

Systematics of the southern African genus *Ixia* (Iridaceae). 2. The filiform-leaved *I. capillaris* complex

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ABSTRACT

Field study and associated examination of herbarium specimens of the filiform-leaved species of section *Morphixia* of the South African genus *Ixia* L. have resulted in an increase in the number of species with this derived leaf type. *Ixia capillaris* and *I. pauciflora* have until now been the only species with such leaves and they have not been regarded as immediately related in past accounts of the genus. The two foliage leaves, typically less than 2 mm wide, with a leathery to succulent texture, and lacking a raised central vein or margins, are specialized in the genus. Associated finely fibrous corm tunics, spikes of 1–3 flowers, and when present, short, thread-like lateral branches, usually bearing 1 or 2 flowers, provide supporting evidence that the group is monophyletic. *I. capillaris* as interpreted until now, comprises four species, three of them new and described here, and the large-flowered *I. pauciflora* includes two species, one of these described here. While *I. capillaris* has a branched stem, radially symmetric flowers with a perianth tube (4–)5–7(–8) mm long, tepals 11–15 mm long and thus substantially exceeding the tube, filaments typically exerted 1–2 mm, and anthers (3–)4–5 mm long, *I. exiliflora* has a tube 8–10 mm long and \pm as long as the tepals, included filaments, and anthers 3.5–4.0 mm long. The new *I. dieramoides* also has included filaments but a perianth tube 13–18(–22) mm long and tepals 11–18 mm long. A third new species, *I. reclinata* has large flowers with a tube 13–15 mm long, tepals 16–21 mm long, and unilateral, declinate stamens with the filaments exerted 8–10 mm, and anthers 4–5 mm long. Typical *I. pauciflora* has flowers with unilateral stamens and filaments exerted 2–6 mm from the flower and anthers prominently displayed, but specimens until now included in that species with short, included filaments 3–5 mm long and anthers half included in the tube, are here regarded as *I. dieramoides*. The *I. capillaris* group as treated here, now includes five species.

INTRODUCTION

In a continuation of our studies of the systematics of *Ixia*, a genus of the winter rainfall zone of southern Africa and largely restricted to the Greater Cape floral region, we re-examine the taxonomy of *I. capillaris* [subgenus *Morphixia sensu* Goldblatt & Manning (1999), thus including Lewis's sections *Morphixia* and *Hyalis*] and allied species that share only two foliage leaves with distinctive narrow, leathery blades less than 2 mm wide, without a visible main vein, and with rounded, unthickened margins when fresh. We refer to the group for convenience as the *I. capillaris* complex, for the first and most widespread species with such leaves to be named. As revised by Lewis (1962), *Ixia* included 44 species, and since the publication of her account, a further 19 species have been added to the genus, one reduced to synonymy (Goldblatt & Manning 2008). With three more here as a result of our reappraisal of the *I. capillaris* complex, the current total in the genus is 66 species, of which 39 fall in subgenus *Morphixia*.

Plants assigned in herbaria to *Ixia capillaris* and *I. pauciflora*, which we consider to be closely related, share distinctive, derived leaf blades, and in addition, comparatively fine, netted corm tunics. Lateral branches, when present, are short, thin and wiry, and bear one or two, rarely three flowers. The leaf morphology, corm tunics and branching pattern all appear derived and we provisionally consider plants with these features to comprise a single lineage. The taxonomy of the group, however, is in need of revision: plant specimens cur-

rently placed under *I. capillaris* and *I. pauciflora* in herbaria seem on close examination to be more diverse than their respective circumscriptions. Plants with a perianth tube 5–7 mm long, filaments exerted 1–2 mm from the tube, anthers 4–5 mm long, and short style branches 1.0–1.8 mm long, match the type of *I. capillaris* according to Lewis's (1962) account of *Ixia*, which comprises the only modern monographic revision of *Ixia* [M.P. de Vos's (1999) account of *Ixia* for *Flora of southern Africa* follows Lewis's taxonomy exactly for the filiform-leaved species]. These plants occur widely across the Cape floral region (*sensu* Goldblatt & Manning 2000; Manning *et al.* 2002), usually on clay and loamy soils. Plants with the vegetative features described above but relatively small flowers with a funnel-shaped perianth tube, have until now been referred to *I. capillaris* by default. Our examination of floral variation in specimens that have accumulated in herbaria since Lewis's account of *Ixia*, however, shows that multiple undescribed species have now been assigned to *I. capillaris*.

Of the three sets of populations that stand out as diverging significantly from the above description, the first extends from Worcester eastward to Touws River, in the interior centre of the range of *Ixia capillaris*. These plants have a perianth tube 8–10 mm long, filaments included in the tube, and anthers 3–4 mm long, with the bases usually also included in the tube. Well-grown specimens stand out in having several 1–3-flowered lateral branches. A second set of populations includes tall plants from the Bonteberg and Voetpadsberg north and east of Touws River and locally in the Little Karoo, that have a perianth tube 13–17 mm long, filaments reaching the mouth of the tube, and 1 or 2 branchlets mostly with a single flower each. Lastly, plants from the Caledon District with larger flowers, a tube 13–15 mm long, unilateral stamens with filaments exerted 8–10 mm from

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the tube, and a style that divides below the level of the anthers into branches 4–5 mm long, appear intermediate between *I. capillaris* and *I. pauciflora*. Notably, none of the plants mentioned above has the chestnut brown cataphylls that are typical of both *I. capillaris* and *I. pauciflora*.

Ixia pauciflora has seemed fairly uniform in morphology but examination of all specimens available in southern African herbaria shows that the species comprises two sets of populations, the typical one with filaments 12–13 mm long, exerted 2–6 mm, and anthers (4–)5–6 mm long, and a second series with short filaments 2.5–5.0 mm long included in the tube, and short anthers 2.5–3.3 mm long, also partly included. These latter plants have a coherent range in the southern Cedarberg and although they occur within the range of *I. pauciflora*, we believe they represent a western series of populations of the plants mentioned above from the Bonteberg and Voetpadsberg.

MATERIALS AND METHODS

Using standard methods of taxonomic investigation, we examined the holdings of *Ixia* in herbaria with significant southern African collections, BOL, K, MO, NBG, PRE, and SAM (acronyms following Holmgren *et al.* 1990). We then assembled sets of measurements for taxonomically important features from well-preserved specimens, bearing in mind that floral features may shrink up to 20% of their original size, depending on the care with which specimens are prepared. We did not use Lewis's (1962) or De Vos's (1999) measures for any taxa because we apply some names in different ways. Leaf sections were made by hand from fresh material and stained with basic fuchsin.

Our herbarium studies were accompanied by field investigation throughout the geographic range of the *Ixia capillaris* complex to determine variation within populations and their ecology, especially soil, aspect, and altitudinal range.

