Science AMA Series: Hi Reddit! We're Rodolfo Dirzo, Wägele J. Wolfgang and Christian Schwägerl, and we're talking about the rise of global insect decline and why it matters - Ask Us Anything!

insect$_d$*ecline*[1]*andr*/*ScienceAMAs*[1]

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April 17, 2023

Abstract

Hi reddit! My name is Christian Schwägerl, and I write for Yale Environment 360 magazine. In my work as a journalist and book author, I have covered science, environment and politics for more than 20 years. In recent years, my main focus is the Anthropocene, the now widely known idea that our human impact on Earth is not only profound and global, but also long-lasting enough to be put on the geological time-scale. My book "The Anthropocene" (Synergetic, 2014) explores pathways towards an Anthropocene that is better than today's destructive and degenerative practicies. In my recent Yale Environment 360 investigation, "Vanishing Act: Why Insects are declining and why it matters", scientists Rodolfo Dirzo and Wägele J. Wolfgang join me to understand why the dwindling insect populations was really disconcerting in this respect. Not only do insect populations decline, but monitoring and research fall far behind what would be necessary to really understand and address the problem. Like with so many other things we take for granted, the small and invisible is hugely important. An extinct bug might make most people shrug. But our lives depend more on healthy insect ecology than we think. In future articles, I want to explore the huge importance of small organisms further. My name is Rodolfo Dirzo and I am an ecologist at Stanford University. My work examines the study of species interactions in tropical ecosystems from Latin America and Africa. My recent research highlights the decline of animal life ("defaunation"), and how this affects ecosystem processes/services. I developed a global index for invertebrate abundance that showed a 45 percent decline over the last four decades, published in 2014 in Science, "Defaunation in the Anthropocene." My name is Wägele J. Wolfgang and I am a biologist and Director of the Zoological Research Museum in Bonn, Germany. With the help of my team, I have developed a plan for an automated biodiversity surveillance system, which would photograph, videotape, capture, or audio-record animal and insect species and perform automatic analysis of species richness and abundance. We have weather stations for climate research all over the country, so we want to add a dense network of biodiversity stations so we can measure automatically how much life there is in our landscapes. We plan to use automated identification techniques, either through artificial intelligence image analysis or genetic fingerprinting, or by matching acoustic recordings with data collections. This system could collect, identify, and record species data 24/7 and gather data we desperately need to assess the decline of insects. We will be answering your questions at 11am EST – Ask Us Anything!

the WINNOWER

REDDIT

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INSECT_DECLINE R/SCIENCE

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CORRESPONDENCE:

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In california, turf is quickly replacing traditional lawns in many suburban neighborhoods. My parents want to follow suit. There are many fascinating local lizards and birds, and I would wager they all rely on the insect population that thrives in the grass.

Do you think that people replacing their lawns with artificial turf will destroy our local ecosystems?

adismail

Wolfgang replying: A clean turf is a green desert, especially when treated with Roundup and similar

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poisons. Some earthworms and soil mites might survive. Animals requiring flowering plants and food chains based on these will have to search in the landscape for a few suitable “islands” where they can survive. If the distances are too great or the “islands” (nice meadows) are too small to maintain a population, the species will soon disappear from the region.

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adismail

Hi. Thx for your question. Christian here. What you describe makes me cringe. You are absolutely right that many birds and lizards depend on insects for food and that landscapes of artificial turf have no habitat value whatsoever. In my home country Germany there's an opposite trend - to replace monotonous lawns with more species-rich vegetation. There are so many amazing plant species in California - why can't people start creating gardens inspired by the nature around them? If you want to do something for the environment, convince the richest family in your neighborhood to develop one best-practice California Garden with you that makes everybody else envious. Or get hold of a little piece of abandoned land and do this with permission from owner. Cities are spreading and increasingly they are vital habitats. So gardens can act as important habitats, see http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12499/full for exapmple. Thanks for raising this question. It's really important and everybody can do something that ultimately benefits humans and nature.

Thanks for being here!

What specific insect species are the hardest hit so far?

