Musick Point poser resolved

Rhys Gardner

In a new edition of his splendid account of Auckland's eastern suburbs, Alan La Roche gives up his contention that the thickets of *Pomaderris apetala* (Rhamnaceae) at Musick Point are of ancient Maori origin. Nothing about them seemed to me to support that idea (Gardner 1993), and now there is documentary evidence to the contrary. To quote La Roche (2011: 274): "The gardens were designed [c. 1940] by Roy Thornton for the Ministry of Works. He planted native trees that would survive the marine environment, including Tainui (*Pomaderris tainui*) from Mokau on the West Coast, Taupata (*Coprosma repens*) and Karo (*Pittosporum crassifolium*)."

References

Gardner, R. O. 1993: "Tribes' claims create poser": – *Pomaderris apetala* at Musick Point, Auckland. *Auckland Botanical Society Journal* 48: 8-9.

La Roche, A. 2011: *Grey's folly.* Tui Vale Productions, Auckland.

The ligules of Auckland's grasses (Gramineae)

Rhys Gardner

Introduction

Sometimes, confessions can be more reassuring than shocking. This is certainly so in the case of that excellent all-rounder Eric Godley 's admission, that he was "probably typical of young botanists of my generation in knowing very little about native grasses" (Godley 2009: 170). The intrinsic interest of this the world's third-largest flowering-plant family is, indeed, largely negated by an esoteric terminology and the need to come to grips with small and uncooperative floral parts.

But there is a passport into the world of grasses, one seemingly provided by a sympathetic Flora herself. It is the ligule. The function of this structure is unclear but its diverse morphology provides great diagnostic opportunities – at the very least, examination of an unknown grass's ligule will often result in a substantial narrowing of the field of possibilities. Furthermore, although ligules do become tattered as they age they have the advantage of looking more or less the same in the herbarium as in life. This is unlike some "field characters", such as colour and texture, which can change so much as to be useless when matching a fresh unknown to a named specimen.

Note that not just grasses have ligules: they occur in numerous genera of the Cyperaceae, e.g., *Gahnia* (but not *Morelotia*), some rushes (e.g. *Juncus tenuis*), and *Potamogeton* and some other monocot aquatics.

Morphology

Almost always (the American tribe Orcuttieae is an exception) the grass leaf is clearly divided into a stem-encircling lower part, the "sheath", and a free (initially folded or rolled) upper part, the "blade". In a growing shoot the sheaths, rolled one inside the other, give mutual support as a "pseudostem" and protect the inner leaves' basal regions of cell division.

The ligule stands across the sheath-blade junction, as a kind of fence between them (Lat. *ligula* little tongue). It is a continuation of the epidermis of the inner (adaxial) surface of the sheath, and is usually 3-layered, although the central layer of cells may be discontinuous. In many of our common weedy European grasses the ligule is a membrane. Its free upper margin may be entire, or undulate, or toothed in some fashion, or it may be topped by a line of hairs ("cilia"). In shape the membranous ligule may be truncate across the top margin, or rounded, or tapered to an acute apex. It may be lacerate, or tear to become so with age. Occasionally, as in *Dactylis glomerata* and *Glyceria maxima*, the margin is sharply peaked near the mid-line. In tightly rolled or

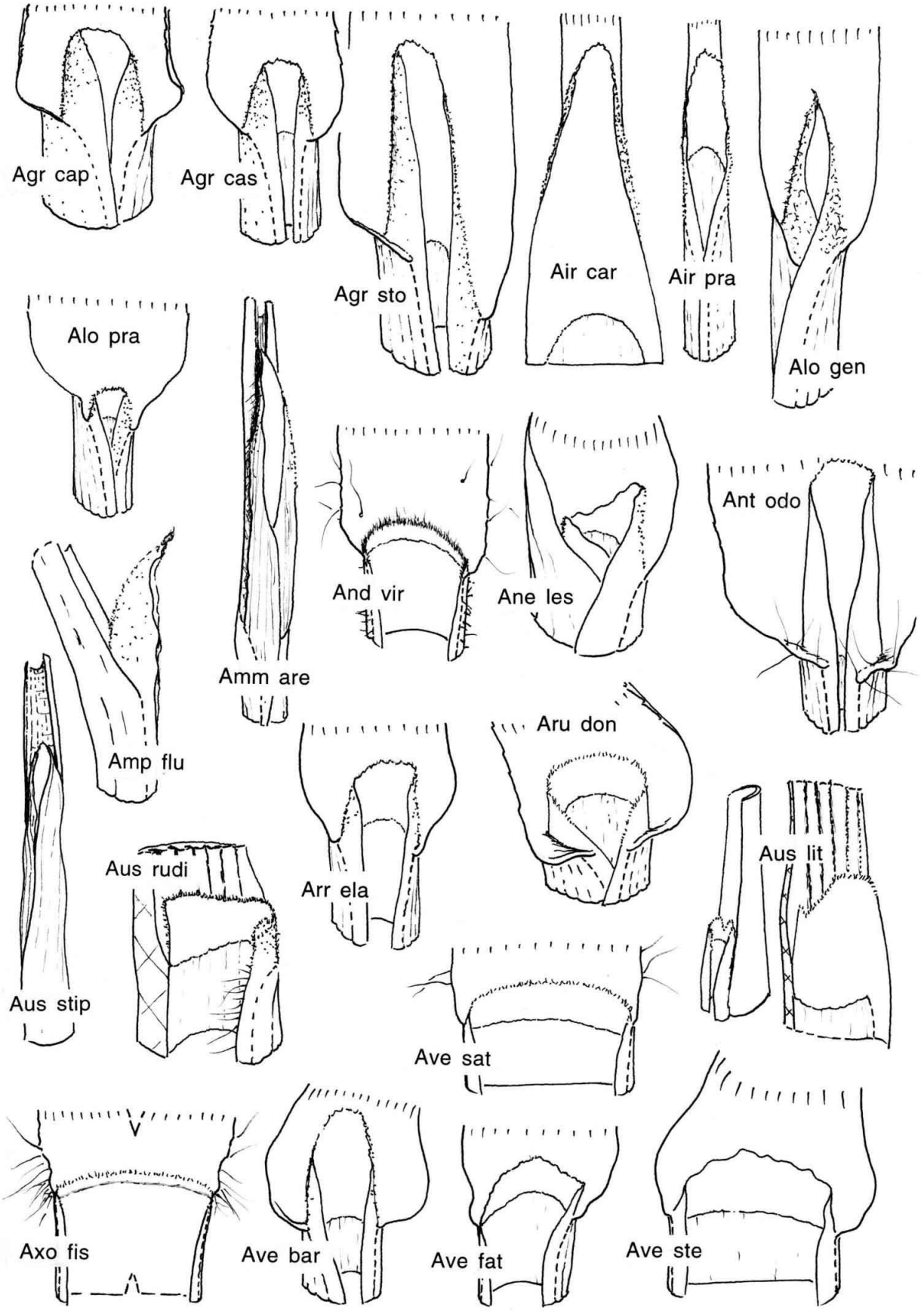

Fig. 1. ***Agrostis capillaris*** **to** ***Avena sterilis*** **(for magnifications see text).**

channelled leaves, e.g. those of *Austrostipa stipoides*, the membranous kind of ligule may be asymmetrical, being higher at one side than the other and centrally emarginate.

The other kind of ligule, familiar from examination of toetoe and pampas grass (*Cortaderia* spp.), is that of a band of hairs. In such robust-bladed grasses the band is several cells deep and is seated on a very short, thickened outgrowth (the "rim") at the sheath-blade junction.

The ligule's adaxial surface is the one that contacts the adjacent axis (culm internode or pseudostem of young leaves rolled one inside the other). A membranous ligule is always glabrous adaxially. The other surface, the abaxial one, faces the base of the blade. It may carry hairs or scabridities. Such small but important details are often omitted from descriptions – it is characteristic of the care taken by the authors of our grass Flora (Edgar & Connor 2000, hereafter FNZ5) that they are very well described.

Early in its growth the leaf is without a ligule. The first appearance of this, as a very low transverse flap or row of minute hairs, more or less marks the cessation of meristematic activity in the blade. From that time on, the leaf's cell-divisions are mainly in the base of the newly demarcated sheath. The upward growth of the sheath soon results in the matured ligule's exposure to the outside world of rainfall, dust, fungal spores, etc., and its function may be to combat all these (Chaffey 1994).

The other structures sometimes present at the sheath-blade junction are the "auricles". These are triangular, curved or strap-like prolongations of the "collar zone" – the region at the very base of the blade that is generally pale rather than chlorophyllose. Auricles may be glabrous or ciliate or hairy, and paired or unequal or solitary. They may spread out sideways but more often are "falcate and clasping", that is, sickle-shaped and curved round inwards towards the sheath's open midline.

In a few genera the auricles are upward-pointing, rounded projections of the sheath apex. In its glossary FNZ5 calls such structures "auricular lobes". However, it does not use this term, at least not in *Festuca*, where they may be a conspicuous and diagnostic feature (and are termed there "apical auricles").

