

# The Role of Life Scientists in the Biospheric Emergency: A Case for Acknowledging Failure and Changing Tactics

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## Abstract

We are facing an emergency that encompasses the entire biosphere, with devastating consequences for both humans and the natural world on which we depend. As the climate and ecological crises accelerate, scientists are coming to terms with failings inherent in the modes of action we have used to engage society about their ongoing and future effects. Life scientists — including biologists, medical scientists, psychologists and public health experts — are no exception. Countless scientific articles, surveys, reports, and methodological advances have enabled exceedingly detailed assessments of the scale and rate of biological devastation, and its consequences for human health. Yet, we have failed to motivate governments and society as a whole to initiate the transformative change required to avoid further catastrophe. Here, we attempt to explain why our current modes of academic behaviour are undermining our own scientific recommendations, and emphasise the need to change the tactics we have used to effectively engage with society. We present a case for embracing activism in our scholarly responsibilities — including outreach, teaching and research — and to adapt these to the strategic logic of civil resistance. We then describe a number of past and present examples of scientist activism: a practice that is not new, but is in dire need of a radical revival.

## Introduction

We are running out of time. Ecosystems across the planet are being destroyed at an accelerating rate. The life sciences — once a field dedicated to studying living systems and our interactions with them — are increasingly becoming sciences of the dead. Up to one million species are currently threatened with extinction, many of them within decades. This includes as many as 10% of insect species (IPBES 2019), as well as two in five plant species (Nic Lughadha et al. 2020). Many of the remaining species that are not immediately threatened by extinction are suffering population declines, affecting the functioning of all our ecosystems (Wagner 2020). Through a combination of unfettered land use change, exploitative farming practices, overfishing, and fossil fuel emissions, our planet is experiencing an extinction process of unprecedented speed (WWF 2020).

Current projections paint a grim picture for what our living planet will look like in the near future, as biodiversity loss is further compounded by climate breakdown (IPBES 2019). The UN Secretary-General, António Guterres, has recently stressed that “the evidence is irrefutable: greenhouse gas emissions from fossil fuel burning and deforestation are choking our planet” (UNO 2021). The latest Intergovernmental Panel on Climate Change (IPCC) report asserts we are en route to exceed 2°C global warming during this century (IPCC 2021). More recent estimates suggest that current policies are putting us on track to a median warming of 2.7°C by 2100 (with a 95% confidence range of between 2°C and 3.6°C; (Climate Action Tracker 2022)). This process will have devastating consequences on ecosystems worldwide, on which humans are intimately dependent. Research indicates that the human climate niche may dramatically shrink over the next 50 years, making large swaths of the planet incompatible with human survival and forcing mass displacements of hundreds of millions of people (Xu et al. 2020). It has been estimated that the disruption of our climate system will cause around 5 million excess deaths annually (Bressler 2021; Q. Zhao et al. 2021), via massively increased risks of heat stress, droughts, crop collapses, outbreaks of diseases and other natural disasters (World Health Organization 2021). The effect of these compound crises is exacerbated in lower-income countries, where the capacity for response is substantially decreased, due to centuries of colonial appropriation and resource depletion (Fanning et al. 2022; Hickel et al. 2022).

Life scientists are becoming highly effective at documenting the extermination of species and the destruction of ecosystems with excruciating detail - e.g. using the latest technologies in ecological surveying, computational modelling and conservation genomics - to keep a tally of the expanding death all around us (Hodgson et al. 2018; Cordier et al. 2021; Schmolke et al. 2010; Fitzpatrick and Keller 2015). Yet our measurements, predictions, and conclusions are overwhelmingly ignored by politicians, i.e. those with the most power to stop the global necrotic process. Even as researchers write countless warnings and reports on the biospheric emergency, it continues to worsen every year (Ripple et al. 2020; 2017; Pyšek et al. 2020; Georgian et al. 2022; Cavicchioli et al. 2019; Albert et al. 2021). The life sciences thus seem powerless to stop the destruction of their own subject of study.

