The Great Simplification

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[00:00:00] Joe Roman: Sea otters were almost completely extinguished due to hunting. And by the 19th and early 20th century, they were only found in one or two remote islands in the Aleutians. And one of those was going to be used for the largest underground nuclear tests that the U.S. Ever conducted. This is the early seventies and a local biologist tells them, you guys are going to have a problem.

You're going to do this underground explosion. You have thousands of otters here, and their pressure waves are going to kill them. I've got a solution. We'll take your otters, and we'll bring them back to the historical areas where they had been found for thousands of years and had been extirpated. It's a term we call trophic rewilding.

Almost within, you know, A few years of bringing those sea otters back, the kelp forest came back, and fish nurseries for fish came back. Eagles started hunting differently. You know, so the whole system changed. That's, to me, the inspiration of how animals can transform ecosystems if we restore them.

[00:01:08] Nate Hagens: An essential component of any healthy ecosystem is adequate nutrient availability of vital minerals, such as nitrogen and phosphorus. Joining me today to unpack how animals uniquely disperse such nutrients across the biosphere, as well as the threats to their ongoing ability to do so, is conservation biologist, Joe Roman.

Joe Roman is fellow and writer in residence at the Gund Institute for the Environment at the University of Vermont, where I happened to get my PhD. His research focusing on endangered species, conservation, and marine ecology has appeared in Science, Proceedings of the National Academy of Science, Trends in Ecology and Evolution, and many other journals.

His latest book published last year is titled Eat, Poop, Learn. die, how animals make our world. And that book is the basis of our discussion today. If you're a fan of the earth science heavy episodes on The Great Simplification, you will be sure to

enjoy this one. And it does drive home the need for more focus from all of us on supporting biodiversity on our one blue green planet in the universe.

Please welcome Joe Roman. Joe Roman. Great to see you. Joe Roman. Nice to see you, Nate. Thanks for having me on. We are going to talk about your new book, Eat, Poop, Die. what a attention grabbing title. But first, before we get to that you know, you and I were at the Gund Institute for Ecological Economics back in the day.

I never knew how you got started in all this. Can you tell us how you became interested in wildlife, biology, research, and then we'll get to your, book and your current work.

[00:02:56] Joe Roman: I grew up in New York the suburbs and, Queens, very few animals around me there. So the one place that I could go to was the ocean in particular, salt marshes and.

For some of your listeners, they might be aware of Jamaica Bay Wildlife Refuge. It's the area that you fly over when you leave JFK or you land in JFK. And I worked with a bunch of high school students. For my first job, we were cleaning the marshes, and I was teaching marine ecology. With pretty much no training in marine ecology, like teachers know, I would get up in the morning and, you know, write a lecture from a couple of textbooks, but it got me really excited about the processes that work on the, in the marshes as well as the oceans.

And that's sort of led to a career that's spanned many of the oceans around the world, looking at how different animals can impact marine ecosystems.

[00:03:54] Nate Hagens: So you have written quite a few books, including one on the history of whales and another on the animals who have come and gone on the United States Endangered Species List.

Not to mention, you have a blog on managing invasive species by eating them. but I'd like to focus today's conversation on your most recent book, Eat, Poop. die, which in your words covers the past decade or so of your research. So what moment inspire you to write this book and what is this book about and why is it important?

[00:04:31] Joe Roman: Sure. I was lucky enough to be in a Fulbright in 2019 working on, and we'll talk about this, I'm sure, the ecology of whales. And I had spent a year looking at migrations of whales, what they ate, what the impact of their poop was, and where they died, and as I was writing the final lecture for the like the, the capstone lecture for that fellowship, I realized that There are three words that can encapsulate my entire career, which was eat, poop, die, how animals make the world.

So, whales were my way in to this, and then after that I started looking at everything from whales, of course, being the largest creatures ever to have existed on the planet, down to midges. which an individual midge might not have a big impact, but they can number in the trillions. So, this book follows the stories of a few species of whales that we still, few species of animals we still share the planet with, that are moving nutrients across thousands of miles.

midge, it might just be from a lake out into the surrounding grasslands, and you think, well, how much could that be? It turns out millions of kilos, by one estimate, two million meatballs worth of meat comes up out of this lake every year onto the grasslands around there.

[00:06:02] Nate Hagens: From midges.

[00:06:03] Joe Roman: Just from midges. You know, these tiny little midges, but they're feeding and they're larvae in the lakes.

They come up once every couple of years. to mate. They go out onto land and then they die in enormous numbers. The animals react to it. The plants react to it. Even the people do. The researcher that I spoke to about this, Claudio Grattan, he said he was really excited when he got this number, so he brought it to the local Icelandic farmers.

And they're like, Yeah, we've known this all the time because they're farmers and they're sheep farmers and they had a term called me grass or midge grass for the years that the midges emerged because for much of Icelandic history, it wasn't a global culture. You depended on that meat source. So if you'd had a bad year for the grasses, that means your sheep were going to have a bad year and it was going to be a really tough winter for you.

So Everything from the smallest animals to the largest ones that are traveling across the planet are moving nutrients like nitrogen and phosphorus to essential nutrients that we need for our DNA, for muscle, for fats, for everything, right? We're using these nutrients all the time. Plants depend on them.

And what we've been looking at is how animals could start moving these nutrients up around the planet and what that might mean for different ecosystems.

[00:07:27] Nate Hagens: I have so many questions. I don't even know where to begin. My initial thought is you were saying that animals are moving nutrients around the planet and eat poop, die.

Humans are animals, but maybe our moniker would be eat poop, turn billions of barrels of ancient sunlight into microliters of dopamine, then die because we are also dispersing nutrients and pollution across the planet as one species, but maybe we could talk about that later, but do you have any initial thoughts on that?

[00:07:58] Joe Roman: For sure. I mean, so here's, I, you know, I sort of fell off my seat the first time I read this number. Right now on the planet, Of all the mammals on the planet, humans are one third of all biomass. Cows, sheep, pigs are 60%. All wild animals on the planet are only four percent of the biomass. So it's not surprising that we think humans are, that animals don't matter because we wiped most of them out.

They're, they still survive in pockets. But it's this really that the book looks at. Okay, here's where these animals survive. And this, I was talking about mammals. Of course, there are insects and birds. We have an impact on those not as severe. We can, look at the, individual animals, species that have survived, and then get an idea of what it might've been in the past and how we can restore those pathways in the future.

[00:08:55] Nate Hagens: Everything else aside, CO2 and biodiversity, setting those things aside are the nutrient flows and the nutrients cycling around the world in Earth's ecosystems, a fraction of what they were 150 years ago, when there was a lot more megafauna and mammals, or versus 10, 000 years ago, when there were considerably more mammals and, and, you know, floating around and moving around and dispersing nutrients.

[00:09:24] Joe Roman: That's right. So Chris Dowdy and I worked on a paper. He's based at in Arizona and he's a modeler and he's been looking at these questions. He started out looking at giant sloths and thinking about how they might have moved nutrients around. Then he looked at Pleistocene animals in general. And we worked together to look at what it would have been like historically for whales, for seabirds, for large herbivores.

And think about North America, we think of bison as being pretty large herbivores. They were pretty small compared to the mastodons, the mammoths, the giant sloths, the enormous armadillos that were around the Americas at that

[00:10:02] Nate Hagens: time. Beavers the size of Volkswagens, I've heard it described, and not that long ago.

We were obsessed with dinosaurs, but 20, 000 years ago, the American mid midpoint was like a Serengeti with five species of Sabre of tigers and lions, big cats. I mean, it was amazing.

[00:10:23] Joe Roman: Exactly. It's, almost hard to imagine, but this is sort of a starting point for scientists like Chris and I as thinking about, okay, we know what it's like now, what could have been in the past.

We think that those numbers, that movement of nutrient has been declined by at least 90%. By taking out the herbivores, we also had an impact on salmon. So another way that nutrients can move are through especially anadromous fish that are migrating from the oceans into the mountains. And a lot of times when we're looking at these, we're thinking of how these nutrients can either be dispersed or move uphill.

Because of course, things like nitrogen and phosphorus, as we well know, tends to flow downhill. That's no surprise. It's how do you get it back? How do you get it into the mountains? So it's things like salmon. It's these herbivores. It's the carnivores. The whales are moving it up and down, up in the ocean column, and seabirds as well are taking these nutrients from the oceans onto land.

