

**SYSTEMATIC STRUCTURE OF *DAMPIERA* R. BR.
(GOODENIACEAE), USING TECHNIQUES OF
NUMERICAL TAXONOMY**

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Abstract

An agglomerative hierarchical cluster analysis of *Dampiera* R. Br. (Goodeniaceae) species was undertaken by using "MULCLAS" 8 computer program, as a basis for classification. Sixty six species of *Dampiera* were analysed for 24 disordered multistate attributes and 8 qualitative (binary) attributes, and 18 primary groups were produced. The analysis described indicates that the divisions between Sect. *Dampiera* and Sect. *Dicoelia* and possibly between Sect. *Linschotenia* are fairly blurred and to some extent this justifies Krause's treatment.

Introduction

The genus *Dampiera* R. Br. of family Goodeniaceae consists of 66 species are confined to Australia. Bentham (1868) and Krause (1912) arranged the species of *Dampiera* into Sect. *Dicoelia*, Sect. *Camptospora*, Sect. *Dampiera*, Sect. *Caphalanthia*, and Sect. *Linschotenia*, according to the nature and shape of the ovary, shape of the ovule and the type of inflorescence.

During the monographic review of genus *Dampiera*, for the flora of Australia, much difficulty has been experienced in giving the species a natural sequence. In the last two decades, several numerical methods have been developed for the construction of phylogenies and determining the relationship among the species of various taxa in producing the comprehensive classification. As the numerical methods in general are likely to provide a reasonable hypothesis for classification, and in present days, keeping in view of the importance of numerical taxonomy, an attempt was made to investigate the systematic structure of *Dampiera* by using the numerical techniques.

Materials and Methods

The morphological data of 66 species of *Dampiera* come from the examination of 6,000 herbarium specimens, borrowed from the following herbaria: AD, ADW, BM, CANB, HAL, K, L, MEL, NSW, NT and PERTH. The anatomical data of Rajput & Carolin (1984) have been used. For each species, 32 attributes scored were arranged in

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possible logical transformation series. The attribute states were not analysed to decide whether a given character state is primitive or derived.

For cladistic analysis in this investigation "MULCLAS" a computer program from C.S.I.R.O. of Australia Taxon Library was used and analysis was carried out at the C.S.I.R.O. Division of computing Research Centre at the University of Sydney.

Attributes. Attributes are abstract entities consisting of one or more states, which are used as a basis for comparing or identification of different taxa, e.g. the attribute "stem shape" can assume one of the three states; flat, triangular and terete.

Disordered multistate attributes. A disordered multistate attribute is one, in which the states are discrete and are not necessarily ordered in a logical sequence. For example leaf shape: linear, lanceolate, oblong, elliptical etc.

Qualitative attributes or binary attributes. These have only two states. For example the leaf margin may be flat or recurved; or the hairs on the outside of the corolla may be present or absent. In a sense binary attributes are also ordered multistate attributes, but this term is normally reserved for attributes with more than 2 states.

MULCLAS is an agglomerative hierarchical clustering analysis which has a number of options available, the options used in this study are given below:

Type of analysis	Coefficient of resemblance	Fusion strategy	Program
Agglomerative	Gower metric	Flexible	MULCLAS
hierarchical cluster analysis.	Gower metric	Average linkage	MULCLAS

The program GROUPER compares the clusters and indicates the attributes which most successfully distinguish them. The results of the MULCLAS analysis are shown in dendrograms.

Attributes. The attributes and their states which are used in this study are listed together with a brief discussion.

(1) *Stem shape.* The shape of the stems are defined by transverse sections of the stem. 1. Triangular, with cortical bundles. 2. Terete, without cortical bundle. 3. Terete below triangular above. 4. Flat, with usually 2 cortical bundles.

(2) *Surface of the stem.* The surface of the stem was defined as: 1. Glabrous when there are no hairs. 2. Tomentose when stem has hairs. 3. Glabrescent when stem hairs falls off at maturity. 4. Pubescent when soft powder-like hairs are present on the stem.

(3) *Stem ribs*. 1. Ribbed when stem has longitudinal ribs. 2. Unribbed when stem has no ribs. 3. Ribbed below, unribbed above.

(4) *Leaf petiole*. Petiole is defined as the stalk of the leaf. 1. Leaves petiolate. 2. Leaves sessile. 3. Lower leaves petiolate, upper leaves sessile.

(5) *Leaf shape*. Shapes are mostly defined as given in the S.A.D.T. chart of plane shapes (Taxon 11: 1962), following shapes are recognized. 1. Linear. 2. Linear-oblong. 3. Oblong-lanceolate. 4. Oblong-elliptical. 5. Oblong-spathulate or lanceolate-spathulate. 6. Ovate-lanceolate obovate-elliptical. 7. Elliptical. 8. Spathulate.