RESULTS

Examination of living plants and anatomical sections of fresh leaves, confirmed the unique leaves of the *Ixia capillaris* complex, also present in *I. pauciflora*. Comparison of living and dried leaves revealed additional leaf details. The fresh leaf blades have a leathery to almost succulent texture and neither the central vein nor the margins are visible as raised portions of the surface. When dry, however, the leaf tissue surrounding the central vein shrinks to a greater degree than the vasculature and the margins. The blade can then be identified to have one main vein or pseudomidrib, now apparently raised above the surface. In addition, the main vein is always displaced toward the abaxial margin. The blade is thus divided into two unequal parts with the abaxial portion about half as wide as the adaxial portion. The blades sometimes have, in addition, one or a pair of secondary veins. Anatomically, the secondary bundles are surrounded by complete sclerenchymatous bundle sheaths and opposing bundles remain distinct (Figure

1C), in contrast to species with thin-textured blades in which opposing secondary bundles often merge at their xylem poles (compare also De Vos 1999: fig. 3i, fig. 7c). Species with such leaf blades, the *I. capillaris* complex, consistently have two foliage leaves with free blades, whereas a third leaf sheaths the stem for most or all of its length. The group is provisionally assumed to be monophyletic on the basis of the derived leaf morphology, branching pattern and finely fibrous corm tunics, which are also specialized in the genus.

Field studies conducted in August and September of 2006 and 2007 confirmed our preliminary hypotheses that *Ixia capillaris*, as treated in herbaria today, comprises four sets of populations. Plants conforming to the type are widespread, and always have a relatively short perianth tube, as described by Lewis (1962), exerted filaments, and frequently distinctive brown cataphylls. Flower colour is most often pale blue-mauve (also described as blue-grey), but white- and yellow-flowered populations have also been recorded.

The first set of divergent populations, from the Worcester District, both in the hills near Worcester and on the plateau at the top of Hex River Pass, consists of plants with the filaments always, and sometimes the bases of the anthers also, included in a tube 8–10 mm long, thus slightly longer than in *Ixia capillaris*, which has a tube (4–)5–7(–8) mm long and filaments mostly exerted 1–2 mm. These populations also have flowers with smaller tepals, 8–10 mm long and anthers 3.5–4.0 mm long, compared with tepals 11–15 mm long and anthers (3–)4–5 mm long in *I. capillaris*. Plants in these populations show no sign of variation for these features, and seen in the field, present a rather different appearance to *I. capillaris*, often having more branches per stem and thus more flowers. The flowers also have a light, sweet, rose-like scent, whereas those of *I. capillaris* that we examined, had a faint or no discernable scent. We conclude that these plants are most appropriately regarded as a separate taxon, which we call *I. exiliflora*. We include in *I. exiliflora*, a population of white-flowered plants from near Simonskloof west of Koo (Goldblatt & Porter 12936). These plants closely resemble the blue-flowered *I. exiliflora* except in colour and have the short stamens and partly included anthers that characterize the species. Plants were in full bloom in undisturbed renosterveld on clay ground.

The second set of divergent populations from the Touws River–Matjiesfontein area, mainly on the lower sandstone slopes of the Bonteberg and Voetpadsberg, and locally in the Little Karoo, consists of plants not only with a longer perianth tube, 13–18(–22) mm, but included filaments that reach just to the mouth of the tube, tepals 11–18 mm long, and anthers 2.5–3.5 mm long. Well-grown plants are also substantially taller than *Ixia capillaris*, up to 70 mm high, and have one or two short branchlets. Notably, at one locality in the Little Karoo, on Op-de-Tradouw Pass, these long-tubed plants grow parapatrically with typical *I. capillaris*, which at that site has a perianth tube 5–6 mm long and exerted filaments typical of the species. Ecological differences were evident between the two taxa at this site, and whereas the long-tubed plants grew in stony ground on ridge tops, *I. capillaris* occurred nearby on south-facing

clay slopes. We believe this set of populations with long-tubed flowers and included filaments also merits status as a separate species, which we call *I. dieramoides*.

The third divergent set of populations has a narrow range in the hills south of Theewaterskloof Dam between Caledon and Villiersdorp, where plants grow in heavy clay. The large flower with a perianth tube 13–15 mm long, tepals 16–21 mm long and filaments exerted up to 10 mm, cannot be accommodated in *Ixia capillaris* without radically expanding its circumscription. Additional collecting near the site of the first collection confirms that the corms match those of the *I. capillaris* complex but, surprisingly, reveal that its flowers are zygomorphic: the stamens are unilateral and are held horizontally, with the anthers abruptly flexed upward, and the style extended horizontally below the stamens, thus reclinate in orientation. The style divides below or opposite the anther bases, and the style branches are 4.5–5.0 mm long, exceptional for the complex. This plant evidently also merits recognition as a separate species, which we here name *I. reclinata*. As in the two other sets of populations, now to be treated as *I. exiliflora* and *I. dieramoides*, there is no evidence of significant morphological variation in *I. reclinata* despite the presence of typi-

cal *I. capillaris* growing a few kilometres to the south. *Ixia reclinata* is closer morphologically to *I. pauciflora* than to *I. capillaris* in flower size, tube length and in the declinate stamens. A species of the Cold Bokkeveld and Cedarberg, typical *I. pauciflora* has flowers with a perianth tube 15–18 mm long, filaments exerted 2–6 mm, a style typically dividing opposite the lower third of the anthers, and often an unbranched stem, occasionally with branchlets 10 mm long, each with one or two, rarely three flowers. In contrast, *I. reclinata* usually has two or three well-developed branchlets, each bearing up to three flowers.

During our examination of herbarium collections assigned to *Ixia pauciflora*, we found a small number of specimens from the southern Cedarberg with short filaments, up to 5 mm long, and anthers half included in the tube. These plants otherwise match *I. pauciflora* closely, so much so that despite the differences in floral features, Lewis (1962) and De Vos (1999) considered them part of the variation in *I. pauciflora*. The plants have symmetrically arranged stamens, the anthers only 3.0–3.3 mm long and a style with branches up to 1.3 mm long. This combination of features provides evidence for treating these plants as a western race of *I. dieramoides*.

