Conflicting Names: What Do You Do When Your Plant Has Alternative Names?

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INTRODUCTION

We have to remember that a major reason for plant names — nomenclature — is to assist communication. The way plants are arranged or classified is taxonomy, and the names help to exchange information about both individual plants and the way they are classified. A scientific name (plant or animal) means the same thing anywhere in the world.

I am talking about what to do when the plant you are dealing with has more than one name, not new discoveries. And I am talking about the scientific names, not the common or vernacular names which are not governed by any rules and so can be used in whatever way you wish.

Because time is short, I'll talk only about changes due to research and the application of the *International Code of Botanical Nomenclature* (the *Code*) (McNeill et al., 2006). The *Code* has been developed as an international "standard" over some 150 years. Essentially, it sets down rules for publishing scientific names. It is reviewed at an International Botanical Congress every 6 years when changes may be made, but the essential rules remain constant.

Right at the start, I wish to point out that there is no obligation to follow a name change simply because it is the latest word, or because organisations such as herbaria have adopted it. Under the *Code* and the *International Code for the Nomenclature of Cultivated Plants* (Brickell et al., 2004), scientific names of plants are available for use if they meet certain criteria, but these *Codes* give no further direction on how to choose which name to use, if a plant has more than one available name. So, how do you decide?

The problem is not new. Our current system of binomial nomenclature was devised by Carl Linnaeus, and for flowering plants it dates from 1753. Very soon afterwards, botanists began to change the names of already-published names. Linnaeus himself made changes by transferring some of his own species from one genus to another, an example being the widespread tropical paperbark *Melaleuca leucadendra* which he first published in the genus *Myrtus*. There are many reasons for changing names.

What happens is that a new species is described. In many cases, a new species is based on one or few specimens. As time goes by, more specimens may be collected, usually over a wider geographical range. Sometimes they indeed represent the same species, but quite often there is seen to be variation among these specimens. For a while they are still called by their original name, but at some stage a botanist studies them closely and decides that in fact there is more than one species in the complex. The original name is restricted to a subset, and distinct variants — that you have known by that name — are named as new species. In Australia, this has been a rather common situation since we have a very large flora and too few botanists to keep up with the research required. A good example is the honey myrtle

M. uncinata, named by Robert Brown in 1812 from specimens that he collected on Eyre Peninsula in South Australia in 1802. The name was used for this and look-alike plants from all Australian mainland States and the Northern Territory, until it was studied by a small team of botanists who divided it into eleven species (Craven et al., 2004).

I should point out that a properly or validly published scientific name is always linked to a specimen of the plant, usually a pressed specimen. It's called a "type specimen." However the species is classified later, whether in its original genus or in another, or as a species or subspecies, its name remains linked to the type specimen, so the same name can never be used for another plant.

Refinement of the taxonomy can lead to new circumscription of named species, usually in conjunction with description of new ones. In my own work, examples have been the *sphaerocarpa* group of *Banksia*. Or it can lead to plants previously known as species being redefined as subspecies or varieties. Again, an example from my own work is the placement of *Calothamnus homalophyllus* and *C. asper* as subspecies within *C. quadrifidus*.

New data, new insights or new discoveries can lead to re-definition of a genus in such a way that one or more species within it must be moved to another, or species in another genus must be moved to it. Large changes of this kind have been made by Paul Wilson, who realised that the Australian species of genera such as *Bassia* and *Helichrysum* were distinct enough from the original species in those genera (which grew outside Australia) that they had to be placed in other genera. So, our bassias became *Sclerolaena* and most of our helichrysums became *Ozothamnus* and various other genera.

