KEYS TO

THE ASTERACEAE OF WISCONSIN

Assembled and edited by

Robert R. Kowal
2007 February 11

KEYS TO THE ASTERACEAE OF WISCONSIN

INTRODUCTION & ACKNOWLEDGMENTS

KEYS TO THE ASTERACEAE OF WISCONSIN is largely a compilation of other taxonomists' work, both published and unpublished. Most of the keys come from the PRELIMINARY REPORTS ON THE FLORA OF WISCONSIN, the work of Professor Hugh H. Iltis and his students, except for my treatments of the tribes Senecioneae and Astereae, which were never covered (except for *Solidago* and *Aster*). I give the intellectual sources after each tribe's and genus's (if different from the tribe's sources) heading (see "References"). Wetter, Cochrane, Black, Iltis, and Berry's CHECKLIST OF THE VASCULAR PLANTS OF WISCONSIN (2001) allowed updating the list of taxa [taxon, -a: a taxonomic group of any rank] occurring in Wisconsin and is the most important source for common names. The publication of the treatments of the Asteraceae in the Flora of North America (FNA, 2006: vols. 19-21), in addition to providing information for improving keys and for including or excluding taxa in the flora, provides (with minor exceptions) the taxonomy and nomenclature used herein, an improvement which is especially important because of the many changes in the circumscriptions of genera as a result of recent cladistic studies.

I have excluded hybrids, to keep the keys as simple as possible; they are usually only rarely encountered and usually require an expert to identify anyway.

Although virtually all information in the keys comes from others' work, I have edited all the keys more or less severely. In particular, the terminology used for the morphological structures characteristic of the Asteraceae is now more consistent among treatments (see "Terminology"). And, splitting of genera has necessitated completely rewriting some keys.

My thanks to the continuing line of plant taxonomists for their undervalued work. In particular, I express my gratitude to the Wisconsin State Herbarium at the University of Wisconsin-Madison, to all the many people who have contributed to it, and to the people responsible for its existence and maintenance, most recently, Prof. Hugh H. Iltis (Director Emeritus), Prof. Paul E. Berry, Director [until January 2006], Theodore Cochrane (Curator) and Mark Wetter (Curator). Ted and Mark are especially to be thanked for always being available to answer questions of content and style.

Dr. James A. Reinartz (Manager – Resident Biologist, Field Station of the University of Wisconsin-Milwaukee) provided the impetus for assembling these keys (which were initially largely xeroxes of published material), when he invited me to give workshops on the taxonomy and evolution of the Asteraceae in 1984, 1988, 1991, 1997, 2000, 2003, and 2005.

Stricter enforcement of copyright laws concerning xeroxing of published materials provided the impetus in 1997 for typing the keys, thereby creating an "original document". So, my sincere thanks to Ms. Barbara Schaack (Technical Typist III, Department of Botany), who accurately and intelligently retyped the source materials, creating the WordPerfect files that I have used for my revisions.

Further improvements are intended: giving pronunciations for Latin names, including more data on distributions and habitats, indicating which taxa are introduced vs. native, and adding a glossary. A start in this direction are the new sections on "Chromosome Numbers", "Terminology", and "Taxonomy, Nomenclature & Pronunciation". I hope that the keys eventually become available on the Wisconsin State Herbarium's website (http://www.botany.wisc.edu/herbarium/), along with pictures.

Note that the keys are explicitly for the taxa occurring in the State of Wisconsin and will not necessarily work elsewhere.

Any suggestions for improvements will be most gratefully received.

Robert R. Kowal
2007 February 11

ARRANGEMENT OF KEYS

The initial key is to tribes within the family, plus two well-marked subtribes within the Heliantheae (Ambrosiinae & Eupatoriinae). Although the emphasis on tribes may appear too academic and esoteric, in fact it is quite practical. The tribes and two subtribes are well-marked, and even a key that ignored tribal groups would strongly resemble this one. For some, learning to recognize tribes will make future identifications more efficient, as many species can then be taken directly to their tribe.

Tribes are arranged, insofar as possible, phylogenetically (Appendix B: 4), from those evolving earlier to those evolving later, and, correlated to some extent with this ordering, with those tending to be characterized by more primitive characters (ones that are thought to have appeared earlier during the course of the evolution of the family) preceding those tending to be characterized by more advanced characters (ones that are thought to have appeared later). The ordering and its interpretation as "primitive" to "advanced" is approximate and intellectually controversial. Some tribes appear simultaneously (as far as the estimated tree shows), times of origin of clades and characters are only roughly known at best, and each tribe has its particular advanced characters as well. However, the ordering provides enough accurate evolutionary information to make it preferable to an arbitrary arrangement. Tribes are numbered from 1 to 10, and the page numbers (in the upper right-hand corner of each page) include this number after the name of the tribe. Each tribe and subtribe has a key to its genera, followed by keys to each genus, arranged alphabetically.

CHROMOSOME NUMBERS

Insofar as possible, I have given chromosome numbers of the genera and species. Virtually all are from the FNA (2006); those for *Packera* are from my own work. Note that the numbers given are for the species as a whole and do not necessarily occur in Wisconsin.

All land plants have an alternation of generations, with one individual producing gametes (by mitosis [sic]) and the other producing meiospores (by meiosis): the gametophyte alternating with the sporophyte. In flowering plants the pollen grain is a highly reduced male gametophyte, and the embryo sac is a highly reduced and modified female gametophyte. Both develop from meiospores produced by the dominant generation, the sporophyte. Usually the two generations are haploid and diploid, respectively, resulting in the traditional convention for referring to their chromosome numbers as n = 9 and 2n = 18 (using the commonest chromosome number in the Asteraceae as an example). However, this is not always the case. The gametophyte and the sporophyte can have the same number (e.g., in some ferns). Also, referring to the sporophyte's number as "2n" implies an even number of chromosomes, which is true for normal, sexually reproducing individuals, but is not true in general. Sporophytes frequently have odd numbers of sets of chromosomes due to the functioning of unreduced gametes; triploids with three sets are frequent and pentaploids (five sets), septaploids (seven sets), etc. occur. In addition, some sporophytes have one or more chromosomes missing from a complete set – or in addition to a complete set. Many other complications exist. A more accurate symbolism is to use "g" and "s" (e.g., g = 9 and s = 18) for the gametophytic ("gametic") and sporophytic ("somatic") numbers, respectively.

The "base number", "x", is the gametophytic or haploid number that is thought to have occurred in the unique ancestral species of a group. For example, our best guesses are that x = 9 for the family Asteraceae, x = 10 for the tribe Senecioneae, and

x = 17 for the genus *Helianthus*. The basis for such a guess traditionally has been the most common low haploid number in a group. As phylogenetic trees become available, the haploid number of the basal branches are considered to give more trustworthy evidence. The genus *Achillea* provides an example of the use of the concept of base number. It has a base number of x = 9. The species *A. Millefolium*, the common yarrow, has s = 2x, 3x, 4x, 5x, 6x, 7x, 8x. Therefore, some individuals and/or populations have diploid, triploid, tetraploid, pentaploid, hexaploid, septaploid, and octoploid sporophytic numbers, or s = 18, 27, 36, 45, 54, 63, and 72.

Note that base numbers are relative: they evolve during the course of evolution. For example, the tribe Senecioneae's base number is probably x = 10. However, a group of genera within the tribe, including *Petasites* (sweet-coltsfoot) and *Tussilago* (coltsfoot), have a base number of x = 30. Presumably the common ancestor of the entire group (as well as each genus) was a hexaploid with s = 6x = 60 and g = 30, derived from a species with g = 10.

Chromosome numbers commonly provide support for the many new generic circumscriptions reflected, most importantly, in FNA (2006). The common white snakeroot, long called *Eupatorium rugosum* is now *Ageratina altissima*; it has g = 17, whereas *Eupatorium*'s base number is x = 10. "*Senecio congestus*", the northern swamp groundsel, with g = 24, is now in *Tephroseris* (as *T. palustris*), where x = 24; Senecio (s.s.) has x = 10. *Packera*'s x = 22 & 23, provide evidence supporting its segregation from *Senecio* (x = 10).

TERMINOLOGY

The Asteraceae are characterized by highly modified inflorescences and flowers. This necessitates a set of terms to refer to the corresponding structures. The terminology has evolved and proliferated, and taxonomists in the past and now differ in their usage. Some terms are synonyms; sometimes the same term is used for different structures; some are misleading. The terminology used in these keys is importantly derived from Arthur Cronquist (e.g., Gleason & Cronquist, 1991) and attempts to eliminate synonyms, to eliminate ambiguity, and to be simple and accurate.

The family is characterized by having its flowers condensed into a **HEAD** (Appendix A: 1a) [syn.: capitulum]. This inflorescence is not unique to the family, but it occurs in all the family's species. It is responsible for the traditional name for the family, the **COMPOSITAE**: what looks like a flower in the family (e.g., a sunflower or daisy "flower") is a "composite" structure of many small, true flowers packed together. Because the flowers are relatively small compared to those in other families, they are traditionally referred to as **FLORETS** (Appendix A: 1b).

Each head consists of outer bracts enclosing tightly packed florets (Appendix A: 1a). The outer bracts collectively form the **INVOLUCRE** with each bract called a **PHYLLARY** [syn.: involucral bract]. The enclosed florets sit on a flat (rarely hemispheric or conical) surface, the **RECEPTACLE**. Each floret may be subtended by a highly modified bract, collectively called **CHAFF**. A receptacle having chaff is called **CHAFFY**; a receptacle lacking chaff is said to be **NAKED**. Independently, the surface of the receptacle may bear hairs or be pitted (e.g., "alveolate").

There are different kinds of florets. The most common is the **DISK FLORET** (Appendix A: 1b), so called because they often cover most of the center of the receptacle, the **DISK**. A disk floret has the basic structure of the presumptive ancestral composite flower: an inferior ovary containing a single ovule (Appendix A: 3f), a 5-

merous sympetalous corolla with five epipetalous stamens, a style terminating in two stigmatic branches. The fruit is an **ACHENE** (Appendix A: 3k, 4k, 6j). [In technical literature, "cypsela", an achene derived from an inferior ovary, is commonly used.] The floret shows a number of characters peculiar to the Asteraceae. On top of the ovary and fruit, outside the corolla, instead of a normal calyx, is usually a modified structure, a **PAPPUS**, consisting of scales (Appendix A: 3h, 6k), awns, bristles, or hairs (Appendix A: 1b), commonly functioning to aid dispersal. The stamens are "syngenesious" (Appendix A: 1g, 6f), with their anthers united laterally to form a cylinder into which their pollen is deposited; the pollen is pushed upwards out of the floret by the elongating style.

The ancestral composite corolla may well have been bilabiate, with an upper (inner) two-toothed lip and a lower (outer) three-toothed lip, as in snapdragons and lobelias, and such corollas occur in many Barnedisieae and Mutisieae (e.g., *Gerbera*, the commonly cultivated African daisy), along with other bilaterally symmetrical variants. However, in Wisconsin only three basic kinds of corollas and florets occur. A **DISK FLORET** (Appendix A: 1b) is radially symmetrical, with a five lobed corolla. It is usually **BISEXUAL**, producing pollen and, if pollinated, a fruit. In some genera it can be **STAMINATE** (Appendix A: 1f) [syn.: "sterile", "functionally staminate"], producing only pollen; usually an aborted ovary persists, as well as a modified style that pushes the pollen upwards. A **RAY FLORET** (Appendix A: 1c, 3c) has a kind of bilaterally symmetrical corolla that is elongated on the outer side into a **RAY** [syn.: "ligule"] terminating in usually three reduced lobes or "teeth". It never has stamens and is either **PISTILLATE** (Appendix A: 1c) [syn.: "fertile"], with a normal style and a functional ovary capable of forming a fruit, or **NEUTER** (Appendix A: 3c), without a style and with an aborted ovary. A **LIGULATE FLORET** (Appendix A: 6e) has a kind of bilaterally symmetrical corolla that is elongated on the outer side into a **LIGULE** terminating in five reduced lobes or "teeth". It is always **BISEXUAL**, with both functional stamens and ovary.

Heads differ in the kinds of florets that they contain. A **DISCOID HEAD** (Appendix A: "4b") contains only disk florets. An infrequent variant of a discoid head is a **RADIANT HEAD**, with marginal florets (bisexual, pistillate or neuter) having enlarged corollas, which are often splayed outward. A **RADIATE HEAD** contains disk florets in the center, surrounded by outer ray florets. A **DISCIFORM HEAD** (Appendix A: 4b) resembles a discoid head but has rayless pistillate florets marginally; these pistillate florets probably represent ray florets that have lost their rays during the course of evolution. A **LIGULATE HEAD** (Appendix A: 6d) contains only ligulate florets.

Composite heads, which often mimic flowers, are borne on a plant comparably to flowers in an inflorescence. Such a group of heads is technically a "capitulescence"; in the Flora of North America (FNA, 2006: vols. 19-21) "array" is used. However, I retain the traditionally used **INFLORESCENCE**; this word is part of the working vocabulary of even beginning taxonomists and allows the use, by analogy, of the terms used for the many kinds of true inflorescences.

TAXONOMY, NOMENCLATURE & PRONUNCIATION

Species

In the Linnaean taxonomic system of classification (which was initiated by Carl Linnaeus (for plants) in his 1753 work, *Species Plantarum*), the most "natural" grouping of individuals is the species (sing. "species", pl. "species"). Its name is a binomial, the name of its genus plus a specific epithet, e.g., *Quercus alba*, for the white oak. The binomial is a Latin name, and, as with other words and phrases from a foreign language used in an English text, it appears in italic type in print (and is underlined in written text). The generic name MUST ALWAYS be capitalized, and the species epithet MAY ALWAYS be lower case. This latter rule is "recommended" by the International Code of Botanical Nomenclature (2000) (ICBN), and virtually all people follow this practice. As an older professional taxonomist, I do not follow this practice, because it results in the loss of information. Such information is interesting in its own right, but, its loss, more importantly, can result in error.

The traditional rule is to capitalize a specific epithet when it is not a simple descriptive adjective, i.e., when it is one of the following: 1) Derived from a person's name, e.g., either as a noun in the genitive case (*Berberis Thunbergii*, Japanese barberry) or as an adjective formed from a person's name (*Pinus Banksiana*, jack pine); 2) A generic name used in apposition [in "G.W. Bush, the president", the noun "president" is used like an adjective to modify another noun], e.g., *Diervilla Lonicera*, bush-honeysuckle, where the epithet is the generic name for honeysuckles; 3) A vernacular (aboriginal) name, e.g., *Erythroxylum Coca*, coca, where "Coca" is the American Indian name for the species. An advantage of the traditional rule is that it provides the reader with interesting information, i.e., that the epithet honors a person or is a generic name or a name used by indigenous people. More importantly, the information can prevent error. Latin adjectives are declined to agree in gender with the nouns they modify [See the discussion following]. If "Coca" is not capitalized one might be tempted to "correct" *Erythroxylum coca* to *Erythroxylum cocum*. More problematical are generic names that look like adjectives when not capitalized. *Sedum* [n.] *Rosea*, even when written *Sedum* [n.] *rosea* must not be "corrected" to *Sedum roseum*. *Senecio* [m.] *Millefolium* may be written *Senecio millefolium*, and must not be "corrected" to "*Senecio millefolius*"; transferring the species to *Packera* [f.], *results in Packera Millefolium* or *Packera millefolium*, not *Packera millefolia*. Both errors involving *Millefolium* have been made. In *Andromeda Polifolia*, the generic name when not capitalized looks like the adjective "poliifolius, -a, -um" ["with leaves like "Polium", where the second "-i-" is a "connecting vowel"]; if the epithet were this adjective, the ICBN requires its correction to *A. poliifolia*. However, such a "correction" would be an error: *A. polifolia* is correct. The recommendation in the ICBN to decapitalize all specific epithets is an example of a "simplification" resulting in unintended complications. A more reasonable recommendation would be to allow this simplification in general, but to maintain the traditional rule in taxonomic and nomenclatural publications.

A species epithet should never be used alone, e.g. "*Quercus alba*" may be abbreviated to "*Q. alba*" but not to "*alba*".

As alluded to above, endings of species epithets may vary – or not (Stearn, 1966). The most common case is adjectives used as specific epithets, whose endings change depending on the generic name that they modify. Nouns in Latin have gender (masculine = m., feminine = f., or neuter = n.), and an adjective's ending "agrees" with its noun in gender. Different groups of adjectives differ in the sets of m., f., and n. endings that are used, for example:

-us, -a, -um
m. – *Amaranthus albus*
f. – Betula alba
n. – *Chenopodium album*

-er, -ra, -rum
m. – *Helleborus niger*
f. – *Betula nigra*
n. – *Acer nigrum*

-is, -is, -e
m. – *Tragopogon pratensis*
f. – *Poa pratensis*
n. – *Trifolium pratense*

Participles and some adjectives don't change, e.g.

m. – *Ranunculus repens*
f. – *Ludwigia repens*
n. – *Trifolium repens*

A common specific epithet is a noun, often a Latinized person's name, in the genitive (possessive) case, as in the phrase, *Lacrimae Christi*, "the tears of Christ", where "*Christi*" is the genitive of "*Christus*". The genitive suffixes of masculine and feminine singular nouns are usually "-i" and "-ae", respectively:

Berberis Thunbergii, for the collector Per Thunberg, Latinized "Thunbergius",
Cornus Priceae, for its discoverer, Sara F. Price, Latinized "*Pricea*",
Cypripedium reginae, "lady-slipper of the queen (*regina*)",
Cooksonia pertoni, "... of Perton Lane", for the street near the discovery site.

Note that if "Perton" had been the name of a person, it would be Latinized as "*Pertonius*", and the ICBN would require the binomial to be corrected to "*Cooksonia Pertonii*". The only easy way to avoid this error is to note that the epithet is not capitalized, indicating that it does not refer to a person.

Just as generic and aboriginal names are used as species epithets, other nouns in apposition are used, and these also remain in the nominative case:

Tyrannosaurus rex, "... the king",
Caryota gigas, "... the giant".

Of course, mostly we copy binomials from an authoritative source, like a flora. However, it is useful when writing and speaking to at least guess the gender of a generic name so that we are more likely to use the correct ending for a species epithet. The following rules will help. First, generic names of plants occur in the following order of frequency: feminine > neuter > masculine. Secondly, a generic name ending in -us, -a, or -um, is usually masculine, feminine, or neuter, respectively: *Ranunculus* (m.), *Poa* (f.), *Chenopodium* (n.). The commonest exception to this rule is that most woody genera are feminine, e.g., *Pinus*, *Quercus*, *Cornus*, *Corylus*, and *Fraxinus*; however, an exception to this rule is *Acer*, which is neuter.

Infraspecific ranks

Species often consist of races, which are sometimes discrete (like diploid and tetraploid races) but which usually intergrade (like eastern and central North American races). These are named as subspecies or varieties; sometimes a species is treated as having more pronounced races, subspecies, within which are less pronounced races, varieties. As with human races, such infraspecific differences are genetically real and ecologically significant at the populational and geographic levels, but their treatment in a system that misleadingly implies discrete taxa necessitates a certain degree of subjectivity and arbitrariness. Traditionally, very conspicuous mutants, like a white-flowered mutant within a pink-flowered species or a sessile-leaved mutant within a perfoliate species, were named as forms, e.g., *Eupatorium perfoliatum* forma *truncatum*; however, this practice (which I find useful) is passing from use.

Cultivated plants include sexual strains and clones artificially selected and maintained by agriculturalists and horticulturists, sometimes from stock derived by hybridizing different species. These are given non-Latin, "fancy" names that are not regulated by the ICBN. Such groups are "cultivated varieties" or "cultivars", e.g., *Helianthus annus* 'Russian Mammoth', a strain (i.e., a sexually reproducing race) with a single, huge head, and *Rudbeckia nitida* × *laciniata* 'Autumn Sun' ('Herbstsonne'), an asexually reproduced clone that is vigorous and floriferous. In general, cultivars are not included in floras, except in the rare cases when they escape from cultivation and persist in the wild.

Supraspecific ranks

The Linnaean classification groups species into successively larger taxa, representing the "supraspecific ranks". The genus (pl. "genera") is the most commonly encountered such group, being the first part of a species name and being a grouping that is often recognized, at least approximately, by non-taxonomists: pines (*Pinus*), oaks (*Quercus*), maples (*Acer*), goldenrods (*Solidago*), pussy's-toes (*Antennaria*), sunflowers (*Helianthus*). Successively larger groupings above the rank of genus have names based on the stem of a generic name to which a rank-specific ending (suffix) is added:

Family:	Aster + -aceae	→ Asteraceae
Order:	Aster + -ales	→ Asterales
Subclass:	Aster + -idae	→ Asteridae
Class:	Magnoli(-a) + -opsida	→ Magnoliopsida
Phylum (Division):	Magnoli(-a) + -(o)phyta	→ Magnoliophyta.

Within families, especially larger ones, other, less well-known groupings may be recognized, as needed. Successively smaller groupings of genera within a family are named using the root of an included genus terminated by a rank-specific ending: Subfamily, -oideae; Tribe, -eae; Subtribe, -inae. In this work I largely use the subfamilial system of Panero & Funk (2002; Appendices B4, D3-4); the following of their taxa have representatives in our flora:

Subfamily Carduoideae
    Tribe Cardueae (Cynareae)
Subfamily Cichorioideae
    Tribe Cichorieae (Lactuceae)
    Tribe Vernonieae

Subfamily Asteroideae
- Tribe Senecioneae
- Tribe Gnaphalieae
- Tribe Astereae
- Tribe Anthemideae
- Tribe Inuleae
- Tribe Helenieae
- Tribe Heliantheae
  - Subtribe Ambrosiinae
  - Subtribe Eupatoriinae (“Tribe Eupatorieae”)

Note that there are other subtribes in the tribe Heliantheae (and other tribes) in our flora. Only the two listed above, representing morphologically well-marked taxa, are explicitly used in the keys.

Panero and Funk’s (2002; Appendices B4, D3-4) recent treatment is based on DNA evidence and recognizes only monophyletic taxa. A consequence of the latter restriction is many more subfamilies (11) and tribes (35) than older, traditional systems, e.g., Bremer’s (1994; Appendices B2, D2). However, none of the new subfamilies (all but one representing basal branches) occur in our flora, except for their Carduoideae, which includes our most basal tribe (the Cardueae), and most of the new tribes also are not in Wisconsin. The one exception is the Heliantheae, s.l., which they split into 11 tribes, 5 of which occur in Wisconsin. Only the traditionally recognized Heliantheae, s.l., is used here; the “tribe Eupatorieae” is phylogenetically embedded in this taxon and, therefore, is treated here as subtribe Eupatoriinae. Panero and Funk's ordering of tribes is largely the same as Bremer's (1994).

Panero & Funk’s (2002) rationale for splitting up the traditional tribe Heliantheae is that, if tribe Eupatorieae is to be maintained as a tribe (the rank at which the taxon has been treated for about two hundred years), then, to avoid a paraphyletic tribe Heliantheae, that taxon would have to be split into separate tribes (ten of their eleven tribes). [A “paraphyletic” taxon is one that does not include all the descendents of its unique common ancestor; in cladistic taxonomy, only monophyletic taxa are recognized. N.B.: This is a contentious issue among taxonomists.] They recognize, but reject as too disruptive, an alternative solution, i.e., reducing tribe Eupatorieae to a subtribe within tribe Heliantheae. This latter solution is least disruptive of traditional usage, in my opinion.

Pronunciation

Pronunciation of Latin names varies among taxonomists. Most follow the rule that “anything goes” if you can get away with it. Classical Latin pronunciation (Stearn, 1966) tends to prevail in continental Europe and is the system I initially learned. Largely I continue to use that system for determining which syllable to accent and whether a vowel is long or short; however, I generally pronounce vowels and consonants as they are in English. An excellent and convenient authority for pronunciation for the flora of northeastern North America is Fernald (1950), where, in addition, meanings of generic names and epithets are given, all the work of Arthur Stanley Pease, a professor of Latin at Harvard.

Some general rules are as follows. All syllables are pronounced, including a terminal "e" (e.g., *Aloë*, *Leucanthemum vulga-re*, *Cirsium arven-se*) and all double vowels (e.g., Cichor-i-e-ae, Ambros-i-i-nae, *Erechtites hierac-i-i-folius*). Note that

diphthongs (most commonly “ae”, as in “Aster-a-ce-ae”) represent single vowel sounds (and used to be written as single symbols, e.g. “æ”).

In general the antepenultimate (third from the end) syllable is accented: *Xanthoxylum Clava-Herculus*. When the penultimate (second form the end) syllable is long, it is accented: *Anemone* (a pronunciation not used by most Americans, myself included), *Xanthoxylum americanum*. The penultimate syllable is long if it ends in two (or more) consonants: *Symphyotrichum macrophyllum*. [The “ch” of the latter genus is the Latin transcription of the single Greek letter “chi” (“τριχος”) and apparently is considered equivalent to a single consonant, and so *Symphyo’-trichum is accented on the antepenultimate syllable*.] An authority like Fernald (1950) or a Latin dictionary must be consulted for many names.

W.T. Stearn’s BOTANICAL LATIN (1966) provides an authoritative comparison of Latin vs. English pronunciation of vowels and consonants. For example, in Latin “Caesar” (“Cæsar”) is pronounced like “Kaiser” in German, with the “c” hard (like “k”) and with the diphthong “ae” sounding like the “ai” in “aisle”. Try pronouncing “Aceraceae” (A-cer-a-ce-æ) with these pronunciations and the a’s as in “father”. Note that diphthongs are pairs of vowels (or a vowel and a “semivowel”) elided together to form a vowel sound, e.g., “ai” in “aisle” and “oy” in “boy”. In Latin and previously in English, the two symbols were joined; the modern practice of not doing so accounts for such superficially unpronounceable strings of vowels as in tribe “*Spiraeeae*”, which is manageable when viewed as Spi-ræ-e-æ. Like the decapitalization of all species epithets, this is another example of “simplification” resulting in problems due to loss of information. Latin pronunciation of vowels and consonants often results in very different soundings for the names of common taxa. Try pronouncing “*Viola*” and “Violaceae” in Latin, with the “V” pronounced as “W” and the “i” as in “machine”. And then one has a sociological problem with “*Pinus*”, which in Latin (and in German!) unfortunately sounds like "penis" – exposing the whimsy in even the most hardened male undergraduate as he pairs the generic name with various, otherwise innocent epithets. One of the only places where Latin pronunciation is retained in English is for “*Thuja*”, where the “j” is always pronounced like “y”.

Rules of botanical nomenclature

The International Code of Botanical Nomenclature (2000) (ICBN) provides the rules governing how taxa are named. It provides a system that is used by taxonomists worldwide, and, the goal is stability, i.e., to reduce name changes to a minimum. It basically has no biological content, simply assuming that taxonomists recognize species and the various infraspecific and supraspecific ranks. Most name changes result from new biological information that requires new circumscriptions of taxa and changes of rank. Basic to the rules is “priority”: the first name given to a taxon, starting with Linnaeus’s *Species Plantarum* (1753), must be used – unless certain complications prevent its use.

