Why are plant names changing so much?

| Alan S Weakley

ABSTRACT

The scientific names of plants continue to change, seemingly at a faster rate than ever, which challenges the broad and diverse group of users of those names. Why do names change? Some changes are nomenclatural, while the majority result from new research and judgments about the taxonomy of plants. A variety of factors contribute to the level of changes. Traditional plant taxonomists continue to discover plants and reclassify those already known. New molecular phylogenetic techniques provide new data that clarifies taxonomy, especially at the level of the genus and above, resulting in changes in the circumscription of genera. A more worldwide community of plant taxonomy has emerged, fostered by the Internet, and taxonomic studies have broader geographic perspectives, resulting in changed opinions about relationships and more rapid communication of those changes. In the art of plant taxonomy, the "splitters" have largely regained influence, after a period of several decades in which "lumpers" were generally in the ascendancy, at least in North America. The result is a large number of name changes in plants, challenging many users, particularly those who are not professional taxonomists—land managers, ecologists, gardeners, and conservationists. A greater effort by authors of floras and other products designed for use by the broad botanical community should make the effort to communicate the changes and reasons behind them.

KEY WORDS
plant nomenclature, molecular phylogenetics, floras

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Kentucky yellowwood (*Cladrastis kentukea* (Dum.-Cours.) Rudd [Fabaceae]).
Photo by Joseph G Strauch Jr

One often hears the refrain these days: "Why do they keep changing all the plant names? As soon as I learn them, they change them, and then they change them again! And the new names are always longer and unpronounceable!" This is usually said in an exasperated, or even angry, tone, and it is clear that "they" (whoever they may be) are in deep trouble with the broader community of those who use scientific plant names on a regular basis—botanists, foresters, gardeners, horticulturists, conservationists, agency biologists, and others. (And even some within the community that uses scientific names are resistant.)

It does seem as though changes in the scientific names of plants are washing over us in larger numbers than ever before, and this seems to undermine the concept that scientific names provide stability and therefore better communi-

cation. But are we indeed in a particularly unstable time in plant systematics and nomenclature? And what causes all these changes? Perhaps if we understand the reasons behind these name changes (rather than seeing them as pronouncements from an evil oracle), it will help us accept them more readily and even increase our understanding of plant relationships and evolution. First, let's review important points about the history, practice, and rules of plant taxonomy and nomenclature, and then take a look at "these modern times."

PLANT TAXONOMY AND NOMENCLATURE

Though often confused with each other, plant systematics or taxonomy is different from plant nomenclature. Of course, they are interrelated, but a change can occur in the taxonomy of a plant that does not affect its name, and conversely a change can occur in the name of a plant that is unrelated to its taxonomy. Put most simply, systematics (taxonomy) deals with the circumscription or conceptualization of the taxonomic units, and nomenclature with the names applied to those units. The fundamental idea behind taxonomy is to make natural groupings, of like with like—that the components of a unit (at any taxonomic level) are more closely related to one another than they are to anything outside the unit. The fundamental principle of nomenclature is that the oldest validly published name that can be definitely associated with a taxon is the name to use, and that this will (overall) lead to stability, consistency, and effective communication.

The name of a plant is composed of the genus name + the specific epithet + (if needed) an infraspecific epithet. Rarely, a plant systematist may elect to use 2 ranks of infraspecific epithets, subspecies and variety, as for instance *Solidago simplex* ssp. *randii* var. *racemosa*. This name is part of a classification hierarchy that extends upward from the species and genus, through family, order, class, division, and kingdom (with subunits of those categories often used as well). Though a plant is classified in that complete hierarchy, the name consists only of the lower levels, the genus and species, and (as needed), the subspecies and variety. (The complete name of a plant for scientific reference purposes includes the authorities responsible for its discovery and classification, for example, *Solidago simplex* Kunth ssp. *randii* (Porter) Ringius var. *racemosa* (Greene) Ringius (see sidebar). Cultivated varieties are identified by genus and species with attached cultivar names, for example, *Solidago sphacelata* 'Golden Fleece'. (See Kujawski and Ogle [2005] for other "pre-varietal" plant designations.) So, a name change results from a change in the genus name, a change in the specific epithet, or a change in an infraspecific epithet. It is important to note that changes in the placement of a genus in the upper level hierarchy do not change the name.