What has gone wrong? In this article, we highlight how we — as life scientists — are failing in our duty to effectively engage with society about the biospheric emergency. We emphasise how

a focus on *status quo*-maintaining behaviours has cornered us into accepting practices and modes of communication that run counter to our own scientific recommendations. This, in turn, is hindering the transformative societal change needed to avert the worst consequences of the climate and ecological crises. Motivated by an academic environment that disincentivizes (and even sanctions) social and political critique, many natural scientists have resigned themselves to reporting on the consequences of the biospheric emergency, while shying away from its underlying social, economic and political causes.

We also provide ways in which we can break out of this dilemma, using effective forms of advocacy, via the growing scientist activism movement (Gardner and Wordley 2019; Capstick et al. 2022). We can — as scientists, without compromising our professional integrity — re-embrace engagement practices that lost steam over the past decades, yet were once integral to academic life.

## **Acknowledging failure**

Life scientists study the natural world: its past, present and future, and its ongoing interplay with human society. In addition to producing knowledge, relaying that knowledge to the public is widely considered a scientific responsibility (Douglas 2009). Crucially, both the act of knowledge production and the act of dissemination exist to benefit our communities. Indeed, many scientists personally feel a sense of duty to increase and improve public understanding of research findings (Cerrato et al. 2018). This duty is also fundamental to many mission-driven professions within the life sciences: the role of conservation biologists and medical researchers, for example, includes an explicit obligation to create and disseminate knowledge in order to preserve life (Meine, Soulé, and Noss 2006; Romanello et al. 2021; Bennett et al. 2020).

Thus, for both personal and professional reasons, many life scientists have been trying to communicate the urgency of the climate and ecological crises for decades now, so as to trigger the cultural and political mechanisms able to prevent further ecosystem degradation and collapse (Diaz et al. 2019; Ripple et al. 2017). In their latest report, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) calls for “fundamental, system-wide reorganisation across technological, economic and social factors, including paradigms, goals and values” (IPBES 2019) whilst the IPCC urges “fundamental changes to how society functions, including changes to underlying values, worldviews, ideologies, social structures, political and economic systems, and power relationships” (IPCC 2022c).

Yet, our societies have not developed the radical, collective, co-ordinated systems change that a planetary-scale emergency would require. Given the level of urgency, it is critical to wonder how effective scientific efforts have been at producing transformative change, or even at generating substantial political capital to make change possible in the near future. We here highlight several key examples to illustrate the failure of life scientists to spark transformative change and galvanise political will: biodiversity loss and population decline, food security, and growing threats to global public health, including mental health. Each issue has garnered enormous attention from life scientists, yet continues to worsen every year.

### *Biodiversity and conservation*

Nearly one out of every eight species is threatened with extermination, and many more have dramatically declining populations (IPBES 2019). This issue has touched virtually all research in ecology, as it is increasingly morphing into a science of extinction and risk assessment (Gardner and Bullock 2021). The biodiversity crisis garnered public attention in the mid-20<sup>th</sup> century with the publication of *Silent Spring* (Carson 1962). The following decades saw some success stories, such as the establishment of the US *Endangered Species Act* and the global ban on whaling, largely as a consequence of activism for these policies (Raymond 2018; Mackenzie 2018). Yet, these efforts are far from enough, and currently the preservation of biodiversity is at the bottom of the list of political concerns (Bradshaw et al. 2021).

The amount of funding dedicated to conservation reflects this stark reality; the spending on global protected areas is estimated to be approximately equal to the total money spent on beard-grooming products around the world (Gardner and Bullock 2021; Waldron et al. 2020; Thomas and Deshmukh 2019). Out of the 20 global targets agreed in 2010 as part of the Convention on Biological Diversity, zero were met by 2020 (Convention on Biological Diversity 2020). This is despite repeated calls from researchers for increased environmental protections and the creation of research and policy organisations such as the IPBES and the International Union for the Conservation of Nature. Research papers, media opinion pieces, and conference reports are clearly not creating the necessary impact for stopping or even slowing down species loss and population declines (Gardner et al. 2021; Green 2021).

