on the above-ground invertebrate community that, in turn, could

decrease ecosystem function. For example, ecosystem changes can indirectly reduce pollinator diversity, leading to a decrease in plant pollination (Guy et al., 2021). Understanding the relationships between ecosystem characteristics, animal functional roles and carbon dynamics is crucial for comprehensive TRACC.

2.3 The social context

Few nature–society interactions can be considered one-sided. Just as animals shape ecosystems, human land use can reshape ecological communities with important implications for ecosystem functioning and conservation efforts, both of which are relevant for rewilding and carbon sequestration (Estes et al., 2011; Suraci et al., 2021; Figure 2h). For example, the restriction of wide-ranging species through fencing or deforestation can concentrate their functional impacts within a small area (Tucker et al., 2021), thereby possibly altering the sequestration of carbon by plants or nutrient cycling rates. The nature and frequency of human–wildlife interactions through land use and infrastructure, as well as through human mobility, recreation, or byproducts can determine the landscape occurrences of rewilded species and hence TRACC. The need to consider local ecological context means enlisting local knowledge and community buy-in will be essential for successful TRACC implementation (Goswami, 2023; Schmitz & Sylvén, 2023; Takacs, 2020). It necessitates active community engagement and power-sharing in decision-making (Ainsworth et al., 2020). TRACC must therefore be responsive to social dynamics influenced by factors such as human well-being, intrinsic values, local knowledge, socio-cultural heritage and access to natural resources (Carver et al., 2021; Schulte To Bühne et al., 2022; Takacs, 2020). In numerous cases, rewilding alone explicitly emphasizes community consent and the transformative potential of rewilding on local rural economies (Martin et al., 2021). For instance, wildlife tourism in Scotland contributes approximately £276 million annually (McVittie et al., 2017). However, these projections do not always materialize as fully realized outcomes and do not always include carbon benefits or tradeoffs. Accurate projections of the economic benefits and costs of TRACC projects must include any consideration of development for recreation and tourism, in addition to carbon offsets. These include acquisition costs, management costs, and transaction costs (Naidoo et al., 2006). Examples of associated costs to rewilding include the potential impacts on other local economies, such as the introduction of beavers potentially impacting habitat for fisheries (Gaywood, 2018) and the initial conversion costs of land for rewilding purposes (Schou et al., 2021). Moreover, rewilding often demands substantial land areas that may require fencing (Schou et al., 2021). The costs and benefits of rewilding are not always economic, and conventional economic valuation frameworks may not adequately capture its social, political and cultural aspects (Thondhlana et al., 2020). Examination of the cost–benefit restrictions should ensure that excessive rewilding costs do not erode its comparative advantage over alternative nature-based or mitigation approaches (e.g. Naidoo et al., 2006; Reed et al., 2013; White et al., 2022). There should also be transparency in which valuations will take priority when the estimation of these tradeoffs do not yield clear solutions (Armsworth et al., 2017). Current policies and incentives also complicate how and when trophic rewilding initiatives will benefit local communities. For example, grazing of natural areas in Denmark is subsidized through the EU's current Common Agricultural Policy. Rewilding could be a stronger economical choice if this policy included additional subsidies for natural rewilding

efforts (Schou et al., 2021). However, current government policies and subsidies render year-round grazing more economically advantageous than rewilding (Schou et al., 2021). Competing land uses and the opportunity costs related to rewilding thus are not only linked to the economic and non-economic costs but also the current political policies. Similar to conservation projects, TRACC efforts necessitate a deep understanding and contextualization of local power dynamics (Margulies & Karanth, 2018). Species can symbolize specific entities, including state intervention or coercion, which can provoke retaliatory responses, hostility and resentment (Naughton-Treves & Treves, 2005). In particular, large-bodied vertebrates often serve as symbols of government or state authority (Margulies & Karanth, 2018). In the United States, wolves have become emblematic of federal government actions that restrict the autonomy of local, place-based communities that oppose wolf reintroduction (Dickman & Hazzah, 2016; Wilson, 1997). Rewilding efforts, including TRACC, need to not only consider animals themselves but also address the underlying social, economic, and cultural factors contributing to local communities' values and hence potential resistance to a project (Dickman & Hazzah, 2016; Margulies & Karanth, 2018; Naughton-Treves & Treves, 2005). Many of these concerns can be effectively addressed by conducting a thorough needs assessment and participating in extensive community consultation during the initial stages of the project. A regional assessment can help fill the social and biological gaps, ensuring ecological accuracy while involving local communities. Decisions that reconcile trade-offs require balancing the benefits and drawbacks of coexisting with wildlife, the incremental carbon benefits, costs of rewilding itself, and the socio-cultural and welfare opportunities for local communities. These decisions would also weigh the intensive management and intangible costs compared to other carbon sequestration projects—such as potential reductions in land access privileges, including hunting, logging, crop production, grazing and the potential impact on landowners' knowledge—alongside the prospects for hydrological, coastal and nutrient restoration (Falcón & Hansen, 2018; Schou et al., 2021). Sustaining ongoing projects requires continuous follow-up through integrative and adaptive management approaches as well as social evaluations, and fostering the collaboration between various levels of governance and local communities (König et al., 2020; Sandom & Wynne-Jones, 2019).

2.4 The ethical context Like all conservation programmes, TRACC is inherently ethical as it is motivated by the normative values that (1) wild, intact ecosystems are good and (2) humans ought to address anthropogenic climate change (Ferraro et al., 2023). Further, it requires that all participants balance the interests, needs and functions of humans, animals and ecosystems together. Human rights, animal welfare, environmental justice, intrinsic values and ecosystem functionality represent some of the interwoven ethical issues that are at stake in determining the outcome of rewilding efforts (Lee et al., 2021), and thus also apply to TRACC endeavours. Conservation science is underpinned by ethical norms and values that are often not critically examined by conservationists (Ferraro et al., 2023; Pyron & Mooers, 2022) and are primarily driven by consequentialist thinking (Ferraro et al., 2021). To some, TRACC may seem similarly consequentialist—driven by the desire to combat climate change for humankind's persistence on the planet. Indeed, many conservation projects focus primarily on financial and environmental cost–benefit implications, rather than considering the

broader range of issues outlined above. These cost–benefit approaches often do not consider conservation and stewardship practices alongside human virtues, and do not value animals beyond their identity as taxonomic entities (Schmitz & Sylvén, 2023; Sommer & Ferraro, 2022; Wallach et al., 2018). Yet, TRACC, like all rewilding, is inherently an ecocentric perspective, one that acknowledges the intrinsic value of ecosystems and their components, emphasizing the interconnectedness of all elements within an ecosystem, and ensures that humans and animals are not treated merely as means to ends (Carver et al., 2021; Schulte To Bühne et al., 2022). It is an important recognition that rewilding projects that aim to create intact and healthy ecosystems, which may help mitigate climate change, are created in a way that respects and appreciates the intrinsic value of nature and individual animals. Importantly, a shift away from an anthropocentric framework does not preclude opportunity for any human intervention (i.e. the human-mediated reintroduction or conservation of animals), nor does it preclude human benefit (i.e. carbon containment). Rather, ecocentrism in TRACC promotes sustainable and responsible interactions with the environment that benefits those within the environment. Further, it demands action for climate change that underscores how the well-being of ecosystems and individuals within are worth protecting. Beyond careful ethical consideration for non-human animals involved in rewilding, Human Rights Impact Assessments (HRIA), or their equivalency, should be used across TRACC programs as an intentional effort to link human rights and wildlife carbon offsets to ensure local communities do not bear the brunt of wildlife's negative impacts. This is particularly important, given growing concern that rewilding initiatives could encourage removing people from landscapes slated for rewilding, an action which would be unjust (Fletcher et al., 2021). Many rewilding scholars explicitly state that rewilding must incorporate humans within nature (Carver et al., 2021), a sentiment which we wholeheartedly support. An example of successful integration, and consideration, of ethics in rewilding can be found in Lee et al. (2021) who critically and thoroughly explore the ethical realities of grizzly rewilding in California; and we argue this kind of assessment must be undertaken for each proposed rewilding scheme. We advocate for a cumulative approach which weighs all parts of a context rather than seeking to simply rank which species or system is more or less important to the carbon cycle. Complex, and sometimes differing, ecological contexts and human values surround biodiversity conservation and carbon storage (see the IPBES, 2023). Without each of these full considerations, we risk a disconnect between the generalizations advertised in carbon offset programs, conservationists' implementations, ecological accuracy, and social and ethical impacts. Effectively navigating these ethical complexities requires greater collaboration with experts in human and environmental ethics, enabling well-informed and ethically sound decisions that foster coexistence between humans and wildlife in a given landscape (Ferraro et al., 2021; Lee et al., 2021; Nelson et al., 2021).

Rewilding land used for beef production solves climate change and increases quality of life worldwide.

Orsagh 23 [Matt Orsagh, 8-3-2023, "Rewilding the U.S. could be a powerful tool for addressing climate change", Trellis, <https://trellis.net/article/rewilding-us-could-be-powerful-tool-addressing-climate-change/>]

Rewilding can have myriad impacts America is a big place, so changing land use could have a big impact on the environment and quality of life not just here but around the world. Let's consider land use, particularly land used for livestock production. About 41 percent of all U.S. land is used to care for livestock. Over two out of every five acres of the 1.9 billion acres of land in the contiguous lower 48 states in the U.S. are used just to raise the food we eat. The story is similar in other countries, as nearly 60 percent of the world's agricultural land is used for beef production. This is wildly inefficient, because beef accounts for only about 2 percent of the total calories humans consume. The environmental damage from beef production is well documented. It uses a lot of land and is a major contributor to the clearing of land in the Amazon and other rainforests. Beef production is also very water intensive, putting stress on the water resources. Cattle emit methane, a powerful greenhouse gas — so the more of them, the bigger the greenhouse gas emissions problem. What's more, feeding cattle requires devoting lots of land to monoculture crops such as soybeans and corn, which often results in soil degradation, chemical pollution from pesticides and the use of more fertilizers and fuel. Time for a thought experiment Let's say for the sake of argument that over the next decade, the United States decreased beef consumption by 10 percent. That would potentially free up about 4-5 percent of U.S. land for rewilding. (I just used 10 percent of the 41 percent of land the U.S. uses for beef production to arrive at that number.) Not all of this hypothetical land would automatically be rewilded, but humor me for this thought experiment. Rewilding 4-5 percent of America's land would allow trees and grasslands to recover, serving as a carbon sink. A move away from beef would relieve the stress on America's rivers, especially the Colorado River. Less cropland used for animal feed would lower the use of pesticides that run off into America's waterways, making these waterways healthier and more able to support their own ecosystems. Less cattle would mean less methane, lowering the amount of greenhouse gases. No one is expecting America to go 100 percent vegan ever, but a meaningful decrease in beef consumption would make a huge difference. Extrapolate this hypothetical 4-5 percent drop in demand for beef around the world, and the impact gets even bigger. A 2021 report from the United Nations estimates that rewilding 350 million hectares of degraded terrestrial and aquatic habitats could generate \$9 trillion in ecosystem services and remove 26 gigatons of greenhouse gases from the atmosphere. This potential GHG reduction number is slightly less than the 33 gigatons of carbon dioxide emitted by the world in 2019. In essence, rewilding 350 million hectares would help lock away about one year of global emissions. One acre is about 0.4 hectares. So, if you start with the 1.9 billion acres in the lower 48 in the United States, then take 41 percent of that currently being used for livestock production, you end up with about 780 million acres in the United States used to raise livestock. In our hypothetical example of a 10

percent decline in beef demand, you get about 78 million acres freed up that can then be rewilded. Multiply 78 million by 0.4 to convert to hectares, and this gets you to about 32 hectares, or just under 10 percent of the 350 million acres needed to rewild and remove about one year's worth of greenhouse gases.

Governments are hoping on the rewilding band wagon, the U.S joining in would strengthen the trend- solves climate change and increases biodiversity.

Orsagh 23 [Matt Orsagh, 8-3-2023, "Rewilding the U.S. could be a powerful tool for addressing climate change", Trellis, <https://trellis.net/article/rewilding-us-could-be-powerful-tool-addressing-climate-change/>]

Governments around the world are jumping on the rewilding bandwagon. Projects in Chile and Scotland are already being planned to rewild 300,000 and 200,000 hectares, respectively. These projects will roll out over a long time, with the Scottish plan stretched out over 30 years. But if similar plans are undertaken in enough countries, rewilding could make a significant impact on climate change and biodiversity challenges.

Alas, politics often gets in the way. A plan to rewild the American West by reintroducing wolves and beavers while lowering the cattle footprint across western public lands could cover tens of millions of acres but is opposed by many state legislatures in the American West. Cattle ranchers vote and can make campaign contributions. Wolves and beavers don't vote and are quite ineffective at lobbying politicians.

Rewilding is not a new idea, but it is one just starting to get more attention as issues of biodiversity become more a part of the climate change conversation. Investors and companies that can find ways to support real and meaningful rewilding that is shown to address both biodiversity loss and climate change may be able to both improve their operations while getting a little goodwill from the public.

Most of the work done to date on rewilding has come from local and national governments in coordination with scientists and NGOS. If companies add their expertise and capital to projects that protect resources that company needs, rewilding could get a monumental shot in the arm. Historically, such support is done through charitable foundations connected to companies or company founders. If companies can make the business case for rewilding, humanity and shareholders could both benefit.

Warming will trigger every extinction scenario – err aff, science still can't comprehend the magnitude of the warming apocalypse.

Carrington 22 [Carrington, D. (2022, August 1). Climate endgame: Risk of human extinction 'dangerously underexplored'. the Guardian. <https://www.theguardian.com/environment/2022/aug/01/climate-endgame-risk-human-extinction-scientists-global-heating-catastrophe> (Damien Carrington is an environment editor for the Guardian)] // Aadit]

The risk of global societal collapse or human extinction has been “dangerously underexplored”, climate scientists have warned in an analysis. They call such a catastrophe the “climate endgame”. Though it had a small chance of occurring, given the uncertainties in future emissions and the climate system, cataclysmic scenarios could not be ruled out, they said. “Facing a future of accelerating climate change while blind to worst-case scenarios is naive risk management at best and fatally foolish at worst,” the scientists said, adding that there were “ample reasons” to suspect global heating could result in an apocalyptic disaster. The international team of experts argue the world needs to start preparing for the possibility of the climate endgame. “Analysing the mechanisms for these extreme consequences could help galvanise action, improve resilience, and inform policy,” they said. Explorations in the 1980s of the nuclear winter that would follow a nuclear war spurred public concern and disarmament efforts, the researchers said. The analysis proposes a research agenda, including what they call the “four horsemen” of the climate endgame: famine, extreme weather, war and disease. They also called for the Intergovernmental Panel on Climate Change to produce a special report on the issue. The IPCC report on the impacts of just 1.5C of heating drove a “groundswell of public concern”, they said. “There are plenty of reasons to believe climate change could become catastrophic, even at modest levels of warming,” said Dr Luke Kemp at the University of Cambridge’s Centre for the Study of Existential Risk, who led the analysis. “Climate change has played a role in every mass extinction event. It has helped fell empires and shaped history. “Paths to disaster are not limited to the direct impacts of high temperatures, such as extreme weather events. Knock-on effects such as financial crises, conflict and new disease outbreaks could trigger other calamities.” The analysis is published in the journal Proceedings of the National Academy of Sciences and was reviewed by a dozen scientists. It argues that the consequences of global heating beyond 3C have been underexamined, with few quantitative estimates of the total impacts. “We know least about the scenarios that matter most,” Kemp said. A thorough risk assessment would consider how risks spread, interacted and amplified, but had not been attempted, the scientists said. “Yet this is how risk unfolds in the real world,” they said. “For example, a cyclone destroys electrical infrastructure, leaving a population vulnerable to an ensuing deadly heatwave.” The Covid pandemic underlined the need to examine rare but high-impact global risks, they added. Particularly concerning are tipping points, where a small rise in global temperature results in a big change in the climate, such as huge carbon emissions from an Amazon rainforest suffering major droughts and fires. Tipping points could trigger others in a cascade and some remained little studied, they said, such as the abrupt loss of stratocumulus cloud decks that could cause an additional 8C of global warming. The researchers warn that climate breakdown could exacerbate or trigger other catastrophic risks, such as international wars or infectious disease pandemics, and worsen existing

vulnerabilities such as poverty, crop failures and lack of water. The analysis suggests superpowers may one day fight over geoengineering plans to reflect sunlight or the right to emit carbon. “There is a striking overlap between currently vulnerable states and future areas of extreme warming,” the scientists said. “If current political fragility does not improve significantly in the coming decades, then a belt of instability with potentially serious ramifications could occur.” There were further good reasons to be concerned about the potential of a global climate catastrophe, the scientists said: “There are warnings from history. Climate change has played a role in the collapse or transformation of numerous previous societies and in each of the five mass extinction events in Earth’s history.” New modelling in the analysis shows that extreme heat – defined as an annual average temperature of more than 29C – could affect 2 billion people by 2070 if carbon emissions continue. “Such temperatures currently affect around 30 million people in the Sahara and Gulf Coast,” said Chi Xu, at Nanjing University in China, who was part of the team. “By 2070, these temperatures and the social and political consequences will directly affect two nuclear powers, and seven maximum containment laboratories housing the most dangerous pathogens. There is serious potential for disastrous knock-on effects.” The current trend of greenhouse gas emissions would cause a rise of 2.1-3.9C by 2100. But if existing pledges of action are fully implemented, the range would be 1.9-3C. Achieving all long-term targets set to date would mean 1.7-2.6C of warming. “Even these optimistic assumptions lead to dangerous Earth system trajectories,” the scientists said. Temperatures more than 2C above pre-industrial levels had not been sustained on Earth for more than 2.6m years, they said, far before the rise of human civilisation, which had risen in a “narrow climatic envelope” over the past 10,000 years. “The more we learn about how our planet functions, the greater the reason for concern,” said Prof Johan Rockström, at the Potsdam Institute for Climate Impact Research in Germany. “We increasingly understand that our planet is a more sophisticated and fragile organism. We must do the maths of disaster in order to avoid it.”

Warming guarantees extinction and o/w all other existential threats

Krosofsky 21 [Andrew, freelance writer for over two decades "How Global Warming May Eventually Lead to Global Extinction," Green Matters, March 11, 2021, <https://www.greenmatters.com/p/will-global-warming-cause-extinction> TG]

Will global warming cause extinction? Eventually, yes. Global warming will invariably result in the mass extinction of millions of different species, humankind included. In fact, the Center for Biological Diversity says that global warming is currently the greatest threat to life on this planet. Global warming causes a number of detrimental effects on the environment that many species won't be able to handle long-term. Extreme weather patterns are shifting climates across the globe, eliminating habitats and altering the landscape. As a result, food and fresh water sources are being drastically reduced. Then, of course, there are the rising global temperatures themselves, which many species are physically unable to contend with. Formerly frozen arctic and antarctic regions are melting, increasing sea levels and temperatures. Eventually, these effects will create a perfect storm of extinction conditions. What species will go extinct if global warming continues? The melting glaciers of the arctic and the searing, unmanageable heat indexes being seen along the Equator are just the tip of the iceberg, so to speak. The species that live in these climate zones have already been affected by the changes caused by global warming. Take polar bears for example, whose habitats and food sources have been so greatly diminished that they have been forced to range further and further south. Increased carbon dioxide levels in the atmosphere and oceans have already led to ocean acidification. This has caused many species of crustaceans to either adapt or perish and has led to the mass bleaching of more than 50 percent of Australia's Great Barrier Reef, according to National Geographic. According to the Center for Biological Diversity, the current trajectory of global warming predicts that more than 30 percent of Earth's plant and animal species will face extinction by 2050. By the end of the century, that number could be as high as 70 percent.

Warming guarantees extinction – multiple scenarios

Specktor 19 [Brandon Specktor "Human Civilization Will Crumble by 2050 If We Don't Stop Climate Change Now, New Paper Claims." Live Science. June 4, 2019. <https://www.livescience.com/65633-climate-change-dooms-humans-by-2050.html>]

It seems every week there's a scary new report about how man-made climate change is going to cause the collapse of the world's ice sheets, result in the extinction of up to 1 million animal species and — if that wasn't bad enough — make our beer very, very expensive. This week, a new policy paper from an Australian think tank claims that those other reports are slightly off; the risks of climate change are actually much, much worse than anyone can imagine. According to the paper, climate change poses a "near- to mid-term existential threat to human civilization," and there's a good chance society could collapse as soon as 2050 if serious mitigation actions aren't taken in the next decade. Published by the Breakthrough National Centre for Climate Restoration in Melbourne (an independent think tank focused on climate policy) and authored by a climate researcher and a former fossil fuel executive, the paper's central thesis is that climate scientists are too restrained in their predictions of how climate change will affect the planet in the near future. [Top 9 Ways the World Could End] The current climate crisis, they say, is larger and more complex than any humans have ever dealt with before. General climate models — like the one that the United Nations' Panel on Climate Change (IPCC) used in 2018 to predict that a global temperature increase of 3.6 degrees Fahrenheit (2 degrees Celsius) could put hundreds of millions of people at risk — fail to account for the sheer complexity of Earth's many interlinked geological processes; as such, they fail to adequately predict the scale of the potential consequences. The truth, the authors wrote, is probably far worse than any models can fathom. How the world ends What might an accurate worst-case picture of the planet's climate-addled future actually look like, then? The authors provide one particularly grim scenario that begins with world governments "politely ignoring" the advice of scientists and the will of the public to decarbonize the economy (finding alternative energy sources), resulting in a global temperature increase 5.4 F (3 C) by the year 2050. At this point, the world's ice sheets vanish; brutal droughts kill many of the trees in the Amazon rainforest (removing one of the world's largest carbon offsets); and the planet plunges into a feedback loop of ever-hotter, ever-deadlier conditions. "Thirty-five percent of the global land area, and 55 percent of the global population, are subject to more than 20 days a year of lethal heat conditions, beyond the threshold of human survivability," the authors hypothesized. Meanwhile, droughts, floods and wildfires regularly ravage the land. Nearly one-third of the world's land surface turns to desert. Entire ecosystems collapse, beginning with the planet's coral reefs, the rainforest and the Arctic ice sheets. The world's tropics are hit hardest by these new climate extremes, destroying the region's agriculture and turning more than 1 billion people into refugees. This mass movement of refugees — coupled with shrinking coastlines and severe drops in food and water availability — begin to stress the fabric of the world's largest nations, including the United States. Armed conflicts over resources, perhaps culminating in nuclear war, are likely. The result, according to the new paper, is "outright chaos" and perhaps "the end of human global civilization as we know it."

Warming causes extinction – a confluence of nonlinear and unpredictable effects prove

Melton 19 [Michelle Melton is a 3L at Harvard Law School. Before law school, she was an associate fellow in the Energy and National Security Program at the Center for Strategic and International Studies, where she focused on climate policy. Climate Change and National Security, Part II: How Big a Threat is the Climate? January 7, 2019. <https://www.lawfareblog.com/climate-change-and-national-security-part-ii-how-big-threat-climate>]

At least until 2050, and possibly for decades after, climate change will remain a creeping threat that will exacerbate and amplify existing, structural global inequalities. While the developed world will be negatively affected by climate change through 2050, the consequences of climate change will be felt most acutely in the developing world. The national security threats posed by climate change to 2050 are likely to differ in degree, not kind, from the kinds of threats already posed by climate change. For the next few decades, climate change will exacerbate humanitarian crises—some of which will result in the deployment of military personnel, as well as material and financial assistance. It will also aggravate natural resource constraints, potentially contributing to political and economic conflict over water, food and energy. The question for the next 30 years is not “can humanity survive as a species with 1.5°C or 2°C of warming,” but, “how much will the existing disparities between the developed and developing world widen, and how long (and how successfully) can these widening political/economic disparities be sustained?” The urgency of the climate threat in the next few decades will depend, to a large degree, on whether and how much the U.S. government perceives a widening of these global inequities as a threat to U.S. national security. By contrast, if emissions continue to creep upward (or if they do not decline rapidly), by 2100 climate-related national security threats could be existential. The question for the next hundred years is not, “are disparities politically and economically manageable?” but, “can the global order, premised on the nation-state system, itself based on territorial sovereignty, survive in a world in which substantial swathes of territory are potentially uninhabitable?” National Security Consequences of Climate Change to 2050 Scientists can predict the consequences of climate change to 2050 with some measure of certainty. (Beyond that date, the pace and magnitude of climate change—and therefore, the national security threat posed by it—depend heavily on the level of emissions in the coming years, as I have explained.) There is relative agreement across modeled climate scenarios that the world will likely warm, on average, at least 1.5°C above pre-industrial levels by about 2050—but perhaps as soon as 2030. This level of warming is likely to occur even if the world succeeds in dramatically reducing greenhouse gas emissions, as even the recent Intergovernmental Panel on Climate Change (IPCC) report implicitly admits. In other words, a certain amount of additional warming—at least 1.5°C, and probably more than that—is presumptively unavoidable. Looking ahead to 2050, it can be said with relative confidence that the national security consequences of climate change will vary in degree, not in kind, from the national security threats already facing the United States. This is hardly good news. Even small differences in global average temperatures result in significant environmental changes, with attendant social, economic and political consequences. By 2050, climate change will wreak increasing havoc on human and natural systems—predominantly, but not exclusively, in the

developing world—with attenuated but profound consequences for national security. In particular, changes in temperature, the hydrological cycle and the ranges of insects will impact food availability and food access in much of the world, increasing food insecurity. Storms, flooding, changes in ocean pH and other climate-linked changes will damage infrastructure and negatively impact labor productivity and economic growth in much of the world. Vector-borne diseases will also become more prevalent, as climate change will expand the geographic range and intensity of transmission of diseases like malaria, West Nile, Zika and dengue fever, and cholera. Rising public health challenges, economic devastation and food insecurity will translate into an increased demand for humanitarian assistance provided by the military, increased migration—especially from tropical and subtropical regions—and geopolitical conflict. Long-term trends such as declining food security, coupled with short-term events like hurricanes, could sustain unprecedented levels of migration. The 2015 refugee crisis in Europe portends the kinds of population movements that will only accelerate in the coming decades: people from Africa, Southwest and South Asia and elsewhere crossing land and water to reach Europe. For the United States, this likely means greater numbers of people seeking entry from both Central America and the Caribbean. Such influxes are not unprecedented, but they are unlikely to abate and could increase in volume over the next few decades, driven in part by climate change-related food insecurity, climate change-related storms and also by economic and political instability. Food insecurity, economic losses and loss of human life are also likely to exacerbate existing political tensions in the developing world, especially in regions with poor governance and/or where the climate is particularly vulnerable to warming (e.g., the Mediterranean basin). While the Arab Spring had many underlying causes, it also coincided with a period of high food prices, which arguably contributed to the protests. In some situations, food insecurity, economic losses and public health crises, combined with weak and ineffectual governance, could precipitate future conflicts of this kind—although it will be difficult to know where and when without more precise local studies of both underlying political dynamics and the regionally-specific impacts of climate change.