Name changes can be purely nomenclatural (involving no change in either the conceptual circumscription or the rank of the taxon) or can reflect a change in the taxonomic judgment about a taxon—either a change in its circumscription (lumping or splitting) or a change in the accepted rank (as a "promotion" of a variety to full species status or the "demotion" of a species to subspecific or varietal status). An example of a purely nomenclatural name change is the substitution of *Cladrastis kentukea* for *Cladrastis lutea* as the name for the uncommon eastern North American yellowwood, because the older (1811) epithet *kentukea* had been overlooked, and the more recent (1825) epithet *lutea* used erroneously. Many kinds of taxonomic changes do not result in name changes of genera, species, and infrataxa—such as changes in the assignment or circumscription of families, subfamilies, orders, and so on. So the family Saxifragaceae has sometimes been very broadly circumscribed to include not only *Saxifraga*, *Mitella*, and other herbaceous genera but also such genera as *Itea*, *Ribes*, *Hydrangea*, *Philadelphus*, and *Parnassia*. Over the centuries, this broad view has been accepted less frequently and for shorter time spans than an approach recognizing various segregate families (Hydrangeaceae, Iteaceae, Grossulariaceae, Parnassiaceae, and so on). But these changes in family level taxonomy do not affect the names of the plants themselves.

Another kind of taxonomic change that does not result in a name change (when viewed from a local perspective) is a change in circumscription outside the area where the botanist is working. For instance, *Vaccinium erythrocarpum* is an interesting shrub of higher elevations in the Southern Appalachian Mountains, known variously as bearberry, highbush cranberry, or mountain cranberry. (Common names, too, have their instability and variation!) While generally considered an endemic of southeastern North America, it is closely related to *Vaccinium japonicum* of the mountains of Japan, so closely related that it is sometimes regarded as synonymous, or a variety, or a subspecies. If regarded as the same species, the North American plants remain *Vaccinium erythrocarpum* (or *V. erythrocarpum* var. *erythrocarpum*, or *V. erythrocarpum* ssp. *erythrocarpum*), however, the species is no longer an endemic of the Southern Appalachians but instead is an interesting and widely disjunct species of eastern Asia and eastern North America!

MODERN TIMES

Are plant names changing more now than ever before? This is a difficult question to answer because factors that affect the level of change may include: number of systematic botanists working, taxonomic techniques, local versus worldwide perspectives on plant taxonomy, and trends in "lumping" versus "splitting."

While there is a widespread view that systematic botany is in decline, there are certainly still many plant systematists

practicing their art—but it is a changing art. Much attention is now directed at describing the plant diversity of areas that have been relatively poorly inventoried, such as much of Central and South America. But many botanists continue to work on North America's flora, and perhaps a thousand new vascular plant species have been described in North America in the past several decades, in addition to an even greater number of taxonomic and nomenclatural changes for species that have already been described.

Classical taxonomic studies, such as monographs that delve into taxonomic and nomenclatural issues at the specific and infraspecific levels, seem to be fewer. That is to be greatly regretted, as we still have a very imperfect understanding of the plant biodiversity of our own backyards, and only studies at the species level will help us resolve the full catalog of plants that we manage, grow, or conserve. The traditional field botanist, with deep knowledge of local habitats and local flora, a keen eye for differences, knowledge of the past literature covering his or her area, and a classic training in plant systematics, has become a rare item—but is still necessary to the process of accurately describing the North American flora. Molecular techniques can assist, but cannot replace, classical taxonomy.

Over the course of history, plant taxonomists have used all the tools they could conceive of to try to improve the classification of the plants before them. Initially, this consisted of morphological characters, visible with the naked eye or with simple lenses. Are the leaves alternate or opposite? How many stamens are there? Are the seeds winged? Is the ovary inferior or superior? Over time, additional tools have become available, including chromosome counts and studies of the shape and size of the chromosomes, embryology, anatomy, developmental studies, biosystematics, common garden experiments, and more. Also, new

The full scientific name of a plant includes the botanical authorities responsible for its discovery and naming, with the position of a botanist's name and whether it is in or out of parentheses giving additional historical information. Thus, for the goldenrod *Solidago simplex* Kunth ssp. *randii* (Porter) Ringius var. *racemosa* (Greene) Ringius, we can infer that the species was named by a botanist named Kunth; the subspecies by one named Porter, with a later revision or reclassification by Ringius; and the variety by Greene, also superseded by the taxonomic authority of Ringius.

tools for analyzing the data have become available—computers, statistics, and cladistics. These analysis tools provided something other than (and often, but not always, better than) the integrative power of the human brain. The most recent innovation has been the direct sequencing of the DNA of various genes, and analysis of differences in the base-pair sequences to create hypotheses of the likely path of evolution of those genes, and therefore of the organisms carrying them. In theory, this is taking taxonomy to the ultimate source—the genome itself, the core of the identity of an organism. The hope is that the genome allows us to step around the pitfalls of subjective interpretations of complex characters and provides answers that are not corrupted by the problems of determining what is similar because of kinship from what is similar because of convergence or simply lack of change from an ancestral condition.