And in fact, really the first time anyone thought about this, at least in Western science, was guano. Alexander Humboldt was one of the first people to bring

guano back from South America, sending it to France, finding the highest amount of phosphorus that had ever been found in any substance at that point.

Humboldt didn't believe it came from living birds, even though the locals knew, the local Inca, told him that they were from, that this was from living birds. He thought it was kind of like coal, that it had been, these were historical layers, but it turns out this was a renewable resource until of course we exploited it too much and then it be, then the numbers started to decline.

But that's just one great example of how numerous animals can make a big difference, not ecosystems, but also in local agriculture.

[00:12:18] Nate Hagens: Why does this matter? I mean, I intuitively know why it matters, but is this a shifting baseline sort of situation that look at all the nutrient flows today in 2024, things must be working.

The earth is this amazing biological pump and things are moving all around. And yet you just said we're at 10 percent of this nutrient cycling moving around versus The past due to the decimation of the megafauna and biodiversity. But to the lay person, why is this important? Sure.

[00:12:52] Joe Roman: All right. Let's look at phosphorus.

All right. So it's non renewable resource. Almost all the phosphorus we're getting right now is mined. A lot of it around the Sahara. So we're taking this out of the ground. Because it's, so rare now. Now, animals used to move the, this phosphorus around. Think about a time and, Chris has done the math on this.

They, there, you can still see legacies of those large Pleistocene fauna where they had pathways. Why does size matter in this case? Because they have a long gut. So when they eat, they move long distances and then they defecate or they pee and they release those nutrients far away. If they're just a small animal, those nutrients don't tend to travel far.

So size absolutely matters for these. They're also moving distances either to feed or to breed. And then when they die, there's this enormous, almost like a firework on the landscape of nutrients that are going into that area. We've replaced that, that

natural system. by intensive agriculture. And, you know, and that's why we're always struggling.

And we could talk about nitrogen too. The problem with both of these is there's areas now that are really depleted and areas where we have too much. Right? That's runoff and pollution. So we're, battling both of those. Animals can help restore that pathway.

[00:14:15] Nate Hagens: So we would, we have a higher standard deviation of, of those nutrients today because like many other things in our economy, instead of living off the interest, which historically would have been the animal residue from healthy global ecosystems full of megafauna, we're now mining, the principle well, the, the, where the concentrated phosphorus stocks are and, using Haber Bosch from natural gas to make nitrogen fertilizer, et cetera.

So it's another principle versus interest story.

[00:14:50] Joe Roman: I agree. And I think the Inca story about the guano in South America is a great one. So the birds there, the source of that phosphorus and nitrogen were protected. It was illegal to hunt. You couldn't bring anything onto those islands. And for them, as far as we know, it was sustainable for centuries that they were taking, they were never deep mining it.

They were taking it off the surface and bringing it to local areas. That's when it was globalized. And then miners from around the world started, were brought in order to extract that, that then, even though this could have been several hundred feet layers of guano, a few decades later, it was almost completely gone.

One of the researchers on guano claims, perhaps controversially, that the Anthropocene started with guano extraction. That was the first sort of global nutrient that had a clear marker on Earth. It really did revolutionize agriculture around the world. They claim that even places like Australia and New Zealand, before phosphorus was brought in, There wasn't much farming going on there.

Once they brought that external source of phosphorus, then they could raise the cows and sheep that we know about from that area. Pete

[00:16:04] Nate Hagens: When was that? The, guano revolution? Nate

[00:16:07] Joe Roman: 1800s. Yeah, the 1800s. It would have been first discovered in the early 1800s. And then, mining would have taken over by, let's say the 20th century.

[00:16:18] Nate Hagens: I hate to ask this question, but since we're on the topic, do you have any scientific data on the modern bat population on Earth relative to times past?

[00:16:29] Joe Roman: Oh, that's a great question. And by the way, I mean, it's a natural link because, of course, the caves were also mined for the gu for bat guano. so in places like Cuba, when I visited, you could still see the tracks from tires in some of those caves.

that they had gone in there in order to extract guano. bat populations, I don't have a specific number, but of course the bat populations have declined severely in Europe, and now with the spread of white white nose syndrome, numbers are also declining here. These cave, and this affects cave dwelling bats in particular.

So there's, No question in my mind that this would have some impact on the movement of nutrients, but we don't to my knowledge, no one's been measuring that in bats at this point.

[00:17:19] Nate Hagens: Well, the other thing is, that the decline of insects bats are largely insectivores. I mean, most of the species.

so that's got to have a, an impact on their populations as well. Everything is so freaking connected, Joe. I mean, this is what I've intuitively felt for a long time, and I increasingly get angry and frustrated that people use technology, politics, and money lens to look at the world when we really should be thinking about the interconnection, the ecological basis of how things really work to think about our time.

Alive while we eat poop before we die. And what are the broader implications of a more sustainable human society? I mean, right now we're using 30 to 40 percent of the net primary productivity from the sunlight and the soil and the rain on the

entire planet, directing it towards humans. And we're using millions of years of fossil sunlight stored as coal, oil, natural gas, and other minerals and rare earths and things like that.

So it's, I love talking to wildlife biologists and ecologists because they, this is their work. this is your work and, and it seems important to me.

[00:18:44] Joe Roman: Thank you. And certainly I think you know, one way to think about this is so whales dive deep to feed some of them more than a mile down beneath the surface.

They're feeding in the deep sea. They come to the surface where they rest, they digest and they poop. And they could be they releasing phosphate and ammonium that could have been locked in the deep sea for hundreds of years. That same nutrients picked up by phytoplankton, consumed by herring. And then consumed by seabirds, which can bring that those nutrients onto land.

Salmon can also move those nutrients into mountain systems where it can be moved by bears and other animals. So you can imagine that these nutrient pathways can go everywhere from the deep sea to the mountains. Humans, as you, as we know, have interrupted that. It doesn't have to be that way, right? You know, I mean, there are there, there's ways we can be part of the ecosystem instead of taking phosphorus and taking nitrogen out.

Those nutrients can go back into the soil. When we die, we don't have to bury our carcasses. You know, they can decompose as all the other animals do, and one way of restoring that pathway for humans.

[00:19:59] Nate Hagens: Is that your plan?

[00:20:01] Joe Roman: That is my plan. The family still hasn't necessarily bought on. I want to call the area behind our house in Vermont Human Meadows and just put bodies out there.

We're not that far away. We would have to bury it, but at this point, I really would plan on that. And I also do P Cycle. So I also try and get the P back either to one of the local non profits that takes it and then distributes it to farms, or of course

you can put it in your own garden. Like, again, I get a little pushback from the family.

[00:20:34] Nate Hagens: I pee, unless I'm traveling, I pee outside in the yard all the time. Right. and, you know, it wasn't that long ago that The entire country of China used night soil and they had, you know, depositories for that to put on their gardens, et cetera. so, oh my gosh, Joe, so many questions. So in your work, you give a powerful example of how animals can turn barren land into a living, thriving environment with Uh, your work on Surtsey Island, which I believe is um, by Iceland.

Can you tell us a little bit about that island and, and how you've been involved with working on that project? Sure. So I mentioned that I worked in Iceland, and I would drive along the southeast coast and there's this small island called Surtsey, which emerged in 1963. So it's a very young island.

[00:21:29] Joe Roman: In fact, several of the researchers that I work on the island are older than the island itself. And even cooler, some of the birds that are nesting there are also as old as the island. They have been nesting there.

[00:21:41] Nate Hagens: You mean the 50

[00:21:43] Joe Roman: years ago? No, it emerged. It erupted. It erupted? Exactly. In 1963, volcanic eruption about 400 feet beneath the surface of the ocean emerged.

There was a local fishing boat there. They smelled some sulfur. They got caught in a whirlpool. They weren't sure what it was, but then they noticed by the end of the day, there was an enormous eruption column and it erupted. over the next year was growing. I think it was something like 25 square yards per second.

So they're a great pyramid of Giza every day was built into this. Island. It stopped being volcanically active about five or six years later. By that time it was just black lava, right? There was no life there. They hadn't even seen a vascular plant yet. The first one, I think, was recorded at the time. A couple of years after the eruption, the only plants that could survive there in the beginning were ones that floated in.

And why would, why could only ones that float? Because if you float, you can carry your nutrients with you. So they can bring the nitrogen with their seed. and then

settle. And in those early days, again, these researchers who were younger, who were older than the island, knew every plant on the island.

