Dr Ron Ehrlich: Hello! Welcome to Unstress. My name is Dr. Ron Ehrlich. Today is a big and very important episode. Well, they're actually all important. So I want to get right down to it. My guest today is Professor Fred Provenza. He is currently Professor Emeritus of Behavioral Ecology at Utah State University.

For the last 30 years, Fred and his research group has produced groundbreaking research that has laid the foundations for what is now known as Behavior-based Management of Landscapes. You don't have to be out on the land. Your landscape goes on in your own house. So listen up.

That work has inspired researchers in many diverse disciplines, including ecology, human and animal nutrition and biopsychology, animal welfare, landscape restoration, sociology, eco development and much, much more. Together with colleagues and graduate students, he has been an author or co-author of 250 publications in peer-reviewed journals and books. He has been an invited speaker at over 325 international meetings. When I spoke to him, he was in Montana, USA and I was in Sydney, Australia. I know that doesn't constitute an international meeting but we certainly enjoyed talking to each other.

He has recently released a fabulous book called, Nourishment: What Animals Can Teach Us About Rediscovering Our Nutritional Wisdom. It turns out they are much smarter than we give them credit for. We do, in fact, have much to learn incidentally. As you can hear, plants are also pretty smart too. I'll let Fred explain. I hope you enjoy this conversation I had with Professor Fred Provenza.

Welcome to the show, Fred!

Prof. Fred Provenza: Thank you very much, Ron! Wonderful to be here with you.

Dr Ron Ehrlich: Now, Fred, we are going to be talking about this wonderful, wonderful book called, Nourishment. Before we jump in, I wondered if you might share with our listeners a little bit about your journey which has brought you to this point professionally, personally.

Prof. Fred Provenza: Happy to do that. For me, it starts as a young fellow with just an absolute fascination with nature and natural kinds of things, especially back in those days: wild animals, anything that moved whether it was an insect, a bird or a mammal, I was just fascinated with those kinds of things.

So I often tell people, "For me, growing up there were only three seasons: hunting, fishing here in the US and then skiing. Those were the three seasons for me. It was a natural then when I went to college to enroll in Wildlife Biology where I was able to learn so many things about ecology, plants and how they work, and animals. It was just amazing.

At the same time, I was working on a ranch in Colorado, in the central part of the state, in the heart of the mountains there, and just absolutely loving and learning about that part of things:

working with sheep, cattle, goats, irrigating crops, harvesting. It was wonderful. The two things really came together for me.

When I finished school at Colorado State University, I really didn't know what to do next though. I knew I wasn't going to be a wildlife biologist; I don't know why. I just knew. The old fellow that I talked about in the book, Henry Deluke and his wife, Rose, who became like parents to my wife and I actually, they encouraged us to just come there. They needed someone to run the ranch year round. So I did that for two years and just took a little time to ponder. I don't know why but I just thought research would be interesting.

So I started looking into graduate school, ended up by Utah State University, and realized that I absolutely love doing research and learning about plants and animals and the relationships between those. Fifty years later, here we are. I've written this book that's reflecting on that journey.

Dr Ron Ehrlich: Before we came on I said, "I've got to read your book." I knew we're going to have this conversation. As I was reading it, I jotted down some questions and I thought to myself, "How cold is this? The author is going to actually answer these questions." I have to do it anyway.

Listen, one of the things I wanted to start 'cause you talked about plants and animals and that whole connection with the earth, which obviously you were attracted to, 'cause as species we've been connected with the earth for a very long time, but in the last 50 years or so that's really changed for us. How has that change, do you think, affected us as a species and also the planet?

Prof. Fred Provenza: I'll speak to my experience here in the U.S. I think that certainly relates to some of what you've experienced in Australia. I think that we've fundamentally broken our linkages with the landscapes that we inhabit and ultimately nurture us. This gets very personal so I don't mean to be trying to talk like this for everyone. When we break those linkages with landscapes, we ultimately end up harming ourselves both physically and spiritually. I think we're so deeply connected after the eons that we've evolved on this planet and that's been manifests here in this country in many different ways that lead to poor health, both physically… You know the crisis that we face now on obesity, diabetes, diet-related diseases basically—

Dr Ron Ehrlich: Mental health.

Prof. Fred Provenza: -- in terms of the planet and the health of the planet. The things that I see people do that makes me think we've just broken those linkages with what a sacred place this planet is and how critical it is to nurture it if we want to nurture ourselves. In all of that comes the spiritual part of things—at least for me personally as well— those deep feelings that I tried to express in different places in the book of just how sacred it all is with nurturing relationships with one another and with the environments that we inhabit.

Dr Ron Ehrlich: Yes, ‘cause one of the things that you raised in the book is our ability to identify and choose nourishing foods. Yeah, that seems to have been hijacked in a way, isn’t it?

Prof. Fred Provenza: Absolutely has. Absolutely has been hijacked. It happens gradually, as you say over the last 50 or even we could say 100 years here in the United States, but certainly in the last 50 to 70 years. So as we go from generation to generation within those times, I think we don't even realize what’s been lost. So it really takes some kind of awakening and transformation to think about what has happened, how have our food preferences, food selection, our relationship with landscapes—all of those things—been hijacked? If we think that that matters, then what are some things that we can do personally to try to reconnect with the landscapes we inhabit? The food we ingest are really a great way to do that.

