Abstract

Engagement with the natural world is a key aspect to its protection, and so knowing what species the public can identify is important in allocating often limited time and resources. This study examines a data-set of photographic identification that were sent to the Woodland Trust to be identified. The analysis found that deciduous rather than evergreen trees were most frequently queried, with Spring and Autumn the most active seasons for engagement. Individual genus and species were isolated from the data, more variable species appearing to be most often queried. Suggestions on how this data can be utilised are given, as well as its limitations.

Keywords

Trees, Identification, Public, Education, Management.

Introduction

The ability to identify a species allows for a greater feeling of connection with the natural world. By knowing what a specimen is, it is possible to better understand the relationship between biotic factors (other plants and animals) and abiotic factors (such as the soil, geology and climate). This helps to facilitate a greater understanding of the world around us, simply by being able to identify a species that is found. Being able to identify species, and their subsequent complex interactions, is thought to be pivotal for environmental protection (Leather and Quicke 2010), and relies on not just trained professionals, but a population that has a reasonable knowledge of the natural world.

A seven-year study was conducted by Natural England, the government's adviser for the natural environment in England, on the English public's engagement with the natural environment (Natural England 2017). In the most recent study period (2015/16) 879 million visits were recorded to parks in towns and cities, with 446 million visits to woodland and forests. This shows a huge opportunity for members of the public to interact with trees and develop a greater understanding of the natural world around them. Between the start of the survey (2009/10) and the end of the survey (2015/16) a significant increase in the proportion of the population visiting the natural environment occurred (from 54% to 58%). This study shows that the public are becoming increasingly engaged with the natural environment. The ability to identify what they are seeing would provide the basis of understanding the natural world that they are experiencing.

Current UK primary level education incorporates ecology into the national curriculum, which includes the prerequisite that students enter secondary school with the ability to identify tree species – the current curriculum for Year 1 primary level students states 'identify and name a variety of common wild and garden plants, including deciduous and evergreen trees' (Department for Education, 2013). Whether this is happening is unclear, as the current cohort of teachers are unlikely to have received this training themselves from the curriculum that they received (Department of Education and Science 1991), and so may struggle to identify common species. This illustrates a clear generational gap, with tree species identification not being taught (including to the author) within compulsory education and may account for a lack of skills to identify species.

The current trends in higher education appear to be mixed for those courses that promote species identification. The ability of undergraduates to identify common plants is thought to have declined over the past 30 years (Bilton 2014), with 1st year undergraduate students no longer able to identify common trees and final year students not having developed the requisite skills on graduation (Leather and Quicke 2010). What is encouraging however, is that students appear to be developing the mechanisms to identify species (the use of field guides and keys) as opposed to having a photographic knowledge of species in the field (Goulder and Scott 2016). This may be due to the highly modularised higher education making the practice of repetitive skills, such as species identification, more problematic to teach at University (Buckley 2018). In the USA, it is thought the number of PhD's with degrees in natural history related fields has declined over the last 50 years (Tewksbury et al. 2014).

Members of the public are likely to have some underlying levels of tree species knowledge, though to what extent is likely to be highly variable depending on their background and individual circumstances. Heberlein and Ericsson (2005) found a separation between the levels of interest in wildlife by two study groups, with people that lived in urban centres being less engaged compared with those living in rural areas. The reasons for this may be lifestyle, with less time spent in the countryside due to the pressures of modern working life (Heberlein and Ericsson 2005) and television and computer entertainment (Tewksbury et al. 2014). The lack of exposure to natural environments by those living in urban centres is thought to be responsible for a decline in plant identification skills (Cheeseman and Key, 2007, Leather and Quicke 2010). A poll published in the Daily Telegraph taken in 2009 (as stated by Leather and Quicke 2010) gives a snapshot of the public's ability to identify trees - 56% could identify an oak (Quercus spp.), 29% a pine (Pinus spp.) and 26% a horse chestnut (*Aesculus hippocastanum*). Promoting rural areas by retaining services and encouraging younger people to move to them, subsequently encouraging positive attitudes towards wildlife, was suggested as a means of reversing the decline in knowledge (Heberlein and Ericsson 2005). An investigation into knowledge of tree diseases in the UK found overall low levels of awareness amongst the participants, but an increasing level of awareness corresponded with an increase in the age and rurality of the respondent (Fuller et al. 2016). This supports the idea that more rural lifestyles, and thus exposure to greater numbers of trees, engenders more knowledge about trees.

