USDA Forest Service

URBAN FOREST CONNECTIONS

webinar series

Restoring Urban Ecosystems with Trees: Cleaning and greening

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TRANSCRIPT

Dana Coelho: Hello, everyone, and welcome to the U.S. Forest Service's Urban Forest Connections webinar series. I'm Dana Coelho, Urban & Community Forestry Program Manager for the Rocky Mountain Region of the U.S. Forest Service and will be moderating the webinar today, *Restoring Urban Ecosystems with Trees: Cleaning and greening*. We'll hear from two speakers: Ron Zalesny, Team Leader and Research Plant Geneticist with the U.S. Forest Service Northern Research Station, and Richard Hallet, Research Ecologist with the Forest Service New York City Urban Field Station.

Our first speaker, Dr. Ron Zalesny, earned his Ph.D. in forest genetics from Iowa State University. He develops short rotation woody crops for phytotechnologies, fiber, and energy. His primary research focus is testing the genetic and physiological mechanisms governing tree growth and development for the provision of ecosystem services. Dr. Zalesny is the coordinator of the International Union of Forest Research Organizations Working Party on Poplar and Willow Physiology and Genetics and he is editor of the *International Journal of Phytoremediation and BioEnergy Research*.

Our second speaker is Dr. Richard Hallett. Dr. Hallett has spent his career studying tree and forest health in the northeastern United States, working towards earlier detection of tree stress caused by acid rain, exotic insects, and diseases. Among his current research projects is a team effort to develop remote sensing technology to map urban tree health. He is also conducting research on urban forest restoration and afforestation, primarily in Kissena Park in Queens and Freshkills Park on Staten Island in New York. When Rich is not deeply engaged in urban forestry and the science of tree health, you may find him judging Timbersports competitions around the world, downhill skiing amongst the trees, or sea kayaking. Thanks to both of you for joining us today and Ron, I think I will turn it over to you to get us started.

Ron Zalesny: Thank you for having Rich and I speak today, and we are really excited to talk about cleaning and greening urban ecosystems. So to get going, we are going to be talking about the continuum from ecosystem degradation to ecosystem restoration, and what we as foresters and natural resource managers and other people interested in general ecosystem health in urban areas can do to restore our ecosystems after starting with degradation. And, of course, the definition of degradation and restoration is very subjective. Everybody probably looks at those words and has different thoughts. But Rich is going to talk later about restoration in terms of the urban work that he's working on and you'll get a good feel for restoration in the context of cleaning degraded sites as I speak. We are really looking at this continuum like, I said, and oftentimes what we find is that people get the impression that they can go from degradation to restoration by walking along this bridge, this road, and it's going to be very easy and they're just going to get there and there're going to put some trees in the ground and everything's going to work. But what we've realized and what has been known for quite a long time is that given the anthropogenic impacts that we as humans have caused, it's not that easy. It's not just a matter of putting some plants in the ground, without knowledge of those plants, without knowledge of the contaminants and potential pollutants that are in the groundwater and soil, and things like climate, so precipitation and soil condition, and all those kinds of things.

So today, we'd like to take you on a little journey, and we'll continue the journey. And we'll start the journey by discussing a brief restoration ecology primer and then continue that on and I will discuss work that I've been doing with regards to phytoremediation. So for those of you who don't know what this is, don't worry about it. Don't feel daunted right now; you'll learn a lot about it in the next slides. And then I'll pass the baton over to Rich and he'll discuss some afforestation work, the greening portion of the presentation, as you saw before. And lastly, especially for those of you it looked like from that poll that the majority of you are with city and county governments and other people that have these types of sites, interested in having, in developing partnerships with the U.S. Forest Service and with other colleagues to try to move from degradation to restoration, and Rich will lead that as well. And so, ultimately what we would like to do is get you to the point where we provide you with information you can put in a toolbox to say, "Okay, now we have some options to move from degradation to restoration."