They had marked all the plants there, right? So it was a lands, a barren landscape for a long time, for maybe six or seven years. Occasionally a bird would land, alight, fly off. The first breeding pair of guillemots was in the early 1970s, and then herring gulls came in, blackback gulls, kitty wakes, and within a couple of years, they were feeding in the ocean.

They were breeding on this barren lava. But they were releasing nitrogen and phosphorus in their poop. And a typical seabird, about three ounces of poop per day. So they were releasing about 60 pounds of nitrogen per acre, which is comparable to what a farmer might put on a permanent grassland, right?

Significant amount. Within a couple of years, you had a meadow. In the system, the birds were bringing in the nutrients. They were also bringing in the seeds that were on their feathers if they went on to land. And I went there in 2021. And if yoU.S.Till most of the island, it's just craggy lava hard to walk on.

You get to the breeding bird area, and it's like walking on a trampoline. It's lush. as one researcher joked, you could have cows, dairy cows on that island. The good news is what's what, Iceland did well as they decided to protect that. People can only go on that island for two weeks per year, about 12 researchers.

I was fortunate enough in 2021 to be one of those. it is now a UNESCO World Heritage Site. Because it's really the only place on earth where we can look at an ecosystem, how it builds from scratch. Most of the seeds come from the birds. The birds bring a lot of the nutrients and seals are also popping on the island.

So you could see from space, if you just type in CIRSE, you could see There's one strip of green to the north and that's where the seals are pupping. And then there's this big area to the south of Searcy where where the seabirds nest. You know, that this is a cool thing for ecologists, but even as it turns out, The U.

S. government was interested in this island in the 1960s and early 70s because they were doing nuclear testing

[00:25:26] Nate Hagens: and they were

[00:25:26] Joe Roman: interested in how life could recolonize after a blast. So they actually funded the Icelandic researchers for about five or six years and some of the money, there's still a hut there, that probably came from U.

S. government money because they wanted to know what would happen.

[00:25:45] Nate Hagens: So what are the implications of your research and Surtsey Island for other restoration initiatives, for example, reintroducing wildlife to previously deforested areas or retired mining sites? I mean, theoretically, I've read in the ocean that if we don't fish in the ocean that other than the real big fish, the other fish would regenerate within seven years.

how fast does nature regenerate and, what does this imply with some of the regenerative agriculture, regenerative economic ideas floating around today?

[00:26:21] Joe Roman: Sure. so here's the great thing about animals is. If you introduce a few, that population, if you bring it to the right area, is going to grow.

You don't really have to do much except release, let's say, a few dozen animals, let's say, on an island system, or if it's bison in North America, or if it's going to be cougars somewhere else. so there's not a lot of input after that initial introduction. What can it do? Well, we've seen evidence of that.

in one experiment, people took elephants from the zoo in Denmark and released them into a nature reserve, and in a very short time, in, in a matter of months, in fact they were taking out a lot of the woody vegetation, and they were disturbing that habitat in a way that Was likely, that's how it would have been historically.

We can talk about whether you want to move elephants around. That's a whole nother question. For most conservation biologists, we're comfortable with if animals have disappeared within the past few hundred years. When we start thinking about going back to the Pleistocene, then we're meddling in another way.

Nonetheless, when we see these animals restored, whether it's These elephants, which is really long time ago before, since they were in Europe, or bison, which is a

better example, right? Bison only extinguished in the 19th century. There used to be more than 30 million. They were down to fewer than a thousand from tens of millions.

I don't think anyone pushes the number down there. You can imagine what that did, how that changed the systems. There were lots of plants. and animals that depended on that migration. When you took that out, the disturbance stopped. We might, we tend to think of disturbance as maybe bad, but for ecosystems, many of them are dynamic, especially if you want biodiversity.

You don't want too much nutrients, you don't want too little, you know, there's like a Goldilocks, one of the terms is intermediate disturbance hypothesis, which means you want occasional disturbance, so that you won't just have a few dominant species, but not too much disturbance where many of the species can't survive at all.

That work has been studied in, largely in rainforests as well as in intertidal areas. Animals kind of do that, right? Without the animals, you're just going to get a more static system. Pete

[00:28:49] Nate Hagens: What, about the we're never going to get to all my questions, Joe, because I keep thinking of new ones. what about the, standard deviation of number of species, like to have a lot of animals, like you mentioned elephants before, or bison.

So if you have big mega fauna, they can transport a lot of nutrients. But what about like a lot of people now are so proud that Spain is regrowing its forests for biomass production and other things, but they're all monoculture, it's all like one species. And so what is the importance of diversity of species vertically and horizontally within it?

ecosystem to do this nutrient cycling and the health of the, ecosystem.

[00:29:35] Joe Roman: That's right. I mean, so we, we often, you think of a forest and you think of trees, right? Which makes sense, but it's also the animals and the fungi that are in that system that are just as important. They're essential to the, diversity in life in these areas.

So yes, a monoculture may serve. your purpose if, I don't know, you're trying to store carbon or you want to grow wood to cut down. But if you're looking for diversity, obviously, then it's the opposite of that, and the only way you're going to have a dynamic system is by restoring several different trees, as well as bringing those animals in.

And we see the differences. Areas like the, Atlantic forest and the Amazon rain forest, the difference when you have animals and you don't, it's a much different system of trees because a lot of the trees and a lot of the plants depend on animals for pollination, eat those seeds and to move them long distances, as well as to provide nutrients.

So it's a restoration of the entire system. that we, often focus on. This is going to benefit people as well. You know, it's going to benefit the, diversity of a system, but also human uses, human well being. It won't have the intense production. that we have in monocultures, but it provides other benefits like resilience, which is real, and adaptation to climate change.

And we can talk about that. When we have certain birds in a particular area, island systems are more protected from climate change. So in a lot of ways, these animals are going to be our allies. We just need them to be a little bit more abundant, again, coming back to the idea that they're just this tiny sliver of the pie right now.

That's why they don't, that's why we don't really think of animals as being that important, because they're so rare.

[00:31:33] Nate Hagens: Here's a thought, I'm sure you've seen the the surveys on the decline in, in animal populations since 1970. It's, dropped about 70%. And that's from a 2018. I would imagine it's, even more.

But the standard deviation of that is wildly different around the planet. In the United States, in North America, it's only like 30%. In Latin America and South America, it's over 90 percent and Asia's like 70 or 80%. I just wonder everything else being equal as we crest, the, the peak and start the downslope of the carbon pulse where we're drawing down ancient carbon and adding it to our economies

are those continents that have a reasonable amount of animals, biodiversity, insects, birds, everything.

Are generally going to be better off because those are the organisms that are in your book. I think you mentioned that plants are the lungs of the earth, but the mammals, birds, insects are acting as the heart and arteries of the planet. So do you have any thoughts on, that speculation?

[00:32:46] Joe Roman: Yeah, I mean, so I think of it in almost like a cardiac arrest when we took all those animals out of the system, right?

So we have them historically moving nutrients vast distances, and I study whales. They travel hundreds of miles every year from high latitudes where they eat to low latitudes where they breed. And they're moving, and they're the largest animals ever to have existed on the planet. They're moving nutrients either through their pee but also through their carcasses and their placentas.

I mentioned whales because it's actually one of the few trends that goes in the other direction. 1970s, many whale species were on the brink of extinction. Through negotiations, fights, commercial whaling was almost completely stopped by the 1980s. And a lot of species like humpbacks are back, maybe off Australia to numbers that they were before we started hunting them.

northern elephant seals, another example, down to 20 individuals in the late 19th century. Now, 180, 000, probably as abundant as they ever were. Marine mammals are a case where really we made the decision we're not going to kill them anymore. And in fact, we're going to try not to even kill them indirectly.

That's been a bit more of a challenge.

[00:34:06] Nate Hagens: Well, I mean, then there's different layers of indirectly because ocean food webs based on CO2 absorption, that's a long term risk.

[00:34:17] Joe Roman: Absolutely. And, that's one that we, well, just the warming of the oceans. I've seen in, during my career, one of the papers I published in 2016 about nutrient cycling by right whales in the Bay of Fundy.

They had been there throughout my career, throughout people ahead of me, their career. They're all of a sudden around 2017, they disappeared. They're not, they don't come back there anymore. So this whole system just stopped. Probably, almost certainly, because there was no food for them there anymore. The copepods, when the food disappeared, they went to a new area.