Molecular techniques have revolutionized plant taxonomy, and now 9 papers out of 10 published are molecular. To date, most of the changes resulting from molecular phylogenetics are at the family level and above, often affecting the circumscription of families and our ideas about their evolutionary relationships. Such changes affect the placement of plant species in the upper levels of the hierarchy, while leaving the names unchanged. Increasingly though, systematists are intensively sampling a genus, or group of genera, and drawing conclusions that often result in changes in generic circumscriptions—lumping genera, or discovering that subgenus X is more closely related to genus Y than to the remainder of the genus and must either be segregated as its own genus or lumped into genus Y. Certainly, molecular phylogenetics can result in wholesale name changes, as for instance when a genus of 500 species is determined to be polyphyletic and 400 species need transfer to a new genus. So, perhaps the changes are greater because more of them occur in large bundles than in "the old days."

Nowadays, taxonomists working at a local level (say, writing a new state flora) have a geographically broad perspective. With the resources available on the Internet, we have a much greater ability to assess whether the taxa in our area are the same or different from those elsewhere—even halfway across the world, as in the *Vaccinium erythrocarpum* example. As comparisons are made across broader geographic areas, taxonomic changes often result. Associated with the molecular approaches is a strong emphasis that taxonomic units must be monophyletic, that is, consisting of all the taxa derived from a common ancestor, and only those taxa. Although this principle has always been important in systematics, it often was stated somewhat more broadly and flexibly, and was not even a theoretically testable hypothesis. Now, molecular systematics offers more objective tests of the relationships of plants, and whether a taxonomic group (sampled across the diversity of its relatives throughout the world) is monophyletic.

Taxonomy is as much an art as a science as it attempts to impose order on the riotous untidiness of evolution.

And then there is "lumping" and "splitting"! We like to believe that science has a single true answer, however, taxonomy is as much an art as a science as it attempts to impose order on the riotous untidiness of evolution. There have always been individual preferences in taxonomy as regards "lumping" or "splitting"—the recognition of broader and more variable taxa (at whatever level) versus the recognition of narrower and more homogeneous taxa. For whatever reason, we seem overall to have entered into a period where "splitting" is more in fashion, so we see the resurrection of old species that were named and discarded in the past. This trend has probably been fostered by greater international communication, as the Europeans, Russians, and Asians have always tended to be "splittier" than most North Americans. So, for instance, the recognition of segregate genera in *Scirpus* (*Blysmus, Bolboschoenus, Isolepis, Oxycaryum, Schoenoplectus, Scirpus, Trichophorum*) and *Lycopodium* (*Diphasiastrum, Huperzia, Lycopodiella, Lycopodium, Palhinhaea, Pseudolycopodiella*) has been common in the Old World for many decades, and only recently has been accepted in North America.

HOW CAN ONE KEEP UP?

One often hears the somewhat wistful and despairing refrain, "I wish they would just leave the traditional names as they are!" But, of course, a 25-y-old botanist and a 75-y-old botanist have very different ideas of what is traditional! And a botanist trained in Europe as opposed to one trained in North America would also likely have very different ideas about what are traditional concepts (and therefore names)! Many generic splits currently being promulgated because of molecular phylogenetic studies are merely validating narrower generic concepts that were widely accepted in the first half of the 20th century in North America through (especially) the influential floras of Per Axel Rydberg (1922) in the western US and John Kunkel Small (1933) in the southeastern US. Moreover, many of these narrower concepts have been generally accepted in most of the world throughout the 20th century. So, traditional is a highly subjective concept, rooted in time and space, and it is thrown around as an argument at the peril of the arguer.

THE FIRMOSS(ES) OF NORTHERN NORTH AMERICA: A TAXONOMIC AND NOMENCLATURAL CASE STUDY

Photo by Jessie M Harris

A small, dichotomously branched firmoss is a familiar plant to many botanists who have worked in arctic-alpine, bog, and mountain cliff habitats of northern Europe, Asia, and North America. In North America, this plant ranges south to northeastern Georgia, Minnesota, Colorado, and Oregon, and until the 1990s was called by the Linnaean name *Lycopodium selago* in most manuals and floras. Various varietal and subspecific names had been sometimes applied but were not widely or confidently accepted.

In the past 12 y new studies of the taxonomy and nomenclature of *Lycopodium selago* have led to a series of changes. First, pteridologists in North America came to agree with their colleagues in Europe and Asia that acceptance of the segregate genus *Huperzia* (named by Bernhardi in 1801) for the fir-clubmosses was warranted. Initially influential in the acceptance of *Huperzia* in North America were traditional (non-molecular) accounts by Wagner and Beitel (1992, 1993) and Beitel and Mickel (1992). Later, molecular phylogenetics further corroborated the isolated position of *Huperzia* and the desirability of splitting *Lycopodium* into smaller and more natural groups (Wikström and Kenrick 2000, 2001). It now appears that *Huperzia* has been a distinct lineage from other lycopods since the Devonian, and many scientists now accept it in a separate family, the Huperziaceae.

