Systematic studies in the genus *Merciera* (Campanulaceae): A re-assessment of species boundaries

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ABSTRACT
Patterns of morphological variation were investigated in the genus *Merciera* A. DC. to re-assess the species boundaries. This study differs from previous studies in the genus because it employs multivariate statistical methods. Vegetative and floral characters obtained from herbarium specimens were analyzed. The results of cluster analysis and principal coordinates analysis support the recognition of six taxa.

MOTS CLÉS
Campanulaceae,
Région Floristique du Cap,
Merciera,
analyses multivariables,
délimitation des espèces,
concept d'espèce.

RÉSUMÉ
Étude systématique du genre Merciera (Campanulaceae) : réévaluation de la délimitation des espèces.
Les modèles de variation morphologique sont examinés chez le genre *Merciera* A. DC. afin d'éclaircir la délimitation des espèces. Cette étude diffère des études antérieures du genre par l'utilisation de méthodes statistiques multivariables. Les caractères végétatifs et floraux obtenus à partir de spécimens d'herbier sont analysés. Les résultats d'analyses de groupement et d'analyses en coordonnées principales appuient la reconnaissance de six taxons.

INTRODUCTION

Merciera A. DC. (Campanulaceae) is a small genus of dwarf shrubs endemic to the Cape Floristic Region (GOLDBLATT 1978) in South Africa. It occurs in the Bredasdorp, Caledon, Simonstown, Cape Town, and Worcester divisions of the southwestern Cape. Current records show that the highest concentration of species is found in the Caledon division. The genus is known to have occurred in the Cape Peninsula more than a century ago, but a record of ECKLON & ZEYHER on the Steenberg Mountains near Muizenberg remains unconfirmed. All currently recognized taxa of *Merciera* are characterized by salverform, pentamerous, blue-violet or white flowers, four basal ovules of which only one develops into seeds and an indehiscent capsule

crowned by the persistent calyx. *Merciera* grows mainly in open sandy, clayey or rocky soil, frequently in disturbed habitats, at altitudes ranging from 30-1500 m.

The delimitation of the species in the genus was always uncertain. This is shown in the different numbers of taxa previously recognized. DE CANDOLLE (1830) recognized three species, *M. tenuifolia*, *M. leptoloba*, *M. brevifolia* and BUEK (1837) added two more species, *M. eckloniana* and *M. heteromorpha*. However, *M. heteromorpha* was incorrectly placed in *Merciera*, belonging in the family Rubiaceae instead. SONDER (1865), reduced the number of species to two, *M. tenuifolia* (L.f.) A. DC. and *M. brevifolia* A. DC., and recognized six varieties, *M. tenuifolia* (L.f.) A. DC. var. *tenuifolia*, *M. tenuifolia* (L.f.) A. DC. var. *candolleana* Sonder, *M. tenuifolia* (L.f.) A. DC. var. *thunbergia* Sonder, *M. tenuifolia* (L.f.) A. DC. var. *eckloniana* (Buek ex Eckl. & Zeyher) Sonder, *M. brevifolia* A. DC. var. *brevifolia* and *M. brevifolia* A. DC. var. *leptoloba* (A. DC.) Sonder. He separated the varieties on the basis of leaf length, degree of leaf hairiness, the shape of the corolla lobes, and the length of the corolla in relation to the leaves. *Merciera eckloniana* Buek ex Eckl. & Zeyher and *M. leptoloba* A. DC., previously recognized by DE CANDOLLE (1830) and BUEK (1837) as species, were considered varieties of *M. tenuifolia* (L.f.) A. DC. and *M. brevifolia* A. DC., respectively by SONDER (1865). At the end of the nineteenth century, SCHLECHTER (1898) described a new species, *M. azurea*, from Sir LOWRY's Pass. He distinguished this violet-blue-flowered species from the other violet-blue-flowered species, *M. tenuifolia* (L.f) A. DC., by its shorter and less hairy leaves, and much shorter and wider corolla. ADAMSON (1954) in his revision recognized five species, *M. tenuifolia* (L.f.) A. DC., *M. eckloniana* Buek ex Eckl. & Zeyher, *M. brevifolia* A. DC., *M. leptoloba* A. DC. and *M. vaginata* Adamson. He reduced *M. azurea* Schltr. to varietal rank within *M. tenuifolia* (L.f.) A. DC., claiming that it is only a smaller and stouter form of *M. tenuifolia* (L.f.) A. DC. ADAMSON and BUEK interpreted these taxa similarly in that both recognized the species *M. tenuifolia* (L.f.) A. DC., *M. eckloniana* Buek ex Eckl. & Zeyher, *M. leptoloba* A. DC. and *M. brevifolia* A. DC. Furthermore, very strangely, like BUEK, ADAMSON placed *M. vaginata* Adamson, which belonged to the Rubiaceae, incorrectly in *Merciera*.