Dr Ron Ehrlich: Well, in your book you mentioned a study done in 1939. I think that was called, Clara’s Kids. I thought that was really amazing. Could you share that with our listeners and tell us some of the lessons that we learned from it?

Prof. Fred Provenza: I’m happy to do that, Ron. It is an amazing story. I’m going to give you some background that I know from reading some of the notes that you sent me. You’re interested in as well. We were doing studies several years ago on the importance of choice and ability to choose for animals. We studied that on extensive landscapes where animals can have up to maybe even 500 different species to select from. We were realizing how important that is, because those landscapes become nutrition centers and pharmacies, both things for animals. So I spent a career studying how does that work.

Well, we were doing work with an animal nutritionist. In animal science and animal nutrition, they’ve spent many, many years and done a wonderful job of trying to understand how needs for nutrients, like energy, protein, minerals, vitamins and putting all that together. One of the reasons they did that was to try to produce animals and meat for people in the U.S. and across the globe.

The way that we went here in the U.S. was originally, animals were finished on pastures. That’s a totally different system from where we evolved after World War II, which is the feedlot system. So animals are born and raised on these extensive pastures and range lands, but during the last few months of their life, they go into feedlots. They’re fed, what’s referred to as total mixed rations. What those are rations that are formulated from different

ingredients, for instance, corn, barley, corn silage, alfalfa, ingredients like that that are mixed in proportions that meet animal's needs. Those ingredients are ground up and mixed so that the animals really have their little ability to self-select from that. It's formulated for the "average individual."

Well, we had done so much work by then that showed there is no such thing as an average individual. Every individual is so different in terms of how it's built and how it functions. So in terms of how it behaves and what it needs to meet its needs, each one is unique. You might think from a human standpoint, each one of us is so different we can be identified by our fingerprint and a bloodhound can tract us by our odors.

So the question we were asking were simply, "What happens if we allow animals to have a choice of the ingredients that go into the total mixed ration or compare that with animals that are fed the total mixed ration? " It was amazing what we found. When we offered animals a choice, they actually ended up eating less food than the animals that were fed the total mixed ration. Why? Because animals in that total mixed ration were over ingesting in order to meet needs for certain nutrients that were in that food.

We could make the argument for instance that they were over ingesting energy to meet needs for protein. Regardless, it costs more money to finish the animals on the total mixed ration than when animals were given a choice, because each individual was allowed a better choice to select what it needed to meet its needs. So animals ate less.

The other thing that was interesting was no animal ever selected the same diet from day to day. It varied like crazy what they would eat. No two individuals ever selected the same ration. So we published that research and this leads to Clara. You may wonder—

Dr Ron Ehrlich: No, no. I'm making notes for it. I'm with you still. Go on.

Prof. Fred Provenza: This leads to Clara. So there's an author in Canada who is aware of our research because he was working on books that are related to our research. In fact, in one of his books, The Dorito Effect, Mark Schatzker features the work that we did.

So Mark sent me a note and said, “Are you aware of this research by Clara Davis?” I said, “No, I’ve never heard of it.” He said, “I’ve got to send you some papers.” So he sent these papers. I was reading what Clara did. What really struck me first off was—she did those nearly 100 years ago—it was like we plagiarized what she were saying.

Some of the text in there was just exactly what we had written about the cattle given a choice. “No two individuals ever selected the same diet. No individual ever selected the same food from day to day.” That's what she’s writing. So what's the essence of Clara’s studies?

I don’t know what gave her. I would love to have met and visited with her. I don’t know how she got started on this idea of the wisdom of the body or to run a study that would reveal so much about that. But however that happened, she had the opportunity to work with people in an orphanage where children were being given up for adoption at birth. What she did was to work with, I think it was 15 children over a six-year period. Six years! This is stunning to think about.

Throughout that 6-year period, she offered those children 34 kinds of wholesome foods that could be procured at the local markets throughout the year. She simply allowed those children to select whatever they wanted. I want to point out, there were pediatricians that were working with the study and reports on it. They said they’ve never seen a healthier bunch of children.

So over the 6-year period, they run the study and documented what these children were doing and as I say, concluded really that not to be a broken record, “No two children ever selected the same diet. No child ever selected the same food from day to day but they all selected foods that met their needs.” It was interesting too that when some of the children came in for instance, they might have been deficient in certain nutrients, she knows that they would select things that would help them to rectify those deficits.

For instance, rickets was an issue back in those days, and they would select foods that would help them to quickly rectify those deficits. Once they had done that, they would no longer focus quite so much on that particular food. It became more part of the diet. That's certainly what we’ve seen when we’ve worked with mineral deficiencies in livestock, creating those mild deficiencies and then looking at how the selection of the cattle, ship and goats that we were studying changed. I think one of the things around that strikes me… So nourishment, the subtitle is “What humans can learn from these other animals,” something to that effect. As a person might think, “What can I learn from a goat? What’s a goat about to teach me about how to select a diet?” On the surface, that’s absolutely right.

But I think what we did as a research group, and I'm giving credit to many, many people that I have worked with, 50 or more grad students, post-doctoral students and collaborators over the years, was to move away from talking about what are animals eating and where are they going in the environment to really trying to ask the question: "Why are they doing that?" Why, not what.

