



Introduction to SEEK Taxon:

The problem of taxonomic resolution

Nico Franz, Albuquerque 2006 (via Mayagüez)

“Linnaean nomenclature is stable enough to say what we know,
flexible enough to accommodate what we learn;
independent of specific theory, yet reflective of known empirical data;
compatible with phylogenetic theory, but not a slave to it;
particular enough for precise communication,
general enough to reflect refuted hypotheses.

Linnaean nomenclature is an effective international, inter-generational and trans-theoretical system of classification that was forged and tested by those describing the Earth’s biota, not touting political slogans.”

Wheeler, 2004

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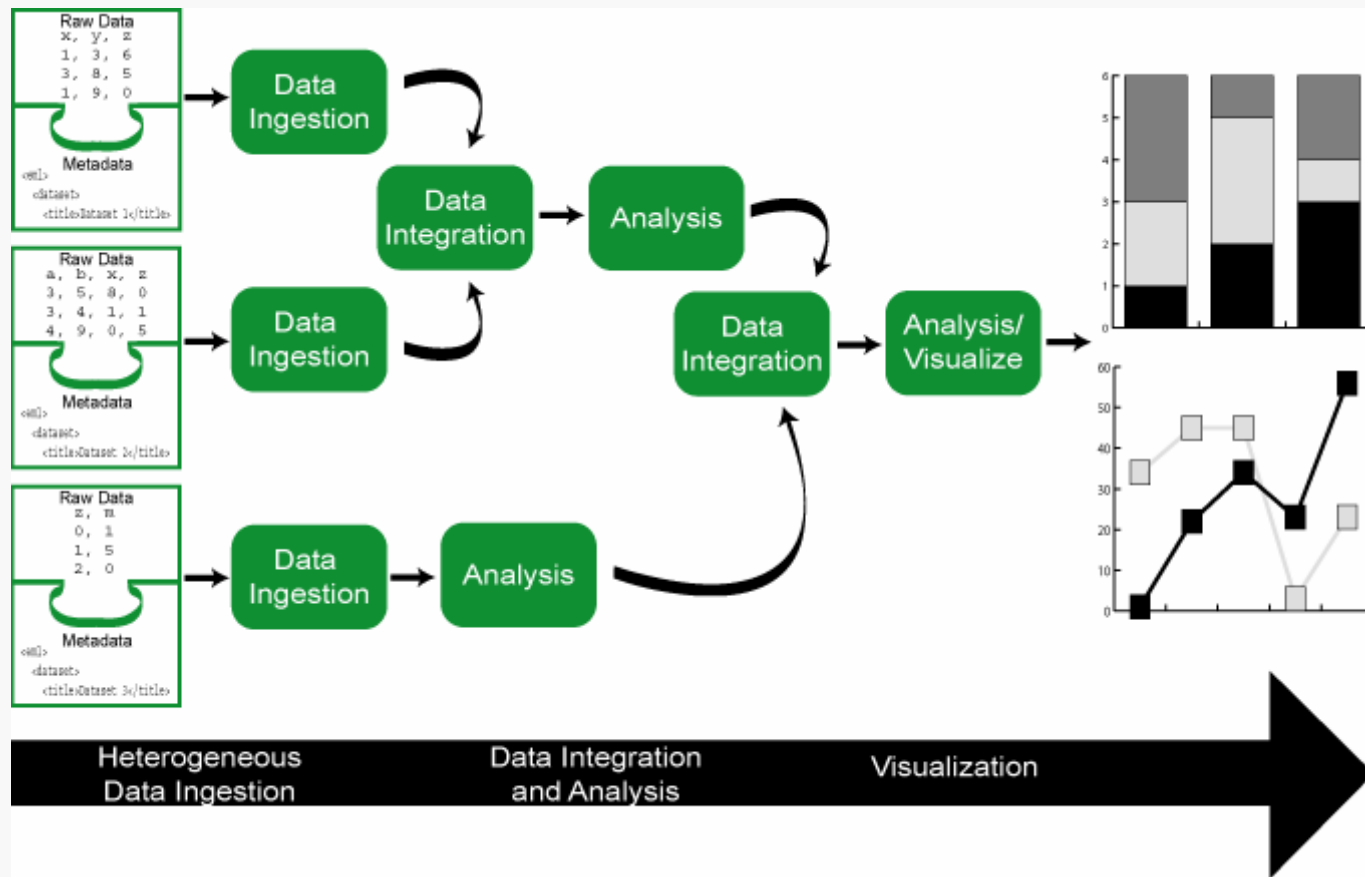
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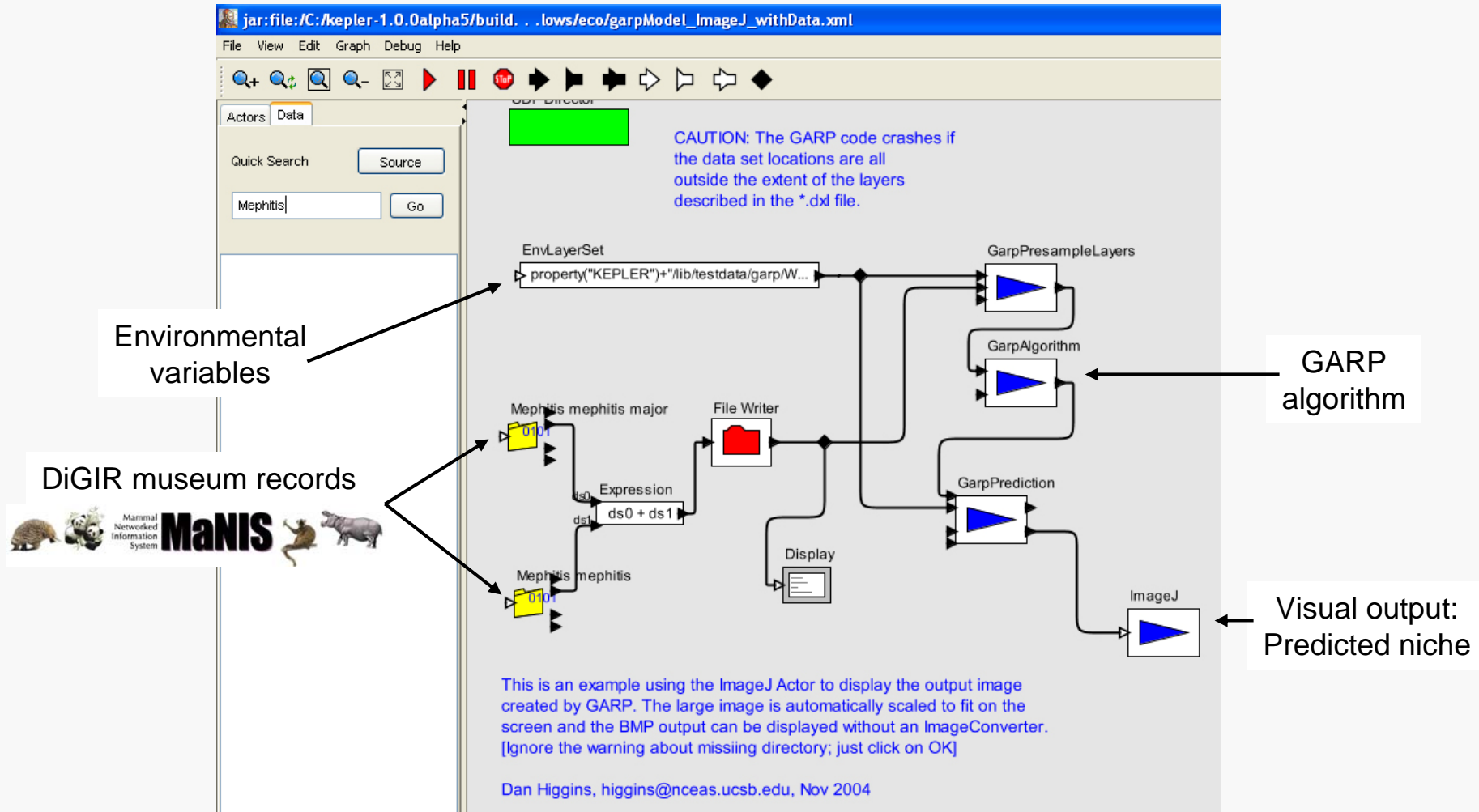
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SEEK – Science Environment for Ecological Knowledge

- Large-scale, long-term ecological analyses are supported via a distributed data network, a scientific workflow system, and “semantic mediation”.

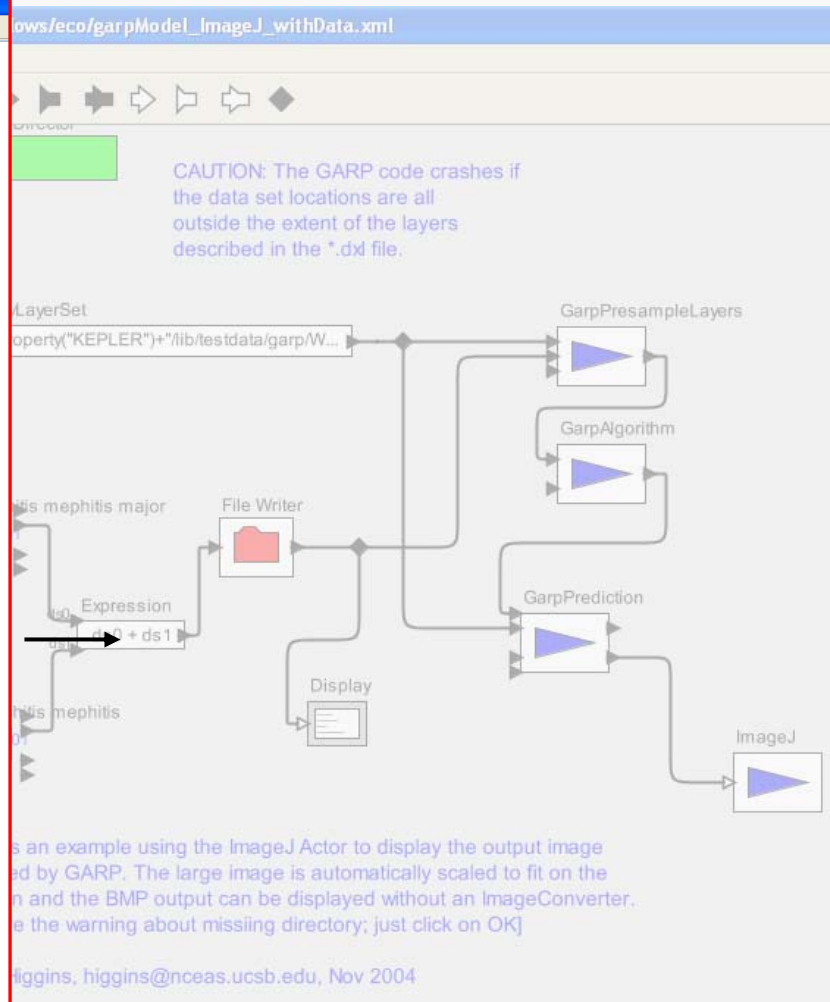


Use case – niche modeling based on specimen data from MaNIS.



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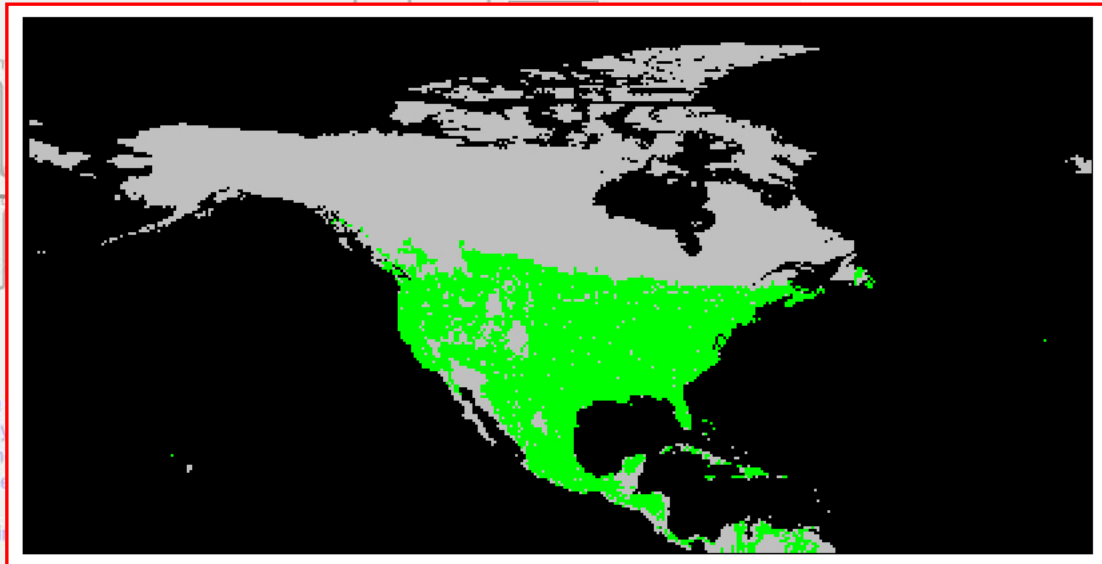
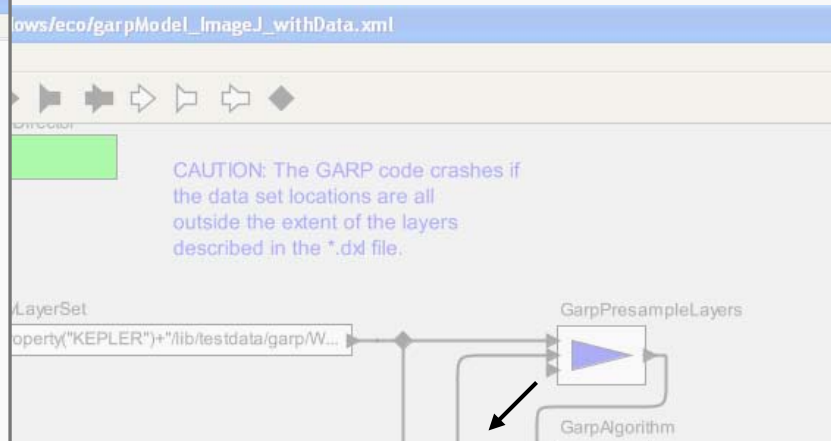
garpModel_ImageJ_withData.Display						
File Help						
mephitis	Mephitis mephitis	spissigrada	1952	-124.10306	48.20444	
mephitis	Mephitis mephitis	1946	-120.08666	47.4696		
mephitis	Mephitis mephitis	notata	1937	-121.13306	45.6865682	
mephitis	Mephitis mephitis	notata	1937	-121.13306	45.61417	
mephitis	Mephitis mephitis	spissigrada	1961	-122.7175	46.58194	
mephitis	Mephitis mephitis	spissigrade	1939	-122.6041	47.09	
mephitis	Mephitis mephitis	spissigrada	1947	-122.66639	47.29028	
mephitis	Mephitis mephitis	spissigrada	1952	-122.68361	47.29333	
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mephitis	Mephitis mephitis	spissigrade	1960	-122.43389	47.14722	
mephitis	Mephitis mephitis	spissigrade	1935	-121.9182	46.742	
mephitis	Mephitis mephitis	notata	1938	-121.92778	45.80417	
mephitis	Mephitis mephitis	nigra null	-75.50028	43.00028		
macroura	Mephitis macroura	milleri	1894	-110.7047	32.4303	
mephitis	Mephitis mephitis	hudsonica	null	-88.2611	43.0806	
mephitis	Mephitis mephitis	hudsonica	null	-88.2611	43.0806	
mephitis	Mephitis mephitis	estor 1889	-112.4678	34.54		
mephitis	Mephitis mephitis	nigra 1889	-73.87917	40.99444		
mephitis	Mephitis mephitis	nigra 1895	-73.87917	40.99444		
mephitis	Mephitis mephitis	nigra 1898	-80.2978	37.7964		
mephitis	Mephitis mephitis	spissigrada	1898	-123.4294	48.1183	
mephitis	Mephitis mephitis	spissigrada	1898	-123.4294	48.1183	
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mephitis	Mephitis mephitis	nigra null	-86.1521	39.7701		
mephitis	Mephitis mephitis	varians	1899	-98.5578	36.805	
mephitis	Mephitis mephitis	varians	1899	-98.5578	36.805	
mephitis	Mephitis mephitis	mephitis	1900	-72.26333	45.13444	
mephitis	Mephitis mephitis	mephitis	1900	-72.26333	45.13444	
mephitis	Mephitis mephitis	elongata	1900	-81.2669	28.8689	
macroura	Mephitis macroura	macroura	1901	-102.77167	20.35083	
macroura	Mephitis macroura	macroura	1901	-102.77167	20.35083	
mephitis	Mephitis mephitis	occidentalis	1901	-124.065278	41.546944	
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mephitis	Mephitis mephitis	nigra 1901	-88.5277	46.3843		
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mephitis	Mephitis mephitis	avia 1902	-95.235	38.9633		
mephitis	Mephitis mephitis	hudsonica	1903	-88.0197	44.5192	
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Museum data (name, date, lat/long)

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Museum data (name, date, lat/long)

Predicted distribution

The taxonomic challenge: integration of names to meaningful entities.