First, we'll just go through some terms. You'll hear us talk today about ecosystem services. The most basic definition is the benefits people obtain from ecosystems. You can see it right there on the upper right there, the cover page of the *Millennium Ecosystem Assessment*. This is another one of those terms where if you have 100 people, you're probably going to get 100 different definitions. We are trying to put them into the context of what the *MEA* says. And the *Millennium Ecosystem Assessment* breaks it into four categories: cultural services, which are these nonmaterial benefits obtained from ecosystems, so the spiritual, educational values; in addition to supporting services, so take yourself back to high school biology class when you went through the nitrogen cycle and the water cycle and all of those processes that maintain ecosystems; in addition to provisioning services, so what we get from the ecosystem in

terms of goods or products. So this could be biomass for paper, structural lumber, in addition to fresh water. And lastly, regulating services, so things like erosion control, soil quality. These are really, these are the benefits that we get from the control of those processes that were up there in the supporting services.

So I said I'd talk about restoration ecology and for some of you, you've probably seen this many times. But one of the keys to phytoremediation, and what I talked about on that introduction slide, is the concept of moving from ecosystem degradation to restoration. Oftentimes, what we find is that when we initially speak with a landfill manager or the manager of an industrial brownfield or someone from a regulatory agency, there is a misconception that you can go straight from degradation to restoration. If we put this continuum on this scale, we see species diversity and complexity on the x-axis and positive ecosystem function on the y. And that could be anything – plant biomass, it could be diameter of the plant, it could be the amount of berries you get off of a plant, something like that. But the point here is that there are all these re- words – recovery, rehabilitation, reclamation – that have to occur before you get to restoration. And one of the most important there from the standpoint of what we're speaking about today is remediation. And so with remediation, it's the step before we get to restoration and the important thing here is about plant selection and thinking about what plants 1) can be grown on these polluted sites, 2) what plants can actually take up and clean up the soil that is at the contaminated sites, and ultimately move us to restoration. I define these as the workhorses. We know that there are three or four genera of trees that are workhorses, and I will get to those in a minute. I want to depict what's in my mind anyway. When I saw this picture, I like this from the standpoint of, here's a good healthy tree that's growing where nothing else will grow. So obviously, the trees were cut down, but you can see a lot of bare soil and bare sand there and everything. But what we are really looking for are these trees that really will grow when virtually nothing else will grow there.

From a phytoremediation perspective, you will hear me talk about this word – I just mentioned it – and, like I said, for some of you, this may be the first time you've ever been exposed to this concept. Essentially, it means using trees to clean up contaminated sites. So that could be soil, it could be groundwater, it could be sludge along the riverbank where there's petroleum hydrocarbon contamination in a canal, for example. And I won't get into the details of this because it's not the point of the presentation today, but what I do want to highlight here is that there are many processes with phytoremediation. And they all relate to two things. The first is where in the tree the actual breakdown or uptake of the contaminant occurs. So you can see a lot of processes going on here in the root system, for example, rhizofiltration, where there is actually active transport of pollutants that are going through the roots, up into the stem and leaves of the tree. You also have something like rhizodegradation down here, which actually is not actively taking part in the plant roots, but it's taking part in the soil. And the plant roots are creating an environment for microorganisms to live and those microorganisms are actually breaking down and eating the contaminants. I won't describe these processes in detail now. If anyone's interested, we can certainly have a conversation after the call or I can give you some literature about it. But I just want you

to think of the concept of breaking down the pollutants in various tissues of the tree and also, like I said, with those microorganisms in the soil environment.

The second thing related to phytoremediation that's really important is related to the kinds of pollutants that are at these sites. From a chemistry perspective, there are organic contaminants and inorganic contaminants. Organic contaminants contain carbon. These are typically human-made things, like petroleum hydrocarbons, or TCE, PCE, so these industrial solvents, and there exist just a whole slew of them, most of which most of us probably can't even pronounce. The inorganics are things like heavy metals, salts, something you would see in the periodic table of the elements.

