Viewpoint: Is the predicted ‘Silent Earth insect armageddon’ the inevitable result of using farm chemicals — or is it alarmist activist propaganda? Insect scientists challenge the doomsayers

For years, journalists and environmental bloggers have been churning out story after story claiming that insects are vanishing, in the United States and globally. There is no question that insects are in decline which lends credence to reasonable concerns as insects are crucial components of many ecosystems. More interesting and of scientific value and far less clear is ‘why’, how severe is the decline, and whether the drop-off portends, as many environmentalists claim, environmental armageddon.

Some but not all environmental activists have seized on this issue, framing it in catastrophic terms, with predictions of a near-inevitable and imminent ecological collapse that would undermine global biodiversity, destroy harvests and trigger widespread starvation. Many of the solutions they are advocating would require a dramatic retooling of many aspects of modern life, from urbanization to agriculture.

Considering the disruptive economic and social trade-offs being demanded by some who embrace the crisis hypothesis, it’s prudent to separate documentable threats from agenda-driven hyperbole. How ecologically threatening are insect declines? Should we be in ‘catastrophic crisis’ mode? What can and should we as a collective society responsibly do?

Glyphosate tort extravaganza: recent roots of the crisis narrative

The hyper-focus on disappearing insects traces back to a 2017 study conducted by an obscure German entomological society that claimed that flying insects in German nature reserves had decreased by 76 percent over just 26 years. Most entomologists viewed the study warily. It focused on a small, protected areas, most of which had been encroached upon by urbanization. Many questions were raised about the areas chosen for study, time of year chosen to set out traps to collect insects, the focus on protected areas that were being encroached upon by expanding urban centers, and numbers other subjective decisions by the study authors. If this issue had not already been controversial, the study would have been seen for what it was: a sliver of information about a small geographic locations on the global map that should be weighed along with dozens of other more robust studies in much larger, insect-rich regions. Instead, with the aggressive support of European activist groups it helped create a global a cause célèbre.

The study, co-authored by twelve scientists, lit a fire in advocacy circles committed to making a case that modern agriculture and its use of crop protection chemicals was bringing Earth close to an environmental reckoning. This framing of the paper was circulated through the loosely coordinated anti-biotechnology movement. Its influence was in decline as genetic modification and an exciting new tool called CRISPR to precisely gene edit crops was gradually being embraced by the general public, even in risk averse Europe. Looking for a way to revive their fading influence, campaigners turned to a proxy: switch the controversy from a losing focus on genetic engineering itself to what they believed is the central sin of modern agriculture: the use of crop protection chemicals, some used in tandem with GM seeds.
The ‘chemophobia strategy’ was birthed in 2015 after a then publicly obscure UN sub-agency, the International Association for Research on Cancer, issued a ‘hazard’ study claiming that there was ‘sufficient evidence’ glyphosate causes cancer in animals and “limited evidence” it can do so in humans. IARC placed glyphosate in its catch-all hazard category “2A”: “probably carcinogenic to humans” — the same category occupied by drinking hot beverages, eating red meat, or going to a barber or hairdresser. It was judged far less hazardous than eating bacon or salted fish, taking oral contraceptives — or drinking the red wine served at IARC’s announcement.

Not surprisingly anti-GM campaigners spun IARC’s modest conclusion into a global fear campaign — and has largely been successful. Reuters later discovered that days before the release of its final report the IARC panel evaluating glyphosate had edited out the conclusion that glyphosate was non-carcinogenic. The change came, it was later learned, at the urging of scientist Christopher Portier, who had urged IARC to examine glyphosate. Within days after the IARC decision, Portier signed a lucrative contract to be a litigation consultant for two law firms; the point firm represented the Church of Scientology, which foresaw that glyphosate litigation was a multi-billion dollar tort extravaganza — they were right.

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Twenty-two other independent ‘risk’ agencies around the world before and since have concluded, as IARC originally did, that glyphosate was not carcinogenic —including the UN World Health Organization itself and two other affiliate agencies — outright rejected IARC’s globally-contested last-minute reversal.
[The Genetic Literacy Project has compiled the findings of the world’s top regulatory and chemical research organizations including IARC’s. They are illustrated in this infographic. [Click here for a downloadable pdf version]

Widely recognized at the time as the most effective and safest herbicide, glyphosate became the global proxy to attack ‘Big Ag’ and crop biotechnology. Now they saw an opportunity to expand their campaign by targeting all crop chemicals, and warning that they were driving a global environmental collapse. And they had the agent privateer to execute this grand strategy: Dr. David Goulson