The screenshot shows a software interface with two main panels. The left panel, titled 'Actors Data', contains a 'Quick Search' section with a text input field containing 'Mephitis' and a 'Go' button. Below this is a list of taxonomic names, each preceded by a small icon and a number in parentheses. The names include: Mephitis mephitis avia, Mephitis mephitis spissigrada, MEPHISIS MEPHISIS MAJOR, MEPHISIS MACROURA MACROURA, Mephitis mephitis mephitis, Mephitis mephitis nigra, MEPHISIS MEPHISIS, Mephitis mephitis notata, Mephitis mephitis holzneri, Mephitis mephitis mesomelas, Mephitis mephitis varians, Mephitis mephitis hudsonica, MEPHISIS MEPHISIS ESTOR, Mephitis mephitis hudsonicus, Mephitis, Mephitis mephitis varians, MEPHISIS, Mephitis mephitis major, Mephitis macroura, MEPHISIS MACROURA MILLERI, Mephitis macroura milleri, Mephitis mephitis holzneri, MEPHISIS MEPHISIS MESOMELAS, Mephitis macroura macroura, MEPHISIS MEPHISIS HUDSONICA, MEPHISIS MEPHISIS ELONGATA, MEPHISIS MEPHISIS VARIANS, Mephitis mephitis estor, Mephitis mephitis, Mephitis mephitis spissigrade, Mephitis mephitis elongata, and Mephitis mephitis occidentalis. The right panel shows a diagram with a green box at the top, a box labeled 'EnvLayerSet' with a property 'KEPL', and two boxes labeled 'Mephitis mephitis' with a yellow box containing '0101' and a black arrow pointing to a box labeled 'Exp' with a black arrow pointing to a box labeled 'ds'.

Different name = different taxonomic entity??
(=> keep data *separate*) **No.**

Same name = same taxonomic entity??
(=> *merge* data) **No.**

Are all returned records relevant to analyzing
Mephitis as presently recognized?? **No.**

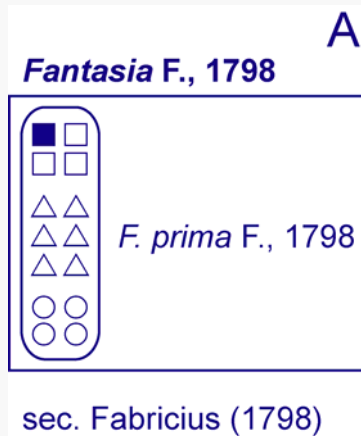
Are records not labeled as *Mephitis* necessarily
irrelevant to the analysis?? **No.**

Conventional solution:

- resolve erroneous spellings,
- resolve nestedness,
- resolve synonymy,
- merge and separate accordingly.

Not precise enough!

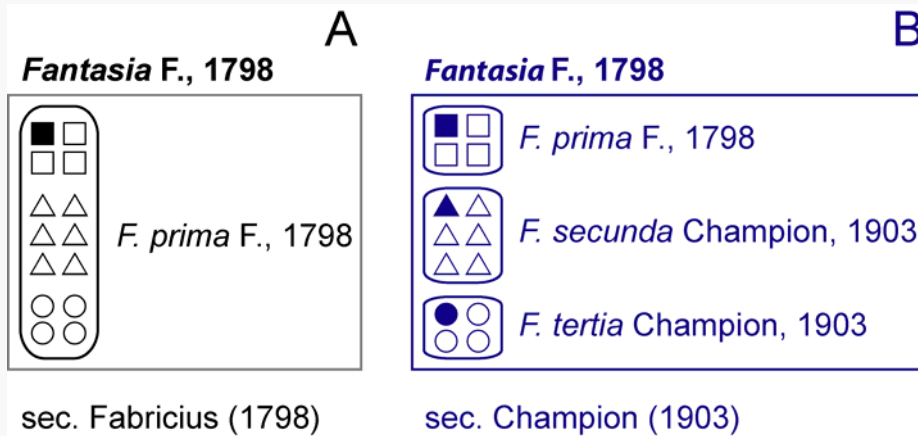
The relationship of Linnaean names and evolving taxonomic perspectives.*



1798: Fabricius describes *Fantasia* and *F. prima*, selecting ■ as the type.

* Adopted from Kennedy *et al.*, 2005

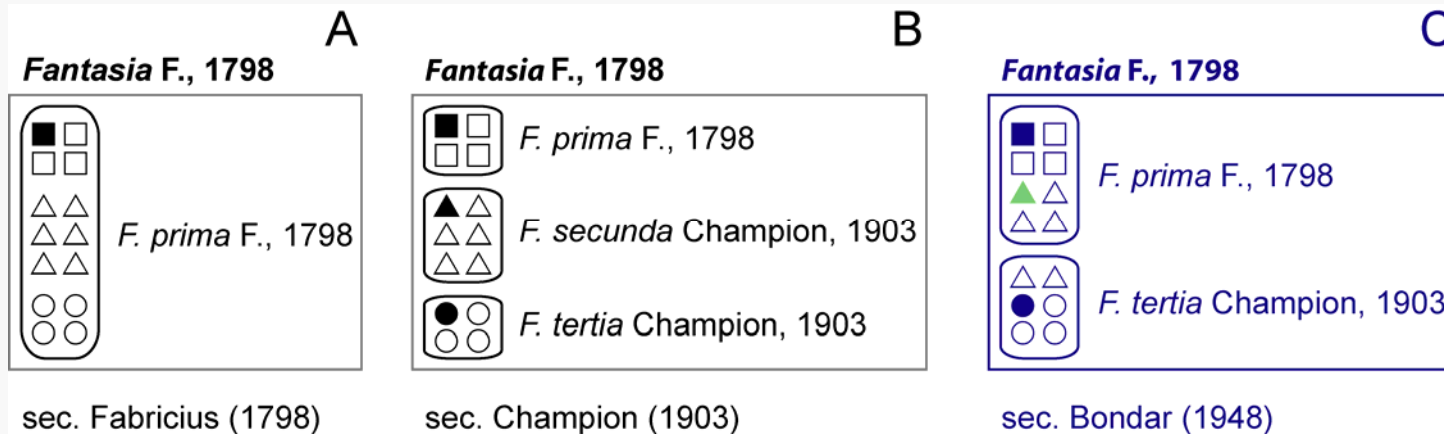
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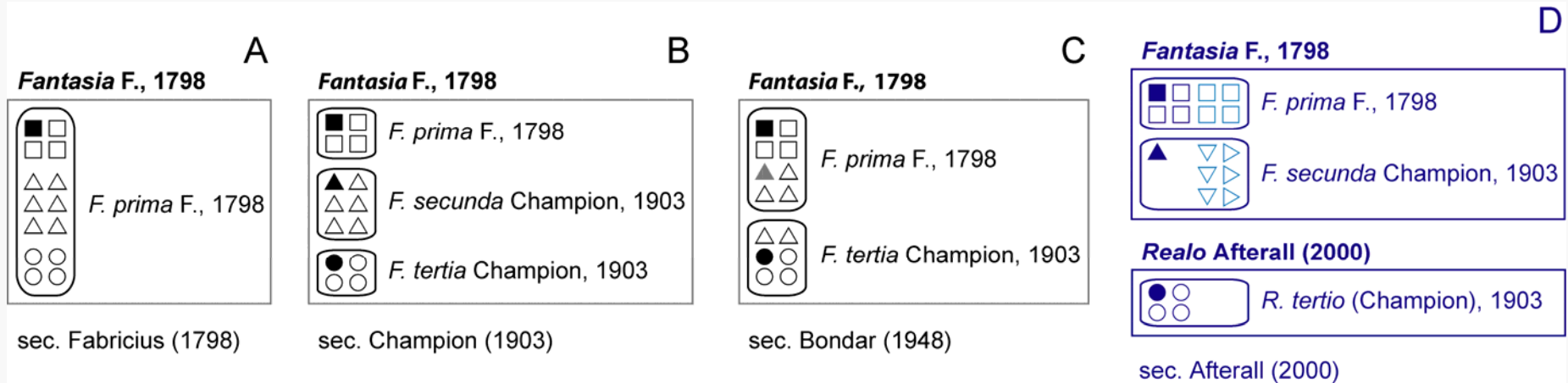


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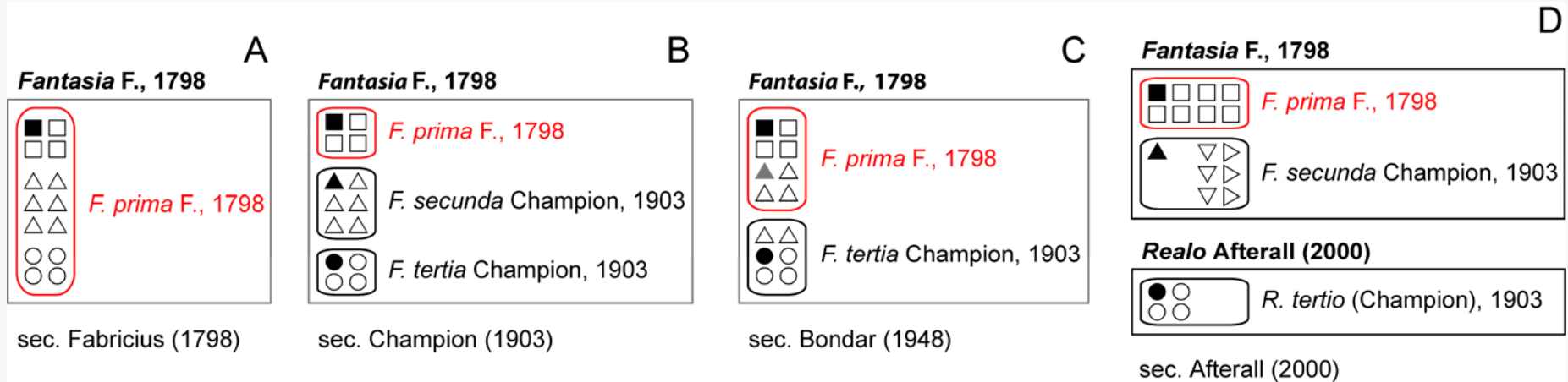
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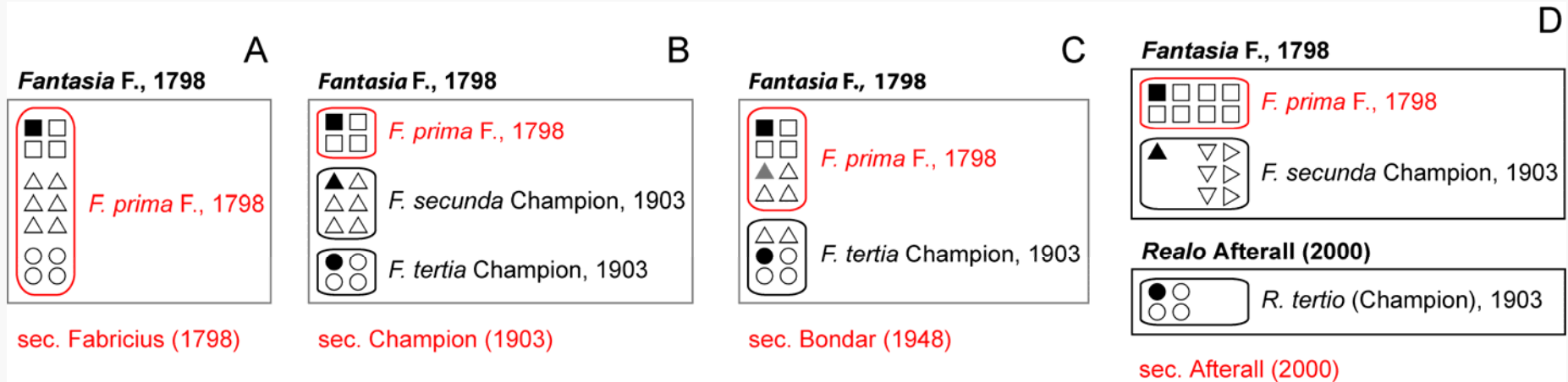
2000: Afterall’s revision adds new specimens (□▽▷) and resurrects *F. secunda*. A new genus name is proposed for *R. tertio*.

The relationship of Linnaean names and evolving taxonomic perspectives.



Names like “*Fantasia prima* F., 1798” may have evolving meanings. Synonymy only refers to types.

The relationship of Linnaean names and evolving taxonomic perspectives.



Reference to the author/publication of a name's (re)definition provides a handle to the evolving meanings.

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- Taxonomic concepts may be *linked* to each other via traditional synonymy relationships. In addition, their **similarities and differences may be analyzed more fully**, and then expressed **via so-called “concept relationships”**.

The five basic kinds of concept relationships.

$B == A$



congruent ($==$)

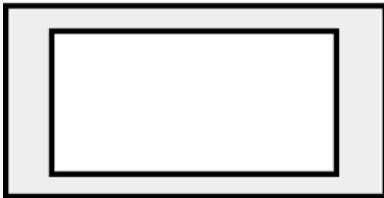
The five basic kinds of concept relationships.

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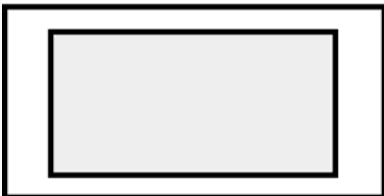
congruent ($==$)

$B > A$



includes ($>$)

$B < A$



is included in ($<$)

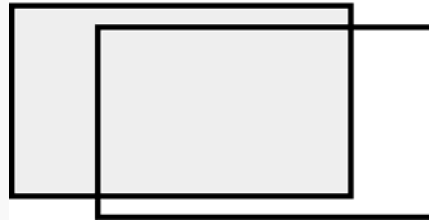
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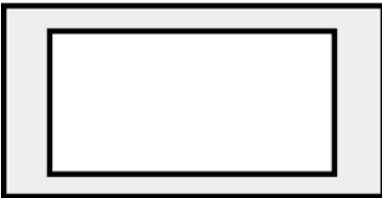
congruent ($==$)

$B >< A$



overlaps ($><$)

$B > A$



includes ($>$)

$B | A$



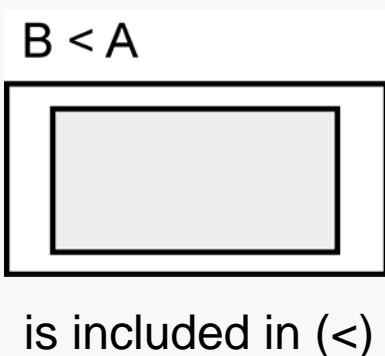
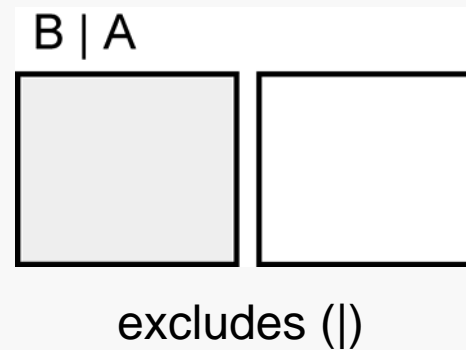
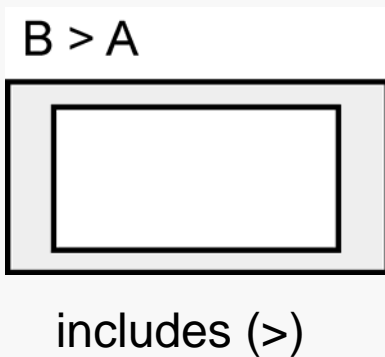
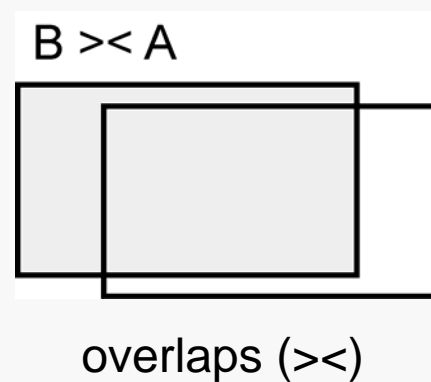
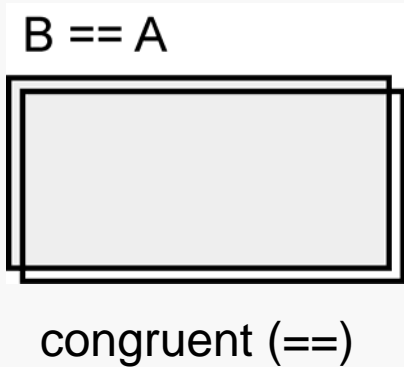
excludes ($|$)

$B < A$



is included in ($<$)

The five basic kinds of concept relationships.