The unconvincing separation of the species of *Merciera* by previous workers contributes to the confusion in the number of taxa recognized, the designation of infraspecific ranks, and the misidentification of species. A sound taxonomy, which is the basis for all detailed biological studies, as well as for making informed conservation decisions, is clearly lacking for *Merciera*. A convincing species level taxonomy for *Merciera* is therefore imperative to unlock the largely unknown biology of the genus. This study aims at addressing this inadequacy by providing a sound species level taxonomy for *Merciera,* employing multivariate statistical methods in delimiting taxa. Multivariate statistical methods provide an objective analysis of patterns of morphological variation within a taxon and are a suitable tool to systematists in making decisions on taxon delimitation. Examples of such studies in recent years are ALDASORO et al. (1998), BAUM & BAILEY (1992), BRUNELL & WHITKUS (1999), EAKES & LAMMERS (1996), EDDIE & INGROUILLE (1999), ERIKSEN (1997), LAMMERS (1996), MATOS (1995), SEPP & PAAL (1998), SHAW (1998), TYTECA & DUFRENE (1994), VERBOOM & LINDER (1998) and WILKIN (1999).

This study has the following objectives. First, to re-evaluate the patterns of morphological variation and determine the species limits within the genus, employing multivariate statistics. Second, to provide a taxonomic account of the genus based on the results obtained in the multivariate analysis. A complete taxonomic account will be published separately.

MATERIAL AND METHODS

Sampling methods

This study is based on herbarium specimens from SAM, BOL, and NBG (abbreviations as in HOLMGREN et al. 1990). A set of 162 specimens was selected in order to obtain representative

material from the known distribution range of the genus. From this set 127 specimens were selected as Operational Taxonomic Units (OTU's). The other specimens were not used because some floral characters were missing or the specimens were too brittle to remove plant parts. In addition to the herbarium specimens a further 8 specimens were collected and examined.

Preparation and examination of study material

Floral morphology was examined using flowers at anthesis. One flower from each specimen was removed, boiled in water for 30 seconds and the floral parts dissected out. The floral parts were mounted on gummed cards and used in the subsequent measurements. Nineteen characters representing reproductive and vegetative morphology were chosen for the investigation (Table 1). The characters included 12 quantitative and 7 qualitative characters. The numbers of corolla lobes, calyx lobes and stamens were considered logically correlated characters and hence scored as one to avoid scoring the same thing twice (DAVIS & HEYWOOD 1963). Flower measurements, shown in Fig. 1, include length of corolla tube, corolla lobe, calyx lobe, hypanthium, style, filament, and bract-like leaf. Leaf measurements (Fig. 1) were taken of the largest leaf from each specimen after the leaf was softened in boiling water and mounted on a gummed card. Leaf width was measured at the widest part of the leaf. All measurements were done using a Vernier caliper precise to 0.02 mm.

Phenetic analysis

Data were entered onto a computerized spreadsheet program, Microsoft Excel version 7. The spreadsheet was later transformed into a file format suitable for phenetic analysis. Principal coordinates analysis (PCO) and clustering analysis were carried out using NTSYS-pc version 2.02 (ROHLF 1999), with a matrix of standardized data. The data were standardized to eliminate the distorting effects of different scales of measurement on the output results. Standardization was performed by subtracting the character mean and dividing by the standard deviation. For PCO, a Manhattan distance matrix of standardized data was obtained. The Manhattan distance was used because the data set contained mixed (metric and binary) data. The distance matrix was double centered and the eigenvectors were calculated and plotted. The PCO gives the distances between OTU's rather than the correlation between the characters. This method is therefore suitable for mixed character data, as it will not be distorted by binary characters as will Principal components analysis (PCA). It has the added advantage of handling missing data well. To test the repeatability of the phenetic groupings, the groupings obtained by ordination were compared to those obtained using various clustering algorithms: single linkage, complete linkage, weighted pair group method using arithmetic averages (WPGMA), and unweighted pair group method using arithmetic averages (UPGMA). Each of the clustering algorithms was performed on a Manhattan distance matrix, resulting in a phenogram depicting simi-

TABLE 1. — List of characters used in the multivariate analysis.

Characters	Units or states
Habit	0 = decumbent, 1 = semi-erect
Corolla tube length	mm
Corolla lobe length	mm
Corolla lobes hairy on the back	0 = absent, 1 = present
Corolla lobe shape	0 = linear-lanceolate, 1 = ovate
Number of corolla lobes	count
Calyx lobe length	mm
Number of calyx lobes	count
Calyx lobe margins hairy	0 = absent, 1 = present
Bract length	mm
Hypanthium length	mm
Style length	mm
Number of stamens	count
Filament length	mm
Leaf length	mm
Leaf width	mm
Leaf orientation (old leaves)	0 = spreading, 1 = ascending
Leaf hairy on the adaxial surface	0 = absent, 1 = present
Flower colour	0 = white, 1 = violet-blue