In the bamboos and also in species of *Miscanthus*, *Pennisetum*, *Rytidosperma*, *Spinifex,* and other genera, there is a "counterligule" externally at the sheath-blade junction, parallel to the ligule proper. Where present in Auckland's grasses this just has the form of a transverse band of hairs, the hairs being longer and denser than those above or below.

Quite a few grasses have a "pseudoligule" – a row or grouping of long hairs seated behind the ligule, on the very base of the blade. When these hairs exceed the ligule (e.g., in *Miscanthus sinensis*) a careful examination is needed to determine the height of the ligule proper.

The presence of a zone of short appressed hairs immediately below the ligule on the inner (adaxial) side of the sheath is rarely found. I have seen it only in the pampas grasses *Cortaderia jubata* and *C. selloana*, and in *Chionochloa* (*C. flavicans* at least).

Membranous ligules sometimes appear "striate", that is, finely longitudinally nerved. FNZ5 notes only *Gastridium ventricosum* but numerous other common species have weakly nerved ligules. Some large and firm-textured ligules, such as those of marram grass (*Ammophila arenaria*) and Manchurian rice grass (*Zizania aquatica*), are very distinctly nerved.

Lastly, in a number of panicoid grasses (*Entolasia*, *Oplismenus*, *Paspalum* spp*.,* especially *P. orbiculare*) and also in *Leersia*, the sheath apex is extended up into the sides of the ligule as a pair of triangular zones. Photosynthetic and slightly thickened, these would seem to function to brace the ligule-sheath junction. I call them "lateral stiffenings" (Roman armourers may have had a term equivalent to the English "gore" or "gusset" but it has not entered botanical terminology).

The reader may now be convinced that a valuable amount of structural diversity exists in the ligule, but will want to know: how constant are these characters? The answer, in my experience, must be "quite good" – that is, about as good as those of the *Coprosma* stipule. For a few grasses though the term "heteroligular" has been applied, where the ligules of the upper leaves differ considerably from those lower down (and not just in size).

Materials, Terminology

The species treated here are those in Mike Wilcox's "Grasses of Auckland" (cf. Wilcox 2000; unpub. ms. dated 2000, copy in AK), but not including: the bamboos, a few ornamentals, some very old "orphan" records, and the very new ones of *Eragrostis* sp. (Gardner 2011) and *Phragmites karka* (Gardner 2011; Wilcox 2011). Additions are: *Amphibromus fluitans*, *Briza uniolae*, *Cymbopogon* sp., *Hemarthria uncinata*, *Lachagrostis lyallii, Leersia oryzoides*.

The length of a ligule is measured from the highest point of its attachment up to its apex, and includes the cilia if present. The range offered, e.g., "0.6-2 mm [long]" is mainly taken from FNZ5, with help for some species from elsewhere, especially the *Flora of North America* volumes (Barkworth et al. 2003, 2007). If

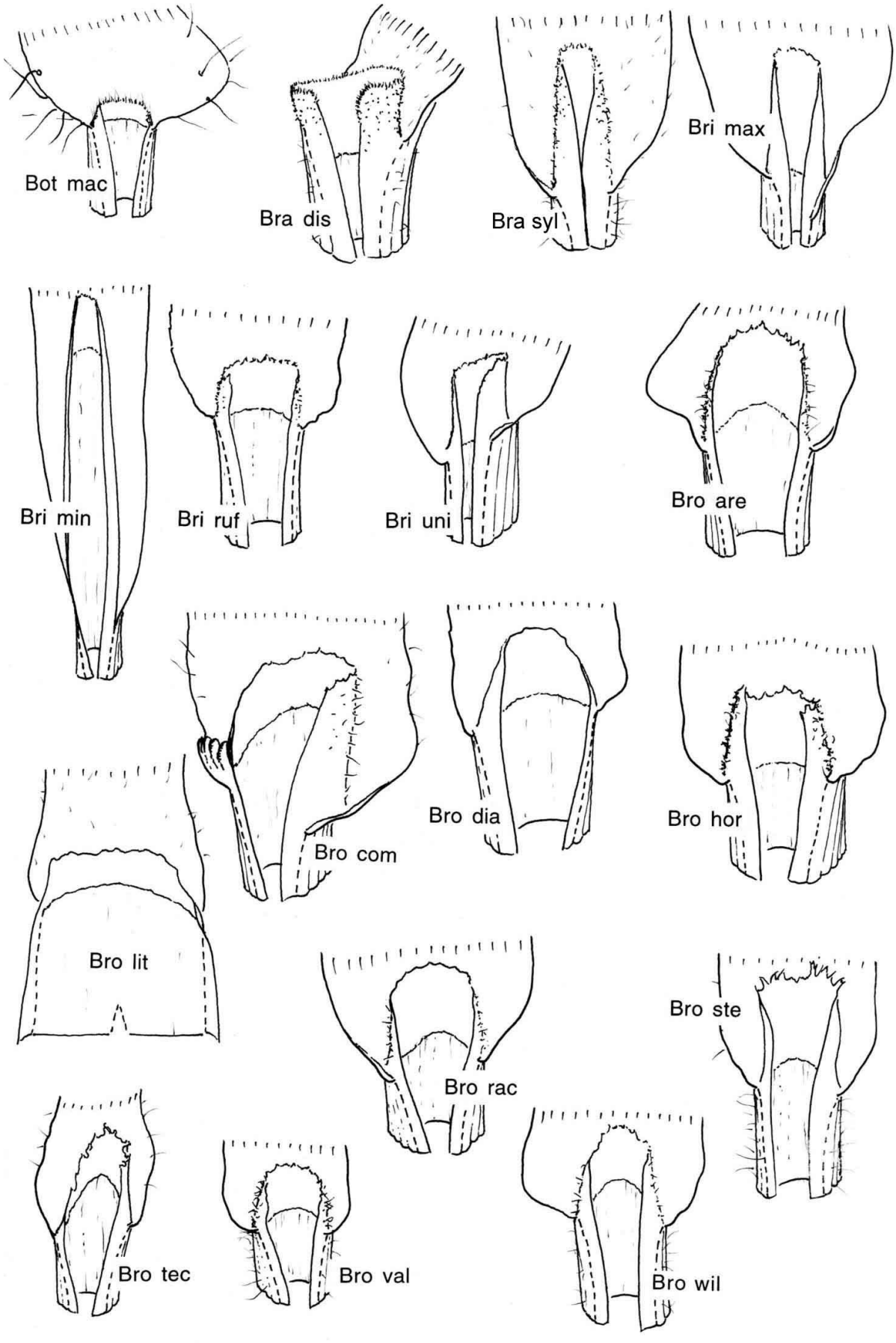

Fig. 2. ***Bothriochloa macra*** **to** ***Bromus willdenowii.***

the condition of the margin is not mentioned then it is entire (note that many ligules become lacerate with age; this is generally not mentioned). Similarly, if the state of the abaxial surface is not mentioned then it is glabrous.

In membranous ligules the margin is often more or less denticulate or crenate to irregularly undulate ("erose"). In this respect I have used a loose terminology, with non-entire margins mostly just being called "erose-denticulate". The term "ciliolate" is used rather more precisely, in cases where the margin has minute hairs much shorter than the membranous portion. If the hairs to membrane ratio is about 1: 4 or greater, then "ciliate" is used.

Abbreviations of various degrees of intelligibility occur in Floras. For unknown reasons two of the neatest are generally neglected: us. usually; occ. occasionally.

The illustrations

These are only as representative as the one to several AK specimens, or the fresh material, that provided their basis — the text has to be consulted for the full picture. Because the specific identity of two species is not clear the AK number of a voucher for each is given.

The view shown is generally the adaxial one. For some species the ligular area has had to be flattened (and held in this position using double-sided sellotape on a microscope slide) — this is indicated by a V inserted at the midpoint of the blade and/or base. A few illustrations are of the block type, the blade-sheath junction and the ligule being cut longitudinally at about midway. For *Trisetum arduanum*, the ligule of a leaf low down on the culm and the slightly different one from higher on the culm are both illustrated.

The hairs on the blade (surfaces and margins) and sheath (margins and body) have largely been omitted. The junction between the photosynthetic tissue of the leaf sheath and the membranous marginal zone down each side of the sheath is indicated by a dashed line.

The names have been shortened to the three or sometimes four first letters of the genus-name and specific epithet. No excuse is offered for this old Forest Service practice, although it may not be one conducive to good spelling (Connor 2004).

Agrostis Ligule membranous, truncate to rounded, erose-denticulate to fimbriate, ciliolate, abaxially scabrid.

1. *Agrostis capillaris* ×20
Ligule 0.6-2 mm.

2. *Agrostis castellana* ×20
Ligule 0.7-3 mm.

3. *Agrostis stolonifera* ×20
Ligule 1-6 mm.

Aira Ligule membranous, tapered, becoming lacerate, abaxially sparsely scabrid.

