PLANT TAXONOMY AND CHAGING TREE NAMES

Matt Ritter

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1. The Naming of Plants

Taxonomy is the science of identifying, naming, and classifying organisms. Since the beginning of language, humans have had ways of describing and communicating about the world and organisms around them. People in each culture and language have coined names for plants and animals with which they interacted, but wide-ranging organisms often have been given multiple vernacular names. While locally derived names work well for local communication, they are a barrier to communication across cultural and linguistic boundaries. After the Roman conquests in Europe and the spread of Christianity, Latin served as the international language of diplomatic and scholarly communication, just as English does today. Early scholarly attempts to compile information about plants and animals were written in Latin, but before the printing press the word spread slowly. Latin plant names were generally in the form of cumbersome, multiword Latin phrases (polynomials) that did double duty—serving as names and summarizing the distinguishing features of plants.

It wasn't until the eighteenth century that a universally accepted method for naming and classifying organisms was invented that transcended cultural and linguistic boundaries. A Swedish naturalist named Carl Linnaeus devised a new way of naming all the plants and animals known at that time. In 1753 he published a two-volume work called *Species Plantarum* ("The Kinds of Plants"); he provided for each plant a phrase name similar to those his predecessors had used, but he also added a two-word Latin name (a binomial). The convenience of the two-word names for communication was quickly evident, and the use of binomials became the standard way of naming organisms and for communicating about them. The polynomial phrase names were retired and evolved into more detailed descriptions. The publication of *Species Plantarum* marks the beginning of our modern system of botanical nomenclature. Linnaeus had an encyclopedic knowledge of the plants known in his day, and many of the binomial names he proposed are still in use today.

The first word in a binomial is the name of the genus in which the plant is classified; by convention it is always capitalized. The second word is the specific epithet, which is written in lower case. To distinguish them from the surrounding text both the genus and specific epithet are italicized in print or underlined when handwritten. All known species of organisms have been given a scientific name with a Latin format, though many of the names are modern inventions that would be unrecognizable to original Latin speakers. As an example, consider the southern magnolia's scientific name. *Magnolia* is the genus name, coined in honor of Pierre Magnol, an early French botanist; *grandiflora* (a compound of two Latin words meaning large-flowered) is the specific epithet. *Magnolia grandiflora* is the species name: the two-word name for that tree species. There are other species in the genus *Magnolia*, but only one bears the epithet *grandiflora*.

When first discovered, a tree species (or other plant) is classified and named by a botanist who investigates the plant to discover its affinities and publishes the name in a journal, in a book, or (since 2012) in an online publication. The first correctly published name becomes the accepted name of the species. The rules that govern the naming of new species are detailed in the current edition of the *International Code of Nomenclature of algae, fungi, and plants* (earlier editions published as the *International Code of Botanical Nomenclature*) and are followed by botanists around the world. When a new species name is published, the name is accompanied by a description of the features that distinguish it from related species, often a detailed description of the plant and its natural habitats, a discussion of its relationships, and often an explanation of the etymology or meaning of the new name.

Scientific names of trees can be derived from many different sources, and both the genus name and specific epithet often have interesting histories and meaning behind their names. Some genus names honor a botanist, collector, patron, or other person involved in the discovery of a new plant. Good examples are the genera *Lewisia* and *Clarkia*, which honor Meriwether Lewis and William Clark, the two leaders of the Lewis and Clark expedition across the northwestern United States. Thomas Jefferson sent them to explore uncharted areas of the Louisiana Purchase and to try to find a water route from the Mississippi River to the Pacific Ocean. Along the way, they discovered and collected many plant species that were completely new to science. Though not strictly necessary for an understanding of the trees we work with, knowing the English translation of the Latin scientific name can help us remember key features about the species or distinguish a tree from related trees. It's also just more fun and interesting!

