

**Podem as coleções de árvores ser museus vivos para a educação ao ar livre? Reflexões sobre um caso de estudo com coleções de árvores de noqueiras-pecã e de pistácios**

**Can tree collections be living museums for outdoor education? Reflections upon a case study about pecan and pistachio tree collections**

**¿Pueden las colecciones de árboles ser museos vivientes para la educación al aire libre? Reflexiones sobre un estudio de caso sobre colecciones de árboles de nuez-pecan y pistacho**

**Les collections d'arbres peuvent-elles être des musées vivants pour l'éducation en plein air? Réflexions sur une étude de cas sur des collections de noix pécan et de pistachier**

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## **Resumo**

Os educadores ambientais reconhecem a importância de aproximar os jovens à natureza, embora os sistemas educacionais atuais operem dentro de estruturas que precisam de melhorar essa ligação. Este artigo contribui para a crescente literatura sobre a forma como os espaços ao ar livre podem ser usados e valorizados como parte de práticas de aprendizagem para promover a ligação dos jovens à natureza. Estes são tópicos cada vez mais relevantes devido a fenómenos de transtorno de déficite da natureza (Louv, 2005) e disparidade de conhecimento sobre as plantas (Hiatt et al., 2021), que desafiam

os sistemas de educação a superá-los. Este estudo descreve iniciativas de aprendizagem ao ar livre sobre coleções de árvores de Nogueira-pecã [*Carya illinoensis* (Wangenh.) K. Koch] e de Pistácios (*Pistacia vera* L.). O estudo segue o método de Investigação-Ação (Clark et al., 2020) que engloba as iniciativas desenvolvidas, a sua análise e discussão. Com uma amostra de 130 alunos, com idades entre os 15 e 17 anos, as visitas a coleções de árvores mostram ser benéficas para favorecer a ligação dos jovens à natureza, enriquecer os currículos escolares e o conhecimento dos alunos sobre biodiversidade vegetal. Os resultados dos pré-testes evidenciaram as lacunas de conhecimento dos alunos sobre estas árvores não nativas. As noqueiras-pecã eram menos conhecidas para a maioria dos alunos (desconhecidas para 83%) do que as de pistácios (desconhecidas para 61%).

Palavras-chave: Ligação à natureza, Aprendizagem ao ar livre, Educação para o desenvolvimento sustentável.

### **Abstract**

Environmental and outdoor educators acknowledge the importance of connecting young people to nature, yet current education systems functions within frameworks that need to enhance such connection. This paper adds to the growing literature on the way outdoor learning spaces can be used and valued as part of learning practices to promote young students' connection to nature. These are increasingly relevant topics due to phenomena of nature deficit disorder (Louv, 2005) and plant awareness disparity (Hiatt et al., 2021), which challenge education systems to overcome them. This study is focused on outdoor learning initiatives about tree collections of Pecan [*Carya illinoensis* (Wangenh.) K. Koch] and Pistachio (*Pistacia vera* L.). It follows the Action Research method that involves the actions developed, their analysis and discussion. With a sample of 130 students, aged between 15 and 17, the initiatives to visit tree collections prove to be beneficial in favoring the connection of young people to nature, enriching school curricula and students' knowledge about plant biodiversity. Pre-tests results evidenced existing students' knowledge gaps about these non-native trees. Pecans were less

known for most of students (unknown for 83 %) than pistacia (unknown for 61%).

Keywords: Nature connection, Outdoor learning, Education for sustainable development.

### Resumen

Los educadores ambientales reconocen la importancia de conectar a los jóvenes con la naturaleza, mientras que los sistemas educativos actuales operan dentro de marcos que necesitan mejorar esa conexión. Este artículo contribuye a la creciente literatura sobre cómo se pueden utilizar y valorar los espacios al aire libre como parte de las prácticas de aprendizaje para promover la conexión de los jóvenes con la naturaleza. Estos son temas de creciente relevancia debido a los fenómenos del trastorno deficitario de la naturaleza (Louv, 2005) y la disparidad de conocimientos sobre las plantas (Hiatt et al., 2021), que desafían a los sistemas educativos a superarlos. Este estudio se centra en iniciativas de aprendizaje al aire libre sobre colecciones de árboles de nuez pecana [*Carya illinoensis* (Wangenh.) K. Koch] y pistacho (*Pistacia vera* L.). Sigue el método de Investigación-Acción (Clark et al., 2020) que involucra las acciones desarrolladas, su análisis y discusión. Con una muestra de 130 alumnos, con edades comprendidas entre los 15 y los 17 años, las iniciativas de visita a las colecciones de árboles resultan beneficiosas para favorecer la conexión de los jóvenes con la naturaleza, enriquecer los planes de estudios escolares y lo conocimiento de los jóvenes sobre la biodiversidad vegetal. Los resultados de las pruebas preliminares evidenciaron las brechas de conocimiento existentes de los estudiantes sobre estos árboles no nativos. Las nueces pecanas fueron menos conocidas por más estudiantes (desconocidas para 83 %) que las pistacias (desconocidas para 61 %).

