NYBG Herbarium Workshop

Herbarium Curation: Resources and Guidance

Matthew Pace mpace@nybg.org
Laura Briscoe lbriscoe@nybg.org
Nicole Tarnowsky ntarnowsky@nybg.org

Things to consider:

- What Kingdoms does the collection cover?
- How is the collection currently organized? (e.g., alphabetical (+/- geography), APG III/IV, Engler (+ modified), etc.)
- Who are the primary users of your collection?
- Are users regularly annotating specimens?
- What is the size of the collection, and what is your capacity for curation?
- What is your workforce like? Who can commit time to curation and for how long?
- In general, how 'out of date' is the taxonomy? (e.g., does the collection still use Scrophulariaceae s.l., Tiliaceae, *Acacia* s.l., etc.)
- Are there 'special' collections (e.g., types, historic material, etc.)

Develop a plan:

• Survey your collection and outline all of the changes needed (e.g., now many new families should be recognized)

• Break it into manageable portions. Set realistic timelines. Develop year 1 goals, y 2 goals, y 5 goals, & y 10 goals

• Identify the most pressing curation problems

• Identify the individuals who will be able to work on these projects, and for how long (short & long-term workers)

• Identify swing space or other workspace that is not needed for everyday activities

• Will these projects need additional monetary support? Possibilities for NSF Collections Improvement Grants? Collaborative grants with institutional researchers? Synergies with classes?

Resources:

• Unfortunately, ‘one taxonomic resource to rule them all’ does not (yet) exist

• Even if your collection only covers vascular plants, you will likely need to consult two (+) resources

• A reminder that species are simply hypotheses, and curation is just maintenance of an organization system. They are all valid, and it’s not necessary or realistic for every taxon to be 100% completely up to date

• What matters most is that users are able to locate specimens easily & efficiently

Resource: Plants of the World Online (POWO; RBG Kew)
https://powo.science.kew.org/
***** will *eventually* merge with World Flora Online**

Pros
- Family nomenclature is very update date, follows APGIV
- Very complete inclusion of published names; accepted genera are listed on family pages, accepted species listed on genus pages
- Genus and species nomenclature and taxonomy is regularly updated
- Clearly indicates if accepted or synonymized, with link to accepted name

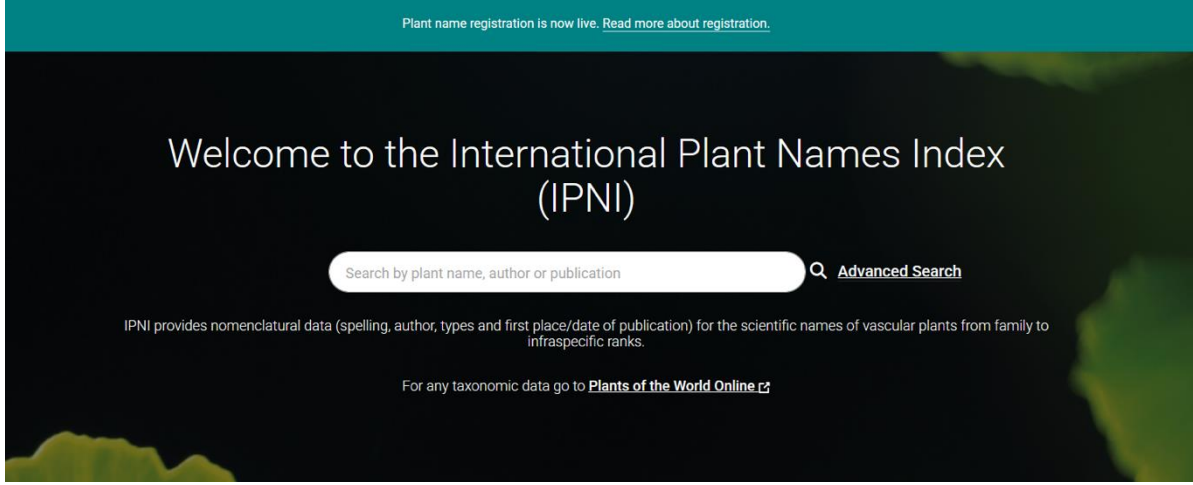
Cons
- Only covers vascular plants
- Does not include live links to protologues
- It can be difficult to find subspecies, varieties, & hybrids, and to understand if they are accepted or synonymized
- It is not unerring, and its generic and species concepts can either be very broad or very narrow, depending on the opinions of Kew scientists (e.g., Kew likes broadly defined orchid genera, *except when it doesn't, can be seemingly arbitrary*)