Sometimes a name must be changed because we have been using it for the wrong plant. Under our type system (enshrined in the *Code*), each scientific name is associated with a specimen used by the original author to prepare his or her description, and the application of the name is always linked to that type specimen. In some cases the specimen has been lost or destroyed, and then we can use an illustration or choose a replacement specimen. Sometimes, in checking the type specimen, a researcher finds that we have been applying the name wrongly. In Australia this happened frequently because the type specimens were held in European herbaria and it was not always possible to see them — we had to go on the descriptions published in books and journals and, if we were lucky, an illustration, and often they included insufficient detail to decide which of two variations the name should be applied to. In recent decades this problem has largely disappeared because we have been able to borrow specimens or obtain high-quality images. But, if we find that we have been using a name wrongly, then a plant that has been wrongly named must be given another — either an already published but "unused" name, or a new name altogether. In my own work in *Calothamnus*, I found that the type specimen of *Calothamnus oldfieldii* is, in fact, the plant that we have been calling *Calothamnus kalbarriensis*. As a result, the name *Calothamnus oldfieldii* must be used for this plant, and the one we have been calling *Calothamnus oldfieldii* must be given a new name. There are further variants of this situation but for the present this must suffice.

We must also use the first published name. There are many cases of the same species being given different names by different botanists (sometimes even the same botanist!). Occasionally a name published in an obscure, little-known place comes

to light that is earlier than one in use. Under the *Code* we usually take up the earlier or earliest one, though there is now provision for very well-known names to be conserved. An example is the Boab of northern Australia, known as *Adansonia gregorii*, named in 1857. Twenty years ago a name that had been ignored since its publication in 1841 was discovered and put forward for use, but *A. gregorii* is so well known that it has been preserved under the *Code*.

The problem of a plant being classified in different genera, even different families, has become more common around the world in recent decades. It has become especially acute with the rise of methodologies known as cladistic analysis (cladistics) and DNA (molecular) analysis. Currently the two go hand-in-hand, the data from a DNA analysis being put through a cladistic program on the computer which produces cladograms or diagrams showing possible relationships between the plants analysed. The way these diagrams are interpreted is commonly different from the results of traditional taxonomy, and some are controversial.

A major difficulty for the nonspecialist trying to understand molecular and cladistic work is the terminology. All subjects have their special terminology, including plant taxonomy. Molecular and cladistic work impose one that is almost impossible for the nonspecialist to follow. I suspect that many current practitioners of these methodologies would themselves have difficulty explaining the full terminology, not to mention the philosophical concepts behind them. What do you make of this sentence, on a DNA analysis, from Mast et al. (2005): "Mr Modeltest 1.1b chose the general time-reversible substitution model (GTR: Lanave et al., 1984; Tavare, 1986; Rodriguez et al., 1990) with among-site heterogeneity assumed to follow a discrete approximation of the gamma distribution (Γ; Yang 1994) and a proportion of invariant sites (I) for the cpDNA dataset, the GTR+I substitution model for the ITS dataset, and the model of Hasegawa et al. (1985) with Γ for the *waxy* dataset." Even our Prime Minister would be proud of the verbal gymnastics. But what it means is that we — the average users — are being asked to take their work on trust and believe the diagrams that they produce.

Taxonomists using DNA want their audience to believe that their data are all that is needed as a basis for a classification. Sometimes, morphological attributes are placed on a cladogram, showing where changes are thought to have occurred or what the uniting character is for a clade (branch of the cladogram). Occasionally a full morphological analysis is done as well. But it's the DNA that is paramount. When I discussed the situation in banksias and dryandras with an experienced botanist who is familiar with these plants, he said, "If that's what the DNA says, then that's how it has to be." An even more extreme view has been expressed in a paper by Mike Crisp and Bernard Pfeil at the Australian National University: "We reject the idea that some kind of objective level of character difference or distinctiveness is an appropriate guiding principle for circumscription of the generic (or any other) rank" (Pfeil and Crisp, 2005). In other words, it doesn't matter what they look like. The diagrams (cladograms) produced in a cladistic analysis of DNA are also taken by the practitioners as "evidence" of how the plants are related and so how they should be classified when, in fact, they are only hypotheses.

There are further problems with DNA analyses but I have time to mention only two:

1) Only small parts of the DNA are used, and they are commonly those that show general relationships, not those that have a large effect in controlling differences. To put it another way, the genes

chosen for analysis are those that show how organisms are related, not those that show how they differ.