Palabras clave: Conexión con la naturaleza, Aprendizaje al aire libre, Educación para el desarrollo sostenible.

## Résumé

Les éducateurs en environnement reconnaissent l'importance de connecter les jeunes à la nature, même si les systèmes éducatifs d'aujourd'hui fonctionnent dans des cadres qui doivent améliorer cette connexion. Cet article contribue à la littérature croissante sur la façon dont les espaces extérieurs peuvent être utilisés et valorisés dans le cadre de pratiques d'apprentissage pour promouvoir le lien des jeunes avec la nature. Ce sont des sujets de plus en plus pertinents en raison des phénomènes de trouble déficitaire de la nature (Louv, 2005) et de la disparité des connaissances sur les plantes (Hiatt et al., 2021), qui interpellent les systèmes éducatifs pour les surmonter. Cette étude se concentre sur les initiatives d'apprentissage en plein air sur les collections d'arbres de noix de pécan [*Carya illinoensis* (Wangenh.) K. Koch] et de pistachier (*Pistacia vera* L.). Il suit la méthode Investigation-Action (Clark et al., 2020) qui implique les actions développées, leur analyse et leur discussion. Avec un échantillon de 130 élèves, âgés de 15 à 17 ans, les initiatives de visite des collections d'arbres s'avèrent bénéfiques pour favoriser le lien des jeunes à la nature, enrichir les programmes scolaires et les connaissances des élèves sur la biodiversité végétale. Les résultats des pré-tests ont mis en évidence les lacunes existantes des connaissances des étudiants sur ces arbres non natifs. Les noix de pécan étaient moins connues pour la plupart des étudiants (inconnues pour 83 %) que les pistaches (inconnues pour 61%).

Mots-clés: Connexion à la nature, Apprentissage en plein air, Éducation au développement durable.

## Introduction

The Sustainable Development Goals (SDG) adopted at the 2015 United Nations Summit aim to foster socio-economic development while protecting the environment. However, increasing trends persist not only for biodiversity loss

(IPBES, 2019) but also for disconnection between humans and nature (Unesco, 2020). As today's students will soon be adults, the fourth of seventeen Sustainable Development Goals -SDG 4 Education- which is focused on quality education for all, is of an utmost relevance to help transform the world. This is particularly relevant nowadays, due to COVID 19 pandemic, which according to the last Human Development Report, led to a massive closure of schools and affected approximately 90 percent of children worldwide (UNDP, 2020). Environmental education has been viewed as an important aspect of education for decades. According to Bonnett (2010) the term can be dated back to a meeting of the International Union for Conservation of Nature and Natural Resources, held at Paris, in 1948. Concern for the environment got widespread in the 1950s-1970s, with particular focus on land misuse, pollution problems and unwise use of natural resources. Nowadays, it seems clear that these and other acute environmental problems affecting humanity, both locally and globally, are becoming wicked, more complex, intertwined and that education has a responsibility to address them (Bonnett, 2010). In this perspective, education for sustainable development became a crucial orientating idea within environmental education. Therefore, education for sustainable development was seen as a logical continuation of and partner to environmental education, with both being essential for moving society toward change (Biedenweg et al., 2016)(cit. Briggs et al., 2018). However, other authors perceive education for sustainable development as a distinct philosophy from environmental education, addressing a wider scope and variety of topics (e.g., human rights, social justice and protection of indigenous cultures). Notwithstanding these conceptual divergences, it is understood that issues brought by environmental concerns and education are multiple and bring implications not only for a single curriculum area, but for the whole education systems. Outdoor learning can contribute to several school curriculum topics (Rickinson et al., 2004) and within this research field, this paper is mainly focused on plant biodiversity. Almost three decades ago, Martin and Holdgate (1994) highlighted that the balance between people and their environment was being upset, with plants being a central component of a threatened nature. For them, the loss of plants was considered as very significant, for they stood at the base of food webs and provided habitats for

other organisms. Nowadays awareness raising about plant biodiversity is increasingly relevant due to ‘plant awareness disparity’ – PAD (Hiatt et al., 2021) and *nature deficit disorder* (Louv, 2005) phenomena, as well as the increasing trend of a disconnection of people from nature, at least in some societies (Unesco, 2020).