4. *Aira caryophyllea* ×20
Ligule 3-6 mm.

5. *Aira praecox* ×20
Ligule 0.6-3.2 mm.

Alopecurus Ligule membranous, obtuse or tapered, ciliolate or not, abaxially minutely hairy.

6. *Alopecurus geniculatus* ×10
Ligule 1.5-4.5 mm.

7. *Alopecurus pratensis* ×10
Ligule 0.5-2.8 mm.

Ammophila Ligule membranous, nerved, tapered to a point, abaxially with dense short hairs.

8. *Ammophila arenaria* ×5
Ligule 15-30 mm.

Amphibromus Ligule membranous, tapered to an acute apex and becoming lacerate, abaxially smooth or sparsely scabrid.

9. *Amphibromus fluitans* (side-view) ×10
Ligule 1.5-5 mm.

Andropogon Ligule a long-ciliate membrane.

10. *Andropogon virginicus* ×10
Ligule c. 0.5 mm (two-thirds membrane, one third cilia); abaxially with a few longer hairs that project above the cilia.

Anemanthele Ligule firmly membranous, us. asymmetrical and centrally emarginate, minutely erose, abaxially sparsely scabrid.

11. *Anemanthele lessoniana* ×20
Ligule to 1.5 mm.

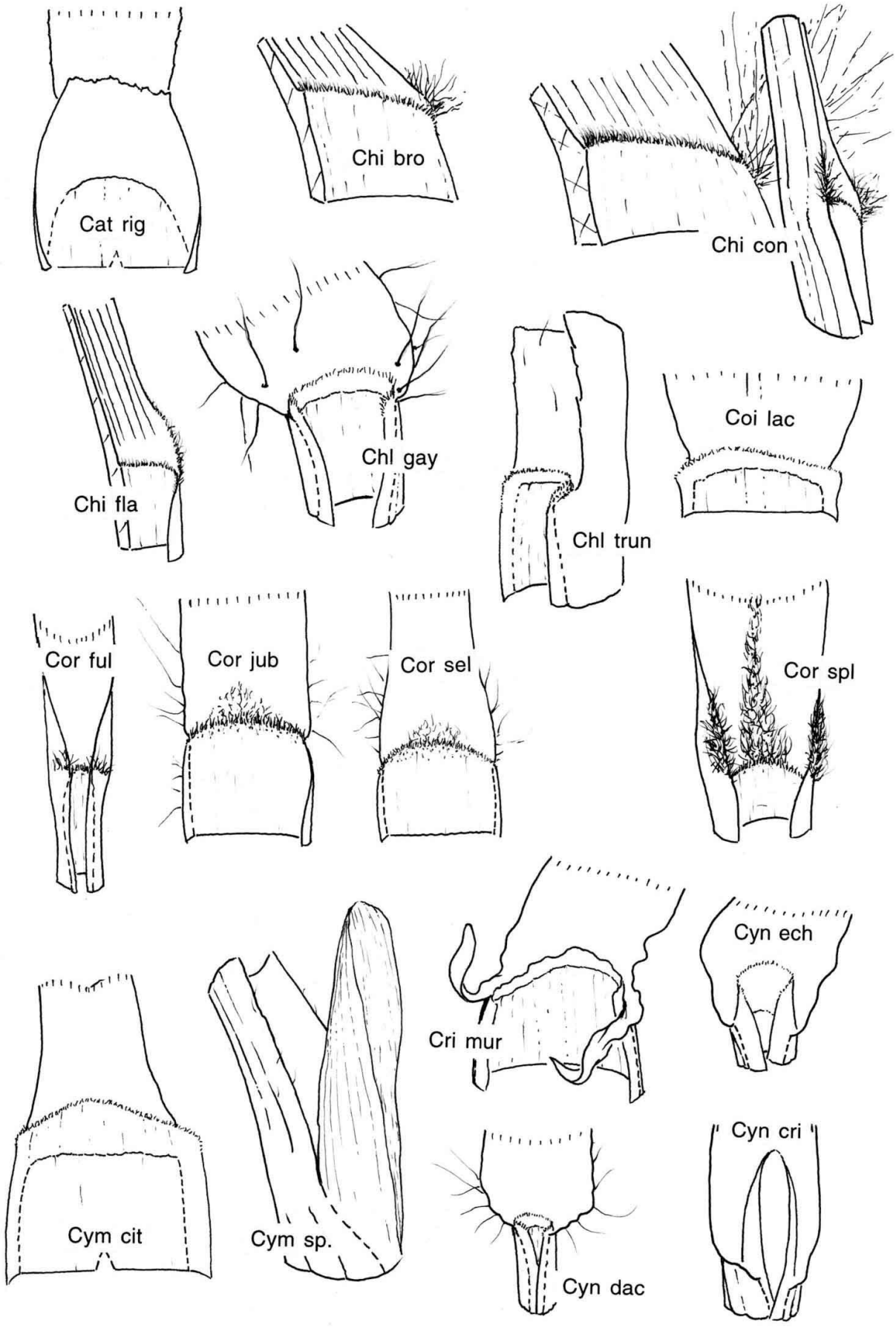

Fig. 3. ***Catapodium rigidum*** **to** ***Cynosurus echinatus*****.**

Anthoxanthum Ligule membranous, erose, ciliolate.

12. *Anthoxanthum odoratum* ×10
Ligule 0.6-5 mm; a single short hairy-ciliate auricle present.

Arrhenatherum Ligule membranous, obtuse to truncate, erose, ciliolate, abaxially scabrid or short-hairy

13. *Arrhenatherum elatius* ×10
Ligule1-4 mm.

Arundo Ligule membranous, truncate, shortly ciliate.

14. *Arundo donax* ×5
Ligule 1-2 mm.

Austrofestuca Ligule firmly membranous, us. asymmetrical and centrally emarginate, ciliolate, abaxially sparsely scabrid.

15. *Austrofestuca littoralis* whole ×10; half ×20
Ligule 0.7-1 mm.

Austrostipa Ligule membranous, us. asymmetrical and centrally emarginate, minutely erose-ciliolate or not.

16. *Austrostipa rudis* half ×40
Ligule to 0.5 mm.

17. *Austrostipa stipoides* ×10
Ligule 3-7 mm, obscurely nerved.

Avena Ligule membranous, obtusely rounded to truncate, erose-denticulate and ciliolate or more or less entire, abaxially us. scabrid.

18. *Avena barbata* ×5
Ligule 2.7-9 mm.

19. *Avena fatua* ×10
Ligule 2-7mm.

20. *Avena sativa* ×5
Ligule 2-5 mm.

21. *Avena sterilis* ×5
Ligule 3-8 mm.

Axonopus Ligule membranous, ciliate.

22. *Axonopus fissifolius* ×10
Ligule 0.2-0.3 mm.

Bothriochloa Ligule membranous, truncate, ciliolate; abaxially with longer hairs projecting above as a pseudoligule.

23. *Bothriochloa macra* ×20
Ligule 0.5-1 mm.

Brachypodium Ligule membranous, ciliolate, abaxially hairy.

24. *Brachypodium distachyon* ×40
Ligule 0.5-2 mm.

25. *Brachypodium sylvaticum* ×10
Ligule 1.5- 3.5 mm.

Briza Ligule membranous, tapered to truncate, entire to erose-denticulate, ciliolate or not.

26. *Briza maxima* ×10
Ligule 2-5 mm.

27. *Briza minor* ×5
Ligule 2.5-5.5 mm.

28. *Briza rufa* ×20
Ligule 1-1.2 mm, abaxially with a few short hairs.

29. *Briza unioloides*
Ligule c. 1.5 mm.

Bromus Ligule membranous, us. truncate to rounded, erose-denticulate to lacerate, abaxially us. hairy or scabrid.

30. *Bromus arenarius* ×20
Ligule 1-2.6 mm.

31. *Bromus commutatus* ×20
Ligule 0.7-2 mm, abaxially with some long hairs.

32. *Bromus diandrus* ×10
Ligule 1.5-4 mm, abaxially glabrous.

33. *Bromus hordeaceus* ×10
Ligule 0.5-1.5 mm, abaxially short-hairy.

34. *Bromus litholobius* ×20
Ligule 1-1.5 mm, sometimes with fine scattered hairs at margins or abaxially.

35. *Bromus racemosus* ×10
Ligule 0.5-1 mm, abaxially short-hairy or glabrous.

36. *Bromus sterilis* ×40
Ligule 1.5-2.5 mm, abaxially glabrous.

37. *Bromus tectorum* ×20
Ligule 0.4-3.5 mm, abaxially glabrous.

38. *Bromus valdivianus* ×10
Ligule 1.5-2 mm, abaxially pilose.

39. *Bromus willdenowii* ×10
Ligule 3-5 mm, abaxially hairy or glabrous.