In particular, the first epithet used for a species has priority, regardless under which genus it is was first used. For example, the first published Latin name of the golden ragwort is “*Senecio aureus* L.”, where “L.” represents the “author citation”, the name of the author of the binomial (as well as the specific epithet), in this case Linnnaeus. For biological reasons the species has now been transferred to the genus *Packera*, so its correct name is now “*Packera aurea* (L.) Löve & Löve”, where the author citation is now "(L.)" (the author of the specific epithet) and "Löve & Löve" (the authors of the binomial). Note that the species epithet (the Latin adjective for “golden”)

has its ending changed when transferred from *Senecio* (m.) to *Packera* (f.) so that it agrees in gender with the noun it modifies: "*Senecio aureus*" to "*Packera aurea*".

Although in sophisticated taxonomic and nomenclatural publications author citations are given to clarify the origin of a name, in most publications they should not be used, as they serve little purpose (ICBN, 2002: xii). In this practical book of keys, author citations would simply clutter the text.

The correct Latin names for the thistle and lettuce tribes

Reveal (1997) has found earlier places of publication of numerous suprageneric taxa in the Asteraceae. In particular, for the thistle and lettuce tribes, traditionally known under Cassini's (1815) names Cardueae and Lactuceae, respectively, Lamarck and DeCandolle published earlier (1806) the tribal names "Cynarocephalae" and "Cichoraceae". As the latter is based on the generic name *Cichorium* (though with an incorrect tribal termination), "Cichorieae" is accepted as the earliest name for the lettuce or chicory tribe. However, the former is not based simply on the generic name *"Cynara*", and so "Cardueae" remains the earliest name for the thistle tribe. The use of Cynareae in FNA (2006) is incorrect.

The fragmentation of the traditional genus *Aster*

The largest disruption of traditional nomenclature in the composite flora of North America involves the species traditionally included in the genus *Aster*. The Wisconsin species have been transferred to four new genera. Molecular phylogenies of the Astereae (simplifying only slightly) indicate that the genus *Aster*, s.str., is imbedded within an Old-World clade containing other Old-World genera and that the North American species of the tribe form a monophyletic clade with groups of species traditionally treated in the genus *Aster* forming separate branches, each more closely related to other New-World genera (e.g., *Solidago*, *Gymnosperma*, *Guttierezia*, *Euthamia*, *Townsendia*, *Chrysopsis*, *Heterotheca*, *Grindelia*, *Erigeron*, *Boltonia*, etc.) than to one another (Noyes and Riesberg, 1999, Appendix B5; Semple et al., 2002, Appendix B6). Therefore, these branches must be put into a number of small, monophyletic genera. In North America there is now only one native taxon of *Aster*, s.str. (an arctic-alpine subspecies of the Eurasian *A. alpinus*), and the remaining species are now split into 8 or 9 new genera, each more closely related to other genera than to one another.

The traditional binomials can be reconstructed from information in the keys. When the specific epithet under *Aster* differs from that in the new genus, the binomial is explicitly given. For most species, the specific epithet remains the same, and, to form the binomial under "*Aster*", simply give the adjectives masculine endings, so that they agree in gender with the masculine noun *Aster*, that they modify: from feminine (-a under *Doellingeria*, *Eurybia* & *Ionactis*) or neuter (-um or -e under *Symphyotrichum*) to masculine (-is for "boreale" & "fragile" or -us for the remainder). Adjectives ending in -es, -ens & -ior and nouns in the genitive (-ii, -iae, & the -is of "ontarionis" remain unchanged.

The genus *Packera* (Senecioneae)

The key to *Packera* (Senecioneae), a segregate from *Senecio*, incorporates the research of Alison M. Mahoney (Mahoney, 2000; Mahoney and Kowal, 2007 [?]) on the *P*. *paupercula* complex, including her more recent findings, and, more generally, my own research on the genus. Included are three diploid varieties of *P*. *paupercula* (vars. *paupercula*, *savannarum*, and *pseudotomentosa*), a group of tetraploid populations related to *P*. *paupercula* in northern Wisconsin (the "Northern tetraploid complex"), and a hexaploid population along the Mississippi River that is intermediate between *P*. *paupercula* var. *savannarum* and *P*. *plattensis* (*P*. *paupercula* var. *savannarum* + *P*. *plattensis*?). The latter two cytologically different taxa do not belong to any currently described species and complicate identifications, but users of the key must be aware of their existence.

Unfortunately, the key to the *P*. *paupercula*/*P*. *plattensis* complex is preliminary and not very useful in practice: measurements and pictures need to be added, and growing the plants and counting their chromosomes, though impractical, would be helpful (in some cases, even necessary) for accurate identifications. However, these taxa exist and are importantly responsible for the complex's being so confusing, especially when one only has information on gross morphology, especially from often inadequately collected and documented dried specimens.

The midwestern taxon originally described as "*Senecio semicordatus*" has been treated as a variety of both *Packera aurea* (Fernald, 1950) of eastern North America and *P*. *pseudaurea* (Gleason & Cronquist, 1950; FNA, 2006) of the Pacific Northwest. However, morphologically, ecologically, and cytologically, it is not closely related to either species. In particular, both *P*. *aurea* and *P*. *pseudaurea* have chromosome numbers based on x = 22, whereas the midwestern taxon has its based on x = 23. The taxon represents a species in its own right, probably best treated as conspecific with "*Senecio flavulus*" of the southern Rocky Mountains, itself also currently treated as a variety (var. *flavula*) of *P*. *pseudaurea* (FNA, 2006). However, the new combinations have not been made, so here the name *Packera pseudaurea* var. *semicordata* is used.

KEY TO TRIBES OF WISCONSIN COMPOSITAE

(R. R. Kowal, 2000 July 14-31.
Sources: L. H. Shinners (May, 1941, unpublished) ,
Fernald, 1950; Johnson & Iltis, 1963, Gleason & Cronquist, 1991; Flora of North America Editorial Committee [FNA], 2006.)

Excluded tribes.

Tribe Mutisieae: *Adenocaulon bicolor* – trail plant. Reports from WI & MN unverified (FNA, 2006).
Tribe Calenduleae: *Calendula officinalis* – pot-marigold. Doubtfully naturalized; not noted for WI & MN in FNA (2006).

1. Flowers wind-pollinated, not showy; rays absent; florets and most heads unisexual; anthers not united; phyllaries typically connate, at least basally, where free (*Iva*) , only 3-5 . . . . . Tribe 10a. HELIANTHEAE, subtribe AMBROSIINAE – ragweed subtribe.

1. Flowers insect-pollinated, usually showy; rays present or absent; heads and most florets bisexual; anthers united; phyllaries free – **IF** wind-pollinated, phyllaries free, scarious and more than 5 (*Artemisia*).

    2. Heads ligulate (florets bisexual & with a 5-toothed ligule); plants with milky sap . . . . . Tribe 2. CICHORIEAE (LACTUCEAE) – chicory (lettuce) tribe.

    2. Heads radiate (with disk florets surrounded marginally by [pistillate or neuter] ray florets) **OR** disciform ("radiate" but with ray florets without rays) **OR** discoid (only disk florets); plants with watery sap.

        3. Heads discoid and corolla lobes of the disk florets at least (and usually well over) 4 times as long as wide [in some *Centaurea*'s the marginal disk florets are enlarged, splayed outward, and neuter (heads "radiant")]; plants and/or heads usually prickly, if not, corollas not yellow; receptacle densely bristly (naked in the prickly *Onopordum*); leaves alternate; style with a ring of hairs (sometimes merely with a thickened ring) below the branches (which are often connate); anthers tailed at base . . . . . Tribe 1. CARDUEAE (CYNAREAE) – thistle tribe.

        3. Heads various but corolla lobes of the disk florets less than 4 times as long as wide; neither plants nor heads prickly; receptacle various, rarely bristly; leaves various; style otherwise; anthers (except in *Gnaphalieae* and *Inuleae*) not tailed.

            4. Heads discoid and corollas never yellow; style-branches long and slender (thread-like) , conspicuously protruding from the corolla and often attractive; receptacle naked.

5. Style-branches hispidulous, acute or acuminate at tip; corollas purple; inflorescence corymbose; leaves alternate . . . . . Tribe 3. VERNONIEAE – ironweed tribe.

5. Style-branches merely papillate, blunt (to acutish) and sometimes thickened (clavate) towards the tip; corollas white, pink, rose or blue-violet; inflorescence various; leaves alternate, opposite or whorled . . . . . Tribe 11. EUPATORIEAE – boneset tribe.

4. Heads various, but if discoid, corollas yellow (or at least creamy); style-branches much shorter (relative to their widths); receptacle various.

6. Pappus of hairs or bristles; leaves alternate (in some *Senecioneae* directly from a rhizome).

7. Phyllaries equal and in 1 row (sometimes with a few small bractlets below them); rays yellow or absent; style-branches mostly truncate, with a tuft of hairs at the end . . . . . Tribe 8. SENECIONEAE – groundsel tribe.

7. Phyllaries in 2-5 rows, equal or unequal, **IF** (rarely) in 1 row, with conspicuous white, pink, purple, or blue rays.

8. Heads discoid or disciform; phyllaries scarious, either virtually entirely or at least at the tip for a third of their lengths [styles and anthers as in *Inuleae*] . . . . . Tribe 5. GNAPHALIEAE – pussy's-toes tribe.

8. Heads radiate (rays minute in *Conyza*); phyllaries not scarious or scarious only on the margins.

9. Giant perennial herb 1-3 m tall, with basal leaves often 1 m long, disk of head more than 2 cm wide, and rays more than 4 cm long, which are yellow, numerous, and narrowly linear; style branch slightly clavate and glabrous; anthers tailed at base; infrequently adventive . . . . . Tribe 4. INULEAE – elecampane tribe.

9. Plant smaller in all parts; rays of various colors and shapes; style branch with a lanceolate or elongate-deltoid hairy appendage; anthers rounded at base . . . . . Tribe 6. ASTEREAE – aster tribe.

6. Pappus absent **OR** of awns, scales, or teeth; leaves alternate or opposite.

10. Phyllaries with scarious or hyaline margins; leaves alternate.

11. Leaves entire, not aromatic; receptacle naked; style branch with a lanceolate or elongate-deltoid hairy appendage . . . . . Tribe 6. ASTEREAE (*Boltonia*) – aster tribe.

11. Leaves toothed, lobed, or finely divided, often aromatic; receptacle chaffy or naked; style-branches mostly truncate, with a tuft of hairs at the end (like *Senecioneae*) . . . . . Tribe 7. ANTHEMIDEAE – camomile tribe.

10. Phyllaries not at all scarious or hyaline, **OR IF SO**, leaves opposite; leaves alternate or opposite.

    12. Receptacle naked; rays present, widest at the prominently 3-lobed apex; leaves alternate and lanceolate to narrowly elliptic . . . . . Tribe 9. HELENIEAE – sneezeweed tribe.

    12. Receptacle chaffy (absent in *Dyssodia*, with unremarkable rays and opposite pinnatisect leaves); rays present or absent, but when present usually not as above, but **BUT IF SO**, then the leaves opposite and either lobed or pinnatifid . . . . . Tribe 10. HELIANTHEAE – sunflower tribe.

Tribe 1. CARDUEAE (CYNAREAE) – thistle tribe

(Source: Johnson and Iltis 1963; Gleason and Cronquist, 1991; FNA, 2006; edited by R. R. Kowal, 2006 July 24.)

1. Neither plants nor heads prickly **OR** phyllaries spine-tipped and corollas yellow; achenes obliquely attached to the receptacle; marginal disk florets often enlarged and showy; phyllaries often with margins scarious and deeply cleft at tip (laciniate); pappus hairs mostly less than 3 mm long or lacking . . . . . CENTAUREA – star-thistle.

1. Plants and/or heads prickly; corollas not yellow; achenes attached by the base to the receptacle; florets all alike; phyllaries not laciniate at tip; pappus hairs usually more than 5 mm long.

    2. Leaves unarmed, broadly rounded at base; tip of phyllary a hook . . . . . ARCTIUM – burdock.

    2. Leaves prickly, lanceolate to ovate; tip of phyllary a straight spine or merely mucronate.

        3. Heads 1-flowered, aggregated into globose secondary heads . . . . . ECHINOPS – globe-thistle.

        3. Heads many-flowered, only rarely sessile.

            4. Pappus plumose; phyllaries with needle-like spiny tips or merely mucronate, often with a glutinous ridge on back . . . . . CIRSIUM – thistle.

            4. Pappus barbellate to capillary; phyllaries not glutinous.

                5. Receptacle bristly; leaves and stem wings glabrous or nearly so; pappus capillary . . . . . CARDUUS – plumeless thistle.

                5. Receptacle alveolate (pitted) , not bristly; leaves and stem wings densely cottony-velutinous; pappus barbellate; extremely rare adventive . . . . . ONOPORDUM – Scotch thistle.

ARCTIUM – burdock

(s = 2x; x = 18)

1. Heads 1-1.6 cm long, (1.5-) 2-2.5 cm wide, subsessile or short pedunculate, in a racemose inflorescence; petioles of larger leaves hollow; common weed . . . . . *A. minus* – common burdock.

1. Heads 1.5-2.5 cm long, 1.5-3.5 cm wide, long pedunculate, in a corymbose inflorescence; petioles solid or hollow; rare weeds.

    2. Heads 1.5-1.7 cm long, 1.5-2.1 cm wide, phyllaries densely cottony-pubescent; petioles of larger leaves hollow . . . . . *A. tomentosum* – hairy burdock, cotton burdock.

    2. Heads ca 2.5 cm long, 3-3.5 cm wide, phyllaries glabrous; petioles of larger leaves solid . . . . . *A. Lappa* – great burdock.

CARDUUS – plumeless thistle

1. Phyllaries mostly 2 mm wide or more; involucres 2.8-3 cm long, heads solitary, nodding (s = 2x; x = 8) . . . . . *C. nutans* – nodding thistle.

1. Phyllaries rarely as much as 2 mm wide; involucres 1.4-2 cm long, heads not nodding, clustered or solitary (s = 2x; x = 11) . . . . . *C. acanthoides* – plumeless thistle.

CENTAUREA – star-thistle, batchelor's button
including the genera PLECTOCEPHALUS and ACROPTILON

(Extremely rare adventive: *C. diffusa* – white knapweed.)

(x = 8-15)

1. Corollas yellow; phyllaries usually spine-tipped; leaf bases more-or-less decurrent on the more or less winged stem; very rare adventives.

    2. Phyllaries spineless or tipped by weak spines 1-2 mm long . . . . . *C. macrocephala* – big-head knapweed.

    2. Phyllaries tipped by long divergent spines 5-25 mm long.

        3. Heads sessile, each closely subtended and more-or-less concealed by involucre-like cluster of expanded, foliar bracts . . . . . *C. (Cnicus) benedicta* – blessed thistle.

        3. Heads pedunculate or, if sessile, not concealed by involucre-like cluster of expanded, foliar bracts.

            4. Central spines of phyllaries very slender, 4-6 (-9) mm long, with conspicuous secondary spines near the flattened base . . . . . *C. melitensis* – Maltese star-thistle.

4. Central spines of phyllaries stout, 17-20 mm long, with minute secondary spinules near the terete base . . . . . *C. solstitialis* – yellow star-thistle, St. Barnaby's thistle.

1. Corollas blue, purple, lavender, pink to white; phyllaries not spine-tipped; leaf bases not decurrent.

5. Principal cauline leaves deeply pinnatifid into long narrow segments.

6. Biennial with base lacking old leaf bases; involucres 1-1.4 cm long; phyllaries smooth, strongly ribbed, with black-brown pectinate tips 1-2 mm long; common weed . . . . . *C. Stoebe* subsp. *micranthos* (*C. maculosa*, *C. Biebersteinii*) – spotted knapweed.

6. Perennial with base conspicuously clothed with long, chaffy-fibrous old leaf-bases; involucres 2-2.5 cm long; phyllaries arachnoid, with dark pectinate tips 4-6 mm long; very rare adventive . . . . . *C. Scabiosa* – hard-heads.

5. Principal cauline leaves simple or merely coarsely dentate or lyrate.

7. Plants annual.

8. Florets usually deep blue; involucres 1-1.5 cm long, ovoid to cylindrical, on slender, mostly leafless peduncles; upper leaves linear, flocculose-pubescent, entire; pappus only 2-3 mm long; common in cultivation . . . . . *C. Cyanus* – bachelor's-button, cornflower.

8. Florets rose-purple; involucre 1.5-3 cm long, subglobose, on very leafy peduncles pronouncedly inflated at the top; leaves broadly lanceolate to oblong-lanceolate, scabrous-puberulent, subentire to entire; pappus well developed, 6-10 mm long; very rare adventive . . . . . *Plectocephalus* (*Centaurea*) *americanus* – basketflower.

7. Plants perennial.

9. Involucre 0.9-1.2 cm long, whitish green; outer phyllaries entire at tips; pappus 5-11 mm long; very rare adventive . . . . . *Acroptilon* (*Centaurea*) *repens* – Russian knapweed.

9. Involucre (1-) 1.3-1.8 cm long, brown to black, outer phyllaries laciniate to pectinate at tips; pappus less than 3 mm long or absent.

10. Phyllary appendages decurrent along phyllary margins . . . . . *C. montana* – mountain bluet.

10. Phyllary appendages not or only slightly decurrent along phyllary margins.

11. Outermost phyllaries rounded to rounded ovate, the light brown scarious appendages entire or irregularly toothed to laciniate with very fine irregular cilia; pappus none . . . . . *C. Jacea* – brown knapweed.

11. Outermost phyllaries deltoid to deltoid-ovate, dark appendages deeply and regularly cut (pectinate); pappus very short (ca 1 mm) or none.

12. Peripheral corollas of head not expanded and showy; pappus blackish, shorter than 1 mm; involucres appearing totally black, green parts of phyllaries obscured by black appendages; upper cauline leaves short pointed . . . . . *C. nigra* – black knapweed.

12. Peripheral corollas of head enlarged, splayed outwards, and showy (heads radiant); pappus absent or rudimentary, when present usually not blackish; green parts of phyllaries sometimes evident or appendages light to dark brown; upper cauline leaves blunt.

13. Heads relatively narrow, pressed involucres usually longer than wide; involucres black and green, green parts of phyllaries usually visible . . . . . *C. nigrescens* – short-fringed knapweed.

13. Heads relatively broad, pressed involucres usually as wide or wider than long; involucres light to dark brown, green parts of phyllaries usually not visible; very rare adventive . . . . . *C. ×Monctonii* (*C. Debauxii*) – meadow knapweed.

CIRSIUM – thistle

(x = 17; n = 18-10)

1. Phyllaries distinctly spine-tipped (at least the outer and middle) , spine usually more than 2 mm long, but when very short, the larger involucres 2 cm or more in diameter.

2. Leaves scabrous-hispid or crisped-hispid and also sometimes silky-pubescent above, more or less cobwebby and sometimes crisped-hispid or tomentose beneath.

3. Cauline leaves conspicuously decurrent, scabrous-hispid above, sparsely to densely cobwebby beneath; phyllaries herbaceous, spreading, gradually tapered into elongate spiny tips, lacking a dorsal glutinous ridge; common introduced weed (s = 4x; x = 17) . . . . . *C. vulgare* – bull thistle.

3. Cauline leaves not decurrent, crisped-hispid with multicellular hairs and also sometimes sparingly silky-pubescent above; phyllaries not herbaceous, appressed, with a dorsal glutinous ridge.

    4. Leaves crisped-hispid on both surfaces, green; phyllaries with an erect apical spine; involucres 3-5 cm long; stem 3-5 dm tall, from persistent basal rosettes; dry or mesic prairies; rare (s = 2x; x = 15) . . . . . *C. pumilum* var. *Hillii* (*C. Hillii*) – Hill's thistle.

    4. Leaves crisped-hispid above, white-tomentose beneath; phyllaries with an abruptly spreading apical spine; involucres 2.5-3.5 cm long; stem mostly 6-15 dm tall, basal rosettes not persistent.

        5. All leaves deeply lobed (except in juvenile forms) , the lobes linear-acuminate, terminating in stout spines, the thickish margins involute; involucral spines 3-7 mm long; plants mostly of open places (s = 2x, 2x-1, 2x-2; x = 11) . . . . . *C. discolor* – prairie thistle.

        5. Leaves shallowly lobed, irregularly dentate, serrate or entire, with small, weak spines, the margins thin, not involute, the lower leaves (and those of juvenile forms) sometimes deeply lobed, then the lobes wide, broadly acute; involucral spines 2.5-4.5 mm long; plants mostly of woods (s = 2x; x = 9) . . . . . *C. altissimum* – wood thistle.

2. Leaves white-tomentose on both surfaces, often more thinly so above, totally lacking hispidity; dorsal glutinous ridge present on phyllaries.

    6. Middle cauline leaves conspicuously decurrent, the narrowly linear to oblong lobes very distant, leaf blade divided nearly to midrib, the decurrent wing often similarly lobed; corollas cream-colored; plants not conspicuously spinescent; dunes of Lake Michigan (s = 2x; x = 17) . . . . . *C. Pitcheri* – dune thistle.

    6. Leaves not decurrent on stem or only very shortly so (to 1 cm) , the lobes lanceolate or deltoid; corollas purple or lavender, rarely white; rare introduced weeds.

        7. Leaves narrowed to the base, rarely clasping; anthers 6.5-11.8 mm long, florets 2.1-3.6 cm long, achenes 3.5-5 mm long, yellowish brown with apical yellow band ca ½ mm wide; involucres 2.0-2.7 cm long, phyllaries narrow and slender; leaves lobed nearly to midrib, lobes narrowly triangular, usually less than 7 mm wide at base; plants strongly clonal by adventitious shoots on roots; rare adventive (s = 2x; x = 11 & 12) . . . . . *C. Flodmanii* – Flodman's thistle.

7. Leaves broadest near the base, partially clasping; anthers 9.4-13.3 mm long, florets 2.7-4 cm long, achenes 5-7 mm long, brown, yellow apical band lacking or very narrow; involucres 3-3.5 cm long, phyllaries broad and stout; leaves shallowly lobed, lobes broadly triangular, usually more than 7 mm wide at base; plants weakly clonal by adventitious shoots on roots; rare adventive (s = 2x; x = 13) . . . . . *C. undulatum* – wavy-leaved thistle.

1. Outer and middle phyllaries with at most a short spine or mucro, this up to 1 mm long (and then involucre about 1 cm in diameter).

8. Perennials, strongly clonal by adventitious shoots on deep roots; imperfectly dioecious; heads numerous, crowded in 2's to 4's or short pedunculate; involucre 1-2 (-2.6) cm long, 0.8-1.1 cm wide at base when in flower, phyllaries usually glabrous and with a narrow dorsal glutinous ridge; very common weed (s = 2x; x = 17) . . . . . *C. arvense* – Canada thistle.

8. Biennials (at least monocarpic); florets perfect; plants of moist habitats.

9. Leaf bases not decurrent; heads solitary or several, pedunculate, not crowded; involucre 2.2-2.7 cm long, 1.2-1.9 cm wide at base when in flower, phyllaries cobwebby with prominent glutinous dorsal ridge; wet prairies and sedge meadows, common (s = 2x [20, 21, 22, 23, 30], x = 10 & 11) . . . . . *C. muticum* – swamp thistle.

9. Leaf bases strongly decurrent into prominent wings on stem; heads many, sessile or sub-sessile, crowded into a dense terminal inflorescence; involucre 0.9-1.2 cm long, phyllaries neither conspicuously glutinous nor cobwebby; rare, N Wis. (s = 2x; x = 17) . . . . . *C. palustre* – European swamp thistle.

ECHINOPS – globe-thistle

(s = 2x; x = 15 & 16)

. . . . . *E. sphaerocephalus* – great globe-thistle.

ONOPORDUM – cotton or Scotch thistle

(s = 2x; x = 17)

. . . . . *O. Acanthium* – Scotch thistle.

Tribe 2. CICHORIEAE (LACTUCEAE) – chicory (lettuce) tribe

(Source: Johnson and Iltis, 1963; FNA, 2006;
edited by R. R. Kowal, 2007 February 2.)

1. Pappus absent . . . . . LAPSANA – nipplewort.

1. Pappus present.

2. Pappus of numerous simple hairlike (capillary) bristles only.

3. Achenes flattened or compressed.

4. Achenes not beaked, not enlarged at the tip; heads yellow with many florets (80 or more) . . . . . SONCHUS – sow-thistle.

4. Achenes beaked or unbeaked, but constricted below enlarged tip; heads yellow or blue, with relatively few florets (5-56).

5. Perennials, arising from adventitious shoots on deep roots, with aerial shoot terminating an underground vertical stem (3-12+ cm long) , roughly uniform in diameter and bearing adventitious roots; heads large and showy, 2-3 cm broad, violet-blue, with 15-50 florets and involucres 13-20 mm long; achenes with a short (< 2 mm long) , stout beak; rare adventive . . . . . MULGEDIUM – blue lettuce.

5. Annuals or biennials, with a relatively shallow, tapering tap root (sometimes obscured by lateral roots arising near base of stem); heads mostly smaller and not showy; fresh corollas yellow or whitish, **IF** blue, involucres < 13 mm long **OR** achenes with a long, filiform beak [Caution: corollas often dry to a different color] . . . . . LACTUCA – wild lettuce.

3. Achenes cylindrical, fusiform or terete, not flattened.

6. Plants scapose; achenes beaked, or tapered and the beak lacking; pappus white; phyllaries in more than one series.

7. Achenes tuberculate-muricate above with a long filiform beak; scapes hollow; leaves variously runcinate-pinnatifid . . . . . TARAXACUM – dandelion.

7. Achenes not tuberculate-muricate above, slightly tapered, but not beaked; scapes solid; leaves grasslike, the margins pubescent . . . . . NOTHOCALAIS – prairie dandelion.

6. Stems branched or unbranched and leafy or subscapose; achenes truncate or tapered, rarely short-beaked; pappus pale yellow, red-brown, tannish or white; phyllaries uni- or biseriate.

    8. Annuals or biennials with well developed, usually pinnatifid basal leaves; inflorescences open corymbs or panicles of yellow campanulate heads; pappus white; main phyllaries uniseriate . . . . . CREPIS – hawk's-beard.

    8. Perennials; cauline leaves lanceolate to palmately lobed, or unlobed and dentate to entire; inflorescences branched racemes, panicles of cylindrical drooping heads, or corymbs with erect campanulate heads; pappus tawny to brown, not pure snowy white; main phyllaries biseriate.

        9. Leaves lanceolate to palmately lobed; heads cylindrical, nodding; corolla pink, purplish to yellow or white; pappus pale yellow to red-brown; plants sometimes tomentose, not glandular . . . . . PRENANTHES – white-lettuce.

        9. Leaves spatulate to oblanceolate, not lobed; heads campanulate, erect; corolla yellow to red-orange; pappus tannish; plants usually glandular-pubescent . . . . . HIERACIUM – hawkweed.

2. Pappus otherwise (plumose bristles, scales, scales mixed with bristles, or a ring of numerous minute bristles).

    10. Pappus of plumose (feathery) bristles only.

        11. Plants leafy stemmed, branched, not scaly-bracted above; leaves cauline, grasslike . . . . . TRAGOPOGON – goat's-beard.

        11. Plants scapose, scaly bracted above; leaves basal, coarsely dentate

            12. Inner and outer achenes uniform, not slender-beaked; receptacle naked . . . . . LEONTODON – hawkbit.

            12. Inner achenes with long, slender beaks; receptacle chaffy . . . . . HYPOCHAERIS – cat's-ear.

    10. Pappus of scales and/or bristles (sometimes minute).

        13. Pappus of 5 to numerous outer scales alternating with 5 to numerous scabrous hairs; plants scapose or sub-scapose, branched or not branched; corolla yellow . . . . . KRIGIA – dwarf-dandelion.