Are there insects whose rise or decline in your biodiversity measures is representative of the wellbeing of ecosystem as a whole? Canaries in the coal mine, so to speak?

p1percub

I'm Wolfgang: You are asking for indicator species. Avaliable insect samples from Central Europe show a losses in numbers of individuals for many different groups of insects. If you focus only on butterflies, for example, their disappearance may indicate that probably either they were poisoned with pesticides or their food plants have been removed or both. Single insect species represent only a few facets of the ecosystem's structure. If you observe a reduction in number of dragonflies, this usually indicates problems with water quality or the availability of ponds and creeks.

Thanks for being here!

What specific insect species are the hardest hit so far?

Are there insects whose rise or decline in your biodiversity measures is representative of the wellbeing of ecosystem as a whole? Canaries in the coal mine, so to speak?

p1percub

Hi! It's Christian here! (Rodolfo will join a bit later) Thanks for your great question. To start with your last

question - yes, in today's world insects are indeed canaries in the coal mine, they signal a looming danger. Many people will just think of mosquitoes and house flies when they hear "insect" and be happy when they are gone (not you, of course), and perhaps think of bees in a positive sense, and that's it. But it's important that there are millions of insect species, many of which live in specialized relationships with plant species. Best example relating to your question of ecosystem health are butterflies which pollinate species-rich plant communities in river valleys and mountainous. The study I report about has shown a decline from 117 butterfly and Burnet moth species in 1840 to 71 species in 2013. http://onlinelibrary.wiley.com/doi/10.1111/cobi.12656/abstract?userIsAuthenticated=false&deniedAccessCustomisedMessage= Some plant species are dependent on one particular insect for pollination. So when insects decline, these plants will go to. This happens in landscapes with multiple stress factors, for instance when enrichment of nitrogen fertilizer impacts nature reserves. The more fertilizer there is in the environment, the smaller is plant biodiversity.

As for your first question, I'd say butterflies, but this may only be because they are the most visible group. There's a severe lack of long-term detailed monitoring.Wolfgang Wägele is developing a great project to adress this.

I've read that pesticides used in agriculture are a huge contributor to insect population decline (especially when it comes to bees!). What are the newest upcoming innovations that minimize the impact of pests in agriculture while avoiding decimating insect populations? Are there and mechanical barrier methods available?

mellyrod

Hallo, I am Wolfgang: I am not aware of innovations that reduce the impact of pesticides. Much better alternatives are for example pheromone traps that can be used to combat in a very specific way single insect species (see e.g. https://www.planetnatural.com/product-category/natural-pest-control/insect-traps-lures/). Their drawback is that a single trap has only effects in a small area around the trap. Cultivating mixtures of plant species is also a way to reduce the proliferation of pest insects. A mechanical barrier would be a greenhouse.....

Do you think there might be any ecologic disaster if house flies or mosquitoes will go extinct? I hate those fuckers!

Pokeputin

Hallo, I'm Wolfgang: The disappearance of houseflies and mosquitos can be a very bad sign. If they disappear “by accident” as collateral damage caused by destruction of natural habitats and by excessive use of pesticides, thousands of other species will also be affected. Therefore, the extinction of flies can be an indication of some catastrophic ecological change

Do you think there might be any ecologic disaster if house flies or mosquitoes will go extinct? I hate those fuckers!

Pokeputin

If they all go extinct globally - yes. Flies are an important force in breaking down shit and organic waste. Mosquitoes are important food for many species. If flies and mosquitoes are wipped out in urban areas *only*, the picture is mixed. With some mosquitoe species it would be beneficial - like the ones transmitting Yellow fever, malaria, Zika, but again expect birds and bats to feel the effect. And of course it depends on the method. Is it harming other insects, too? The main point of my Yale E360

story was to look beyond mosquitos, houseflies, even bees. There are 30.000 insect species in my small home country (Germany) alone, 99% of them most people will never notice. But they quietly keep the soil fertile, help forest regenerate, kill off pest species, pollinate flowers and so forth...

Whats your stances on the current trend of using insects like crickets and grasshoppers as an alternative form of livestock for consumption?

tekomuto

Wolfgang replying: Edibel insects can be an important source of proteins. For some Amazon tribes insects are a normal and very useful food. For the industrial food production insects would be reared in factories and not extracted from nature, and therefore this is harmless from ecological point of view. A good argument is that out there in the wild there are living thousands of insect species whose nutritional value has not been tested. It is therefore wise to protect these living resources for future generations who might want to use them.