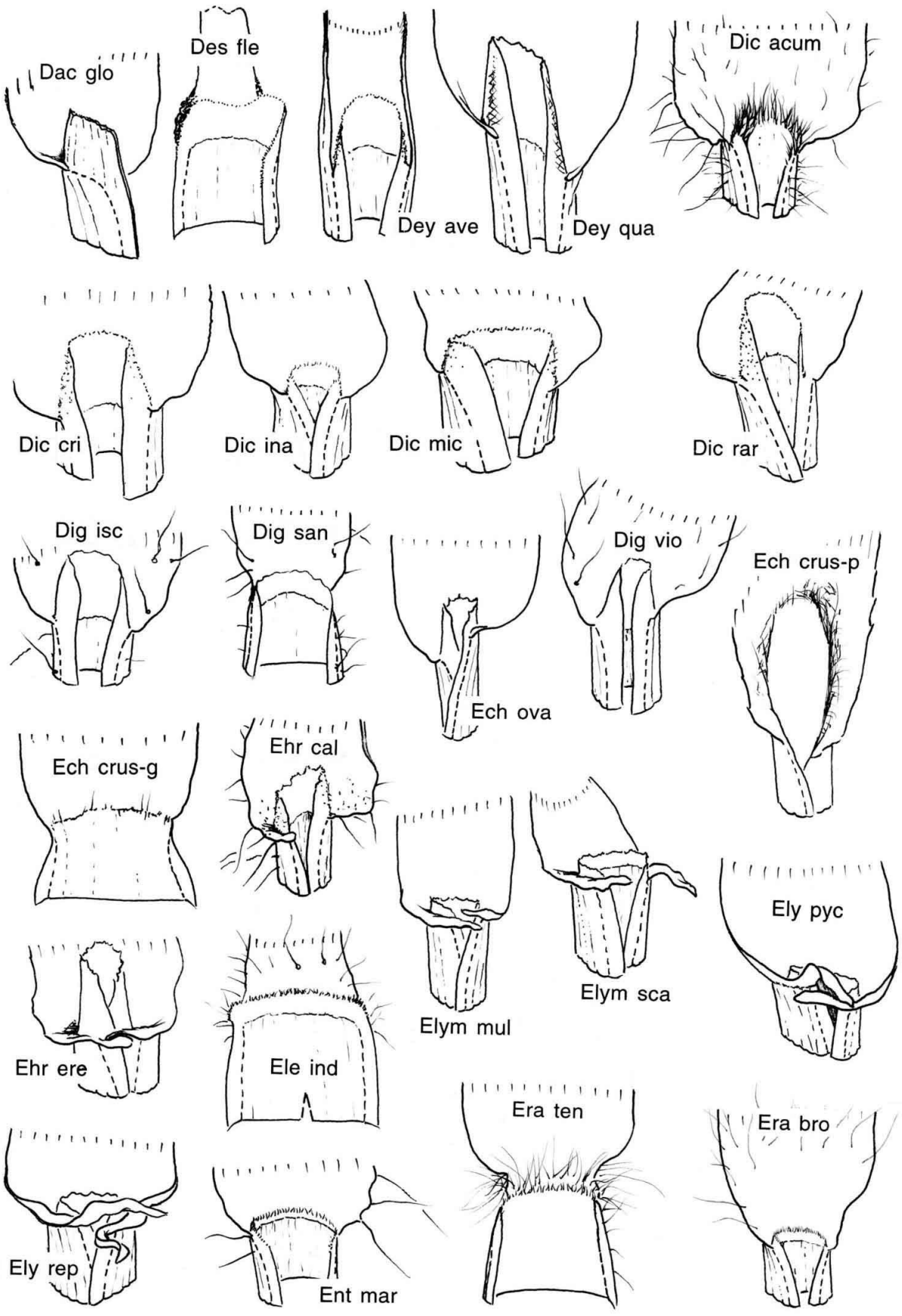

Fig. 4. ***Dactylis glomerata*** **to** ***Eragrostis brownii*****.**

Catapodium Ligule membranous, truncate, erose-denticulate.

40. *Catapodium rigidum* ×20
Ligule 1.5-3.8 mm.

Chionochloa Ligule a dense band of hairs, sometimes adjoined by an irregular mat of hairs adaxially across sheath apex (*C. flavicans* at least).

41. *Chionochloa bromoides* half-leaf ×10
Ligule to 1.5 mm.

42. *Chionochloa conspicua* subsp. *cunninghamii* half-leaf × 10; whole ×2
Ligule to 1.5 mm.

43. *Chionochloa flavicans* half-leaf ×2
Ligule to 0.7(-l) mm.

Chloris Ligule membranous, ciliolate to ciliate

44. *Chloris gayana* ×10
Ligule 0.4-0.8 mm.

45. *Chloris truncata* ×10
Ligule 0.2-0.4 mm.

Coix Ligule membranous, erose-denticulate, ciliolate.

46. *Coix lachryma-jobi* 5
Ligule c. 2 mm.

Cortaderia Ligule a band of hairs, sometimes (*C. jubata*, *selloana)* with an irregular mat of short appressed hairs across uppermost several mm of sheath adaxially.

47. *Cortaderia fulvida* ×2
Ligule to 1 mm; blade glabrous at base adaxially.

48. *Cortaderia jubata* ×2
Ligule to 4 mm; blade with a central triangular weft of hairs at base adaxially.

49. *Cortaderia selloana* ×2
Ligule to 3 mm; blade as in *C. jubata.*

50. *Cortaderia splendens* ×2
Ligule a rim of hairs, to 3 mm; blade base adaxially with a dense central weft of relatively long hairs that extends up from ligule for c. 2-3 cm.

Critesion Ligule membranous, erose-ciliolate.

51. *Critesion murinum* ×10
Ligule 0.3-1 mm, truncate-rounded; auricles 1.5-3 mm, clasping, glabrous.

Cymbopogon Ligule membranous (sometimes more or less scarious), ciliolate

52. *Cymbopogon citratus* ×5
Ligule 0.5-2 mm (but longer in upper leaves ?), obscurely nerved.

53. *Cymbopogon* sp. (cult. ARC, AK 224354) ×5
Ligule (in upper leaves) to at least 18 mm, distinctly longitudinally nerved (sometimes as ridges abaxially), abaxially with a few long hairs.

Cynodon Ligule membranous, truncate, ciliolate.

54. *Cynodon dactylon* ×10
Ligule 0.1-0.2 mm, ciliolate; blade of base adaxially with scattered longer hairs that may project above as a pseudoligule.

Cynosurus Ligule membranous.

55. *Cynosurus cristatus* ×10
Ligule 0.4-1.8 mm, erose-ciliolate.

56. *Cynosurus echinatus* ×10
Ligule 0.7-6.5 mm, entire.

Dactylis Ligule membranous.

57. *Dactylis glomerata* ×10
Ligule 3-10.5 mm, rounded to a short central acute apex, erose to ciliolate, abaxially smooth or puberulent or scabridulous, obscurely nerved.

Deschampsia Ligule membranous.

58. *Deschampsia flexuosa* ×40
Ligule 0.2-3 mm, truncate or shallowly emarginate, erose, ciliolate, abaxially scabrid.

Deyeuxia Ligule membranous, us. more or less truncate, ciliolate.

59. *Deyeuxia avenoides* ×40
Ligule 0.5-4.5 mm, abaxially minutely hairy-scabrid.

60. *Deyeuxia quadriseta* ×10
Ligule membranous, 1.5-6 mm, abaxially glabrous.

Dichanthelium Ligule a line of hairs, their bases more or less fused to form a very short membrane.

61. *Dichanthelium acuminatum* (= *Panicum huachucae*) ×10
Ligule 3-4.5 mm.

Dichelachne Ligule membranous, truncate, ciliolate, abaxially scabrid

62. *Dichelachne crinita* ×10
Ligule 0.5-1.5 mm.