13. Pappus a ring of numerous minute (≤ 0.2 mm) scales or bristles; plants profusely branched; corolla blue, rarely pink or white . . . . . CICHORIUM – chicory.

CICHORIUM – chicory

(s = 2x; x = 9)

. . . . . *C. Intybus* – chicory, blue sailors.

CREPIS – hawk's-beard

(Very rare waif: *C. foetida* – stinking hawk's-beard)

1. Achenes distinctly slender-beaked; rare waif (s = 2x; x = 4) . . . . . *C. setosa* – bristly hawk's-beard.

1. Achenes narrowed toward the top but scarcely beaked.

   2. Ligules yellow; inner surface of inner series of bracts microscopically appressed-puberulent; locally common (s = 2x; x = 4) . . . . . *C. tectorum* – narrow-leaved hawk's-beard.

   2. Ligules yellow, minutely tipped with red; inner surface of inner series of bracts glabrous; rare adventive (s = 2x; x = 3) . . . . . *C. capillaris* – smooth hawk's-beard.

HIERACIUM – hawkweed

(s = 2x, 3x [most apomicts]; x = 9)

(Hybrids between *H. scabrum* & *H. umbellatum* are not uncommon.
Rare adventive: *H. murorum* – wall hawkweed. Not noted for WI & MN in FNA (2006).

1. Plants scapose; leaves clustered at base, linear to spatulate or oblanceolate, sessile, pilose or glabrous, entire; heads yellow or red-orange; hairs less than 1 cm long or absent; introduced weeds.

   2. Scapes 0.4-4.5 dm tall, with 1 or rarely 2 or 3 heads; leaves pale beneath with close minute tomentum; extremely rare adventive . . . . . *H. Pilosella* – mouse-ear hawkweed.

   2. Scapes (1-) 2-10 dm tall with 7 to many heads; leaves with longer hairs or glabrous beneath.

3. Florets bright red-orange; involucre densely covered with black-glandular and eglandular hairs; leaves spatulate to oblanceolate, with rusty-red pubescence; stolons present . . . . . *H. aurantiacum* – orange hawkweed, devil's paintbrush.

3. Florets yellow; leaves oblanceolate to spatulate.

4. Leaves narrowly oblanceolate to spatulate, essentially glabrous; stolons lacking, short rhizomes present; peduncles minutely white-stellate . . . . . *H. piloselloides* (*H. florentinum*) – glaucous king-devil.

4. Leaves oblanceolate with tawny-white hairs on both surfaces; stolons erect or arching with abundant fine pubescence, rhizomes lacking or inconspicuous; peduncles glandular hirsute . . . . . *H. caespitosum* (*H. pratense*) – yellow king-devil.

1. Plants not scapose; leaves not clustered at base, **OR**, if so, then plants with abundant hairs 7-20 mm long; leaves lanceolate to elliptic or spatulate, petioled or sessile-clasping, pilose to glabrous, the margins dentate to denticulate or subentire; heads yellow; rhizomes and stolons lacking [except *H. Lachenallii* (*H. vulgatum*)]; North American natives [except *H. Lachenallii* (*H. vulgatum*)].

5. Leaves chiefly basal, abruptly reduced upward; plants, except the inflorescence, densely long-pilose, the hairs (7-) 10-20 mm long; peduncles with yellow-orange gland-tipped hairs; prairies, S and central Wisconsin . . . . . *H. longipilum* – long-haired or prairie hawkweed.

5. Leaves often cauline; plants with hairs to 3 mm long or glabrous; peduncles glabrous, scabrous, stellate or appressed-pubescent, sometimes glandular.

6. Leaves broadly elliptic, tapering to long and villous petioles, coarsely dentate; involucres 6-8 mm long, the hairs stellate; stem glabrous [or hairy the length]; very rare adventive . . . . . *H. Lachenallii* (*H. vulgatum*) – European hawkweed.

6. Leaves various, tapering to shorter petioles or sessile, toothed to subentire; involucres 5-13 mm long, glabrous to glandular; stem glabrous or hairy; common.

7. Leaves spatulate, the lower petioled, the upper sessile, subentire; involucres (and peduncles) black-glandular, 5-8 mm long; stem setose . . . . . *H. scabrum* – sticky hawkweed.

7. Leaves lanceolate to oblanceolate, sessile, toothed; involucres (and peduncles) rarely glandular, 8-13 mm long; stem glabrous to villous-hispid or setose below . . . . . *H. umbellatum* (*H. Kalmii*, *H. scabriusculum*) – northern hawkweed.

HYPOCHAERIS – cat's-ear

(s = 2x; x = 4)

. . . . . *H. radicata* – spotted cat's-ear.

KRIGIA – dwarf-dandelion

1. Plants annual; achene conical; pappus of 5 outer scales alternating with 5 inner scabrous hairs; scape leafless; rare, S Wisconsin (s = 2x, 4x; x = 5) . . . . . *K. virginica* – Virginia dwarf-dandelion.

1. Plants perennial; achene cylindrical; pappus of more numerous scales and scabrous hairs; scape bearing 1-2 reduced sessile leaves; peduncles glabrous or glandular; common throughout (s = 2x, 4x; x = 5) . . . . . *K. biflora* – orange dwarf-dandelion.

LACTUCA – lettuce

(x = 9 & 17)

1. Achenes with short stout beak or beak lacking; at least the lower leaves deeply lobed, petiolate or sessile, but if sessile the bases not sagittate-clasping; corolla bluish to whitish; tall woodland species.

    2. Pappus white; leaves lyrately lobed, petioled; florets bluish; S Wisconsin (s = 2x; x = 17) . . . . . *L. floridana* – woodland or blue lettuce.

    2. Pappus brown or tawny, never white; leaves sessile, the lower lobed, the upper entire; florets very pale bluish to ivory or whitish, inconspicuous; common throughout (s = 2x; x = 17) . . . . . *L. biennis* – woodland or tall blue lettuce.

1. Achenes with distinct filiform beak; leaves variously lobed or entire, petiolate or sessile, but if sessile the bases sagittate-clasping; corollas yellow (sometimes aging or drying to bluish).

    3. Body of achenes with short white hispid hairs near summit; leaves with margins and midribs spinulose; common weed (s = 2x; x = 9) . . . . . *L. serriola* – prickly lettuce.

    3. Body of achenes lacking hairs near summit; leaves not spinulose (except in *L. ludoviciana*, which has involucres longer than 15 mm).

        4. Achenes (including beak) 4.5-6.5 mm long; involucre 10-15 mm long; leaves lobed or the upper unlobed, the margins dentate to entire; corollas yellow; very common (s = 2x; x = 17) . . . . . *L. canadensis* – tall wild lettuce.

4. Achenes (including beak) 7-10 mm long; involucre 15-23 mm long; leaves lobed to dentate, pronouncedly glaucous and rather thick-textured, spinulose on margin and midrib beneath; corollas violet-bluish or yellow; prairies (s = 2x; x = 17) . . . . . *L. ludoviciana* – prairie lettuce.

LAPSANA – nipplewort

(s = 2x; x = 6, 7, 8)

. . . . . *L. communis* – nipplewort

LEONTODON – hawkbit

1. Scape hairy-bracted above; heads usually several, erect before anthesis; pappus of plumose bristles in all florets (s = 2x, 4x; x = 6) . . . . . *L. autumnalis* – fall-dandelion.

1. Scape naked; heads solitary, nodding before anthesis; pappus of marginal flowers reduced to a crown of short scales (s = 2x; x = 4) . . . . . *L. taraxicoides* subsp. *saxatilis* (*L. taraxicoides*) – little hawk's-bit.

MULGEDIUM – blue lettuce

(s = 2x; x = 9)

. . . . . *M.* (*Lactuca*) *pulchellum* (*L. tatarica* subsp. *pulchella*) – showy blue lettuce.

NOTHOCALAIS

(s = 2x; x = 9)

. . . . . *N. cuspidata* (*Microseris cuspidata*) – prairie or false dandelion.

PRENANTHES – white-lettuce

1. Inflorescence an open panicle; leaves, at least the lower, long-petiolate, broadly ovate, deltoid to sagittate, or hastate.

   2. Basal leaves deeply palmately lobed; plants glabrous or nearly so; phyllaries purplish; pappus rich red-brown; very common throughout (s = 4x; x = 8) . . . . . *P. alba* – white-lettuce, rattlesnake root, lion's foot.

   2. Basal leaves coarsely and irregularly dentate; plants pubescent in inflorescence; phyllaries green; pappus pale yellow to brown; rare, S Wisconsin (s = 4x; x = 8) . . . . . *P. crepidinea* – midwestern white-lettuce.

1. Inflorescence a dense, strict, elongate racemose panicle (thyrse); leaves, at least the lower, spatulate, the rounded blades gradually attenuate into the petiole; uncommon species of prairies.

    3. Leaves of inflorescence with broad sessile auriculate bases; florets 8-13 mm long, white to purplish; leaves and stem glabrous and glaucous except in the uppermost inflorescence; S and W Wisconsin (s = 2x; x = 8) . . . . . *P. racemosa* – glaucous white-lettuce.

    3. Leaves of inflorescence lanceolate, with attenuate narrow bases; florets (8-) 11-15 (-19) mm long, yellow; stem, at least the upper parts, and leaves scabrous, not glaucous; S Wisconsin (s = 2x; x = 8) . . . . . *P. aspera* – rough white-lettuce.

SONCHUS – sow-thistle

1. Perennials, strongly clonal by adventitious shoots on deep roots; heads large, the involucre 12-20 mm long; leaf bases auriculate, more or less clasping the stem, the rounded auricles small and inconspicuous; achenes 5-nerved; terminal leaf lobe elongate-triangular to oblong . . . . . *S. arvensis*.

    2. Peduncles and involucre glandular (s = 6x; x = 9) . . . . . subsp. *arvensis* – perennial sow-thistle.

    2. Peduncles and involucre glabrous (s = 4x; x = 9) . . . . . subsp. *uliginosus* (var. *glabrescens*) – marsh sow-thistle.

1. Annuals with elongate taproots; heads smaller, mostly 9-12 (-14) mm long; leaf bases auriculate-clasping, the acute or rounded auricles large and conspicuous; achenes 3- to 5-nerved; terminal leaf lobe triangular.

    3. Auriculate leaf bases acute, the leaf margins sparsely prickly; upper leaf surface glaucous light green; achenes striate with 5 weak nerves; terminal leaf lobe sharply equilaterally triangular, cut nearly to midrib (s = 4x, 4x-4; x = 9) . . . . . *S. oleraceus* – common sow-thistle.

    3. Auriculate leaf bases rounded, the leaf margins abundantly spinulose-dentate; upper leaf surface dark green and lustrous, not glaucous; achenes 3-nerved; leaves mostly unlobed, **OR**, if lobed, terminal leaf lobe broadly or irregularly triangular, the leaf cut about halfway to midrib (s = 2x; x = 9) . . . . . *S. asper* – prickly sow-thistle.

TARAXACUM – dandelion

1. Mature achenes reddish to deep brown or purplish; leaves generally deeply lobed or cut to midrib (s = 2x, 3x, 4x; x = 8) . . . . . *T. erythrospermum* (*T. laevigatum*) – red-seeded dandelion.

1. Mature achenes tan to olivaceous, not red; leaves various, deeply lobed to entire (s = 3x, 5x; x = 8) . . . . . *T. officinale* – common dandelion.

TRAGOPOGON – goat's-beard

(s = 2x; x = 6)

1. Ligules pale violet to deep purple; achenes abruptly tapering to beak longer than achene body; phyllaries 7-11; cultivated and rarely escaped . . . . . *T. porrifolius* – salsify, vegetable-oyster.

1. Ligules yellow; achenes gradually tapering to a beak longer or shorter than the achene body; common weeds.

    2. Phyllaries generally 8 or 9, margined with red or purple, about equal to the corollas; achene beak shorter than body; peduncle slender, not enlarged below the head; leaf tips recurved . . . . . *T. pratensis* – showy goat's-beard.

    2. Phyllaries generally 11-13 (only 8 on later heads and small plants) , not margined with red or purple, much longer than corollas; achene beak longer than body; peduncle strongly enlarged (inflated) below the head; leaf tips not recurved . . . . . *T. dubius* – fistulose goat's-beard.

Tribe 3. Vernonieae: 1
Tribe 4. Inuleae: 1

Tribe 3. VERNONIEAE – ironweed tribe

(Source: Johnson and Iltis, 1963.)

VERNONIA – ironweed

(s = 2x; x = 17)

. . . . . *V*. *fasciculata* – smooth ironweed.

Tribe 4. INULEAE – elecampane tribe

(Source: Beals and Peters, 1966.)

INULA

(s = 2x; x = 10)

. . . . . *I*. *Helenium* – elecampane.

Tribe 5. GNAPHALIEAE – the pussy's-toes tribe

(Source: Beals and Peters, 1966; FNA, 2006; edited by R. R. Kowal, 2006 July 30.)

1. Cauline leaves few, much smaller than those of the persistent basal rosette, strongly ascending; stolons present; plants either staminate or pistillate, populations dioecious (or with only pistillate plants in agamospermous taxa) . . . . . ANTENNARIA – pussy's-toes.

1. Cauline leaves many, about the same size as the basal leaves, which soon wither; stolons absent.

    2. Phyllaries pure white, with conspicuous, longitudinal creases creating the appearance of wrinkled tissue paper; populations dioecious, although pistillate plants often with heads having a few staminate florets in the center; dried plants without a strong odor . . . . . ANAPHALIS – everlasting.

    2. Phyllaries grayish white, yellow or brown, scarious, with very small longitudinal ridges but no conspicuous creases; heads bisexual, with pistillate florets marginally and staminate heads in center; dried plants with strong tobacco-like odor.

        3. Perennial with narrow, spiciform or subcapitate inflorescence; achenes sparsely strigose; boreal (Outer Island of Apostle Islands) . . . . . OMALOTHECA – Arctic-cudweed.

        3. Annual or biennial; inflorescence various; achenes smooth or papillate.

            4. Heads 2-3 mm long, in capitate leafy-bracted clusters; upper stems very densely white-floccose-tomentose, obvious to the naked eye; stems usually much branched, 1-2 dm tall . . . . . GNAPHALIUM – marsh cudweed.

            4. Heads 4-6 mm long, capitate or corymbose; upper stems with appressed or nearly microscopic loose-spreading tomentum; stems erect, seldom branching except within a corymbose inflorescence, 1-10 dm tall . . . . . PSEUDOGNAPHALIUM – cudweed.

ANAPHALIS – everlasting

(s = 2x; x = 14)

. . . . . *A. margaritacea* – pearly everlasting.

ANTENNARIA – pussy's-toes, everlasting, ladies'-tobacco

(Source: Beals and Peters, 1966; Bayer and Stebbins, 1982; Bayer, 1989. Edited by R. R. Kowal to include only Wisconsin species.)

(x = 14)

1. Basal leaves with 3-7 prominent nerves.

    2. Pistillate involucres 5-7 mm long; pistillate corollas 3-4 mm long; staminate corollas 2-3.5 mm long; basal leaves tomentose adaxially; young stolons mostly ascending; staminate and pistillate plants equally common; plants of Appalachians, Piedmont, the Atlantic seaboard, and the Driftless Area of Wisconsin and Minnesota (s = 2x) . . . . . *A. plantaginifolia* – plantain-leaved pussy's-toes.

    2. Pistillate involucres 7-10 mm long; pistillate corollas 4-7 mm long; staminate corollas 3.5-5 mm long; basal leaves tomentose or glabrous adaxially; young stolons mostly lying flat with only the tips ascending [decumbent]; sexual and agamospermous populations present; plants widespread throughout the eastern United States (s = 4x, 5x, 6x, 8x) . . . . . *A. Parlinii* – Parlin's pussy's-toes.

        3. Basal leaves glabrous adaxially or nearly so; summit of young cauline stem usually glandular . . . . . subsp. *Parlinii*.

        3. Basal leaves tomentose adaxially; summit of young cauline stem usually glandless . . . . . subsp. *fallax* (*A. munda*).

1. Basal leaves with 1 prominent nerve.

    4. Stolons 5-8 cm long, lying flat but with tips ascending [decumbent], leaves along the stolon about equal in size to those of the basal rosette; basal leaves having a distinct petiole or nearly so; plants widespread north of glacial margin in the eastern United States; pistillate plants common, staminate rare or absent (s = 4x, 6x) . . . . . *A. Howellii* subsp. *neodioica*.

    4. Stolons 8-12 cm long, lying flat [procumbent], leaves along the stolon smaller than those of the basal rosette; basal leaves gradually tapering to the base, non-petiolate.

        5. Young leaves glabrous adaxially, bright green; pistillate plants common, staminate rare or absent; widespread above terminal glacial margin (s = 4x, 6x) . . . . . *A. Howellii* subsp. *canadensis*.

        5. Young leaves tomentose adaxially, gray-green; staminate plants equal in number to pistillate or completely absent.

6. Upper cauline leaves tipped by a flat or curled, scarious, flag-like tip; phyllaries brown at base; pistillate and staminate plants equally common (s = 2x) . . . . . *A. neglecta*.

6. Upper cauline leaves subulate or only those about the corymb scarious-tipped; phyllaries white or green at base; pistillate plants only, staminate absent (s = 4x, 6x) . . . . . *A. Howellii* subsp. *petaloidea*.

GNAPHALIUM – marsh cudweed

(s = 2x; x = 7)

. . . . . *G*n. (*Fillaginella*) *uliginosum* – marsh cudweed.

PSEUDOGNAPHALIUM – cudweed, everlasting

(Source: Ralph F. Peters *in* Beals and Peters, 1966; Ballard and Kowal, 1994; Feller, 2000; FNA 2006.)

(x = 7)

1. Leaf bases decurrent; middle or lower stem with glandular-hirsute pubescence 0.2-0.5 (-1) mm long; leaves usually 10-15 times as long as wide, tapering gradually to an acute tip; achenes distinctly papillate under high magnification (s = 4x) . . . . . *Ps*. (*Gnaphalium*) *Macounii* – western or clammy cudweed.

1. Leaf bases not decurrent; middle or lower stem with glandular-hirsute pubescence less than 0.25 mm long or lacking; leaves usually only 7-10 times as long as wide, tapering more abruptly to the acute tip; achenes ridged but glabrous and not papillate.

   2. Stem glandular-puberulent, scarcely wooly except in inflorescence . . . . . *Ps*. *microdenium* (*Gnaphalium Helleri* var. *microdenium*) – delicate cudweed.

   2. Stem wooly, scarcely glandular except at base.

      3. Plants biennial, 1.5-10 dm tall, first year's individuals only vegetative rosettes; tomentum of stem dense and close; leaves glandular, with crisped margins; phyllaries rounded or obtusely pointed at tip; common throughout all but northernmost Wisconsin (s = 4x) . . . . . *Ps*. (*Gnaphalium*) *obtusifolium* – fragrant cudweed.

      3. Plants annual, 0.1-3 dm tall, no vegetative rosettes in population; tomentum of stem loose and flocculent; leaves eglandular, with flat margins; phyllaries linear, acute and often toothed at tip; ledges of sandstone cliffs along Wisconsin, Kickapoo and Pine Rivers in the Driftless Area, rare . . . . . *Ps*. (*Gnaphalium*) *saxicola* – cliff cudweed.

OMALOTHECA – Arctic-cudweed

(s = 4x; x = 14)

. . . . . *O*. (*Gnaphalium*) *sylvatica* – woodland Arctic-cudweed.

Tribe 6. ASTEREAE – aster tribe

(Source: written by R. R. Kowal, 1984 Summer;
references: Fernald, 1950; Gleason & Cronquist, 1963, 1991; Cronquist, 1980; FNA, 2006; edited by R. R. Kowal, 2006 July 31.)

(Garden escape: *Callistephus chinensis* – China aster. Not in FNA, 2006.)

1. Ray corollas yellow, conspicuous; disk corollas yellow.

    2. Pappus of 2-8 caducous awns; involucre more or less glutinous . . . . . GRINDELIA – gumweed.

    2. Pappus of numerous capillary bristles or hairs; involucre not glutinous.

        3. Pappus double with long capillary bristles surrounded by short, somewhat chaffy bristles; heads wider than 5 mm and rays longer than 4 mm . . . . . HETEROTHECA (CHRYSOPSIS) – golden aster.

        3. Pappus simple; heads small with disks no wider than 5 mm and with rays no longer than 4 mm.

            4. Inflorescence corymbiform; leaves glandular punctate, linear to narrowly oblong, only slightly reduced upwards on stem; ray florets more numerous than the disk florets . . . . . EUTHAMIA – flat-topped goldenrod.

            4. Plants not with **BOTH** inflorescence corymbiform **AND** ray florets more numerous than the disk florets; leaves usually broader, not glandular punctate . . . . . SOLIDAGO – goldenrod.

1. Ray corollas white, pink, violet, bluish or purple; disk corollas various.

    5. Pappus absent or inconspicuous (2-4 awns up to 2 mm long and several minute bristles); receptacle conic, low-conical or hemispherical.

        6. Plant 3-15 dm tall, with numerous heads; pappus inconspicuous; receptacle low-conical or hemispherical . . . . . BOLTONIA.

        6. Plant 1.5 dm or less tall, with one head on a scape; pappus absent; receptacle conic . . . . . BELLIS.

    5. Pappus of long capillary bristles or hairs; receptacles flat.

7. Rays minute, shorter than the corolla tube and barely longer than the pappus; heads small with involucres no more than 4 mm long, disks no more than 4 mm wide, and disk florets numbering no more than 21 . . . . . CONYZA.

7. Rays conspicuous, larger; heads larger.

8. Phyllaries approximately in one series, neither chartaceous at base nor with herbaceous green tip; style appendages roundish or obtuse, no longer than 0.3 mm; rays very numerous and narrowly linear (mostly 1.3 mm or less wide); plants blooming chiefly in spring and early summer (when later, plants also with heads past fruiting) . . . . . ERIGERON – fleabane.

8. Phyllaries clearly imbricated or with a foliaceous outer series; style appendages longer and more acute; rays in one or two series and relatively broader; plants blooming in late summer and fall . . . . . "ASTER" – aster.

"ASTER" – aster
DOELLINGERIA, EURYBIA, IONACTIS, SOLIDAGO (1 sp.) , SYMPHYOTRICHUM

(Source: Shinners, 1941; Fernald, 1950; Jones, 1989; Gleason & Cronquist, 1991; Voss, 1996; Semple et al., 1996 & 2002; nomenclature up-dated using Semple et al., 2002, and Wetter et al., 2001; FNA, 2006.)

[The species of *Doelingeria*, *Eurybia*, *Ionactis*, and *Sympyotrichum* have been traditionally treated under the genus *Aster*. Binomials under *Aster* are only given when specific epithets differ.]

1. MIDDLE AND LOWER CAULINE LEAVES DISTINCTLY PETIOLED: most of the petioles more than 1 cm long, wingless, **OR** winged but less than ¼ as wide as the blades; blades (except the uppermost) more than 12 mm wide, abruptly narrowed to a truncate or cordate base . . . . . Key 1.

1. MIDDLE AND LOWER CAULINE LEAVES NOT DISTINCTLY PETIOLED: sessile, **OR** subsessile on petioles less than 0.5 cm long, **OR** apparently on broad-winged petioles more than ¼ as wide as the blades, **OR** with long narrow tapering petiole-like bases, but the blades not more than 12 mm wide.

2. Pappus double, the inner of long capillary bristles, the outer of short bristles, ca 1 mm long or less [Very obscure!]; middle and upper phyllaries with scarious margins extending to tip, central green line not or only slightly expanded towards tip; inflorescence corymbose (heads sometimes few or solitary in *I. linariifolia*) . . . . . Key 2.

2. Pappus not double; phyllaries various, but in most species with the central green line conspicuously dilated at tip; inflorescence various, but in most species not corymbose (*Symphyotrichum*).

3. Rays much reduced or absent (heads “disciform”); pappus conspicuous at anthesis; plants annual, with taproots (s = 2x; x = 7) . . . . . *Symphyotrichum ciliatum* (*Aster Brachyactis*) – alkali rayless aster.

3. Rays present, heads conspicuously radiate; pappus inconspicuous at anthesis or at most barely overtopping disk corollas; plants perennial, forming clumps or with rhizomes.

    4. Phyllaries pubescent and/or glandular, with prominent green or colored tips, straw-colored or whitish near the base . . . . . Key 3.

    4. Phyllaries glabrous (ciliate or glabrous on the margins); middle phyllaries with a central green or colored line extending to the base . . . . . Key 4.

Key 1

1. Phyllaries narrowly to broadly ovate-lanceolate, outer ones 1.0-2.5 mm wide, less than 2½ times as long as wide; inflorescence corymbiform (*Eurybia*).

    2. Branches of the inflorescence bearing glands; rays lilac or violet blue (rarely white) when fresh, retaining their color or turning brown in drying; leaves ovate-lanceolate to ovate, the upper petioled ones with blades usually less than twice as long as wide, sometimes longer; stems rather sparingly leafy, with 3-8 leaves below the inflorescence; upper leaves usually abruptly and conspicuously reduced, the blade of the lowest stem leaf 1.5-7.0 times as long as the blade of the first leaf below the inflorescence; clones usually with abundant rosettes of basal leaves (s = 8x; x = 9) . . . . . *Eurybia macrophylla* – big-leaved aster.

    2. Branches of the inflorescence without glands; rays white (rarely rosy or rosy-lilac) when fresh, drying white, brown or rosy lilac; leaves lanceolate or ovate-lanceolate, the upper petioled ones with blades twice or more as long as wide; stems evenly and rather densely leafy, with 6-14 cauline leaves below the inflorescence; upper leaves little reduced, the blade of the lowest stem leaf one to two times as long as the blade of the first leaf below the inflorescence; clones without abundant rosettes of basal leaves (s = 2x; x = 9) . . . . . *Eurybia furcata* – midwestern white heart-leaved aster.

1. Phyllaries linear-deltoid to lanceolate, outer ones 0.2-1.0 mm wide, greater than 2½ times as long as wide; inflorescence elongate (paniculate or racemose) (*Symphyotrichum*).

    3. Middle phyllaries with slender green tips ⅓ - ⅔ their length, not diamond-shaped, the central green line gradually expanded from below or slightly above the middle, the broad apical portion more than 4 times as long as wide; phyllaries rather loose, acute or acuminate, gradually tapered in the apical ⅓ or more.

4. Heads loosely corymbose-paniculate, mostly on elongate peduncles of very uneven lengths and with 0-2 bracts; heads larger, involucres 6-8 mm long; rays (7-) 8-15 mm long, bluish (s = 6x; x = 8) . . . . . *Symphyotrichum ciliolatum* – northern heart-leaved aster.

4. Heads racemose-paniculate, mostly on short peduncles 1-5 (-10) mm long or grading in size from base to tip of main branches; heads smaller, involucres 5-7 mm long; rays 5-10 mm long, color various.

    5. Lower leaves with blades deeply cordate and prominently toothed (some teeth (1.5-) 2-5 mm long on forward margin); petioles, especially on mid-cauline leaves, wingless or with a wing 1 mm or less on each side; inflorescence open, paniculiform; rays usually pale blue, sometimes roseate or white (s = 2x, 4x; x = 8) . . . . . *Symphyotrichum cordifolium* – common blue arrow-leaved aster.