2100 and Beyond While the national security impacts of climate change to 2050 are likely to be costly and disruptive for the U.S. military—and devastating for many people around the world—at some point after 2050, if warming continues at its current pace, changes to the climate could fundamentally reshape geopolitics and possibly even the current nation-state basis of the current global order. To be clear, both the ultimate level of warming and its attendant political consequences is highly speculative, for the reasons I explained in my last post. Nonetheless, we do know that the planet is currently on track for at least 3-4°C of warming by 2100. The “known knowns” of higher levels of warming—say, 3°C—are frightening. At that 3°C of warming, for example, scientists project that there will be a nearly 70 percent decline in wheat production in Central America and the Caribbean, 75 percent of the land area in the Middle East and more than 50 percent in South Asia will be affected by highly unusual heat, and sea level rise could displace and imperil the lives hundreds of millions of people, among other consequences. But even higher levels of warming are physically possible within this century. At these levels of warming, some regions of the world would be literally uninhabitable, likely resulting in the depopulation of the tropics, to say

nothing of the consequences of sea-level rise for economically important cities such as Amsterdam and New York. Even if newly warmed regions of the far north could theoretically accommodate the resulting migrants, this presumes that the political response to this unprecedented global displacement would be orderly and conflict-free borders on fantasy. The geopolitical consequences of significant levels of warming are severe, but if these changes occur in a linear way, at least there will be time for human systems to adjust. Perhaps more challenging for national security is the possibility that the until-now linear changes give way to abrupt and irreversible ones. Scientists forecast that, at higher levels of warming—precisely what level is speculative—humanity could trigger catastrophic, abrupt and unavoidable consequences to the ecosystem. The IPCC has considered nine such abrupt changes; one example is the potential shutting down of the Indian summer monsoon. Over a billion people are dependent upon the Indian monsoon, which provides parts of South Asia with about 80 percent of its annual rainfall; relatively minor changes in the monsoon in either direction can cause disasters. In 2010, a wetter monsoon led to the catastrophic flooding in Pakistan, which directly affected 20 million people; a drier monsoon in 2002 led to devastating drought. Studies suggest that the Indian summer monsoon has two stable states: wet (i.e., the current state) and dry (characterized by low precipitation over the subcontinent). At some point, if warming continues, the monsoon could abruptly shift into the second, “dry” state, with catastrophic consequences for over a billion people dependent on monsoon-fed agriculture. The IPCC suggests that such a state-shift is “unlikely”—that is, there is a 10 to 33 percent chance that a state-shift will happen in the 21st century—but scientists also have relatively low confidence in their understanding of the underlying mechanisms in this and other large-scale natural systems. The consequences of abrupt, severe warming for national security are obvious in general, if unclear in the specifics. In 2003, the Defense Department asked a contractor to explore such a scenario. The resulting report outlined the offensive and defensive national security strategies countries may adopt if faced with abrupt climate change, and highlighted the increased risk of inter- and intra-state conflict over natural resources and immigration. Although the report may be off in its imagined timeframe (positing abrupt climate change by 2020), the world it conjures is improbable but not outlandish. If the Indian monsoon were to switch to dry state, and a billion people were suddenly without reliable food sources, for example, it is not clear how the Indian government would react, assuming it would survive in its current form. Major wars or low-intensity proxy conflicts seem likely, if not inevitable, in such a scenario

Biodiversity

Biodiversity is on decline and won't come back if we don't act

Keespies et al. 24 [Matthias Winfried Kleespies, et al. "Perceptions of Biodiversity Loss among Future Decision-Makers in 37 Countries." Npj Biodiversity, vol. 3, no. 1, Aug. 2024, <https://doi.org/10.1038/s44185-024-00057-3>. Accessed 29 Sept. 2024.]

Due to the ongoing decline in global biodiversity, the world is facing a biodiversity crisis. Predictions suggest that this decline will continue throughout the 21st century. The current extinction rate is approximately 1000 times higher than the background rate of extinction due to human activities and may increase further in the future. Biodiversity degradation has now already reached an irreversible level with unforeseeable consequences. By now, it can be assumed that a major sixth mass extinction in Earth's history is currently underway.[¶] The five main drivers of the global decline in biodiversity are well known: Habitat loss, overexploitation, pollution, climate change, and invasive species. Various studies have assigned different levels of importance to these factors,,,,. However, ranking these drivers is criticized because it can lead to conservation actions being misguided. Therefore, it is preferable to consider the drivers collectively, as they are closely interrelated and potentially reinforce each other,[¶] Despite the problems and the resulting severe consequences being well known, not enough actions are currently being taken to halt the loss of biodiversity. The gaps in action may be due to the lack of mainstreaming of biodiversity in public policy and limited awareness of biodiversity loss among policy makers and the public,. There are also deficits in the general population's understanding of biodiversity: studies provide evidence that many adults and high school students are not familiar with the term biodiversity,. What is understood by biodiversity often differs between individuals and the terms nature and biodiversity are often used interchangeably. As a result, there is often a discrepancy between institutional definitions of biodiversity and what people understand by it. These differences in perception of biodiversity can be shaped, for example, by the social or cultural group.

Rewilding increases biodiversity – Studies prove

Hart et al 23 [Hart, Emma E., et al. "A Scoping Review of the Scientific Evidence Base for Rewilding in Europe." *Biological Conservation*, vol. 285, no. 285, Elsevier BV, Sept. 2023, pp. 110243–43, <https://doi.org/10.1016/j.biocon.2023.110243>.]

Restoring functional ecosystems is crucial to reversing the global biodiversity and climate crises. The concept of rewilding has gained increasing attention as a proactive tool for achieving ecosystem restoration quickly and at scale. However, the science of rewilding has been criticised for being largely theory-led rather than evidence based, a factor that continues to stymie policy actions. Here, we conduct a scoping review with the aim of mapping the nature and extent of the peer-reviewed literature that has measured outcomes of European rewilding projects. Our findings reveal significant growth in this area, although with a geographical bias towards the Netherlands and Scandinavian countries. Our synthesis of evidence shows that, although rewilding is not a biodiversity or climate panacea, there is a growing evidence base in support of theoretical propositions that it can restore biodiversity, deliver ecosystem services and support nature-based economies. To advance the field and address spatial disparity in reporting, we propose the establishment of country-specific networks of monitored and data-driven experimental rewilding projects, focused on national contexts. We also propose that the concept of standardizing the assessment of rewilding success across sites should be approached with caution, considering the site-specific and self-defining nature of rewilding outcomes. Lastly, we emphasize the importance of careful consideration by practitioners in terms of large herbivore refaunation efforts in Europe. Implementing comprehensive long-term plans to manage herbivore populations and address unforeseen effects is essential to mitigate welfare concerns, overgrazing, and reputational risks, while also maximizing biodiversity gains.

Rewilding boosts biodiversity and sustains it

Wildland Conservancy 24 [The Wildlands Conservancy. "The Wildlands Conservancy." the Wildlands Conservancy, 4 Oct. 2024,

wildlandsconservancy.org/stories/rewilding-tule-elk.]

¶ "To restore stability to our planet, we must restore its biodiversity, the very thing that we've removed. It's the only way out of this crisis we've created – we must rewild the world." – Sir David Attenborough¶ As we face the challenges of biodiversity loss and climate change, the concept of rewilding has emerged as a beacon of hope. Rewilding, which involves restoring natural processes and reintroducing native species to their original habitats, is a transformative movement aimed at healing our planet.¶ What is Rewilding?¶ Rewilding is the process of returning ecosystems to their natural state by allowing nature to take its course. This conservation strategy involves reintroducing species that were previously driven out by human activities, restoring natural habitats, and reducing human interference. By doing so, ecosystems can regain their balance, leading to increased biodiversity, healthier habitats, and a more resilient natural world.¶ Why is Rewilding Important?¶ Biodiversity is the foundation of healthy ecosystems. It supports everything from clean air and water to fertile soils and climate regulation. When species disappear, the ecosystems they support start to crumble, impacting everything from plant growth to the stability of food chains. Rewilding is essential because it not only brings back individual species but also the intricate web of interactions that sustain life.¶ Sir David Attenborough's words resonate deeply in this context: the loss of biodiversity is a crisis of our own making, and rewilding is the most effective way to restore what has been lost. By reintroducing species and reviving habitats, we can help stabilize the climate, increase resilience to environmental changes, and ensure that future generations can experience the wonder of vibrant, thriving ecosystems.

Rewilding creates sustainable ecosystems to increase biodiversity

IUCN 22 [IUCN. "The Benefits and Risks of Rewilding." IUCN, 7 July 2022, iucn.org/resources/issues-brief/benefits-and-risks-rewilding.]

Rewilding aims to restore ecosystems and reverse biodiversity declines by allowing wildlife and natural processes to reclaim areas no longer under human management. Misunderstanding of the rewilding concept has led to applications that harm communities and biodiversity, and threaten to undermine an approach with enormous conservation potential. Well-applied rewilding can restore ecosystems at a landscape scale, help mitigate climate change, and provide socio-economic opportunities for communities. Evidence-based rewilding principles will guide practitioners to rewild safely, help assess the effectiveness of projects, and incorporate rewilding into global conservation targets.

Rewilding creates sustainable ecosystems to increase biodiversity - Empirics Prove

Mutillod and Chollet 24 [Clémentine Mutillod, Simon Chollet. "Rewilding, a New Approach to Protecting Biodiversity." Polytechnique Insights, 16 Oct. 2024, www.polytechnique-insights.com/en/columns/planet/rewilding-a-new-approach-to-protecting-biodiversity/.]

"Rewilding became fashionable at the end of the 1990s and has exploded since the 2010s at a time when the protection of biodiversity is becoming increasingly technocratic" explains Simon Chollet. In 1998, two American ecologists published their first article mentioning the concept of rewilding. The approach was based on three key elements: large reserves that were strictly protected, interconnected and in which key species were reintroduced. "At that time, we understood that many ecosystems were controlled by a few "key" species," explains Simon Chollet. The leading example was the reintroduction of the wolf into Yellowstone National Park (United States) in 1995, 70 years after its disappearance. The interaction of this predator with certain prey triggered a cascade of reactions, affecting the entire ecosystem and even transforming landscapes.

Biodiversity loss cascades across the world

Fallah 24 [Fallah, Amy. "Catastrophic 73% Decline in the Average Size of Global Wildlife Populations in Just 50 Years Reveals a 'System in Peril' | Press Releases | WWF." World Wildlife Fund, 9 Oct. 2024, www.worldwildlife.org/press-releases/catastrophic-73-decline-in-the-average-size-of-global-wildlife-populations-in-just-50-years-reveals-a-system-in-peril.] Washington, DC (October 9, 2024) -There has been a catastrophic 73% decline in the average size of monitored wildlife populations* in just 50 years (1970-2020), according to World Wildlife Fund's (WWF) [Living Planet Report 2024](#). The report warns that parts of our planet are approaching dangerous tipping points driven by the combination of nature loss and climate change which pose grave threats to humanity. The Living Planet Index, provided by the Zoological Society of London (ZSL), tracks almost 35,000 vertebrate populations of 5,495 species from 1970-2020. The steepest decline is in freshwater populations (85%), followed by terrestrial (69%) and then marine (56%). Habitat loss and degradation and overharvesting, driven primarily by our global food system are the dominant threats to wildlife populations around the world, followed by invasive species, disease and climate change. Significant declines in wildlife populations negatively impact the health and resilience of our environment and push nature closer to disastrous tipping points— critical thresholds resulting in substantial and potentially irreversible change. Regional tipping points, such as the decimation of North American pine forests, the destruction of the Amazon rainforest, and the mass die-off of coral reefs, have the potential to create shockwaves far beyond the immediate region, impacting food security, livelihoods, and economies.** "Nature provides the foundation for human health, a stable climate, the world's economy, and life on earth. The Living Planet Report updates fifty-year trend lines of how much we've lost and tipping points that lie ahead," said WWF-US President and CEO Carter Roberts. "It highlights the most powerful tools to stem the loss and match the scale of this slow-motion catastrophe. A wake-up call that we need to get going, and fast."

Laundry list of biodiversity loss impacts

World Health Organization 25 [World Health Organization. "Biodiversity." World Health Organization, 18 Feb. 2025,

www.who.int/news-room/fact-sheets/detail/biodiversity.] Overview Biodiversity, the variability among living organisms from all sources, underpins all life on Earth. This includes diversity within species, between species and across ecosystems, representing the genetic makeup of plants, animals, microorganisms and the complexity of ecosystems. Healthy communities are sustained by well-functioning ecosystems, which provide critical services such as clean air, fresh water, natural medicines and food security. These ecosystems also regulate diseases and help stabilize the climate. For example, forests absorb over 2.6 billion tonnes of CO₂ annually, contributing to climate regulation and reducing the incidence of diseases linked to pollution. However, biodiversity loss is accelerating at an unprecedented rate, with approximately 1 million species at risk of extinction, threatening these vital services and exacerbating public health risks globally. Impact People depend on biodiversity in many ways. Human health relies on ecosystem resources, products and services (such as fresh water, food and fuel sources; the regulation of crop pests and diseases; and the regulation of air, water and soil quality) which are needed for good health and productive livelihoods. Biodiversity loss can have significant direct health impacts if ecosystem services no longer meet societal needs. Changes in ecosystems can affect livelihoods, income, local migration and may even cause or increase political conflict. Significant medical and pharmacological discoveries are made through greater understanding of the Earth's biodiversity. Biological diversity of microorganisms, flora and fauna provides extensive benefits for biological, health, and pharmacological sciences. It is also the source of [traditional and complementary medicines](#). Biodiversity loss also has profound economic consequences, particularly in sectors like agriculture, fisheries and healthcare. It is estimated that the global economic impact of biodiversity loss amounts to US\$ 10 trillion annually, including healthcare costs from increased disease transmission and agricultural losses from pollinator declines. For example, the decline in bee populations, which are responsible for pollinating crops worth over US\$ 235 billion annually, threatens global food security and nutrition. Threats to biodiversity and health Biodiversity loss is occurring at an alarming rate, with recent estimates showing that species extinctions are currently 10 to 100 times higher than the natural baseline. This is largely due to human activities like deforestation, habitat fragmentation, and climate change. This loss threatens essential ecosystem services, including pollination, soil fertility, and water purification, with direct consequences for human health. For example, the degradation of wetlands, which filter freshwater, has led to a 35% decline in global wetland coverage since 1970, increasing waterborne diseases and reducing water availability for over 2 billion people. Biodiversity loss and ecosystem degradation are becoming major health concerns. When ecosystems are disrupted, services like clean air, water, and food can be affected. Additionally, we lose valuable natural resources – like plants and animals – that may hold untapped benefits for health and medicine. Sustainable, healthy food systems Biodiversity serves as the foundation of healthy sustainable food systems. It directly influences the availability and nutritional value of food, as a diverse range of plant and animal species, ecosystems, and genetic resources contributes to healthier, more resilient food production. Access to enough nutritious and varied food is a fundamental determinant of health. Nutrition and biodiversity are interconnected at various levels, from ecosystems that provide food to the genetic diversity within species. This diversity affects the nutritional composition of food, including micronutrient availability.

Healthy diets with adequate nutrient intake depend on high biodiversity. Biodiversity offers a genetic pool for developing resilient and sustainable food crops, livestock and marine species. It plays a crucial role in breeding varieties resistant to pests, diseases and climate extremes. Utilizing this genetic potential enhances agricultural productivity and resilience, reducing dependence on chemical inputs and promoting sustainable practices. This not only improves food quality but also supports community health and well-being. Biodiversity supports key ecosystem services like soil fertility, natural pest control, pollination and water regulation. Preserving biodiversity in agricultural landscapes promotes sustainable food systems capable of producing nutritious food with minimal environmental impact. However, intensified food production practices affects global nutrition and health. Biodiversity degradation occurs through activities such as excessive use of irrigation, fertilizers and pesticides. Habitat simplification (the selective removal of species, such as in monoculture) and species loss increases vulnerabilities, highlighting the need for biodiversity-friendly practices to support food security and public health. Health research and traditional medicine Traditional medicine continues to play a crucial role in healthcare, particularly in primary healthcare settings. It is estimated that 60% of the world's population utilizes traditional medicines. Among the various modalities of traditional medicine, the use of medicinal plants stands out as the most prevalent worldwide. Medicinal plants are obtained through wild collection and cultivation, providing communities and Indigenous Peoples with natural products that serve medicinal, cultural and even nutritional purposes. Infectious diseases Human activities disrupt biodiversity and ecosystems, affecting their structure and functions. Deforestation, land-use change, habitat loss and fragmentation, population growth, climate change, pollution, invasive alien species, migration, trade and other drivers all play a role in disease patterns. These disturbances alter organism abundance, population dynamics and ecological interactions, ultimately impacting infectious diseases. Increased contact between wildlife, livestock and people lead to increased risk of disease transmission. Biodiversity plays a crucial role in disease regulation by maintaining balanced ecosystems where no single species dominates. This balance helps limit the spread of zoonotic diseases (infectious diseases that jump from animals to humans). Recent studies estimate that over 75% of emerging infectious diseases, such as Ebola or Nipah virus, are zoonotic and often arise in areas where ecosystems and habitats have been disrupted by deforestation or land-use change. By maintaining biodiversity, ecosystems can buffer humans from risks of exposure to disease reservoirs. Climate change Climate is an integral part of ecosystem functioning and human health is impacted directly and indirectly by climatic condition changes in terrestrial, aquatic and marine ecosystems. Biodiversity is influenced by climate variability and change, and extreme weather events (e.g. drought, flooding) that directly influence ecosystem health, productivity and availability of ecosystem goods and services for human use. Marine biodiversity is affected by ocean acidification related to levels of carbon in the atmosphere. Longer term changes in climate affect the viability and health of ecosystems, influencing shifts in the distribution of plants, pathogens, animals and even human settlements. In addressing these challenges, there is growing recognition of the potential of ecosystem-based approaches, also known as nature-based solutions, to mitigate and adapt to the impacts of climate change on biodiversity and human health. Ecosystems such as forests and wetlands act as natural carbon sinks, absorbing CO₂ and regulating global temperatures. The destruction of these ecosystems accelerates climate change, leading to increased heatwaves, floods, and other climate-related health risks, including heat-stress, malnutrition, and the spread of vector-borne diseases like malaria and dengue.

Biodiversity loss causes extinction

Torres 16 [Emile Torres, Scholar at the Institute for Ethics and Emerging Technologies, 5-20-2016, "Biodiversity Loss: An Existential Risk Comparable to Climate Change," Future of Life Institute, <https://futureoflife.org/2016/05/20/biodiversity-loss/>]

Catastrophic consequences for civilization. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. There could be surprising effects of biodiversity loss that scientists are unable to fully anticipate in advance. For example, prior research has shown that localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point. According to a 2012 paper published in Nature, there are reasons for thinking that we may be approaching a tipping point of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization. As the authors write, a planetary-scale transition could precipitate “substantial losses of ecosystem services required to sustain the human population.” An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be “widespread social unrest, economic instability, and loss of human life.” According to Missouri Botanical Garden ecologist Adam Smith, one of the paper’s co-authors, this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive. Biodiversity loss is a “threat multiplier” that, by pushing societies to the brink of collapse, will exacerbate existing conflicts and introduce entirely new struggles between state and non-state actors. Indeed, it could even fuel the rise of terrorism. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.) The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization “in as little as three human lifetimes,” as the aforementioned 2012 Nature paper notes. Furthermore, the widespread decline of biological populations could plausibly initiate a dramatic transformation of the global ecosystem on an even faster timescale: perhaps a single human lifetime. The unavoidable conclusion is that biodiversity loss constitutes an existential threat in its own right. As such, it ought to be considered alongside climate change and nuclear weapons as one of the most significant contemporary risks to human prosperity and survival

Watershed

America's rivers and streams are in crisis.

EPA 2024 [U.S. EPA, *National Rivers and Streams Assessment 2018-19: Key Findings*, 2024; accessed 13 Oct 2025; <https://www.epa.gov/national-aquatic-resource-surveys/national-river-and-streams-assessment-2018-19-key-findings>]

Clean and healthy rivers and streams enhance the quality of our lives. They supply our drinking water, irrigate our crops, provide highways for shipping, and offer us recreation. They support aquatic life and provide shelter, food, and habitat for birds and wildlife. Rivers and streams shape America's landscape. They are the land's vast, interconnected circulatory system, carrying water from the mountains to the sea. The National Rivers and Streams Assessment: The Third Collaborative Survey presents the results of the 2018-19 survey of perennial rivers and streams in the conterminous United States. The NRSA is part of the National Aquatic Resource Surveys, a series of statistically-based assessments designed to provide the public and decision-makers with nationally consistent and representative information on the condition of the nation's waters. Less than one-third of our river and stream miles (28%) had healthy biological communities, based on an analysis of benthic macroinvertebrate communities. Biological condition was based on the abundance and diversity of benthic macroinvertebrates (bottom-dwelling invertebrates such as dragonfly and stonefly larvae, snails, worms, and beetles). Close to half of river and stream miles (47%) were in poor condition. Just over one-third (35%) of river and stream miles had healthy fish communities. Fish community health was based on fish abundance and diversity. Sixteen percent of river and stream miles were not assessed for fish. The remainder (49%) were in fair and poor condition. Nutrients (phosphorus and nitrogen) were the most widespread stressors. Forty-two percent of the nation's river and stream miles were in poor condition, with elevated levels of phosphorus, and 44% were in poor condition for nitrogen. Poor biological condition was more likely when rivers and streams were in poor condition for nutrients. Reducing nutrient pollution could improve biological condition. NRSA analyses indicated that approximately 20% of the river and stream miles in poor biological condition could be improved if nutrient condition changed from poor to fair or good. The level of improvement was estimated to be similar regardless of nutrient and biological indicator analyzed. Healthy habitat occurred in over half of our river and stream miles. Physical habitat indicator scores revealed that 68% of river and stream miles were rated good for in-stream fish habitat, 57% scored good for streambed sediment levels, and 56% of river and stream miles had good ratings for riparian vegetation (vegetation on or adjacent to the river or stream banks). However, 64% of river and stream miles had moderate or high levels of riparian disturbance. Bacteria exceeded EPA's recreational benchmark in 20% of river and stream miles. Enterococci, bacteria that indicate fecal contamination, were above EPA's benchmark in 20% of river and stream miles. Swimming and recreating in water contaminated with pathogens could make people ill. Algal toxins were present, but at very low levels, with minimal recreational human health concerns. Microcystins and cylindrospermopsin were detected in 9% and 10% of river and stream miles, respectively, but did not exceed EPA recommended criteria in any samples. Contaminants were present in all fish tissue, but risk varied by contaminant and fish

consumption levels. In samples composed of fillet tissue from multiple fish, concentrations exceeded screening levels as follows (as a percentage of the 41,099 river miles comprising the sampled population): Mercury: 26% Total PCBs: 45% for general fish consumers, 74% for high-frequency fish consumers. Additionally, PFOS was detected in 91% of the 290 fish composite samples analyzed for NRSA 2018-19. EPA is not currently comparing PFOS concentrations in fish to screening levels because the toxicity assessment used to calculate screening levels is draft. When the assessment is final, EPA intends to update the PFOS information provided in this report to include screening level exceedances.

The decline of wetlands is accelerating.

USFWS 2024 [U.S. Fish & Wildlife Service, “Continued Decline of Wetlands Documented in the Conterminous United States,” press release, 26 Mar 2024; accessed 13 Oct 2025; <https://www.fws.gov/press-release/2024-03/continued-decline-wetlands-documented-new-us-fish-and-wildlife-service-report>]

A new report released by the U.S. Fish and Wildlife Service reveals wetlands – 95 percent of which are freshwater — covered less than 6 percent of the lower 48 states as of 2019 – which is half the area they covered since the 1780s. The report also identifies that loss rates have increased by 50 percent since 2009 and that without additional conservation actions taken to protect these ecosystems, wetland loss will likely continue, reducing ecosystem benefits for people and habitat for fish, wildlife and plants. This sixth edition of the national “Wetlands Status and Trends” report to Congress measured wetland change from 2009 to 2019 and builds on data from a series of reports spanning 70 years, highlighting the importance of wetlands. “The reasons for these losses are multiple, but the results are clear – wetland loss leads to the reduced health, safety and prosperity of all Americans,” said Martha Williams, Director of the U.S. Fish and Wildlife Service. “This report serves as a call to action to stop and reverse wetland loss and ensure we continue to provide future generations with clean water, protection against natural disasters, and resilience to climate change and sea level rise, as well as habitat for many plants and animals.” The report shows wetland loss has disproportionately impacted vegetated wetlands like marshes and swamps. The rapid disappearance of vegetated wetlands between 2009 and 2019 has resulted in a loss of 670,000 acres, an area approximately equal to the land area of Rhode Island. Declines in vegetated wetlands primarily occurred in the Southeast, Great Lakes, and Prairie Pothole regions. Decreases were particularly prevalent in the coastal watersheds of the Carolinas, the Delmarva Peninsula, Florida, Louisiana and Texas, as well as near the Mississippi and Mobile rivers. The main drivers of wetland loss have shifted over time. In the mid-1900s, loss was primarily caused by drainage and fill associated with agriculture. During the 2009 through 2019 study period, loss was associated with development, upland planted forest, and agriculture. However, other drivers also likely contributed to the loss, including climate change and sea level rise, especially along the coasts. To achieve no net loss of all wetlands, including vegetated wetlands, the report concludes that a strategic update is needed to America’s approach to wetland conservation. Conserving and restoring vegetated wetlands will be critical to addressing climate change and threats to biodiversity.

Riparian/forested buffers solve by reducing peak flows, filtering pollutants, and reconnecting streams to their floodplains—strengthening watershed resilience.

EPA 2021 [U.S. Environmental Protection Agency, “NPDES: Stormwater Best Management Practice—Riparian/Forested Buffer,” Office of Water, published Nov. 2021, 4 pp.; accessed 13 Oct 2025; <https://www.epa.gov/system/files/documents/2021-11/bmp-riparian-forested-buffer.pdf>]

Forested riparian buffers are effective at reducing peak flows to downstream waterbodies, reducing stormwater pollutant concentrations through direct filtration, and enhancing in-stream and riparian nutrient processing through increased stream–floodplain connectivity. The effectiveness of each depends on the design of the buffer and the length of installation along the riparian zone. Although quantifying the effectiveness of stream floodplain connectivity is still an evolving area of research, more data exists to quantify the effectiveness of buffers as direct filtration systems. Unlike more traditional stormwater treatment practices, design engineers generally size buffers according to the space available and not around any specific treatment volume. Accordingly, buffers’ abilities to reduce peak flows, infiltrate stormwater and filter pollutants are more variable, according to pollutant removal studies (see Table 1). Still, proper buffer design can increase pollutant removal from stormwater discharge. Factors that improve effectiveness include: Slopes less than 5 percent Upgradient overland flow paths less than 150 feet Groundwater close to the surface Contact times longer than 5 minutes Planting during the growing season Buffer widths greater than 25 feet Presence of organic matter, humus or mulch layer Entry stormwater velocity less than 1.5 feet per second Trees with deep root systems

Wetland restoration creates ‘distance’ from impact—restored marshes spread and store floodwaters instead of overtopping levees, protecting roads and downtowns.