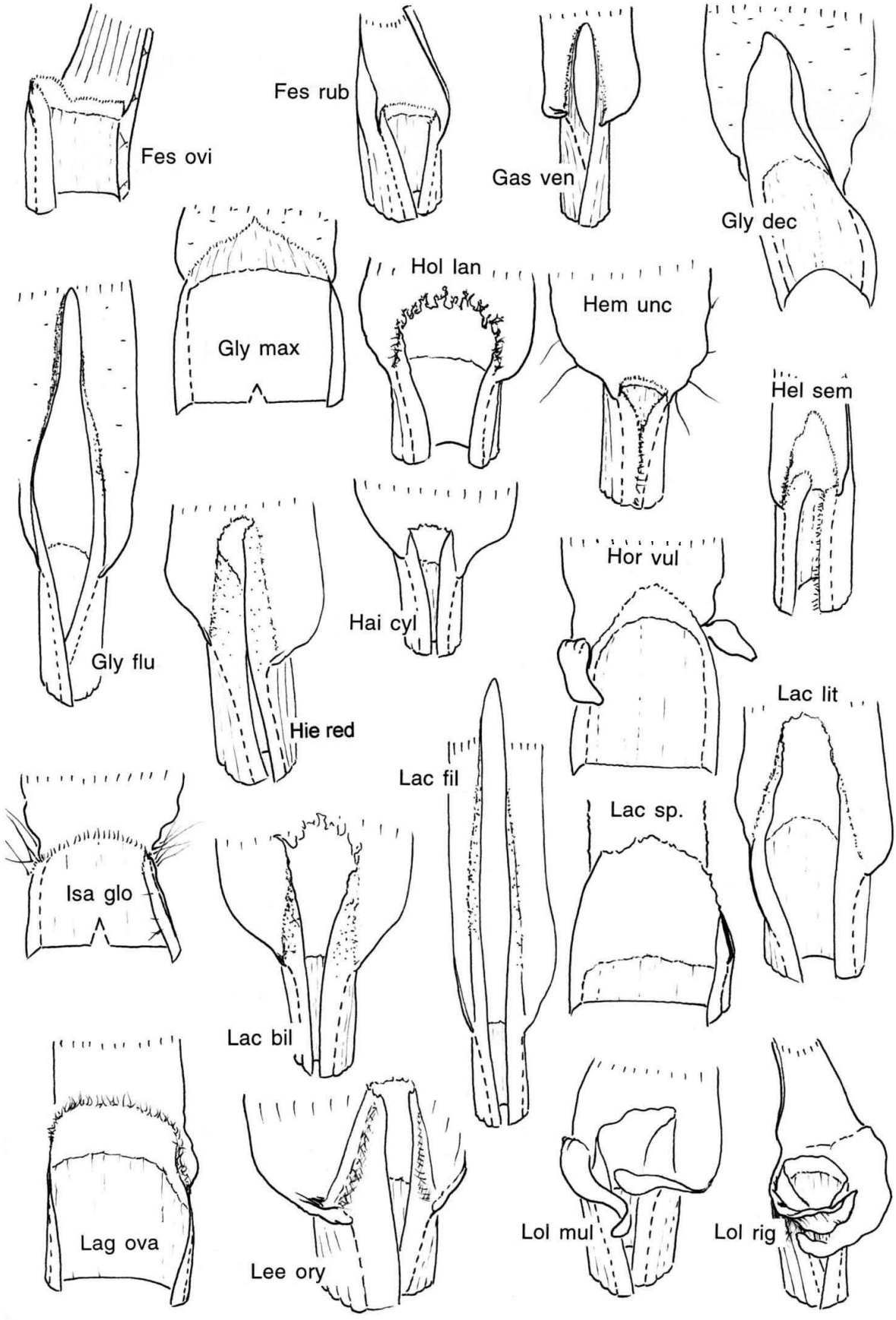

Fig. 5. ***Festuca ovina*** **to** ***Lolium rigidum*****.**

63. *Dichelachne inaequiglumis* ×20
Ligule 0.1-0.5 mm.

64. *Dichelachne micrantha* ×20
Ligule 0.3-1 mm.

65. *Dichelachne rara* ×20
Ligule 0.5-1.5 mm.

Digitaria Ligule membranous, truncate, erose.

66. *Digitaria ischaemum* ×10
Ligule 1-1.5(-2) mm.

67. *Digitaria sanguinalis* ×5
Ligule 0.5-1 mm.

68. *Digitaria violascens* ×5
Ligule 1-2 mm.

Echinochloa Ligule lacking, but ligular area well-defined and occ. pubescent.

69. *Echinochloa crus-galli* ×5

70. *Echinochloa crus-pavonis* ×5

Echinopogon Ligule membranous.

71. *Echinopogon ovatus* ×10
Ligule 0.5-2.7 mm, finely erose-denticulate.

Ehrharta Ligule membranous, lacerate, small ciliate auricles us. present (sometimes solitary).

72. *Ehrharta calycina* ×10
Ligule 1.5-3 mm, abaxially scabridulous.

73. *Ehrharta erecta* ×10
Ligule 1-4 mm, lacerate, abaxially glabrous.

Eleusine Ligule membranous, truncate, ciliate (2/3 membrane 1/3 cilia).

74. *Eleusine indica* ×10
Ligule 0.3-1 mm, abaxially with long appressed hairs.

Elymus Ligule membranous, truncate, erose; auricles c. 1 mm long, glabrous or with long hairs.

75. *Elymus multiflorus* ×10
Ligule 0.2-0.5 mm.

76. *Elymus scaber* ×10
Ligule 0.1-0.5 mm.

Elytrigia Ligule firmly membranous, truncate, occ. sparsely ciliolate;
auricles present.

77. *Elytrigia pycnantha* ×20
Ligule c. 0.5 mm; auricles 0.5-1.5 mm, occ. long-hairy.

78. *Elytrigia repens* ×20
Ligule 0.25- 0.5 mm; auricles to 2 mm, glabrous.

Entolasia Ligule a line of hairs.

79. *Entolasia marginata* ×10
Ligule 0.3-1 mm.

Eragrostis Ligule membranous and long-ciliate but sometimes appearing just as a line of hairs.

80. *Eragrostis brownii* ×20
Ligule 0.1-0.2 mm.

81. *Eragrostis tenella* ×20
Ligule 0.1-0.4 mm.

Festuca Ligule membranous, truncate-rounded, ciliolate; leaf-sheath apex sometimes shortly prolonged vertically into a pair of rounded and ciliolate-scabrid auricular lobes.

82. *Festuca ovina* subsp. *hirtula* ×20
Ligule 0.1-0.5 mm; auricular lobes lacking or minute.

83. *Festuca rubra* ×20
Ligule 0.25 mm; auricular lobes to 0.25 mm.

Gastridium Ligule membranous, truncate or rounded, becoming lacerate, nerved (abaxially the nerves appearing as scabrid ridges).

84. *Gastridium ventricosum* ×10
Ligule 1-3 mm.

Glyceria Ligule membranous, us. tapered to a rounded or acute apex.

85. *Glyceria declinata* ×10
Ligule 3.5-7 mm, abaxially glabrous.

86. *Glyceria fluitans* ×10
Ligule 4-10 mm, abaxially sparsely scabrid.

87. *Glyceria maxima* ×5
Ligule stiffly membranous and opaque in lower leaves, 4-6.5 mm, abaxially glabrous, obtuse then shortly acuminate to an acute apex, obscurely finely nerved.

Hainardia Ligule membranous, truncate, us. centrally emarginate, erose-denticulate.

88. *Hainardia cylindrica*
Ligule 0.2-0.7 mm.

Hemarthria Ligule a line of hairs.