When you start asking the why questions, then you see a commonality that emerges, whether you're talking about an insect that's self-medicating to heal itself, a goat or a human being. The why is what really took us to the commonality that I think enables a person like me to write a book like Nourishment that talks about what animals can teach us about rediscovering our nutrition wisdom.

Dr Ron Ehrlich: Yeah. Now, I've got that covered right in front of me as you mentioned it. This notion that what makes humans unique is our ability to medicate ourselves, to make medications for various illness, but as you mentioned, it turns out we're not as unique as we think and that animals, these 500 different species that are out on the pasture, it's a nutritional center but it's also a pharmacy. Can you explain that a little more—an animal will make choices that are actually designed to medicate itself?

Prof. Fred Provenza: Happy to. There's a really interesting historical context for this when I think back over my career at least, and then when I think of the human part of it, this notion that you mentioned there's a quote by the Father of Medicine that that's one of the things that makes humans unique—our ability to self-medicate. It's not to detract from all of the wonderful work that he did over the years, but it's to show that our knowledge of this is just broadening out.

Years ago, when we and others were initiating some of the research that we were doing on extensive landscape, we were all interested in trying to describe the "botanical and chemical compositions of the "diets of species X forging on landscape Y times Z," as you would say. So there were tons of studies like that. We were to realize that maybe three to five species make up the bulk of the diet for animals at any point in time, but then there's another 50, 60, 70, 80 species that are in the diets. We never made much of that. I don't think we saw them as a part of the diet nor appreciated what that probably meant for animals.

You can think of two ways to self-medicate: (1) prophylactically; and (2) therapeutically. I was talking with a rancher here, who just does phenomenal work on the landscape. So I was talking with him last week. We had a two hour visit. He was saying, “They shepherd their cattle across these landscapes, nurturing them day-to-day. We’ve got 500 species up here.” He said, I was giving a talk to 200 ranchers in Lewiston, Idaho. They were questioning me after my presentation, because it was kind of a challenge to them, a lot of what I talked about. They were saying, “How do you medicate animals up on these extensive landscapes?” He said, “I can tell you honestly, I’ve never had to medicate an animal. The pharmacy is right out there and they’re eating. The diverse array of these plants is keeping them healthy.” They say, “What about mineral supplements?” He says, “‘I don’t need a supplement with minerals. Again, they’re exposed to these diverse array of plants and so they’re getting those minerals.”

So I see that kind of a landscape where we have this tremendous diversity of plants, as opposed for instance, a monoculture or a pasture that has a handful of plants; or a feedlot, in my mind even worst, where there’s basically no choice. These landscapes that have these diverse array of these beautiful different grasses, forbs, shrubs and trees literally are nutrition centers and pharmacies. They enable animals to self-medicate prophylactically. We also know that if animals are sick, if they have high loads of internal parasites, for instance which has been studied extensively, they will seek out for instance, plants that are high in tannins or combinations of plants that are high in compounds called tannins and terpenes that occur in plants.

They’ll seek those plants out specifically, and they self-medicate on those plants. I find it really interesting too, some of the research I quoted in that chapter on “Self-medication and Nourishment,” that if we give telematics to animals, then they’ll no longer select those plants to the degree that they will when they need them to self-medicate.

So this ability to self-medicate has been demonstrated now in everything from insects. Some of the studies with insects are just absolutely fascinating to me to read how they’ll switch their selection. At the level of the central nervous system, they’re liking for plants that have the medicines they need goes up. They’ve been able to demonstrate these hedonic shifts, these increases in liking as a function of the need for a particular medicine.

So everything from insects to our work with domestic animals and other people as well to a huge amount of work by my friend and colleague, Mike Coffman on the Primate. He’s a world leader. He’s just in demand around the globe all the time to talk about the amazing study he's done on self-medication. One of the things we were able to do that it’s harder to do for people like Mike that are studying primates under free ranging conditions, we were able

to show through a series of studies that we did on sheep. That sheep will learn to select the medicine they need to rectify the particular malady.

So without going into details so I'm happy to do that. We set up three different kinds of maladies in sheep, and then we knew that three different kinds of medicines would rectify the three different maladies. We were able to show that when sheep experience a certain kind of malady and given a choice of the different medicines, they selected the medicine they needed to rectify the specific malady—no different from what we humans learned to do as well.

Dr Ron Ehrlich: Which Clara's kids instinctively did, given the choice.

Prof. Fred Provenza: Absolutely! An important thing that Clara pointed out too was that they didn't just know automatically what of those different choices. They would really sample. They'd sample a lot. We found out with animals, when they get in to a state that they're lacking a particular nutrient or they're in a particular state of malaise where they need something, if they don't already know that, they start to sample broadly. When they discover something that rectifies the situation, then they learn a preference for that. Their preference becomes really state specific. So when they experience a particular kind of internal state, then they know what to do with that.

Clara made an important point of that. She went along in that they really sampled a lot early on, and then the body would quickly hone in on what they need. Let me say some things here. As far as nutritional wisdom goes, we've talked about what I considered the three legs of the stool, Ron. Let's make them really explicit right here.

Dr Ron Ehrlich: Yeah, good.

