South African Journal of Botany 111 (2017) 371–386

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Marasmodes (Asteraceae, Anthemideae), the most threatened plant genus of the Cape Floristic Region, South Africa: Conservation and taxonomy

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ARTICLE INFO

Article history:
Received 17 October 2016
Received in revised form 2 March 2017
Accepted 13 April 2017
Available online 15 May 2017

Edited by GV Goodman-Cron

Keywords:
Conservation status
Extinction
Critically endangered
Lowland vegetation
Marasmodes crewiana
Marasmodes oppositifolia
New species

ABSTRACT

We confirm *Marasmodes* to be the Cape Floristic Region and South Africa's most threatened plant genus, classifying ten, of the thirteen species recognised here, as Critically Endangered (of which one, *M. reflexa*, is possibly extinct), and the remaining three as Endangered. The species are all highly localised to specialised, transitional habitats along moisture gradients or across soil-type boundaries. All are restricted to lowland vegetation of which more than 80% have already been lost, predominantly to agriculture and urban expansion. The remaining fragments are threatened further by significant development pressure. Historically, the conservation of *Marasmodes* has been impeded by a lack of collections and taxonomic confusion. We present here a revision of this highly threatened genus, in which we describe two new species, *Marasmodes crewiana* Magee & I.Ebrahim and *Marasmodes oppositifolia* Magee & Koopman. We also reduce two species, *M. beyersiana* S.Ortiz and *M. schlechteri* Magee and J.C.Manning, into synonymy (with *M. polycephala* DC and *M. oubinae* S.Ortiz, respectively). We therefore also review the conservation status of all the species in light of the revised taxonomic concepts and new distribution and population data. Urgent interventions, particularly habitat restoration and ex situ cultivation of plants for reintroduction to the wild, are needed to prevent the imminent extinction of most of the species.

1. Introduction

Marasmodes DC. is endemic to the Cape Floristic Region of South Africa. All of the species occur in lowland fynbos and renosterveld, which are some of the most threatened and poorly protected habitats in South Africa (Driver et al., 2012). The species of *Marasmodes* are unusual in that they flower during the dry autumn months, before the winter rains of the Cape Floristic Region, which stimulates flowering in the majority of plants of this region. In addition, their inconspicuous habit and small, discoid inflorescences make them cryptic. As a result they have been historically poorly collected and presently they are still easily overlooked in field surveys for environmental impact assessments, which are generally focused on the peak flowering season, resulting in ongoing loss of populations.

The genus is distinguished from the closely related *Cymbopappus* B. Nord. and *Pentzia* Thunb. by the rather inconspicuous woody habit with sclerophylous ericoid leaves, sessile discoid flower heads and a pappus of more than seven scales (Källersjo, 1988; Bremer and Humphries, 1993). Recent phylogenetic data places *Marasmodes*, together with *Cymbopappus* and an expanded *Pentzia*, in a perennial clade within the subtribe Pentziinae (Magee et al., 2015). The subtribe is one of the earliest diverging lineages within the Anthemideae and is sister to the Asian-centred subtribes Handeliinae and Artemisiinae (Oberprieler et al., 2007; Himmelreich et al., 2008). *Marasmodes* was recovered as monophyletic in the expanded phylogenetic analyses of the Pentziiane (Magee et al., 2015). However, the position of the genus, either embedded within a paraphyletic *Pentzia* or possibly sister, could not be determined and so Magee et al. (2015) maintained the genus pending further investigation.

Von Staden et al. (2013) highlighted *Marasmodes* as one of the South African Asteraceae genera most urgently in need of revision. These authors recognised the need for a taxonomic revision of the genus to clarify the delimitation, identification, distribution and abundance of these poorly known and highly threatened species, before they were lost to rapid transformation of the last remaining fragments of their lowland habitat.

Marasmodes was last revised by Hutchinson (1917), who recognised four species. One of which, *M. adenosolen* sensu Harv. non DC, he misapplied with the result that the taxon was only formally described much later by Magee and Manning (2010). Other than the description

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http://dx.doi.org/10.1016/j.sajb.2017.04.006
0254-6299/

of a fifth species in Compton and Salter (1946), the taxonomy remained largely unchanged until Ortiz (2009) described eight new species to accommodate the variation observed in the herbarium collections since Hutchinson's revision. A thorough taxonomic revision of the genus is therefore required to assess the status of the four original species in relation to the newly described taxa, as well as to provide a comprehensive taxonomic key to identify them. In the absence of a revision, not only is the confidence in the species identifications and resulting distribution data uncertain, but also the accuracy of the conservation assessments (Kirschner and Kaplan, 2002; Powell et al., 2014). As part of this revision, we therefore also review the conservation status of all the species in light of the revised taxonomic concepts and new distribution and abundance data.

2. Material and methods

Distribution and species descriptions are based on a comprehensive study of material from the following herbaria: BOL, K, NBG (including SAM), PRE. Field visits were carried out to study the species in situ and to survey potential sites for new populations. Field surveys were aided by the Custodians of Rare and Endangered Wildflowers (CREW), a citizen science programme dedicated to surveying and monitoring populations of rare and threatened plants in South Africa. The persistent poor knowledge of *Marasmodes* species, combined with their suspected high risk of extinction and likelihood of being overlooked in environmental impact surveys, prompted CREW to specifically focus on locating and documenting all remaining *Marasmodes* populations. The 21st of March each year is dedicated specifically to surveying potential sites for surviving populations of species of this genus (Ebrahim, 2009).

Twelve of the thirteen species recognized here were observed and studied in the field. During these visits, information such as habitat, population size and species associations were noted. Voucher specimens were prepared and are housed at Compton Herbarium (NBG).

Red list status of all the species were re-assessed following the IUCN Red List Categories and Criteria (IUCN, 2001). These assessments were compared to historical assessments published in Hall et al. (1980), Hall and Veldhuis (1985), Hilton-Taylor (1996) and Raimondo et al. (2009), to track the impact of increasing collections and taxonomic revision on the accuracy of Red List assessments.

Species' range sizes were calculated following the IUCN standard of Extent of Occurrence (EOO), which is the area of a minimum convex polygon around known points of occurrence (IUCN, 2001). Historical EOOs were calculated by including all known occurrence records for each species, while current EOOs included only occurrence records verified to be still extant in recent field surveys.

The vegetation types in which each species occurs were recorded, based on field observations and habitat notes on specimens, and verified against South Africa's national vegetation map (Mucina and Rutherford, 2006). Habitat loss was estimated for species known from three or more occurrence records by intersecting the historical EOO with the vegetation types recorded for that species. A national land cover dataset was then used to calculate the percentage of the EOO-vegetation type intersect that is irreversibly transformed. For species with fewer than three occurrence records, habitat loss is reported as the overall transformation of the vegetation types in which they occur, as documented by the Department of Environmental Affairs (2011) for threatened vegetation types and Mucina and Rutherford (2006) for non-threatened vegetation types.

The relationship between conservation efforts and collection trends in *Marasmodes* was evaluated in terms of trends in the number of specimens collected per decade. These trends were compared to overall collection trends for species from the Cape Floristic Region. The number of collections per decade for the species was calculated by extracting the collection dates of specimens, from the South African National Biodiversity Institute's herbarium database, for species documented in Goldblatt and Manning (2000) and Manning and Goldblatt (2012).

3. Results and discussion

3.1. Conservation assessments

Historically, the conservation of *Marasmodes* has been impeded by a lack of collections and taxonomic confusion. The imperilled status of the genus has been suspected since the 1980s, when three of the four species then recognised were included in South Africa's first Red Data Book (Hall et al., 1980). However, at the time, *Marasmodes* was known from only 27 collections, with 21 of these collected more than 20 years previously (Fig. 1). As a result, both *M. dummeri* Bolus ex Hutch. and *M. oligocephala* DC. were listed in categories indicating that they are suspected to be in danger of extinction, but too poorly known to confidently classify their threat status (Table 1). *Marasmodes undulata* Compton was classified as Extinct, as it had not been collected since Compton's type collection in 1946, and habitat at the type locality was subsequently lost to urban expansion (Table 1).

Following Hall et al.'s publication (Hall et al., 1980), Chris Burgers, a botanist at Cape Nature Conservation (now CapeNature), meticulously documented populations of threatened lowland fynbos species, and recorded many previously unknown *Marasmodes* populations. Burgers almost singlehandedly contributed to doubling the collection rate of the genus in previous decades, contributing 11 of the 14 specimens collected during the 1980s (Fig. 1). He showed that *M. undulata* was merely overlooked, and not extinct, when in 1980 he rediscovered the species in the same area where Compton first collected it (Hall and Veldhuis, 1985). Poor taxonomic resolution however prevented the correct identification of many of Burgers's collections, and *M. dummeri* and *M. oligocephala* remained in categories of data deficiency in subsequent updates of South Africa's plant Red List (Hall and Veldhuis, 1985; Hilton-Taylor, 1996; Table 1). Within the genus, only *M undulata* was classified in a threatened category (Table 1). *Marasmodes polycephala* was not listed due to a broader circumscription, which included populations subsequently shown to represent distinct species.

The CREW programme was founded in 2003 specifically to address the need for recent field observations to inform conservation assessments (Raimondo, 2004). Through their focus on documenting remaining *Marasmodes* populations, the CREW programme has significantly increased the number of *Marasmodes* records during the 2000s and 2010s (Fig. 1). As a result of conservation attention stimulated by Red Listing in the 1980s, followed up by CREW's survey efforts in the 2000s and 2010s, collection trends for this previously very poorly sampled genus are in contrast to the overall collecting trends for other Cape Floristic Region species, which peak in the 1970s (Fig. 1).

However, in spite of improving field knowledge of *Marasmodes* populations, taxonomic problems continued to hamper conservation assessments well into the 2000s. Raimondo et al. (2009) were the first

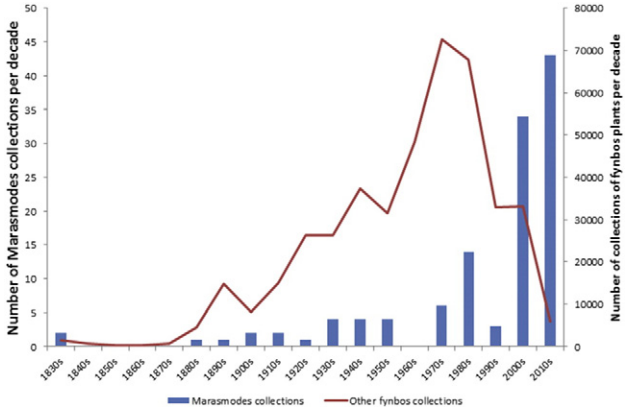

Fig. 1. Comparison of the collection trend of *Marasmodes* to that of other genera in the Cape Floristic Region.

Table. 1
Summary of *Marasmodes* conservation assessment history.

Species	Year described	First collected	Hall et al. (1980)	Hall and Veldhuis (1985)	Hilton-Taylor (1996)	Raimondo et al. (2009)	This treatment	Historical EOO	Current EOO	% EOO reduction
M. crewiana	2016	2009	–	–	–	–	Critically Endangered	Unknown (only one population ever recorded)	1.6 km^2	Unknown
M. defoliata	2009	1932	–	–	–	–	Critically Endangered	Unknown (only one population ever recorded)	1 km^2	Unknown
M. dummeri	1916	1908	Indeterminate	Indeterminate	Indeterminate	Endangered	Endangered	212 km^2	134 km^2	37%
M. fasciculata	2009	1937	–	–	–	–	Critically Endangered	142 km^2	8 km^2	94%
M. macrocephala	2009	1907	–	–	–	–	Critically Endangered	18 km^2	1 km^2	94%
M. oligocephala	1838	1835	Uncertain	Uncertain	Insufficiently Known	Critically Endangered	Endangered	37 km^2	7 km^2	81%
M. oppositifolia	2016	2010	–	–	–	–	Critically Endangered	Unknown (only one population ever recorded)	0.2 km^2	Unknown
M. oubinae	2009	1887	–	–	–		Critically Endangered	989 km^2	280 km^2	72%
M. polycephala	1838	1835	Not listed	Not listed	Not listed	Least Concern	Critically Endangered	56 km^2	15 km^2	73%
M. reflexa	2009	1946	–	–	–	–	Critically Endangered (Possibly Extinct)	Unknown (only one population ever recorded)	Unknown	Unknown
M. spinosa	2009	1978	–	–	–	Endangered (as sp. nov.)	Endangered	Unknown	134 km^2	Unknown
M. trifida	2009	1915	–	–	–	–	Critically Endangered	5 km^2	1 km^2	80%
M. undulata	1946	1946	Extinct	Endangered	Endangered	Critically Endangered	Critically Endangered	Unknown (only one population ever recorded)	0.04 km^2	Unknown

to confirm the threatened status of *M. dummeri* and *M. oligocephala* (Table 1). However, their assessments were based on incorrect distribution ranges due to the still poorly refined species concepts. Shortly thereafter, Ortiz (2009) described eight new species, citing very few collections for each species, suggesting that the majority of *Marasmodes* species were more range-restricted and localized than previously assumed.