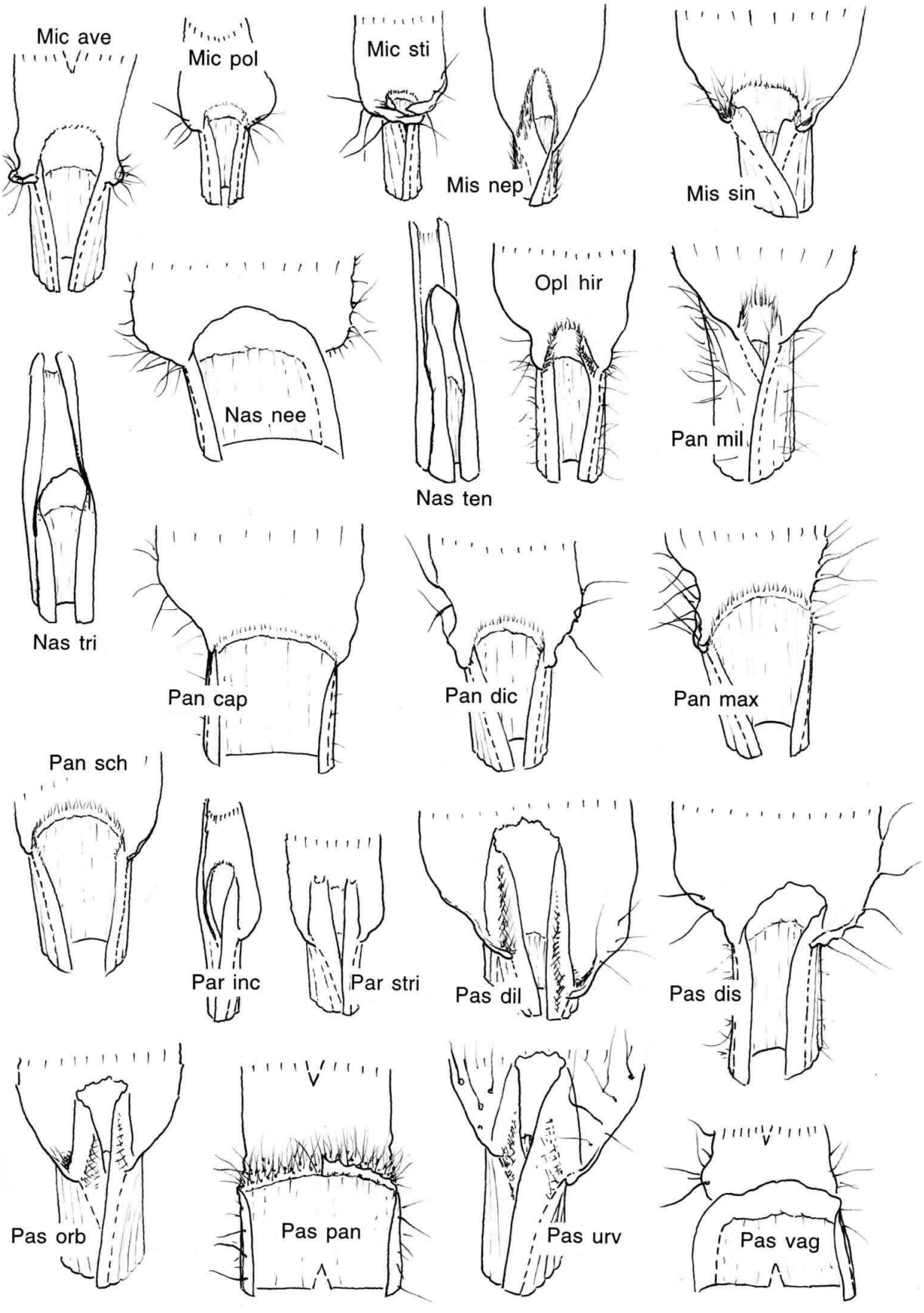

Fig. 6. ***Microlaena avenacea*** **to** ***Paspalum vaginatum*****.**

89. *Hemarthria uncinata* ×10
Ligule c. 0.75 mm.

Helictotrichon Ligule membranous.

90. *Helictotrichon sempervirens* ×10
Ligule rounded-truncate, 0.5-1.5 mm, abaxially scabrid.

Hierochloe Ligule membranous.

91. *Hierochloe redolens* ×10
Ligule 2-4 mm, truncate-rounded, minutely erose-ciliolate, abaxially scabrid.

Holcus Ligule membranous.

92. *Holcus lanatus* ×5

Ligule 0.6-3 mm, truncate, denticulate-lacerate, ciliolate and occ. with a few longer hairs, abaxially with short and long hairs.

Hordeum Ligule membranous.

93. *Hordeum vulgare* ×5
Ligule 0.5-3 mm, entire to obscurely erose-crenate, minutely ciliolate-papillose; auricles well-developed even on the upper leaves, to 6 mm.

Isachne Ligule a line of hairs.

94. *Isachne globosa* ×5
Ligule 0.4-1.8 mm.

Lachnagrostis Ligule membranous, us. tapered, us. erose-denticulate and becoming lacerate, abaxially scabrid.

95. *Lachnagrostis billardierei* ×20
Ligule 1-4.5 mm.

96. *Lachnagrostis filiformis* ×20
Ligule 1-5 mm, rounded or tapered.

97. *Lachnagrostis littoralis* ×20
Ligule to 3 mm, tapered.

98. *Lachnagrostis* cf. *lyallii* ×20 (Waimauku, AK 302057)
Ligule c. 1.5 mm.

Lagurus Ligule membranous.

99. *Lagurus ovatus* ×10
Ligule 1.4-2.6 mm, truncate, erose to lacerate, ciliate (membrane: cilia 4: 1), abaxially densely pubescent.

Leersia Ligule firmly membranous, with conspicuous lateral stiffenings.

100. *Leersia oryzoides* ×20
Ligule 0.8 mm truncate, erose to shortly lacerate, abaxially occ. sparsely scabrid.

Lolium Ligule membranous, truncate, auricles present or not.

101. *Lolium multiflorum* ×10
Ligule 0.5-2 mm.

102. *Lolium rigidum* ×20
Ligule 0.4-1.2 mm.

Microlaena Ligule membranous, truncate to rounded, erose-crenate and ciliolate; auricles present or not.

103. *Microlaena avenacea* ×10
Ligule to 0.5 mm; auricles solitary, c. 5 mm, with long cushion-based cilia.

104. *Microlaena polynoda* ×10
Ligule 0.2-0.5 mm; auricles lacking.

105. *Microlaena stipoides* ×10
Ligule to 0.5 mm; auricles small and sparsely long-ciliate.

Miscanthus Ligule firmly membranous, obtuse, ciliolate, us. abaxially sericeous, counterligule us. conspicuous.

106. *Miscanthus nepalensis* ×5
Ligule 2-3.5 mm.

107. *Miscanthus sinensis* ×5
Ligule 3.5-6.5 mm.

Nassella Ligule membranous.

108. *Nassella neesiana* ×10
Ligule c. 0.5 mm, truncate, minutely ciliolate, abaxially with a few short hairs.

109. *Nassella tenuissima* ×40
Ligule 2.5 mm, tapered to a truncate ciliolate apex, abaxially glabrous.

110. *Nassella trichotoma* ×40
Ligule to 1.5 mm, rounded or apiculate.

Oplismenus Ligule membranous, stiffened laterally.

111. *Oplismenus hirtellus* ×20
Ligule truncate, erose, ciliate, 0.6-1.5 mm.

Panicum Ligule membranous, truncate-rounded, us. densely long-ciliate.

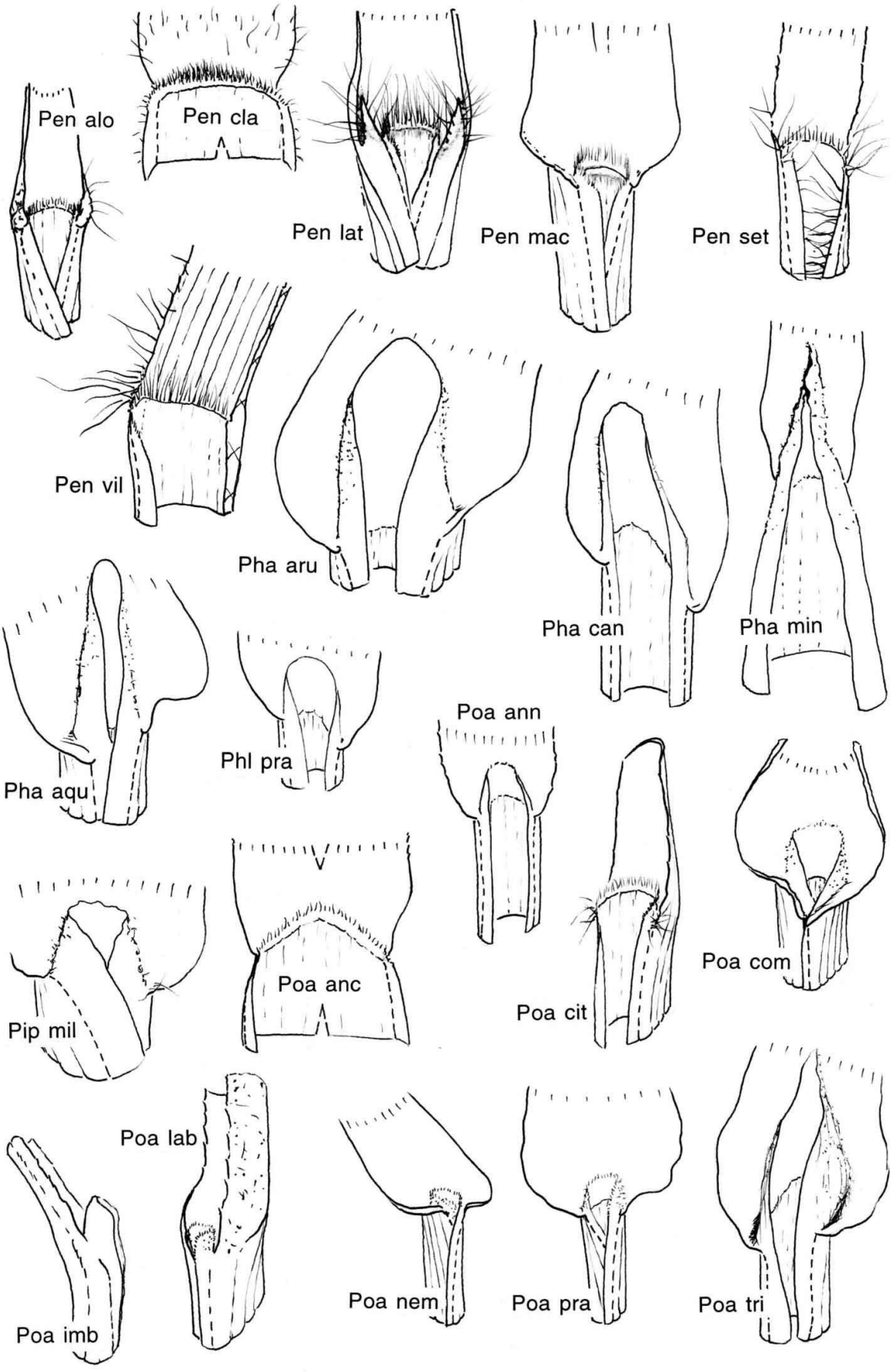

Fig. 7. ***Pennisetum alopecuroides*** **to** ***Poa trivialis*****.**

112. *Panicum capillare* ×10
Ligule 1-2 mm.