Specific epithets, the second words in binomial names, usually fall into one of three categories: descriptive adjectives (for instance *alba* = white), Latin versions of people's names (*douglasii* = honoring Scottish botanist David Douglas), or Latin versions of place names (*chinensis* or *sinensis* = from China). Sometimes scientific names are derived from Greek instead of Latin. As an example, red-leaved in Latin, *rubifolius*, become *erythrophyllus* in Greek. Dealing with these languages take some practice, memorization, and learning. A good guide, such as *Stearn's Dictionary of Plant Names* by William T. Stearn (Timber Press, 1996), can help decode the names of tree species. See Table 1 for the English translations of a number of common specific epithets. Genus names are unique but the same specific epithet can occur in many genera, such as *robusta*, meaning stout, found in *Grevillea robusta* (silk oak) and *Eucalyptus robusta* (swamp mahogany).

Latin is a complex language with a formal structure and many grammatical idiosyncrasies. In Latin, nouns carry grammatical gender, a concept foreign to most English speakers; a name may be masculine, feminine, or neuter [this has nothing to do with the maleness or femaleness of the organism to which the name is assigned]. In the construction of scientific names, adjectives that serve as specific epithets have different suffixes depending on the grammatical gender of the noun that serves as the generic name. Note the different endings for the specific epithet in the following binomials: *Lupinus leucophyllus* (male), *Salvia leucophylla* (female), and *Eriogonum leucophyllum* (neuter). All three names contain the same adjective, from Greek roots meaning white-leaved, but the rules of Latin require the different endings. In Latin most trees are treated linguistically as feminine, so even seemingly masculine names of tree genera such as *Pinus*, *Quercus*, *Eucalyptus*, *Platanus*, and *Prunus* have feminine specific epithets like *radiata, agrifolia, saligna, racemosa,* and *ilicifolia*.

For each correctly published new species name a type specimen is designated (Figure 1). A type specimen is dried, pressed, and preserved material (stems, leaves, flowers, fruit, etc.) from a plant showing its distinct features. Such specimens are glued to special archival paper and stored in herbaria (collections of plant specimens). Next to the dried plant material on the type specimen is a label with the date and location of collection, the published scientific name, the name of the collector, and often also a description of the plant and notes about the habitat where it was collected. Type specimens can be crucial for settling disputes about plant identities and conflicting names that can arise later. Type specimens are the means by which we know when and if two different scientific names are actually referring to the same species. There may be many other specimens of a species housed in herbaria but only one type collection.

It's not at all unusual that a plant was discovered and named more than once. The southern magnolia was first described and named by Linnaeus in 1759 in *Systema Naturae,* and though a number of subsequent names have been published for this species (e.g. *Magnolia longifolia*), no validly published name existed earlier than Linnaeus's, so his name takes priority. The name(s) of the botanist(s) who first published the name of a species is commonly written after the binomial in technical or scientific papers. For southern magnolia, the name with its author is *Magnolia grandiflora* L.; "L." is an abbreviation for Linnaeus as the publishing author of that name.

After the first appearance of a binomial such as *Magnolia grandiflora* in a piece of writing, the generic name is often abbreviated in subsequent appearances to just the capital letter of the genus (e.g., *M. grandiflora*). However, an abbreviation should never begin a sentence. If a name begins a sentence, spell out the genus.

All the rules and language associated with plant names can be daunting, and scientific names are hard to remember and pronounce but don't lose sight of the forest for the trees. The point of taxonomy is to help us communicate accurately about and better understand plants. Taxonomy informs us about the evolution, relatedness, and biogeography of the tree species commonly found in the urban forest. Understanding relatedness can also help us employ better horticultural and arboricultural practices. Knowing that a Pacific Madrone (*Arbutus menziesii*) is a member of the blueberry family (Ericaceae) also informs disease susceptibility, such as to *Phytophthora* root rot and necessary growth factors, such as well-drained somewhat acidic soils.