### *Food security*

The climate and ecological crises are deeply linked to threats to food security, as ecosystems on which humans are dependent are jointly disrupted by ecosystem decimation and climate breakdown (FAO 2019). Out of the world's agricultural land, 77% is used to support livestock, which is not only one of the largest sources of greenhouse gas emissions (Rojas-Downing et al. 2017; IATP, GRAIN, and Heinrich Böll Stiftung 2017) and global habitat destruction (Mundy 2021), but also makes up only 18% of the world's caloric supply, predominantly in high-income nations (FAO 2022). In addition, humans are now massively reliant on a select set of commodity crops, produced via industrial-scale monoculture farming and traded by a few corporations through international markets: maize, rice and wheat provide approximately 40% of humanity's chemical energy. They are predominantly grown in unevenly distributed continental grassland areas, which are particularly vulnerable to climate breakdown and consequent water scarcity (Dai 2013; Smaje 2020). Rising temperatures are directly reducing crop growth duration, effectively reducing yield (C. Zhao et al. 2017). Our crop production also relies on insect pollination, natural pest control and nutrient recycling by arthropods, all of which are threatened by the ongoing collapse of invertebrate populations (Wagner 2020). These issues have been exhaustively documented (Arora 2019; Hatfield and Prueger 2015; Gourdji, Sibley, and Lobell 2013) and have been the topic of discussion at large international organisations (FAO 2019).

After all this reporting and debate, are governments working to secure resilient food systems and decrease the risk of crop failures for the years ahead? The evidence points squarely against this. The rate of fossil fuel emissions has never been higher, taking us rapidly away from the planetary safe zone in which our agricultural systems have existed for millennia (IPCC 2021; 2022a). A number of studies predict declines in global crop yields of between 20% and 90% within just a few decades, as a consequence of climate change, soil erosion and the decline in key pollinator populations (Schlenker and Roberts 2009; Arora 2019; Hatfield and Prueger 2015; Gourdj, Sibley, and Lobell 2013). Meanwhile, governments are neglecting to develop resilient and equitable food production and distribution strategies at the scale needed to prevent simultaneous crop collapses and famine (Tigchelaar et al. 2018; Gaupp et al. 2019). For example, a recent study showed that much of the research funded by the US Department of Agriculture is completely unrelated to sustainable agriculture, instead focusing on (unsustainable) animal farming or enhancing monoculture technologies: projects with a focus on agroecology and socioeconomic sustainability constitute just between 5% and 10% of allocated public funds (DeLonge, Miles, and Carlisle 2016).

### *Global public health*

The biospheric emergency is linked to the deterioration of human health, through increasing exposure to extreme events (Romanello et al. 2021; Vicedo-Cabrera et al. 2021; Gasparrini et al. 2015), and our decreasing ability to effectively respond to epidemics (World Health Organization, 2021). As governments and corporations are demolishing the biosphere, they are forcing species to coexist in new ways, including new interactions between pathogens and potential hosts (Schmeller, Courchamp, and Killeen 2020; Carlson et al. 2022). More than half of human pathogenic diseases are predicted to be aggravated by climate change (Mora et al. 2022). Emerging epidemics in livestock and crops, as well as direct effects of climate on food production, will also increase the risk of malnutrition and famine (Romanello et al. 2021; Mora et al. 2022); undernutrition and disease will thus be overlapping threats to an increasingly vulnerable number of people worldwide.

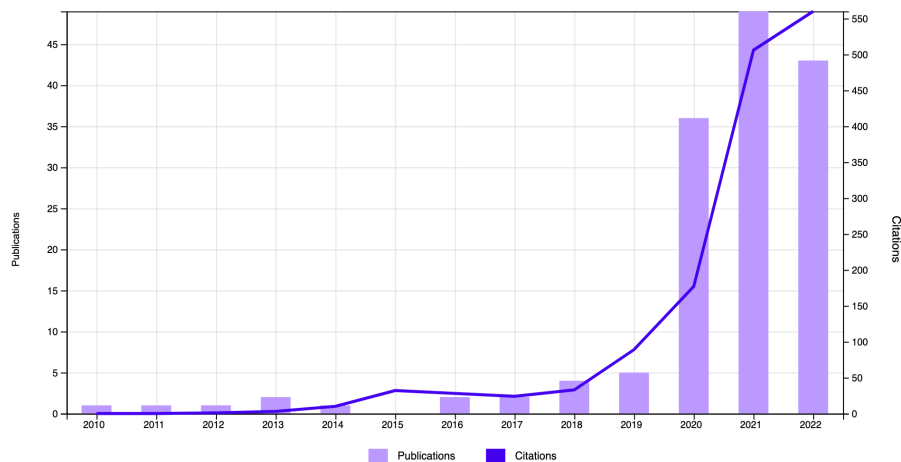
In light of this knowledge, is the connection between ecosystems degradation and public health at the top of political and scientific agendas? Recent studies highlight our outstanding lack of preparedness for the coming plagues (Gibb et al. 2020; Romanello et al. 2021). As one of the co-authors of Gibb et al. commented, “We’ve been warning about this for decades. Nobody paid any attention” (Tollefson 2020). Multi-year medical research programmes are planned without mention of the context of rising temperatures and extreme weather, giving the incorrect impression that global health issues can be tackled regardless of the environmental conditions around us. Similarly, policymakers are neglecting to account for premature death related to heat stress from global temperature increases (Gasparrini et al. 2015), which has already claimed thousands of victims in 2022 (Coi and Weise 2022).