Through targeted field work as part of this study, as well as CREW's survey efforts, 10 previously undocumented *Marasmodes* populations have been discovered, as well as two new species (*M. crewiana* Magee & I.Ebrahim and *M. oppositifolia* Magee & Koopman), both described herein. Twenty-five of the 28 known remaining *Marasmodes* populations have been studied in situ, representing all of the extant species.

All species were found to occur in small populations localized to specialized, transitional habitats along moisture gradients or across soil-type boundaries. Except for *M. crewiana*, all species occur in threatened vegetation types with 8–60% of their original extents remaining (Table 2). Eight of the thirteen species occur in Critically Endangered Swartland Shale Renosterveld (Table 2), a formerly widespread vegetation and one of the most agriculturally productive soils in the Western Cape. As a result of intensive, large-scale commercial cultivation of shale-derived soils, only 8% of Swartland Shale Renosterveld remains and these as small, isolated fragments. Overall, less than 20% of *Marasmodes* habitat remains intact, due to extensive past and ongoing habitat loss to agricultural and urban expansion.

All species of *Marasmodes* are highly range-restricted (Table 1), with the most widespread species, *M. oubinae*, having an Extent of Occurrence of only 280 km^2. Remaining populations of all species are extremely small. Six of the species are known from one remaining subpopulation and/or have wild populations numbering fewer than 50 individuals (*M. crewiana*, *M. defoliata*, *M. oppositifolia,* M. reflexa, *M. trifida* and *M. undulata*). In fact wild populations of more than 1000 plants are known for only two of the species, *M. defoliata* and *Marasmodes spinosa*.

With the revision of *Marasmodes* species' conservation assessments, in light of taxonomic clarification and extensive field studies, we confirm *Marasmodes* to be the Cape Floristic Region's (and South Africa's) most threatened plant genus. Ten species are here classified as Critically Endangered (of which one, *M. reflexa*, is possibly extinct), and the other three as Endangered (Table 1). The genus has a higher proportion of Endangered and Critically Endangered species than the cycad genus *Encephalartos* Lehm., widely considered to be the most threatened plant genus (Brummitt et al., 2015; Fragnière et al., 2015). The South African endemic legume genus *Polhillia* also has all of its species classified as in danger of extinction, with one already extinct. In contrast to *Encephalartos* and *Polhillia*, *Marasmodes* species overall have much more restricted ranges, far fewer surviving populations, and smaller

Table 2
Vegetation types where species of *Marasmodes* have been recorded.

Vegetation type	Status	% remaining	Species
Atlantis sand fynbos	Critically Endangered	51%	*M. defoliata* *M. fasciculata* *M. trifida*
Breede alluvium fynbos	Endangered	43%	*M. macrocephala* *M. oppositifolia*
Breede quartzite fynbos	Not threatened	94%	*M. crewiana*
Breede shale renosterveld	Not threatened	69%	*M. crewiana*
Cape Flats sand fynbos	Critically Endangered	16%	*M. fasciculata* *M. polycephala*
Central Ruens shale renosterveld	Critically Endangered	9%	*M. reflexa*
Lourensford alluvium fynbos	Critically Endangered	9%	*M. polycephala*
Piketberg quartz succulent shrubland	Vulnerable	60%	*M. oubinae*
Swartland alluvium fynbos	Critically Endangered	27%	*M. dummeri* *M. spinosa* *M. undulata*
Swartland shale renosterveld	Critically Endangered	8%	*M. dummeri* *M. fasciculata* *M. oligocephala* *M. oubinae* *M. polycephala* *M. spinosa* *M. trifida* *M. undulata*
Swartland silcrete renosterveld	Critically Endangered	8%	*M. oligocephala*

remaining wild populations. Urgent intervention, particularly habitat restoration and ex situ cultivation of plants for reintroduction to the wild, is needed to prevent the imminent extinction of most of the species.

3.2. Taxonomic treatment

Marasmodes DC., Prodr. 6: 136 (1838); Harv. in Harv. & Sond., Fl. Cap. 3: 175 (1865); Hutch., Bull. Misc. Inform. 1916: 171 (1917). Type: *Marasmodes polycephalus* (designated here).

Oligodorella Turcz. Mull. Mosc. XXIV.: 187 (1851). Type: *Oligodorella teretifolia* Turcz.

Weak to stout, single to multistemmed, laxly to well branched, evergreen shrublets, 0.15–0.7 m tall; branches subglabrous, with sparse sessile glands. *Leaves* alternate or opposite, regularly arranged along branches or restricted to upper branches and branch tips, sometimes caducous, adpressed to reflexed, lanceolate to linear or elliptic to oblong or obovate, 2–20 × 0.5–5.0 mm, simple or sometimes trifid to rarely pinnatifid; lobes mucronulate or spine-tipped, subterete, leathery, green, glandular-punctate, secondary basal lobes well developed, rudimentary or absent; axillary fascicles present or absent. *Capitula* discoid, homogamous, solitary or clusters of 2 to 12, sessile, terminal or on axillary shoots 0.5–150 mm long. *Involucre* campanulate, obconical or cylindrical-campanulate to broadly campanulate or narrowly oblong, 1.5–10.0 × 2–8 mm; bracts 3- to 6-seriate, glabrous, margins and apices scarious to broadly scarious, sessile glands at appendage base prominent or inconspicuous, stereome (a thickened, cartilaginous central portion, Fig. 7B) prominent or obscure; outer bracts broadly ovate to ovate, 0.5–2.5 mm long, margins very narrowly to narrowly scarious, apex rarely with a broadly ovate scarious appendage; middle bracts ovate to narrowly ovate or oblong, 1.5–4.0 mm long, margins slightly to broadly scarious, apex slightly to broadly scarious, rarely with a broadly to very broadly ovate scarious appendage; inner bracts oblong, 2.0–5.5 mm long, margins narrowly to broadly scarious, apex with a prominent scarious appendage, ovate to very broadly ovate, yellowish-brown to reddish-pink. *Receptacle* convex, epaleate. *Florets* 4 to 36, bisexual; corolla yellow, glandular, tube 5-nerved; limb campanulate, 5-lobed; lobes triangular, erect to recurved; anthers ecaudate, apical appendages ovate, obtuse; style terete with thickened base; branches truncate, papillate apically-dorsally. *Pappus* of 7 to 14 scales, longer, equal to or shorter than the corolla tube; scales oblong to narrowly oblong or linear, overlapping, adaxially longer, membranous, white. *Cypselas* ± 1.5–2.0 × 0.5–0.7 mm, oblong, 5-ribbed, glandular between ribs, mucilaginous when soaked.

3.2.1. Key to the species of Marasmodes

1a Primary leaves predominantly trifid to pinnate:

2a Primary leaves all 1-pinnate, lobes spine-tipped ..... ***M. spinosa.***
2b Primary leaves predominately trifid, lobes mucronulate:
3a Primary leaves 2–7 mm long, spreading to reflexed; leaves regularly arranged along branches; inner involucral bracts with conspicuous yellow glands at base of scarious apex; Overberg, Napier ..... ***M. reflexa.***
3b Primary leaves (8) 10–14 mm long, suberect to spreading; leaves restricted to upper branches or branch tips; inner involucral bracts without conspicuous yellow glands at base of scarious apex; West Coast, Kalbaskraal ..... ***M. trifida.***
1b Primary leaves predominantly simple:
2a Heads regularly arranged in terminal clusters:
3a Leaves adpressed, 2–3(4) mm long ..... ***M. dummeri.***
3b Leaves erect to spreading, 3–7 mm long:
4a Leaves erect to suberect; scarious margins of innermost involucral bracts reddish-pink; Faure to Gordons Bay ..... ***M. polycephala.***
4b Leaves spreading; scarious margins of innermost involucral bracts yellowish-brown; Malmesbury to Paardeberg ..... ***M. fasciculata.***
2b Heads solitary or in irregular loose clusters along the stem:
5a Involucral bracts all with broadly to very broadly ovate scarious apical appendages. ..... ***M. undulata.***
5b Involucral bracts with ovate scarious apical appendages only on inner bracts:
6a Primary leaves opposite ..... ***M. oppositifolia.***
6b Primary leaves alternate:
7a Involucral bracts with prominent stereome (thickened, cartilaginous central portion, Fig. 7B), upper portion conspicuously green-flanked:
8a Capitula cylindrical-campanulate, 2–3 mm wide; involucral bracts all with broad scarious margins ..... ***M. oligocephala.***
8b Capitula obconical or broadly campanulate, 4–7 mm wide; only inner bracts with broad scarious margins:
9a Capitula borne on very short lateral shoots, 0.5–4.0 mm long; pappus long, equal to or longer than the corolla tube; involucre 4–5 mm broad ..... ***M. oubinae.***
9b Capitula borne on prominent leafy shoots, 5–60 mm long; pappus short, half the length of the corolla tube; involucre 5–7 mm broad ..... ***M. macrocephala.***
7b Involucral bracts without a prominent stereome:
10a Involucre broadly campanulate; apex of middle involucral bracts not obviously scarious, obtuse; single or few-stemmed, sparsely leafy shrublets with leaves restricted to upper branches or branch tips; West Coast, Riverlands ..... ***M. defoliata.***
10b Involucre obconical to urceolate; apex of middle involucral bracts broadly scarious, ± truncate; well branched multistemmed leafy shrublets with leaves regularly arranged along branches; Worcester ..... ***M. crewiana.***

3.2.2. Species descriptions

1. Marasmodes crewiana Magee & I.Ebrahim, sp. nov. Type: South Africa. Western Cape, Worcester (3319): Spes Bona Farm, between the Brandvlei and Draaivlei dams near Worcester (–CD), 30 Apr 2013, *Magee & Ebrahim 1017* (NBG, holo.!; BOL!, K!, PRE!, NBG!, S!, iso.).

Well-branched, multistemmed, twiggy shrublets, 0.3–0.6 m tall. *Leaves* alternate, regularly arranged along branches, suberect, linear, 4–10 × 0.5 mm, simple, mucronulate, secondary basal lobes well developed, rudimentary or absent; axillary fascicles absent or rarely poorly developed on old stems. *Capitula* solitary, terminal or on axillary shoots 5–70 mm long. *Involucre* obconical to campanulate, 4–5 × 4–6 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome obscure; outer bracts broadly ovate, 1.0–1.5 mm long, margin and apex narrowly scarious; middle bracts ovate, 1.5–2.0 mm long, margins scarious, apex broadly scarious, ± truncate; inner bracts oblong, 2.5–3.5 mm long, margins scarious, apex with a prominent scarious appendage, ovate to broadly ovate, reddish pink. *Florets* ca. 14 to 36; limb 5-lobed from just above midpoint; lobes erect to recurved. *Pappus* with adaxial scales ± length of corolla tube.