2. Why Plant Names Change

Knowing how trees are named in the first place and why these names are important helps us understand why tree names can change. We have all had the experience of learning the scientific name of a tree, only to learn later that the name has changed. Some scientific names can, and do, occasionally change. Douglas fir (*Pseudotsuga menziesii*) has been assigned nearly twenty different scientific names as different scientists made their best guess as to what it was related to. It isn't a true fir (*Abies*), nor is it a pine as it was first described in 1796 (*Pinus taxifolia*), nor is it a member of any of the other genera in which it was once placed, including hemlock (*Tsuga*), spruce (*Picea*), and even *Sequoia*. The Monterey cypress has been *Callitropsis macrocarpa*, *Cupressus macrocarpa*, *Neocupressus macrocarpa*, and now *Hesperocyparis macrocarpa*. In this case expert botanists have disagreed (and still do disagree) about the correct genus for the Monterey cypress.

A newly changed scientific name can have repercussions for commercially important plants and commonly grown trees. Name changes mean work and time: learning new names, changing documents, databases, labels, and tags, updating references, and cross-referencing old names until new ones become widely used. New names can impose economic costs for nurseries, landscape architects, and arborists. Despite these downsides, there are valid reasons for scientific name changes. Without the ability to change names for tree species, our taxonomic system would quickly become broken and out of date. Change in any taxonomically based naming system is inevitable. Change can also be viewed as an opportunity to learn more about commonly grown trees.

Accurate taxonomy is crucial for understanding relatedness among plants, yet nature is not easily understood, defined, or categorized. Experts disagree about relationships and the names that represent those relationships. When the name of a familiar tree has changed, it is usually for one of three reasons. The first two reasons involve nomenclature (rules for choosing a name) and misidentification and are relatively rare among common trees in the urban forest.

Nomenclatural name changes are often based on the rule of priority of publication. This rule, stipulated in the *International Code of Nomenclature*, says that the first correctly published name in its rank is the one that must be used, all subsequent names become unused synonyms. Familiar names can be replaced if an earlier published name is found, even if those names are widely used or economically important. As an example, the London plane tree, a hybrid between Oriental plane (*Platanus orientalis*) from Eurasia, and the American sycamore (*Platanus occidentalis*) from the eastern United States, had a common and widely used name, *Platanus × acerifolia* (the multiplication sign is due to its hybrid origin). This name was published by botanist Carl Willdenow in an 1805 edition of *Species Plantarum*. However, years earlier botanist Otto von Munchhausen had already published a name for these hybrids, *Platanus × hispanica*, in 1770, which then becomes the correct name to use for the London plane tree.

Trees can be misidentified. A species can be brought into cultivation, propagated, and widely distributed under an incorrect name. By the time the misidentification is rectified, the incorrect name is already widely used. Name changes of this second type are exemplified by two commonly cultivated trees. The king palm (*Archontophoenix cunninghamiana*) was for a long time incorrectly sold as *Seaforthia elegans*, which is an altogether different palm species not regularly found in cultivation. A second example is one of the most spectacular flowering trees grown in subtropical regions of the world, the pink trumpet tree. This species has been known widely as *Tabebuia impetiginosa* in California. Only recently it was discovered by correspondence with botanists in Brazil (the native range of the pink trumpet tree) that what is commonly grown is *T. heptaphylla*, not *T. impetiginosa*. At the same time this misidentification was discovered, new relationships among species of *Tabebuia* were being recognized, leading to the adoption of the genus *Handroanthus* for our cultivated trumpet trees. This new genus name, *Handroanthus*, for the pink trumpet tree brings up the third and most common reason why a scientific name can change: for taxonomic reasons.

Taxonomic name changes happen when advances in our botanical knowledge lead to reclassifications of trees. All scientific names generated by taxonomist are based on hypotheses about relatedness. A taxonomist proposes that a newly discovered plant should belong to a certain genus based on similar characteristics to other members of that genus. A new name is based on a hypothesis that the plant in question is related to other similar plants. Since the publication of Darwin's *On the Origin of Species* in 1859, most taxonomists have classified plants based on the perceived evolutionary relationships among them. All species in a genus should be more closely related to each other than they are to species in other genera. A genus (or any other level of classification) should, therefore, consist of all descendants of a common ancestor—and only the descendants from that ancestor.

