

# The Great Simplification

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For the last 30 years, he's led the world's largest experiment, testing the role of landscape corridors in increasing dispersal of plant and animal species. He's written books about butterflies and his comments with me today on the insect apocalypse. Why butterflies are the canaries in the coal mine of the greater insect population, which we are losing insect biomass at one to 2% a year. This is another aspect of the metacrisis that is not often talked about, is the role of insects in our current world and in the future, and what is happening to them. Please welcome Professor Nick Haddad. Professor Haddad, welcome to the program.

Nick Haddad (00:02:00):

Oh, it's great to be here. Thanks for having me.

Nate Hagens (00:02:03):

You're one state over from me.

Nick Haddad (00:02:05):

Awesome. Separated by the big lake. We're surrounded by 20% of the world's fresh water.

Nate Hagens (00:02:12):

Is that right?

Nick Haddad (00:02:13):

Yeah. The lakes, the Great Lakes, 20%.

Nate Hagens (00:02:14):

Wow. I think I might've heard that somewhere. That's quite something, isn't it, on a water planet?

Nick Haddad (00:02:23):

It is. It makes us a climate refuge because we have water, we don't have natural disasters, and it only gets nicer as it gets warmer here.

Nate Hagens (00:02:34):

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I have a lot of questions for you. We're going to talk about insects, but since you bring up the Great Lakes, how much of the research on insects is terrestrial versus aquatic? Because I imagine the insect populations are huge in water.

Nick Haddad (00:02:52):

I will say that I don't do any work on insects in the water, but I'm around the water all the time. In fact, some of the most important butterflies I study are located in wetlands, like bog-like habitats. I'm wading in water often, and then others are out on islands in the ocean, so I'm surrounded by water, but not in water. There's a lot of great studies on insects in water, especially in rivers and streams where insects are used as indicators of environmental change, but much more work is done on insects on the land.

Nate Hagens (00:03:37):

Let me take a step back from you being a professor at Michigan State to you as an eight or 10 year old kid. You are a terrestrial ecologist with particular scientific specialty on butterflies. When you were young, were you one of those kids that went around with butterfly nets and was obsessed with natural systems? I kind of was.

Nick Haddad (00:04:03):

Well, I was obsessed with natural systems, but never with butterflies.

Nate Hagens (00:04:07):

Okay.

Nick Haddad (00:04:08):

I was obsessed with one invertebrate, which was blue crabs. And so my love for nature started when I was growing up, spending summers on my grandparents' farm. They had a farm. They didn't farm it, but they owned a farm on the Chesapeake Bay in Maryland, and right offshore, we could get out there and catch blue crabs. Well, the interesting connections then to the butterflies... Well, there are two. One is that blue crabs are invertebrates, and then the other is that it takes a big net on a stick to catch them. I can't really claim that there's a direct line, but there's an uncanny coincidence. But I spent a lot of time on that farm in nature, running around in the water on land, and doing a lot of fishing and hunting, actually. It wasn't thinking

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about butterflies, certainly not thinking about rare species, except that things like Canada geese were declining when I was young.

Nate Hagens (00:05:08):

It's a common thing with people in my circles that somehow we were blessed or privileged or lucky enough to be imprinted on nature or nature imprinted on us when we were kids. And maybe that's why 50 years on we're working on these issues because some people-

Nick Haddad (00:05:27):

That's for sure the case. For sure the case.

Nate Hagens (00:05:29):

Do you think?

Nick Haddad (00:05:30):

Yeah. For me it is. I remember being... I floated around between majors as an undergraduate, from engineering to economics to biology thinking, molecular biology. And then one day I was walking at Yosemite National Park and it dawned on me, I could study this stuff that's around me and make a profession of it and the stuff that I love, so that's what I do. The great thing about my research is every day I'm doing things that I love in environments that I love to be in. And so hey, it's the greatest job in the world. The other thing that, by the way, surprised me about now looking back, not being a butterfly enthusiast, that many of the biologists I know whether they're in ecology or other areas of biology, grew up as butterfly collectors. And I'm a collector of many things. As that eight or 10 year old you asked about, I was collecting baseball cards, coins, stamps, but never butterflies, ironically. Anyway, there's some surprise looking back that I wasn't a butterfly person.

Nate Hagens (00:06:42):

Give us an overview of your work, including a prominent book you published in 2019 called *The Last Butterflies: A Scientist's Quest to Save a Rare and Vanishing Creature*. What's that about? What's your work about? What have you been doing since 2019 and that book?

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Nick Haddad (00:07:02):

My work when I started in ecology was on conservation of nature, conservation of biodiversity, conservation of ecosystems. And again, when I was an undergraduate, I never thought I would be working with a life on butterflies, but I ended up being steered on that path. I could tell you that story, but going to your question about what my work is, I am an experimental ecologist, so that factors heavily into my work on rare butterflies and other things. And so I am interested in understanding long-term dynamics of ecological assistance, including butterfly populations. I conduct studies that last for decades, and that includes on rare butterflies. And I went through a series of steps in my PhD and other work that took me to butterflies as a study system. It turns out that like we think of lab rats or fruit flies as model organisms, butterflies are model organisms, but for studies of global change, whether it's in climate or land use.

(00:08:22):

And so that's what got me into butterflies. Once I knew something about butterflies, I was called pretty quickly to answer questions about how to conserve rare butterflies in the places I was. And so that got me started when I arrived as a professor in North Carolina State University in the early 2000s. I was called by a group that was interested in conservation of one endangered butterfly called the Saint Francis' satyr. And the group that called me was the US Army, and they called me because this butterfly is endangered, and it was found only on one army base in North Carolina, Fort Bragg. And to further complicate matters, most of the butterflies were found in one area of the army base, the artillery range. And so it's got this complicated feature that the bomb ranges are actually protecting the butterfly. That got my foothold into-

Nate Hagens (00:09:29):

Why is that, because no humans go there?

Nick Haddad (00:09:32):

Yeah. Well, that's one reason, but that is an important reason, but not the most important reason. It turns out that the bombs are beneficial to butterflies, and it's totally counterintuitive. When I walked out into the bomb range... And I'm the only civilian that has access to the artillery ranges to go do work on these butterflies and help to keep the army in compliance. When I walked out there the first time, I thought I'd be walking onto a moonscape. That's what bombs would create. But I am actually

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not walking into the places where the bombs land, so then I think of it more like a donut with a hole, and the hole is the places the bombs land. I'm walking into the donut part. And what's interesting about the donut part is that people are kept out, as you said, but it's also a place that is disturbed by the bombs, but not directly by the bombs hitting those areas, but by the bombs creating fires that burn out through the landscape.

(00:10:39):

And the habitats that I work in are maintained by frequent fires. And so naturally there would've been fires in that landscape every one to three years. But there aren't now, people stop fires. They stop fires because of course, we don't want them burning through our cities or our fields. But in doing so, they change the nature of the habitat. Well, bombs just amazingly do a great job of replicating what nature would have done naturally.

Nate Hagens (00:11:14):

Are we going to have an explosion of butterfly populations after this year's Canadian wildfires?

Nick Haddad (00:11:21):

That's a good question. I get this question about fires and wildfires and the natural fires that occurred on the landscape were quite different. I like to make the point that it's natural disturbances, whereas the wildfires like those in Canada, they're catastrophic fires that are started not because of the natural dynamics of the ecosystem, but for many reasons of human influence on the landscape. And so no, the catastrophic fires in Canada now or in California two years ago, that's not the catastrophic... That doesn't have the beneficial effects that I'm talking about. Where I work, and in many of these landscapes, including in the Boreal regions or in California, there naturally would've been fires, but on a regular basis where that cadence would help to maintain the ecosystem properties and ecosystem dynamics. But we're far from that in most places. Well, I'm saying this, which is, I'm kind of laughing at myself as I'm saying this because now I'm talking about bombs creating the fires, and they're far from a natural disturbance.