### *Mental health*

A rapidly growing public health crisis concerns the effect of climate and ecological breakdown on mental health (Hayward and Ayeb-Karlsson 2021; Kelman et al. 2021; Royal College of

Psychiatrists 2021). In the last IPCC Sixth Assessment Report (AR6), scientists overwhelmingly agreed that climate change has already had a negative global impact on mental health, and is expected to worsen in the future (IPCC 2022a). To illustrate this, we performed a Web of Science search for research articles on the topics of “eco-anxiety,” “climate anxiety,” or “ecological grief” and found that these have skyrocketed in recent years: 0 such articles were found for any year before 2010, less than 2 articles per year in the period of 2010-2017 and 49 articles in 2021 alone. The year 2022 is not even over and yet, at the time of writing (13 September), there are almost as many articles on these topics (43) as in the whole of last year (Figure 1). Indeed, despite some taxonomic confusion (Clayton 2020), studies suggest a wealth of emotions associated with awareness of climate change are burgeoning (Brosch 2021). In the US alone, the climate grief and anxiety crisis is seriously affecting the lives of about half of the adults aged 18 to 34 (APA 2020). Increases in heat exposure are also contributing to increased aggressivity and suicide rates (Miles-Novelo and Anderson 2019; R. Thompson et al. 2018).

Meanwhile, there is an ongoing shortfall in global mental health investment (WHO 2020), and calls to action have been made for professionals to urgently address these issues (Cunsolo and Ellis 2018; APA 2020). Even as numerous research studies are published on the topic, funding for mitigation and adaptation strategies in this area is still nowhere near the scale needed (Berrang-Ford et al. 2021; Hayes et al. 2018).



**Figure 1. Web of Science results for research articles and citations relating to climate and ecological anxiety.** The Web of Science Core Collection was queried using the following search terms: TS=(climate NEAR/0 anxiety OR ecological NEAR/0 anxiety OR eco-anxiety OR ecological NEAR/0 grief). Results for 2022 are only partial (up to 13/09/2022).

### *Life science education and dissemination*

To top things off, universities around the world advertise degrees on the premise that a career in biological or ecological research will help protect endangered ecosystems, improve public health, or promote care for the environment. Yet, little is done to teach students about how their own specific disciplines will be affected by climate and ecological breakdown, and how this will, in turn, impact on their future career. More importantly, educational curricula rarely include

training on scientific advocacy and communication strategies, or about the relationship between scientific behaviours and social change (Gardner et al. 2021; Green 2021; Leal Filho et al. 2021; Steinberger 2022). Instead, universities have largely emphasised approaching these crises via changes in individual behaviour rather than collective action and institutional accountability (Wynes and Nicholas 2017; Stevenson, Nicholls, and Whitehouse 2017; Robottom and Hart 1995) — an approach driven by the imposition of industrial and corporate control systems into academia (Kleinman and Vallas 2001). University management narratives thus effectively shift the blame towards individuals, delay action, and leave the current generation of students with feelings of hopelessness and defeat, when in fact, systemic change is entirely within our grasp (Stoddard et al. 2021).