(6) *Leaf surface*. 1. Glabrous on both surfaces. 2. Tomentose on both surfaces. 3. Glabrescent on both surfaces. 4. Glabrous or glabrescent on the upper surface, and tomentose on the lower surface. 5. Glabrous on lower surface, and tomentose on the upper surface. 6. Irregularly pubescent on both surfaces.

(7) *Leaf margin*. 1. Entire. 2. Dentate. 3. Lobed.

(8) *Leaf base*. 1. Cordate. 2. Flat as broad as stem (leaves are sessile). 3. Narrowing towards the base. 4. Broad base (leaves are petiolate).

(9) *Inflorescence*. 1. Cymose. 2. Racemose. 3. A loose head.

(10) *Peduncle surface*. 1. Glabrous. 2. Tomentose. 3. Glabrescent. 4. Irregularly pubescent.

(11) *Bracteoles*. 1. Present. 2. Absent.

(12) *Bracteole shapes*. Shapes of the bracteoles are defined as set out in the S.A.D.T. chart of plane shapes (Taxon 11: 1962) and reprinted in Stearn (1966). 1. Linear. 2. Linear-oblong. 3. Oblong-elliptical. 4. Oblong-lanceolate. 5. Elliptical. 6. Ovate.

(13) *Surface of the bracteoles*. 1. Glabrous on both surfaces. 2. Tomentose on both surfaces. 3. Tomentose on the outer surface, glabrous on the inner surface. 4. Glabrous outside, tomentose or pubescent on the inner surface. 5. Glabrescent on both surfaces.

(14) *Sepal lobes*. 1. Present. 2. Absent.

(15) *Nature of the hairs on the outside of the corolla*. 1. Appressed. 2. Spreading. 3. Semi-appressed. 4. Loose and tangled.

(16) *Type of hairs on the outside of the corolla.* 1. Dendritic. 2. Plumose.

(17) *Colour of the hairs on the outside of the corolla.* 1. Grey. 2. Whitish-grey. 3. Dirty-white. 4. Rusty or golden. 5. Yellow-grey or brown-grey. 6. Silvery. 7. Silvery-grey. 8. Smokey.

(18) *Auricle colour.* 1. Purple or purple-red. 2. Pale yellow. 3. Purple-brown to brown-yellow.

(19) *Wing venation.* 1. Distinctly veined. 2. Slightly veined. 3. Unveined.

(20) *Wing above auricle on the superior lobe of the corolla.* 1. Obsolete. 2. Present.

(21) *Wing Colour.* 1. Purple or blue. 2. Yellow. 3. White.

(22) *Calli.* 1. Present. 2. Absent.

(23) *Shape of the ovary.* 1. Gibbous. 2. Oblique. 3. Straight.

(24) *Surface of the Ovary.* 1. Glabrous. 2. Tomentose. 3. Glabrescent.

Qualitative or binary attributes:

(1) *Leaf T.S. morphology.* 1. Recurved. 2. Flat.

(2) *Position of flowers on the plants.* 1. Flowers restricted to the upper axils. 2. Flowers are not restricted to the upper axils but present on the entire plant except the lowermost vegetative zone.

(3) *Bracts shape.* 1. Leaf-like. 2. Not leaf-like.

(4) *Outer surface of the corolla.* 1. Glabrous. 2. Tomentose.

(5) *Number of locules in the ovary.* 1. One. 2. Two.

(6) *Ovule shape.* 1. Linear erect. 2. U-shaped.

(7) *Indusium shape.* 1. 2-lipped. 2. Entire or globular.

(8) *Surface of the indusium lips.* 1. Glabrous. 2. Hairy.

Results

The results of MULCLAS analysis are depicted in the dendrograms, developed with Gower metric and average linkage strategy (Fig. 1). Dendrogram with Gower metric as the coefficient of resemblance and flexible clustering strategy is shown in Fig. 2. Both of these computer analyses show some interesting departures from expectation although the major groups come out fairly clearly.

MULCLAS with Gower metric and average linkage strategy. In dendrogram (Fig. 1), four major clusters are developed and they contain the following groups.

Cluster I. This cluster includes groups 113 and 70, and it represents the members of the sect. *Linschotenia*, which was recognized by Bentham (1868) and De Vriese (1848), but which Krause (1912) did not recognize. The main attributes distinguishing group 70 from group 113 of cluster I are that, the members of group 70 have veined wings of the corolla, the lips of the indusium are hairy, sessile leaves, grey hairs on the outside of the corolla and distinctly dentate leaves.

Cluster II. This includes groups 112, 42, 22, 18, 114, 34, 23 and 63. of the members of sect. *Camptospora*, sect. *Dicoelia* and sect. *Dampiera*.