Additional terms:

is parent/child of

and, or

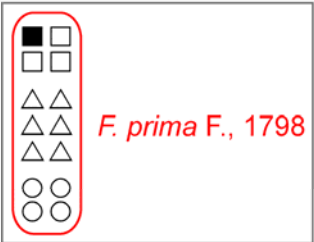
plus, minus

overall, intensional, ostensive

Examples of concept relationships.

A

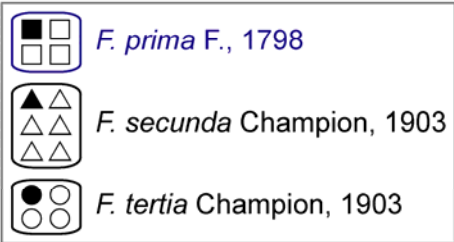
Fantasia F., 1798



sec. Fabricius (1798)

B

Fantasia F., 1798



sec. Champion (1903)

C

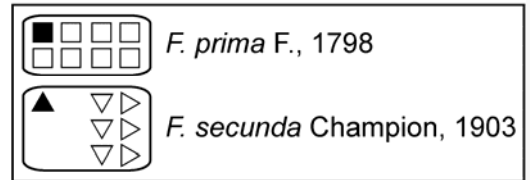
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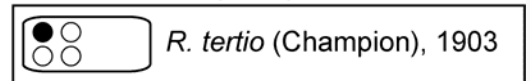
sec. Bondar (1948)

D

Fantasia F., 1798



Realo Afterall (2000)

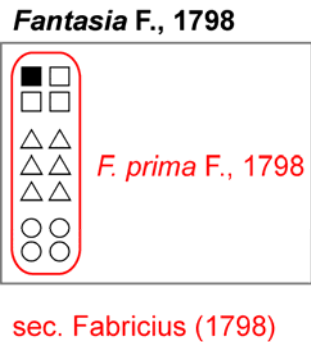


sec. Afterall (2000)

F. prima sec. Fabricius (1798) > *F. prima* sec. Champion (1903)

Examples of concept relationships.

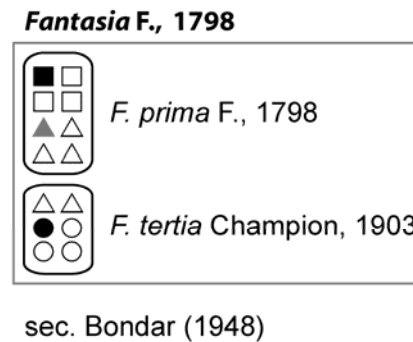
A



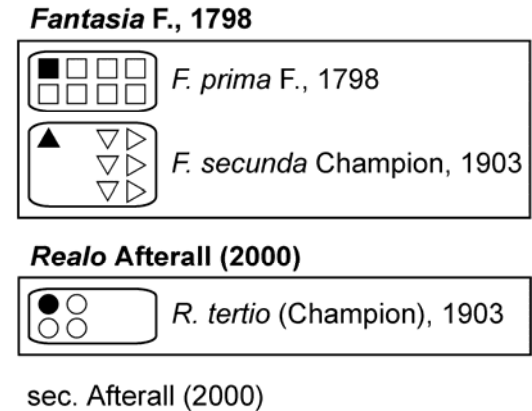
B



C



D



F. prima sec. Fabricius (1798) > *F. prima* sec. Champion (1903)

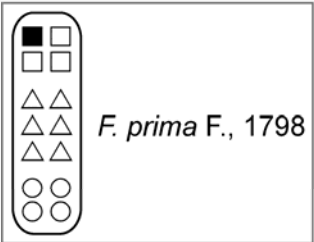
F. prima sec. Fabricius (1798) ==

- + *F. prima* sec. Champion (1903)
- + *F. secunda* sec. Champion (1903)
- + *F. tertia* sec. Champion (1903)

Examples of concept relationships.

A

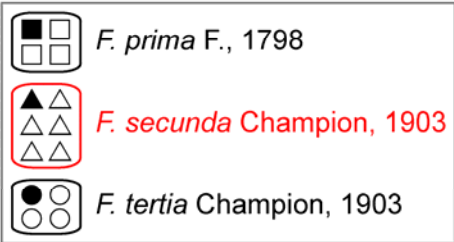
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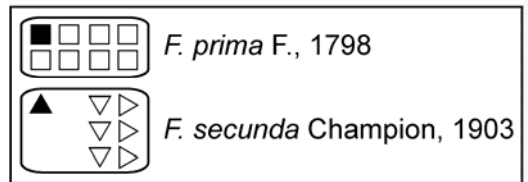
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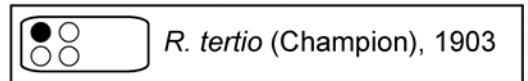
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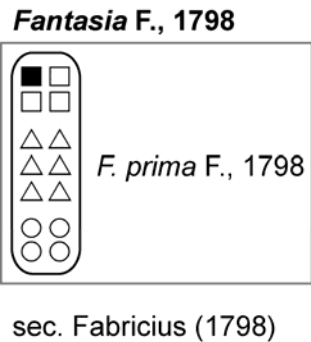


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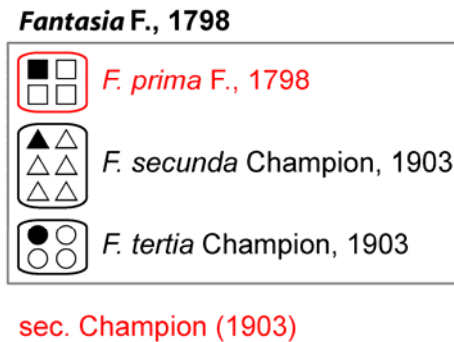
F. secunda sec. Champion (1903) >< *F. tertia* sec. Bondar (1948)

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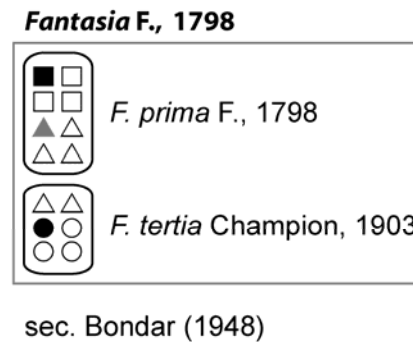
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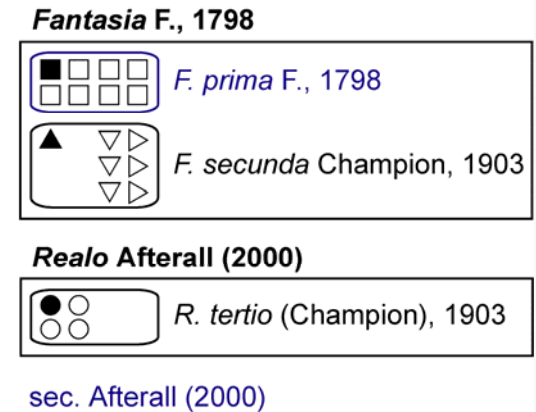
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C



D



F. prima sec. Champion (1903) == (int) *F. prima* sec. Afterall (2000)
and

F. prima sec. Champion (1903) < (ost) *F. prima* sec. Afterall (2000)

Vision for long-term taxonomic resolution using the concept approach.

- Based not just on type-driven synonymy, but on a more powerful vocabulary of concept relationships.

Vision for long-term taxonomic resolution using the concept approach.

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1. Ecological observations are *identified to concepts* instead of just names.

- *Mephitis mephitis* Schreber => *Mephitis mephitis* Schreber [sec. Wilson & Reeder \(1993\)](#)

2. “Third-party” concept relationships are established by taxonomic experts via new tools.

- *M. mephitis* [sec. Wilson & Reeder \(1993\)](#) > *M. major* [sec. Howell \(1901\)](#)

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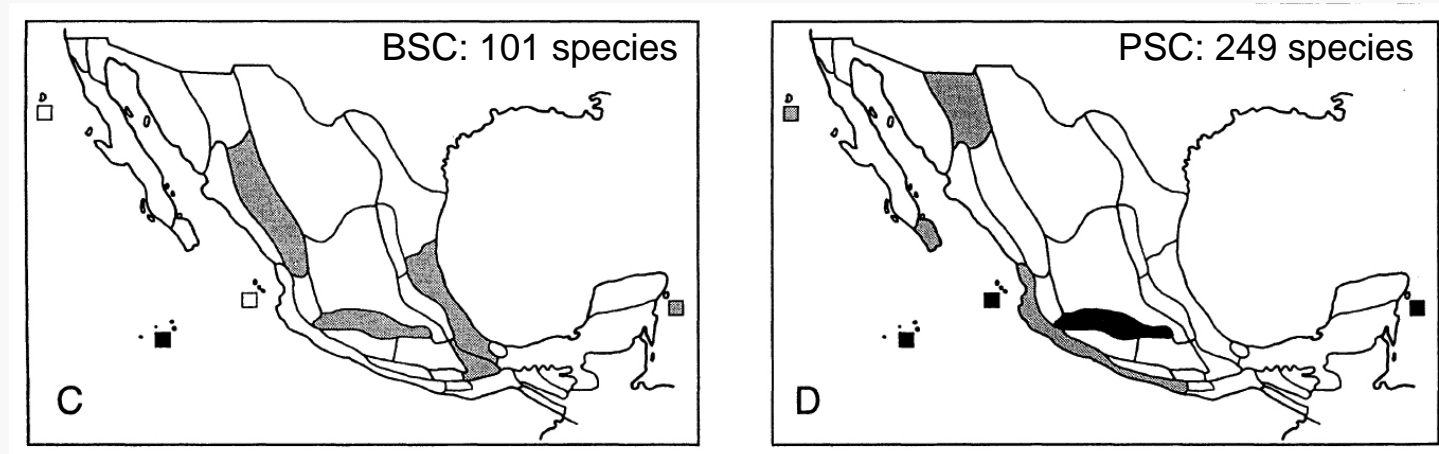
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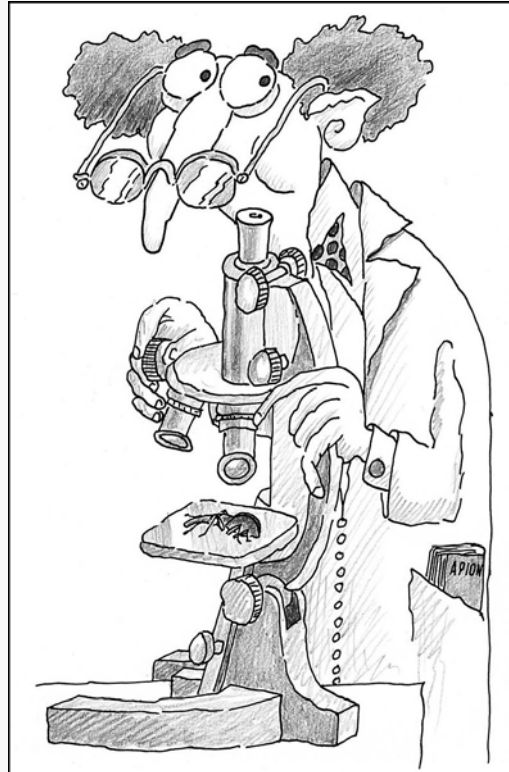
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Peterson & Navarro-Sigüenza, 1999 -- taxonomy affects conservation priorities.

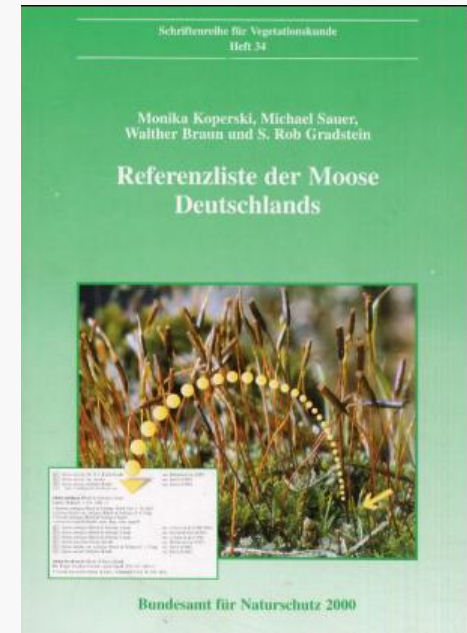
Taxonomic concepts – are they useful for all involved?



Drawing by Carlo Giusto, 2003

Example: concept checklist of German mosses.

- Authors: Koperski *et al.*, 2000
- 8,544 names treated;
- 12 reference classifications considered (years: 1927-2000);
- 24,390 taxonomic concepts analyzed;
- 1,548 concepts currently accepted (genus, species, variety);
- 7,891 concept relationships proposed.



Example: concept checklist of German mosses.

Dicranum flexicaule Brid. sec. Koperski *et al.*, 2000
Bryol. Univ. 1: 421. 1826 <1>

≡ *Dicranum congestum* var. *flexicaule* (Brid.) Bruch & Schimp.

≡ *Dicranum fuscescens* var. *flexicaule* (Brid.) Wilson

≡ *Dicranum flexicaule* Brid.

sec. CORLEY & al. (1981/1991)

≡ *Dicranum flexicaule* Brid.

sec. LUDWIG & al. (1996)

< *Dicranum fuscescens* Turner

sec. FRAHM & FREY (1992)

Der Beschreibung nach wird *D. flexicaule* nicht eindeutig von *D. fuscescens* abgetrennt.

< *Dicranum fuscescens* Turner

sec. MÖNKEMEYER (1927)

< *Dicranum fuscescens* Sm.

sec. SMITH (1980)

< *Dicranum fuscescens* var. *fuscescens*

sec. SMITH (1980)

Vgl. Anmerkung bei *D. fuscescens*.

> *Dicranum fuscescens* var. *congestum* (Brid.) Husn.

sec. FRAHM & FREY (1992)

> *Dicranum fuscescens* fo. *flexicaulis* (Brid.) Mönk.

sec. MÖNKEMEYER (1927)

Autor ergänzt

> *Dicranum fuscescens* var. *congestum* (Brid.) Husn.

sec. MÖNKEMEYER (1927)

Aufgrund der morphologischen Beschreibung („Blätter [...] unterseits glatt. Kapsel undeutlich oder nicht gestreift.“) ist das Taxonym zu *D. flexicaule* zu stellen.

§ *Dicranum fuscescens* var. *fuscescens*

sec. FRAHM & FREY (1992)

Autonym ergänzt

Die Beschreibung der Typussippe umfasst auch Merkmale von *D. flexicaule*.

Example: concept checklist of German mosses.

Dicranum flexicaule Brid. Bryol. Univ. 1: 421. 1826 <1>	sec. Koperski <i>et al.</i> , 2000	
≡ <i>Dicranum congestum</i> var. <i>flexicaule</i> (Brid.) Bruch & Schimp. ≡ <i>Dicranum fuscescens</i> var. <i>flexicaule</i> (Brid.) Wilson	Nomenclatural synonymy	
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Evolving concept taxonomy

Example: concept checklist of German mosses.

- 6,966 rejected names are assigned to 1,548 accepted concepts.

Name then... → ...name now.