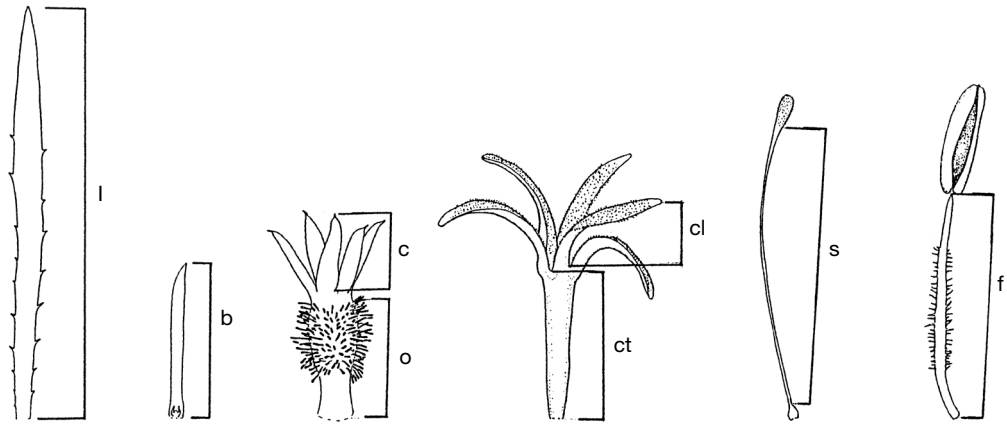


Fig. 1. — Illustrations depicting how floral parts and leaves were measured for the morphometric analysis (not to scale): l = leaf length; b = bract-like leaf length; c = calyx lobe length; o = hypanthium length; ct = corolla tube length; cl = corolla lobe length; s = style length; f = filament length. Illustrations were done from FAA preserved material (*Cupido 66*, NBG) collected near Pringle Bay.

TABLE 2. — The cophenetic values obtained using different clustering methods.

Clustering methods	Cophenetic values
Single linkage	0.77
Complete linkage	0.83
WPGMA	0.76
UPGMA	0.85

larity between the OTU's. A cophenetic correlation was then calculated to show the degree of relationship between the original distance matrix and the tree matrix. The highest cophenetic value was obtained using the UPGMA algorithm. (Table 2). The phenogram produced by the UPGMA algorithm was preferred, as it has been shown to reduce distortion of inter-OTU distances during clustering (ROLF 1970).