Prof. Fred Provenza: It's fair to say that people who study food selection, nutrition and health of domestic animals until the research we did over 40 years, people didn't believe that domestic animals had nutritional wisdom. There was a sense that wild animals had it. They must have it; how else could they survive? Although some people said, "Well, if you have a broad enough array of things, just by chance alone you'd be able to do it." I think that's not a good statement because you can get poisoned really easy just by chance alone on these divers' landscapes.

With the domestic animals, there have been some trials run and for some reasons, we don't need to get into our discussion. Sheep and camel didn't select what people taught so this idea that domestic animals had nutritional wisdom went by the wayside. I think it's fair to say nowadays too with human beings that given the crisis of obesity, diabetes and all the diet-related kind of diseases, people who study human food selection, nutrition and health don't tend to think very much of this notion of nutritional wisdom.

So I really tried in "Nourishment" to develop the ideas of how nutritional wisdom functions. I didn't say this in the book, but I see there are three legs to a stool and if you break any one of those legs, the nutritional wisdom wouldn't be manifest. With human beings and with the animals on our care, I think we've broken all three of those legs. You're nicely alluding to that when you're talking about Clara's kids figuring this stuff out is what we refer to as this "flavor feedback relationships."

When we first started to realize that what's happening at the level of cells and organ systems including the microbiome is influencing liking for the flavor of food and food selection. It really twisted my mind in a big way that you could offer an animal something that wasn't nutritious at all. For instance, straw. Immediately after they ate that, infuse something into their bloodstream or drench them with something that goes directly into the gut. That is going to radically change their selection on the next day really twisted my mind. It was just stunning to think that that was happening but over and over again and some of those earlier days, we were being hit over the head with that.

So we systematically studied that with energy, protein, ratios of energy to protein, and minerals. Folks in Australia have gone on to look at vitamins. Simply, the basic idea is that cell and organ systems, including the microbiome, are sending messages to the palate and they can do that through hormones, neurotransmitters, peptides. I just read a great article in science that's pursuing this kind of stuff at a really basic molecular level, but they're sending signals to the palate to alter liking for different foods in the environment as a function of need.

If you think of a cell, I think of this and talk about it in the book you know. A cell can only forage by what's in the capillaries. What's coming through those capillaries is what the cell is able to select. So it's foraging in that sense at that level. What we realized is that those cells and organ systems are through feedback altering what's in those capillaries. This is kind of a simple way to say that.

Dr Ron Ehrlich: Yeah. Well, you used the word “psychobiology” which I must admit, I wasn’t all that familiar with. Is this part of that or can you explain?

Prof. Fred Provenza: Absolutely. The term would be really in my mind how form, morphology, function, physiology, needs, the kind of things that we’re talking about alter behavior. How the relationship between those kind of things: the psycho part and then the biology, the linkages in that sense with the landscape. So very much it’s those kinds of things. That becomes one really, really important leg to the stool. It is safe to say, before the research that we did on goat, sheep and cattle, there really wasn't a sense of that. We had to be hit over the head with it initially to start to think about that. We just did so many, many studies over the years that over and over again just showed that feedback from these nutrients; and then we started on the secondary compounds like we were talking about the alkaloids, terpenes, phenolics, tens of thousands of compounds of plants produced and their roles, not only on self-medicating but more generally in health.

So we really studied that a lot. The further along we went, the more complex we came to realize it is because it's not just energy, protein, minerals, vitamins or these alkaloids, phenolic and terpenes. It’s the interrelationships among those things that the body’s integrating. All that’s a part of this flavor feedback relationships.

I don’t know. I used to be so intent on trying to learn… We’re working with natural products chemists at the University of Alaska were hugely helpful. We’re trying to learn all these jillions and jillions of compounds. I don't worry about them so much anymore of trying to know everyone what we think we know about them. I just come to a point where I so appreciate that there’s… Strawberry, for instance, produces 5000 volatile compounds. Just 5000 volatiles! It gives you just a hint of the numbers of these compounds that plants are producing. You can take garlic, oregano, any of the herbs and spices or any of these plants that people try to look at in depth. You just see page after page of this secondary compounds.

So I have come to the point where I appreciate that there’s this incredible complexity. Through these flavor feedback relationships, the body is able to figure all of these out at a subconscious level. It’s not anything that we sit and think about. I often ask people when I’m giving talks, “How many of you are thinking about which enzymes to release to digest the food that you just take.” They all laugh. Occasionally, one or two raise their hands. Obviously, we don’t do that. All of these are happening at a subconscious level and gently guiding us in terms of our selection.

So that’s one leg to the stool, this flavor feedback relationships. You let us run very nicely into the second leg of that stool which we’ve talked about. That’s the availability of wholesome alternative foods, and that’s certainly what Clara was doing for those children in the orphanage. She was providing them with a wide array of different foods to select from.

The third part, which really what Clara became is the social cultural part. Clara became the culture for those kids by providing them with wholesome alternatives. We know from studies that we did and then many, many studies with humans that these experiences beginning in utero and then early in life are just so important as transgenerational linkages to help offspring learn what and what not to eat, where and where not to go, what's a predator and what's not a predator. All of these things are learned.

If you think about the in utero part of the experience, the fetal taste system is fully functional during the last trimester of gestation. So the foods that mom is eating, the flavors of those food are getting into the amniotic fluid, starting to prepare the young offspring for what’s food when it gets into the environment.