In their treatment of the lycopods in the *Flora of North America*, Wagner and Beitel (1993) accepted separate species for what had traditionally been considered *Lycopodium selago* in North America: two in eastern North America, *Huperzia selago* (in a more narrow sense) and *Huperzia appalachiana*, and three in western North America, *Huperzia haleakalae*, *Huperzia miyoshiana*, and *Huperzia occidentalis*. Recognition of these taxa as species was based on distinctive (though subtle) morphologic traits and clinched by the discovery that sterile hybrids are produced when co-occurring taxa interbreed. Later Haines (2003) determined that *Huperzia appalachiana* (named in 1992) had a pre-existing name, *Huperzia appressa*, that has nomenclatural priority.

So, here we have splitting at family, generic, and specific levels based on both traditional and molecular data, with taxonomically based name changes all around and a nomenclatural name change as well. Most of what was called *Lycopodium selago* now has a name with no remnant of the former name, and those working in the Appalachians, New England, and the Canadian maritime provinces have gone through 2 shifts in a little over a decade, from *Lycopodium selago* to *Huperzia appalachiana* to *Huperzia appressa*. Although this may seem overwhelming and irritating, surely we now have a better understanding and richer appreciation of the diversity and evolution of firmosses, and that understanding is reflected in the new names we are now learning!

For most botanists, whether scientists or interested amateurs, the name one likes for a plant and defends as "traditional" and "right" is usually the name one learned from a state or regional flora when one was "young." So, I "grew up on" Radford, Ahles, and Bell's 1968 *Manual of the Vascular Flora of the Carolinas*, and the names used in that flora form a kind of basic nomenclature that is overturned only with some resistance by a brain reluctant to accept new things. It is interesting to note that major state and regional floras function (for better and worse) as a conservative anchor of the plant taxonomy and names in common usage in an area. Radford and others (1968) was published in its full and final form over a third of a century ago (and most of the taxonomic and nomenclatural decisions were made 40 y ago or more), yet it is still the most widely used flora in most of the southeastern US, and many users simply accept the names in it as correct because that is a simple and practical thing to do. To varying degrees, we may be aware there are some new names and new taxa "out there," but delving through thousands of papers to find them is beyond the realistic expectation for all but the most zealous.

I'll issue the following challenge: seek out a flora that covered your area 50 y before the one that you learned from, and look at the names. I bet you will see many that are familiar, many that are unfamiliar, and some that have "come back around." The level of change in plant names has always been high, and

the older generation has always tut-tutted about all those radical changes that are probably unfounded, based on new and untested methods.

National checklists have become valuable tools for use by the botanist interested in "updating" his or her taxonomy to a more modern accepted standard. The most important and influential of these is the series issued by John T Kartesz in a variety of forms including books, a "digital synthesis" on CD, and various Internet-based products such as the USDA Plants Database (http://plants. usda.gov/). But a checklist is not a flora: it lacks keys and descriptions, and taxonomic concepts must be deduced (sometimes with difficulty or error). The ongoing *Flora of North America* (8 volumes of a projected 30, issued from 1993 to the present) offers a current snapshot of taxonomic opinion, though as a "flora by committee" the conservativeness of the treatments is variable.

Authors of new state and regional floras should make an effort to modernize the taxonomy and nomenclature without being "out on the ragged edge" of using new concepts and names that may be particularly unstable because they have not received sufficient peer review and assessment. It is also very helpful to the wide range of flora users to read a simple explanation of the reason for the change. An understanding of the reason(s) provides some depth and comprehension of taxonomic relationships and reduces the impression that taxonomy is a mysterious black box from which oracular and arbitrary pronouncements emerge. In the long run, greater appreciation and acceptance of the new names will result. As users of the Latin names of plants, we need to accept that change is inevitable. As science progresses and we gain new insights into the evolutionary relationships of plants, additional name change will occur.

To me, it is worth the extra effort of learning new names to gain new appreciation of the connections among our flora—to understand that *Hepatica* is just an unusual *Anemone*, that *Cimicifuga* is part of *Actaea*, that nearly all North American "Asters" are not closely related to the Eurasian genus *Aster*, that *Platanthera* has little to do with *Habenaria*, and many more. So, let's close with a bouquet of "asters" that have turned out not to be that closely related to one another, or to *Aster*: climbing aster (*Ampelaster carolinianus*), stiff-leaved aster (*Ionactis linariifolius*), tall flat-topped aster (*Doellingeria umbellata*), whorled aster (*Oclemena acuminata*), common blue aster (*Symphyotrichum cordifolium*), big-leaved wood-aster (*Eurybia macrophylla*), and white-topped aster (*Sericocarpus linifolius*). Fortunately, we can appreciate our new understanding of the diversity of asters, and in common names at least, they are still "asters"!

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