00:04

Hi there. I'm in the habit of saying I would like it if butterflies could talk, but I've been recently reconsidering that, because we already have a pretty loud world. Can you imagine if butterflies were yakking out there all over the place?

00:19

But I would like to ask butterflies one question, which is, what is the meaning of some of the stories that we humans tell about them? Because remarkably, all over the world, cultures have really similar stories, similar mythologies about butterflies having to do with the human soul. Some cultures tell us butterflies are carrying the souls of children who have died wrongly or too soon, and other cultures tell us that butterflies are carrying the souls of our ancestors among us. This butterfly is called a Kallima inachus. On one side, it looks like a beautiful butterfly, and on the other side, it looks like a leaf, and it folds up like a leaf to elude predators. So now you see it, now you don't, something hidden, something revealed. Maybe we got our ideas about the human soul from this butterfly.

01:06

So it's possible that butterflies have some sort of outsized role in our afterlife. But in this life, in this world, butterflies are in really serious trouble.

01:17

This is a moth. Moths and butterflies are related. Moths generally fly at night. This is called "praedicta," because Darwin predicted that it must exist.

01:28

So today, more than 60 species of butterflies are endangered around the world, but even more than that, insects are declining, declining, declining. In the last 50 years, we've lost nearly 50 percent of the total number of bodies of insects. Now this is a disaster. It could impact us in a more serious way more quickly than climate change, because butterflies don't do that much in the ecosystem that we depend on, but they do things for other creatures that we do depend on, and that's the same story with all insect life. Insect life is at the very foundation of our life-support systems. We can't lose these insects. Biodiversity all over the globe is in a vast decline. Habitat loss, pesticides, herbicides and impacts of climate change. Habitat loss is very serious, and that's where we really have to get developing better, more mindfully.

02:28

It's the worst of times, we are kind of overloaded with our problems. It's also the best of times -- there's incredibly good news. We have exactly what we need. We have exactly the platform to save nature. It's called citizen science.

02:43

So citizen science is generally a term used to mean people without a PhD contributing to scientific research. Sometimes, it's called community science, which gets at the communal purpose of citizen science, which is to do something for our commons together. It's amateur science. It's being turbocharged today by vast computing power, statistical analysis and the smartphone, but it's an ancient practice that people have always practiced. It's amateur science. Professional science has its roots in amateur science.

03:14

Charles Darwin was a citizen scientist. He had no advanced degree, and he worked only for himself. So someone showed Darwin this Madagascar star orchid, which as a spur that's 12 inches long, and the spur is the part of a flower that the nectar is in. So this person showed this to Darwin and said, "This proves that evolution does not come about in a natural way. This flower proves that only God can make these incredibly bizarre and tricky-looking creatures on the earth, because no insect could possibly pollinate this. God must reproduce it." And Darwin said, "No, I'm sure that there is an insect somewhere with a proboscis long enough to pollinate that star orchid." And he was right.

04:05

This is a map of the monarch butterfly. So, the monarch butterfly has a different story than that particular moth, but reflects the same kind of fundamental idea that Darwin had called coevolution, and coevolution is at the heart of how nature works, and it's also at the heart of what's going wrong with nature today. So over time, as the moth developed a longer proboscis, so the plant developed a longer spur. Over millions of years, the plant and the moth developed a relationship whereby they both make each other's chances of existence better. The monarch butterfly has a different kind of coevolutionary relationship, and today, it is at the heart of what's going wrong for the monarch butterfly.

04:52

So this is a map of the monarch butterfly migration. The monarch does this amazing thing, and over the course of a year, it goes over the entirety of North America. It does this in four or five

generations. The first generations only live a couple of weeks. They mate, they lay eggs and they die. The next generation emerges as butterflies and takes the next leg of the journey. Nobody knows how they do it. By the time the fifth generation comes back around -- and that one lives longer, they overwinter in Mexico and California -- by the time it gets there, those butterflies are going back to where their ancestors came from, but they've never been there before, and nobody that they're immediately related to has been there before either. We don't know how they do it.