Group 114 represents the members of sect. *Camptospora*, which was recognized by Bentham (1868) and Krause (1912), whereas group 22, 18, 63 and nine members of group 112 belonging to members of sect. *Dicoelia*, which was also recognized by Bentham (1868) and Krause (1912), but they recognized this section on the basis of bilocular ovary, whereas in the present study it is based on triangular stem with 3 cortical bundles and with 1/3 phyllotaxis. Group 42, 34, 23 and 25 members of group 112 constitutes the sect. *Dampiera*, which was also recognized by Bentham (1868) and Krause (1912).

Cluster II contains 3 major groups, which we thought could be separate taxa; a group with triangular stem, a group with flat stem and a group with terete or ribbed stem. However, other members of these putative taxa are left out of the groupings, and (group 31, 20, 17, 40 and 14, each with one species) are not included until after cluster I and cluster II.

Thus the computer analysis suggests that even these well recognized sub-generic taxa are not so distinct, as may have been thought and indeed, this may well be the case. For instance: (c.f. U-shaped ovule of *D. tephrea* and *D. incana* and sect. *Camptospora*) (c.f. sect. *Linschotenia*, (cluster I) being included before many *Dicoelia* etc.) There seems to be a considerable overlap between the species with triangular stem and those with terete or ribbed stem. Some species e.g. *D. diversifolia* and *D. linearis* have \pm triangular stem in the upper parts but ribbed-terete towards base.

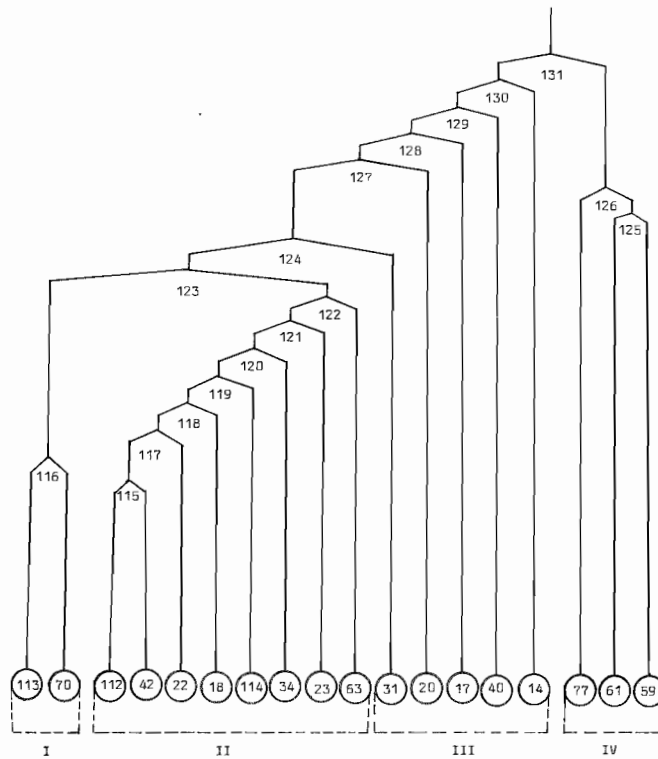


Fig. 1. Agglomerative clustering strategy with Gowermetric and average linkage, showing 4 clusters in the species of *Dampiera*.

The species belonging to groups shown in dendrogram are as follows:

Group 113. *D. atriplicina*, *D. candicans*, *D. cinerea*, *D. conospermoides*, *D. discolor*, *D. ramosa*, *D. stenostachya*, *D. teres*. Group 70. *D. krausiana*, *D. spicigera*.

Group 112. *D. decurrens*, *D. latealata*, *D. trigona*, *D. fasciculata*, *D. galbraithiana*, *D. leptoclada*, *D. loranthifolia*, *D. sericantha*, *D. sylvestris*, *D. altissima*, *D. fitzgeraldensis*, *D. diversifolia*, *D. haematotricha*, *D. dysantha*, *D. eriantha*, *D. ferruginea*, *D. incana*, *D. lanceolata*, *D. linearis*, *D. luteiflora*, *D. marifolia*, *D. oligophylla*, *D. pedunculata*, *D. purpurea*, *D. orchardii*, *D. rosmarinifolia*, *D. roycei*, *D. salehae*, *D. scaevolina*, *D. stenophylla*, *D. tenuicaulis*, *D. tomentosa*, *D. tephrea*.

Group 42. *D. rodwayana*. Group 22. *D. triloba*. Group 18. *D. parvifolia*. Group 114. *D. angulata*, *D. alata*, *D. carinata*, *D. coronata*, *D. deltoidea*, *D. heteroptera*, *D. lindleyi*, *D. sacculata*. Group 34. *D. lavandulacea*. Group 14. *D. glabrescens*. Group 23. *D. adpressa*. Group 77. *D. eriocephala*, *D. wellsiana*. Group 63. *D. fusca*. Group 61. *D. plumosa*. Group 31. *D. heheracea*. Group 59. *D. dentata*. Group 20. *D. stricta*. Group 17. *D. obliqua*. Group 40. *D. pritzelii*.