### **Learning plant biodiversity beyond the classroom.**

Outdoor education and outdoor learning include a set of activities and concepts such as adventure activities, outdoor recreation, place-based learning, environmental education, and experiential education (Mackenzie et al., 2018). Outdoor learning is a ‘broad term that includes discovery, experimentation, learning about and connecting to the natural world, and engaging in environmental and adventure activities’ (Institute of Outdoor Learning, 2020). Although the analysis of historic developments within outdoor education (which has a long history that dates back, at least, to 19<sup>th</sup> century) is beyond the scope of this paper, it is worth emphasize not only John Dewey’s foundational contribution to the movement of experiential learning (Dewey, 1938), studied by several researchers (e.g. Luff, 2018; Moss and Normore, 2006), but also the pioneer role of Lilian Clarke in outdoor education at United Kingdom (Sanders, 2008). From 1896 to 1926 she has developed at London innovative teaching practices in the design and use of school gardens. Her legacy for contemporary field studies/outdoor education was, among other things, to promulgate the use of the ‘outdoor classroom’ (Rickinson et al., 2004). Later, in the 1940s, it has begun to be argued that ‘all growing children should at least be given the opportunity of gaining an insight into the nature and significance of their actual surroundings’ (Tansley, 1945). In the 1950s, field trips and excursions were perceived by outdoor education researchers as beneficial to student’s educational development (NASSP, 1941) being stated that ‘good learning and the outdoors are inseparable’ (NASSP, 1957). In the 1970s, outdoor learning was valued as a learning methodology through first-hand experience, and as a teaching methodology which uses the real world as a resource (Passmore, 1972). Outdoor recreation/education has even been

referred in Scandinavian countries (Denmark, Norway and Sweden) as *friluftsliv*, literally meaning free/open-air life (e.g. Henderson and Vikander, 2007; Andkjær, 2005)(cit. Bentsen et al., 2009). Therefore, within outdoor learning literature although the prevalent idea that being in the outdoors provides deeper and real learning opportunities is not a new one (Henderson, 1999; Potter and Gray, 1999)(cit. Zink, 2010), it has a high relevance due to the current biodiversity loss crisis. This crisis challenge educators, scientists, among other civil society stakeholders to develop outdoor learning initiatives about biodiversity issues within biology and biosphere studies. Biodiversity, a word which is a contraction of *biological diversity*, is the inherent property of living systems of being distinct and is meant to describe and embrace all the diversity of life found on earth, encompassing therefore biological systems complex functions and processes. The term *Biodiversity* dates back to the National Forum on BioDiversity, held in Washington, D.C., in 1986, under the auspices of the National Academy of Sciences and Smithsonian Institution (National Academy of Sciences, 1988). Awareness that biological diversity is enormously valuable to present and future generations, notwithstanding it keeps being threatened, lead the United Nations Environment Programme (UNEP) to convene the *Ad Hoc Working Group of Experts on Biological Diversity*, in November 1988, to explore the need for an international convention on biological diversity. Nowadays, the Convention on Biological Diversity occurs every two years to provide a multi-stakeholder global legal framework for action on biodiversity at the Conference of the Parties (Secretariat of the Convention on Biological Diversity, 2020). However, the national and global efforts to halt biodiversity loss are known to be still far from sufficient, which is a serious threat to environment and our societies. This is currently relevant for plant biodiversity, as Hiatt et al. (2021) highlighted the need to create authentic research opportunities in plant biology as crucial to address ‘plant awareness disparity’ (PAD), formerly known as plant blindness (i.e., people tendency to neither properly notice nor value plants in their daily lives, in the environment and societies). The higher preference for, superior recall of, and better visual detection of animals compared with plants (in *zoocentric societies*) can be attributable not only to perceptual factors, but also to cultural factors (e.g., by giving a greater focus on animals in formal biological education) (Balding and

Williams, 2016). For these authors, although plant blindness is common, it is not inevitable and therefore strategies to better communicate plant biodiversity and its role in biosphere are highly valuable to counteract this phenomenon. For the purposes of this paper, the term outdoor learning refers to experiences held at two non-native nut tree collections to enrich school curricula about plant biodiversity. Concerning agricultural resources, it is well known that for each country or region, current crop distribution depends not only upon the availability of irrigation water, climate, soil type, but also on the economic and social influences, that will determine, what species of plants to grow, whenever the above specified requirements are met.