NOAA 2025 [National Centers for Coastal Ocean Science (NOAA), “Modeling Reveals How Wetland Restoration Mitigates Flooding in Coastal Bays,” Mar. 25, 2025; accessed 13 Oct 2025; <https://coastalscience.noaa.gov/news/modeling-reveals-how-wetland-restoration-mitigates-flooding-in-coastal-bays/>]

As sea levels continue to rise, so too does nuisance flooding along the coast, which can cause road closures, damage to infrastructure, and increased insurance costs. Using Coos Bay, Oregon, as a study area, NCCOS-funded researchers found that restoring wetland habitat is one way to reduce future flooding in the region’s downtown areas and along its major transportation routes. These natural areas help buffer infrastructure from extreme tides and rising sea levels by allowing floodwaters to spread across restored marshes instead of overtopping levees. The research team developed a hydrodynamic model to predict changes in estuarine conditions and rapidly assess different restoration scenarios. Their analysis included repositioning levees to restore wetland habitat, effectively creating a larger “bathtub” for floodwaters. Under a scenario with no additional restoration, model projections indicate that by 2100, the highest high tides each month (known as spring tides) could flood large portions of downtown Coos Bay, with more than 11 inches of water across both lanes of U.S. Highway 101 (Figure 2a). The northbound lanes could experience over 19 inches of water across a 2,300-foot stretch of road, making the route impassable. When the team evaluated this flood scenario with a full restoration of the marshes (Figure 1), the extent of the flooding would be less severe and the southbound lane of U.S. 101 would be fully protected (Figure 2b). Study findings show that wetland restoration is more effective at reducing tidal flooding at inland sites, with less flood reduction near the coast. The researchers also found that restoration effectiveness was driven by increased flood accommodation space, allowing floodwaters to spread and not overtop levees near communities. The team aims to develop practical tools and insights for regional restoration efforts, such as the Columbia Estuary Ecosystem Restoration Program (CEERP), a joint initiative of the Bonneville Power Administration, the U.S. Army Corps of Engineers (Portland District), and others. To date, these partners have successfully completed numerous large-scale levee realignment projects.

Levee setbacks/floodplain reconnection expand room for water—lowering stages and velocities while delivering environmental co-benefits.

USACE 2017 [U.S. Army Engineer Research and Development Center, *Levee Setbacks: An Innovative, Cost-Effective, and Sustainable Solution for Improved Flood Risk Management* (ERDC/EL SR-17-3), 2017; accessed 13 Oct 2025; <https://www.govlink.org/watersheds/8/pdf/Levee-Setbacks-ERDC-EL-SR-17-3.pdf>]

Levee setbacks are a relatively recent innovation in Corps flood risk management practice to reduce rehabilitation costs and reduce flood stages and velocities (Figure 1). Levee setbacks are constructed at a greater distance from the river channel than traditional levees and they allow a river to occupy a portion of its historic floodplain. Compared to traditional levees, levee setbacks appear to have a number of economic and flood risk management benefits while reducing environmental impacts and, if properly designed, can even achieve environmental benefits. Levee setbacks are of increasing interest to Corps districts as a more sustainable solution to reduce reoccurring flood damages. In a memorandum addressed to the Deputy Commanding General for Civil and Emergency Operations dated May 26, 2016, the Assistant Secretary of the Army for Civil Works makes the following important statements in her policy concurrence with the Director of Civil Works on the Nooksack River Delta Levee setbacks: 1. “It is the policy of the Army to encourage floodplain restoration, as it encourages community resilience and provides benefits to both the ecosystem and human well-being.” 2. “If the level of flood risk associated with an ecosystem restoration project is decreased, then the risk reduction increment above the baseline must be cost-effective and incrementally justified.” 3. “If the level of flood risk is increased as a result of ecosystem restoration, then the Corps must mitigate any induced damages as part of the restoration project.” 4. “This policy shall be added to ER 1105-2-100 during its next update.”

Without wetlands and riparian storage, floods get taller and faster—watersheds lose their built-in sponge.

NOAA 2025 [National Oceanic and Atmospheric Administration, “Coastal Wetland Habitat,” Habitat Conservation, accessed 13 Oct 2025, <https://www.fisheries.noaa.gov/national/habitat-conservation/coastal-wetland-habitat>]

Wetlands act as natural water purifiers, filtering sediment and absorbing pollution. Runoff from hard surfaces like concrete, asphalt, and rooftops is a leading cause of water pollution. Development and agriculture contribute extra nutrients, pesticides, and silt to local waterways. Wetlands trap and filter these impurities, maintaining healthy rivers, bays, and beaches. Wetlands act as natural sponges, absorbing and temporarily storing floodwaters. By holding back some of the floodwaters and slowing the rate that water enters a river or stream, wetlands can reduce the severity of downstream flooding and erosion. Wetlands can lower overall flood heights, protecting people, property, infrastructure, and agriculture from devastating flood damages. This protection saves vulnerable coastal communities \$23 billion each year. During Hurricane Sandy, for example, wetlands protected areas of the East Coast from more than \$625 million in direct flood damages. But the continued loss of coastal wetlands means less protection for coastal communities from the impacts of strong storms.

When nature-based infrastructure is missing, communities pay more—wetlands and reefs that would have blocked surge and floodwaters aren't there to do the job.

NOAA 2024 [NOAA Office for Coastal Management, “Nature-Based Solutions—Fast Facts,” accessed 13 Oct 2025, <https://coast.noaa.gov/states/fast-facts/natural-infrastructure.html>]

Conserving and restoring oyster reefs, wetlands, and mangroves can prevent flooding and save hundreds of millions of dollars in storm damage. Wetlands reduced damages by more than 22 percent in half of the areas affected by Hurricane Sandy, and by as much as 30 percent in some states. This stabilization technique relies on natural materials—often a combination of oyster reefs, sand, and vegetation. The living shoreline approach can keep pace with sea level rise, and can be cheaper to build and maintain than gray infrastructure. Added benefits: improved water and air quality; can store carbon dioxide; and can self-maintain, self-repair, and self-recover. Oyster reefs and marshes act as natural barriers to waves; 15 feet of marsh can absorb up to 50 percent of incoming wave energy. Nature-based solutions could help avert more than 45 percent of the climate risk in the Gulf of America over a 20-year period, saving the region over \$50 billion in flood damages. Residential property values can increase by up to 37 percent due to the presence of trees and vegetation. Trees and vegetation also absorb and clean water, reducing flooding and pollution impacts and saving communities money on stormwater infrastructure.

Watershed disconnection drives drought-type low flows—without groundwater and wetland support, streams literally stop running in dry periods.

EPA 2015 [U.S. Environmental Protection Agency, *Streamflow Duration Assessment Method—Pacific Northwest*, Nov. 2015, accessed 13 Oct 2025, https://www.epa.gov/system/files/documents/2022-03/sdam-pnw_nov-2015-final.pdf]

In cases where groundwater aquifers are unable to supply sufficient quantities of water, intermittent streams cease to flow during dry periods (Mosley and McKerchar 1993; Rains and Mount 2002; Rains et al. 2006). Ephemeral streams flow only in direct response to precipitation including rainstorms, rain on snow events, or snowmelt. They do not receive appreciable quantities of water from any other source, and their channels are, at all times, above local water tables (Gordon et al. 2004; McDonough et al. 2011). As a stream flows from its origin, water may be derived primarily from stormflow, baseflow, or some combination of the two. Streams typically continue to accumulate water from stormflow, baseflow and other tributaries as they flow downstream. As streams accumulate flow they commonly transition along a gradient from ephemeral to intermittent and perennial, but sometimes quickly transition from ephemeral to perennial in high gradient systems, or transition from perennial to ephemeral or to total cessation of surface flow. Often these changes are gradual and may not be obvious to the casual observer. There are, however, indicators of streamflow that can be used to characterize the flow duration of a stream along a particular reach as ephemeral, intermittent or perennial.

Disaster Relief (Wildfires)

Past attempts at fire suppression have only made forests more vulnerable- rewilding will revive native species and increase resilience.

Johnston 21 [Johnston, James D. "Does conserving roadless wildland increase wildfire activity in western US national forests?"

iopscience.iop.org, IOP Science, 30 7 2021, <https://iopscience.iop.org/article/10.1088/1748-9326/ac13ee#fnref-erlac13eebib44>. Accessed 10 10 2025.]

Despite these challenges, in many areas throughout the western states, fire associated with management for roadless and wilderness characteristics has the potential to confer resilience in the context of climate change. Fire suppression has sharply reduced wildfire activity on national forest lands over the last 100–150 years, and most western forests are in a 'fire deficit' relative to the natural fire regime (Marlon *et al* 2012, Parks *et al* 2015). Lack of fire has resulted in increased forest density, shifts in species composition, and loss of resiliency to fire, drought, and insect outbreaks (Hessburg *et al* 2005, Stephens and Fulé 2005, Collins *et al* 2011). A number of recent studies have shown that forests in wilderness and roadless areas that have experienced multiple fires are less likely to experience stand-replacing fire and are recovering structural and compositional characteristics that were prevalent prior to Euro-American colonization (Larson *et al* 2013, Parks *et al* 2014b, Coop *et al* 2016). Climate change will increase flammability of most forests in the American West, and recent fire occurrence has a strong potential to moderate future fire effects and promote more diverse landscapes (Parks *et al* 2016, Hurteau *et al* 2019).

The current extremity of wildfires has been caused by human intervention and unsustainable attempted wildfire control -- a policy change is necessary.

Marlon 12 [Marlon, Jennifer. "Long-term perspective on wildfires in the western USA." *pnas.org*, PNAS, 2 14 2012, <https://www.pnas.org/doi/abs/10.1073/pnas.1112839109>. Accessed 10 10 2025.]

Forest fires in the western United States have been increasing in extent for several decades, prompting much research into the causes and consequences of such changes. The overall level of fire activity in a given place is governed by processes relating to climate, people, and vegetation that operate over decades and centuries; yet, most fire research is based on much shorter time scales. Given that future climate change is expected to drive fire activity well above its historical range of variability, a long-term perspective provides essential context to current changes. We use sedimentary charcoal accumulation rates to construct baseline levels of burning for the past 3,000 y in the American West; we then compare this record to independent fire-history data obtained from historical records and fire scars. We also create a statistical model, based only on independent temperature and drought reconstructions, that predicts 85% of the variability in biomass burnt (thought to reflect area burnt) prior to the 1800s, before human and ecological influences became dominant. Large shifts in biomass burning since the 1800s are not unprecedented, but their causes and effects differ greatly from climate-driven shifts in the past. Fire regimes are currently in disequilibrium with the climate, due to the opposing forces of fire exclusion practices (e.g., grazing and fire suppression) and global warming; consequently, a large "fire deficit" exists. The 20th Century Fire Deficit in the Western United States. Observed and predicted changes in biomass burning diverge in the late 1800s, despite increasing temperature and drought (Fig. 4A). Observed biomass burning, fire scars, charcoal-based fire frequencies, and human-caused fires decline to levels similar to the levels during the LIA. In contrast, predicted biomass burning rises from 1880 CE to present, which is consistent with increased temperature and drought. This pattern indicates that nonclimatic factors became the dominant control of fires around 1880 CE. The decline in fires during the 20th century may be explained by multiple factors. In the late 1800s, widespread

domestic livestock grazing reduced grassy fuel loads, compacted soils, and greatly reduced fire frequencies. By 1900 CE, the western frontier had largely closed, and intentionally set fires probably declined due to changing attitudes and policies towards fire. In addition, landscape fragmentation from trail and road building limited the spread of fire. Furthermore, after the 1940s, fire suppression became highly effective, preventing the spread of many forest fires. However, ecological factors also played a role, as the number of young stands and aspen stands, which are resistant to burning, increased after logging and previous extensive burning. Consequently, a fire deficit now exists and has been growing throughout the 20th century, pushing fire regimes into disequilibrium with climate. Hence, while current levels of large-scale biomass burning (1) remain within the realm of natural variability during the past 1,000 y, if levels of burning were to come into equilibrium with climate, they would exceed the natural range of variability experienced in at least the last 3,000 y. Three independent fire-history reconstructions for the western United States show that there have been large changes in wildfires since the 1800s. In earlier periods, changes of this scale were driven by climate; in the past 200 y, human behavior has played a much larger role. Fire suppression practices have greatly reduced fire, whereas global warming has increased the probability of fire. A widening gap, or fire deficit, therefore exists between actual levels of burning and expected levels of burning given current climate conditions. Recent increases in catastrophic wildfires in the West are an indication of this deficit, and suggest that current fire suppression practices are unsustainable. Fires are projected to increase even further in coming decades, and may require reevaluation of fire management policies and potential investment of additional resources.

Wildfires cost between 400 and 900 billion dollars to the US annually.

JEC Democrats 23 [Joint Economic Committee Democrats. "Climate-exacerbated wildfires cost the U.S. between \$394 to \$893 billion each year in economic costs and damages - Climate-exacerbated wildfires cost the U.S. between \$394 to \$893 billion each year in economic costs and damages - United States Joint ..." *Joint Economic Committee*, 16 October 2023, <https://www.jec.senate.gov/public/index.cfm/democrats/2023/10/climate-exacerbated-wildfires-cost-the-u-s-between-394-to-893-billion-each-year-in-economic-costs-and-damages>. Accessed 10 October 2025.]

Wildfires represent a growing threat to the health and well-being of communities across the country. The United States has already seen a devastating string of catastrophic wildfires this year in places like Maui, the western United States, and Louisiana as these disasters become more and more damaging due to climate change. This continues a string of deadly wildfire years that make the threat of wildfires to people and the broader economy increasingly clear. The total cost of wildfires in the United States is between \$394 billion to \$893 billion each year. This range was calculated by combining estimates from the existing research on the specific costs related to property damage, direct and indirect deaths and injuries, health impacts from wildfire smoke, income loss, watershed pollution, and a range of other factors. Each of these impacts on their own are very costly. Taken together, they represent disastrous consequences for the country. The total annual economic burden of wildfires in the United States is between \$394 billion and \$893 billion. The JEC Democratic Majority's analysis finds that wildfires in the United States cause between \$394 billion and \$893 billion dollars in damages annually, which is equivalent to between 2-4% of U.S. GDP. This range is notably higher than existing estimates in the literature, which put the total cost of wildfires at between \$87.4 and \$427.8 billion in 2022 dollars annually based on a smaller subset of costs. The economic costs in this analysis include: diminished real estate values, lost income, damage to watersheds and aquifers, insurance payouts, timber loss, property and infrastructure damage, electricity costs, evacuation costs, federal wildfire suppression costs, school and learning losses related to wildfires, insurance premium increases, and tourism loss. The health costs of wildfires accounted for in this analysis include direct deaths and injuries from wildfires, costs from short and long-term exposure to wildfire smoke, and psychological costs. The total cost estimates in this report should be viewed

as a likely undercount of the true total cost, as there are several costs connected to wildfires that have not yet been fully quantified by researchers. These additional costs include: how post-fire erosion harms agriculture and makes mudslides and flooding more likely; post-wildfire rehabilitation costs to help burn scars and other parts of the ecosystem recover; and the costs of managed retreat when certain areas become too wildfire prone to live in. Including these effects would push the total cost estimates even higher. Climate change is also likely to increase many of these costs going forward, as wildfires burn longer and produce more smoke, which would further enlarge the total cost of fires. These significant costs from wildfires motivate continued policy action to reduce the incidence of catastrophic wildfires and address their significant effects on people and the planet. The immense cost of wildfires—both the human toll and the economic damages—requires government action.

Chemical pollution is extremely detrimental to human health and can have a plethora of effects.

Shetty 23 [Shetty, Shilpa S., et al. "Environmental pollutants and their effects on human health." *PubMed Central*, Heliyon, 23 8 2023, <https://pmc.ncbi.nlm.nih.gov/articles/PMC10472068/#abs0010>. Accessed 10 October 2025.]

Chemicals that are harmful to human health and have gotten into the environment due to human activity are called environmental pollutants. Additionally, environmental pollution is caused by natural events like volcanic eruptions. Human activities introduce pollutants by polluting the water, air, and soil. Inhalation, oral absorption, and ingestion are the three main ways that contaminants reach the human body. To indicate the amount of a specific pollutant that is consumed, the word "dose" is frequently employed. The dose is dependent on exposure duration and intensity. Depending on the exposure level, different health effects may result. Although Industrialization develops a country, it introduces a large number of pollutants into the environment, which harms the health of those exposed [1]. Exposure to environmental pollution is a significant source of health risks all over the world. In general, hazardous substances from both natural and man-made sources pollute the air. The main sources of contaminants include automobile emissions, power plants, burning garbage, chemical companies, and volcanic eruptions contaminants like sulfur dioxide (SO₂), carbon monoxide (CO), nitrogen oxides (NO_x), heavy metals, biological contaminants, ozone, tobacco smoke, etc. are all released into the air that is inhaled When these pollutants are ingested, they interfere with the body's internal functioning, causing diseases like cancer, cardiovascular, reproductive, prenatal central nervous system, and respiratory health issue. Tobacco smoke, which consists of harmful chemicals like benzene, cadmium, arsenic, formaldehyde, and nicotine is responsible for health illnesses. It will cause cancer, not only to the smoker but also affect passive smoker (who is exposed to tobacco smoke and is not a smoker). A person may develop asthma, bronchitis, throat infection, and a burning sensation in the eyes. Exposure to biological pollutants like bacteria, viruses, house dust, mites, cockroaches, and pollen can cause asthma, hay fever, and other allergic diseases, and volatile organic compounds cause eye, nose, and throat irritation, headaches, nausea, and loss of coordination. Prolonged exposure may cause damage to the parts of the body, mainly the liver. Lead exposure can harm the brain and digestive systems, and in certain circumstances, it can result in cancer. Exposure to ozone causes itching in the eyes, burns, may develop respiratory disorders like asthma, and our resistance to colds and pneumonia will be lowered. In winter, children may suffer from respiratory problems from exposure to oxides of nitrogen. Depending on the exposure's type and intensity, the effect may be either short- or long-term. Short-term effects range from irritation of the eye, skin, nose, and throat, coughing, headaches, nausea, and dizziness to severe conditions like asthma, bronchitis, and lung and heart problems. Long-term effects will be neurological, reproductive, respiratory, and cancer [1,2]. Exposure to soil in which the presence of unwanted chemicals/substances higher than the normal concentration disturbs the

health of living organisms. Anthropogenic sources of soil contamination are chemicals used in or produced as a byproduct of industrial processes, wastewater, domestic, livestock, pesticide, and petroleum-derived products. These chemicals are introduced intensively into the soil by using fertilizers and pesticides, accidentally by discharging untreated sewage water and sewage sludge from oil spills, or by leaching from landfills and organic pollutants Atmospheric deposition results from smelting, incomplete combustion of many substances, radionuclide deposition from weapon testing, and nuclear accidents. Production and consumption of plastic are also rising nowadays. It is usually discharged into the soil, which degrades into its additive like bisphenol A, phthalates, dioxins, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals, which are carcinogenic and toxic. Exposure to soil that is contaminated with plastic additives increases the risk of cardiovascular diseases.

Pharmaceuticals, hormones, and biological pollutants like bacteria, viruses, and endocrine disruptors are emerging pollutants, that have recently appeared in the atmosphere and are usually not monitored. These contaminants can enter the human body through the nose, mouth, and skin. Exposure to such soil can cause different acute and chronic health problems. Short-term health problems like headaches, coughing, chest pain, nausea, and skin or irritation. People who continuously work with soil or reside nearby such areas are affected by inhalation because dust particles in the air are inhaled easily, causing different health issues. In some countries, people consume soil in the name of culture, which results in direct exposure to soil. Children under three are always at high risk because they are easily exposed to soil. Exposure to heavy metals causes skin contact problems. Prolonged exposure may disturb the functioning of the central nervous system and damage organs. Long-term exposure may increase cancer risk [3]. Crops produced from soil with high levels of contaminants are highly toxic. Consumption of these causes major health risks. Many soil contaminants are recognized as neurotoxic. Lead, polychlorinated biphenyls (PCB), As(arsenic), and Hg(mercury) are used in industries referred to as contaminants with neurotoxic potential [4].

Water pollution causes over 2 million deaths each year and is associated with the spread of disease.

Li 22 [Lin, Li. "Effects of Water Pollution on Human Health and Disease Heterogeneity: A Review." *Frontiers*, 29 6 22, <https://www.frontiersin.org/journals/environmental-science/articles/10.3389/fenvs.2022.880246/full>. Accessed 10 October 2025.]

Water is an essential resource for human survival. According to the *2021 World Water Development Report* released by UNESCO, the global use of freshwater has increased six-fold in the past 100 years and has been growing by about 1% per year since the 1980s. With the increase of water consumption, water quality is facing severe challenges. Industrialization, agricultural production, and urban life have resulted in the degradation and pollution of the environment, adversely affecting the water bodies (rivers and oceans) necessary for life, ultimately affecting human health and sustainable social development (Xu et al., 2022a). Globally, an estimated 80% of industrial and municipal wastewater is discharged into the environment without any prior treatment, with adverse effects on human health and ecosystems. This proportion is higher in the least developed countries, where sanitation and wastewater treatment facilities are severely lacking. Sources of Water Pollution Water pollution are mainly concentrated in industrialization, agricultural activities, natural factors, and insufficient water supply and sewage treatment facilities. First, industry is the main cause of water pollution, these industries include distillery industry, tannery industry, pulp and paper industry, textile industry, food industry, iron and steel industry, nuclear industry and so on. Various toxic chemicals, organic and inorganic substances, toxic solvents and volatile organic chemicals may be released in industrial production. If these wastes are released into aquatic ecosystems without adequate treatment, they will cause water pollution (Chowdhary et al., 2020). Arsenic, cadmium, and chromium are vital pollutants discharged in wastewater, and the industrial sector is a significant contributor to harmful pollutants (Chen et al., 2019). With the acceleration of urbanization, wastewater from industrial production has gradually increased. (Wu et al., 2020). In addition, water pollution caused by industrialization is also greatly affected by foreign direct investment. Industrial water pollution in less developed countries is positively correlated with foreign direct investment (Jorgenson, 2009). Second, water pollution is closely related to agriculture. Pesticides, nitrogen fertilizers and organic farm wastes from agriculture are significant causes of water pollution (RCEP, 1979). Agricultural activities will contaminate the water with nitrates, phosphorus, pesticides, soil sediments, salts and pathogens (Parris, 2011). Furthermore, agriculture has severely damaged all freshwater systems in their pristine state (Moss, 2008). Untreated or partially treated wastewater is widely used for irrigation in water-scarce regions of developing countries, including China and India, and the presence of pollutants in sewage poses risks to the environment and health. Taking China as an example, the imbalance in the quantity and quality of surface water resources has led to the long-term use of wastewater irrigation in some areas in developing countries to meet the water demand of agricultural production, resulting in serious agricultural land and food pollution, pesticide residues and heavy metal pollution threatening food safety and Human Health (Lu et al., 2015). Pesticides have an adverse impact on health through drinking water. Comparing pesticide use

with health life Expectancy Longitudinal Survey data, it was found that a 10% increase in pesticide use resulted in a 1% increase in the medical disability index over 65 years of age (Lai, 2017). The case of the Musi River in India shows a higher incidence of morbidity in wastewater-irrigated villages than normal-water households. Third, water pollution is related to natural factors. Taking Child Loess Plateau as an example, the concentration of trace elements in water quality is higher than the average world level, and trace elements come from natural weathering and manufacture causes. Poor river water quality is associated with high sodium and salinity hazards (Xiao et al., 2019). The most typical water pollution in the middle part of the loess Plateau is hexavalent chromium pollution, which is caused by the natural environment and human activities. Loess and mudstone are the main sources, and groundwater with high concentrations of hexavalent chromium is also an important factor in surface water pollution (He et al., 2020). Finally, water supply and sewage treatment facilities are also important factors affecting drinking water quality, especially in developing countries. In parallel with China rapid economic growth, industrialization and urbanization, underinvestment in basic water supply and treatment facilities has led to water pollution, increased incidence of infectious and parasitic diseases, and increased exposure to industrial chemicals, heavy metals and algal toxins (Wu et al., 1999). An econometric model predicts the impact of water purification equipment on water quality and therefore human health. When the proportion of household water treated with water purification equipment is reduced from 100% to 90%, the expected health benefits are reduced by up to 96%. When the risk of pretreatment water quality is high, the decline is even more significant (Brown and Clasen, 2012). To sum up, water pollution results from both human and natural factors. Various human activities will directly affect water quality, including urbanization, population growth, industrial production, climate change, and other factors (Halder and Islam, 2015) and religious activities (Dwivedi et al., 2018). Improper disposal of solid waste, sand, and gravel is also one reason for decreasing water quality (Ustaoglu et al., 2020).

Impact of Water Pollution on Human Health Unsafe water has severe implications for human health. According to UNESCO 2021 World Water Development Report, about 829,000 people die each year from diarrhea caused by unsafe drinking water, sanitation, and hand hygiene, including nearly 300,000 children under the age of five, representing 5.3 percent of all deaths in this age group. Data from Palestine suggest that people who drink municipal water directly are more likely to suffer from diseases such as diarrhea than those who use desalinated and household-filtered drinking water (Yassin et al., 2006). In a comparative study of tap water, purified water, and bottled water, tap water was an essential source of gastrointestinal disease (Payment et al., 1997). Lack of water and sanitation services also increases the incidence of diseases such as cholera, trachoma, schistosomiasis, and helminthiasis. Data from studies in developing countries show a clear relationship between cholera and contaminated water, and household water treatment and storage can reduce cholera (Gundry et al., 2004). In addition to disease, unsafe drinking water, and poor environmental hygiene can lead to gastrointestinal illness, inhibiting nutrient absorption and malnutrition. These effects are especially pronounced for children.

Purpose of This Paper More than two million people worldwide die each year from diarrhoeal diseases, with poor sanitation and unsafe drinking water being the leading cause of

nearly 90% of deaths and affecting children the most (United Nations, 2016). More than 50 kinds of diseases are caused by poor drinking water quality, and 80% of diseases and 50% of child deaths are related to poor drinking water quality in the world. However, water pollution causes diarrhea, skin diseases, malnutrition, and even cancer and other diseases related to water pollution. Therefore, it is necessary to study the impact of water pollution on human health, especially disease heterogeneity, and clarify the importance of clean drinking water, which has important theoretical and practical significance for realizing sustainable development goals. Unfortunately, although many kinds of literature focus on water pollution and a particular disease, there is still a lack of research results that systematically analyze the impact of water pollution on human health and the heterogeneity of diseases. Based on the above background and discussion, this paper focuses on the effect of water pollution on human health and its disease heterogeneity.

