

A biodiversity statement

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Reframing climate change

Climate change is often described in terms of heatwaves, wildfires, hurricanes, floods, melting ice caps, and rising seas. We hear about the risks it poses to coastal cities and the need for infrastructure that can withstand extreme weather. We may also notice the rising summer temperatures and imagine a future where air conditioning becomes a necessity rather than a luxury.

These are real and important concerns. But they obscure a deeper, more existential crisis: climate change is not only a technical or infrastructural problem, it is a biological and evolutionary one.

The ecosystems we depend on for food, water, and even breathable air, are built on organisms that evolved under relatively stable climate envelopes: predictable temperatures and seasonal rhythms. Yes, species can adapt, but adaptation unfolds on evolutionary timescales: centuries, millennia, or longer. We are now altering the planet's climate within a matter of decades.

Plants, insects, and fungi, the scaffolding of terrestrial life, cannot migrate, evolve, or reorganize at the pace we are imposing on them. Even if we halted all emissions tomorrow, that would not stop the ongoing loss of wild habitats due to land conversion and overuse. Reducing consumption and stabilizing greenhouse gas levels are both necessary but nowhere near sufficient.

If we fail to preserve biodiversity now — not just species, but wild populations and habitats — we will lose the biological material needed for ecosystems to recover. This is not about preserving “nature” in the abstract. It is about the long-term viability of agriculture and, ultimately, human life itself.

To understand why this matters so profoundly, we need to look more closely at how nature builds resilience: through redundancy, diversity, time, and space.

Resilience through numbers

Selection is everywhere in nature: An oak tree may produce billions of pollen grains in a single year. From this immense output, a few thousand will land on receptive flowers and form viable acorns. Of those, many will be eaten or trampled; some will fall on concrete, in dense shade, or on poor soil. Others may germinate before the last frost and die, or germinate too late to grow strong before the first frost in the next year. Most acorns never grow up.

The same holds for almost all life on Earth. A single human ejaculation contains hundreds of millions of sperm cells, but, typically, only one results in a new person. Reproduction produces abundance because nature filters ruthlessly at every stage. Survival is not guaranteed; it is sampled from staggering numbers.

We often imagine that plants and animals are perfectly tuned to their environments, but this is an illusion due to survivorship bias. Species as a whole may be adapted, but most individuals within a species are not. What we see around us are the survivors, the rare combinations that happened to withstand the conditions they faced. The rest, by definition, did not make it.

This filtering process, the sifting of huge populations through variable environments, is how evolution works. The greater the number of individuals, and the greater the diversity within a population, the more likely that some will carry traits — perhaps hidden, rare, or seemingly trivial — that turn out to be vital when a new disease emerges or the climate shifts.

As in any large population, rare traits become more likely to appear. In evolution, outliers can be the survivors. Natural selection is a numbers game: the more individuals, the higher the chance that one will carry the genetic key to persistence in a hostile future.

In most plants and animals, each individual inherits roughly half its DNA from each parent, meaning it can carry at most two variants of any given gene. But across a wild population, there may be hundreds or thousands of functional gene variants which are subtly different, each with potential advantages or disadvantages depending on the environment. In other words, a population encodes vastly more resilience than any individual can.

But if natural habitats are destroyed and populations reduced to isolated fragments — or worse, to a few cultivated strains — the game breaks down. We no longer have the vast field of variation from which resilience can emerge. A single frost, a single drought, or a single new disease can wipe out the entire population.

Zoos and seed banks can be valuable tools, but they are not silver bullets. If the seeds stored in a seed bank germinate into plants that no longer match their environment, we haven't saved the species; we've preserved a blueprint for something that can no longer thrive.

Evolution requires time, space, and scale. It needs thousands or millions of individuals interacting with their environments, over generations, in wild and unpredictable conditions. The fewer the individuals, the slower evolution proceeds. To give species a real chance at survival, they must be allowed to grow wild; not in gardens or labs or zoos, but in dynamic ecosystems. They need habitats, gene flow, and population turnover.