(00:12:32):

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But those bombs happen with regularity that simulates the natural dynamics of the system. I don't know. Go figure. It's one of these unexpected events, and I stumble upon it frequently in my conservation of insects, butterflies, that there's something that we think, this must be the most terrible thing for conservation. And yet it turns out to be an important feature of the landscape that humans have introduced that keep, like this butterfly from extinction. I get the army worries sometimes that, "Oh, because this endangered species are here, I might recommend to curtail their activities in these ranges." No, it's the opposite. If they stopped, the butterfly could be extinct.

Nate Hagens (00:13:19):

I have lots of questions. Has anyone studied the butterfly populations in Chernobyl?

Nick Haddad (00:13:26):

That's a good question. I can't answer about butterflies, but my colleagues in South Carolina at the Savannah River ecology that I do work, active work in Chernobyl, and it turns out that military lands across the world can be safe havens for many threatened species and ecosystems. And why is that? It's because, it gets back to your first point, it keeps people out. And also where I work in North Carolina, they're trying to maintain habitats that simulate natural environments that soldiers might be fighting in. And so all of a sudden you've got these areas that, well, they can be a wealth of diversity, and they're huge areas across the United States, tens of millions of acres across the world in the hundreds of millions of acres. And so they can be refuges.

Nate Hagens (00:14:21):

Do we know roughly how many species order of magnitude of butterflies there are in the world?

Nick Haddad (00:14:30):

About 20,000. That's comparable. It's more than the number of some vertebrate groups like birds or mammals that we'd worry about. It's less than many other insect groups. As an example, there are about 10 to 20 times more moth species than butterfly species. If I say 20,000 butterflies, then there's 200 to 400,000 moth species.

Nate Hagens (00:14:57):

What is the scientific differentiation between a moth and a butterfly?

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Nick Haddad (00:15:03):

Great question. I get that all the time. What do you think of when you think of moth, butterfly? If you-

Nate Hagens (00:15:12):

I think butterflies are more colorful and more daytime.

Nick Haddad (00:15:15):

Daytime, that's like the very first obvious differentiators. And in many cases, probably most cases, you'd get that right by using that. But it's not always the case. There are colorful moths, I'm thinking about luna moth is one that people might know. There are others that are even more colorful. And then there are moths that fly during the day. And butterflies, butterflies don't fly at night, but they can fly at dusk. There are brown butterflies that fly towards dusk. Anyway, the key differentiator is the antenna. The antenna of butterflies are straight, they're like strings. The antenna of mods are feathered, so they're much more complicated.

Nate Hagens (00:16:05):

There's 20,000 species give or take of butterflies. How many of those are endangered or critically endangered? Do we know?

Nick Haddad (00:16:17):

We only know of a small number that are critically endangered. And the answer in the US, the critically endangered number is less than 30. And that's 30 out of around a thousand butterflies that occur in the US. In the world, there are a good number that are recognized that are endangered, critically endangered, threatened into the hundreds. But I have to say, we don't know as much as we need to know to have that good statement. We just don't know enough about the insects. We know more about butterflies than any other insect, but we still don't know enough about the insect.

Nate Hagens (00:17:00):

Why is that? Why do we know more about butterflies than any other insect?

Nick Haddad (00:17:04):

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Butterflies, first they're easy for people to know and understand. And so they're colorful, they're fun to look at. They're big. They fly in places where people are. And so going back to what we talked about earlier, butterflies were the way people knew the natural world, going back to the time of Darwin and after. Butterfly collections were a huge way to understand natural history. But then beyond that, people, scientists or non-scientists can contribute to understanding about butterflies. In the detailed science, I told you that butterflies are the model organism for understanding how landscape change and global change affect populations. But more broadly, people are getting involved in understanding the numbers of butterflies out in the world. And so I can tell you about studies by citizen scientists and scientists that happen across whole states, across whole countries, where people are going out to survey butterflies every week of the year when butterflies are flying. And so they can generate enormous amounts of data about butterflies and their plight.

Nate Hagens (00:18:22):

We probably don't have the same evolutionary response that we do to spiders per se, because butterflies are slower, and we know that they don't really bite us. Can butterflies, bite some species or not?

Nick Haddad (00:18:37):

Nope. No butterflies bite.

Nate Hagens (00:18:39):

And plus, spiders are really fast and you don't know where they're going to go. And butterflies, you can just watch.

Nick Haddad (00:18:47):

Butterflies can be fast. They can be fast. I know from having tried to catch them, but I understand your point.

Nate Hagens (00:18:54):

There's an unexpected nature of spiders, so you don't know where they're going to go or where they are, and there's a vigilance to humans. I don't want to get too far off of the topic that I want to address with you today, it's a global insect population. But I'm just wondering what was our evolutionary history with insects generally? Do we have a

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sense? Because clearly those evolutionary psychologists that look at the modular mind think that we have snake detector modules still in existence now because our brains were built up and forward. And it's still you and I somewhere are subconsciously looking for snakes. In fact, there's a funny video on YouTube cats and cucumbers. If you hide a cucumber, the cat will freak out. But I wonder what our ancestors might have thought about at that point. Must've been a cornucopia of different insects in our ancestral environment. Did they not like them and step on them and stuff because there wasn't any worry about decimating the global insect population back then? Is there any anthropological stories or evidence on that?

Nick Haddad (00:20:19):

Two things. One is that you brought up snakes. There are butterfly caterpillars that mimic snakes. The caterpillar, I call it the cutest caterpillar in the world. It's of a butterfly called the spicebush swallowtail. It's long and green, has big black eye spots. And then when you touch it, it puts out what looks like a forked tongue. It's not a forked tongue, it's chemical receptors. But nonetheless, they're trying to take advantage of people's fear of snakes. The response to insects, I think it's more specific than you're saying. At first, I think people know almost no insects. Think about this. Well, I would ask you how many insect species could you name? But how many butterfly species could you name?

Nate Hagens (00:21:10):

I was a naturalist growing up. I could probably name 30 or 40, maybe.

Nick Haddad (00:21:20):

You did good. You're in the rarefied group that can name more than one. Most people can name one butterfly the Monarch, and if they know a couple more, they would know Cabbage Whites because they're a pest on their cabbage-

Nate Hagens (00:21:30):

Cabbage Whites, Red Admirals.

Nick Haddad (00:21:31):

Or they would know

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Nate Hagens (00:21:31):

Swallowtail.

Nick Haddad (00:21:35):

Tiger Swallowtails. They would know maybe Painted Ladies because they raise them and release them into the wild. But it's a very, very small number. Well, if people can't name butterflies, how many of the other 5.5 million insects in the world could people name? Definitely there is none.

Nate Hagens (00:21:48):

Okay, so there's 20,000 butterflies and there's 5.5 million other insects?

Nick Haddad (00:21:54):

Insects. Yes. It's a huge group. There's 20,000 butterflies, 40,000 moths, and then many more flies, wasps, beetles, which are the most diverse group. People can't name or don't know the butterflies, and I'll give you another example in a sec, but getting back to people's fear or dislike. I think we can all agree that people will fear things that are venomous, so then that gets to the spider issue. Some spiders bite or are venomous, many are not. I had a student who studied the Argiope spider, it's also called the zipper spider. It's got the-

Nate Hagens (00:22:35):

The black and yellow ones we have them.