Environmental injustice causes air pollution to unequally effect minority Black and Latinx communities.

Alvarez 22 [Alvarez, Camilla H. "Structural Racism as an Environmental Justice Issue: A Multilevel Analysis of the State Racism Index and

Environmental Health Risk from Air Toxics." *pmc.ncbi.nlm.nih.gov*, Springer Nature, 22 1 2022,

<https://pmc.ncbi.nlm.nih.gov/articles/PMC9810559/#Sec10>. Accessed 10 10 2025.]

Communities of color and poor neighborhoods are disproportionately exposed to more air pollution—a pattern known as environmental injustices. Environmental injustices increase susceptibility to negative health outcomes among residents in affected communities. The structural mechanisms distributing environmental injustices in the USA are understudied. Bridging the literatures on the social determinants of health and environmental justice highlights the importance of the environmental conditions for health inequalities and sheds light on the institutional mechanisms driving environmental health inequalities. Employing a critical quantitative methods approach, we use data from an innovative state racism index to argue that systematic racialized inequalities in areas from housing to employment increase outdoor airborne environmental health risks in neighborhoods. Results of a multilevel analysis in over 65,000 census tracts demonstrate that tracts in states with higher levels of state-level Black–white gaps report greater environmental health risk exposure to outdoor air pollution. The state racism index explains four-to-ten percent of county- and state-level variation in carcinogenic risk and noncarcinogenic respiratory system risks from outdoor air toxics. The findings suggest that the disproportional exposure across communities is tied to systematic inequalities in environmental regulation and other structural elements such as housing and incarceration. Structural racism is an environmental justice issue. Supplementary Information The online version contains supplementary material available at 10.1007/s40615-021-01215-0. Keywords: Environmental justice, Structural racism, Multilevel modeling, Critical race quantitative methods, Air pollution, Neighborhood effects *“One of the most important indicators of one’s health is one’s street address” [1, p. 2]. -Robert D. Bullard and Beverly Wright* In 2011, air pollution caused an estimated 107,000 premature deaths in the USA—more than

traffic accidents and homicides combined [2]. However, these numbers were not equally distributed across the population, but rather reflected the inequalities of US society. A recent PNAS study reported that while not-Latinx, white people are exposed to 17 percent less pollution than they consume, Black and Latinx people are exposed to over 50 percent more pollution than they consume [3]. Communities that are exposed to higher levels of air pollution, a pattern known as environmental injustice, experience serious health consequences. The structural mechanisms driving the distribution of environmental injustices in the USA are understudied. Understanding these injustices in their social context requires recognizing the role that systematic racism plays in creating environmental disparities. A recent body of research [4, 5] shows that systematic racism contributes to the Black/white gap in health outcomes including infant mortality and cardiovascular diseases. While these studies have made a significant contribution to the literature on racial/ethnic health disparities, one aspect of systematic racism—environmental conditions—remains understudied [6]. On the other hand, a long line environmental justice literature focuses on the environmental conditions to neighborhood-level health outcomes. Environmental justice research [7–10] reveals systematic forms of oppressions such as residential segregation, urban poverty, and mass incarceration contribute to racial/ethnic and socioeconomic environmental disparities. Moreover, research shows these institutional mechanisms put all racial and ethnic groups more at risk for pollution exposure [8]. Exposure to air toxics, such as diesel fumes, particular matter, ethylene oxide, and formaldehyde, has both acute and chronic health consequences, many of which, such as respiratory and cardiovascular problems, are the focus of the health literature [11]. The associations between economic, residential, and environmental injustices highlight the necessity of viewing environmental justice as a “freedom struggle” [12, p. 14]. However, quantitative environmental justice research focusing on the role of systematic racism outside of residential and economic dimensions remains sparse. Bridging the literatures on the social determinants of health and environmental justice emphasizes both the importance of the environmental conditions for health inequalities and the institutional mechanisms that drive

environmental health inequalities. This article draws on the social determinants of health literature by using the state racism index to demonstrate the importance of institutional mechanism in generating disparities in environmental health risks from air pollution. Further, we adopt a critical quantitative methods approach by situating the empirical study within critical race theory. We expand the extant research by focusing on how structural racism influences neighborhood-level environmental health risk from air pollution. We use a cross-sectional multilevel analysis on data from over 65,000 census tracts. Results reveal tracts in states with a higher state-level Black-white gaps have a higher level of estimated cancer risk and noncancer respiratory system risks from outdoor air toxics for all racial and ethnic groups. This suggests that systematic inequalities in environmental regulation and other aspects of the social structure such as housing and incarceration may lead to worse air pollution. Thus, the findings emphasize the importance of the environmental justice literature for expanding research in other fields such as public health and the sociology of race and ethnicity.

Pollution directly causes climate change.

Chia 23 [Chia, Rogers. "Role of soil microplastic pollution in climate change." *Sciencedirect.com*, Science of the Total Environment, 20 8 2023, <https://www.sciencedirect.com/science/article/abs/pii/S004896972302733X>. Accessed 10 10 2025.]

In recent decades, environmental pollution from microplastic (MPs: <5 mm) and climate change have received international attention. However, these two issues have been primarily investigated separately hitherto, although they exhibit a cause-and-effect relationship. Studies considering MPs and climate change as causal entities have focused only on MP pollution in marine environments as a contributor to climate change. Meanwhile, systematic causal studies have not been performed inadequately to understand the role of soil, which is a primary terrestrial sink of greenhouse gases (GHGs) in the context of MP pollution, in climate change. In this study, the causal effect of soil MP pollution on GHG emissions as direct and indirect contributors to climate change is systematically analyzed. The mechanisms underlying the contribution of soil MPs to climate change are discussed, and future research perspectives are suggested. Approximately 121 research manuscripts pertaining to MP pollution and its associated effects on GHGs, carbon sinks, and soil respiration, recorded between 2018 and 2023, are selected and cataloged from seven database categories in PubMed, Google Scholar, Nature's database, and Web of Science. Several studies demonstrated that soil MP[Microplastic] pollution directly contributes to climate change by accelerating the emission of GHGs [Green House Gasses] from the soil to the atmosphere and indirectly by promoting soil respiration and adversely affecting natural carbon sinks, such as trees. Other studies correlated the release of GHGs from the soil to mechanisms such as the alteration of soil aeration, methanogen activity, and carbon and nitrogen cycles, and improved the abundance of carbon and nitrogen soil microbial functional genes adhering to plant roots to create anoxic conditions for plant growth. In general, soil MP pollution increases the release of GHGs into the atmosphere, thereby contributing to climate change. However, further research is to be conducted by investigating the underlying mechanisms using more practical field-scale data.

Introduction Currently, climate change and environmental pollution from emerging contaminants such as microplastics (MPs) have received global attention (Cha et al., 2023;

Jimoh et al., 2023; Walker and Fequet, 2023). Climate change is typically triggered by either direct or indirect emissions of greenhouse gases (GHGs), such as CO₂, CH₄, and N₂O, from the Earth's surface into the atmosphere, thus trapping heat. This process is exacerbated by anthropogenic activities such as farming, the use and disposal of plastic household products, and land-use change (Chia et al., 2020; Leng et al., 2019; Nunes et al., 2020; Long et al., 2021; Walker, 2021; Ponce et al., 2022). The emissions originate from various sources in both marine and terrestrial environments (e.g., oceans, soils, and trees). Among these sources, the ocean is the largest carbon storage that can release GHGs, with a carbon storage capacity of approximately 38,000 Gt, followed by soils in terrestrial environments, with a carbon storage capacity of approximately 2344 Gt (Naik et al., 2021; Osman et al., 2023). Recently, several evidence-based studies have shown that plastics directly contribute to climate change by affecting the carbon storage capacity of marine environments (Ford et al., 2022; Kakar et al., 2023). For example, Shen et al. (2020) showed that marine plastic pollution hinders marine carbon storage capacity and triggers GHG emissions into the atmosphere, thus contributing to climate change. The human population has widely adopted plastic products for convenience (Chia et al., 2021; Cha et al., 2023). Following the use and disposal of plastics in the natural environment, they can disintegrate into small particles (measuring 1 nm to <5 mm), or MPs, which are currently a major global concern (Chia et al., 2021; Lee et al., 2023). MPs emit GHGs at every stage of their life cycle during degradation, thereby contributing to long-term climate change (Koutnik et al., 2021; Chia et al., 2022b). Several studies have shown that MP pollution and climate change are correlated (Ford et al., 2022; Kida et al., 2023). To develop robust and holistic approaches for climate change mitigation and integrated approaches to manage MP pollution, the relationship between MP pollution and climate change must be investigated. Whereas the causal relationship between MP pollution and climate change has been investigated in marine environments, information regarding this relationship in terrestrial environments is insufficient. Hence, studies must be investigated to determine whether MP pollution in terrestrial environments (e.g., soil) contributes to climate change by directly or

indirectly triggering GHG emissions from soil. This critical review aims to substantiate and discuss the potential contribution of soil MP pollution to climate change based on the (1) direct triggering of GHG emissions from soils into the atmosphere and/or (2) the indirect triggering of GHG emissions from soils into the atmosphere by adversely affecting carbon sinks and enhancing soil respiration.

Ocean pollution inhibits the ability of the ocean to absorb CO₂.

Parvez 24 [Parvez, Sohel. "Role of Microplastics in Global Warming and Climate Change: A Review." *Springer.com, Springer Nature*, 8 3

2024, <https://link.springer.com/article/10.1007/s11270-024-07003-w#Sec3>. Accessed 10 10 2025.]

Water, especially oceanic and marine water, covers the majority of the Earth's surface. MPs are found in all bodies of water (Supplementary Information Table 1). The world's oceans play a crucial role in maintaining a stable climate by significantly contributing to the global carbon cycle, in addition to exchanging heat, water, momentum, particles, and other substances with the atmosphere (Bigg et al., 2003; Mendler de Suarez et al., 2014). The oceans are the top producers of O₂ (Borisov & Björn, 2018; Sekerci & Petrovskii, 2015) and are the largest carbon sink (Armstrong McKay et al., 2021; Findlay & Turley, 2021; Shen et al., 2020b) on the planet. Oceans safeguard the Earth from the most detrimental impacts of climate change by absorbing and neutralizing rising CO₂ and other greenhouse gases from the atmosphere (Bijma et al., 2013; Reid et al., 2009). They have a magnificent capability to absorb CO₂ and have already absorbed around one-fourth to one-third of the CO₂ released into the atmosphere by human activity (Findlay & Turley, 2021). However, MPs impede the ocean's incredible climate change mitigation capacity and climate resilience in a variety of ways, such as inhibiting light penetration in the water column, interfering with the growth and photosynthesis efficiency of phytoplankton, reducing the oxygen content in water, fueling deoxygenation in the ocean, and affecting the marine biological carbon pump.

4.1 Microplastics Inhibit Light Penetration in the Water Column

MPs are often less dense than seawater, allowing them to float on the ocean surface, resulting in higher quantities of the sea surface microlayer (Anderson et al., 2018; Bain, 2022). MPs floating on the ocean surface can change the rate of reflection and absorption of the incoming solar radiation in the water column (Fig. 6). Any floating material having more optical density than water might change the optical properties of surface waters. MPs floating on the ocean surface are composed of different polymers and greatly vary in color. MPs, especially those with dark colors (e.g., black, gray, or brown), would, therefore, absorb solar

radiation. Moreover, each particle may host a distinct combination of bacteria, viruses, and algae in its plastisphere, leading to a huge variation in the optical properties of surface water, which may alter the surface albedos. Airborne MPs were recently envisaged as significant light-absorbing particles that would impact albedos in the cryosphere (Fig. 6) through positive net radiative forcing (Zhang et al., 2022). MPs can influence the cooling or warming of water by scattering and attenuating the short-wave radiation from the sun, thereby changing other physicochemical properties of the water column (VishnuRadhan et al., 2019). Revell et al. (2021) quantified the optical properties and potential direct radiative effects of atmospheric MPs to influence Earth's climate by absorbing and scattering radiation. However, VishnuRadhan et al. (2019) raised the novel idea that by altering the incoming radiation from the sun, plastics can change physical processes in the ocean water column and influence the global climate cycles. However, we are still not concerned enough about the issue, which may be attributable to the fact that plastics have not yet had a discernable effect on the Earth's climate cycles. An effect may occur in the upcoming decades given that in some areas of the ocean, plastics have already reached high concentrations. **4.2 Microplastics Interfere with the Growth and**

Photosynthesis Efficiency of Phytoplankton Although its global biomass is small, phytoplankton plays a key role in aquatic primary production and Earth's climate (Uwizeye et al., 2021). These tiny organisms are among the most efficient photoautotrophs in the ocean, sequestering a large portion of atmospheric CO₂ into the ocean's interior via photosynthesis and the carbon pump (Pierella Karlusich et al., 2021). Phytoplankton contributes approximately 80% of the Earth's entire O₂ production and almost half of the global carbon fixation through photosynthesis (Käse & Geuer, 2018; Sekerci & Petrovskii, 2015; Shen et al., 2020b). The organisms could incorporate approximately 45–50 billion tons of inorganic carbon into their cells by absorbing CO₂ that would otherwise dissolve in the water and make it more acidic (Falkowski, 2012). A large volume of MPs floating in the world's oceans could reduce light transmission, lowering phytoplankton growth and photosynthetic efficiency (Shen et al., 2020b). Plastic particle attachment could prevent light from reaching the photosynthetic

centers, resulting in reduced photosynthesis, and could also rupture the cell wall, leading to the creation of holes and the absorption of particles by phytoplankton (Bhattacharya et al., [2010](#); Kakar et al., [2023](#)). MPs have toxic effects on phytoplankton, affecting growth, gene expression, morphology, and colony size and limiting overall photosynthesis efficiency (Supplementary Information Table [2](#)) through interactions with compounds linked with plastics or adsorbed pollutants (Nava & Leoni, [2021](#); Yokota et al., [2017](#)). The proliferation of cells, concentration of chlorophyll-a, and photosynthetic efficiency of *Phaeodactylum tricornutum* were decreased by 53.53%, 25.45%, and 12.50%, respectively, by polystyrene (PS) microplastic (Lang et al., [2022](#)). PS particles decreased the growth of phytoplankton *Dunaliella tertiolecta* by as much as 45% at high concentrations, and these negative effects were shown to worsen with finer particles (Sjollem et al., [2016](#)). PS nanoparticles reduced the content of chlorophyll production and impeded the growth and development of phytoplankton *Scenedesmus (S.) obliquus* in experimental exposure (Besseling et al., [2014](#)). PVC-type MPs had serious negative effects on the growth and photosynthesis of marine phytoplankton *Skeletonema costatum* (Zhang et al., [2017](#)). Polypropylene (PP) and PVC hindered photosynthesis in *Chlorella (C.) pyrenoidosa* and *Microcystis (M.) flos-aquae* (Wu et al., [2019](#)). Ansari et al. ([2021](#)) reported up to 42.7%, 41.6%, and 37.7% growth inhibition of *Acutodesmus (A.) obliquus* by polyethylene (PE), PVC, and PP, respectively, along with decreased photosynthetic efficiency in high exposure to MPs. MPs of polyethylene terephthalate had a strong negative influence on the growth, chlorophyll content, and toxicity of *Scenedesmus* sp., with the effects becoming more severe at higher concentrations (200 mg/L) (Khatriwada et al., [2023](#)). Strong negative effects were seen on the growth and photosynthesis of the microalgae *S. vacuolatus* by the MPs produced from an additive including electronic trash and a computer keyboard (Rummel et al., [2022](#)). MPs stunted the growth of *S. obliquus* by 50% through light obstruction and, in some cases, hampered the cell wall for attachment to the algal body (Liu et al., [2020](#)). Adsorption of plastic beads inhibited the photosynthesis of *Chlorella* and *Scenedesmus*, presumably due to the nanoparticles physically blocking light and air movement (Bhattacharya et al., [2010](#)).

Negative Evidence

Cost

The economy is good now. The CPI is steady even in the face of tariffs and future rate cuts keep inflation rates down.

Amundson 8/16 Amundson Chris (2025, August 16). *Inflation remains muted and more turnover at the service*. Chicago CPA, Accountant, Tax, Audit, Small Business Accounting Services.

<https://accountingsolutionsltd.com/chicago-cpa/inflation-remains-muted-and-more-turnover-at-the-service/>

The rate of inflation held steady in July as the New Administration imposed tariffs on almost all of our trading partners. This raises the question about what The Federal Reserve Board will do next month in response. The Consumer Price Index (CPI) held steady in July at 2.7%. But that doesn't tell the whole story. Economists generally watch a core measure which excludes volatile food and energy prices. This measure showed prices increasing by 3.1%. It was only expected to increase 3.0%, which tells us that lower energy prices offset most of the inflation in the other rate. Interestingly enough, the CBOE VIX "Fear Gauge" has since dropped to its lowest level in 2025. This gauges overall economic fear that investors have in the future. Also the CPI Report and weaker jobs data that was reported on August 1st have traders implying that there will be two interest rate cuts by The Fed before December of this year. What a difference a couple of days can make. Personally, I don't believe that will happen. The Fed has constantly spoken about the "efficient" use of interest rate cuts to drive the economy forward.

Economy is growing rapidly but its on the brink---GDP Growth, Rate Cuts, Consumer Spending, Building Permits, Recession

Ma 9-27 [Jason Ma 9-27, B.A. in Political Science and Government from University of California, Berkeley, M.A. in Specialized Journalism from University of Southern California, Weekend Editor at Fortune, "The U.S. economy is running even hotter than previously thought, and GDP growth could reach 4% in Q3", September 27, 2025, <https://fortune.com/2025/09/27/economic-outlook-gdp-forecast-q3-4-percent-consumer-spending-income-recession-warning/>]

While some on Wall Street are worried about a recession, recent economic data show that GDP growth is actually speeding up faster than earlier numbers indicated. On Thursday, second-quarter growth was revised even higher, to 3.8% from a prior reading of 3.3%, on robust consumer spending. That's after a first-quarter dip that was driven by President Donald Trump's trade war. Meanwhile, third-quarter growth is shaping up to be hotter. Durable goods orders for August jumped more than expected, according to data released on Thursday. And the personal income and spending report on Friday showed consumption remained healthy in August while also topping forecasts. Given that consumer spending represents over two-thirds of the U.S. economy, the gains more than offset weakness in housing, which remains buffeted by high home prices and mortgage rates. The Atlanta Fed's GDP tracker now puts third-quarter growth at 3.9%, up from an earlier estimate of 3.3%, citing the consumption data and a narrower trade deficit in August. Growth may not stop at that lofty rate. Stephen Brown, deputy chief North America economist at Capital Economics, said in a note on Friday that the income and spending data should further ease fears that the U.S. is on the cusp of a sharp slowdown. He also noted that discretionary spending, which typically is cut when consumers are suffering, drove growth. And while gains in spending have outpaced income for the last three months, the August savings rate was still at a relatively high 4.6%, meaning consumers are not yet overextended. "The rise in real consumption in August means that, given the stronger momentum going into the third quarter, we now have third-quarter consumption growth tracking as high as 3.3%, up from 2.3% last week," Brown added. "Third-quarter GDP growth will be as high as 4%." To be sure, stronger GDP also means the Federal Reserve will be under less pressure to lower rates aggressively. Capital Economics expects the Fed to cut at only one of its two remaining meetings this year, while Wall Street is betting on cuts at both meetings. Recession fears The upbeat growth forecast contrasts with warnings from Moody's Analytics chief economist Mark Zandi, who has said the economy is "on the precipice of recession." While the third quarter, which ends on Tuesday, looks good, he predicted the U.S. will be most vulnerable to a recession late this year and early next as the impacts of Trump's tariffs and immigration crackdown peak. And despite consumption staying resilient in the face of elevated inflation and tariffs, housing could still lead the economy lower. Zandi has pointed to building permits as the most critical economic variable for predicting recessions, and they are now at pandemic-era lows. The gains in aggregate consumption also obscure the sharp divide among American consumers, and the growing reliance on top earners. Moody's recently estimated that the bottom 80% of earners have merely spent in line with inflation since the pandemic, while the top 20% are driving growth. "As long as they keep spending, the economy should avoid recession, but if they turn more cautious, for whatever reason, the economy has a big problem," Zandi noted.

Rewilding pushes over the brink with its astronomical costs.

Saccone-24 Ben Saccone[Student at Colombia Climate School, Author of the Bitman Project], "The Huge Potential and Potential Harm of Rewilding," September 12, 2024, <https://bittmanproject.com/the-huge-potential-and-potential-harm-of-rewilding/>

Taking on these four steps to tackle the biodiversity and climate crisis has the power to be transformational. If applied on a global scale, the food system could be the greatest asset to solving the biodiversity and climate crises as opposed to being one of the biggest contributors to them. However, each individual step is a daunting challenge that requires significant capital and personnel investment. With a projected lifetime cost of \$2,500-\$6,000 USD per hectare, rewilding the 2.9 billion hectares of land identified for land neutral ecosystem restoration could cost over \$10 trillion to accomplish and maintain. To put this into perspective, however, the climate crisis is expected to cost the world \$1.7-\$3.1 trillion every year by 2050, potentially justifying the price tag for the climate change mitigation benefits. The costs associated with accomplishing each of these four steps could be covered by governments trying to meet their emissions and biodiversity goals, NGOs and philanthropies, and even through carbon markets. Unfortunately, those funds currently aren't sufficient and must increase if land-neutral ecological restoration is to gain significant traction. One shortcoming of this strategy is that it does not aim to reduce food insecurity or malnutrition, but seeks only to maintain current rates while repairing the environment.

Reintroducing 40 wolves in Colorado led to devastating costs for both the state and farmers.

Mckennie-25 Caitlin Mckennie [Dr. Caitlin McKennie is an experienced economist and demographer that comes to the Common Sense Institute (CSI) with more than eight years of experience working as a public servant for the State of Colorado. Her previous roles as an economist within the state government span across multiple agencies including: the State Demography Office (SDO) at the Department of Local Affairs (DOLA); the Colorado Workforce Development Council (CWDC) at the Department of Labor and Employment (CDLE); the Office of State Planning and Budgeting (OSPB) at Governor Polis's Office; and the Department of Natural Resources (DNR). Caitlin is motivated by data analysis and empirical modeling as a tool for informed decision-making. She brings extensive experience in public policy and econometrics to this role at CSI in a manner that is outcome-focused and equity-driven. She holds an M.A. in applied economics from the University of Colorado, Denver, an M.S. in mineral and energy economics from the Colorado School of Mines, and a PhD in economics from the University of Stirling, Scotland. She loves living in the Colorado mountains with her husband and dog, Boswell, and looks forward to getting her new puppy, Otter, in May], "Rewilding at a Cost," September 9, 2025 <https://www.commonsenseinstituteus.org/colorado/research/energy-and-our-environment/rewilding-at-a-cost>

Over the last two years, approximately 25 wolves were introduced in Colorado. CPW plans to introduce an additional 15 wolves in 2026. These wolves roam across an estimated 29 counties, including both rural agricultural regions and more densely populated areas like Boulder and Jefferson counties. Relative to FY 2023-24, actual program costs for gray wolf introduction have increased by nearly 119%. The State of Colorado has spent \$3.5 million in the past year (between May 2024 and August 2025) on wolf reintroduction efforts – more than triple the amount initially communicated to voters during the 2020 ballot measure campaign. That spending included \$1.6 million for staffing, \$900,000 for operations, \$410,000 for compensating ranchers whose livestock have been preyed upon by the wolves, and \$85,000 for "conflict minimization." Each adult wolf is associated with roughly 2 confirmed depredation cases per year. CSI estimates each case costs ranchers and farmers approximately \$32,000. Between 2026 and 2030, the cumulative cost of livestock depredation compensation is projected to total approximately \$35.1 million. By 2030, when the wolf population is expected to reach a self-sustaining level of 200 wolves, CSI estimates that annual costs will be \$12.5 million per year. Modeling using REMI forecasts suggests that wolf reintroduction results in substantial economic disruption, including a projected loss of nearly 400 jobs statewide and 170 in areas outside of Denver Metro and South Denver during 2030 alone. Between 2026 and 2040, the Coloradan reintroduction program is expected to cost the entire state: Over \$334 million in GDP; Over \$611 million in lost output from businesses; More than \$333 million in forgone personal income; and Roughly \$267 million in forgone disposable personal income. Cumulatively, by 2040, gray wolf reintroduction is estimated to cost rural Coloradans: Over \$200 million in GDP; Nearly \$400 million in lost output from businesses; Roughly \$140 million in forgone personal income; and Over \$120 million in forgone disposable personal income. Compensation claims from ranchers out of Grand County – where approximately 1,800 head of cattle have been impacted since the wolf reintroduction – indicate that CPW assessments undervalue the true economic losses to ranchers by an average of 43.3%. Since the program's inception in 2021, the average live weight of Colorado cattle has declined by at least 3%, suggesting broader systemic effects of predator-induced stress on herd productivity. At least 65 animals

have been harmed or killed as a result of the wolf reintroduction as of May 2025, resulting in an estimated direct cost of \$8.15 million. While it's still too early to publish definitive data on deer and elk population declines in Colorado, historical patterns from other states show that wolf reintroduction typically results in a 50% reduction in big game populations such as deer and elk. If similar trends hold, both ranchers and outfitters could face additional substantial long-term economic consequences.

Because rewilding largely increases farmers' costs, increasing food prices can lead to an economic recession.

Winne and Peersman-16 Winne, Jasmien De, and G. Peersman [Ghent University].

"Macroeconomic Effects of Disruptions in Global Food Commodity Markets: Evidence for the United States." Brookings Papers on Economic Activity, November 23, 2016.

<https://muse.jhu.edu/article/648590>.

Finally, when food prices increase, households may decide to consume less and to increase their precautionary savings because of a rise in uncertainty or a greater perceived likelihood of future unemployment and income loss. According to John Cochrane (2016), precautionary savings and risk aversion are prominent ingredients of business cycle fluctuations. In particular, he argues that higher risk premiums and increases in risk aversion triggered by relatively small shocks affecting consumers, rather than risk-free rates and intertemporal substitution, are the central features of recessions. Edelstein and Kilian (2009) provide empirical evidence that shifts in precautionary savings and deteriorating consumer confidence are likely an important determinant of the excess response of household consumption to energy price shocks. To assess the possibility of precautionary savings effects, the final panel of figure 15 shows the impulse responses of the University of Michigan's Index of Consumer Sentiment to food commodity and crude oil supply JASMIEN DE WINNE and GERT PEERSMAN 253 shocks. As can be observed, there is a significant decline in consumer sentiment after both shocks, which is consistent with increased uncertainty by households. Precautionary savings effects may thus also be an important propagation mechanism of food market disruptions to the real economy. Whether this is indeed the case, and the relevance of the different mechanisms to explain the overall effects, are questions that cannot be answered with the methods used in this paper. This requires other methods, such as general equilibrium models that incorporate food markets, and is left for future research.