Dicranum congestum Brid. → *Dicranum fuscescens* Sm.

Dicranum congestum var. *flexicaule* (Brid.) Bruch & Schimp. → *Dicranum flexicaule* Brid.

Dicranum crispum Hedw. → *Dicranella crispa* (Hedw.) Schimp.

Dicranum denudatum Brid. → *Dicranodontium denudatum* (Brid.) E. Britton

Dicranum enerve Thed. → *Paraleucobryum enerve* (Thed.) Loeske

Dicranum falcatum Hedw. → *Kiaeria falcata* (Hedw.) I. Hagen

Dicranum flexuosum Hedw. → *Campylopus flexuosus* (Hedw.) Brid.

(1) *Dicranum fragile* Brid. → *Campylopus fragilis* (Brid.) Bruch & Schimp.

Dicranum fuscescens var. *flexicaule* (Brid.) Wilson → *Dicranum flexicaule* Brid.

(1) *Dicranum glaucum* Hedw. → *Leucobryum glaucum* (Hedw.) Ångstr.

Dicranum gracile Mitt. → *Campylopus gracilis* (Mitt.) A. Jaeger

Dicranum gracilescens F. Weber & D. Mohr → *Cynodontium gracilescens* (F. Weber & D. Mohr) Schimp.

Dicranum heteromallum Hedw. → *Dicranella heteromalla* (Hedw.) Schimp.

Dicranum introflexum Hedw. → *Campylopus introflexus* (Hedw.) Brid.

Dicranum juniperoideum Brid. → *Leucobryum juniperoideum* (Brid.) Müll. Hal.

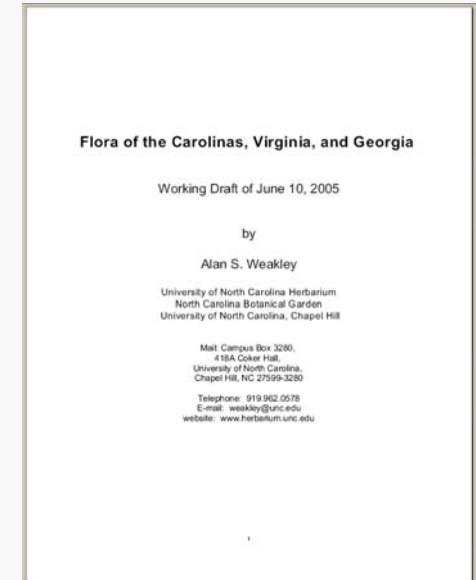
Dicranum latifolium Hedw. → *Desmatodon latifolius* (Hedw.) Brid.

Dicranum longifolium Ehrh. ex Hedw. → *Paraleucobryum longifolium* (Hedw.) Loeske

Dicranum longifolium var. *sauteri* (Bruch & Schimp.) Velen. → *Paraleucobryum sauteri* (Bruch & Schimp.)
Loeske

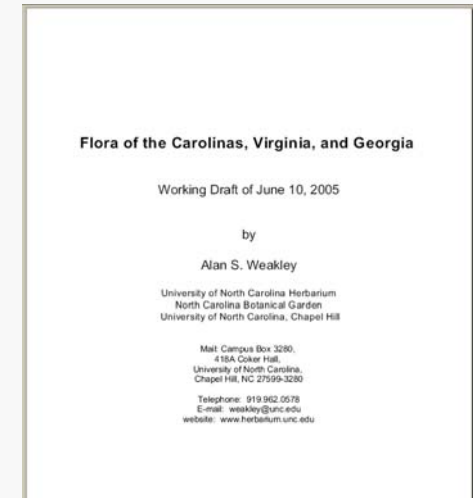
Example: Flora of the Carolinas, Virginia, and Georgia.

- Author: Alan Weakley (on-line at <http://www.herbarium.unc.edu>)
- ca. 6,300 valid concepts recognized;
- 8-10 reference classifications considered (years: 1933-2005);
- more than 40,000 concept relationships proposed.



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Aureolaria flava (Linnaeus) Farwell var. ***flava***, Eastern Smooth Oak-leach. Pd, Mt, Cp (GA, NC, SC, VA): oak forests and woodlands; common. August-September; September-October. ME west to MN, south to GA, FL, and AL. Var. ***reticulata*** (Rafinesque) Pennell, of the southeastern Coastal Plain, needs additional study. It is alleged to differ in its lower leaves entire, dentate, or divided less than ½ way to the midrib (vs. deeply pinnatifid-divided). [= C, G, K; < *A. flava* -- RAB, W; > *Gerardia flava* Linnaeus var. *flava* -- F; > *Gerardia flava* var. *reticulata* (Rafinesque) Cory -- F; > *A. flava* ssp. *typica* -- P; >< *A. flava* ssp. *flava* -- S; > *A. flava* ssp. *reticulata* (Rafinesque) Pennell -- P, S]

Aureolaria flava (Linnaeus) Farwell var. ***macrantha*** Pennell, Midwestern Smooth Oak-leach. Mt (NC): oak forests and woodlands; rare. S. Ontario and MO south to e. WV, e. TN, w. NC (Fernald 1950), n. AL, and e. LA. August-September; September-October. [= C, G, K; < *A. flava* -- RAB, W; = *Gerardia flava* Linnaeus var. *macrantha* (Pennell) Fernald -- F; *A. flava* ssp. *macrantha* Pennell -- P; >< *A. flava* ssp. *flava* -- S, in part]

Aureolaria laevigata (Rafinesque) Rafinesque, Appalachian Oak-leach. Mt, Pd (GA, NC, SC, VA), Cp (NC, SC, VA): oak forests and woodlands; common (uncommon in Piedmont, rare in Coastal Plain). August-September; September-October. PA west to s. OH, south to SC and GA, primarily a Central and Southern Appalachian endemic, but extending into adjacent provinces, and, rarely, even the Coastal Plain. [= RAB, C, G, K, P, S, W; = *Gerardia laevigata* Rafinesque -- F]

*What can concepts teach us about names? – German mosses, 1927-2000.**

N = 1,548 accepted concepts

Kind of relationship	# of concepts	% of concepts
==	1,509	97.5
>	267	17.2
<	515	33.3
><	90	5.8
	11	0.7

* Data from Geoffroy & Berendsohn, 2003

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Concept stability	# of concepts	% of concepts
Homotypic syn./==	550	35.5
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Unstable (>,<,><,)	688	44.5

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Kinds of instability	# of concepts	% of concepts
1 (= min.)	530	34.2
2	122	7.8
3	35	2.3
4 (= max.)	1	0.0

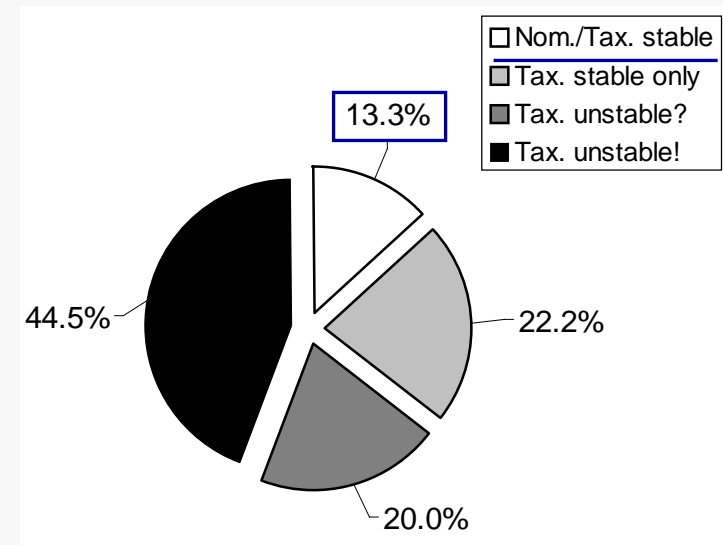
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*What can concepts teach us about names? – Carolina plants, 1933-2005.**

- Concept stability: Weakley (2005) compared with eight preceding classifications.

Weakley (2005) with ... (%)	=	>	<	><		Nom./Tax. stable	(totals)
Kartesz (1999)	92.9	2.5	4.6	0.0	0.0	86.4%	(4064 / 4705)
Flora North America (1993)	93.9	0.5	5.6	0.0	0.0	87.5%	(1737 / 1985)
Gleason & Cronquist (1991)	87.3	2.5	10.1	0.1	0.0	75.9%	(2385 / 3144)
Godfrey & Wooten (1979)	82.4	1.1	16.4	0.0	0.0	72.8%	(975 / 1339)
Radford <i>et al.</i> (1968)	81.1	2.6	16.3	0.0	0.0	68.7%	(1884 / 2742)
Gleason (1952)	81.9	8.0	10.0	0.1	0.0	67.8%	(1866 / 2751)
Fernald (1950)	77.1	16.4	6.2	0.3	0.0	63.5%	(1951 / 3073)
Small (1933)	78.2	10.5	11.0	0.3	0.0	54.9%	(1571 / 2859)

* Data from Weakley, pers. comm.

What can concepts teach us about names? – Carolina plants, 1933-2005.

- Taxonomic concept evolution in *Andropogon* L., sec. Weakley (2005).

Weakley 2005	C. Campbell (1983, FNA 2003)	Godfrey & Wooten 1979	RAB 1968	Hitchcock & Chase 1950	Blomquist 1948	Small 1933	Hackel 1889	finest entity	
Andropogon capillipes var. capillipes	<i>A. virginicus</i> var. <i>glaucus</i> "drylands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>glaucus</i>	capillipes entity	capillipes + dealbatus entity
Andropogon capillipes var. dealbatus (in prep.)	<i>A. virginicus</i> var. <i>glaucus</i> "wetlands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>dealbatus</i>	dealbatus entity	virginicus entity
Andropogon virginicus var. virginicus	<i>A. virginicus</i> var. <i>virginicus</i> "old-field variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"old-field" entity	"glom 4" entity
Andropogon virginicus var. virginicus	<i>A. virginicus</i> var. <i>virginicus</i> "smooth variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"smooth" entity	"glom 2a" entity
Andropogon virginicus var. decipiens	<i>A. virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	decipiens entity	"glom 2b" entity
Andropogon glaucopsis	<i>A. glomeratus</i> var. <i>glaucopsis</i>	<i>A. glaucopsis</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>glaucopsis</i>	glaucopsis entity	"glom 3" entity
Andropogon glomeratus var. hirsutior	<i>A. glomeratus</i> var. <i>hirsutior</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>hirsutior</i>	?	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>hirsutior</i>	hirsutior entity	"latissimo" entity
Andropogon glomeratus var. glomeratus	<i>A. glomeratus</i> var. <i>glomeratus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>abbreviatus</i>	glomeratus entity	"old-field" + "smooth" entity
Andropogon tenuispatheus	<i>A. glomeratus</i> var. <i>pumilus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. virginicus</i> var. <i>tenuispatheus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>genuinus</i>	tenuispatheus entity	
5 species, 8 vars.	2 species, 7 vars (+ 2 informal "variants")	3 species, 4 vars.	1 species	3 species, 5 vars.	3 species, 5 vars.	3 species, 3 vars.	2 species, 7 vars.		

What can concepts teach us about names? – Carolina plants, 1933-2005.

- Taxonomic concept evolution in *Andropogon* L., sec. Weakley (2005).

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Andropogon capillipes var. dealbatus (in prep.)	<i>A. virginicus</i> var. <i>glaucus</i> "wetlands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>dealbatus</i>	dealbatus entity	virginicus entity
Andropogon virginicus var. virginicus	<i>A. virginicus</i> var. <i>virginicus</i> "old-field variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"old-field" entity	"glom 4" entity
Andropogon virginicus var. virginicus	<i>A. virginicus</i> var. <i>virginicus</i> "smooth variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"smooth" entity	"glom 2a" entity
Andropogon virginicus var. decipiens	<i>A. virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	decipiens entity	"glom 2b" entity
Andropogon glaucopsis	<i>A. glomeratus</i> var. <i>glaucopsis</i>	<i>A. glaucopsis</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>glaucopsis</i>	glaucopsis entity	"glom 3" entity
Andropogon glomeratus var. hirsutior	<i>A. glomeratus</i> var. <i>hirsutior</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>hirsutior</i>	?	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>hirsutior</i>	hirsutior entity	"latissimo" entity
Andropogon glomeratus var. glomeratus	<i>A. glomeratus</i> var. <i>glomeratus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>abbreviatus</i>	glomeratus entity	"old-field" + "smooth" entity
Andropogon tenuispatheus	<i>A. glomeratus</i> var. <i>pumilus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. virginicus</i> var. <i>tenuispatheus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>genuinus</i>	tenuispatheus entity	
5 species, 8 vars.	2 species, 7 vars (+ 2 informal "variants")	3 species, 4 vars.	1 species	3 species, 5 vars.	3 species, 5 vars.	3 species, 3 vars.	2 species, 7 vars.		

17 granular concepts
(sec. Weakley, 2005)

What can concepts teach us about names? – Carolina plants, 1933-2005.

- Taxonomic concept evolution in *Andropogon* L., sec. Weakley (2005).

Weakley 2005	C. Campbell (1983, FNA 2003)	Godfrey & Wooten 1979	RAB 1968	Hitchcock & Chase 1950	Blomquist 1948	Small 1933	Hackel 1889	finest entity	
<i>Andropogon capillipes</i> var. <i>capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> "drylands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>glaucus</i>	capillipes entity	capillipes + dealbatus entity
<i>Andropogon capillipes</i> var. <i>dealbatus</i> (in prep.)	<i>A. virginicus</i> var. <i>glaucus</i> "wetlands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>dealbatus</i>	dealbatus entity	virginicus entity
<i>Andropogon virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i> "old-field variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"old-field" entity	"glom 4" entity
<i>Andropogon virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i> "smooth variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	"smooth" entity	"glom 2a" entity
<i>Andropogon virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>	decipiens entity	"glom 2b" entity
<i>Andropogon glaucopsis</i>	<i>A. glomeratus</i> var. <i>glaucopsis</i>	<i>A. glaucopsis</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>glaucopsis</i>	glaucopsis entity	"glom 3" entity
<i>Andropogon glomeratus</i> var. <i>hirsutior</i>	<i>A. glomeratus</i> var. <i>hirsutior</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>hirsutior</i>	?	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>hirsutior</i>	hirsutior entity	"latissimo" entity
<i>Andropogon glomeratus</i> var. <i>glomeratus</i>	<i>A. glomeratus</i> var. <i>glomeratus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>abbreviatus</i>	glomeratus entity	"old-field" + "smooth" entity
<i>Andropogon tenuispatheus</i>	<i>A. glomeratus</i> var. <i>pumilus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. virginicus</i> var. <i>tenuispatheus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>genuinus</i>	tenuispatheus entity	
5 species, 8 vars.	2 species, 7 vars (+ 2 informal "variants")	3 species, 4 vars.	1 species	3 species, 5 vars.	3 species, 5 vars.	3 species, 3 vars.	2 species, 7 vars.		

A. glomeratus sec. Weakley, 2005

17 granular concepts (sec. Weakley, 2005)

What can concepts teach us about names? – Carolina plants, 1933-2005.

- Taxonomic concept evolution in *Andropogon virginicus* L., sec. Weakley (2005).