We did studies with this and wonderful studies by your compatriots there in Western Australia showing the same things that these experiences in utero also alter form and function. So how an animal’s built, how their body function is really being influenced by these experiences as well. For instance, we were showing that an animal who’s eating poor quality kinds of roughages (as they do during the winter time here when they’re pregnant) on landscapes, they're not only preparing their offspring to like those foods but to better able to digest those forages. So “digestible dry matter intake,” as we would say in the nutrition jargon, is enhanced for an animal that’s been exposed in utero to particular kinds of foods that it will need to survive during the harsher winter periods on our landscapes than an animal that’s never seen those.

Studies in Western Australia were sought an important part of the landscapes, Dean Ravel and colleagues showed in really nice series of studies with some of their graduate students that experiences in utero enhanced the ability of animals to utilize salt brush. They actually drink less water. You would think they would drink more but they would drink less water as a result of these experiences in utero. Kidney form and function has been changed.

So what we come to appreciate is this experiences in utero early in life are really changing animals at all levels of these organ systems, including the central nervous system where people have looked at how neurons get wired together at that central nervous system level.

So throughout the body, bodies are becoming locally adaptive, going back to our release part of this stuff to the landscapes that animals are going to be challenged to thrive in.

Dr Ron Ehrlich: This is what I also loved about the book, the way it was kind of backwards and forwards between animals and humans, animals and humans. It was so clear that we have so much to learn from that and realize we've lost so much. Interestingly, he mentioned strawberries with 5000 volatile compounds because you know, we always hear, "You ain't going to have your fruit and vegetables. It got to be vegetables and fruits— put that in that order." Vegetables and fruits because they're so much better for you. There might be a strawberry extract supplement but I'm almost certain it doesn't have 5000 volatile compounds in it. Supplements become really popular in our modern world but taking them comes at quite a price. Why might supplements not be quite as simple as they seem?

Prof. Fred Provenza: Two things come to mind right off when you asked that question, Ron. I really appreciate where you're going and what you're thinking about that. One thing that comes to my mind relative to supplements, and you really alluded to that perfectly with the strawberry… For instance, as you well know and the listeners as well, you can buy a number of supplements from omega-3 which are so popular nowadays to things like herbs, garlic and onion. Over here, you can buy odorless garlic supplements. I often tease people saying, "What good can that possibly be if you can't breathe on somebody and knock them over if you had a garlic?"

Dr Ron Ehrlich: It's part of the therapeutic value of it, isn't it?

Prof. Fred Provenza: Right. The point I'm going at this first one is that there's no way in virtually all of these cases to include the hundreds, if not possibly thousands of compounds that are in the garlic, for instance, that you would grow in your garden or might buy from a nice herb store. What strikes me is that it's the synergies amongst all those compounds that are really where the action are.

One of the review papers I read that was written by two co-authors in Australia, I think it's a fabulous paper but the title of it is something like Food, Not Nutrient, is the Basic Unit in Nutrition. The whole point of that paper is that it's the synergies that occur amongst all the

diverse arrays of wholesome foods, not the individual compounds that are in them. But we focus on that and people becomes millions, if not billion dollar industries, of taking these supplements that are really quite simple relative to the complexity that we're talking about when you eat the diverse arrays of fruits and vegetables, herbs and spices and so forth. That's really illustrated with omega-3s.

I recently wrote a paper that in part talked about omega-3s. It gives some history of how it got on the bandwagon of omega-3 fatty acids and then some of the initial research that seem to suggest that omega-3s had some health benefits in a supplemental form. We know omega-3s and omega 6s is our central fatty acids. So that's not the issue. It's the supplemental parts that we're addressing here.

In reviewing all the literature nowadays, hate to say no but basically, that's what comes out of all the analysis. There are no evidence for all these alleged benefits for taking supplemental omega-3 fatty acids or DHA and EPA which is even more micro focusing in on that. As you go though from the omega 3s to eating oily fish, which is now what I see the researchers who study this is recommending, they're highlighting that it's the synergies of all these different things. There are going to be all of these different compounds in the oily fish. That's where the action is. That's where you, as alluding to earlier, move away from this single nutrient focus to the idea that it's about synergies, eating wholesome foods and simply allowing the body… If you're eating these wholesome foods, exposing as Clara did to her children to this array of wholesome foods and just letting the body guide you meal after meal and day to day. Don't worry about all the specifics of how any one compound's acting because we probably will never get our heads around all of that.

Dr Ron Ehrlich: Yeah. It's interesting because in all the podcasts I've done, and it doesn't matter whether I've been talking about regenerative agriculture farming soil, if it's the soil microbiome, an oral microbiome or gut microbiome, a word that keeps cropping up as being so totally important is the word "diversity."

Prof. Fred Provenza: Yes.

Dr Ron Ehrlich: I mean, the more diverse… Here we are talking about it nutritionally. You're saying, "Well you could take a supplement but hey, you might get 1, 2, 5, 10 compounds in there, but you could eat the food and get 5000. So there's a diversity there.

Prof. Fred Provenza: Absolutely.

Dr Ron Ehrlich: You're talking about a phatic that offers an animal 500 different species and allowing them to self-medicate and diversity, diversity, diversity. It's really an important word, isn't it? Constant.