RESULTS

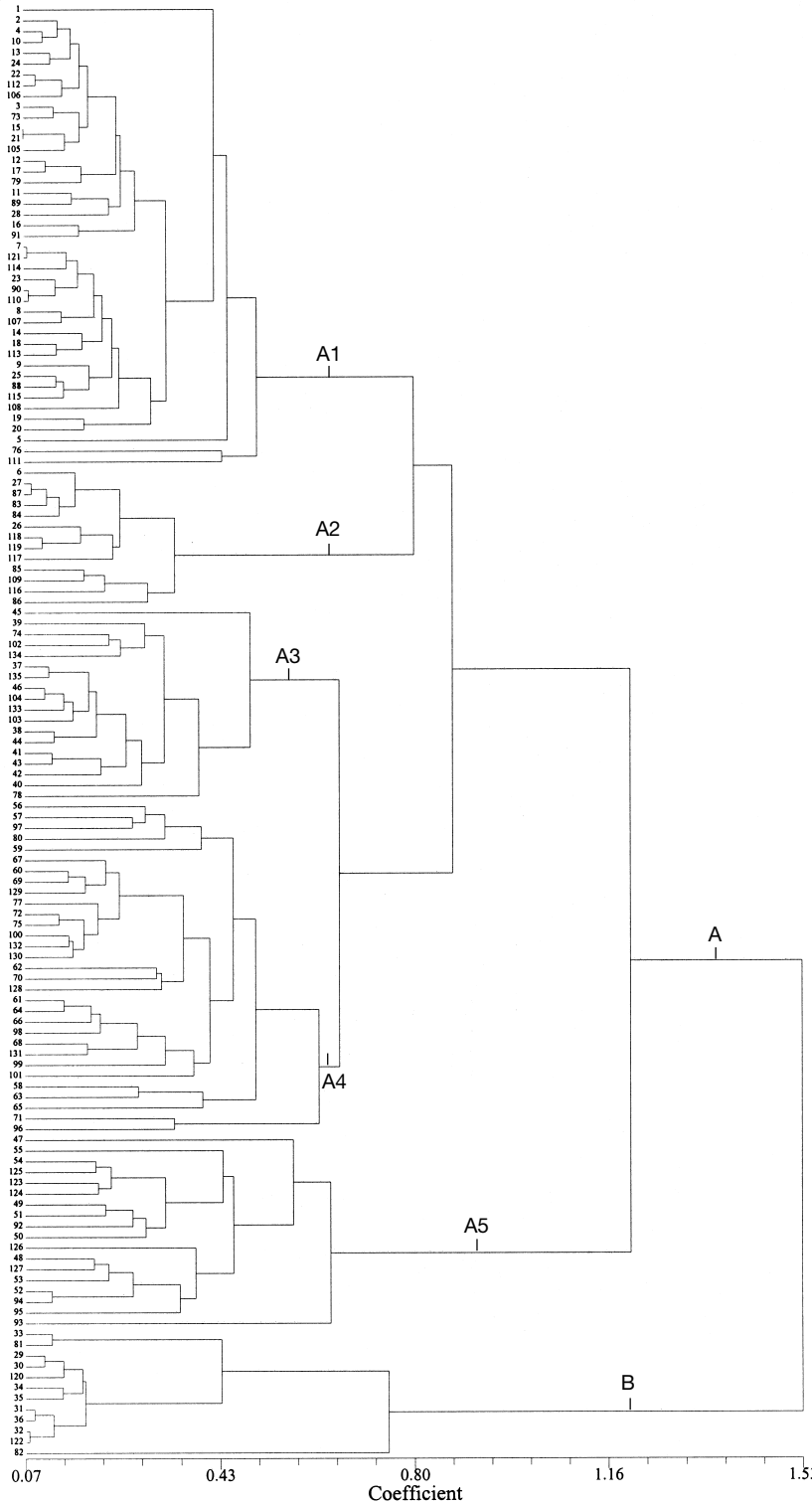
Phenetic analysis

Cluster analysis (Fig. 2) produced two primary groupings of the OTU's: A and B. Group A included specimens from *M. leptoloba*, *M. brevifolia, M. tenuifolia* var. *tenuifolia*, *M. tenuifolia* var. *azurea* and *M. eckloniana*, and group B of specimens assigned to *M. brevifolia*. Group B shows no distinct internal structure, whereas group A does, separating into the sub-groups A1, A2, A3, A4 and A5. A similar grouping pattern of the OTU's can be imposed on the PCO (Fig. 3) as the CA. However, in group A4, A5 and B several outliers are present suggesting that they could be of hybrid origin or due to extreme outliers for individual characters.

CA and PCO suggest recognition of six distinct groups within *Merciera*: 1. the *M. leptoloba* group (A1); 2. the *M. brevifolia* 1 group (A2); 3. the *M. eckloniana* group (A3); 4. the *M. tenuifolia* var. *azurea* group (A4); 5. the *M. tenuifolia* var. *tenuifolia* group (A5); and 6. the *M. brevifolia* 2 group (B).

Analysis of the nine quantitative characters (Fig. 4) indicates that the ranges of all nine characters overlap among the six groups. Corolla tube length (Fig. 4D) convincingly separates the white-flowered groups, *M. leptoloba, M. brevifolia* 1 and *M. brevifolia* 2 from the violet-blue-flowered groups, *M. eckloniana, M. tenuifolia* var. *azurea* and *M. tenuifolia* var. *tenuifolia*. Except for a slight overlap, the ranges of the filament length (Fig. 4G) show a similar separation. The num-

Fig. 2. — Phenogram depicting the groups within ***Merciera*** based on CA using all characters. The cophenetic correlation, r = 0.85. A1 = the *M. leptoloba* group; A2 = the *M. brevifolia* 1 group; A3 = the *M. eckloniana* group; A4 = the *M. tenuifolia* var. *azurea* group; A5 = the *M. tenuifolia* var. *tenuifolia* group; B = the *M. brevifolia* 2 group.


