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Q-NET – a new scholarly network on quantitative wood anatomy

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A R T I C L E I N F O

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A B S T R A C T

Quantitative wood anatomy (QWA) is a dynamic research approach of increasing interest that can provide answers to a wide range of research questions across different disciplines. However, the lack of common protocols and knowledge gaps hinder the realisation of the full potential of QWA. Therefore, we established the new community-based network Q-NET to provide an open interdisciplinary platform for exchange and research around QWA. Q-NET (https://qwa-net.com) combines an online knowledge and exchange base with virtual workshops. The first two workshops each attracted more than 125 participants from around the world, demonstrating the community's interest in QWA and this virtual way of networking and collaborating. Indeed, virtual networks such as Q-NET could increase the inclusiveness, efficiency and sustainability of scientific collaboration while providing additional training and teaching opportunities for early career scientists, both of which complement in-person conferences and workshops.

Quantitative wood anatomy (QWA) is the numeric analysis of xylem anatomical traits of trees, shrubs, and herbaceous species and their relationship to plant functioning, growth, environment, wood quality and species identification (De Micco et al., 2019; Lens et al., 2020; von Arx et al., 2016). The xylem anatomical traits include measurable and countable anatomical variables of cells (lumen and cell wall dimensions, counts, position and spatial arrangement; e.g., IAWA Committee, 1989, 2004; Scholz et al., 2013), tissues (area, abundance and counts; e.g., von Arx et al. (2015); Zielińska et al., 2013), pits (dimensions of aperture, pit border, pit membrane thickness, torus and margo, and counts; e.g., Bouche et al. (2014), Li et al. (2016), Plavcová et al. (2013)), discrete anatomical features such as intra-annual density fluctuations (IADFs; e.

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g., De Micco et al. (2016)), resin ducts (e.g., Rosner and Hannrup (2004), Vázquez-González et al. (2020)), frost rings (e.g., Payette et al. (2010)), light rings (e.g., Filion et al. (1986)), blue rings (e.g., Piermattei et al. (2015)) and more. The variability is often measured along time series of growth rings, and matching the position within the ring to the sub-seasonal time window in which an anatomical feature was formed (Ziaco, 2020) allows reconstruction of processes (Carrer et al., 2017; Castagneri et al., 2017) and environmental variability (Björklund et al., 2020; Fonti et al., 2010; Hillabrand et al., 2018) at high resolution. Other viewpoints from which variability in anatomical traits is commonly investigated include phylogeny (Lens et al., 2016; Pace et al., 2009), patterns among species (Hietz et al., 2017; Olson et al., 2020), genetics (Davin et al., 2016; Eilmann et al., 2014; Hajek et al., 2016), allometry (Anfodillo et al., 2006; Rosell et al., 2017) and basic understanding of structure-function relationships (Hacke et al., 2015; Lens et al., 2011; Sviderskaya et al., 2020). Time series of QWA data can also be linked to other plant physiological data streams, such as time series of stable isotopes (Martin-Benito et al., 2017), dendrometer (Cocozza et al., 2016), and sap flow data (Tateishi et al., 2008). Altogether, QWA contributes to answering research questions related to ecophysiology, evolution, plant identification, tree biology, forest ecology, wood quality, and is applied in many different disciplines such as dendrosciences, geosciences and forest management. However, as with many dynamically evolving research approaches, there are limitations at many levels, including lack of common protocols and data analysis standards as well as knowledge gaps for proper interpretation.

1. Q-NET is a new community-based QWA network

Awareness of these limitations motivated the creation of the new community-based network Q-NET (https://qwa-net.com). Q-NET brings together scientists using QWA with the goal of providing an open interdisciplinary platform for exchange and research around QWA. Specifically, Q-NET aims to (i) identify key knowledge gaps, (ii) harmonise field and lab methods, and define standards and procedures for sampling, lab methods and data analysis, (iii) integrate QWA data to address large-scale environmental effects on tree growth and functioning, (iv) develop ideas for common projects, research agenda and priorities, and other activities, and (v) integrate with other disciplines to upscale from tree to stand and ecosystem level, e.g. through remote sensing, modelling approaches and artificial intelligence. The ultimate goal of Q-NET is to provide a platform to facilitate synergies among members that advance QWA and promote breakthroughs in the multidisciplinary field of wood science.