    5. Lower leaves with blades at most subcordate and more shallowly toothed; petioles, especially on mid-cauline leaves, often with a wing 1-3.5 (-6) mm on each side; inflorescence racemiform with ascending branches.

        6. Stems glabrous or pubescent in lines; rays pale bluish, pinkish or white (s = 2x, 4x, 6x; x = 8) . . . . . *Symphyotrichum urophyllum* (*Aster* sagittifolius) – arrow-leaved aster.

        6. Stems densely pubescent, at least in the upper part; rays usually bluish (s = 2x, 4x; x = 8) . . . . . *Symphyotrichum Drummondii* – hairy arrow-leaved aster.

3. Middle phyllaries with prominent more or less diamond-shaped green tips 1/5 - ⅓ their length, the central green line rather abruptly expanded above the middle, the broad apical portion not more than 4 times as long as wide; phyllaries more or less closely appressed, acute, abruptly tapered in the apical ¼.

    7. Leaves prominently toothed; involucres 3.5-5.0 mm long; disks 3-5 mm wide; rays 3-6 mm long (s = 2x, 4x; x = 8) . . . . . *Symphyotrichum cordifolium* – common blue heart-leaved aster.

    7. Leaves entire or at most with few irregular teeth; involucres 5-8 mm long; disks 5-8 mm wide; rays 6-10 mm long.

        8. Mid-cauline leaves sessile and clasping, smooth, glabrous and more or less glaucous (s = 6x; x = 8) . . . . . *Symphyotrichum laeve* var. *laeve* – smooth blue aster.

        8. Mid-cauline leaves petioled or tapering to base, scabrous (at least above) , not glaucous.

9. Upper cauline leaves petiolate with cordate blades; blades smooth to slightly scabrous but glabrous above, pubescent to glabrous beneath; phyllaries minutely pubescent on back, rays usually pale violet (s = 2x, 4x; x = 8) . . . . *Symphyotrichum Shortii* – midwestern blue heart-leaved aster.

9. Upper cauline leaves sessile, only the lowermost petiolate and with cordate blades; blades scabrous-hispid on both surfaces; phyllaries glabrous on back (margin sometimes ciliolate); rays usually blue (s = 4x; x = 8) . . . . *Symphyotrichum oolentangiense (Aster azureus*) – prairie heart-leaved aster.

Key 2

1. Leaves rigid, linear, veinless except for the strong midrib; rays pink or violet; scarious margins and tips of phyllaries often purplish; pappus obscurely double [!], bristles slender to tip (*Ionactis*) (s = 2x; x = 9) . . . . *Ionactis linariifolia* – flax-leaved aster.

1. Leaves herbaceous, veiny and broad; rays white; scarious margins and tips of phyllaries whitish; pappus distinctly double, the longer series thickened terminally (*Doellingeria*) . . . . *Doellingeria umbellata* – flat-topped white aster.

2. Leaves glabrous beneath, **OR** pubescent on the midrib and main veins, **OR** sparingly pubescent over the surface, but then much more densely pubescent on the main veins; heads with 7-14 rays and 16-40 disk florets (s = 2x; x = 9) . . . . var. *umbellata* – tall flat-topped white aster.

2. Leaves densely and evenly pubescent over the lower surface; heads with 4-7 rays and 8-15 disk florets . . . . var. *pubens* (*Aster pubentior*) – northwestern flat-topped white aster.

Key 3

1. Leaves and phyllaries silvery-silky; rootstock cormoid, woody (s = 2x; x = 5) . . . . *Symphyotrichum sericeum* – silky aster.

1. Leaves and phyllaries not silvery-silky; rootstock various.

2. Phyllaries and peduncles with sessile or stalked glands, with or without coarse hairs in addition.

3. Leaves with auriculate clasping bases more than half encircling the stem; involucres 8-10 mm long; rays 40-50 (-100) (s = 2x, 4x; x = 5) . . . . *Symphyotrichum novae-angliae* – New England aster.

3. Leaves not with auriculate bases, slightly or not at all clasping; involucres 5-8 mm long; rays 12-35 (s = 2x, 4x; x = 5) . . . . . *Symphyotrichum oblongifolium* – aromatic aster.

2. Phyllaries and peduncles not glandular, with fine or coarse hairs.

4. Cauline leaves tapering to both ends, 0.3-5.0 cm wide, 5-15 cm long; outer phyllaries at most loose, not spinulose-mucronate.

5. Leaves narrowly oblanceolate or subrhombic, thin and flexible, less than 10 times as long as wide, pubescent beneath; inflorescence a loose panicle (s = 4x; x = 8) . . . . . *Symphyotrichum ontarionis* [sic] – bottomland or Ontario aster.

5. Leaves linear (at least above) , coriaceous and rigid, more than 10 times as long as wide, glabrous beneath; inflorescence corymbose (s = 2x; x = 9) . . . . . *Solidago* (*Aster*) *ptarmicoides* (S. *asteroides*) – upland white goldenrod.

4. Cauline leaves about the same width throughout, 0.1-0.5 cm wide, 1-7 cm long; outer phyllaries loose or squarrose, with minutely spinulose-mucronate tips.

6. Heads larger, fewer, solitary or clustered; involucres 5-8 mm long; outermost phyllaries more than ⅔ as long as the innermost; rays 20-35, disk florets (14-) 18-30 (s = 4x, 6x; x = 5) . . . . . *Symphyotrichum falcatum* var. *commutatum* – white prairie aster.

6. Heads smaller, more numerous and often secund; involucres 3-5 mm long; outermost phyllaries not more than ⅔ as long as the innermost; rays 8-20, disk florets 4-15 (-20) . . . . . *Symphyotrichum ericoides* var. *ericoides* – white heath aster.

Key 4

1. Leaves with auriculate clasping bases encircling the stem half way or more.

2. Leaves glaucous; stems glabrous or nearly so; outermost phyllaries not more than half as long as the innermost; phyllaries firm, appressed when fresh, with diamond-shaped green tips shorter than the scarious basal portion (s = 6x; x = 8) . . . . . *Symphyotrichum laeve* var. *laeve* – smooth blue aster.

2. Leaves not glaucous; stems pubescent; outermost phyllaries more than half as long as the innermost; phyllaries often flexible and leaf-like, at least somewhat spreading, with green tips longer than the scarious basal portion or the outer wholly green.

3. Leaves contracting below the middle and then expanding into a strongly auriculate-clasping base, entire or subentire in the basal portion, sharply serrate in the terminal portion; pappus dingy yellow, ochre or brown (s = 4x; x = 8) . . . . . *Symphyotrichum prenanthoides* – zigzag aster.

3. Leaves tapering from near the middle to both ends or nearly the same width throughout, entire or serrate; pappus white, yellowish or gray.

4. Rhizomes short and stout, occasionally with short stolons; middle and upper leaves not conspicuously crowded, with internodes 1-2.5 (-6) cm long, hispid-pubescent over the surface (very rarely glabrous); lower leaf surface minutely strigillose, the midrib hispidulous or densely hirsute to villous (s = 2x, 4x; x = 8) . . . . . *Symphyotrichum puniceum* – bristly or swamp aster.

4. Rhizomes elongate; middle and upper leaves conspicuously crowded, with internodes 0.5-1.6 cm long, glabrous or hispid-pubescent in lines; lower leaf surface glabrous or sparsely scabrous along the midrib . . . . . *Symphyotrichum firmum* – shining aster.

1. Leaves not with auriculate bases, slightly or not at all clasping.

5. Outermost phyllaries and bracts at base of heads with their upper thirds narrowly linear, nearly as thick as wide, and tapering into a cartilaginous spine (subulate); outermost phyllaries usually more than ⅓ as long as the innermost . . . . . *Symphyotrichum pilosum* – awl aster.

6. Stem and often also the leaves sparsely to, more often, densely spreading hirsute over the surface (s = 4x, 5x, 6x; x = 8) . . . . . var. *pilosum*.

6. Stem and leaves nearly or quite glabrous, at most stem pubescent only in lines (s = 6x; x = 8) . . . . . var. *Pringlei*.

5. Outermost phyllaries and bracts at base of heads with their upper thirds broader, flat, either blunt or only acute; relative lengths of outermost and innermost phyllaries various.

7. Middle phyllaries 0.8-1.2 mm wide, less than 4 times as long as wide; disk corollas white; inflorescence corymbose (s = 2x; x = 9) . . . . . *Solidago* (*Aster*) *ptarmicoides* (S. *asteroides*) – upland white goldenrod.

7. Middle phyllaries 0.2-1.0 mm wide, more than 4 times as long as wide; disk corollas yellow or anthocynanic; inflorescence paniculate.

8. Lobes of the disk corollas 45-75% the length of the cup; cauline leaves pubescent beneath, at least on the midrib; rays white.

9. Lower leaf surface uniformly short-pubescent; heads not secund; rhizomes distinctly long-creeping, stoloniform, the plants forming colonial stands, usually in moist ground (s = 4x; x = 8) . . . . *Symphyotrichum ontarionis* [sic] – bottomland or Ontario aster.

9. Lower leaf surface usually glabrous, but villous to hirtellous along the midrib; heads secund; rhizomes short, not long-creeping, the plants forming scattered individual clumps, usually in drier sites (s = 2x, 4x, 6x; x = 8) . . . . *Symphyotrichum lateriflorum* – starved, calico, white woodland or side-flowering aster.

8. Lobes of the disk corollas 15-45% the length of the cup; cauline leaves glabrous beneath; rays white, pink, bluish or purple . . . . Key 5.

Key 5

1. Leaves subcoriaceous or firm, with a distinct reticulate pattern formed by dark veinlets surrounding paler, isodiametric areolae; rays lavender to purple (s = 4x, 8x; x = 8) . . . . *Symphyotrichum praealtum* – willow-leaved aster.

1. Leaves firm to membranaceous, without a distinct reticulum, areolae, if visible, oblong; rays variously colored. [A very difficult complex with much polyploidy and some taxa poorly differentiated and/or hybridizing.]

2. Phyllaries subequal, the outermost more than ⅔ as long as the innermost; involucres tending to be larger (5-8.5 mm long) , often subtended by bracts longer than the involucres (rare).

3. Middle leaves clasping the stem, (10-) 15-20 cm long; inflorescence open and few-headed, with branches sharply bent at nodes; rays blue-violet, rarely pale blue to white (s = 8x,10x; x = 8) . . . . *Symphyotrichum Robynsianum* (*Aster longifolius*) – long-leaved blue aster.

3. Middle leaves sessile to very weakly clasping, less than 15 cm long; inflorescence many-headed and crowded, with branches not bent at nodes and with heads generally subtended by 1 or 2 long, leafy bracts; rays pale blue-violet, pink to white (s = 8x; x = 8) . . . . *Symphyotrichum lanceolatum* var. *hesperium* (*S. hesperium*) – western lined aster.

2. Phyllaries unequal, the outermost less than ⅔ as long as the innermost; involucres tending to be smaller (3-7 mm long) , with subtending bracts shorter than the involucres.

4. Heads smaller, mostly 0.6-1.5 cm in diameter (including rays); involucres 3-5 (-5.5) mm long.

5. Cauline leaves mostly more than 3 mm wide, 8-15 cm long, lateral veins evident, margins not inrolled (s = 6x, 8x; x = 8) . . . . . *Symphyotrichum lanceolatum* var. *interior* – inland panicled aster.

5. Cauline leaves 1-3 (-5) mm wide, 2-10 cm long, only midrib strongly expressed, margins often inrolled.

    6. Median phyllaries (3rd or 4th series inward) ca twice as wide as those of the outer series, typically obtuse, the green areoles rhombic-obovate to broadly oblanceolate; leaves of branches of main stem relatively uniform in size; peduncles usually at least 1 cm long (often much longer) , with numerous linear-oblong bracts, 1-4 mm long; subsessile heads relatively few (s = 4x; x = 8) . . . . . *Symphyotrichum dumosum* complex ("var. *strictior*") – long-stalked aster.

    6. Median phyllaries slender, less than twice as wide as those of the outer series, acute or attenuate, the green areoles linear to narrowly oblanceolate; leaves of branches of main stem notably unequal in size; peduncles variable in length, with few bracts; subsessile heads often numerous . . . . . *Symphyotrichum racemosum (S. fragilis*) – brittle aster.

4. Heads larger, mostly 1.5-2.5 cm in diameter (including rays); involucres (4-) 4.5-7 mm long.

    7. Plants gracile, rootstock slender, thread-like, 0.5-2.0 mm thick; stems normally solitary; inflorescence a more or less dichotomously branched, round- or flat-topped panicle; achenes purple or gray with purple streaks; larger cauline leaves mostly less that 1 cm wide, 12-15 (or more) times longer than wide, shallowly and remotely serrate to subentire; marshes, bogs, fens, wet shorelines (s = 2x, 4x, 6x, 8x; x = 8) . . . . . *Symphyotrichum boreale* – rush or northern bog aster.

    7. Plants stout, rhizomes 2-6 mm thick; stems usually numerous from an extensive system of creeping rootstocks; inflorescence a diffusely branched or elongate panicle; achenes gray; leaves narrowly linear to broader; various moist-soil habitats . . . . . *Symphyotrichum lanceolatum* – panicled or eastern lined aster.

        8. Stems stout, evenly, moderately to densely short-wooly . . . . . var. *hirsuticaule*.

        8. Stems stout to slender, glabrous or at most hairy in lines at bases.

            9. Leaves broadly oblanceolate, not much reduced in inflorescences; involucres usually 4-5.5 mm long; rays white . . . . . var. *latifolium*.

9. Leaves linear to oblanceolate, reduced in inflorescences; involucres usually 3.5-5 (-6) mm long; rays white to purplish . . . . . var. *lanceolatum* ("var. *simplex*" no longer recognized).

CONYZA

(s = 2x; x = 9)

1. Plant usually unbranched below the inflorescence, with a well-defined central axis; stem spreading-hirsute; often taller than 3 dm; very common . . . . . *C. canadensis* – horse-weed.

1. Plant diffusely branched from near the base, without a central axis; stem cinereous-strigose; mostly 1-3 dm tall; infrequent . . . . . *C. ramosissima* – dwarf fleabane.

BOLTONIA

(s = 4x; x = 9)

. . . . . *B. asteroides* var. *recognita* – false aster.

BELLIS

(s = 2x; x = 9)

. . . . . *B. perennis* – English daisy.

ERIGERON – fleabane

(References: as for *Asteraceae* plus Morley, 1969.)

(x = 9)

1. Disk corollas 3.5 mm long or more; rays 1 mm wide or more; inflorescence of 1-9 heads; perennials with either a ligneous caudex or flagelliform stolons.

    2. Pappus double, with short bristles outside the long ones; rays 125-175; leaves coriaceous, mostly entire; stolons absent (s = 2x) . . . . . *E. glabellus* var. *pubescens* – stream-side fleabane.

    2. Pappus simple; rays 50-80 (-100); leaves softer, mostly toothed; stolons present (s = 2x) . . . . . *E. pulchellus* var. *pulchellus* – Robin's plantain.

1. Disk corollas less than 3.5 mm long; rays 1 mm wide or less; inflorescence usually with more than 9 heads; annuals to short-lived perennials, lacking both a ligneous caudex and stolons.

    3. Disk corollas 2.5 mm long or more; pappus simple, of long capillary bristles in **BOTH** disk and ray florets; rays 150-400, commonly pink; short-lived perennials (s = 2x) . . . . . *E. philadelphicus* – common fleabane.

    3. Disk corollas 2.5 mm long or less; pappus of **DISK** florets double, with short, slender outer scales surrounding long capillary bristles, **BUT** pappus of **RAY** florets lacking the long bristles; rays 50-100; commonly white; annuals or rarely short-lived perennials.

        4. Pubescence of stem (half-way up the plant) sparsely spreading-hispid; leaves membranous, coarsely toothed; plants robust, mostly 6-15 dm tall (s = 2x, 3x, 6x) . . . . . *E. annuus* – annual fleabane.

        4. Pubescence of stem (half-way up the plant) minutely cinereous-strigose; leaves firm, entire or nearly so; plants more slender, mostly 3-7 (-9) dm tall (s = 2x, 3x, 4x) . . . . . *E. strigosus* – prairie or daisy fleabane.

            5. Hairs on phyllaries flattened, 0.5-1.2 mm long; hairs on stem appressed to spreading, 0.5-1 mm long . . . . . var. *septentrionalis*.

            5. Hairs on phyllaries terete, mostly 0.1-0.5 mm long; hairs on stem appressed to ascending, 0.1-0.4 (-0.8) mm long . . . . . var. *strigosus*.

EUTHAMIA – flat-topped goldenrod

(x = 9)

1. Leaves evidently 3-nerved, the larger ones ordinarily with 1 or 2 additional pairs of fainter lateral nerves, 2-12 mm wide and 4-13 cm long, with less conspicuous punctation; heads slenderly campanulate to turbinate, chiefly sessile or subsessile in small glomerules, mostly 20-35 (-45) flowered; throughout Wisconsin (s = 2x) . . . . . *E. graminifolia* – grass-leaved or common flat-topped goldenrod.

1. Leaves 1-nerved or sometimes faintly 3-nerved, but without any additional nerves, 2-5 mm (rarely 6 mm) wide and 4-9 cm long, with conspicuous, dark and viscid punctation; heads slenderly cylindric (becoming slenderly turbinate on pressing) , tending to be evidently pedicellate, mostly 10-21 flowered; south of the Tension Zone.

2. Leaves relatively thick and firm, ordinarily without axillary fascicles; involucre (4.5-) 5-6.5 mm long (s = 4x, 6x) . . . . . *E. gymnospermoides* – Great Plains flat-topped goldenrod.

2. Leaves relatively thin and lax, commonly with well-developed axillary fascicles; involucre 3-4.5 (-5) mm long (s = 2x) . . . . . *E. caroliniana* (*E. tenuifolia*) – coastal plain flat-topped goldenrod.

GRINDELIA – gumweed

(s = 2x; x = 6)

1. Involucre heavily glutinous; phyllaries strongly recurving at tip; leaf margin (when not entire) crenate to serrate . . . . . *G. squarrosa* – curly-cup gumweed.

1. Involucre barely glutinous; phyllaries loosely spreading; leaf margin (when not entire) sharply serrulate with bristle-tipped teeth; very rare adventive . . . . . *G. lanceolata* – spiny-tooth gumweed.

HETEROTHECA (CHRYSOPSIS) – golden aster

(Source: FNA, 2006.)

(s = 2x, 4x; x = 9)

. . . . . *H. villosa* – hairy golden aster.

1. Stems and distal cauline leaves sparsely to densely stipitate glandular (sparsely to densely hispid-strigose, as well) . . . . . var. *minor.*

1. Stems and distal cauline leaves eglandular or sparsely stipitate glandular (moderately to densely hispid-strigose, as well).

2. Subtending bracts of heads long, often longer than the heads; distal cauline leaves oblong (narrowly to broadly); stems often abundantly long-hirsute . . . . . var. *Ballardii*.

2. Subtending bracts of heads short or absent; distal cauline leaves oblanceolate (narrowly to broadly); stems only sparsely to moderately long-hirsute . . . . . var. *villosa*.

SOLIDAGO – goldenrod

(Source: Salamun 1963; references: Fernald, 1950; Cronquist *in* Gleason, 1952; Semple et al., 1999; FNA, 2006.)

(x = 9)

1. Heads in flat corymbiform inflorescences . . . . . Key 1.

1. Heads in clusters or short racemes in the axils of upper leaves **OR** on elongate branches forming racemose, thyrsoid or spreading panicles.

    2. Inflorescence a series of clusters or short racemes in the axils of upper cauline leaves **OR**, if a terminal panicle or thyrse with erect summit, the HEADS SPIRALLY ARRANGED ON THE BRANCHES, THUS NOT SECUND . . . . . Key 2.

    2. Inflorescence a terminal panicle with nodding summit and with at least the lower branches more or less recurved; HEADS SECUND (one sided) , viz., borne on the upper side of the branches . . . . . Key 3.

Key 1

1. Cauline leaves elliptic, broadly lanceolate to broadly ovate, densely pubescent above and below; stems densely pubescent; plants of mesic-dry habitats, common, mostly south of the Tension Zone . . . . . *S. rigida* – stiff goldenrod.

    2. Inner phyllaries glabrate to sparsely strigillose, oblong and rounded; plants robust (6-15 dm); inflorescences loose, open; leaves and stems coarsely hispid; E North America (s = 2x, 4x) . . . . . subsp. *rigida*.

    2. Inner phyllaries conspicuously strigillose,often linear; plants usually short (3-7 dm) , sometimes taller; inflorescences compact; leaves and stems finely and densely hispid-strigose; central North America (s = 2x) . . . . . subsp. *humilis*.

1. Leaves glabrous to sparsely short pubescent.

    3. Rays white (rarely cream colored); cauline leaves linear, stiff, glabrous to sparsely short pubescent; dry, mostly calcareous, rocks, bluffs and sands (s = 2x) . . . . . *S. ptarmicoides* (*S. asteroides*) – upland white aster or goldenrod.

    3. Rays yellow; cauline leaves narrowly elliptic to linear-lanceolate, glabrous except for scabrous margins; plants of marshes, swamps, wet prairies and moist calcareous meadows.

4. Basal and lower cauline leaves narrowly elliptic, flat, obtuse or rounded at the tip, often serrate above the middle, not triple-nerved; southeastern Wisconsin and Door County (s = 2x) . . . . . *S. ohioensis* – Ohio goldenrod.

4. Basal and lower cauline leaves linear-lanceolate, often longitudinally folded, acute, entire, tending to be triple-nerved; southeastern Wisconsin (s = 2x) . . . . . *S. Riddellii* – Riddell's goldenrod.

Key 2.

1. Inflorescence a series of axillary clusters or short racemes, all but the uppermost of which are exceeded by their subtending leaves.

2. Cauline leaves lanceolate, acuminate, tapering to a sessile or obscurely short-petiolate base; stem glabrous, glaucous, terete; rare, in southeastern-most Wisconsin (s = 2x) . . . . . *S. caesia* – axillary or blue-stemmed goldenrod.

2. Cauline leaves ovate to elliptic, abruptly acuminate at the tip, abruptly narrowed to a short winged petiole; stem glabrous or slightly pubescent above, somewhat angled; widespread (s = 2x, 4x) . . . . . *S. flexicaulis* – broad-leaved or zigzag goldenrod.

1. Inflorescence a terminal panicle or thyrse, **OR**, if of axillary clusters or racemes, only the lowermost exceeded by the subtending leaves.

3. Lower cauline leaves, including petioles, mostly 7-15 times as long as wide, petioles with sheathing bases; plants of marshes and bogs (s = 2x, 4x) . . . . . *S. uliginosa* – northern bog goldenrod.

3. Lower cauline leaves, including petioles, seldom more than 7 times as long as wide, if longer, then without sheathing petioles; plants chiefly of upland areas.

4. Involucres mostly 5-9 mm long; many pedicels 5-15 mm long; very local, Door County (s = 4x) . . . . . *S. simplex* [subsp. *Randii*] var. *Gillmanii* – dune goldenrod.

4. Involucres mostly 3-5 mm (sometimes 6 mm) long; pedicels mostly less than 5 mm long.

5. Stems pubescent from base through inflorescence; leaves pubescent above and below.

6. Rays cream-colored to nearly white; outer phyllaries usually with strongly contrasting green tips and whitish to stramineous bases and margins (s = 2x) . . . . . *S. bicolor* – white goldenrod.

6. Rays orange-yellow; outer phyllaries usually with less contrasting coloring (s = 2x) . . . . . *S. hispida* – hairy goldenrod.

5. Stems glabrous except for occasional sparse puberulence in the inflorescence and on the uppermost stem; leaves glabrous except for hispidulous margins, sometimes sparsely pubescence beneath.

7. Achenes short-hairy; basal and lower cauline leaves broadly spatulate to obovate, sharply serrate; mostly on cliffs, in the Driftless Area of southwestern Wisconsin (s = 4x) . . . . . *S. sciaphila* – cliff goldenrod.

7. Achenes glabrous; basal and lower cauline leaves ovate to oblong-lanceolate, crenate-serrate; widespread (s = 2x, 4x, 6x) . . . . . *S. speciosa* – showy goldenrod.

8. Basal leaves 0.8-2 cm wide, often entire or shallowly serrate, sometimes absent at flowering time; mid cauline leaves 0.4-1.5 (-2) cm wide, often crowded, stiff, and somewhat scabrous; central North America . . . . . var. *rigidiuscula*.

8. Basal leaves (2-) 2.8-5.5 cm wide, often coarsely serrate and usually present at flowering time; mid cauline leaves (1-) 2-2.9 cm wide, not crowded, stiff, or scabrous; E North America . . . . . var. *speciosa*.

Key 3.

1. Leaves pinnately veined, the lateral veins not conspicuously prolonged parallel with the midrib.

2. Basal and lower cauline leaves mostly smaller than the middle ones, deciduous and lacking at flowering time; cauline leaves reduced only slightly upwards (s = 2x, 4x) . . . . . *S. rugosa* – wrinkle-leaved goldenrod.

2. Basal and lower cauline leaves the largest, persistent at flowering time; cauline leaves progressively reduced upwards.

3. Stems pubescent or scabrous their entire length; very widespread . . . . . *S. nemoralis* – gray or old-field goldenrod.

4. Pappus at most barely exceeding tubes of ray corollas and bases of lobes of disk corollas; lobes of disk corollas 0.5-0.9 (-1) mm long; involucres usually 2.6-4.2 mm long (longer in tetraploids); achenes usually only sparsely strigose; basal leaves usually crenate, oblanceolate to obovate; E North America (s = 2x, 4x) . . . . . var. *nemoralis*.

4. Pappus usually exceeding tubes of ray corollas and bases of lobes of disk corollas; lobes of disk corollas (0.6-) 0.8-1.5 mm long; involucres usually 4.6-5.8 mm long; achenes moderately strigose; basal leaves usually not crenate, often linear-oblanceolate; central North America (s = 4x) . . . . . var. *decemflora*.

3. Stems glabrous or only slightly pubescent in the upper portion below the inflorescence.

5. Upper surface of leaves strongly scabrous; upper portions of stems strongly angled (s = 2x) . . . . . *S. patula* var. *patula* – rough-leaved or swamp goldenrod.

5. Upper surface of leaves only slightly pubescent or glabrous; stems terete.

6. Basal and lower cauline leaves elliptic or elliptic-ovate and abruptly tapering to the petiole, loosely hirsute on midrib and main veins beneath; inflorescence an open panicle with a few long, slender and strongly divergent or arched ascending branches (s = 2x) . . . . . *S. ulmifolia* var. *ulmifolia* – elm-leaved goldenrod.

6. Basal and lower cauline leaves with long-tapering bases, glabrous or sometimes short hirsute on both surfaces; inflorescence more or less compact.

7. Plant with stout branched caudex and fibrous roots; basal and lower cauline leaves mostly 2-7.5 cm wide; achenes short-hairy; throughout Wisconsin (s = 2x) . . . . . *S. juncea* – early goldenrod.

7. Plant with creeping rhizome; basal and lower cauline leaves mostly 0.5-2 cm wide; achenes glabrous or sparsely-hairy; prairies south of Tension Zone (s = 2x [4x]) . . . . . *S. missouriensis* – Missouri goldenrod.