The controversial German insect paper and the role of the New York Times

Environmental activist NGOs around the world, many tied to tort lawyers who often funded their campaigns, help circulate the German study. It became the sixth-most-discussed scientific paper of 2017. Headlines around the world predicted that impending mass insect deaths would lead to an “ecological Armageddon” — a turn of phrase from by one of the co-authors, Dave Goulson. Then a relatively obscure English biology professor, Goulson rapidly became the public face of the crisis narrative. Although there was immediate and widespread skepticism in the entomology community, for the most part journalists embraced the ‘end of world’ narrative.
The New York Times Magazine's Brooke Jarvis christened the study's legitimacy, headlining its 2018 feature: "The Insect Apocalypse Is Here" and promoting it with a visually stunning, and frightening, cover illustration.
The lengthy feature was filled with speculation about the imminent “complete” disappearance of insects, using descriptors such as “chaos”, “collapse”, “ecological dark age” and “Armageddon”. Compounding the imminent catastrophe, our most despised pests, from cockroaches to house flies, would largely be spared, booming out of control as beneficial insects vanished. The Times’ summary conclusion? The world is facing a loss of biodiversity, what it called the “sixth extinction”. And it will get worse; the insect declines were the canary in the ecological mine. What is to blame? Agricultural synthetic chemicals.

Goulson, a professor at the University of Sussex, was the featured scientist in the piece. The Times quoted him as choking up in grief as he shared his poignant, ‘end-of-life-as-we-know-it’ crisis scenario:

“If we lose insects, life on earth will. …” He trailed off, pausing for what felt like a long time.

In talking with reporters, Goulson refocuses almost every discussion about threats to insects into an attack on synthetic chemicals. As he told The Guardian at the time of the publication of his co-authored 2017 study, “[The insect deaths could be caused by] exposure to chemical pesticides,” even though the German study sampled populations from nature reserves and its purpose wasn’t to detect causes of declines.

Goulson reignited the controversy in 2021, transforming the supposed “bee-pocalypse” into a global apocalypse for all insects, and potentially all life on Earth. In “Silent Earth: Awaiting the Insect Apocalypse”, he blames modern agriculture, agricultural chemicals, “greedy corporations,” and capitalism. The New York Times chose not to review the book, but hundreds of other news outlets did, including London’s Sunday Times and The Telegraph. both which named it one of its books of the year.
Seeing himself as following in the footsteps of Rachel Carson, and in his now familiar understated style, Goulson claimed that developed countries are committing environmental suicide with what he calls their “chemical onslaught on nature … akin to genocide,” and the “fragile web of life on our planet is beginning to tear apart.” The culprits: Agricultural corporations such as Syngenta, Bayer and Corteva, among others. As one popular horticulturist wrote admiringly, “Author, Dave Goulson has written Silent Earth as a call to arms, raising awareness of the perils of using many of the products that have become common place in our homes and gardens, towns, cities, farms, and countryside.” Almost unanimously praised by non-scientists, the science community was less enthusiastic. Physician and molecular biologist Henry Miller wrote:

[M]uch of Goulson’s evidence is purely anecdotal — such as fewer bugs splattering on the windshields of European cars now compared to the past — and the few studies of global insect populations he does consider are deeply flawed or mischaracterized in his account.

The tsunami of crisis articles served as a wake-up call. But to what? What are the facts?

Insectageddon is a great read. But what are the facts?
A number of studies suggest that insect populations are declining in some areas of the world (but not in others) or that certain kinds of insects (taxa) may in decline in those regions (even as others are increasing). But Armageddon? Such catastrophic framing and the policy implications that would inevitably flow from that conclusion are significant. If Goulson is accurate in his assessment, we need to dramatically reshape agriculture, and quickly.

What is the consensus view? Manu Sanders is a prominent entomologist, recipient of the Office of Environment & Heritage/Ecological Society of Australia Award for Outstanding Science Outreach. She and colleagues Jasmine Janes and James O’Hanlon outlined the science-based perspective in 2019 in BioScience, where they examined the headline-grabbing apocalypse studies that had appeared to that date. They presented their conclusions in a post for Ecology Is Not a Dirty Word, a highly respected blog that Saunders oversees:

We summarise the major flaws in the pop culture ‘insect apocalypse’ narrative and argue that focusing on a hyped global apocalypse narrative distracts us from the more important insect conservation issues that we can tackle right now. Promoting this narrative as fact also sends the wrong message about how science works, and could have huge impacts on public understanding of science. … And, frankly, it’s just depressing.