Diagnostic characters

Marasmodes crewiana and *M. undulata* both have prominent scarious apices on all the involucral bracts. In *M. crewiana* however the apices of the middle and outer bracts are not extended into ovate or broadly ovate appendages, as in *M. undulata*, but remain comparatively short and prominently blunt-tipped (Fig. 2A–C). Furthermore, the involucre is usually obconical (Fig. 2A, broadly campanulate in *M. undulata*), the involucral bracts have an obscure stereome and the pappus is as long as or longer than the corolla tube (shorter than the corolla tube in *M. undulata*).

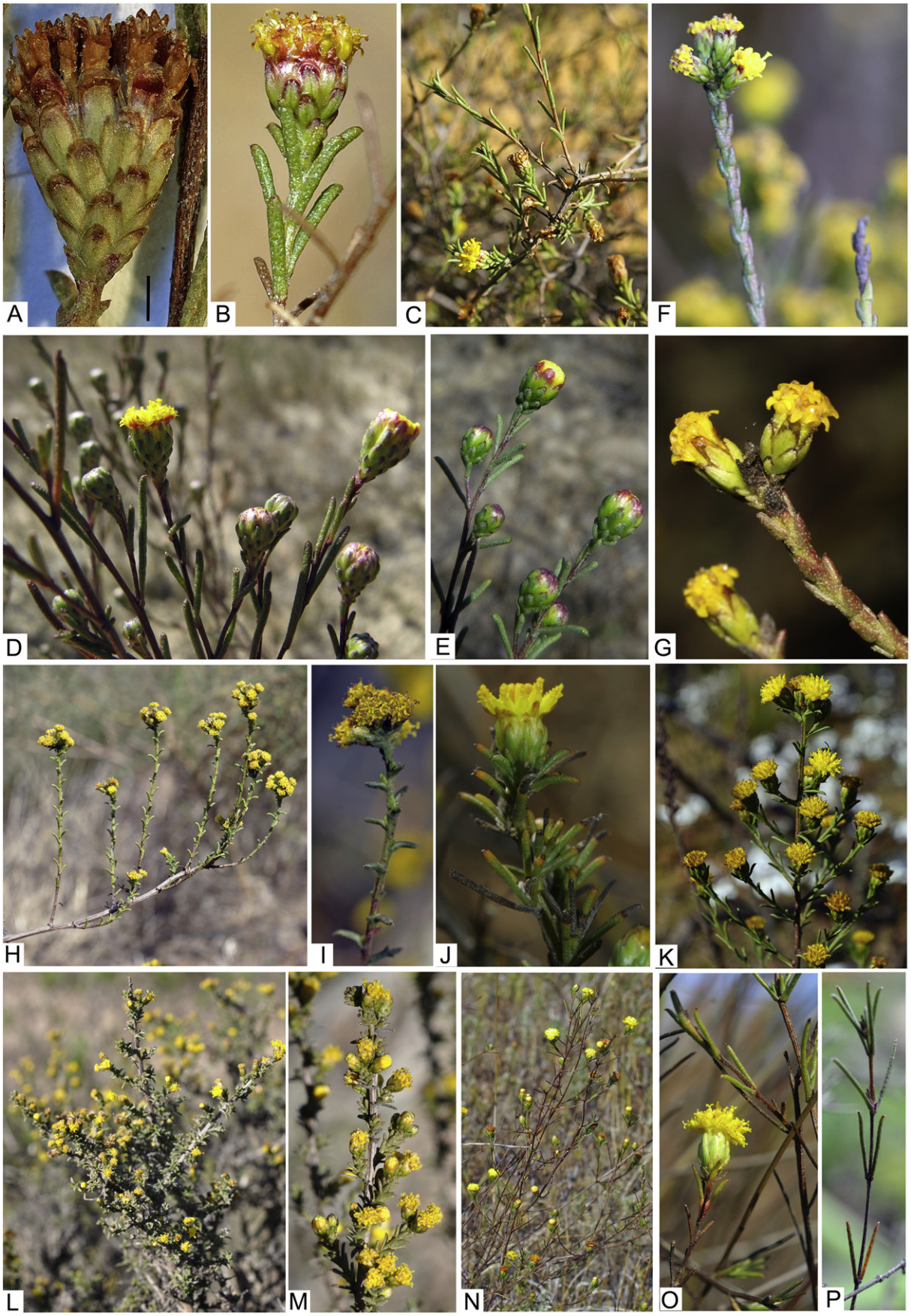

Fig. 2. General morphology of *Marasmodes crewiana* (A–C), *M. defoliata* (D & E), *M. dummeri* (F & G), *M. fasciculata* (H & I), *M. macrocephala* (J & K), *M. oligocephala* (L & M), and *M. oppositifolia* (O & P).

It has also been confused with *Marasmodes macrocephala* in the past but can be readily distinguished by the distinctive scarious apices on all the involucral bracts, the absence of a prominent stereome, the shorter leaves, 4–10 mm long (vs 10–18 mm long in *M. macrocephala*) and the longer pappus, as long as or longer than the corolla tube (vs more or less equal to half the length of the corolla tube).

Distribution and ecology

The species is known from only two small clumps on adjoining farms between the Brandvlei and Draaivlei dams near Worcester (Fig. 3), where it occurs in and alongside drainage washes in transitional areas between quartzite fynbos and shale renosterveld on lower slopes, together with *Cymbopappus adenosolen* (Harv.) B.Nord. There are in total fewer than 50 plants, and the population is threatened by ongoing habitat degradation due to erosion caused by livestock grazing, spreading alien invasive plants and too infrequent fire. It is therefore assessed as Critically Endangered according to the criteria C2a(ii); D.

Additional specimens examined

South Africa. WESTERN CAPE: **3319 (Worcester):** Draaivlei farm between the Brandvlei and Draaivlei dams near Worcester (–CD), 30 Apr 2013, *Magee & Ebrahim 1019* (NBG, BOL); Hentie De Wet's Farm [Spes

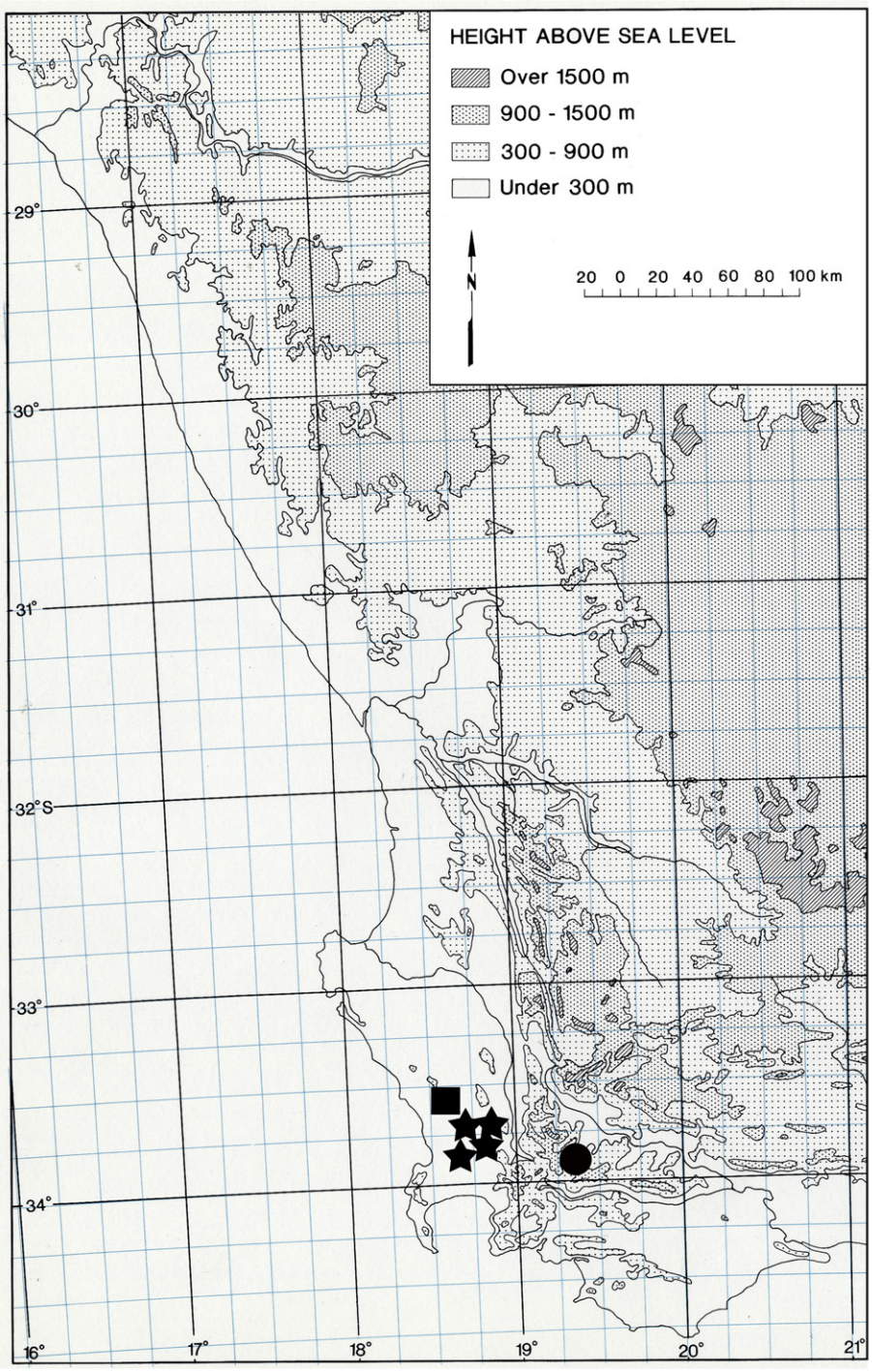

Fig. 3. The known geographical distribution of *Marasmodes crewiana* (circle), *M. defoliata* (square) and *M. dummeri* (stars).

Bona], near Villiersdorp, W of the road to Worcester, N of the 27 mile road mark (–CD), 23 Apr 2009, *Ebrahim CR3770* (NBG, 2 sheets).

2. Marasmodes defoliata S.Ortiz, Bot. J. Linn. Soc. 159: 339 (2009). Type: South Africa. Western Cape, Cape Town (3318): Riverlands (Michiel Heyns Kraal), on flats, wet in winter (–BC), 25 Apr 1978, *Esterhuysen 34925* (BOL!, holo.; K, iso.).

Weak, single or few-stemmed, sparsely leafy shrublets, 0.2–0.4 m tall. *Leaves* alternate, some rarely subopposite, restricted to upper branches or branch tips, caducous, suberect, linear to oblanceolate, 8–20 × 0.5–3.0 mm, simple or sometimes apically 2- or 3-fid, mucronulate, secondary basal lobes absent; axillary fascicles absent. *Capitula* solitary, terminal or on axillary shoots 5–20 mm long. *Involucre* broadly campanulate, 6–10 × 5–7 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome not prominent; outer bracts broadly ovate, 1.5–2.0 mm long, margin and apex not scarious; middle bracts ovate to narrowly ovate, 2–3 mm long, margin and apex at most only slightly scarious, obtuse; inner bracts oblong, 3–4 mm long, margins narrowly scarious, apex with a prominent scarious appendage, ovate to broadly ovate, reddish-pink. *Florets* ca. 20 to 30; limb 5-lobed from just above midpoint; lobes erect to recurved. *Pappus* with adaxial scales to ± half corolla tube length.

Diagnostic characters

Marasmodes defoliata shares the single or few-stemmed habit, sparsely leafy stems with the leaves restricted to the branch tips, and relatively large campanulate capitula (Fig. 2D & E) with *M. oppositifolia* but differs most prominently by the alternate primary leaves and the reddish pink scarious appendages on the innermost involucral bracts (Fig. 2E). The leaves of *M. trifida* are similarly sparse and restricted to the branch tips but *M. defoliata* differs in the predominantly simple primary leaves (predominantly apically trifid in *M. trifida*), the larger broadly campanulate capitula, 6–10 × 5–7 mm (vs cylindrical-campanulate, 4–5 × 3–5 mm) and the short pappus, ± half the length of the corolla tube (vs equal to or longer than the corolla tube).