Prof. Fred Provenza: Honest to goodness, it is. You asked me where my interest started, and I explained some of that. I think back to when I was a young undergraduate, 57 years ago, and going to school at Colorado State University. Ecology was a fairly young discipline back in those days, but even then they were talking about the importance of diversity. I understood what they were saying, but I have to say, after a lifetime of working with that, they were just on target with that.

So that has not gone away, the notion of the importance of diversity and ecological systems. Diversity, I often think of it in terms of plants because plants are so much the glue that binds everything together. Of course, now, there's a huge interest in the soil, rightfully so and all the life that's in soil—moving away from just the physical chemistry of soil to the life and that's where the action is. I certainly appreciate that and the notion that there are herbivores, omnivores and carnivores below ground that are all munching on one another and facilitating relationships of plants with the mineral soils and so forth.

So there's a tremendous diversity within soils, but I think so much of plant diversity. Without plants, there's nothing below ground. Without plants, there's nothing above ground. I see them as just amazing.

My mother had always grown gardens and she loved plants. She loved horticulture plants. Our yard had lots of them. So I was exposed to plants. I have to say I never really had seen a plant until that spring semester when I took a class in plant identification. We had to go out, collect 50 plants and mount them on our barium sheets. We had to learn how to use these horrible dichotomous keys, you know these monstrous books. We had to read an entire book just to learn the terms that are in these monstrous dichotomous keys. But I tell you, going out there and identifying those plants just about bring tears to my eyes, even to this day because it's like I really got introduced to plants. These little plants that come up in the spring of the year, some of the first to pass flowers here, are just stunningly beautiful. Plants, and not just for diversity. It's amazing.

Dr Ron Ehrlich: Fred, you have this notion about intelligence. I think our listener is getting a sense that animals actually do have an innate intelligence. We could argue about the innate intelligence of humans. I think it's there. It's just being suppressed. You also mentioned about the innate intelligence of a plant. You point out that in fact, they're very intelligent. Can you explain that to our listener?

Prof. Fred Provenza: Yeah, years ago there were books. I remember one in particular that was published on the wisdom of plants. It was stunning to read that book but it was a little ahead of its time. A lot of the scientists kind of poopooed the book basically. In the time since that book came out, which is maybe 30, 40, 50 years ago. I can't remember. It's an old book, The Secret Lives of Plants.

There's been so much research done right up to books like I talked about in Nourishment, this one titled, Plant Intelligence. The rigor that's gone into the research that underlies a book like that is stunning. It's just topnotch science at the most basic levels, and simply revealing plants are conscious. They interact with the environment in stunning ways. What deceives us is they don't get up and walk around. We don't see like we might see our pet cat or dog engaging in behaviors that we can relate to more.

Well, plants do move. They track the sun in lieu of tropism. Down below ground, it's stunning to see the way roots interact with that environment—roots forage. They'll seek out water of course, they'll track water in the environment, they'll seek out nutrients they need. They're very actively foraging below ground, much as we would above ground.

Plants can communicate with one another. That's one of the things that came clear during my career by research that some of the plant ecologists did. So we mentioned the strawberries and the 5000 volatile compounds. That's a key way that plants communicate with one another and with organisms in the environment. So they'll produce these compounds—they're volatile. So through the stomachs, they'll be released and they get out into the environment, and they can alert plants. For instance, if a plant is being eaten by a caterpillar, goat or whatever it is, the plant that's having that happen to it will release its volatile compounds. That will be a cue to the plants around it. "Hey, better kick up the concentrations of these compounds that deter animals from eating us." So we see a rise in those concentrations of compounds.

So they release these compounds and predatory insects that are predators on the caterpillars will have learned that, “Hey when the plant releases these compounds that means there’s food on that plant.” So they’ll come and attack the caterpillar.

So there are amazing kinds of relationships that plants have with the environment that we simply didn’t realize in the past. I mentioned in the book, plants were the first biochemists. I originally had a whole chapter on plants. I reduced it to, not too much in the book now, enough to give this flavor. There was an entire chapter and of course, as we’re saying, people are writing entire books on this.

This whole business of plants and plant intelligence, and in the book I talked about plants as the first biochemists. For any people who have taken biochemistry, you realize there’s an incredible level of what goes on in organic chemistry at all. For some people, it’s mind boggling to the point where they can’t think that way. They don’t like biochemistry at all.

For certain, it’s an amazing field of inquiry. People who are biochemists, we tend to hold in high esteem and the things that biochemists have done are amazing. But then one realizes, plants were probably like I say in the book, “the first biochemists.” They’re doing that all the time. So then I raised the question, “What are we to think of that when it comes to plants? Do we just think of them as a machine?” I try to argue in the book, no it’s really not. You know back in the day, when biochemists and physiologists were studying plants, they were focusing on nitrogen, phosphorus and potassium from a mineral standpoint and of course, photosynthesis and these processes. They realized there were these tremendous number of other kinds of compounds. They’re so interesting to me to realize that they originally referred to them as “waste products.” I used to think, “Well, okay. That makes sense. Maybe it’s kind of the feces, what’s left after plants do their primary metabolism—off with protein, energy, all that kind of stuff.