That put them at risk because the protections weren't in place there. That wasn't, the risks, the new risks weren't necessarily the people, the local people's fault because they never had whales there. But those systems are fragile. in, a time of climate change. And I think that holds true for almost any of these animals we're discussing.

but they can be reversed. And you mentioned shifting baselines. We have a paper called Lifting Baselines. There are lots of species out there that I have students who can't imagine that, you know, used to be that Massachusetts, there weren't any seals and there weren't any whales there. only 30 or 40 years ago, and now they're really abundant.

So there, you know, as baselines can shift in, in a positive way, that can cause conflict. I mentioned the seals in Massachusetts, a lot of fishers, they're not happy to have the gray seals back and the, seals have attracted great white sharks. So not every surfer is happy that sharks are back in the waters either.

These things can change over time and we can, I can give yoU.S.Uccess over success and I do not deny that the overall trend is down. That's the bad news. Right? You know, there's there, that's undeniable. But there are several trends that are, bucking up. And if we decide that this is really important to us as a society, we can turn a lot of this around.

We're not gonna win everything. But we can win a lot more for all the other plant animals and plants on earth.

[00:36:27] Nate Hagens: I agree. which is one of the reasons I invited you on the show, Joe. so you just mentioned a specific area of your research that you call a whale pump. so that's pulling up nutrients from the bottom and disseminating them on the top.

and then there are other organisms that get involved. What was the inspiration for your research on that? And how do you even begin to collect fecal samples of, whales in the vast ocean? And how do you analyze the data?

[00:37:01] Joe Roman: Yeah great question. So I mentioned the Bay of Fundy. I worked for the New England Aquarium in the mid 1990s.

We were going out doing photo ID of North Atlantic right whales, so taking pictures of them, knowing which individuals, where do they move, where do they feed. The first day I was on the water, though, a male right whale, came to the surface, mud on his bonnet because he had been diving all the way to the bottom of the Bay of Fundy to feed, and just be he breathed, and then just before he dove, he released this enormous fecal plume.

And biologists get really excited often once they see a bunch of poop in the water because there's so much you can learn from it. At that point, 1990s, we were basically just wanting to know what it was eating. Even then, I had a feeling, well, okay, there are only 350 right whales on the planet. What would it have been like when there were 10, 000?

Because yoU.S.Tare at a lot of empty ocean when you're on the water in the modern ocean. So that started. My thinking about, well, was there any ecological importance to this? I learned about this process called the biological pump, which you mentioned, and that's basically carbon photosynthesis only occurs at the surface of the ocean, because that's where the light is.

And when the phytoplankton and the zooplankton that eat it die, they bring that carbon back. down to the, bottom of the ocean, to the deep sea, where it can be sequestered for hundreds of years, depending on where it occurs. When I learned about that system, I realized, well, actually whales are doing the entirely opposite thing.

They're diving, and they're coming to the surface, and they're releasing carbon and nitrogen and phosphorus at the surface. I put together a model that with a colleague of mine who, Jim McCarthy, biological oceanographer, often hard to find oceanographers willing to entertain the idea that whales really matter.

They, most of them look at phytoplankton, they look at the microscopic organisms. As one of my colleagues said, you know, Joe, is that ecologically important or is it a fart in a hurricane? So that's what we did. We looked at how much nutrient is actually getting in to this system that I As much nitrogen is Brought up to the surface by whales as all the rivers combined in the Gulf of Maine.

So a large amount and almost similar to what you, what humans do. Obviously, we've changed the whole, the cycles here. It, has, a large role now, and then if you look historically, when there were five times more whales, then they would have been one of the dominant influences in these areas. So,

[00:39:33] Nate Hagens: so, I don't know if you watched the podcast that I did with Sir David King, who's the chief science advisor to the UK government, and one of the things he mentioned was, We have to go towards global cooling.

And one of the strategies that he's working on is to increase the global well population to do this pump that you described as a way of pulling in carbon from the atmosphere.

[00:40:01] Joe Roman: Yeah, so I did see that. I know he spoke about a friend and colleague of mine, Victor Smeticek, who's been at the front of this iron artificial iron fertilization as a way to mitigate.

That's controversial in its own way. Whales also move, we've been talking about nitrogen, but in the southern hemisphere it's iron that's limiting and they can, they also, their poop is very rich in iron. So they can have an impact. And there have been several studies suggesting that whale restoration could increase the amount of carbon that's absorbed.

I have to say the data, in my view, are not really there. And I've seen some numbers that I think are fantastical, like each whale is worth two million dollars in carbon sequestration schemes, and that all whales are worth a trillion dollars a year. The evidence is not there. I'm sorry to say that. I wish it was, but I've had long, many hours of research.

We have papers out about this. I want whales to be our climate champions, but they're, going to play a very small role. And by the way, I want all the whales back.

[00:41:06] Nate Hagens: And well, let me ask you a question there. you know, there are ebbs and flows and Volterra model and predator prey and overshoot and R and K species and such.

Is it possible that I mean, it was, it's a future I would like to imagine, but is it possible that if whales come back, that whales, it's because of us helping them or whatever, could go into an overshoot situation? Or is that just fantasy land?

[00:41:35] Joe Roman: Yeah, I mean, whale pop animal populations fluctuate.

Right. So, I mean, naturally, there wouldn't have been any time where there would be a stable whale population, right?

[00:41:44] Nate Hagens: Right.

[00:41:45] Joe Roman: Things change. for whatever reason, maybe they're prey or there's a cl a natural climate variation. And now, at a time, of course, climate change that's human caused, almost certainly, Sadly, we're probably going to hit that with whales, not because the ocean's the current ocean doesn't have the carrying capacity, but because the ocean's changing so quickly that it's hard to imagine that a warming ocean is going to be better for whales.

There may be a few, but for the most part, it's going to be a tougher future for them. Again, I feel like we, the overshoot I understand in the context of humans but for animals, think about that, the classic lynx and snowshoe hare studies that were done where lynx snowshoe hare populations increase, lynx increase, snowshoe hare populations go down.

That's just a natural state of things. And we see that in many times that these ecosystems are, have dynamic equilibrium. So, so yes, you know, that was a long answer to say, are some whale populations going to overshoot? Absolutely. And in fact, we've probably seen that with both gray whales and humpback whales in the North Pacific.

The problem is that we're having climate change too. So it's possible their prey populations are. depressed because of rising temperatures. In fact, in the case of

humpbacks, it's very likely that, it wasn't that there were too many, but that their prey populations declined. JS

[00:43:19] Nate Hagens: Are whales I don't know if you watched the podcast I did with Daniel Pauly, who had the gill oxygen limit theory saying that fish are swimming poleward both in the northern and the southern hemisphere because warmer water holds less oxygen.

So they have to swim further north. Word is that also happening with whales either because of that mechanism? Well, they don't have gills, but right.

[00:43:45] Joe Roman: So the whales are going to get one work around and that they breathe the air, right? So they're not limited by the their prey might be. So they might be moving because their prey has to move northward.

But directly there's still enough oxygen in the air, you know, for whales to survive. However, as I mentioned, when prey population shifts, whales have to eat two or 3 percent of their body weight every day in the summertime in order to fast during the winter and have their offspring. So they are very dependent.

Wait a minute.

[00:44:17] Nate Hagens: When

[00:44:17] Joe Roman: whales

[00:44:18] Nate Hagens: go south in the winter, they fast?

[00:44:20] Joe Roman: Yes. So here's really what's a cool thing. And this opens up a lot of things. So whales can fast for about five or six months. And that might be hard enough for a male. But think about a female that is having a calf, lactating an enormous amount of milk, and swimming back and forth.

That isn't true of all whales, but I would say the majority of baleen whales. Yes. Fast. A few of them go to places where there's actually some food, so they get to work around. And the

[00:44:51] Nate Hagens: evolutionary adaptation of that is because the advantage of surviving offspring in the warmer waters without predators outweighs the nutrient benefit of continuing to eat.

[00:45:03] Joe Roman: That's one hypothesis is predator avoidance, killer whales in particular. Killer whales do feed on calves, on vulnerable calves, so a lot of the whales that, bright whales I mentioned, humpbacks I mentioned, they go to shallow, sandy waters in order to have their offspring. That's possible that the sand can help muff, because they're communicating with their calves, they don't want it to be a dinner bell for the killer whales.

So they stay in shallow waters, the killer whales can't come and attack them from below, so it protects them from that, and it also might muffle some of the sound. I have to say there are a bunch of, it's science, so there are a bunch of hypotheses here about why that is. That's probably the dominant one.