Resource: World Flora Online (WFO; consortium)
https://www.worldfloraonline.org/

Pros
- Covers bryophytes and vascular plants
- Family nomenclature is very up to date, follows APGIV
- Very complete inclusion of published names
- Will likely eventually be 'the' global resource, subsuming POWO (*but not there yet*)
- Clearly indicates if accepted or synonymized, with links to accepted names

Cons
- I personally find it hard to navigate
- Links to protologues are buried in a general bibliography list
- Family pages do not list accepted genera and/or species
- Currently mostly links out/back to POWO
- Unclear how regularly it is updated (e.g., synonymization, addition of protologues, etc.)

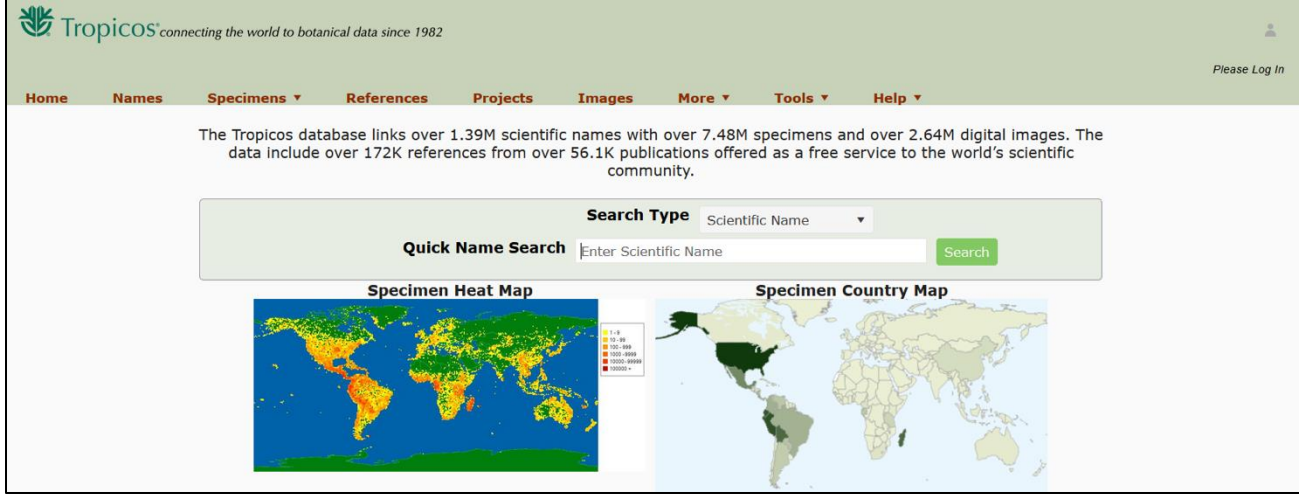
Resource: International Plant Names Index (IPNI; consortium)
https://www.ipni.org/



Pros
- Family nomenclature is (mostly) up to date, (mostly) follows APG IV
- Very complete inclusion of published names
- Very clear publication and authorship information

Cons
- Only covers vascular plants
- Live links to protologues in BHL is spotty
- Generally does not indicate if a name is accepted or synonymized
- Family and genus pages do not include lists of accepted subtaxa

