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Conspectus of and key to the world's species of *Vulpia* C.C. Gmel. (Poaceae: Loliinae) and seven related genera

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Abstract
A synonymised world-wide list of the annual taxa (excluding *Lolium*) of Poaceae: Loliinae (sensu Soreng *et al.*, 2017) is presented, with a brief discussion of the more contentious taxonomic issues. Eight genera are recognised for present purposes. A dichotomous key is provided to all the 33 accepted species plus three extra subspecies. Genera of the related subtribe Parapholinae are also briefly considered.

Keywords: Synonymy, *Castellia*, *Catapodium*, *Ctenopsis*, *Cutandia*, *Desmazeria*, *Hainardia*, *Loliolum*, *Micropyrum*, *Narduroides*, *Parapholis*, *Psilurus*, *Sphenopus*, *Vulpiella*, *Wangenheimia*.

The genus *Vulpia*

The genus *Vulpia* was founded by C.C. Gmelin in 1805 to accommodate *Festuca myuros* (and subsequently relatives) that differ from *Festuca* in their annual habit, short lower glumes and usually single stamens. Since then well over 100 names have been added, representing in my opinion a total of 21 species. *The Euro+Med Plantbase* (as at March 2022) accepts the same 16 species (naturally excluding the five American endemics), plus *V. obtusa* which is in this paper synonymised under *V. geniculata*. *The Plant List* (2013) recognises 26 species, the above 21 plus the four species of the genus *Ctenopsis* and *V. alpina*, a hexaploid species described from Tibet in 2002 but clearly representing a rather depauperate *V. myuros*.

Of the 21 species, ten fit within what Gmelin would have recognized as his new genus, i.e. annuals with cleistogamous or semi-cleistogamous florets usually with 1-2 stamens; these may be designated as section *Vulpia*. The other eleven extend the concept of the genus in that they are mainly chasmogamous or semi-chasmogamous species with three stamens; ten of them can also be distinguished by the fact that the pedicels are distinctly dilated distally, seven of them have an ovary with a hairy apex, and two of them (*V. sicula* and *V. litardiereana*) are perennials. Ten of these species have been placed in three other sections (*Loretia*, *Spirachne*, *Monachne*), the first of which has been segregated as the genus *Loretia* in the past. *Vulpia unilateralis* does not fit satisfactorily into any of these groups (Stace, 1978) and is often assigned its own section, *Apalochloa* (syn: sect. *Nardurus*). The 21 species with what may now be termed their five traditional sectional assignations are listed in Appendix 1 at the end of the paper.

Taxonomic issues

In the text of this paper authorities are omitted as they are provided in Appendix 1.

Perennial species

Vulpia litardiereana and *V. sicula* are the only two perennial species. The latter, which I have seen in the field in S. France, Sicily and Corsica, is an open-tufted perennial with culms more conspicuous and often more numerous than the tillers. It seems clearly related to two annual members of section *Loretia*, *V. ligustica* and *V. geniculata*, sharing with them a distally dilated pedicel, unequal glumes and a hairy ovary tip. *V. litardiereana*, confined to the Grand Atlas of Morocco (2,400-2,800 m), is evidently a densely tussocked perennial; it has abundant tillers and vegetatively resembles a fine-leaved *Festuca* rather than a *Vulpia*, although the inflorescence resembles that of *V. sicula*. It has somewhat unequal glumes, the ovary is hairy at the apex, all the tillers are intravaginal in origin, and the leaf-sheaths are overlapping (not fused into a tube). Until a thorough molecular study including this species is made, it seems for present purposes best to retain *V. litardiereana* in *Vulpia,* although it does extend the concept of that genus and might be better retained in *Festuca*. *V. sicula* is often divided into two varieties, vars *sicula* and *setacea*. Var. *setacea* has a looser, more spreading panicle, and there are small differences in the relative lengths of the glumes, lemmas and paleas. Maire (1955) stated that in North Africa var. *sicula* is the commoner variety and that var. *setacea* occurs "Çà et là avec le type", suggesting that varietal status is justified. In Europe var. *setacea* seems to be the commoner variety.

Vulpia attenuata

Parlatore (1844) described "*Vulpia attenuata* nob." and stated that it occurred in Sicily "in campi marittimi vicino Palermo a Mondello". Despite Parlatore's provision of a long description, and detailed comparisons with both *V. geniculata* and *V. setacea* (*V. sicula* var. *setacea*), *V. attenuata* has not subsequently been accepted at species level, but has been placed under one or other of three species, *Vulpiella stipoides* and the above two. Fiori (Fiori & Paoletti, 1896) reduced it to *V. geniculata* var. *attenuata*, and Trabut (Battandier & Trabut, 1895) treated it as *V. geniculata* subsp. *attenuata*. Similarly, Maire (1955), in his monumental *Flore de l'Afrique du Nord*, presented *attenuata* as one of five subspecies of *V. geniculata*, and the same treatment is maintained in Dobignard & Chatelain's *Index Synonymique* of the North African flora (2010), in the catalogue of Sicilian plants by Giardina *et al*. (2007, p. 455), and (as at March 2022) in the Euro+Med Plantbase. In *The Plant List* (version 1.1, 2013), however, *V. attenuata* is treated as a synonym of *V. sicula*, and the same is true in the latest Italian checklist (Bartolucci *et al*., 2018), and in *The World Checklist of Selected Plant Families* (as at January 2021). Finally, Pignatti (2017), in the second edition of *Flora d'Italia*, placed *V. attenuata* as a synonym of *Vulpiella tenuis* (= *V. stipoides*), a much more distantly related taxon. In the first edition (Pignatti, 1982) it had appeared under *V. geniculata*.

In order to settle the position of *V. attenuata*, I have recently lectotypified it on a specimen of *V. geniculata* in **FI** (sheet FI007024) collected by Parlatore at Mondello, Sicily before 1844 (Stace, 2021). Nevertheless, many specimens so-labelled in herbaria and described in Floras as *V. geniculata* subsp. *attenuata* are actually *V. sicula*.

Festuca morisiana
Festuca morisiana Parl. was a Sardinian endemic until subsp. *sicula* was described from Sicily in 2007 (Cristaudo *et al.*, 2007). However, Salvatore Brullo (Catania) recently alerted me to the fact that the latter seems very similar to *Vulpia sicula*, and study of the fine line-drawings of this subspecies provided by Cristaudo *et al*. (2007) and of subsp. *morisiana* provided by Barbey (1884) has convinced me that *F. morisiana* subsp. *sicula* should be included under *Vulpia sicula* and not placed under *F. morisiana*.

Vulpia geniculata
Vulpia geniculata is easily recognised despite its being very variable, especially in North Africa. Four extra subspecies were recognised in Algeria and Morocco by Maire (1955) and by Dobignard & Chatelain (2010). Only one of these (subsp. *attenuata*), in addition to the type subspecies, is also found in Europe. There was confusion about the position of subsp. *attenuata* which was only solved when it was lectotypified on a typical specimen of *V. geniculata* (Stace, 2021). Many specimens labelled as subsp. *attenuata* in fact belong to the related species *V. sicula*.

In a study of *V. geniculata* Stace (2022) concluded that it is conveniently separated into three subspecies, *geniculata*, *pauana* and *flavescens*, a classification that is followed here.

Little is known of a further species, *V. obtusa*, from extreme N.E. Algeria. Maire had seen no material, despite searching in herb. Trabut, and he merely quoted from Trabut's inadequate protologue, which describes a short (10-12 cm) plant with a little-branched panicle included in the top leaf-sheath at its base. There is nothing there to distinguish it from *V. geniculata* subsp. *pauana*; the inclusion of the base of the panicle in the top-most leaf-sheath is a common feature of droughted material. Dobignard & Chatelain (2010) listed it with a question mark.

Vulpia alopecuros
Subspp*. fibrosa* and *schousboei*, from Morocco, are sometimes (e.g. Maire, 1955) recognised in *V. alopecuros*. They appear to be based merely on the variation in growth habit and inflorescence shape in this species, best treated at the level of variety, if at all. Maire implied that subsp. *fibrosa* includes the type of the species and, although he recognized the two subspecies, he doubted their systematic value. They were not recognised by Dobignard & Chatelain (2010).

Vulpia alopecuros differs from the other species of section *Loretia* in its unilateral inflorescence shape and its lemma with an elongated pointed callus, which suggests that it might be more closely related to section *Monachne*, although it lacks the cluster of small sterile apical florets characteristic of *Monachne* and it has a completely glabrous ovary.