Well, that changed. At that time I was a young pup in the field, the ecologists were referring to them as “secondary compounds”. In other words, we had all these primary compounds that we understood their roles and then there were these other so-called “secondary.” What we’ve come to realize in the last 50 years is they’re not secondary at all. They’re fundamentally important for plants as they mediate interactions with the external environment. They’re just in concentrations of these compounds as a function day to day of their interactions with other plants, animals, temperature, and everything that goes on in the environment. These secondary compounds are playing really important roles. That’s a whole amazing area.

Dr Ron Ehrlich: What gives plants colors? The secondary compounds as well or is that a whole other area?

Prof. Fred Provenza: That's right. All of these secondary compounds give these vast array of different colors that occur. Of course, green we know is a common one, but then all these other reds, oranges, salmons that occur in leaves that reveal different classes of compounds that are functioning and then the showy flowers that are just stunning in their different colors and serve as ways to attract insects and--

Dr Ron Ehrlich: A lot of people are vegan and vegetarian because they feel you shouldn't be eating an intelligent animal. I've just kind of started to throw up this whole new ethical question. "How do I justify myself ethically by eating an intelligent plant who communicates, forages, sends out signals to other animals and plants?" You know what I mean? I will eat my vegetables. I will eat my vegetables but I'm just saying that there is a much bigger ethical issue here than let's not kill animals.

Prof. Fred Provenza: Honestly, Ron. I so appreciate you saying that. I think it really raises and goes back to a question you asked at the beginning—our relationship with the environments. I think there's a real interesting irony to be pondered in that notion that life lives on life. Life can't exists without living on other life in a very real sense. Plants, of course, are the givers of that below ground and above ground. What it brings in to me is that whatever way a person chooses to forage, to realize that it's all sacred, whether you are foraging on a plant, an animal, or whatever you choose or combinations of those, I think that's a part to me where it takes you back to "It's all sacred."

My wife, Sue and I who were peas in a pod related to loving the outdoors, to fish and to hunt which is really our foraging activities. We love to grow gardens. Now, here where we are in Ennis, we have a vegetable, herbal and medicinal gardens. That's a really nice thing when we either grow or procure our own food in one way or another, especially if it's out of this notion that you're making me think about relative to the sentience and consciousness. You know, that it's all life and sacred in our relationship. Only by nurturing the environments that nurture us are we going to really be able to continue to exist on this planet. We were talking before we got on air about Charles Massy's book, The Call of the Reed Warbler.

Dr Ron Ehrlich: The Call of the Reed Warbler. Beautiful book.

Prof. Fred Provenza: Yeah, and I'm thinking about the aboriginal people in Australia and the U.S. Before all of the modern technology and what fossil fuels and all of that enabled, people really did have very intimate relationships with landscapes. I think they saw it all as sacred in that sense of you know, that's what's nurturing us ultimately.

Dr Ron Ehrlich: Now Fred, we've got a very anthropocene of people-centered view of the world.

Prof. Fred Provenza: Yes.

Dr Ron Ehrlich: Tell me, are you an optimist? Do you reflect on how we're going at this point in time and do you feel optimistic?

Prof. Fred Provenza: I've always been an optimist. I've never been a fearmonger. It's not in my nature. So I am. I do see reasons for optimism. Saying that though, I think too that there are reasons for us to be paying attention. In our country, there are people who wrote interesting things about what we're talking about back in the day. One of them, that all of us a natural resources get exposed to a fellow named Adler Leopold and he wrote, A Sand County Almanac, probably 75 years ago, he's writing about these things.

I've read that several times. It's just beautiful stories of his knowledge and intimate relationship. It's amazing. Here, he was concerned back in the 40s in writing in such beautiful prose about what was happening. If he thought it was bad then and in the sense of the human footprint on this landscape, he hadn't seen anything.

So now we're in the anthropocene.

Dr Ron Ehrlich: hat's it.

Prof. Fred Provenza: I often think the anthropocene and some of its symptoms from species extinctions. If it's not outright extinctions, the massive influences we're having on populations of everything from the insect world to the fish world to the coral reefs to the herbivore populations, there's no denying that we are massively influencing their numbers. And then we think of things like changing climates and the degree to which humans are influencing that. I think we really need to be doing everything we can as individuals to not have each footprint be a littler footprint. You and I should try to think about that here and what are things that we can do. I'm not trying to say like we're some great saints. At least you just realize it. By being on the planet, you are participating in all these stuffs.

But then, there are things that one can think about on how to try to reduce the footprint. We were talking about an article related to the world of agriculture. In that sense, each of us can be little agriculturalists. I mentioned that Sue and I love to grow our own herbal, vegetable and medicinal gardens. We don't have a large property here—in state terms, it's an acre and a half—but we've really worked to revegetate it, to encourage the native plants species that grow here and the diversity that's here and to have a smaller lawn because we see that as places where you can put a lot of water, fossil fuel and pesticides if you want— we don't. But we try to encourage the native plants. We plant a ton of probably 150 different species of trees and native shrubs that produce berries. Again, I'm not trying to sound like we're… I'm just trying to say there are things that each of us can do at a really local level in terms of how much energy we use.

But then agriculture as a group, there's this huge report that's just come out, The Eat- Lancet Report.

Dr Ron Ehrlich: Yes.