The objective of this study was to analyse a dataset that had been collected over a six-year period, that gave an insight into the tree species that members of the UK public struggled to identify. This analysis was not initially sought when the voluntary 'species identifier' role was started by the author, but due to the potential insight this data would provide the wider community, it was felt a useful investigation to conduct. Though the metadata such as record location and exact dates was lacking,

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thus inhibiting the level of analysis that could be carried, it was still felt to provide an interesting and useful study that may provide useful information to a wide range of stakeholders within the scientific community.

Method

The data for this project was collected as part of a volunteer role that the author occupies for The Woodland Trust the UK's largest woodland conservation charity. Photographs of tree species are submitted by members of the public to be identified. This has resulted in a dataset being collated over the six years of participation, and provides an insight into the species that members of the public who are looking to engage with increasing their tree identification skills, struggle to identify. The purpose of this analysis was to ascertain which species have occurred most frequently, to identify any trends that may be apparent.

Photographs of tree species that required identification were received digitally from members of staff at The Woodland Trust (Fig.ure1.) The images were identified using field guides and web-based sources, and where necessary cross-checked using image searches.

FIGURE 1 APPROX. HERE.

A dataset of submitted tree identifications was compiled from August 2012 to May 2018, which contained 272 tree records (shrubs, climbers and herbaceous perennials were excluded). The dataset was manipulated using a range of 'Count and Sum' functions across groups of interest. These included: -

- Month of query
- Evergreen or deciduous
- Genus groupings
- Individual species counts

Results

The species submitted were predominately deciduous trees at 86%, with 14% being evergreen species.

TABLE 1 APPROX HERE.

The most common genus to be queried were *Sorbus* (23), *Quercus* (22) and *Salix* (21) (Table 1). The most common species to be queried were *Salix caprea* (Goat willow) (14), *Fraxinus excelsior* (Ash) (11) and *Sorbus aria* (Whitebeam)(9) (Table 1). Figure 2 provides a full breakdown of the species submitted and identified.

FIGURE 2 APPROX. HERE.

There were two peaks in submission frequency, with late spring/early summer and mid-autumn being the most frequently represented by the data. The least number of queries were submitted during the winter months of December-March.

Discussion

This study has identified a range of tree species that are most commonly unidentified by members of the public. This information may be of use to practitioners looking to enhance the public's ability to engage with nature, and thereby promote involvement with the forestry and wildlife sectors.

The month in which queries were submitted may be of benefit to practitioners in knowing when to target interpretation and staffing provision, which may have impacts on budgets. The State of Nature report by Natural England found the December to February quarter of their study to show the lowest proportion of visits to the natural environment (Natural England 2017). As winter was the time when least queries were submitted, it may be that this is when public engagement is having least impact and so staffing and resources can be reallocated. This may be particularly useful as the winter months are often the most useful time of the year for active tree work to be carried out. The highest proportion of visits was recorded in the June to August quarter (Natural England 2017). In comparison to this is a focus on the summer months, with high numbers of photographs being submitted when the public are actively engaging in the natural environment (Natural England 2017).

When considering the type of trees queried, our analysis would appear to indicate that deciduous trees are the least well known. Whilst this could be interpreted as the public having greater knowledge of evergreen species, it would seem unlikely when considering the complexities of identifying groups such as conifers. It is likely that deciduous trees are more frequently encountered in urban habitats, and therefore are more likely to be queried and presented in this analysis. The ability for the public to identify trees may be related to their experience with certain species, such as their use as firewood, being present in gardens or used commercially for products. An investigation in Yunnan, China, of the ability for locals to reliably identify trees found that they were least successful at identifying light weight, low density woods that they would often not use and were of limited value to the community (Zhao et al. 2016). This was thought to illustrate how knowledge was directed towards meaningful associations with species (fuel, food, income or cultural associations) with other, less useful trees being disregarded. If this is the same for the UK public, then attention should be directed towards species that have minimal economic use but are often widely observed. This could be the case for species such as holm oak and goat willow, which are widespread and common, but have little everyday economic benefit but great wildlife importance. This would appear to be reflected in the analysis of data, whereby species that are common but have no direct 'use' by the public may be less well known. Another explanation may be the level of variability that some species can exhibit. Goat willow, ash and common whitebeam can have a level of variability that can lead to confusion in identification.