Rewilding collapses economy---ruins development projects

Smith 18 [Wesley J. Smith, Award-winning author and Senior fellow at the Discovery Institute's Center on Human Exceptionalism, "The return of nature worship", August 06, 2018, <https://www.acton.org/religion-liberty/volume-28-number-3/return-nature-worship>]

Nature rights would cause profound harm to human thriving: Granting rights to nature would bring economic growth to a screeching halt by empowering the most committed and radical environmentalists – granted legal standing to act on “nature’s” behalf – to impose their extreme views of proper environmental stewardship through the buzz saw of unending litigation. Backed by well-funded environmentalist organizations and their lawyers, any and all large-scale economic or development projects – from oil drilling, to housing developments, to mining, to farming, to renewable energy projects, such as electricity-generating windmills that kill countless birds – could face years of harassing lawsuits and extorted financial settlements. At the very least, liability insurance for such endeavors would become prohibitively costly – indeed, if underwriters permitted policies to be issued for such projects at all. Of course, that is the whole point.

Investor certainty for projects is key---collapse economy otherwise

Keely 16 [Louise Kelley 16, President of The Demand Institute and Senior Vice President at Nielsen, one of The Demand Institute's founders. "Uncertainty Is The Key To Eroding Consumer Confidence". Forbes. 04-22-16. <https://www.forbes.com/sites/greatspeculations/2016/04/22/uncertainty-is-the-key-to-eroding-consumer-confidence/?sh=25432085639f>]

In a previous article, I argued that consumer confidence is almost always determined by national economic conditions, rather than by global events, or events in one or more other countries. The one exception to that rule in recent memory was the 2009 financial crisis that originated in the United States. Because the U.S. makes up one-quarter of global GDP, the effects on confidence were felt worldwide. There was another reason for the effects of the financial crisis on confidence. When Nielsen's global consumer confidence index -- Nielsen conducts a quarterly online survey in over 60 countries -- registered a 20 percent decline between the first quarter of 2007 and the first quarter of 2009, it was in part because the financial crisis was, for most consumers, completely unexpected. When consumers know what to expect, and are not feeling uncertain, they can tolerate a lot. Inflation, high or low, matters more or less depending on how far those affected anticipate it and can consequently incorporate it into their expectations about coming price changes, but consumers often react strongly when inflation or deflation is unexpected. They don't like economic surprises. While economic growth in Europe has been weak for years, consumer confidence has increased in recent quarters, and consumer spending has been a bright spot within many European economies. They didn't expect strong growth, so took weak growth in stride. Even in Russia, which never really recovered from the financial crisis, consumer confidence did not drop precipitously when Russia entered a period of recession combined with high inflation in late 2014. Russian consumers had already shown high levels of concern about inflation and rising food prices, which suggests they recognize that high inflation is likely -- so we didn't see a big confidence drop when it happened. Brazil entered a period of recession and high inflation at about the same time as Russia. However, Brazil's situation was exacerbated by political scandal, uncertainty about the state's ability to service public debt, and a central bank that raised interest rates as the economy moved into recession. What to expect from this complicated set of events was not at all clear to Brazilian consumers (or others). The result was a significant drop in consumer confidence from a high of 112 in Q1 2013, falling continuously to 76 in Q4 2015. Brazilian consumers' inflation expectations are all over the map, and do not suggest a broad understanding that inflation is high and is likely to continue to be so in the near term. Malaysia is another country in which recent uncertainty about what to expect from the economy is plaguing consumer confidence, though with a different root cause. In Malaysia, political instability emerged before and independently of economic weakness, but the concern now is that continuing economic weakness may be a consequence of this political instability. Indeed, in recent quarters, GDP growth has decreased, although it is still in positive territory. But again, the degree and nature of the instability, and how it may lead to changes in consumers' circumstances, is highly uncertain. Not surprisingly, then, Malaysian consumer confidence declined from 99 in Q3 2014 to 80 in Q4 2015. Uncertainty in the political arena and about its consequences for the Malaysian economy appear to have spilled over powerfully to how consumers think about their own economic prospects and their willingness to spend. These examples show us that when consumers do not know what to expect of their local economic and political environment, they become less confident. The degree of stability consumers feel matters as much as how good or bad the economy and labor markets actually are -- which is why these two things do not by any means move in lockstep. Consumer expectations matter enormously because consumption is an important part of most global economies. In the US, at one extreme, household consumption represents three-fourths of GDP. In China, at the other, it is still below

40%. In most economies, however, consumption is at least half of GDP, and the median level is above 60%. So a big decline in confidence because consumers are feeling uncertain about their financial situation may both presage and contribute to economic decline. Confidence is the lens through which consumers see their economic environment, and what we see influences how we respond. We may now be on the brink of another of those exceptions to the rule – a global development that drives declines in consumer confidence around the globe, on a scale not experienced since the 2009 financial crisis. This time, however, if it comes, it will not be triggered by events in the United States – indeed, the United States is now a relative bright spot on the global scene, a consumer-driven economy that the American consumer appears to be happy to drive for now – but by global uncertainty. Outside the U.S., the world seems to be getting the jitters. One important piece of evidence that we are, generally, in a highly uncertain state is the recent volatility of equity and commodity markets around the world. Another is that central banks in major economies are pursuing divergent monetary policies, and that many have recently questioned the efficacy of monetary policy to manage economies in general. A third element are the concerns expressed by many that emerging market debt quality is deteriorating significantly. If confidence does drop across markets, it will be because consumers, seeing these signals, really are worrying about how slower global growth and the ability of governments around the world to manage it might affect their economies or their governments' economic policies. Such a drop in confidence would create a self-fulfilling prophecy, as lower spending in a world in which consumption makes up the majority of most major economies reinforces the likelihood of the global economy moving into recession.

Government spending to a great extent leads to decreased private sector investment, a horrendously high federal debt, and drives inflation which all leads to economic decline.

Millsap-21 Adam A. Millsap [Adam A. Millsap is a Senior Economist and Program Officer working on economic issues at Stand Together Trust. He writes about state and local policy, urban development, and labor markets. His writing has appeared in national outlets such as USA Today and The Hill, as well as regional outlets such as the Detroit Free Press, Cincinnati Enquirer, and Orlando Sentinel, among others. He is also the author of *Dayton: The Rise, Decline, and Transition of an Industrial City*, published by the Ohio State University Press. In addition to his writing he has taught courses in economics at Johns Hopkins University, Florida State University, and George Mason University. He earned his M.A. and Ph.D in economics from Clemson University and a B.S. in economics and a B.A. in comparative religion from Miami University in Ohio. Follow Millsap for coverage of state and local tax issues, housing markets, and stories about how regulation impacts the economy.] "The High Costs Of Too Much Government Spending," August 6, 2021 <https://www.forbes.com/sites/adammillsap/2021/08/06/the-high-costs-of-too-much-government-spending/>

This debt will not solve our problems. America needs more private sector innovation to solve our biggest challenges—uplifting the poor, healing the sick, and protecting the planet—not more government spending and top-down regulation. If all this proposed spending occurs, the federal debt is likely to hit 109% of GDP by 2031 but could get as high as 125%. This would surpass the debt-to-GDP ratio in the years immediately following World War II. Debt as percent of GDP 2019-2031 COMMITTEE FOR A RESPONSIBLE FEDERAL BUDGET [HTTPS://WWW.CRFB.ORG/BLOGS/HOW-MUCH-COULD-BUILD-BACK-BETTER-ADD-DEBT](https://www.crfb.org/blogs/how-much-could-build-back-better-add-debt) Too much government spending harms society and individuals in several ways. First, it increases the cost of living via subsidies that drive inflation. Government subsidies artificially increase demand. The result is higher prices that disproportionately harm the working poor and middle class. The companies with subsidized offerings get richer, while these higher prices increase demand for larger subsidies. The cycle repeats, and costs head skyward. Subsidies are why the average cost of attending a four-year college or university rose by 497% between 1986 and 2018, more than twice the rate of inflation. A substantial body of research shows that universities respond to increases in state and federal subsidies by cutting their own aid, raising tuition or fees, or all the above. This forces many middle-class students and families to take on debt to pay for school. MORE FROM FORBES ADVISOR Best Travel Insurance Companies By Amy Danise Editor Best Covid-19 Travel Insurance Plans By Amy Danise Editor Per capita health care spending has nearly quadrupled over the last 40 years. Thanks in part to legislation such as the ACA, health insurance has moved beyond true insurance to cover routine care. As a result, government subsidies for insurance shield consumers from the full cost of routine health care spending. This increases demand for more tests, procedures, and consultations, many of which don't improve actual health. Research shows that subsidies also encourage consumers to switch to more expensive insurance plans, which further increases overall costs. Instead of subsidizing health insurance, which does nothing to address the underlying cost issues, we should reduce regulation that impedes competition to increase access to care for low and middle-income Americans. Scope of practice laws, certificate of need laws, and other regulations restricting technologies such as telehealth reduce the supply of health care and drive up costs. Americans deserve personalized health care that actually improves health. Large government deficits and debt also increase the risk of sustained inflation that acts as a tax on consumers. Unexpected inflation creates uncertainty for investors, which results in less

investment and thus less economic growth. Stable and predictable fiscal policy makes it easier for people to make long-term plans. Growing a business is a long-term endeavor that requires a minimum level of certainty about the future. Government can help maintain certainty through stable fiscal policy that reduces the risk of future inflation or tax increases. Too much spending reduces innovation by crowding out private sector investment. Estimates of fiscal multipliers are typically less than one, meaning that a dollar of government spending results in less than a dollar's worth of economic activity since the private sector curtails activity in response to greater government spending. Resources used by the government cannot simultaneously be used by the private sector, and researchers have found that private sector investment and consumption is crowded out by government spending. Private sector investment is the key ingredient in a growing economy. Less investment means fewer new businesses, fewer expanding businesses, fewer job opportunities, and less innovation. The products and services we rely on today—smart phones, amazonAMZN+0.2%, safer cars, mRNA vaccines, and more efficient home appliances—would not exist absent private investors willing to take risks.

US economy collapse from inflation is extinction — allows China and Russia dominance supplanting war .

Skaperdas '20 [Stergios; June 16; Professor of Economics at the University of California Irvine, former Director of the Center for Global Peace and Conflict Studies; Peace Economics, Peace Science and Public Policy, "The Decline of US Power and the Future of Conflict Management after Covid," vol. 26]

Whether the pandemic ends soon or is longer-lasting, the global economy and global geopolitics are very likely to have a different shape than they had before its onset. The high likelihood of a world depression and the differential responses across countries – especially those of China and the US – is changing the existing distribution of power across the world. After going over recent trends in the US's superpower status, I will discuss the pandemic's implications for the rise of China as a challenger to the US's position and a consequent urgent importance for improving global conflict management. Urgency is justified because international institutions have atrophied over the past few decades whereas the possibilities for conflict are expanding. During the late 90's when many thought that the end of US dominance was ending, Wohlforth (1999) argued well that unipolarity – with the US as the sole superpower – was likely to last for decades. More recently, Brooks and Wohlforth (2016) noted that "[T]he United States currently has defense pacts with sixty eight countries – a security network that spans five continents, contains a quarter of the Earth's population, and accounts for nearly three-quarters of global economic output." Bleckley (2018) even asserts that unipolarity will last for the rest of this century. I don't confront the debate on "unipolarity" here. However, with the rapid economic growth of China and the emergence of Russia as a military and diplomatic competitor to the US in Eurasia, the US's dominance in Eurasia cannot be taken for granted. If anything, as I will argue, the trends over the past two decades have been more negative for the US than is commonly recognized. With Eurasia having nearly 70 percent of the world's population and about the same in total GDP (at PPP, IMF 2020), it will be no longer possible for a non-Eurasian power to dominate the world's economics and geopolitics by itself. 1 Trends before the Pandemic I will discuss recent trends relating China to the US in terms of three dimensions that are often used to assess great power status: the economy, military capabilities, and technology. 1.1 Economy China has been quickly catching up with the US in its economy. In fact, by the beginning of 2020, China's GDP at PPP was 37 percent higher than that of the US (IMF 2020). While GDP at nominal exchange rates might be better in projecting economic power, GDP at PPP is better in gauging the actual productive capacity of an economy. The trend, however, that has been in favor of the US lately, has been the enhanced status of the US dollar as a reserve currency, paradoxically since 2008. The currency swaps between the Fed and other Central Banks – to help primarily the banks of US allied countries – appears to have been the major factor in this trend (Tooze 2018). This financial power has been increasingly used in sanctions against adversaries but even Allies. 1.2 Military China has been rapidly modernizing and expanding its conventional forces but is very far away from becoming a peer to the US militarily. The US has maintained its extraordinary predominance to move military resources by sea, land, and air throughout the world. However, the actual ability for the US to force its will on others has been shown to be limited recently. It can barely hold onto its troops in Afghanistan and Iraq and has had limited influence in Syria and in Libya. The fact that, after the assassination of Iranian General Suleimani, Iran was allowed to hit the US Al-Asad military base in Iraq (with apparently pretty accurate missiles) without any reaction shows the limits of US power projection. I suspect this is the first time that the US had one of its bases hit by another sovereign state without retaliating against them. While Iraq could be occupied, Iran is unlikely to be so – it is three times

as big and populous as Iraq and its invasion would involve many additional complications. Moreover, US aircraft carriers and bases are vulnerable to increasingly accurate missiles not just from Russia and China but from Iran as well. Hypersonic missiles are even deadlier, with Russia and China being reportedly ahead of the US in their development. With such vulnerabilities the US's ability to project military power in Eurasia becomes much more limited. It would be no exaggeration to say that it is "game over" for the US's projecting military power in Eurasia without the expectation of a challenge. Finally, the relatively small wars that US have already entered have been extremely costly. The cost of the Iraq and Afghanistan wars to US alone was estimated 10 years ago by Stiglitz and Bilmes (2012) to be between \$4-6 trillion, a quarter to 40% of US GDP at the time.

1.3 Technology

While the US was far ahead of China in technology and basic research barely a few years ago, China has been rapidly catching up. For example, one respectable index of current high-quality research is the Nature Index (natureindex.com) which includes articles only in the top natural science journals. In 2012 China's scientific productivity was at 24% of the US but by 2019 it was 67% of the US's level. This is likely a much better level than the Soviet Union ever achieved relative to the US. In technological disciplines such as computer science and AI China is likely in even better place. Furthermore, China has been demonstrating the ability to rapidly learn how to adapt foreign technologies and implement them in production at large scale. Highspeed rail, for instance, expanded from nothing to a 30,000 km network within a decade, while pushing the technology to new limits. The US by contrast seems to have largely divested itself of the necessity of maintaining primacy in engineering and manufacturing. The US's emphasis on expensive high-tech weaponry is largely driven by military-industrial complex rent-seeking and is, at best, a gamble that would have highly uncertain returns in a hypothetical conventional battlefield. Overall, China, while still markedly militarily inferior, has become at least an equal to the US economically and has been catching up rapidly in technology, while Russia has been counter-balancing the US militarily and diplomatically in Eurasia.

2 Effects of the Pandemic

The pandemic has brought about Depression levels of unemployment in the US in record time and almost all countries are facing severe contraction.¹ Employment is unlikely to reach its pre-pandemic level for a long time and, because this is happening simultaneously around the world, there is no single large country or region that could help lift the rest of the world with its demand. However, in relative terms China and East Asia have been less affected thus far and will continue to do so as long as they maintain a better health policy response to the pandemic.² China will likely have to restructure its economy to be less dependent on existing supply chains, rapidly expand the Belt-and-Road initiative, and expand its social welfare so as to rely more on internal demand for continued growth. Nevertheless, although all predictions now can be expected to have high variance, China is likely to come out in the end economically better off relative to the US. Other widely discussed probable effects include the strengthening of the nation-state and a retreat of globalization in production, trade, and capital movements. We can envision scenarios from a mild retreat of globalization with shorter supply chains to a full blown new Cold War with two or more separate economic blocks. Regardless of what the medium and long run will look like, the pandemic appears to have accelerated pre-existing trends of US declining power to the extent that we cannot say that there is one superpower dictating the international politics and economics of Eurasia. China and, secondarily, Russia will have much to say about how the global political economy evolves. Under such conditions opportunities for conflict increase and institutions of conflict management become ever more important.

3 The Alarming Future of Conflict Management

US policy until recently was as if the liberal trade hypothesis were true and there was no chance of an adversarial relation with China in the future. That is consistent with a neoclassical economic perspective according to which more trade is always

better. However, trade policy cannot be separated from security considerations when there is the possibility of insecurity (Garfinkel et al. 2015; Skaperdas and Syropoulos 2001). Now US policy seems to have been reversed with China being treated, not as trade partner, but effectively as an enemy. In such a case international institutions of conflict management would be important for reducing the chance of conflict, reducing the costs of arming, and allowing for smoother trade relations; most of all, for minimizing the chance of nuclear war. Those institutions, however, have gradually atrophied or have been intentionally boycotted during the time of US dominance. Over the past two decades, for example, and contrary to previous practices the US entered a number of wars without UN Security Council resolutions (including those that it could have obtained agreement such as the Afghanistan war). The recent withdrawal from the WHO, and the series of withdrawals from arms-control agreements (ABM, INF, Open Skies, and perhaps START) are other examples of the weakening of international institutions. Perhaps this is to be expected of a world hegemon, but the unilateralism appears to have increased while US power has been decreasing and the need for future restraint on all has become more visible. The conditions appear to be leading to a “bad” equilibrium without investments in conflict management and high probability of conflict as opposed to a “good” equilibrium with investments in conflict management and low probability of conflict (Genicot and Skaperdas 2002). The times we are now have similarities with the pre-WWI period which combined a high degree of globalization with the absence of institutions of conflict management (instead of their atrophy that we now have). At the time, there was a wide-spread belief that economic interdependence, and the break of that interdependence and other costs that war brings about, would by themselves guarantee peace (see, e.g., Angell 1913). Yet war came unexpectedly and with a vengeance. With the dismantling of previous arms control agreements, without good prospects for their replacement in the future, and the weakening of the UN and other international organizations, the risks and challenges facing the world include the following: Multiple-pronged arms races that go beyond hypersonic weapons to cyberweapons, autonomous weapon systems, other AI technology-enabled systems, and deployments in outer space. The costs and, most important, the multiple uncertainties that such arms races can generate are of immense risk. Highly risk averse leaders, perhaps as a result of a mistake or misunderstanding but not only so, could launch wars from which there might be no going back (Mearsheimer 2001; Wong et al. 2020). In the absence of nuclear weapons treaties, the only restraint on nuclear war is Mutual Assured Destruction (MAD). With new platforms, such as hypersonic missiles, that make possible delivery of nuclear weapons faster than it ever has been, could there be a greater temptation for a first strike (thinking that retaliation would never come)? Many examples of preconceptions, mishaps, and near-accidents from the 1950s and 60s that were not previously known (reported in Ellsberg 2017) show how the world we are now entering is likely more dangerous than the Cold War ever was. A scramble for trading partners and Allies across the world that could go beyond just the offering of carrots. The undermining of governments that are perceived to be unfriendly by one side and their shoring up by the other side often leads to less autonomy, externally-induced political conflicts, increased authoritarianism, and not infrequently to outright civil war. The danger of many countries in Eurasia, Africa, and Latin America becoming battlegrounds for continual proxy conflicts between the superpowers is increasing

Cavaciuti-Wishart et al. 24 [Ellissa Cavaciuti-Wishart, MPhil, Head, Global Risks, World Economic Forum; Sophie Heading, MA, Lead, Global Risks, World Economic Forum; Kevin Kohler, MA, Specialist, Global Risks, World Economic Forum; and Saadia Zahidi, MPhil, Managing Director, World Economic Forum, "Global Risks 2024: At a Turning Point," & "Global Risks 2034: Over the Limit," in The Global Risks Report 2024, Chapters 1-2, January 2024, pg. 14-39]

Figure 10: The mean squared error of the estimator of the true parameter θ for the logit model with 1000 replications. The x-axis represents the sample size n (ranging from 100 to 1000) and the y-axis represents the mean squared error (ranging from 0.00 to 0.05). The legend indicates the true parameter values: $\theta = 0.5$ (blue line), $\theta = 0.7$ (orange line), and $\theta = 0.9$ (green line). The error generally decreases as the sample size increases, with the $\theta = 0.5$ case showing the lowest error and the $\theta = 0.9$ case showing the highest error.

speech is always before you. Twitter and YouTube agreed to remove it to a BBC documentary in 2018. In 2018, the video has been removed about the government's approach to take over and reorganisations for peace between and within the world. **Rise in conflict [Figure omitted] Escalation in three key hotspots – Ukraine, Israel and Taiwan – is possible, with high-stakes ramifications for the geopolitical order, global economy, and safety and security. Geographic, ideological, socioeconomic and environmental trends could converge to spark new and resurgent hostilities, amplifying state fragility. As the world becomes more multipolar, a widening array of pivotal powers will step into the vacuum, potentially eroding guardrails to conflict containment.** The world has become significantly less peaceful over the past decade, with conflict erupting in multiple regions last year.³⁰ Active conflicts are at the highest levels in decades, while related deaths have witnessed a steep increase, nearly quadrupling over the two-year period from 2020 to 2022 (Figure 1.12), largely attributable to developments in Ethiopia and Ukraine. While difficult to attribute to a single cause, longer-term shifts in geopolitical power, economic fragility and limits to the efficacy and capacity of international security mechanisms have all contributed to this surge. Interstate armed conflict (#5) is a new entrant to the top 10 risk rankings this year. Specific flashpoints could absorb focus and split the resources of major powers over the next two years, degrading global security and destabilizing the global financial system and supply chains. Although war between two states in the strict definition remains relatively rare (Figure 1.12), this could contribute to conflict contagion, leading to rapidly expanding humanitarian crises that overwhelm the capacity to respond. [Figure omitted] High-stakes hotspots Over the next two years, the attention and resources of global powers are likely to be focused on three hotspots in particular: the war in Ukraine, the Israel-Gaza

conflict and tensions over Taiwan. Escalation in any one of these hotspots would radically disrupt global supply chains, financial markets, security dynamics and political stability, viscerally threatening the sense of security and safety of individuals worldwide. All three areas stand at a geopolitical crossroads, where major powers have vested interests: oil and trade routes in the Middle East, stability and the balance of power in Eastern Europe, and advanced technological supply chains in East Asia. Each could lead to broader regional destabilization, directly drawing in major power(s) and escalating the scale of conflict. All three also directly involve power(s) reckoned to possess nuclear capabilities. Over the next two years, the war in Ukraine could sporadically alternate between intensifying and refreezing. Despite sanctions, Russia has continued to benefit from energy profits and commodity exports – and this could increase further if the conflict in the Middle East widens.³¹ Pro-Russian or neutral sentiment in Eastern and Central Europe could soften support from Ukraine’s European allies,³² while support in the United States could wane under domestic pressures, other international priorities, or under a new government. Global divisions with respect to the Middle East conflict may also complicate efforts by Ukraine to maintain unity with Western allies, while also garnering support from the Global South.³³ If the conflict intensifies, it is still more likely to do so through conventional rather than nuclear means, but it could also expand to neighbouring countries. While post-conflict scenarios for both Ukraine and Russia are difficult to predict, the war could ‘refreeze’ into a prolonged, sporadic conflict that could last years or even decades.³⁴ Proximate developments in the Middle East are a source of considerable uncertainty, risking further indirect or direct confrontation between global powers. If the Israel-Gaza conflict destabilizes into wider regional warfare, more extensive intervention by major powers is possible, including Iran and the West.³⁵ Beyond potentially seismic shocks to global energy prices and supply chains, escalation could split the attention and resources of the EU and the United States between Ukraine and Israel.³⁶ The scale of Gulf countries’ or Western intervention is uncertain; it’s likely to continue to be deeply polarizing domestically and hold significant political sway. Numerous GRPS respondents also cited Taiwan and disputed territories in East and South-East Asia as areas of concern. In contrast to Russia, which doubled its defense spending target to more than \$100 billion in 2023, and the United States, which allocated over \$113 billion in assistance relating to the war in Ukraine alone,³⁷ China has largely acted as a non-interventionist power in both the Ukraine and Middle East conflicts, avoiding the risk of overstretch.³⁸ While there is no evidence to suggest that escalation is imminent, there remains a material possibility of accidental or intentional outbreak of hostilities, given heightened activity in the region.³⁹ Conflict contagion As high-stakes hotspots undermine global security, a wider set of trends may fuel a combustible environment in which new and existing hostilities are more likely to ignite. As conflicts spread, guardrails to their containment are eroding and resolve for long-term solutions have stalled.⁴⁰ In parallel, the internationalization of conflicts by a wider set of alternate powers will accelerate ‘multipolarity’ and the risk of inadvertent escalation. First, simmering tensions and frozen conflicts that are proximate to existing hotspots could heat up. For example, spillover impacts from a high concentration of conflicts, such as in Asia and Africa (Figure 1.13), could range from more readily available arms trafficking to conflict-driven migration. Other states could also deliberately stoke tensions in neighbouring countries to divert attention and resources, through disinformation campaigns or the deployment of state-backed militia groups, for example. Frozen conflicts at risk could include the Balkans, Libya, Syria, Kashmir, Guyana, the Kurdish region and Korean peninsula.⁴¹ These risks are well-recognized by business leaders: Interstate armed conflict features as a top-five risk in 20 countries (18%) surveyed in the Forum’s Executive Opinion Survey (EOS, see Appendix C: Executive Opinion Survey: National Risk Perceptions), including Egypt, Iraq, Kazakhstan and Serbia, and is the top risk in Armenia, Georgia, Kyrgyzstan and Japan. Second, resource stress, economic hardship and weakened state capacity will likely grow and, in turn, fuel conflict.⁴² There may also be a rise of ‘ungoverned

countries', where non-state actors fight for control over large swathes of territory, or where parties not recognized by the international system gain full control. For example, resource-rich countries could become caught in a battleground of proxy warfare between multiple powers, including neighbouring economies, organized crime networks and paramilitary groups (Chapter 2.6: Crime wave).⁴³ [Figure omitted] Third, with instant information networks and reinforcing algorithms, the symbolism of high-stakes hotspots could trigger contagion beyond conflict geographies. Deeply ingrained ideological grievances are in some cases driving hostilities, and these divisions are resonating with communities and political parties elsewhere. This expands beyond religious and ethnic divisions to broader challenges to systems of governance. National identities, international law and democratic values are coming into question, contributing to civil unrest, threatening human rights, and reigniting violence, including in advanced democracies and between the Global North and South. North-South rift Dissatisfaction with the continued political, military and economic dominance of the Global North is growing, particularly as states in the Global South bear the brunt of a changing climate, the aftereffects of pandemic-era crises and geoeconomic rifts between major powers. Historical grievances of colonialism, combined with more recent ones regarding the costs of food and fuel, geopolitical alliances, the United Nations and Bretton Woods systems, and the loss and damage agenda, could accelerate anti-Western sentiment over the next two years. In conjunction with more thinly spread resources and tighter economic conditions, military power projection by the West could fade further, potentially creating power vacuums in parts of Africa, the Middle East and Asia. France, for example, has withdrawn troops on request from Mali, Burkina Faso and Niger over the past two years.⁴⁴ As the dominance of long-held power centres wanes, alternate powers will compete for influence in interstate and intrastate conflicts, potentially leading to deadlier, prolonged proxy warfare and overwhelming humanitarian crises.⁴⁵ There are a number of incentives to this involvement, from access to raw resources, such as minerals and oil, to the protection and promotion of trade, investment and security interests. Pivotal powers will also increasingly lend support and resources to garner political allies, taking advantage of this widening rift between the Global North and the Global South. As a new set of influences in global affairs takes shape, political alliances and alignment within the Global South will also shape the longer-term trajectory of internationalized conflicts. A deep divide on the international stage could mean that coordinated efforts to isolate 'rogue' states may be increasingly futile, while international governance and peacekeeping mechanisms shown to be ineffective at 'policing' conflict could be sidelined. Economic uncertainty [Figure omitted] The near-term outlook remains highly uncertain due to domestic factors in some of the world's largest markets as well as geopolitical developments. Continued supply-side pressures and demand uncertainty could contribute to persistent inflation and high interest rates. Small- and medium-sized companies and heavily indebted countries will be particularly exposed to slowing growth amid elevated interest rates. According to one narrative, the global economy has shown surprising resilience in the face of the most aggressive global tightening of monetary policy in decades. Despite widespread predictions of a recession in 2023 (Figure 1.15),⁴⁶ the perception of a 'softer landing' appears to be prevailing. Inflation is falling amid tight labour markets and stronger-than-anticipated consumer spending and growth, particularly in the United States.⁴⁷ In another version, persistently elevated inflation in many countries and high interest rates are weighing heavily on economic growth, particularly in export- and manufacturing-led markets. An already visible economic downturn is likely to spread, with a risk that new economic shocks would be unmanageable in such fragility and debt passes the tipping point of

Growth is an impact filter---wars, arms races, cyber threats

Norrlöf et al. 24 [Carla Norrlof 24, Professor, Political Science, University of Toronto. Non-Resident Senior Fellow, Atlantic Council, "What the Global Economy and Security Require," Project Syndicate, 01/12/2024, <https://www.project-syndicate.org/commentary/economic-security-agenda-balancing-competing-objectives-by-carla-norrlof-2024-01>.