Key to the *Ixia capillaris* complex of Subgenus *Morphixia*

- 1a Plants with blades leathery and linear-filiform, less than 2 mm wide when fresh; midvein lying closer to abaxial margin, not thickened or evident when fresh unless held to the light [when dry main vein and margins evident and appearing thickened due to collapse of mesophyll between them] *I. capillaris* complex
- 1b Plants with leaf blades linear to lanceolate or falcate but never leathery and filiform, mostly more than 2 mm wide in mature plants; midvein evident when fresh, and central or only slightly displaced toward abaxial margin (remaining species of subgenus *Morphixia*):
 - 2a Flowers relatively small with perianth tube 4–10 mm long; filaments included or exerted up to 2 mm from tube; anthers symmetrically arranged and enclosing style:
 - 3a Perianth tube (4–)5–7(–8) mm long; tepals 11–15 mm long, ± twice as long as tube; filaments exerted 1–2 mm and anthers fully exerted; anthers (3–)4–5 mm long; cataphylls often chestnut-brown above ground, or green becoming membranous ... 1. *I. capillaris*
 - 3b Perianth tube 8–10 mm long; tepals 8–10 mm long, up to 1.5 times as long as tube; filaments always included and bases of anthers held within tube; anthers 3–4 mm long; cataphylls green with membranous margins or dry and turning light brown from tips 2. *I. exiliflora*
 - 2b Flowers larger with perianth 12–22 mm long; filaments included or well exerted from tube; anthers symmetrically arranged, or unilateral and facing upward and then style lying below anthers:
 - 4a Stamens symmetrically arranged; filaments included, 3–6 mm long; anthers 2.5–3.5 mm long, exerted or lower halves included in tube. 3. *I. dieramoides*
 - 4b Stamens usually (?always) unilateral and declinate; filaments 12–15 mm long, exerted 2–10 mm; anthers 4–5 mm long, fully exerted from tube:
 - 5a Filaments exerted 2–6 mm from tube; stem simple or 1 or 2(3) lateral branches, branches when present mostly 1- or 2(3)-flowered; cataphylls chestnut-brown above ground; stamens usually (?always) unilateral and extended horizontally 4. *I. pauciflora*
 - 5b Filaments exerted 8–10 mm from tube; stem with (1)2- or 3-lateral branches, branches (1)2- or 3-flowered; cataphylls green with ± membranous margins; stamens always unilateral and declinate with anthers abruptly flexed upward 5. *I. reclinata*

TAXONOMY

1. *Ixia capillaris* L.f., Supplementum plantarum: 92 (1782); Lewis: 68 (1962). Type: South Africa [Western Cape], without precise locality, collected circa 1773, C.P. Thunberg s.n. (UPS—Herb. Thunberg 935, 936, syn!).

I. capillaris var. *gracillima* Ker Gawl.: t. 570 (1802). Type: South Africa, without precise locality, illustration in Curtis’s Botanical Magazine 16: t. 570 (1802).

I. gracilis Salisb.: 37 (1796), nom. illeg. superfl. pro *I. capillaris* L.f.

I. tenella Klatt: 396 (1882). Type: South Africa, without precise locality or date, Zeyher 557 (B—Herb. Lubeck, believed destroyed, drawing at S, not seen).

Plants 200–350(–500) mm high, usually with thin collar of fibres around stem base; cataphylls often chestnut-

brown, or green. *Corm* globose, 8–12(–15) mm diam.; tunics fine to medium-textured, netted fibres. *Stem* slender, usually with 1–3 lateral branches, rarely unbranched but then with 1 or more scale-like bracts on stem; branchlets mostly 8–15 mm long, filiform, curving outward, subtended by translucent, irregularly lobed, attenuate bracts and prophylls 2–3 mm long. *Leaves* three, lower two with linear blades 1.2–2.0 mm wide, one- to two-thirds as long as stem, central vein not raised when fresh, margins occasionally slightly raised, uppermost leaf sheathing stem, sometimes reaching base of spike. *Spike* drooping above, (1)2- or 3-flowered, lateral branchlets 1- or 2(3)-flowered; bracts translucent with dark veins, 7–10 mm long, outer 3-toothed, inner notched apically. *Flowers* held ± horizontally, pale blue to pale mauve or white, unscented in living plants examined; perianth tube funnel-shaped, (4–)5–7(–8) mm long; tepals sub-

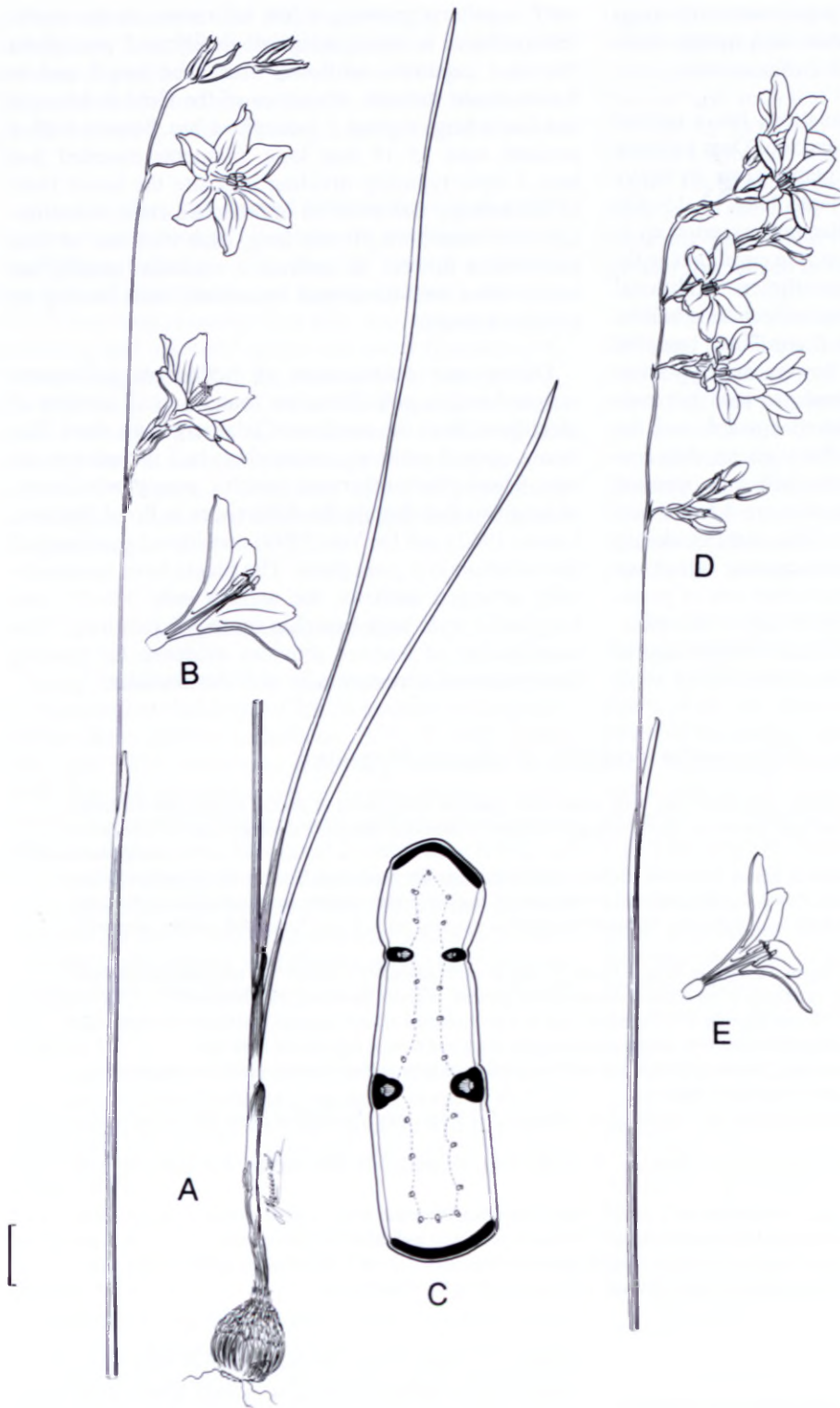


FIGURE 1.—A–C, *Ixiacapillaris*, Goldblatt, Manning & Porter 12986 (MO, NBG): A, whole plant; B, 1/5 flower; C, section of leaf blade. *Ixia exiliflora*, Goldblatt & Porter 12688 (MO, NBG): D, flowering stem; E, 1/5 flower. Scale bar: 10 mm. Artist: J.C. Manning.