A1
A2
A3
A4
A5
A
B
0.07
0.43
0.80
1.16
1.53
Coefficient

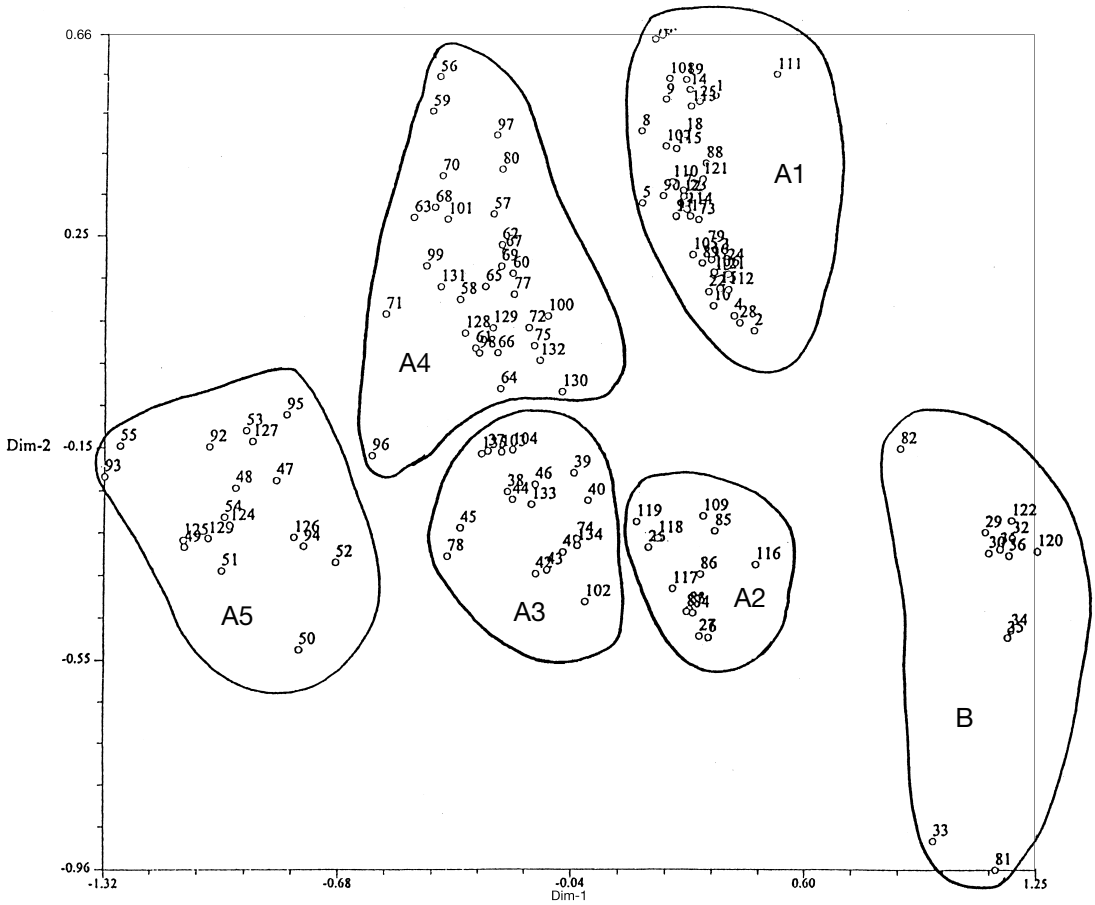


Fig. 3. — The phenetic groupings obtained from Principal coordinates analysis (PCO) using all characters: A1 = the *M. leptoloba* group; A2 = the *M. brevifolia* 1 group; A3 = the *M. eckloniana* group; A4 = the *M. tenuifolia* var. *azurea* group; A5 = the *M. tenuifolia* var. *tenuifolia* group; B = the *M. brevifolia* 2 group.

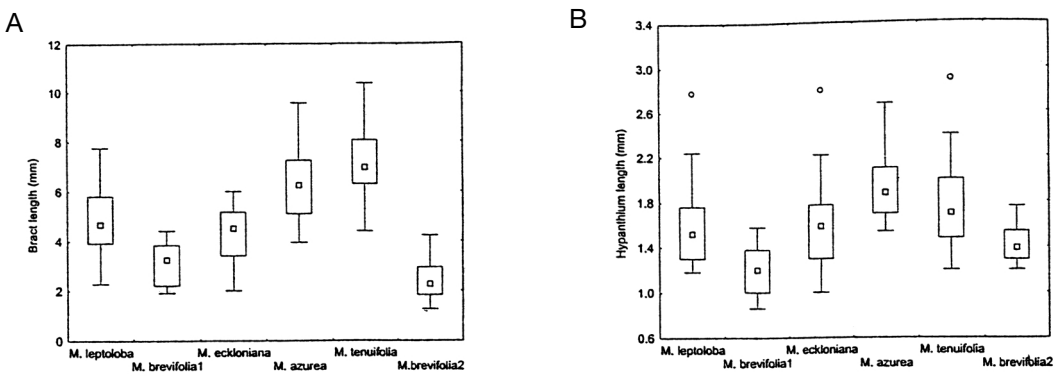


Fig. 4. — Box and whisker plots depicting the character variation ranges in the six phenetic groups: **A**, bract length; **B**, hypanthium length; **C**, calyx lobe length; **D**, corolla tube length; **E**, corolla lobe length; **F**, style length; **G**, filament length; **H**, leaf length; **I**, leaf width.