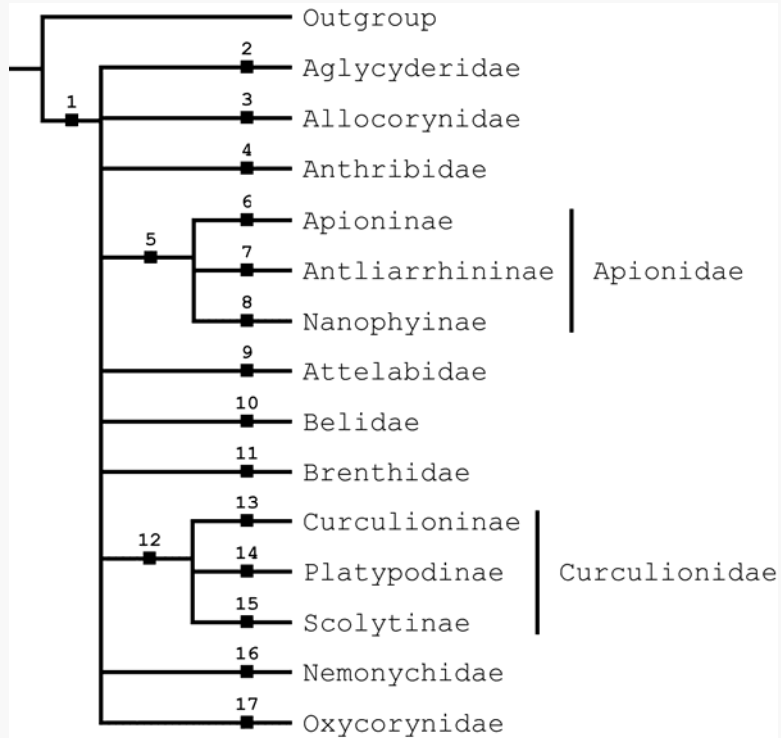
Weakley 2005	C. Campbell (1983, FNA 2003)	Godfrey & Wooten 1979	RAB 1968	Hitchcock & Chase 1950	Blomquist 1948	Small 1933	Hackel 1889
<i>Andropogon capillipes</i> var. <i>capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> "drylands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>glaucus</i>
<i>Andropogon capillipes</i> var. <i>dealbatus</i> (in prep.)	<i>A. virginicus</i> var. <i>glaucus</i> "wetlands variant"	<i>A. capillipes</i>	<i>A. virginicus</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. capillipes</i>	<i>A. virginicus</i> var. <i>glaucus</i> subvar. <i>dealbatus</i>
<i>Andropogon virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i> "old-field variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>
<i>Andropogon virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i> "smooth variant"	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>
<i>Andropogon virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>decipiens</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i> var. <i>virginicus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>viridis</i> subvar. <i>genuinus</i>
<i>Andropogon glaucopsis</i>	<i>A. glomeratus</i> var. <i>glaucopsis</i>	<i>A. glaucopsis</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. virginicus</i> var. <i>glaucopsis</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>glaucopsis</i>
<i>Andropogon glomeratus</i> var. <i>hirsutior</i>	<i>A. glomeratus</i> var. <i>hirsutior</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. virginicus</i> var. <i>hirsutior</i>	?	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>hirsutior</i>
<i>Andropogon glomeratus</i> var. <i>glomeratus</i>	<i>A. glomeratus</i> var. <i>glomeratus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>abbreviatus</i>
<i>Andropogon tenuispatheus</i>	<i>A. glomeratus</i> var. <i>pumilus</i>	<i>A. virginicus</i> var. <i>abbreviatus</i>	<i>A. virginicus</i>	<i>A. glomeratus</i>	<i>A. virginicus</i> var. <i>tenuispatheus</i>	<i>A. glomeratus</i>	<i>A. macrourus</i> var. <i>genuinus</i>
5 species, 8 vars.	2 species, 7 vars. (+ 2 informal "variants")	3 species, 4 vars.	1 species	3 species, 5 vars.	3 species, 5 vars.	3 species, 3 vars.	2 species, 7 vars.
<i>Andropogon glomeratus</i> species concept	<i>Andropogon virginicus</i> species concept	<i>Andropogon capillipes</i> species concept	<i>Andropogon glaucopsis</i> species concept	<i>Andropogon tenuispatheus</i> species concept			

A. glaucopsis
sec. Weakley, 2005

A. tenuispatheus
sec. Weakley, 2005

What can concepts teach us about names? – “higher weevils”, 1981-2000.

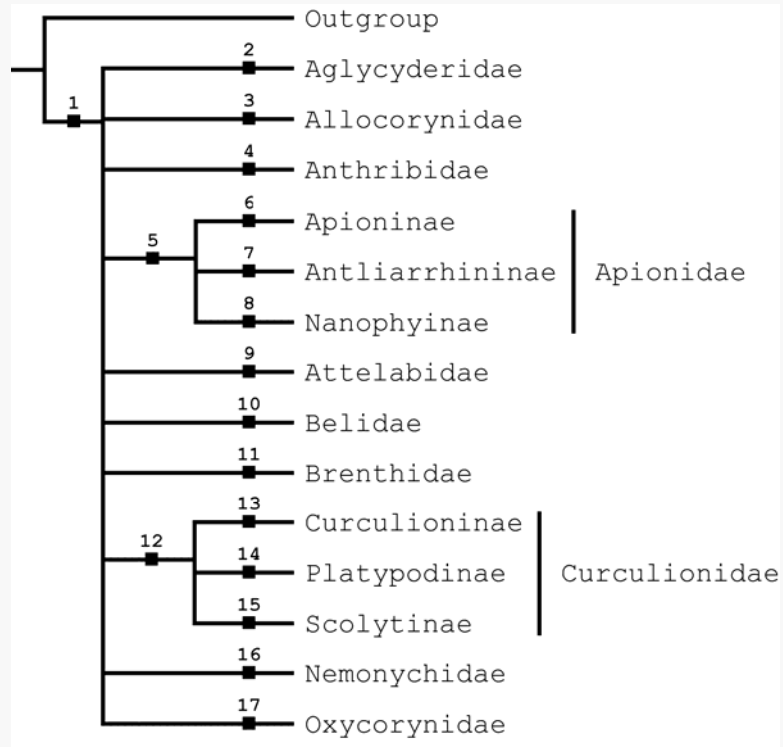
Curculionoidea [sec. Crowson \(1981\)](#)



No new names.

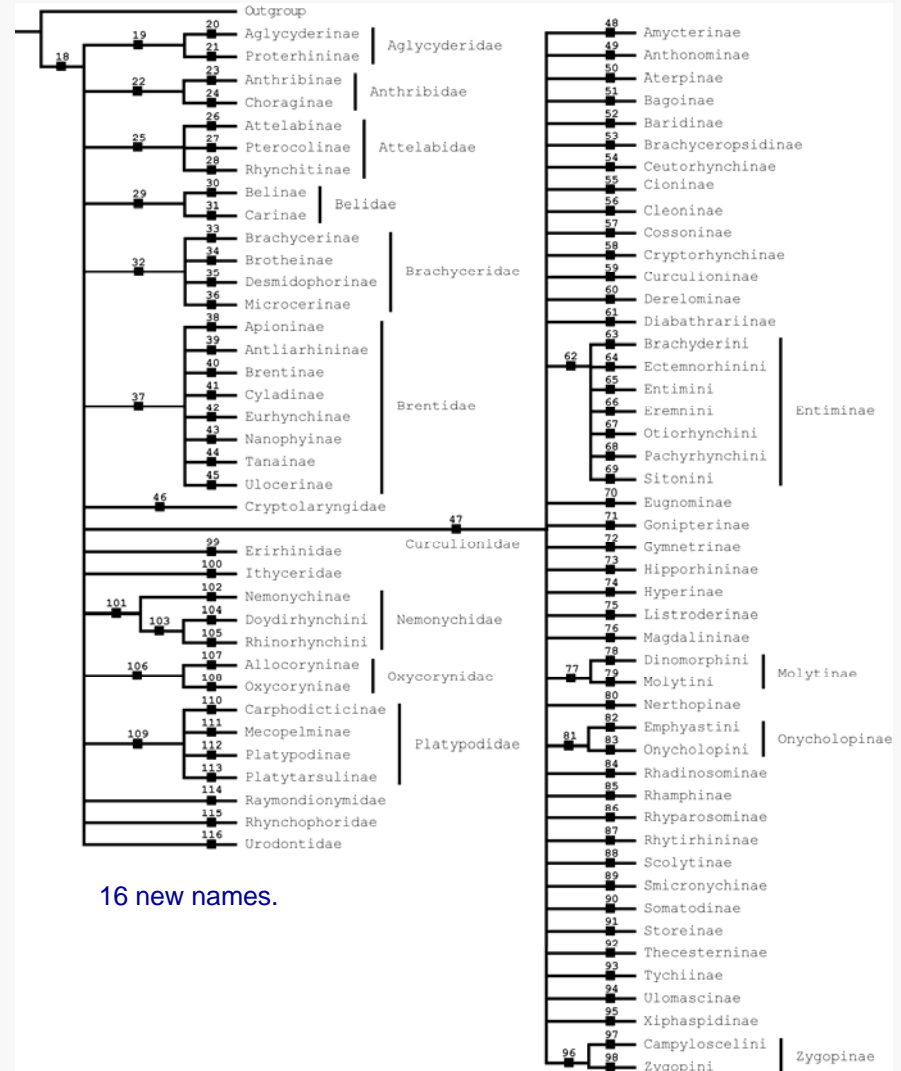
What can concepts teach us about names? – “higher weevils”, 1981-2000.

Curculionoidea **sec. Crowson (1981)**



No new names.

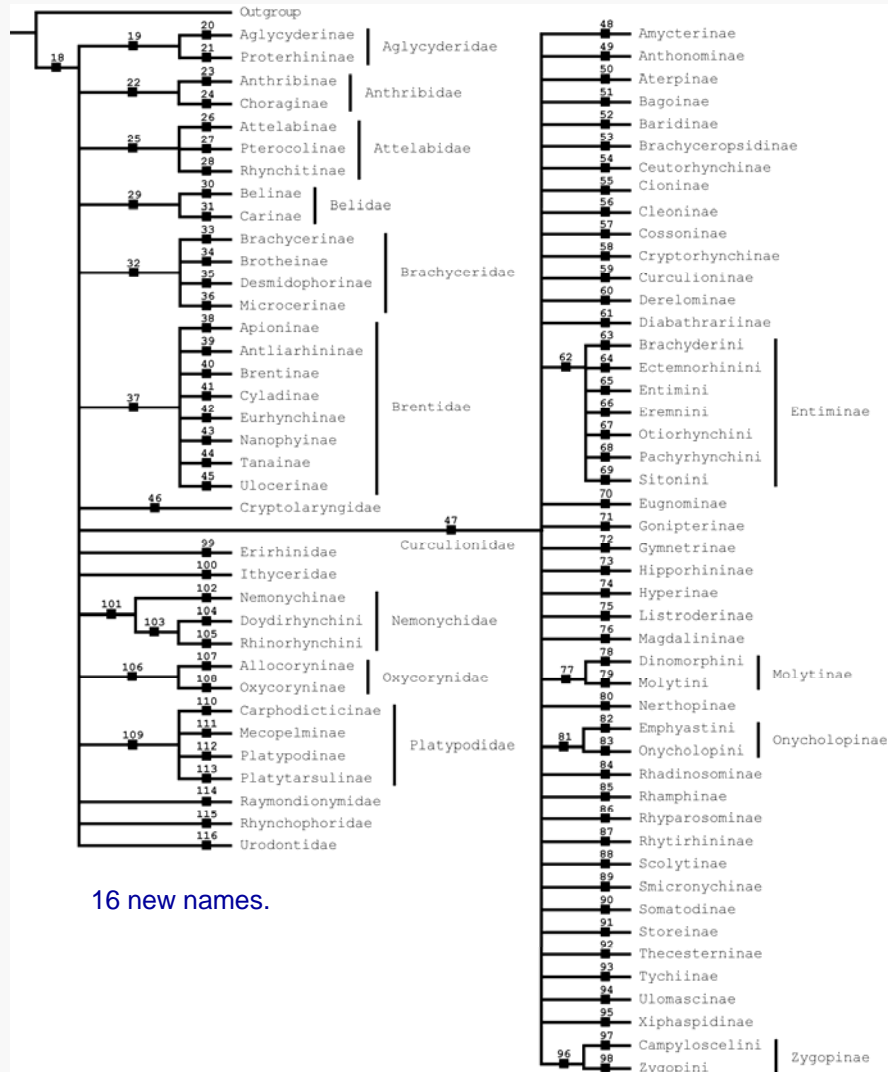
Curculionoidea **sec. Thompson (1992)**



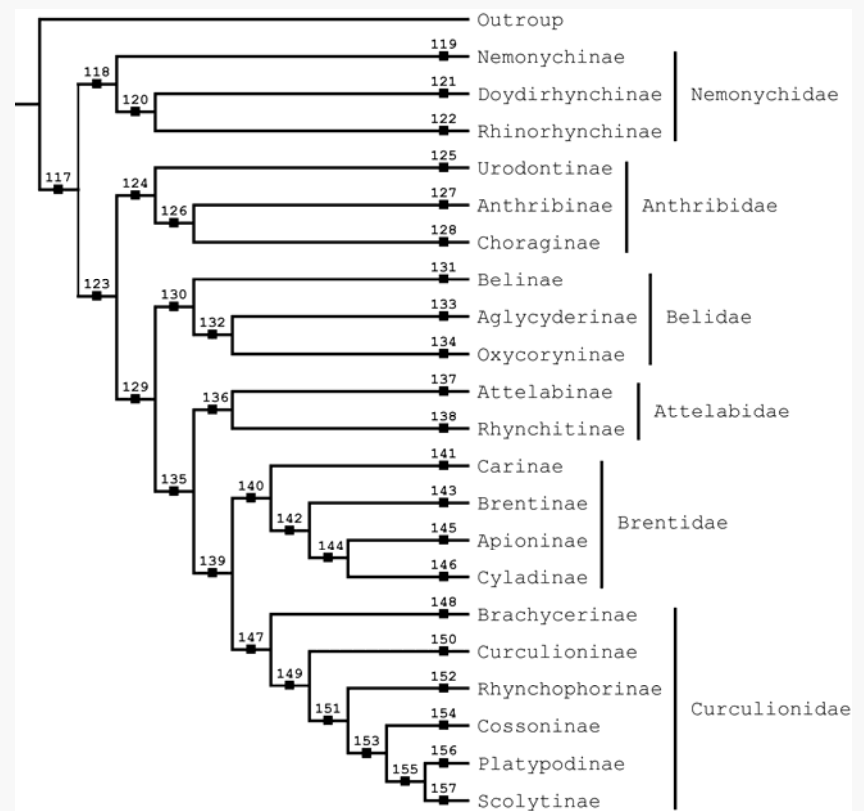
16 new names.

What can concepts teach us about names? – “higher weevils”, 1981-2000.

Curculionoidea [sec. Thompson \(1992\)](#)



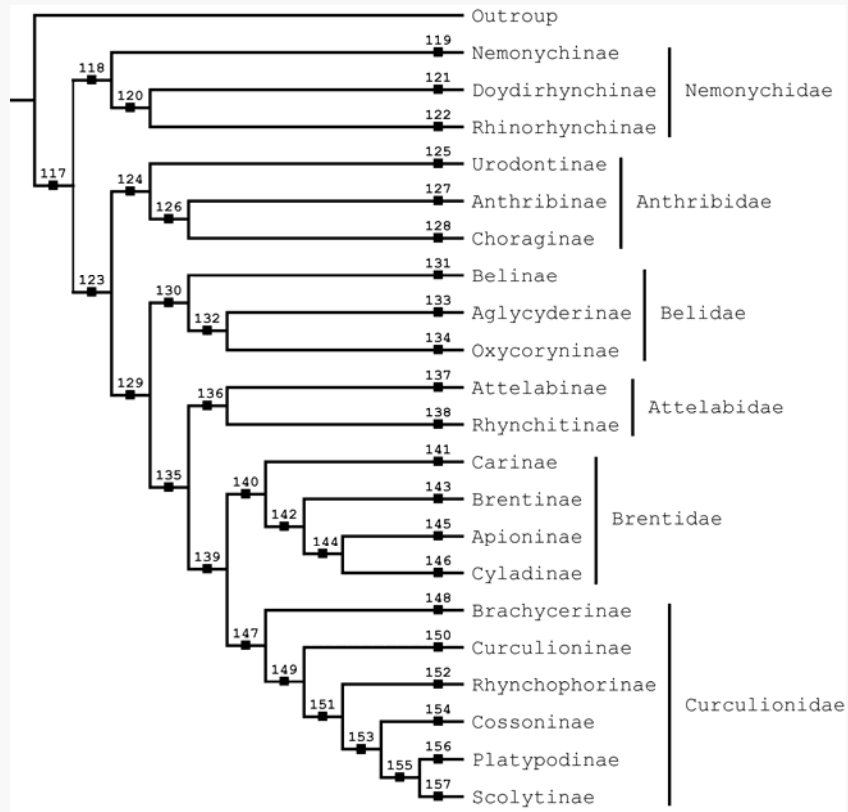
Curculionoidea [sec. Kuschel \(1995\)](#)



1 new name.