On these results there seems to be a little basis for separating these two sections. But, in fact, if we consider the number of the cortical bundles and the phyllotatic arrangements of the leaves on the stem, sect. *Dicoelia* can be separated from sect. *Dampiera*. The main reason for overlapping the members of sect. *Dicoelia* with the members of sect. *Dampiera* is because MULCLAS analysis has put much emphasis on the fasciculate nature of the leaves and the type and colour of the hairs. It is difficult to recognize small groupings produced by MULCLAS, the attributes on which they are separated from the main groups or sections have little significance. The attributes on the basis of which the small groups are separated from the major groups shows two group 42 which include one species differs from the members of group 112, mainly in the hair colour, stem shape, recurved leaf margin, ribbed stem, leaf shape and stem surface. The members of group 22, 18, and 63 were expected to come with the members of group 112, which mostly includes the species with triangular stem with 3 cortical bundles. Group 22 includes only one species *D. triloba*, which differs from the members of group 112 mainly in having hairs on the stem and leaves, whereas the other members of group 112 has mostly glabrous or glabrescent leaves and stem, and same is the case with the members of group 63, which also includes one species i.e., *D. fusca*, besides the hairs on the stem and leaves, it also differs from the members of group 112, which includes the members of sect. *Dicoelia*, having flowers restricted to the upper axils.

D. parvifolia which belongs to group 18, differs from the group 112, mainly by the bracteoles which are arranged in clusters below each flower, are glabrous on both surfaces and also have more or less hairy lipped indusium and have plumose hairs on the outside of corolla. Group 34 which includes *D. lavandulacea*, and differs from members of sect. *Dampiera*, by its indusium which is hairy on the lips.

D. adpressa belongs to group 23, which also differs from the members of sect. *Dampiera* in auricle colour, type and colour of the hairs on the outside of the corolla and the calli.

Cluster III. This cluster includes group 31, 20, 17, 40 and 14. Group 31 includes *D. hederacea*, which is separated from other groups of sect. *Dampiera*, by its leaves which are petiolate with cordate leaf-base. Group 20 and 17 includes.

D. stricta and *D. obliqua* respectively, and according to our interpretation of sections they would have come with group 112, which includes the members of sect. *Dicoelia*, but *D. stricta* differs from the other members of group 112, by its indusium which is globular and rusty hairs on the outside of the corolla, whereas *D. obliqua* differs by its ovary which is oblique. *D. glabrescens* of group 14 was also expected with group 112, but it differs from that group by its stem and leaves which are pubescent. *D. pritzelii* of group 40 is also displaced, because of its auricles, which are yellow-brown, and have distinctly

veined wings, and also flowers are arranged on short leafy-terminating branches. Thus these species are separated because they have a unique character. The strategy does not seem to be a very satisfactory one for this type of data.

Cluster IV. This cluster includes group 77, 61 and 59 which corresponds to sect. *Cephalantha*, which both Bentham (1868) and Krausa (1912) recognize. The members of these groups merge together before they join with cluster I and cluster II, which indicates that it is a well defined species cluster.

MULCLAS with Gower metric and flexible strategy: Agglomerative hierarchical cluster analysis Gower metric flexible MULCLAS program was also used and 4 main clusters were produced. The results are shown in dendrogram (Fig. 2) and they contain the following groups.

Cluster I, includes group 92, 112, 84 and 14.

Cluster II, includes group 107.

Cluster III, includes group 87, 63, 40, 111, 110 and 113.

Cluster IV A, includes group 109, 114, 108, 103 and 88.

Cluster IV B, includes group 99 and 94.

These clusters form a hierarchy in which the major divisions separate clusters from each other. The results of flexible strategy are more or less similar to the results using average linkage strategy except the position of a few groups have been changed.

Cluster I. This cluster includes all the members of sect. *Linschotenina*, except group 14, which includes *D. glabrescens*, which has pubescent stem, yellow-brown auricles and also flowers are arranged on short leafy-terminating branches. We would have expected it with the members of group 114, 108, 103 or 88.

Cluster II. This cluster includes only one group 107, which includes all the members of sect. *Cephalantha*. This group came out fairly clearly in both strategies.

Cluster III. It includes the members of sect. *Dampiera*, except *D. fusca* of group 63, and *D. triloba* of group 110. These two species were expected in sect. *Dicoelia*, but they are probably removed from their original position by having hairs on the stem and leaves, whereas, the other members of sect. *Dicoelia* have glabrous or glabrescent stem and leaves.

