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One Lump or Two: How Many Wild Gingers Inhabit North America?

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One lump or two:

How many wild gingers inhabit North America?

Depending on which source one consults, the answer is either one (*Asarum*), or two (*Asarum* + *Hexastylis*). It is a classic lump-or-split situation. To mention just a few sources, Fernald (1950) and Gleason & Cronquist (1991) lump all the wild gingers into a single genus, whereas Radford et al. (1968), the Digital Atlas of the Virginia Flora (Virginia Botanical Associates 2010), and the *Flora of North America* (Whitmore & Gaddy 1997; Whitmore et al. 1997) split *Asarum* and *Hexastylis* apart. Deference to authority is a poor way to assess any scientific question, and for these wild gingers, the authorities are deeply split. To understand the case at hand, one needs to dig a little deeper.

Let's consider morphology first. There is a long tradition in botany that genera should be distinguished from each other based on qualitative differences in the plants' flowers and fruits, whereas species within a genus should be distinguished by non-floral characters or quantitative aspects of the reproductive structures, i.e., mere dimensions, not basic morphology of flowers and fruits. Oaks provide an excellent example: fruits of any oak species are readily recognized as some sort of acorn, but acorns of different species of oak come in different sizes, the ratios of cap to nut also vary, as do many aspects of the leaves and bark.

On first impression, all the wild gingers share a similar morphological aspect: all are herbaceous

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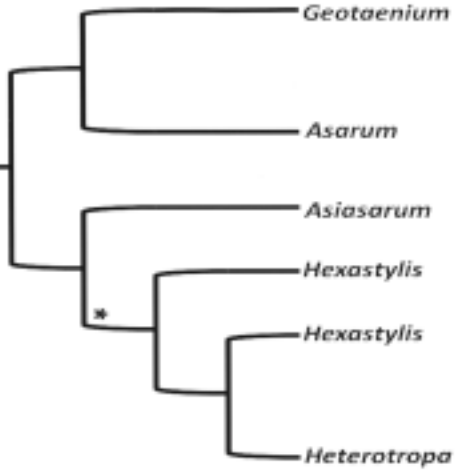

Simplified cladogram of wild gingers, after Kelly (1998). Genera at branch tips represent narrow (split) taxonomic concepts and contain from one to several dozen species each; asterisk marks the common ancestor to Hexastylis *and* Heterotropa.

• *Wild ginger*

(Continued from page 1)

perennials with shallow rhizomes bearing kidney- to heart-shaped leaves and jug-like flowers borne essentially at soil level. Further, all the flowers are dominated by three sepals enclosing 12 stamens and an ovary composed of six subunits (carpels). Overall similarity of reproductive features could argue for lumping all into a single genus, *Asarum*. But if one looks a little closer, the sepals of *Asarum* are mostly separate from each other above the ovary, where they are clearly fused and tubular in *Hexastylis*, the anthers of *Asarum* have terminal appendages that are absent in *Hexastylis*, and the ovary of *Asarum* is inferior whereas ovaries in *Hexastylis* are superior or at most one-third inferior. So, with a closer examination of reproductive structures, a case based on morphology could be made for splitting *Hexastylis*. Do the similarities outweigh the differences? Are the similarities somehow more important, and the differences mere details? Or vice versa? These questions have no obvious single answer; morphology could be used to justify either splitting these genera apart or lumping them as one. Natural diversity does not come sorted and labeled; the patterns that nature gives us don't always fit simple, preconceived notions of what should constitute a distinct genus. Nevertheless, at some point a decision needs to be made, and it looks like morphology is not going to decide this case.

Over the last two decades or so, plant systematists have made great strides in deciphering the details of relationships among plants. Two revolutions have brought this about: 1) the adoption of cladistic methods for reconstructing evolutionary relationships (phylogeny) and 2) the inclusion of molecular characters (DNA or gene-sequence information) in cladistic analyses. Lawrence Kelly has published two cladistic analyses of wild gingers, one based entirely on morphological data

(See Ginger confusion, page 8)

•*Ginger confusion*

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(Kelly 1997), the other incorporating both morphology and DNA-based characters (Kelly 1998). In both studies, the species always placed in *Asarum* and those sometimes split as *Hexastylis* occupy distinctly different branches of the phylogenetic tree generated by his data (figure on page 1). Nevertheless, despite the clear split between the two, Kelly prefers to lump *Hexastylis* with *Asarum* rather than maintain them as distinct. Why, one might ask?

The problem is that the plants from the southeastern U.S. that traditionally have been called *Hexastylis* are not the only plants that occupy the branch opposite *Asarum* on Kelly's cladograms. At the base of that branch is a Chinese species sometimes classified in the genus *Asiasarum*, then there are two successive branches that contain our southeastern U.S. species of *Hexastylis*, and then another large branch containing Asian plants sometimes classified as *Heterotropa*. So, the question of whether to lump or split *Asarum* and *Hexastylis* is not the whole story here; rather it is just one aspect of how best to classify all the wild gingers of the world. In other words, the existence of species in China impacts how we apply names to plants in North America! Further, the powerful toolkit that cladistic analysis provides comes with some rather stringent rules about how taxonomic groups can be defined. In cladistics, the foremost rule for defining taxonomic groups is that they must be monophyletic, i.e., all members of the group must have a common ancestor *and* the group must include *all* descendents of that common ancestor. And this is the essence of the problem with *Hexastylis*. As modeled by Kelly's cladograms, the species that have been traditionally distinguished by some as the genus *Hexastylis* do not constitute a group that includes all descendents of their common ancestor. Specifically, all the species classified as *Heterotropa* share a common ancestor with *Hexastylis* but are not included in *Hexastylis* as that genus has been defined. Hence, from global and cladistic perspectives, maintaining *Hexastylis* as traditionally defined for a handful of species in the southeast U.S. is untenable. It looks like the lumpers win: all wild gingers should be classified as species of *Asarum*.

Ah . . . but is that the final word? The lumpers should not be overly smug. One could argue that the big split in the phylogenetic tree, *Asarum* (plus another small genus called *Geotaenium*) on the left side of and *Asiasarum-Hexastylis-Heterotropa* on the right side, defines two genera. A quick perusal of the dates on which the genus names of the right-hand branch were first published suggests that *Hexastylis* would have priority if all three were grouped together. So, it looks like it may be possible to maintain the *Hexastylis* split from *Asarum*, but *only* if proponents of that option would be willing to lump *Hexastylis* with these Asian entities which, of course, would alter the traditional concept of *Hexastylis*.

It is human nature to prefer a single, simple, straightforward answer to a question. Whether wild gingers constitute one or two genera seems like a simple, straightforward question, but it looks like nature is giving us two subtly nuanced solutions. Does this sort of conundrum leave you with a splitting headache? Perhaps a nice soothing cup of ginger tea would be just the thing . . . one lump or two?

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