1. Leaves triple-nerved, i.e., the two obvious lateral nerves prolonged parallel with the midrib.

8. Stems more or less pubescent or scabrous, at least in the upper portion below the inflorescence.

9. Cauline leaves obovate, oblanceolate to linear, entire or sparingly serrate, obscurely 3-nerved; basal leaves present at flowering time; very widespread (s = 2x, 4x) . . . . . *S. nemoralis* – gray or old-field goldenrod.
(See couplet 4 for varieties.)

9. Cauline leaves mostly lanceolate to ovate, evidently 3-nerved; basal leaves wanting or deciduous at flowering time.

10. Cauline leaves canescent on both surfaces, mostly ovate to elliptic, acute to roundish at the tips; very rare adventive (s = 2x, 4x, 6x) . . . . . *S. mollis* – velvety goldenrod.

10. Cauline leaves glabrous to puberulent beneath, glabrous or scabrous above, mostly narrowly lance-elliptic, acuminate at the tips; widespread species.

11. Involucres 2-3 mm long (s = 2x) . . . . . *S. canadensis* – Canada goldenrod.

12. Lower half of stems glabrous to sparsely hairy; 7-15 (-18) ray florets per head . . . . . var. *canadensis*.

12. Lower half of stems moderately hairy; 5-10 (-13) ray florets per head, averaging ca. 9 . . . . . var. *Hargeri*.

11. Involucres 3-6 mm long.

13. Mid to upper leaves serrate, glabrous or scabrous above, pubescent on the veins beneath; stem pilose chiefly above the middle (s = 2x) . . . . . *S. canadensis* – Canada goldenrod.
(See couplet 12 for varieties.)

13. Mid to upper leaves minutely serrate to entire, scabrous above, densely pubescent beneath; stem grayish with close puberulence throughout, except sometimes near the base (s = 4x, 6x) . . . . . *S. altissima* – Canada goldenrod.

8. Stems glabrous below the inflorescence.

14. Basal and lower cauline leaves the largest, persistent at flowering time; cauline leaves progressively reduced upwards.

15. Basal and lower cauline leaves mostly 2-7.5 cm wide, scarcely 3-nerved, glabrous except for ciliate margins, sometimes sparingly hirsute on one or both surfaces; achenes short-hairy; throughout Wisconsin (s = 2x) . . . . . *S. juncea* – early goldenrod.

15. Basal and lower cauline leaves mostly 0.5-2 cm wide, more or less strongly 3-nerved, glabrous except for ciliate margins; achenes glabrous or sparsely hairy; prairies south of Tension Zone (s = 2x [4x]) . . . . . *S. missouriensis* – Missouri goldenrod.

14. Basal and lower cauline leaves mostly smaller than the middle ones, deciduous and lacking at flowering time; cauline leaves reduced only slightly upwards.

16. Branchlets of panicle and peduncles glabrous; prairies south of Tension Zone (s = 2x [4x]) . . . . . *S. missouriensis* – Missouri goldenrod.

16. Branchlets of panicle and peduncles more or less pilose; throughout Wisconsin (s = 2x, 4x, 6x) . . . . . *S. gigantea* – smooth goldenrod.

Tribe 7. ANTHEMIDEAE – chamomile tribe

(Source: Mickelson and Iltis, 1966; Fernald, 1950; Gleason and Cronquist, 1991; FNA, 2006.)

1. Receptacle chaffy; heads radiate.

    2. Heads small, 5 mm or less in diameter, densely corymbose; receptacle flat; achenes compressed . . . . . ACHILLEA – yarrow.

    2. Heads rather large, 1-4 cm in diameter, solitary and terminal on long peduncles; receptacle conic at maturity; achenes terete or angled.

        3. Ray florets white; disk 0.5-1.2 cm in diameter . . . . . ANTHEMIS – chamomile, dog-fennel.

        3. Ray florets yellow; disk 1-2 cm in diameter; rare adventive . . . . . COTA – marguerite.

1. Receptacle naked or villous; heads radiate, disciform or discoid.

    4. Inflorescence paniculate, racemose or spike-like with inconspicuous (2-8 mm long) disciform or discoid heads; florets green . . . . . ARTEMISIA – wormwood.

    4. Inflorescence corymbose **OR** heads terminal on long peduncles; ray florets showy, yellow or white (sometimes obsolete).

        5. Receptacle conic at maturity; leaves pinnatisect . . . . . MATRICARIA & TRIPLEUROSPERMUM – wild chamomile.

        5. Receptacle flat or low-convex.

            6. Heads several or numerous, in corymbs, disk 4-9 mm wide, with or without rays; leaves often highly lobed . . . . . TANACETUM – tansy.

            6. Heads solitary at tips of stem or long branches, large, disk 1-2.5 cm wide, with conspicuous white rays; leaves toothed to lobed.

                7. Heads solitary on long, slender, naked peduncles; upper leaves strongly reduced or lacking; stems slender, 4-6 dm tall; abundant throughout . . . . . LEUCANTHEMUM

                7. Heads few to many at end of robust, leafy, 1-2 m tall stems; peduncles 3-15 cm long; rare garden escape . . . . . LEUCANTHEMELLA

ACHILLEA – yarrow

(s = 9)

1. Leaves undissected, serrulate; plant glabrate to subglabrous; rare adventive (s = 2x) . . . . . *A. Ptarmica* – sneezeweed.

1. Leaves finely dissected into linear segments; plant tomentose; ubiquitous throughout (s = 2x, 3x, 4x, 5x, 6x, 7x, 8x) . . . . . *A. Millefolium* – common yarrow, milfoil.

   2. Leaves flat, the relatively broad ultimate segments all nearly in the same plane; hexaploid; less common introduced taxon (mostly s = 6x) . . . . . subsp. *Millefolium*.

   2. Leaves airily 3-dimensional, the ultimate segments narrower and disposed in various planes; tetraploid; very common native taxon (mostly s = 4x) . . . . . subsp. *lanulosa*.

ANTHEMIS – chamomile, dog-fennel

(s = 2x; x = 9)

1. Ray florets sterile; receptacle chaffy only toward the middle; ill-scented; very common, especially southern Wisconsin . . . . . *A. Cotula* – dog-fennel, stinking camomile.

1. Ray florets fertile; receptacle chaffy throughout; odorless . . . . . *A. arvensis* – corn chamomile.

ARTEMISIA – wormwood

(x = 9)

1. Receptacle hairy; leaves white-silky canescent; plants perennial and somewhat woody at base.

   2. Leaves short, 1-2 cm long, the segments filiform, 0.5-1 mm wide; flowering stems ascending, to 5 dm tall, the vegetative stems forming mats; inflorescence a narrow panicle; very local on Mississippi River bluffs from Pierce Co. to Trempealeau Co., rarely weedy elsewhere (s = 2x) . . . . . *A. frigida* – prairie sage-wort.

   2. Leaves 5-15 cm long, the segments 2-3 mm wide; flowering stems erect, to 9 dm tall; inflorescence a leafy panicle; sporadic adventive (s = 2x) . . . . . *A. Absinthium* – common wormwood, absinthe sage-wort.

1. Receptacle naked; leaves tomentose to glabrous; plants annual, biennial or perennial.

    3. Disk florets staminate, their ovaries aborting; adult plants usually glabrous.

        4. Biennial with a taproot; first year's lower leaves forming a basal rosette; leaves tomentose-glabrate; involucre 2-3.5 mm long; common in sandy areas (s = 2x, 4x [within species]) . . . . . *A. campestris* subsp. *caudata* – field wormwood or sage-wort, beach wormwood.

        4. Robust perennial from a rootstock; lower leaves not in a rosette; leaves glabrous; involucre 2 mm long; very rare and sporadic (s = 2x) . . . . . *A. Dracunculus* – tarragon, estragon.

    3. Disk florets producing achenes.

        5. Leaves glabrous or glabrate, 2-3 times pinnatisect or pinnatifid.

            6. Perennial shrub; involucre 2-2.5 mm long; bracts canescent or tomentose; rare garden escape (not naturalized) (s = 2x) . . . . . *A. Abrotanum* – southernwood.

            6. Annual or biennial herbs; involucre 1-2 mm long; bracts glabrous.

                7. Inflorescence a dense racemose panicle with many spike-like branches from the leaf axils; heads erect; common weed (s = 2x) . . . . . *A. biennis* – biennial wormwood or sage-wort.

                7. Inflorescence a broad terminal panicle with nodding heads; rare annual weed (s = 2x) . . . . . *A. annua* – annual wormwood or sage-wort.

        5. Leaves tomentose at least on one surface, simple or dissected.

            8. Leaves unlobed and linear-lanceolate, the margins regularly serrate to entire in the inflorescence, densely white-tomentose beneath, bright green-glabrous above; moist deep-soil prairies (s = 4x) . . . . . *A. serrata* – saw-tooth wormwood.

            8. Leaves deeply lobed or cut, **OR** entire with the margins irregularly toothed.

                9. Leaves delicately divided, the segments filiform, gray-green pubescent; rare garden escape (s = 2x) . . . . . *A. pontica* – Roman wormwood.

                9. Leaf segments broader or leaves entire.

10. Leaves green-glabrate above, white-tomentose beneath, coarsely lobed; rare weed, eastern Wisconsin (s = 2x, 4x, 40, 6x) . . . . . *A*. *vulgaris* – mugwort, common wormwood.

10. Leaves pubescent on both surfaces.

    11. Involucre 2-4 mm long; leaves entire or irregularly toothed, densely white-tomentose beneath, tomentose to glabrate above; common prairie species (s = 2x, 4x) . . . . . *A*. *ludoviciana* subsp. *ludoviciana* – white sage, western mugwort.

    11. Involucre 5-8 mm long; leaves obtusely lobed, densely creamy white wooly; rare garden escape on Lakes Michigan and Superior (s = 2x) . . . . . *A*. *Stelleriana* – beach wormwood, dusty miller.

COTA – marguerite

(s = 2x; x = 9)

. . . . . *C*. (*Anthemis*) *tinctoria* – golden marguerite, yellow chamomile.

LEUCANTHEMELLA

(s = 2x; x = 9)

. . . . . *Leucanthemella* (*Chrysanthemum*) *serotina* – giant daisy.

LEUCANTHEMUM

(s = 2x, 4x, 6x, 8x, 10x; x = 9)

. . . . . *Leucanthemum vulgare* (*Chrysanthemum Leucanthemum*) – common or ox-eye daisy.

MATRICARIA & TRIPLEUROSPERMUM – wild chamomile

1. Ray florets none; disk florets greenish, 4-lobed; heads short-stalked; achenes marked by elongate red-brown oil glands; very common throughout . . . . . *M. discoidea* (*M. matricarioides*) – pineapple-weed.

1. Ray florets white; disk florets yellow, 5-lobed; heads long-stalked.

    2. Receptacle conic at maturity; achenes ribbed, smooth, unmarked; involucre 2-3 mm long; rare adventive (See also *Anthemis Cotula*) . . . . . *M. Chamomilla* (*M. recutita*) – sweet false camomile.

    2. Receptacle hemispheric at maturity; achenes prominently ribbed, transversely rugulose or tuberculate with apical oil glands; involucre 3.5-6 mm long; rare adventive on Lake Superior shores . . . . . *Tripleurospermum* (*Matricaria*) *maritimum* – scentless camomile.

TANACETUM – tansy

(x = 9)

1. Rays white, conspicuous, minute or absent; leaves largely unlobed **OR** 1-2 pinnatifid with broad ultimate segments.

    2. Heads radiate, the rays 4-8 mm long; leaves 1-2 pinnatifid; rare garden escape (s = 2x) . . . . . *T.* (*Chrysanthemum*) *Parthenium* – feverfew.

    2. Heads discoid or rays minute; leaves crenate, rarely lobed at base; rare adventive (s = 2x, 6x) . . . . . *Tanacetum* (*Chrysanthemum*) *Balsamita* – costmary, mint-geranium.

1. Rays yellow and short (2-4 mm) or absent; leaves 2-3 pinnatifid with narrow ultimate segments.

    3. Heads disciform, 25-100 or more in dense corymbs, 7-10 mm in diam.; leaves glabrate; plants in dense, many stemmed clumps; common introduced weed (s = 2x) . . . . . *T. vulgare* – common tansy, golden-buttons.

    3. Heads radiate, 3-17 in loose corymbs, 1-2 cm in diam., rays 2-4 mm long; leaves tomentose; stems solitary; rare on inner beaches of Lake Michigan, Door Co. (s = 6x) . . . . . *T. bipinnatum* subsp. *huronense* – eastern or Lake Huron tansy.

Tribe 8. SENECIONEAE – groundsel tribe

(Source: Kowal, Summer 1984; references: Fernald, 1950; Cronquist, 1980; Gleason & Cronquist, 1991; FNA, 2006; edited by Kowal, 2006 August 1.)

1. Perennials with green leaves arising individually from the ground from an underground rhizome; aerial stems consisting of scaly bracted flowering scapes arising before or as the leaves develop in early Spring.

    2. Heads solitary, yellow, radiate with ray florets pistillate and disk florets staminate; radical leaves rounded-cordate, dentate **AND** very shallowly lobed; rare adventive . . . . . TUSSILAGO – coltsfoot.

    2. Heads numerous, creamy-white, radiate but with disk florets largely staminate or largely pistillate on different plants (imperfectly dioecious); radical leaves either merely dentate **OR** deeply lobed . . . . . PETASITES – sweet-coltsfoot.

1. Habit various but with well developed cauline leaves (though these may differ from the basal leaves).

    3. Corollas yellow to orange; heads usually with rays.

        4. Cauline leaves progressively reduced upward and lobed (unlike the basal leaves); perennials, usually with obvious vegetative reproduction . . . . . PACKERA – ragwort.

        4. Leaves more or less equal in size up the stem; annuals (perhaps rarely biennials).

            5. Rays conspicuous; leaves entire to weakly toothed; pubescence often copious; rare native, N Wisconsin . . . . . TEPHROSERIS

            5. Rays inconspicuous or absent; leaves, or some of them, lobed to pinnatifid; pubescence short and often scant, crisp; introduced weeds . . . . . SENECIO – groundsel.

    3. Corollas whitish or creamy; heads without rays.

        6. Annuals; heads disciform, with 2 to several marginal rows of pistillate florets with filiform corollas; leaves roughly the same size up the stem . . . . . ERECHTITES – fireweed.

        6. Perennials; heads discoid, containing only bisexual florets with 5-lobed corollas.

7. Heads with ca 13 phyllaries and 20-40 florets; receptacle flat; larger leaves hastate; leaves roughly the same size up the stem; wet areas, S Wisconsin . . . . . HASTEOLA – Indian-plantain

7. Heads with ca 5 phyllaries and ca 5 florets; receptacle with a short conic projection in the center; leaves not hastate; leaves largest at base of the stem and becoming smaller upwards . . . . . ARNOGLOSSUM – Indian-plantain

ARNOGLOSSUM – Indian-plantain

1. Lower leaves lance-ovate or oval, entire or only shallowly crenate or dentate, with arcuate venation; wet prairies and pastures, calcareous marshes (s = 2x; x = 27) . . . . . *A. plantagineum* (*Cacalia tuberosa*) – prairie or tuberous Indian-plantain.

1. Lower leaves reniform, roundish or deltoid, lobed or coarsely angulate-dentate, with palmate venation.

   2. Leaves not glaucous; stem angled or sulcate, not glaucous; open woods, rare, S Wisconsin (s = 2x; x = 25) . . . . . *A. reniforme* (*A. Muehlenbergii*) – great Indian-plantain.

   2. Leaves glaucous beneath; stem terete or slightly striate, glaucous; mesic prairies and pastures, woodland edges (s = 2x; x = 28, 27, 26, 25) . . . . . *A. atriplicifolium* – pale Indian-plantain.

ERECHTITES – fireweed

(s = 4x; x = 10)

. . . . . *E. hieraciifolius* – fireweed.

HASTEOLA – Indian-plantain

(s = 4x; x = 10)

. . . . . *H. suaveolens* – sweet or hastate Indian-plantain.

PACKERA – ragwort

(Source: Barkley, 1963; Mahoney, 2000; Mahoney and Kowal, 2007; edited by R. R. Kowal, 2007 February 6.)

(An F_1 individual between each of the wetland species, *P. aurea* and *P. pseudaurea* var. *semicordata*, with the mesic prairie subspecies, *P. paupercula* var. *savannarum*, have been found in the field.)

(x = 22 & 23)

1. Basal leaves cordate, subcordate or abruptly contracted to the petiole; plants typically of wet or moist habitats.

    2. Rays absent or inconspicuous, shorter than 6 (-7) mm; basal leaf blades abruptly contracted to the petiole; vegetative reproduction absent; self-compatible, achenes abundant in all heads; Forest Co. (discoid; extinct?) , Apostle Islands in Lake Superior (radiate in all seen), rare (s = 8x; x = 22?) . . . . . *P. indecora* – northern squaw-weed, rayless ragwort.

    2. Rays prominent, longer than 6 mm; vegetative reproduction usually present (rhizomes or adventitious shoots on roots); self-incompatible, achene production sporadic.

        3. Basal leaves cordate; vegetative reproduction by horizontal rhizomes [with adventitious shoots on roots as well in SW Canada]; shady, wet areas throughout, common (s = 2x; x = 22) . . . . . *P. aurea* – golden ragwort.

        3. Basal leaves subcordate to abruptly contracted to petiole; vegetative reproduction ONLY by adventitious shoots on roots, resulting in a simple, short, erect rootstock lacking vegetative rosettes (a "nubbin"); sunny, wet areas (e.g., wet prairies) in S Wisconsin, infrequent (s = 2x; x = 23) . . . . . *P. pseudaurea* var. *semicordata* (“*P. semicordata*”) – heart-leaved ragwort.

1. Basal leaves tapering to the petiole, sometimes rounded or subtruncate; plants typically of mesic or dry habitats (except for *P. paupercula* var. *paupercula*).

    4. Plants moderately to heavily arachnoid tomentose, especially on the undersides of the basal leaves, the upper stem and the involucral bases; asexual reproduction ONLY by adventitious shoots on roots, resulting in a simple, short, erect rootstock lacking vegetative rosettes (a "nubbin").

        5. Cauline leaves fewer in number, less quickly reduced in size from base to inflorescence, the uppermost usually pinnatifid to the leaf tip; leaves deep spinach green, though superficially greyish due to the overlying pubescence; heads large; adventitious shoots sparse; infrequent in dry areas in W Wisconsin, e.g., bluff prairies (s = 4x; x = 23) . . . . . *P. plattensis* – prairie ragwort.

5. Cauline leaves greater in number, rapidly reduced in size from base to inflorescence, the uppermost usually with an unlobed tip; leaves often pale green; heads in the common taxon (var. *savannarum*) small; adventitious shoots typically frequent to abundant.

    6. Adventitious shoots typically abundant, individuals frequently forming extensive clones; common S of the Tension Zone (s = 2x; x = 22) . . . . . *P. paupercula* var. *savannarum*.

    6. Adventitious shoots only "frequent", clones with more sparsely distributed rosettes; sandy savanna at Perrot State Park, Trempealeau Co. (where the two previous species also occur in different habitats) , but may also occur elsewhere in the sandy floodplain of the Mississippi River (s = ca 6x) . . . . . *P. paupercula* var. *savannarum* + *P. plattensis*?.

4. Plants lightly pubescent to glabrous, except in the stoloniferous *P. paupercula* var. *pseudotomentosa*; vegetative reproduction by horizontal rhizomes and/or adventitious shoots on roots **OR** by stolons **OR** absent (though with vegetative rosettes on rootstock) . . . . . *P. paupercula* (s.l.) – northern ragwort.

.

    7. Vegetative reproduction ONLY by adventitious shoots on roots; cauline leaves usually more numerous, more quickly reduced in size up the stem, uppermost often unlobed at leaf tip; common S of the Tension Zone (s = 2x; x = 22) . . . . . var. *savannarum*.

    7. Vegetative reproduction by horizontal rhizomes (sometimes with sparse adventitious shoot production) **OR** by stolons **OR** absent; cauline leaves usually fewer and less quickly reduced in size up the stem, the uppermost often lobed to the tip.

        8. Stolons present and adventitious shoots on roots absent; plants typically pubescent; leaves broadly elliptical and abrubtly contracted to the petiole ("lollipop" leaves); sandy savannas of central Wisconsin (s = 2x; x = 22) . . . . . var. *pseudotomentosa*.

        8. Stolons absent, rhizomes usually present, sometimes with adventitious shoots on roots in addition; plants lightly pubescent to glabrous; leaves narrowly elliptical to lanceolate, gradually narrowed to the petiole.

            9. Plants glabrous and gracile; heads smaller; wet or moist habitats along the shores of Lakes Superior and Michigan and in calcareous fens inland in SE Wisconsin (s = 2x; x = 22) . . . . . var. *paupercula*.

            9. Plants more or less pubescent and coarser; heads larger; moist to mesic habitats, frequent N of the Tension Zone (s = 4x; x = 22) . . . . . – "Northern tetraploid complex".

SENECIO – groundsel

(Source: Barkley 1963; edited by R. R. Kowal, 2006 Aug 1.)

(s = 4x in these species; x = 10)

1. Rays absent; calyculate bracts well developed with distinct black tips; common . . . . . *S. vulgaris* – common groundsel.

1. Rays present, small; calyculate bracts usually without distinct black tips.

   2 Plants densely and conspicuously glandular hairy; caluculate bracts about half as long as phyllaries; achenes glabrous; very rare adventive in Superior, WI . . . . . *S. viscosus* – sticky groundsel.

   2 Plants sparsely hairy or subglabrate, scarcely or obscurely glandular; caluculate bracts many times shorter than phyllaries; achenes pubescent; very rare adventive in Iron Co. . . . . *S. sylvaticus* – woodland groundsel.

PETASITES – sweet-coltsfoot

(s = 2x or 3x; x =30)

1. Leaves lobed more than two-thirds to base, reniform or suborbicular in overall shape, essentially glabrous above; wet habitats, N of the Tension Zone (s = 2x & 3x; x = 30) . . . . . *P. frigidus* var. *palmatus* – northern sweet-coltsfoot.

1. Leaves unlobed with margin dentate, deltoid-oblong to reniform-hastate, floccose above; wet habitats, infrequent, northernmost and, especially, NW Wisconsin (s = 2x; x = 30, 29) . . . . . *P. sagittatus* (*P. frigidus* var. *sagittatus*) – arrowhead sweet-coltsfoot.

TEPHROSERIS

(s = 2x; x = 24)

. . . . . *T. palustris* (*S. congestus*) – marsh-fleabane, northern swamp groundsel.

TUSSILAGO – coltsfoot

(s = 2x; x = 30)

. . . . . *T. Farfara* – coltsfoot.

Tribe 9. HELENIEAE – sneezeweed tribe

(Source: Mickelson and Iltis, 1966; FNA, 2006.)

1. Receptacle naked; style branches truncate, without an appendage . . . . . HELENIUM – sneezeweed.

1. Receptacle bristly; style branches with a subulate appendage . . . . . GAILLARDIA – blanket-flower.

HELENIUM – sneezeweed

1. Leaves filiform, less than 2 mm wide; stems not winged; disk yellow; very rare introduced weed (s = 2x; x = 15) . . . . . *H. amarum* var. *amarum* – bitter-weed, narrow-leaved sneezeweed.

1. Leaves lanceolate; stems winged by the decurrent leaf bases.

   2. Disk florets yellow, 5-lobed; ray florets pistillate; cauline leaves 1-3.5 cm wide; widespread throughout (s = 2x; x = 16, 17, 18) . . . . . *H. autumnale* – common sneezeweed.

   2. Disk florets dark brown, 4-lobed; ray florets neuter; cauline leaves to 1 cm wide; very rare, in central Wisconsin (s = 2x; x = 14) . . . . . *H. flexuosum* – purple-head or southern sneezeweed.

GAILLARDIA – blanket-flower

(s = 2x, 4x; x = 17)

. . . . . *G. aristata* – common blanket-flower.

Tribe 10. HELIANTHEAE (s.l.) – sunflower tribe
(Including Panero & Funk's (2002) tribes MADIEAE [*Madia*], COREOPSIDEAE [*Bidens*, *Coreopsis*, *Cosmos*], POLYMNIEAE [*Polymnia*], TRIBUS INCOGNITUS [*Eclipta*, *Galinsoga*].)

(Sources Melchert, 1960, unpublished; FNA, 2006;
edited by R. R. Kowal, 2006 Aug 2.)

(Rare waif, presumably from bird seed: *Guizzotia abyssinica* – niger-seed.
Not in FNA, 2006.)

[For the wind-pollinated subtribe Ambrosiinae, go to Tribe 10a. HELIANTHEAE subtribe AMBROSIINAE – ragweed subtribe. For subtribe Eupatoriinae, go to Tribe 10b. HELIANTHEAE subtribe EUPATORIINAE – boneset subtribe. See KEY TO TRIBES for characters of these two subtribes.]

1. Phyllaries (some or all) highly modified, either infolding outer achenes or united into a cup or tube; strongly scented annuals; very rare adventives or escapes from cultivation.

    2. Phyllaries free, outer (or larger) laterally compressed and infolding the laterally compressed achene; cauline leaves mostly alternate and unlobed; stems viscid and glandular pubescent . . . . . MADIA – tarweed.

    2. Phyllaries (at least innermost) united into a cup or tube, none inclosing the opposite flower or achene; cauline leaves mostly opposite and pinnately lobed; stems glabrous or glabrate.

        3. Involucre a cup, with loose phyllaries at base of the united series; receptacle bearing slender chaff; pappus of chaffy scales dissected into numerous, long bristles . . . . . DYSSODIA – fetid marigold.

        3. Involucre a tube, naked at base; receptacle honeycombed; scales of pappus entire . . . . . TAGETES – marigold

1. Phyllaries not highly modified, free and not infolding outer achenes; annuals and perennials, not strongly scented.

    4. Involucre distinctly double, the outer larger (**OR** minute, 2 mm or less long) , foliaceous, somewhat spreading, the inner broader and appressed, nearly membranous.

        5. Pappus absent or of a few teeth . . . . . COREOPSIS – coreopsis, tickseed.

        5. Pappus of 2 to 4 barbed awns.

6. Achenes beakless, flattened or slender and 4-sided (rarely subterete) . . . . . BIDENS – beggar-ticks.

6. Achenes long-beaked, slenderly fusiform, 5-angled and subterete . . . . . COSMOS – cosmos.

4. Involucre not double, phyllaries all about equal in length, the inner and outer similar in texture.

7. Rays white or absent, if present, 1-10 mm long; disk small, 3-10 mm wide.

8. Leaves alternate; heads whitish; leaves large, rough . . . . . PARTHENIUM.

8. Leaves opposite.

9. Lower leaves deeply lobed, with connate-perfoliate expanded blade tissue at the nodes . . . . . POLYMNIA – leafcup.

9. Leaves not lobed, toothed, without such a foliaceous expansion at the nodes.

10. Leaves, except the uppermost, petioled, the blades less than three times as long as wide . . . . . GALINSOGA – quickweed.

10. Leaves tapered to the base, not distinctly petioled, the blades more than three times as long as wide; Mississippi River, rare . . . . . ECLIPTA.

7. Rays yellow, orange or purple, generally 1-6 cm long; disk generally large, (4-) 10-40 mm wide.

11. Rays purple, the receptacular bracts spiny-pointed . . . . . ECHINACEA – coneflower.

11. Rays yellow or orange.

12. Disk florets staminate; ray florets pistillate, their large achenes broadly ovate, winged, strongly flattened parallel with the adjoining phyllaries; plants large, usually resinous . . . . . SILPHIUM – rosinweed.