One of my colleagues thinks it's also to slough skin. Whales are constantly, they can, algae can build up on the skin, and that can be like fouling. Think about a boat when it's fouling, you know, you can't operate a boat efficiently, so they may go to the southern hemisphere, or rather the lower latitudes where there's very little growth, think of how clear the waters of the Caribbean or Hawaii are, in order to get rid of those diatoms, or it could be both.

And there are a couple of other hypotheses as well. One of them is metabolism. Possibly because of the warmer waters, as you had mentioned, it's metabolically advantageous for the calves. The moms probably don't care, but the calves, it might be better since they, they're, you know, they're at that point, they're still vulnerable and don't have the blubber layer that the adults do.

[00:46:33] Nate Hagens: So we've talked about whales and midges are, are there any other species that are particularly powerful nutrient spreaders especially ones you've personally worked on in the field?

[00:46:47] Joe Roman: Yeah. So two answers to that. One is probably the classic example is salmon. Is a nadromus fish. And think of the Pacific Northwest.

So They spawn in river systems, spend most of their lives in the ocean, feeding, come back as adults, and they're semalparous. They just breed once and they die, right? So, you can think of the whole carcass as staying up in that area, as well as they're releasing some urine and feces into the water column as well.

If you've ever seen pictures or you've been to a place like Alaska, that's attracting eagles, it attracts geese. It attracts all kinds of carnivorous animals that are feeding on that and bringing some of those nutrients into the forests. This is a classic example. Again, it's a bit science, so I have a colleague who I interviewed for the book who questions how much of the nutrients and how important it is.

But it is a classic example of moving between one ecosystem, the oceans, onto a terrestrial or a freshwater system. Great one, and As a wildlife biologist, I have to say, I went to Alaska, and it made me think about when North America, when Europeans first arrived in, in New England or something, you really could walk on the backs of the salmon crossing a stream.

I didn't intend to do that, but they were so thick that you couldn't really avoid them in that area, so that was phenomenal. So it's no surprise that a lot of organisms depend on these animals. That's a nutrient. We haven't really spoken about eating all that much. We were talking about rewilding, and I think probably the best case of both of these is the sea otter.

So, sea otters were almost completely extinguished due to hunting by the 19th and early 20th century. They were only found in one or two remote islands in the Aleutians, and one of those was going to be used for the largest underground nuclear test that the U. S. ever conducted. They had done lots of tests in you know, in Nevada, but they were getting too big for Nevada.

The locals were not happy that they kept getting bigger and bigger bombs. So they took this remote area. This is really the start of Greenpeace, by the way. This is the early 70s. There's protests against this. And a local biologist tells, this is the Atomic Energy Commission I mentioned earlier, tells them, you guys are going to have a problem.

You're going to do this underground explosion. You have thousands of otters here and their pressure waves are going to kill them. You're gonna have these bloody

otters. It's gonna be look terrible PR for you. I've got a solution. We'll take your otters and we'll bring them back to the historical areas where they had been found for thousands of years and had been extirpated.

They wanted that this was before Alaska had oil. Alaska was a poor state. They didn't have the money to do this. They wanted to do it. The Atomic Energy Commission, as you can imagine, is a, that this kind of money that they were talking about, hundreds of thousands, wasn't even the smallest rounding error to them.

You know, he asked for radios and they're like, yeah, we can give you radios, but we can also give you planes. You know what I mean? Like, you don't think a little bit bigger. If you've ever seen sea otters anywhere from Washington state to Alaska, There are almost certainly the descendants of those animals that were evacuated before that bomb was released.

And there are 50, 000. So maybe half of all the sea otters in the world are descendants of those that moved there. Why this is relevant to the book is it's a term we call trophic rewilding. The impact of their feeding is in areas absent where sea otters are absent, there's lots of sea otters. Herbivores, they feed on kelp and they create urchin barrens when there aren't any predators around.

Almost within a few years of bringing those sea otters back, they love sea urchins are like their top favorite thing to eat. The kelp forest came back and fish nurse, nurseries for fish came back. Eagles started hunting differently. You know, so the whole system changed. And I think for me, that's, those sea otters, which is, this is largely a food thing, but that's part of the, you know, it's largely the impact of direct eating.

that's, to me, the inspiration of how animals can transform ecosystems if we restore them. to those areas. Let's be honest, you know, as economists, there's some, there are trade offs in this decision, because they love benthic invertebrates. So not only do they eat urchins, but they also really like clams and crabs.

And the fishers who are there, had never seen a sea otter since they had been gone for a hundred years. They were used to a lot of spent invertebrates in those areas. Those numbers went down. So, you know, we have to be mindful that there are

trade offs when you restore these animals. Many of us are all for bringing them back, but there probably needs to be a balance or at least a good discussion.

My dream is that we use the climate crisis in the same way that we, you think about animals as being, how can this crisis that we've created help encourage us to restore biodiversity around the planet?

[00:52:27] Nate Hagens: So, so how is a warming climate and a built in already going to be further warmer in coming decades?

How is that going to disrupt animals ability to spread these nutrients generally or specifically?

[00:52:40] Joe Roman: Yeah probably a lot. I don't think, you know, it's, too early, except for a few examples, which I've already mentioned. North Atlantic right whales, for example, studies looking at southern um, elephant, or rather, sorry, whales in the southern hemisphere that their numbers are likely to decline along with their prey.

As those numbers go down, they It's going to have an impact on all the other species that are dependent on them. And I'll give you, I'll stick with whales for one second before we move on. in the 1990s, people were just starting to discover hydrothermal vents and all these deep sea ecosystems that no one had known had been there before.

They also discovered whale fall communities that are entirely dependent on dead whales in the deep sea. More than a hundred species. found that we know of now, and this is probably just scratching the surface, they're entirely dependent on these dead whales. And also there's some species that are only getting out of the bone.

So, you know, one of the first reactions to this paper was, well, whales are so few that how could they have an impact compared to diatoms? That's true in pure carbon numbers, but when you have this big Island of repulses. And in this area, one of my colleagues estimates about a thousand years of carbon falling out from diatoms or marine snow comes in one pulse.

And you have these species that don't even, eat. They're just surviving animals that are surviving on the sulfides and other compounds that are coming out of, the whale bone. When we took those habitats out through commercial whaling, probably some of the first extinctions in the ocean occurred in these deep sea communities that we didn't even know existed at that point, right?

We're, my point is we're just learning what the impact is of biodiversity loss, as well as climate change. How long have we been looking at new climate change? You know, a couple of decades now. So it's, it's hard to tell. There are some concerning warning signs. It's hard to imagine most species are going to improve, or that this nutrient transport is going to get better.

But it could help, here we can talk about why it matters, it could help mitigate, or at least help us adapt to some of those changes from climate. What about plastics and chemical pollutants? they're increasingly in the news, PFAS, forever chemicals, endocrine disrupting chemicals. Is this part of the story also affecting the the process of nutrient cycling around the earth?

Absolutely. you know, pretty much every animal we look at has some, there's evidence of microplastics. I'm going to stick to whales because it's what I know best. sad story. So a new species was described in 2018, the Gulf of Mexico whale or the Rice's whale. It's down to about 50 individuals, only found in the Gulf of Mexico, probably became, critically endangered as a result of oil exploration in that area, because it was mostly found off of Mississippi, where it's no longer found.

If you know anything about that part, there's lots of oil rigs and exploration. This species really hit the spotlight. after Deepwater Horizon, when 20 percent of the whales died, and we think 20 percent of them had reproductive failure as a result of this one incident in that area. The plastic connection is the type individual for this species, the one that we've realized that this is a new species, washed up in the Everglades in, I think it was 2019.

And when they did the necropsy, they found a piece of plastic in its gut about the size of a credit card, and that's what likely killed it. Think about what we're facing. When anim if something that small can kill an animal that large, you can imagine if it's sharp how it could happen. but this is the warning sign that we have to.

And this is one, I feel like, plastics out of the ocean, At least it's something we can decide not to put any more in. If we wanted to, getting it out is going to be a bigger challenge, but at least restricting how much plastic we put in the ocean. That's the smaller pieces. Larger pieces also cause entanglements and direct death as well.

you know, on terrestrial systems, Again, I'm look thinking more towards seabirds, lots of seabirds dying. They're feeding on, you know, they, they feed on whatever's floating in the oceans and bring it back and die. and they can even kill their chicks that way. Getting a handle on this is, it essential?