Nick Haddad (00:22:37):

They're huge.

Nate Hagens (00:22:38):

This time of year too, in the fields.

Nick Haddad (00:22:40):

This time of year. And they look terrifying. But then she would just grab one off the web and show people how you can handle them. They're never going to bite you.

Nate Hagens (00:22:50):

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They don't bite?

Nick Haddad (00:22:50):

No, but still we're scared of them. They're in our face and we're going to avoid them. But so many of the insects that we know are pests, so then that's another reason to dislike them. If they're cockroaches or they're mosquitoes or the other things that we can name, things that spread disease or consume our food or degrade our other things around where we're living. I don't think there's an innate fear of all insects, but it starts with the things that we dislike. And then that can amplify to a bigger group from a few spider species to all spiders or a few bee species to all bees. That's the sad one because if you or I went out to survey bees, we all care about pollinators. If we survey bees, you or me, here I am, a person who studies insects, I could identify just a few species of the dozens that would be out in the prairie outside of my backyard without catching them, pinning them, identifying them under a microscope or not.

(00:24:00):

That's the bad side. I think there is a positive. I think there there's a change that's happening with insects and the change is happening because of pollinators first. People care about pollinators, so they might not know all the pollinators that are out there. What pollinators can we name? We can name honeybees, bumblebees. Maybe the butterflies aren't so effective as pollinators, but a few butterflies. But still, we know that pollinators have beneficial effect and people are doing active conservation, just even individuals in their yards or in their farm fields to benefit pollinator populations. I think there is a change happening as we recognize the beneficial effect and the potential of the loss, how that loss could impact human civilization.

Nate Hagens (00:24:52):

I want to get to that, but I want to bring up a personal example without naming names. Someone in my family when they were young was petrified, even if a moth was in the bathroom. To the point of being unable to physically move until I removed it or killed it, I always removed it. Can you speculate on the current cultural human disconnect with insects specifically? And maybe it's a US thing, because I was at a conference where there was a wolf spider, and I was like, "Why? Can someone shush this away?" And this German-

Nick Haddad (00:25:31):

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Those are scary looking.

Nate Hagens (00:25:32):

They're scary looking, but this German guy, Stefan, just came over and put it in his hand and cupped it and removed it, so maybe it's a US phobia. But do you think that humans have always considered invertebrates pests? And it's just now, like you were saying-

Nick Haddad (00:25:49):

Always?

Nate Hagens (00:25:49):

You think?

Nick Haddad (00:25:51):

No, no, I was asking was that rhetorically. Always? I think some insects for sure, as long as there's been stored food around people, then insect... And also disease spread by insects, then they have to be have been considered pests. But then you get to questions like moths. I have students or have had students who are terrified of butterflies. Now-

Nate Hagens (00:26:17):

What's up with that?

Nick Haddad (00:26:19):

I often will say, who does not love butterflies? How can you not love these beautiful things that are flying around our gardens? And then I had more than one student say, "I am terrified of butterflies." And I ask why, and I don't get a good reason. Maybe it does trace to just an innate fear of insects. I don't know. Butterflies is a hard one for me to understand.

Nate Hagens (00:26:46):

Getting to the core of why I invited you on the program, other than that we have mutual friends. How do butterflies act as, and butterfly populations and the research that you are doing and your colleagues, how do they act as a canary in the coal mine

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for general global insect loss? And I know you're a butterfly expert and not a general insect expert, but I have read that we are losing global insect biomass at something like one to 2% a year, which is a horrifying statistic. And I know of course we... That's another thing I wanted to ask you. It's not like we have 2.3 million entomologists scouring the planet, counting species. This is probably underfunded and underknown, so we have to have an order of magnitude guess. But it seems like insects are not doing well.

Nick Haddad (00:27:47):

No, they're doing... It's horrific, the rate of loss. I'll tell you more about butterflies and say we know most about them. We know less about all the other insects, which are the great diversity of insects. But all the numbers align that what we see with butterflies represents what is happening with other insects. I should start by telling you the insects they are the canary in the coal mine, because well, first they're the canary that we can observe. And why is that? It's because people, thousands, tens of thousands of people can go out and collect data on butterflies that is used by scientists to understand decline. Now, what do I mean when I say that? We don't have all these scientists walking out there with their rulers in their pockets and whatever other instruments you might want to have to collect data. They're out there with their binoculars and a pad to record the number of butterflies and they're walking standard pass that anybody could do.

(00:28:52):

I could set you up to do this in a couple of hours. Yes, it would take you a little time. Well, you know about butterflies, but it would take an individual some time to learn the butterflies, but not much time. And then they could be going for the year, for years. And that's what people do. They're fanatical about butterflies once they start. And so I'll give you an example of where I started was in the state of Ohio where I started with data. Other people had collected the data. And there are places across the state where people have set up paths that they walk every week of the year. They've done it every year for 20 or more years across the whole state, so we have data from people. These are citizen scientists. They're not all scientists. When you say it's underfunded, well, it's underfunded except that people love doing it, so it costs a lot less money. And what we found... Then we can bring together all those data and ask, what is the status of butterflies in the state of Ohio? And we did this-

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Nate Hagens (00:29:57):

That's been going on for how long?

Nick Haddad (00:29:59):

It's been going on for about 25 years now.

Nate Hagens (00:30:01):

Okay.

Nick Haddad (00:30:02):

What we found is that butterflies in Ohio are declining by just as you said, 2% per year, 2% per year, over 10% per decade. The 25 years since these surveys have started, they've declined by over 30%. Now, what does this mean? 2% per year might not seem like a lot. You go in your backyard and you see a hundred butterflies. Well, you'd never see a hundred butterflies, but if you did one year and then one year later you might see 98. Well, that's kind of in the noise, but 10 years later you'd see less than 90 and 25 years later you'd see less than 70. And it's a huge change over a fraction of our lifetimes. And so we did this in... The interesting thing about Ohio is what I'm telling you is the numbers, if you summed up all the butterflies, so not by... Whatever the species is, you just add them to the total number. But what we found is that-

Nate Hagens (00:31:01):

But I bet some of them were down 90%.

Nick Haddad (00:31:06):

But the interesting thing is that when we looked at individual species, well, some are increasing, but most are declining. But the declining species are things like, well Monarchs, we know Monarchs are declining, but also butterflies like the Cabbage White. The Cabbage White's an introduced pest species that if any species is doing well, it should be thriving on people's broccoli and cabbage, but it's also declining. Then we did the work in Ohio. Others since have done work in US states like Illinois and in countries in the world like the United Kingdom, the Netherlands, Spain, Catalonia. And guess what? Every long-term, decades long study has found 2% decline per year or tens of percents per decade. And so it's not something somebody could make up. It's not me going out and designing a study and collecting all the data

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and doing it in some way that's biased. It's hundreds, thousands of people that are collecting the data that are scientists, non-scientists and reporting back and finding this 2% per year decline. It's nuts. It's going on so regularly and for so long, and we don't see the end. It's brutal.

Nate Hagens (00:32:31):

One can presume that if butterflies are declining at 2% per year, that whatever is doing it is also affecting many of the other insect species, the five million species that you mentioned?

Nick Haddad (00:32:47):

Yeah.

Nate Hagens (00:32:49):

Or is that possibly a false assumption?