In addition, phytoremediation with these workhorse trees is important because of three traits of interest. The first is elevated water usage. You'll see in some of the slides coming up that this is in part from the standpoint of hydraulic control. Gaining control of the groundwater and being able to suck that groundwater up through the tree and take it out of the soil while simultaneously the tree is cleaning pollutants out of that water. In addition, fast growth and extensive root systems.

So, examples of these workhorse species. I mentioned before the genera that we typically use, two of them in particular: poplars and willows. So this is the genus *Populus* and the genus *Salix*. They are what are called phreatophytes, so they have the three traits that were on the previous slides. So the rationale for phytoremediation in general, and cleaning contaminated sites: imagine this is a leaf and it's from a tree that's growing in a heavily contaminated site and it's just hanging on. And it's about to die and fall off. But what we are really looking for are those workhorse trees that can act like the Incredible Hulk and can say, "You know what? We're going to go in there and we're going to clean that up. And we're going to find a way to be healthy in the process and we're going to create a more sustainable, healthy ecosystem while doing it." So that's the whole, in my opinion, the overarching rationale of phytoremediation.

This slide shows examples of some projects that we've done in recent year. I'm not going to go through every one, but the take-home message of the slide is to just show the diversity of the kinds of sites, systems, and issues that we deal with. So you can see a lot of landfill stuff on the top, but also these industrial brownfields and then like I talked about before, inorganics and organic contaminants. And then the systems, so what is it really is for? Some of them are actually used for remediation, per se, other things – you can see there, a riparian buffer – so in addition to taking up the contaminants just establishing the trees on the shoreline to reduce erosion and other impacts is just as important.

So I'll go through some examples from northcentral Illinois, northeast North Carolina, Panama City, Florida, and then Rhinelander, Wisconsin. This is the LaSalle, Illinois site which is on that previous slide. You can see the trees there are 11 years old. So this is a site that is heavily contaminated with TCE and PCE. So these are industrial solvents that are used in primarily things like the manufacture of batteries and they survive in the soil and they are really difficult to get rid of. The trees at the LaSalle site, in the

photos that you're seeing, are at 11 years and I won't go into great detail, but if someone is interested, I definitely would like to have the conversation. You see there 19 clones. So, imagine you had a family that had 19 siblings. That's essentially what we're dealing with here, or 19 varieties, if you're going to go to the grocery store and get different kinds of apples. So the names on the top of the pictures, the Crandon and the 7300501, the 220-5, are clonal names. So these are different trees that we've identified to be good for cleaning up these types of contaminants. And you can see the diameter at breast height underneath there. So at 11 years old, Crandon exhibited 8 inches of diameter. 220-5 exhibited over 12 inches. And what does this mean from a practical standpoint? At this site, these trees were growing almost 20% greater than what we would expect in the region if we were to grow trees on non-contaminated sites. This is an example of a very good, very successful phytoremediation system.

Now I'll go in contrast to that. This is a study that collaborators are conducting from North Carolina State University at a U.S. Coast Guard base with soils contaminated with petroleum hydrocarbons. And I'm talking about two different plantings. They're both five years old, and you can see here, this is for tree diameters, so diameter at breast height. And what I want to point out is kind of going back to this concept of needing to test and select certain workhorse species and certain workhorse clones. And if we look at the two bars on the left, where the blue star is, these belong to the same family. They have the exact same genetic parentage. The ones on the right have their exact same genetic parentage. You can see here, at this particular planting, the clones are segregated by family. However, at the third one, you can see, it totally breaks down. And the point here, the take-home message here that I want to show to you is the importance of plant selection. And you can see, if we would have just gone by the results of what's indicated there as Elizabeth City (II), we would have thought that the family on the right was superior. But then, you go not that far away to Elizabeth City (III) and it becomes an issue of having to select a specific variety. And so, I think I'll leave it there, but like I say, the point is trying to match specific varieties, specific clones to the contaminants. And I'll drive it home a little later here, as well. One thing I'd also like to point out is, we saw a +19% increase versus the expected diameter in the region for these plantings. You can see -40% and -46%. So an example of something where the trees were alive, they're healthy, but the growth is stunted, but still, in my opinion, a success from the standpoint of having something grown on those polluted soils.