And I've, this is one that just across my career, I'd never, when I started teaching marine conservation, I didn't talk about plastic at all. Maybe we've mentioned it now. It's like, you know, three lectures. it's a huge issue. No one knew. I feel like 25 years ago, we really didn't. There were a few biologists that were starting to put up the warning sign.

So, so huge issue, not only for direct impacts, but also concerns about oil production.

[00:58:07] Nate Hagens: Are there enough? Well, I know the answer is unequivocally no, but it seems like this is yet another one of those David and Goliath situations. Are there enough wildlife biologists and resources to look at the full Monty on, these issues that you're talking about?

It seems kind of fascinating, but esoteric and it's not part of the profit. System to understand our cousins, nieces, nephews in nature and the eat poop dying, that's contributing to a healthier world doesn't seem to be prominent in our cultural aspirations. how do you feel about doing such important work, but as a tiny minority?

[00:58:52] Joe Roman: I agree. It, you know, it's. If you don't have money, it's, this is, and I don't, I didn't when I started out, this is a hard field. You know, there's no straight line in order to be a whale, a conservation biologist or a whale biologist. Most of my colleagues have noodled their way through in various different ways.

It's not like going to med school or law school where you have a clear path. And also, most of my colleagues and I, we're not making a lot of money on this. We do it for, other reasons. Most of us are making a living though, so we're fine. so I do have long, careful thoughts with young people. If you want to do this field, please, we need more of you, but be aware of the challenges.

It's not for everyone. I see burnout In, some, in young people or in, among my colleagues, there's a certain point maybe that you have your first 10 years where you're doing fieldwork and it's really fun and you're going to travel and then there's, comes like a sort of a part two where there's a drop off point.

Like some people, like, okay, well, that was fun, but I gotta get, you know. and then I feel like if you can get through that bottleneck, then most of my colleagues now are like, okay, this is who I am. This is what I do. And we talk about it over beers, like how, to answer, how to address this crisis all the time.

[01:00:16] Nate Hagens: How, do we address this crisis?

[01:00:19] Joe Roman: So we're, with the one that we're, we've been focused on again is, returning to Wales. A lot of it is, and we're doing this now and the book does this, is, about storytelling. It's about creating metaphors. Because if I just give you a number and I say, okay, 80 million.

Tons of nitrogen is moved around the world by this. There, there are going to be a few scientists that'll be interested in that number, but for people that are living their lives, that's hard to understand. I get it because it doesn't mean it's meaningless to me too. So creating, whether it's circulatory system, these metaphors, creating these stories about individual animals, as well as the processes that they make can help it.

I think expand the tell the story to a wider audience. This is the work that you do as well. I mean, whether we're talking about economics or we're talking about ecology, it's not the answer. There's probably no single answer, but, it's one approach that I think is important. HM.

[01:01:22] Nate Hagens: So The thinking there is change awareness through education, awareness changes, values changes political advocacy and behavioral

choices, and then we have a new cultural conversation and, emergent efforts by individuals and organizations working on these issues.

[01:01:47] Joe Roman: I'd like to believe that it that sounds all too straightforward. Like, I feel like it's probably yes, but to that one, as I'm sure know, in that like if I, you know, how did we come to view certain animals as really important and others not? You know, why is it there certain charismatic animals that were willing to spend a lot of money and a lot of time to protect, whereas the vast majority, by far, the vast majority of animals, people don't really care about at all.

And to me, they're just as important. You know, a rare velvet worm in Brazil is important as a rare whale in the North Atlantic. I just happen to work on the whale, so we chat about that a lot. and it is, you know, it's a good question how we expand that out from, let's say, the Whatever number hundred, the top hundred animals that people care about, right?

You know, and probably if we think about it, you could, we've been talking a lot about whales, but lions, tigers, you know, and a couple of other large charismatic species, chimpanzees and apes,

[01:02:49] Nate Hagens: how much of how we care about animals? is because of their scarcity and rareness. like I don't really care that much about raccoons where I live because they eat my chickens and ducks periodically and there's so many of them and there's this one that's coming on my porch at night and pulling out all the soil in my bonsai plants.

I don't know why, but I'm kind of pissed off at the raccoons here, but in a broader sense, how is that different than a messiah warrior wanting to kill a lion that's encroaching? So, I wonder if our appreciation for nature is novelty, scarcity, and maybe with more education and books like yours, Eat, Poop, and Die, we can appreciate animals partially because they're animals.

We're related to them, they're our kin, we're connected to everything on this blue green earth, but also partially because of the benefits that they give to the broader ecosystem, which includes humans and our economies. H.

[01:03:56] Joe Roman: Y. K. I think that's a wonderful point. We should be celebrating when, animals are abundant, right?

We're often, it's kind of uncomfortable for me that yoU.S.Ee a celebration when an animal is listed on the Endangered Species Act. And often you'll see it like, Oh, this is like, well, yeah, I'm glad it's on there given that state. But really, the, you know, all of our work is to celebrate when animals are abundant.

And by the way, we've been talking about Wild animals, and how rare wild mammals are. Any guess what's the most abundant wild mammal on the planet?

[01:04:33] Nate Hagens: The Norwegian rat.

[01:04:35] Joe Roman: by biomass, probably by number. white tailed deer.

[01:04:39] Nate Hagens: Well, in North America.

[01:04:41] Joe Roman: No, planet, on the planet, white tailed deer Fin whale second, according to the same folks that did the work on biodiversity.

So

[01:04:51] Nate Hagens: there's,

30 million white tailed deer in, the United States. Cause I have actually researched that. and a hundred years ago, there used to be 1 million. because they are one of the species that benefits from our, taking down of the forests and putting up corn and soybeans monoculture. Wow. I didn't know that. That's the single, by biomass, it's the largest. By biomass,

[01:05:12] Joe Roman: it is. That's right. And now again, it's not mice and rats would outweigh them if, we were talking about numbers and individuals. Fin whales are number two, second largest animal ever to live on the planet. My point is to follow up on your question is, I spoke to some old timers here in Vermont who can remember in the 50s or 60s going with their parents to go deer watching.

Because deer, it was so amazing because whitetail deer had basically been eradicated from the state. People would go, like, people go whale watching. Like, I laugh. It's like, oh, you know, the thought of, like, going out to doing that now it seems, you know, I don't think many Vermonters do it. But we should value, again, there's a, There is a balance here.

I don't, but we should appreciate animals when they are abundant. And we often, there's a certain layer where level where we're like, Ooh, really matters rare. Okay, here. And then there's, you know, a social carrying capacity. It's like, well, now there's too many. and so we, need to value the numbers because 30 million bison, beavers are another good example.

Beavers have a huge impact on the environment, not when they're rare, but when they're abundant. And there used to be. tens of millions of beavers as well.

[01:06:30] Nate Hagens: How can the things you've learned about nature animals nutrient cycling be part of what many are talking about? I have John Fullerton coming on here uh, in the near future, talking about a regenerative economic system.

So we've been drawing down. the, fossil bank account, adding that primary productivity from the past to our current economies, that has an expiration date. Our current you know, cultural expectations based on non renewable inputs, how can animals and the things you've been studying regenerative economic system?

[01:07:13] Joe Roman: in a very direct way, luckily. So, we've been talking about nitrogen and phosphorus, and when you look at the planetary boundaries, there are often two areas where we've gone way beyond the planetary boundaries, right? We may be at peak phosphorus, we can argue when that occurs, but some scientists would argue we're already at peak phosphorus.

We've had huge impacts because of Haber Bosch and, the impacts of The use for fossil fuels in order to generate nitrogen from the atmosphere. We've looked at these flows in systems where we restore animals. We've spoken about Vermont, so let's move away from the marine system for a moment.

Anadromous fish coming in from the lake. So we have a problem here in Vermont of phosphorus pollution in the lake. If we restore the movement of fish going out of the lake, that would be one way of getting night phosphorus out. If we restored beavers, that's one way of retaining phosphorus on the landscape and making those river systems more heterogeneous.

Herbivores, scavengers, carnivores can help distribute that. So disperse it. And that's the work that. that Chris Dowdy has done is that's what we've lost when we've taken out these large animals is that we tend to have areas that are very concentrated and areas that have almost none. What animals can do in this regenerative sense is help restore that balance.