Nick Haddad (00:32:52):

That's an easy question to ask. Are butterflies, canaries in the coal mine. Butterflies, they are different. We know them, so they have to be different. They're bigger flying things. But a recent study came out in 2020 where they assembled all the long-term, decades long insect data sets in the world. This is across all continents, across all types of insects. And guess what they found? Insects on land declining by 2% per year. What we've learned for butterflies have lined up exactly with what we're now seeing for other insects. You brought up a study that was in Germany, this set off the alarms about the insect apocalypse, and it was about a different measure, not the number of individuals, but the biomass of insects.

(00:33:47):

And they found an even more shocking decline. They measured, this is in a forest in Germany, the biomass of all insects combined in the 1970s then measured it again in the 2000 teens, and they found a 75% decline in insect biomass. It's just mind-boggling and frightening that insects can be declining this quickly. It's one of the challenges of our time, one of the grand scientific challenges to understand why those butterflies are declining and all insects are declining. It's really frightening.

Nate Hagens (00:34:28):

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That's why I invited you because I'm very concerned about it because given our evolution-

Nick Haddad (00:34:36):

Everyone should be concerned. We have to get the word out because it's like you said, people don't know. We talked about it. People don't know insects so well. They know butterflies. My neighbors are all the time asking me, "Oh, are the butterfly numbers down? I'm not seeing butterflies in my garden." And 15 years ago, if somebody said that to me, I'd be like, "Yeah, maybe they are." But thinking in the back of my head, "Oh, you just went out on a bad day or you went out in some year where something different is happening." Now I know that my neighbors, these are just people looking out in the backyard at things in their garden, they're right. Butterflies are declining.

Nate Hagens (00:35:15):

I have so many different questions for you. Let's start with this one. What if the St. Francis butterfly went extinct? Big deal?

Nick Haddad (00:35:32):

You had to ask me that question. The answer is depends on what the big deal is. Is it a big deal for ecological systems? No, it is not a big deal for ecological system.

Nate Hagens (00:35:43):

One species, not a big deal.

Nick Haddad (00:35:45):

No. Some species, it would be a big deal. We could go to a different one like a Monarch or others that are more abundant. But Saint Francis's satyr, there are at most 3000 adult butterflies in the world, 3000. This is a number that's so small that they'll have trivial effects on ecosystems. If I took those 3000 butterflies and wadded them up into a ball, the ball would be this big. This is how much butterfly there would be. If they're lost-

Nate Hagens (00:36:16):

From a perspective of what they're doing for ecosystems, they're functionally extinct already.

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Nick Haddad (00:36:23):

Functionally extinct. They're not pollinators, they're not food for predators. And so if they're lost, their impact on ecosystems... Yes, they're functionally extinct. It's inconsequential, but the bigger... There's then a more cosmic question. What is the effect for people? And I think that effect is profound, that people should not be the cause of loss of a whole species from the face of the Earth. That's the crux of things. And so it's getting to a, not a functional or other kind of value, but the just core value of do we cause species to go extinct?

Nate Hagens (00:37:04):

Well, I don't know how much you know of my work, but I deeply concur with that, but I'm trying to build a logic with that question. Okay. Let's say we lost all the butterfly species. What would be the impact then?

Nick Haddad (00:37:23):

Well, starting with the butterflies, and then you could go onto all insects.

Nate Hagens (00:37:27):

Exactly.

Nick Haddad (00:37:29):

But with butterflies, butterflies and other insects, they're just foundational to our ecological system. Butterflies, they're consuming plants, they're prey for predators, they're pollinating. I have a former collaborator who studied pollination of cotton, and we often don't think of butterflies as big pollinators. It turns out that butterflies are responsible for 10% of cotton pollination. They're worth over a hundred million dollars a year in Texas alone for pollen crops. And so if you lost all butterflies, you'd be losing the pollination that other pollinators can't do. Butterflies can pollinate those parts of the plants that others don't. They're pollinators, they're food for predators. We now know that bird declines... Because how fast breeding birds in the US are declining. I'm leaving that one for you.

Nate Hagens (00:38:42):

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Oh, well, it depends on whether it's an insectivore or other types of birds, but I know the insectivores are dropping faster than others because they don't have enough to eat. I would guess they're down to 30 or 40% in the last few decades.

Nick Haddad (00:39:01):

You're right on. And I asked that question. It was an unfair question to pop on you, but birds, breeding birds in the US have declined by guess what? 2% per year, the same rate that butterflies are declining. And further than going to your point, we've shown now there's been big analyses done recently of all the studies of effects of insects on bird performance at nest. Do chicks survive and do they leave the nest? And a strong factor affecting their success at nest is there an abundance of insects around for them to prey on? We can talk about, the insects are declining, but it's not just the insects. It propagates to the whole ecological system. Birds are the most obvious recent example. People have estimated that there are currently three billion fewer breeding birds in the United States. Well, what causes that? We can think of a lot of reasons. But turns out the rate is exactly the same as loss of insects. And we now know that... Scientists know that insects are critical to performance of birds.

Nate Hagens (00:40:13):

How important are insects really? It's somewhat of a rhetorical question. I remember there's... And Albert Einstein famously said, if bees were to die out, humans would not be far behind. Just forgetting about the values and the ethics of it, can humanity survive and thrive if we are losing insect biomass at 2% a year?

Nick Haddad (00:40:40):

No. If insects are lost at the rate they're being lost, then no, it will fundamentally degrade the Earth's systems in ways that humans can't tolerate the environment.

Nate Hagens (00:40:55):

Can you give us some examples on some of the impacts?

Nick Haddad (00:41:00):

The thing is that if... This is taking it to a logical extreme, but we're talking about 2% decline per year consistent over decades since the seventies and no end in sight. Now we have 30% loss, and we can talk about the loss of three billion birds or whatever.

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But if we lose another 30%, which we're on track to do in the next 20 to 30 years, and then another 30%, there's a point where the end comes. And so then what's the effect? Well, we know that there are 200 pollinated crops in the world. Well, if there aren't insects to pollinate those crops, then what's happening to a large fraction of our food. And insects, they're responsible for health of our soils through decomposition. There's so many ways that insects just weave into the fabric of our lives that it's hard to see how those functions can be performed without those insects there.

Nate Hagens (00:42:05):

There was a video that I showed my students when I taught at the University of Minnesota. I'll have Lizzy put it in the show notes. But it was a thing with plants and ant species, and it showed the complexity. And the system would maintain stability as we lost ant species. There were other ones that could pollinate and do things, but once they went below a certain level, there was a phase shift and a collapse. Even though there were plenty of species available, it was the interconnectedness of the web of life that was transformed by the loss. And I expect something like that also could happen with insects in a way that entomologists and terrestrial ecologists like you don't really know yet.

Nick Haddad (00:42:54):

Oh, no, we don't know. Well, we don't know because even now, with a 30% loss in butterflies and then in all insects, to the extent that we know that insect populations are changing. I ask people, well, how can't we see the just profound ecosystem consequences? And I think those are starting to arise with the birds as a big example. We're losing birds so fast and it's so tightly related to loss of insects. There are other factors of course, but nonetheless, that's a big driving factor.

Nate Hagens (00:43:35):

I'm sure you've been asked this many different times. There's even cartoons about it because I think it's become obvious to people that are our age or older. When I was a kid in the 1970s in Wisconsin, we would drive up to our family cabin and my dad would have to stop-

Nick Haddad (00:43:56):

I know what you're going to say.

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Nate Hagens (00:43:56):

You know I'm going to say.

Nick Haddad (00:43:57):

Yes, I do. I know what you're going to say.

