

HAMPSHIRE FLORA GROUP

GRASSES WORKSHOP

Workshop Notes

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Introduction

It is hard to over-estimate the importance of grasses to life on earth in the present era. Having (as far as we can tell) evolved in the early Tertiary, 55-65 million years ago, they rose to dominate about a third of Earth's land surface by natural means, while through agriculture our own dependence on them for life has become critical.

The total number of species in the grass family Poaceae is large (about 10,000), ranking it probably fifth in the family league table. Generally it is considered to have three evolutionary lines, comprising a number of subfamilies:

- Bambusoideae (Bamboos and Rice-grasses): while hugely important world-wide they are mostly tropical species, and we shall not devote much attention to them in this workshop. However an increasing number of species is becoming established in the wild in Britain.
- Arundinoideae, Chloridoideae, Panicoideae. etc: a diverse set of subfamilies, mostly tropical and southern hemisphere, that includes just a few important native genera in Britain such as *Phragmites* (Common Reed), *Molinia* (Purple Moor-grass), *Danthonia* (Heath-grass) and *Spartina* (Cord-grass). However the Panicoideae in particular includes several non-native species that are increasingly frequent in Britain.
- Pooideae: temperate plants, including most of our native species.

Although the taxonomy of grasses was originally worked out on the basis of visible characters such as spikelet structure, and while this approach still works well for constructing artificial keys, it hides many details of parallel or convergent evolution – grasses have succeeded by playing endless variations on a relatively small repertoire of structural features. The natural relationships of grasses are now described on a much wider set of criteria including detailed anatomy, cytology, photosynthetic metabolism and genetics. Anyone interested in more background, and in gaining an appreciation of grasses on the world stage, is recommended to read Clayton & Renvoize (1986).

Understanding a little of grass classification is important because the new standard handbook for British grasses, and the basis for this course, Cope & Gray (2009), uses a hierarchical key system that identifies first to tribe, then to genus, then to species. (From now on we refer to this as 'the Handbook'.) This is the approach adopted on a world scale by Clayton and Renvoize. Anyone who has used the earlier major British field guide, Hubbard (1954, 1968, 1981) will know that the identification key takes one directly down to species. This has the advantage that it can be as 'artificial' as one likes, picking only the best field characters; but it can make for very long and tedious pathways through the key. With the inclusion of many more non-native species such an approach would probably have been unworkable. Most other technical floras key to genus in the first place, or to an artificial grouping of genera where different members of the same genus are arrived at through different groupings.

The subfamilies mentioned above are subdivided into **Tribes**. There are 40 of these worldwide, but you will be relieved to know that in Britain there are only 15, and 7 of these either consist only of relatively casual introductions, or comprise one or a few easily recognisable genera.

The tribes can be distinguished on field characters, and it is a feature of the Handbook that all distinguishing characters described are observable in the field and without the need for dissection. However fine measurement is sometimes needed. With a little practice and experience, you will be able to place most grasses in the correct genus without the need for the top levels of key, and to run an unfamiliar species down to its correct genus using the features given.

The Handbook provides a great deal of information on grass structure and features, biology and ecology, as well as keys and useful identification hints. It is not our intention to repeat these here,

and the following notes will simply offer comments or point out things that may otherwise be missed in the wealth of detail.

Finally, it may come as a further relief that Tom Cope is temperamentally a ‘lumper’, based on his knowledge of variation in a species outside one narrow geographical range, as well as the practical consideration that if a feature cannot be readily observed then it is of little or no use to most of the potential Handbook users. However he does describe variation within species where it is readily observable, and deals comprehensively with ‘awkward’ genera such as *Festuca* and *Bromus*. Unlike Hubbard, the Handbook’s illustrations concentrate on distinctive features rather than illustrating every part of the plant.

The Handbook gives much fuller coverage to alien species than Hubbard, in both numbers of taxa and level of detail. With several species becoming more common and more persistent, this is very desirable.

Grass Structure and Features

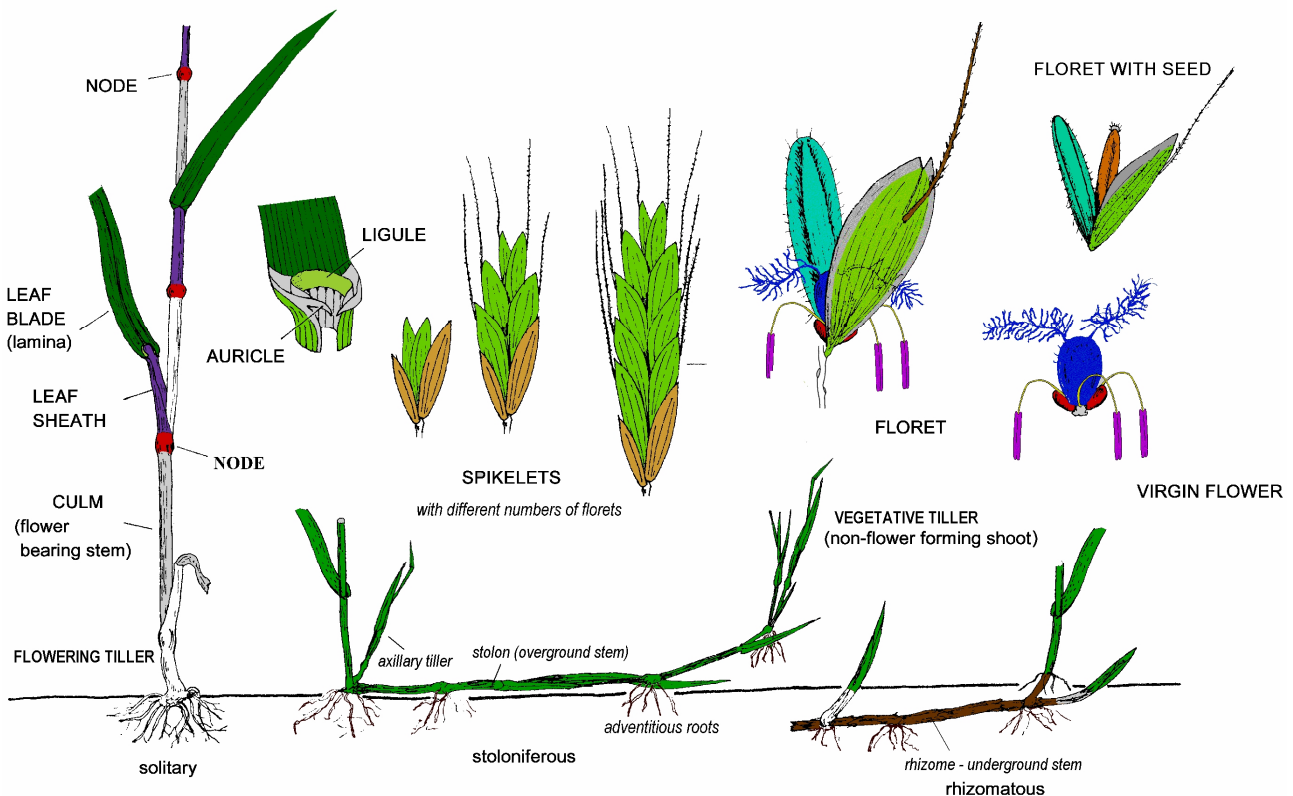
Features of the grass plant are described on pages 10-19 of the Handbook. It is worth taking to heart Cope's statement on p. 10 that "grasses... have a tendency to be relaxed about the finer distinctions between annual and perennial". This is something to watch out for in genera like *Poa* (Meadow-grasses) and *Bromus* (Bromes) particularly. Look at the more mature plants where possible and be prepared to reserve judgement.

Roots and Shoots

With a few notorious exceptions like *Ammophila* (Marram), grass roots tend to be fine and matted, and to penetrate to no great depth. Fortunately both for us and for the grasses, the roots hold few useful recognition characters.