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Eating insects is proposed as an alternative to eating meat. If one considers the environmental destruction practized to industrially produced meat – from cutting rainforest for soy feed plantations to emitting enourmous amounts of nitrogen into the environment, which directly reduces plant biodiversity – I think this is an alternative worth researching and experimenting with. I assume insects would not be collected in the wild, but grown in farms. Resource requirements should be lower compared to industrially produced meat.

How would you encourage current and future generation to preserve insects? I am 25 and I live in Uganda. I have planted plenty of plants which bees, other insects and birds enjoy.

Kobaltchardonnay

Wolfgang replying: How to motivate people: Unfortunately, many kids in industrialized countries are living as avatars in artificial worlds they find in the internet. They love computer games and do not experience nature. They may believe that a golf turf is nature. Therefore, we have to start with the education of a) school teachers and b) kids. Once young people have experienced the joy of walking in a beautiful landscape and to observe the difference between species of butterflies or flowers they may learn to appreciate nature. Planting plants for insects and birds can be a good example for your neighbors. Convince them to do the same on their ground. Tell them that their turf or their paved court is a desert!

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Kobaltchardonnay

Hi, thanks for your great question! It's Christian. Humans and insects live in complicated relationships. Sometimes they are our enemies, but more often, they are our friends. And we depend on the many things they do, starting with pollination. So how encourage people to appreciate this more? I think you

already did the best thing one can do as a private individual - curating a piece of land so it harbours insects is great. Direct experience of nature is the best encouragement to care. I'm worried that we grow a generation of kids in the West which is ultra-concerned about the environment but has only experienced it through digital devices. Practical, sensual experience is the best way to really become aware of what the environment gives us. Perhaps you can try to invite other young people to do the same or develop community gardens? Another really good way to increase appreciation is by studying biology or a related science. The world needs young conservation biologists, taxanomists, entomologists...if only governments directed research funds appropriately.

Thank you for doing this AMA. As in sure you're aware one methodology for combating Zika is the introduction of GMO mosquitos that will render the population sterile. Are mosquitos really non vital to our global climate? Would the complete irradiation of them be fine or not?

wesypoomagoo

Hi, I am Wolfgang: GMOs are a good alternative to pesticides because – if they really work - they will reduce only the population of the target species, all other ones will survive. That is what we want to achieve. Mosquitoes are not relevant for climate, but they are part of ecosystems. Many of them are harmless for us humans, but serve as food for other animals like birds...

Do you think the use of GMOs to stop the spread of Zika is justifiable yet? What about to assist in repairing ecosystems?

Katylest

Zika + GMO is hugely controversial, and as I haven't covered it intensely I prefer not to comment. But your second point is really important. A lot of new pathogens, including Zika but also Ebola, have arisen from the destruction of natural habitats, which brings humans in close contact with animals. This isn't new phenomenon but destroying wilderness always brings this risk. So in order to reduce the limit of new pathogens arising, it's absolutely important to protect remaining habitats and to restore ones that have been damaged. Habitat restoration is an important skill for the 21st century!

Do you think the use of GMOs to stop the spread of Zika is justifiable yet? What about to assist in repairing ecosystems?

Katylest

GMOs are a good alternative to pesticides because – if they really work - they will reduce only the population of the target species. Repairing ecosystems with GMOs? I cannot imagine how this could work. If you want to regenerate a forest you have to plant native tree species that ideally are genetically identical to those that always had existed in that place. [Wolfgang]

Hi guys! What can I do to help the insects?

Science_the_ish_out

Wolfgang's suggestions: thanks for your interest in this issue. You can do many things. If you have a garden, plant native flowers and shrubs, avoid the more expensive introduced ornamental things. Build a pond, however not in form of a plastic tub: the pond should have a sandy ground and many native moisture-loving plants growing on its shores. You can build along a fence a "Benjes hedge" consisting

of branches and twigs which usually are considered wastes. The hedge will become the home of many animals. You can also build a "bee hotel". Here are some examples (http://www.foxleas.com/make-a-bee-hotel.asp). Avoid the use of pesticides. Buy organic food. And talk to your neighbors about this subject...

Hi guys! What can I do to help the insects?