2) Usually only one plant of a species is sampled, and in order to repeat an analysis you would have to have access to the *same samples* used in the first analysis — this is possible if they have been preserved according to proper protocol — and samples from different plants of the same species might produce different results.

This means that the DNA database is good as far as it goes, but is very narrow. In contrast, in a morphological study, the characters used are expressions of scores or hundreds of genes, and we can look at multiple specimens going back several hundred years, including those that previous botanists looked at — such as (in the case of Proteaceae) Robert Brown, Carl Meisner, and George Bentham in the 19th century, Lawrie Johnson and Barbara Briggs in the 20th.

There are also problems with the cladistic methods used to analyse the DNA data, and again I have time to mention only the major one.

Cladists use similarity in the way that taxa have evolved to group them, and all taxa within a group that have a common ancestor are termed monophyletic. If, from such a monophyletic group, you take out some and classify them differently, it makes the remaining ones paraphyletic, and this concept is inadmissible in cladistics. In other words, strict cladistics does not allow a taxonomic group to evolve from another. This is not logical since, in a cladistic analysis of a whole family of plants — which evolved from a single ancestor — the only way the family can be monophyletic is to call them all a single genus. And then you should add other families, until you make all flowering plants one genus — then add the mosses, the green algae, etc. OK, you could be logical and do that, but for communication by plant names it would be pretty horrendous. It's the major reason why cladistics is causing problems around the world, and why many taxonomists see it as a useful tool but not one to be followed blindly.

The *Dryandra* and *Banksia* Case. As a practical example of the effect of these methodologies, I take the merger of *Dryandra* with *Banksia* since I have a fair understanding of the plants. *Banksia* was named in 1782 and true banksias now total 78 species and another 20 subspecies and varieties. *Dryandra* was named in 1810 and contains 95 species and 40 subspecies and varieties. Until Mast and Thiele's research over the past 15 years, there has been no suggestion that they should be merged as a single genus. There are four papers that provide the background to the merger and the major basis was a DNA analysis (Mast, 1998; Mast and Givnish, 2002; Mast et al., 2005; Mast and Thiele, 2007). I believe that there are flaws in the scientific basis that weaken the case for this merger.

First, only 11 taxa of *Dryandra* (out of 135) were analysed for DNA, compared with 84 (out of 98) for *Banksia*. The authors considered the number of dryandras adequate because they sampled from each of the three subgenera, but there are 24 series — groupings within the subgenera — in *Dryandra*, some highly distinctive. It's a massive assumption to take a sample of 8% as the basis for such a huge reclassification. The small sample is possibly the reason why *Dryandra* comes out in all the cladograms as a single group while *Banksia* is a diverse group on several branches — morphologically; *Dryandra* is at least as diverse as *Banksia* and I would expect this to show up in any analysis. It is impossible to verify whether all the samples

were correctly identified, since cultivated material with no vouchers cited was used for four taxa, and no source or voucher was cited for a further six taxa.

Second, the few characters imposed in Fig. 1 of Mast and Thiele (2007) show inadequate understanding of the morphology. Below the first branch they give "Flowers in condensed heads" as a unifying character for the whole group, but above the fourth branch they have "Capitate inflorescence" to distinguish dryandras from "true" banksias — these phrases mean much the same thing (and true banksias don't have heads of flowers). Species on the first branch are said to be distinguished by having spathulate cotyledons, but spathulate cotyledons also occur in other species of *Banksia* and many of *Dryandra*. Then, above the first branch they give "Beaked follicles" leading to the remainder of *Banksia* and all *Dryandra* — but not all species of *Dryandra* have beaked follicles. Finally, their "Involucre of conspicuous bracts" as a unifying character distinguishing *Dryandra* from *Banksia* is incorrect. All species of *Banksia* and all species of *Dryandra* have an involucre of bracts subtending the inflorescence. It is correct that in most species of *Banksia* these are inconspicuous (in fact, in many they fall by anthesis), but in several species such as *B. goodii* and *B. victoriae* they are conspicuous and persistent. Conversely, in most species of *Dryandra* the involucre is conspicuous, but in some it is not, e.g., *D. concinna* and *D. sessilis*. The appearance of a third branch on the cladogram compared with a similar one in the previous paper (Mast et al., 2005) is not explained. Then, it is impossible to work out what species of true banksias are on each branch — this in a "classification" claimed to improve our understanding of these plants. We are not told which species are included in their new subgenus *Spathulatae* — there's a reference to a group called by an informal name *Phanerostomata* in previous papers, but those papers do not provide the full answer. The distinguishing feature of this subgenus — spathulate cotyledons — occurs in a number of species of *Banksia*, and also in *Dryandra* — they may be broad or narrow, but they are still spathulate. So, as described, it is rather meaningless. We are not told if *Banksia* subg. *Isostylis* is recognised by Mast and Thiele, or if they consider it part of subg. *Banksia*.