equal, 11–15 × 4–7 mm, spreading at right angles to tube. *Stamens*: filaments ± 5 mm long, usually exerted 1–2 mm from tube, rarely reaching only to mouth of tube; anthers (3–)4–5 mm long. *Style* usually dividing between middle and upper third of anthers, branches 1–2 mm long. *Flowering time*: mainly late July to late September. Figure 1A–C.

Distribution and habitat: with the widest range of any species of the complex, *Ixia capillaris* extends from the Piketberg and Cold Bokkeveld in the north to Bot River in the south and through the southern Cape to Riversdale (Figure 2). Plants favour clay slopes, usually in wetter sites, thus often on south-facing slopes.

Diagnosis and relationships: the type collection (or collections) of *Ixia capillaris* were made by C.P. Thunberg in the early 1770s (Linnaeus fil. 1782), probably in September 1773 when he was in the Cold Bokkeveld (Forbes 1986) where the species is common. Several specimens, on two sheets (*Thunberg Herbarium* 935, 936), show the typical attributes of the species, that is, narrow, linear leaves, corm tunics of fine, netted fibres, main spike of 1–3 flowers, branchlets when present very short and 1- or 2-flowered, and a perianth tube ± 5 mm long, enclosed by the translucent floral bracts, 6–8 mm long. The plants have a prominent dark cataphyll, a feature typical of the northern populations of the species. The flowers, excluding the ovary, are ± 20 mm long. The

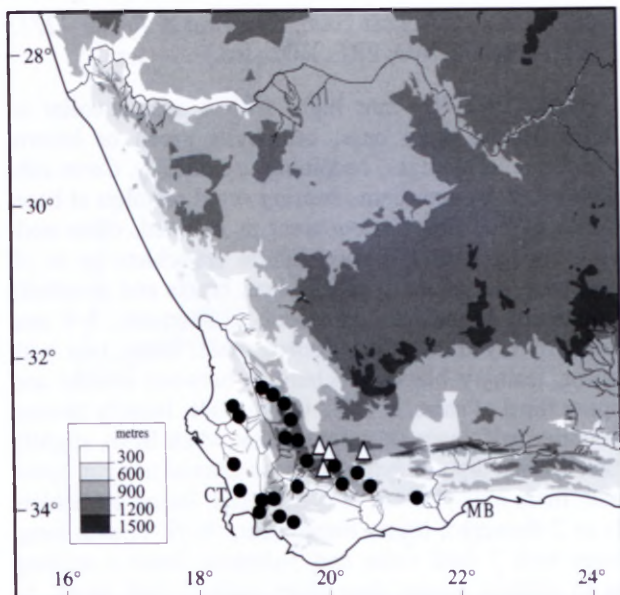


FIGURE 2.—Known distribution of *Ixia capillaris*, ●; and *I. exiliflora*, △.

distinctive pair of very slender basal leaves less than 2 mm wide and the upper leaf that sheaths the stem for \pm half its length, are likewise present in all specimens, some of which have the fairly small corms, mostly \pm 8 mm in diameter, and tunics of fine fibres that are characteristic of the group.

The type material is readily matched by plants from the mountains of Western Cape, long known by the name, and which also have filaments exerted 1–2 mm and anthers held in a column 4.0–4.5 mm long and a style dividing opposite the upper third of the anthers into short branches 1–2 mm long.

For many years in the early 20th century, *Ixia capillaris* was known as *I. linearis* L.f., a species described by Linnaeus fil. in 1782 at the same time as *I. capillaris*. Examination of the type by Brown (1928) showed this plant to be a species of *Gladiolus* with a radially symmetric perianth, the current name for which is *G. quadrangulus* (D.Delaroche) Barnard (Goldblatt & Manning 1998).

Plants included here in *Ixia capillaris* from the Breede River Valley south of Worcester (Goldblatt 2416) and in the hills around Bot River (Goldblatt & Manning 10674, 12685) in the south of its range, are more robust than usual for the species, some individuals more than 500 mm high, and some specimens of these collections have two or three flowers per spike. The short lateral branches and consistently narrow leaves, \pm 1.5 mm wide, as well as the floral features match *Ixia capillaris* well, although the flowers are among the largest for the species, with the perianth tube exceptional in reaching 8 mm long.

Ixia capillaris is most likely to be confused with *I. exiliflora*, specimens of which have until now been included in the species. Whereas *I. capillaris* has flowers with a perianth tube 4–7, rarely 8 mm long, and tepals about twice as long as the tube, *I. exiliflora* has a perianth tube 8–10 mm long, and tepals about as long as the tube. The bases of the anthers of *I. exiliflora* are included

in the tube, whereas in *I. capillaris* the anthers are normally exerted 1–2 mm, or rarely barely exerted on included filaments.