STOCKHOLM – The global order is undergoing significant changes that demand a new economic-security agenda. From hot wars and localized insurgencies to great-power standoffs, geopolitical conflict has made the complex relationship between economics and security a daily concern for ordinary people everywhere. Complicating matters even more is the fact that emerging markets are gaining economic clout and directly challenging traditional powers' longstanding dominance through new networks and strategic alliances. These developments alone would have made this a tumultuous period marked by economic instability, inflation, and supply-chain disruptions. But one also must account for rapid technological advances – which have introduced new security risks (such as arms races and cyber threats) – as well as natural risks such as pandemics and climate change. To navigate this dangerous new world, we must reckon with three interrelated dimensions: the effects of geopolitics on the global economy; the influence of global economic relations on national security; and the relationship between global economic competition and overall prosperity. Each pathway sheds light on the multifaceted interplay between economics and security. We will need to understand all of them if we are to tackle the varied and complex challenges presented by our highly interconnected global system. As recent years have shown, geopolitics can profoundly affect the global economy, reshaping trade, investment flows, and policies sometimes almost overnight. Aside from their devastating human toll, wars like the Russian invasion of Ukraine and Israel's campaign in Gaza often reverberate far beyond the immediate theater of conflict. For example, Western-led sanctions on Russia, and the disruption of Ukrainian grain exports through the Black Sea, caused energy and food prices to soar, resulting in supply insecurity and inflation on a global scale. Moreover, China has deepened its economic relationship with Russia following the mass exodus of Western firms in 2022 and 2023. Similarly, Israel's bombing of Gaza has destabilized the entire Middle East, especially tourism-dependent neighboring countries such as Egypt, Jordan, and Lebanon. Meanwhile, Yemeni Houthi rebels, long supplied by Iran, have been attacking cargo ships in the Red Sea, leading international shipping firms to suspend or adjust their routes, and directly impeding trade through the Suez Canal – a major artery of global commerce. We are witnessing the destabilizing effects of natural threats as well. The COVID-19 pandemic drove a massive shift away from cost-effective "just-in-time" supply chains to a "just-in-case" model aimed at strengthening resilience during disruptions. And, more recently, an El Niño-induced drought has diminished the capacity of the Panama Canal – another major artery of global commerce. Whether for geopolitical or ecological reasons, rerouting around these new bottlenecks inevitably increases shipping costs, causes delivery delays, disrupts global supply chains, and creates inflationary pressure. Turning to the second dimension – the implications of global economic relations for national security – it is clear that countries will be more likely to adopt bold or aggressive security policies if they already have a web of economic ties that can either attract support or dampen opposition. China, for example, is counting on economically dependent countries within its Belt and Road Initiative to accept its political influence and longer-term bid for hegemony. Many countries also now rely on China for critical defense-related supply-chain components, which leaves them vulnerable diplomatically and militarily. More broadly, global connectivity, in the form of economic networks and infrastructure, is increasingly being weaponized for geopolitical ends. As Russia's war on Ukraine shows, economic ties can create dependencies that raise the cost of opposing assertive security policies (or even outright aggression). The implicit threat of supply disruptions has a coercive – sometimes quite subtle and insidious – effect on a country's national-security objectives. Owing to the network effects of the dollar system, the

United States retains significant leverage to enforce international order through coercive sanctions against states that violate international norms. Trading with the enemy can be lucrative, or simply practical, but it also alters the distribution of power. As Western governments learned over the past two decades, the advantages conferred by technological superiority can be substantially offset by forced technology transfers, intellectual-property theft, and reverse engineering. The third dimension – the relationship between global economic competition and prosperity – has been complicated by these first two dynamics, because the pursuit of material well-being now must be weighed against security considerations. Discussions in this area thus center around the concept of economic security, meaning stable incomes and a reliable supply of the resources needed to support a given standard of living. Both Donald Trump’s “Make America Great Again” slogan and President Joe Biden’s “Build Back Better” plan reflect concerns that economic relations with China harm US prosperity. The challenge for the US and its allies is to manage the tensions between these varying economic and security objectives. There is a potential conflict between adapting to market- and geopolitically-driven shifts in economic power and sustaining the economic strength to finance a military force capable of protecting the global economy. The US, as the dominant power, must remain both willing and capable of preserving an open, rules-based global economy and a peaceful international order. That will require additional investments in military capabilities and alliances to counteract territorial aggression and safeguard sea lanes, as well as stronger environmental policies and frameworks to distribute global economic gains according to market principles. By attempting to mitigate security risks through deglobalization (reshoring, onshoring, and “friend-shoring”), we risk adding to the economic and security threats presented by a more fragmented world. Though economic ties with rivals can create dangerous dependencies, they also can act as a safeguard against hostility. T Economy Wide

Invasive Species

New animals extinguish insects. Take horses for example:

Davies & Boyd 19 [Kirk W. Davies & Chad S. Boyd, 2019 Rangeland Scientist at the United States Department of Agriculture Agricultural Research Service, Ph.D. in Rangeland Resources from Oregon State University; Research Leader at the United States Department of Agriculture Agricultural Research Service, Ph.D. in Rangeland Ecology and Management from Oklahoma State University, "Ecological Effects of Free-Roaming Horses in North American Rangelands," BioScience, Vol. 69, No. 7, July 2019, <https://doi.org/10.1093/biosci/biz060>]

It is well established that free-roaming horses can alter vegetation and soils in rangeland ecosystems (e.g., Beaver and Herrick 2006, Beever et al. 2008, Davies et al. 2014a), and this can negatively affect wildlife habitat (Beever and Aldridge 2011). Free-roaming-horse use has also been linked to negative impacts on insects (Beever and Herrick 2006), small mammals (Beever and Brussard 2004), birds (Zalba and Conzani 2004), and estuarine fauna (Levin et al. 2002). Shrubs are a critical habitat component for many wildlife species, and therefore, horse use limiting the recovery of shrubs could negatively affect these species. In particular, unmanaged horse use may negatively affect sagebrush-associated wildlife. The results from recent horse-exclusion studies (Davies et al. 2014a, Boyd et al. 2017) support the prior conclusions that free-roaming-horse effects may negatively influence sagebrush-associated wildlife (Beever and Brussard 2004, Beever and Aldridge 2011). Altered vegetation structure and composition in riparian areas can affect the availability and suitability of habitat for a variety of wildlife species. Avian species often select particular vegetation characteristics in riparian habitats (Ammon and Stacey 1997); therefore, horse effects may negatively influence some species and positively influence other species, depending on their habitat requirements. In moisture-limited ecosystems, horses may cause additional stress on native wildlife through competition for water. Free-roaming horses frequently prevented water acquisition by elk at a natural water source in Colorado (Perry et al. 2015) and pronghorn in Nevada (Gooch et al. 2017). Pronghorn and mule deer also used water sources less often where horse activity was high (Hall et al. 2018). Free-roaming-horse use of water sources was also associated with decreased native wildlife species richness and diversity (Hall et al. 2016). Native wildlife also visit and spend less time at water sources used by free-roaming horses, indicating that horses further constrain access to a limited resource (Hall et al. 2016, 2018). Clearly, free-roaming horses displace native wildlife at water sources. How this affects wildlife populations, demographics, and fitness is unknown (Berger 1985), but further loss of water in these water-limited environments from competition with free-roaming horses could amplify conservation challenges for native wildlife. We agree with Beever and Aldridge (2011) that the effects of free-roaming-horse use in sagebrush uplands and riparian areas (Beever and Brussard 2000, Beever et al. 2008, Davies et al. 2014, Boyd et al. 2017) on the conservation of sage-grouse and other sagebrush-associated wildlife need to be considered in developing wildlife management plans and conservation strategies. Free-roaming horses are an additional stressor on the wildlife species of conservation concern in North America, particularly in water-limited ecosystems. Therefore, horse effects likely need to be considered when developing wildlife plans and conservations strategies for any species with a range that substantially overlaps with horse-occupied areas.

Aff ignores human-introduced invasive species that have wrecked ecosystems. Specifically, feral pigs – introduced to the US by European settlers – have devastated threatened and endangered animals

USDOA 20 [US Department of Agriculture, "FERAL SWINE: Impacts on Threatened and Endangered Species," Revised May 2020
https://www.aphis.usda.gov/publications/wildlife_damage/fsc-feral-swine-impacts-tes.pdf]

What Are Feral Swine? **Feral swine** (also called wild pigs, boar, feral hogs, and many others) **are a destructive, invasive species**. They vary in color from black to brown and even patchwork colors, and range in size from 75 to 250 pounds. Feral swine belong to the family Suidae and were introduced into the United States in the 1500s by early explorers and settlers as a source of food. Over centuries, domestic pigs, Eurasian boar, and their hybrids have escaped, been released, and been reintroduced, setting the scene for the expanded populations we have today. Why Are They Considered an Invasive Species? Invasive species are defined as plants or animals that are non-native to an ecosystem and often have broad negative impacts on the environment into which they are introduced. With feral swine populations of approximately 6 million and distributed across more than 31 States, the damage they cause is significant to the environment, economy, and human health. Feral swine damage to habitats, predation on wildlife, and disease transmission can be linked to the decline of nearly 300 native plants and animals in the United States, many of which are threatened or endangered species. What Is Their Impact? Feral swine directly impact threatened and endangered species by preying on the nests, eggs, and young of ground-nesting birds and reptiles. They actively hunt and consume small mammals, reptiles, amphibians, and insects. They compete for important resources such as food, water, and habitat, often displacing other wildlife. Additionally, wildlife are vulnerable to many of the diseases and parasites feral swine carry. The most far-reaching impact feral swine have on native wildlife is habitat change and destruction through their rooting, wallowing, trampling, and feeding behaviors. Feral swine are ecosystem engineers, which means they can change their environment by altering water quality and runoff in wetlands, shifting plant composition and distribution in grasslands, and decreasing tree diversity in forests. Feral swine have played a role in the decline of nearly 300 native plants and animals in the United States; over 250 of these species are threatened or endangered. What Can I Do? Feral swine cause problems by damaging native ecosystems, preying on or competing with native wildlife, and spreading diseases. • Do not relocate feral swine to new areas or transport them to other States. • Share the knowledge; discourage transportation and spread of feral swine. • If you live in a State with no or low levels of feral swine, report any sightings, signs, or damage to wildlife or agriculture officials in your State. Examples of THREATENED and ENDANGERED SPECIES at Risk From Feral Swine Impacts and Damages Sea Turtle Feral swine's keen sense of smell, along with their digging and rooting abilities, allows them to prey on reptile eggs buried in sand or soil. On Keewaydin Island in Florida, in some years, feral swine nest predation devastated endangered green sea turtle reproduction by destroying every nest

on the island. The turtles' nest success improved dramatically after feral swine were removed.

Prairie Chicken Lesser prairie chickens are a unique and iconic species. Prairie chickens nest on the ground, leaving their eggs and young easily accessible. Their decline can be partially attributed to predation by feral swine. Habitat damage is also a threat to lesser prairie chickens. Feral swine will root up and consume native plants and introduce invasive plant seeds to the freshly disturbed soil, thereby accelerating the spread of invasive grasses and weeds.

Houston Toad Feral swine are aggressive animals that live in groups, called sounders. They will actively chase off other species with their aggressive behavior, particularly around feeding or wallowing areas. Feral swine wallowing in seasonal pools in parts of Texas have prevented the endangered Houston toad from breeding successfully by disturbing adult toads, eating eggs, and contaminating water. After fencing was installed, toads were able to successfully breed because swine were excluded from damaging their breeding habitat.

Mead's Milkweed Feral swine degrade the tallgrass prairie and glade habitat that the milkweed depends on for its lifecycle. They also prey on this milkweed by uprooting it and consuming the roots and seed pods. This delicate plant takes 15 years or longer to reach sexual maturity, making it very sensitive to feral swine damage. Mead's milkweed is important for many other species, including the Monarch butterfly, American bumblebee, digger bees, and other pollinators.

Hine's Emerald Dragonfly The Hine's emerald dragonfly is extremely rare, only living in a few small populations in Illinois, Michigan, Missouri, and Wisconsin. Feral swine threaten this unique species by damaging the delicate wetland habitat it depends on through rooting and wallowing. Dragonflies are important parts of an ecosystem because they prey on mosquitoes, gnats, and biting flies and their larva provide food for fish.

Hawaiian Moorhen Known as the "keeper of fire" in Hawaiian tradition, the Hawaiian moorhen is threatened by feral swine through direct predation on ground nests and habitat damage. Feral swine root up and consume vegetation on hillsides, causing erosion and flooding downstream in the wetlands the Hawaiian moorhen uses for breeding and nesting. Flooding of their shoreline nests is the most common reason for nest loss, followed closely by nest predation.

Rewilding destroys ecosystems. Empirical study from the Netherlands proves.

ICUN 21 [ICUN, June 2021, "The benefits and risks of rewilding", International Union for Conservation of Nature, <https://iucn.org/resources/issues-brief/benefits-and-risks-rewilding>, accessed 10-8-2025]

A 2019 study evaluates the Oostvaardersplassen (OVP) project in the Netherlands which began in 1983 with the introduction of Heck cattle, Konik horses and red deer to reclaimed land. Their numbers were not managed and the **animals could not move to new habitats, so populations were largely regulated by food availability. Native vegetation was degraded by overgrazing, and up to 30% of the animals died over winter periods when food was scarce.** In 2018 the management plan for OVP was revised, with reduced herbivore numbers.

Rewilding fixes ecosystems by introducing new species, but at the cost of eradicating old species.

Planet Wild 23 [Letting Nature, 6-27-2023, "How rewilding benefits our planet · Planet Wild", No Publication, <https://planetwild.com/blog/how-rewilding-benefits-nature>, accessed 10-8-2025]

Rewilding heals ecosystems by letting nature take care of itself. It has the power to protect species from extinction and even restore lost ecosystems. This is done by reintroducing native plants and animals to an area damaged by human activity, and then letting nature do its thing. When we allow nature to heal itself, we give it one of the best opportunities to thrive. This is one of the many awesome things about our world and its ecosystems—it knows how to survive (when given the chance)! There have been some notable rewilding success stories in recent years. In Yellowstone National Park, gray wolves were reintroduced to the region after disappearing for nearly 70 years. Wolves are a keystone species, which means their presence can define the health and success of an entire ecosystem. Without keystone species, an ecosystem would be dramatically different or cease to exist altogether. The presence of the wolves led to a significant reduction in the park's elk population, creating a stronger and more resilient herd by removing the sick and weak. The park also saw a recovery of vegetation and an increase in habitat for other species to flourish.

Rewilding reintroduces native species back to the environment to let natural processes work on their own.

Stevens 22 [Alison Pearce Stevens, 1-6-2022, "Rewilding returns lost species to strengthen ecosystems", Science News Explores, <https://www.snexplores.org/article/rewilding-lost-species-strengthen-ecosystems>, accessed 10-8-2025]

A mottled nose poked out from one tube, followed by the rest of a pointy black head. Whiskers twitched. Then a Tasmanian devil — the world's largest carnivorous marsupial — eased out onto the forest floor. It was soon followed by the others — the first devils in the wilds of mainland Australia in 3,000 years. Reintroduction of Tasmanian devils to the Australian mainland is part of an effort called rewilding. All over the world, species have been disappearing from parts of their native habitats. Often people are the cause. It might be due to hunting. Or their introduction of invasive species. Those intruders can sometimes out-compete or prey on the natives until those natives are all gone. Affected species didn't go extinct everywhere. But they were no longer part of the complex web of life in that particular place. More and more, scientists have begun to reintroduce animals into spaces from which they had disappeared. The idea is that this **rewilding will help return the ecosystem to its original state** — or something close. By reintroducing animals, people can let natural processes work on their own. Bringing back predators, for example, could restore balance to populations of their prey and the plants those prey eat. Rewilding herbivores could alter how much carbon an ecosystem stores. Restoring some animals might even slow drought and reduce the risk of fire.

Private economic ownership provides owners with incentive for ecosystem management to increase productivity.

Freeman 19 [Abstract, 5-30-2019, "The effect of ownership on ecosystem management among human foragers", ScienceDirect, <https://www.sciencedirect.com/science/article/abs/pii/S1040618217309175>, accessed 10-8-2025]

The adoption and spread of agriculture occurred in many places throughout the Holocene. Why this occurred is one of the most debated topics in quaternary science. A series of novel, recent arguments posit that territorial ownership provides an incentive for the adoption of food production by hunter-gatherers and, in some places, the domestication of plants and full scale farming (Smith, 2016, Bettinger, 2015, Bowles and Choi, 2013, Acemoglu and Robinson, 2012, Zeder, 2012, Smith, 2011a). Territorial ownership is complex, but, at base, describes rules and norms that provide legitimate access to a territory (or resource) for some and a justification for excluding others (Freeman and Anderies, 2015a, Smith, 1988). All of the recent arguments that link food production and ownership propose a complex causal structure centered around a fundamental premise of Neoclassical Economic Theory: Ownership rights are necessary to create incentives for individuals to invest in place and modify ecosystems. Ownership rights are necessary, it is argued, because such rights protect resources from arbitrary expropriation by free riders. **Free riders are individuals, in this context, who make sharing demands but have not contributed to improving the productivity of a territory.** In the absence of ownership rights, sharing demands (by free riders) decrease the incentive for individuals to work hard and produce food (see also Stevens et al., this issue). In this paper, we use path models to evaluate the complex causal effects of ownership rights on food production in hunter-gatherer societies. In particular, we evaluate one recent ownership–food production model that we call “The Niche Construction Model of Economic Defense” (NC-MED). The NC-MED is a synthesis of interrelated arguments made by Smith, 2016, Smith, 2011a and Zeder (2012), which distills these arguments into a single model amenable to empirical analysis. The NC-MED has a complex causal structure. The model combines an optimal foraging model, known as the Model of Economic Defense (MED), with niche construction theory (Smith, 2016, Smith, 2011a, Zeder, 2012). The NC-MED postulates that ecological variables provide incentives for individuals to adopt ownership and, in turn, ownership provides incentives for individuals to adopt food production. The dynamics are as follows: The onset of the Holocene created a predictable and “rich” resource base in many locales (Smith, 2011a, 267). In response, foragers reduced the amount of territory used to find food and developed a more detailed knowledge of local ecosystems. Both of these processes, a reduction in territory size and a more fine grained knowledge of an individual's territory, Smith argues, increase the net benefits of territorial ownership (Smith, 2011a, p. 267; Zeder, 2012, 258). In turn, territorial rights protect resources from free riders and, thus, provide incentives for individuals to (1) audition species for intensive management, and (2) select species that respond positively to human interventions that increase the productivity of a territory over the long-term (Smith, 2011a). Over time, territorial rights concentrate individuals on a landscape (i.e., increase population density) and the density

of resources within a territory increases due to resource management, which locks-in norms of territorial ownership that protect the improved resources within a territory from arbitrary expropriation (a positive feedback loop; see Zeder, 2012, 259). The NC-MED is provocative and some archaeological data are consistent with predictions drawn from the logic of the model (Smith, 2016, Smith, 2015); however, there is also contradictory evidence (Weitzel and Coddling, 2016). More importantly, like all arguments for the adoption of food production, the model is based on associations between ownership and the deliberate management of ecosystems in small-scale societies documented in the ethnographic record (Smith, 2011b). Yet, there has not been a systematic, cross-cultural study of the effect of ownership on food production strategies among hunter-gatherers, let alone a study that also attempts to evaluate the complex causal structure proposed by the NC-MED. Such a study is critical to evaluate the underlying assumption of the NC-MED that territorial ownership creates an incentive for individuals to manage the productivity of ecosystems (see Keeley, 1995). While many of the papers in this special issue focus on the processes that cause individuals to adopt strategies of territoriality (Bayham et al., 2017, Coddling et al., 2017, Stevens et al., 2017 or forgo such strategies (McCool and Yaworsky, this issue), our question is focused on the consequences of territoriality (see also Whitaker et al., this issue). In the end, we find quite limited support for the causal structure of NC-MED and the assumption that ownership provides an incentive for individuals to manage the productivity of ecosystems. Our results suggest that ownership has a positive effect on the food production strategy of planting seeds and tending plants, but not on landscape burning. Further, the coefficient of variation in rainfall, an estimate of inter-annual variation in primary productivity, and population density have positive effects on food production strategies. We discuss the implications of our results for trajectories of hunter-gatherer intensification in the archaeological record.

20 years of research proves— biodiversity loss undermines ecosystem viability.