Resource: TROPICOS
(Missouri Botanic Garden)
https://www.tropicos.org/home



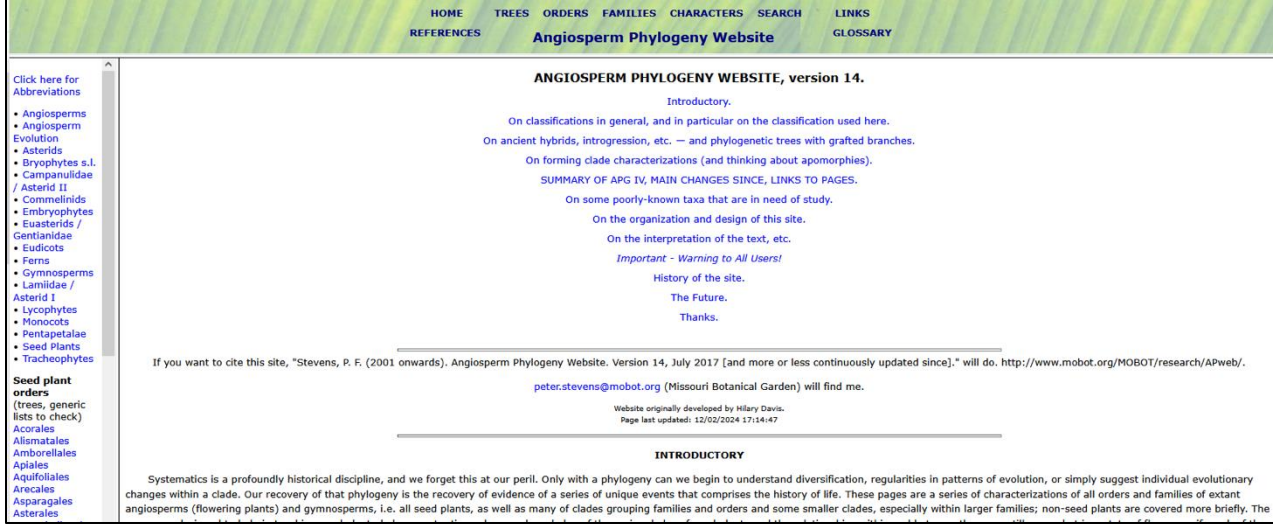
Pros

- Covers all plant groups (also includes fungi/lichens and algae but very incomplete)
- 'First stop' resource for bryophytes
- Clearly indicates if accepted or synonymized, with links to accepted names**
- Very clear publication and standardized authorship information
- Very high proportion of protologue information has live BHL links (non-copy written material)
- Often lists type specimen collection information for basionyms
- Family entries list included genera (under "subordinate taxa" tab, with indication of status**)

Cons

- Website design is a bit 'retro' (maybe a plus?)
- ** Taxonomy and nomenclature can be out of date (not sure if MO is keeping this up to date, does not seem to be as regularly updated as POWO; I generally do not trust TROPICOS to provide currently accepted names for synonymy, verify with POWO)

Resource: Angiosperm Phylogeny Website (Missouri Botanic Garden)
https://www.mobot.org/mobot/research/APweb/



Pros

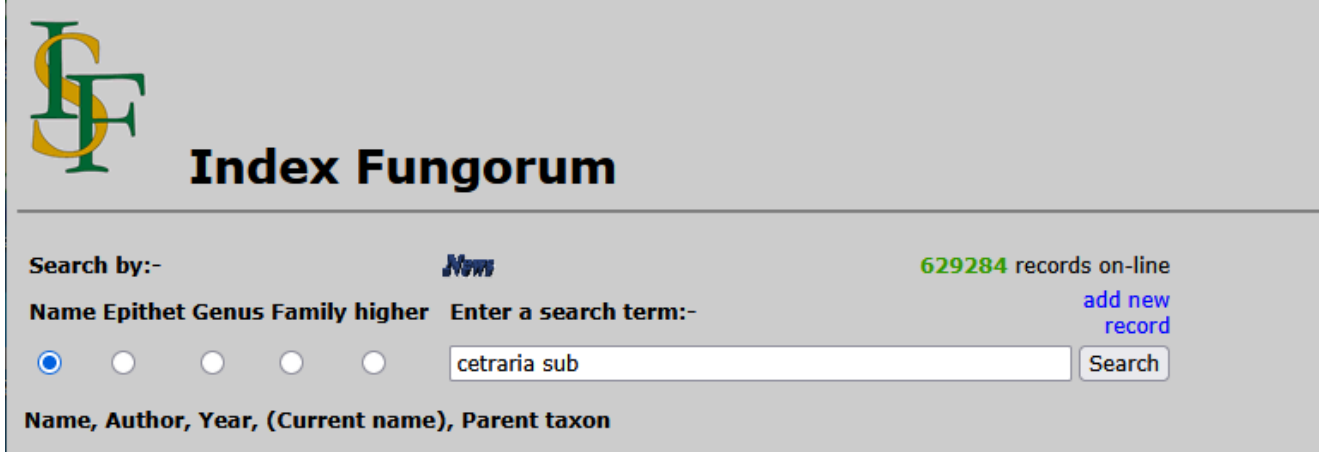
- Good resource for family or genus level phylogenetic information
- Family entries list included genera (sometimes as a link and/or included under tribes with indication of status)

Cons

- *Primarily intended to summarize evolutionary / phylogenetic information, not taxonomy*
- Only includes vascular plants
- Website design is a bit ‘retro’ (maybe a plus?)
- Information is very dense & broad, and can be difficult to navigate / find relevant information
- Generic synonymy can be out of date (not sure if MO is keeping this up to date, does not seem to be as regularly updated as POWO; I generally do not trust TROPICOS (related) to provide currently accepted names for synonymy)