Science_the_ish_out

As you have "science" in your user name, what's your area of expertise? Scientists can contribute in many ways - like chemists developing less harmful pesticides, biologists helping to understand biodiversity, or economists designing ways in which farmers get paid for conserving nature, too. As a private citizen, urban gardening or urban farming can be fun. One can become a bee-keeper (takes expertise, but fun). Or lobby for insect hotels https://en.wikipedia.org/wiki/Insect_hotel be put in public parks...Also as a rule of thumb, eating less industrially produced meat is a big thing. Helps protect rainforest and reduce acrage needed for producing our food. Buyong more expensive produce from farmers that keep cows in open meadows can help, too, as meadows often are rich in flowers and insects. Most importantly, you can help insects by noticing them and perhaps showing somebody else the beauty of a hooverfly or a butterfly...Endless possibilities.

Do you think insects are capable of feeling pain or suffering?

If so, could one argue that due to their reproductive strategies, many insects have lives that are net-negative or not worth living? How do the interests of individual insects conflict with human and ecosystem well-being?

freegan4lyfe

Hi, it's Christian - these are difficult questions. Certainly insects will react to being hurt. We don't know what's going on inside and what would be "pain" in their perception. I'm not happy with the Cartesian interpretation that animals are machines, though.

Yes, there are many conflicts between certain insects, in particular mosquitoes, and humans, as mosquitoes carry deadly diseases. But overall, humans benefit greatly from a wide range of "services" performed by insects. Without insects, many ecosystems would more or less collapse. If we keep reducing insect populations that are not directly harmful to us, we will learn about their importance the hard way.

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freegan4lyfe

Wolfgang's opinion: To be able to "feel" pain, you need a brain capable of conscious self-perception. If you look into a mirror you should be able to recognize "that's me", and you should be able to consciously watch "your" hand and feet moving. Most animals do not have this ability. They will react to pain, and they have reflexes to avoid pain and further damage of their body. However, they lack the consciousness we know, which also exists to different degrees in dogs, monkeys, dolphins, I guess also parrots and other more evolved animals, but certainly not in insects. Which creature is worth

living? That is an ethical question, everybody has to answer for him- or herself. A general rule for me is that if you have compassion with other creatures you will also behave in a humane way in our society. However, it is part of nature that we kill (e.g. cattle to eat meat, other creatures causing diseases) to survive.

Can the insects not adapt, or is this all just happening too fast for them?

HeavenlySun

Hi, it's Christian. Very good point! Nature is all about constant change and adaptation. And I'm sure many species will adapt or even expand their range with climate change (these might not be the species we'd WANT to expand, though). Generally speaking, insects have done quite well over time and have been around much longer than us humans. But we're now calling it the "Anthropocene" because man-made substances and impacts are everywhere. What I wrote about concerns those 100.000s insect species nobody except a few experts will know by name, species which live in specialized relationships in their local environments and in partnerships with plants, as part of the local food-chain. For them, environmental changes might indeed happen to fast. Like as a person, one can take one hard blow in any given year and adapt, two are difficult, three might just break a person's health. Now I don't want to say this is the same (adaptation works differently in Nature, of course) but when half of your habitat is lost to a highway, while pesticides rain down on you and then somebody comes and takes away half of your food - that's when things might just happen too fast. The technical term is "habitat loss"..

Can the insects not adapt, or is this all just happening too fast for them?

HeavenlySun

Hi, I am Wolfgang. Good question. Adaptation is an evolutionary process that takes a lot of time, because evolution requires a series of many consecutive generations that slowly change from generation to generation. If you are killed by a pesticide you will have no chance to evolve. Many flowering plants disappear in Central Europe because beautiful meadows are soaked extensively with manure. This means that the food plants for caterpillars, adult butterflies, cicadas, bees, beetles etc. disappear. These insects are not able to adapt to a completely different food source, they cannot feed on plain grass.

Is there a way that the decline can be halted or reversed?

spectrosoldier

Yes, absolutely! Agriculture companies need to develop pesticides that either only target pest species or pioneer even smarter, bio-inspired solutions for pest control. Much more research is needed here, a bridge between high-tech science and ecological/organic approaches. Secondly it's really important to enrich agricultural landscapes with hedges and other habitats again. Today, they've often become biological deserts. But this is reversible still and can actually have positive effects for productions and soil health. Preserving existing habitat and protect them from urban sprawl etc. is equally important. Also, we can build cities that serve as habitats for the many totally harmless insect species that make nature richer. A garden is a good place to start.