Nate Hagens (00:43:58):

We would have to stop at a gas station halfway out and get those squeegee things and get all the dead bugs off our windshield. That never happens, ever.

Nick Haddad (00:44:06):

No.

Nate Hagens (00:44:07):

No.

Nick Haddad (00:44:07):

No. It never happens.

Nate Hagens (00:44:09):

And it's like old people are... Here's the other thing-

Nick Haddad (00:44:15):

Well, let me ask this. Do you remember-

Nate Hagens (00:44:17):

Sure.

Nick Haddad (00:44:18):

I was telling the story one time and then it was to an older fellow and he said, "Oh yeah, we used to have screens over the grill of our car to keep insects from going through the grills of the car." Do you remember those? Then there would be butterflies or other things impaled on those grills, on those screens.

Nate Hagens (00:44:41):

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I don't know if you know Daniel Pauly's work on fisheries, but he invented the concept or coined the term shifting baselines that we see what this year is very similar to last year. And next year will be similar to this year, maybe a 2% drop. But we forget even a generation ago, the unbelievable web of life that has been compressed. And so we emotionally miss the significance of the die off of the natural world. And I think that applies to insects as well, even though insects are not a favored species in our culture. Do you have any thoughts on that?

Nick Haddad (00:45:22):

Well, I think yes, I think we do see a phase shift. There's two sides to this, but first, when you say... I'm going to push back a little bit on not a favored group. I think you're right in many ways and for sure around our houses and when we think about pests or mosquitoes or whatever, but I think there is a change that's happening, and I think it's driven by pollinators specifically. I think people love pollinators. They know the benefits of pollinators, and then that's extending to a broader group of insects, like butterflies.

Nate Hagens (00:46:03):

I'm very happy to hear that, Nick, but I will also push back that you are in the middle of that choir because those people are reporting to you. I think the general person doesn't give a crap about insects.

Nick Haddad (00:46:16):

Okay, so let me give you an example. I work in farmed landscapes where farmers plant native prairies within their corn and soy fields, and they do it for primarily these two reasons. One is to prevent erosion, and the other is to increase water quality. Those are two sensible reasons that also affect bottom line of agriculture. But people have done studies on why people might do these and measured all sorts of ecological responses. And it turns out the third most important reason not far behind the erosion control and water quality is pollinator conservation. And so that is not part of the choir that I'm preaching to. I think it's a bigger thing than... I don't know.

Nate Hagens (00:47:10):

True.

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Nick Haddad (00:47:10):

Maybe I'm an optimist, though. I am a hopeful person.

Nate Hagens (00:47:12):

Well, I like the fact that you're an optimist, but farmers are like one to 1.5% of our population. But that is also good news.

Nick Haddad (00:47:19):

It's true.

Nate Hagens (00:47:19):

That is also good news.

Nick Haddad (00:47:19):

It's true.

Nate Hagens (00:47:22):

Okay, so why is this happening? We understand we're losing insects one to 2% biomass per year. It's not a Michigan thing, it's a global thing. Why? Do we know why?

Nick Haddad (00:47:38):

We know more now than we did, and even just a few years ago. If you pick up one of these scientific papers that talks about insect apocalypse or insect decline, then the last few paragraphs inevitably say insects decline because habitat is being lost because the climate is warming or becoming wetter or dryer or because of pesticide use, yet there's no next step. Which of these three big global changes is having the greatest effect? Recently, very recently, in the last couple of years, a group of students I work with compiled all the long-term butterfly datasets I've already talked about, and in the same counties compiled the land use data. Understanding where habitat's been lost, that's pretty easy. There's land cover datasets. They've compiled the weather data. Well, anybody can get the temperature precipitation data and the use of pesticides in every county where the butterfly data had been collected over a 20-year period.

(00:48:53):

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And there's different kinds of pesticides. There's herbicides, there's insecticides, and then there's different kinds of those. Well, the person I was working with was able to get records of the specific pesticide uses across all these classes. Then we could put all these data into one big analysis and ask what are the most important factors affecting decline? And what came out on the top is a new class of insecticide. It's a mouthful to talk about, but neonicotinoids are what they're called. And these things showed up on the scene in the late nineties. And then it's not surprising that we see a correlation between increased use of neonicotinoids and the decline of butterflies, but still other things have been changing. This came out on top, and now I can say with good certainty that neonicotinoids are a main driver of insect decline, but what about other factors?

Nate Hagens (00:50:00):

Are those neonicotinoids used planet wide and in every state? Are they quite-

Nick Haddad (00:50:04):

They're almost ubiquitous in corn, soy growing regions in the United States. We do research at our station that investigates different types of cropping systems. It's hard for us to find seeds that don't have this class of chemicals coating the seeds before they're planted. And then it's beyond... We can track to some extent agricultural use. It's also used in people's yards. It's a huge source of pest control to keep those unwanted insects that people don't like, to keep them out of their spaces. And so they're ubiquitous. They're used over large areas, and they're used... It's just...

Nate Hagens (00:50:51):

What are they trying to kill, the neonicotinoids?

Nick Haddad (00:50:55):

Well, they're trying to kill the pest insects. They do a good job of keeping corn borers out of corn or aphids off of soybeans or wheat. And so they do a good job. They're starting from the beginning, from the seed of having the compounds absorbed and taken up into plants and then being there through the life stages to kill or keep off insects. But the problem is they're not stuck just on the agricultural plants. At one time, they were sprayed and people were realizing that they could have negative effects, so a solution was to stick it in the seeds and then bury them in the ground. Well, the two

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problems with that one is when the seeds are being planted, a dust flies up of this powder that's on the edge of a seed, and then that spreads to the environment. And then they're also resident for long periods of time in the soil. And so they become ubiquitous. They come out as the leading factor in decline of insect abundance and insect diversity.

Nate Hagens (00:52:06):

A couple of follow up questions. Actually, I have like 10.

Nick Haddad (00:52:09):

I know.

Nate Hagens (00:52:11):

But I want to be... I know. Dude, it's horrible. But I want to highlight it because-

Nick Haddad (00:52:15):

No, I know.

Nate Hagens (00:52:17):

... we talk aloud what's happening with climate change and the oceans and biodiversity loss. But insects is not usually a front page story.

Nick Haddad (00:52:26):

No, it has to be.

Nate Hagens (00:52:29):

I'm going to let you talk more about that in a second. Here are my two questions. Of those five million insect invertebrate species, plus or minus, how many are in the soil?

Nick Haddad (00:52:48):

That's a good question. I don't have a great answer to that.

Nate Hagens (00:52:52):

A lot, right?

(00:52:52):

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A lot are in the soil. I study and do work on the-

Nick Haddad (00:52:54):

And are those being impacted too, by the neonicotinoids and the seeds?

Nate Hagens (00:52:58):

Oh, yes. Mm-hm. Well, think about this. The soil insects, what are they eating? They're in the soil, but they're either eating plants, so they could be eating roots or crawling out of the soil to eat plants, or they're predators of other insects that are eating plants. And so yes, it's affected throughout the food chain.

(00:53:22):

You work at ADM or Cargill or some big food company and your shareholders want profits, and the profits are linked to reducing costs and selling corn and soybeans at a high enough price and processing them. Neonicotinoids from a profit standpoint are quite a good thing, quite a good investment. But that's because you're trying to kill aphids and corn borers. But it's like using a bazooka to kill a squirrel, you're also taking out a lot of other species And having ecosystem impacts. The fault is that we don't value those things in our economic system. What would happen to our yields if we stopped using neonics?