Overall, life scientists are failing at fully engaging society with the consequences of the biospheric emergency (Steinberger 2019). Whether we talk about threats to wildlife, food systems, or global health, the public either lacks an understanding of their fundamental causes (de Bruin et al. 2021), or is being actively misinformed (Lewandowsky 2020). The level of contamination of the public debate on the emergency has reached great sophistication, with entire think-tanks dedicated to occluding or misinterpreting scientific findings (Dunlap and Jacques 2013; Jacques, Dunlap, and Freeman 2008; Lamb et al. 2020; Lewandowsky 2021). Indeed, recent research highlights that correct information about climate and ecology is kept in memory for a short period of time and is often easily distorted by contrasting (wrong) information voiced by corporate-funded actors (Nyhan, Porter, and Wood 2022). Scientific counterweights to these misinformation campaigns have largely consisted in dry, dispassionate reporting to those in power (with the strongest interests in maintaining the *status quo*), rather than passionate and insistent communication with the people being misinformed: in short, a recipe for disaster (Steinberger 2019).

## Changing tactics

It is clear that the current situation calls for a radical change to the way we engage with society. What would this involve? How can we become effective social actors in the biospheric emergency? Many scientists are now outlining a path forwards, which entails embracing advocacy and activism in academia (Gardner and Wordley 2019; Gardner et al. 2021; Capstick et al. 2022). Advocacy consists in taking a specific public stand in support of a cause – in this case, climate and ecological action – while activism refers to particularly direct forms of advocacy, like petitioning, protest or civil resistance. Among these, civil resistance has been shown to be highly effective at garnering public support, especially when done peacefully and en masse (Chenoweth, Stephan, and Stephan 2011). This involves publicly confronting or refusing to obey a particular law, order, power or rule deemed to be unjust or unethical, with the potential risk for detention or arrest. By placing oneself in a position of vulnerability with respect to a ruling regime (e.g. by blocking a road or occupying a building), one can generate public concern and sympathy, in ways other forms of engagement often fail to do (Thackeray et al. 2020). Indeed, civil resistance has been a major force behind societal changes over the past two centuries, including decolonisation processes, labour rights, women's voting rights, and civil rights for people of colour (Roberts and Ash 2009; Chenoweth 2021).

Activism and advocacy need not be seen as a departure from our professional duties as academics, but rather as a natural adaptation of them to times of crisis (Gardner et al. 2021). Scientific freedom is indeed yoked together with responsibility (Douglas 2021). We are in a privileged position to be able to study life in its various forms, and produce knowledge about it — intimately attached to this freedom is the responsibility to use that knowledge to protect life. As stated in the handbook on research ethics published by the National Academy of Sciences: “[...] researchers also have the right to express their convictions and work for social change, and these activities need not undercut a rigorous commitment to objectivity in research. The values on which science is based — including honesty, fairness, collegiality, and openness — serve as guides to action in everyday life as well as in research” (NAS, NAE and COSEMPUP 2009).

Not everyone agrees. It has been argued that scientists should not take normative stances on any subject, and should therefore limit themselves to informing politicians, policymakers and the public about the ever-worsening state of life on Earth (Wells 2018; Young 2017). Yet, this argument assumes that science can ever exist outside the political arenas that frame how science is practised in the first place. In fact, the vast majority of fields that are now regarded as essential to the scientific community initially grew out of conscious efforts to improve society and intervene in various crises. From genetic toxicology’s ties to the environmental movements of the 1960s and 70s (Frickel 2004a) to “crisis disciplines” such as epidemiology and conservation biology — with their inherent normative aim of preserving the foundations supporting human and non-human life (Soulé 1985; Susser and Bresnahan 2001; Meine, Soulé, and Noss 2006; Cox 2007) — the struggle for social progress is often, if not always, intrinsically part of knowledge production (Choudry 2020).

Scientists are, after all, citizens before scientists. All citizens in a society have a moral obligation to advocate for what they justifiably recognize to be right or good (Nelson and Vucetich 2009). Thus, our role as citizens entails a responsibility to participate in the betterment of society to the best of our abilities. The fact that we are also scientists should not prevent us from being good citizens, or to abdicate our societal responsibilities. On the contrary, we enjoy the privileged position of having first-hand access to scientific knowledge, so our responsibility is even greater. Indeed, in a crisis situation, failure to advocate for particular positions can have devastating consequences, and even lead to preventable loss of life (Pietrucci and Ceccarelli 2019; Benessia and De Marchi 2017). Even though many of us are working with non-permanent, short-term contracts – and often lack the rights of full citizens in the societies we live in – advocacy and activism can be a way to more deeply connect with those societies, while participating in global struggles that also affect our homelands (Frickel 2004b).