Section *Apalochloa*
Vulpia unilateralis presents strikingly different facies according to the size of its floral parts, the degree to which the spike appears unilateral, and the length of the lemma awns (almost absent to *c*.5 mm and longer than the lemma body). Accordingly, the species has often been subject to subdivision into varieties or subspecies.

A frequently recognised segregate is subsp. *montana*, from the mountains of southern Spain, which Devesa (1986) and Muñoz Rodriguez & Devesa (2020) characterised by spikelets (4)5-7 mm with 4-7 florets and anthers (1)1.3-2 mm, as opposed to the type subspecies with spikelets 2.5-4.5(5) mm with 3-4 florets and anthers 0.6-1 mm. Plants with small spikelets that Devesa assigned to subsp. *unilateralis* are indeed common in Spain, but they do not accord with plants at the northern end of the species' range (e.g. northern France and England), in which the spikelets are 4-7(8) mm with 3-6 florets and anthers 0.75-1.3 mm. Probably Devesa's two subspecies summarise the variation in Spain, but they do not adequately account for the variation over the total range. For example, Fiori (1969) for Italy, Krechetovich & Bobrov (1934, transl. 1963) for the USSR, and Tzvelev (1976, transl. 1983) for the Soviet Union, all recognise two taxa at specific, subspecific or varietal levels, with differing characters and names which are not easily correlated. More recently subsp. *tomentosa* was described from Iran (Faramarzi *et al*., 2012), but similarly pubescent plants are found in southern Europe and North Africa. Clearly the species requires further study across its total range before an infraspecific classification can be established.

Section *Vulpia*
Under *V. ciliata* two subspecies are here recognised. They represent separate geographical races with constant albeit small morphological differences, as discussed by Stace & Auquier (1978). Records of subsp. *ambigua* from the Mediterranean region are glabrous variants of subsp. *ciliata*.

The species in what can be called the *V. myuros* group are very similar and have been much confused. There are four species (*V. bromoides*, *V. muralis*, *V. myuros* and *V. persica*) in the Old World, and three in America (*V. octoflora*, *V. antucensis* and *V. australis*). The first three have often been reduced to subspecific or varietal status under *V. myuros*, e.g. by Maire (1955) and Dobignard & Chatelain (2010), but they are retained as species here because the diploids have probably been progenitors of the two hexaploids in the group (*V. myuros* and *V. persica*), and possibly of the tetraploid *V. ciliata* as well (Stace, 2005), and they are all, with experience, distinguishable on morphological characters.

Although *V. persica* and *V. hirtiglumis* are sometimes retained as separate species (e.g. Bor, 1970), I can see no differences apart from pubescence (glabrous to scabrid in the former, pubescent in the latter). Several species in section *Vulpia* vary in this way. Bor used this character in his key, but in the text also stated that in *V. hirtiglumis* the two glumes are more or less equal, whereas in *V. persica* the lower glume is half as long as the upper. This observation might have arisen from observations on spikelets terminal on lateral branches of the inflorescence in the former species; it does not apply to most of the spikelets. This species is very close to *V. myuros*, and might even be better as a subspecies of it. In addition to the characters given in the key (couplet 18), *V. persica* has a slightly longer lower glume (1/3-3/5 as long as upper) than *V. myuros* (1/10-2/5 as long as upper). Bor actually treated *V. persica* (but not *V. hirtiglumis*) as the sole Iranian representative of section *Loretia*, on the basis of one of its two or three anthers being large, not small ("antherae magnae", versus "antherae minimae", no lengths given). In my experience these two adjectives, in this group of the genus, indicate 1.5-2 mm and less than 1 mm respectively. Such unusually large anthers as the former, usually not in all three stamens, are frequently found in the cleistogamous species of section *Vulpia* (Auquier & Stace, 1980), and *V. persica* possesses none of the diagnostic characters of section *Loretia*. All the anthers of *V. persica* that I have observed are within 0.3-0.6 mm.

Vulpia octoflora is the only species native to both North and South America. In South America there are apparently native plants that have been segregated as *V. antofagastensis*, as well as aliens from North America. The former has slightly smaller spikelets and florets, but there is too much overlap and the distributions are too mixed to justify subspecific recognition.

Vulpia microstachys is a classic example of an inbreeding annual that has given rise to a number of 'pure lines' (Jordanons), of which eight have been given specific rank. However, Lonard & Gould (1974) reduced these to varietal level, with which I agree.

Vulpiella

The genus *Vulpiella* (Trab.) Burollet, with a single species *V. stipoides* (L.) Maire (*V. tenuis* (Tineo) Kerguélen), bears a close superficial resemblance to *Vulpia*, and has often been confused with it. *Vulpiella stipoides* has four synonyms at specific level under *Vulpia*. However, there are wide differences, as listed by Cotton & Stace (1977), notably the 3-veined, 3-keeled lemma, the short hilum, and several fundamental epidermal characters. Soreng et al. (2017) placed it with seven other mostly annual genera in the separate subtribe Parapholinae.

Related genera

In addition to the above 21 species there are 12 or 13 others apparently quite closely related, many of which have been included in *Vulpia* or *Nardurus* in the past but are now usually assigned to a few small separate genera, and it has therefore been difficult to define the limits of the *'Vulpia* group' (Stace, 1981). Recent molecular studies (summarised in Soreng et al., 2017), however, have clarified this. The following seven related small annual genera nested with *Lolium* L., *Drymochloa* Holub, *Schedonorus* P. Beauv., *Festuca* L. and other perennials as well as *Vulpia* in what Soreng defined as subtribe Loliinae: *Ctenopsis*, *Loliolum*, *Micropyrum*, *Narduroides*, *Psilurus*, *Wangenheimia* and *Castellia*. Their species are also included in Appendix 1. Other small annual genera that have sometimes been associated with *Vulpia* in the past were not included in Loliinae, i.e. *Desmazeria* Dumort., *Catapodium* Link, *Cutandia* Willk. and *Vulpiella* (Trab.) Burollet. These all have morphological and anatomical features which further indicate their less close relationship to the Loliinae, and Soreng placed them together with three other annual genera (*Hainardia* Greuter, *Parapholis* C.E. Hubb. and *Sphenopus* Trin.), amounting to a total of *c.*23 species, and the perennial *Agropyropsis* A. Camus in the subtribe Parapholinae. The scope of this paper is therefore the annual species of Soreng's Loliinae (excluding *Lolium*). The Parapholinae are, however, of relevance to the present paper as several species of Loliinae have in the past been placed in their genera (particularly in *Catapodium*), and for that reason the seven annual genera of Parapholinae are included in the generic key below.

The allocation of the above annual genera to two different subtribes is supported by more than just molecular evidence. Cotton & Stace (1977) investigated a range of morphological and anatomical characters in these grasses, and found two strongly contrasting patterns in the intercostal long-cells of the leaf inter-costal abaxial epidermis:

Type A – Long-cells very narrowly rectangular, parallel-sided, and with thick, tightly sinuate lateral walls.

Type B – Long-cells elongated-hexagonal, not parallel-sided, with thin, straight walls.

Type A is found in all of the perennial and in seven of the eight annual genera of the Loliinae. Type B is found in at least four (possibly all) of the annual genera of the Parapholinae and in *Loliolum* (Loliinae). This strongly suggests that the placement of *Loliolum* should be reinvestigated, but it is retained in Loliinae for present purposes.

The genus *Nardurus* has been used as a repository for small, more or less spicate annuals allied to *Vulpia*, but the species concerned belong to seven different genera, and the type species (*N. maritimus*) is a member of *Vulpia* as here defined (Stace, 1978). Nevertheless, Dobignard & Chatelain (2010) bizarrely resurrected *Nardurus* for *N. subulatus* (= *Loliolum subulatum*) alone, while retaining the type species in *Vulpia* (as *V. unilateralis*). As mentioned above, *Nardurus* (*Vulpia* section *Apalochloa*) does not fit in satisfactorily with either of the two main groups of *Vulpia* (sections *Vulpia* and *Loretia* s.l.), much less with *Loliolum*.