Of one of the major studies used to promote the apocalypse narrative (“Worldwide decline of the entomofauna: A review of its drivers”, by Sanchez-Bayo and Wychkuys, discussed below), Sanders noted an appallingly selective and apparently willful misrepresentation and manipulation of the data in the original 2017 paper from which Goulson cites as the most compelling data in support of his narrative:

From a scientific perspective, there is so much wrong with the paper, it really shouldn’t have been published in its current form: the biased search method, the cherry-picked studies, the absence of any real quantitative data to back up the bizarre 40% extinction rate that appears in the abstract (we don’t even have population data for 40% of the world’s insect species), and the errors in the reference list. And it was presented as a ‘comprehensive review’ and a ‘meta-analysis’, even though it is neither.

Reflecting broad concerns among ecologists, Saunders also worried about the failure of prominent news organizations like the New York Times and the Times of London to treat alarmist claims with proper skepticism. She argued that ideological group-think had captured the credulous media:

Most journalists I spoke to have been great, and really understand the importance of getting the facts straight. But a few seemed confused when they realized I wasn’t agreeing with the apocalyptic narrative – ‘other scientists are confirming this, so why aren’t you?’
Professor Sanders has written a stunning 4-part series on what she sees as the crisis manipulation by scare-promoting journalists and scientists [see: Part 1, Part 2, Part 3, Part 4].

**Early roots of the crisis narrative**

It’s important to understand how we got from the consensus —‘there is fragmentary but concerning evidence’ of insect declines — to ‘the world faces imminent collapse’. The insect crisis narrative dates back more than a decade, and was originally focused on alarming reports beginning in 2006 of a surge in honeybee mortality.

The die-offs, concentrated mostly along the west coast of the US, were dubbed Colony Collapse Disorder. CCD is an enigmatic condition that causes bees to vanish without a clear explanation. At the time, many environmental activists claimed it was the early signs of a ‘bee-apocalypse’, blamed insecticides as the root cause, a conclusion widely circulated by the media.

Then as now, the mainstream entomology community (and even a special task force set up by President Obama’s USDA) tried to push back on the crisis narrative. Incidents similar to CCD (previously known as ‘disappearing disease’) had occurred in the 1800s and 1900s, long before synthetic pesticides were invented. This iteration of CCD had largely ended by the early 2010s, experts say.
Honey bee colony levels have remained stable despite elevated loss rates.
But that’s not the story that dominated headlines. The ‘media crisis’ persisted for years, cresting in an article by *Time*, which proclaimed in a 2013 cover story: “A World Without Bees: The Price We’ll Pay If We Don’t Figure Out What’s Killing the Honeybee”. But by then, unbeknownst to journalists and scientists, the crisis was fast fading; honeybee populations had begun to stabilize by 2011, and by 2015, they hit a 20 year high in the US. This trend was even more pronounced globally: honeybee populations have increased 30 percent worldwide since 2000.

By 2018, almost every major news organization, from the *Washington Post* ("Believe it or not, the bees are doing just fine") to *Slate* ("The Bees are Alright") and including many environmental publications such as *Grist* ("Why the bee crisis isn’t as bad as you think") were sheepishly acknowledging there never was an imminent worldwide honeybee catastrophe. Conspicuously, the *New York Times* was one of the few news outlets to not reconsider its crisis narrative.

How healthy are bees? As the GLP has previously reported (here, here and here), dire predictions of an impending insect extinction rest on studies that suffer from flawed methodologies and fragmentary and mostly regional data. While honeybees face health challenges, that’s mostly because they are “pack animals” trucked around from one region to another to pollinate crops. Their ongoing health problems are primarily linked to the spread of disease-carrying Varroa mites. The mites are virtually absent in certain parts of the world, such as Australia, which has seen steady growth of honeybees for decades.

Even the hardline Sierra Club was forced (briefly) to do an about face after 8 years of near-hysterical claims about an escalating honeybee disaster.
In 2016 (well after other news organizations had revised their crisis narrative), the group’s “save the bees” fund raising campaign mailer was still dominated by media-hyped hysteria:

Bees had a devastating year. 44% of colonies killed…and Bayer and Syngenta are still flooding your land with bee-killing toxic ‘neonic’ pesticides—now among the most widely used crop sprays in the country.

**Challenged by the GLP**, and as the tide of mainstream environmentalists turned against the bee apocalypse narrative, Sierra Club, with no mea culpa or even an explanation, suddenly reversed itself in 2018, posting a far different message on its blog:

Honeybees are at no risk of dying off. While diseases, parasites and other threats are certainly real problems for beekeepers, the total number of managed honeybees worldwide has risen 45% over the last half century.