Selected specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, near Berg River bridge, (–DC), 19 August 1932, *L. Bolus* s.n. (BOL20836, K, PRE); Piketberg, Versveld Pass, middle slopes on clay, (–DC), 1 September 1992, Goldblatt & Manning 9344 (MO, NBG). 3219 (Wuppertal): Elandskloof, south slope of mountain, (–CA), 3 October 1940, Esterhuysen 3184 (BOL); Koue Bokkeveld, Skoongesig, stony sand, (–CC), 27 August 1968, Hanekom 1171 (PRE); Farm Houdenk, \pm 33 miles [53 km] NW of Ceres, deep sand, (–CD), 28 August, Boucher 3074 (NBG, PRE). 3318 (Cape Town): Waylands, Darling, (–AD), 29 August 1971, Axelson 473 (NBG); Tygerberg, south slopes, (–DC), August 1924, Pillans 4754 (BOL); Tygerberg Nature Reserve, (–DC), August 1976, Loubser 3027 (MO); Stellenbosch, (–DD), August 1924, Duthie 1507 (BOL); Simonsberg, (–DD), 22 August 1967, Srey 555 (PRE). 3319 (Worcester): Cold Bokkeveld, Elandsfontein, \pm 6 miles [10 km] N of top of Gydo Pass, (–AB), 20 September 1952, Lewis 2662 (PRE); \pm 19 miles [30.4 km] N of Ceres, (–AB), 11 September 1968, Marsh 763 (NBG, PRE), Mauve 4682 (PRE); flats near Ceres, 3600 ft [\pm 1150 m], (–AD), September 1924, Levyns 1030 (BOL); Eselfontein, clay slopes, (–AD), 1 September 1952, Esterhuysen 20346 (BOL, PRE); Hex River Valley at Orchard, in sand at foot of mountains, (–BC), July 1944, Esterhuysen 10348 (BOL); stony flats between Worcester and the Breede River, (–CB), 24 August 1974, Goldblatt 2416 (MO, NBG, PRE); Groot Drakenstein, (–CC), 1914, Rogers s.n. (BOL10534); Stettynskloof, (–CD), 18 August 1961, Barker 9459 (K, NBG, PRE); Eendrag Pass, near the Koo, south slopes, (–DB), 23 September 1946, Levyns 7992 (BOL). 3320 (Montagu): south slopes of the Anysberg, 2000 ft [\pm 660 m], (–BC), 2 August 1956, Wurts 1428 (NBG); Oudeberg, NE of Montagu, mountain renosterveld on S slopes, (–CA), 27 July 1959, Acocks 20535 (NBG, PRE); hill \pm 5 miles [8 km] E of Montagu, (–CC), July 1918, Mitchell s.n. (BOL15566); upper slopes of Op-de-Tradouw Pass, clay ground in renosterveld, (–DC), 27 August 2006, Goldblatt & Porter 12718 (MO, NBG, PRE). 3418 (Simonstown): Vergelegen, Somerset West, (–BB), 20 August 1961, Johnson s.n. (NBG). 3419 (Caledon): Langhooft, E of Bot River, (–AA), 16 August 1997, Goldblatt & Manning 10674 (MO, NBG); clay slopes between Caledon and Riviersonderend, (–BA), 2 August 1976, Goldblatt 3712 (MO, PRE). 3420 (Swellendam): Hessaquaspoort, coastal renosterveld, (–AA), 20 July 1962, Acocks 22393 (K, PRE). 3421 (Riversdale): hill slopes near Riversdale show grounds, (–AB), August 1924, Muir 3248 (BOL, PRE).

2. *Ixia exiliflora* Goldblatt & J.C.Manning, sp. nov.

Plantae *Ixiae capillaris* similes sed floribus secundis pallide griseo-caeruleis vel albescentibus fauce pallide flava, tubo perianthii 8–10 mm longo anguste campanulato, tepalis subaequalibus ovatis 8–10 mm longis, filamentis 3–4 mm longis, antheris 3.5–4.0 mm longis partibus superis ex tubo exsertis, stylo prope apicem antherarum dividenti, ramis styli \pm 1.3 mm longis.

TYPE.—Western Cape, 3319 (Worcester): \pm 0.8 km S of turnoff to Montagu from N1, flat plateau, 3200 ft [\pm 1050 m], (–BD), 25 August 2006, Goldblatt & Porter 12688 (NBG, holo.; K, MO, PRE, iso.).

Plants 250–700 mm high; cataphylls green with membranous margins, becoming dry distally. Corm subglobose, 8–12 mm diam., bearing small cormlets at base; tunics of fine fibres. Stem erect, sometimes nodding above, usually with 2 or 3 branchlets; bracts and prophylls subtending branchlets 3–4 mm long, acute to attenuate, translucent white. Leaves three, lower two with linear blades, reaching lower third to middle of stem, 1.0–1.7 mm wide, loosely twisted in upper half, midrib not evident when alive, slightly raised when dry. Spike with main axis (2)3- or 4-flowered, lateral spikes

(1)2- or 3-flowered; bracts translucent, 6–8 mm long, outer with 3 dark veins and 3-dentate, inner \pm as long as outer, with 2 dark veins and 2-dentate. *Flowers* held horizontally, grey-blue to dingy white with creamy yellow cup, with faint rose scent; perianth tube narrowly funnel-shaped, 8–10 mm long; tepals ovate, 8–10 \times 4–5 mm. *Stamens*: filaments 3–4 mm long, inserted 3–4 mm from base of tube; anthers 3.5–4.0 mm long, half included in tube and entirely within floral cup, yellow. *Style* dividing close to anther tips, style branches \pm 1.3 mm long, when fully expanded often shortly exceeding anthers. *Capsules* and *seeds* unknown. *Flowering time*: July to mid-September. Figure 1D, E.

Distribution and habitat: *Ixia exiliflora* has a narrow range in the Worcester and Montagu Districts (Figure 2), where it has been collected in the hills north of Worcester, in the high country to the east of Keeromsberg, and beyond the top of Hex River Pass. Flowering is relatively early, in later July at lower elevations and from mid-August to mid-September at higher elevations. Plants favour loamy clay soils in stony ground, sometimes with sandstone bedrock.

Diagnosis and relationships: at first appearing to be a slightly smaller-flowered variant of the widespread, short-tubed *Ixia capillaris*, specimens here included in *I. exiliflora* differ in their longer perianth tube 8–10 mm [versus (4–)5–7(–8) mm in *I. capillaris*] and anthers partly included in the tube, whereas the filaments are always exerted \pm 2 mm in *I. capillaris*. The partly included anthers recall the *I. rapunculoides* complex of species (Goldblatt & Manning 2008), but the very different, narrow leaves and small corms with finely fibrous tunics, as well as the smaller flowers, make it clear that the included filaments are convergent. A collection from near Simonskloof, west of Koo, with white flowers with a yellow cup, expands the known variation of the species. The flowers of these plants closely resemble blue-flowered *I. exiliflora* except in colour and have the short stamens and partly included anthers that characterize the species.

Selected specimens

WESTERN CAPE.—3319 (Worcester): Worcester, Karoo Garden, Veld Reserve, southwest slope, (–CB), July 1962, *Olivier 28* (PRE); Matroosberg station turnoff, (–BD), 22 August 1967, *McMurtry 230* (PRE); N1 to Matroosberg station, flat plateau, 975 m, (–BD), 16 September 1974, *Mauve & Oliver 186* (NBG, PRE); 2.5 km S of turn-off to Montagu from N1, flat plateau, 3200 ft [\pm 1 050 m], (–BD), 25 August 2006, *Goldblatt & Porter 12694* (MO); shale hills west of Koo near Simonskloof, renosterveld, (–DA), 30 August 2007, *Goldblatt & Porter 12936* (MO, NBG, PRE). 3320 (Montagu): Witteberg, Bantams, 5000 ft [\pm 1 660 m], (–BC), 27 October 1941, *Compton 12243* (NBG).