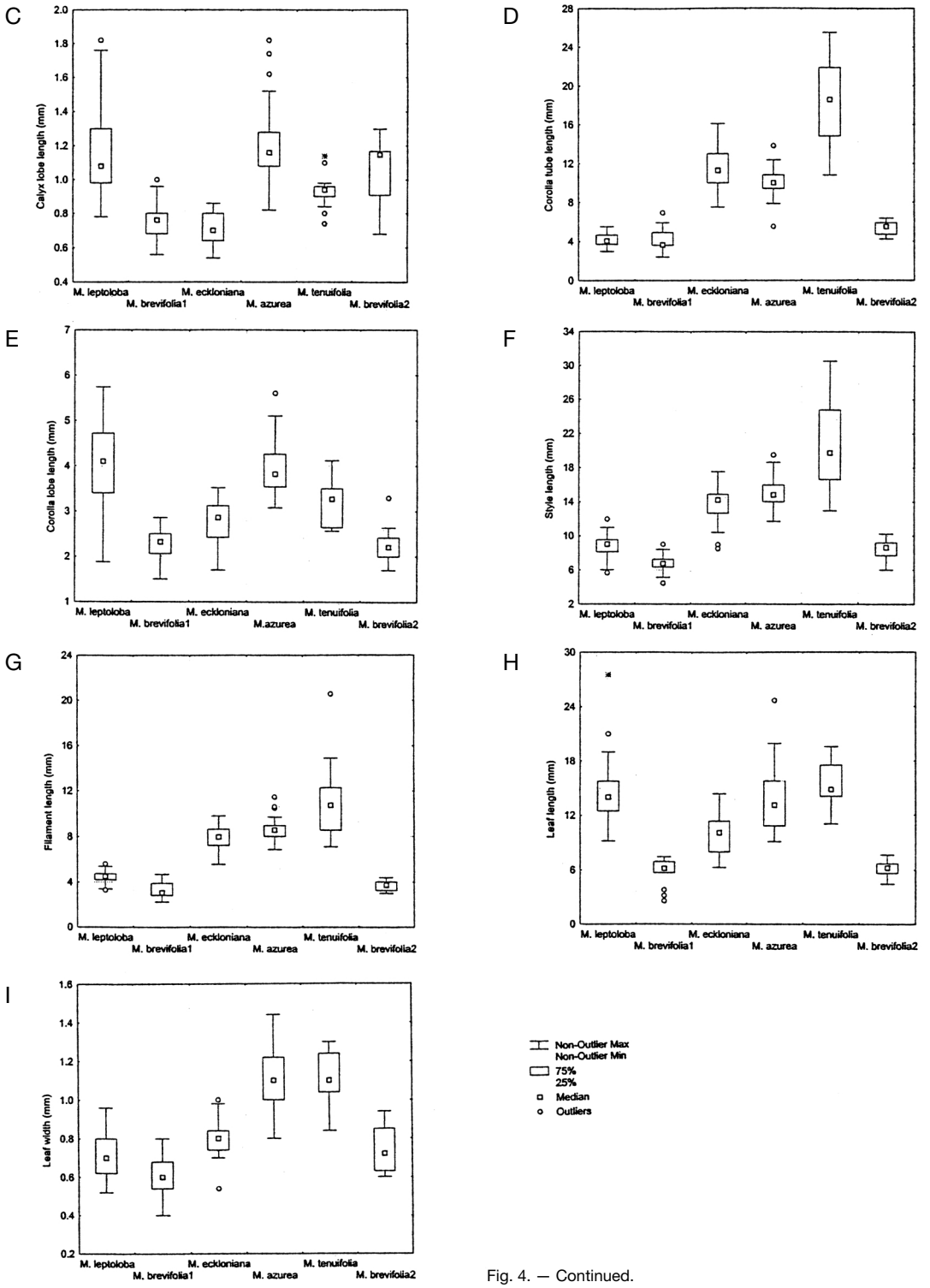


Fig. 4. — Continued.

TABLE 3. — The distribution of the states of the seven qualitative characters and one quantitative character across the six phenetic groups: **A1** = the *M. leptoloba* group; **A2** = the *M. brevifolia* 1 group; **A3** = the *M. eckloniana* group; **A4** = the *M. tenuifolia* var. *azurea* group; **A5** = the *M. tenuifolia* var. *tenuifolia* group; **B** = the *M. brevifolia* 2 group.

Characters	A1	A2	A3	A4	A5	B
Habit	0	1	1	0	1	0
Corolla lobes hairy on the back	0	0	0	1	1	1
Corolla lobe shape	0	1	1	1	1	1
Calyx lobe margins hairy	0	0	0	0	0	1
Leaf orientation	0	0	0	0	1	0
Leaf hairy on abaxial surface	1	1	1	1	1	0
Flower colour	0	0	1	1	1	0
Correlated numbers of corolla lobes, calyx lobes and stamens	5	5	5	5	5	4

bers of corolla lobes, calyx lobes, and stamens show a distinct difference between *M. brevifolia* group 2 and the remaining groups (Table 3).

The seven qualitative characters (Table 3) show that some character states are unique to particular groups. Hairs on the calyx lobe margins are only present in *M. brevifolia* group 2, except for its presence in one specimen in the *M. leptoloba* group. The absence of hairs on the back of the corolla lobes is unique to the *M. leptoloba, M. brevifolia* 1, and *M. eckloniana* groups. The *Merciera leptoloba* group is the only group with elongated (linear-lanceolate) corolla lobes, whereas the remaining groups possesses non-elongated (ovate) corolla lobes.

Leaf hairs are only absent in *M. brevifolia* group 2, and ascending leaves are present in only *M. tenuifolia* var. *tenuifolia*. Flower colour splits the groups into two subsets: the white-flowered *M. leptoloba, M. brevifolia* 1 and *M. brevifolia* 2 groups versus the violet-blue *M. tenuifolia* var. *azurea, M. eckloniana* and *M. tenuifolia* var. *tenuifolia* groups.

DISCUSSION

Taxon delimitation

The value of phenetic methods in systematics lies in the translation of results into defensible taxonomic decisions. In the absence of agreement among biologists on a universally acceptable species concept (DAVIS & GOLDMAN 1993), it is up to the individual taxonomist to define species level taxa. Various authors have used different criteria to define species, such as reproductive compatibility (PATERSON 1985; MAYR & ASHLOCK 1991), ecological adaptation (VAN VALEN 1976), overall similarity (SNEATH & SOKAL 1973), and minimal diagnosability (NIXON & WHEELER 1990). These criteria were formulated into the biological-, ecological-, phenetic-, and phylogenetic species concepts and are based on process or pattern to define species. The biological and ecological species concepts are process related and include criteria concerning the origin and function of species, whereas the phenetic and phylogenetic species concepts are pattern related. The pattern-related species concepts are feasible for practicing taxonomists because they use criteria that are based on observed patterns of character variation to delineate species. Three pattern related species concepts, the phenetic, phylogenetic and autapomorphic are briefly discussed.