05:37

The reason we know they do this kind of migration -- and we still have a lot of unanswered questions about the monarch migration -- is because of citizen science. So for decades, people have made observations about monarch butterflies, where and when they see them, and they've contributed these observations to platforms like Journey North. This is a map of some observations of butterflies given to Journey North. And if you can see the dots are coded by what time of year those observations were made. So these massive amounts of data come into a place like Journey North, and they can create a map of this time of over a course of a year of where monarchs go. Also because of citizen science, we understand that monarch butterfly numbers are going down, down, down. So in the 1980s, the overwintering butterflies here in California, there were four million counted. Last year, 30,000.

06:35

(Audience gasps)

06:36

Four million to 30,000 since the 1980s. The monarchs on the east coast are doing a little better, but they're also going down.

06:44

OK, so what are we going to do about it? Well, very organically, nobody really asking anybody to do it, people all over the continent are supporting monarch butterflies.

06:55

The heart of the problem for monarchs is milkweed. It's another coevolutionary relationship, and here's the story. Milkweed is toxic. It has a poison in it that it evolved to deter other insects from eating it, but the monarch developed a different kind of relationship, a different strategy with the milkweed. Not only does it tolerate the toxin, the monarch actually sequesters the toxin in its

body, thus becoming poisonous to its predators. Monarch butterflies will only lay their eggs on milkweed, and monarch caterpillars will only eat milkweed, because they need that toxin to actually create what they are as a species.

07:37

So people are planting milkweed all over the country where we have lost milkweed due to habitat destruction, pesticide use, herbicide use and climate change impacts. You can create a lot of butterfly habitat and pollinator habitat on a windowsill. You go to a native nursery in your area and find out what's native to where you live, and you will bring beautiful things to yourself.

08:01

Now, citizen science can do even more than rescue monarch butterflies. It has the capacity to scale to the level necessary that we need to mobilize to save nature. And this is an example. It's called City Nature Challenge, and City Nature Challenge is a project of the California Academy of Sciences and the Los Angeles Museum of Natural History. So for four years, City Nature Challenge has enjoined cities all over the globe to participate in counting up biodiversity in their cities. We're up to, like, a million observations of biodiversity collected by people around the globe this past April. The winner this year was South Africa, much to the chagrin of San Francisco.

08:47

(Laughter)

08:48

Look at them, they have more biodiversity than we do. It's kind of an interesting thing, what is revealed when you start seeing what are the natural resources where you live, because as we go forward, you want to live where there's more biodiversity. And by the way, citizen science is a very good tool for social justice and environmental justice goals, for helping reach them. You need to have data and you need to show a picture, you need to point to a cause and then you need to have the surgical strike to help support whatever that problem is.

09:16

So City Nature Challenge, I think, should get a commendation from the UN. Has there ever been a global effort on behalf of nature undertaken in this coordinated manner? It's amazing, it's

fantastic and it's really a pretty grassroots thing, and we get very interesting information about butterflies and other creatures when we do these bioblitzes.

09:41

City Nature Challenge basically works with a tool called iNaturalist, and iNaturalist is your entry drug to citizen science. (Laughs) I suggest signing up for it on a laptop or on a desktop, and then you put the app on your phone. With iNaturalist, you take a picture of a bird, a bug, a snake, anything, and an artificial intelligence function and an expert vetting system works to verify that observation. The app gives the observation the date, the time, the latitude and the longitude, geolocates that observation. That's the data, that's the science of citizen science. And then that data is shared, and that sharing, that is the soul of citizen science. When we share data, we can see much bigger pictures of what's going on. There's no way to see that whole monarch migration without sharing data that's been collected over decades, seeing the heart and soul of how nature works through citizen science.

10:42

This is a Xerces blue butterfly, which went extinct when it lost its habitat in Golden Gate Park. It had a coevolutionary relationship with an ant, and that's another story.

10:52

(Laughter)

10:54

I'll end by asking you, please participate in citizen science in some way, shape or form. It is an amazingly positive thing. It takes an army of people to make it really work.

11:08

And I'll just add that I think butterflies probably really do have enough on their plate without carrying around human souls.

11:16

(Laughter)

11:18

But there's a lot we don't know, right? And what about all those stories? What are those stories telling us? Maybe we coevolved our souls with butterflies? Certainly, we are connected to butterflies in deeper ways than we currently know, and the mystery of the butterfly will never be revealed if we don't save them. So, please join me in helping to save nature now.

11:42

Thank you.

11:43

(Applause)