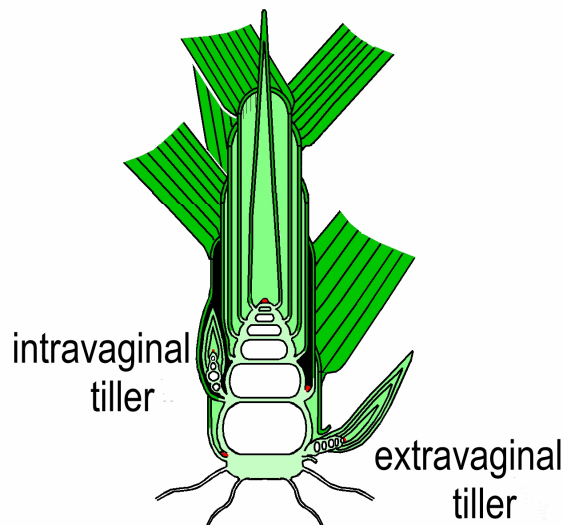
Much more important is the system of stem branching close to the ground that enables many perennial grasses to maintain their lifestyle and to spread, regardless of grazers, mowers and other contingencies of life. These branches, with new growth buds, may be short and relatively crowded in tussock-forming species; or they may form runners at or just above ground level (**stolons**); or they may produce extended **rhizomes** below the soil. All these forms (including the last) are stems, not roots, and have the anatomy and function of stems, throwing off new bundles of roots at intervals and new aerial shoots (**tillers**) that can give rise to flowering stems (**culms**). Stolons often are quite obvious runners as in *Agrostis canina* (Velvet Bent), but rhizomes can present more of a problem and may often be best inferred by the growth form of the plant. The presence or absence of these different forms of stem are often important recognition features of perennials, even within the same genus such as *Agrostis* (Bents).

Stems, Leaves and Tillers



The grass stem is a tube, usually hollow, which is interrupted every so often with a dividing wall at a **node** (the stretches of stem between the nodes are known, logically enough, as **internodes**). But typically the lower parts of this stem are wrapped around by the more or less tubular part of the leaf, which originates at a node, is known as the **sheath**, and gives the stem support. The sheath

eventually breaks away from the stem in a **blade**. At the junction is a stiffened collar where there is usually a ring of membrane or hairs known as the **ligule**; the presence, form and size of the ligule is often an important identification feature. Also at the junction some leaf blades are projected into wings or clasping points called **auricles**, and these can be useful recognition features.



VEGETATIVE TILLERS

Grass leaves do not have true stalks (**petioles**), but it is a feature of Bamboos that they often have a lower part of the leaf that is stalk-like and called a **pseudopetiole**.

As mentioned above, the stems of perennial grasses that have ground contact can also throw off new roots and shoots, and this happens at the nodes. The shoots or tillers are an important part of the grass's survival mechanism under grazing or cutting. Sometimes the tillers grow up inside the leaf sheath or sheaths that enfold that node; sometimes they break through the side of it. These patterns are known as **intravaginal** or **extravaginal** tillering respectively.

Inflorescence

There are no leaves within a grass inflorescence (other than some planted introductions). The terminology of grass inflorescences is complicated by the fact that florets do not usually occur individually, but in a cluster (sometimes reduced to one 'good' floret) called the spikelet. This means that technically there is some justification for calling all grass inflorescences **panicles**, and some books take this approach. A more useful practical approach that reduces the need for contorted terminology, and is followed by Cope and Hubbard, takes the spikelet as the equivalent of a single floret in other families.

This gives us two main types of inflorescence:

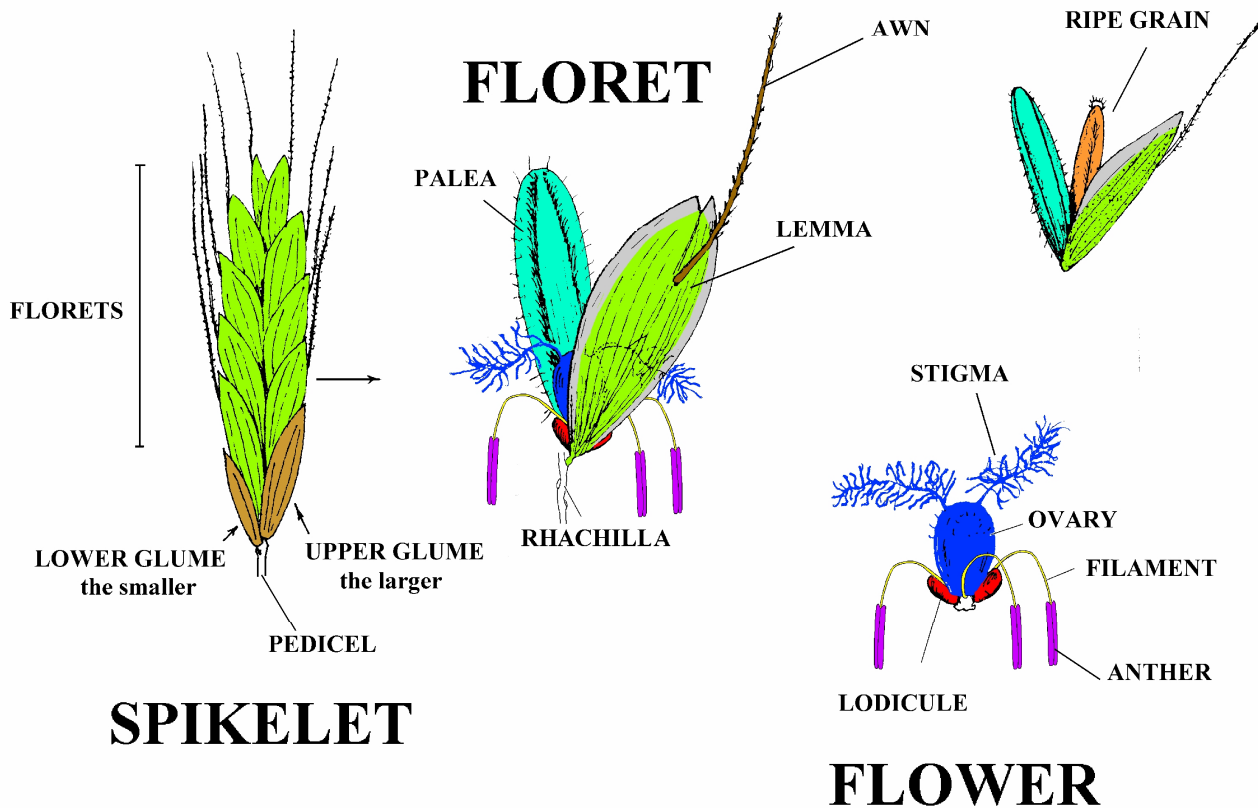
- **Panicles**, where the spikelets are on branched stalks off the main stem or axis of the inflorescence (the **rhachis**). Classic and clear-cut examples are *Festuca* (Fescues), *Poa* (Meadow-grasses) and *Agrostis* (Bents).
- **Racemes**, where the spikelets are borne, with or without a simple usually short stalk, on the rhachis. Examples (all with different arrangements on the rhachis) are *Nardus* (Mat-grass), *Elymus* (Couches) and *Lolium* (Rye-grass). Sometimes a distinction is made between **spikes**, where the spikelets are unstalked, and **racemes**, where they are stalked. But even in individual genera or species this can be a hard distinction.

However this neat division does not always work so well in practice, and there are plenty of cases that give the beginner difficulty.

- Many inflorescences that are really panicles are densely packed and look like spikes. Examples are *Alopecurus* (Foxtails) and *Cynosurus* (Dog's-tails). One has to part the inflorescence and see what is going on close to the rhachis. Even then, in the case of *Phleum* (Cat's-tails), branches may be fused with the main axis. In *Hordeum* (Barleys), the branches themselves have more or less disappeared and have to be inferred from the constant grouping of three spikelets together on the axis.
- Some inflorescences are branched, but the spikelets are borne on each branch like a raceme. Cope treats these as "multiple racemes". The most widespread British example, with the

branches coming off at intervals from the main axis, is *Spartina* (Cord-grasses), but there is also a distinctive group of several alien genera including *Digitaria* and *Cynodon* where the branches radiate from a single point.

Spikelets, Flowers and Seeds



The spikelet is a structure bearing one or more grass florets. At its base may be a tough knob or stalklet called the callus. Apart from the sexual parts, the stamens (always 3) and the stigmas (always 2, and usually feathery), most of what is on show in the spikelet consists of bracts, and one needs to be able to distinguish these clearly.

At the bottom of the whole spikelet are the (usually) two **glumes**, which are empty of florets. A few genera have unusual glume arrangements (*Lolium* – mostly single, *Nardus* – minute, *Parapholis* – side by side, *Hordeum* – turned into bristles).

Above the glumes come pairs of bracts arising one above the other; the lower is called the **lemma**, the upper the **palea**. These enclose a flower, although in some species some of these flowers are sterile or the bracts are empty.

Size, shape, relative size in the two pairs, and number of veins can all be valuable identification features in many grasses. The glumes or the lemma may also bear a bristle or **awn**. Presence or absence of awns, where they arise from the bract, and whether they are straight or bent at an angle, can all be important in determining genus, or species with a genus.