The three species of the genus *Narduretia* have been treated within *Vulpia*, but Paunero (1963) transferred them to *Ctenopsis* with its type species, *C. pectinella*. The latter is here segregated from *Narduretia* at subgeneric level. Two of the species, the African *C. cynosuroides* and the Spanish *C. gypsophila*, are very similar; Huguet del Villar (1925) admitted that if the two were not specifically distinct the Spanish plant could be known as *Narduretia cynosuroides* var. *gypsacea* (Willk.) Villar (not validly published). Despite their great similarity there are small quantitative differences, albeit all of them overlapping, and I have found an important difference in anther length (see Key). The short anthers of *C. cynosuroides* suggest a cleistogamous inbreeding species (although I have not been able to observe anthesis), while the long anthers of *C. gypsophila*, which are exserted at anthesis, indicate an at least partially outbreeding taxon, as is the related *C. delicatula*. The Spanish *C. gypsophila* is confined to gypsaceous soils in central Spain, but I have not found any such association mentioned concerning the African *C. cynosuroides*. There is an outlying area of *C. gypsophila* in western Sicily, which seems to be correctly assigned to the Spanish plant as it is one of only five of the 380 Italian taxa found on gypsum that are totally confined to it (Musarella *et al.*, 2018).

The genus *Wangenheimia* has traditionally been recognised as monotypic, containing only the very distinctive western Mediterranean gypsophile *W. lima*. The orientation of the glumes in this species is unusual in that the lower glume is twisted out of its usual position (lateral to the spikelet and adjacent to the back of the first lemma) to lie in the centre of the abaxial flattened face of the spikelet adjacent to and parallel with the rhachilla or to the lateral margin of the first lemma. A North African species, originally described as *Festuca demnatensis*, transferred to *Nardurus* by Maire and later to *Catapodium* by Maire & Weiller, has the same distinctive spikelet structure, as described by Maire (1955), and mainly on this basis it was transferred to *Wangenheimia* by Stace (1978). The situation is complicated, however, by the fact that *Loliolum subulatum* also has a similar spikelet structure, which, as far as I know, is confined in the Loliinae/Parapholinae to these three species. Other morphological characters, including those of the caryopsis, are not decisive in determining generic affiliation. Whatever the correct generic placement of *W. demnatensis*, the keys below are designed to identify it at species level.

Nardurus mamoraeus was described by Maire from his 1936 collection "In arenosis in sylva Mamora", Morocco, and was later transferred to *Catapodium* by Maire & Weiller. I have seen images of the isotypes in **MPU** (MPU010589) and **P** (P00434529). The species appears to have been collected since only once, by Charles Sauvage in 1961 from the same area ("Reg. Rabat, Mamora occidentale, sables mobiles aux abords de Dayete Er-Rma"). There are no other collections in **BA**, **BM**, **G**, **K**, **M**, **MPU**, **P**, **RNG** or **SEV**. Sauvage's herbarium is in **RAB** and **MPU** (specimen MPU1400378 in the latter seen courtesy of Caroline Loup), but the collection was also used as number 3709 in the *Société française pour l'Échange des Plantes vasculaires*, Fascicule 10 (1960-61). Filip Veerlove (Meise) has kindly furnished me with a list of the participants and associates of the *Société* at that time. The total of 31 was mainly made up of individuals (including Sauvage, working in Rabat in 1961), but included at least six institutions: **AL**, **BR**, **MPU**, **P**, **RAB** and **STR**. These institutions should have duplicates of 3709. The label for 3709 in the distribution gives some further data: (transl.) in open places on mobile siliceous sand in cork-oak woodland. Endemic to Mamora and surroundings (Souk-el-Arba-du-Rharb).

In general appearance and spikelet details *N. mamoraeus* much more closely resembles a *Micropyrum*, to which it was transferred by Stace (1978), than a *Catapodium*. Unfortunately, both the collections (early April) are at anthesis, and no caryopsides are present. The position of the hilum would decisively decide between the latter two genera. This is another taxonomic problem that requires a wide-ranging DNA analysis of the Loliinae/Parapholinae. In this paper *Nardurus mamoraeus* is treated as of uncertain position, and it is ***not*** catered for in the keys. The inclusion or not of this species in *Micropyrum* would decide whether there are 12 or 13 *Vulpia* relatives.

Classification of Loliinae

There is still no agreed generic classification of Loliinae, and this paper does not aim to present one. Molecular purists, i.e. those unwilling to accept paraphyletic groups as genera, include seven of the eight genera treated here (not *Castellia*) within *Festuca*, on the grounds that these seven genera are nested within *Festuca* in their cladograms (Soreng *et al.,* 2017). Others can see the logic in this (strict adherence to monophyly as a taxonomic criterion), but not necessarily the wisdom (Stace, 2020). Excellent molecular analyses of the Loliinae at species level have been carried out by a research group at the Universidad de Zaragoza (Catalán *et al.*, 2004; Torrecilla *et al.*, 2004; Díaz-Pérez *et al.*, 2014). The presence of polyploids, particularly *V. ciliata* and *V. myuros*, which are by definition often polyphyletic, as always complicates the issue. The species covered in each of these three reports varies slightly, but a total of 22 of the 34 species treated in this paper was included.

The main results from the Zaragoza group are that (a) a large monophyletic fine-leaved *Festuca* clade (FEVRE – *Festuca*, *Vulpia* and related ephemerals) is defined; and (b) the genus *Vulpia* is polyphyletic, being dispersed within FEVRE in four separate subclades. Subclade (**A**) contains the sections *Loretia*, *Monachne* and

Spirachne; the second (**B**) contains the section *Apalochloa*; and the third (**C**) and fourth (**D**) subclades contain the diploid and polyploid species respectively of the section *Vulpia*. Díaz-Pérez et al. (2014) added three American species of section *Vulpia* to the Old World species covered by the other two reports; these formed a fifth subclade. These results could be used as evidence that the first two subclades should be recognised as distinct genera (sections *Loretia*, *Monachne* and *Spirachne* as *Loretia* Duval-Jouve; section *Apalochloa* as *Nardurus*). However, a solution regarding section *Vulpia* is less obvious, since the diploids and polyploids, and the American species, are widely separated in the cladogram. It is notable that, within the restraints imposed by the sample size, the limits of FEVRE coincide almost exactly with those of Soreng's Loliinae. It should also be noted that the annual species in all the above four subclades are associated with different groups of perennial fine-leaved *Festuca* species.

It is not the purpose of this paper to assess the merits of different classification systems of *Vulpia* and allied genera, but instead to present a clarification of the often complex nomenclature and a means of identifying all the species. Clearly the genus *Vulpia* as here defined is artificial (polyphyletic). However, recognition of an enlarged fine-leaved *Festuca* will clearly not solve all the taxonomic problems. Presumably such a genus, with perhaps some 600 species, will require an infrageneric classification, so the taxonomic problems will simply shift from the generic to the infrageneric level. For convenience, in Appendix 1 the traditional classification of the annual Loliinae is presented, but if these annual genera are to be maintained then *Vulpia* should be divided, probably into three genera: *Vulpia*, comprised of the type section; *Loretia*, to include sections *Loretia*, *Monachne* and *Spirachne*, and *Nardurus* (section *Apalochloa*). The position of *V. litardiereana* remains doubtful. A final decision can be reached only when all 34 annual species of Loliinae, as well as the *c.*23 species of Parapholinae, have been subjected to more detailed molecular analyses.

Chromosome numbers

Chromosome counts of most of the species in Appendix 1 have been made. There is considerable variation in the older reports (diploid to hexaploid) of some species, especially in *Vulpia* and often for British species. However, the many counts that I and my colleagues have made over half a century have convinced us that this variation is spurious; as far as I am aware all the species have a single chromosome count based on x = 7. Within *Vulpia*, 12 species are diploids, two species are tetraploids with 2n = 28 (*V. fasciculata* and *V. ciliata*) and four are hexaploids with 2n = 42 (*V. myuros*, *V. persica*, *V. microstachys* and *V. elliotea*). *Vulpia gracilis*, *V. litardiereana* and *V. antucensis* have not been counted. All the species that have been counted in the seven small genera are diploids with 2n = 14, except the single species of *Psilurus* which is a tetraploid with 2n = 28. Apparently only *Micropyrum mamoraeum*, *Ctenopsis pectinella* and *C. cynosuroides* have not been counted.