Thirdly, whereas Thiele and Ladiges previously gave a detailed analysis of the morphology of true *Banksia*, there is no such analysis for *Dryandra* in the papers on which the merger is based. Mast et al. (2005) acknowledged that "we do not have the morphological data that might help to place it [*Dryandra*] when analysed in concert with that sampled in *Banksia* by Thiele and Ladiges (1996)."

Their results, in fact, confirm that *Dryandra* is a "good" natural group, whereas *Banksia* contains several groups that come out as distinct — very similar to what I concluded in my revision, based on the morphology, published in 1981. Two features that provide clear unifying characters for *Dryandra* are the flat or slightly concave or convex receptacle on which the flowers are borne, and the loosely arranged common and floral bracts of the inflorescence (not to be confused with the involucral bracts subtending the inflorescence). These have been overlooked in all the cladistic analyses, including Thiele and Ladiges (1996).

Fourthly, in assessing a cladogram, the researcher decides where to draw the ranking line across it and what rank to give each group above the line. Mast and Thiele (2007) drew it low down, choosing to regard the whole lot as one genus. A line marking genera drawn higher on the cladogram would have left *Dryandra* as a genus and left *Banksia* in several groups, the upper three of which are "unresolved" branches and further work should have been done to clarify these. We have been

given no explanation why this was not done — there is a mention of "fine-scale taxonomic sampling" being carried out in Mast's laboratory, without explaining what they meant by this.

Finally, as is common in cladistic analyses, the published background papers abound with statements of uncertainty that you might expect with an hypothesis — this may/might be the case, this suggests …, this seems/appears …, this could have …, if such and such … . The paper by Mast and Givnish (2005) that provides most of the DNA analysis on which the *Dryandra*/*Banksia* merger is based contains more than 20 such uses — not a convincing argument for such a major change.

Going back to the taxonomy — information in a classification — Kevin Thiele claims that combining the genera gives us a "new understanding" of their relationships (Thiele, 2008a, 2008b). In fact, we already knew that *Dryandra* is closely related to *Banksia*, and their new classification obscures relationships because they have placed all 95 species of *Dryandra* in a single series within *Banksia* while retaining a comprehensive infrageneric classification for the taxa of *Banksia* in the strict sense.

Likewise, their claim that an expanded *Banksia* is "a single, easily recognised genus" (Mast and Thiele, 2007) makes no sense to those who have no difficulty recognising a *Banksia* or a *Dryandra* when they see one, even if it is a species that they have never seen before. In the 1980s, the Banksia Atlas project involved 421 people recording banksias across Australia. Of these, 185 were in Western Australia, making 5143 records. No one ever recorded a *Dryandra* in mistake for a *Banksia*.

Thiele (2008a) argues that, because some species of *Banksia* are related more closely to *Dryandra* than to other banksias, keeping the genera separate is a "serious anomaly." When a new organism evolves from a member of a large group, it is going to be more closely related to that member than the others. At some point it may then become different enough to be called a new genus, and this is what has happened with *Dryandra*.