The nearest equivalent to a perianth in a grass flower is a pair of tiny scales called **lodicules**. They are minute, hard to separate and most look much the same – so fortunately they play little or no part in identification systems. Hubbard has pictures of them for those who are curious.

Grass florets often break away from the plant when ripe. In some cases the whole spikelet comes away together leaving a callus scar. In others, the individual florets break off, leaving a series of

callus scars. Or the fruit may break away, leaving the palea and lemma; the shape of that scar (the **hilum**) may be diagnostic.

Grasses are of course wind-pollinated, and the anthers shed pollen before the stigmas in the same flower mature. There are no native grasses that bear male and female flowers in separate spikelets (**monoecy**) or on different plants (**dioecy**), but the example of *Zea mais* (Maize), a monoecious grass, will be familiar. Flowers of different sexes, or fertile and sterile flowers, may however be present in the same spikelet.

Very few British grasses are **cleistogamous** (self-fertilising without opening the floret), but a number of mountain grasses are **proliferous** – that is, instead of growing flowers in the spikelet, the grass produces a mini-plant that then falls off to grow on. (This is sometimes called **vivipary**, and even the scientific names of species may use this term, but it is not strictly correct. In vivipary, actual seeds would develop and start to grow while still attached to the parent plant.) This is obviously a useful strategy to overcome poor weather conditions, and it is not unusual to see the same thing late in the season in a number of lowland species. The coastal *Poa bulbosa* (Bulbous Meadow-grass) also does this normally, as well as producing ‘bulblets’ at its base, which get dispersed to grow on as independent plants.

The grass fruit is a seed tightly wrapped round with a tough outer sheath, technically known as a **caryopsis**. Apart from the trace it leaves behind, the fruit rarely has useful field ID characters. However features of the embryo are important in the highest-level classification of grasses.

A Note on Finer Anatomy

There are many points of grass anatomy that are important to grass classification and indicate different growth patterns and metabolic mechanisms. For more details see the Handbook, or Clayton & Renvoize. Fortunately these are not usually of great importance to identification. One major exception is the subgenus *Festuca* of genus *Festuca* (Fescues). This includes the ‘Red Fescue’ and ‘Sheep’s Fescue’ complexes. A number of the rarer or overlooked species ideally need a microtome and compound microscope to determine, as transverse sections need to be made from the leaves. However the Handbook (p.56) includes some helpful hints on how to improvise in the field with a pair of sharp dissecting scissors and a x20 lens.

Measurements

While many grasses are distinctive with a little experience, at times one needs to measure carefully, even down to a 0.1mm or 0.2mm precision. The section ‘Useful Equipment’ suggests some means of doing this.

With any identification guide it is important to know exactly what one should be measuring, and some are rather lax about explaining this. Fortunately the Handbook is very thorough on this point. The main details are on pp. 26-27, but there is further information for some individual genera, which should always be read before launching into the species accounts, and again for some individual species.

Distinguishing Grasses from Other Monocots

The distinctive features of the grass spikelet and the grass floret should make it relatively easy to distinguish flowering or fruiting material from any other family likely to be found in Britain. Some key points are summarised below.

- Like many other monocots, grasses have leaves which (when not all basal) are arranged alternately up the stem. Unlike most, however, they are **distichous** (arranged in two ranks on opposite sides of the stem) rather than spiralling around the stem.
- Grass culm stems are generally hollow (this may not be obvious where there are several overlapping sheaths) and rounded or flattened. Flowering stems of *Cyperaceae* (Sedges) are rarely hollow and often more or less triangular in cross-section.
- *Cyperaceae* (Sedges) never have a second bract like the palea of a grass floret; those members of *Poaceae* (Grasses) that lack a palea all have hollow stems.
- *Juncaceae* (Rushes) have a regular symmetrical flower of 6 tepals, in outer and inner rows of 3 each.
- The somewhat hardened shoulder of cells that occurs where the leaf sheath meets the blade is characteristic of *Poaceae*.
- The ligule of *Poaceae* is usually free of the sheath and blade for most of its length. The typical *Cyperaceae* ligule is attached to the blade over the greater part of its length.

Classification: Tribes and Genera

One of the more unusual features of the Handbook in a British context, and one you may find intimidating at first, is the three-level identification key: first to **Tribe**, then to **Genus**, then to **Species**. Subspecies are described under the species account, and not keyed out.

In the beginning this may mean that you spend some time with several fingers in the book, hopping from one level of the key and descriptions to another. This is particularly true because details at a higher level of classification are often not repeated at a lower level; to build up a complete mental portrait you must collect information from all levels. With experience, you will of course be able to place most grasses you encounter in the correct genus, without the need for the topmost level of key. Meanwhile, you will have acquired a skill with structural features of the grass family that will make it easier to place grasses from unfamiliar genera.

Tribes may seem a rather abstract basis for identification in the field, but in fact they are distinguished largely on easily observable features. Of the 15 tribes with members encountered in Britain, only 2 have a large and diverse set of genera, and 11 have 2 or fewer native genera. The following notes are intended as aide-memoires for finding one's way around the tribes in a British context. You should use the Handbook for rigorous ID.

Oryzeae (Rice-grasses)

Distinguished by having no glumes at all. They are mostly tropical and southern hemisphere (and include both *Oryza*, Rice, and *Zizania*, 'Wild Rice'), but there is a single very rare species native in Britain: *Leersia oryzoides*, Cut-grass.



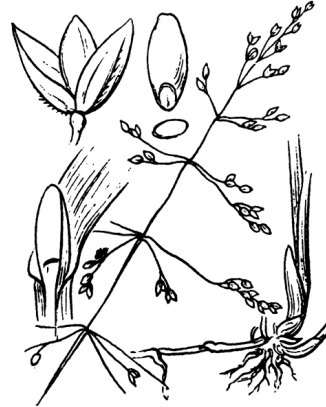
Nardeae (Mat-grass)

A single-species tribe, worldwide as well as in Britain. The single-sided spike-like raceme, with 1-flowered spikelets edge-on to the axis and almost no glumes to speak of, is unlikely to be mistaken for anything else. *Nardus stricta* (Mat-grass) is an important grass over huge areas of upland where it is preferentially avoided by grazing sheep. In less intensively grazed montane habitats it is often associated with late snow beds (best seen on the Continent). It is a more minor but sometimes abundant constituent of lowland heaths and acid grassland.



Stipaeae

Members also have single-flowered spikelets, with no barren florets, but the inflorescence is a panicle. Most genera in this tribe have awns arising from the tip of the lemma and sometimes these are spectacularly long; but the only British genus (*Milium*, with a single species here, *Milium effusum*, Wood Millet) has no awn at all. Some non-native species are grown as ornamentals and are becoming more or less naturalised.



Poeae

The first big tribe with a bewildering diversity of genera. What they have in common is a spikelet with 2 or more florets, an inflorescence either a panicle or a single raceme, a membranous ligule, and no hairy appendage on the ovary.

This tribe includes several important or large native genera, and the following are dealt with later under 'Key Genera': *Festuca* (Fescues), *Lolium* (Rye-grasses), *Vulpia* (Bearded Fescues), *Puccinellia* (Saltmarsh-grasses) and *Poa* (Meadow-grasses). Other genera are mentioned below.

Cynosurus (Dog's-tails) are a strange member of this tribe, as they have all their spikelets in pairs: an outer one which is entirely sterile and consists of a persistent comb-like cluster of lemmas, covering a fertile one. Apart from this feature, the two species in Britain are rather different-looking plants, the native *Cynosurus cristatus* with a narrow, semi-cylindrical spike and the introduced *C. echinatus* with a one-sided roughly ovoid, tight panicle.

Briza (Quaking-grasses) are instantly recognisable because of the shape of their spikelets. This comes from the broad, almost circular lemmas that are deeply cupped, and enfold each other rather tightly.

Dactylis (Cock's-foots) has a single native species that will be readily recognisable in flower or fruit to most people by its lumpy, one-sided panicle. Look for the spiny bristles along the back of the lemma midrib, which is itself usually prolonged into a point or very short awn. Although so distinctive here, in Europe as a whole the Cock's-foots are a difficult genus with wide and complex genetic variation, and there is little agreement about how they should be classified.



Catabrosa (Whorl-grass) has one rather uncommon British species that beginners may overlook from a distance as a *Poa*, but once known has several distinctive features. The key one is the lemma, which has 3 nerves (all *Poa* have at least 5) and is rather broad and cut off at the top. Once known, the rather regular whorls of panicle branches, usually embracing about $\frac{3}{4}$ of a full circle and with the gap spirally offset from whorl to whorl, is a helpful ‘naked eye’ guide, as are the broad, blunt-tipped leaves.