DNA sequencing now allows taxonomists to infer relatedness by comparing thousands of DNA base pairs among different species. This method has greatly improved our understanding of relationships and in some cases changed our earlier conceptions of relatedness in certain plant groups. As a result plant names have been changed with new, more accurate names that reflect the actual genealogy. When new evolutionary relationships are discovered, name changes are required to uphold the principle that our names must represent relatedness. Many species have been transferred from one genus to another. The tomato is no longer in the genus *Lycopersicon*, now it's a *Solanum*. Some species of *Acacia* have become *Senegalia*, and others *Vachellia.* The floss silk tree goes from *Chorisia* to *Ceiba*, and the widely cultivated trumpet trees are reassigned from *Tabebuia* to *Handroanthus.* As we learn more and make discoveries, the list goes on (Table 2).

In addition to the examples above, newly made discoveries about species relationships from DNA and morphological data have affected the names of several ubiquitously grown urban trees. Examples from three species in the myrtle or eucalypt family (Myrtaceae) will suffice to enumerate the issues and complications associated with a new understanding of evolutionary relationships. These are the lemon scented gum (*Corymbia citriodora* (Hook.) K.D. Hill & L.A.S.Johnson), the red flowering gum (*Corymbia ficifolia* (F.Muell.) K.D.Hill & L.A.S.Johnson), and the Brisbane box (*Lophostemon confertus* (R.Br.) Peter G.Wilson & J.T.Waterh.).

As of 1995, about 100 of the 800 species in the genus *Eucalyptus* were considered to be members of the subgenera *Corymbia* and *Blakella*. Taxonomic studies using DNA sequencing allowed scientists to discover that these species were more closely related to *Angophora* trees (a different Australian genus in the same family) than they were to any other species of *Eucalyptus* (Figure 2). A finding like this demands a name change. If all species of *Corymbia* were to remain under the name *Eucalyptus*, then all ten *Angophora* species would have to be renamed as *Eucalyptus* (the taxonomic lumper's solution). Instead, the affected species were placed in a newly erected genus: *Corymbia* (the taxonomic splitter's solutions). This splitting solution led to name changes in approximately 100 species of *Eucalyptus* while leaving the genus *Angophora* unaffected. Notice, however, that both the lumping and splitting solutions to this discovery require changing the names of either some *Eucalyptus* species or all *Angophora* species.

Even before DNA sequencing was widely available, scientists changed the names of common trees based on the investigation of morphology alone. In 1982 Peter Wilson and John Waterhouse from the University of New South Wales, Australia, published their research on the genus *Tristania*, dividing it into five new genera. Among these new genera was *Lophostemon*. *Lophostemon* became the new genus name for four species with alternate leaves clustered around the branch tips, including the commonly grown Brisbane box (*L. confertus*). Notice that all these name changes are reflected in the names of the authors that follow the scientific names: *Lophostemon confertus* (R.Br.) Peter G.Wilson & J.T.Waterh. Robert Brown (R.Br.) originally described the species in the genus *Tristania* in 1830, so his abbreviated name is in parentheses, and abbreviations for the new authors, Peter G. Wilson and John T. Waterhouse, follow the original author. This naming system allows interested people to study the record of name publications based on the authorities.

A new interpretation of what a single species is can also modify names. Imagine a species that is widely distributed, and highly variable in its characteristics. A botanist studies that species closely and realizes that it should be treated as several related species. An example of this type of taxonomically driven name change is the spider gum or bushy yate, a shrubby eucalypt grown widely as a windbreak and road screen. This commonly grown tree was correctly referred to by the scientific name *Eucalyptus lehmanii* until 1980. This was the year that Australian botanist Maisie Carr and her husband Denis published research splitting *Eucalyptus lehmanii* into several species, each with their unique set of characters. The trees growing in California, which, unlike true *E. lehmanii* never make a basal resprouting burl and have very stout flower stalks, became part of a new species, *E. conferruminata*. As of 1980, no *E. lehmanii,* as it is now considered, was growing in California, it had all become E. *conferruminata*. This name changed when a morphologically diverse species was split into several new species, and the cultivated trees were clearly from one of the new species.