Other species such as holm~~lly~~ oak (*Quercus ilex*), red oak (*Quercus rubra*) and black locust (*Robinia pseudoacacia*) attract attention due to their substantially different appearances, but can only be readily identified with a degree of knowledge that members of the public may not possess. MacKenzie

Commented [d4]: Give scientific name please et al. (2017) found that identification is influenced by the relative abundance of the species being identified. This may explain why species that are less common, and so less likely to be interacted with on a frequent basis, are often queried. A counter argument to this may be that more common species such as field maple and chestnut have high numbers of queries due to the number of interactions that the public have with them. This may be an element of sampling bias within the data, whereby common species are still likely to be queried even though it would be expected that a proportionate amount of the public would know them.

A simple way of increasing the knowledge of species for the public may be through changes in education and the curriculum. There are some issues with this approach however. The current national curriculum is heavily weighted towards ecology and includes sections specifically on tree species identification. The current cohort of newly qualified and trainee teachers are unlikely to have received much in the way of formal teaching of tree identification themselves especially if they have no additional training at further or higher education levels, and so are at a disadvantage when trying to pass on this knowledge to their students. They should therefore be heavily supported by training establishments that specialise in these fields (the author can attest this does occur at some institutions, with trips to woodlands to collect samples for both undergraduate and postgraduate trainee teachers to identify.) Education by itself should not be the sole route to better knowledge dissemination. In a study of plant knowledge in Kenya between students and young herders of comparable age, the students were shown to have less knowledge of plants (Bruyere et al. 2016). This was thought to be due to time being spent studying other subjects, with herders spending more time outside amongst plants and with those that had traditional knowledge to pass on. A balance therefore should be found between formal education, and time spent experiencing wildlife and tree species – this may be where 'forest schools' are filling a niche in UK schools.

The data from this study could be used by organisations to target their interpretation and educational material. From the 2015/16 study period conducted by Natural England, only 31% of visitors to the natural environment felt that they learnt something. This shows that there is a possibility to increase the learning potential of visits, which could be tailored to include the species that are most often struggled with. Whilst the labelling of trees with names and information in woods and forests in unfeasible (though could potentially be applied to feature trees or landscapes descriptions), parks in towns and cities would be the ideal target due to their high footfall and the low economic requirement to install signage.

The constraints of this study may lie in its small dataset size. A trade off in data quantity must be made with a balance in the quality of identification by a trained individual. Traditional citizen science derived data often results in far larger data-sets that require members of the public to act as the identifying agents and thus may lead to erroneous results. This balance is an issue that is often noted in citizen science derived data sets, with analyses often having to opt for either quality or quantity (Tulloch et al. 2013; Newson et al. 2015). This analysis addresses one of the key points made by Tulloch et al. (2013), in that it utilises a small dataset to explore untargeted questions early on, rather than waiting for more complete datasets. Aceves-Bueno et al. (2017) carried out a review of ecological studies that examined the accuracy of citizen-science projects. They found that 51% of studies examined correlated strongly with professionally analysed data. This shows that, in some instances, identification by untrained members of the public may be a useful tool for ecologist, but would require input in terms of cross-checking and validating records. This level of proof-checking could make the use of untrained volunteers redundant, in that the time spent checking could end up being better utilised carrying out the identifications directly. This would need to considered when developing the projects on a case-by-case basis.

This method of data collection may also be of use due to its ability to reward the participant by gaining an answer to their question. Sullivan and Molles (2016) noted that an incentive is often needed to promote engagement with projects. With the tree identification data, a direct question is asked with the reward being an answer to that question in the form of an identification. This gives the participant what they want, as well as a useful data point for the analyst.