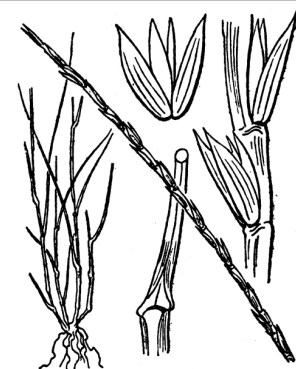
Catapodium (Fern-grasses) might also be mistaken for small, stiff *Poa* but the lemmas are rounded rather than keeled on the back, and distinctively stiff and horny like the glumes. The panicle is either raceme-like or else branches in a single plane, giving a distinctive appearance to the inflorescence. Although *Catapodium marinum* is called Sea Fern-grass, both British species can occur at the coast and it is necessary on some specimens to measure floral parts to be sure of the species.

Sesleria (Blue Moor-grass) has a single British species confined to the Highland zone and not coming south of the Peak District and the Burren, although occurring at both high and low altitudes. On the Continent it has a much broader distribution in calcareous grassland and open communities. *Sesleria* species are highly distinctive because the entire, compact panicle has a pair of conspicuous subtending bracts – not mentioned by Stace at all! Once known, the tufts of stiff, bluish, rather blunt-tipped leaves, a little reminiscent of Thrift, stand out.



Hainardieae (Hard-grasses)

Another small and very distinctive tribe with just two British native seaside species in the genus *Parapholis* (Hard-grasses), and a single casual introduction very similar in overall appearance. The spikelets are more or less sunk in the stem of the inflorescence (rhachis), and in the native species they are tucked behind the two glumes which are aligned side by side flat to the rhachis. When the anthers are not showing, the inflorescence looks like “all stalk”.



Aveneae

The other big, diverse tribe. The glumes are thin and papery and are mostly large enough to enfold the rest of the spikelet. The awns, when they occur, are usually kinked and usually from a point on the back of the lemma. (Poeae awns, when they occur, are always straight and always arise from the lemma tip.) It splits down into a number of sub-tribes: those with two or more fertile florets in the spikelet (sometimes one of them male only), **Aveninae**, including all the genera loosely referred to as Oat-grasses; those with a single bisexual floret and usually 2 male or sterile florets below it, **Phalaridinae**, including Canary-grasses; and those with a single (bisexual) floret, **Alopecurinae**,

including Foxtails, Cat's-tails and Bents. The Oat-grass genera and Bents are dealt with more fully later.

Aveninae

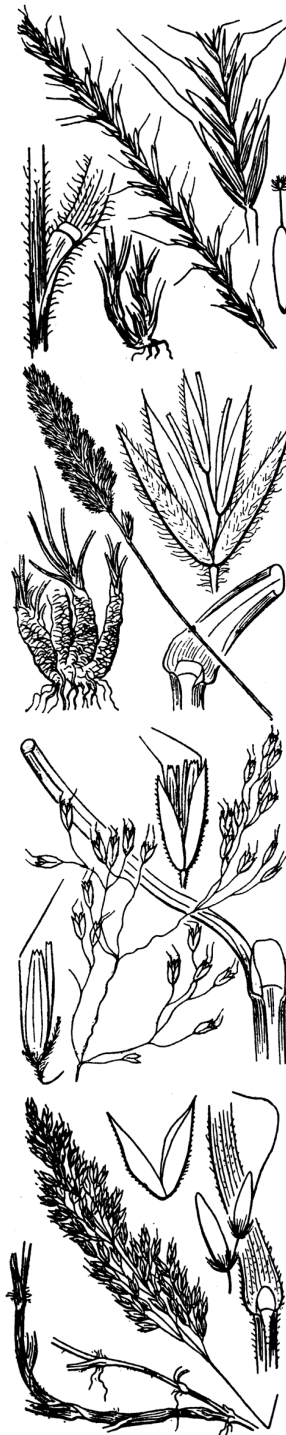
The Oat-grass genera, dealt with more fully later, conform pretty much to a standard pattern of two or more fertile florets topped by a reduced floret or extension of the spikelet stalk (**rhachilla**). When ripe, each floret breaks away individually from the spikelet. Lemmas are awned, from a point on the back of the lemma rather than the tip, and the awns have a kink. Many of the other genera differ from this pattern in one or more ways.

Gaudinia (French Oat-grass) is unusual in having spikelets in a raceme rather than a panicle, and this raceme breaks up easily at the base of each spikelet. A single species in Britain and a rare grass, it has several Hampshire sites.

Koeleria (Limestone Hair-grasses) has just two British representatives, one of them very rare. It completely lacks awns, but has a spike-like panicle with minutely hairy branches, distinguishing it from any member of *Poa* with which it might be confused.

Deschampsia (Hair-grasses) have spikelets usually 2-flowered, occasionally 3-flowered, with relatively small delicate flowering parts, slender awns and a 4-toothed lemma. There are 3 British species, all found in Hampshire.

Holcus (Soft-grasses) spikelets break off below the glumes when mature. The 2-flowered spikelets have a male floret above and a bisexual floret below. There are just two native British species, which are distinctive in appearance, but some species on the Continent approach *Deschampsia*.



Corynephorus (Grey Hair-grass) is a rare grass of mobile sand and vegetated shingle, not known south of East Anglia. The very distinctive feature of this genus is the awn, which comes from the very base of the lemma and is divided into a darker lower half with a crown of hairs at its junction with the slender club-shaped upper half.



Aira (Annual Hair-grasses) are annuals with delicate inflorescences and spikelets which are not drooping like the larger annual *Avena* (Oats). The two native species are common in our area on dry sandy and gravelly soil.



Phalaridinae

This is a small sub-tribe, covering plants with a single bisexual floret and one or (more usually) two male or sterile florets below it. The lemma is glossy and tough.

Anthoxanthum (Vernal-grasses) have two well-developed sterile or male florets below the bisexual floret, and all species have the characteristic new-mown hay smell of coumarin. Apart from the very common *A. odoratum*, there are just two rare species in Britain. The Handbook's definition of *Anthoxanthum* includes the species that used to be known as *Hierochloe odorata*.



Phalaris (Canary-grasses) have the two lower florets reduced to minute scales or stumps, and sometimes one of them is missing entirely. Apart from the native and common *P. arundinacea*, there are several introduced and casual species, some of which provide bird seed.



Alopecurinae

In this sub-tribe are all those plants with strictly a single floret in the spikelet.

Calamagrostis (Small-reeds) are perennials close to *Agrostis* (Bents) but in our area they are mostly more robust, rather reed-like plants represented by 2 of the 5 British species locally. (Kalamos = reed.) Technically they are distinguished by having a “beard” around the base of the lemma which is at least half the length of the lemma.

Ammophila (Marram) is a close relative of *Calamagrostis* with which it hybridises. Britain has one of the two world species, *A. arenaria*, well-known for its ability to bind dunes. It has a similar hair tuft around the base of the lemma to *Calamagrostis*, but this is less than half as long as the lemma. The lemmas are strongly keeled, not rounded as in *Calamagrostis* and *Agrostis*.

Gastridium (Nit-grasses) are annuals with glumes hairless, shiny and conspicuously swollen near the base, giving the plants their vernacular name. The lemma sometimes has a slender but lengthy awn arising from the back (Cope’s key may mislead you here). Once seen, unlikely to be mistaken for anything else. Two species in Britain of which one is a very rare casual and the other is rare.

Lagurus (Hare’s-tail), with a single world species *L. ovatus*, is also unmistakable once looked at reasonably closely. The glumes are densely hairy and awned and the whole dense, ovoid panicle has a fluffy appearance, white when fresh.

Apera (Silky-bents) have shining, hairless glumes like *Gastridium* but without the swollen bases, and the upper glume is 3-nerved (whereas in *Agrostis* it is almost always 1-nerved). Highly characteristic is the very long awn in relation to the lemma, arising from near the tip of the lemma. Britain has 2 of the 3 species worldwide. The illustration shows *A. interrupta*, which is much the more localised.



Mibora (Early Sand-grass) are tiny annual grasses with a one-sided raceme and are utterly distinctive. There is a single, rare British species (*M. minima*).