Distribution and ecology

Known only from one population at Riverlands Nature Reserve, between Atlantis and Malmesbury (Fig. 3), where it occurs on the edges of seasonally inundated places often together with *Metalasia distans* DC. The population consists of between 1000 and 2000 mature individuals. Due to the continued threat of habitat degradation due to dense infestations of alien invasive plants surrounding the reserve, the species is Critically Endangered, CR B1ab(iii) + 2ab(iii).

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** Riverlands Nature Reserve, central alluvial area (–BC), 18 Mar 2009, *Helme 6018* (NBG); Riverlands Nature Reserve, Middelpad, extensive seasonal wetlands in the central part of the reserve (–BC), 26 Mar 2009, *Magee & Koopman 138* (NBG). **Precise locality unknown:** Between Malmesbury and Darling, 4 Apr 1932, *Salter 2077* (BOL, K).

3. Marasmodes dummeri Bolus ex Hutch., Bull. Misc. Inform. Kew 1916, 172 (1917). Type: SOUTH AFRICA. Cape Town (3318): Grassy plains around Kraaifontein (–DC), Jun 1908, *Dummer 1549* (K, sheet K000036593!, lecto., designated here; BOL!, E, K-sheet K0000378265!, NBG!, SAM!, isolecto.).

Laxly branched shrublets, 0.4–0.6 m tall. *Leaves* alternate, regularly arranged along branches, adpressed, lanceolate to linear, 2–3(4) × 0.5 mm, simple, mucronulate, secondary basal lobes rudimentary or absent; axillary fascicles absent. *Capitula* in clusters of 2 to 12, at branch tips. *Involucre* narrowly oblong to narrowly obconical, 1.5–2.0 × 3–4 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 0.5–1.0 mm long, margin and apex broadly scarious; middle bracts narrowly ovate to oblong, 1.5–2.0 mm long, margin broadly scarious, apex with a scarious appendage, yellowish brown; inner bracts oblong, 3.0–3.5 mm long, margins scarious, apex with a prominent scarious appendage. *Florets* ca. 4 to 6; limb 5-lobed from midpoint; lobes erect to recurved. *Pappus* with adaxial scales less than half the length of corolla tube.

Diagnostic characters

Marasmodes dummeri is easily distinguished by the very short adpressed leaves, 2–3 (4) mm long, and the heads arranged in terminal clusters (Fig. 2F & G).

Distribution and ecology

The species is known historically from a small area between Klipheuwel, Kraaifontein and Agter-Paarl (Fig. 3), where it occurs on seasonally moist flats in Swartland Alluvium Fynbos and Swartland Shale Renosterveld. The nutrient rich soils on which both these vegetation types occur are some of the most productive agricultural land in the Western Cape, and only small, isolated fragments of natural vegetation remain scattered among extensive crop fields (Table 2). Surveys of these fragments indicate that it is now locally extinct at several historical localities, including the type locality at Kraaifontein, and only four small subpopulations of *M. dummeri* remain within an area of 134 km^2 between Klipheuwel and Muldersvlei. The largest subpopulation, which is protected within a small provincial reserve, consists of about 200 plants, and there is in total fewer than 500 plants left in the wild. There is ongoing pressure of agricultural expansion and other development on remaining habitat of this species, and therefore we assess it as Endangered, B1ab(iii,v) + 2ab(iii,v); C2a(i), based on its small distribution range and small, fragmented population.

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** 2 km N of Klipheuwel along Malmesbury road (–DA), 2 May 1980, *Burgers 2370* (NBG, PRE); Kuilenberg farm [Kulemberg], Agter Paarl (–DB), 23 Apr 1980, Burgers 2352 (PRE); Bulelwa, Agter-Paarl area (–DB), 1 May 1983, *Van Zyl 3464* (NBG, PRE); Bellville, Old Gymkhana Club, NE of Durbanville, S of Wellington road, farm 1165 (–DC), 28 Apr 2003, *Helme 2666* (NBG); Kraaifontein (–DC), May 1912, *Brown s.n.* (PRE); Eensaamheid Nature Reserve [now Briers Louw], Agter Paarl (–DD), *Burgers 2351* (NBG); Briers Louw Reserve, Klapmuts (–DD), 20 Apr 2005, *Hitchcock 10167* (NBG); 26 May 2006, *Walton & Pienaar 365b* (NBG, 3 sheets); gravelly soil on slope facing NW, about ¾ mile SW of Hercules Pillar (–DD), *Pillans 10054* (BOL, K); Joostenberg's kloof (–DD), 10 Jun 1975, *Esterhuysen 33883* (BOL, K); Paarl, Joostenbergkloof, N of R302 and 1 km N of Joostenberg Hill (–DD), 30 May 2002, *Helme 2465* (NBG); between Klapmuts and Mulders Vlei (–DD), 25 May 1938, *Salter 7228* (BOL, NBG).

4. Marasmodes fasciculata S.Ortiz, Bot. J. Linn. Soc. 159: 334 (2009). Type: South Africa. Western Cape, Cape Town (3318): Malmesbury, east side of Cape Town to Malmesbury road, near the turning to road to Mamre (–DA), 20 May 1956, *N.S. Pillans 10114* (BOL, holo.; K, iso.).

Laxly branched shrublets, 0.3–0.6 m tall. *Leaves* alternate, regularly arranged along branches, spreading, narrowly lanceolate to linear or oblanceolate, 3–10 × 0.5 mm, simple or sometimes trifid, mucronulate, secondary basal lobes rudimentary or well developed; axillary fascicles present or absent. *Capitula* in clusters of 2 to 8, rarely some solitary, at branch tips. *Involucre* campanulate or sometimes narrowly obconical, 3.5–5.0 × 3–5 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 1.5–2.0 mm long, margin and apex broadly scarious; middle bracts narrowly ovate to oblong, 2.0–2.5 mm long, margin broadly scarious, apex with a scarious appendage; inner bracts oblong, 3–4 mm long, margins scarious, apex with a prominent scarious appendage, yellowish brown or sometimes reddish pink. *Florets* ca. 12 to 26; limb

5-lobed from just above midpoint; lobes recurved. *Pappus* with adaxial scales ± half to full length of corolla tube.

Diagnostic characters

Marasmodes fasciculata shares the terminally clustered heads with *M. polycephala* and *M. dummeri* but is distinguished by the spreading leaves (Fig. 2H & I) (adpressed in *M. dummeri* and erect to suberect in *M. polycephala*). The three species also have distinctly sympatric distributions.

Due to the presence of both solitary and irregular clusters of 2 (3) heads in *M. oligocephala*, it has been confused with *M. fasciculata* in the past (e.g. one of the *M. fasciculata* paratypes, *Daines 932* (BOL), is considered here rather to be *M. oligocephala*). Both species share the broadly scarious margins on the outer and middle involucral bracts but *M. fasciculata* can be distinguished by the mostly regular terminal clusters of 2 to 8 heads (vs mostly solitary, some in irregular loose clusters of 2(3) along the upper parts of the stem in *M. oligocephala*) and the larger campanulate or sometimes narrowly obconical heads,

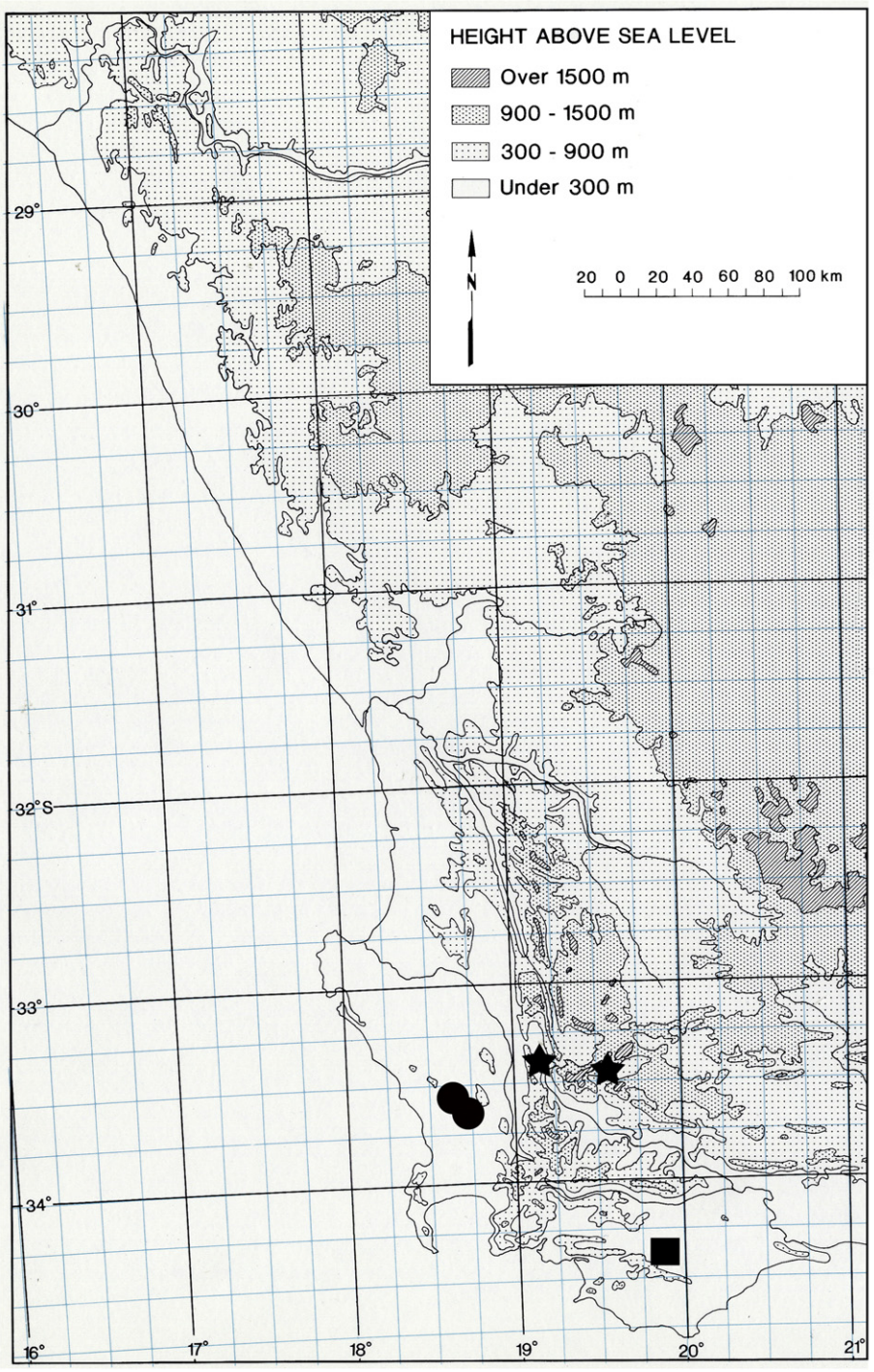

Fig. 4. The known geographical distribution of *Marasmodes fasciculata* (circles), *M. macrocephala* (stars) and *M. reflexa* (square).

3–5 mm broad (vs cylindrical-campanulate, 2–3 mm broad in *M. oligocephala*).

Ortiz (2009) treated material from the Paardeberg as *M. oubinae*, when describing that species. The Paardeberg population is however very different from *M. oubinae*, which has solitary heads borne on very short lateral shoots and with only the inner involucral bracts with prominent scarious margins. After studying this population in situ its identity as rather *M. fasciculata* could be clarified.

Distribution and ecology

This species is restricted to lowland renosterveld between Atlantis and the Paardeberg (Fig. 4) on transition zones between clay and acid sands.