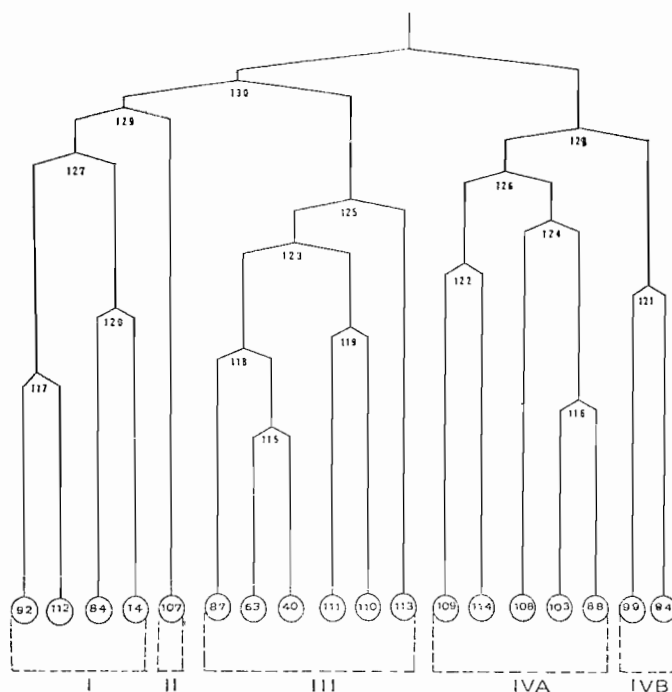


Fig. 2. Agglomerative clustering strategy with Gower metric and flexible, showing 4 clusters.

The species belonging to groups shown in dendrogram are as follows:

Group 92. *D. conospermoides*, *D. ramosa*. Group 112. *D. atriplicina*, *D. candicans*, *D. cinerea*, *D. discolor*, *D. krausiana*, *D. spicigera*. Group 84. *D. stenostachya*, *D. teres*. Group 14. *D. glabrescens*. Group 107. *D. dentata*, *D. eriocephala*, *D. plumosa*, *D. wellsiana*. Group 87. *D. incana*, *D. tephrea*. Group 63. *D. fusca*. Group 40. *D. pritzelii*. Group 111. *D. ferruginea*, *D. luteiflora*, *D. marifolia*, *D. purpurea*, *D. roycei*, *D. salehiae*, *D. tomentosa*. Group 110. *D. triloba*, *D. haematotricha*, *D. hederacea*, *D. orchardii*, *D. stenophylla*. Group 113. *D. altissima*, *D. fitzgeraldensis*, *D. dysantha*, *D. eriantha*, *D. lanceolata*, *D. rodwayana*, *D. rosmarinifolia*, *D. tenuicaulis*. Group 109. *D. adpressa*, *D. diversifolia*, *D. scaevolina*. Group 114. *D. fasciculata*, *D. loranthifolia*, *D. parvifolia*, *D. sylvestris*, *D. linearis*, *D. oligophylla*, *D. pedunculata*. Group 108. *D. obliqua*, *D. stricta*. Group 103. *D. decurrens*, *D. trigona*, *D. leptoclada*, *D. sericantha*. Group 88. *D. latealata*, *D. galbraithiana*. Group 99. *D. carinata*, *D. heteroptera*, *D. lindleyi*, *D. sacculata*. Group 94. *D. alata*, *D. angulata*, *D. coronata*, *D. deltoidea*.

Cluster IV A. All the members of group 109, and *D. linearis*, *D. oligophylla* and *D. pedunculata* of group 114 belongs to sect. *Dampiera*. The main reason that the species of group 109 and 114 are coming with the members of sect. *Dicoelia* is that, they have fasciculate leaves, and the type of the hairs on the outside of the corolla. *D. fasciculata*, *D. loranthifolia*, *D. parvifolia* and *D. sylvestris* of group 114, and all other members of group 108, 103 and 88 belongs to sect. *Dicoelia*. The members of sect. *Dicoelia* come out

more clearly in the flexible strategy, rather than in average linkage strategy, where they overlapped more with other sections.

Cluster IV B. This cluster includes two groups and the species belonging to these groups are included in sect. *Camptospora*, which was recognized by Bentham (1868) and Krause (1912). This section come out fairly clearly in both strategies.

The analysis described here indicate that the divisions between sect. *Dampiera* and sect. *Dicoelia* and possibly between sect. *Linschotenia* are fairly blurred. To some extent this justifies Krause's treatment except his separation of sect. *Dicoelia*. Nevertheless it does seem useful from the taxonomists point of view to retain some sub-generic levels even though they may not be quite as clear as one would hope for or that they may be based on very few attributes.