Finally, they even acknowledge that their results are preliminary, stating (Mast and Thiele, 2007) that their new classification "is the least disruptive option at present" — in other words, try this for size, spend hundreds of hours and thousands of dollars changing all your labels, your conservation lists, your databases — but we may change the classification again later. The least disruptive option was to retain the status quo. Despite more than 10 years' work, they have made no advance in our knowledge of taxa below generic rank in *Dryandra*.

In short — this research has, essentially, confirmed a taxonomy that we already had but, by making unjustified changes to the names of dryandras, has confused the nomenclature and the taxonomy — and the users.

THE AUSTRALIAN PLANT CENSUS

Now I turn to the acceptance of the merger of *Dryandra* with *Banksia* by Australian herbaria. Because botanists sometimes have different views on the correct names, and each herbarium takes an official line, the Australian herbaria have established the Australian Plant Census in order to provide a nationally agreed list of names. It's a database of the accepted scientific names for the Australian vascular flora, both native and introduced. In 2004, the herbaria established a committee to "make judgements on any contentious conflicts" (Orchard, 2006). The committee's decisions are meant to represent the considered opinion and nomenclatural research of about 35 people in Australian herbaria and user groups.

Guidelines were developed for the Census. In a paper published in 2005, discussing alternative taxonomies, Tim Entwistle and Peter Weston wrote that "for day-to-day business and pleasure, we [I assume that they meant the above committee] must deliver what the customer wants" (Entwisle and Weston, 2005). Note those words — what the customer wants. This means you. Five of the guidelines are relevant to this discussion:

Guideline 1. Where possible, named taxa should be monophyletic based on current reliable evidence. This is qualified by Entwistle and Weston: "… there are times when we need to accept higher taxa [above species] that are not monophyletic, at least in the short term [earlier defined as "e.g., 10 years"] … [such as] when different lines of evidence (especially molecular vs. morphological) are in conflict." In the case of *Dryandra* and *Banksia* this guideline was not followed. There is conflict, and the merger was adopted less than 5 months after it was published.

Guideline 2. Minimise taxonomic change (across Australia as a primary focus). In their discussion, Entwistle and Weston (2005) say that "accepting stability … should result in both information gain and minimisation of nomenclatural confusion." The transfer of *Dryandra* has done just the opposite — established some 135 new name combinations and lost information — all the subdivision within *Dryandra*.

Guideline 3. Change is more acceptable in groups that are not "charismatic," are not economically important, or do not have a substantial "interest group." Dryandras occur naturally only in Western Australia and are both charismatic and economically important, but it's possible that committee members in other States may not be aware of this, or even that there are significant "interest groups" for *Dryandra* and *Banksia* (Australian Plants Society Study Groups).

Guideline 4. The "preferred name" should be as scientifically defensible as possible, but its acceptance does not imply that it is necessarily the "best name" on scientific and/or social grounds. In my opinion, the merger of *Dryandra* and *Banksia* is not based on sound science.

Guideline 5. Avoid epithets already in use in possible congeners. Eighteen species names in *Dryandra* are also used in *Banksia*, so these have to be changed when all are called *Banksia*.

Guideline 6. **The preferred name is that used in most states and territories ("majority rules").** Fair enough, but the decision should still be based on good science. I'll comment further on this shortly.

Discussing changes in the nomenclature of orchids, Barker and Bates (2008) wrote that "Herbaria … tend to adopt a conservative approach in the adoption of new names, preferring to wait until there has been sufficient testing of new concepts and hence greater stability and acceptance of these names … Rushing in and adopting name changes as they occur can lead to a later reversal of a decision and an unnecessary confusion of names." A similar cautionary approach was given in regard to splitting taxa by Thiele and Brown (2008), who argued that the position accepted for the Census with respect to certain orchids "is to retain the traditional genera … until compelling evidence for the need to segregate is presented."

