Fabio Ascarini—Veteran tree management and protection: The great Mulberry in Cervia

[00:00:12] **Jennifer Gernt:** Hello and welcome to the ISA Conference Rewind video series. I'm Jennifer Gerndt, Director of Member Services with the International Society of Arboriculture. Today, ISA is excited to bring you a presentation by Fabio Ascarini on Veteran Tree Management and the great Mulberry tree in Cervia. This presentation was originally given at the 2022 ISA Virtual Conference, so the views seen here are those of the presenters. If you are interested in tree form and dynamics, impacts of topping, or veteran tree care in Italy, I expect you will like this presentation. Now, sit back and enjoy.

Fabio Ascarini: Hi, everybody. It's a pleasure for me to stay [00:01:00] here and talk about veteran tree management. I'm Fabio Ascarini, and it's a pleasure also to be in the ISA Virtual Conference. My topic will be "Veteran tree management and protection: The great mulberry in Cervia." We are in Italy.

So, the contents of this presentation will be divided into three principal parts: the tree form, firstly, and then the topping and the morphological alteration of the stem, and then finally, the great *Morus alba* in Cervia, the tree that we are talking about.

So, let's start with the tree form. Tree form is the plastic result of the dynamic relationship of each specimen [00:02:00] with the constants, including the physical context in which it's embedded. Since the dynamics of form is a current and consequential process, through its study, it is possible to understand a tree's present, analyze its past, and of course, predict its future. The form dynamics is a known and obvious process. Those depicted in this slide are all oaks, although extremely different in terms of sites and general organization. So, you can see small oaks in your left, on the top, and then a centenary oak in the center, in the photo. However, the dynamics of tree form follows temporal logics that escaped the perception of us humans, that may [00:03:00] go through hundreds of years. So, we need conceptual perspective to help us understand it. The dynamics of the form is oriented in time and space. As time goes by, the tree changes both its sizes and its organization. The first change of a quantitative order is called growth, while the second of a qualitative order is called development. However much time, growth, and development are mutually related, they do not exhibit a direct correlation. The study of their mutual relationship is called morphophysiology. So, today we are talking about morphophysiology.

Oh, this slide is a bit complicated, but let's see. The morphophysiological evolution of the tree over time [00:04:00] is represented by a succession of stages. Call it the development sequence. So, we have (A) the infant phase, (B) the juvenile phase, (C) the adult phase, and (D) the mature phase. Let's start with the first one, the infant phase. The infant phase involves the construction of the architectural unit and the increase in size of the tree through partial reiteration, that is, the formation of lateral axis and their subsequent branching. Then, in the infant phase, we can call also that there is the architectural unit amplification stage.

Let's go through (B) the juvenile phase. That phase involves the introduction of primary total reiteration [00:05:00] through the formation of branch structures equivalent to the architectural unit. The juvenile phase is also called the architectural unit multiplication phase. Now in (C), we have the adult phase that involves the succession of increasingly frequent total reiteration of smaller and smaller sites. We can call also "miniaturization." Then, in the end, (D) the mature phase involves the formation of vigorous, new total reiteration backward in a contest of canopy self-reduction.

So, canopy self-reduction, or centripetal mortality, is only one of the elements of mortality that contributes to development sequence along with other types of mortality. These other types of mortality are acropetal mortality, centrifugal [00:06:00] mortality, heartwood formation, and finally, tree cavitation. The different types of mortality contribute to the simplification of the architectural unit. So, the morphophysiological evolution of the crown, described by the suggestion of these phases as its epigeal counterpart affecting the root system.

The phenomenon of total reiteration involves the anatomical and functional reorganization of the main trunk. The total reiteration is connected to the trunk through a stipe, produces a cambial column that reaches the collar, and through a buttress, connects to a shallow fasciculate root. The cambial column is the result of a differential increase in secondary growth. From this moment, the trunk [00:07:00] section is no longer circular but is characterized by the succession of cambial columns. As a consequence of these anatomical reorganizations, the lymphatic flow is more and more concentrated in the cambial columns. Subsequently, the cambial columns, increasingly vigorous, are mutually connected through cambial bridge while internally the heartwood is forming, and at the root system level, we have the beginning of the decay of the top root. Finally, the top root and the heartwood are totally decayed. The tree becomes hollow, and adventitious roots develop at the level of the crown, which from the base of the delayed total reiterations, fall into the cavity towards the ground.