Distribution

16 of the 21 species of *Vulpia*, plus all the 13 species in the other seven small genera (as well as all the *c.*23 species of Soreng's Parapholinae), occur in the Mediterranean area, with a few extending northwards to southern Scandinavia, east to Tibet, south to tropical African mountains and west to Macaronesia. *Vulpia*

australis and *V. antucensis* occur in temperate South America; *V. elliotea* and *V. microstachys* occur in temperate North America; and *V. octoflora* occurs in both South and North America. A few species, notably *V. bromoides* and *V. myuros*, are weedy and occur very widely as aliens in all continents, especially in English-speaking areas such as South Africa, North America and Australasia, where they can be troublesome due to their poor pasture value and the barbed fruiting lemmas. In southern Europe the central and northern European *V. bromoides* is largely replaced by *V. muralis*, and it is interesting to note that, whereas *V. bromoides* is a common alien in North America, it is largely replaced by *V. muralis* in the Spanish- and Portuguese-speaking areas of South America. Indeed, *V. muralis* was described from alien material in Ecuador in 1822.

Keys
It is thought that the provision of keys to all the species of Loliinae in the world, as opposed to regional keys which are the norm, should be useful in a group whose species are frequently found as aliens in areas far from their native range. Keys to the species of North America (Lonard & Gould, 1974), Argentina (Stace, 2012), North Africa (Maire, 1955), Europe (Stace, 1980), Italy (Pignatti, 2017), Iberian Peninsula (Muñoz Rodriguez & Devesa, 2020) and Turkey (Stace, 1985) remain informative, despite differences in taxonomic treatment. The generic key also covers Soreng's Parapholinae.

Key to the annual genera of Loliinae and Parapholinae sensu Soreng *et al.*
Genera in square brackets are not treated further here (all these, apart from *Lolium*, belong to Parapholinae; see text)

1 Terminal spikelet with 2 glumes, all others with 1 glume — 2
1 All spikelets with 2 glumes, sometimes the lower glume minute — 4

2 Spikelets with more than 1 floret — (Loliinae) [**LOLIUM**]
2 Spikelets with 1 floret — 3

3 Glume much longer than lemma; lemma awnless — (Parapholinae) [**HAINARDIA cylindrica**]
3 Glume much shorter than lemma; lemma with awn *c.* as long as body — (Loliinae) **PSILURUS incurvus**

4 Lower glume less than 1/2 as long as upper — 5
4 Lower glume at least 1/2 as long as upper — 7

5 Lemma membranous, subacute to rounded or truncate at apex, awnless — (Parapholinae) [**SPHENOPUS**]
5 Lemma chartaceous, acute to acuminate at apex, often with terminal awn — 6

6 Hilum less than 1/2 as long as grain; pedicels held at 45-90° to rhachis after anthesis; grain loosely adherent to palea — (Loliinae; see key below) **CTENOPSIS**
6 Hilum more than 1/2 as long as grain; pedicels suberect after anthesis; grain firmly adherent to palea — (Loliinae; see key below) **VULPIA p.p.**

7 Lemmas densely tuberculate, glabrous (Loliinae) **CASTELLIA tuberculosa**
7 Lemmas glabrous, scabrid or hairy, not tuberculate 8

8 Lemmas 3-veined, notched at apex, awnless or with awn arising from notch 9
8 Lemmas 5-veined, rarely 3-veined and then gradually tapered to long awn and not notched at apex 11

9 Rhachis breaking at maturity below each spikelet; spikelets 1-flowered; glumes as long as spikelet; lemmas membranous, not keeled (Parapholinae) [**PARAPHOLIS**]
9 Spikelets several- to many-flowered, breaking at maturity below each floret; glumes shorter than rest of spikelet; lemmas chartaceous, keeled on each vein 10

10 Spikelets becoming strongly divaricate at maturity; lemmas awnless or with short awns up to 1(1.5) mm; caryopsis more or less free from palea (Parapholinae) [**CUTANDIA**]
10 Spikelets not becoming divaricate at maturity; most lemmas with awn at least 1/2 as long as body; palea adherent to caryopsis (Parapholinae) [**VULPIELLA stipoides**]

11 Spikelets set in depressions on the rhachis; glumes emarginate (Loliinae) **NARDUROIDES salzmannii**
11 Spikelets not set in depressions on the rhachis; glumes obtuse or acute to subulate 12

12 Lower glumes mostly twisted to lie close to and parallel to rhachilla on the flattened face of the spikelet 13
12 Lower glumes not so twisted, lying in same plane as first lemma 14

13 Upper glume longer than rest of spikelet; anthers 0.5-1 mm (Loliinae) **LOLIOLUM subulatum**
13 Upper glume shorter than rest of spikelet; anthers 2-2.5 mm (Loliinae; see key below) **WANGENHEIMIA**

14 Hilum linear, more than 1/2 as long as caryopsis; glumes markedly unequal to subequal 15
14 Hilum punctiform to oblong, up to 1/2 as long as caryopsis; glumes subequal 16

15 Inflorescence usually a simple raceme; lower glume more than 3/4 as long as upper; lemmas obtuse to acute, awned or not (Loliinae; see key below) **MICROPYRUM**
15 Inflorescence usually branched, if a simple raceme then lower glume not more than 3/4 as long as upper; lemmas usually gradually acuminate, awned or not (Loliinae; see key below) **VULPIA p.p.**

16 Lemma strongly keeled throughout, (3)3.5-4.5(6) mm; lemma and rhachilla with minute (up to 0.2 mm) capitate-apiculate hairs

(Parapholinae) [**DESMAZERIA**]

16 Lemma rounded on back or keeled only near apex, 2-3(3.8) mm; lemma and rhachilla glabrous or with tapering pointed hairs (Parapholinae) [**CATAPODIUM**]

Key to species of Vulpia

Glume measurements must be taken from spikelets that are **not** apical on the main inflorescence or on its side branches (however short).

1 Callus at base of fertile lemma 0.5-1.5 mm, pointed, minutely antrorsely scabrid or hairy 2
1 Callus at base of fertile lemma *c.*0.2 mm, rounded, glabrous 6

2 Anthers 3, 2-5 mm, fully exserted at anthesis; spikelet with *c.*4-10 fertile florets, with 1-2(3) smaller sterile distal ones **V. alopecuros**
2 Anthers 1-3, 0.5-2 mm, slightly exserted at anthesis; spikelets with 1-3(5) proximal fertile florets and at least as many smaller sterile distal ones 3

3 Ovary and caryopsis minutely hairy at apex 4
3 Ovary and caryopsis glabrous 5

4 Spikelets with 2-5 fertile florets; upper glume with awn mostly 0.5-1 times as long as body; anthers 0.8-2 mm **V. fasciculata**
4 Spikelets with 1 fertile floret; upper glume with awn mostly 1.5-3 times as long as body; anthers 0.5-1.2 mm **V. gracilis**

5 Lemma 4-8 mm (excl. awn); callus 1-1.5 mm **V. fontqueriana**
5 Lemma 7-15 mm (excl. awn); callus 0.5-0.8 mm **V. membranacea**

6 Spikelets borne in regular clusters of 3, dispersed as a unit, the 3 pedicels borne on a common stalk; each spikelet with 1 female-fertile floret; glumes subequal, each with awn ± as long as body **V. brevis**
6 Spikelets not aggregated into clusters of 3; each spikelet normally with more than 1 female-fertile floret; lower glume usually conspicuously shorter than upper glume, neither with awn as long as body 7

7 Perennial; non-flowering tillers mixed with flowering culms 8
7 Annual; non-flowering tillers absent 9

8 Tillers not or scarcely outnumbering culms, forming loose tuft; lower glume 1/5-3/5 as long as upper **V. sicula**
8 Tillers greatly outnumbering culms, forming dense tussock; lower glume 2/3-4/5 as long as upper **V. litardiereana**

9 Pedicels distinctly flattened and widened distally; anthers (1-)3, well exserted at anthesis, (1.25)2-6 mm 10
9 Pedicels more or less parallel-sided; anthers 1(-3), usually not exserted at anthesis, but sometimes exserted, usually 0.3-0.8 mm, rarely up to 1.8 mm

but if so rarely more than 1 13

10 Lower glume less than 1/6 as long as upper; inflorescence-branches patent to pendent at maturity **V. ligustica**
10 Lower glume at least 1/3 as long as upper; inflorescence-branches erect to erecto-patent (*V. geniculata*) 11

11 Panicle with long spreading primary branches devoid of spikelets for 1-4 cm, hence very diffuse **V. geniculata subsp. flavescens**
11 Panicle with primary branches bearing spikelets close to base, hence relatively compact 12