The phenetic species concept (SNEATH & SOKAL 1973) is an empirical approach that considers distinct phenetic clusters as species without making assumptions about speciation. The formation of clusters is produced by overall similarity between objects as a function of their individual similarities in each of the many characters in which they are being compared. Phenetic clusters may not include a fixed character, but are recognized by the possession of a suit of partially correlating (polythetic) characters.

Sometimes the phenetic species concept is combined with the phylogenetic species concept, under which phenetic clusters accompanied by

fixed character differences are considered species. A quantitative character in which there are intervals in values could be used to delineate phylogenetic species, but one that shows differences only in mean values could not in the phylogenetic species concept. However, populations or phenetic groups that differ by differences in mean values would be recognized as subspecies or varieties (LUCKOW 1995). The recognition of infraspecific taxa is in conflict with the phylogenetic species concept, which does not recognize infraspecific taxa, but the smallest diagnosable groups as species (ELDREDGE & CRACRAFT 1980; NIXON & WHEELER 1990). CROWE (1999), an advocate of the phylogenetic species concept defended the use of the rank of subspecies in taxonomy, stating that: "species cannot always be delineated unambiguously and the goals of 100% diagnosability and precise character congruence are not always achieved". The use of the subspecies rank will therefore allow the taxonomist to assign a taxon not accorded species status under the phylogenetic species concept to the subspecies rank. An extreme view on the recognition of infraspecific taxa comes from BRUNELL & WHITKUS (1999). They argued that if infraspecific taxa are to be recognized they should be delimited from other taxa by non-overlapping discontinuity in one or more characters and have a geographical basis. Most practitioners of the phylogenetic species concept would assign specific ranks to taxa when using the BRUNELL & WHITKUS criteria for delimiting infraspecific taxa.

The phenetic species concept differs from the phylogenetic species concept, which searches for fixed differences or gaps in continuously varying characters in order to distinguish species. The phylogenetic species concept is equivalent to the taxonomic species concept used in the majority of taxonomic publications surveyed by MCDADE (1995). Under the phylogenetic species concept, a unique or diagnostic character may be either apomorphic or pleisomorphic, and a group diagnosed only by pleisomorphic features is not monophyletic. Phylogenetic species could therefore be either paraphyletic or monophyletic. MISHLER & DONOGHUE (1982), DONOGHUE (1985), and DE QUEIROZ & DONOGHUE (1988) are amongst the authors who have based a species concept on the idea that species are monophyletic units that are supported by at least one autapomorphy, hence the autapomorphic species concept. One of the shortcomings of this species concept is the inability of the practitioners thereof to recognize species that do not possess autapomorphies. This shortcoming is overcome by assigning those assemblages that lack autapomorphies to an entity outside any species, called a metataxon (DONOGHUE 1985; DE QUEIROZ & DONOGHUE 1988). Under this approach, distinct clusters accompanied by an autapomorphy would be assigned to species and those lacking autapomorphies are considered metaspecies.

The criteria used to choose between species concepts are various. ROJAS (1992) suggests that the choice of species concept used depends on what is to be studied and explained. An example of this approach is found in a study by PEDERSEN (1998) on the applicable taxonomic concepts in *Dactylorhiza.* PEDERSEN (1998) suggested that in *Dactylorhiza* the following taxonomic concepts should apply: "species" should comply with the biological species concept, "subspecies" with the ecological species concept and "varieties" with the phenetic species concept. According to LUCKOW (1995), the species concept employed depends on the method used to delimit species. It would therefore be inappropriate, for example, to promote a monophyletic species concept and then use phenetic analysis to delimit species. If LUCKOW's approach is followed then the use of phenetic analysis almost compels the taxonomist to use of the phenetic species concept to delimit species. This approach is rigid and limiting.

Phenetic analysis suggests that the groups within *Merciera* satisfy the three species concepts differently. Under the autapomorphic species concept three groups, *M. leptoloba*, *M. tenuifolia* var. *tenuifolia,* and *M. brevifolia* 2 will be true species, because they are clearly monophyletic as indicated by their possession of autapomorphies (Table 3). In contrast, the other three groups, *M. brevifolia* 1, *M. tenuifolia* var. *azurea* and *M. eckloniana* would be metaspecies because they lack autapomorphies. The *Merciera tenuifolia* var. *tenuifolia* and *M. brevifolia* 2 groups satisfy the phylogenetic species concept because both groups can be distinguished from each other and all

other groups by unique characters that do not overlap among the groups. Ascending leaves are unique to *M. tenuifolia* var. *tenuifolia* and tetramerous flowers and the absence of hairs on the abaxial surface of the leaves are unique to the *M. brevifolia* 2 group. The other four groups could be considered as subspecies or varieties of the two phylogenetic species. Under the phenetic species concept which looks for discrete clusters in multidimensional space all six groups should be recognized as species. This is the approach followed in this study.