The last example that I'll show you some data for is from Panama City, Florida. This is led by a collaborator at the University of Florida. It's an industrial brownfield with arsenic contamination in the soils. And the trees were almost five and a half years old when the data were collected. And you can see here on the bottom, these bars represent 15 different clones and what I want to point out is just the variability. And if we look at the worst clone to the best clone, the top one is for diameter, you can see a 102% increase when you go from the best to the worst. Likewise, the bottom graph is for biomass, so the dry woody aboveground biomass, you can see a 340% increase. So, once again, that take-home message that selection of specific trees is really good. Here, expected diameter again, 8.9. So it's kind of in the middle of the other two

examples that I showed you. And, for biomass, 7.2. So it's a little bit lower, but still, considering the contamination in the soil, not bad.

This slide really is the crux of what phytoremediation means to me personally and what our program is working on: this identification of specific clones – integrating the specific clones with the specific contaminant and what tissue those contaminants are going to go into. So, I'll give you an example. If a brownfields manager calls and says, "We have cadmium and chromium in our soils, what would you suggest?" The ultimate goal would be, to be able to say, "Okay, should we use poplars or should we use willows?" That's the first question. Once we've answered that question, and it's cadmium, "Where do we want it to go?" And we probably want it to go to the woody tissue, therefore, let's use clones X,Y, and Z. That's kind of the practical nature. And obviously we don't have this matrix for every single pollutant that's out there, but we are moving in that direction that's one of the things that our research is really focused on.

So I'll give you some picture examples. This is an industrial production facility in the Midwest. Soils are heavily contaminated with salt, metals, and nitrates. These trees are 11 years old. You can see, very healthy. You can see, I don't really have anything in the picture in terms of seeing the diameter growth, but a very nice stand of trees.

In addition, this is a landfill in northern Wisconsin where leachate was used as irrigation and fertilization of the trees. This was at eight years. You can see, very dense. These trees were planted pretty tight, so you can't see anything through there, and they have not begun to self-prune yet. But again, you can see general, overall health of the trees there.

Another situation where we had a landfill manager, at our county landfill here up in northern Wisconsin, that was extremely progressive and proactive and really valued the benefit of research and trying out new things from the standpoint of sustainability. And you can see here, well, I say here fiber cake recycling, so we have a paper mill in town and he worked it out so that the paper mill would deliver their fiber cake to the landfill. And there were asphalt pads that you can't see in the left side of the photo there, and they would dump the fiber cake on those asphalt pads and with precipitation and infiltration through the fiber cake, it would then run into a collection pond. And he used that leachate to irrigate and fertilize the trees during establishment. So, you can see here, at 12.5 years, I wish someone was standing in there, but you can see the posts. Those are 10 foot posts, so quite huge trees, really.

With all of this, one thing that I really want to stress is that tree planting is strategic, and it's strategic from the standpoint of biology and ecology and getting the benefits, carbon sequestration and other benefits for the environment. But it's also strategic from the standpoint of communities. So in this situation, I use the example of redevelopment. We want to create green space, increase livability, decrease direct contact issues with these pollutants. And in some situations, actually get some economic value from these trees. So we really want to think about what we're putting out there based on what the pollutants are in the soils and really move forward with

something that we think can get us from degradation to restoration in a stepwise approach rather than trying to do it all in one step and then having the system fail.

And so this is just another pictorial. Typically, in rural areas, the concept of it is moving from the degraded lands to healthy ecosystems. Now that we are working more along the rural to urban gradient, and especially for those of you today who work in urban environments all the time, we're taking the same concept and taking it to the city and bringing it to urban communities. So if you're interested in this, I have a *Research Review* that our Northern Research Station did a couple winters ago that really drives home the points that I talked about today. So with that, I'll turn it over to Dr. Rich Hallett, who will talk to you about greening and will also talk to you about partnerships.