**What about wild bees?**

There is fragmentary but real evidence of health challenges facing wild bees. The data is hard to interpret however, because wild bees are notoriously hard to evaluate. But a worldwide pollinator crisis caused by insecticide overuse, as Goulson and others claim? The most comprehensive recent study, released in May 2021, found few of the 250 bumblebee species from around the world were in peril, challenging the apocalypse narrative. “If you look at all the species, on average, there is no decline,” concludes ecologist Laura Melissa Guzman at Simon Fraser University in British Columbia.

Even as claims of a honey beeepocalypse faded in the science community, many environmental groups, often citing Goulson (an ardent early promoter of the honeybee catastrophe false narrative), gish-galloped to claims that wild bees, then birds, and now all of the insect world face extinction.

That’s what happened at the Sierra Club in 2016, looking for a way to distract from years of misreporting. For much of a decade, claiming honeybees were dying was a sure fire way to raise money. Within months of its reversal on honeybees, it brazenly launched yet another campaign asking for more contributions — again, to protect bees. The once venerable environmental group turned to touting Goulson’s broader insect Armageddon claims, again fingering “pesticides” as the driving culprit.

**Goulson imitators**

Goulson is not alone in his myopic focus. In 2019, in a meta-analysis of insect population trends around the world, Australian environmental scientist Francisco Sánchez-Bayo, a Goulson ally, claimed that all insects will disappear from the Earth in a century. (I've previously discussed the study in depth here). In an interview with *The Guardian*, Sánchez-Bayo commented:

The 2.5% rate of annual loss over the last 25-30 years is ‘shocking’, Sánchez-Bayo told the Guardian: ‘It is very rapid. In 10 years you will have a quarter less, in 50 years only half left and
in 100 years you will have none.' One of the biggest impacts of insect loss is on the many birds, reptiles, amphibians and fish that eat insects. ‘If this food source is taken away, all these animals starve to death.’

Sánchez-Bayo argued this frightening prospect was due to “industrial-scale, intensive agriculture.” But that conclusion was not supported by the evidence in his paper and was criticized by the entomology community. While some of the studies included in the meta-analysis were related to agriculture, and some speculated pesticides were responsible for declines, that was his personal opinion, voiced without any data — yet it was cited by many reporters as the main ‘take away’ from the study.

As Manu Sanders noted in American Scientist, the Sánchez-Bayo study was beset by numerous methodological errors. The authors only included studies that specifically mentioned the phrase” insect declines,” thus biasing the results, as some reports of stable or rising populations were excluded from the analysis.

While Sánchez-Bayo claimed that “almost half of the [world’s insect] species are rapidly declining, his team’s data documented declines for only about 2,900 species, a tiny fraction, less than 1/10th of 1%) of the insect species on Earth. As Sanders and others noted, while about 900,000 species of insects have been identified globally, studies of Latin American forest canopies have suggested there may be upwards of 30 million insect species.

Sánchez-Bayo et al. also claimed that their research was based on a “worldwide” assessment, but nearly all of the data were drawn from the US and Europe. There could be as many as 200,000 insect species in Australia alone, but data from that country focused solely on managed honeybees. The statistics from Asia (excluding Japan) only included managed beehives and there were no studies from Central Africa and almost none from South America, a global insect population epicenter.

Scientists say that excluding data from some of the most ecologically diverse regions on the planet, along with studies on increasing or stable insect populations, biased the study so severely that its results cannot be used to draw any conclusions on changes in insect populations worldwide.
Geographic location of the 73 reports studied on the world map. Columns show the relative proportion of surveys for each taxa as indicated by different colors in the legend. Data for China and Queensland (Australia) refer to managed honeybees only.

What do mainstream insect experts conclude?

The silver lining from the recent spate of advocacy-focused studies news is that entomologists are doing a deeper dive into the reasons behind the global declines. Goulson’s upcoming media blitz notwithstanding, the most thorough studies to date on insects in North America challenges the catastrophe narrative (although you may not have heard about them as they have been almost ignored by the media), and even offers some reassuring news.

A 2020 study by German researchers led by Dr. Roel van Klink represented the largest and most definitive study on global insect populations at the time of its publication. The meta-analysis of 166 studies found that insects are declining much less rapidly (3- to 6-fold less) than previously reported, and freshwater insects are actually increasing. Other major findings:

- The only correlation with insect declines was habitat, specifically urbanization
- Cropland was correlated with insect abundance
- Insect declines in North America ended by the year 2000

While comprehensive, the report wasn’t flawless. The primary issue, shared with Sánchez-Bayo, was that nearly all data came from Europe and North America. As the below map shows, there were only a few studies from South America and Africa, and none from South Asia, making it impossible to declare
whether insects are declining or increasing in those regions.