Hello and thank you for doing this AMA!

What insects have been the least, and most, affected?

BananaBunnies

Samples from Germany proving the loss of insects primarily show that total numbers decreased. The analysis of the samples at species level is still going on. However, it seems that insects that need flowers in general or specific flowering plant species are especially affected. It is not surprising that populations of butterflies, bees and hoverflies are breaking down. This has also consequences for other insect-feeding animals like birds, bats, reptiles, hedgehogs and shrews. [Wolfgang]

Hello and thank you for doing this AMA!

What insects have been the least, and most, affected?

BananaBunnies

The entomologists from Germany which have raised alarm have reported dramatic losses across the taxonomic spectrum. (see http://e360.yale.edu/feature/insect_numbers_declining_why_it_matters/3012/) In many areas of the world, decline of butterflies is the most visible phenomenon. What I find disconcerting is that there are too few specialists to really assess what's going on, experts able to get to the bottom of it. Prof. Wägele is developing an automated method to monitor insect populations in whole countries, an approach I find very valuable.

This is interesting. I must say I have not given insect extinction a thought. For appreciation, could you cite a specific example wherein an extinction of an insect can affect a whole chain of organisms (even humans)?

westorch

Wolfgang replying: Effects of insect extinctions and their role in ecosystems: the consequences are little known, because the mode of life of most species has not been studied yet. It is only logical that there are many interactions between species in an ecosystem, and the networks of mutual dependencies probably are complex in many cases. A well known example for a chain of events is the disappearance of bees: Bees are important pollinators, not only for crop plants but for many wild plants as well. Without bees, plants will not bear fruits and seeds and will stop to reproduce. In agriculture, people may be forced to replace the bees, pollinating flowers manually (see https://www.chinadialogue.net/article/show/single/en/5193-Decline-of-bees-forces-China-s-apple-farmers-to-pollinate-by-hand). To understand why it is dangerous to take out elements of complex systems think of the following example: I want to sell you a used but otherwise modern and powerful desktop computer. You offer me –let's say – 200 $. Before I hand you over the machine, I open it and take out with pliers some diode of unknown function. Afterwards I demonstrate that all installed software is still running. Would you still want to pay the 200 $? In analogy: can we be sure that an ecosystem is fully functional if we remove one or a few species? There is another, different level of argumentation: Why do tourists spend money to go hiking in beautiful landscapes? They could as well walk among corn fields. Diversity of flowers, insects, birds obviously has a value for the quality of our life...

This is interesting. I must say I have not given insect extinction a thought. For appreciation, could you cite a specific example wherein an extinction of an insect can affect a whole chain of organisms (even humans)?

westorch

Great this has made you curious! It's Christian here. Ok, the easy answer certainly is our beloved bee. Should it get extinct, effects would be major, as pollination and honey production heavily depends on them allover the world. But there are many more insect species that play an important role in ecological processes, for example specialized insects such as long-legged flies, dance flies, dagger flies, and balloon flies, which prey upon pest species. I don't think there are too many examples where you'd wipe out one species and we would feel it immediately. What is more disconcerting is the overall loss of insect biomass which I describe in the intro of my article This limits food supply for birds and bats directly - less birds, less bats! In the US, the number of birds has decreased considerably already - many factors are behind this, but food supply certainly matters, as we all now from when we are hungry. https://e360.yale.edu/digest/survey_bird_loss_north_america_partners_in_flight/4805/

How much do you think is humanity undeestimating its effect on the ecosystem? And how much / how little we actually know about insects part in the ecosystem?

I heard recently we have for ex. very little knowledge about microbes and things in soil and that process. Shouldnt we shift our way of doing things to adapt to the ecosystem instead trying to abuse it to our advantage?

Bloody_Ozran

Very thoughtful questions, thanks. Yes, we generally underestimate the many small, hidden and invisible services provided by ecosystems both near and far. This is reflected in the tiny number of specialists that gets trained to know and study soil organisms or the insects world. If importance was reflected in science spending, departments for soil and biodiversity would be much larger instead of gettinge their budgets slashed like world-famous Kew Botanic Gardens in London. As to your last point: absolutely. I've writte a whole book about this (The Anthropocene, 2014). It's our major task unless we want stress and disasters from an impoverished environment to become the new norm.