### **Connection to nature.**

Human societies are deeply interwoven with nature in several different ways. All around the world it is known that connection to nature and issues of nature conservation vary deeply among different human communities and cultures. Nowadays, with the urbanization of the globe and increasing numbers of people living in cities (U.N., 2015), it seems clear that opportunities for them to establish a connection with nature may be decreasing, while concomitantly, human sprawl threatens the habitat of most wild living species (Thompson, 2000). However, for all societies, nature constitutes the main resource system that provides humans with a huge variety of materials or services, such as foods and medicines, water, furnishings, building materials or, within the set of ecosystems services, air purification, flood regulation and aesthetic appeals or recreation. This later is particularly relevant in societies where an *asphalt jungle* (Thompson, 2000) brought by an increasing urbanization, has led to a growing need to reconnect young people with nature and to promote outdoor recreation in forests, in green spaces and associated ecosystems (Charles et al., 2008). For these reasons, even if there is a distance between some people and nature, awareness about not only human dependence upon natural systems, but also of the shift to the ethic which sees humanity as part of the biosphere (Wilson, 2000) deserves to be highlighted. This is also Martin and Holdgate (1994) point of view as they highlighted that even city inhabitants are part of

wider ecosystems, based on wild plants and natural vegetation. For this paper scope, connection to nature is studied with a sample of 130 young students aged between 15 and 17 years, with a focus on outdoor visits to two non-native nut fruit tree collections held in Portugal. Around the world, for children living in cities of developing countries and industrialized societies, which are increasingly out of touch with nature, their knowledge about nature differs from the one held by children living in contact with natural systems on a daily basis (e.g. within indigenous cultures of tropical areas in countries such as Brazil, Mexico and other South American countries)(Barraza, 2001; Kinoshita et al., 2006; Bang et al., 2007)(cit. Bartoszeck et al., 2015). For urban contexts, Thaman (2013) recommendation concerning young people's knowledge about nature was that we should assure our children know the names and types of animals, plants and other organisms and the ways ecosystems functions. It has been evidenced that effective environmental education, or simply quality time spent outdoors, could increase care for nature (Chawla, 2007) and connection to nature in individuals (Ernst and Theimer, 2011)(cit. Laird et al., 2014). For this paper, students' connection to nature is framed in this perspective of outdoor learning and quality time spent outdoors during students' exploratory visits to tree collections. It is worth mentioning that there have been developed frameworks and scales to assess the affective, the cognitive and the experiential aspects of individuals' connection to nature, such as the 'NR scale-Nature Relatedness' (Nisbet et al., 2009) or the 'ACHUNAS- Assessment framework for Children's Human Nature Situations' (Giusti et al., 2018). Although it is beyond this paper's purpose to assess any relationship between connection to nature and conservation behavior, previous research has shown that childhood experiences of camping, hiking, playing in woods or picking flowers is positively related to protective environmental behaviors in adults (James et al., 2010, Wells and Lekies, 2006)(cit. Hughes et al., 2018). Therefore, for these authors, there is a positive relationship between connection to nature and conservation behavior. This connection aroused from a direct experience of nature which Zylstra et al. (2014) considered, based upon their literature review, as necessary to form an ecological consciousness, which motivates care and action.

## Objectives

This study seeks to highlight tree collections' role as living museums able to enrich school curricula and promote young students' connection to nature. Specific objectives of tree collections outdoor visits initiatives are: 1) to foster young people connection to nature, enhancing their curiosity and knowledge about agriculture and biodiversity; 2) to encourage and support teachers and educators in outdoor learning initiatives about agriculture and biodiversity to enrich school curricula.