3. *Ixia dieramoides* Goldblatt & J.C.Manning, sp. nov.

Plantae *Ixiae capillaris* similes sed caule ad 700 mm alto, floribus subnutantibus, tubo perianthii 13–18(–22) mm longo anguste campanulato, tepalis 11–18 \times 5–9 mm, filamentis ad apicem tubi attingentibus, antheris 2.5–3.5 mm longis, stylo medium vel tertiam partem inferam antherarum adversus dividenti, ramis styli \pm 1–2 mm longis.

TYPE.—Western Cape, 3320 (Montagu): north of N1 between Matjiesfontein and Touws River, sandstone out-

crop, (–BA), 27 August 2006, *Goldblatt & Porter 12713* (NBG, holo., K, MO, PRE, BOL, iso.).

Plants 350–700 mm high, with a sparse collar of fibres around stem base; cataphylls green or brown, membranous at edges, becoming dry distally. *Corm* subglobose, 9–14 mm diam., bearing small cormlets at base; tunics of fine fibres. *Stem* erect or inclined, often nodding above, with 1–3 short lateral branchlets up to 10 mm long, occasionally unbranched; bracts and prophylls subtending branchlets, lanceolate to attenuate, 3–8 mm long, silvery translucent. *Leaves* three, lower two with linear, leathery blades reaching to between middle and upper third of stem, \pm 1.2–2.0 mm wide, loosely twisted in upper half, main vein not evident when fresh, slightly raised when dry and lying closer to abaxial margin. *Spike* with main axis (1)2- or 3(4)-flowered, lateral branchlets 1- or 2-flowered; bracts translucent, (8–)9–11 mm long, outer with 3 dark veins and 3-dentate, inner \pm as long as to slightly longer than outer, with 2 dark veins, 2-dentate. *Flowers* ascending, pale mauve-blue to watery lilac or \pm violet with pale yellow cup, often sweetly scented; perianth tube 13–18(–22) mm long, widening \pm uniformly from base to mouth, 5–6 mm diam. at mouth; tepals ovate, outer 13–18 \times 7–9 mm, inner 11–14 \times 5–8 mm, ascending below, spreading in upper two thirds. *Stamens* parallel; filaments 3–6 mm long, inserted 10–11 mm from base of tube, reaching to mouth of tube, rarely barely exerted \pm 1 mm but held within floral cup; anthers 2.5–3.5 mm long, parallel, yellow, exerted or bases included in tube. *Style* dividing opposite lower to middle third of anthers, branches 1–2 mm long, when fully extended not reaching anther tips. *Capsules* and *seeds* unknown. *Flowering time*: early August to early October. Figure 3.

Distribution and habitat: fairly common on south-facing slopes of the Bonteberg and Voetpadsberg north and west of Touws River. *Ixia dieramoides* has, until now, seldom been collected but is locally quite frequent on the sandstone slopes of these mountains, and also occurs in a few sites to the southeast in the Little Karoo and in the southern Cedarberg between Wolfberg and Krom River (Figure 4).

Diagnosis and relationships: *Ixia dieramoides* has corms with fine, netted tunics and narrow, leathery leaves of the *I. capillaris* type, and differs from that species mainly in the larger flower with a tube 13–18(–22) mm long and in having the filaments and often the bases of the anthers included in the tube. The smaller flowers of *I. capillaris* have a tube (4–)5–7(–8) mm long, tepals spreading from the base and filaments typically exerted 1–2 mm. Unlike *I. capillaris*, the flowers are often faintly scented. Well-grown plants usually reach 600 mm high, thus extending substantially above the surrounding clumps of grass and low shrubs, which in open dry ground may be only 350 mm high. In dry and stony ground in poor soils, plants may be just 250 mm high, have just one or two flowers and may be unbranched. Seen from a distance, the flowering spikes nodding in the breeze resemble smaller-flowered species of *Dierama*. The immediate affinities of *I. dieramoides* may be with shorter-tubed *I. capillaris* or with the larger-flowered *I. pauciflora*, which though similar at first glance, has unilateral stamens, the filaments 12–13 mm long and

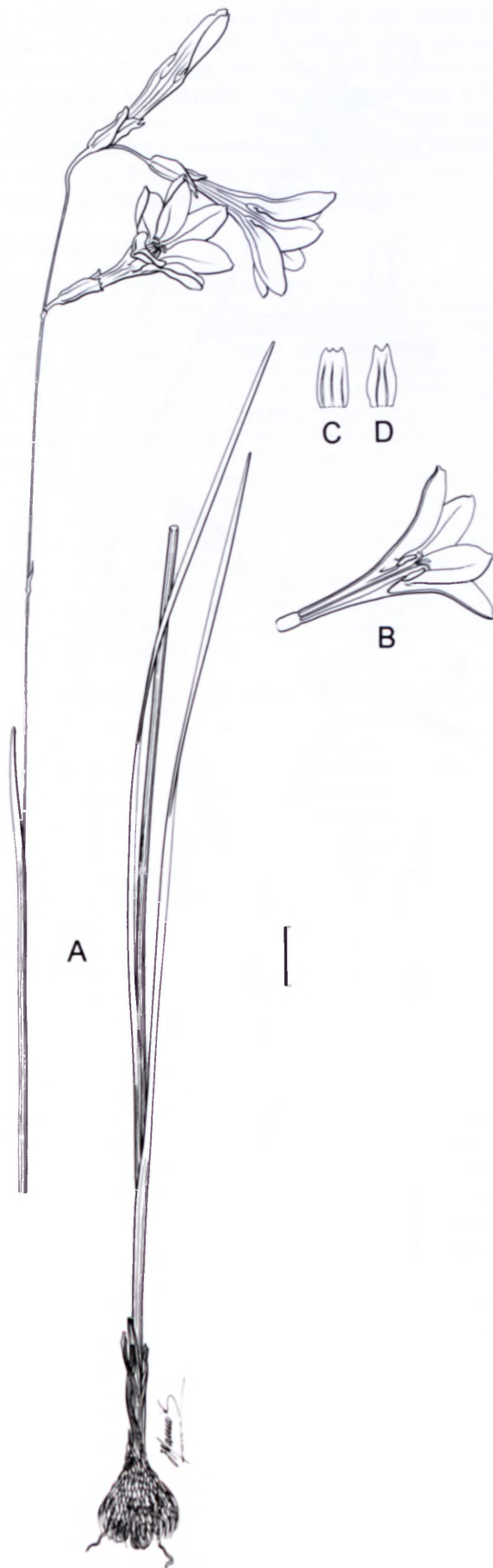


FIGURE 3.—*Ixia dieramoides*, Goldblatt & Porter 12713 (MO, NBG): A, whole plant; B, 1/5 flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