12. Disk florets bisexual; ray florets neuter or pistillate; achenes wingless, sub-terete or angled.

13. At least some of the leaves opposite **OR** all basal.

14. Outer phyllaries shorter than the inner; ray florets neuter, their rays thin and easily wilting, deciduous . . . . . HELIANTHUS – sunflower.

14. Outer phyllaries longer than the inner; ray florets pistillate, their rays marcescent (thickish and persistent after flowering) . . . . . HELIOPSIS – ox-eye.

13. Leaves all alternate.

15. Disk flat or convex; leaves neither lobed nor divided.

16. Leaves not decurrent; achenes 3- or 4-angled, wingless, forming a flat head . . . . . HELIANTHUS – sunflower.

16. Leaves decurrent down the stem; achenes flat, usually winged, forming a globose head . . . . . VERBESINA.

15. Disk conical, hemispheric or columnar; leaves simple in *Rudbeckia hirta*, otherwise lobed, cleft, laciniate or pinnately parted.

17. Leaves simple, 3-lobed, or -cleft, or laciniate; rays not subtended by receptacular bracts; achenes 4-sided . . . . . RUDBECKIA – black-eyed susan, coneflower.

17. Leaves pinnately divided; rays subtended by receptacular bracts; achenes laterally flattened . . . . . RATIBIDA – prairie coneflower.

BIDENS – beggar-ticks, stick-tight

(Rare waif: *B. pilosa* – Spanish needles. Not in FNA, 2006.)

1. Plants strictly aquatic, submerged or floating, with leaves finely dissected into filiform segments suggesting whorls (s = 2x; x = 13) . . . . . *B.* (*Megalodonta*) *Beckii* – water beggar-ticks or water-marigold.

1. Plants terrestrial (or rarely emergent in shallow water); leaves simple or pinnately divided, the segments lanceolate to linear.

2. Leaves pinnately compound or tri-foliolate.

3. Leaves with 3 to 7 lance-linear to linear segments; achenes with 2 to 4 awns, if 2-awned the awns normally with a thin ciliate margin on the inner surface and on the summit of the achene; heads radiate or discoid.

4. Rays, if developed, inconspicuous, to 8 mm long; achenes normally 4-awned, occasionally 2- or 3-awned, the awns aristate, without a thin margin; barbs on awns and on achene margins RETRORSE (s = 4x; x = 12) . . . . . *B. connata* – purple-stem beggar-ticks or tickseed.

4. Rays showy, 1-3 cm long; achenes 2-awned or awnless, the awns with a thin margin near the base; barbs on awns and achene margins antrorse or retrorse.

5. Achenes broadly cuneate, oblanceolate, or obovate, 1.5 to 2.5 times as long as wide, margins hispid-ciliate and more-or-less corky winged; barbs on awns and achene margins antrorse or retrorse . . . . . *B. aristosa* – mid-western tickseed-sunflower.

5. Achenes narrowly cuneate-oblong, 2.5 to 4 times as long as wide, margins glabrous or strigose-ciliolate and not winged; barbs on awns and achene margins ANTRORSE (s = 2x; x = 12) . . . . . *B. trichosperma* (*B. coronata*) – northern tickseed-sunflower, tall swamp-marigold.

3. Leaves 3- to 5-foliolate; leaflets lanceolate to lance-ovate; achenes 2-awned; awns barb-like, without a thin margin; heads discoid or with rays less than 5 mm long.

6. Outer phyllaries 3 to 5, smooth-margined (non-ciliate) or nearly so; achenes with antrorsely barbed awns (*B. frondosa* forma *anomala*, rare in Wisconsin, also has antrorsely barbed awns) (s = 2x; x = 12) . . . . . *B. discoidea* – few-bracted or swamp beggar-ticks.

6. Outer phyllaries 5 to many, ciliate, at least at the base; achenes with retrorsely barbed awns.

7. Outer phyllaries usually 8 (5-9) , the inner bracts oblong, equaling the disk (s = 2x, 4x, 6x; x = 12) . . . . . *B. frondosa* – devil's or common beggar-ticks.

7. Outer phyllaries usually 12 or 13 (10-16) , the inner bracts ovate-triangular, shorter than the disk (s = 2x, 4x; x = 12) . . . . . *B. vulgata* – tall beggar-ticks.

2. Leaves simple (sometimes lobed) , not compound.

8. Stem usually hispid below; leaves linear to lanceolate, sessile or the lowermost sometimes slightly petioled; achenes with a convex cartilagenous summit, normally curved in the compacted head, the surface glabrous or with a few retrorse hairs (s = 2x, 4x; x = 12) . . . . . *B. cernua* – nodding beggar-ticks or bur-marigold.

8. Stem smooth; leaves lanceolate to ovate, with winged petioles; achenes without a convex cartilagenous summit, straight, the surface with antrorse **OR** retrorse hairs **OR** glabrous.

    9. Surface of achenes with ANTRORSE hairs, the margins of achenes usually with at least a few antrorse barbs near the base; achenes usually 4-awned, occasionally 2 or 3-awned (s = 4x; x = 12) . . . . . *B. connata* – purple-stem beggar-ticks or tickseed.

    9. Surface of achenes GLABROUS or with a few RETRORSE hairs, the margins of achenes with retrorse barbs throughout; achenes 2 or 3-awned (s = 4x; x = 12) . . . . . *B. tripartita* (*B. comosa*) – straw-stem beggar-ticks, swamp-marigold.

COREOPSIS – coreopsis, tickseed

1. Phyllaries of outer involucre minute, 2 mm or less long; phyllaries of inner involucre and base of the rays reddish-brown at anthesis; heads many; achenes wingless; pappus wanting; leaf segments filiform to linear (s = 2x; x = 13) . . . . . *C. tinctoria* – plains or golden tickseed.

1. Phyllaries of outer involucre more than 2 mm long; phyllaries of inner involucre greenish at anthesis; heads solitary or several; achenes winged; pappus present.

    2. Leaves sessile, palmately 3- to 5-lobed (very rarely simple and linear-oblong); achenes narrowly winged, essentially glabrous (s = 2x; x = 13) . . . . . *C. palmata* – finger or prairie tickseed.

    2. Basal leaves petioled, simple or pinnately parted, oblanceolate to spatulate; achenes broadly winged, dorsally papillate.

        3. Plants essentially leafy throughout; upper leaves pinnatifid (appearing whorled) , the segments linear to narrowly lanceolate, the lowermost entire, spatulate to oblanceolate; peduncles normally less than 1.5 dm long (s = 2x + 0-2B; x = 13) . . . . . *C. grandiflora* – big- or large-flowered tickseed.

        3. Leaves mostly on the lower half of the stem, simple or with 1 or 2 pairs of lateral lobes, long petioled, spatulate or oblanceolate (not appearing whorled above); peduncles normally (1-) 1.5-3.5 dm long (s = 2x + 0-4B; x = 13) . . . . . *C. lanceolata* – long-stalk or sand tickseed.

COSMOS – cosmos

(s = 2x; x = 12)

. . . . . *C. bipinnatus* – common garden cosmos.

DYSSODIA – fetid marigold

(s = 2x; x = 13)

. . . . . *D. papposa* – stinking or fetid marigold.

ECHINACEA – coneflower

(Sources: Fernald, 1950; Gleason & Cronquist, 1991; FNA, 2006.)

(s = 2x; x = 11)

1. Leaves broadly to narrowly ovate, rounded at base; blades mostly less than 5 times as long as wide, usually more than 5 cm wide; rays spreading; stems from a coarsely fibrous-rooted crown, caudex, or short stout rhizome . . . . . *E. purpurea* – eastern purple coneflower.

1. Leaves lanceolate to lance-linear, attenuate at base; blades mostly more than 5 times as long as wide, usually less than 5 cm wide; rays drooping; stems from a strong taprooot . . . . . *E. pallida* – prairie or pale purple coneflower.

ECLIPTA

(s = 2x; x = 11)

. . . . . *E. prostrata* (*E. alba*) – yerba-de-tajo.

GALINSOGA – quickweed

(x = 8)

1. Ray florets' pappus of scales about as long as the tube; scales of disk florets' pappus tapering to a very sharp point; marginal achenes densely hispid on inner faces (s = 4x) . . . . . *G. quadriradiata* (*G. ciliata*) – common quickweed.

1. Ray florets' pappus absent or nearly so; scales of disk florets' pappus obtuse and fimbriate at tip; marginal achenes glabrous, at most merely pilose at summit (s = 2x) . . . . . *G. parviflora* – lesser quickweed.

HELIANTHUS – sunflower

(Source: T. E. Melchert and Hugh H. Iltis, 1976, based on T. E. Melchert's MS Thesis, 1960; FNA, 2006; edited by R. R. Kowal, 2006 Aug 2.)

(Very rare waif: *H. salicifolius* – willow-leaved sunflower.)

(x = 17)

(Species boundaries are often obscured by natural hybridization and polyploidy. The entire plant should be collected, with special attention and effort directed towards obtaining the underground parts, which often offer critical characters.)

1. Annuals; disk, when in flower, usually brown or purple-black, 1.5-4 cm broad (when yellow, then 3-40 cm broad); upper leaves alternate.

    2. Phyllaries broadly ovate or lance-ovate, usually 5 mm or more wide, usually ABRUPTLY NARROWED to acuminate tips, ciliate with hairs that are decidedly longer than those on the bract surface; leaf blades frequently cordate, serrate; central receptacular bracts hispid (s = 2x) . . . . . *H. annuus* – common sunflower.

    2. Phyllaries lanceolate or narrowly ovate, usually less than 5 mm wide, gradually tapering to acute or acuminate tips, ciliate with hairs that are about as long as those on the bract surface; leaf blades truncate or wedge-shaped, entire or nearly so; central receptacular bracts with long, white-villous tips; southern half and northwest Wisconsin (s = 2x) . . . . . *H. petiolaris* subsp. *petiolaris* – plains sunflower.

1. Perennials; disk, when in flower, yellow (except in *H. pauciflorus*) , 1-3 cm broad; upper leaves alternate or opposite.

    3. Leaves mostly basal, the stems slender, elongate, and scapose (nearly leafless); heads few, small, the disks mostly 1-1.5 cm broad; common in sandy soil (s = 2x) . . . . . *H. occidentalis* var. *occidentalis* – naked-stemmed or western sunflower.

    3. Plants leafy throughout, though leaves reduced upwards in *H. pauciflorus* and *H.* ×*laetiflorus*; stems coarse.

        4. Leaves rounded to sessile or very short-petioled bases, mostly opposite, their petioles, when developed, rarely 5 mm long.

            5. Leaves cordate to subcordate, sessile, usually somewhat CLASPING, copiously villous throughout; very rare adventive (s = 2x) . . . . . *H. mollis* – ashy or downy sunflower.

            5. Leaves usually not clasping, glabrous, scabrous, short pilose or hirsute.

6. Stem glabrous, often glaucous; leaves horizontally divergent, sessile, their long lateral veins joining midrib at very base of blade (s = 2x) . . . . . *H. divaricatus* – woodland sunflower.

6. Stem scabrous to hirsute; leaves divergent to subascending, sessile or short-petioled, their long lateral veins joining midrib slightly above base of blade (s = 4x) . . . . . *H. hirsutus* – hairy sunflower.

4. Leaves tapering to base, if strongly rounded, petioles more than 5 mm long.

7. Phyllaries STRONGLY APPRESSED, SHORTER THAN THE DISK (rarely over 10 mm long) , oblong to ovate, glabrous or nearly so, the margins sometimes ciliate; leaves narrowly lanceolate to subrhombic, rigid, scabrous, usually strongly reduced upward; stems usually rough throughout.

8. Phyllaries ovate with acute tips, glabrate to hispid; disk red-purple (s = 6x) . . . . . *H. pauciflorus* (*H. rigidus*) – stiff sunflower.

9. Leaves usually alternate distally, blades oblong-lanceolate to lance-ovate, 8-27 cm long, apices acuminate; plants 0.8-2 m tall . . . . . subsp. *pauciflorus*.

9. Leaves all opposite, blades rhombic-ovate to lance-linear, 5-12 cm long, apices acute to obtuse; plants 0.5-1.2 m tall . . . . . subsp. *subrhomboidius*.

8. Phyllaries oblong lanceolate with acuminate tips, usually hairy; disk yellow (s = 6x) . . . . . *H. ×laetiflorus* (*H. pauciflorus* × *H. tuberosus*) – cheerful sunflower.

7. Phyllaries loose, ovate-lanceolate to attenuate, with acute to acuminate SPREADING TIPS, usually equaling or exceeding the disk, generally pubescent; leaves opposite, alternate or both, only moderately reduced upward.

10. Roots usually CONSPICUOUSLY THICKENED, fusiform and fascicled, **OR** with short thickened rhizomes, the rhizomes not elongate; leaves usually alternate, linear-lanceolate to lanceolate, mostly 1-3 (-4) cm wide, tapering to sessile or petioled bases.

11. Leaves linear to linear-lanceolate, entire or nearly so, frequently folded along the midrib; roots from a short thickened rhizome; stem copiously rough-pubescent throughout (whitened underneath the heads); heads normally in a racemose inflorescence; uncommon adventive (s = 2x) . . . . . *H. Maximilianii* – Maximillian's sunflower.

11. Leaves lance-linear to lanceolate, serrate, flat; roots short, usually conspicuously thickened, somewhat fascicled, never with elongate rhizomes; stem glabrous **OR** scabrous with short, scattered hairs.

    12. Petioles prominent, 1.5-4 cm long; stems glabrous, OFTEN GLAUCOUS, the uppermost parts sometimes sparsely pubescent; lower leaf surfaces with short, dense, appressed pubescence, OFTEN WHITENED (s = 2x) . . . . . *H. grosseserratus* – saw-tooth sunflower.

    12. Petioles 0-1.5 cm long; stem usually pubescent with short scabrous hairs; lower leaf surface with scattered, or occasionally rather dense, harsh, ascending pubescence, never whitened (s = 2x) . . . . . *H. giganteus* – swamp or giant sunflower.

10. Roots NOT THICKENED, CORD-LIKE; leaves USUALLY OPPOSITE, if alternate, then more than 3 cm wide.

    13. Leaves OPPOSITE BELOW, ALTERNATE ABOVE, usually BROADLY lance-ovate to ovate, abruptly tapering to rather long, usually winged, petioles.

        14. Rhizomes frequently tuber-bearing; stem rough-pubescent throughout; leaves coarse, the lower surface densely pubescent, USUALLY VELUTINOUS; PHYLLARIES FREQUENTLY DARK GREEN OR BLACKISH (s = 6x) . . . . . *H. tuberosus* – Jerusalem-artichoke.

        14. Rhizomes not tuber-bearing; stem smooth; leaves thin, coarsely toothed, the lower surface essentially glabrous, or slightly scabrous; phyllaries light green, frequently considerably exceeding the disk, leaf-like (s = 2x, 4x) . . . . . *H. decapetalus* – forest or pale sunflower.

    13. Leaves essentially OPPOSITE THROUGHOUT, lanceolate to ovate-lanceolate, the blades often contracted at the base to a short unwinged petiole **OR** abruptly tapering to, and decurrent on, the petiole.

15. Rhizomes frequently producing TUBERS (late in growing season); STEMS NORMALLY SCABROUS or HISPID throughout or smooth near the base; LEAVES USUALLY VELUTINOUS BENEATH; phyllaries not greatly exceeding the disk, USUALLY DARK GREEN or blackish at maturity, with conspicuous white cilia (s = 6x) . . . . . *H. tuberosus* – Jerusalem-artichoke.

15. Rhizomes elongate, often woody, not tuber-bearing; stems ESSENTIALLY GLABROUS **OR** scabrous on the upper internodes; leaves either thin, the lower surface glabrous to slightly scabrous, **OR** coarse, the lower surface slightly to densely scabrous or grayed with soft, appressed pubescence; phyllaries equaling to greatly exceeding the disk, not dark green.

    16. Leaves thin, the blades TAPERING to and decurrent on the often winged petiole; lower leaf surface essentially glabrous to lightly scabrous; leaf margins coarsely to moderately serrate; phyllaries, often leaflike, exceeding the disk (s = 2x, 4x) . . . . . *H. decapetalus* – forest or pale sunflower.

    16. Leaves coarse, the blades normally ABRUPTLY CONTRACTED at the base to a short unwinged petiole or slightly decurrent on the petiole; lower leaf surface densely to slightly scabrous **OR** grayed with soft, dense, appressed or ascending pubescence; leaf margins moderately serrate to subentire; phyllaries not leaflike, equaling or exceeding the disk (s = 4x, 6x) . . . . . *H. strumosus* – rough-leaved sunflower.

HELIOPSIS – ox-eye

(s = 2x; x = 14)

. . . . . *H. helianthoides* – false sunflower, ox-eye.

1. Leaf blades ovate, 8-12 (-15) cm long × 4-8 (-12) cm wide, abaxially glabrous or sparsely pubescent, adaxially glabrous or minutely scabrellous; E North America . . . . . var. *helianthoides*.

1. Leaf blades deltate to narrowly ovate-lanceolate, 6-12 cm long × 2-5 cm wide, both surfaces scabrellous to scabrous; central North America . . . . . var.*scabra*.

MADIA – tarweed

(s = 4x; x = 7)

. . . . . *M. glomerata* – mountain or stinking tarweed.

PARTHENIUM

(s = 8x; x = 9)

. . . . . *P. integrifolium* – wild-quinine, eastern feverfew.

POLYMNIA – leaf-cup

(s = 2x; x = 15)

. . . . . *P. canadensis* – pale-flowered leaf-cup.

RATIBIDA – prairie coneflower

(s = 2x; x = 14)

1. Head ellipsoid-globose, shorter than rays; leaflets 5-20 mm wide; pappus none . . . . . *R. pinnata* – globular or yellow coneflower.

1. Head elongate columnar, as long as or longer than rays; leaflets mostly 2-5 mm wide; pappus of 1 or 2 teeth . . . . . *R. columnifera* – columnar or long-headed coneflower.

RUDBECKIA – black-eyed susan, coneflower

1. Pappus absent; style appendages elongate; leaves simple, densely hirsute or hispid (s = 2x; x = 19) . . . . . *R. hirta* var. *pulcherrima* – black-eyed Susan.

1. Pappus coroniform, to 0.2 mm long (to 1.5 mm long or of 4 scales in *R. laciniata*); style appendages short and blunt; lower leaves unlobed, 3-lobed, 3-cleft, or laciniate, not densely hirsute.

    2. Stem essentially glabrous; lower leaves very large, deeply laciniate; disk yellow-brown, the rays yellow, drooping (s = 2x, 3x; x = 18) . . . . . *R. laciniata* var. *laciniata* – cutleaf coneflower, wild golden glow.

    2. Stem pubescent; lower leaves at most 3-lobed or cleft; disk brownish-black.

3. Bracts of receptacle (chaff) cuspidate, with awn-like tips 1.5 mm or more long, glabrous; lower leaves usually 3(-5)-lobed (s = 2x, 3x; x = 19) . . . . . *R. triloba* – brown-eyed Susan.

3. Bracts of receptacle acute, obtuse or rounded, glabrous or canescent at tip; lower leaves unlobed or 3(-5)-lobed.

    4. Bracts of receptacle obtuse to acute, glabrous or rarely glabrate, at most with ciliolate margin; leaves unlobed, strigose-hispid beneath (s = ca 4x; x = 19) . . . . . *R. fulgida* var. *speciosa* – showy coneflower.

    4. Bracts of receptacle rounded, canescent near the tip; lower leaves usually 3(-5)-lobed, densely pubescent (downy) beneath (s = 2x; x = 19) . . . . . *R. subtomentosa* – sweet coneflower or black-eyed Susan.

SILPHIUM – rosinweed

(s = 2x; x = 7)

1. Leaves and\or bracts alternate; leaves largest at or near the base of the stem, and these long-petioled and usually much longer than 3 dm, commonly up to 5-6 dm long.

    2. Stem leafy, hirsute; leaves deeply laciniate . . . . . *S. laciniatum* – compass-plant.

    2. Stem essentially naked except for a few bracts, glabrous; leaves all basal, unlobed, broadly cordate, dentate . . . . . *S. terebinthinaceum* var. *terebinthinaceum* – prairie-dock.

1. Leaves opposite, either sessile or perfoliate, roughly the same size up the stem and mostly less than 3 dm long.

    3. Leaves sessile, not perfoliate, slightly, if at all clasping, entire or slightly serrate; stem terete . . . . . *S. integrifolium* var. *integrifolium* – prairie rosin-weed.

    3. Leaves, or their petiolar bases, strongly connate-perfoliate, grossly serrate; stem square . . . . . *S. perfoliatum* var. *perfoliatum* – cup-plant.

TAGETES – marigold

(s = 4x; x = 12)

. . . . . *Tagetes patula* (*T. erecta* s.l.) – French marigold.

VERBESINA

(s = 4x; x = 17)

. . . . . *V. alternifolia* – wing-stem.

Tribe 10a. HELIANTHEAE (s.l.) subtribe AMBROSIINAE – ragweed subtribe

(Source: Payne, 1970.)

1. Staminate and pistillate florets in the same head; ray florets pistillate, disk florets staminate . . . . . IVA – marsh-elder.

1. Staminate and pistillate florets borne in separate heads.

    2. Pistillate heads 2-flowered and with many, sharply-hooked spines; staminate heads lacking phyllaries . . . . . XANTHIUM – cocklebur.

    2. Pistillate heads 1 (-2) -flowered with a few vestigial spines or none; staminate heads with involucres of connate phyllaries . . . . . AMBROSIA – ragweed.

AMBROSIA – ragweed

1. Pistillate involucres with 2 flowers and 2 sharp beaks . . . . . *A. tomentosa* (*Franseria discolor*) – skeleton-leaf bur-sage.

1. Pistillate involucres with 1 flower and 1 beak.

    2. Leaves palmately lobed or unlobed; staminate involucres marked with dorsal striations; usually all cauline leaves opposite; plants annual (s = 2x, 4x; x = 12) . . . . . *A. trifida* – giant ragweed.

    2. Leaves pinnately or bipinnately lobed or parted; staminate involucres lacking dorsal striations; upper cauline leaves usually alternate.

        3. Plants perennial with horizontal runner-like underground roots; involucral spines blunt or absent; leaves usually coarsely lobed (s = 2x, 3x, 4x, 5x, 6x, 7x, 8x, ca 11x, 12x, 16x; x = 9) . . . . . *A. psilostachya* – western or perennial ragweed.

        3. Plants annual with taproots; involucral spines usually sharply pointed; leaves usually delicately lobed and parted (s = 2x; x = 18, 17) . . . . . *A. artemisiifolia* – common ragweed.

IVA – marsh-elder

1. Plants perennial; phyllaries basally connate (s = 2x, 3x; x = 18) . . . . . *I. axillaris* – poverty-weed.

1. Plants annual; phyllaries free.

    2. Leaves ovate, coarsely serrate; heads subtended by prominent bracts; phyllaries 3-4 (s = 2x; x = 17) . . . . . *I. annua* – rough marsh-elder.

    2. Leaves subcordate to ovate, usually coarsely lobed and toothed; heads ebracteate; phyllaries 5 (s = 2x; x = 18) . . . . . *I.* (*Cyclachaena*) *xanthifolia* – big marsh-elder.

XANTHIUM – cocklebur

(s = 2x; x = 18)

1. Leaves pinnately lobed; stems bearing long, golden, three-rayed, axillary spines . . . . . *X. spinosum* – spiny cocklebur.

1. Leaves coarsely palmately lobed; stems unarmed . . . . . *X. strumarium* – common cocklebur.

Tribe 10b. HELIANTHEAE (s.l.) subtribe EUPATORIINAE – boneset subtribe (EUPATORIEAE – boneset tribe)

(Source: Johnson and Iltis, 1963; Fernald, 1950; Gleason & Cronquist, 1991; FNA, 2006.)

1. Leaves alternate; plants from a stout taproot or enlarged corm; achenes 10-ribbed; pappus of plumose or barbellate bristles; phyllaries weakly or strongly ribbed.

    2. Plants from stout taproots; pappus plumose; phyllaries strongly ribbed; inflorescence corymbiform, the heads creamy-white . . . . . BRICKELLIA – false-boneset.

    2. Plants from enlarged corms; pappus plumose or barbellate; phyllaries weakly ribbed; inflorescence spicate or racemose, the heads purple and often very showy . . . . . LIATRIS – blazing-star.

1. Leaves opposite or whorled; roots fibrous; achenes 5-angled; pappus of capillary bristles; phyllaries not ribbed.

    3. Leaves in whorls of 3, 4 or 5; heads purple or dull rose; involucres cylindric with phyllaries in 5-6 series . . . . . EUTROCHIUM – Joe-Pye-weed.

    3. Leaves opposite (rarely in 3's in *E. perfoliatum*); heads white (rarely purple in *E. perfoliatum*); involucres short-cylindric with phyllaries in 2-3 series.

        4. Leaves long-petioled, ovate; phyllaries nearly uniseriate, narrowly linear, any basal ones usually much less than half the length of the longest; heads with 15-30 florets; amber resin glands absent . . . . . AGERATINA – throughwort, boneset.

        4. Leaves sessile (except *E. serotinum*) , narrowly ovate or lanceolate; phyllaries in 2-3 series, not narrowly linear, many roughly half the length of the longest; heads with 15 or fewer florets; tiny amber resin glands on leaf undersides, phyllaries, corollas, and achenes . . . . . EUPATORIUM – throughwort, boneset.

AGERATINA

(s = 2x; x = 17)

. . . . *Ageratina altissima* var. *altissima* (*E. rugosum*) – white snakeroot.

Tribe 10b. HELIANTHEAE (s.l.) subtribe EUPATORIINAE – boneset subtribe: 2

EUPATORIUM

(x = 10)

1. Leaves long-petioled, scabrous-pilose, thickish; heads with 5 (2-7) florets; rare in S Wisconsin (s = 2x) . . . . . *E. serotinum* – late boneset.

1. Leaves very short-petioled, sessile or perfoliate (their bases fused around the stem).

   2. Leaves attenuate to the winged petiole, broadest near middle, with 3 prominent veins beneath; plants pubescent; heads with 5 (3-7) florets; SW Wisconsin (s = 2x, 3x, 4x) . . . . . *E. altissimum* – tall boneset.

   2. Leaves sessile or perfoliate, broadest at the rounded base, not 3-nerved.

      3. Plants glabrous; leaves with very prominent white midrib beneath; heads with 5 (-6) florets; S Wisconsin (s = 2x, 3x) . . . . . *E. sessilifolium* – upland or woodland boneset.

      3. Plants pubescent; leaves with midrib not very prominent beneath; heads with 7-11 florets.

         4. Leaves perfoliate; very common throughout (s = 2x) . . . . . *E. perfoliatum* – common boneset, thoroughwort.

         4. Leaves sessile, not perfoliate; sporadic within perfoliate populations . . . . . *E. perfoliatum* forma *truncatum* – common boneset, thoroughwort.

EUTROCHIUM – Joe-Pye-weed

(s = 2x; x = 10)

1. Florets 8-24 per head; stem purple throughout or purple spotted; inflorescence flat-topped; very common throughout, wet habitats . . . . . *E. maculatum* – spotted joe-pye-weed.