Even modern taxonomists, who rely on DNA sequences and sophisticated analyses of relatedness, disagree about interpretations of plant names and relatedness. Their judgment and experience still play an important part in naming plants and changing their names. New evolutionary relationships amongst plants are still being discovered and will always be the subject of reinterpretation. Tree names will continue to change due to misidentifications, the discovery of earlier names, and newly uncovered evolutionary relationships. Plant names, as we know them now, and the names we will use in the future, are the achievements of the hard work of scientists whose work is crucial for our understanding of trees. Scientific names are also just hypotheses, subject to change with new experiments, investigation, and data. Names changes are unavoidable as we organize and manage the bewildering world of plant diversity. Although new information can be inconvenient and sometimes confusing in the short term, it is ultimately necessary for our continued deeper understanding of the trees we grow, tend, and love.

References:

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Figure 1. The type specimen for *Ceanothus maritimus* Hoover, with enlarged label showing that this species was collected on January 24th, 1948 in San Luis Obispo County, California. The name C. maritimus was first published by Dr. Robert Hoover in *Leaflets of Western Botany* in 1953.

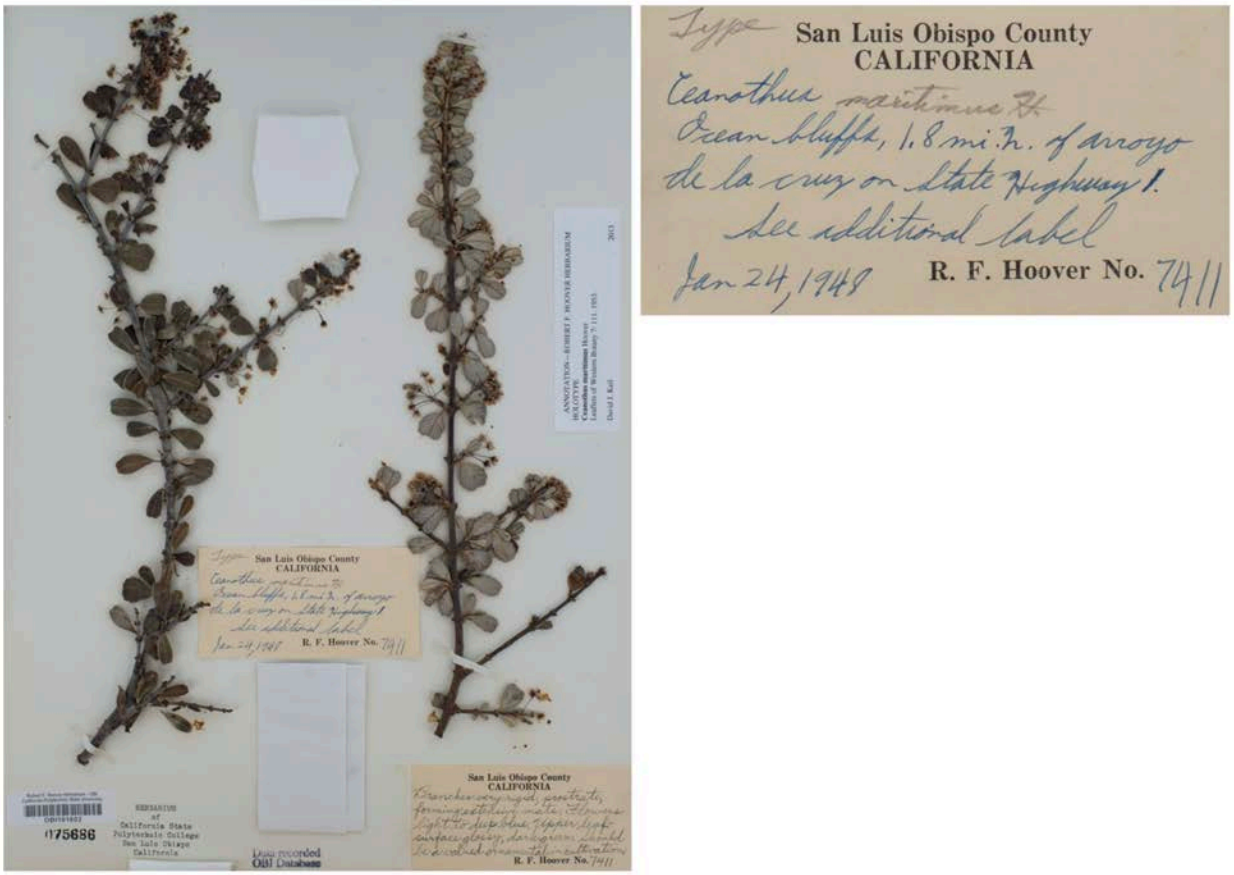

Figure 2. Evolutionary relationships among the genera *Eucalyptus*, *Corymbia*, and *Angophora*.

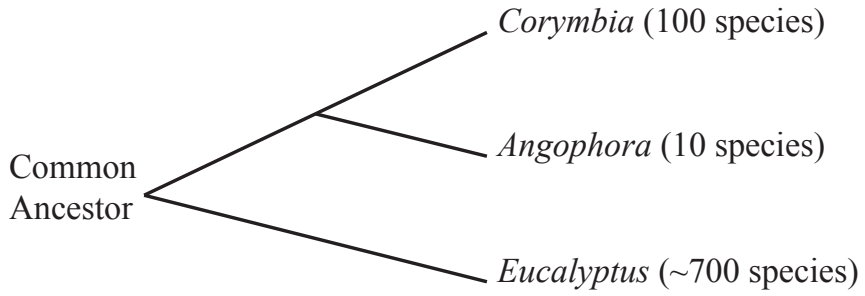

Table 1. Some common specific epithets and their English definitions.

acerifolia: maple-leaved	***excelsa***: tall	***microcarpa***: small-fruited	***religiosa***: sacred
aculeata: prickly	***falcata***: sickle-shaped	***microphylla***: small-leaved	***reticulata***: netted
alba: white	***ficifolia***: fig-leaved	***monticola***: inhabiting mountains	***revoluta***: rolled backwards
altissima: very tall tallest	***filifera***: bearing filaments or threads	***muricata***: rough with hard points	***rhombifolia***: diamond-shaped leaves
angustifolia: narrow-leaved	***flavum***: yellow	***neglecta***: overlooked	***robusta***: stout
arborescens: becoming tree-like	***flexuosa***: bending	***nigra***: black	***rostrata***: beaked
atropurpurea: dark purple	***glabrata***: smooth	***nitens***: shining	***rubra***: red