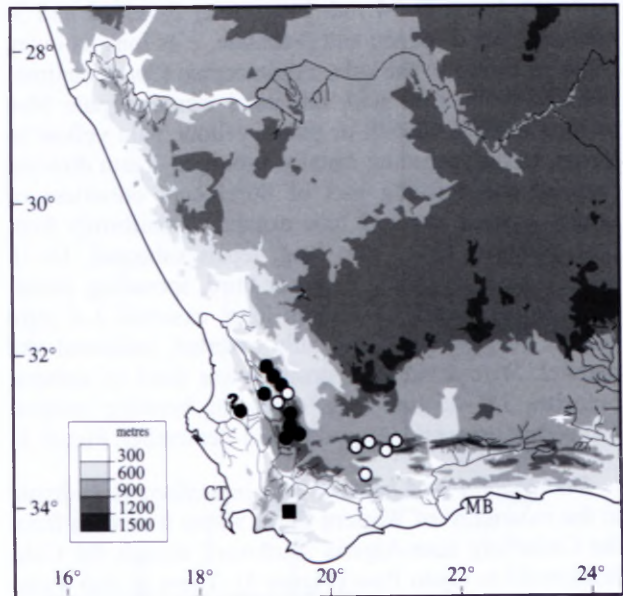


FIGURE 4.—Known distribution of *Ixia dieramoides*, ○; *Ixia pauciflora*, ●; and *I. reclinata*, ■.

exserted 2–6 mm from the perianth tube, anthers (4–)5–6 mm long and style branches 3.0–4.5 mm long.

The Cedarberg plants included here in *Ixia dieramoides* were treated by both Lewis (1962) and De Vos (1999) as *I. pauciflora* but cannot be accommodated within that species without expanding its circumscription to include plants with short, included filaments 2.5–5.0 mm long, as well as shorter anthers and style branches.

Selected specimens

WESTERN CAPE.—3219 (Wuppertal): South Cedarberg, Wolfberg, (–AD), 3 October 1952, *Esterhuysen 20570* (BOL); Cedarberg, Matjiesrivier, (–CB), 8 September 1943, *Wagener 140* (NBG); Cedarberg, Krom River, (–CA), August 1949, *Stokoe s.n.* (SAM60110, 2 sheets). 3320 (Montagu): Bonteberg, Pienaarskloof, in stony sandstone ground, (–AC), 31 August 2007, *Goldblatt & Porter 12930* (MO, NBG); Pienaarskloof, western slopes of Voetpadsberg, among sandstone boulders, (–AC), 31 August 2007, *Goldblatt & Porter 12926* (MO, NBG); lower south slopes of the Voetpadsberg east of Touws River, (–AC), 26 August 2006, *Goldblatt & Porter 12700* (K, MO, NBG); valley west of Konstabel, sandy flats among restios along stream, (–AD), *Thompson 1228* (NBG); Op-de-Tradouw Pass, burned renosterveld on shale slopes at top of pass, (–DC), 7 September 2002, *Goldblatt, Porter & Manning 12178* (MO, NBG), 27 August 2006, *Goldblatt & Porter 12719* (MO, NBG). Without precise locality: Cedarberg, shale band, September 1930, 5000 ft [\pm 1 660 m], *Levyms 2961* (BOL).

4. *Ixia pauciflora* G.J.Lewis, *Journal of South African Botany* 27: 88 (1962). Type: South Africa [Western Cape], Cold Bokkeveld, north of Waboomsriver, 2 September 1956, *W.F. Barker 8635* (NBG, holo.!).

Plants 150–300(–400) mm high, with collar of fibres around stem base; cataphylls conspicuously chestnut-brown. *Corm* 9–14 mm diam.; tunics of fine, dark fibres. *Stem* usually unbranched, then often with a node bearing a short membranous scale, or with 1 or 2(–4) short branchlets up to 10 mm long, subtended by thread-like, attenuate bracts and prophylls 4–8 mm long. *Leaves* three, lower two with linear blades, leathery, \pm 1.8 mm wide; uppermost leaf sheathing stem sometimes to base of spike. *Main spike* 1- or 2(3)-flowered, branchlets 1(2)-

flowered; bracts 9–14 mm long, outer 3-veined and 3-dentate, inner 2-veined and 2-dentate, \pm as long as outer. *Flowers* facing to the side, zygomorphic (?or sometimes radially symmetric) with unilateral stamens, pale blue to blue mauve, whitish or palest yellow, pale yellow in throat, tepals spreading distally, proximal 3 mm directed forward and forming part of floral cup, odourless or faintly scented; perianth tube expanding uniformly from base to apex, 15–18 mm long; tepals subequal, 16–18 \times 8–10 mm, ascending in lower third, spreading above. *Stamens*: filaments 12–13 mm long, exserted 2–6 mm; anthers (4–)5–6 mm long, fully exserted, unilateral and parallel. *Style* dividing opposite lower third of anthers, branches 3.0–4.5 mm long, extending between anthers. *Flowering time*: mid-August to mid-September. Figure 5.

Distribution and habitat: *Ixia pauciflora* is endemic to the mountains of Western Cape, where it extends from the Cedarberg near Algeria southward through the Cold Bokkeveld to Gydo Pass (Figure 4). There is also a single early record from Piketberg, *Marloth 10563*, which seems unlikely and requires confirmation. Plants favour seasonally moist sites on rocky sandstone slopes but may also be found on loamy clay.

Diagnosis and variation: well named for its few-flowered spikes, *Ixia pauciflora* typically has just one or two flowers on slender, often unbranched stems, or with one or two short branchlets. Robust plants may, however, occasionally have more branchlets, including an exceptional collection from Gydo Pass (*Goldblatt & Porter 12987*) that includes some plants with up to four branchlets, each bearing two flowers. The flowers are relatively large, having tepals 16–18 mm long, \pm as long as the flared perianth tube, long filaments exserted 2–6 mm from the tube, and anthers 4–6 mm long. The stamens on fully open flowers are unilateral and are held horizontally with the anthers facing the dorsal tepal, a feature impossible to determine from pressed specimens. Vegetatively, the species is virtually identical to the more common *I. capillaris* in its two linear leaves, small corms with finely fibrous tunics, a collar of fine fibres around the underground part of the stem, and dry, chestnut-brown cataphylls, and differs mainly in the flower. Blooms of *I. capillaris* are radially symmetric and have a perianth tube 4–8 mm long, \pm half as long as the tepals, and filaments \pm 5 mm long, usually exserted 1–2 mm from the tube.

Ixia pauciflora also closely resembles the local Villiersdorp endemic, *I. reclinata*, in its flower, including the unilateral stamens, extended horizontally with declinate anthers but the latter has longer filaments, exserted 8–10 mm (vs 2–6 mm in *I. pauciflora*). *Ixia reclinata* also lacks the collar fibres around the stem base present in *I. pauciflora*, the stems typically have one or two branchlets, and the cataphylls are green or partly membranous when alive and not dry and chestnut-coloured. *Ixia reclinata* also differs in having the bracts and prophylls subtending the branchlets short and obtuse to subacute, quite different to the fine, thread-like bracts and prophylls of the remainder of the complex.