1. Florets (3-) 5-7 (-9) per head; stem green, purple only at nodes, not spotted; inflorescence convex; dry woods . . . . . *E. purpureum* – purple-node or green-stemmed joy-pye-weed.

BRICKELLIA

(s = 2x; x = 9)

. . . . . *B.* (*Kuhnia*) *eupatorioides* var. *corymbulosa* – false boneset.

Tribe 10b. HELIANTHEAE (s.l.) subtribe EUPATORIINAE – boneset subtribe: 3

LIATRIS – blazing-star, gay-feather

(x = 10)

(Plants intermediate between species *L. spicata* & *L. pycnostachya* and between species *L. ligulistylis* & *L. aspera* are known from SE and NW Wisconsin, respectively.)

1. Pappus barbellate, not plumose, the lateral cilia 3-6 times the diameter of the bristle.

    2. Inflorescence a usually dense spike; heads sessile, small, the involucre 7-11 mm long.

        3. Inflorescence rachis glabrous to pilose-hirsute; phyllaries obtuse, erect, appressed, the tips not reflexed, 7-8 mm long; SE-most Wisconsin (s = 2x) . . . . . *L. spicata* – sessile or marsh blazing-star.

        3. Inflorescence rachis pilose-hirsute; phyllaries acute, the acuminate tips reflexed, 9-11 mm long (s = 2x, 4x) . . . . . *L. pycnostachya* – prairie or thick-spike blazing-star.

    2. Inflorescence an open spike or raceme; heads larger, the involucre 9-20 mm long.

        4. Inflorescence spicate, rarely racemose, heads sessile or with peduncles 1-5 (-10) mm long; corolla pilose within; involucres 9-15 mm long; leaves scabrous to glabrous, the margins not harsh (s = 2x) . . . . . *L. aspera* – lacerate or rough blazing-star.

        4. Inflorescence a raceme, rarely spiciform, heads with peduncles (5-) 8-15 (-30) mm long; corolla glabrous within; involucres 12-20 mm long, the terminal head often much larger; leaves scabrous-pubescent, the margins harshly ciliate (s = 2x) . . . . . *L. ligulistylis* – northern plains or showy blazing-star.

1. Pappus plumose, the lateral cilia 15 or more times the diameter of the bristle; heads cylindrical; phyllaries mucronate to acuminate, the margins ciliate.

    5. Inflorescence racemose, the heads 15-60 flowered; bracts mucronate; leaves not crowded, more lax, weakly punctate, not ciliate, 9-22 cm long, 3-7 mm wide; dry prairies, southern Wisconsin (s = 2x) . . . . . *L. cylindracea* – few-headed or cylindrical blazing-star.

    5. Inflorescence a dense to loose spike, the heads 3-8 flowered; bracts acuminate; leaves crowded, rigid, conspicuously punctate, ciliate, 6-15 cm long, 1-2 mm wide; prairies of Pierce and St. Croix counties (s = 2x, 4x, 6x) . . . . . *L. punctata* var. *punctata* (var. *nebraskana*) – dotted blazing-star.

CHECKLIST OF SPECIES OF ASTERACEAE IN WISCONSIN ARRANGED BY TRIBE AND GENUS

Genera are arranged alphabetically within tribes.
Taxa enclosed in square brackets are not included in the flora of Wisconsin.

Tribe 1. CARDUEAE (CYNAREAE) – thistle tribe

ACROPTILON [CENTAUREA key]
- *A*. (*Centaurea*) *repens* – Russian knapweed

ARCTIUM – burdock
- *A*. *Lappa* – great burdock
- *A*. *minus* – common burdock
- *A*. *tomentosum* – hairy burdock, cotton burdock

CARDUUS – plumeless thistle
- *C*. *acanthoides* – plumeless thistle
- *C*. *nutans* – nodding thistle

CENTAUREA – star-thistle, batchelor's button
- *C*. *(Cnicus) benedicta* – blessed thistle
- *C*. *Cyanus* – bachelor's-button, cornflower
- [*C*. *diffusa* – white knapweed. Extremely rare adventive.]
- *C*. *Jacea* – brown knapweed
- *C*. *nigra* – black knapweed
- *C*. *nigrescens* – short-fringed knapweed
- *C*. *macrocephala* – big-head knapweed
- *C*. *melitensis* – Maltese star-thistle
- *C*. ×*Monctonii* (*C*. *Debauxii*) – meadow knapweed
- *C*. *montana* – mountain bluet
- *C*. *Scabiosa* – hard-heads
- *C*. *solstitialis* – yellow star-thistle, St. Barnaby's thistle
- *C*. *Stoebe* subsp. *micranthos* (*C*. *maculosa*, *C*. *Biebersteinii*) – spotted knapweed

CIRSIUM – thistle
- *C*. *altissimum* – wood thistle
- *C*. *arvense* – Canada thistle
- *C*. *discolor* – prairie thistle
- *C*. *Flodmanii* – Flodman's thistle
- *C*. *muticum* – swamp thistle
- *C*. *palustre* – European swamp thistle
- *C*. *Pitcheri* – dune thistle
- *C*. *pumilum* var. *Hillii* (*C*. *Hillii*) – Hill's thistle
- *C*. *undulatum* – wavy-leaved thistle
- *C*. *vulgare* – bull thistle

ECHINOPS – globe-thistle
- *E*. *sphaerocephalus* – great globe-thistle

ONOPORDUM – cotton or Scotch thistle
O. Acanthium – Scotch thistle

PLECTOCEPHALUS [CENTAUREA key]
P. (*Centaurea*) *americanus* – basketflower

Tribe 2. CICHORIEAE (LACTUCEAE) – chicory (lettuce) tribe

CICHORIUM – chicory
C. Intybus – chicory, blue sailors

CREPIS – hawk's-beard
C. capillaris – smooth hawk's-beard
[*C. foetida* – stinking hawk's-beard. Very rare waif.]
C. setosa – bristly hawk's-beard
C. tectorum – narrow-leaved hawk's-beard

HIERACIUM – hawkweed
H. aurantiacum – orange hawkweed, devil's paintbrush
H. caespitosum (*H. pratense*) – yellow king-devil
H. Lachenallii (*H. vulgatum*) – European hawkweed
H. longipilum – long-haired or prairie hawkweed
[*H. murorum* – wall hawkweed. Not noted for WI & MN in FNA (2006).]
H. Pilosella – mouse-ear hawkweed
H. piloselloides (*H. florentinum*) – glaucous king-devil
H. scabrum – sticky hawkweed
H. umbellatum (*H. Kalmii*, *H. scabriusculum*) – northern hawkweed

HYPOCHAERIS – cat's-ear
H. radicata – spotted cat's-ear

KRIGIA – dwarf-dandelion
K. biflora – orange dwarf-dandelion
K. virginica – Virginia dwarf-dandelion

LACTUCA – lettuce
L. biennis – woodland or tall blue lettuce
L. canadensis – tall wild lettuce
L. floridana – woodland or blue lettuce
L. ludoviciana – prairie lettuce
L. serriola – prickly lettuce

LAPSANA – nipplewort
L. communis – nipplewort

LEONTODON – hawkbit
L. autumnalis – fall-dandelion
L. taraxicoides subsp. *saxatilis* (*L. taraxicoides*) – little hawk's-bit

MULGEDIUM [LACTUCA key]
M. (*Lactuca*) *pulchellum* (*L. tatarica* subsp. *pulchella*) – showy blue lettuce

NOTHOCALAIS
- *N*. (*Microseris*) *cuspidata* – prairie or false dandelion

PRENANTHES – white-lettuce
- *P*. *alba* – white-lettuce, rattlesnake root, lion's foot
- *P*. *aspera* – rough white-lettuce
- *P*. *crepidinea* – Midwestern white-lettuce
- *P*. *racemosa* – glaucous white-lettuce

SONCHUS – sow-thistle
- *S*. *arvensis*
  - subsp. *arvensis* – perennial sow-thistle
  - subsp. *uliginosus* (var. *glabrescens*) – marsh sow-thistle
- *S*. *asper* – prickly sow-thistle
- *S*. *oleraceus* – common sow-thistle

TARAXACUM – dandelion
- *T*. *erythrospermum* (*T*. *laevigatum*) – red-seeded dandelion
- *T*. *officinale* – common dandelion

TRAGOPOGON – goat's-beard
- *T*. *dubius* – fistulose goat's-beard
- *T*. *porrifolius* – salsify, vegetable-oyster
- *T*. *pratensis* – showy goat's-beard

Tribe 3. VERNONIEAE – ironweed tribe

VERNONIA – ironweed
- *V*. *fasciculata* – smooth ironweed

Tribe 4. INULEAE – elecampane tribe

INULA
- *I*. *Helenium* – elecampane

Tribe 5. GNAPHALIEAE – pussy's-toes tribe

ANTENNARIA – pussy's-toes, everlasting, ladies'-tobacco
- *A*. *Howellii*
  - subsp. *canadensis*
  - subsp. *neodioica*
  - subsp. *petaloidea*
- *A*. *neglecta*
- *A*. *Parlinii* – Parlin's pussy's-toes
  - subsp. *fallax* (*A*. *munda*)
  - subsp. *Parlinii*
- *A*. *plantaginifolia* – plantain-leaved pussy's-toes

ANAPHALIS – everlasting
A. margaritacea – pearly everlasting

GNAPHALIUM – marsh cudweed
G. (*Fillaginella*) *uliginosum* – marsh cudweed

PSEUDOGNAPHALIUM – cudweed, everlasting
Ps. (*Gnaphalium*) *Macounii* – western or clammy cudweed
Ps. microdenium (*Gnaphalium Helleri* var. *microdenium*) – delicate cudweed
Ps. (*Gnaphalium*) *obtusifolium* – fragrant cudweed
Ps. (*Gnaphalium*) *saxicola* – cliff cudweed

OMALOTHECA – Arctic-cudweed
O. (*Gnaphalium*) *sylvatica* – woodland Arctic-cudweed

Tribe 6. ASTEREAE – aster tribe

BELLIS
B. perennis – English daisy

BOLTONIA
B. asteroides var. *recognita* – false aster

[CALLISTEPHUS]
[*Callistephus chinensis* – China aster. Garden escape; not in FNA (2006).]

CONYZA
C. canadensis – horse-weed
C. ramosissima – dwarf fleabane

DOELLINGERIA – aster ["ASTER" key]
D. umbellata
var. *umbellata* – tall flat-topped white aster
var. *pubens* (*Aster pubentior*) – northwestern flat-topped white aster

EURYBIA – aster ["ASTER" key]
E. furcata – midwestern white heart-leaved aster
E .macrophylla – big-leaved aster

ERIGERON – fleabane
E. annuus – annual fleabane
E. glabellus – stream-side fleabane
E. pulchellus var. *pulchellus* – Robin's plantain
E. philadelphicus – common fleabane
E. strigosus vars. *septentrionalis* & *strigosus* – prairie or daisy fleabane

EUTHAMIA – flat-topped goldenrod
E. caroliniana (*E. tenuifolia*) – coastal plain flat-topped goldenrod
E. graminifolia – grass-leaved or common flat-topped goldenrod
E. gymnospermoides – Great Plains flat-topped goldenrod

GRINDELIA – gumweed
- *G. lanceolata* – spiny-tooth gumweed
- *G. squarrosa* – curly-cup gumweed

HETEROTHECA (CHRYSOPSIS) – golden aster
- *H. villosa* – hairy golden aster
  - var. *Ballardii*
  - var. *minor*
  - var. *villosa*

IONACTIS – aster ["ASTER" key]
- *I. linariifolia* – flax-leaved aster

SOLIDAGO – goldenrod
- *S. altissima* – Canada goldenrod
- *S. bicolor* – white goldenrod
- *S. caesia* – axillary or blue-stemmed goldenrod
- *S. canadensis* – Canada goldenrod
  - var. *canadensis*
  - var. *Hargeri*
- *S. flexicaulis* – broad-leaved or zigzag goldenrod
- *S. gigantea* – smooth goldenrod
- *S. hispida* – hairy goldenrod
- *S. juncea* – early goldenrod
- *S. nemoralis* – gray or old-field goldenrod
  - var. *nemoralis*
  - var. *decemflora*
- *S. missouriensis* – Missouri goldenrod
- *S. mollis* – velvety goldenrod
- *S. ohioensis* – Ohio goldenrod
- *S. patula* var. *patula* – rough-leaved or swamp goldenrod
- *S.* (*Aster*) *ptarmicoides* (*S. asteroides*) – upland white aster or goldenrod
- *S. Riddellii* – Riddell's goldenrod
- *S. rigida* subsp. *rigida* & *humilis* – stiff goldenrod
- *S. rugosa* – wrinkle-leaved goldenrod
- *S. sciaphila* – cliff goldenrod
- *S. simplex* [subsp. *Randii*] var. *Gillmanii* – dune goldenrod
- *S. speciosa* – showy goldenrod
  - var. *speciosa*
  - var. *rigidiuscula*
- *S. uliginosa* – northern bog goldenrod
- *S. ulmifolia* var. *ulmifolia* – elm-leaved goldenrod

SYMPHYOTRICHUM ["ASTER" key]
- *S. boreale* – rush or northern bog aster
- *S. ciliatum* (*Aster Brachyactis*) – alkali rayless aster
- *S. ciliolatum* – northern heart-leaved aster
- *S. cordifolium* – common blue arrow-leaved aster
- *S. Drummondii* – hairy arrow-leaved aster
- *S. dumosum* complex ("var. *strictior*") – long-stalked aster
- *S. ericoides* var. *ericoides*
- *S. falcatum* var. *commutatum* – white prairie aster
- *S. firmum* – shining aster
- *S. laeve* – smooth blue aster
- *S. laeve* var. *laeve* – smooth blue aster
- *S. lanceolatum*
  - var. *hesperium* (*S. hesperium*) – western lined aster
  - var. *hirsuticaule* – panicled or eastern lined aster
  - var. *interior* – inland panicled aster
  - var. *lanceolatum* – panicled or eastern lined aster
  - var. *latifolium* – panicled or eastern lined aster
- *S. lateriflorum* – starved, calico, white woodland or side-flowering aster
- *S. novae-angliae* – New England aster
- *S. oblongifolium* – aromatic aster
- *S. ontarionis* [sic] – bottomland or Ontario aster
- *S. oolentangiense (Aster azureus*) – prairie heart-leaved aster
- *S. pilosum* – awl aster
  - var. *pilosum*
  - var. *Pringlei*
- *S. praealtum* – willow-leaved aster
- *S. prenanthoides* – zigzag aster
- *S. puniceum* – bristly or swamp aster
- *S. racemosum (S. fragilis*) – brittle aster
- *S .Robynsianum* (*Aster longifolius*) – long-leaved blue aster
- *S. Shortii* – midwestern blue heart-leaved aster
- *S. sericeum* – silky aster
- *S. urophyllum* (*Aster* sagittifolius) – arrow-leaved aster

Tribe 7. ANTHEMIDEAE – chamomile tribe

ACHILLEA – yarrow
- *A. Millefolium* – common yarrow, milfoil
  - subsp. *Millefolium*
  - subsp. *lanulosa*
- *A. Ptarmica* – sneezeweed

ANTHEMIS – chamomile, dog-fennel
- *A. arvensis* – corn chamomile
- *A. Cotula* – dog-fennel, stinking camomile

ARTEMISIA – wormwood
- *A. Abrotanum* – southernwood
- *A. Absinthium* – common wormwood, absinthe sage-wort
- *A. annua* – annual wormwood or sage-wort
- *A. biennis* – biennial wormwood or sage-wort.
- *A. campestris* subsp. *caudata* – field wormwood or sage-wort, beach wormwood
- *A. Dracunculus* – tarragon, estragon
- *A. frigida* – prairie sage-wort
- *A. ludoviciana* subsp. *ludoviciana* – white sage, western mugwort
- *A. pontica* – Roman wormwood
- *A. serrata* – saw-tooth wormwood
- *A. Stelleriana* – beach wormwood, dusty miller
- *A. vulgaris* – mugwort, common wormwood

COTA – marguerite
- *C.* (*Anthemis*) *tinctoria* – golden marguerite, yellow chamomile

LEUCANTHEMELLA ["CHRYSANTHEMUM" key]
- *L.* (*Chrysanthemum*) *serotina* – giant daisy

LEUCANTHEMUM ["CHRYSANTHEMUM" key]
- *L. vulgare* (*C. Leucanthemum*) – common or ox-eye daisy

MATRICARIA – wild chamomile
- *M. discoidea* (*M. matricarioides*) – pineapple-weed
- *M. Chamomilla* (*M. recutita*) – sweet false camomile

TANACETUM – tansy ["CHRYSANTHEMUM" key p.p.]
- *T.* (*Chrysanthemum*) *Balsamita* (*Balsamita major*) – costmary, mint-geranium
- *T. bipinnatum* subsp. *huronense* – eastern or Lake Huron tansy
- *T.* (*Chrysanthemum*) *Parthenium* – feverfew
- *T. vulgare* – common tansy, golden-buttons

TRIPLEUROSPERMUM – wild chamomile [MATRICARIA key]
- *T.* (*Matricaria*) *maritimum* – scentless camomile

Tribe 8. SENECIONEAE – groundsel tribe

ARNOGLOSSUM – Indian-plantain
- *A. atriplicifolium* – pale Indian-plantain
- *A. plantagineum* – prairie or tuberous Indian-plantain
- *A. reniforme* – great Indian-plantain

ERECHTITES – fireweed
- *E. hieraciifolius* – fireweed

HASTEOLA – Indian-plantain
- *H. suaveolens* – sweet or hastate Indian-plantain

PACKERA – ragwort
- *P. aurea* – golden ragwort
- *P. indecora* – northern squaw-weed, rayless ragwort
- *P. paupercula* – northern ragwort
  - "Northern tetraploid complex"
  - var. *paupercula*
  - var. *pseudotomentosa*
  - var. *savannarum*
- *P. paupercula* var. *savannarum* + *P. plattensis*?
- *P. plattensis* – prairie ragwort
- *P. pseudaurea* var. *semicordata* (*P. semicordata*) – heart-leaved ragwort

SENECIO – groundsel
- *S. sylvaticus* – woodland groundsel
- *S. viscosus* – sticky groundsel
- *S. vulgaris* – common groundsel

PETASITES – sweet-coltsfoot
- *P. frigidus* var. *palmatus* – northern sweet-coltsfoot
- *P. sagittatus* (*P. frigidus* var. *sagittatus*) – arrowhead sweet-coltsfoot

TEPHROSERIS
- *T. congestus* – marsh-fleabane, northern swamp groundsel

TUSSILAGO – coltsfoot
- *T. Farfara* – coltsfoot

Tribe 9. HELENIEAE – sneezeweed tribe

HELENIUM – sneezeweed
- *H. amarum* var. *amarum* – bitter-weed, narrow-leaved sneezeweed
- *H. autumnale* L. – common sneezeweed
- *H. flexuosum* – purple-head or southern sneezeweed

GAILLARDIA – blanket-flower
- *G. aristata* – common blanket-flower

Tribe 10. HELIANTHEAE (s.l.) – sunflower tribe

BIDENS – beggar-ticks, stick-tight
- *B. aristosa* – mid-western tickseed-sunflower
- *B.* (*Megalodonta*) *Beckii* – water beggar-ticks or water-marigold
- *B. cernua* – nodding beggar-ticks or bur-marigold
- *B. connata* – purple-stem beggar-ticks or tickseed
- *B. discoidea* – few-bracted or swamp beggar-ticks
- *B. frondosa* – devil's or common beggar-ticks
- [*B. pilosa* – Spanish needles. Rare waif. Not in FNA (2006).]
- *B. trichosperma* (*B. coronata*) – northern tick-seed sunflower, tall swamp-marigold
- *B. tripartita* (*B. comosa*) – straw-stem beggar-ticks, swamp-marigold
- *B. vulgata* – tall beggar-ticks

COREOPSIS – coreopsis, tickseed
- *C. grandiflora* – big- or large-flowered tickseed
- *C. lanceolata* – long-stalk or sand tickseed
- *C. palmata* – finger or prairie tickseed
- *C. tinctoria* – plains or golden tickseed

COSMOS – cosmos
- *C. bipinnatus* – common garden cosmos

DYSSODIA – fetid marigold
- *D. papposa* – stinking or fetid marigold

ECHINACEA – coneflower
- *E. pallida* – prairie or pale purple coneflower
- *E. purpurea* – prairie or pale purple coneflower

ECLIPTA
- *E. prostrata* (*E. alba*) – yerba-de-tajo

GALINSOGA – quickweed
- *G. parviflora* – lesser quickweed
- *G. quadriradiata* (*G. ciliata*) – common quickweed

[GUIZZOTIA]
- [*G. abyssinica* – niger-seed. Very rare waif, presumably from bird seed.]

HELIANTHUS – sunflower
- *H. annuus* – common sunflower
- *H. decapetalus* – forest or pale sunflower
- *H. divaricatus* – woodland sunflower
- *H. giganteus* – swamp or giant sunflower
- *H. grosseserratus* – saw-tooth sunflower
- *H. hirsutus* – hairy sunflower
- *H.* ×*laetiflorus* (*H. pauciflorus* × *H. tuberosus*) – cheerful sunflower
- *H. Maximilianii* – Maximillian's sunflower
- *H. mollis* – ashy or downy sunflower
- *H. occidentalis* var. *occidentalis* – naked-stemmed or western sunflower
- *H. pauciflorus* (*H. rigidus*) – stiff sunflower
  - var. *pauciflorus*
  - var. *subrhomboidius*
- *H. petiolaris* subsp. *petiolaris* – plains sunflower
- [*H. salicifolius* – willow-leaved sunflower. Very rare waif.]
- *H. strumosus* – rough-leaved sunflower
- *H. tuberosus* – Jerusalem-artichoke

HELIOPSIS – ox-eye
- *H. helianthoides* – false sunflower, ox-eye
  - var. *helianthoides*
  - var. *scabra*

MADIA – tarweed
- *M. glomerata* – mountain or stinking tarweed

PARTHENUIUM
- *P. integrifolium* – wild-quinine, eastern feverfew

POLYMNIA – leaf-cup
- *P. canadensis* – pale-flowered leaf-cup

RATIBIDA – prairie coneflower
- *R. columnifera* – columnar or long-headed coneflower
- *R. pinnata* – globular or yellow coneflower

RUDBECKIA – black-eyed susan, coneflower
- *R. fulgida* var. *speciosa* – showy coneflower
- *R. hirta* var. *pulcherrima* – black-eyed Susan
- *R. laciniata* var. *laciniata* – cutleaf coneflower, wild golden glow
- *R. triloba* – brown-eyed Susan
- *R. subtomentosa* – sweet coneflower or black-eyed Susan

SILPHIUM – rosinweed
- *S. integrifolium* var. *integrifolium* – prairie rosin-weed
- *S. laciniatum* – compass-plant
- *S. perfoliatum* var. *perfoliatum* – cup-plant
- *S. terebinthinaceum* var. *terebinthinaceum* – prairie-dock

TAGETES – marigold
- *T. patula* – French marigold

VERBESINA
V. alternifolia – wing-stem

Tribe 10a. HELIANTHEAE (s.l.) subtribe AMBROSIINAE

AMBROSIA – ragweed
A. artemisiifolia – common ragweed
A. psilostachya – western or perennial ragweed
A. tomentosa (*Franseria discolor*) – skeleton-leaf bur-sage
A. trifida – giant ragweed

IVA – marsh-elder
I. annua – rough marsh-elder
I. axillaris – poverty-weed
I. (*Cyclachaena*) *xanthifolia* – big marsh-elder

XANTHIUM – cocklebur
X. spinosum – spiny cocklebur
X. strumarium – common cocklebur

Tribe 10b. HELIANTHEAE (s.l.) subtribe EUPATORIINAE – boneset subtribe

AGERATINA
A. altissima var. *altissima* (*E. rugosum*) – white snakeroot

BRICKELLIA
B. (*Kuhnia*) *eupatorioides* var. *corymbulosa* – false boneset

EUPATORIUM – throughwort
E. altissimum – tall boneset
E. perfoliatum – common boneset, thoroughwort
forma *truncatum*
E. serotinum – late boneset
E. sessilifolium – upland or woodland boneset

EUTROCHIUM – Joe-Pye-weed
E. maculatum – spotted joe-pye-weed
E. purpureum – purple-node or green-stemmed joy-pye-weed

LIATRIS – blazing-star, gay-feather
L. aspera – lacerate or rough blazing-star
L. cylindracea – few-headed or cylindrical blazing-star
L. ligulistylis – northern plains or showy blazing-star
L. punctata var. *punctata* (var. *nebraskana*) – dotted blazing-star
L. pycnostachya – prairie or thick-spike blazing-star
L. spicata – sessile or marsh blazing-star

CLASSIFICATIONS OF SUBFAMILIES AND TRIBES OF ASTERACEAE

CRONQUIST, 1955 (modified: Heywood et al., 1977)

I. Asteroideae
- A. Heliantheae (*sensu lato*)
  1. Heliantheae
  2. Tageteae
  3. Helenieae (accepted for reasons of expedience)
- B. Astereae
- C. Anthemideae
- D. Arctoteae
- E. Inuleae
- F. Senecioneae
- G. Calenduleae
- H. Eupatorieae
- I. Vernonieae
- J. Liabeae
- K. Cynareae
- L. Mutisieae

II. Cichorioideae
- A. Lactuceae

THORNE, 1983

Asteraceae (Compositae)
1. Genera: 1164
2. Species: 21300

I. Cichorioideae (Lactucoideae)
1. Genera: 339
2. Species: 7775

- A. Mutisieae
  1. Genera: 89
  2. Species: 975
- B. Vernonieae (including *Trichospira*)
  1. Genera: 70
  2. Species: 1455
- C. Liabeae
  1. Genera: 15
  2. Species: 185
- D. Cichorieae (Lactuceae)
  1. Genera: 70
  2. Species: 2300
- E. Cardueae (Cynareae; including Carlinae, Echinopeae, Echinopsideae, Eremothamneae, Gunelieae)
  1. Genera: 79
  2. Species: 2660
- F. Arctotideae (excluding *Ursinia*)
  1. Genera: 16

2. Species: 200

II. Asteroideae
1. Genera: 825
2. Species: 13510

A. Heliantheae (including *Arnica*, Bahiinae, Gaillardiinae)
1. Genera: 209
2. Species: 2165

B. Tageteae
1. Genera: 17
2. Species: 237

C. Eupatorieae
1. Genera: 60
2. Species: 2000

D. Astereae
1. Genera: 135
2. Species: 2500

E. Inuleae
1. Genera: 180
2. Species: 2100

F. Anthemideae (including Ursiniinae)
1. Genera: 102
2. Species: 1400

G. Senecioneae (including Blennospermatinae)
1. Genera: 114
2. Species: 3000

H. Calenduleae
1. Genera: 8
2. Species: 110

BREMER, 1994

I. Barnedesioideae
A. Barnedesieae

II. Cichorioideae
A. Mutisieae
B. Cardueae
C. Lactuceae
D. Vernonieae
E. Liabeae
F. Arctoteae

III. Asteroideae
A. Inuleae
B. Plucheeae
C. Gnaphalieae
D. Calenduleae
E. Astereae
F. Anthemideae
G. Senecioneae
H. Helenieae
I. Heliantheae
J. Eupatorieae

JANSEN & KIM, 1996

I. Barnedesioideae
    A. Barnedesieae
II. Subfamilial classification uncertain
    A. Mutisieae
    B. Cardueae (includes the Carlineae & Echinopeae)
    C. Tarchonantheae
III. Cichorioideae
    A. Vernonieae
    B. Liabeae
    C. Lactuceae
    D. Arctoteae (includes the Eremothamneae)
IV. Asteroideae
    A. Astereae
    B. Anthemideae (includes the Ursinieae)
    C. Inuleae (includes the Plucheeae)
    D. Gnaphalieae
    E. Calenduleae
    F. Senecioneae
    G. Helenieae
    H. Tageteae
    I. Coreopsideae
    J. Heliantheae (includes the *Athroisma* group)
    K. Eupatorieae

PANERO & FUNK, 2002

I. Barnedesioideae
    A. Barnedesieae
II. "The *Stiftia* Group"
    A. Mutisieae (South America, Asia)
III. Mutisioideae
    A. Mutisieae (South America)
IV. Gochnatioideae
    A. Gochnatieae
V. Hecastocleidoideae
    A. Hecastocleideae
VI. Carduoideae
    A. Dichomeae
    B. Tarchonantheae
    C. Cardueae
VII. Pertyoideae
    A. Pertyeae
VIII. Gymnarrhenoideae
    A. Gymnarrheneae
IX. Cichorioideae
    A. Gundelieae
    B. Cichorieae (Lactuceae)
    C. Liabeae
    D. Vernonieae
    E. Arctoteae
X. Corymbioideae
    A. Corymbieae
XI. Asteroideae
    A. Senecioneae
    B. Calenduleae
    C. Gnaphalieae
    D. Astereae
    E. Anthemideae
    F. Inuleae
    G. Plucheeae
    H. Athroismeae
    I. Helenieae
    J. Coreopsideae
    K. Neurolaeneae
    L. Tageteae
    M. Chaenactideae
    N. Bahieae
    O. Polymnieae
    P. Millerieae
    Q. Eupatorieae
    R. Perityleae
    S. Madieae
    T. Heliantheae

DESCRIPTIONS OF TRIBES OF ASTERACEAE

(Heywood et al., 1977; Jeffrey, 1978; Bremer, 1994; et al.)