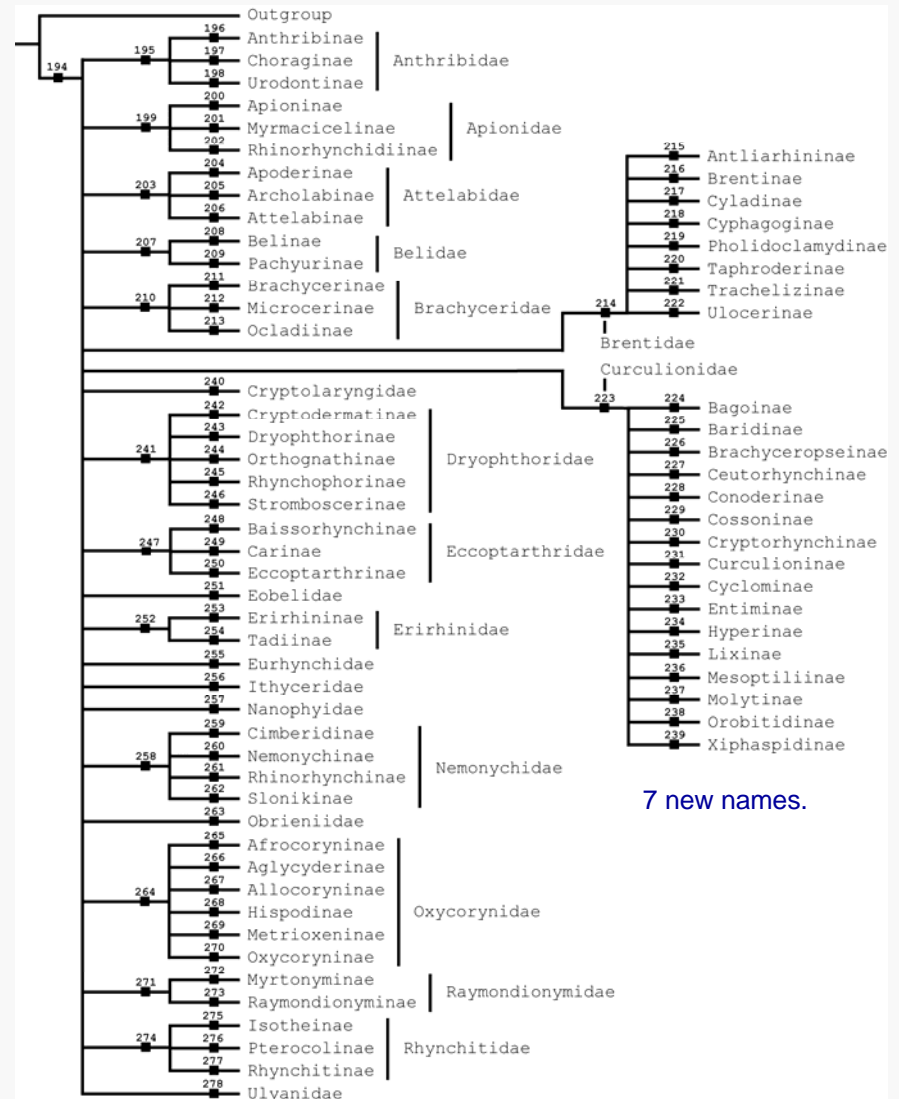
What can concepts teach us about names? – “higher weevils”, 1981-2000.

Curculionoidea sec. Kuschel (1995)



1 new name.

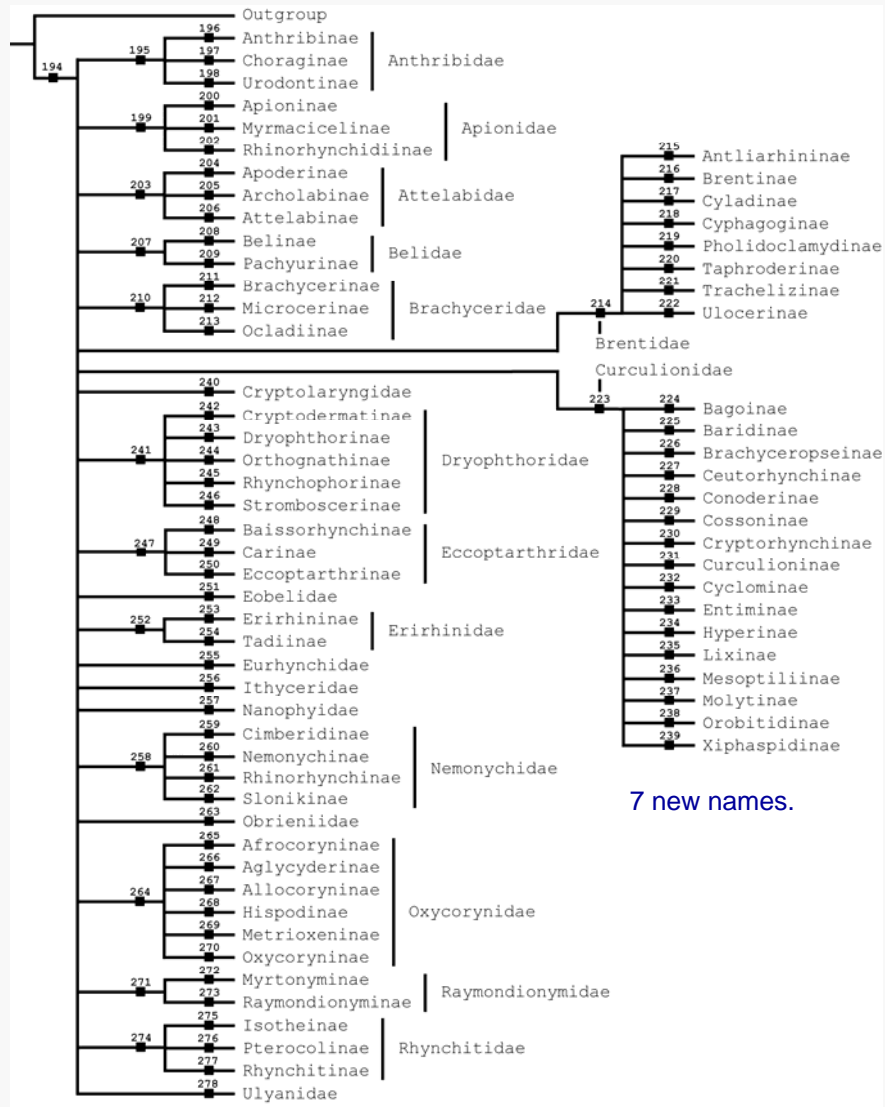
Curculionoidea sec. Alonso-Zarazaga & Lyal (1999)



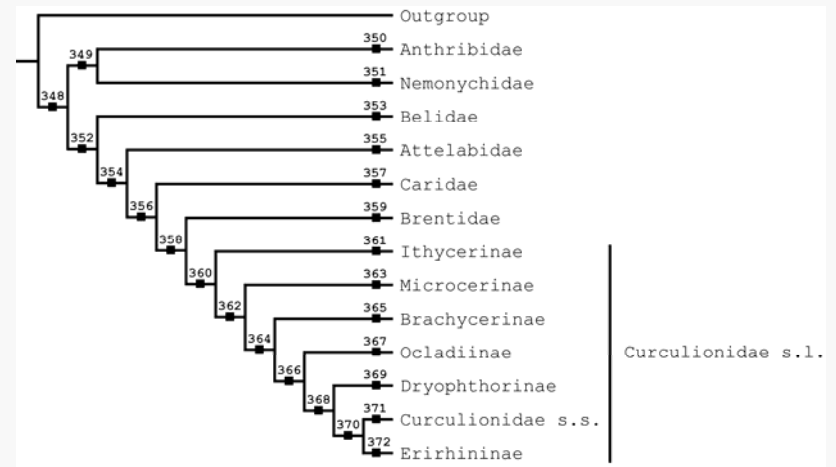
7 new names.

What can concepts teach us about names? – “higher weevils”, 1981-2000.

Curculionoidea sec. Alonso-Z. & Lyal (1999)



Curculionoidea sec. Marvaldi & Morrone (2000)



No new names.

7 new names.

What can concepts teach us about names? – “higher weevils”, 1981-2000.

- Concept stability: pairwise comparisons of concepts in five “higher weevil” classifications.

Concept comparison (%)	==	>	<	><		Nom./Tax. stable	(totals)
A-Z & L '99 with M & M '00	46.8	25.8	22.6	4.8	0.0	8.1%	(5 / 62)
Kusch. '95 with M & M '00	26.8	25.0	26.8	21.4	0.0	12.5%	(7 / 56)
Kusch. '95 with A-Z & L '99	34.7	12.2	40.8	4.1	8.2	13.3%	(13 / 98)
Thom. '92 with M & M '00	41.3	33.3	20.6	4.8	0.0	7.9%	(5 / 63)
Thom. '92 with A-Z & L '99	41.9	30.9	17.6	2.2	7.4	18.4%	(25 / 136)
Thom. '92 with Kusch. '95	30.4	55.6	8.1	5.9	0.0	7.4%	(10 / 135)
Crow. '81 with M & M '00	18.2	34.5	34.5	12.7	0.0	10.9%	(6 / 55)
Crow. '81 with A-Z & L '99	31.4	9.8	39.2	5.9	13.7	5.9%	(3 / 51)
Crow. '81 with Kusch. '95	37.1	25.8	22.6	14.5	0.0	11.3%	(7 / 62)
Crow. '81 with Thom. '92	53.3	13.3	30.0	3.3	0.0	50.0%	(15 / 30)

What can concepts teach us about names? – “higher weevils”, 1981-2000.

- Changing names / stable concepts.

Nomenclature <i>unstable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	24	61	12	3	11
Kusch. '95 with M & M '00	8	32	11	12	0
Kusch. '95 with A-Z & L '99	21	8	50	4	8
Thom. '92 with M & M '00	21	93	13	2	0
Thom. '92 with A-Z & L '99	32	49	26	3	10
Thom. '92 with Kusch. '95	31	72	11	7	0
Crow. '81 with M & M '00	4	22	18	6	0
Crow. '81 with A-Z & L '99	13	0	65	3	7
Crow. '81 with Kusch. '95	16	16	25	8	0
Crow. '81 with Thom. '92	24	106	19	0	0
Total	194	459	250	48	36

What can concepts teach us about names? – “higher weevils”, 1981-2000.

- Changing names / stable concepts.

Nomenclature <i>unstable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	24	61	12	3	11
Kusch. '95 with M & M '00	8	32	11	12	0
Kusch. '95 with A-Z & L '99	21	8	50	4	8
Thom. '92 with M & M '00	21	93	13	2	0
Thom. '92 with A-Z & L '99	32	49	26	3	10
Thom. '92 with Kusch. '95	31	72	11	7	0
Crow. '81 with M & M '00	4	22	18	6	0
Crow. '81 with A-Z & L '99	13	0	65	3	7
Crow. '81 with Kusch. '95	16	16	25	8	0
Crow. '81 with Thom. '92	24	106	19	0	0
Total	194	459	250	48	36

- Stable names / changing concepts.

Nomenclature <i>stable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	5	7	2	0	0
Kusch. '95 with M & M '00	7	0	4	0	0
Kusch. '95 with A-Z & L '99	13	4	10	0	0
Thom. '92 with M & M '00	5	4	0	1	0
Thom. '92 with A-Z & L '99	25	11	8	0	0
Thom. '92 with Kusch. '95	10	11	0	1	0
Crow. '81 with M & M '00	6	0	1	1	0
Crow. '81 with A-Z & L '99	3	3	6	0	0
Crow. '81 with Kusch. '95	7	0	1	1	0
Crow. '81 with Thom. '92	15	1	5	1	0
Total	96	41	37	5	0

What can concepts teach us about names? – “higher weevils”, 1981-2000.

- Changing names / **stable concepts**.

Nomenclature <i>unstable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	24	61	12	3	11
Kusch. '95 with M & M '00	8	32	11	12	0
Kusch. '95 with A-Z & L '99	21	8	50	4	8
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- **Stable names** / **changing concepts**.

Nomenclature <i>stable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	5	7	2	0	0
Kusch. '95 with M & M '00	7	0	4	0	0
Kusch. '95 with A-Z & L '99	13	4	10	0	0
Thom. '92 with M & M '00	5	4	0	1	0
Thom. '92 with A-Z & L '99	25	11	8	0	0
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Crow. '81 with Thom. '92	15	1	5	1	0
Total	96	41	37	5	0

What can concepts teach us about names? – “higher weevils”, 1981-2000.

- Changing names / stable concepts.

Nomenclature <i>unstable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	24	61	12	3	11
Kusch. '95 with M & M '00	8	32	11	12	0
Kusch. '95 with A-Z & L '99	21	8	50	4	8
Thom. '92 with M & M '00	21	93	13	2	0
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Crow. '81 with A-Z & L '99	13	0	65	3	7
Crow. '81 with Kusch. '95	16	16	25	8	0
Crow. '81 with Thom. '92	24	106	19	0	0
Total	194	459	250	48	36

- Stable names / changing concepts.

Nomenclature <i>stable</i>	==	>	<	><	
A-Z & L '99 with M & M '00	5	7	2	0	0
Kusch. '95 with M & M '00	7	0	4	0	0
Kusch. '95 with A-Z & L '99	13	4	10	0	0
Thom. '92 with M & M '00	5	4	0	1	0
Thom. '92 with A-Z & L '99	25	11	8	0	0
Thom. '92 with Kusch. '95	10	11	0	1	0
Crow. '81 with M & M '00	6	0	1	1	0
Crow. '81 with A-Z & L '99	3	3	6	0	0
Crow. '81 with Kusch. '95	7	0	1	1	0
Crow. '81 with Thom. '92	15	1	5	1	0
Total	96	41	37	5	0

“Linnaean nomenclature is stable enough to say what we know,

is it flexible enough to accommodate what we learn??; => Not really.

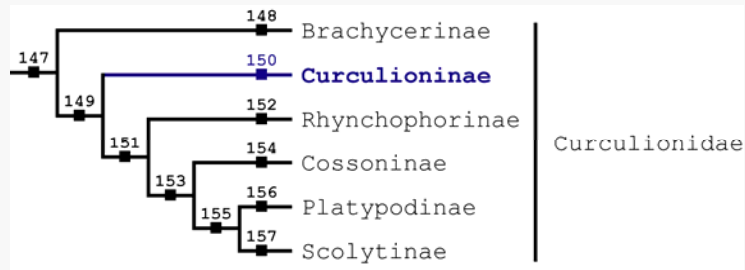
independent of specific theory, yet reflective of known empirical data;

compatible with phylogenetic theory, but not a slave to it;

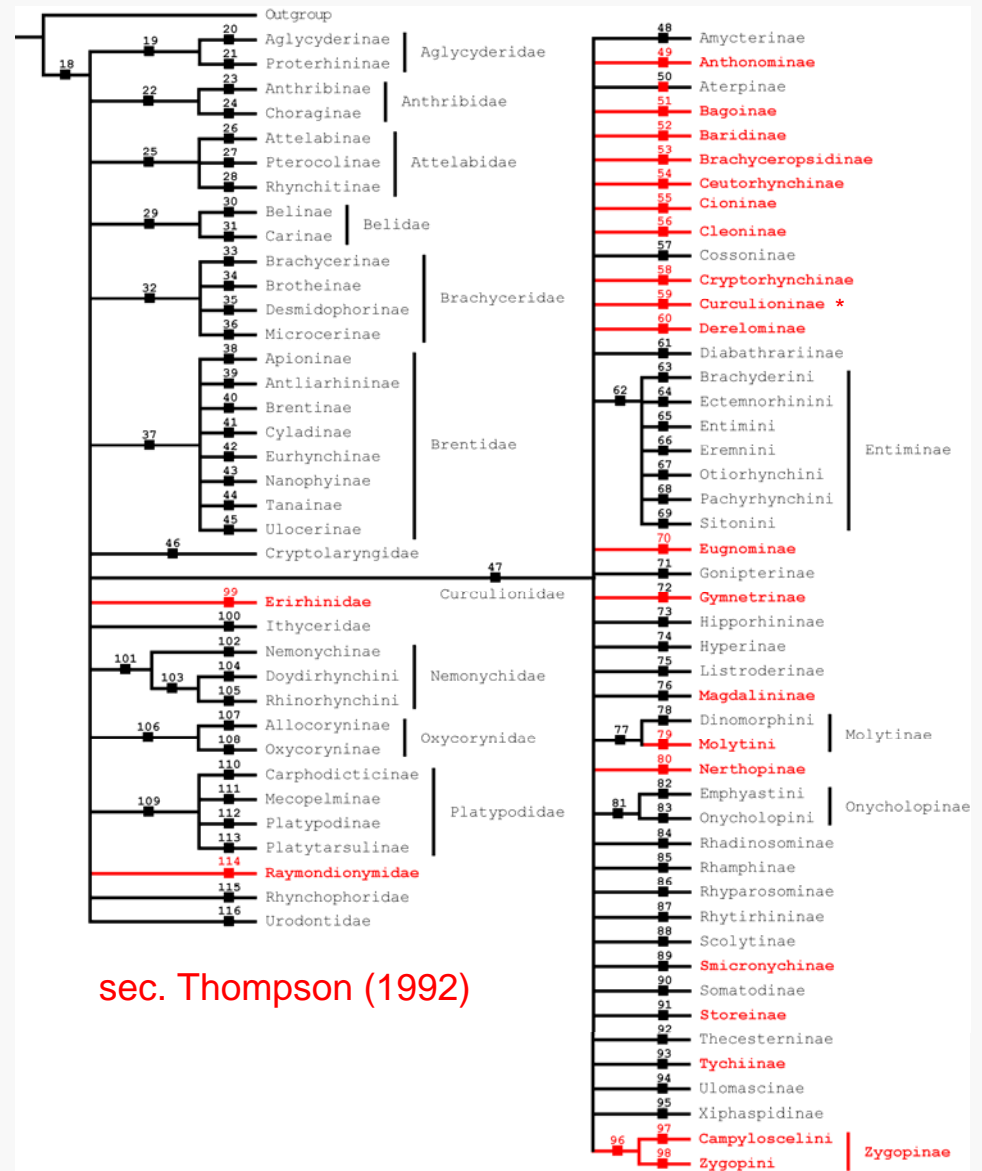
is it particular enough for precise communication??, => Not really.

general enough to reflect refuted hypotheses.