Resource: IndexFungorum
https://www.indexfungorum.org/Names/Names.asp

For fungal names (including lichenized fungi)



Pros
- Easy to search for binomials or individual ranks
- Entries include publication details for taxa, often with links to scanned protologue

Cons
- Website design is a bit ‘retro’ (maybe a plus?)
- Some names missing, some minor errors, but you can submit comments or updates
- Full synonymies on separate website, Species Fungarium, and it's a little cumbersome to switch back and forth

Resource: MycoBank
https://www.mycobank.org/

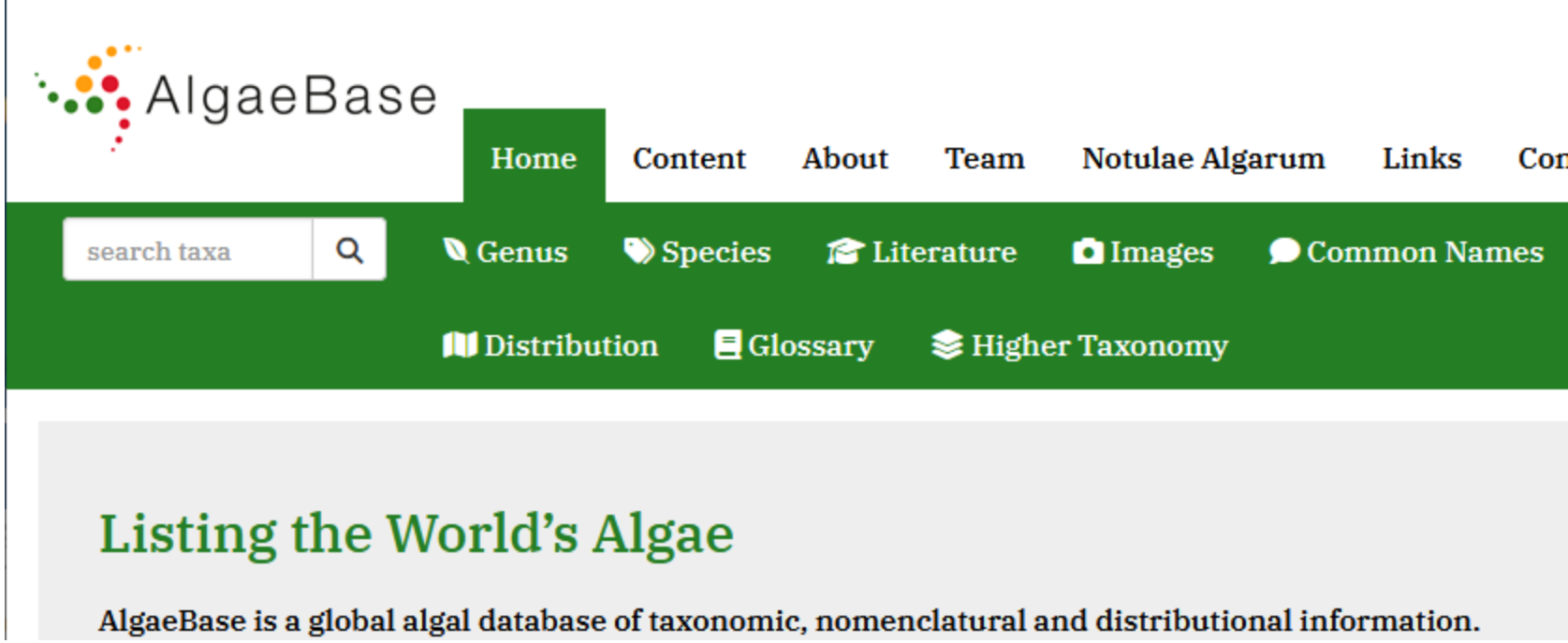
For fungal names (including lichenized fungi)

Pros
- More modern interface, linked with IF, NCBI, IT IS, GBIF and other databases
- Each taxon has a MycoBank#

Cons
- Searching takes more steps and navigation than IF
- Limited data for many taxa, and does not directly link to protologues the way IF does