113. *Panicum dichotomoflorum* ×10
Ligule 1-2 mm.

114. *Panicum maximum* var. *trichoglume* ×10
Ligule c. 1 mm.

115. *Panicum miliaceum* ×5
Ligule c. 3-4 mm.

116. *Panicum schinzii* ×10
Ligule c. 1.5 mm.

Parapholis Ligule membranous, truncate, slightly emarginate, erose.

117. *Parapholis incurva* ×20
Ligule 0.3-1 mm.

118. *Parapholis strigosa* ×20
Ligule 0.3-0.6 mm.

Paspalum Ligule membranous, truncate to rounded, entire to weakly erose-denticulate, sometimes stiffened laterally.

119. *Paspalum dilatatum* ×10
Ligule (2)-3-5 mm.

120. *Paspalum distichum* ×10
Ligule c. 1.6 mm.

121. *Paspalum orbiculare* ×10
Ligule 1-2 mm.

122. *Paspalum paniculatum* ×10
Ligule 0.2-0.5 mm.

123. *Paspalum urvillei* ×10
Ligule 3.5-9.5 mm.

124. *Paspalum vaginatum* ×20
Ligule 0.5-1 mm.

Pennisetum Ligule of dense long cilia on a rim or short membrane.

125. *Pennisetum alopecuroides* ×10
Ligule 0.3-0.6 mm.

126. *Pennisetum clandestinum* ×10
Ligule 1-2 mm.

127. *Pennisetum latifolium* ×10
Ligule 2-5.5 mm.

128. *Pennisetum macrourum* ×10
Ligule 1-4.5 mm

129. *Pennisetum setaceum* × 10
Ligule 0.3-0.7 mm.

130. *Pennisetum villosum* half ×10
Ligule 0.7-1.5 mm.

Phalaris Ligule membranous, oblong to tapered, abaxially scabrid or short-hairy.

131. *Phalaris aquatica* ×5
Ligule 4-9 mm.

132. *Phalaris arundinacea* ×5
Ligule 2.5-10 mm.

133. *Phalaris canariensis* ×10
Ligule 2-6 mm.

134. *Phalaris minor* ×10
Ligule 2-6.5 mm.

Phleum Ligule membranous.

135. *Phleum pratense* ×5
Ligule truncate or slightly rounded, 1-4 mm.

Piptatherum Ligule membranous, crenate, abaxially with a few short hairs.

136. *Piptatherum miliaceum* ×10
Ligule in lower leaves truncate and to 1.5 mm, in upper leaves acute and to 4 mm.

Poa Ligule membranous, us. rounded-truncate, us. ciliolate (sometimes ciliate in *P. anceps*) and abaxially scabrid or (*P. cita*) with minute hairs.

137. *Poa anceps* ×5
Ligule 0.5 mm.

138. *Poa annua* ×20
Ligule 0.5-2 mm.

139. *Poa cita* ×40
Ligule c. 0.5 mm.

140. Poa compressa ×20
Ligule 0.5-l mm.

141. *Poa imbecilla* ×40
Ligule 0.2-1 mm.

142. *Poa labillardierei* ×20
Ligule 0.2-0.6 mm.

143. *Poa nemoralis* ×10
Ligule 0.4-0.8 mm.

144. *Poa pratensis* ×10
Ligule 0.2-2 mm.

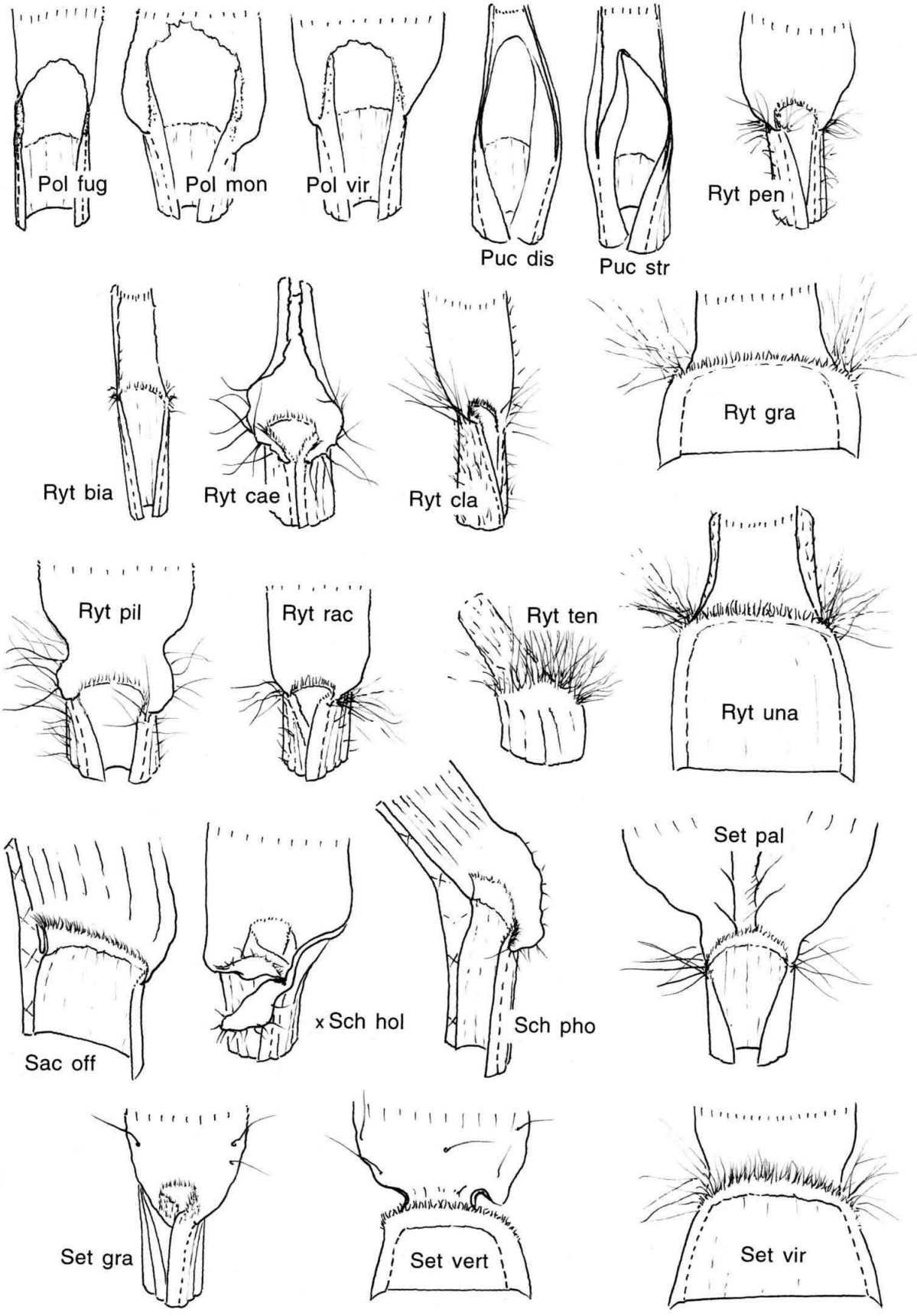

Fig. 8. ***Polypogon fugax*** **to** ***Setaria viridis*****.**

145. *Poa trivialis* ×10
Ligule 2.5-10 mm, tapered to an acute apex, nerved (obscure in dry material).

Polypogon Ligule membranous, tapered to more or less rounded apex, erose-lacerate, ciliolate or not, abaxially scabrid.

146. *Polypogon fugax* ×5
Ligule 1.5-9 mm.

147. *Polypogon monspeliensis* ×5
Ligule 1.5-18 mm.

148. *Polypogon viridis* ×10
Ligule 1.5-5.5 mm.

Puccinellia Ligule membranous, truncate to rounded or tapered.

149. *Puccinellia distans* ×20
Ligule 1-1.5(-2) mm.

150. *Puccinellia stricta* ×20
Ligule 0.7-1.5-(-2) mm, entire but with a central short triangular apex.

Rytidosperma Ligule a line of hairs, their bases more or less fused to form a us. very short membrane.

151. *Rytidosperma biannulare* ×20
Ligule 0.3-0.5 mm.

152. *Rytidosperma caespitosum* ×20
Ligule 0.3- 0.5 mm.

153. *Rytidosperma clavatum* ×20
Ligule c. 0.1-0.7 mm.

154. *Rytidosperma gracile* ×20
Ligule 0.2-1 mm.

155. *Rytidosperma penicillatum* ×20
Ligule c. 0.1 mm.

156. *Rytidosperma pilosum* ×20
Ligule 0.1-0.2 mm.

157. *Rytidosperma racemosum* ×20
Ligule 0.2-0.5 mm.

158. *Rytidosperma tenuius* (side view) ×20
Ligule c. 0.5 mm (membranous part sometimes distinct).