aurea: golden	***globulus***: spherical	***nobilis***: famous	***rubiginosa***: rusty
australis: southern	***gracilis***: graceful or slender	***notholithocarpus***: false stone-fruited	***rupestris***: rock-dwelling
biloba: two-lobed	***heterophylla***: with varied leaves	***nucifera***: nut-bearing	***saccharum***: with sugar
boaria: of cattle	***humilis***: dwarf	***occidentalis***: western	***salicifolia***: willow-leaved
borealis: northern	***ilicifolia***: holly-leaved	***officinalis***: medicinal	***saligna***: willow-like
botrys: clustered like grapes	***ingens***: enormous	***orientalis***: eastern	***saponaria***: soapy
caespitosa: tufted	***insularis***: from an island	***pallida***: pale	***sativa***: cultivated
campanulata: bell-shaped	***integrifolia***: entire-leaved	***parviflora***: small-flowered	***sebifera***: tallow-bearing
campestris: of the fields or plains	***laevigata***: smooth	***pendula***: hanging	***sempervirens***: evergreen
candida: white	***laetum***: bright	***platyphylla***: broad-leaved	***spathulata***: spoon-shaped
cerasifera: cherry-bearing	***lanceolata***: lance-shaped	***polymorpha***: variable	***speciosa***: showy
cinerea: ash-colored	***latifolia***: broad-leaved	***ponderosa***: heavy	***spectabilis***: spectacular
citriodora: lemon-scented	***leptophylla***: thin-leaved	***procera***: tall	***suaveolens***: sweet-scented
coccifera: berry-forming	***leucophylla***: white-leaved	***pulchella***: beautiful	***suber***: corky
conferta: crowded	***leucoxylon***: white-wooded	***pulverulenta***: powdered	***sylvatica***: growing in woods or forests.
cordata: heart-shaped	***lithocarpus***: stone-fruited	***punctata***: dotted	***tereticornis***: with cylindrical horns
cornuta: horned	***longiflora***: long-flowered	***pungens***: sharp-pointed	***tomentosa***: densely woolly
crassifolia: thick-leaved	***lucidum***: shining	***quinquenervia***: five-veined	***triacanthos***: three-spined
dactylifera: finger-bearing	***lyrata***: with large terminal lobes	***racemosa***: with flowers in racemes	***truncata***: cut off square
dealbata: whitened	***macrocarpa***: large-fruited	***radiata***: radiating	***tulipifera***: tulip-bearing
decurrens: running down the stem	***macrophylla***: large-leaved	***reclinata***: bent backwards	***villosa***: soft-hairy
discolor: of different colors	***maculata***: spotted	***regina***: queen	***viminalis***: willowy
elata: tall	***marginata***: margined	***regia***: royal	
erythrocarpa: red-fruited	***melanoxylon***: black-wooded		