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References

- Anonymous. 1962. Systematic Association Committee for descriptive Terminology, II. Terminology of simple Symmetrical Plane shapes. *Taxon* 11: 145-156, 245.
- Bentham, G. 1868. *Flora Australiensis*. Lovell Reeve & Co. London. 4: 106-120.
- De Vriese. 1854. *Goodenovieae*. Nat Verh. Holl. Maats. Wet. te Haarlem. Vol. 2, Part 10.
- Krause, K. 1912. *Goodeniaceae und Brunoniaceae*. Das Pflanzenreich, 54: 171-200, H.R. Engelmann, Weinheim, Berlin.
- Rajput, M.T.M. and R.C. Carolin. 1984. Phyllo taxis and stem Vascularization of *Dampiera* R. Br. (*Goodeniaceae*). Pro. Linn. Soc. New South Wales, 107: 479-485.
- Rajput, M.T.M. and R.C. Carolin. 1988. The genus *Dampiera* (*Goodeniaceae*): Systematic arrangement, nomenclatural notes and new taxa. *Telpea* 3: 183-216.
- Stearn, W.T. 1966. *Botanical Latin*. Hafner Publishing Co., New York.

APPENDIX-I

Data matrix of *Dampiera* species used for MULCLAS analysis. The attributes and their states are numerically coded.

An asterisk (*) instead of an attribute state indicates that no state could be scored for that particular attribute. A stop (.) separates attributes, when one attribute has many states they are separated by commas (,). Binary attributes are given after disordered multistate attributes.

D. alata

4.1.2.2.3, 5.1.1, 2.3.1.2.1.3.3.1.2.1, 2.2.1.1.2.1.1, 2.1.2.
2.2.2.2.1.2.1.1.

D. angulata

1.1.1.2.1, 2.1.1.3.1.2.1.3.2.1.1.1.1.1.2.1.1, 2.1.
2.2.2.2.1.2.1.1.

D. carinata

3.1.1.2.1, 3.1.1.3.1.1.1.2.5.1.1.1.6.1.2.2.1.2.1.2.
2.2.1.2.1.2.1.1.

D. coronata

1.1.2.2.3, 5.1.2.3.1.2.1.1.2.1.1.1.1.1.2.1.2.1.2.
2.2.2.2.1.2.1.1.

D. deltoidea

4.1.2.2.4.1.1.2.1.2.2.*.*.1.1.1.1.1.1.2.1.1, 2.1.2.
2.2.2.2.1.2.1.1.

D. heteroptera

4.1.2.2.1.1.1.3.1.1.1.1.1.1.1.1.1.1.1.1.1.1, 2.1.2, 3.
2.2.1.2.1.2.1.1.

D. lindleyi

4.1.2.2.1, 2.1.1.3.1.1.1.2.1.1.1.1.1.2.2.1.2.1.2.
2.2.1.2.1.2.1.1.

D. sacculata

4.1.2.2.2.1.1.3.1.1.1.3.2.1.1.1.1.1.2.2.1.2.1.2.
2.2.1.2.1.2.1.1.

D. decurrens

1.1.2.2.6.1.2, 3.2.1.1.1.2.1.2.1.1.1.1.1.1, 2.1.1.3.1.
2.1.2.2.2.1.1.1.

D. latealata

1.1.2.2.2, 3.1.1, 3.3.1.2, 3.1, 2.2.3.1.1.1.1.1.2.1.1.3.
2.2.2.1.2.2.1.1.1.

D. trigona

1.1.2.2.1, 3.1.1, 3.3.1.1.1, 2.2.1.2.1.1.1.1.1, 2.1.1..3.1.
2.2.2.2.2.1.1.1.

D. fasciculata

1.1.2.2.3.1.1, 2.3.1.2.1.3.3.2.1.1.1.1.2.2.1.1.3.2.
2.2.1.2.1.1.1.1.

D. galbraithiana

1.1.1.2.4.1.2.3.1.2.1.2.5.1.1.1.1.1.1, 2.2.1.1.3.2.
2.2.1.2.1.1.1.1.

D. glabrescens

1.4.2.2.3.6.1.3.1.2.1.2.3.1.1.1.2.1.2.2.1.2.3.2.

2.1.2.2.1.1.1.2.

D. leptoclada

1.1.2.2.2, 3.1.1, 2.3.1.1.1.2.1.1.1.1.1.1.2.2.1.1.3.1, 3.

2.2.2.2.1.1.1.1.

D. loranthifolia

1.1, 2.2.2.3, 6.1.1, 2.3.1.2.1.3.3.2.2.1.1, 2.2.2.2.1.1.3.2.

2.1.2.2.1.1.1.1.

D. obliqua

1.1.2.2.1, 2, 3.1.1.3.1.1.1.3.5.1.3.1.7.1.2.1.1.1.2.2.

2.2.2.2.1.1.1.1.

D. parvifoia

1.1.2.2.3, 4.1.1, 2.3.1.2.1.6.1.1, 2.2.2.6.1.2.2.1.1.3.2.

2.2.1.2.1.1.1.2.

D. sericantha

1.1.2.2.3, 6.1.1, 2.3.1.1.1.2.1.1, 2.1.1.1.3.2.1.1.3.2.