Until the discovery of three individuals at Three Fountains farm in 2012, the species was considered to be possibly extinct with subpopulations at other localities known at the time lost to urban and agricultural expansion and extremely dense alien invasive wattle infestations of the habitat. The revised identification of the Paardeberg subpopulation as *M. fasciculata* (the largest extant subpopulation) increases the known range and population size of this species. However, it is still Critically Endangered, as the two subpopulations are isolated and threatened by ongoing habitat loss and degradation. It qualifies under the criteria B1ab(iii,v) + 2ab(iii,v); C2a(i) due to its small range size (Extent of Occurrence 8 km^2), and a small remaining wild population of fewer than 60 plants, which is fragmented into two small, isolated subpopulations.

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** Three Fountains farm, Atlantis (–DA), 1 Jun 2012, *Magee 496* (NBG); near to the E side of the main road, Cape Town to Malmesbury, about 15 mile out (–DA), 7 Jun 1942, *Pillans 9778* (BOL, NBG); along Malmesbury road, c. 15–20 miles beyond the turn-off from the N7, in zone between sand and clay (–DA), 19 Mar 1971, *Esterhuysen 32584* (BOL); Vlakfontein farm at E side of Paardeberg Flats (–DA), 26 Apr 1980, *Burgers 2361* (NBG), 23 Apr 2014, *Magee & Ebrahim 1067* (NBG); low flats at the E base of the Paardeberg (–DA), Jun 1937, *Pillans 8367* (BOL, NBG, PRE).

5. Marasmodes macrocephala S.Ortiz, Bot. J. Linn. Soc. 159: 338 (2009). Type: South Africa. Western Cape, Worcester (3319): in convalle Hex River, prope De Doorns (–BC), Apr 1907, *Bolus 13126* (BOL, holo.; BM, BOL!, K, iso).

Well-branched, multistemmed, twiggy shrublets, 0.3–0.6 m tall. *Leaves* alternate, those on axillary flowering shoots opposite to subopposite, regularly arranged along branches, suberect to spreading, linear to oblanceolate, 10–18 × 0.5 mm, simple or rarely with 1 or 2 lateral lobes, mucronulate, secondary basal lobes rudimentary; axillary fascicles developed into flowering shoots. *Capitula* solitary, on axillary shoots 5–60 mm long, sometimes less than 3 mm long near the branch tips. *Involucre* campanulate to obconical, 5–7 × 5–7 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent, conspicuously green-flanked; outer bracts ovate, 1.5–2.5 mm long, margin and apex very narrowly scarious; middle bracts narrowly ovate, 3.0–3.5 mm long, margins and apex very narrowly scarious; inner bracts oblong, 4.5–5.0 mm long, margins narrowly scarious, apex with a prominent scarious appendage, yellowish brown. *Florets* ca. 16 to 25; limb 5-lobed from midpoint; lobes recurved. *Pappus* with adaxial scales ± half length of corolla tube.

Diagnostic characters

M. macrocephala and *M. oubinae* share the relatively large, solitary capitula with obconical to broadly campanulate involucre, 5–7 mm wide and involucral bracts with a prominent stereome. It can however be distinguished by the capitula which are borne on prominent leafy shoots, 5–60 mm long (Fig. 2J & K; vs very short lateral shoots, 0.5–4.0 mm long in *M. oubinae*) and the short pappus, extending only halfway up the corolla tube (vs pappus equal to or longer than tube). The involucre of *M. macrocephala* is also somewhat larger, 5–7 mm broad (vs 4–5 mm in *M. oubinae*).

Distribution and ecology

The species occurs on seasonally wet patches between Wolseley and De Doorns (Fig. 4). Ortiz (2009) described this species from a single collection from the Hex River Valley in De Doorns dating from 1907. As this area is almost completely transformed to vineyards, the species was initially thought to be extinct, until CREW members found a small subpopulation of about 200 plants on a commonage on the edge of Wolseley in the Breede River Valley in 2010, and in 2013, another, even smaller subpopulation of 15 plants was found about 2 km away on the opposite side of the town. At both these sites it occurs in seasonally wet transitional areas between shale renosterveld and Breede Alluvium Fynbos, which is also present in the Hex River Valley, and of which less than 40% remains intact (Table 2). The Breede and Hex River valleys are some of South Africa's foremost wine production regions, and valley-bottom alluvial soils are most intensively cultivated. There is ongoing pressure of agricultural expansion on remaining lowland alluvial fynbos fragments, as well as urban expansion around growing towns in this region.

The Wolseley commonage site burnt in the summer of 2013. When surveyed the following year (May 2014) the mature plants of this species had been killed in the fire but the subpopulation had reseeded and most of the plants were already flowering. At that time the subpopulation size was estimated to be less than 200 individuals. The species is therefore assessed as Critically Endangered, C2a(ii), due to the small number of plants remaining in the wild, of which more than 90% occur in one subpopulation that is threatened by spreading alien invasive plants and urban expansion. Surveys of the remaining alluvial fynbos-renosterveld fragments in the Hex River Valley are still needed to confirm whether any extant subpopulations remain in this area.

Additional specimens examined

South Africa. WESTERN CAPE: **3319 (Worcester):** Wolseley commonage NW of town (–AC), 27 Apr 2010, *Koopman CR6067* (NBG); 9 Jul 2012, *Magee & Koopman 500* (NBG); near Wolseley cemetery (–AC), 22 May 2013, *Koopman 1032* (NBG).

6. Marasmodes oligocephala DC., Prodr. 6: 136 (1838); Hutch., Bull. Misc. Inform. 1916: 172 (1917). *Marasmodes polycephalus* var. *oligocephalus* (DC.) Harv. in Harv. & Sond., Fl. Cap. 3: 175 (1865). — *Type*: South Africa. Western Cape, Cape Town (3318): Cape, near Groenkloof (–CB), Apr, *Ecklon 867* (G-DC, image!, holo.).

Stout, well-branched shrublets, 0.3–0.7 m tall. *Leaves* alternate, regularly arranged along branches, spreading to reflexed, narrowly lanceolate to linear or oblanceolate, 3–8 × 0.5–3.0 mm, simple or sometimes trifid, mucronulate, secondary basal lobes rudimentary or well developed; axillary fascicles present. *Capitula* mostly solitary, some in irregular clusters of 2(3), terminal or on axillary shoots 2–12 mm long. *Involucre* cylindrical-campanulate, 3–4 × 2–3 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 1.0–1.5 mm long, margin and apex broadly scarious; middle bracts narrowly ovate to oblong, 1.5–2.0 mm long, margin broadly scarious, apex with a scarious appendage; inner bracts oblong, 2.0–2.5 mm long, margins scarious, apex with a prominent scarious appendage, yellowish brown. *Florets* ca. 6 to 10; limb 5-lobed from just above midpoint; lobes recurved. *Pappus* with adaxial scales ± length of corolla tube.

Diagnostic characters

This species shares the mostly solitary, cylindrical-campanulate heads with *M. trifida* but can be distinguished by the primary leaves which are shorter, 3–8 mm long, and predominantly simple (vs (8)10–14 mm long and predominantly trifid in *M. trifida*), the stoutly branched, densely leafy habit with the leaves regularly arranged along

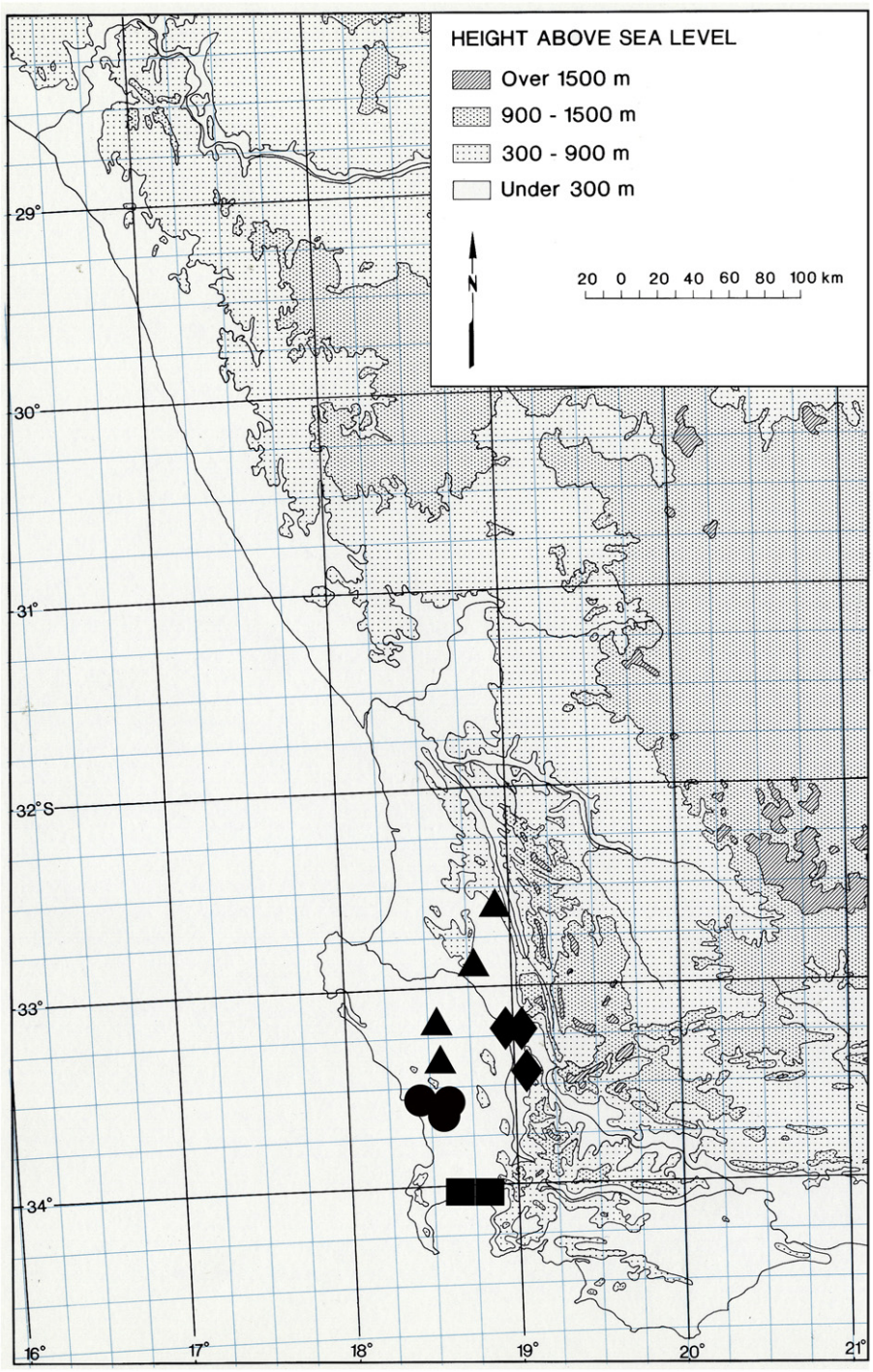

Fig. 5. The known geographical distribution of *Marasmodes oligocephala* (circles), *M. oubinae* (triangles), *M. polycephala* (squares) and *M. spinosa* (diamond).

branches (Fig. 2L), (vs weak, single or few-stemmed, sparsely leafy shrublets with leaves restricted to upper branches or branch tips in *M. trifida*) and the involucral bracts which all have broad scarious margins (vs broadly scarious on the inner bracts only in *M. trifida*).

Marasmodes oligocephala is easily confused with *M. fasciculata* but can be distinguished by the smaller cylindrical-campanulate heads, 2–3 mm broad (vs campanulate or narrowly obconical, 3–5 mm broad), which are mostly solitary or with some in irregular clusters of 2(3) along the upper parts of the stem (Fig. 2M) (vs regular terminal clusters of 2 to 8).