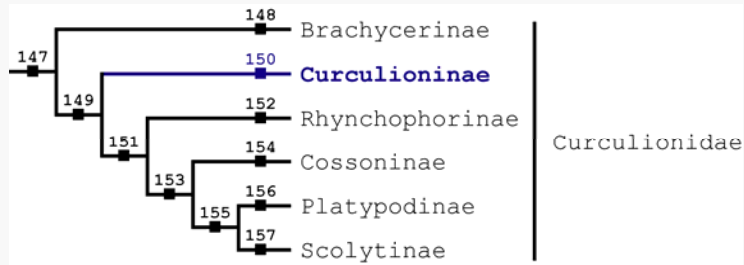
What can concepts teach us about names? – “higher weevils”, 1981-2000.



sec. Kuschel (1995)



What can concepts teach us about names? – “higher weevils”, 1981-2000.



sec. Kuschel (1995)

Concept relationship:

Curculioninae

sec. Kuschel (1995)



Anthonominae...

+ ... [7 subfam.]

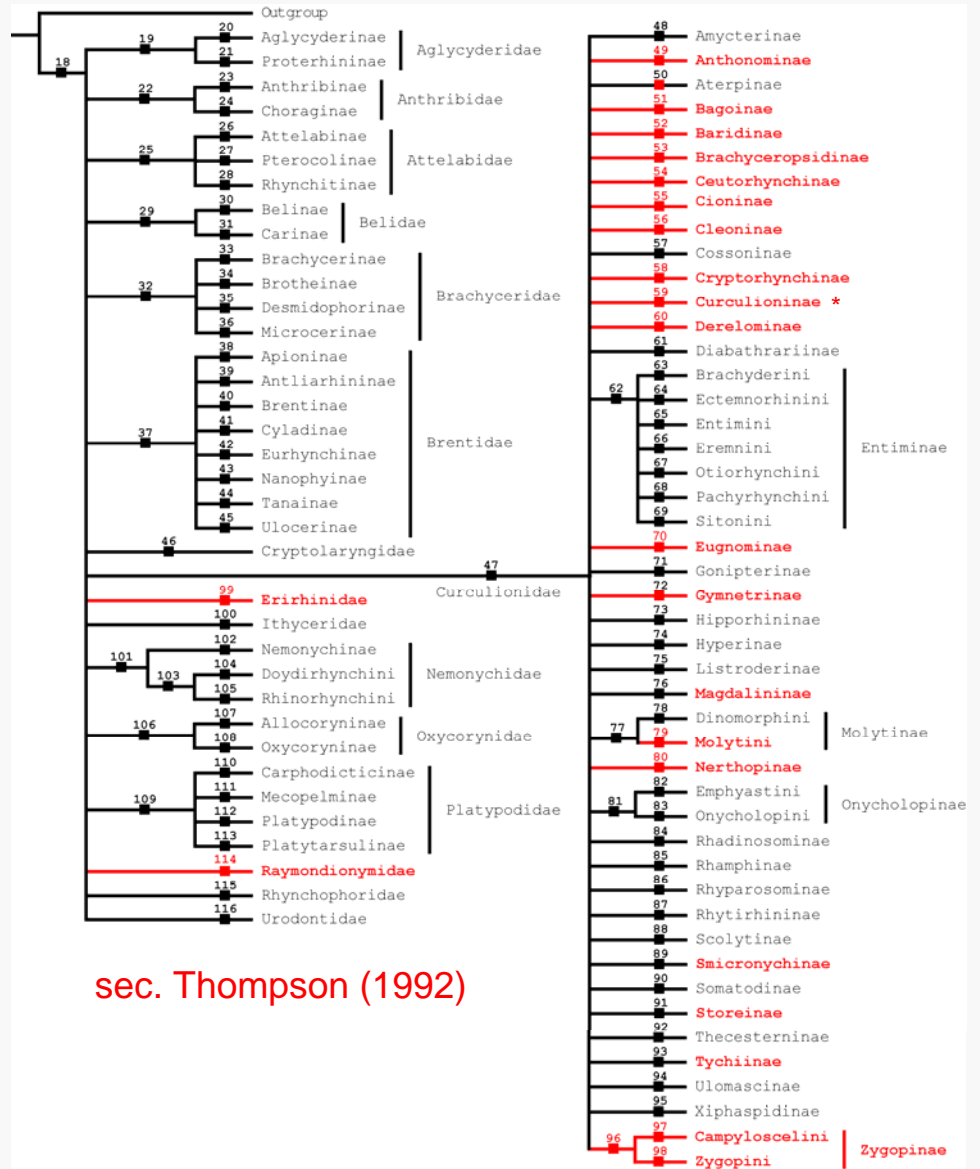
+ Curculioninae

+ ... [9 subfam.]

+ Erirhinidae

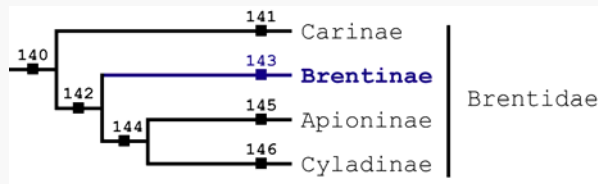
+ Raymondionymidae

sec. Thompson (1992)

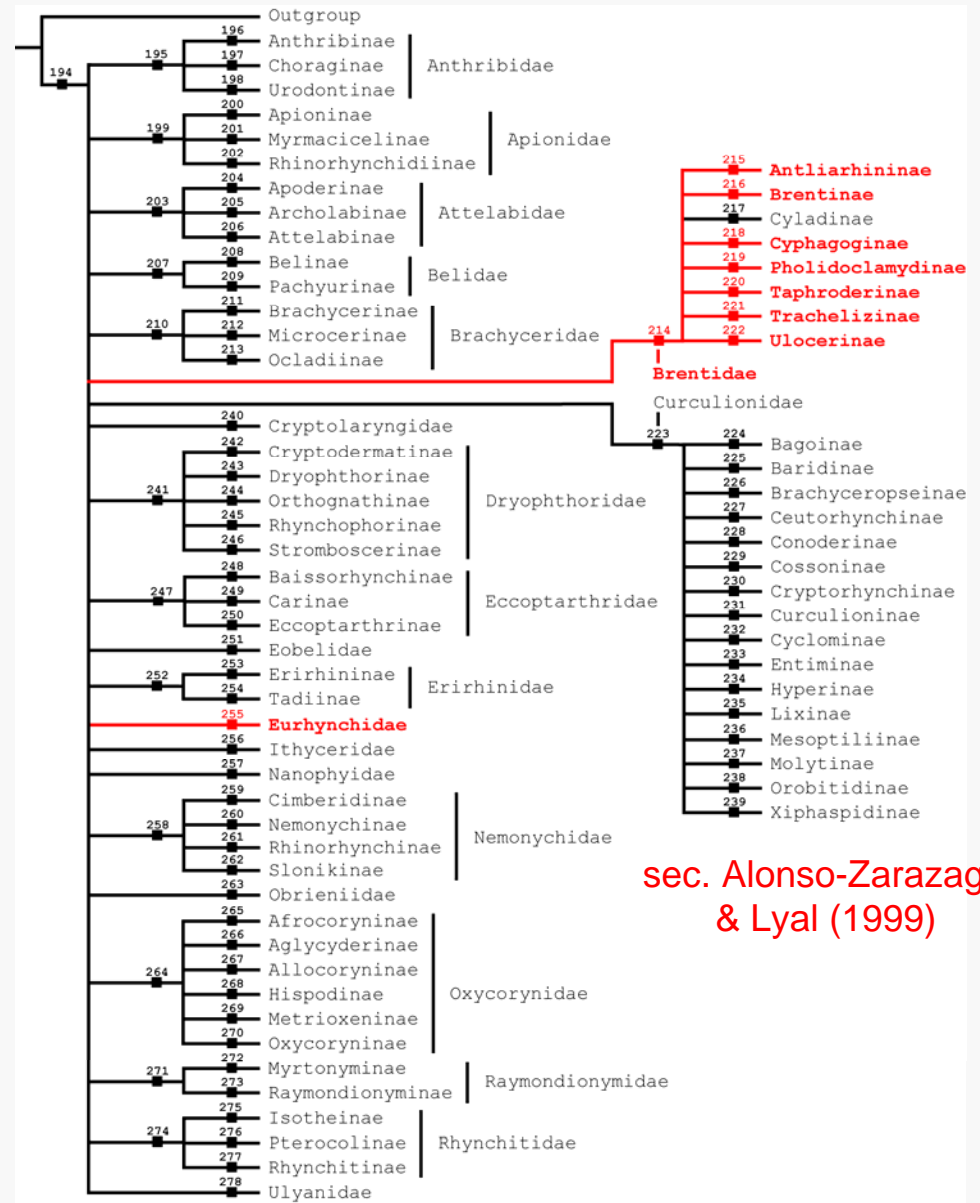


sec. Thompson (1992)

What can concepts teach us about names? – “higher weevils”, 1981-2000.

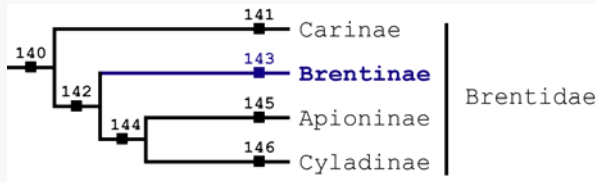


sec. Kuschel (1995)



sec. Alonso-Zarazaga & Lyal (1999)

What can concepts teach us about names? – “higher weevils”, 1981-2000.



sec. Kuschel (1995)

Concept relationship:

Brentinae

sec. Kuschel (1995)

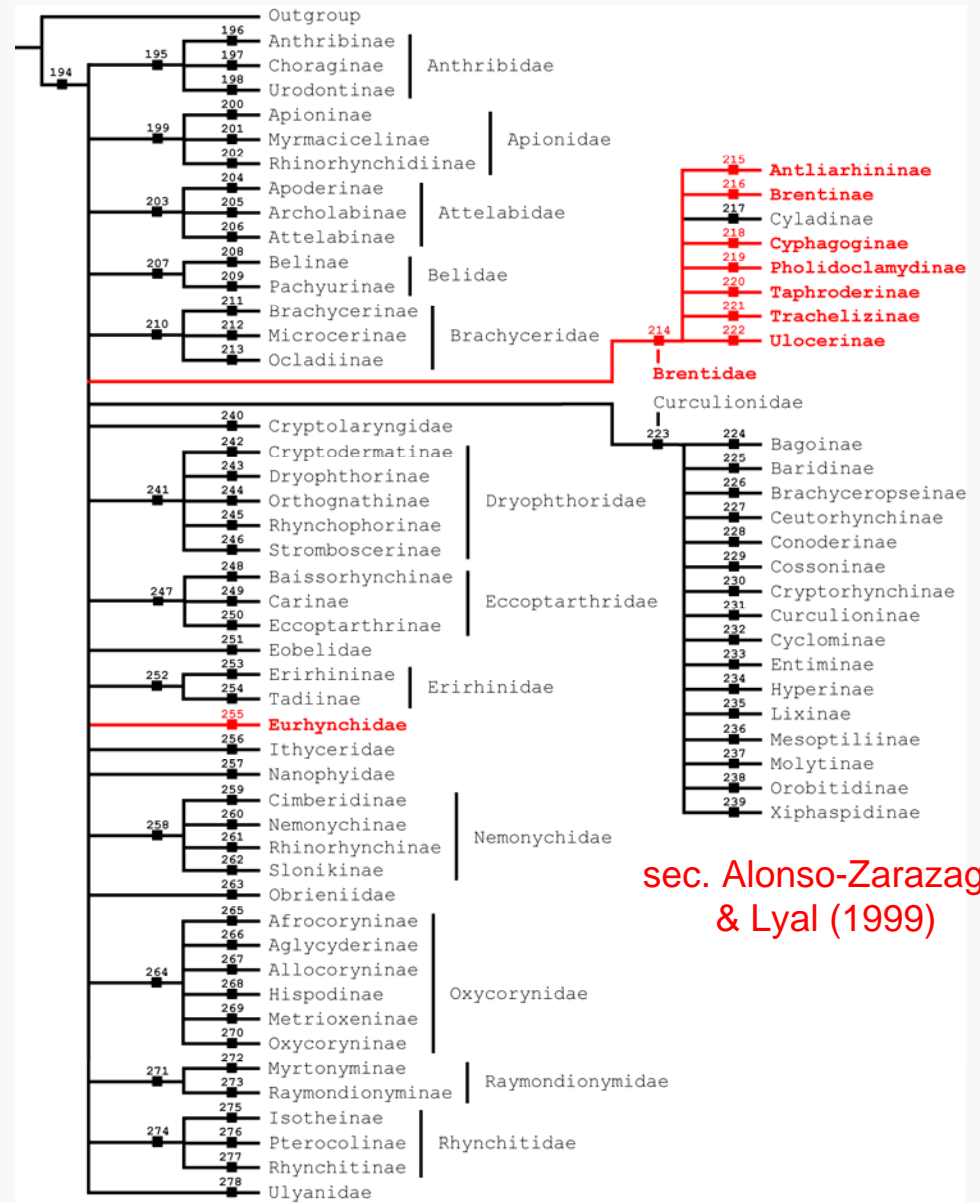
==

Brentidae

+ Eurhynchidae

– Cyladinae

sec. Thompson (1992)



sec. Alonso-Zarazaga & Lyal (1999)

Taxonomic databases – an immediate application of the concept approach.

Taxonomic databases – an immediate application of the concept approach.

NMNH Department of Systematic Biol...



Department of Systematic Biology
Vertebrate Zoology



sec. Wilson & Reeder (1993)

Division of Mammals

Mammal Species of the World (MSW)

About MSW

MSW Root

Scientific Name?

Common Name?

The **Mammal Species of the World (MSW)** contains the names of the 4,629 currently recognized species of mammals, in a taxonomic hierarchy that includes Order, Family, Subfamily, and Genus. The information was taken from:

Wilson, D. E., and D. M. Reeder (eds). 1993. *Mammal Species of the World*. Smithsonian Institution Press, 1206 pp. (Available from Smithsonian Institution Press, 1-800-782-4612 or 703-435-7809.)

The list was compiled by an international team of [contributors](#). It can be used as an on-line reference, or adapted as an authority file for collections management activities of mammal collections.