Resource: AlgaeBase
https://www.algaebase.org

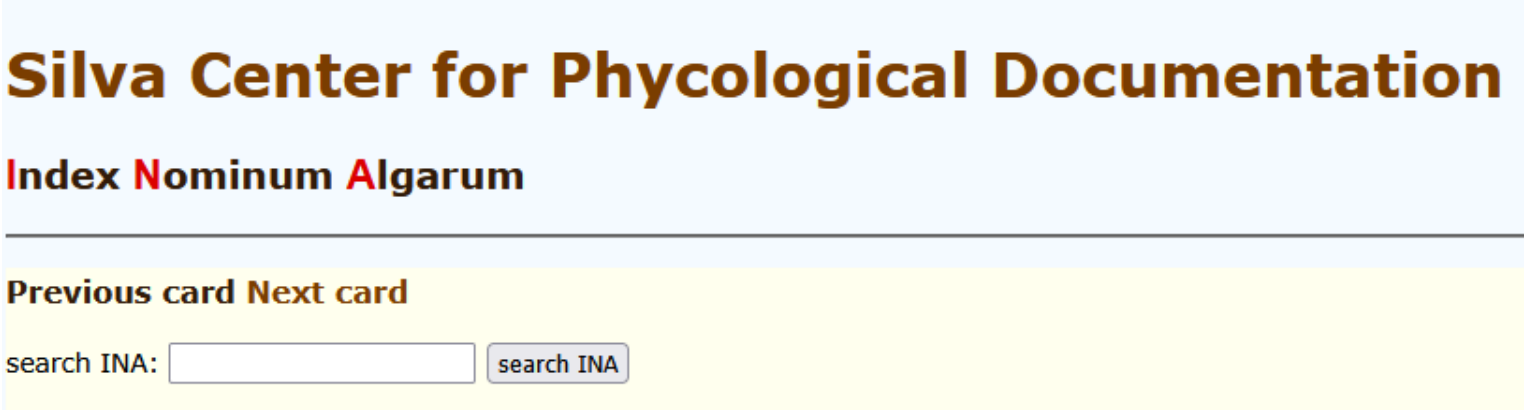
For algal names



Pros
- More modern interface, easy to search
- Clearly provides currently accepted synonyms

Cons
- Has pdfs for many protologues, but requires additional steps to receive them by e-mail
- Frequently lists invalid or illegitimate names as currently accepted
- Missing many older names, especially later homonyms

Resource: Index Nominum Algarum
https://ucjeps.berkeley.edu/INA.html



For algal names

Pros
- Great resource for harder to find names, especially later homonyms or hard to find publications
- Really good for finding bibliographic references

Cons
- Scanned card file system, a little clunky to use (requires downloading images of cards that have not been transcribed)
- Has bibliographic references, but no links
- Has all combinations, but does not give opinion on which is currently accepted

Resource: Systematic & Taxonomic Journals

Brittonia
Edinburgh Journal of Botany
Flora Neotropica Monographs
Kew Bulletin
Lankesteriana (orchids)
Novon
PhytoKeys
Phytotaxa
Plant Systematics and Evolution
Systematic Botany
Systematic Botany Monographs
Taiwania
Taxon

Case Study: NYBG's Liliaceae collection

• When NY was founded in 1891, it implemented Engler's 1892 system of plant families

• Accepted families were updated to Cronquist's 1988 system, in use through 2015 (+/- present)

• APG system (Angiosperm Phylogeny Group) is a mostly molecular-based system of plant taxonomy. Begun in 1998, most recent update published in 2016 (APG IV). This is the community standard for accepted families

• NY is about halfway to including the families accepted by APG IV

Case Study: NYBG's Liliaceae collection

• Classification at the family level has now mostly stabilized. "Overall, the changes from APG III (2009) to APG IV are minimal."

• Many families remained stable from Engler/Cronquist to APG IV, but some have undergone tremendous change

• Some of the changes lead to confusion for in-house curation, visitors, and data sharing

– confusion for specimen filers and digitizers
– misfiling species under multiple families
– wasted time for visitors trying to locate a taxon

Hosta L.