Prof. Fred Provenza: You know, is certainly drawing attention and arguing that there's a huge relationship between the foods we eat, human health and environmental health. That is so true. Then one can think about, what role does agriculture play? We know that agriculture has a fair size footprint.

So a lot of times, agriculture and raising a beef for instance, really gets negative press. But what one can realize is that domestic animals when managed in really good ways, like Charles Massy talks about throughout the Call of the Reed Warbler with example after example after example. When you put them together as a group, simple pasture, grazing management, intercropping and on and on, those are the top ways that we can, not only reduce greenhouse gas emissions but sequester greenhouse gases.

Because it's things that we can do of just to fearmonger or to be pessimistic doesn't do much. But if we think, "Okay, here's to the best of our knowledge things that we've done and ways that we've broken our linkages with the landscapes that nurture us" then we think, "Well, what are things that we can do." There are things at the household level right on through to agriculture and as we'd like to say, "Here, we all vote with our dollars."

Dr Ron Ehrlich: Yeah, that's a big one.

Prof. Fred Provenza: At the political level, I think nobody likes politicians much. They always poll really low down in the 20s. I'm not badmouthing them but that's tough duty at that level. We vote with our dollars so we can encourage the kind of behaviors that we would like in Corporate America through the things that we purchase and don't purchase. That feeds back then to these higher levels of relationships between corporate and political kind of interactions and relationships. I am optimistic in that sense. "By participating, we're creating" like I ended up on Chapter… By the things that we do, it's never a neutral thing by participating and helping to create.

Dr Ron Ehrlich: Now, we're just coming to the end, Fred. It's been terrific. I can't believe. Well, we cover quite a territory here but I just want you to take a step back. To a logic extent, you may have already answered this. Taking a step back from your role as a researcher, learner as well as a teacher, what do you think is the biggest challenges for people on their health journey through life in our modern world today?

Prof. Fred Provenza: That's an excellent question, Ron. The time has gone really quickly and I want to do enough to you for the service that you're doing with the podcast and for the wonderful kinds of issues that you discuss on a regular basis related to that question—to health. I know you do a good job of covering all the different facets of that. It's such a diverse thing of what makes us healthy, you know, the physical aspects of that, our relationships with one another, environments that we inhabit and then the spiritual nature of that, the notion of how sacred everything is. To me, just this notion of gratitude for reading the book. I tend to view this as a visit. We're here for a visit. We barely stepped under the planet and we're gone. For me, even though you can look and see all the horrors that are here and certainly look, and "Oh my goodness, some of the things…" But then, there are incredible beauties, the wonders and the mysteries. I think getting wrapped up in that and for me, gratitude for the chance to however all that works, to be able to be here for the blink of an eye. I try to think of that sometimes when I get a little negative just to be grateful for it all.

Sue and I were living in those backwoods where I wrote the book. I could have never written this book if we weren't living there. I couldn't have done it from the office at the university or wherever. We were just in a meditation there basically surrounded by nature and the beauty of nature. I got out of the "professor" mode, not interested in trying to study anything anymore, in having to teach courses basically whatever it was and just got like a child again. You know, like made these transformations from the child into all of the stages of life where you have to do all these things and then to get the chance to transform back into a child again, and just awe of the beauty, mystery and the wonder.

That really happened when we were there backwards. Sue and I, both just struck me with it. Heaven and there are some books that I was reading that I talked about in there. I used to think a lot about this notion of heaven really isn't a place. It's a state. You're in a dimension of that. I used to look around and think, "Oh my goodness! I just totally get that." It was so refreshing for my health. I think all those kind of things really contribute to overall health, physical, mental spiritual, the whole ball of wax.

Dr Ron Ehrlich: Well, Fred that's a great note to finish on. Thank you so much for joining me today and for sharing so much of your knowledge with my wish list. Thanks for joining us, Fred.

Prof. Fred Provenza: Ron, thank you very much for having me. It was an absolute pleasure to visit with you.

Dr Ron Ehrlich: That word "diversity" keeps popping up. It's a recurring theme on this podcast, and it's very well worth exploring. Diversity builds resilience, and resilience is what we need in our modern world. Imagine the diversity of nutrients, we haven't discovered yet if you just ate real food. A humbled strawberry with 5000 volatile compounds if you needed motivation for eating your vegetables and fruits and keeping the carbs low of course, that would have to be it.

Another word is ethics and how interesting to hear how intelligent plants are as our animals. The more we rely on processed foods and supplements, the further we move from our own nutritional wisdom using foods prophylactically to avoid disease and therapeutically to treat it. When I read his book, so much in it resonated with me. It really is a fabulous book. It's really well-worth read. We'll have links to it in the show notes.

Now, there's really some exciting stuff coming up. We have our own Unstress app. Yes, our own app! Now, I mentioned this podcast was a little self-indulgent. I often said that and that I really enjoyed talking to people who know much more than me. Every week, I get to ask them questions and they answer them. I learned a lot when I research them and I talk to them. It occurred to me, while I was on the self-indulgent trip, there were so many clicks to find the latest episode. People are doing so much on their phones so maybe, a simple app would be a good idea.

So there it is, downloaded and keep in touch. There's a lot going on. There are some free webinars, great eBooks and an online posts, workshops, blogs, Facebook, etc.

So until next time, this is Dr. Ron Ehrlich. Be well.