The data collected from the submitted photographs would have passed through some filters before being received to be analysed. Firstly, the more common species may have been identified by the member of the public, and so would not have been submitted. Members of staff at the Woodland Trust intercept quick identification queries, though the bulk were passed to a volunteer for identification. This would have left species that were either difficult to identify due to being uncommon, or species that had natural variations and multiple growth forms (such as goat willow) making them difficult to identify. This would have resulted in a data set that only contained either difficult, or atypical species. This however leaves an interesting dataset, in that it contains only species that are more challenging to recognise.

A further limitation is the quality of photographs submitted. The level of detail and quality of the image submitted is proportional to the accuracy of the offered identification. Whilst a certain level of detail is requested, this is not always adhered to, and so the accuracy may be affected negatively. This provides evidence that those without identification skills may believe that a species can be identified just from a single feature (leaves, bark or the overall shape of the tree). What is required is a collection of these features, with each additional feature providing a greater level of accuracy of the identification. Those photographs that are of too poor a quality or of little detail to offer an identification are filtered out.

Conclusion

This study has provided an insight into what tree species members of the UK public find difficult to identify. The aim of this study was to provide an overview of these more challenging tree species, therefore aiding the wider community. This has been achieved by analysing the data in a relatively simplistic but user-friendly way, which provides specific information that could be useful to a range of stakeholders. This information could be used to target educational programmes to enhance knowledge of these species. This may take the form of taught programmes, on-site interpretation or media campaigns by a wide range of organisations. These could include educational institutions from primary level schools to universities, conservation charities and non-governmental organisations. Funding availability for teaching and learning identification skills is likely to be minimal. Knowing where to target these resources to gain the best possible outcomes and fill the shortfalls in knowledge would help to create a more informed public audience. This could enable a more enhanced association with the natural environment, which could work in conjunction with promoting environmental awareness and sustainability.

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Figures

Figure 1. An example of the types of photograph that were submitted by members of the public and indented – this photoset is of *Aesculus hippocastanum*, showing the tree shape, bark and a leaf example.