Distribution and ecology

The species is restricted to silcrete outcrops in shale renosterveld between Atlantis and Malmesbury (Fig. 5), a habitat of which less than 10% remains after extensive loss to crop cultivation. Much confusion about the identity of *M. oligocephala* has limited conservation efforts in the past. Hall and Veldhuis (1985) thought the species had a wide distribution range, including many collections that Ortiz (2009) later separated as belonging to other species. Hall and Veldhuis (1985) suspected that it may be in danger of extinction as many populations on the Cape's western coastal lowlands were known to have been severely reduced through habitat loss. Raimondo et al. (2009), included records now

recognised as *M. trifida* in their assessment, mistakenly assuming that the species is protected in the Kalbaskraal Nature Reserve. Our revision of the material revealed *M. oligocephala* to be limited to a very small area (Extent of Occurrence 7 km^2). Recent collections indicate that there are four remaining subpopulations, all occurring on small renosterveld remnants. At two of these fragments, the species is fairly common, with around 200 plants occurring at each. A third subpopulation is very small, consisting of about 10 plants. The fourth subpopulation was last observed in 2006, and the number of plants was not counted. This subpopulation occurs on a tiny fragment of about 2 ha, and is unlikely to be large. It is therefore estimated that the species has fewer than 500 mature individuals remaining in the wild, and continues to decline due to ongoing habitat loss and degradation. It is therefore classified as Endangered according to the criteria B1ab(iii,v) + 2ab(iii,v); C2a(i).

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** Malmesbury, 7 km E of Atlantis, W of N7 on Zouterivier 22, 1 km NW of Rondeberg farmhouse (–DA), 12 Feb 2002, *Helme 2490* (NBG); 26 May 2006, *Walton 369* (NBG); N7, E side of road, just S of Rondeberg turnoff near Zoutrivier (–DA), 26 May 2006, *Walton 369B* (NBG); Atlantis, Rondeberg road off N7, Kora homestead (–DA), 19 May 2009, *Cowell* et al. *MSBP3984* (NBG); Schoongezicht, near Riverlands (–DA), 22 Apr 1992, *Daines 932* (BOL); 27 Apr 2009, *Ebrahim CR3769* (NBG); 1 Jun 2012, *Magee 495* (NBG); 7 Jun 2013, *Hutchinson* et al. *MSBP 4877* (NBG); Three Fountains farm (–DA), 1 Jun 2012, *Magee 497* (NBG).

7. Marasmodes oppositifolia Magee & Koopman sp. nov. Type: South Africa. Western Cape, Worcester (3319): Romansrivier Nature Reserve (–AC), 9 Jul 2012, *Magee & Koopman 499* (NBG, holo.!; BOL!, K!, PRE!, NBG!, S!, iso.).

Weak, single or few-stemmed, sparsely leafy shrublets, 0.2–0.4 m tall. *Leaves* opposite, restricted to upper branches or branch tips, caducous, suberect, linear, 9–20 × 1 mm, simple, mucronulate, secondary basal lobes absent; axillary fascicles absent. *Capitula* solitary, terminal or on axillary shoots 5–150 mm long. *Involucre* campanulate to broadly campanulate, 5–8 × 5–8 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome somewhat prominent; outer bracts broadly ovate, 1.5–2.0 mm long, margin and apex very narrowly scarious; middle bracts ovate, 3–4 mm long, margin and apex narrowly scarious; inner bracts oblong, 4.0–5.5 mm long, margins narrowly scarious, apex with a prominent scarious appendage, yellowish brown. *Florets* ca. 20 to 30; limb deeply 5-lobed from below midpoint; lobes erect to recurved. *Pappus* with adaxially longer, adaxial scales to less than half corolla tube length.

Diagnostic characters

This is the only species with opposite primary leaves and with the floral limb deeply 5-lobed from below the midpoint (Fig. 2N–P).

Distribution and ecology

Marasmodes oppositifolia is known from a single 20 ha fragment of seasonally damp Breede Alluvium Fynbos between Worcester and Wolseley (Fig. 6). Despite this site being well-collected and long known as a hotspot of threatened species (19 other threatened species occur there), *M. oppositifolia* was first discovered in 2010, through CREW's survey efforts. Further surveys of remaining fragments of Breede Alluvium Fynbos have failed to locate any other subpopulations. The site has been secured for conservation through a 15-year biodiversity agreement, whereby the landowners retain ownership of the land, but agree to manage the site for conservation. It is not certain that the contract will be renewed after it comes to an end. There are some alien invasive plants present at the site, which need to be cleared to prevent them from outcompeting native species. Recent road construction at the edge of the site may have altered water flow patterns in the wetland, which may impact this wetland-dependent species in future. The population is being monitored to determine the impact of these threats over time. There are currently only about 20 plants, and therefore the species is assessed as Critically Endangered according to criteria B1ab(iii,v) + 2ab(iii,v); C2a(i,ii); D.

Additional specimens examined

South Africa. WESTERN CAPE: **3319 (Worcester):** Romansrivier Nature Reserve (–AC), 26 Apr 2013, *Koopman 1180* (NBG, BOL).

8. Marasmodes oubinae S.Ortiz, Bot. J. Linn. Soc. 159: 338 (2009). Type: South Africa. Western Cape, Cape Town (3318): between Malmesbury and Hopefield, near Oude Post (–BC), 24 Apr 1934, *Salter 4408* (NBG, holo.; BM, BOL!, K!, iso.).

Marasmodes schlechteri Magee & J.C.Manning, S. A. J. Bot. 76: 280 (2010), syn. nov. Type: South Africa. Western Cape, Clanwilliam (3218): western foot of Piekenierskloof Pass (–DB), 27 May 2009, *Magee, Manning & Boatwright 145* (NBG!, holo.; BOL!, K!, PRE!, S!, iso.).

Marasmodes adenosolen auct. non Harv.: Hutch., Bull. Misc. Inform. 1916: 172 (1917).

Well-branched, multistemmed, twiggy shrublets, 0.3–0.6 m tall. *Leaves* alternate, regularly arranged along branches, spreading, lanceolate to linear or oblanceolate to obovate, 3–10(−12) × 0.5(−5.0) mm, simple or sometimes trifid, mucronulate, secondary basal lobes rudimentary or well developed; axillary fascicles conspicuous. *Capitula* solitary, on axillary shoots 0.5–4.0(−10) mm long. *Involucre* obconical, ca. 4–7 × 4–5 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent, with upper portion conspicuously green-flanked; outer bracts ovate, 1.5–2.5 mm long, margin and apex very narrowly scarious; middle bracts narrowly ovate, 3.0–3.5 mm long, margin and apex very narrowly scarious; inner bracts oblong, ± 4 mm long, margins scarious, apex with a prominent scarious appendage, yellowish brown or reddish pink. *Florets* ca. 10 to 25; limb 5-lobed from just above midpoint; lobes erect to recurved. *Pappus* with adaxial scales ± length of corolla tube.

Diagnostic characters

This species shares the relatively large, solitary capitula with obconical to broadly campanulate involucre and involucral bracts with a prominent stereome (Fig. 7B) with *M. macrocephala*. It is distinguished from *M. macrocephala* by the smaller capitula, 4–5 mm broad (vs 5–7 mm broad in *M. macrocephala*), borne on very short lateral shoots, 0.5–4.0 mm long (Fig. 7A) (vs. prominent leafy shoots, 5–60 mm long) and the longer pappus which is equal to or longer than the corolla tube (vs pappus equal to half floral tube length).

Ortiz (2009) also included material from the Paardeberg when describing *M. oubinae*. The Paardeberg specimen(-s) examined by Ortiz (2009) however, has largely solitary heads and is clearly atypical. Field studies of the Paardeberg population revealed that the capitula are clustered at the branch tips and all the involucral bracts have prominent scarious margins. As such they are very different from the type population of *M. oubinae*. Rather these traits are diagnostic of *M. fasciculata* and as a result the Paardeberg material is treated here under the latter.

When describing *M. schlechterii*, Magee and Manning (2010) had only seen the Paardeberg material and as a result considered *M. oubinae* to represent a very different taxon with clustered capitula (Manning and Goldblatt, 2012). Subsequent comparison of *M. schlechterii* with the type material of *M. oubinae* has revealed that other than a slight difference in the size of the capitula the two taxa are inseparable and as a result *M. schlechterii* is here reduced into synonymy.

Distribution and ecology

Historical records indicate that *M. oubinae* was formerly relatively widespread in shale renosterveld across the northern Swartland between Moorreesburg, the Piketberg and the foot of the Olifants River

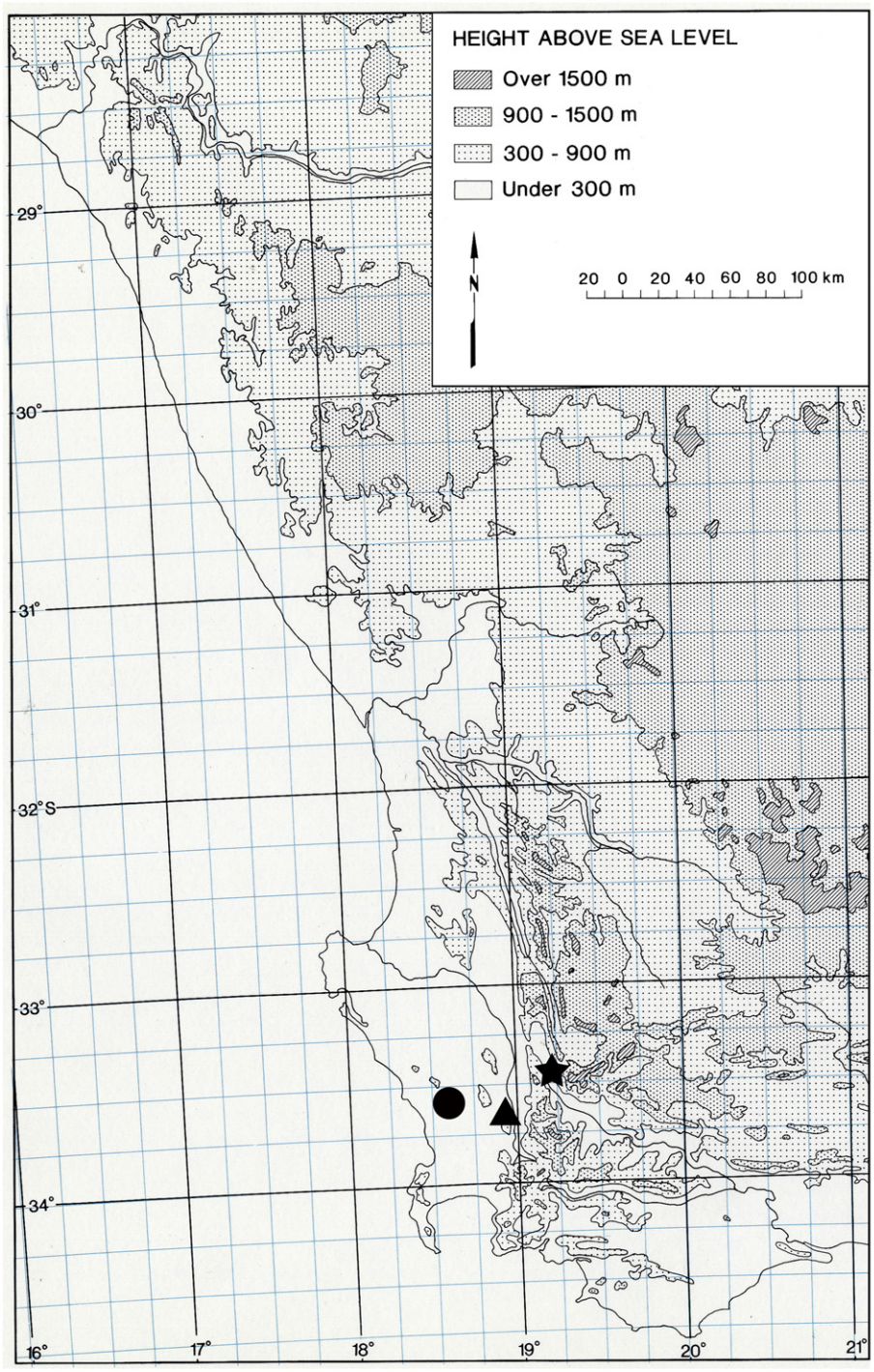

Fig. 6. The known geographical distribution of *Marasmodes oppositifolia* (star), *M. trifida* (circle) and *M. undulata* (triangle).