The list was compiled under the auspices of the American Society of Mammalogists. **Copyright 1993 Smithsonian Institution, Washington, DC USA. All rights are reserved.** The data in this checklist of mammal species of the world are being presented for non-commercial, personal, and collections management use only. Copying or redistributing these data in any manner for personal or corporate gain is not permitted.

- [How to use the MSW](#)
- [Go to the Root of the MSW Tree](#)
- [Search the MSW by Scientific Name](#)
- [Search the MSW by Common Name](#)
- [Browse the MSW Literature Citations](#) (750K text/html)
- [Browse the Checklist of Mammal Names as Text](#) (200K text only)

Taxonomic databases – an immediate application of the concept approach.

NMNH - Mammal Species of the World

Smithsonian
National Museum of Natural History

MSW Scientific Names

[Query](#) [Home](#) [Help](#)

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[Parent](#) [Offspring](#) [Synonyms](#)

Lasiurus

- **Author**..... : Gray, 1831.
- **Citation**..... : Zool. Misc., 1:38.
- **Type Species**... : *Vesperugo borealis* Müller, 1776.
- **Comments**..... : Treated under the name *Myotis* by Hall (1981^{ref219}). as an on-line reference, or adapted a...

[Search USNM Collections for *Lasiurus*](#)

- [How to use the MSW](#)
- [Go to the Root of the MSW Tree](#)
- [Search the MSW by Scientific Name](#)
- [Search the MSW by Common Name](#)
- [Browse the MSW Literature Citations](#) (750K text/html)
- [Browse the Checklist of Mammal Names as Text](#) (200K text only)

Mammal Species of the World

MSW Scientific Name List

[Query](#) [Home](#)

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Name

- [Lasiurus borealis](#)
- [Lasiurus castaneus](#)
- [Lasiurus cinereus](#)
- [Lasiurus ega](#)
- [Lasiurus egregius](#)
- [Lasiurus intermedius](#)
- [Lasiurus seminolus](#)

A total of 7 were retrieved

sec. Wilson & Reeder (1993)

NMNH - Mammal Species of the World

Smithsonian
National Museum of Natural History

MSW Scientific Names

[Query](#) [Home](#) [Help](#)

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[Parent](#) [Synonyms](#)

Lasiurus seminolus

- **Author**..... : (Rhoads, 1895).
- **Citation**..... : Proc. Acad. Nat. Sci. Philadelphia, 47:32.
- **Common Name**... : Seminole Bat
- **Distribution**... : Florida and Texas to Oklahoma and Virginia; Pennsylvania and New York (USA); Bermuda. N Veracruz (Mexico) record unverified.
- **Type Locality**... : USA, Florida, Pinellas Co., Tarpon Springs.
- **Comments**..... : Subgenus *Lasiurus*. Probably only a subspecies of *borealis* since the characters do not hold; see Koopman et al. (1957^{ref168}); but also see Baker et al. (1988^{ref}). See Wilkins (1987^{ref}, Mammalian Species, 280).

Distribution Map for *Lasiurus seminolus*:

[Search USNM Collections for *Lasiurus seminolus*](#)

Taxonomic databases – an immediate application of the concept approach.

- Challenge: the concepts of the 2006 update contain many taxonomic changes that are *not* reflected in new Linnaean names or new synonymy relationships.

Example: *Lasiurus* Gray **sec. W & R (1993)** < *Lasiurus* Gray **sec. W & R (2006)**

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- With the present database structure, Wilson and Reeder face the following dilemma:
 - (1) *overwrite the 1993 concepts* and thereby erase the taxonomic judgments and meanings upon which many studies have relied for the past 13 years.
 - (2) *leave the database as is* (sec. 1993) and thereby fail to adjust to the latest and most supported taxonomic perspective.
- Neither solution is desirable.

Taxonomic databases – an immediate application of the concept approach.

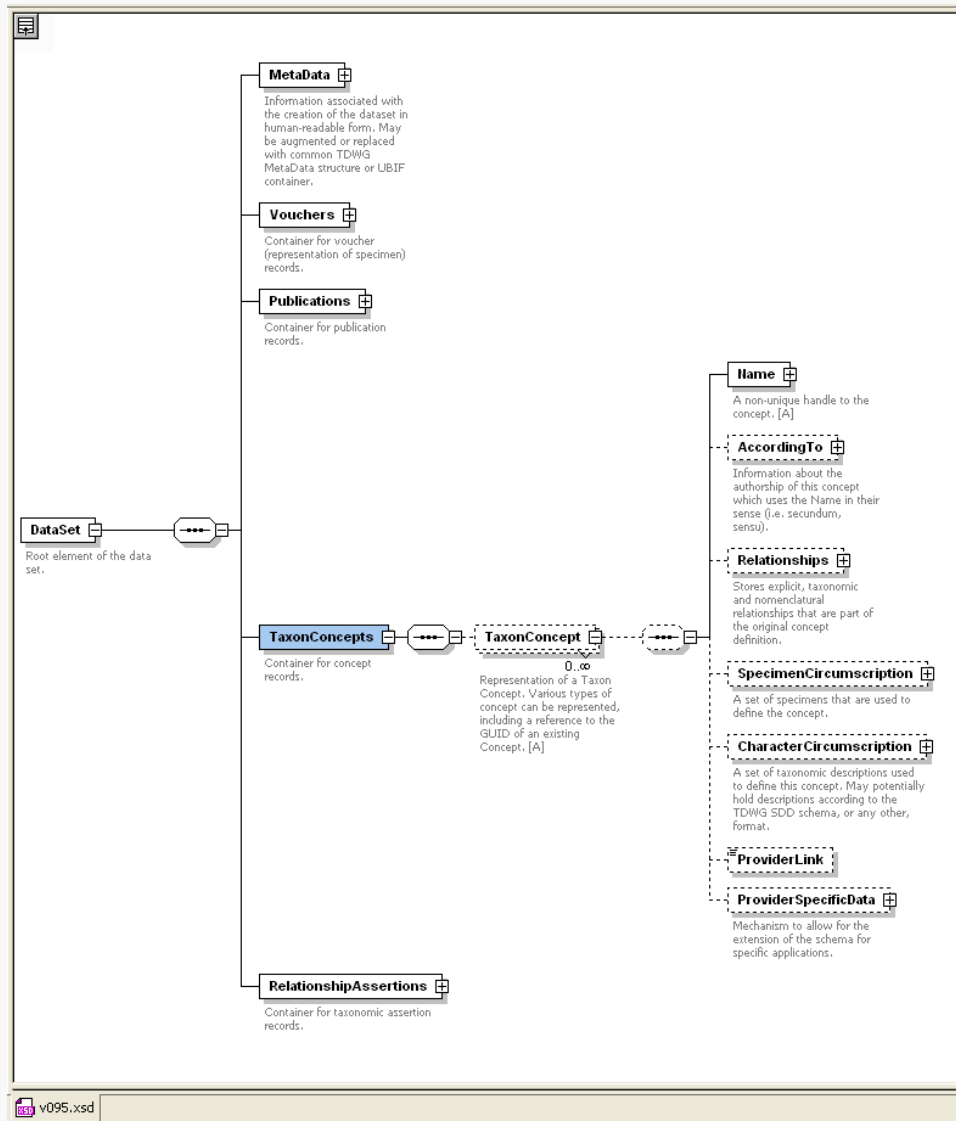
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 - (2) leave the database *as is* (sec. 1993) and thereby fail to adjust to the latest and most supported taxonomic perspective.
- Neither solution is desirable.
- If the **1993 version is converted to concepts** rather than names, then the **2006 update can be added** with losing the preceding perspective. Concept relationships can be used to explain the taxonomic changes with high semantic precision.

SEEK schemas and tools in support of concept taxonomy.

SEEK schemas and tools in support of concept taxonomy.



- “Taxonomic Concept Schema” – an XML schema that allows the exchange of taxonomic information stemming from a wide range of taxonomic databases and -models.
- A two-year community-wide effort; was adopted as a **TDWG standard** at the 2005 meetings in St. Petersburg.
- Enables taxonomic providers to “translate” **name-based information into concepts** for the purpose of data merging and periodical updates.

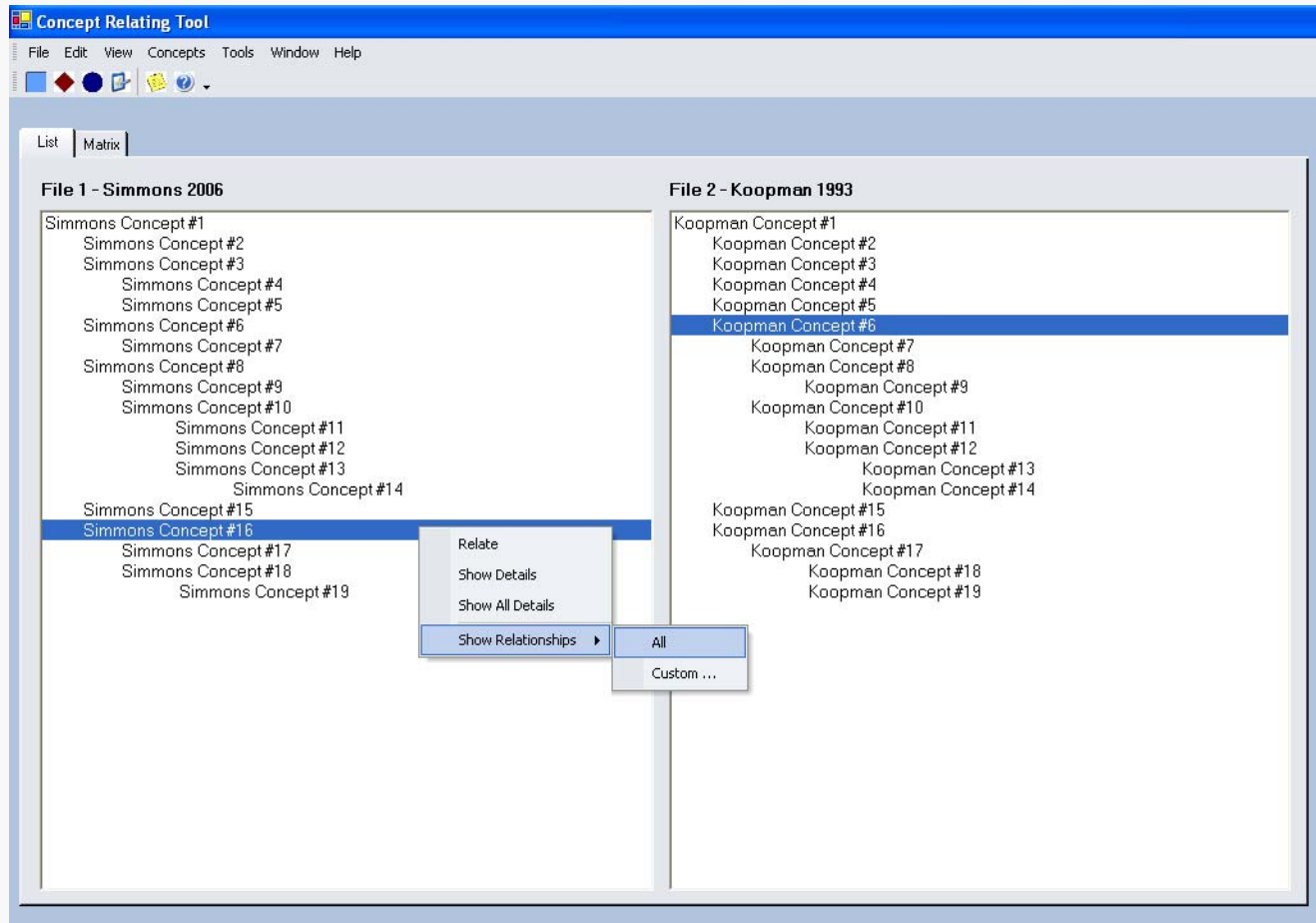
SEEK schemas and tools in support of concept taxonomy.

- A simple tool (MS Excel macro) to enter concept relationships for the “Flora of Carolinas” project.

Relationship_ID									
Relationship_ID	From_ID	From_Name	From_Source	Relation	To_ID	To_Name	To_Source		
10000	220000106	Achyrionychia cooperi	FNA Vol 5	=	K1972700	Achyrionychia cooperi	USDA Plants 2003		
10001	250060047	Cerastium nutans var. nutans	FNA Vol 5	=	K1990300	Cerastium nutans var. nutans	USDA Plants 2003		
10002	250060048	Cerastium nutans var. obtectum	FNA Vol 5	=	K1990500	Cerastium nutans var. obtectum	USDA Plants 2003		
10003	220003349	Corrigiola litoralis	FNA Vol 5	=	K1991800	Corrigiola litoralis	USDA Plants 2003		
10004	220005528	Geocarpon minimum	FNA Vol 5	=	K1994500	Geocarpon minimum	USDA Plants 2003		
10005	220006471	Holosteum umbellatum	FNA Vol 5	=	K1996100	Holosteum umbellatum	USDA Plants 2003		
10006	220006496	Honckenya peploides	FNA Vol 5	=	K1996300	Honckenya peploides	USDA Plants 2003		
10007									
10008									
10009									
10010									
10011									
10012									
10013									
10014									
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10040									
10041									
10042									
10043	250060907	Spergula morisonii	FNA Vol 5	=	K2064750	Spergula morisonii	USDA Plants 2003		
10044	250060908	Spergula pentandra	FNA Vol 5	=	K2064800	Spergula pentandra	USDA Plants 2003		
10045	250060912	Spergularia canadensis var. cana	FNA Vol 5	=	K2065300	Spergularia canadensis var. cana	USDA Plants 2003		

SEEK schemas and tools in support of concept taxonomy.

- In progress: user-driven design of a concept relationship visualization and editing tool.



SEEK schemas and tools in support of concept taxonomy.

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Concept Relating Tool

File Edit View Concepts Tools Window Help

List Matrix

File 1 - Simmons 2006

- Simmons Concept #1
- Simmons Concept #2
- Simmons Concept #3
 - Simmons Concept #4
 - Simmons Concept #5
- Simmons Concept #6
- Simmons Concept #7
- Simmons Concept #8
- Simmons Concept #9
- Simmons Concept #10
 - Simmons Concept #11
 - Simmons Concept #12
 - Simmons Concept #13
 - Simmons Concept #14
- Simmons Concept #15
- Simmons Concept #16
- Simmons Concept #17
- Simmons Concept #18
- Simmons Concept #19

Relate
Show Details
Show All Details
Show Relationships ▶

Concept Relating Tool

File Edit View Concepts Tools Window Help

List Matrix

	Koopman C1	Koopman C2	Koopman C3	Koopman C4	Koopman C4	Koopman C5	Koopman C6	Koopman C7	Koopman C8
Simmons C1	==	<	><	>	?	N/A			>
Simmons C2	>	>	==	>		><	N/A		>
Simmons C3	<		><		==	><			==
Simmons C4			><	>		>			>
Simmons C5	> OR ><			>		<			>
Simmons C6	><	SC6== KC2 + KC3	SC6== KC2 + KC3	<		==			>
Simmons C7	?	?		<					><
Simmons C8	N/A	N/A		==	?				><
Simmons C9	N/A	N/A		?	N/A				N/A

Relate
Show Details
Show All Details
Show Relationships ▶

Summary and conclusions.

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Summary and conclusions.

- Linnaean names and synonymy neither support all our resolution needs in biodiversity research, nor a full documentation of the taxonomic process.
- The taxonomic concept approach is able to overcome these obstacles. It provides more granularity and semantic precision when needed, *without* sacrificing or altering any of the desirable properties of the Linnaean system.
- In the concept world, the onus is less on getting it right and more on *securing long-term resolvability*. Multiple competing taxonomic perspectives are allowed to coexist and gradually evolve. This picture comes closest to actual practice.

Acknowledgments.

SEEK Taxon group:

Robert Peet, Xianhua Liu, Jessie Kennedy, James Beach



NSF, award no. 0225676

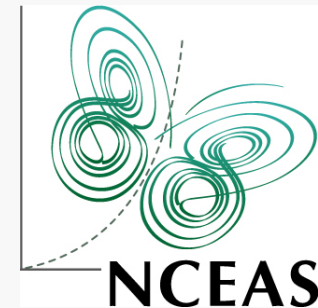
NCEAS:

James Reichman, Mark Schildhauer, Daniel Higgins

- Alan Weakley

- Andrew W. Mellon Foundation

- ...and Samantha Romanello for organizing the Workshop. Thank you!



Questions...