Cardinale et al 12 [Bradley J. Cardinale¹, J. Emmett Duffy², Andrew Gonzalez³, David U. Hooper⁴, Charles Perrings⁵, Patrick Venail¹, Anita Narwani¹, Georgina M. Mace⁶, David Tilman⁷, David A. Wardle⁸, Ann P. Kinzig⁵, Gretchen C. Daily⁹, Michel Loreau¹⁰, James B. Grace¹¹, Anne Larigauderie¹², Diane S. Srivastava¹³ & Shahid Naeem¹⁴, “Biodiversity loss and its impact on humanity” <http://snre.umich.edu/cardinale/wp-content/uploads/2012/04/Cardinale-et-al-Nature-2012.pdf>]

20 years of research on BEF In addition to the proliferation of experiments (.600 since 1990)¹², BEF research has developed a substantial body of mathematical theory^{17–19}, and expanded its scope to include global patterns in natural ecosystems^{20–22}. More than half of all work has been published since the last consensus paper in 2005 (ref. 23), and since that time, several milestones have been crossed: the field has coalesced around a series of key findings and themes that have been fostered by the publication of 13 quantitative data syntheses^{12,24–35}; many of the early scientific debates have subsided as data have amassed to resolve key controversies; a new consensus is emerging concerning the field’s unanswered questions and how to address them. These milestones provide a unique opportunity to re-evaluate earlier conclusions and to identify emerging trends. Six consensus statements We conclude that the balance of evidence that has accrued over the last two decades justifies the following statements about how biodiversity loss has an impact on the functioning of ecosystems. Consensus statement one **There is now unequivocal evidence that biodiversity loss reduces the efficiency by which ecological communities capture biologically essential resources**, produce biomass, decompose and recycle biologically essential nutrients. Meta-analyses published since 2005 have shown that, as a general rule, reductions in the number of genes, species and functional groups of organisms reduce the efficiency by which whole communities capture biologically essential resources (nutrients, water, light, prey), and convert those resources into biomass^{12,24–28,30–35} (Fig. 1). Recent meta-analyses further suggest that plant litter diversity enhances decomposition and recycling of elements after organisms die¹², although the effects tend to be weaker than for other processes. Biodiversity effects seem to be remarkably consistent across different groups of organisms, among trophic levels and across the various ecosystems that have been studied^{12,24,25,31}. This consistency indicates that there are general underlying principles that dictate how the organization of communities influences the functioning of ecosystems. There are exceptions to this statement for some ecosystems and processes^{12,32,36}, and these offer opportunities to explore the boundaries that constrain biodiversity effects. Consensus statement two **There is mounting evidence that biodiversity increases the stability of ecosystem functions through time**. Numerous forms of ‘stability’ have been described, and there is no theoretical reason to believe that biodiversity should enhance all forms of stability³⁷. But theory and data both support greater temporal stability of a community property like total biomass at higher levels of diversity. Five syntheses have summarized how diversity has an impact on variation of ecosystem functions through time^{38–42}, and these have shown that total resource capture and biomass production are generally more stable in more diverse communities. The mechanisms by which diversity confers stability include over-yielding, statistical averaging and compensatory dynamics. Over-yielding enhances stability when mean biomass production increases with diversity more rapidly than its standard deviation. Statistical averaging occurs when random variation in the population

abundances of different species reduces the variability of aggregate ecosystem variables⁴³. Compensatory dynamics are driven by competitive interactions and/or differential responses to environmental fluctuations among different life forms, both of which lead to asynchrony in their environmental responses^{18,44}. We have yet to quantify the relative importance of these mechanisms and the conditions under which they operate. Consensus statement three **The impact of biodiversity on any single ecosystem process is nonlinear and saturating, such that change accelerates as biodiversity loss increases.** The form of BEF relationships in most experimental studies indicates that **initial losses of biodiversity in diverse ecosystems have relatively small impacts on ecosystem functions, but increasing losses lead to accelerating rates of change**^{12,25,31}(Fig. 1). We do not yet have quantitative estimates of the level of biodiversity at which change in ecosystem functions become significant for different processes or ecosystems, and this is an active area of research^{12,31}. Although our statement is an empirical generality, some researchers question whether saturating curves are an artefact of overly simplified experiments⁴⁵. Saturation could be imposed by the spatial homogeneity, short timescales, or limited species pools of experiments that minimize opportunities for expression of niche differences. In support of this hypothesis, select case studies suggest that as experiments run longer, saturating curves become more monotonically increasing⁴⁶. In addition, biodiversity–ecosystem function relationships in natural ecosystems sometimes differ from saturating curves²², and future research needs to assess when and why these differences occur. Consensus statement four Diverse communities are more productive because they contain key species that have a large influence on productivity, and differences in functional traits among organisms increase total resource capture. Much of the historical controversy in BEF research involved the extent to which diversity effects are driven by single, highly productive species versus some form of ‘complementarity’ among species^{47,48}. Research and syntheses over the past 10 years have made it clear that both the identity and the diversity of organisms jointly control the functioning of ecosystems. Quantification of the variance explained by species identity versus diversity in .200 experiments found that, on average across many ecosystems, each contributes roughly 50% to the net biodiversity effect¹². Complementarity may represent niche partitioning or positive species interactions⁴⁸, but the extent to which these mechanisms broadly contribute to ecosystem functioning has yet to be confirmed^{12,49}. Consensus statement five **Loss of diversity across trophic levels has the potential to influence ecosystem functions even more strongly than diversity loss within trophic levels.** Much work has shown that food web interactions are key mediators of ecosystem functioning, and that loss of higher consumers can cascade through a food web to influence plant biomass^{50,51}. Loss of one or a few top predator species can reduce plant biomass by at least as much⁵² as does the transformation of a diverse plant assemblage into a species monoculture¹². Loss of consumers can also alter vegetation structure, fire frequency, and even disease epidemics in a range of ecosystems⁵¹. Consensus statement six Functional traits of organisms have large impacts on the magnitude of ecosystem functions, which give rise to a wide range of plausible impacts of extinction on ecosystem function. The extent to which ecological functions change after extinction depends greatly on which biological traits are

extirpated^{23,53}. Depending on the traits lost, scenarios of change vary from large reductions in ecological processes (for example, if the surviving life form is highly unproductive) to the opposite where the efficiency, productivity and stability of an ecosystem increase. To illustrate this latter possibility, a summary of BEF experiments showed that 65% of 1,019 experimental plots containing plant polycultures produced less biomass than that achieved by their most productive species grown alone²⁷. This result has been questioned on statistical grounds⁵⁴, and because the short duration of experiments may limit the opportunity for diverse polycultures to out-perform productive species²⁷. Even so, the key point is that although diversity clearly has an impact on ecosystem functions when averaged across all genes, species and traits, considerable variation surrounds this mean effect, stemming from differences in the identity of the organisms and their functional traits (Fig. 1). To predict accurately the consequences of any particular scenario of extinction, we must know which life forms have greatest extinction risk, and how the traits of those organisms influence function⁵⁵. Quantifying functional trait diversity and linking this to both extinction risk and ecosystem processes is a rapidly expanding area of research^{53,55}. Four emerging trends In addition to the consensus statements above, data published in the past few years have revealed four emerging trends that are changing the way we view the functional consequences of biodiversity loss. Emerging trend one The impacts of diversity loss on ecological processes might be sufficiently large to rival the impacts of many other global drivers of environmental change. Although biodiversity has a significant impact on most ecosystem functions, there have been questions about whether these effects are large enough to rank among the major drivers of global change. One recent study⁵⁶ compared 11 long-term experiments performed at one research site, and another⁵⁷ used a suite of meta-analyses from published data to show that the impacts of species loss on primary productivity are of comparable magnitude to the impacts of drought, ultraviolet radiation, climate warming, ozone, acidification, elevated CO₂, herbivory, fire and certain forms of nutrient pollution. Because the BEF relationship is nonlinear (see above), the exact ranking of diversity relative to other drivers will depend on the magnitude of biodiversity loss, as well as magnitudes of other environmental changes. Nevertheless, these two studies indicate that diversity loss may have as quantitatively significant an impact on ecosystem functions as other global change stressors (for example, climate change) that have already received substantial policy attention.

Loss of biodiversity causes extinction.

Watts 19 [Jonathan Watts, Global Environment Editor at Guardian News & Media, "Human society under urgent threat from loss of Earth's natural life", The Guardian, 05/06/19, [theguardian.com/environment/2019/may/06/human-society-under-urgent-threat-loss-earth-natural-life-un-report](https://www.theguardian.com/environment/2019/may/06/human-society-under-urgent-threat-loss-earth-natural-life-un-report)]

Human society is in jeopardy from the accelerating decline of the Earth's natural life-support systems, the world's leading scientists have warned, as they announced the results of the most thorough planetary health check ever undertaken. **From coral reefs flickering out beneath the oceans to rainforests desiccating into savannahs, nature is being destroyed at a rate tens to hundreds of times higher than the average over the past 10m years,** according to the UN global assessment report. **The biomass of wild mammals has fallen by 82%,** natural ecosystems have lost about half their area and **a million species are at risk of extinction** – all largely as a result of human actions, said the study, compiled over three years by more than 450 scientists and diplomats. **Two in five amphibian species are at risk of extinction,** as are one-third of reef-forming corals, and close to one-third of other marine species. The picture for insects – which are crucial to plant pollination – is less clear, but conservative estimates suggest at least one in 10 are threatened with extinction and, in some regions, populations have crashed. In economic terms, the losses are jaw-dropping. Pollinator loss has put up to \$577bn (£440bn) of crop output at risk, while land degradation has reduced the productivity of 23% of global land. **The knock-on impacts on humankind, including freshwater shortages and climate instability, are already "ominous" and will worsen without drastic remedial action,** the authors said. **"The health of the ecosystems on which we and other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of economies, livelihoods, food security, health and quality of life worldwide,"** said Robert Watson, the chair of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (Ibpes). **"We have lost time. We must act now."** **Human activity has impacted both the abundance and diversity of animals and plants** The warning was unusually stark for a UN report that has to be agreed by consensus across all nations. Hundreds of scientists have compiled 15,000 academic studies and reports from indigenous communities living on the frontline of change. They build on the millennium ecosystem assessment of 2005, but go much further by looking not just at an inventory of species, but the web of interactions between biodiversity, climate and human wellbeing. Over the past week, representatives from the world's governments have fine-tuned the summary for policymakers, which includes remedial scenarios, such as "transformative change" across all areas of government, revised trade rules, massive investments in forests and other green infrastructure, and changes in individual behaviour such as lower consumption of meat and material goods. Following school strikes, Extinction Rebellion protests, the UK parliament's declaration of a climate emergency and Green New Deal debates in the US and Spain, the authors hope the 1,800-page assessment of biodiversity will push the nature crisis into the global spotlight in the same way climate breakdown has surged up the political agenda since the 1.5C report last year by the UN Intergovernmental Panel on Climate Change. David Obura, one of the main authors on the report and a global authority on corals, said: "We tried to document how far in trouble we are to focus people's minds, but also to say it is not too late if

we put a huge amount into transformational behavioural change. This is fundamental to humanity. We are not just talking about nice species out there; **this is our life-support system.**" The report shows **a planet in which the human footprint is so large it leaves little space for anything else.** Three-quarters of all land has been turned into farm fields, covered by concrete, swallowed up by dam reservoirs or otherwise significantly altered. Two-thirds of the marine environment has also been changed by fish farms, shipping routes, subsea mines and other projects. Three-quarters of rivers and lakes are used for crop or livestock cultivation. As a result, **more than 500,000 species have insufficient habitats for long-term survival.** Many are on course to **disappear within decades.**

Biodiversity collapse causes extinction.

Bittel 18 [Jason Bittel, "New Study Is First to Demonstrate That Biodiversity Inoculates Against Extinction," Natural Resources Defense Council, 3/8, <https://www.nrdc.org/onearth/new-study-first-demonstrate-biodiversity-inoculates-against-extinction>]

Biodiversity has long been touted as important for **staving off extinction**. The more kinds of critters you have, in other words, **the less likely any one of them—or a whole bunch of them—will disappear forever**. The trouble is, no one has ever really demonstrated this idea in a lab setting. Until now. In a study published this month in Proceedings of the National Academy of Sciences, Dirk Sanders of the University of Exeter in the United Kingdom and his coauthors show that **when you remove a species from a simple community**—that is, a community with fewer overall species—it can trigger **extinctions** in other species. What's more, the **scientists provide evidence** that **more complex communities—those with more species—are better able to stave off** the chain of events where one loss leads to **another and another**. Scientists refer to this phenomenon as an **extinction cascade**. Why should biodiversity be a **buffer against tragedy**? Well, because **when you lose an animal in a complex community, chances are good that something else will fill its role**, says Sanders. It's sort of impossible to control for variables in a large ecosystem like a river or a forest, so the **scientists opted to study** how **extinction** plays out in **mesocosms**, or miniature ecosystems. These consisted of bean and barley plants inhabited by several species of tiny insects called aphids. Aphids eat plants—technically, they suck sap—so they can represent a larger ecosystem's grazers, like deer. As for predators, the study included three parasitic wasp species, each of which preys on a specific type of aphid, as well as a fourth species of wasp that preys on any old aphid it can find. Finally, because nature is a bit of a Russian nesting doll of horrors, there were also several species of wasps that prey on the wasps that prey on the aphids. These so-called hyperparasitoids, or parasites that prey on parasites, represent yet another level in the food chain, like jaguars that kill caimans. Each community was set up on a table outdoors and surrounded by a 6.5-foot square of fine mesh that contained the creatures and prevented other insects from entering the mesocosm. At the same time, it allowed exposure to natural conditions like wind, rain, and sunlight, just as the plants and insects would experience in the wild. To simulate extinction in half of the mesocosms, the scientists started squishing mummies. And that's when things got interesting. You see, these wasps don't prey on aphids by just killing and eating them. No, the wasps stab the aphid with a highly evolved syringe and then squirt an egg into its body. This egg hatches and begins eating the aphid alive. After the wasp larva has had its fill, it spins a cozy little cocoon around itself and begins to transform into an adult. Just like the Very Hungry Caterpillar turning into a butterfly—if that caterpillar were hanging out inside the corpse of an aphid. The scientists sought out larvae from one parasitic wasp species, *Aphidius megourae*, and euthanized them with a pair of forceps. (To paraphrase T. S. Eliot, "This is the way the world ends. Not with a bang but a tweezer.") *A. megourae* direct all of their destructive force against just one kind of aphid, *Megoura viciae*. So when this wasp was removed from the equation, its prey experienced a population explosion. After a few weeks, there were twice as many *M. viciae* in these mesocosms as in the control mesocosms in which no wasps were culled. That

part was to be expected—get rid of wolves and mountain lions, and your deer population will go gangbusters.

Biodiversity loss causes extinction.

McCarthy 18 [Joe McCarthy, 2018, a Staff Writer at Global Citizen, Nov 8 2018, "Humans Could Face Extinction if We Don't Protect Biodiversity: UN", Global Citizen, <https://www.globalcitizen.org/en/content/biodiversity-loss-human-extinction/>]

As the sixth mass extinction event accelerates around the world, engulfing thousands of animal and plant species, **humans risk facing a similar fate** unless drastic interventions are made, according to Cristiana Paşca Palmer, the United Nations biodiversity chief, who recently spoke with the Guardian. Palmer said that within the next two years, countries have to develop an ambitious plan to conserve land, protect animals, and stop practices that are harming wildlife. This effort is equally as urgent as the Paris climate agreement's goal of **mitigating climate change**, she said. "The loss of biodiversity is a silent killer," she told the Guardian. "It's different from climate change, where people feel the impact in everyday life. With biodiversity, it is not so clear but by the time you feel what is happening, it may be too late." Next month, countries will meet in Sharm el Sheikh, Egypt, to begin mapping out what such a plan would like. Palmer hopes that a final version will be formalized in Beijing in 2020. If a binding global treaty fails to materialize, then humanity faces an uncertain future, she said. Past efforts to stop the loss of biodiversity have not proved successful, according to the Guardian. In recent years, evidence of this staggering loss has begun accumulating. Wild animal populations have declined by 60% since 1970, more than 26,000 plants and animals are close to extinction, nearly two-thirds of the world's wetlands and half of all rainforests have been destroyed, more than 87% of the world's ocean area is dying, and the planet needs an estimated 5 million years to recover from the biodiversity loss it has already sustained. "We are sleepwalking towards the edge of a cliff," Mike Barrett, executive director of science and conservation at WWF, recently told the Guardian. "If there was a 60% decline in the human population, that would be equivalent to emptying North America, South America, Africa, Europe, China, and Oceania. That is the scale of what we have done." "This is far more than just being about losing the wonders of nature, desperately sad though that is," he said. "This is actually now jeopardising the future of people. Nature is not a 'nice to have' — it is our **life-support system**." The benefits of biodiversity are hard to overstate. The **food chain, climate systems, atmospheric conditions, natural resources,** and much more depend on the delicately structured interactions of ecosystems around the world. The truly wild places in the world, meanwhile, are crucial to generating, cleaning, and distributing water around the world, and could help to **mitigate the looming water crisis**. These landscapes and marine environments also clean the air and act as **carbon sinks**, stabilize the global environment, and protect countries from **natural disasters**. In addition to climate change, the biggest threats to biodiversity are deforestation, agriculture, over-development, and **industrial pollution**. While Palmer sounded an urgent alarm bell while speaking with the Guardian, she's hopeful that countries will recognize the threat of biodiversity loss and begin to take action. The UN is calling for at least 30% of all land and 15% of all marine environments to be protected by 2030 and for targets to be lifted in the following years. "Things are moving. There is a lot of goodwill," Palmer said. "We should be aware of the dangers but not paralysed by inaction. It's still in our hands but the window for action is narrowing. We need higher levels of political and citizen will to support nature."

Rural Communities

Taking working lands out of production hits rural economies—retiring land reduces local demand for inputs, services, and labor.

USDA ERS 2006 [U.S. Department of Agriculture, Economic Research Service, “Farmland Retirement’s Impact on Rural Growth,” *Amber Waves* (Feature), by Patrick Sullivan, Daniel Hellerstein, David McGranahan & Stephen Vogel, July 1, 2006, accessed Oct. 2025, <https://www.ers.usda.gov/amber-waves/2006/july/farmland-retirement-s-impact-on-rural-growth>]

The Conservation Reserve Program (CRP) aims to reduce soil erosion, improve air and water quality, enhance wildlife habitat, preserve the productive capacity of the Nation’s farmland, and support farm income by taking land out of production for 10-15 years and putting it into conservation uses. Landowners and farm operators have voluntarily enrolled over 35 million acres of highly erodible and environmentally sensitive farmland in the program. In return for planting qualifying land to grasses, trees, and other protective vegetative cover, enrollees receive an annual rental payment, are reimbursed for roughly half the cost of establishing approved ground cover, and may be eligible for other incentive and maintenance payments. The program provides a stable source of income to participants and produces a wide range of environmental benefits. But by retiring farmland, it also reduces local demand for farm inputs, marketing services, and labor. To limit the local economic impact of taking land out of production, no more than 25 percent of a county’s cropland can normally be enrolled in the CRP without formal approval to exceed this cap. Nonetheless, the program is often blamed for the loss of farm-related jobs and the depopulation of nearby communities that provide agricultural and retail services.

Public acquisition/stricter land designations shrink local tax bases and limit economic use.

U.S. House 2011 [U.S. House of Representatives, Committee on Natural Resources, Subcommittee on National Parks, Forests and Public Lands, *Hearing on Payments in Lieu of Taxes (PILT)*, Oct. 14, 2011, opening statement of Chairman Rob Bishop; accessed Oct. 2025, <https://www.govinfo.gov/content/pkg/CHRG-112hhrg70721/html/CHRG-112hhrg70721.htm>]

While PILT is enacted to compensate local governments for the loss of property tax revenues for nontaxable Federally owned land, it has never fully accounted for the numerous management proscriptions that accompany that particular land. Not all Federal public lands are created equal. PILT does not adjust for variations in land-use designation, especially if moving from accessible multiple-use to a more restrictive or non-impairment management status. PILT has become an essential lifeline for many rural communities and counties. And since more than half of all the land in the West is unfortunately owned and managed by the Federal Government, PILT has a significant impact on all rural economies of western states. PILT is not an equalizer. While PILT is a necessary source of funds for rural and primarily western counties, although almost every county benefits in some way throughout this country from it, it often does not accurately reflect the economic opportunities that would be available through active management and use of the Federal public lands. When land management decisions reduce access or utilization of natural resources, local economies bear the brunt, and too often vital economic opportunities and resources, including traditional and renewable energy sources, are lost. And again, PILT cannot and does not fill that void. PILT alone is not adequate reimbursement for an absentee Federal landlord, especially one that pushes additional reductions in access and multiple use on our public lands. Contrary to claims by the Administration and others, the designation of monuments and wilderness are not a boon to local economies but rather a detriment in most scenarios. And I look forward to hearing about the work of Dr. Yonk and his colleagues which clearly calls into question the validity of recent testimony this Subcommittee had from the Director of Headwaters Economics. America is in the midst of a recession with elevated unemployment, yet the Obama Administration continues to push a wilderness agenda that competes with our natural priorities of job creation and domestic energy independence. This is counterproductive. At a time when the budgets are tight around the nation, particularly in the rural West, the Obama Administration needs to closely evaluate the real impact of advancing a wilderness agenda. To lock out millions of acres of public lands in the West without Congressional approval and restricting access for energy production, recreation and other job-creating activities would devastate these rural communities that unfairly bear the brunt of the restrictive land management designations. With the expiration of the full funding of PILT looming in Fiscal Year 2012, the interests and livelihoods of all the residents and stakeholders should be considered and protected when making land use decisions. Land use designations, such as national monuments and wilderness, should be initiated at the local level, not out of pressure from Washington without adequate

understanding of the impact on local communities, who are too often left shouldering the heavy burden of these dictates.

Rural communities are nationally foundational—policy shifts must account for impacts on their workforce and local economies.

DOE 2025 [U.S. Department of Energy, “Rural & Remote Communities: The Backbone of our Nation,” Office of the Under Secretary for Infrastructure, accessed Oct. 2025, <https://www.energy.gov/infrastructure/rural-remote-communities-backbone-our-nation>]

Rural communities form the backbone of our nation. We have relied on these communities to supply the country with critical supplies: food, fuel, natural resources, and much more. Thriving communities in rural areas are beginning to transition away from some of the industries that have supported their communities for decades, such as coal and other fossil fuels, and we know that this means potential impacts on their local workforce and economy. That's why we've been working closely with rural and remote communities for years to help them achieve their clean energy goals and fund new programs and technologies, build out their local economy, and provide new job opportunities.

Farmers DA

Rewilding causes cession of farming and forestry opportunity costs. Best studies show. Schou et al 25

[Associate Professor, Head of Division Verified email at ifro.ku.dk] Schou, J.S., Bladt, J., Ejrnæs, R. *et al.* Economic assessment of rewilding versus agri-environmental nature management. *Ambio* 50, 1047–1057 (2021). <https://doi.org/10.1007/s13280-020-01423-8> (accessed 10/3/2025)

Policies aiming at improving biodiversity often consist of costly agri-environmental schemes, i.e. subsidized grazing or mowing of semi-natural areas. However, these practices have widely been found to be insufficient to mitigate biodiversity loss. Rewilding, i.e. restoring natural processes in self-sustaining biodiverse ecosystems, has been proposed as an alternative and is hypothesized to be a more cost-efficient approach to promote biodiversity conservation. Rewilding requires the availability of large natural areas which are not allocated for farming, forestry, and infrastructure to avoid potential conflicts over the use of the area. We perform an ex-ante private cost–benefit analysis of the establishment of four large nature reserves for rewilding in Denmark. We analyse the economic effects of changing from summer grazing in nature areas in combination with cultivated fields and forestry to the establishment of nature reserves in four case areas. We consider two scenarios involving conversion of agriculture and forestry areas into natural areas in combination with either extensive year-round cattle grazing or rewilding with wild large herbivores. In two case areas, it appears possible to establish large nature areas without incurring extra costs. Additionally, rewilding further reduces costs compared to year-round cattle grazing. Two opposing effects were dominant: increased economic rent occurred from the shift from summer grazing to year-round grazing or rewilding, while cessation of agriculture and forestry caused opportunity costs.

Rewilding leads to substantially less economic outputs - farmers themselves agree

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[Micolajczak is a corresponding author at Grantham Research Institute, London School of Economics, London, UK School of Life Sciences, Anglia Ruskin University, Cambridge, UK "Rewilding—The farmers' perspective. Perceptions and attitudinal support for rewilding among the English farming community," Katarzyna M. Micolajczak, Nikoleta Jones, Christopher J. Sandom, Sophie Wynne-Jones, Antonia Beardsall, Suzanna Burgelman, Lucy Ellam, Helen C. Wheeler, First published: 19 August 2022 <https://doi.org/10.1002/pan3.10376>] (Accessed 10/3/2025)

3.4 Issue 3: Is rewilding compatible with ensuring food security? The third issue concerned food production and security. The vast majority of participants identified producing sufficient amounts of high-quality food to supply the nation as a primary role of farmers in the United Kingdom, highlighting the importance of this value to the farming community (Table 4). Some of the participants believed that the rewilding scenarios discussed could be compatible with productive rural landscapes, as an element of larger, diverse, nature-friendly networks of different management and land-use forms. They also thought that food produced within them would have high nutritional value. However, most participants worried that rewilding could threaten food security—and farmers' identity as 'principal food providers for the country' (Table 4). Materially, all three scenarios were considered to have the potential to reduce the amount of food produced at the site of implementation, either by decreasing the land's productivity or by removing parcels of land from production entirely: 'if it was the wrong area and we started to have more land flooded then obviously that land [would go] out of production for food and it's just getting that compromise of food and wildlife.' [AB04]. For this reason, participants often favoured the idea of rewilding happening on unproductive lands or on a smaller scale. Moreover, there was a fear that nature restoration in the United Kingdom at the expense of farmland could lead to importing foods with potentially higher environmental footprint and lower animal welfare standards. Such an outcome was considered ecologically ineffective and immoral, conflicting not only with the value of producing food to feed people but also with environmental stewardship (Table 4): *'[We] are from one acre here producing the same as five to ten or more acres over in Australia. ...if we set aside 10,000 hectares in the UK that's 100,000 or 200,000 in Australia, or it's 20,000 in South America, and I would say ...that's probably irresponsible. ...I don't think our bees are worth more than their bees. (...) an acre of our landscape isn't worth five or ten acres of somebody else's landscape.'* [AB07].

Perceptions are overwhelmingly negative from farmers - Conflict is inevitable

Micolajczak 25

[Micolajczak is a corresponding author at Grantham Research Institute, London School of Economics, London, UK School of Life Sciences, Anglia Ruskin University, Cambridge, UK "Rewilding—The farmers' perspective. Perceptions and attitudinal support for rewilding among the English farming community," Katarzyna M. Mikołajczak, Nikoleta Jones, Christopher J. Sandom, Sophie Wynne-Jones, Antonia Beardsall, Suzanna Burgelman, Lucy Ellam, Helen C. Wheeler, First published: 19 August 2022 <https://doi.org/10.1002/pan3.10376>] (Accessed 10/3/2025)

5 CONCLUSION As rewilding becomes more common, it is important to understand how different stakeholders might engage with this practice. Our research shows that in England, farmers' attitudes towards rewilding revolve around perceptions of five core issues: the perceived need for restoration, rewilding's ecological efficacy, compatibility with food security, compatibility with rural lifestyles, and justice. While some members of the English farming community feel enthusiastic about rewilding proposals, others remain more cautious or opposed to them. Engaging with the core issues outlined here may help rewilding proponents to widen the support for rewilding initiatives within the farming community, particularly among those whose opinions are currently undecided. However, it is important to recognise that part of rewilding is about bold ambitions aiming for large-scale, connected habitats with all trophic levels present, including large predators. Many farmers perceive these ambitions to strike at the very essence of what farming is and to stand in direct opposition to the values they hold. Although the institutional and societal rhetoric on the role of farmers increasingly shifts towards custodians of the environment and providers of multiple ecological services, other farming values that are often perceived as less compatible with rewilding are unlikely to change rapidly. Hence, pursuing ambitious rewilding goals may likely lead to conflicts, which will need to be grappled with on both sides of the debate. Moreover, the real and substantive issues around the distribution of costs and benefits arising from any incentives promoting rewilding as a form of land use must be tackled head-on by policymakers. Recognising the common area of agreement—the need to look after the environment—and engaging with key farmer concerns can serve as a good entry point to facilitate stakeholder dialogue and negotiate the path forward.

And perceptions matter - they shape the material policies and impacts behind rewilding

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[Micolajczak is a corresponding author at Grantham Research Institute, London School of Economics, London, UK School of Life Sciences, Anglia Ruskin University, Cambridge, UK "Rewilding—The farmers' perspective. Perceptions and attitudinal support for rewilding among the English farming community," Katarzyna M. Mikołajczak, Nikoleta Jones, Christopher J. Sandom, Sophie Wynne-Jones, Antonia Beardsall, Suzanna Burgelman, Lucy Ellam, Helen C. Wheeler, First published: 19 August 2022 <https://doi.org/10.1002/pan3.10376>] (Accessed 10/3/2025)

4 DISCUSSION Interest in new rewilding initiatives in the United Kingdom is rapidly expanding (Rewilding Britain, 2020). This may be further bolstered through the introduction of the post-Brexit Environmental Land Management Scheme (ELMS) that will likely incentivise 'nature recovery' and the creation of 'wilder landscapes'. As such, rewilding could become a widespread land use in the United Kingdom in the coming decades. Given that around 70% of the UK's area is owned or managed by farmers (DEFRA, 2020b), collaboration and engagement with the farming community will be necessary to advance this vision. Our study maps the core issues that matter to the English farming community in relation to rewilding, the range of farmers' perceptions of those issues, and the way these perceptions shape farmers' attitudes to rewilding practices. Rewilding perceptions were elicited using three hypothetical scenarios, including the release of free-ranging beavers, a fenced rewilding of a farm using reintroduced wild and semi-domestic herbivores, and a landscape-scale multi-stakeholder partnership to rewild a larger piece of land. We identified five core issues that structured the perceptions and attitudes towards rewilding practices: (1) the perceived need for ecosystem restoration, (2) ecological effectiveness of rewilding, (3) compatibility with food security, (4) compatibility with rural lifestyles and (5) social justice of rewilding initiatives. The farming value principles in which these issues are rooted appear widely shared and consistent with those found elsewhere, for example, in Europe and North America (Burton, 2004; Burton & Wilson, 2006; Chapman et al., 2019), suggesting that the identified criteria against which farmers commonly evaluate rewilding practices may also be relevant in some contexts beyond England. Our findings contribute to the literature about the influence of people's perceptions on conservation support by showing how different types of perceptions may interact to affect attitudes (Bennett, 2016). According to our analysis, individuals assess rewilding scenarios across the core issues that matter to them, based on the perceived fit between their values and the perceived social impacts and ecological outcomes. The perceived social and ecological impacts, in turn, depend on the mental models, that is, causal assumptions about the consequences of rewilding practices (Jones et al., 2011). Mental models that are incompatible with rewilding and the perceived incompatibility between values and rewilding appear as the primary sources of opposition to rewilding. As heuristic devices, mental models can be changed in light of new information (Jones et al., 2011). However, subjective, value-based principles and preferences are notoriously difficult to change (Fulton et al., 1996; Manfredo et al., 2017). Hence, we argue that depending on whether negative perceptions stem from individuals' mental models or values, there will be limits to the extent to which negative perceptions can be accommodated for without compromising on rewilding's own goals. The five core issues

identified here provide a simple framework to make sense of and engage with the complexity of farmers' views on rewilding. Below, we consider what these issues mean for rewilding research and practice, and the scope for engaging with them to increase support for rewilding.