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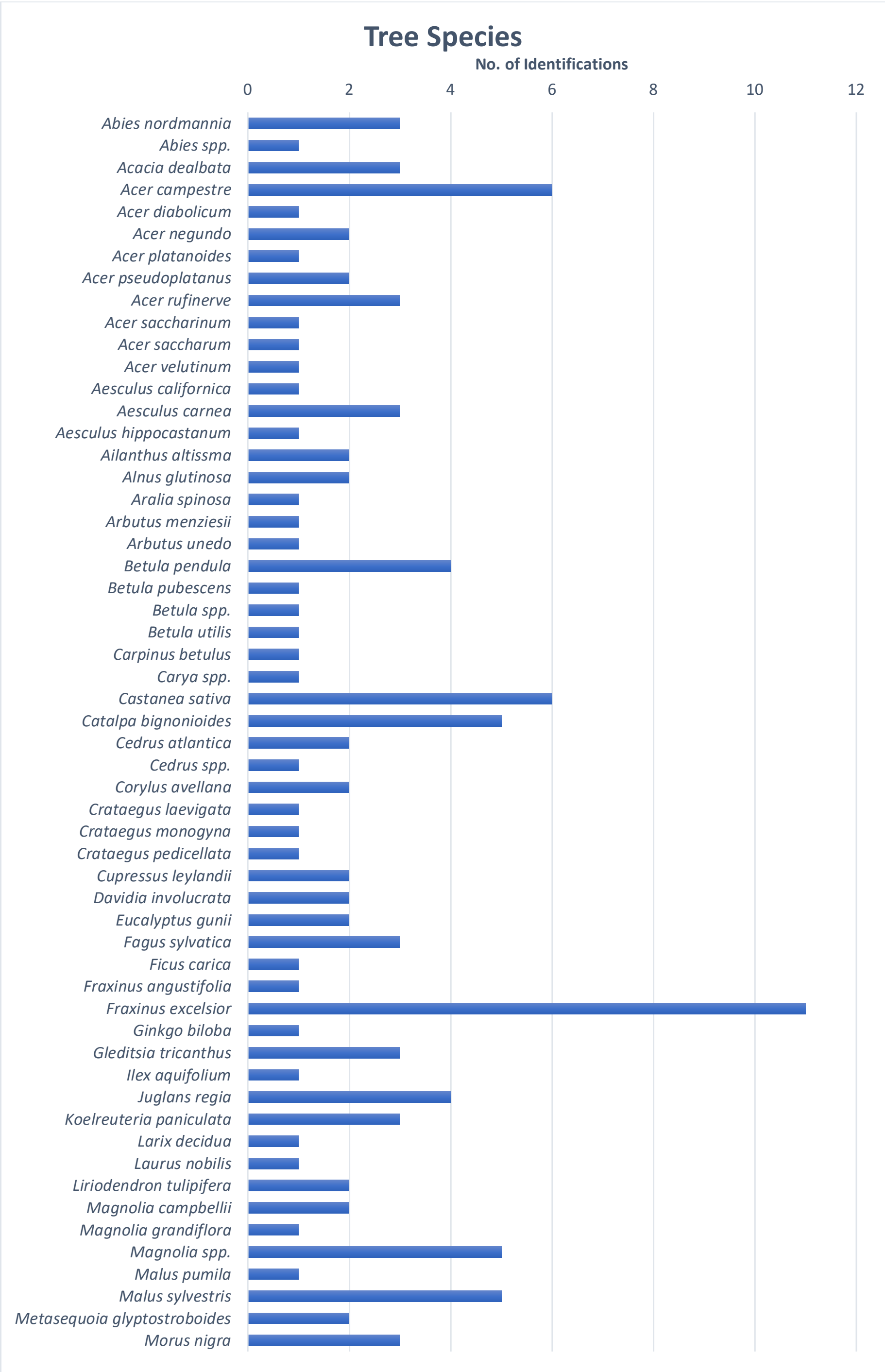
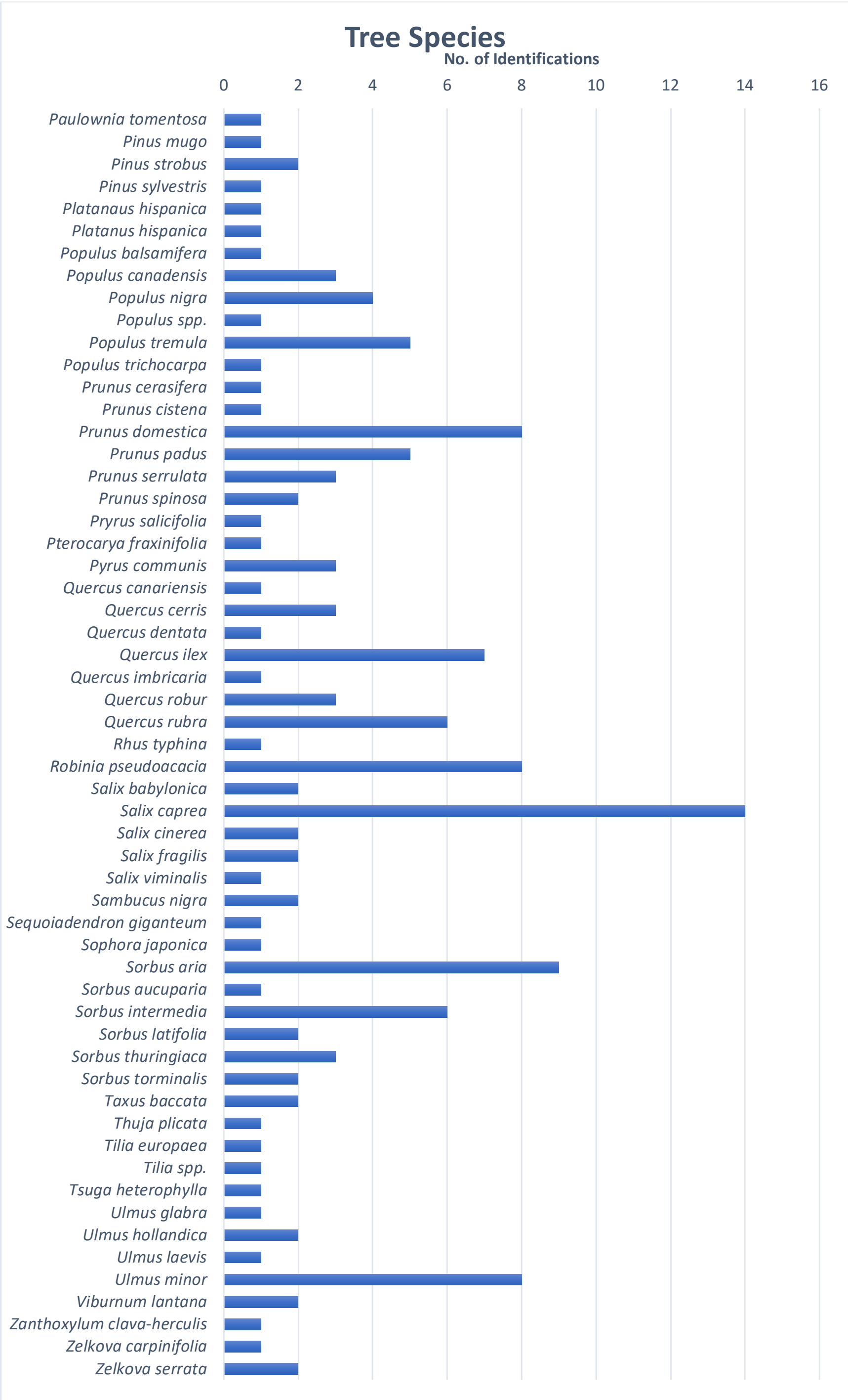
Figure 3. All tree species identified to species level.



