How lessons from bees, leaves and our own blood may help us save civilization

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Credit: Kevin Krajick/Earth Institute

Once upon a time, everything theoretically could be managed with neatly functioning human inventions: wars could be won, diseases cured, weather predicted, crops improved. These days, things seem to be

spinning out of control: violent weather, catastrophic wildfires, political upheavals, a global pandemic—all in a world increasingly crowded and interconnected by modern technology and transport, where one failure threatens to cascade into many.

In a new book, environmental geographer and Earth Institute professor Ruth DeFries argues that we can survive by adopting the strategies of the nonhuman world: Communications networks, public health and agriculture might benefit if we observe how plants distribute nutrients; how bees deal with diseased individuals; or how forests persist by periodically going up in flames. The book is called "What Would Nature Do? A Guide for Our Uncertain Times." I recently spoke with DeFries about the book, what led her to write it, and where she thinks we are going. (Some answers have been condensed for clarity or space.)

Inventions like high-yield crops, global trade and the Internet have made us better off. But have they possibly also made us more fragile?

Technology has undoubtedly led to great strides in health and prosperity. With high-yield crops, we produce more food per person than we did 50 years ago, despite the enormous increase in world population. But technology also makes us fragile. For example, humanity relies increasingly on a small handful of high-yielding crop varieties. Farmers are losing the seeds and know-how to grow varieties that suit their local climates and soils. As climate changes, those seeds and know-how could be the secret to withstanding conditions that high-yielding varieties can't. And, global trade has made the food supply more reliable. That is, until something disrupts the supply chain. Most of us now live in cities, tethered to other regions where farmers produce food, and to transport networks that get it to warehouses and ultimately to stores. If a drought, political upheaval or some other shock hits somewhere along the line, the kink disrupts the entire chain.

You say the natural world works in ways counter to the way we do. How so?

Societies have organized their economies based largely on efficiency. How to produce the most food for the least amount of land and labor? How to streamline just-in-time supply chains that reduce the need for expensive storage? That makes a lot of sense if things remain stable, but the world is dynamic. A farmer who plants a monoculture corn field can lose the whole crop if a single pest sweeps through. Or a company that relies on a single supplier can find itself without a key part if something goes awry. For instance, in 2011 a flood hit factories in Thailand that supplied half of the world's hard disks. Shortages and high prices went on for months. Nature counteracts the dangers of such over-reliance on efficiency. These strategies are not by intentional design, but rather evolved from nature's long experience. Networks to move food and water follow multiple paths rather than a single path.The cycle that moves carbon in and out of the atmosphere regulates itself to avoid a runaway greenhouse effect. The insulin in our bodies is part of a self-regulating system that keeps our blood sugar at safe levels.

OK, multiple paths versus a single path. Can you dig into that?

If you look closely at the veins of a leaf, you'll see that there are many tiny veins. An efficient leaf would have only a few veins to move water and sugar back and forth. Multiple veins require a plant to invest energy and materials, just as building multiple highways to get from one place to another requires extra costs. It makes sense to minimize the investment. But the evolution of leaf veins has favored multiple highways, so if an insect takes a bite and a vein gets cut off, there is another way around to keep water and sugars flowing. Redundancy, even with the extra cost, pays off. The global food trade, which moves food

around the world the way veins move water and sugar around a leaf, is efficient, but it lacks redundancy. Many countries rely on a few other countries to feed their people. Food price spikes in 2008 and 2011 were triggered by droughts in food-producing regions, and exacerbated by trade restrictions. This revealed the dangers of efficiency without redundancy.

What about the importance of biodiversity?

In a world where an asteroid can strike or the climate can shift, life can survive only if it's prepared for the unknown. Diversity keeps the options open—it provides a portfolio of possibilities for life to persist. If the climate changes or a predator comes along, and one species succumbs, another one more suited to the new conditions can take over. The history of life on Earth is a climb towards diversity, punctuated by drastic crashes that could have been the death knell for all life without a diversity of options in reserve. Diversity in human societies takes many forms. Not only the diversity of plants and animals that feed humanity, but diversity of languages, cultures and knowledge. The tendency of the modern world is to squash diversity in the interest of efficiency. But that diversity is our reservoir of options for an unpredictable future.

Have we harnessed any lessons from nature at this point?

I came across many cases when people have learned through trial and error that nature's strategies are worthwhile. Most likely without any thought to the parallels in nature. The Internet is made of redundant networks, like leaf veins. The stock market has circuit breakers to keep it from crashing too far, like the Earth's self-regulating carbon cycle. Engineers have learned over time that building both redundant and diverse parts into their designs is a matter of life and death. Interestingly,

the examples come mostly from the worlds of finance and engineering. One would expect efficiency to prevail in those arenas, but redundancy, diversity and self-regulating mechanisms have proven to be the better strategy. Many other fields have yet to take these strategies on board. Among them are our food systems, the homogenization of cultures, the loss of languages, and the disregard for Indigenous peoples' traditional ways of managing fire.

Is there anything we can learn from the current pandemic?

Social insects like ants and bees have the same problem as humans: They live in close contact. An infection can run rampant and decimate a population. But pandemics in social insects are not very common. They instinctively arrange their social structures to be modular, meaning that sections of the population can cut off from each other with the first sign of infection. This strategy is akin to stopping the spread of COVID by cutting off travel and staying in social pods. But insects are much more effective. That stands to reason, because they have been evolving many millions of years longer than humans. Of course, insects also kill off infected individuals, or those individuals leave the nest to die. That obviously is not a strategy we want to emulate.

Are we headed the way of the Romans or other collapsed civilizations?

Civilizations are complex systems. Complex systems go through cycles of growth, stagnation, breakdown and renewal. We can think of the rise and fall of the Romans, the Maya and others as this cycle repeating over the long course of human civilization. Modern civilization is probably the most complex and intertwined ever, and there's no reason to think that it is somehow exempt from this cycle. But the comparison with

others falls short. We have more knowledge, technology, communications and ability to project into the future than ever before. We can better prepare for problems outside of our control, like volcanoes and earthquakes, and problems we bring upon ourselves, like climate change. The question is whether we can organize our affairs to harness our expanding knowledge.

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