Is there a direct correlation between human population increase and insect population decrease? If so can you use this data to predict a time when a certain species may go extinct? How long we got Docs?

duckbilledtiger

Hi, I'm Wolfgang: Current insect extinction observed in Central Europe is not the consequence of human population growth, but of new and more intensive agricultural practices. One unforeseen chain of events is the following: The European Union abolished the quotas for milk production which formerly regulated how much milk a farmer can sell on the market. The consequences: Farmes started to keep more cows and to produce more milk – milk prices dropped on the market – to keep their income farmers produced more milk (which did not help to increase their profits). They started to remove flower stripes, hedges and shrubs and to use more fertilizers to grow more grass, and the habitats of many animals disappeared. Many of those farmers who had to sell their cows are now growing corn for biogas production. The wastes of the biogas factories is a new type of manure, which is helping to poison meadows, creeks, and the groundwater. In other countries, forests are burning because of population growth. However, investors who want to grow e.g. oil palms (or coca plants in Latin America) are also important and very destructive drivers.

Is there a direct correlation between human population increase and insect population decrease? If so can you use this data to predict a time when a certain species may go extinct? How long we got Docs?

duckbilledtiger

Hi, it's Christian here - no, such a calculation is not possible. Humans have created many habitats for insects by spreading over the globe. Like in Europe, when a diverse agricultural landscape replaces forests, insect diversity strongly increase. But this relates to past centuries. In today's monotonous agricultural landscapes, living conditions for insects are very limited. With more sustainable agricultural practices, less consumption of industrially produced meat, integration of habitats into farmland etc. the picture could change in a positive way. Best example is milk. If you put all cows into factory farms and feed them corn or soy, major habitat losses happen. If you produce milk from cows on a meadow, it not only enriches carbon in the soil but also helps the diversity of plants and animals, including insects. But doing that makes milk more expensive. If consumers are prepared to pay twice as much for milk sustainable production methods are possible. In terms of the calculations, there are not enough data and too many variables - impossible, even for a rough modelling exercise - unless you have a species that's already very very low in numbers and where monitoring is easy and you know what will happen in its habitat. To do this is hard even for large animals.

I developed a global index for invertebrate abundance that showed a 45 percent decline over the last four decades.

Dr. Dirzo: Since this devastation has taken place over the last four decades, approximately how much of the decline can be attributed to habitat destruction and how much from the rise in global temperature?

youcallthatform

Dr. Dirzo was not able to participate so please send this question directly to him at Stanford.

I tore down an old rotting shed in my backyard last spring. There were tons of insect larvae living in the rotting wood. I'm now worried that I may have decimated the local solitary bee population. Any tips on encouraging their return? (short of creating a new structure out of rotting wood) I should mention that I live in an urban environment in Nova Scotia. This summer there were lots of bumblebees on my garden, but not a lot of the smaller pollinators I've seen in the past.

Salt_or_restart

Wolfgang replying: Rottin wood is often colonized by beetle larvae, there are fly larvae living in wood, some wasps ley their eggs into other insects that occur within wood, etc., there are woodlice and millipeds, and rotting wood is important for the survival of many species of fungi. This fauna is used by several birds as food source. Therefore: keep in your garden some stabs and piles with branches, they can also be the home for small mammals and reptiles.

Missing pollinators: If there are too few plants that can serve as food source and habitat for the caterpillars and larvae, the pollinators will disappear.

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Salt_or_restart

I really appreciate that you are so sensitive about this issue! It's Christian here. Yes, our built environment is an important habitat. No, you don't have to rebuild your rotten shed. Have you heard of "Insect hotels"? You can buy them or design/ build them yourself.
https://en.wikipedia.org/wiki/Insect_hotel

I recently heard an entomologist opining that there are so many types of mosquitoes that killing off the one that carries zika would not adversely affect anything.

Are there any other insects that it would be really really ok to lose.

PerilousAll

Hi, I'm Wolfgang: There are certainly creatures that nobody would miss if they become extinct. Concerning flies and mosquitoes we have to keep in mind that other animals like swallows and swifts need them for food. However, if only a single species disappears, there are enough others that can be used as food by birds

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Are there any other insects that it would be really really ok to lose.