12 Panicle up to 5 cm, very compact, with branches not evident without dissection, lemmas with awns much shorter than body **V. geniculata subsp. pauana**
12 Panicle often more than 5 cm, with some primary branches clearly visible; lemma-awns as long as or longer than body **V. geniculata subsp. geniculata**

13 Panicle-branches and pedicels becoming patent to deflexed at fruiting, due to conspicuous pulvinus (callus) in their axils; anthers 0.7-3 mm **V. microstachys**
13 Panicle-branches and pedicels without a callus in their axils, not becoming patent to deflexed at fruiting; anthers 0.2-0.8(1.8) mm 14

14 Spikelets with 1-3 proximal fertile florets, with (2)3-7 larger but sterile distal florets (*V. ciliata*) 15
14 Spikelets with most florets fertile, the distal (0)1-2(3) florets sterile and smaller than the fertile ones 16

15 Spikelets mostly 7-10.5 mm; fertile lemma 5-6.5 mm, usually pubescent on dorsal midline and ciliate on margins, rarely glabrous **V. ciliata subsp. ciliata**
15 Spikelets mostly 5-7 mm; fertile lemma 4-5 mm, glabrous **V. ciliata ssp. ambigua**

16 Lemmas with 3 veins, 2.5-3.5 mm; inflorescence a panicle **V. elliotea**
16 Lemmas with 5 veins, (2)3.5-8(10) mm, if less than 3.5 mm then inflorescence a raceme or with few short proximal branches 17

17 Stamens 3; anthers 0.7-1.3(1.9) mm, well exserted at anthesis; inflorescence usually a simple raceme, sometimes with a few short branches proximally; lemmas (2)3-4(5) mm (excl. awns) **V. unilateralis**
17 Stamens 1(-3); anthers 0.2-0.8(1.8) mm, usually not exserted at anthesis (rare chasmogamous variants with 1(-3) anthers up to 1.8 mm occur in several species); inflorescence usually with conspicuous branches, if racemose then lemmas 4-7 mm (excl. awns) 18

18 Inflorescence racemose or with a few short branches proximally; pedicels 0.2-1(2.5) mm **V. persica**
18 Inflorescence paniculate except in depauperate specimens; pedicels (0.4)1-2.5(3.5) mm 19

19 Lower glume up to 1/2 as long as upper glume 20
19 Lower glume more than 1/2 as long as upper glume 21

20 Mature inflorescence usually not fully exserted from uppermost leaf-sheath, up to 35 cm; lower glume 1/10-2/5 as long as upper glume **V. myuros**
20 Mature inflorescence usually well exserted from uppermost leaf-sheath, up to 15 cm; lower glume 1/4-1/2 as long as upper glume **V. muralis**

21 Lemmas (excl. awns) 4-8 mm, 1.3-2 mm wide when flattened out; lower glume 2.4-6 mm; spikelets with mostly 3-8 florets 22
21 Lemmas (excl. awns) (2.7)3.5-6.5 mm, 0.8-1.3 mm wide when flattened out; lower glume (1.7)2.5-3.5(4.5) mm; spikelets with mostly 5-12 florets 23

22 Lower glume (0.6)0.75-0.9 times as long as upper glume; upper glume 3-7.5 mm (incl. awn); spikelets with 3-6 florets **V. antucensis**
22 Lower glume 0.5-0.75 times as long as upper glume; upper glume 4.5-9(10.5) mm (incl. awn); spikelets with (4)5-8(10) florets **V. bromoides**

23 Spikelets elliptic to obovate in side view, with curved edges; lemma with awn usually about as long as or shorter than body **V. octoflora**
23 Spikelets obtriangular in side view, with straight edges; lemma with awn usually longer than body **V. australis**

Key to the species of *Ctenopsis*

1 Inflorescence a simple spike of more or less sessile spikelets (pedicels 0-0.4 mm); spikelets 3.5-5.5 mm; lemmas with awn 0 or much less than 1/2 as long as body **C. pectinella**
1 Inflorescence a simple spike or branched proximally; pedicels 0.4-1(2) mm; spikelets 5.5-12 mm; lemmas with awn *c.*1/2-1 times as long as body 2

2 Ligule of upper cauline leaves 0.2-0.6 mm; anthers 1.5-2.5 mm; lower glume acuminate to subulate **C. delicatula**
2 Ligule of upper cauline leaves 0.5-1.5 mm; anthers 0.4-2 mm; lower glume acute to obtuse **3**

3 Panicle 1-3 cm, with crowded spikelets; anthers 0.4-0.9 mm; N Africa **C. cynosuroides**
3 Panicle (1)2-6 cm, with clearly spaced spikelets; anthers (0.5)1-2 mm; SW Europe **C. gypsophila**

Key to the species of Micropyrum

1 Spikelets erecto-patent at anthesis, (7)9-15 mm; rhachilla-segments 1-1.6 mm; anthers 2-3.2 mm **M. patens**
1 Spikelets more or less appressed to rhachis at anthesis, (3)4-9(14) mm; rhachilla-segments 0.6-0.9 mm; anthers 0.5-1.3 mm **M. tenellum**

Key to the species of Wangenheimia

1 Inflorescence 1-2.5(3.5) cm, with all spikelets reaching *c.* half-way up next higher spikelet on same side of rhachis **W. lima**
1 Inflorescence 5-10 cm (longer in cultivation), with spikelets not or only just reaching next higher spikelet on same side of rhachis **W. demnatensis**

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Appendix 1. Conspectus of annual Loliinae

All taxa at species and subspecies level are included, as well as their basionyms, but other varieties and formae are not listed

VULPIA C.C. Gmel., *Fl. Bad.* 1: 8 (1805)
Syn: see under sections *Loretia*, *Monachne*, *Spirachne*, *Apalochloa* and *Vulpia*

Section Loretia (Duval-Jouve) Boiss., *Fl. Or.* 5: 630 (1884)
Bas: *Loretia* Duval-Jouve, *Rev. Sci. Nat.*, Sér. 2, 2: 38 (1880)
Syn: *Vulpia* subg. *Pseudofestuca* Rouy, *Vulpia* sect. *Festucoides* A Camus

V. alopecuros (Schousb.) Dumort., *Obs. Gram. Belg.* 100 (1824)
Bas: *Festuca alopecuros* Schousb., *Iagttag. Vextrig. Marokko* 40 (1800)
Syn: *Bromus barbatus* Savi, *Festuca gibraltarica* Willd. ex Steud., *F. ciliata* Link non Gouan, *F. pubescens* Zea ex Roem. & Schult. non Willd., *F. savii* Ten., *Mygalurus alopecuroides* Link, *Vulpia alopecurus* subsp. *fibrosa* H. Lindb., *V. alopecurus* subsp. *schousboei* H. Lindb. *V. ciliata* auct. non Dumort., *V. fibrosa* (H. Lindb.) A.W. Hill

V. geniculata (L.) Link, *Hort. Berol.* 1: 148 (1827)
Bas: *Bromus geniculatus* L., *Mant. Pl.* 33 (1767)

Subsp. flavescens (Sennen) Stace, *Brit. Irish Bot.* 4: 50 (2022)
Bas: *Vulpia flavescens* Sennen, *Diagn. Nouv.*, ser. 1933: 208, no. 8973 (1936)

Subsp. geniculata
Syn: *Bromus incrassatus* Lam. non *V. incrassata* (Salzm. ex Loisel.) Parl., *Festuca attenuata* (Parl.) Guss., *F. geniculata* (L.) Lag. & Rodr., *F. geniculata* subsp. *attenuata* (Parl.) Jahand. & Maire, *F. geniculata* subsp. *monanthera* Maire ('*monantha*'), *Loretia geniculata* (L.) Duval-Jouve, *Loretia incrassata* (Lam.) Duval-Jouve, *Mygalurus geniculatus* (L.) Link, *Vulpia attenuata* Parl., *V. flavescens* Sennen & Mauricio, *V. geniculata* f. *breviglumis* Trab., *V. geniculata* subsp. *attenuata* (Parl.) Trab., *V. geniculata* subsp. *breviglumis* (Trab.) Maire, *V. geniculata* subsp. *monanthera* (Maire) Maire, *V. subalata* Sennen

Subsp. pauana (Font Quer) Maire, *Cat. Pl. Maroc* 864 (1934)
Bas: *Festuca pauana* Font Quer, *Cavanillesia* 4: 25 (1931)

Syn: *?Vulpia obtusa* Trab., *V. pauana* (Font Quer) Font Quer

V. ligustica (All.) Link, *Hort. Berol.* 1: 148 (1827)
Bas: *Bromus ligusticus* All., *Fl. Pedem.* 2: 249 (1785)
Syn: *Festuca incrassata* L. non *V. incrassata* (Salzm. ex Loisel.) Parl., *Festuca ligustica* (All.) Bertol., *Loretia ligustica* (All.) Duval-Jouve, *Vulpia hispidula* De Not. ex Parl., *Zerna ligustica* (All.) B.D. Jacks.