They're not, I don't want to think of them as like our warriors or, you know, in that they're not going to be able to do it. That's up to us, but they can play an important role in helping to move these nutrients in a, way that, that has been done historically, where we're not losing it all to the oceans.

[01:09:01] Nate Hagens: And it's not only animals, right? It's, also insects, like yoU.S.Aid, the midges, but that's a much more local impact.

[01:09:09] Joe Roman: Sorry to interrupt, but cicadas, just recently there's been this large cicada emergence and there's been studies looking at, so they spend, these 17 year cicadas, seven, 16 and a half more years feeding on sap beneath the forest floor.

They come up to breed once every 17 years, an enormous, resource of nitrogen and phosphorus going out into those forests, also to the animals that are feeding us. The animals are changing, the ones that are preying on it, but it's also supplied it, supplying those nutrients to the forest system as well.

[01:09:43] Nate Hagens: What will it take, Joe, for a young human and I remember living in a suburb of Chicago when I was eight years old and we had that cicada bloom, and I was, Fascinated at eight years old. Like look at all these, know, bugs and they're so colorful. They're green and red eyes and things like that.

and really noisy. And you know, what would it take for humans to look at that and view it as a part of, life? and an ecosystem and the majesty of it and the 16 and a

half years of underground and now a release rather than just some noisy pain in the ass insects. Is it within our phenotype as a species to have that viewpoint?

[01:10:33] Joe Roman: Yes here's the good news. So, I went down to Maryland for the 2021 emergence of cicadas. This was another three species coming out in the trillions, probably, certainly many billions. And the, there have been a lot of people, scientists, out in the media talking about this. You've got a 17 year gap, so it's a long time between emergences, right?

A lot of the kids have never, all the kids really, if you're not 17, have never seen one before. There was a lot of positive messaging, and if you went back in time every 17 years, they did look at least 17 years back. So the last emergence, where the word plague was more common, people think of them as locusts.

I don't even want to put bad on the locusts, but you know, that's another question, but they're not actually feeding when they're emerging, you know, they've already, they're, basically just breeding and dying. So they're not going to strip trees bare or anything like that. Having that message out has been pretty good.

I mean, so I feel like we are making progress. I don't know that we ever win it. You know, we can, talk about political scenario. but I feel like cicadas have, and the midges. both have gotten better story, better coverage in recent years. When I was in Maryland, I just sat down in a park and listened.

Like, you know, I didn't ask anyone questions. I just listened to everyone who was walking by. And many people were talking about cicadas, and It wasn't a negative, you know, it was pretty positive response. So I feel like maybe if you go back to where you grew up for the next emergence, I'm hoping you'll feel like there's more of a general appreciation.

[01:12:18] Nate Hagens: As my dad once called me an environmental wacko which he then used as a term of endearment. But since I've become aware of these things over the past decades, I am a little strange in my behaviors. Like I'll go on a bike ride and there will be a night crawler on a, a rainy asphalt road that clearly is going to die.

And sometimes I'll actually stop and get off my bike and pick it up and chuck it into the woods where there's soil or things like that, that I never would have done 20 years ago. And it seems like a waste of energy. it's the sentiment, That, that matters. So, so let me ask you this. in one of my previous Earth Day talks, I had the idea of a life brigade or something locally.

this isn't your forte, you're a scientist, but what, what could happen if in every watershed, in every community across our country, or maybe even beyond, there was a cadre of people who understood and cared about the things that you're discussing today? What could people locally do to expand the ability of insects and animals to play a productive role in the ecosystems of their children and grandchildren where they live?

[01:13:38] Joe Roman: Having lived in, Vermont for about over 20 years now. One of the big problems in the spring is there's these large amphibian migrations. They cross rows in the spring from upland habitats to vernal ponds, ephemeral springs. And by the way, they're bringing nutrient, people have measured, there's a large amount of nutrients that they're bringing in when they're releasing eggs going from that system.

In just 20 years, there was some concern in the beginning, and a few of us would go out on rainy, cold nights and move the salamanders and frogs from one side of the road to the other. That felt good, though it was also risky. I mean, you're going on roads where there are people driving. Quickly we actually did a local fundraiser and put two or three amphibian underpasses that was endorsed by the town, and I see around Vermont now, they call it Big Night, where when I go out now It's rare on a rainy night in March that I don't see other people with flashlights looking and moving them.

And that is relatively new. Yeah, it is awesome. And that's happening in England too. And the idea of amphib animal underpasses and overpasses has become more popular. That is something that's That was funded. I think it was GoFundMe. You know, the feds put in some money in the state, put in some money, but local people had ownership in that.

We got I've never heard of

[01:15:14] Nate Hagens: that. What is an underpass? What is that? Explain that.

[01:15:18] Joe Roman: Right now, looking out the window, you often see like two ditches running along the road. If an animal's coming down from the mountain, it's got to go into the ditch and over and then back to the other side into the pond.

Incredibly risky move going both directions. So it's just putting what we might call a culvert, but a bigger one, putting a large one. You want to make it big enough so that bobcats and other animals can do it too. They're not big enough for white tailed deer, but they're big enough for like small mammals as well as amphibians.

And it's reduced it. I don't have the number off the top of my head. Mortality is down by more than 80%.

[01:16:00] Nate Hagens: So, so the, animals prefer the underpass to going over the road.

[01:16:08] Joe Roman: You have to, make it what they want. They, probably would go over the road. So you're putting up, you're putting either a fence or in this case, a concrete A low wall, you won't see it when you're driving, but something that's going to be a challenge for either a frog or an amphibian to get up over.

There's a bit of, there's an art and a science to doing that, of course, but when it works beautifully, and that's something that local people can get involved with. What blew my mind, I once took a class down in Massachusetts, and we went out on the water, and we were working every day, and I'm like, you guys can have the day off today.

We had gotten up early that day. We came across, just by chance, a stranding of a couple of dolphins. And I'm like, or we can just see what happens. So it attracted maybe a hundred people, including police were there, vets were there volunteers were there, and just people curious, taking those dolphins that have been stranded and releasing them on the beach side.

And it occurred to me that this is part of the economy. We don't think about that. These people, like a lot of these people, this is their job or they're donating money because they care about it. And I'll argue there is not a thing, no ecosystem

services, like those dolphins aren't doing anything for us, except that we care about them and they matter in the ocean.

Don't put a dollar value on it because I'm going to be skeptical. but you can see clearly. that this is an important part of this economy. And we compared how much people donated and volunteered and worked in, this part on coastal Massachusetts, comparable to commercial fishing. It's a lot of money that people pay.

And this is coming up, this is bottom up, you know what I mean? This is, grassroots. This isn't people coming in, making these decisions for other people.

[01:18:03] Nate Hagens: Let me ask you a personal question, Joe. Do you have children?

[01:18:06] Joe Roman: I do. My daughter just left. She's going away for the weekend.

[01:18:11] Nate Hagens: do your children care about animals and nature and whales as much as you do?

Well,

[01:18:19] Joe Roman: some of our fondest memories are amphibian crossings. I just mentioned the amphibian crossings. So this year, I was glad, because she's 17, now she can drive. She wanted to go out on a couple of rainy days and help cross them. So I'm happy to say that's still sticking with her. my wife is also a wildlife biologist.

So there is a little bit of pushback, you know what I mean? She's like, Oh, you know, animals like, Oh, nature. there can be an eye roll part of it too. But I honestly, I know that she also heard her friend, she and her friends care about these things. I don't know that's going, Oh, actually one of her friends wants to be a marine biologist.

So, so that may carry on. I do believe that they care in a way. What I've seen the shift in young people is, and you would know this in your careers, more thinking about the rights of the animals themselves. That's been a long fight, right? And,

but I hear it more. I think even we have a unit, you know, Josh Farley, I think he has a term, I forget, something like the ecosystem services of the animals.

We're often thinking of the services that animals provide for humans. But of course, the agency of the individual plant or animal also, they need the They need whatever it is, the food and the atmosphere and all of those. So what I'm optimistic is expanding out beyond just thinking about people and especially people like us, but thinking beyond that to what are the rest of creation?

You had mentioned earlier, our cousins in the ocean are real, you know, that there, there are cultures that, that acknowledge that I'm hoping we get there. As a culture, too, that we can be comfortable using, you did, using that terminology and not getting an eye roll or something like, but Frank, what, you know, what

[01:20:07] Nate Hagens: cousins, I might get eye rolls, but I can't see them because there are people watching on YouTube.

