

Johan Östberg-What is Tree Vitality and How to Rate It

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[00:00:00] **Tinitia Price:** Welcome to the ISA Conference Rewind series. I am Tinitia Price, instructional designer at the International Society of Arboriculture. Today, ISA is happy to bring you “What is Tree Vitality and How to Rate It” featuring Johan Östberg. This presentation was originally given at the 2020 ISA Virtual Conference and the views and information expressed are those of the presenter.

Now sit back and enjoy the video.

Johan Östberg: [00:00:39] Hi everyone. My name is Johan Östberg and I'm going to do a presentation about “What is Tree Vitality and How to Rate It”. And I think that you probably had a chance to read my bio, but I'm a researcher from the Swedish Agriculture University in Alnarp, Sweden and I also run my own consultancy [00:01:00] firm. A lot of the work that I'm doing both as a consultant and as a researcher is sort of focused on tree vitality and talking about how well a tree is performing in different types of areas.

But at the same time, I always struggle when it comes to tree vitality. I of course had my opinion, what is a correct way of reading it. But at the same time, I know that it's really differs between different individuals, and a lot of things that I'm doing, uh, this sort of started off as an argument.

I had an argument with one of my colleagues, a biologist, and they had a completely different way of thinking about vitality and how to rate it. So we said “ why argue?”, why not just run a research project? We started off with a research project and this is what I'm going to talk about: the whole project and where we sort of ended up.

When it comes to my presentation material and so on, I think that [00:02:00] you will be given the opportunity to get most of it through the ISA portals and conference homepage. But if you're, for some reason can't reach everything, and you want to get to the scientific articles that I'm referring to all this presentation, just feel free to use this QR code and it will end up in my Dropbox and I'll make sure to add information there as well If questions come up. QR code link: <https://www.dropbox.com/sh/zbq9uf6t14llp10/AADMgHaj-CI3e8l6-l22lddOa?dl=0>

Let's get started. So from the beginning then, what is vitality? Like the definition of it? The ISA of course has a definition of tree vitality. So their definition is “overall health. The ability of a plant to deal effectively with stress.” But the Swedish Institute of standards, they released the standard, I think it was five, four or five years ago. And they ended up with an even shorter explanation, “the tree's life force”. I'm not really sure how much that actually explains things, but those are sort of [00:03:00] the two different versions, two different definitions, that we've been working with and talking about as well.

And on the topic of definitions and talking about how do you actually define things? I also wanted to bring up the word “condition” that I stumbled across quite a lot and see in a lot of

different types of publications. We both have this “vitality” and “condition” and some authors. And in some instances you can sort of see that they're intertwined, that the author is referring to vitality when they were mentioning a condition and vice versa.

So just to structure this out, when it comes to the word “condition”, I have not been able to find that actually in the ISA dictionary and we don't have it in the Swedish dictionary either or the Swedish standard. But for me and when I'm talking about a condition of a tree, it's a combination of both vitality and damages and sometimes even adding risks to that.

[00:04:00] So vitality is not the same as condition and this person station and the whole research project was about vitality. So just sort of framing it a bit and why this is actually something that we should be interested in and why we did this study.

What is tree vitality used for? It's used for a wide range of different topics. Of course, ease of selection, how good is the tree performing, to monitor a tree, one single tree or a tree population's condition. In some economic valuation models, vitality is also present. Sort of one of many factor that comes into being when we're evaluating how much a tree may cost or how much you should have for an amenity value or for a type of validations.

There might also be part of a work planning. If we're gonna do a new construction in an area, we need to know which trees are actually performing well, so we can save them and maybe take away [00:05:00] trees that aren't performing well. In some instances it's also used for risk evaluation, not as a term that is used for risk evaluation, but more one part of it. Where you can look at a tree and say, okay, the vitality is declining. Why is this? And there might be some kind of fungi or something. So sort of part of an assessment.

And of course research projects always come up and we sort of need to use vitality, or we're all using tree vitality, for a wide range of different of things. So this is just some of the examples.

How are actually are tree vitalities then rated? I mean, we as professionals can look at these two trees and say, one of the trees are performing better than the other one. And we can sort of start to discuss “why is this?”. Okay, The soil conditions are different and we have concrete slabs close to one tree and not the next one.