V. litardiereana (Maire) A. Camus, *Riviera Sci.* 21: 44 (1934)
Bas: *Festuca litardiereana* Maire, *Bull. Soc. Hist. Nat. Afrique N.* 22: 323 (1931)

V. sicula (C. Presl) Link, *Hort. Berol.* 2: 272 (1833)
Bas: *Festuca sicula* C. Presl, *Cyper. Gram. Sicul.* 36 (1820)
Syn: *Festuca gussonis* Trin. ex Steud., *F. morisiana* Parl. subsp. *sicula* Cristaudo, Foggi, Galesi & Maugeri, *F. setacea* Parl. non Poir., *F. thomasiana* J. Gay ex Mutel, *Loretia setacea* (Parl.) Duval-Jouve, *Vilfa sicula* (C. Presl) Steud., *Vulpia avenella* Lojac., *V. hackelii* Lojac., *V. parlatoris* Lojac., *V. setacea* Parl., *V. sicula* var. *setacea* (Parl.) Hack.

Section Monachne Dumort., *Obs. Gram. Belg.* 100 (1824)
Syn: *Vulpia* sect. *Intermediae* Rouy

V. fasciculata (Forssk.) Samp., *Lista das Espécies Representadas no Herbário Português* 24 (1913)
Bas: *Festuca fasciculata* Forssk., *Fl. Aegypt.-Arab.* 22 (1775)
Syn: *Bromus hordeiformis* Lam., *Festuca uniglumis* Aiton, *Lolium bromoides* Huds., *Mygalurus uniglumis* (Aiton) Link, *Vulpia fontanesii* Parl., *V. membranacea* auct. non (L.) Dumort., *V. membranacea* subsp. *fasciculata* (Forssk.) O. Bolòs, Masalles & Vigo, *V. uniglumis* (Aiton) Dumort.

V. fontqueriana Melderis & Stace, *Collect. Bot. (Barcelona)* 7: 782 (1968)

V. gracilis H. Scholz, *Willdenowia* 5: 109 (1968)
Syn.: *Festuca scholziana* Domina & El Mokni

V. membranacea (L.) Dumort., *Obs. Gram. Belg.* 100 (1824)
Bas: *Stipa membranacea* L., *Sp. Pl.* 1: 560 (1753)
Syn: *Festuca agrestis* Loisel., *F. linneana* Steud., *F. longiseta* Brot., *F. membranacea* (L.) Druce, *F. pyramidata* Link, *Vulpia agrestis* (Loisel.) Duval-Jouve, *V. linnaeana* Parl., *V. longiseta* (Brot.) Hack., *V. membranacea* subsp. *longiseta* (Brot.) Rouy, *V. pyramidata* (Link) Rothm., *V. uniglumis* var. *longiseta* (Brot.) Husn.

Section Spirachne (Hack.) Boiss., *Fl. Or.* 5: 630 (1884)
Bas: *Vulpia* subg. *Spirachne* Hack., *Flora* 63: 475 (1880)

V. brevis Boiss. & Kotchy, *Diagn. Pl. Orient.*, Ser. 2, 4: 139 (1859)
Syn: *Festuca biaristata* Ehrh. ex Boiss., *F. brevis* (Boiss. & Kotchy) Asch., Schweinf, & Muschl., *F. inops* (Hack.) Delile ex Asch. & Graebn., *F. marmarica* F. Herm., *Vulpia inops* Hack.

Section Apalochloa (Dumort.) Stace, *Nord. J. Bot.* 1: 24 (1981)
Bas: *Brachypodium* sect. *Apalochloa* Dumort., *Obs. Gram. Belg.* 99 (1824)
Syn: *Festucaria* Link non Heist. ex Fabr., *Nardurus* Rchb., *Prosphysis* Dulac, *Vulpia* sect. *Nardurus* (Rchb.) Stace

V. unilateralis (L.) Stace, *Bot. J. Linn. Soc.* 76: 350 (1978)
Bas: *Triticum unilaterale* L., *Mant. Pl.* 35 (1767)
Syn: *Agropyron hispanicum* (Reichard) C. Presl, *A. unilaterale* (L.) P. Beauv., *Brachypodium hispanicum* (Reichard) Rchb., *B. montanum* (Boiss. & Reut.) Nyman, *B. psilanthum* Link, *B. tenuiflorum* (Schrad.) Roem. & Schult., *B. unilaterale* (L.) P. Beauv., *Catapodium montanum* (Boiss. & Reut.) Laínz, *C. unilaterale* (L.) Griseb., *Festuca divaricata* Sieber ex Steud. non Desf., *F. krausei* Regel, *F. lolioides* Trin. ex Steud., *F. maritima* L., *F. montana* (Boiss. & Reut.) Steud., *F. smithii* Kunth, *F. tenuiflora* Schrad., *F. tenuiflora* var.

aristata W.D.J. Koch, F. *unilateralis* (L.) Schrad., *Festucaria psilantha* (Link) Link, *Nardurus elegans* Drobow, *N. gandogeri* Gredilla, *N. krausei* (Regel) V.I. Krecz. & Bobrov, *N. maritimus* (L.) Murb., *N. maritimus* subsp. *aristatus* (W.D.J. Koch) Tzvelev, *N. montanus* Boiss. & Reut., *N. tenuiflorus* (Schrad.) Boiss., *N. unilateralis* (L.) Boiss., *N. woronowii* Schischk., *Triticum biunciale* Vill., *T. hispanicum* Reichard, *Vulpia hispanica* (Reichard) Kerguélen, *V. hispanica* subsp. *montana* (Boiss. & Reut.) Devesa, *V. maritima* (L.) Gray, *V. tenuiflora* (Schrad.) Heynh., *V. unilateralis* subsp. *montana* (Boiss. & Reut.) Cabezudo, Devesa, R. Tormo, F. Vázquez & J.M. Nieto, *V. unilateralis* subsp. *tomentosa* Faramarzi & Rahimin.

Section Vulpia

Syn: *Chloamnia* Raf., *Dasiola* Raf., *Distomomischus* Dulac, *Mygalurus* Link, *Vulpia* sect. *Articulatae* A. Camus

V. antucensis Trin., *Linnaea* 10: 303 (1836)

Syn: *Festuca antucensis* (Trin.) Steud., *F. eriolepis* É. Desv., *F. eriolepis* var. *nana* Hieron., *Vulpia australis* var. *nana* (Hieron.) Parodi, *V. australis* f. *glabrata* C.H. Blom, *V. eriolepis* (É. Desv.) C.H. Blom

V. australis (Nees ex Steud.) C.H. Blom, *Acta Horti Gothob.* 9: 163 (1934)

Bas: *Festuca australis* Nees ex Steud., *Syn. Pl. Glumac.* 1: 304 (1854)

V. bromoides (L.) Gray, *Nat. Arr. Brit. Pl.* 2: 124 (1821)

Bas: *Festuca bromoides* L., *Sp. Pl.* 1: 75 (1753)

Syn: *Bromus ambiguus* Cirillo, *B. dertonensis* All., *Distomomischus sciuroides* (Roth) Dulac, *D. subuniglumis* Dulac, *Festuca commutata* Scheele, *F. dertonensis* (All.) Asch. & Graebn., *F. geniculata* var. *monandra* Döll, *F. hordeiformis* Wulfen ex Steud., *F. onurus* Willd. ex Spreng., *F. panormitana* Guss., *F. sciuroides* Roth, *F. willemetii* Savi, *Lolium bromoides* (L.) Huds., *Mygalurus bromoides* (L.) Link. *Vulpia brachypoda* Font Quer, *V. bromoidea* St.-Lag., *V. dertonensis* (All.) Gola, *V. exserta* St.-Lag., *V. granulata* Sennen, *V. myuros* var. *bromoides* (L.) Parl., *V. myuros* var. *dertonensis* (All.) Fiori, *V. myuros* var. *sciuroides* (Roth) Coss. & Durieu, *V. myuros* var. *subuniglumis* Hack., *V. panormitana* (Guss.) Parl., *V. sciuroides* (Roth) C.C. Gmel., *Zerna bromoides* (L.) B.D. Jacks.