Polypogon (Beard-grasses) are very similar to *Agrostis* (Bents) with which they hybridise. One naturalised species in particular, *P. viridis*, which is now spreading rapidly in Britain, is very easily mistaken for one. The main distinction is made on the way the spikelets come away intact from the inflorescence, with a small stalk attached. The native annual *P. monspeliensis* (illustrated) is very different in appearance.



Alopecurus (Foxtails): this and the next genus (*Phleum*) have more or less cylindrical, spike-like panicles that are superficially rather similar and for this reason can give trouble to beginners. However an inspection of the spikelets will easily distinguish them.



Alopecurus have glumes that are joined at least at the base, are unawned, and in most species are more or less hairy. The lemmas are awned (in all British species), usually from low on the back of the lemma and certainly from less than half way up. There is no palea.

Phleum (Cat's-tails) differ from *Alopecurus* as follows. The glumes are not joined at the base, and each has a stiff usually short awn giving the spikelet a distinctive appearance (but in *P. arenarium* the glumes are little more than acuminate). They are strongly keeled and stiffly bristly along the keel at least at the top. The lemmas are unawned. A palea is present.



Meliceae

This is not a very easy tribe to characterise. What they have in common as a field character is a sheath fused along the margins for almost all its length to make a cylindrical tube. This is not a unique feature but it is quite distinctive given other characteristics; for instance, it serves to distinguish *Glyceria* from *Puccinellia*, some of whose species can have superficially similar spikelets. Fortunately there are only two genera in Britain and they will not be hard to recognise.

Glyceria (Sweet-grasses) have a 1-nerved upper glume and a single rudimentary floret at the top of the spikelet.



Melica (Melicks) have a 5-nerved upper glume (in British species) and a small club-shaped clump of reduced sterile lemmas at the top of the spikelet. There are only two British species and they are very easily recognised grasses.



Brachypodieae (False-bromes)

This is a small tribe with just one British genus and two (possibly three) British species. In fact some authors put them in with either the Bromeae or the Triticeae, with which they share the feature of a knob on the end of the ovary with a tuft of hairs. The species of *Brachypodium* can resemble a *Bromus* superficially, but the inflorescence is a simple raceme rather than a panicle. The spikelets have short stalks (c. 1mm), whereas all Triticeae have strictly sessile spikelets, racemose or tightly packed to look like a raceme but in fact occurring in groups of two or three.



Bromeae (Bromes)

This tribe has distinctive ovaries with a hairy knob on the end of the ovary; unlike the other tribes with this feature, its inflorescences are always “proper” panicles, although very diminutive plants with one or two spikelets may not make this obvious.

Following Clayton and Renvoize, the Handbook puts all European plants into a single genus, *Bromus*. In many other works, Stace included, they are divided into genera *Bromus*, *Anisantha*, *Bromopsis* and *Ceratochloa*, which Cope recognises as sections. These are all dealt with later.

Triticeae

The third tribe with a hairy knob terminating the ovary, its inflorescences are racemes, or appear like racemes where two or three spikelets are packed together on the axis, without stalks. The tribe includes many of the cultivated cereal crops as well as Couches and wild Barleys.

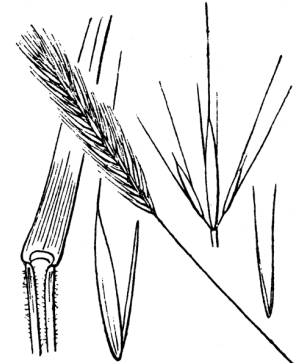
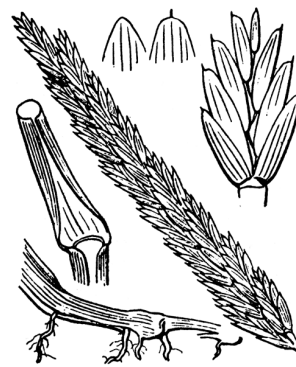
Elymus (Couches) are perennials with spikelets borne singly on the rhachis, a characteristic they share with the annual *Secale* (Ryes) and *Triticum* (Wheats) but with no other wild British members of the tribe.

The Handbook combines in the one genus what Stace and other authors segregate into two, *Elymus* and *Elytrigia*. Members of the genus interbreeds rather frequently with other members and also with *Hordeum* (Barleys), and care is needed with determinations.

Leymus (Lyme-grass): the single British species, *L. arenarius*, is distinguished from *Elymus* by having two spikelets at each node on the rhachis, but technically the genera as a whole are separated on their glumes; *Leymus* has indistinct nerves, or a single narrow glume that is “all nerve”; while all *Elymus* have strongly ribbed nerves.

Hordelymus (Wood Barley) has a single species world-wide, *H. europaeus*. It has three spikelets together at a node on the rhachis, like *Hordeum* (Barleys); but whereas those have the central spikelet bisexual and the lateral ones male or sterile, *Hordelymus* has all three spikelets bisexual, or the central one sometimes male.

Hordeum (Barleys): three permanent members of the British flora (one perennial, two annual), and another half a dozen casual or crop plants. They have three spikelets together at each node in the inflorescence, the central one bisexual and the lateral male or barren.



Arundineae

This tribe is, to be honest, a mess on both morphological and genetic grounds. Stace puts *Danthonia* and *Cortaderia* into a separate tribe *Danthonieae*, while some other authors put *Danthonia* and *Molinia* there. What they all have in common (although not exclusively) is a ligule consisting of a minutely short membrane crowned by a conspicuous line of hairs. Most other characters have to be qualified by exceptions, and it is simplest to learn the small number of individual genera to be found in Britain. Not detailed below, but now spreading, sometimes invasively, in Britain, are the large and distinctive *Cortaderia* (Pampas-grasses).

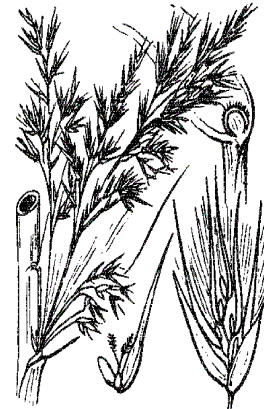
Danthonia (Heath-grass) is represented by a single species in Britain, which uncharacteristically for the genus has no awn on the lemma. It is relatively small and tufted, with mostly basal leaves; the panicles are quite small and raceme-like with few, relatively large spikelets; and the lemmas are 7-9-veined.



Molinia (Purple Moor-grass) is a small genus with just the single British species *M. caerulea*. Also tufted and with mostly basal leaves, but rather larger, it has much larger often narrow panicles whose branches may spread as they mature, and numerous small spikelets. The lemmas are 3-5-veined. This grass is very unusual in being deciduous, and the dead shed leaf blades are often present for much of the year and provide an instant diagnostic.



Phragmites (Reed) is another small genus with just one British species, *P. australis*. The rhizomatous habit, forming dense reed-beds; the large leaf-blades ascending high up the stem, and also deciduous; the large feathery panicle, with spikelets only maturing some time after they have emerged from the sheath; and the conspicuous ligule-hairs, will make this a familiar plant to most people.



Eragrostideae

This is a large tribe worldwide but it contains no British genera and is represented here by a handful of genera of rare casuals or introductions. We shall not consider it further.

Cynodonteae

This is a tribe with only a few genera in Britain and they are reasonably distinctive. The ligule is again a short membrane crowned with a more or less long ciliate margin. The inflorescence is what the Handbook describes as “multiple racemes”, a character that also appears in the entirely non-native *Eragrostideae* and *Paniceae*. Unlike both of those, however, the spikelets have a single bisexual floret; in fact, those generally found here and detailed below have just one floret of any kind.

Spartina (Cord-grasses) have racemes branching at intervals from the main axis of the inflorescence. Most taxa are denizens of salt-marshes and coastal mud flats, and are famous for the development of a new allopolyploid species, *S. anglica*, in historic times from the hybridisation of a native British and an introduced North American species.



Cynodon (Bermuda-grasses) have racemes arranged digitally (radiating out from a single point). They are non-native species, only one of which, *C. dactylon*, is anything other than very rare and casual.



Paniceae

This is another tribe that is entirely non-native in Britain, but several of its genera are now becoming so widespread as plants of arable and waste ground that it is worth giving space to them here. Again, the ligule combines a short membrane with ciliate hairs, or else is totally absent. Spikelets are two-flowered and the lower floret is male or sterile while the upper is tough and tightly wrapped round the seed. The glumes are in many cases relatively small and insignificant. Several other genera are recorded in Britain but are rare and casual.

Panicum (Millets) have spikelets without a ring of bristles, and rather loose open panicles. Several species turn up as casuals but the one most frequently seen in the wider countryside is *P. miliaceum*, which is often a constituent of game strips in arable land.