159. *Rytidosperma unarede* ×20
Ligule 0.2-0.8 mm.

Saccharum Ligule membranous, ciliolate.

160. *Saccharum officinarum* ×2
Ligule truncate, 2-6 mm.

x*Schedolium* Ligule membranous, auricles present.

161. x*Schedolium holmbergii* ×10
Ligule truncate, 1-1.5 mm; auricles 1 or 2, clasping, hairs few or lacking.

Schedonorus Ligule membranous.

162. *Schedonorus phoenix* ×10
Ligule truncate, 0.5-3 mm;auricles clasping, 0.7-1.5 mm, falcate, hairy-ciliate with hairs c. 0.3 mm.

Setaria Ligule membranous, long-ciliate (us. c. half membrane, half cilia).

163. *Setaria gracilis* ×10
Ligule c. 1.3 mm.

164. *Setaria palmifolia* ×5
Ligule 2.5-5 mm.

165. *Setaria verticillata* ×10
Ligule 1-2 mm.

166. *Setaria viridis* ×10
Ligule 1-2 mm.

Sieglingia Ligule a line of hairs; counterligule us. conspicuous.

167. *Sieglingia decumbens* (side-view)×10
Ligule 0.3-0.7 mm.

Sorghum Ligule stiffly membranous, truncate, ciliate.

168. *Sorghum bicolor* (half) ×10
Ligule 2-3 mm.

169. *Sorghum halepense* ×10
Ligule 3.5-5 mm.

Spartina Ligule a band of hairs.

170. *Spartina anglica* ×5
Ligule 2-3 mm.

171. *Spartina* × *townsendii* half-leaf ×10
Ligule 1-2 mm.

Spinifex Ligule a dense narrow band of hairs; counterligule conspicuous.

172. *Spinifex sericeus* side-view ×5
Ligule c. 6 mm.

Sporobolus Ligule membranous, ciliolate.

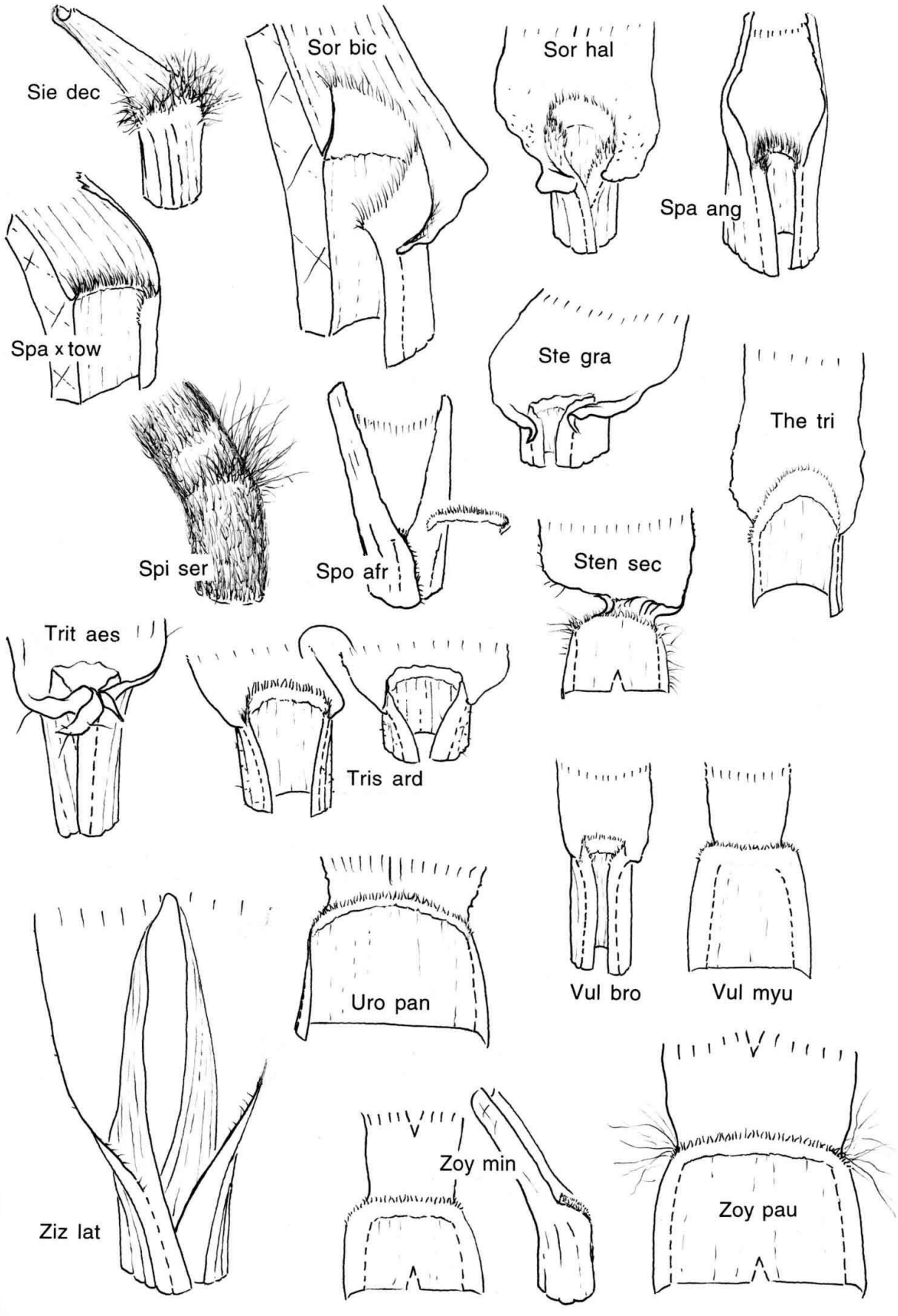

Fig. 9. ***Sieglingia decumbens*** **to** ***Zoysia pauciflora*****.**

173. *Sporobolus africanus* (concealed ligule shown separately) ×5
Ligule 0.2-0.5 mm.

Stenostachys Ligule membranous, erose; auricles present.

174. *Stenostachys gracilis* ×10
Ligule 0.3-1 mm; auricles to 0.5 mm, scarcely clasping.

Stenotaphrum Ligule membranous, long-ciliate.

175. *Stenotaphrum secundatum* ×5
Ligule 0.75 mm.

Themeda Ligule a ciliolate membrane, abaxially sericeous.

176. *Themeda triandra* ×10
Ligule truncate-rounded, 0.75 mm.

Trisetum Ligule membranous, us. ciliate or ciliolate (sometimes not in the upper leaves), abaxially scabridulous or not.

177. *Trisetum arduanum* (left, from a lower leaf; right, from an upper leaf) ×20
Ligule truncate, slightly erose, ciliolate in lower leaves, 0.2-0.3 mm.

Triticum Ligule membranous; auricles present but often deciduous.

178. *Triticum aestivum* ×20
Ligule truncate, denticulate and ciliolate, 0.6-4 mm; auricles c. 2.5 mm.

Urochloa Ligule membranous, ciliolate.

179. *Urochloa panicoides* ×5
Ligule truncate to rounded, becoming lacerate, c. 1.5 mm.

Vulpia Ligule membranous, truncate, ciliolate.

180. *Vulpia bromoides* ×20
Ligule 0.2-0.5 mm.

181. *Vulpia myuros* ×20
Ligule 0.2-0.7 mm.

Zizania Ligule firmly membranous, nerved.

182. *Zizania latifolia* ×2
Ligule 25-40 mm, acute, entire.

Zoysia Ligule membranous, ciliate.

183. *Zoysia minima* ×40
Ligule 0.1-0.2 mm.

184. *Zoysia pauciflora* ×40
Ligule 0.2-0.3 mm.

References

Barkworth, M. E. et al. 2003: Flora of North America. Vol. 25. OUP, New York.
Barkworth, M. E. et al. 2007: Flora of North America. Vol. 24. OUP, New York.
Chaffey, N. J. 1994: Structure and function of the membranous grass ligule: a comparative study. *Botanical Journal of the Linnean Society* 116: 53-69.
Connor, H. E. 2004: Needle-grasses and nasellas (sic), a comment. *Auckland Botanical Society Journal* 59: 69-70.
Edgar E. E. and Connor, H. E.: 2000. Flora of New Zealand. Vol. 5. Gramineae.
Gardner, R. 2011: Collecting in the footsteps of another: an *Eragrostis* sp. in the Waitakeres. *Auckland Botanical Society Journal* 66: 46
Gardner, R. 2011: *Arundo* and *Phragmites* distinguished by their ligules. *Auckland Botanical Society Journal* 66: 143.
Godley, E. 2009: Rangitoto remembered at ninety. *Auckland Botanical Society Journal* 64: 169-171.
Wilcox, M.D. 2000: Observations on grasses in the Auckland Region. *Auckland Botanical Society Journal* 55: 1-6.
Wilcox, M. 2011: Occurrence of the tropical reed-grass, *Phragmites karka*, in Auckland. *Auckland Botanical Society Journal* 66: 140-142.