Mountains (Fig. 5). Less than 10% of shale renosterveld remain in this intensively cultivated area, and the species was not recorded for 50 years until a small subpopulation of about 20 plants was found in 2002 at the foot of the Olifants River Mountains (Magee and Manning, 2010; Manning and Goldblatt, 2012). At this locality the plants occur on gravelly alluvium in transitional renosterveld–fynbos vegetation together with the endangered *Annesorhiza refracta* Magee (Magee et al., 2011), *Diplosoma retroversum* (Kensit) Schwantes (Klak et al., 2005) and *Oxalis pallens* Eckl. & Zeyh. (Helme et al., 2012).

Despite a recent search the subpopulation at the type locality near Darling could not be relocated and may no longer be extant. Furthermore, it is unlikely that many, if any, subpopulations remain on the lower slopes of the Piketberg due to the extensive transformation of the plains between the Olifants River and Piketberg Mountains (Manning et al., 2012.). CREW recently recorded two subpopulations on small fragments between Eendekuil and the Olifants River Mountains. At these sites, plants were found in renosterveld fragments with quartz gravel. A fourth subpopulation was found near the type locality, at a site earmarked for gravel mining. All four subpopulations are small, the largest with only 35 plants, and three occur on small, isolated renosterveld remnants of less than 25 ha in size. The species is therefore assessed as Critically Endangered, B2ab(iii,v); C2a(i) due to its small Area of Occupancy (<1 km^2), small, severely fragmented population, and ongoing threat of habitat loss and degradation.

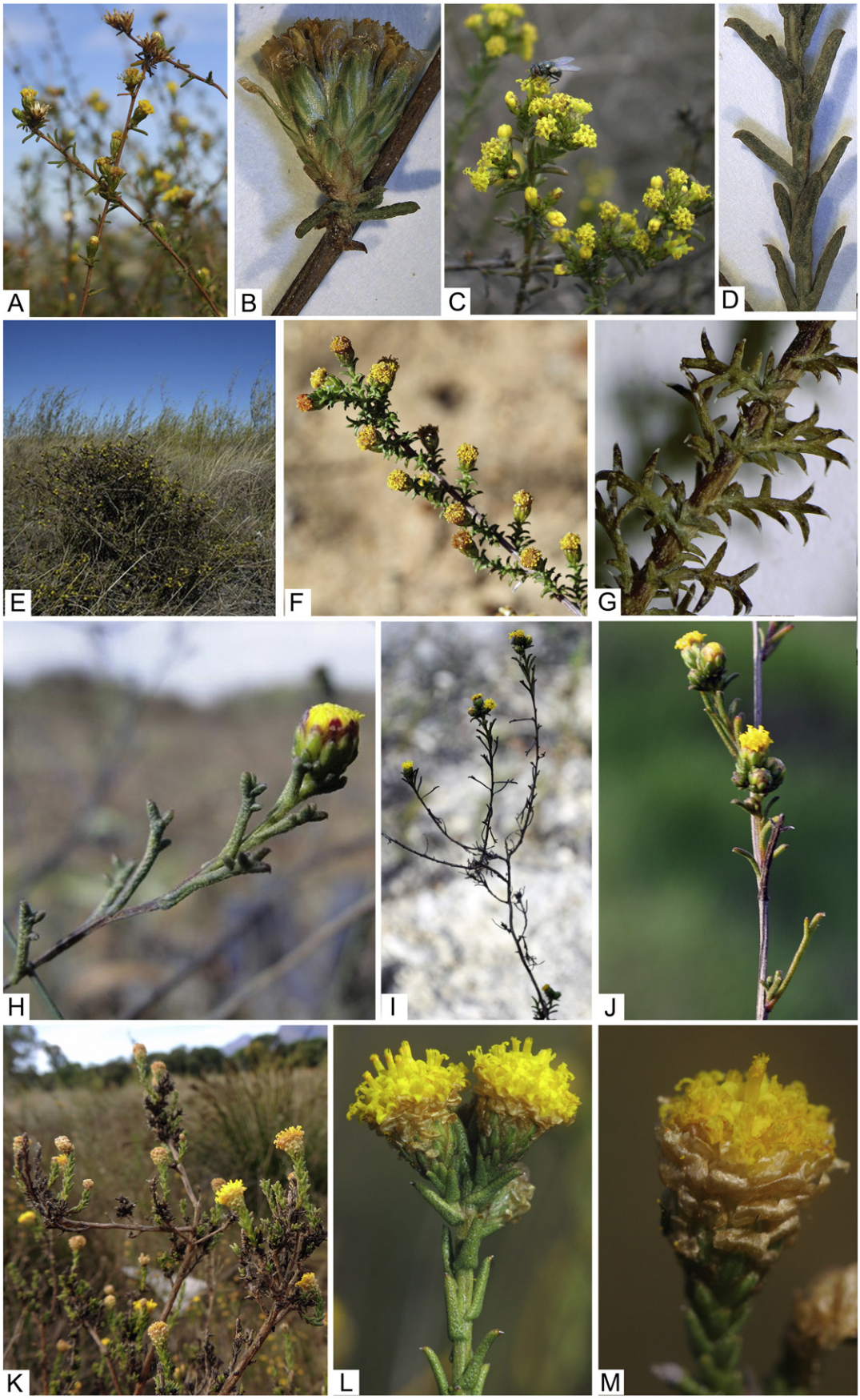

Fig. 7. General morphology of *Marasmodes oubinae* (A & B), *M. polycephala* (C & D), *M. spinosa* (E–G), *M. trifida* (H–J), *M. undulata* (K–M).

Additional specimens examined

South Africa. WESTERN CAPE: **3218 (Clanwilliam):** Near Eendekuil, western foot of Piekenierskloof Pass (–DB), 1 Jul 2002, *Manning 2747* (NBG); SE end of Piketberg Mountain, stony, clayish lower slopes (–DC/DD), 28 May 1952, *Esterhuysen 20134* (BOL, PRE); Piketberg, 29 Jun 1896, *Schlechter 7899* (BOL, PRE, Z). **3318 (Cape Town):** Farm Schilpadvalley (Skilpadvlei), 3 km east of R45 along R307, ca. 11 km SW of Moorreesburg, 5 ha remnant of Swartland Shale Renosterveld (–BA), 21 Apr 2015, *Koopman 1237* (NBG).

9. Marasmodes polycephala DC., Prodr. 6: 136 (1838); Harv. in Harv. & Sond., Fl. Cap. 3: 175 (1865); Hutch., Bull. Misc. Inform. 1916: 172 (1917). Type: South Africa. Western Cape, Stellenbosch, Hottentottsholland, May 1835, *Ecklon 1333* (G-DC, image!, holo.; NBG!, P, image!, S, image!, iso.).

Oligodorella teretifolia Turcz. Mull. Mosc. XXIV.: 188 (1851). Type: South Africa. Western Cape, Stellenbosch, Hottentottsholland, May 1835, *Ecklon 1333* (KW, image!, lecto., designated here; G-DC, image!, NBG!, P, image!, S, image!, isolecto.).

Marasmodes beyersiana S.Ortiz in Bot. J. Linn. Soc. 159: 331 (2009), syn. nov. Type: South Africa. Western Cape, Simonstown (3418), Faure (–BA), 11 May 1945, *Bolus 23198* (BOL!, holo.).

Laxly branched shrublets, 0.2–0.4 m tall. *Leaves* alternate, regularly arranged along branches, erect to suberect, lanceolate, 3–7 × 0.5 mm, simple, mucronulate, secondary basal lobes absent; axillary fascicles absent. *Capitula* in clusters of 2 to 12, rarely some solitary, at branch tips. *Involucre* narrowly obconical to campanulate, 2–5 × 3–5 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 0.5–1.0 mm long, margin and apex broadly scarious; middle bracts narrowly ovate to oblong, 1.5–2.0 mm long, margin broadly scarious, apex with a scarious appendage; inner bracts oblong, 2.5–3.5 mm long, margins scarious, apex with a prominent scarious appendage, reddish pink. *Florets* ca. 4 to 16; limb 5-lobed from midpoint; lobes erect to recurved. *Pappus* with adaxial scales ±half the length of corolla tube.

Diagnostic characters

Marasmodes polycephala is closely related to *M. dummeri* and *M. fasciculata* and the three species share the capitula arranged into prominent terminal clusters (Fig. 7C). *Marasmodes polycephala* can be readily distinguished by the erect to suberect leaves (Fig. 7D) (vs adpressed in *M. dummeri* and spreading in *M. fasciculata*). It can be further distinguished from *M. dummeri* by the longer leaves, 3–7 mm long (vs 2–3(4) mm long) and from *M. fasciculata* by the prominent reddish pink scarious margins of innermost involucral bracts (vs usually yellowish brown). The distribution of these three closely related species is sympatric.

Distribution and ecology

This species is restricted to alluvial fynbos flats between Faure and Gordon's Bay (Fig. 5). There is critically little of this habitat left, as most has been lost to urban expansion, and there is ongoing development pressure on remaining fragments. Two small, isolated subpopulations persist, one at Gordon's Bay and one at Faure. The formerly extensive subpopulation at Gordon's Bay, monitored by CapeNature's conservation officials during the 1980s has been reduced by habitat loss to urban expansion during the 1990s, and now only 300 plants remain on a 22 ha fragment partially protected in a municipal nature reserve. At Faure, 50 plants remain in a small area of transitional renosterveld-sand fynbos infested with alien invasive plants, and there have been development applications on the land in the past, which have thus far been turned down due to the presence of many threatened plant species. *M. polycephala* is therefore assessed as Critically Endangered, B1ab(iii,v) + 2ab(iii,v). Of all *Marasmodes* species, effective conservation of *M. polycephala* has been most severely limited by taxonomic confusion. Hall et al. (1980), Hall and Veldhuis (1985), and Hilton-Taylor (1996) did not include the species in their Red Data books, and Raimondo et al. (2009) assessed it as Least Concern, as it was thought to be widespread and not in danger of extinction, due to confusion with *M. dummeri*, and *M. fasciculata* not being recognised as a distinct species until 2009.

Additional specimens examined

South Africa. WESTERN CAPE: **3418 (Simonstown):** Faure, Vergenoegd Farm, E of R310, N of N2, south of entrance road off R310 (–BA), 16 Aug 2005, *Helme 3522* (NBG); 4 May 2006, *Helme 3884* (NBG); Vergenoegd Wine Farm (–BA), 23 Jun 2006, *Cowell* et al. *MSBP 3126* (NBG); Faure, western flats close to national road (–BA), 14 May 1975, *Oliver 5914* (NBG); near Faure Station (–BA), 4 May 1929, *Duthie 2012* (BOL, NBG, PRE); Harmony/Gustrouw flats, Gordon's Bay, erf 6329, Disa road, 0.2 km SE of Harmony Flats Nature Reserve (–BB), 14 May 2004, *Helme 3001* (NBG); Harmony Flats Reserve (–BB), 3 Jun 1972, *Oliver 3744* (PRE); 1 May 2005, *Runnalls 1159* (NBG); flats between Rusthof and Gordon's Bay (–BB), 16 Apr 1980, *Burgers 2343* (NBG).

10. Marasmodes reflexa S.Ortiz, Bot. J. Linn. Soc. 159: 334 (2009). Type: South Africa, Western Cape Province, Bredasdorp District, Napier, Renosterbos community, 15 Jun 1946, *P.G. Jordaan 51* (NBG, holo.; NBG, iso.).

Well-branched shrublets, at least 0.3 m tall. *Leaves* alternate, regularly arranged along branches, spreading to reflexed, linear to narrowly obovate, 2–7 × 0.5–5.0 mm, mostly trifid, some simple, mucronulate; axillary fascicles conspicuous. *Capitula* solitary, terminal. *Involucre* campanulate to slightly obconical, 3–4 × 3.0–3.5 mm; bract margins and apices scarious, sessile glands at appendage base prominent; outer bracts ovate, ±1 mm long, without scarious margins; inner bracts narrowly oblong, ±4 mm long, margins scarious, apex with a prominent scarious appendage, yellowish brown or colourless, sessile glands conspicuous at appendage base, yellowish. *Florets* ca. 8 to 12; limb 5-lobed from just above midpoint; lobes recurved. *Pappus* with adaxial scales more than half corolla tube length.