Echinochloa (Cockspurs) similarly lack bristles around the spikelets, and have no ligule. The inflorescence is a rather untidy raceme with a chunky appearance due to the spikelets being roughly aligned in several rows. A critical genus, most plants in Britain being referable to *E. crus-galli* which is a spreading main road colonist and is also found in maize fields and game strips.



Setaria (Bristle-grasses) have, as the name implies, a number of rather stiff, awn-like bristles arising from under each spikelet in the dense rather spike-like panicles. Several species are becoming increasingly frequent on roadsides, waste places, and in maize fields and game plantings. The backward-pointing bristles on the bristle are a distinguishing feature of the species illustrated, *S. verticillata*.



Digitaria (Finger-grasses) look similar to *Cynodon*, with several racemes arising from a single point or short stretch of the main inflorescence axis (but spikelets are two-flowered rather than one-flowered). Spikelets are clustered by twos or threes. The most frequently occurring species at present, *D. sanguinalis*, is appearing increasingly as a pavement and waste ground weed.



Andropogoneae

This mostly tropical and warm-temperate tribe is represented in Britain only by the planted crop Maize *Zea mais*, remarkable for its monoecious inflorescences, and a couple of members of the genus *Sorghum*, one of which (*S. bicolor*) appears as a casual and in game plantings, the other (*S. halepense*) having the dubious fame of being one of the world's most pernicious weeds – though fortunately not in Britain, where it is a rare casual.



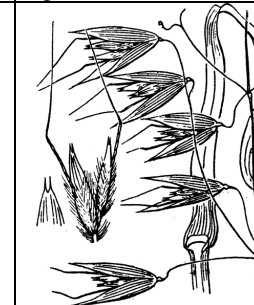

Key Genera

The following notes are not intended to duplicate the ID material in the Handbook, but simply to point out some of the key recognition features for quick reference.

Oat-grasses: *Helictotrichon*, *Arrhenatherum*, *Avena*, *Trisetum*

In this group come a number of genera that all possess the distinctive ‘oaty’ look: namely, panicate inflorescences; thin papery glumes which are generally as long as the spikelet and to some degree enclose it; awns which arise from the back of the lemma and turn away from it, often with a kink and a spirally twisted lower section.

Since the Handbook key covers several other genera of different appearance, the following table summarises the key recognition features of these four genera in Britain.

<i>Helictotrichon</i>	<i>Arrhenatherum</i>	<i>Avena</i>	<i>Trisetum</i>
Perennials	Perennials	Annuals	Perennials
Ligules long, triangular, bluntly pointed	Ligules short, blunt	Ligules medium to long but blunt and more or less rounded at tip	Ligule short, truncate or broadly blunt
Panicle narrow and erect	Panicle spreading but fairly dense	Panicle loose and nodding	Panicle usually erect, neat and dense or shortly spreading, golden in colour
Spikelets with 2 or more fertile florets and 1 or 2 reduced florets	Spikelets 2-flowered, sometimes with an additional rudimentary floret, but with the lower floret male and strongly awned and the upper bisexual and with weak or no awns	Spikelets large, typically 2- or 3-flowered, sometimes with the topmost floret reduced	Spikelets 2- to 4-flowered
Glumes 1- to 3-nerved	Glumes 1- to 3-nerved	Glumes 5- to 11-nerved	Glumes 1- to 3-nerved
Lemmas 2-toothed at tip	Lemmas simple at tip	Lemmas shortly to lengthily 2-toothed at tip	Lemmas shortly 2-toothed at tip
			

Meadow-grasses and Saltmarsh-grasses: *Poa* and *Puccinellia*

These two genera, with spikelets multi-flowered and all similar, and lemmas (almost always) unawned, can superficially look very much alike and they are indeed quite closely related. The key difference is in the lemma: rounded on the back in *Puccinellia*, keeled in *Poa*. Since *Puccinellia* are traditionally grasses of saltmarshes and bare damp ground near the coast, one used to be able to assume that any grass found inland would not be a *Puccinellia*. However several species have now spread along roadsides under the winter salting regimes.

Once one starts looking closely at *Poa* they can prove to be quite troublesome. Cope says: “It has facetiously been described as a genus of 500 identical species but this is uncomfortably close to being true... The species in the British Isles are not, on the whole, too difficult but there are two apomictic complexes which will give some trouble.”

Some points to look out for:

- *Poa annua* can behave as a perennial. When it does, it can produce runners.
- *Poa annua* and *P. infirma* can be difficult to tell apart as there appear to be intermediate plants; whether these are hybrids is not generally known. With practice ‘good’ plants can be distinguished at a glance, but until one has experience the best guide is the measurement of the developed anther.
- All British species of *Poa* have unawned lemmas – apart from the introduced *P. flabellata*, which occurs on Scottish islands.
- Two species of *Poa* have flattened stems: whereas the introduced *P. chaixii* has broad stems, the usually native *P. compressa* has slender stems.
- *Poa compressa* quite often grows on walls; *P. pratensis* subsp. *irrigata* can also grow on walls and may then have flattened stems too, and both species are rhizomatous; but well-developed plants of *P. compressa* will be more tufted and have a characteristic ‘line of elbows’ at the culm nodes. *P. pratensis* subsp. *irrigata* will lack the hardened, inrolled lemma of *P. compressa*.
- Other *Poa* that may appear on walls (without flattened stems) are *P. pratensis* subsp. *angustifolia*, with dense tufts of usually very upright culms; and the non-rhizomatous *P. nemoralis*, which can then look very different from the rather wispy plant of woods and hedgerows.
- *Poa nemoralis* is one of those taxon complexes that combines sexual reproduction and apomixis, and so gives rise to many local forms. Its non-rhizomatous growth, combined with a short ligule, will distinguish it from most other members of the genus.
- *Poa pratensis* is yet another taxon complex combining sexual reproduction and apomixis. The Handbook treats of three subspecies, subsp. *pratensis*, *irrigata* and *angustifolia* - more often given as species in British books, respectively *P. pratensis*, *P. humilis* (or *subcaerulea*), and *P. angustifolia*. Intermediates especially between the first two occur, and the first has probably been over-recorded in the past, just as the second has been under-recorded; over large parts of the country it is actually the commoner plant.
- *Poa trivialis* is another very variable species. The often-quoted character of rough sheaths is not constant, and one then needs to check for the long, pointed ligule. It is also stoloniferous rather than rhizomatous, but this is not always an obvious distinction.

Fescues and Rye-grasses: *Festuca*, *Lolium* and *Vulpia*

These three genera are closely related, despite their rather distinctive appearance, and the quite common hybridisation between them attests to this. *Lolium* has a two-sided raceme, with the spikelets edge-on to the rachis (in *Elymus* and *Leymus* they are broadside on). The other two genera have panicles but, like *Poa* and *Puccinellia*, the distinction between them is between rounded lemmas (*Festuca*) and keeled lemmas (*Vulpia*). Many *Festuca* species are awned but some are not; they can then be distinguished from *Puccinellia* by the firm tip to the lemma.

The Handbook key for *Lolium* makes a clear distinction between the two species *L. perenne* and *L. multiflorum*, and where the species are pure this is unproblematic. But be aware that the hybrid between these is very widespread and backcrosses with both parents. Bred forms of it are often sown in temporary grass leys and can then persist either in reploughed arable or in headlands or other more permanent grasslands. Cope states that the uppermost leaf is always spirally curled in the hybrid, as in *L. multiflorum*; but whether this holds true for all back-crossed plants I am unsure.

Festuca can be broken down into a couple of subgenera in our area (a third has a single species in the uplands). The 3rd edition of Stace goes further than this and names them as different genera. Rather robust, broad-leaved plants with conspicuous pointed auricles at the sheath junction go to *Schedonorus*. The rest go to *Festuca*. Here we stick to the Handbook convention of treating them all under the one genus *Festuca*.