Table 2. Some commonly grown trees with changed scientific names.

Common Name	**Former Scientific Name (Synonym)**	**Current Scientific Name**	**Reason for Name Change**
Moluccan Albizia	*Albizia falcata*	*Falcataria moluccana*	Taxonomic
Pindo Palm	*Butia capitata*	*Butia odorata*	Nomenclatural
Floss Silk Tree	*Chorisia speciosa*	*Ceiba speciosa*	Taxonomic
Ghost Gum	*Corymbia papuana*	*Corymbia aparrerinja*	Taxonomic
Monterey cypress	*Cupressus macrocarpa*	*Hesperocyparis macrocarpa*	Taxonomic
Lemon Scented Gum	*Eucalyptus citriodora*	*Corymbia citriodora*	Taxonomic
Red Flowering Gum	*Eucalyptus ficifolia*	*Corymbia ficifolia*	Taxonomic
Spider Gum, Bushy Yate	*Eucalyptus lehmannii*	*Eucalyptus conferruminata*	Taxonomic
Spotted Gum	*Eucalyptus maculata*	*Corymbia maculata*	Taxonomic
Triangle Palm	*Neodypsis decaryi*	*Dypsis decaryi*	Taxonomic
London Plane Tree	*Platanus × acerifolia*	*Platanus × hispanica*	Nomenclatural
East African Yellowwood	*Podocarpus gracilior*	*Afrocarpus falcatus*	Taxonomic and Misidentification
Scrub Oak	*Quercus dumosa*	*Quercus berberidifolia*	Taxonomic
African Sumac	*Rhus lancea*	*Searsia lancea*	Taxonomic
Chinese Tallow Tree	*Sapium sebiferum*	*Triadica sebifera*	Taxonomic
King Palm	*Seaforthia elegans*	*Archontophoenix cunninghamiana*	Misidentification
Australian Bush Cherry	*Syzygium paniculatum*	*Syzygium australe*	Misidentification
Golden Trumpet Tree	*Tabebuia chrysotricha*	*Handroanthus chrysotrichus*	Taxonomic
Pink Trumpet Tree	*Tabebuia impetiginosa*	*Handroanthus heptaphyllus*	Taxonomic and Misidentification
Brisbane Box	*Tristania conferta*	*Lophostemon confertus*	Taxonomic
Water Gum	*Tristania laurina*	*Tristaniopsis laurina*	Taxonomic