Rich Hallett: First, I would like to just start out by asking us to think about some of these terms that we use when we are working in our urban environment and thinking about greening. So, considering afforestation, where we are establishing a forest in an area where there was not a previous forest, and then the concept of reforestation, so reestablishing forest cover in areas where there used to be a forest. In our cities, we often talk about restoration or reforestation and you could make a case for that. For instance, New York City 400 years ago was a pristine forest, and so yes, there was forest in this landscape. But today I would argue that conditions are very, very different from those conditions the trees of 400 years ago evolved in. So, are we really thinking about reforestation, forest restoration, or afforestation? And the reason I think this matters, and it's not really just about what do you think, but I think it influences our thinking as we embark on this journey of greening our city. And so if we're thinking about just replacing a forest, it may influence our actions, whereas – my background is rural ecosystems and you just plant trees and they grow – and I think things are different in our cities.

And so, I'd like to bring this back to Ron's "Re-" continuum and revisit it for a minute. This is where I'd like to tie together what Ron just talked about with what I'm going to focus on for the rest of our time together. When Ron and I met, he was interested in doing some work here in New York City, and specifically working on phytoremediation, as he just described. But as we talked more, I realized that there may be some active applications for some of these concepts – these purposeful concepts that Ron described – and being strategic in our planting, even where we're not trying to clean up some contaminant. And the genetic variability within a species was actually much larger than I really realized and maybe we could use some of these concepts to select individuals, individual varieties to help us with the greening efforts in the city, irrespective of contamination. So, thinking about this continuum, we have a situation where at some point in the past, we had forest and we degraded it through some actions, anthropogenic, by building a city. And then, we're back at the bottom point where Ron described the degradation piece and then working our way up through the recovery, rehabilitation, reclamation, and then the remediation part. And so following

those same steps, but perhaps not only in the context of cleaning up some contaminant.

And so, we start thinking about what we want to do in our cities, and actually thinking about what we are asking of our green spaces. We want trees to grow under these conditions that they did not evolve in. The climactic conditions are different, the chemical conditions are different, the atmospheric conditions are different. And we also want these green spaces to be sustainable and resilient. It's a big ask, I think. And so, I'll bring us back to considering, are we really reforesting or creating something new by way of afforestation? And I'm arguing that we are creating something new and that requires new thinking and new techniques. And I think that's where some of what Ron just talked about and described, we can bring into our toolbox and begin to think about how to do this in our cities and maybe make, instead of planting native species in the place where we want them to grow, perhaps we will be able to create something a little more purposeful by selecting genotypes that are best tailored to the sites we're engaging in.

And so, as I was talking with Ron about maybe doing some phytoremediation work here in New York City, I was also working with some collaborators with the New York City Parks Department through the MillionTrees program and the Yale School of Forestry. And this is a picture from Kissena Park, which is in Queens, New York and it was planted as a designed experiment. Alex Felson was in on the design of it, as were some colleagues from the Parks Department. It purposefully was set up to discover and develop a long term research study where we would look at which species did best on these sites and then some species diversity, mixes – for instance, one to two species per plot, versus five or six, and then mulching or not mulching. And as you go through these trees and begin to try measure them – many of you have probably been in sites like this, where you see a pretty wide variety of exotic invasive species that are beginning to compete or even overtop some of the planted trees, which by the way were planted in this picture four years ago, and they were three to five years old when they were planted. And yet the exotic invasive vegetation that you see in the back right, *ailanthus*, tree-of-heaven, is doing quite well, as well. And then we start to look at measuring these trees and thinking about the trees that were planted at the same time. On the right, we see a *Celtis occidentalis,* not really doing very well. On the left, we see in the middle a basswood, which is doing extraordinarily well. These are essentially right next to each other. And then we see on the far left, a black locust, which, by the way, is a native species. And it started from seed at the same time as the purposefully planted trees, which were three to five years old and were planted and taken care of in pots for the first part of their life, and carefully planted in the ground. The black locust started from a seed at the same time and is outperforming everybody. You start to think about what's going on. There's different species, different kinds of soils across the city, and so we started to design some studies to look at this.