The other one that the tree on the right-hand side has shrubs close [00:06:00] by, more organic material, on all of these things. But we also need to have a structured way of actually defining and rating vitality. Not only saying, oh, everyone sees this because we have earlier autumn colors or poorer growth.

One of the things that we can do is measuring the shoot growth. The more the tree grows, there's more bigger it is. But at the same time, if a tree is pollarded, for example, we would have quite long shoot growth, just because of this. Topping a tree, is that actually something that increases vitality hardly, but at the same time, we will get an increase in shoot growth, but at the same time it is used and I'm not saying that it's a bad method. It just has it's problems.

Another way of measuring, and this is much more scientific, is measuring the turgor pressure. So sort of how much pressure is needed to take away water from the actual leaves. And this is [00:07:00] something that has been used in different types of studies.

I'm just referring to one of many studies here, from Henry Kerman and he's his co-authors. And what they did was that they measure this in a wide range of variety of different types of species and to see how well they were coping with, with stress. And then this case was actually water stress. So how good they work, actually keeping the water in.

They did this both in spring and the summertime. But, it's quite tricky doing this in the middle of the winter, because of course you will need leaves to do that.

Another study use chlorophyll fluorescence and both in the trunk of the tree and also in the leaves and just sort of try to find a more scientific way to actually calculate the vitality of trees.

But I sort of love one of their first sentences in the abstract, where they state “the assessment [00:08:00] of mature urban tree vitality using physiological measurements is still in its infancy”. And that's sort of where they ended up in the study as well that they could see some tendencies in some species, but this wasn't really reliable.

Where we sort of end up in is still the visual assessments. Visually being able to rate the trees vitality. And some studies have used, or some methods are using, different types of parameters. So in this case, its crown size, crown density and crown epicormic growth. Different ways to actually look at the canopy and the crown of the tree and thereby rating their vitality.

Another researcher that does similar things is Andrea Roloff from Germany, who used a system where he was looking at the crown architecture. This has been a bit developed, and this is the development you see here for a Swedish context. The illustrations is a bit [00:09:00] different and also the rating from one to four is a bit different compared to a Roloff's studies.

But at the same time, it is showcasing each crown's structure. You can look at the tree and both in winter and in summertime. That is sort of the pros of having those visual assessments that you can do it both in wintertime and the summertime. Especially from a Nordic country, the vast majority of time where we actually work with trees is during the winter or when the trees at least don't have leaves on. So we need to be able to have a system that works all year round.

A couple of slides on the use of vitality, some more examples of that. And then we're going to dive into the actual study. This is a study that I did, or sort of a combination of a study and the consultancy. So I did a consultancy for the city of Lund here in Sweden, and I used the four grade rating system based on Roloff's study.

[00:10:00] As you can see here, we listed the amount of trees planted and also the year of planting and the different vitality rating from one to four. You can see here, of course there's an increase in trees that were planted, but we can also see that there's actually a difference

here in the vitality rating. In some years, the trees that were planted had actually a poor vitality than other years. So for example, looking at the, just the light latest, say 10 or 20 years, we still have quite a lot of trees in poor vitality. And that is something, of course, that is very problematic. We're planting new trees and they're actually not surviving.

And we can also see a dip in the 1990s here and in Sweden had an economic crisis and what happened, of course, the funding for tree plantings went down and hence you also get fewer trees planted. And the trees that were planted are [00:11:00] not performing not so good. And so thereby we can sort of link vitality studies to inventories and also the economic situation.

Another thing that we did was link tree vitality into what type of growing site they had or ...what actually affected the vitality. I've tried to be as pedagogic as possible, and this was a friend of mine he has a PhD in nuclear physics, and he helped me do this slide.

He hid his eyes and just shook his head when he looked at this graph. "It's obvious for everyone, isn't it? Uh, but not for me. I needed to color it." So green means positive. Red means negative. So everything that is above zero actually has a negative impact on pre growth or tree vitality in this instance. Whereas the green [00:12:00] one is something that is positive, right? It's actually helping to increase tree vitality.

So, I mean, for us within the industry, this is quite obvious. But it's really powerful to have some kind of statistics, some kind of data saying to the politicians, the planners of tree plantings that if you plant trees you with concrete slabs close to them, or with an asphalt close to them, you will actually have an decrease in tree vitality.