So what projects are you currently working on? And what's next for you, Joe? We

[01:20:23] Joe Roman: are finally putting some numbers on what we describe as the Great Whale Conveyor Belt. So this is those migrations of great whales that they do every year. We know they're moving some nutrients, and now we've got an idea that nitrogen that's going from these high latitudes to these low latitudes can be more than the amount of nitrogen that's just coming in from upwelling in these particular areas.

This is external nutrients, you know, it's like we mentioned the guano, you know, they're bringing nutrients from an entirely different part of the world to here, to these lower latitudes. Why does that matter? If you've been to Hawaii or the Caribbean, the clear waters that many people like and are important, that's also a sign that there aren't many nutrients.

So the whales are bringing nutrients into this system, and that can help in the resilience of coral reef systems. And even, as one of my colleagues have noted, when seabirds are bringing nutrients to those islands, they're increasing the, growth of the plants around the island, and that, with the fish eating in the sand, can

actually allow the islands to grow more quickly than the absence of those birds and those fish.

and making those islands more resilient to climate change. So, that's the direction we're taking our work these days.

[01:21:53] Nate Hagens: Excellent. it feels to me that we're discovering all this stuff at the 11th hour and it's so fascinating and so beautiful and so important, but it's like, We had to almost destroy it before we realized that we're going to miss it.

And not only is it a sentiment, but it's actually the biological underpinning of our ecosystems, all these things connecting.

[01:22:17] Joe Roman: Yeah, I agree. And, you know, we've chatted about, they can go in two directions. We talk about them like a perturbation or we're doing these global experiments. I don't recommend doing this, but we're doing them anyway.

whether it's climate change or. adding more nitrogen, more phosphorus. However, so when we take animals out of the system, we have a perturbation, we see the change, but we also see those changes when we store them to areas, right? So these disturbances, can have, let's say, positive impacts for biodiversity, if we're doing it in the right direction, or very strong negative ones.

it's up to us to decide which direction we're going to take it in.

[01:23:01] Nate Hagens: So, this has been a fascinating discussion. A lot of things I didn't know, and it just Strikes a nerve with me to care about these things. And it's so fascinating. You've followed my podcast. I'm sure you're aware of the closing questions.

I ask all my guests, but you're aware of the dwindling of nature, but also the human predicament more broadly. Do you have any personal advice to the viewers of this program on being alive at this time with all the things that we face?

[01:23:34] Joe Roman: Yeah, I mean, from my view, the way I act, I don't know if it's advice, I'll just give you one example of an approach, is focusing on the local and observing what yoU.S.Ee around you.

And by the way, all the work that I'm talking about today, a lot of it just came from me spending some time outside. on the water, allowing myself to be bored. In fact, almost in a way I would say that would be the biggest recommendation I'd have for most people is go out and just watch. Right? You'll be amazed what you learn.

[01:24:07] Nate Hagens: Leave your social media device at home.

[01:24:10] Joe Roman: Exactly. If you can, and that was a benefit I've worked a lot in Cuba in that there is no social media. You know, it was enforced. I couldn't access the internet or a cell phone. Right? By having that and observing the natural world, for me it's about science, but I also think it's an appreciation of wonder and understanding the world around you and the environmental history and just getting to know these animals.

So that's on the simplest level. Then getting involved also though, on a societal level, which is what you do and what you talk about, because it's not enough, like on an individual level, if I go across a couple of frogs, I feel good about it. I'm glad I did it, but the crisis is much more about me and it's much more than those frogs.

So it is taking on whatever cause that resonates with you. I wouldn't wanna. prescribe what that cause might be, whether it's climate equity or, you know, biodiversity, all incredible ones that, that can be tied together. So for me, I, try to operate on both of the see the importance of both of those levels, that policy change matters, but so does being outside and enjoying the day.

[01:25:27] Nate Hagens: And you are a professor now at the U of Vermont. And what sort of advice do you give to young people? And how would you change what you just said to a young 20, 25 year old?

[01:25:42] Joe Roman: Yeah, I'm a fellow at UVA at the Gund Institute right now. I'm not teaching. but, The advice I, the conversations I have, maybe I shy away from advice, but the conversations that we have is, as I had said, if you're interested in wildlife, get out in it in whatever way you can.

That, that's a, that's, the first start. And then looking at whether you're going to want to take on. Let's use biodiversity as an example. Biodiversity is what you really

care about. That's what drives me as a conservation biologist. There are two ways of going about it. One is Dedicating yourself through a career or volunteering, you know, and working with an organization.

I have seen both of those be incredibly effective. The risks of a job, as we mentioned, is there can be some burnout. There's, not a lot of, there's a bottleneck for a lot of these. The benefits to making it your side job is that it gives you It's maybe like the pressure valve is off there. And I feel like that's a personality, you know, I would certainly not prescribe everyone to go out and be conservation biologists or that we don't have any right, but you know, you, you need to, I think you want to think about what direction you want to go in.

And I just had lunch with one of my students who just graduated. and doesn't know, and that's okay. I didn't know it. I didn't know a 21 or 22 either. For her, she was used to like always having like deadlines. This is what I do next. This is what I do next. Not going to medical school, wanting to work as a choral ecologist.

It's not clear what's next. And that, that could work in your favor. So maybe on a personal level, don't feel like you have to, you know, make, know what's next for you because it, the world and one's own decisions can change.

[01:27:42] Nate Hagens: What's next may change, but what's first is caring about and being interested in the animals and the ecosystems of which we are a part is how I see it.

So what do you care most about in the world, Joe? I could probably guess, but I'll ask just the same. So

[01:28:01] Joe Roman: it's everything because it's biodiversity, right? In a way, biodiversity includes all of us and everything on the planet. So it's almost like every living thing. And then I would even maybe want to expand it to non living things.

but, let's go, you know, so it's very broad and really what I care about though, I probably took me years to realize it is, where the angle that we've been think discussing and that tree that I'm looking at across the street right now where the bird that's you know, running flying by that they matter and understanding how they live in the world and how we can protect them.

is what drives me. So biodiversity, you know, is the single word, but also a thriving planet where animals matter, where all the other species on the world, you know, on the planet matter.

[01:28:59] Nate Hagens: Well, to put in different words your work and your career is in service to life. So if you could wave a magic wand and there were no personal recourse to your actions, what is one thing you would do to improve human and planetary futures?

[01:29:18] Joe Roman: The world we live in right now has an extinction rate that's probably a thousand times higher than it's ever been, or at least the average, maybe, or maybe even in order of magnitude more. So we're having many extinctions every year, and extinction is natural just like death is natural. Every species out there is going to go extinct at some point, just like every person we talk to is going to die.

And sometimes I think the role of a conservation biologist is similar to being a doctor, right? You want the, you want a patient to have a healthy, long life, good quality of life, but you also know that at some point it's going to die. So recognizing that extinction is natural, we have caused an incredibly high unnatural extinction rate right now.

So. My goal, the thing, the wand I would be is getting it back to zero human caused extinction, whether that's convincing people to make that the priority, or if the wand has allowed me to do it, I, think that's a really special wand if I'm going to, but I think the real goal is going to be humans decide like they did with whales, that this really matters.

We're going to put our time, effort. That would be my wand is, you know, and in a way we're talking about how you get people to care. The wand would be, well, people are already there. And now let's discuss how we get there.

[01:30:45] Nate Hagens: Thank you. And thank you for all your decades of curiosity and work on these issues.

Do you have any closing comments for our viewers, Joe?

[01:30:55] Joe Roman: Yeah, I just. Similar to what I've said, get outside, look at this. I mean, appreciate right now, you could probably go out and, you know, and go out in the world and see an animal feeding, pooping and dying, and think about it in a different way. You won't see it die, a corpse.

You probably won't see it die, but you might see a carcass. And think about how those processes. are influencing everything around you, whether it's the river, or the forest, or even your yard. You know, these processes are happening all the time. It doesn't have to be a white tailed deer or a whale, but it could be something as simple as

[01:31:41] Nate Hagens: I'm going to go do it this afternoon.

Thanks so much, Joe. Thank you. To be continued, my friend.

[01:31:47] Joe Roman: Great. I really appreciate it. Thanks so much for the chat. Great questions.

[01:31:51] Nate Hagens: If you enjoyed or learned from this episode of The Great Simplification, please follow us on your favorite podcast platform. You can also visit thegreatsimplification. com for references and show notes from today's conversation.

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