Monocultures

When you walk into a modern supermarket, it is easy to believe that we have access to a dazzling array of fruits and vegetables. However, this is partly an illusion. You may find several varieties of apples and tomatoes, but with many fruits and vegetables you will find only a single type, genetically identical to those found everywhere else.

Take bananas. The Gros Michel was the dominant commercial banana until the 1950s, when it was nearly wiped out by Panama disease, a soil-borne fungal disease. We don't find Gros Michel bananas in supermarkets anymore; today's bananas are almost all of the Cavendish variety. The Cavendish, too, is a clone, genetically uniform, and again vulnerable to disease. In fact, a new strain of Panama disease is now spreading globally and threatening the production of Cavendish bananas too.

Citrus orchards face a similar crisis. Since the early 2000s, citrus production in Florida has declined by over 90%, primarily due to Huanglongbing (HLB), also known as citrus greening, a bacterial disease that affects all commercial citrus: mandarins, oranges, lemons, limes, grapefruits, etc. Some wild or ancestral citrus species have partial resistance, but turning those into a commercially viable fruit could take decades.

For avocado trees, it's laurel wilt, a fungal disease that is lethal to avocado trees. As of today, there is not a single known variety with resistance to this disease. Even if one were to be found, 95% of commercial avocado production is a single cultivar, the Hass avocado.

These diseases don't arise in isolation. Both HLB and laurel wilt are spread by insects whose ranges expand as global temperatures rise and human movement accelerates. Climate change doesn't just introduce new stress — it increases the connectivity of ecological threats.

What all these crops have in common is a dangerously shallow gene pool. They are planted widely, feed billions, and yet are built on a narrow genetic base. And unlike annual crops such as tomatoes or corn, fruit trees like avocado and citrus take 5 to 15 years to mature. This makes them slow to evolve, slow to respond, and slow to replace. Even under the best conditions, developing a new disease-resistant variety takes time — and time is exactly what we're running out of.

Citrus and avocado farms grow hundreds or thousands of trees each, but they do not contribute significantly to biodiversity. Most of the trees are genetically identical and the seeds of their fruits are all siblings, so the amount of genetic material on a typical fruit tree farm is vanishingly small compared to the genetic potential of the same area planted with genetically different trees.

This is the danger of monoculture: we remove wild genetic diversity and replace it with uniform systems that cannot adapt, suppressing the very evolutionary processes that once made resilience possible.

Technology alone is not enough

Returning to climate change, we tend to think that the biggest dangers will affect someone else, somewhere else. Coastal cities might flood, low-lying nations might vanish, but we assume that if we live inland or in a colder region we'll be fine. We assume that technological progress will continue: that if we switch

to solar, replace our gas boilers, and drive electric cars, we'll have done enough. And if the weather becomes more extreme, we trust that we'll adapt — with better buildings, smarter infrastructure, and more resilient supply chains.

These are not foolish ideas. They reflect a belief that has served industrial society well: that with enough ingenuity, we can manage and control our environment. This belief, once useful, is now dangerously incomplete.

We often talk about climate change in terms of rising temperatures. But the climate envelope, the full set of conditions under which species survive, is far more complex. It includes rainfall, humidity, seasonality, wind patterns, and the timing of ecological events like flowering or migration. We can perhaps move, but our ecosystems cannot — at least not that fast; besides, many of the corridors that would have facilitated the slow relocation of ecosystems in the past have already been erased by human development.

It is comfortable to think that we can use technology to fix climate change, survive it, or buy our way through it. However, this completely misses the collapse of the living systems that sustain us. These effects cannot be mitigated without changing the way we live: reducing demand and repairing ecosystems.

Diversity is infrastructure

We rarely think about infrastructure until it fails.

Infrastructure isn't just pipes and power lines. It's the roads we drive on, the institutions that deliver education and justice, the supply chains that keep store shelves stocked. These systems operate quietly in the background, largely invisible, until something goes wrong. A power outage, a dry tap, or a stalled shipment is all it takes to remind us how much we rely on what we can't always see.