- *Festuca gigantea* grows in much the same shaded habitat as *Bromus ramosus* and can superficially resemble it, but they are easily distinguished by the latter's hairy sheaths. Also the awn in *Festuca* is from the tip of the lemma; in *Bromus* it arises from a short distance behind the tip.
- *Festuca arundinacea* is often distinguished from *F. pratensis* by its ciliate auricles but for most of the auricles' life this is a lousy criterion, as the cilia soon come off. As a result, there is a suspicion that *F. pratensis* is over-recorded. They are best distinguished by counting the number of spikelets on the short panicle-branch of the lower pairs of branches; if the lemma has a short awn this is also a decider for *F. arundinacea*, but this is not a constant character. In fact, once the plants are known they are usually simple to distinguish at a glance – but beware of occasional hybrids.
- *Festuca heterophylla* may be a somewhat overlooked species in southern Britain; the place to look is on wood-borders on light, usually calcareous soils. The contrast between narrow inrolled tiller leaves and broader, more or less flat culm leaves is a key feature, although some forms of *F. rubra* show this to a lesser extent.
- The *Festuca rubra* and *F. ovina* complexes need to be distinguished on tillering habit and on fused or overlapping sheath margins. Because of the variability in both taxa, judgements based on size, colour etc. are unreliable.
- *Festuca brevipila* is a hugely under-recorded species, which is widely used in road verge plantings and many other amenity grasslands, and then persists and spreads. Any Fescue with open sheaths flowering in late April and early May in our area is likely to be this.
- In Hampshire it is worth getting to recognise *Festuca filiformis* in the *F. ovina* complex, as it is widespread in heathland, acid grassland and vegetated coastal shingle. In the New Forest it is overwhelmingly the commoner plant, *F. ovina* only appearing where chalk or lime has been introduced in modified habitats. This is very different from much of Britain. It is usually not hard to tell by its delicate spikelets and the very short or non-existent awn.
- Of the various hybrids between *Festuca* and *Lolium*, *x Festulolium loliaceum* is quite widespread and is often a characteristic member of old water meadows and riverine pastures.

All *Vulpia* species in our area are annual, though the hybrids they form with *Festuca* are perennial. Most species are not hard to separate using the Handbook key features, but some care must be taken with *V. bromoides* and *V. myuros*. The relative length of glumes is the most reliable character but when this is borderline, the full range of characters should be considered. Relative overall size of plants should not be taken into account; on light but well-fertilised soils in arable, *V. bromoides* can sometimes grow much taller than 'book heights'.

Bents: Agrostis

Agrostis species often excite dismay in beginners because the spikelets are so small and fiddly to examine, and distinguishing the species requires remembering a complex combination of features. Here is a little table summarising the main differences between the commoner species. The difficult distinctions are between *A. vinealis* and *A. canina*, and between *A. capillaris* and *A. gigantea*.

<i>A. vinealis</i>	<i>A. canina</i>	<i>A. stolonifera</i>	<i>A. capillaris</i>	<i>A. gigantea</i>
Densely tufted, may sometimes form turf	Tufted, may form scattered mat of tufts	Tufted, may form turf	Tufted, extensively turf-forming	Loosely tufted, not turf-forming
Rhizomes present	Rhizomes absent	Rhizomes absent	Rhizomes present	Rhizomes present
Stolons absent	Stolons present	Stolons present	Stolons rarely present	Stolons absent
Ligules long, rounded or bluntly pointed	Ligules long, sharply or bluntly pointed	Ligules long, rounded or subtruncate	Ligules short, truncate	Ligules short to medium, rounded to truncate
Panicle contracted and rather dense after flowering	Panicle rather open or loosely contracted after flowering	Panicle contracted after flowering	Panicle open with widely spreading branches after flowering	Panicle rather open with spreading branches after flowering
Lemma awned	Lemma awned	Lemma unawned	Lemma unawned	Lemma unawned
Dry heath, moor and open woodland	Acidic wetland habitats of most kinds	Very wide-ranging in habitat, but avoiding tall-herb communities	Dry grasslands and open ground	Arable weed, and disturbed grassland in agricultural areas; occasionally in damp grassland habitats

Agrostis curtisii, an important constituent of dry open heathland in our area, could be taken at a distance for members of the *Festuca ovina* complex with which it may occur, but the long, narrow acutely pointed ligule distinguishes it immediately. It is much harder to tell apart from a rare grass, *Deschampsia setacea*, that occurs quite widely on the New Forest; they should be ecologically separated but this is not always easy to tell at the end of a dry summer season. *D. setacea* has veins running down the sheath, while *A. curtisii* has none.



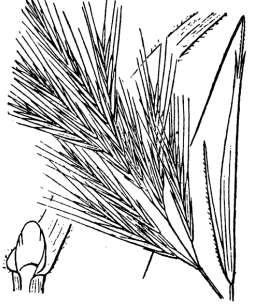

Bromes: *Bromus*

Bromes can superficially resemble some Fescue species but can usually be easily distinguished on the following characters.

- The awn arises from the tip of the lemma in *Festuca*, and from shortly below the tip in *Bromus*.
- The ovary of *Bromus* has a hairy terminal knob, lacking in *Festuca*.
- Most *Bromus* (certainly the ones likely to be confused) have hairy leaf-sheaths; in *Festuca* they are hairless.

The Handbook places all our members of the tribe *Bromeae* in the single genus *Bromus*; a traditional approach, current on the Continent, which has not been followed by most recent British texts, however. Yet the division of the genus into Sections (whether given different generic names or not) still applies and is of practical use in the field.

Sect. <i>Ceratochloa</i>	Sect. <i>Pnigma</i>	Sect. <i>Genea</i>	Sect. <i>Bromus</i>
Alt genus: <i>Ceratochloa</i>	Alt genus: <i>Bromopsis</i>	Alt genus: <i>Anisantha</i>	Alt genus: <i>Bromus</i>
Annual or short-lived perennial	Perennial	Annual	Annual or rarely biennial
Lemmas strongly compressed and keeled on the back	Lemmas rounded on the back	Lemmas rounded on the back	Lemmas rounded on the back
Spikelets narrowly lanceolate to narrowly ovate, not gaping	Spikelets narrowly lanceolate to narrowly oblong, not gaping.	Spikelets wedge-shaped and gaping	Spikelets lanceolate, ovate or oblong, not gaping

Sect. <i>Ceratochloa</i>	Sect. <i>Pnigma</i>	Sect. <i>Genea</i>	Sect. <i>Bromus</i>
Lower glume 3-5-nerved; upper glume 7-9-nerved	Lower glume 1(-3)-nerved; upper glume 3-nerved	Lower glume 1-nerved; upper glume 3-nerved	Lower glume 3-5-nerved; upper glume 5-7-nerved
Uncommon introduced species	Mostly widespread native species	Widespread and rare ruderal species	Widespread and rare native and introduced species of grasslands and waysides
			

Plants of the Section *Ceratochloa* are rarely to be met with. Some members of Section *Bromus* have large, rather compressed spikelets but they are never as flattened and keeled as *Ceratochloa*, which once seen are unlikely to be forgotten.

In Section *Pnigma* there are a number of points to be made.

- The distinctions between *Bromus ramosus* and the superficially rather similar *Festuca gigantea*, with which it can grow, are made earlier.
- Subsp. *benekenii* of *Bromus ramosus* (often treated as a separate species) is a difficult plant to identify, for the reasons given in the Handbook. (I have had one positive expert confirmation, not from Hampshire, in the last 10 years.) Consequently it is likely to be both misrecorded and under-recorded, but it appears to be very rare in our area.
- *Bromus inermis* can be a puzzling plant to place in *Bromus* if you are not familiar with it, since the majority of populations lack an awn on the lemma. It has strong rhizomes and is often aggressively patch-forming, but is rather rare in Britain.

Section *Genea* can be quite challenging, and the Handbook takes a conservative approach to defining species which seems to be realistic and practical.

- *Bromus diandrus* was formerly recorded in our area as a largely coastal plant, but at present it seems to be undergoing a considerable expansion inland as an arable weed, perhaps introduced with game strips. Many of these inland plants, though distinct in inflorescence shape from the *B. sterilis* with which they often grow, have lemma lengths which are on the lower limits for *B. diandrus*, and measurements should be taken on several plants and spikelets (remembering to exclude the awn!), using 24mm as a cut-off point. It is also worth measuring glumes.
- The Handbook reduces the plant often given species status as *Anisantha rigida* to a variety of *Bromus diandrus*, saying that many plants are morphologically intermediate and that immature specimens of *B. diandrus* are often misidentified. *A. rigida* has been recorded at several times on the Hampshire coast, but certainly plants on the Bournemouth cliffs are difficult to separate from *B. diandrus* var. *diandrus*. Cope states that true var. *rigidus* is only established in East Anglia and the Channel Islands.
- *Anisantha madritensis* is easier to separate on account of its shorter spikelets and lemmas. It is recorded at several spots quite close to the coast.

Section *Bromus* (Soft-bromes) is the part of the genus that causes most taxonomic controversy and identification challenge. The Handbook takes a conservative approach to species definition, and you

will have a much easier time using the keys there, and then reading the species descriptions for details of variants and infraspecific taxa, than by using the keys in Stace.