Whereas mulching a tree has a very positive effect on tree vitality. And of course we can also see tree age as a tree age. The vitality becomes less, so a reduction in mortality. And that is something that is of course obvious as well. But now we have data on it, and this is based on around 5,000 to 10,000 trees or so, so quite good data set.

Another way that we used vitality, and this was one of the studies that I did on a cemetery. So pure consultancy, just helping them out. But this is also a, quite a powerful [00:13:00] picture showing where we have trees with good vitality and poor vitality. And the interesting thing is that a lot of the trees on the left-hand side, which has a really poor vitality is in a newly constructed area.

The newest trees, the youngest trees are actually the ones that are performing least good here or aren't performing as well. Just having this type of data is of course, really, really powerful and useful. But how do actually professionals rate tree vitality then?

We collected 30 experts and were of 19 actually completed the study. Yeah, this is how research is done. We had 19 experts that follow us from the start to the end of the study. We had 21 trees and we performed a Delphi-study. And of course, a lot, a lot of time was put into this.

First of all, then what is a Delphi-study. [00:14:00] And I will base the rest of my presentation on the sort of deep way that Delphi-study is performed. Just so you can follow the different steps and understand where, why we ended up where we actually did.

A Delphi-study is sort of a systematic way to reach consensus in a specific question. It's used in extremely many fields. I think this is one of the methods that had the widest use, even though it's not like extremely common to use it in a lot of studies, it's still used in a lot of different types of studies.

For example, medicine, social sciences, and of course in urban forestry. The drawback here, it is very time consuming, both for us as researchers and of course for the poor panelists. That's probably why so many of them dropped out. How is this actually conducted? Yet from the start we need to talk about a research question and we had to like proper research questions.

The first of them was which [00:15:00] parameters through expert rate as being the most relevant to rate a tree vitality. The second does the rating of parameters deviate between different user groups. In this case, we have urban forestry professionals and biologists. As I said, from the beginning, this was an argument between me and my colleague, who is a biologist. Now you can sort of understand where we're coming from.

As an additional question, this was more of an aim saying, we of course, wanted to have something to use when we're talking with people that are interested in tree vitality. If you will sort of the best management practice, a photographic textbook. Where we can say, okay, this tree has this vitality and it's been rated by these 19 individuals.

You can sort of understand more where they're coming from and how they are performing their vitality ratings. As I said, we [00:16:00] had 19 people, 19 experts, and that was part of the whole study. But from the beginning we had 30 people involved. So selecting the panelists is as you can see her the next step, it's not only to just find experts. We need to think about who you're actually recruiting for this task. We had 10 people what we call from the landscape group, but that's in the mostly, I would say extremely widest definition of that word. We had urban foresters from cities. We had municipal arborists and we had climbing arborists and some consultants as well. Really a wide range of people.

When it comes to the biologists, they were both from the Swedish government, but also from consultancy firms. People that are both working theoretical and practical. I would say that the two groups were quite comparable in that sense. That both contain people that will work in professionally outdoors [00:17:00] and also people working professional from the inside, working from the office and with these types of questions.

We also then followed 21 different trees and that was part of, sort of this actually part of the study and was the sort of the study topic. And you will see here a list of the different species and the environment that we're growing in and also the age. We do have a bit too many Oaks. *Quercus robur*, and that's because they are usually these species that are rated mostly by biologists.

Because they have so many biological values and are very rare, especially the old ones, really old, large Oaks. That is sort of a drawback, I would say with this study. It would have been interesting to having a bit more exotic species in rural environments, but let's face it there are [00:18:00] quite few of them in the rural environments. We also tried to mix both adult and younger trees, so we can have a mixture there as well.

Okay. So we have our panelists, uh, we have designed our study, or we're working on designing the study. We found the trees. Now we need to find the parameters as well. What are they actually gonna rate?

Me and my colleague, we found twenty-six different parameters that we thought that was sort of part or could be part of an assessment of vitality. It was for example, die-back crown, missing crown, transparency, and a lot of other stuff. But following the step of actual Delphi-study, we sent these out to all of the panelists.