Nick Haddad (00:54:15):

That's a great question. I was out at our research plots today. We have research plots that we've been studying for 35 years that grow from business as usual agriculture through all different kinds of what's called regenerative agriculture. More sustainable and best practice and through to organic. But one of our plots has 30% the level of insecticides, herbicides, and nitrogen added as to the business as usual plots. And guess what their yield is? It's about equal. And so what that tells you is what we're over applying. First pesticides are needed at some-

Nate Hagens (00:55:01):

Does that plot need more human labor input?

Nick Haddad (00:55:05):

No, they're farmed exactly the same. It's business as usual plot minus those.

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Nate Hagens (00:55:10):

What?

Nick Haddad (00:55:14):

There's other evidence that pesticides... There we are using some pesticides. There's other evidence that pesticides are... That's even still an over application of pesticides.

Nate Hagens (00:55:26):

On that plot where you have 30% only of those things applied, do you see a difference in the insect populations?

Nick Haddad (00:55:35):

We don't, but we also don't generally have problems with pest insects. I think the answer is no, we don't see major pest impacts because we're not applying more nitrogen. Or is that not nitrogen? Well, nitrogen too, but pesticides. And so I think a key message is we're way over applying pesticides. And so then to get to your question, well sure, do we need pest control? Yes, but we're applying it well over the rate that's needed. And why is that? Well, it's thought of, and part of the security blanket too, have the stuff there when it's not needed, so that it's for sure there when it is needed. But when you bring up the companies that need to make money from selling pesticides, well, they're taking some action too. And that's in part because it's forced on them by governments. In Europe, these neonicotinoids have been banned. And so there the force has to go against two other types of pest control.

Nate Hagens (00:56:43):

Neonics have been banned in Europe, but not in the United States?

Nick Haddad (00:56:47):

Yeah.

Nate Hagens (00:56:47):

And when was that?

Nick Haddad (00:56:49):

I don't know the exact year. Sometime in the last decade.

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Nate Hagens (00:56:51):

It's because citizens and scientists got together and lobbied and advocated for the importance of our complex ecosystems in our continent?

Nick Haddad (00:57:02):

Yes, there's that. And of course, we are worried about just the nasty chemicals that are out in the environment.

Nate Hagens (00:57:10):

And is there any evidence that has stemmed the decline in some of those regions of insects?

Nick Haddad (00:57:16):

That is a great question. I'm an experimental ecologist. This was not a true experiment, but it's as close as we're going to get to understand effects of insect declines and the ability to recover from the threats we've imposed on them. And so to me, it's a great experiment. And the other great thing is we're accumulating the data through these butterfly surveys that are happening every year. We should be able to detect change in response to change in application of pesticides.

(00:57:52):

Now, will it be immediate? No, we're not going to see it right away. And so I would want to see a decade or more of data just as we're seeing this slow decline of 2% per year. It might take as long for those populations to recover. The nice thing about insects is they have the capacity to recover rapidly because they can produce so many offspring. Every insect can produce so many offspring. And we see that in the record of Monarchs, for example. And so we know Monarch populations are down, but they were way down. In the eastern half of the US, they went from about a billion Monarchs down, down, down to at one point, about 30 million Monarchs. That's a massive decline.

Nate Hagens (00:58:45):

97% decline.

Nick Haddad (00:58:48):

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97% decline. Well, guess what? They've rebounded now to about 200 million in the last year. Well, 200 million sounds like a big number, but it's still an 80% decline from where we were 20 years ago. It's like two sides of the same coin. One is that yes, butterflies can recover rapidly, but still the long-term trajectory is downward.

Nate Hagens (00:59:14):

I mentioned Daniel Pauly before, who's an ocean scientist who has told me that if left alone, fish populations can swiftly recover. If for some reason we were to ban pesticides or even reduce it to 30% of what we're using in the business as usual case, that theme could play out with insects around the world. And would that be welcomed by people or not? I think we- Go ahead.

Nick Haddad (00:59:47):

I think welcomed, because pest species, well, they're likely going to do well because we create environments for pest species to thrive in. But that's just a few of the total species. And besides that, when people go out to see their butterflies or their pollinators or the effects of pollinators, people will relish that. Frankly, they need it to sustain our populations.

Nate Hagens (01:00:13):

Does the Half-Earth concept popularized by EO Wilson apply to insects as well?

Nick Haddad (01:00:20):

That's a great question. The answer, well, for sure, yes. I said pesticides are the greatest cause of this rapid decline. But for sure, habitat loss has driven declines. The thing we're seeing is that the recent declines have happened concurrent with the advances in these pesticides, but habitat's been lost for decades, centuries. And that's caused a change in the insects that are out there, including the loss of Saint Francis's satyr butterfly that I've studied, and other of the rare butterflies. The question is, should we be pushing towards Half-Earth? Well, we know that to save biodiversity, we're going to need more habitat than is currently on the planet. And so Half-Earth is a great vision. What I've noticed in the US and other countries and worldwide come up recently is this idea of 30 by 30 conserving 30% of habitats by 2030. And I do think, well, that'll benefit insects and other types of species on a biodiverse planet. But

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I think that is in reach the 30% conservation by 2030. And I think that will be critical to protecting butterflies and other insects.

Nate Hagens (01:01:50):

We have amazing scientists that work at these labs, and they come up with all kinds of modified GMO corn seeds and whatever. Is it too far of a stretch to imagine that there's a targeted pesticide for aphids and corn borers alone that doesn't affect other insects? Or is that fantasy land?

Nick Haddad (01:02:14):

No, I don't think it's fantasy. I think those types of things are in the works, and I'd love to see them. Some pest control is going to be necessary. I'm not saying that we should never control pests, but if they're targeted at the species we don't want, then great. I'd love to see it. Will that happen? I do have some hope that... I've seen signs that those kinds of pesticides are being developed, but we'll see how long it takes for them to be deployed and effective. But yes, I am all in favor of technological solutions to reduce applications of the most dangerous pesticides. It's interesting... I'll leave it at that.

Nate Hagens (01:02:56):

Go ahead.

Nick Haddad (01:02:58):

Well, I was thinking about neonicotinoids. They were developed to replace other insecticides that were harmful to people. And so there was an environmental benefit of developing neonicotinoids. The problem is they ended up being too effective for the other insects that we want. And so then the worry is just as we could develop other insecticides that are more targeted, that's the dream. We could also develop more... We could ban neonicotinoids and come up with even more toxic chemicals to put out in the environment. That would be disastrous.

Nate Hagens (01:03:33):

Well, the reason I think your work is critical and why I'm so happy to have you on the program is I think part of this comes with a change in awareness and a change in consciousness and a change in perspective.

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Nick Haddad (01:03:45):

I hope so.

Nate Hagens (01:03:46):

In my own life, and I'm, as my dad would say, an environmental wacko, but I remember when I was a kid or a teenager, if there was a wolf spider in the house, I would step on it or kill it. 10 or 20 years after that, I would ignore it and let it be. 10 years ago until now, I would actually trap it in a jar and bring it outside. And now, only in the last couple of years after learning about all this, I just stop. And I look at it for a few minutes and I watch its behaviors, and it's not my peer or anything, but it's part of the web of life, and I'm just stopping in the moment to appreciate one of the other creatures on the world. And that's a progression from stomping on them when I was younger. And maybe our culture needs to go through some mental progression like that, not only with insects, but with all of the other creatures on the Earth.

Nick Haddad (01:04:57):

I agree. I see it happening in small steps, and hopefully it can become more progressive. I think so. But just think about people planting pollinator gardens. Did you see that when you were a kid?