One of these studies was designed by a colleague in the New York City Parks Department and it was designed to be a pot study, or a greenhouse study. Recognizing that there are different classes of soils throughout areas that were slated

to be part of an afforestation project – or a reforestation project, depending on how you look at it – we're planting trees in these soils and these parks across the city. And they identified several categories of soils, first being coal ash. And so we collected soil from street parks that had coal ash in them. And this is basically areas where people when they were burning coal for heat had dumped the waste from their stoves and it built up to quite a large degree. Urban fill is a category of soil, which is quite a mixture. It could include rebar, a little trash, some concrete, things like that. Clean fill – this is specifically brought in from construction projects to put over areas that need some additional soil or something like that, only it's not really very rich in nutrients. But it does meet the regulatory standards to be clean, from the chemical standpoint. Native till is what we might find out in our rural forests. There are places within the city that remain essentially untouched and so they haven't been impacted by people to a large degree because they've been protected. All of these soils went back to the greenhouse and then we planted several species in these soils to see how they might do. And we have a paper that we just submitted, which hopefully will be out soon, but basically we saw some big differences between species across all the soils. So for instance, silver maple did quite well, regardless of the [indiscernible], and serviceberry did not do quite as well. But we also, if we took all the species and summed up the dry leaf weight that they're producing (some indicator of productivity for biomass production), you see that regardless of species, certain soils support these species better. And so what we're illustrating, similar to what Ron was saying, is that there is a need for being purposeful, or thinking about what kind of soil is out there and what species might match up to it. And Ron's work shows even a finer level of detail in that even within a species there may be certain varieties that will do better, perform better, if managed properly to the soil.

This brings us to the next part of our story and that is, we in the Forest Service are used to working in areas and in forests and on lands where the federal government owns the land. So basically the federal employees are on agency-owned lands, and control it and regulate it. And yet we move into a city and, speaking for the Forest Service, we don't have this regulatory oversight or control. So that's one aspect that's really different for us, so we really rely on partners to help us engage in our research and get things off the ground. And the other really exciting part about this is that our partners have been engaged in urban ecosystem studies or management of urban forests for quite a long time and have a lot of experience, but maybe haven't had the time to do the scientific studies. And so engaging with our partners in this way has been a really positive and fruitful area, to have management help us design the research questions as I described in the last study, to help us gain new knowledge but also to help us figure out how best to manage our urban ecosystems and forests.

And so we have the New York City Urban Field Station. We have been talking with and collaborating with Rutgers University; the New York City Parks Department, the nature and land management agency in the city; Freshkills Park, and I'll be getting to that next – Freshkills is a landfill that they are converting to a park; the Yale School of Forestry and Environmental Studies – we're working with them on urban ecosystems; and then the Department of Sanitation in New York City; and many others. What we bring to the

table in the Northern Research Station – and it's illustrated very well by Ron, who is working in Rhinelander, Wisconsin, primarily and I am based in New York City and Durham, New Hampshire, two other research Station locations – we have at our disposal a broad network of disciplined and accomplished scientists in this area that we can tap into. So that is something else we could bring to the table when we're working in some of these areas because the fact that Ron's in Rhinelander, he really has no interest in moving to New York City. But I'm here, and we can work together to do some pretty interesting work, which I will talk about next.