2.2.2.2.1.1.1.1.

D. stricta

1.1.2.2.2, 4, 5.1.1, 2.3, 1.2.1.1.1.1.3.1.4.1.2.2.1.1.3.2.

2.1.2.2.1.1.2.1.

D. sylvestris

1.1.2.2.2, 3, 4.1.1, 2.3.1.2, 3.1.3.3.1.2.1, 2.8.1.2.2.1.1.3.2.

2.2.2.2.1.1.1.1.

D., triloba

1.2, 3.2.2.4, 6.2, 3.3.1.2.1.3.3.1.1.1.4, 5.3.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. adpressa

3.1.1.2.3, 6.1.1, 2.3.1.2.1.2.1, 2.1.2.2.3, 6.3.2, 3.2.1.2.3.2.

2.2.2.2.1.1.1.1.

D. altissima

2.2.1.1, 2.3, 7, 8.4.2.3.1.2.1.2.3.1.1.1.2.1.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. fitzgeraldensis

3.2.1.2.4, 8.4.2.3.1.4.1.2.3.1.1.1.3, 6.1.2.2.1.1.3.2.

1.2.2.2.1.1.1.1.

D. diversifolia

3.1.1.2.2, 3, 5.1.1, 2.3.1.1.1.2.1.1.*.*.1.2.2.1.1.3.1.

2.2.1.1.1.1.1.1.

D. haematotricha

2.2, 3.1.2.4, 7.2, 4.1, 2.3.1.2.1.3.3.1, 2.2.1.5.3.1.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. dysantha

2.1, 3.1.2.2, 4.4.1, 2.3.1.2.1.2.3.1.3.1.5.1.2.2.1.1.3.2.

1.2.1.2.1.1.1.1.

D. eriantha

2.1.1.2.1, 2.1, 4.1.3.1.2.1.2.3.2.2.1, 2.2, 7.2.2.2.1.1.3.2.

1.2.1.2.1.1.1.1.

D. ferruginea

2.2.1.1, 2.3, 4, 7.2, 4.1, 2.3.1.2.1.3.2.1.2.1.4.1.3.2.1.1.3.2.

2.1.1.2.1.1.2.1.

D. hederacea

2.2, 3.1.1.3, 6.2.2, 3.1.1.2.1.3.3.1.2.1.5.1.2.2.1.2.3.2.

2.2.2.2.1.1.1.1.

D. incana

2.2.1.2.4, 6, 8.2.1, 2.3.1.2.1.3.3.1.4.1.2, 3.1.1.2.1.1, 2.3.2.

2.2.1.2.1.2.1.1.

D. lanceolata

2.1, 2.1.2.2, 3, 6.1.1, 2.3.1.2.1.2.3.1.2.1, 2.1, 2, 3.2.1, 2.2.1.1, 2.3.2.

1.2.1.2.1.1.1.1.

D. lavandulacea

2.1.1.2.1, 3, 4.4.1, 2.3.1.2.1.2, 4.2.1.2.1, 2.2.1.2.2.1.1.3.2.

1.2.2.2.1.1.1.2.

D. linearis

3.1.1, 2.2.2, 3, 5, 8.1.1, 2.3.1.1, 2, 3.1.2, 3.3.1, 2.2.1, 2.1, 2, 7.3.2, 3.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. lutiflora

2.2.1.2.3, 6.2.1.3.1.2.1.2, 3.2.2.2.2.5.1.2.2.2.3.2.

2.2.1.2.1.1.1.1.

D. marifolia

2.2.1.2.6, 7.2.1.3.1.2.1.3.2.1.2.1.4, 5.1.2.2.1.1.3.2.

1.2.1.2.1.1.1.1.

D. oligophylla

2, 3.1, 4.1, 2.2.1, 2, 3, 4, 8.1, 2.1, 2.3.1.2.1.3.3.1, 2.2.1, 2.1, 7.3.1.2.1.1, 2.3.2.

2.2.1.2.1.1.1.2.

D. pedunculate

3.1.2.2.1, 2.1.3.3.1.1, 3.1.2.1, 3.2.2.1, 2.1.2.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. pritzelli

3.1.2.1.2.3, 6, 8.1, 2.1, 2.3.1.2.2.*.*2.3.1, 2.2.2.1.2.1.1.3.2.

2.1.1.2.1.1.1.1.

O. purpurea

2.2, 3.1.1, 2.3, 4, 6.2, 3.1, 2.3.1.1.2.1, 2.1, 2.1, 2.2.1.1.1.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

O. rodwayana

3.2.2.1, 2, 3.4.1, 2.3.1.2.1.2.3.1.2.1, 2.7.1.2.2.1.1, 2.3.2.

1.2.1.2.1.1.1.1.

D. orchardii

2.1, 2.1.2.4.2, 3.1.4.1.2.1.3.3.1.1.1.4.1.2.2.1.1.3.