Phenetic groups

Five of the six groups revealed by CA and PCO correspond with previously described taxa within *Merciera*: A1-A5 = *M. leptoloba, M. brevifolia* 1, *M. tenuifolia* var. *azurea, M. eckloniana,* and *M. tenuifolia* var. *tenuifolia*, respectively. Group B (*M. brevifolia* 2) constitutes a new taxonomic entity within the genus.

— The *Merciera leptoloba* (A1) and *M. brevifolia* 1 (A2) groups.

DE CANDOLLE (1830), BUEK (1837), and ADAMSON (1954) considered *M. leptoloba* and *M. brevifolia* as distinct species, whereas SONDER (1865) treated *M. leptoloba* as a variety of *M. brevifolia.* This study has found no support for SONDER's concept of taxon delimitation within the genus. Specimens of *M. leptoloba* (Fig. 2, A1) do form a subgroup distinct from specimens of *M. brevifolia* 1 (Fig. 2, A2). This separation of the taxa appears weak as they show overlapping ranges in all but one quantitative character, leaf length (Fig. 4H). Furthermore, the two taxa co-occur on the Houwhoek Mountains, which makes sub-division on geographical grounds inappropriate. The qualitative characters, corolla lobe shape, and habit (Table 3) support the recognition of two distinct taxa. *Merciera leptoloba* and *M. brevifolia* 1 are distinct from all other groups, except the *M. eckloniana* (A3) group by the absence of hairs on the back of the corolla lobes, and from *M. brevifolia* group 2 by the number of calyx lobes, corolla lobes, stamens, and geographical distribution.

— The *Merciera eckloniana* (A3) and *M. tenuifolia* var. *azurea* (A4) groups.

The association between specimens of *M. eckloniana* and *M. tenuifolia* var. *azurea* is surprising. The specimens of *M. eckloniana* (Fig. 2, A3) form a distinct sub-group from specimens of *M. tenuifolia* var. *azurea* (Fig. 2, A4) within the *M. tenuifolia* var. *azurea* — *M. eckloniana* group. *Merciera eckloniana* is separated from *M. tenuifolia* var. *azurea* by the absence of hairs on the back of the corolla lobes, difference in habit (Table 3), and a distinct geographical distribution. BUEK (1837) and ADAMSON (1954) considered *M. eckloniana* a species; SONDER (1865), on the other hand, relegated the species to a variety of *M. tenuifolia*. SCHLECHTER (1898), who described *M. azurea,* regarded it as a distinct species, whereas ADAMSON (1954) regarded it as a variety of *M. tenuifolia*. CA and PCO indicate a clear division between *M. tenuifolia* var. *azurea* and *M. eckloniana*.

— The *Merciera tenuifolia* var. *tenuifolia* (A5) group.

Specimens from *M. tenuifolia* var. *tenuifolia* constitute this group. No single quantitative character (Fig. 4) separates this group from the other violet-blue flowered groups (A3 and A4). However, the distinctly ascending leaves separate this group from all the other groups. Geographically, this group occurs in sympatry with the *M. tenuifolia* var. *azurea* group but does differ from it in having a more erect habit. According to ADAMSON (1954), *M. azurea* is only a smaller and stouter form of *M. tenuifolia* and he accordingly assigned it varietal status. The distance between the *M. tenuifolia* var. *azurea* and *M. tenuifolia* var. *tenuifolia* clusters revealed by CA and PCO do not support ADAMSON's concept of taxon boundaries.

— The *Merciera brevifolia* 2 group.

This group is a well-defined entity separated by CA and PCO. It is characterized by a reduction in the number of calyx lobes, corolla lobes and stamens, the presence of hairs on the calyx lobe margins, and the absence of leaf hairs on the abaxial surface. In addition to the floral and leaf characters, it also occupies a geographical range west of the Hottentots Holland Mountains in the Western Cape.

All previous workers considered specimens here assigned to the *M. brevifolia* group 2 as belonging to *M. brevifolia*. SONDER (1865) described *M. brevifolia* as having four or five corolla lobes, but did not recognize the four corolla lobed specimens taxonomically. The type specimen of *M. brevifolia,* Masson in herb. BM (I have seen a scanned image) does not resemble any of the specimens in *M. brevifolia* group 2, but rather suspiciously, specimens in the *tenuifolia* var. *tenuifolia* group. In the light of the substantial evidence favouring the recognition of the *M. brevifolia* 2 group, it should be given formal taxonomic status.

Taxonomic implications

The results of cluster analysis and principal coordinates analysis support the recognition of six taxa within *Merciera*: *M. tenuifolia, M. leptoloba, M. brevifolia* and *M. eckloniana* should be retained as species; *M. azurea* should be returned to species status (as proposed by SCHLECHTER); and *M. brevifolia* group 2 constitutes a new taxon. A new species, *M. tetraloba* C.N. Cupido has been proposed (CUPIDO in press*)*.

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