PerilousAll

Hi, it's Christian. This is a question Dr. Dirzo could answer best. It's important to control populations of harmful mosquitoes in effective ways - but targeted extinction? Not so sure. Nobody would have predicted 100 years ago that the antibiotic age came through ugly species of mold fungi. You never know.

the rise of global insect decline

That's a very interesting way to put it.

What do you think of the recent purchase of Monsanto by Bayer?

EuroTrash69

Wolfgang's opinion: These are companies who are responsible for the killing of insects and plants at a very large scale. "Insectizide" or "plant protection product" means "poison killing insects". For all those in Germany who engage in the protection of habitats and species, the image of Bayer has deteriorated further with the purchase of Monsanto.

the rise of global insect decline

That's a very interesting way to put it.

What do you think of the recent purchase of Monsanto by Bayer?

EuroTrash69

This is a very controversial topic. Having fewer and fewer companies control the world's agricultural business certainly creates a risk of monotony not only on fields but also in terms of strategies and

research projects. I'm not sure whether giants like the one that's now being created will be innovative and flexible enough to produce solutions that not just maximize short-term profits but serve a truly sustainable development. The world desperately needs a start-up scene in agriculture which tries to develeop solutions tailored to the needs for example of smallholders in Asia or Africa instead of just forcing methods from the industrialized West on them. And in the West, it will be important to build a bridge between high-tech approach and the wisdom that's passed on in organic agriculture. Germans consider themselves to be very "green" - perhaps in the long run, this can impact the direction this new giant will take a little bit.

Hi, thanks for this interesting AMA. I heard that the mosquito population could be increasing, possibly due to climate change. If true, how does that fit into your work?

Also, what can you tell about modern insect ecosystems from the fossil record, such as during the carboniferous period? I find extinct animals fascinating and always am interested in how our findings can be applied to modern times.

SaluteYourSymptom

Hi, I am Wolfgang, and thanks for your interest in this topic. About Climate change and mosquitoes: Mosquitoes occur nearly everywhere and are especially numerous not only in wet tropical landscapes but also in cold landscapes (Norway, Siberia...). There will be a shift in geographic distribution of species due to global warming, however, since some regions will get dryer and others wetter, the effects could possibly compensate each other. To get a more precise prediction, it is possible to combine models of climate change with ecological models for habitat requirements of mosquito species. We have not done this. Fossil record: I am not a specialist for fossil insects. However, an important insight is that there have been in the past catastrophic extinction events, and that the subsequent regeneration of species diversity takes millions of years (see e.g. http://www.nature.com/nature/journal/v404/n6774/full/404177a0.html). Neither your children nor a hundred generations later will be able to witness the recovery of ecosystems after a mass extinction.

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SaluteYourSymptom

Hi it's Christian. I can only respond to your first question. Picture is very mixed here. It's important that ecologically speaking insects are an incredibly diverse groups, with hugely different habitat requirements and reproduction strategies. Also, animals that feed on insects are highly diverse. Many are specialized, some will eat anything that comes along. Yes, it is highly likely that climate change will increase the ranges and population sizes of some insect species, probably those we want the least. But for example insects that co-exist with plants in alpine meadows are under threat to disappear, as a warming world pushes them to higher and higher altitudes. Drought also will reduce available habitats, as wetlands are crucially for the reproduction of many insects and are prone to drying out. Generally, the more specialized a species is, the harder it will find it to survive on a world with climate change, and, importantly, many many other man-made impacts, including pesticide run-off etc.

Is there a terrestrial ecosystem where insects don't play a major role?

Your names are hilarious.

the_tolerator

The Antarctic is a whole continent with nearly no insects. It is covered with ice and there are - with very few exceptions - no plants.... [Wolfgang]

Is there a terrestrial ecosystem where insects don't play a major role?

Your names are hilarious.

the_tolerator

Hi - it's Christian. "The" is an interesting first name, too! In terms of terrestrial ecosystems with no major role for insects, high alpine areas and arctic areas come to mind. But if you go a bit south from the Arctic, Tundra areas for example in Scandinavia will sustain masses and masses of mosquitoes, which provide nice food for birds and fish (eating larvae) in the summer.