So on Staten Island, we have Freshkills. And as I mentioned, this is an area that was a landfill and is being capped right now. And there are areas that are sort of off-cap, but are part of what they call the legacy landfill. In other words, these are areas that people were traditionally just dumping and throwing trash before it became a formal landfill. And they stopped that practice decades ago and the areas are still there, but not quite clean enough to use. But they're cleaning up and beginning to think about getting some trees on there and engaging in afforestation. So this was an area of interest for us to begin to think about using some of this hybrid, if you will, techniques to create a forest in an area that is highly compromised, but maybe not contaminated to the extent that Ron would use phytoremediation techniques. We began to think about a concept we are calling anthropogenic succession. By this I mean trying to create a forest in these new environments, I'm arguing, many times it will need to involve some activity by people to keep it going. So in our rural forests, we will often plant trees and you don't have to go in and do very much to them over time. I think in our cities, we need to continue to maintain. We saw pictures from Kissena Park, where those areas have to be herbicided and exotic invasive species need to be cut, in terms of invasives. So if we can think about minimizing the need for going in, but not making it truly sustainable in a natural forest sense. So moving more toward that, but it needs help, hence the concept of anthropogenic succession.

And so at Freshkills, we collected genetic material from willows and poplars – these are the species that Ron spoke about – from Staten Island because it is important to begin to use native genetic stock, but at the same time maybe from species that we would consider to be early successional species, to plant out on these fields that are basically reminiscent of the areas that had landslides or perhaps fires in the past. So these species are uniquely adapted to capture at a site like this. And you can see here this is the place where we will be installing our afforestation study, and the New York City Parks Department has gone in for the past two years and herbicided and cut the exotic invasive vegetation that was there. It's ready for planting now. So we collected these species and then Ron did some work on how to actually begin to propagate these and get them ready so we can use them in the selection process that's outlined on the left.

So right now, we've got, we've shipped soils from the site up to Rhinelander, Wisconsin, and Ron grew those different genotypes in that soil. We're in the process of, we just finished harvesting them and weighing them, and checking them for growth and biomass production. We will take the best-performing genotypes and begin to

plant them out into the Freshkills site next fall. We've designed a study along with the Parks Department and the Freshkills Park folks that will begin to test some of these different afforestation techniques side-by-side. So on the left you see a box that represents a plot, which would include the standard palette. So this is a list of species that the Parks Department has decided could work well based on their empirical experience with doing these projects over the years and looking at the site and saying, "These are the species that we think would do well on this site and that we would like to have there as a mature forest." And then on the far right, we see our experimental planting palette. And this is made up of the species we select from the selection process I just described. We're planning on taking the ten best willow genotypes and the ten best poplar genotypes and planting them in a series of plots. And then we have a third treatment, if you will, that is a mix. So it's the willows and poplars that we selected interspersed with the planting palette the Parks is using.

This is meant to be a long-term research site, so we will install these plants in a format and then we will measure them over time to see what happens. And our goal is that hopefully we will find a way that maybe willows and poplars can grow faster and reach canopy closure quicker, which would then hopefully shade out the exotic invasive species that tend to come in and begin to overtop our young trees. If this comes to pass, then arguably we would be able to reduce the need for human intervention in the future. And then, as the willows and poplars grow up, we can begin to think about maybe underplanting with more shade tolerant trees that we would like to be in our final forest. This sort of fully describes the concept of anthropogenic succession, and hopefully we're reducing the need for human intervention, but I would argue, in a situation like this we always need to be mindful of the need for coming in and make sure that these sites are not being taken over by exotic invasive species. But this would provide the basis and the framework for testing some of these theories and watching them over time so we can come up with some pretty specific recommendations and then ultimately a process by which we can apply these same types of techniques to other sites. In other words, using soils from a new site and then planting other genotypes on that area that are known to perform well. So that is our overall goal for this project. That concludes my portion of the talk and both Ron and I would be pleased to take any questions you may have.

Dana Coelho: Great! Thanks so much to both of you. We just have a few minutes left for questions and a lot of them have come on the chat pod. I just want to let you know that we will collect those questions and do what we can to get some responses back to the group. To help facilitate a bit of discussion now, I will try to summarize across the most often asked questions and pose this one to both of you. What kind of interactions are anticipated or are you seeing between wildlife and these trees that are absorbing pollutants?

Ron Zalesny: Rich, do you want me to take that one?