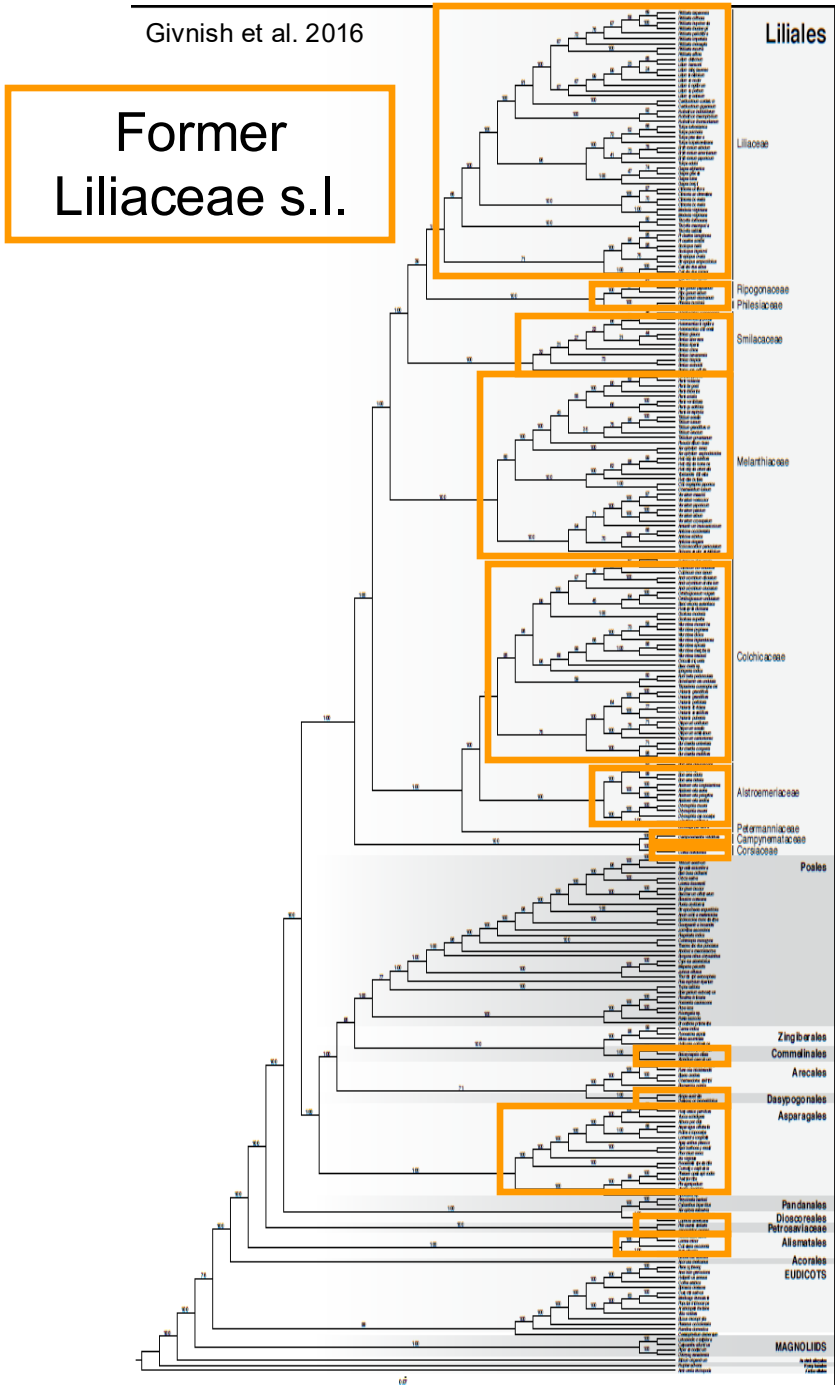
Engler: Liliaceae
Cronquist: Agavaceae
APG IV: Asparagaceae

Case Study: NYBG's Liliaceae collection

• In total, 110 new families must be added and 30 families must be combined to be in agreement with APG IV

• Many families were grossly polyphyletic and have mostly 'disintegrated'
e.g., Liliaceae, Scrophulariaceae, Grossulariaceae

• For Liliaceae (s.l.), NY needed to distribute genera/specimens to 20 families, many of them newly recognized within the Herbarium. We also found genera such as *Colchicum* were filed under several (long synonymized) genera in different families. This quickly morphed into curation of the entire monocot collection



Established NY families & numbers

Lanariaceae (Liliaceae)
Langsdorffiaceae (Balanophoraceae)
Lapageriaceae (Smilacaceae)
Lardizabalaceae 110
Lauraceae 120
Lecythidaceae 245
Ledocarpaceae (Geraniaceae)
Leeaceae 196.1
Leguminosae (Mimosaceae, Caesalpiniaceae, Fabaceae)
Leitneriaceae 75
Lemnaceae 39
Lennoaceae 260
Lentibulariaceae 289
Leonticaceae (Berberidaceae)
Lepidobotryaceae (Oxalidaceae)
Lepuropetalaceae (Saxifragaceae)
Lilaeaceae (Juncaginaceae)
Liliaceae 53
Limnanthaceae 178
Limnocharitaceae 31.1
Linaceae 157
Lissocarpaceae 271.1
Loasaceae 231
Lobeliaceae (Campanulaceae)
Loganiaceae 275
Lomandraceae (Xanthorrhoeaceae)
Lophiraceae (Ochnaceae)
Lophophytaceae (Balanophoraceae)
Lophopyxidaceae (Celastraceae)
Loranthaceae 84
Lowiaceae 60.2
Luzuriagaceae (Smilacaceae)
Lythraceae 241