Some scientists and researchers are, perhaps understandably, wary of damaging their credibility by getting involved in addressing societal crises through advocacy and activism. However, research indicates that this fear may be unfounded (Kotcher et al. 2017). In fact, the public expects scientists to be actively involved in critical issues and participate in policy advocacy, because of their scientific expertise (Cologna et al. 2021). Studies show that, specifically when it comes to ecological activism by scientists, our objectivity is not inherently compromised by the political aspects of the research and communication (Isopp 2015). In the health sciences, for



example, activism has been recommended as "sitting on a spectrum of possible health professional advocacy actions" (Bennett et al. 2020).

In contrast, the fear of being perceived as alarmists has caused serious impediments to accurate and effective scientific reporting. For instance, this fear has led researchers to consistently underestimate the negative impacts of climate and ecological breakdown (Brysse et al. 2013). It has also led many to communicate in dispassionate ways, even when passionate and emotional engagement has been shown to be much more effective in generating environmental action (Brosch 2021). In the words of Marcus & Oranski: "Although the conduct of science demands honesty and rigour, nowhere is it written that researchers must remain silent when governments or other powerful players either misuse science or suppress findings in the service of harmful policies" (Marcus and Oransky 2017).

## **Expanding academic practices**

Which specific forms of advocacy and activism can life scientists embrace today? Below, we outline three realms of academic activities in which these expanded academic practices can play pivotal roles in facilitating societal change: outreach, teaching and research (Figure 2).

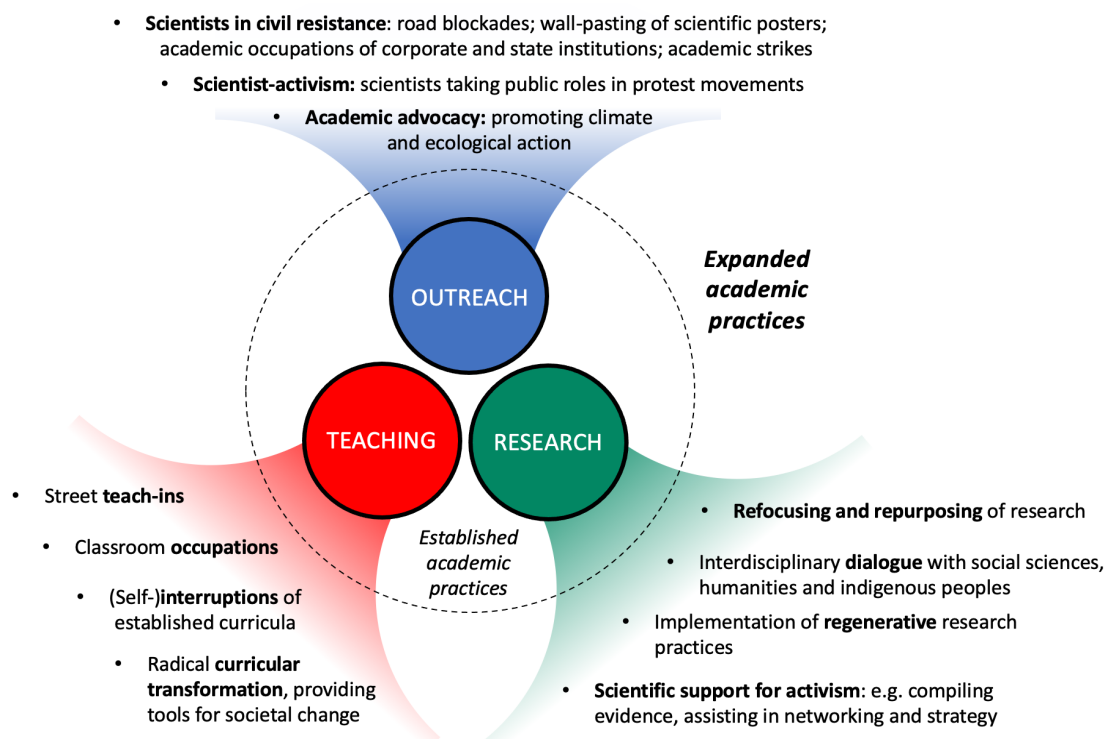
Outreach is an essential aspect of being an academic. In the biospheric emergency, outreach must go beyond those activities currently considered conventional. An emergency calls upon us to actively participate in movements openly engaging with it, via effective forms of direct actions that can garner mass media attention (Chenoweth, Stephan, and Stephan 2011; Chenoweth 2020). In this context, alternative forms of academic outreach may involve, for example, wall-postering of scientific papers on polluting organisations (Real Media 2020), scientist blockades of streets or bridges (T. Thompson 2021), occupations of corporate or government facilities (Chiarin 2022), and academic strikes (Ambjørseiet 2022), to name a few. Scientists are also in a unique position to amplify voices of civil resistance that are currently under-powered. For instance, activists blocking the construction of an oil pipeline may be more likely to gain the favour of the public if they are backed by biologists, ecologists or public health experts, explaining to journalists why new pipelines are conducive to a dangerously unlivable planet.