We had those 26 parameters, send them out to our panelists and ask them, is anything missing? Maybe there we're gonna add one or two. They added [00:19:00] 14 new parameters. We ended up with a total of 40 parameters and that these poor panelists had to use when they were rating them. So what we did here was we had a list of 40 parameters. And what can we ask the panelists do then was to look at the trees from photos because we couldn't get them to travel all across the country just to look at a tree. We asked the panelists, the 30 panelists to rate the tree vitality from zero to a hundred. And I will show you later on how that actually works.

But of course we need the pictures. Because they've added so many parameters, it took us half a year because we were taking photos in summer, but we also had to take photos in the winter. We really spoiled all panelists here. And so photos of every parameter for all of those trees, that was part of the study, all of the 40 parameters.

[00:20:00] Just so everyone is aware of what type of parameters that we use. Then I'm not going to go into like reading from the first to the end here, but you can, you can have a look yourself. And I think that you could probably pause the video as well. And, but the interesting thing here, and I'll come back to that later on. It's also that they added a lot of parameters that I wouldn't regard as actually being part of the vitality rating, but more of understanding why the tree is in decline or why it has poor vitality. I think that they were sort of jumping a bit from the study and actually doing a bit more analysis than we from the beginning, thought that they would do.

But at the same time, the panelists themselves, all the ones that are, are making the calls here, they were saying that we want to add a parameter, then we need to add for that. A couple of examples here, just so you know how the trees were looking and how the data set look. We had [00:21:00] a tree, number six, a young maple, growing in gravel in the city center with some die back. We didn't say anything about this. We just showed pictures and said the tree species. So only pictures and tree species. I'm the one adding some that die back and so on. This was sort of some of the, or this was some of the photos, actual photos that would show them to the participants.

So they got both a winter picture or a leaf-off picture at least, and on the arm picture, because that was what they wanted. Yeah, because some were talking about meets needs, size, and so on, for example. And also some of them wanted pictures of the trunk. So we got pictures of the trunk. Also if they have pictures of the soil. Here we have some close ups on the shoots and the top of the crown and the growth and so on.

So we really spoiled them here and to be honest, in an actual rating, and I doubt that you would have this much data that we [00:22:00] gave them. This is just some photos of some of the Oaks. As I said, we did have a bit too many Oaks in the study, but that's how research goes sometimes. And so a large oak in a meadow, a few living branches.

These are just some of the photos from that instance. Then you can see here. Uh, my colleague here chose much, much better weather to go around than I did. Nice sunny skies, fantastic weather. Some other photos, all of them specific. Also some close up of both the trunk and the stems.

Now it's time to actually conduct the study. I mentioned this before that all experts had to rate the vitality of the tree, of the 21 trees from zero dead tree, to a hundred, which means fully alive tree. And also tell us which of the 40 parameters that they were using. And we asked them to rate those on zero to 10 [00:23:00]. Zero means that they didn't use the parameter at all. 10 means it was extremely valuable for them. They really needed this to be able to end up where they did when it comes to the rating. As I said before, and I said, a couple of times now, 19 of the 30 experts actually fulfilled the whole study.

The next step is if we reached consensus or not. Once we send out all the information here, we asked them about the rating. We got them back. And what we can actually see was that we, they were in agreement already from the start. We reached consensus already in the first round, but because this is Delphi-study and all of the panelists, then it was given all of the data again. All of the names were hidden, of course, but then they got the rating from all of the other panelists. They can say, okay, everyone else has said that this tree is a hundred. I just gave a 10. Maybe I should change my mind. Or maybe I missed something that the other one saw.

[00:24:00] There was no obligation at all to change your rating, but they had the possibility to do it. So of course after the second round, we reached an even higher consensus. But as I stated before already in the first round, we actually reached consensus. How did the actual data look then? This is just some of the examples and hopefully we'll get this published soon so everyone can read the whole material, but here is tree number five.

We have a Linden tree in the city center and the mean rating was 75. A hundred being the best, zero means dead. But we had quite a wide spread. Some people rated as a hundred. and some 40. That is something you can see that there were always some outliers, some outliers that said, "a hundred" more or less for every tree.