All these guidelines and considerations advise caution when deciding whether to adopt taxonomic and nomenclatural changes for the Census, especially of large

groups. Yet the Census committee has ignored them in deciding to accept the merger of *Banksia* and *Dryandra*. As far as I am aware, there has been no publicised report on how the committee reached its decision. I have been advised that the only herbarium where a discussion took place was the Western Australian Herbarium, where Kevin Thiele, one of the authors of the change, is director. The others all simply agreed in response to a request by email. No approach was made to what they call customers (users) such as those who know the plants well, the horticultural trade, the Banksia and Dryandra Study Groups (and other members) of the Australian Native Plants Society. It would be interesting to know if all those involved in the decision read the background papers? If they did — even worse if they did not — and still voted to accept the change, then all I can say is, "heaven help Australian plant systematics until the cladistics fad passes."

Many "customers" are continuing to use *Dryandra*. The Banksia and Dryandra Study Groups have considered the change and rejected it. The Wildflower Society of Western Australia continues to use *Dryandra*. Very importantly, the Botanic Gardens of Adelaide list *Dryandra* in their 2010 catalogue of plants being grown there, despite the Garden's own herbarium accepting the merger 3 years ago. Clearly, many people with a working knowledge of these plants have rejected the merger. But we are left with the situation of Australian herbaria using one nomenclature and the "customers" another.

The names of all species (except one) of *Dryandra* are valid under the *Code* in both *Dryandra* and *Banksia*, and *you can choose* whichever generic name you prefer. But calling a *Dryandra* a *Dryandra* tells you much more about it than calling it a *Banksia*, i.e., we have better communication of information.

***Eucalyptus* and *Corymbia*.** While the Australian herbaria have adopted the name *Corymbia*, many users continue to place all gums in *Eucalyptus*. The arguments for recognising *Corymbia* as a genus also take a cladistic analysis of molecular data as "evidence" (Ladiges and Udovic, 2000) when in fact it is an hypothesis. A leading expert in eucalypts, Ian Brooker, is the only botanist I know who has studied all species, including seeing most species in the field. He considers that *Corymbia* is better classified as a subgenus of *Eucalyptus*. Because *Angophora* is part of the same morphological complex and has a similar position within it, he treats it, too, as a subgenus of *Eucalyptus*.

I note that the catalogue of the Botanic Gardens of Adelaide (2010) does not use *Corymbia*.

We even have the situation of the same author being involved in the transfer of species from one genus to another (Crisp and Weston, 1987) and then back again a few years later after further research (Chandler et al., 2002), or revising a genus (Crisp, 1995) and then transferring it to another just 7 years later (Chandler et al., 2002)!

The views of users are important (Brickell et al., 2008) — as happened in the case of *Chrysanthemum*. In some situations, the *Code* provides for a name change that may be necessary under its rules to be overturned. Some years ago, research showed that *Chrysanthemum* contained more variation than was considered acceptable in a genus and it was split into several genera. Under the rules, it meant that the "florists Chrysanthemum" was placed in the genus *Dendranthema*. This would have affected thousands of people in the horticultural industry around the world, so a proposal was made, and accepted, to change the type or defining species

of *Chrysanthemum* so that the generic name would remain in use for the "florists chrysanthemum." No such case can be made for *Dryandra*. There is no "court" to which any appeal can be made. Unless the Australian herbaria reverse their decision, it seems that they will follow the merger while many users continue to recognise *Dryandra*.

CONCLUSION

Returning to the title of my talk, I may not have helped you to decide when there are alternative names for plants, but I hope you have a better idea of the issues involved. For native plants, the Australian Plant Census is a good guide but has no formal status that requires it to be followed. The biggest difficulty is understanding the scientific background and, as is clear from what I have said, this is extremely difficult even for those in the field. And I haven't even mentioned the arguments that go on between those on the cladistic bandwagon!! To a large extent it comes down to which argument you prefer, whose work you trust even which name you like.

As a general rule I would say:

1) Check what the most authoritative list for your state or country says.
2) Ask two or more botanists (if possible, with different views) for their opinion.
3) If there is a controversial nomenclature based on a cladistic study (especially one that has not included traditional taxonomic research), follow the traditional nomenclature — it is likely to be more stable in the long run.

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