So, at this point, as you can see, on the left in this *Tilia* (spp.), at this point, the main trunk consists only [00:08:00] of the succession of cambial columns mutually connected by the cambium bridge to surround a cavity after opening to the outside. This behavior is completely physiological. The morphophysiological evolution of the trunk can also be interpreted in a mechanical way, as we can see in this slide. Trees in the infant phase are like poles. So, we are in the A (Letter A). In the juvenile phase (Letter B) are a set of cambium columns. In the adult phase (Letter C) the cambial columns are connected to each other by cambial bridge and surround the central structure, which is now heartwood. Finally, in the last phase, the phase mature, mature phase, the letter D, the columns, [00:09:00] connected by increasingly vigorous bridge, arrange to surround the cavity without consequences of a structural failure. So, at this point, the final point, the tree shows the structure of a trellis.

Now, that we are talking about general points about morphophysiological evolution, we can go through, and we are now going to talk about topping and the morphological alteration of the stem tree form. So, what happens in top trees, which are the consequences of the topping, there is a formation of total traumatic reiterations that grows to replace the remote canopy. These reiterates connect with the fasciculated roots to ensure [00:10:00] metabolic activities and do it through the formation of adventitious cambial columns. These cambial columns, however, do not connect to each other through cambial bridge, and remain anatomically, biologically, and mechanically distinct.

Over time, the different adventitious columns, eventually became separated by the development of internal decay and cavities. Those ones are in descent or accelerated by the topping itself. So, in the absence of cambial bridges, as the cavities reach outward, the probability of cambial column separation increases progressively. You can see in that slide the lack of cambial bridge in this *Celtis australis* that had been pruned many years, yearly. [00:11:00] So, you can see, the cambial column separation failure related to the development of a large cavity documented by the tomography image that you can see on your right.

Now, finally, we can talk about the great *Morus alba* in Cervia. So, our tree, or the tree of this presentation. So, this is the *Morus alba*, some pictures that you can see, and the picture in the center is about the *Morus alba* in 2009. The mulberry tree represents a typical species of the rural Italian tradition, used once for feeding livestock, for the breeding of silkworms, and for fruit production. So, this species was typically [00:12:00] pollarded to pick up the leaves. The traditional forms of farming were abandoned after the Second World War, and the mulberries were left free to develop or subjected to topping. The white mulberry of Cervia is the largest specimen of the Emilia-Romagna region. Originally planted in front of a farmhouse, in 1995, the tree was transplanted into a public park which has since been called Parco del Gelso, Mulberry Park.

Okay, so through more physiological analysis, it was possible to reconstruct the pruning history of the Cervia mulberry tree. From its plantation—that was in the late-18th, early-19th century—until about 1940, the tree was maintained and pollarded for production purposes. [00:13:00] Pruning was abundant between 1940 and 1950, and in about 1950, the mulberry tree underwent its first topping. In the following years, the tree was subjected to more or less like pruning and topping with the consequent development of bark inclusion among traumatic, total reiteration, and the development of pathological cavitation that haven't gone into the physiologic cavitation.

So, that part is shown in the letters B, C, and D in the upper part of this line. In 1995, the specimen was totally hollow with the trunk consisting only of traumatic cambial columns lacking cambial bridge. So, at this point it was topping it, top it again, transplanting. We are in the letter E. Once moved in the Mulberry Park, the tree was left more or less free to [00:14:00] develop for about 10 years. In this way, the great traumatic reiterations had the opportunity to form adventitious roots inside the cavity. We can see that phase in the letter F.

Finally, judging it to be too big around 2005, the mulberry was topped for the last time (Letter G). In 2009, the mulberry appeared with the reconstructed advantageous canopy and the totally hollow tree, as you can see in the tomography images, and the trunk was formed by four main cambial columns. You can see these cambial columns in the picture with the letters A, B, C, and D, and the column C immediately appeared divided into two sub columns, C1 and C2, [00:15:00] without cambial bridge, but with many basal adventitious roots. Looking at the crown from above, a lot to opposite the points of structural weakness due to the fragility or the absence of cambial bridge between columns C and D, and especially between B and C, particularly between B and C1, as you can see in red. In this way, a detachment of the entire C complex appeared very probable. For this reason, an intervention program was proposed but unfortunately never applied.