2. Q-NET organisation, participation and deliverables

Membership in Q-NET is open to anyone interested in sharing experiences and ideas on QWA. Membership is free and only requires registration (https://qwa-net.com/membership/). Since its launch on October 16th, 2020, Q-NET has grown to more than 390 registered members from 49 countries around the world (as of September 1st, 2021). The network is managed by the Q-NET Coordination Team, a rotating group of researchers in the field who volunteer time and energy to keep the idea alive.

The online member area of Q-NET hosts a directory with research profiles of all members to facilitate the search for scientific partners with specific expertise and lab equipment. The ongoing compilation of online tools and resources such as tutorial videos, books and articles about laboratory methods, online databases, software and hardware, etc. provides an important and growing knowledge platform. In addition, a set of different forums are available to post general questions, announce open positions and seminars, and interact in specific projects and activities.

A key activity of Q-NET is virtual workshops. The Q-NET workshops are “idea markets” that benefit from an interdisciplinary network for developing and elaborating new collaborative ideas, defining standards, advancing methodology, creating synergies from a larger and more diverse network, developing proposals and publications, etc.

3. Q-NET workshops and projects

The first virtual Q-NET workshop on November 30th, 2020, was attended by more than 160 participants and was dedicated to develop ideas for joint activities around the ten topics: (1) knowledge gaps in QWA; (2) protocols and standardised methods for QWA data production; (3) online toolbox for data analysis; (4) identification of structure-function relationships and relevant functional traits; (5) linking QWA with other data and proxies; (6) analysing wood anatomical time series: requirements and guidelines; (7) modelling and QWA: from cell to ecosystem; (8) wood technology and QWA: from dimensional measurements to biomechanics; (9) xylogenesis amd QWA: from counting to measuring; and (10) developing next-generation tools for quantification of anatomical structures. These topics were discussed in parallel breakout rooms prepared and led by experts in the field. The workshop produced ten ideas for common projects. The developed project ideas targeted a diversity of outcomes including perspective and review articles, regular exchange platforms, surveys, analyses scripts and databases.

A survey after the workshop revealed that two-thirds of the workshop participants considered themselves as juniors, which reflects the membership structure well. Slightly less than two-thirds indicated that such workshops should be organised twice per year. The workshop was rated very positively overall by participants, which shows that such virtual workshops can be a welcome complement to physical conferences and workshops.

A second workshop took place on May 19th, 2021, and was titled “A journey through QWA with stopovers”. Different from the concept of the first workshop, questions and suggested topics were collected previously and then answered and discussed by experts in five sequential sessions grouped into: (1) study design and field work, (2) sample preparation, (3) measuring techniques, (4) data analysis, and (5) xylogenesis. This second workshop was attended by more than 125 participants.

4. Conclusions

Quantitative wood anatomy (QWA) is a dynamically developing research approach that can contribute to providing answers to research questions on a wide range of environmental topics. However, there is a lack of consolidated common protocols. Furthermore, informed use and interpretation of QWA data requires an understanding of the complexity of the drivers behind the measured characteristics, which in turn requires multidisciplinary expertise. The newly established, community-based network Q-NET combines online and virtual tools to address these challenges and create synergies that advance QWA and its application in research.

Our experience to date suggests that Q-NET could be a model for a new, complementary channel of scientific exchange and collaboration in a relatively small research community. The benefits of this virtual networking include (i) greater inclusiveness, as there are no fees, making it easier for many members with small budgets to participate, (ii) a reduced time commitment to participate, as no travel is required, which could attract additional participants with time constraints, and (iii) a smaller carbon footprint. However, virtual meetings also bring challenges, such as different time zones that make it impossible for a global community to meet at the same time. Moreover, the social aspect of in-person conferences and workshops, which is often seen as equally important for networking and developing creative ideas, has no real equivalent in the virtual world. Altogether, virtual events offer the opportunity for a more inclusive group of researchers to interact with each other and provide additional training and teaching opportunities for early career scientists. This could help establish more consolidated common standards, protocols and knowledge bases, which is particularly important for dynamically evolving research approaches such as QWA.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Declaration of Competing Interests

None.

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