While threats to certain species do exist in certain locations, that doesn’t support claims that we face a broad, global population collapse among insects.

**North American insect populations are stable**

The deficiencies of the studies by Goulson and his acolytes encouraged a team of 12 researchers led by Michael Moran at Hendrix College in Arkansas to examine the “insect crisis” in North America. As the authors noted, “much evidence for what has been dubbed the ‘insect apocalypse’ comes from Europe, where humans have intensively managed landscapes for centuries and human population densities are particularly high.” They wondered if examining the extensive data collected on the geographically and ecologically diverse North American continent would yield the same or a different conclusion.
The Moran study, published in August 2020, examined four to 36 years of data on arthropods (insects and other invertebrates) collected from US Long-Term Ecological Research sites located in ecoregions throughout the country. The finding: “There is no evidence of precipitous and widespread insect abundance declines in North America akin to those reported from some sites in Europe.”

The data show that while some taxa declined, others increased, and the vast majority had stable numbers. The overall trend, they concluded, is “generally indistinguishable from zero.” Neither could the authors attribute population changes to any specific cause, including insecticides. The study compared the data on insect populations to “human footprint index data” which includes factors such as pesticides, light pollution, and urbanization.
In the press release announcing the study — “Insect Apocalypse May Not be Happening in the US” — University of Georgia postdoctoral researcher Matthew Crossley stated, “No matter what factor we looked at, nothing could explain the trends in a satisfactory way.” With headlines relentlessly heralding impending doom for insects, it’s unsurprising the results left the authors “perplexed.” As Moran later wrote:

At first, we thought we were missing something. We tried comparing different taxonomic groups, such as beetles and butterflies, and different types of feeding, such as herbivores and carnivores. We tried comparing urban, agricultural and relatively undisturbed areas. We tried comparing different habitats and different periods of time.

But the answer remained the same: no change. We had to conclude that at the sites we examined, there were no signs of an insect apocalypse and, in reality, no broad declines at all.

The robustness of the Moran study data suggests the insect population story is much more complicated — and less dire — than many headlines suggest. If a thorough examination of the data on one continent can lead to such a dramatically different and more hopeful conclusion, broad trends in the vast, highly
The overall paucity of data on insect numbers globally has provided an opening for alarmists to speculate, and Goulson and others have taken advantage of that. But why is the data so fragmentary? Moran and co-authors attributed the lack of corroborating studies supporting the consensus view that insect populations are mostly stable to what he calls “publication bias … more dramatic results are more publishable. Reviewers and journals are more likely to be interested in species that are disappearing than in species that show no change over time,” he wrote in the Washington Post.

It’s a reinforcing feedback loop, with journalists playing a key role in this disinformation cycle. Scientific publications are more likely to publish reports of declining species. Then, when researchers search for data, “declines are what they find. "The media often seizes on incomplete or even biased conclusions to build a compelling narrative — an insect apocalypse or insectageddon or zombie-like resurrections of debunked reports of birdpocalypses and beepocalypses.

The result is that enormously complex issues often are portrayed in cartoon terms. Conventional farmers, who use targeted, synthetic chemicals, are cast as the ‘black hats’ who dare to use advanced tools of biotechnology and targeted synthetic chemicals; they are harshly contrasted with crusading ‘white hat’ scientists and advocacy journalists cast as partners with the Earth and Nature. Independent scientists are increasingly frustrated. As professors Sanders, James and O’Hanlon have written, there are consequences to simplistic frames:

We disagree with the catastrophic decline narrative, not the concept of population declines or that individual studies have shown declines in some places. Declines are probably happening elsewhere too, but we have no data to prove it. Yet other insects are not declining, and some are increasing in population size or range distribution. New species are being named every year, most of which we still know nothing about.

Presenting the global decline narrative as consensus or fact is simply misrepresentation of science. By continuing to promote the narrative, we may suffer from confirmation bias, potentially encouraging scientists to look for evidence of declines in their data where they may be none.

It is perhaps too much to hope that journalists would have learned their lesson after chasing so many ‘verge of extinction’ tales over the past 15 years that proved false. That’s why more independent studies like Moran et al. are needed to break the cycle of bias. And maybe a little restraint from pack journalists.

“Let’s move on from the decline narrative,” Manu Sanders and her colleagues plead. “We need less hype and more evidence-based action on the priorities we can address right now.”
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