## Methodology

This study relies upon the Action-Research methodology (Clark et al., 2020), which involves the actions developed, their analysis and discussion. This study enrolled two school communities of two Portuguese urban localities, during the scholarly year of 2015/2016. It engaged 130 students, aged 15-17 years, in outdoor visits to two non-native nut tree collections which differ in their geographic origin. Teachers were invited to participate with their students in these outdoor visits to trees which represent unique biological resources, useful as tools to promote students' connection with nature and a better understanding about species richness and their adaptability to environmental conditions.

### **Assessment of student's knowledge about Pistachio and Pecan species.**

Previously to outdoor visits, a pre-test was fulfilled by participating school students to assess their previous knowledge about Pistachio and Pecan tree species. Pre-test questionnaire had the following two questions: 'Q1- Do you know Pistachio?' and 'Q2- Do you know Pecan?'. Students answered the pre-test before the visit to tree collections and results were quantitatively analyzed in terms of percentage values of students who know the trees versus those who were unaware.

### **Outdoor visits to Pecan and Pistachio tree collections.**

Outdoor visits were held at a Research Institute Campus located nearby the two invited schools; with one located at less than 1 km distance and a second one at 17 km distance. The former group did not need transportation but teachers from the second one managed to provide their students with the required transportation to the Campus by bus. Outdoor visits were scheduled to last 2 hours with a methodology centered on a playful approach, allowing students to freely explore and observe Pecan and Pistachio tree collections, which are located apart one another only by a few meters distance. These tree collections exist in a Portuguese region with a mild climate, that allows outdoor visits to occur almost during all year, except between the coolest periods of late November and February, when minimum average temperatures range between 46°F (8°C) to 52°F (11°C). These two non-native nut tree collections were planted in the 1980s for agronomic research projects and are currently useful for outdoor learning visits, structured as a complement to enrich classroom curricula about agriculture, plant biodiversity and botany.

During the outdoor visits to the two tree collections students observe different trees organs (e.g., leaves, nuts), feel their texture and look closely with magnifying glasses. A paper map brochure describing the two collection tree varieties names is distributed to students to facilitate their exploration during the visit. They also became aware of their geographic origin, reproduction cycle, among other biological and agronomic features. Pecan [*Carya illinoensis* (Wangenh.) K. Koch] and Pistachio (*Pistacia vera* L.) tree collections visited by students were initially planted by researchers with the purpose of evaluating these nut trees' adaptability to several distinct Portuguese local geophysical and climatic conditions.

### **Pecan tree collection.**

Pecan tree (Fig. 1 a, b) is the most important nut tree of North America growing on the rich forested bottomlands of the Mississippi Valley as far north as Illinois and west into Texas and Kansas (Menninger, 1977), occurring locally on highlands of Mexico (Sargent, 1961; Menninger, 1977). They produce edible

nuts that have a high percentage of fat, being extensively used in candies and cookies (Stephens, 1973, cit. USDA, 2001), besides other uses of their by-products (FAO, 1995). According to Texas Pecan Growers Association (TPGA, 2015), United States of America was the world largest producer of pecans, which were also produced in other countries such as Mexico, South Africa, Israel, China, Argentina, Australia and Brasil. Commercial planting of pecans started in the 1880s at USA and since then, they took off as a commercial crop in other geographic regions during the following decades.



**Figure 1 a- Students outdoor visit to the Pecan tree collection.**



**Figure 1 b- Pecan nut collected by a student.**

### **Pistachio tree collection.**

Pistachio tree (*Pistacia vera* L., Fig. 2 a, b) is native from Asia Minor but its cultivation now extends to other geographic places such as India, the Far East, southern United States to California, Mexico into Europe and north Africa (Menninger, 1977). *Pistacia vera* L. is economically important as the source of pistachio nuts (FAO, 1995), which is broadly cultivated in Mediterranean countries (Humphries, 1982).



**Figure 2 a- Pistachio tree collection.**



**Figure 2 b- Pistachio fruits.**

## Results

### Students' knowledge about tree species.

To assess students' knowledge about these two non-native trees, whose fruits are consumed in Portugal, as whole nuts and/or processed food ingredients, the two pre-test questions were: 'Q1- Do you know Pistacia?' and 'Q2- Do you know Pecan?'. Results from the 130 enrolled students' answers are shown in Table 1.

**Table 1**

Table 1: Students' questionnaires results (and respective percentage values) obtained for the two questions about Pistacia and Pecan trees (total number of students=130; NR- no reply).