V. ciliata Dumort., *Obs. Gram. Belg.* 100 (1824)

Subsp. ambigua (Le Gall) Stace & Auquier, *Bot. J. Linn. Soc.* 76: 384 (1978)

Bas: *Festuca ambigua* Le Gall, *Fl. Morbihan* 731 (1852)

Syn: *Vulpia ambigua* (Le Gall) More

Subsp. ciliata

Syn: *Distomomischus ciliatus* (Dumort.) Dulac, *Festuca aetnensis* (Tineo) Walp., *F. barbata* Gaudin non L., *F. ciliata* Gouan, *F. ciliata* var. *imberbis* Vis., *F. danthonii* Asch. & Graebn., *F. exigua* Litv., *F. gaudiniana* Guss., *Vulpia aetnensis* Tineo, *V. ciliata* var. *danthonii* (Asch. & Graeb.) Maire & Weiller, *V. danthonii* (Asch. & Graebn.) Volkart, *V. gaudiniana* (Guss.) N. Terracc., *V. mandaliscae* Lojac., *V. myuros* var. *ciliata* (Dumort.) Bonnier & Barratte, *V. unioloides* Lojac.

V. elliotea (Raf.) Fernald, *Rhodora* 47: 106 (1945)

Bas: *Dasiola elliotea* Raf. *Neogenyton* 4 (1825)

Syn: *Festuca monandra* Elliot, *F. sciurea* Nutt., *Vulpia quadriflora* Trin. ex Steud., *V. sciurea* (Nutt.) Henrard

V. microstachys (Nutt.) Munro, *Pl. Hartw. [Bentham]* 342 (1857)

Bas: *Festuca microstachys* Nutt., *Proc. Acad. Nat. Sci. Philadelphia* 4: 24 (1848)

Syn: *Festuca arida* Elmer, *F. confusa* Piper, *F. dives* Suksd., *F. eastwoodiae* Piper, *F. grayi* (Abrams) Piper, *F. pacifica* Piper, *F. reflexa* Buckley, *F. suksdorfii* Piper ex Suksd., *F. tracyi* Hitchc., *Vulpia arida* (Elmer) Henrard, *V. confusa* (Piper) Henrard, *V. eastwoodiae* (Piper) Henrard, *V. grayi* (Abrams) Henrard, *V. pacifica* (Piper) Rydb., *V. reflexa* (Buckley) Rydb., *V. tracyi* (Hitchc.) Henrard

V. muralis (Kunth) Nees, *Linnaea* 19: 694 (1847)
Bas: *Festuca muralis* Kunth, *Syn. Pl.* 1: 218 (1828)
Syn: *Festuca bromoides* var. *broteroi* (Boiss. & Reut.) Henriq., *F. broteroi* (Boiss. & Reut.) Steud., *F. hybrida* Brot., *F. dertonensis* var. *tenella* (Boiss.) Briq., *F. myuros* var. *muralis* (Kunth) Speg., *F. myuros* var. *tenella* Boiss., *Vulpia bromoides* var. *hybrida* (Brot.) A. Fern, J.G. García & R. Fern., *V. broteroi* Boiss. & Reut., *V. dertonensis* var. *broteroi* (Boiss. & Reut.) Hegi, *V. dertonensis* var. *longearistata* (Willk. ex Husn.) Azn., *V. hybrida* (Brot.) Pau, *V. longiseta* var. *hybrida* (Brot.) Cout., *V. myuros* var. *broteroi* (Boiss. & Reut.) Pérez Lara, *V. myuros* var. *tenella* (Boiss.) Maire & Weiller, *V. sciuroides* var. *broteroi* (Boiss. & Reut.) Trab., *V. sciuroides* var. *longearistata* Willk. ex Husn., *V. sciuroides* var. *microstachys* Hack.

V. myuros (L.) C.C. Gmel., *Fl. Bad.* 1: 8 (1805)
Bas: *Festuca myuros* L., *Sp. Pl.* 1: 74 (1753)
Syn: *Avena muralis* Salisb., *Bromus bohemicus* F.W. Schmidt ex Mert. & Koch, *Distomomischus myuros* (L.) Dulac, *Festuca linearis* Gilib., *F. megalura* Nutt., *F. myuros* f. *major* Rohlena, *F. pseudomyuros* Soy.-Will., *Mygalurus caudatus* Link, *Vulpia alpina* L. Lui, *V. bromoides* var. *rigida* Nees, *V. crinita* Lojac., *V. longivaginata* St.-Lag., *V. major* (Rohlena) Á. Löve & D. Löve, *V. megalura* (Nutt.) Rydb., *V. murorum* Gray, *V. myuros* f. *hirsuta* (Hack.) C.H. Blom, *V. myuros* f. *megalura* (Nutt.) Stace & R. Cotton, *V. myuros* subsp. *pseudomyuros* (Soy.-Will.) Maire & Weiller, *V. pilosa* C.C. Gmel., *V. pseudomyuros* (Soy.-Will.) Rchb, *V. reclinata* Dumort., *V. vaginata* St.-Lag.

V. octoflora (Walter) Rydb., *Bull. Torrey Bot. Club* 36: 538 (1909)
Bas: *Festuca octoflora* Walter, *Fl. Carol.* 81 (1788)
Syn: *Brachypodium festucoides* Link, *Diarrhena setacea* (Poir.) Roem. & Schult., *Festuca gracilenta* Buckley, *F. parviflora* Elliott, *F. pusilla* Buckley, *F. setacea* Poir., *F. tenella* Willd., *Gnomonia octoflora* (Walter) Lunell, *Schedonorus tenellus* (Willd.) P. Beauv., *Vulpia antofagastensis* Parodi, *V. tenella* (Willd.) Heynh.

V. persica (Boiss. & Buhse) V.I. Krecz. & Bobrov, *Fl. URSS* 2: 535 (1934)
Bas: *Nardurus persicus* Boiss. & Buhse, *Mem. Soc. Nat. Mosc.* 12: 225 (1860)
Syn: *V. hirtiglumis* Boiss., *V. villosa* Maslenn.

CTENOPSIS De Not., *Ind. Sem. Horti Bot. Genuensis* 1847: 26 (1847)

Section Ctenopsis
Syn: *Festuca* subsect. *Pectinula* F. Herm., *Vulpia* sect. *Ctenopsis* (De Not.) Boiss.

C. pectinella (Delile) De Not., *Ind. Sem. Horti Bot. Genuensis* 1847: 26 (1847)
Bas: *Festuca pectinella* Delile, *Index Seminum [Montpellier]* 1836: 24 (1837)
Syn: *Ctenopsis patens* (Boiss.) Melderis, *Festuca cynosuroides* Delile non Desf., *F. patens* (Boiss.) Steud., *Vulpia patens* Boiss., *V. pectinella* (Delile) Boiss.

Section Pseudocynosurus (Willk.) Cotton & Stace, *Bot. Not.* 130: 187 (1977)
Bas: *Vulpia* sect. *Pseudocynosurus* Willk., in Willk. & Lange, *Prodr. Fl. Hisp.* 1: 90 (1861)
Syn: *Festuca* subsect. *Ctenopsis* F. Herm., *Narduretia* Villar

C. cynosuroides (Desf.) Paunero ex Romero García, *Lagascalia* 18: 321 (1996)
Bas: *Festuca cynosuroides* Desf., *Fl. Atlant.* 1: 88 (1798)
Syn: *Narduretia cynosuroides* (Desf.) Villar, *Nardurus cynosuroides* (Desf.) Trab., *Triticum cynosuroides* (Desf.) Spreng., *Vulpia cynosuroides* (Desf.) Parl.

C. delicatula (Lag.) Paunero, *Anales Inst. Bot. Cavanilles* 21: 365 (1963)
Bas: *Festuca delicatula* Lag., *Varied. Ci.* 2(4): 39 (1805)
Syn: *Loretia delicatula* (Lag.) Willk., *Mygalurus delicatulus* (Lag.) Link, *Narduretia delicatula* (Lag.) Villar, *Vulpia delicatula* (Lag.) Dumort.