Tree Species
No. of Identifications
0
2
4
6
8
10
12
Abies nordmannia
Abies spp.
Acacia dealbata
Acer campestre
Acer diabolicum
Acer negundo
Acer platanoides
Acer pseudoplatanus
Acer rufinerve
Acer saccharinum
Acer saccharum
Acer velutinum
Aesculus californica
Aesculus carnea
Aesculus hippocastanum
Ailanthus altissma
Alnus glutinosa
Aralia spinosa
Arbutus menziesii
Arbutus unedo
Betula pendula
Betula pubescens
Betula spp.
Betula utilis
Carpinus betulus
Carya spp.
Castanea sativa
Catalpa bignonioides
Cedrus atlantica
Cedrus spp.
Corylus avellana
Crataegus laevigata
Crataegus monogyna
Crataegus pedicellata
Cupressus leylandii
Davidia involucrata
Eucalyptus gunii
Fagus sylvatica
Ficus carica
Fraxinus angustifolia
Fraxinus excelsior
Ginkgo biloba
Gleditsia tricanthus
Ilex aquifolium
Juglans regia
Koelreuteria paniculata
Larix decidua
Laurus nobilis
Liriodendron tulipifera
Magnolia campbellii
Magnolia grandiflora
Magnolia spp.
Malus pumila
Malus sylvestris
Metasequoia glyptostroboides
Morus nigra


Tree Species
No. of Identifications
0
2
4
6
8
10
12
14
16
Paulownia tomentosa
Pinus mugo
Pinus strobus
Pinus sylvestris
Platanaus hispanica
Platanus hispanica
Populus balsamifera
Populus canadensis
Populus nigra
Populus spp.
Populus tremula
Populus trichocarpa
Prunus cerasifera
Prunus cistena
Prunus domestica
Prunus padus
Prunus serrulata
Prunus spinosa
Pryrus salicifolia
Pterocarya fraxinifolia
Pyrus communis
Quercus canariensis
Quercus cerris
Quercus dentata
Quercus ilex
Quercus imbricaria
Quercus robur
Quercus rubra
Rhus typhina
Robinia pseudoacacia
Salix babylonica
Salix caprea
Salix cinerea
Salix fragilis
Salix viminalis
Sambucus nigra
Sequoiadendron giganteum
Sophora japonica
Sorbus aria
Sorbus aucuparia
Sorbus intermedia
Sorbus latifolia
Sorbus thuringiaca
Sorbus torminalis
Taxus baccata
Thuja plicata
Tilia europaea
Tilia spp.
Tsuga heterophylla
Ulmus glabra
Ulmus hollandica
Ulmus laevis
Ulmus minor
Viburnum lantana
Zanthoxylum clava-herculis
Zelkova carpinifolia
Zelkova serrata