- *Bromus secalinus* is a plant that seemed to be heading for extinction for most of the 20th century, but it is now making a comeback, mostly on arable field margins. It is one of the easiest to recognise because of the large spikelets and the way the lemmas wrap around the inrolled seeds, exposing the spikelet axis (rachilla) in between the florets.
- The Handbook makes no distinction between *Bromus racemosus* and *B. commutatus*, which are often treated as separate species. They are both plants of damp grasslands, generally avoiding the waste and bare places in which *B. hordeaceus* is found, and Cope claims that they simply represent ends of a range with all points between represented. Certainly the Stace key is frustrating as every single key character shows a substantial overlap.
- *Bromus lepidus* is an extremely elusive grass; although the Handbook says that it crops up in sown or resown grasslands, having had the benefit of looking at good *B. lepidus* specimens I can say that I have never seen it in this situation. The short palea, not covering up the top of the seed, is the crucial character. What I have often seen in such places is a plant that fits reasonably well with published descriptions of a hybrid between this and *B. hordeaceus*, *B. x pseudothominei*. Cope doubts whether this hybrid occurs much at all, so on that basis such plants must be considered as variants of *B. hordeaceus*.
- *Bromus hordeaceus* is an extremely variable species. In droughted situations, stunted specimens are very difficult to determine below species level. Before trying to identify subspecies by keying out, you are strongly advised to read the Handbook account carefully. In particular, note the point that no reliance can be placed on whether the lemma is glabrous or hairy. On this basis, the plant often named subsp. *thominei* appears to be unrecognisable as a separate entity on the Hampshire coasts. Subsp. *ferronii* is easier to determine, but seems to be rare and perhaps over-recorded.

Resources

Further Reading

Clayton, W D & Renvoize, S A (1986), *Genera Graminum: Grasses of the World*, London

In classification and identification, this book is the model for the BSBI Handbook in many ways, and is the authoritative conspectus of the grass family worldwide. If you want to set the British grass flora in a world perspective, and understand something of the relationships of the genera, read this book.

Cope, T & Gray, A (2010), *Grasses of the British Isles*, BSBI Handbook 13, London

The essential accompaniment to this workshop.

Fitter, R, Fitter, A & Farrer, A (1984), *Grasses, Sedges, Rushes and Ferns of Britain and Northern Europe*, London

Usable, but loses out to Rose in most respects except portability.

Hubbard, C E (1954, 1968, 1992), *Grasses*, Harmondsworth

The classic handbook, which still contains the most detailed illustrations and technical descriptions and remains a valuable work of reference. However its taxonomy is now rather outdated and its coverage of non-native species is limited. If you are buying second-hand, the 2nd edition is effectively as good as the 3rd edition.

Poland, J & Clement, E J (2009), *The Vegetative Key to the British Flora*, London

If you are conducting survey work then vegetative grass identification is often a *sine qua non*, since grasses can define the vegetation and yet often be out of flower and grazed or cut down to the tillers. Turn straight to Division H of this book for a shortcut to the grass keys.

Rose, F (1989), *Colour Identification Guide to the Grasses, Sedges, Rushes and Ferns of the British Isles*, Harmondsworth

If you want an illustrated colour guide this is unbeatable, and it also works for the nearest parts of the Continent. Its drawbacks are its high cost and (for field work) its bulky format.

Ryves, T B, Clement, E J & Foster, M C (1996), *Alien Grasses of the British Isles*, London

A compendious catalogue of every non-native grass that has ever reared its head in Britain, with a huge set of source references. Useful keys and line drawings of some of the more important genera and species.

Sell, P D & Murrell, G (1996), *Flora of Great Britain and Ireland*, vol. 5, Cambridge.

The most disappointing and derivative of the volumes that have appeared so far, but it does include very full descriptions with some accounts of infraspecific variation, and detailed coverage of non-natives.

Stace, C A (2010), *New Flora of the British Isles*, 3rd edn., Cambridge

This new edition of the standard Flora retains and in some cases extends the more ‘splitty’ approach to genera used in most recent British accounts. Its keys are organised on more artificial lines, which is helpful to a degree, but the succinctness of the detail tends to offset this. It includes fair coverage of the naturalised Bamboos, omitted by Cope altogether, and brings in more of the casual non-native species.

If you are a French reader and want to tackle some of the larger and trickier genera, you may be interested in the following. They are definitely for the experienced!

Kerguélen, M & Plonka, F (1989), *Les Festuca de la Flore de France*, Dignac

No easy read, but contains an astonishingly detailed account of Fescues. Now available free for download on the Internet.

Portal, R (2009), *Agrostis de France*, Vals près Le Puy

Portal, R (1999), *Festuca de France*, Vals près Le Puy

Portal, R (2005), *Poa de France, Belgique et Suisse*, Vals près Le Puy

Each of the above contains excellent line drawings, a very full coverage of infraspecific variation, and extensive notes on the taxonomic history and sources of individual species. Of course many taxa are not known in Britain, and a few British taxa are not covered.

Illustrations for this document were taken from Coste's *Flore de France* of 1937, which is in the public domain and available online (see the Acknowledgements section at the end).

Useful Equipment

Although you will recognise most grasses by 'jizz' with a little experience, a lens is essential when keying out an unfamiliar specimen or critical species; generally a 10x lens will suffice, but sometimes 20x is useful.

Unless you are an extremely good visual estimator, a measuring device for floral parts and ligules is essential. An ordinary cabinet-makers' steel 6-inch rule is robust, reasonably cheap and will let you measure to 0.5mm. Better is a measuring loupe with a 0.1mm graticule. There are cheap and not very robust devices with built-in LED illumination from UKGE Ltd. Better quality loupes with built-in focusing are available from companies such as Peak and Bausch & Lomb, but typically cost £25-£50(-£250!). One of the best value at the moment is a 10x device from Schweizer at about £20, from <http://www.theloupestore.co.uk>. An 8x or 10x magnification is quite adequate. If using a measuring loupe in the field it's worth carrying a small piece of stout white card or plastic as a backfield.

Grasses are among the more satisfying plants to preserve, since (apart from some of the juicier marsh grasses) they dry simply and quickly and they generally preserve their features well. You do not need specialist equipment to press them; all you need is:

- some sheets of newspaper (the technical term for these is 'flimsies');
- some **large** sheets of blotting paper (not easy to obtain these days, but hugely cheaper than botanical drying paper);
- two large coffee-table books;
- Some heavy weights, or a lot more coffee-table books.

Make your specimens as complete as possible, without endangering the population. Of course you should not collect from small populations of rarities, or (without permission) from designated sites such as nature reserves and SSSIs. Put your specimens into the newspaper, nicely arranged to show both sides of the leaves where possible and the inflorescence with florets accessible. Put two or three sheets of blotting paper each side (more if your specimen is thick-stemmed or sappy), put the whole arrangement between the books, and stack weights on top. Check the sappier specimens after a day or two and change the blotting paper. The blotting paper is reusable once it has dried again. Most grasses will be pressed satisfactorily after a few days or a week. They can stay in the flimsies unless or until they are going to a permanent home in a herbarium. In fact, unless you have the materials and knowledge to carry out mounting onto herbarium sheets, it's better that they do; but make sure that you keep a full set of collection details (Place, date, collector, any field notes) **with**

the specimen. But if you want to preserve the specimens for posterity, you should arrange to have them mounted onto acid-free herbarium sheets, and ‘debugged’ by freeze-drying, before too long.

One problem with grasses is that many species will shed their spikelets or individual florets. This will be obvious by the end of the pressing process. For these species, make up a small folding envelope from paper and put the bits that are coming adrift into it.

Making your own grass herbarium set will give you a useful reference tool; equally, consulting a public herbarium such as the Hampshire County Museums Service herbarium at Bar End, Winchester, will give you quick access to many species that you might otherwise spend a long time tracking down in the field.

Acknowledgements

The colour illustrations of grass structure were kindly provided by Ken Adams, BSBI Recorder for Essex, and can be found also on his excellent web site devoted to the Essex flora, as part of an introduction and identification key to grasses:

<http://s231645534.websitehome.co.uk/Key%20to%20grass%20genera.htm>

The black and white illustrations of grass species were taken from Coste's *Flore de France*, 2nd edition, 1937, which are in the public domain and are most easily downloaded at present as three huge scanned PDF volumes and an index from:

http://www.tela-botanica.org/page:flore_de_coste

Many of the other Web sites with out-of-copyright biological books only hold references to the 3rd volume.