Magnoliaceae 113
Malesherbiaceae 227
Parnassiaceae 136.5
Passifloraceae 228
Pedaliaceae 294
Peganaceae (Zygophyllaceae)
Pellicieraceae 212.3
Penaeaceae 237
Pentadiplandraceae (Capparaceae)
Pentaphragmataceae 307.1
Pentaphylacaceae 181
Pentastemonaceae (Stemonaceae)
Penthoraceae (Saxifragaceae)
Peperomiaceae (Piperaceae)
Peraceae (Euphorbiaceae)
Peridiscaceae 224.1
Periplocaceae (Asclepiadaceae)
Petermanniaceae (Smilacaceae)
Petiveriaceae (Phytolaccaceae)
Petrosaviaceae 33.1
Phellinaceae (Aquifoliaceae)
Philadelphaceae (Hydrangeaceae)
Philesiaceae (Smilacaceae)
Philydraceae 50
Phormiaceae (Agavaceae)
Phrymaceae (Verbenaceae)
Phyllanthaceae (Euphorbiaceae)
Phyllonomaceae (Grossulariaceae)
Physenaceae 213.2
Phytolaccaceae 100
Picramniaceae 163.2
Picrodendraceae (Euphorbiaceae)
Pinaceae 21
Piperaceae 69
Pistaciaceae (Anacardiaceae)
Pistiaceae (Araceae)
Pittosporaceae 137
Plagiopteraceae (Flacourtiaceae)
Plantaginaceae 300

APG IV families & numbers

193 [192]. Balanopaceae Benth. & Hook.f., *nom. cons.*
194 [193]. Trigoniaceae A.Juss., *nom. cons.*
195 [194]. Dichapetalaceae Baill., *nom. cons.*
196 [195]. Euphroniaceae Marc.-Berti
197 [196]. Chrysobalanaceae R.Br., *nom. cons.*
198 [206]. Humiriaceae A.Juss., *nom. cons.*
199 [204]. Achariaceae Harms, *nom. cons.*
200 [202]. Violaceae Batsch, *nom. cons.*
201 [203]. Goupiaceae Miers
202 [199]. Passifloraceae Juss. ex Roussel, *nom. cons.*
203 [200]. Lacistemataceae Mart., *nom. cons.*
204 [201]. Salicaceae Mirb., *nom. cons.*
205 [—]. *Peraceae Klotzsch
206 [183]. Rafflesiaceae Dumort., *nom. cons.*
207 [184]. *Euphorbiaceae Juss., *nom. cons.*
208 [208]. Linaceae DC. ex Perleb, *nom. cons.*
209 [209]. *Ixonanthaceae Planch. ex Miq., *nom. cons.*
210 [188]. Picrodendraceae Small, *nom. cons.*
211 [189]. Phyllanthaceae Martinov, *nom. cons.*

List of new families to add & their new numbers (inserted in the current numbering system) All genera, accepted & synonymized (consulting POWO, Tropicos, etc.)

Quillajaceae (new # 151): *Quillaja*

Francoaceae (new # 154.1): *Balbisia, Bersama, Caesarea, Cissarobryon, Dematophyllum, Diplerisma, Francoa, Greyia, Ledocarpon, Melianthus, Natalia, Rhynchotheca, Tetilla, Viviania, Wendtia*

Phyllanthaceae (new # 157.3):

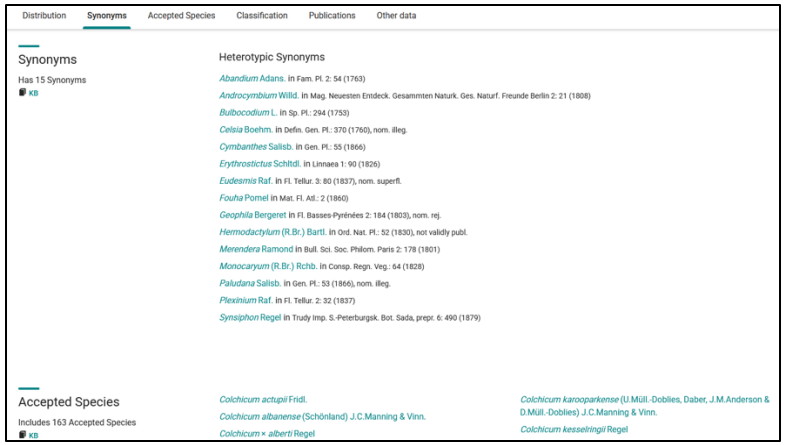
Picrodendraceae (new # 157.4): *Androstachys, Aristogeitonia, Austrobuxus, Canaca, Cecchia, Celaendendrom, Choriceras, Dissiliaria, Hyaenanche, Kairothamnus, Longetia, Micrantheum, Mischodon, Neoroepera, Oldfieldia, Paivaeusa, Parodiodendron, Petalostigma, Picrodendron, Piranhea, Podocalyx, Pseudanthis, Scagea, Stachyandra, Stachystemon, Tetracoccus, Voatamalo, Whyanbeelia*