Philosophy – Autonomy

Rewilding violates the autonomy and several rights of landowners and farmers.

Jones et al. 22 [Katarzyna M. Mikołajczak^{1,2} | Nikoleta Jones³ | Christopher J. Sandom^{4,5} | Sophie Wynne-Jones⁶ | Antonia Beardsall² | Suzanna Burgelman² | Lucy Ellam² | Helen C. Wheeler² 1 Grantham Research Institute, London School of Economics, London, UK; 2 School of Life Sciences, Anglia Ruskin University, Cambridge, UK; 3 Institute for Global Sustainable Development, School for Cross-Faculty Studies, University of Warwick, Coventry, UK; 4 School of Life Science, University of Sussex, Brighton, UK; 5 Sussex Sustainability Research Programme (SSRP), University of Sussex, Brighton, UK and 6 School of Natural Sciences, University of Bangor, Bangor, UK], “Rewilding—The farmers’ perspective. Perceptions and attitudinal support for rewilding among the English farming community”, May 19, 2022, Date Accessed: 10-6-25, <https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1002/pan3.10376#:~:text=on%20rewilding%20i mpacts%2C%20we%20conducted%20semi-structured%20interviews%20with%2036%20individuals%20who%20were%20farmers%2C%20land&text=imposing%20on%20farmers%27%20autonomy%20and%20ability%20to%20make%20a%20living%20from%20their%20land.>

The negative perceptions were based on economic beliefs and subjective attachments mirroring but opposite to those of enthusiasts. Economically, there were fears about impacts on farming businesses and the associated emotional distress, for example, ‘if you woke up every morning and say the beavers had knocked down another set of trees that you'd planted and ...when it came a lot of rain, land was flooded then ...that would be pretty detrimental to your mental health ...and wellbeing.’ [LE03, re beaver release]. There was also the worry that successful tourism enterprises are not ‘going to be ...replicable on every rewilded landscape’ and that rewilding on a wide scale could ‘reduce a lot of the labour’, negatively impacting local communities. Negative perceptions of subjective impacts were rooted in attachments to the traditional ‘iconic British landscape’, involving the tamed and peopled rural spaces. Participants worried that unmanaged landscapes would ‘look a bloomin mess,’ that rewilding could damage cultural heritage, for example, by beavers ‘chewing historic trees’, and that it could sever the ties between farming families and their land. Again, some advocated for regenerative farming involving naturalistic grazing as a more suitable socio-economic alternative to rewilding, which can provide ‘all of the ecological benefits that you get from that sort of rewilding, and at the same time... produce food and have businesses working in the countryside..., leave farmers on the land that they have been on for generations that they have worked with their families, without having to shake them of it’ [AB11, re farm-level restoration]. 3.6 | Issue 5: Will rewilding projects be socially just? The final issue was social justice, and it was reflected in the perceived impacts on the wellbeing domains of equality and fairness and in autonomy and self-direction (Table 3). Here, the value of respecting farmers' autonomy and property rights (Table 4) was highly visible; farmers were less accepting of rewilding scenarios where the perceived impacts spilt over to areas managed by people not involved in the decision-making. For example, very few participants outright rejected the farm-level restoration scenario, even if they did not agree with it, because they perceived its impacts as localised and because they believed that every landowner has the right to decide how best to manage their land. In

contrast, the case of reintroduced beavers wandering onto the land of someone who did not want them there was invoked as an infringement on the landowners' rights. Landscape-scale restoration and species reintroductions also evoked fears about unequal cost distribution: '[if] a pair of beavers ... make a dam below a housing estate that then floods 300 homes ...what's the difference between that and ...flooding 300 acres of someone's livelihood.' [LE03]. Key tools suggested to mitigate unfair costs, particularly for species reintroductions, included management plans with a long-term allocation of responsibilities, an exit strategy and either incentives or compensation for material losses of income and assets. However, livestock farmers emphasised that adequate compensation for depredation by reintroduced predators was not possible due to emotional distress and loss of genetic material. There were also fears of possible top-down imposition of rules in landscape-scale projects. For some, these fears were informed by past experiences of certain agri-environmental schemes with rigid conservation targets and prescriptive management, which reportedly ignored farmers' local knowledge yet blamed them if the desired outcomes were not achieved: 'I think ... when schemes were set up, there wasn't really a definitive pathway in what was going to happen. There was a sort of, if we take all the sheep and all the cows off the moorland, it's going to be better. Ten years later, when forty per cent of it is covered by gorse that's five-foot-high, well that's your fault. (...) when ...initially, an awful lot of those farmers would have said, if you want ground-nesting birds, you have to let me burn it.' [KM08]. Most participants stressed that to preserve farmers' autonomy and ensure the recognition of farmers' voices, any projects involving multiple landowners should be voluntary, grass-root, ensure collaborative decision-making, and give value to local knowledge and experiences. Participants also emphasised the crucial role of good communication and responsiveness: I was pretty against the [raptor reintroduction] project at the start to be honest... but when they came to us with their ideas and we sat around the table with them ...they did not only answer our questions, they did adapt their ideas around our responses [KM07]. Finally, farmer representatives highlighted the need for skilled, charismatic and trust-inspiring individuals who can organise and galvanise others for action.

Rewilding pressures commoners into violation of morals, rights, and cultural ties.

Olwig-16 Kenneth R. Olwig[Department of Landscape Architecture, Planning and Management, SLU-Alnarp, Alnarp, Sweden] Virtual enclosure, ecosystem services, Landscape's character and the 'rewilding' of the commons: the 'Lake District' case, Landscape Research, 2016, <https://www.tandfonline.com/doi/full/10.1080/01426397.2015.1135320>

The arguments for the rewilding of the Lake District resemble Linné's notion of nature's economy as a form of self-regulating and purposeful (i.e. teleological) service-providing eco(nomic) and bureaucratic managerial system, now recast as 'ecosystem services' servicing privatised conglomerates like United Figure 3. Sign listing English and EU organisations supporting the environmental projects at Haweswater. Photograph by author. Downloaded by [University of California, San Diego] at 13:34 16 February 2016 10 K. R. Olwig Utilities (Norgaard, 2010). In this form of virtual enclosure, nature receives its own 'home' (oikos) thus enabling the application of various bureaucratic management schemes to pressure commoners into violating their moral habitus by abandoning their pastures and allow them to deteriorate into bush, and thereby effectively loose their use rights in the process. This virtual enclosure can be seen not only on the land owned by United Utilities, but also in other areas of the National Park. There are thus a number of pilot projects where Natural England is fencing common land for rewilding. Rewilding is thereby fostering a situation by which, according to the rural sociologist Chris Short 'an environmental threat may be caused by the actions of an environmental organisation.' This is based around a strong and rather exclusive view of the management of common land from some nature conservationists' by which nature conservation becomes 'the singular governance and management objective' (Short, 2000, p. 125). The irony of these policies is that, internationally, natural scientists are deploring just this sort of abandonment and degeneration of multi-functional 'semi-natural' pasturage because when this happens environmental diversity deteriorates (Emanuelsson, 2009; Hartel & Plieninger, 2014; Rotherham, 2013). A similar realisation of the fact that valued natural environments often are 'seminatural', and require an appreciation of the culture of local agriculture to maintain, has likewise led to an influential movement against wild nature preservation by enclosure in the United States, which previously had pioneered wilderness conservation

The concerns for cultural, economic, and practical factors will go unheard in rewilding.

Sandom et al. 19 [Sandom, C., Dempsey, B., Bullock, D., Ely, A., Jepson, P., Jimenez-Wisler, S., Newton, A., Pettorelli, N., & Senior, R. A.] "Rewilding in the English uplands: policy and practice" (Version 1). University of Sussex, 2019 <https://hdl.handle.net/10779/uos.23462243.v1>

The workshop highlighted that resistance from landowners/occupiers is a major barrier to implementing rewilding. However, landowner resistance reflects a variety of cultural, economic and practical factors. Culturally, there is often a strong connection to production in the uplands. Landowners or managers typically do not want to lose the utility of the land and want to leave a farming-based land use as a legacy to their children and grand-children. Some species reintroductions conflict with tradition, culture, and neighbour relationships in the uplands, and may represent an economic threat to game and livestock rearing. A perceived focus on large carnivores has been effective at bringing the rewilding agenda to the fore but, as a controversial form of rewilding, has also polarized opinion and drawn opposition to the term rewilding more generally. Economic barriers to rewilding include subsidy policy, which is generally focused on supporting production and associated activities. For example, CAP payments support production and environmental protection only on productive land.

REMOVE Act CP

CP Text: The United States federal government ought to pass the Removing Emissions to Mend Our Vulnerable Earth Act of 2024.

REMOVE act sets up carbon dioxide removal measures---(this card also says it solves climate change, but is more of link a advocate.)

World Resources Institute 24 [World Resources Institute 24, "REMOVE Act of 2024," August 1, 2024, <https://www.wri.org/update/remove-act-carbon-removal>]

Carbon dioxide removal (CDR) is a necessary complement to deep and rapid greenhouse gas emission reductions to avoid the worst impacts of climate change and realize the U.S. national target of net-zero greenhouse gas emissions by 2050. Carbon removal approaches are diverse — ranging from nature-based to novel, technological solutions — and vary in terms of cost, stage of development and possible scale of deployment. Investing in the development of a diverse portfolio of carbon removal approaches and technologies will help maximize the likelihood that CDR solutions can meet the climate challenge across the United States. Government-wide coordination is needed to lead a cross-cutting CDR research, demonstration and deployment effort grounded in carbon removal's efficacy, rigorous monitoring and reporting and assessment of environmental and social impacts. The Removing Emissions to Mend Our Vulnerable Earth Act of 2024, or the REMOVE Act, was reintroduced by Rep. Ann Kuster (D-N.H.), Rep. Paul Tonko (D-N.Y.), and Rep. Scott Peters (D-C.A.) in the House of Representatives on July 31. The REMOVE Act was originally introduced in 2022, and it matches a Senate version of the bill, introduced the previous year, called the CREATE Act. The REMOVE Act of 2024 would enact a new Interagency Group on Large-Scale Carbon Management within the White House's National Science and Technology Council, tasked with forming a strategic government-wide plan to advance carbon removal development. An executive committee would be established within the interagency group, with representatives from the White House Office of Science and Technology Policy, the Department of Energy, the Department of Agriculture, the Department of Defense, the National Oceanic and Atmospheric Administration and the Environmental Protection Agency. Interagency group responsibilities would include, but would not be limited to: Creating a strategic plan for federal research, development and demonstration (RD&D) of technological CDR. Creating and overseeing working groups. Coordinating RD&D budgets. Identifying cost-effective CDR technologies that are appropriate for large-scale demonstration. Identifying protocols for monitoring, data collection and long-term storage for CDR technologies. Assessing the environmental and social impacts and co-benefits of CDR. The working groups established under the new interagency group would carry out the research, development and demonstration of CDR technology — a collective effort that would be known as the Carbon Removal Initiative. The groups, which would be subject to review every three years, would focus on four types of CDR: Oceans Terrestrial Geological Technological Why This Legislation Is Important The REMOVE Act would activate a whole-of-government approach for developing and deploying carbon removal technologies at an unprecedented scale. This approach will not only invest in the formation of working groups and scaling up of research efforts, but it will also explicitly direct relevant federal agencies to incorporate CDR into their annual budgets. This cross-agency budgetary approach is significant because it shows the federal government's clear financial and personnel investment in the successful deployment of CDR. The committees and working groups proposed in the REMOVE Act would provide the necessary framework for research and development to accelerate climate mitigation efforts in communities across the United States. The REMOVE Act stands apart from other legislative actions on carbon removal efforts because of its key focus on a whole-of-government, cross-agency approach to financially invest in responsible CDR deployment. The knowledge and resources expected to emerge could lay the groundwork for widespread CDR deployment in the coming decades as its need grows alongside increasing impacts of climate change.

Solves climate change

Pour 24 [Nasim Pour 24, Ph.D. in Carbon Removal Technologies from university of Melbourne, Lead of Climate Finance for the World Economic Forum, "Why carbon dioxide removal needs more government support", July 3, 2024, <https://www.weforum.org/stories/2024/07/why-carbon-dioxide-removal-needs-more-government-support/>]

Carbon dioxide removal (CDR) could play a key role in decarbonizing the global economy. It can not only offset "hard to abate" emissions from industries like aviation and shipping, it can also reduce emissions from natural events like forest fires that are exacerbated by continued global warming. Crucially, CDR can also reverse the historical build-up of global greenhouse gas emissions. CDR removes CO₂ from the atmosphere in two ways. Firstly, through the creation or conservation of natural carbon sinks such as forests and mangroves. Alternatively, more durable technologies such as direct air capture and storage (DACs) or bioenergy with carbon capture and storage (BECCS) can be used to remove CO₂ from the air and store it underground. These methods can remove carbon that's already in the atmosphere, as well as that emitted by sources on an ongoing basis. CDR should therefore be an essential element of global decarbonization efforts, forming part of the transition to a net-zero economy. Sizing up the CDR challenge To reach net zero by 2050, up to 10 billion tonnes of CO₂ must be removed from the atmosphere every year. CDR currently removes 2 billion metric tonnes of CO₂ per year, of which 99.9% comes from nature-based CDR solutions such as afforestation or reforestation. Only 0.1% results from durable CDR. In other words, we need to scale durable CDR by a factor of 5,000 by mid-century. To date there has been limited uptake of these technologies. This is because scalable and durable CDR is still quite costly due to the nascent nature of the technology, the lack of mature measurement, reporting and verification (MRV) standards, and weak support from policy-makers. To rapidly innovate, implement and scale up carbon dioxide removal technologies to match growing climate risks, companies and governments must invest in carbon removal solutions today to ensure cost-effective deployment at scale tomorrow. Government support in the form of new policy mechanisms, initiatives and investment could help more CDR innovations enter the market. This would also create the confidence and certainty needed to encourage private sector investors to fund CDR projects.

Set Col K

Settler colonialism is the permeating structure of the nation-state reliant on the elimination of indigenous life and land through the occupation of settlers turning Natives into ghosts and chattel slaves into excess labor.

Tuck and Yang 12 (Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40)

Our intention in this descriptive exercise is not be exhaustive, or even inarguable; instead, we wish to emphasize that (a) decolonization will take a different shape in each of these contexts - though they can overlap⁴ - and that (b) neither external nor internal colonialism adequately describe the form of colonialism which operates in the United States or other nation-states in which the colonizer comes to stay. Settler colonialism operates through internal/external colonial modes simultaneously because there is no spatial separation between metropole and colony. For example, in the United States, many Indigenous peoples have been forcibly removed from their homelands onto reservations, indentured, and abducted into state custody, signaling the form of colonization as simultaneously internal (via boarding schools and other biopolitical modes of control) and external (via uranium mining on Indigenous land in the US Southwest and oil extraction on Indigenous land in Alaska) with a frontier (the US military still nicknames all enemy territory "Indian Country"). The horizons of the settler colonial nation-state are total and require a mode of total appropriation of Indigenous life and land, rather than the selective expropriation of profit-producing fragments. Settler colonialism is different from other forms of colonialism in that settlers come with the intention of making a new home on the land, a homemaking that insists on settler sovereignty over all things in their new domain. Thus, relying solely on postcolonial literatures or theories of coloniality that ignore settler colonialism will not help to envision the shape that decolonization must take in settler colonial contexts. Within settler colonialism, the most important concern is land/water/air/subterranean earth (land, for shorthand, in this article.) Land is what is most valuable, contested, required. This is both because the settlers make Indigenous land their new home and source of capital, and also because the disruption of Indigenous relationships to land represents a profound epistemic, ontological, cosmological violence. This violence is not temporally contained in the arrival of the settler but is reasserted each day of occupation. This is why Patrick Wolfe (1999) emphasizes that settler colonialism is a structure and not an event. In the process of settler colonialism, land is remade into property and human relationships to land are restricted to the relationship of the owner to his property. Epistemological, ontological, and cosmological relationships to land are interred, indeed made pre-modern and backward. Made savage. In order for the settlers to make a place their home, they must destroy and disappear the Indigenous peoples that live there. Indigenous peoples are those who have creation stories, not colonization stories, about how we/they came to be in a particular place - indeed how we/they came to be a place. Our/their relationships to land comprise our/their epistemologies, ontologies, and cosmologies. For the settlers, Indigenous peoples are in the way and, in the destruction of Indigenous peoples, Indigenous communities, and over time and through law and policy, Indigenous peoples' claims to land under settler regimes, land is recast as property and as a resource. Indigenous peoples must be erased, must be made into ghosts (Tuck and Ree, forthcoming). At the same time, settler colonialism involves the subjugation and forced labor of chattel slaves⁵, whose bodies and lives become the property, and who are kept landless. Slavery in settler colonial contexts is distinct from other forms of indenture whereby excess labor is extracted from persons. First, chattels are commodities of labor and therefore it is the slave's person that is the excess. Second, unlike workers who may aspire to own land, the slave's very presence on the land is already an

excess that must be dis-located. Thus, the slave is a desirable commodity but the person underneath is imprisonable, punishable, and murderable. The violence of keeping/killing the chattel slave makes them deathlike monsters in the settler imagination; they are reconfigured/disfigured as the threat, the razor's edge of safety and terror. The settler, if known by his actions and how he justifies them, sees himself as holding dominion over the earth and its flora and fauna, as the anthropocentric normal, and as more developed, more human, more deserving than other groups or species. The settler is making a new "home" and that home is rooted in a homesteading worldview where the wild land and wild people were made for his benefit. He can only make his identity as a settler by making the land produce, and produce excessively, because "civilization" is defined as production in excess of the "natural" world (i.e. in excess of the sustainable production already present in the Indigenous world). In order for excess production, he needs excess labor, which he cannot provide himself. The chattel slave serves as that excess labor, labor that can never be paid because payment would have to be in the form of property (land). The settler's wealth is land, or a fungible version of it, and so payment for labor is impossible.⁶ The settler positions himself as both superior and normal; the settler is natural, whereas the Indigenous inhabitant and the chattel slave are unnatural, even supernatural. Settlers are not immigrants. Immigrants are beholden to the Indigenous laws and epistemologies of the lands they migrate to. Settlers become the law, supplanting Indigenous laws and epistemologies. Therefore, settler nations are not immigrant nations (See also A.J. Barker, 2009). Not unique, the United States, as a settler colonial nation-state, also operates as an empire - utilizing external forms and internal forms of colonization simultaneous to the settler colonial project. This means, and this is perplexing to some, that dispossessed people are brought onto seized Indigenous land through other colonial projects. Other colonial projects include enslavement, as discussed, but also military recruitment, low-wage and high-wage labor recruitment (such as agricultural workers and overseas-trained engineers), and displacement/migration (such as the coerced immigration from nations torn by U.S. wars or devastated by U.S. economic policy). In this set of settler colonial relations, colonial subjects who are displaced by external colonialism, as well as racialized and minoritized by internal colonialism, still occupy and settle stolen Indigenous land. Settlers are diverse, not just of white European descent, and include people of color, even from other colonial contexts. This tightly wound set of conditions and racialized, globalized relations exponentially complicates what is meant by decolonization, and by solidarity, against settler colonial forces. Decolonization in exploitative colonial situations could involve the seizing of imperial wealth by the postcolonial subject. In settler colonial situations, seizing imperial wealth is inextricably tied to settlement and re-invasion. Likewise, the promise of integration and civil rights is predicated on securing a share of a settler-appropriated wealth (as well as expropriated 'third-world' wealth). Decolonization in a settler context is fraught because empire, settlement, and internal colony have no spatial separation. Each of these features of settler colonialism in the US context - empire, settlement, and internal colony - make it a site of contradictory decolonial desires⁷. Decolonization as metaphor allows people to equivocate these contradictory decolonial desires because it turns decolonization into an empty signifier to be filled by any track towards liberation. In reality, the tracks walk all over land/people in settler contexts. Though the details are not fixed or agreed upon, in our view, decolonization in the settler colonial context must involve the repatriation of land simultaneous to the recognition of how land and relations to land have always already been differently understood and enacted; that is, all of the land, and not just symbolically. This is precisely why decolonization is necessarily unsettling, especially across lines of solidarity. "Decolonization never takes place unnoticed" (Fanon, 1963, p. 36). Settler colonialism and its decolonization implicates and unsettles everyone.

Rewilding the U.S erases the indigenous peoples who first shaped the land and ignores the destruction of tropical ecosystems in the name of capitalism.

Cox et al. 18 [Cox, C. R., Hintz, J. G., Emel, J., McBrien, J., & Dawson, A. (2018). Extinction: A Radical History. The AAG Review of Books, 6(4), 282–292. <https://doi.org/10.1080/2325548X.2018.1508199> Ph.D Geography, University of Washington, 2021 M.S.c. Political Science, Portland State University, 2014 B.A. Political Science, Sonoma State University, 2005]

When Hintz turns to my discussion of rewilding, however, he offers a useful critique of my own efforts to challenge contemporary conservation measures intended to mitigate biodiversity loss. I agree with Hintz that my critical commentary on proposals for rewilding parts of Europe and North America would have been strengthened had I draw more careful distinctions between unapologetically Malthusian advocates such as Foreman, conservation biologists such as Noss and Soule, and more radical activists such as Monbiot. My criticism of rewilding was shaped by my discomfort with the very idea of wilderness, as this concept constitutively erases the indigenous peoples who shaped the landscape that settler colonials described as wild. Rewilding advocates repeat this colonial outlook today, I argued, not simply by using the idea of wilderness but by focusing on the repopulation of portions of North America and Europe even as once-colonized countries in the tropical latitudes continue to have their rich ecosystems mowed down by global capitalism. In some cases, advocates actually embrace the idea of stealing African megafauna to rewild the North American plains. Although, as Hintz usefully notes, such forms of latter-day colonialism do not characterize the rewilding movement as a whole, I continue to believe that rewilding efforts in the Global North should not be undertaken without commensurate pledges of economic assistance for conservation in the Global South.

Rewilding attempts to erase human histories and prevent involvement of humans with nature.

Jørgensen 15 [Dolly Jørgensen, Rethinking rewilding, Geoforum, Volume 65, 2015, Pages 482-488, ISSN 0016-7185, <https://doi.org/10.1016/j.geoforum.2014.11.016>. (<https://www.sciencedirect.com/science/article/pii/S0016718514002504>)]

Rewilding definitions indicate that the 'wild' exists for advocates at a time when there are more animals and less people (or at least, much less intrusive people). Such a definition of wild has been seriously criticized by environmental historians like Cronon (1995) who argued that making wilderness out to be equivalent to a nature profoundly apart from humans is fundamentally flawed. Cronon does not argue that setting aside nature reserves is inappropriate, but he points out that if 'wilderness leaves no place for human beings...it can offer no solution to the environmental and other problems which confront us'. This is because we should never imagine 'that we can flee into a mythical wilderness to escape history and the obligation to take responsibility for our own actions that history inescapably entails' (Cronon, 1995, p. 90). The idea of the wild without people leads us to undervalue the wild where people in fact are—the sparrow in the urban garden or the butterfly in the agricultural field. These too have the potential to be 'wild', both out of direct human control and ecologically productive as eloquently expressed by Marris (2011). Although this criticism of the 'wild' as a place without people was made before rewilding was coined as a term and there was an explosion of literature debating the definition of 'wilderness' in humanities circles after Cronon's piece (e.g. Callicott and Nelson, 1998; Nelson and Callicott, 2008), rewilders apparently have failed to take notice. They still want to re-create a wild without people and are oblivious to the problematic nature of the wilderness construct. Rewilding as activist practice attempts to erase human history and involvement with the land and flora and fauna, yet nature and culture cannot be easily separated into distinct units. Rewilding as currently practiced disavows human history and finds value only in historical ecologies prior to human habitation. The rewilding concept has been deployed in a myriad of ways to exclude humans in time and space from nature.

Thus, decolonization is the only alternative.

Tuck and Yang 12 (Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40)

An ethic of incommensurability, which guides moves that unsettle innocence, stands in contrast to aims of reconciliation, which motivate settler moves to innocence. Reconciliation is about rescuing settler normalcy, about rescuing a settler future. Reconciliation is concerned with questions of what will decolonization look like? What will happen after abolition? What will be the consequences of decolonization for the settler? Incommensurability acknowledges that these questions need not, and perhaps cannot, be answered in order for decolonization to exist as a framework. We want to say, first, that decolonization is not obliged to answer those questions - decolonization is not accountable to settlers, or settler futurity. Decolonization is accountable to Indigenous sovereignty and futurity. Still, we acknowledge the questions of those wary participants in Occupy Oakland and other settlers who want to know what decolonization will require of them. The answers are not fully in view and can't be as long as decolonization remains punctuated by metaphor. The answers will not emerge from friendly understanding, and indeed require a dangerous understanding of uncommonality that un-coalesces coalition politics - moves that may feel very unfriendly. But we will find out the answers as we get there, "in the exact measure that we can discern the movements which give [decolonization] historical form and content" (Fanon, 1963, p. 36). To fully enact an ethic of incommensurability means relinquishing settler futurity, abandoning the hope that settlers may one day be commensurable to Native peoples. It means removing the asterisks, periods, commas, apostrophes, the whereas's, buts, and conditional clauses that punctuate decolonization and underwrite settler innocence. The Native futures, the lives to be lived once the settler nation is gone - these are the unwritten possibilities made possible by an ethic of incommensurability. when you take away the punctuation he says of lines lifted from the documents about military-occupied land its acreage and location you take away its finality opening the possibility of other futures - Craig Santos Perez, Chamoru scholar and poet (as quoted by Voeltz, 2012) Decolonization offers a different perspective to human and civil rights based approaches to justice, an unsettling one, rather than a complementary one. Decolonization is not an "and". It is an elsewhere.