Question	Yes	No	NR
Q1 - Do you know Pistacia?	45/130 (35 %)	80/130 (61 %)	5/130 (4 %)
Q2 - Do you know Pecans?	17/130 (13 %)	108/130 (83 %)	5/130 (4 %)

### Students' participation in outdoor visits.

During outdoor visits students were eager to observe pecan and pistachio trees. They had the opportunity to collect some biological material and to learn details about each tree geographic origin: Asia for 'Pistachio'; and North America and Mexico for 'Pecan'. Students were given the tools to see these nut trees, to understand their differences and became aware about the agronomic studies carried out about these trees' adaptability to geophysical and climatic conditions in Portugal and their usefulness to help diversify human diets.

## Discussion

### Pre-tests results.

Pre-tests results evidenced existing students' knowledge gaps about these non-native trees. Pecans were less known for most of students (unknown for 83 %) than Pistacia (unknown for 61%) and during the outdoor visits it was possible to overcome these knowledge gaps.

### Outdoor visits results.

The drive to discover, to explore, to understand and use natural resources is perceived as a basic human trait. However, in western societies, the increasing trend of young people to be disconnected from nature (Louv, 2005; Unesco, 2020) is challenging outdoor learning educators, teachers, civil society organizations, among other stakeholders to develop networks to effectively engage them, both cognitively and physically, with natural habitats (e.g., 'Children & Nature Network C&NN' in United States of America, Charles et al., 2008; or 'Reef Guardian Schools Program in Australia', GBRMPA, 2020). Nowadays young people engagement with nature, biodiversity and even with *humanized biodiversity* of cities, namely agricultural fields (Arya, 2012; Thaman, 2013) is increasingly relevant and it is even perceived as a must. According to Uno (2018) we need to expose students to the beauty, excitement and wonder of plants, and to their importance for people lives and our countries' future. Effective outdoor learning initiatives, or simply quality time spent outdoors, have been suggested to help increase connection to nature in individuals (Ernst and Theimer, 2011)(cit. Laird et al., 2014) and for this study, connection to nature was precisely interpreted and framed as such. Therefore, in this study, connection to nature consisted in students' outdoor visits, which allowed them to train their observational skills, using eagerly the magnifying glass provided. These are results in agreement with Arya' (2012) findings about field studies concerning botany, held at different settings such as agricultural fields, natural parks or botanical gardens. Students also become aware that the worldwide diffusion of plants, which has occurred throughout millennia, is still

highly relevant nowadays within the current climate change scenarios. Concomitantly, the Food and Agriculture Organization (FAO, 2015) presumed as likely that climate change will need more international exchanges of genetic resources as countries seek to obtain well-adapted crops, livestock, trees and aquatic organisms

## Conclusion

The outdoor visits to two non-native nut tree collections were useful not only to improve students' knowledge about plant biodiversity (pecan and pistachio trees become known for those who were unaware of them) and to enrich school curricula, but also to (re)connect students with nature. Students were highly motivated during the outdoor visits to carefully explore the field and to collect some biological materials. Their motivation will help them not only to learn, but also to remember some biological concepts of botany. According to Arya (2012), botany is a subject which cannot wholly rely upon classroom teaching, as it does not help students to absorb the ethos of plants' natural habitats. Therefore, it can be assumed that traditional, formal education about botany and plant-based science, with their prescribed and linear curricula can be enriched with outdoor learning, due to its relevant outcomes. These include benefits not only in terms of students' personal satisfaction and learning process, but also as a mean to reconnect them with nature and provide hands-on experiences, which in turn, as suggested by previous studies, may enhance environmental consciousness and behavior. This is particularly relevant whenever young people are out of touch with nature and disconnected from the process of growing plants, lacking knowledge about the landscapes or farming systems where their food comes from. For practitioners interested in young people connection with nature, which holds a renewed importance due to COVID-19 pandemic which affected every person, everywhere in the world (UNDP, 2020), this paper illustrates good practices about outdoor learning. It particularly demonstrates how tree collections hold an important outreach capability as truly living museums that provide opportunities to explore nature, plant species and their resources, with multiple benefits for their visitors. Visitors to tree collections may belong to learning communities beyond

secondary schools, such as primary schools, some learning communities from other institutions, as well as the public at large. In short: we can manage to see a living museum in each tree collection to enrich school curricula, to improve students' knowledge and to benefit young people (re)connection to nature.

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