Nate Hagens (01:05:11):

No.

Nick Haddad (01:05:11):

People planted flowers, but they didn't plant pollinator gardens. Now-

Nate Hagens (01:05:17):

How can someone listening to this start that? I'm sure you have resources available that we could put in the show notes, but if someone's listening and they want to just do a little bit of citizen science and do what's right for their backyard to encourage pollinators, but also be friendly to other insects, how would you recommend they get started?

Nick Haddad (01:05:40):

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First, I think just as a general rule, and I can talk about other ways, this is true, that some of the best places for conservation are hidden in plain sight, and one of those is our yards. I think we can all be excited about some diversity in our yards, even pretty flowers that are in our gardens or might be attracting pollinators that we see like Monarchs. But what I recommend to people is, "Hey, if you don't want to tear up your whole yard, just start small. Make a small pollinator garden. Maybe it's the size of, I don't know, a coffee table or the size of a room, just a small area of your yard. And if you do that, there's two benefits. One is as it builds on other small areas that are across the community and across the world, well, that's in the end, going to have a net benefit for pollinators. But then also you're going to see and learn more about your environment."

(01:06:43):

I think of insects. Of course, I think about butterflies. I love butterflies. But you'll see more butterflies and start to understand them. I think butterflies are the new birds. In my yard there might be as many butterfly species as bird species, and I can pick up a nice field guide like, Butterflies through Binoculars, and I can learn them. And then gradually I might learn something about the other bees that are there, not just the honeybees or bumblebees. But if we start in small steps, maybe it expands over time or maybe not. But even those small steps are beneficial. And I think we can all do that. We can all benefit nature and the natural world by making those small contributions.

Nate Hagens (01:07:24):

And if people do that, and there's a lot of people in a neighborhood or something, but that neighborhood butts up against a industrial corn or soybean field. Does that matter? Does it help?

Nick Haddad (01:07:38):

Yeah.

Nate Hagens (01:07:39):

It does?

Nick Haddad (01:07:40):

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No. Well, I think it does. I get that question all the time. I struggle with it, because we recommend planting, native plantings through corn fields and through soybean fields. And then of course, the question is, is there a negative spillover? And what we know is that... Well, if there's no habitat there, there's going to be zero butterflies. There have to be more, and then the question is though, are we going to attract butterflies to these places, and then they get whacked by the chemicals nearby? And I think the net effect is going to be positive. And so yes, we go for it.

Nate Hagens (01:08:20):

How far do butterflies fly in a day?

Nick Haddad (01:08:24):

Good question. It depends. If you're a Saint Francis's satyr butterfly, it might be 50 to a hundred meters, the length of a football field or less. It could be just meters. But if you're a Monarch, it can be a hundred miles a day. It can be a long distance.

Nate Hagens (01:08:43):

Literally a hundred miles in one day?

Nick Haddad (01:08:45):

I think. A hundred miles is probably an overestimate, but maybe not by much. They have to travel 3000 miles from-

Nate Hagens (01:08:53):

South America.

Nick Haddad (01:08:54):

If they travel hundred miles in a day. That would be 30 days to get from Michigan to Mexico.

Nate Hagens (01:09:00):

Okay.

Nick Haddad (01:09:02):

They go a long ways.

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Nate Hagens (01:09:03):

Have you been to Mexico to see those trees where they-

Nick Haddad (01:09:06):

I have not. It's tragic.

Nate Hagens (01:09:07):

Come on.

Nick Haddad (01:09:07):

How can I not have seen that yet? Have you?

Nate Hagens (01:09:10):

No, I haven't. But I'm not a world butterfly expert.

Nick Haddad (01:09:14):

But it's a miracle of biology, so everybody should see it. Though, I've not seen it. It's tragic. I've seen good numbers. I've traveled, just this last year, I've saw three of the Monarch overwintering sites in California. There's an eastern Monarch, that's what we're talking about now. But there's also a western Monarch that's doing worse than the eastern Monarch, but it over winters on coastal California, and I visited three of their sites and they cluster like the eastern Monarch does in Mexico. But the balls are this big of clusters of butterflies that maybe are hundreds or a thousand butterflies together, not millions of butterflies clustered in the same tree.

Nate Hagens (01:10:05):

What's you're advocating for... I'm a little dense, but what you're really saying is for people who want to take a stand for biodiversity and ecology and who maybe are a little overwhelmed at the decimation of nature, that a really good starting point is just start a garden for targeting pollinators. And start there and you learn from it and you're actually increasing the insect abundance in your neck of the woods, wherever that might be. And that acts as a microcosm of extinction rebellion on the micro level of sorts.

Nick Haddad (01:10:45):

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I think that it is a starting point. You asked what any person could do, and I think that's what any person could do. Of course, there are the next steps beyond that, becoming advocates for biodiversity conservation, doing grand conservation through a bigger conservation organization, doing butterfly surveys once a week. Anybody watching this could identify a organization that runs these butterfly surveys. That would be the real next step is to do something like that. It might take a half hour, an hour a week, and you contribute to your knowledge of butterflies and your knowledge of science. I don't want to be too superficial. How much is planting a butterfly garden going to change the world? It's just a small piece, but still, I think it's something active that people can do to think about conservation of nature.

Nate Hagens (01:11:43):

I'm going to do it. I live in a farm, but I don't pay much attention to the butterflies. I don't think I see too many, but I'm going to try to identify them like a half hour, an hour a week, like you said. But on the back row level-

Nick Haddad (01:11:55):

What kind of farm do you live on?

Nate Hagens (01:11:57):

I live on the border of Wisconsin and Minnesota, and we have some land that we own with a friend of mine that has nine acres of, it used to be soy and corn, but now we have a variety of plants. We have buckwheat there this year.

Nick Haddad (01:12:18):

Oh, cool.

Nate Hagens (01:12:19):

We also have hundreds of hazelnut plants that I planted 10 years ago, so we have hazelnuts. And then there's forest around those fields.

Nick Haddad (01:12:29):

Well, I should send you our... As I told you, we're thinking about prairie strips through agricultural fields. That would be a big way. You could start by planting a mix of these prairie plants that'll-

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Nate Hagens (01:12:41):

I'll do it.

Nick Haddad (01:12:42):

... have benefits in the prairie themselves and to the surrounding croplands.

Nate Hagens (01:12:46):

I'll do it. Thank you. On the macro sense, before I get to my closing questions for you, you were an active advocate against some of the recent changes to legislation on the Endangered Species Act, which were later rescinded. Can you tell us a bit about the current state of conservation policy in our country, the United States, and how that compares to global conservation regulations?

Nick Haddad (01:13:15):

Great question. I study endangered butterflies, so my starting point is the Endangered Species Act, which is up for reauthorization soon. It's getting its 50-year anniversary, which is cool that it made it this far and it's done a world of good for conserving species. It's been done a world of good for conserving vertebrate species most. It's had a harder time getting a foothold in with the insects. There's less than 30 endangered insect species, and they often get listed as endangered when they're so close to extinction that it's like they've fallen through the last-

Nate Hagens (01:13:55):

Hold on a second. We are losing insects at 2% a year, and out of five million, there's only 30 that are endangered.

Nick Haddad (01:14:05):

This is just in the US. And so in the US there might be a thousand butterflies and there's 30 that are endangered.

Nate Hagens (01:14:11):

Okay, got it.