So, without any intervention, in 2010, the complex C, formed by C1 and C2, partially broke by rotation—00:16:00] you can see the rotation shown with the yellow arrow—with the stripe, breaking through inside the cavity. The result was the complete separation between this cambial column from the rest of the trunk. You can see it with the small red arrows. After the collapse, the whole complex C was raised from the ground and supported with the emergency system. You can see in the left of the picture with the white arrows. The recovery of the mulberry was based on the study of its morphophysiological features, the organization of the branches, so, presented to distinct regions. You can see the first in the central and upper part of the crown in yellow was characterized by a succession of a [00:17:00] total reiteration while the second—you can see it in green—in the left part, in the lower and lateral part of the crown was characterized by epitone ramifications.

So, epitones are ramifications in the upper part of the branch. So, the first recovery phase that was done, involved a destabilization of the C complex, as well as the other branch complexes. At this point, a self-supporting metal structure was created, consisting of three vertical poles fixed to the ground and joined by transverse elements. Steel cables were fixed to the transversal elements to support links on which to place the individual branches. The links alone [00:18:00] board the lateral movement of the branches, and they're raising but not flowering. This way, in this way, the tree can dissipate energy with the movement of the ground. Furthermore, these links are open in the upper part, so as to allow the secondary growth of the branches. The second step of the recovery involved the definition of a long term pruning program, again, based on the morphophysiological features of the tree, applying different techniques in the different parts of the ground. So, this slide represents the tree before the start of the pruning program, on the left in 2009, and then you can see the tree after the pruning [00:19:00] and after 10 years of pruning in 2019.

So, you can see in red, the parts to be removed during the first pruning, and then in green on the right, the tree's reaction to the pruning and, with the red arrows, the possible locations for future pruning. In this slide, we present the general details of the pruning to be done for each intervention. So, what should we do in each pruning? We should remove the weakest old, top branches as you can see, on the right. Then we removed the weak trunks. We removed the crossing branches. Then we do a simplification or reduction of the upper trunk, [00:20:00] a key chapter. And we do a simplification and reduction of the peripheral branches and the removal of weak and low branches. As we can see also in this slide, the two different organizations of the crown.

This slide presents the general details of expected responses, both in terms of the mission of new branching, the production of internal roots, directed at the crown, and finally, the production of the new cambial bridge. That is the main objective, the main hem to do with this tree. So, the production of roots and cambial bridge depends on an increase in cambial activity, partially due to the pruning program and partially due to both cavity feeling and root uncovering. So, what we want is the formation [00:21:00] of the new cambial bridge. You can see it in yellow.

So, the basal and internal restorations on trunks are feeding the cambium of the upper surface of the branches and internal roots of the trunk, and then the other part of the crown, the other crown organization made of internal epitone restorations on peripheral branches, feeding the cambium of the underside of the branches and the trunk. The third part, therefore, has been the filling of the cavity and the uncovering of the roots with air spade, followed by covering with the mixed substrate rich in organic matter. The filling of the cavity and lost adventitious roots already present immediately find a suitable environment for that [00:22:00] development and stimulates the cambium to produce new root elements. The soil excavation, performed with air spade and followed by the partial replacement of the soil, is described on this slide.

Thanks to these activities, the root shoot to the crown tends to connect the different cambial columns, again, as seen in the photo on the right. We also specify the composition of the mixed substrate that was made of 60% of soil, 20% of volcanic rock, and 20% of mulch.

This slide, finally, shows an adventitious root produced at the crown at the level of complex C in 2012, about three years after the filling. In the photo, in the center, [00:23:00] we can see the same root ten years later, in 2022, transformed into a cambial bridge that connects two adjacent, cambial columns. So, in 10 years, we reached the objective, starting from an adventitious root, on the left in the small photo, and reached the cambial bridge that is showed in the big central photo.

We can also see in this photo, the supporting system, and in the other photos below, we can see the mulberry today, after 12 years from the start of the recovery program. The tree management program for the next 10 years is going to be defined in the coming months. Obviously, the executed program requires planning, skills, and special expertise in the execution of interventions [00:24:00] to predict tree response and act appropriately, both qualitatively and quantitatively. The skills required for activities such as those that have affected the mulberry are now fully included in the Vet Cert Specialist Certification.

So, thank you for your attention. I'm Fabio Ascarini and this presentation was made of Eleonora Misuraca and Giovanni Morelli. Thank you everybody.