Rich Hallett: Yes, I think so. You have more experience with the polluted side of things.

Ron Zalesny: Yeah, sure. In our group, we have not done a lot of research looking at that interaction. We have done some studies in some soil-related studies looking at the abundance and diversity of soil microfauna under these contaminated systems, and specifically, how the interaction between the trees and the contaminated soil either increases or decreases the diversity and abundance. What we find, typically, is that in most situations, the diversity, I mean, the sites are contaminated anyway. So when the trees are put in, there typically is not a significant increase in either abundance or diversity. So it's not like they are really increasing a lot in the soil, but at the same time, just my observation and not really any data that we have, they are kind of stabilizing it to the point where we at least aren't losing anything. Now one system that we've worked quite a bit with landfills is recycling of landfill leachate. So using the leachate as irrigation and fertilization for the trees. In that situation, with soil fauna we have found that the diversity has decreased, but the abundance of ones that are present has virtually stayed the same.

Now to answer your question more directly with regard to small mammals and birds, stuff like that, there is not a lot of literature and there aren't a lot of researchers out there that I know of, worldwide even, that have tested those kinds of things. So you bring up a good point, especially from the standpoint of berries and such. Now the question that would come up is if you have contamination in the soil, by the time it fades to heavy metal and actually gets into the leaves, is it really going to be at a concentration that would impact a bird, let's say? That's the key question and to be honest with you, I don't know the answer to it right now. On a related note, something that both Rich and I on separate project, but are now trying to integrate on, is the concept of urban foraging and what to do, and assessing the potential impacts of human urban foraging on sites that are less than ideal. We are working right now in Chicago on a project with the American Indian Center, where they collect a lot of plant parts and eat a lot of them. And so we're working to see if the actual, if the bioconcentration in the fruits and edible parts of the trees and plants are actually at a level that would impact human health. So we're moving in that direction, but it's a very good question.

Dana Coelho: Great, thanks for that, Ron. Unfortunately, that's all the discussion we're going to get to today. We have reached the noon hour and want to be respectful of folks' schedules. I would like to thank the presenters for their time and for sharing information about this topic and thank all of you for participating.

Ron Zalesny: Can I say something really quick? If people – Rich, I don't know if you're available right now, but I can give an 800-number if people want to have a post-webinar discussion while things are fresh in their mind. I don't know if that's been done before or whatever, but I'd be willing to do it if there is a desire.

Dana Coelho: We haven’t done that before. I’d be open to staying and helping out with that, I don't know if we can leave this up at all, but I have captured all the questions. Maybe we wrap this up and provide this number for folks if they want to continue having a conversation?

Emilio Garza: Yeah, I think that would be a good idea and I will be capturing all the questions from the chat pod, as well.

Dana Coelho: I think that was Ron who offered the 800-number. If you want to type that into the chat pod, I will go ahead close out this portion of the webinar and get our credit information up for folks.

Ron Zalesny: Are you available, Rich, or do you have another appointment or meeting?

Rich Hallett: Yeah, I unfortunately have another meeting right after this, but I’d be happy to answer any compiled questions. I don't know if there's a process whereby we can work on getting those questions answered that have been typed in.

Dana Coelho: Yeah, we can definitely work with you on that.

Great, and for those of you who do need to go and are looking for credits, I just put up the code for getting ISA CEU credit. Please just write down the code that you see on the screen and send that in to ISA using their form. You can download it here from the pod to the right of the presentation screen or from our webpage. If you’re interested in receiving a Certificate of Participation to submit to another continuing education program, please type your full name and e-mail address into the group chat and questions pod. We will keep this open for another few minutes for you to do that.If you have any questions, feel free to e-mail us using the link on our webpage.

Please consider joining us next month on March 11 for the next Urban Forest Connections webinar. The topic will be *Wildlife Conservation in Cities and Suburbs: Research, programs, and tools*.

Thanks so much. Enjoy the rest of your day.

[Event concluded]