[N.B.: Not up-dated since 1997.]

BARNEDESIOIDEAE

Basal branch of Compositae — 22 kb cpDNA inversion absent (unique within Compositae)

BARNEDESIEAE

9 genera & 92 species
Shrubs (or small trees or herbs)
Leaves alternate (most)
Axillary spines (frequent & unique)
Receptacle without bracts, usually pubescent
Corollas, achenes & pappus pappus bristles villous
Corollas "pseudobilabiate" (4 + 1, virtually unique) — also radial, bilabiate (3 + 2) & ligulate (5 + 0)
Corollas cyanic — or yellow
Anthers various
Pollen without spines
Styles shortly bilobed & glabrous
Pappus of villous bristles (most)

South American (exclusively), mostly the Andes

n = 8, 12, 27 → 25 → 24, 31; approximately 54, 50, & 48
x = 8 → 12; x = 9 implicitly (n = 27)?

Barnadesia

In WI: none

CICHORIOIDEAE (*sensu lato*)

Probably paraphyletic

Broad Tendencies

Benzopyrans & benzofurans absent (in all)
Latex present (though rare except in Lactuceae)
Leaves alternate
Receptacle naked, bristly (bracts rare)
Florets larger
Floret types: disk, bilabiate, ligulate. Ray florets rare.
Corollas more deeply lobed, cyanic
Anthers
calcarate [anther sac extending below filament attachment],
commonly caudate [with a sterile extension],
appendage not constricted at base
Pollen lophate [with ridges], larger, with thinner exineand ecaveate pollen wall
Styles long and slender with hairs along length (outside) & even on shaft, stigmatic area continuous on inner surface along entire length (inside)

SUBFAMILIAL CLASSIFICATION UNCERTAIN

MUTISIEAE

[Tarchonantheae perhaps better split off]
76 genera & 970 species
Receptacle naked (rarely chaffy)
Florets: bilabiate, disk, ligulate (few)
Corollas at least deeply lobed
Corolla cyanic (commonly)
Styles various, branches frequently short: Barnadesioid, vernonioid, truncate ("anthemoid"), but stigmatic area continuous on inner surface
Pappus bristles, rarely scales

South American (largely), especially Andes; pantropical.

x = 9 (commonest; x = 9 in Barnedesieae also [sic])
x = 4, 6, 8 through 18, 20 through 28, 54

Gerbera

In WI: none [*Adenocaulon* in n MI & possibly MN]

CARDUEAE — THISTLE TRIBE

["Cynareae", includes the Carlineae & Echinopeae]
83 species & 2,500 species
Herbs or shrublets
Often spiny (as in Mutisieae)
Leaves alternate
Receptacle densely setose (most)
Florets disk, ligulate (rare)
Anthers caudate (as in Mutisieae)
Corollas cyanic (most)
Anthers calcarate & with long tails
Filaments papillose or pilose (rare elsewhere)
Pollen spiny
Styles with thickened hairy ring below fork
Style branches connate below (often)
Receptacle bristly (→ chaffy or naked)

Predominantly Old World: Europe & North Africa (most), Asia (many)

n = 8, 9, 10, 11, 12, 13, 15, 17, 19

Centaurea 600 sp.
Cousinia 600 sp.

In WI: 4 genera

TARCHONANTHEAE

CICHORIOIDEAE (*sensu stricto*)

VERNONIEAE — IRONWEED TRIBE

98 genera & 1,300 species
Herbs to trees
Leaves alternate
Receptacle without scales (most)
Florets disk
Corollas cyanic (orange-yellow in one genus of Africa and Madegascar)
Anthers calcarate, ecaudate (most)
Pollen echinolophate or psilolophate
Style "vernonioid" branches attenuate & hispidulous outside (also in Lactuceae)
Pappus of bristles

Pantropical, especially Brazil and tropical Africa

x = 7, 8, 9, 10, 11, 13

Vernonia
Old World: n = 9 (ancestral?), 10
New World: n = 17

Vernonia 900 sp.

In WI: 1 genus

LIABEAE

14 genera & 160 species
Perennial herbs, vines, shrubs (annuals & trees)
Latex (common)
Leaves opposite (never alternate)
Radiate heads (or discoid)
Yellow corollas
Styles vernonioid (minority)
Blunt tipped & fused except at tip
Anthers calcarate -- some caudate
Pollen spiny
Pappus double -- bristles surrounded by short bristles or scales

South America north to Mexico & West Indies (only): mainly Andean

x = 9
n = 7, 9 through 12, 14, 16 & 18

Munnozia x = 10
Liabum x = 18

In WI: none

CHICORIEAE (LACTUCEAE) — CHICORY (LETTUCE) TRIBE

98 genera & 1550 species
Most distinctive tribe
    Latex -- no resin ducts (±; + in roots only)
    Heads ligulate (all)
Herbs
Leaves alternate (most)
Involucral bracts imbricate or subequal, in 1--2 series (frequently)
Receptacle naked (most)
Corollas yellow (most)
Anthers calcarate & caudate
Pollen lophate (±)
Style branches long and evenly pilose externally
Pappus of bristles

Predominantly Northern Hemisphere: Central Asia, Mediterranean, western North America

x = 9
x = 4 & 5 possible
x = 3 - 11

Hieracium 800+ sp.

In WI: 12 genera

ARCTOTEAE — GAZANIA TRIBE

[Includes the Eremothamneae]
"Radiate heads with styles of Cardueae"
16 genera & 200 species
Herbs to shrubs
Leaves alternate (virtually all)
Spiney leaves or involucre (often)
Heads radiate (most)
Receptacle naked (or chaffy)
Corollas yellow
Anthers calcarate, mostly ecaudate
Anther appendage constricted at base
Pollen spiney
Style branches connate to near tip, papillate
Style thickened below fork
Pappus scaley (most), never of bristles

Southern Africa largely; northward in Africa, Near East, one species in southern Australia

Subtribe 1 x = 9, 15
  " 2 x = 9
  " 3 x = 5, 7, 8 (x = 5 in *Gazania*)

Gazania

In WI: none

ASTEROIDEAE

Monophyletic

Broad Tendencies

Synapomorphies
- Benzofurans & benzopyrans
- Latex absent (virtually all)
- Ray florets
- Disc corollas with short lobes
- Pollen caveate
- Stigmatic areas in two marginal bands on inner side of branches

Florets smaller
Corollas yellow
Anthers
- ecalcarate
- ecaudate
- appendage constricted at base

Pollen spiny, never lophate, smalller, with thicker exine & caveate pollen wall
Styles shorter, with hairs restricted to the upper parts of the branches
Stigmatic area restricted to two marginal bands on inner surface, tip not stigmatic
Anthers ecalcarate & ecaudate
Anther appendages short & constricted at base
Pollen spiny

INULEAE — ELECAMPANE TRIBE

[Includes the Plucheeae]
38 + 28 genera & 480 + 220 species
Herbs to shrubs
Woodiness secondary -- secondary cambium
Leaves alternate
Heads radiate, often disciform or discoid
Rays yellow (when present)
Involucre not uniseriate
Anther base caudate (sagittate)
Style branches flattened
- Marginal stigmatic lines, apically confluent
- Glabrous or only papillate
- Tip subtruncate or rounded

Pappus of scales or bristles
Receptacle chaffy or naked
Predominantly western Eurasia (Inusleae, s.s., and mainly tropical & subtropical (Plucheae)

x = 10, 9 (Inuleae?)

In WI: 1 genus

GNAPHALIEAE — PUSSY'S-TOES TRIBE

162 genera & 2,000 species
Herbs to shrubs
Heads disciform or discoid (rarely radiate)

Involucral bracts imbricate, scarious
Receptacle without scales (most)
Florets tending to be unisexual
Anthers caudate
Styles anthemoid (?)
Pappus of capillary bristles
Worldwide, particularly southern Africa & Australia

x = 7 (Gnalphalieae?)

Helichrysum 500 sp.

In WI: 3 genera

CALENDULEAE — CALENDULA TRIBE

8 genera & 110 species
Like Senecioneae BUT
Pappus none
Achenes heteromorphic

Predominantly Africa, especially South Africa

x = 10
n = 7, 8, 9, 10, 11, 15

In WI: none

ASTEREAE — ASTER TRIBE

174 genera & 2,800 species
Heads radiate, disciform or discoid
Involucre herbaceous → chartaceous
Receptacle naked (most)
Style branches appendiculate
Pappus various
Leaves not dissected (usually)

Worldwide, especially North and South America, southern Africa, Australia, New Zealand, and central Asia

x = 9
n = 9 → 2 in *Brachycome* and *Haplopappu*s

Baccharis 400 sp.
Xanthocephalum complex
Aster, *Solidago*
*Erigero*n
*Conyz*a

In WI: 5 genera

ANTHEMIDEAE — CAMOMILE TRIBE

[includes the Ursinieae]
109 genera & 1,740 speciea
Heads radiate, disciform or discoid
Involucral bracts dry, scarcely herbaceous, hyaline-scarious toward margins
Receptacle chaffy or naked
Style branches truncate & penicellate
Pappus none or small (never of capillary bristles
Leaves dissected (most)
Odor
Pollen

Worldwide (Palaearctic with 3/4 of species), especially central Asia, the Mediterranean & South Africa.

x = 9 but x = 8, 10, 13 & 17 occur

Chrysanthemum-Leucanthemum
Artemisia 400 sp.

In WI: 7 genera

SENECIONEAE — GROUNDSEL TRIBE

120 genera & 3,200 species
Leaves alternate
Involucral bracts equal & uniseriate with tiny bracts at base
Style branches flattened
    Marginal stigmatic lines
    Tip truncate, penicillate
Receptacle naked (most)
Pappus capillary (→ none)

Tussilaginoid (Cacalioid) complex: Mexican region & eastern Asia
Senecionoid complex: cosmopolitan -- Andes, West Indies and southern and Tropical Africa

Woodiness secondary -- derived from herbs
    Dendrosenecio's
    Senecio praecox

x = 10
x = 30

Senecio 1500-2000 sp.

In WI: 4 genera

HELENIEAE — SNEEZEWEED TRIBE

110 genera & 830 species
Receptacle without scales (most) — "separates" from Heliantheae

Pappus of scales (most)

Mostly New World, especially North America

TAGETEAE — MARIGOLD TRIBE

[Bremer (1994) puts in Helenieae]
23 genera & 240 species
Leaves generally dissected with pellucid secretory cavities — "they stink"
Involucral bracts in one or two (or three) rows, inner row often connate
Receptacle without scales

North and South America

COREOPSIDEAE — COSMOS TRIBE

[Bremer (1994) puts in Heliantheae]
24 genera & 505 species
Leaves opposite & often dissected
Involucral bracts in two rows, often dimorphic
Pappus of awns, a crown, or absent

Worldwide

HELIANTHEAE (s.l.) — SUNFLOWER TRIBE

[Helenieae, Tageteae & Coreopsideae now split out; includes the *Athroisma* group]]
189 genera & 2,500 species
Heads radiate → disciform → discoid
Resin ducts -- no latex
Corollas yellow (most)
Leaves opposite (tendency)
Pappus chaffy (→ none or hairy)
Receptacle chaffy (→ naked)
Involucral bracts herbaceous and several-seriate → various
Style branches ± hispidulous, stigmatic lines poorly defined
Anther base obtuse → sagittate
Rays large and broad

Americas (mostly)
- Dry highlands of central Mexico = center of diversity
- Many woody
- Wood unspecialized (also Vernonieae + Mutisieae)

Verbesininae line x = 15, 16, 17
Galinsoginae line x = 8, 9
Coreopsidinae x = 12

x = 8, 9 for tribe
Widest range of chromosome numbers

In WI: 15 genera

EUPATORIEAE — BONESET TRIBE

Leaves opposite (most)
Heads discoid
Corollas not yellow
Receptacle naked (most)
Style branches with long sterile appendages, which are obtuse and often clavate -- and not hairy
Pollen

New World (almost all): tropics & subtropics (most)

x = 17 (ex Heliantheae with x = 17-19) → x = 10 (Watanabe et al., 1995)
x = 10 [the commonest number and previously thought to be the base number]
groups: n = 10
n = 9
n = 11-12
n = 16-18

Eupatorium 600

In WI: 3 genera

REFERENCES

Ballard, Harvey E., and Robert R. Kowal. 1994. Status survey and taxonomic study of cliff cudweed, *Gnaphalium saxicola* Fassett. Unpublished report to the U.S. Fish & Wildlife Service.

Barkley, Theodore M. 1963. Preliminary reports on the flora of Wisconsin, no. 49. Compositae II – composite family II: the genus *Senecio* – the ragworts – in Wisconsin. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 52: 343-352.

Bayer, Randall J. 1989. Nomenclatural rearrangements in *Antennaria neodioica* and *A. howellii* (Asteraceae: Inuleae: Gnaphaliinae). Brittonia 41: 396-398.

—— and G. Ledyard Stebbins. 1982. A revised classification of *Antennaria* (Asteraceae: Inuleae) of the eastern United States. Systematic Botany 7(3): 300-313.

Beals, Edward W., and Ralph F. Peters. 1966. Preliminary reports on the flora of Wisconsin, no. 56. Compositae V – composite family V: tribe Inuleae (*Antennaria*, *Gnaphalium*, *Anaphalis*, and *Inula*). Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 55: 223-242.

Bentham, George. 1873. Notes on the classification, history, and geographical distribution of the Compositae. Journal of the Linnean Society, Botany 13: 335-577.

Bohm, Bruce A., and Tod F. Stuessy. 2001. Flavonoids of the sunflower family (Asteraceae). Springer-Verlag, Vienna.

Boulter, D., J.T. Gleaves, B.G. Haslett, D. Peacock, V. Jensen. 1978. The relationships of 8 tribes of the compositae as suggested by plastocyanin amino acid sequence data. Phytochemistry 17: 1585-1589.

Bremer, Kåre. 1987. Tribal interrelationships of the Asteraceae. Cladistics 3(3): 210-253.

——. 1994. Asteraceae: Cladistics & classification. Portland, Oregon: Timber Press.

——. 1996. Major clades and grades of the Asteraceae. Pages 1-7 *in* D. J. N. Hind and H. J. Beentje, eds. 1996. Compositae: systematics. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 1. Kew: The Royal Botanic Gardens.

Brouillet, Luc, Geraldine A. Allen, John C. Semple, and Motomi Ito. 2001. ITS phylogeny of North American asters (Asteraceae: Astereae). Botany 2001 Abstracts: 1 (Abstract 412).

Caligari, P. D. S., and D. J. N. Hind, eds. 1996. Compositae: biology and utilization. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 2. Kew: The Royal Botanic Gardens.

Carlquist, Sherwin. 1976. Tribal interrelationships and phylogeny of the Asteraceae. Aliso 8: 465-492.

Croat, Thomas. 1972. *Solidago canadensis* complex of the Great Plains. Brittonia 24(3): 317-326.

Cronquist, Arthur. 1955. Phylogeny and taxonomy of the Compositae. American Midland Naturalist 53: 478-511.

——. 1977. The Compositae revisited. Brittonia 29: 137-153.

——. 1980. Vascular flora of the southeastern United States. Volume I: Asteraceae. The University of North Carolina Press, Chapel Hill.

——. 1981. An integrated system of classification of flowering plants. Columbia University Press, N.Y.

Feller, Danielle Sky. 2000. A study of the distribution, ecology, and genetic diversity of *Pseudognaphalium saxicola* (Fassett) comb. nov. (Asteraceae), a rare annual plant endemic to Wisconsin. Master's thesis. University of Wisconsin-Madison, Madison, Wisconsin.

Fernald, Merritt L. 1950. Gray's manual of botany. 8th ed. American Book Co., New York.

Flora of North America Editorial Committee. 2006. Vol. 19: Magnoliophyta: Asteridae (in part): Asteraceae, part 1 [Mutisieae-Anthemideae]. Vol. 20: Magnoliophyta: Asteridae (in part): Asteraceae, part 2 [Astereae & Senecioneae]. Vol. 21: Magnoliophyta: Asteridae (in part): Asteraceae, part 3 [Heliantheae & Eupatorieae]. New York: Oxford University Press.

Freckmann, Robert W., and William J. Fraundorf. 1981. *Gnaphalium sylvaticum* (Compositae) new to Wisconsin. The Michigan Botanist 20: 87-88.

Gleason, Henry A., and Arthur Cronquist. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. D. van Nostrand Co., Inc., Princeton, New Jersey.

—— and ——. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. 2nd ed. The New York Botanical Garden, Bronx, New York.

Heywood, Vernon H., Jeffrey G. Harbone, and Billie L. Turner, eds. 1977. The biology and chemistry of the Compositae. Academic Press, N.Y. 2 vols.

Hind, D. J. N., and H. J. Beentje, eds. 1996. Compositae: systematics. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 1. Kew: The Royal Botanic Gardens.

International code of botanical nomenclature (Saint Louis Code): adopted by the Sixteenth International Botanical Congress, St. Louis, July-August 1999. 2000. W. Greuter, ed. Regnum Vegetabile 138: 1-474.

Jansen, Robert J., and Ki-Joong Kim. 1996. Implications for chloroplast DNA data for the classification and phylogeny of the Asteraceae. Pages 317-339 *in* D. J. N. Hind and H. J. Beentje, eds. 1996. Compositae: systematics. Proceedings of the International Compositae Conference, Kew, 1994. Vol. 1. Kew: The Royal Botanic Gardens.

—— and Jeffrey D. Palmer. 1987. A chloroplast DNA inversion marks an ancient evolutionary split in the sunflower family (Asteraceae). Proc. Natl. Acad. Sci. USA 84: 5818-5822.

—— and ——. 1988. Phylogenetic implications of chloroplast DNA restriction site variation in the Mutisieae (Asteraceae). Amer. J. Bot. 75(5): 753-766.

Jeffrey, Charles. 1978. Compositae. Pages 263-268 *in* V.H. Heywood, ed. Flowering plants of the world. Mayflower Books, New York.

Johnson, Miles F., and Hugh H. Iltis. 1963. Preliminary reports on the flora of Wisconsin, no. 48. Compositae I – composite family I: tribes Eupatorieae, Vernonieae, Cynareae, and Cichorieae [= Lactuceae]. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 52: 255-342.

Jones, Almut G. 1978. The taxonomy of *Aster* section *Multiflori* (Asteraceae): I. Nomenclatural review and formal presentation of taxa. Rhodora 80: 319-357.

——. 1978. The taxonomy of *Aster* section *Multiflori* (Asteraceae): II. Biosystematic investigations. Rhodora 80: 453-490.

——. 1980. A classification of the New World species of *Aster* (Asteraceae). Brittonia 32(2): 230-239.

——. 1984. Nomenclatural notes on *Aster* (Asteraceae) – II. New combinations and some transfers. Phytologia 55(6): 373-388.

——. 1989. *Aster* and *Brachyactis* in Illinois. Bulletin Illinois Natural History Survev. 34(2): 139-194.

Mahoney, Alison McKenzie. 2000. The systematics and biogeography of the *Packera paupercula* complex (Senecioneae, Asteraceae). Ph.D. thesis. University of Wisconsin-Madison, Madison, Wisconsin.

—— and Robert R. Kowal. 2007 [?]. Three new varieties of *Packera paupercula* (Asteraceae: Senecioneae) in the Upper Midwest and southeastern United States. Novon.

Melchert, Thomas E. 1960. Heliantheae of Wisconsin. M.S. Thesis. University of Wisconsin-Madison, Madison, Wisconsin.

—— and Hugh H. Iltis. 1976. Key to Wisconsin *Helianthus* L., the sunflowers [based on T. E. Melchert's M.S. thesis (1960)]. Mimeographed handout, Department of Botany, University of Wisconsin-Madison, Madison, Wisconsin.

Michaels, Helen J., Kathy M. Scott, Richard G. Olmstead, Tim Szaro, Robert K. Jansen, and Jeffery D. Palmer. 1993. Interfamilial relationships of the Asteraceae: insights from rbcL sequence variation. Ann. Missouri Bot. Gard. 80: 742-751.

Mickelson, Carol J., and Hugh H. Iltis. 1966. Preliminary reports on the flora of Wisconsin, no. 55. Compositae IV – composite family IV: tribes Helenieae and Anthemideae. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 55: 187-222.

Morley, Thomas. 1969. Spring flora of Minnesota. The University of Minnesota Press, Minneapolis.

Muller, Jan. 1978. Fossil pollen records of extant angiosperms. The Botanical Review 47: 1-142.

Nesom, Guy. 2000. Generic conspectus of the tribe Astereae (Asteraceae) in North American and Central America, the Antilles, and Hawaii. Sida, Botanical Miscellany, No. 20.

Noyes, Richard D., and Loren H. Riesberg. 1999. ITS sequence data support a single origin for North American Astereae (Asteraceae) and reflect deep geographic divisions in *Aster* s.l. Amer. J. Bot. 86: 396-412.

Ownbey, G. B. and T. Morley. 1991. Vascular plants of Minnesota: a checklist and atlas. University of Minnesota Press, Minneapolis.

Palmer, Jeffrey D., Robert K. Jansen, Helen J. Michaels, Mark W. Chase, and James R. Manhart. 1988. Chloroplast DNA variation and plant phylogeny. Ann. Missouri Bot. Gard. 75: 1180-1206.

Panero, Jose L., and Vicki A. Funk. 2002. Toward a phylogenetic subfamilial classification for the Compositae (Asteraceae). Proceedings of the Biological Society of Washington 115(4): 909-922.

Payne, Willard W. 1970. Preliminary reports on the flora of Wisconsin, no. 62. Compositae VI – composite family VI: the genus *Ambrosia* – the ragweeds. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 58: 353-371.

Reveal, James L. 1997. Early suprageneric names in Asteraceae. Comp. Newsl. 30: 29-45.

Robinson, Harold. 1987. Some suggestions regarding the significance of chloroplast DNA variation in the Asteraceae. Phytologia 63(5): 316-324.

Salamun, Peter J. 1963. Preliminary reports on the flora of Wisconsin, no. 50. Compositae III -- composite family III: the genus *Solidago* – goldenrod. Transactions of the Wisconsin Academy of Sciences, Arts, and Letters 52: 353-382.

Semple, John C., Stephan B. Heard, and Luc Brouillet. 2002. Cultivated and Native Asters of Ontario (Compositae: Astereae). University of Waterloo Biology Series 41: 1-134.

——, ——, and ChunSheng Xiang. 1996. The Asters of Ontario (Compositae: Astereae): *Diplactis* Raf., *Oclemena* Greene, *Doelingeria* Nees, and *Aster* L. (including *Canadanthus* Nesom, *Symphyotrichum* Nees, and *Virgulus* Raf.). University of Waterloo Biology Series 38: 1-94.

——, Gordon S. Ringius, and Jie Jay Zhang. 1999. The goldenrods of Ontario: *Solidago* L. and *Euthamia* Nutt. 3rd ed. University of Waterloo Biology Series 39: 1-90.

Shinners, Lloyd H. 1941. The genus *Aster* in Wisconsin. The American Midland Naturalist 26(2): 398-420.

Small, James. 1917-1918. The origin and development of the Compositae. New Phytologist 16[1917]: 157-177, 198-221, 253-276. 17[1918]: 13-40, 69-94, 114-142, 200-230. 18[1919]: 1-35, 65-89, 129-176, 201-234.

Stearn, William T. 1983. Botanical Latin: history, grammer, syntax, terminology and vocabulary. 3rd. ed., revised. David & Charles, North Pomfret, Vermont. [Introduction, index and pagination are exactly the same as the earlier two editions of 1966 and 1973.]

Thorne, Robert F. 1976. A phylogenetic classification of the Angiospermae. Evolutionary Biology 9: 35-106.

——. 1983. Proposed new realignments in the angiosperms. Nord. J. Bot. 3: 85-117.

Voss, Edward G. 1996. Michigan flora; a guide to the identification and occurrence of the native and naturalized seed-plants of the state. Part III: Dicots (Pyrolaceae – Compositae); Bulletin 61. Cranbrook Institute of Science, Bloomfield Hills, Michigan and University of Michigan Herbarium.

Wagenitz, Gerhard. 1976. Systematics and phylogeny of the Compositae (Asteraceae). Plant Systematics and Evolution 125: 29-46.

Watanabe, Kuniaki, Robert M. King, Tetsukazu Yahara, Motomi Ito, Jun Yokoyama, Takeshi Suzuki, and Daniel J. Crawford. 1995. Chromosomal cytology and evolution in Eupatorieae (Asteraceae). Ann. Missouri Bot. Gard. 82(4): 581-592. [Ancestral x = 17 (ex Heliantheae with x = 17-19) → x = 10]

Wetter, Mark Allen, Theodore S. Cochrane, Merel R. Black, Hugh H. Iltis, and Paul E. Berry. 2001. Checklist of the vascular plants of Wisconsin. Technical Bulletin No. 192. Department of Natural Resources, Madison, Wisconsin.

Wood, Carroll E., Jr. 1974. A student's atlas of flowering plants: Some dicotyledons of eastern North America. Planned and prepared under the direction of Carroll E. Wood, Jr., assisted by Elizabeth A. Shaw; with the technical help of Karen S. Velmure and Kenneth R. Robertson. New York: Harper & Row.

ALPHABETICAL INDEX OF ASTERACEAE IN WISCONSIN

Genera are arranged alphabetically within tribes in the keys.
Taxa in square brackets are not naturalized in Wisconsin and are not included in the keys.