Peraceae (new # 157.5): *Altora, Chaetocarpus, Clistranthus, Clutia, Gaedawakka, Mettenia, Neochevaliera, Peniculifera, pera, Peridium, Perula, Pogonophora, Poraresia, Regnaldia, Schosmatopera, Spixia, Trigonopleura*

Count cubbies needed

Remove folders to create swing space if necessary

Curate genera in new families as they are moved



Shift & Refile

Finding Aids

• Regardless of how the collections in your herbarium are arranged, it is helpful to have finding aids for students, volunteers, visitors, or whoever might come after you.

• We utilize family numbers for vascular plants and have lists available throughout the herbarium for people to consult

• We have additional lists for other subgroups that may have been curated with additional sets of family or clade numbers (eg algae, bryophytes, ferns, fungi, lichens) These lists are stored near their respective collections, and require some ongoing maintenance.

Collection Types

• Your collection may consist of only mounted sheets.

• Or you may have a combination of collections in packets, boxes, glass jars, or even oversized or bulky specimens or objects. You may have multiple object types for the same taxonomic groups, which can be challenging.

• There are several ways to approach this. If you only have a limited number of bulky specimens, you may want to store them all together on appropriate shelving, and provide cross reference sheets in the herbarium to direct users to the oversized collections (similar to many libraries!)

• If there are taxonomic groups you have significant material in of multiple object types, you may wish to file them staggered by object type, eg. All the sheets of a genus first, and then all of the boxes.

Destructive Sampling

• Perhaps the most frequent current use of our specimens is for molecular sampling

• Use this as an opportunity to build collaborations

• Make a formal Policy & Sign Off Sheet

• Annotation labels should be added, indicating who sampled what, when, for what type of study

• You/your collection is empowered to say no

• Make sure researchers properly cite your herbarium in the paper. Make sure to stress the need for including vouchers in their papers. If you are providing a lot of support, ask for co-authorship

• Ask for a copy of the published paper so you can tract citations

Biocultural Collections

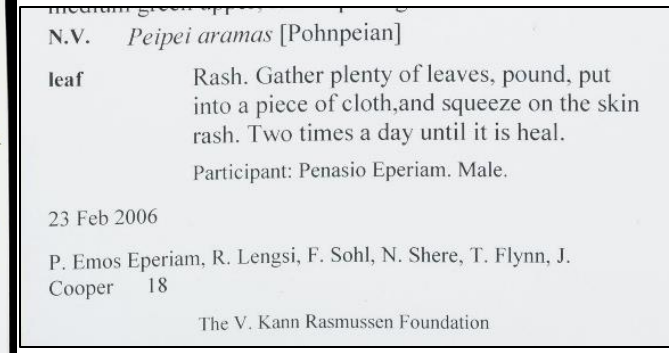
• May include use or other cultural information or vernacular names. This type of information may even appear on specimens collected for systematic purposes

• Includes collections from formally recognized Indigenous lands (e.g., Reservations in the US, Terra Indígena in Brazil)

• US Indigenous objects and information could fall under NAGPRA (Native American Graves Protection and Repatriation Act). Opportunities for rematriation/ repatriation and/or community co-curation

• Cultural Information may be freely shared with the researcher, but have conditions on digital sharing. Centralize where this information is documented

• This is an opportunity to build bridges and collaborations with First Nations, Indigenous Communities, and other traditional peoples



N.V. *Peipei aramas* [Pohnpeian]

leaf Rash. Gather plenty of leaves, pound, put into a piece of cloth,and squeeze on the skin rash. Two times a day until it is heal.

Participant: Penasio Eperiam. Male.

23 Feb 2006

P. Emos Eperiam, R. Lengsi, F. Sohl, N. Shere, T. Flynn, J. Cooper 18

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