C. gypsophila (Hack.) Paunero, *Anales Inst. Bot. Cavanilles* 21: 368 (1963)
Bas: *Festuca gypsophila* Hack., *Oesterr. Bot. Z.* 27: 47 (1877)
Syn: *Loretia gypsophila* (Hack.) Willk., *Narduretia gypsacea* (Willk.) Villar, *Vulpia delicatula* var. *gypsacea* Willk., *Vulpia gypsophila* (Hack.) Nyman

MICROPYRUM (Gaudin) Link, *Linnaea* 17: 397 (1844)
Bas: *Triticum* sect. *Micropyrum* Gaudin, *Fl. Helv.* 1: 366 (1828)

M. patens (Brot.) Rothm. ex Pilg., *Bot. Jahrb. Syst.* 74: 567 (1949)
Bas: *Triticum patens* Brot., *Fl. Lusit.* 1: 120 (1804)
Syn: *Brachypodium patens* (Brot.) Nyman, *Catapodium patens* (Brot.) Rothm. & P. Silva, *Festuca patens* (Brot.) K. Richt., *Micropyrum albaredae* Paunero, *M. tenellum* subsp. *patens* (Brot.) Rivas Mart., *Nardurus patens* (Brot.) Hack.

M. tenellum (L.) Link, *Linnaea* 17: 398 (1844)
Bas: *Triticum tenellum* L., *Syst. Nat.*, ed. 10, 2: 880 (1759)
Syn: *Brachypodium nardus* (DC.) P. Beauv., *B. poa* (DC.) Roem. & Schult., *B. tenellum* (L.) P. Beauv., *Catapodium halleri* (Viv.) Rchb., *C. tenellum* (L.) Trab., *Festuca festucoides* (Bertol.) Bech., *F. gracilis* Kunth, *F. lachenalii* (C.C. Gmel.) Spenn., *F. nardus* (DC.) Raspail, *F. racemifera* Trin. ex Steud., *Festucaria tenuicula* (Loisel.) Link, *Nardurus halleri* (Viv.) Fiori, *N. lachenalii* (C.C. Gmel.) Godr., *N. morisonii* Lojac., *N. poa* (DC.) Boiss., *N. tenellus* (L.) Reichard ex Godr., *N. tenuiculmis* Fourr., *Prosphysis tenella* (L.) Dulac, *Triticum festuca* DC., *T. festucoides* Bertol., *T. halleri* Viv., *T. lachenalii* C.C. Gmel., *T. lolioides* Pers., *T. nardus* DC., *T. poa* DC., *T. subulatum* Sm. ex Munro, *T. tenuiculum* Loisel., *Vulpia lachenalii* (C.C. Gmel.) Heynh., *V. nardus* (DC.) Dumort.

LOLIOLUM V.I. Krecz. & Bobrov, *Fl. URSS* 2: 544 (1934)

L. subulatum (Banks & Sol.) Eig, *J. Bot.* 75: 189 (1937)
Bas: *Triticum subulatum* Banks & Sol., *Nat. Hist. Aleppo*, ed. 2, 2: 244 (1794)
Syn: *Agropyron subulatiforme* Soó, *A. subulatum* (Banks & Sol.) Roem. & Schult., *Festuca orientalis* (Boiss.) B. Fedtsch., *Loliolum orientale* (Boiss.) V.I. Krecz. & Bobrov, *Nardurus orientalis* Boiss., *N. subulatus* (Banks & Sol.) Bor

WANGENHEIMIA Moench, *Methodus (Moench)* 200 (1794)

W. demnatensis (Murb.) Stace, *Bot. J. Linn. Soc.* 76: 350 (1978)
Bas: *Festuca demnatensis* Murb., *Lunds Univ. Arsskrift*, n.s., 18(3): 14 (1922)
Syn: *Catapodium demnatense* (Murb.) Maire & Weiller, *Nardurus demnatensis* (Murb.) Maire

W. lima (L.) Trin., *Fund. Agrost. (Trinius)* 132 (1820)
Bas: *Cynosurus lima* L., *Sp. Pl.* 1: 72 (1753)
Syn: *Catapodium pauciflorum* (Merino) Brullo, Giusso, Miniss. & Spamp., *Dactylis disticha* (Moench) Ball, *D. lima* (L.) Steud., *Desmazeria pauciflora* Merino, *D. rhachiantha* (Steud.) Mendonça & Vasc., *D. castellana* Willk., *Eleusine lima* (L.) Lam., *Dinebra lima* (L.) P. Beauv., *Festuca rhachiantha* Steud., *Poa lima* (L.) Trin., *Wangenheimia disticha* Moench

NARDUROIDES Rouy, *Fl. France [Rouy & Foucaud]* 14: 301 (1913)

N. salzmannii (Boiss.) Rouy, *Fl. France [Rouy & Foucaud]* 14: 301 (1913)
Bas: *Nardurus salzmannii* Boiss., *Voy. Bot. Espagne* 2: t.178 (1842)
Syn: *Brachypodium salzmannii* (Boiss.) Nyman, *Catapodium salzmannii* (Boiss.) Boiss., *Festuca salzmannii* (Boiss.) Boiss. ex Coss., *Nardurus filiformis* (Salzm. ex Willk. & Lange) C. Vicioso, *Triticum filiforme* Salzm. ex Willk. & Lange

PSILURUS Trin., *Fund. Agrost. (Trinius)* 93 (1820)

P. incurvus (Gouan) Schinz & Thell., *Vierteljahrsschr. Naturf. Ges. Zürich* 58: 40 (1913)
Bas: *Nardus incurva* Gouan, *Hortus Monsp.* 33: (1762)

Syn: *Asprella aristata* (L.) Kuntze, *A. nardiformis* Host, *Festuca incurva* (Gouan) Gutermann, *Nardus aristata* L., *Psilurus aristatus* (L.) Duval-Jouve, *P. hirtellus* Simonk., *P. nardoides* Trin., *P. rottboellioides* Griff., *Rottboelia monandra* Cav.

CASTELLIA Tineo, *Pl. Rar. Sicil.* 17 (1817)

C. tuberculosa (Moris) Bor, *Indian Forester* 74: 90 (1948)
Bas: *Catapodium tuberculosum* Moris, *Atti Riunione Sci. Ital.* 2: 481 (1841)
Syn: *Castellia tuberculata* Tineo, *Desmazeria tuberculosa* (Moris) Bonnier, *Festuca muricata* Durieu ex Parl., *F. tuberculosa* (Moris) Coss. & Durieu, *Lolium elegans* Steud., *Micropyrum tuberculosum* (Moris) Pilg., *Nardurus tuberculosus* (Moris) Hayek

SPECIES INCERTAE SEDIS

Nardurus mamoraeus Maire, *Bull. Soc. Hist. Nat. Afrique N.* 28: 386 (1937)
Syn: *Catapodium mamoraeum* (Maire) Maire & Weiller
Micropyrum mamoraeum (Maire) Stace

EXCLUDED SPECIES

Ctenopsis cerasiformis (Stocks) Naudin = *Ctenolepis cerasiformis* (Stocks) C.B. Clarke (Cucurbitaceae)
C. garcinii (L.) Naudin = *Ctenolepis garcinii* (L.) C.B. Clarke (Cucurbitaceae)
Vulpia brauniana Nees = *Anthosachne scabra* (R. Br.) Nevski
V. incrassata (Salzm. ex Loisel.) Parl. = *Vulpiella stipoides* (L.) Maire
V. letourneuxii Asch. ex E.A. Durande & Barratte = *Vulpiella stipoides* (L.) Maire
V. megastachya Nees = *Festuca vulpioides* Steud.
V. michelii (Savi) Rchb. = *Avellinia festucoides* (Link) Váldes & H. Scholz
V. pectinata (Labill.) Nees = *Australopyrum pectinatum* (Labill.) Á. Löve
V. rectiseta Nees = *Anthosachne rectiseta* (Nees) Barkworth & S.W.L. Jacobs
V. scabra (R. Br.) Nees = *Anthosachne scabra* (R. Br.) Nevski
V. stipoides (L.) Dumort. = *Vulpiella stipoides* (L.) Maire
V. tenuicula Boiss. & Reut. = *Avellinia festucoides* (Link) Váldes & H. Scholz
V. tenuis (Tineo) Parl. = *Vulpiella stipoides* (L.) Maire
V. ulochaeta Nees ex Steud. = *Festuca ulochaeta* Steud.
Wangenheimia umbellata (Ruiz & Pav.) F. Dietr. = *Dendropanax umbellata* (Ruiz & Pav.) J.F. Macbr. (Araliaceae)