We often see nature as decoration: forests, birds, wildflowers, coral reefs; beautiful, but peripheral. Something to protect if we can, once the real work is done. But this is a fundamental misunderstanding; biodiversity isn't the scenery of the world, it's the scaffolding.

It pollinates our crops. It filters our water. It maintains our soils. It regulates pests and diseases, decomposes waste, buffers floods, and balances the atmosphere. It is the operating system beneath all agriculture, all food security, and all livable conditions on Earth. Diversity is literally infrastructure.

When we degrade biodiversity, we're not just losing species. We're stripping out functions, quietly and irreversibly, from the systems that keep civilization running. And like any infrastructure, we tend not to notice until it's already failing.

If biodiversity is infrastructure, we need to treat it as such — not just in speeches or scientific reports, but in the way we build our laws, our institutions, and our education systems.

That means protecting wild land not as a luxury or a carbon offset, but as essential infrastructure, no less critical than a water treatment plant or a power grid. It means funding biodiversity conservation the way we fund roads and schools: regularly, predictably, and at scale. It means embedding ecological function into urban planning, agriculture, trade policy, and land use, not as an afterthought, but as a baseline requirement.

Governments must treat habitat loss and genetic erosion not as environmental issues, but as threats to national security and public health. Agricultural policy must stop rewarding homogeneity and start incentivizing genetic and ecological diversity. Legal frameworks must evolve to recognize that the loss of biodiversity is not merely a degradation of nature, but a loss of function — possibly irrecoverable.

We need to teach this from the ground up. Biodiversity should not be a footnote in biology class. It should be taught as what it is: critical infrastructure on which our civilization depends.

We cannot protect what we don't understand, and we won't protect what we don't value. To preserve biodiversity, we must reconnect with the living world and with the truth of our dependence on it.

Reconnecting with nature

For most of human history, we lived with the land, not apart from it.

Ancient cultures shaped their lives around the rhythms of soil, water, and season. In Mesoamerica, the cultivation of maize was not just agriculture but a way of life, a sacred process that balanced genetic diversity with nutritional resilience. In Mesopotamia, early societies tracked the flooding of rivers, the behavior of animals, and the timing of planting with careful attention. Across the world, Indigenous cultures developed seed-sharing traditions, crop rotation systems, and rituals that recognized the land not as property, but as kin.

These ways of living weren't primitive. They were sustainable, sophisticated, and built on an understanding that human flourishing depends on the health of ecosystems. The goal wasn't to dominate the land, but to live well within its boundaries.

That perspective has nearly vanished.

Today, most people are disconnected from how food is grown, where it comes from, or what it depends on. A frost that arrives too early in spring, killing the buds on a fruit tree, might go unnoticed by anyone who isn't a farmer. A drought in a distant region might devastate a harvest, and the only signal the rest of us receive is a price hike at the grocery store, quietly blamed on inflation or nebulous "market forces", never traced back to biodiversity loss or climate disruption.

When we don't see how things are grown, we stop asking what they require to grow. We forget that every tomato, every grain of rice, every almond, every avocado relies on a living chain of relationships: pollinators, microbes, soil fungi, rainfall, timing, temperature. We stop noticing when those links begin to fray.

And when we no longer notice, we no longer act.

To protect biodiversity, we have to make it visible again — not just in science, but in daily life. This doesn't mean returning to a romanticized past. It means remembering that our future depends on what we are willing to see, care for, and protect now.

Epilogue

Reconnecting with nature doesn't require moving to the countryside or giving up technology. It can begin with something small: growing herbs on a balcony, tending a fruit tree in a yard, observing the plants and wildlife in a nearby park. These are not solutions in themselves. But they are gestures of attention — ways of remembering that we are part of a living system, not separate from it.

And through that attention, something shifts. Biodiversity stops being an abstraction. It becomes something present, particular, and alive.