There was some, of these trees that were extremely horrible conditions. And that's sort of where we got, [00:25:00] a bit lower max value. But otherwise some thought that every tree looks fantastic. So the maple tree that I were talking about before in this study, the vitality

was rated at 66 and going from 40 up to a hundred. And this poor little tree, mean rating 45 mean rating and the minimum 10 and maximum 90. To be honest, I have sort of a hard time seeing that this could be a 90, but I mean, some people are optimistic.

Here is one of the other trees, one of the large oaks that we're talking about, uh, the rating 75, with the minimum value of 40 and maximum a hundred. And the last tree here, a mean rating of 14, and that's the tree that I showed you before. I think it's extremely optimistic. The person who said 50%....yeah, but anyway, it is still interesting.

I think that if [00:26:00] we're just focusing on the mean value, it is sort of in agreement with most people that I talk to and that mean value is something that also will be part of the actual DMP.

A bit of statistics, not much. But we can see already from the beginning that the two groups differed, I hear you say it's ecology and urban forestry. I simplified a bit and said it's biologists and landscape professionals. But the two groups, they did differ already from the beginning. So we can say they were two groups. But they did sort of come together a bit when it comes to the rating of the trees.

When it comes to the parameters used, the top parameters used both. If we see mean value per tree or mean value per person, is different parameters that sorta talks about the crown. And so it's very focused on the crown. [00:27:00] It's shoot grow and also the die back on the tree. And so those are the top parameters. But as we go sort of down the list, we can see things that I would more say, it's actually about explaining the vitality.

The person is doing the rating, they both rated the vitality, but they also wanted to explain a bit. And so we have a growing side and ground cover under the crown here, for example, which is something that, yes, it definitely influenced the vitality of the tree, but to say that it's actually part of a vitality grading, I'm a bit reluctant there.

Looking at the top three parameters, rigidity growth, means shoot growth, and shoot growth in the crown top. Those were by far the most common parameters used. So reiterative growth is something that we see in older trees. And we did have quite a lot of old trees and that was [00:28:00] part of the study. And this is something that, of course, that mostly the biologists, but also some of the landscape professional were looking at when they were doing their rating.

Instead of just focusing on the top part of the crowd, which roll up, for example, a suggest, they were also looking more in the interior part of the actual crown and the structure of it. Mean shoot growth. I was starting my presentation and saying that this is sort of a problematic parameter, but at the same time, it is definitely used by our professionals.

And so they are using it when looking at the whole canopy. I think that they're not just looking at one specific shoot growth, but they're looking more at the actual mean shoot growth as the title here says. That of course takes a bit of a training. You can't do like a measurement of one single branch that you see here, you need to look at the whole structure.

When it comes to the [00:29:00] method and the systematic way that Roloff has created a look at the shoot growth and the crown talk, that is sort of part of the rating as well. And we can see that, probably because this is something that is widely used it has influence, especially in landscape professionals.

But at the same time, I wouldn't say that it's a hundred percent. Even though we are using this system and when we are looking at the ratings from this study and comparing it to the ratings that we've gotten, a lot of them I would say of the ratings that we got is a bit more new nuanced, a bit more, um, looking at the more holistic part of it, looking at the interior branches and not only the top branches.

Some of the trees would probably have invading of poor, which is almost dead. Uh, whereas it actually had quite a lot of, uh, new growth in the inner part of the crown. So reiterative growth. [00:30:00] We are probably still going to use Andrea's role of study and his method. But at the same time, we probably need to think about, making a bit more new nuanced.

This sort of leads me to the last slide. How this be used? Neither will are going to move away a bit more from the good, fair, poor ratings. But, or at least being a bit more nuanced. We are right now actually creating a BMP on and tree vitality and vitality ratings. And that will be used by the Swedish EPA when they're conducting field work and also training sessions. It will be given to everyone that is volunteering or hired to do inventories. So they have sort of a picture book of different trees with the rating from the professionals.

I also think that the whole study sort of created a deeper awareness of both the similarities, but also the differences between the different [00:31:00] professions that we see. And for us, it is landscape professional and biologists, and that we studied, but those are also the ones that are conducting most inventories and urban and peri-urban environments. And also rural of course.

Thank you so much for taking the time to listen to this presentation and feel free to reach out to me. If you have any questions and I'll be happy to us to answer them. Thank you.

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