Diagnostic characters

This species shares the regularly trifid primary leaves with *M. trifida* but can be readily distinguished by its shorter spreading to reflexed leaves, 2–7 mm long (vs suberect to spreading and (8)10–14 mm long in *M. trifida*), the robust well branched habit with the leaves regularly arranged along the branches (vs. weak, single or few-stemmed habit with leaves restricted to upper branches or branch tips) and the inner involucral bracts with conspicuous yellow glands at the base of the scarious apex (vs glands not conspicuous).

Distribution and ecology

Marasmodes reflexa is known only from the type specimen, collected in renosterveld vegetation around Napier in 1946 (Fig. 4). Since then, much of this habitat in the area has been converted to crop fields, and only small fragments remain. CREW has surveyed renosterveld fragments around Napier and further towards Caledon in 2011 and 2016, but has not yet located any surviving populations. If this species, like other *Marasmodes* species, is localized to transitional habitats, it is likely that it could be easily overlooked. Surveys are ongoing, but the species may also be extinct. It is therefore assessed as Critically Endangered (Possibly Extinct). This is the only *Marasmodes* species recorded in the Overberg.

11. Marasmodes spinosa S.Ortiz, Bot. J. Linn. Soc. 159: 333 (2009). Type: South Africa. Western Cape, Worcester (3319): 25 km from Wellington, Elandsberg Private Natural Reserve (–AC), 12 Nov 1986, *De Villiers 18* (NBG, holo.).

Stout, well-branched shrublets, 0.15–0.3 m tall. *Leaves* alternate, regularly arranged along branches, spreading, elliptic to oblong or

obovate, 2.5–6.0 × 1.5–3.0 mm, pinnatifid, with 3 to 6(8) lateral lobes, some trifid, spine-tipped, rigid, secondary basal lobes well developed; axillary fascicles well-developed. *Capitula* mostly solitary, some in irregular clusters of 2 or 3, terminal or on axillary shoots 0.5–10.0 mm long. *Involucre* cylindrical-campanulate to obconical, 3–5 × 3–4 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate to narrowly ovate, 1.0–1.5 mm long, margin and apex broadly scarious; middle bracts narrowly ovate to oblong, 2.0–2.5 mm long, margin and apex broadly scarious; inner bracts oblong, 3–4 mm long, broadly scarious, apex with a prominent scarious appendage, reddish pink. *Florets* ca. 10 to 20; limb 5-lobed from ± midpoint; lobes recurved. *Pappus* with adaxial scales less than half or sometimes almost equal length of corolla tube.

Diagnostic characters

This is the only species with pinnatifid primary leaves and rigid, spine-tipped lobes (Fig. 7E–G). As such it is unlikely to be confused with any of the other species.

Distribution and ecology

Marasmodes spinosa has a limited distribution between Saron and Gouda on the eastern edge of the Swartland, where it occurs in seasonally waterlogged transitional alluvial-shale soils (Fig. 5). Although much of its habitat has been lost to crop fields, about 20% remains intact, and a large portion is protected within a private nature reserve on the flats at the foot of the Elandsberg Mountains. Consequently, *M. spinosa* has two of the largest remaining subpopulations of all *Marasmodes* species. *M. spinosa* was known for a long time only from the type locality, where it was first collected in 1986. CREW surveys recently recorded two additional subpopulations further north, one of which has over 1000 plants. The species however has a restricted Extent of Occurrence (134 km^2), and is impacted by ongoing habitat loss and degradation, and therefore it is assessed as Endangered, B1ab(iii,v) + 2ab(iii,v).

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** Riebeek Valley, Rhenostervlei farm, NE of Riebeek Kasteel (–BB), 5 May 2016, *Marais 208* (NBG). **3319 (Worcester):** Gouda Wind Farm, east of canal near to Northern Boundary of property (–AA), 12 May 2016, *Koopman 1260* (NBG); Elandsberg Nature Reserve (–AC), 25 Apr 2003, *Walton 273* (NBG); 27 Apr 2005, *Walton & Mucina 270405/7* (NBG); 28 Apr 2008, *Koopman 760* (NBG); 26 May 2005, *Raimondo CR650* (NBG); 26 Jul 2009, *Magee & Boatwright 152* (NBG).

12. Marasmodes trifida S.Ortiz, Bot. J. Linn. Soc. 159: 331 (2009). Type: South Africa, Western Cape Province. Cape Town (3318): Groenrivier farm, between the eastern slopes of Dassenberg and Kalabaskraal village, on heavy brackish clay in association with *Salicornia* (–DA), 2 May 1980, *Rourke 1672* (NBG, holo.; K, NBG!, PRE!, iso.).

Weak, single or few-stemmed, sparsely leafy shrublets, 0.3–0.4 m tall. *Leaves* alternate, restricted to upper branches or branch tips, caducous, suberect to spreading, narrowly obovate, (8)10–14 × 1–4 mm, predominantly apically trifid, some simple or weakly pinnatifid, mucronulate, secondary basal lobes absent; axillary fascicles weakly developed or absent. *Capitula* mostly solitary, some in irregular clusters of 2 or 3, terminal or on axillary shoots 2–15 mm long. *Involucre* cylindrical-campanulate, 4–5 × 3–5 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 1.0–1.5 mm long, margin and apex not scarious; middle bracts narrowly ovate to oblong, 2.0–2.5 mm long, margin and apex at most only slightly scarious; inner bracts oblong, 3–4 mm long, narrowly scarious, apex with a prominent scarious appendage, yellowish brown to reddish pink. *Florets* ca. 10 to 14; limb 5-lobed from midpoint; lobes recurved. *Pappus* with adaxial scales ≥ length of corolla tube.

Diagnostic characters

The combination of the regularly trifid primary leaves and the single or few stemmed sparsely leafy habit, with the leaves restricted to upper branches or branch tips makes this species easily identifiable. It differs further from *M. oligocephala* by the longer primary leaves, 10–14 mm long (vs 3–8 mm long) and the absence of prominent scarious margins on the outer and middle involucral bracts.

The weakly branched habit and sparse leaves (Fig. 7I & J) is reminiscent of *M. defoliata* from which it differs by the regularly trifid primary leaves (Fig. 7J), the smaller cylindrical-campanulate capitula, 4–5 mm long (Fig. 7H) (vs broadly campanulate, 6–10 mm in *M. defoliata*) and the longer pappus, equal to or longer than the length of the corolla tube (vs ± half tube length in *M. defoliata*).

Distribution and ecology

Marasmodes trifida is localized to heavy, brackish clay flats in sand fynbos, and since it was first recorded in 1980, it has been only known from a small area between Rondeberg and Kalabaskraal near Malmesbury (Fig. 6). Monitoring of the population at the type locality in the 1980s indicated that the species was formerly abundant at this site, but ongoing habitat degradation, particularly due to the spread of alien invasive wattles, which by now have become an impenetrable thicket, has led to severe decline of this subpopulation over the past 30 years. A few plants persist in a road verge that is frequently cleared of woody vegetation, but there are concerns that frequent mowing is likely to damage the last remaining plants. Three more plants were found on the edge of a nearby clay quarry in 2010, a site that is also densely infested with alien wattles. A single plant was found at a commercial chicken farm in 2011, but at the time of discovery, it had already been sprayed with herbicide intended for clearing alien invasive plants, and later died. *M. trifida* is on the brink of extinction, and is classified as Critically Endangered, C2a(i); D. Urgent conservation interventions are needed to restore the population to viable numbers. A portion of the property at the chicken farm has been set aside for conservation, and *M. trifida* plants are being cultivated ex situ with the intent to reintroduce them to this site.

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** Kalbaskraal Nature Reserve (–DA), 26 Apr 1980, *Burgers 2360* (PRE); 2 May 1980, *Burgers 2368* (PRE); 27 Apr 2009, *Ebrahim CR3768* (NBG); Farm north of Rondeberg turnoff, 1.3 km W of N7, clay quarry (–DA), 31 Mar 2010, *Koopman 976* (NBG).

13. Marasmodes undulata Compton, J. S. African Bot. 12: 87 (1946). Type: South Africa. Western Cape, Cape Town (3318): Paarl division, gravelly flats north of Hueguenot (–DB), 26 Apr 1946, *Compton 17987* (NBG, holo.; BOL!, PRE!, iso.).

Well-branched, multistemmed, twiggy shrublets, 0.3–0.7 m tall. *Leaves* alternate, regularly arranged along branches, adpressed to erect, lanceolate, 2.5–5.0 × 0.5 mm, simple, mucronulate, secondary basal lobes absent; axillary fascicles absent or poorly developed. *Capitula* solitary, terminal or on axillary shoots 2–25 mm long. *Involucre* campanulate, 4–6 × 4–5 mm; bract margins and apices scarious, sessile glands at appendage base inconspicuous, stereome prominent; outer bracts ovate, 1.5–2.0 mm long, margin scarious, apex with a broadly ovate scarious appendage, undulate, ± spreading; middle bracts ovate, 2.5–3.5 mm long, margins broadly scarious, apex with a broadly to very broadly ovate scarious appendage; inner bracts oblong, 4–5 mm long, margins broadly scarious, apex with a broadly to very broadly ovate scarious appendage, yellowish brown to reddish pink. *Florets* ca. 18 to 30; limb 5-lobed from midpoint; lobes recurved. *Pappus* with adaxial scales ± half to ¾ length of corolla tube.

Diagnostic characters

This species is easily distinguished by the prominent, broadly to very broadly ovate scarious apical appendages on the outer, middle and inner involucral bracts (Fig. 7K–M). In all other species scarious apical appendages are present only on the innermost involucral bracts. The scarious appendages are often prominently undulate, so that they appear ruffled (Fig. 7M).

Distribution and ecology

Marasmodes undulata occurs on seasonally damp gravelly alluvial flats near Paarl (Fig. 6). It is known from only one population on a 4 ha fragment of natural vegetation within the New Orleans municipal campsite, together with *Annesorhiza articulata* Magee (Magee, 2015). This remaining population has been monitored since its discovery in the 1980s, when there were 300 plants. However, only 20 plants were recorded in 2005 and the site was partially burnt in 2006 in an attempt to promote recruitment. However, no new post-fire recruitment have been recorded during surveys in 2006 and 2011. In 2012, we counted about 30 individuals in the unburnt area. For these reasons *M. undulata* is considered Critically Endangered, B1ab(iii,v) + 2ab(iii,v); C2a(ii).

Additional specimens examined

South Africa. WESTERN CAPE: **3318 (Cape Town):** New Orleans campsite, Paarl (–DB), 13 Apr 1980, *Burgers 2334* (K, PRE); 17 May 1992, *Ivey 20* (NBG); 12 Dec 2004, *Helme 3172* (NBG); 12 May 2005, *Mucina 120505*/1 (NBG, 2 sheets); 9 Jul 2012, *Magee & Koopman 502* (NBG).

Acknowledgements

The curators and staff of the cited herbaria are thanked for their kind hospitality and assistance during visits and for making specimens available on loan. The curators and herbarium staff from Conservatoire Botanique de la Ville de Genève and Trinity College Dublin are thanked for supplying electronic images of type material. CapeNature is thanked for providing the relevant permits. This work is based upon research supported by the National Research Foundation and Department of Science and Technology under the SABI Programme. Craig Hilton-Taylor contributed insight into the historical assessments of *Marasmodes*, and Jacques van der Merwe is thanked for providing information regarding conservation efforts for *M. trifida*. The following people are also acknowledged for allowing us to use their photographs, Nick Helme (Fig. 2D, Fig. 7C), John Manning (Fig. 7A), Clifford Dorse (Fig. 2G), Janeen Nichols (Fig. 7K) and Richard Adcock (Fig. 7L & M).

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