In the realm of teaching, we can adapt educational practices to the strategic logic of civil resistance, in order to jointly provide knowledge and engage with the public, both inside and outside institutions of higher education. For example, we can organise street teach-ins while blocking traffic (Nielsen and Thymark 2021), interrupt our own course curricula with talks about the biospheric emergency (Steinberger 2022), or occupy university classrooms (Volkstimme 2022), thereby putting pressure on institutions to seriously mobilise their resources. The emergency also calls for a radical transformation of academic curricula, to provide students not just with knowledge about the consequences of climate and ecological breakdown, but also with the social and political tools to address their causes (Steinberger 2022).

Our research can also be expanded beyond business-as-usual, i.e. generating data, models, papers and reports that are placed behind inaccessible paywalls and are largely targeted to other academics (Veríssimo et al. 2020). Instead of building research programs designed for a

world that the scientific consensus shows will not exist (IPCC 2021), we can instead refocus and repurpose our research, to equip society with transformative tools for change (e.g. <https://facultyforafuture.org/>; <https://aronlab.org/climate-psychology-and-action-lab/>) or aid activist groups in their local needs for strategy-development, community-building, and evidence-collection (Gardner et al. 2021).

Along these lines, knowledge production practices in the biospheric emergency should involve local stakeholders in extended peer communities, across all stages of the process (Funtowicz and Ravetz 1993). They should also serve to transition away from the unsustainable patterns of thinking in which we have been raised to operate (Stengers 2018), and aid in the development of regenerative cultures (Wahl 2016). Even scientists working on basic science questions with no immediate direct applications can implement regenerative modes of knowledge production, and help change academic cultures. Perhaps most critically, it is vital for life scientists to listen to, collaborate and co-produce with social scientists, humanities scholars and indigenous communities: our modes of knowledge-production must be in open and honest dialogue with other modes that have been excluded by the colonial and neo-colonial projects that are contributing to the climate and ecological crises (Salomon et al. 2018; Stein et al. 2021).



**Figure 2. Examples of expanded academic practices which embrace activism and advocacy across different realms of academic activities: outreach, teaching and research.**

Finally, across our research, teaching and outreach efforts, we must not shy away from naming the ultimate systemic drivers behind ecological breakdown, if we are to provide an honest assessment to society about the problems at hand. Statements that vaguely ascribe land degradation or species loss to “human activities” are often found in the life sciences academic

literature, inviting gross mis-interpretations: not all humans are equally responsible, nor are all human activities destructive of nature. Indeed, the people and countries most affected by ecological breakdown and climate change are also the least responsible for them (Gore 2020; Oswald, Owen, and Steinberger 2020). Overly vague statements occlude the specific social, economic and political systems that are ultimately driving the biospheric emergency. These systems include, for example:

- **Extractivist capitalism**, which prioritises unfettered economic growth and environmental exploitation over long-term socio-ecological wellbeing (Jackson 2016; Hickel 2020; Schmelzer, Vetter, and Vansintjan 2022)
- **Settler-state colonialism**, which uses state-sanctioned violence to displace, imprison or murder indigenous land care-takers (Whyte 2018; Garnett et al. 2018; Stein et al. 2021; Global Witness 2018)
- **Corporate capture of state institutions**, which makes elected officials unwilling to act in favour of the interests of the broader public (Lucas 2021)
- **Disenfranchisement of citizens** from direct participation in decision-making processes (Smith 2009; Gerwin 2020), which perpetuates the incompetence of electoral politics in advancing transformative change (Gilens and Page 2014).