2.2.1.2.1.1.1.1.

D. rosmarinifolia

2.2, 3.1.2.1, 2.4.1.3.1.2.1.3.2.1.3.1, 2.1, 2.1.2.2.1.1.1.3.2.

1.2.1.2.1.1.1.1.

D. roycei

2.2.1.2.4, 6, 7.2, 4.1.3.1.2.1.3.3.1.2.1, 2.1.1.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. salehae

2.2.1.2.6, 7, 8.4.1.3.1.2.1.2.3.2.2.7.1.2.2.1.1.3.2.

2.2.1.2.1.1.1.1.

D. scaevolina

2.1, 4.1.2.2.1.1.3.1.4.1.2.1.1.1.1.6.1.2.2.1.1, 2.3.2.

2.2.1.2.1.1.1.1.

D. stenophylla

2.2.1.2.4.2, 4.2.4.1.2.1.3.3.1.2, 4.1, 2.2.1.2.2.1.2.3.2.

1.2.1.2.1.1.1.1.

D. tenuicaulis

2.1, 4.1.2.2, 4.1, 2, 3.1, 2.3.1.2.1.2.3.1.3.1.1, 2.1.2, 3.2.1.1, 2.3.2.

2.2.1.2.1.1.1.1.

D. tomentosa

2.2.1.2.4, 6, 7.2.1.3.1.2.1.3.2.2.2.2.1.1.2.2.1.2, 2.3.2.

2.2.1.2.1.1.1.1.

D. atriplicina

2.2.2.1.6, 7.2.1, 2.4.2.2.2.*.1.2.2.3.1.2, 3.2.*.2.3.

2.2.2.2.2.1.1.1.1.

D. candicans

2.2.2.3.6, 7, 8.4.2.3.2.2.1, 2.2.2.1, 2.2.1.2, 5.1.3.1, 2.1.2.3.

2.2.2.2.2.1.1.1.1.

D. cinerea

2.2.2.1.4.2.1, 2.3.2.2.1.3.3.1.2.1.2.1.3.2.1.2.3.

2.2.2.2.2.1.1.1.1.

D. discolor

2.2.2.1.6.4.1, 2.3.2.2.1, 2.1.3.1.3.1.2, 3.1.3.1, 2.1.2.3.

2.2.2.2.2.1.1.1.1.

D. krausiana

2.2.2.2.8.2, 4.2.3.2.2.1.1.3.1.2.1.1.1.2.2.1.2.3.

2.2.2.2.2.1.1.1.2.

D. spicigera

2.2.2.2.3, 4, 6.4.2.3.2.2.1, 2.2.3.1.2.1, 2.1, 2.1.2.2.1.2.3.

2.2.2.2.2.1.1.1.2.

D. stenostachya

2.2.2.2.3, 4, 7.2.1.3.2.2.1.3.2.1.3.2.1.3.1.2, 3.1.3.2.1, 3.2.3.

2.2.2.2.2.1.1.1.2.

D. teres

2.2.2.2.1.3.1.3.2.2.1.3.2.1.3.1.1.1.2.2.1.1, 2.3.2.2.

2.1.2.1.1.1.1.2.

D. dentata

2.2.2.3.2, 4, 8.1.2.3.3.1.2.*.1.3.2.3.2.2, 3.2.*.2.3.2.

2.1.1.2.1.1.1.1.

D. eriocephala

2.2.2.1.5, 6, 8.4.1, 2.3.3.2.2.*.1, 2.3.2.3.1.2.2.1.1.3.2.

2.1.1.2.1.1.1.2.

D. plumosa

2.2.2.3.3, 8.4.1, 2.3.3.3, 4.1.3.2, 5.1.3.2.3.1.2.2.1.2.3.2.

2.1.2.2.1.1.1.1.

D. wellsiana

2.2.2.1.6, 7, 8.1.1, 2.3.3.2, 4.2.*.2.3.2.3.1.2.2.1.1.3.2.

2.1.1.2.1.1.1.1.

D. fusca

1.2, 3.1.2.3, 8.2, 3.2.3.1.2.1.4.3, 5.1.1.2.2.1.1, 2.3.2.
1.1.1.2.1.1.1.1.

D. conospermoides

2.2.1.1.3, 5.4.1.3.2.2.1.2.3.1.2.1.4.1.3.1.1.2.3.2.2.
2.2.2.1.1.1.1.1.

D. tephrea

2.2.1.2.6, 8.4.1, 2.3.1.2.1.2.3.1.3.1, 2.1.1.1.2.1.1.2.2.
2.2.1.2.1.2.1.1.

D. ramosa

2.2, 3.1.1.5, 8.4.1, 2.3.2.1, 3.1.1.3.1.2.1.5.1.3.2.1.2.2.2.
2.2.2.2.1.1.1.1.1.