Nick Haddad (01:14:11):

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It's almost all... A small fraction is endangered or considered endangered. But as an example, the Saint Francis satyr that I told you about, numbered in the few thousands before it was listed as an endangered. I study a butterfly now called the Poweshiek skipperling, that was spread from where I live all through Michigan to where you live, Wisconsin, Minnesota, all the way up to Manitoba and hundreds of populations as recently as the early 2000s. Now there are three populations left in the world, two in Southeast Michigan, one in Manitoba. All the others were wiped off the Earth and all in a blink of the eye. And it took till almost all were gone till the butterfly was listed as endangered. One issue with the Endangered Species Act that is problematic is there's no standard for being listed as an endangered species.

(01:15:10):

And that's one thing that's different from global standards. The International Union for the Conservation of Nature has a red list of endangered and threatened species, but the criteria are published. If a species has a high rate of population decline, it's listed as endangered. If it has a high rate of range loss that is the area that it covers becomes restricted, then it becomes endangered. And so there's very clear criteria that lead to conservation recognition. And in fact, the Monarch was listed as endangered by the International Union for Conservation of Nature, but not on the US Endangered Species Act, that is being evaluated. But there's also no teeth to that. They're identified, recognized as endangered, but that doesn't lead to national recognition. The point is that yes, it's wanting, it's done a world of good. For some species it's wanting, but I think also that conservation is moving to also consider ecosystems more holistically.

(01:16:21):

Right now there's a assessment called the National Nature Assessment that's ongoing, underway, and it's going to be released I think in 2026, but it's comes by an act of Congress to ask the Office of Science, Technology, and Policy to incorporate the value of nature and understanding the costs of doing business. These are called ecosystem services, the values that nature generates for people. And so this assessment's happening now to feed back into federal policy for conservation. Well, that's not about endangered species, but in conserving the rest of nature, hopefully many of those endangered species will come along.

Nate Hagens (01:17:11):

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I just had a thought. I've had many, many thoughts on this conversation. Climate change is going to affect the entire planet and the oceans, but our response to insect decline could be wildly different on different continents in different countries and different regions, right?

Nick Haddad (01:17:32):

Yeah, it could. And we also know... I've been talking about butterfly declines, but where we know most about them is in Europe and the United States. And so where the most butterflies are and where the most insects are, we know the very least about their rate of change.

Nate Hagens (01:17:51):

It's possible that that 2% that we're measuring in those countries that can afford to have the science to measure it might be worse elsewhere?

Nick Haddad (01:18:01):

It might be worse elsewhere. There's no reason to think it's better. Just as an example, the three biggest soy producers in the world are the US, Argentina, and Brazil. And so the same threats are happening there is happening elsewhere.

Nate Hagens (01:18:23):

Well, this is a fascinating, heart-wrenching and profound, but we need more-

Nick Haddad (01:18:33):

It should be a deep concern to everybody. The rate of loss and the trajectory of loss is so fast and the end is unknown at this point. We're really heading in a direction that well, ecosystems can't tolerate.

Nate Hagens (01:18:51):

Thank you. Nick. I have some closing personal questions if you have a few more minutes. You have obviously cared about these things for a long time. You've chosen to be an ecologist as a profession. Do you have any personal advice to listeners just more broadly on the times that we're alive in with global upheaval and anxiety and climate change and species loss and economy, what some people might call the polycrisis? Do you have any advice to listeners?

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Nick Haddad (01:19:21):

Yeah. There are so many threats coming in around us that it really is hard to bear. It's hard to look at the news every day. It's hard for me and my friends colleagues to think about not just the world we're living in, but the world our children are going to be living in as all this is changing. It's easy to get gloomy about what prospects are. We see the change happening so rapidly that, how do we change it? Well, we can do our little things to make our contributions. I think there's value there, but that's not going to reduce global change or reduce climate change just at an individual level. We all need to be in this together. What advice do I have?

(01:20:08):

I think my main advice is to be involved just personally as ourselves to our little contributions, but also to get engaged at whatever level that you're interested in. I brought up butterfly surveys that's contributing to science, that's having broader understanding or to bigger policy initiatives work with conservation organizations that are around your community or in bigger ways. I don't know. It's hard because these are big problems. They're hard to get our minds around, but we can all do just our little parts.

Nate Hagens (01:20:46):

And you're a college teacher and I have recently been one, so I know that these issues, environmental issues are very prominent in young people's minds. I think older people are very split on climate change, but I think both conservatives and progressive young people care about climate change. What do you tell your students at the end of the semester after they've learned about insect apocalypse and everything, what sort of advice do you give to your 18, 19, 20 year old?

Nick Haddad (01:21:22):

I do. I'll say I try to stay away from advice, but I am telling them, like you said through the whole semester about impacts of global change on ecological systems. And you're right, it's in every one of these places. And like I said, the irony about me personally here, I'm talking about all of these negative effects of environments and I see it in all the science I do. And yet personally in my heart of hearts, I try to be optimistic and look forward to a positive future. And so then how do we do that? It's becoming

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harder and harder, and I really feel bad for myself and for what my kids and their kids are going to have to wrestle with what we're leaving them with in the future.

Nate Hagens (01:22:09):

What I know about human psychology and physiology is 10 years from now, even if things get worse, you're still going to be a pretty cheerful positive guy. It's just who you are.

Nick Haddad (01:22:25):

Yes, it's just who I am. It's getting harder though. But I get this question at the end of seminars now, and it's usually the youngest people. As an audience full of faculty and postdoctoral researchers, students, graduates, undergraduates, and the youngest people who asked the question, what can I do? Given what I'm seeing, what can I do? I used to have what I thought were compelling answers, and now I'm kind of stuck. Just stopped short to say anything. I don't know. I've got to have a better answer.

Nate Hagens (01:23:01):

I'm in the same boat. And I think you first have to understand and be aware, and then you have to care. And then there are other steps. I think education is still very important, so I'm very happy that you're doing what you're doing.

Nick Haddad (01:23:17):

Well, I do teach a 200 person class. I've taught it for 25 years and I love it.

Nate Hagens (01:23:23):

What's the course called?

Nick Haddad (01:23:24):

Well, it's just ecology. It's general ecology. But ecology can go towards basic biology. But I always infuse understanding of how global change affects the ecological systems we live within.

Nate Hagens (01:23:38):

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If you were king or prime minister and you could wave a magic wand and there was no personal recourse to your decision, what is one thing that you would want done to improve human planetary futures?

Nick Haddad (01:23:53):

The one that I am on a bandwagon now for is taking all of the unproductive agricultural land out of production and restoring it to natural habitat. Now, why do I say that? These are among those areas that I talked about that are hiding in plain sight. On any farm, there's areas that are not productive. They might be in areas where water impounds or at the tops of hills that become dry or near the edge of fields. And on any farm, it might just be a few acres or a few tens of acres. But across the Midwestern US, it's 20 million acres. With my magic wand, I would see 20 million acres conserved. And then if we go from the US Midwest to the world, then we're talking about many times that. That's my magic wand, is conservation of what would end up being hundreds of millions of acres by taking out agricultural lands that are consistently under yielding.

Nate Hagens (01:24:59):

It's not implausible. Let's hope something like that could happen.

Nick Haddad (01:25:04):

I think it's possible. I think it's plausible.

Nate Hagens (01:25:08):

Thank you so much for your time, professor Haddad, and we will be in touch and maybe have you back for a round table on this incredibly important, and hopefully more people see it as an important, issue of butterflies, insects, and the complex ecosystems of Earth. Thank you so much.

Nick Haddad (01:25:27):

Thank you. I'd love to talk more about it, and I really appreciate you having me on the show.

Nate Hagens (01:25:32):

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