Ultimately, we must realise that scientific recommendations will be lost in the wind if they only take the form of polite appeals to dominant structures of power, particularly when those very same structures are the ones we are trying to transform. Instead, scientists stand to facilitate change more effectively by talking to the public about why these structures prevent us from fully tackling the emergency, and how they can be reshaped through popular struggle (Steinberger 2019; 2022).

## Scientists in rebellion

Many scientists are already engaging in some of the aforementioned forms of activism, as the consequences of the climate and ecological crises become ever more present in our everyday lives (T. Thompson 2021). In April 2022, shortly after the publication of the sixth IPCC Working Group 3 report, the global Scientist Rebellion mobilised over 1,500 scientists across 28 countries, highlighting the dire global situation outlined by the report (IPCC 2022b). Researchers of all scientific backgrounds risked arrest across all continents, taking disruptive, non-violent actions directed at governmental, scientific and corporate institutions deemed responsible for the crises (C. Harvey 2022; Osborne 2022). The IPCC report itself had been leaked by anonymous scientists almost a year in advance — another form of scientist activism — due to fears it would be watered down by politicians and corporate lobbyists before publication (F. Harvey 2021). This fear was later shown to be founded, when the modified document was officially released to the public and contrasted to the leaked version (Bordera 2022).

Though regaining momentum today, scientist activism is not new (Figure 3). Its history is long, rich and diverse, testifying against the notion that it is unusual for researchers to get directly involved in societal problems (Moore 2009). Prominent scientists like Albert Einstein, Bertrand Russell and Linus Pauling actively engaged in the debate on the development of nuclear

weapons and the dangers of modern warfare (Russell et al. 1955; Pauling 1958). American scholars and students participated in numerous teach-ins and strikes in the 1960s (Allen 2019), as did the Science for the People collective in the late 60s and early 70s, in order to protest the US-Vietnam War. Prominent biologists, like Stephen Jay Gould and Richard Lewontin, were key figures in this anti-war mobilisation (Schmalzer, Chard, and Botelho 2018). Likewise, activism has a proud tradition in the health sciences: scientist-campaigners like Florence Nightingale and Elizabeth Garrett Anderson contributed to major gains in social welfare rights for underprivileged groups, and in the fight for women's right to vote (Launer 2021).

Throughout the 20th and 21st centuries, well-known scientists have participated in activism specifically targeted against ecological deterioration. As early as the 1920s, activist biologists in Brazil were instrumental in influencing public policy to advance environmental protection policies (Duarte 2016). More recently, the climatologist James Hansen has repeatedly engaged in activism, ever since his historical testimony to the US Senate in 1988 to raise public awareness about climate change and its effects on the biosphere. This has often been in the form of civil resistance, leading to arrest (Bryner 2013). Another example is the Argentine biologist Esteban Servat, who rose to global fame after publishing a secret government report on the disastrous effects of fracking in Mendoza, and was then forced into exile from his own country (Ketcham 2019). He has also been responsible for co-organizing mass mobilizations across the world, highlighting links between social struggles in impoverished nations with environmental abuses by European and North American corporations (Ketcham 2019; Monbiot 2022).



**Figure 3. Timeline of a small subset of scientist-activist examples from recent decades.** None of the tactics outlined in this article are new, nor are their usage by academics, in light of the historical records of our field. Warming stripes credit: Ed Hawkins.

## Moving forwards

We — the authors of this manuscript — are (mostly) life scientists<sup>1</sup>, and hence our scope largely focuses on life science fields and practices. However, we believe our recommendations are broadly applicable to all scientists and academics, regardless of their area of expertise. In times of emergency, the entire scientific community must act their part: we are among the most trusted members of society (Funk et al. 2020) and we cannot let our immense prestige, knowledge and privilege go to waste.

We set out to write this perspective because we are all currently participating in activism. We ask our colleagues, mentors, students and teachers to join us. Let us not turn ourselves into passive witnesses of mass death and extinction. We are life scientists after all — let's stand up for life.

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<sup>1</sup> All the authors of this manuscript are life scientists, with the exception of F.A.O., who is an expert in the rhetoric and history of scientist activism.

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