Collections from the southern Cedarberg assigned to *Ixia pauciflora* by Lewis (1962), e.g. *Wagener 140* and *Esterhuysen 20570*, stand out in having shorter filaments

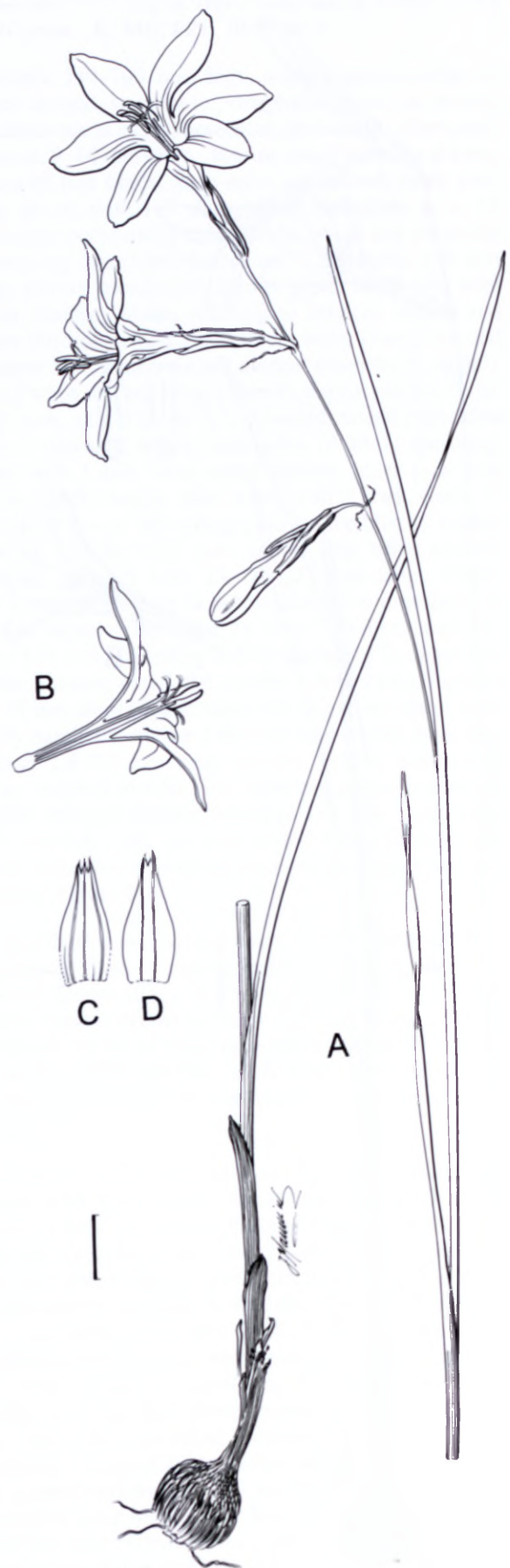


FIGURE 5.—*Ixia pauciflora*, Goldblatt & Porter 12987 (MO, NBG): A, whole plant; B, 1/3 flower; C, outer bract; D, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

2.5–5.0 mm long, included in the tube, and anthers 2.5–3.3 mm long, the bases of which are also included. Anthers of *I. pauciflora* are (4–)5–6 mm long and the filaments are 12–13 mm long. The style branches are also discordant with typical *I. pauciflora* in being 1.0–1.3 mm long; those of *I. pauciflora* are 3.0–4.5 mm long. These plants match *I. dieramoides* in all critical features and we include them in this species, which is centred to the east in the Bonteberg–Voetpadsberg complex.

Selected specimens

WESTERN CAPE.—3218 (Clanwilliam): Piketberg, (–DC), September 1921, *Marloth 10563* (PRE). 3219 (Wuppertal): Cedarberg, Algeria, De Rif, (–AC), 18 August 1982, *Viviers 470* (NBG, PRE); Cedarberg, Sederhoutkloof, NE base of Sneeuberg, 3000 ft [\pm 960 m], (–AC), 3 September 1963, *Taylor 5114* (NBG); Welbedachtkloof, near Bushman Cave, \pm 5500 ft [\pm 1 780 m], (–AC), 23 September 1930, *Barnes s.n. (BOL19322)*; Cedarberg, Scorpion Kloof, (–AC), September 1942, *Stokoe s.n. SAM55669*; Elandskloof Pass, (–CA), 8 September 1945, *Barker 3781* (NBG), August 1985, *De Vos 2589* (NBG); Cold Bokkeveld near Elandskloof, (–CA), 9 September 1945, *Leighton 1276* (BOL); Cold Bokkeveld near Waboomsrivier, (–DC), 27 August 1954, *Lewis 4438* (SAM), 2 September 1956, *Lewis 5009* (SAM); Groenfontein, Zeekoegat west of Riet River, sandy ground, (–DC), 11 August 2001, *Stobie 3* (NBG). 3319 (Worcester): Cold Bokkeveld, 24 miles [\pm 38.4 km] from Prince Alfred's Hamlet, marshy sandy ground, (–AB), 4 September 1947, *Story 3004* (PRE); top of Gydo Pass, on sandstone slope, (–AB), 11 September 2007, *Goldblatt & Porter 12987* (MO, NBG, PRE).

5. *Ixia reclinata* Goldblatt & J.C.Manning, sp. nov.

Plantae *Ixiae capillaris* et *I. pauciflorae* similes sed floribus grandioribus, albis, tubo perianthii 13–15 mm longo, tepalis 16–21 \times 8.5–11 mm, filamentis 11–12 mm longis, unilateralibus, 8–10 mm ex tubo exsertis, antheris 4–5 mm longis, stylo infra usque ad partem tertiam inferiorem antherarum adversus dividenti, ramis styli 4.5–5.0 mm longis.

TYPE.—Western Cape, 3419 (Caledon): hills south of Theewaterskloof Dam, Farm Cranesfield, north of Draaiberg road, stony shale outcrops, (–AA), 24 August 2006, *Goldblatt, Manning & Porter 12686* (NBG, holo.; MO, PRE, iso.).

Plants 300–450 mm high, with green to \pm membranous cataphylls. *Corm* 10–12 mm diam.; tunics fine to medium-textured. *Stem* with 1 or 2(3) short branchlets subtended by broad, obtuse to subacute bracts sometimes with a dark central vein, 2–3 mm long, exceeding prophylls. *Leaves* three, lower two with linear, leathery blades, \pm 1.5 mm wide, central vein not evident when fresh, visible and close to abaxial margin when dry, margins hyaline when dry; uppermost leaf entirely sheathing, reaching to shortly below first branch or with a free tip reaching middle of spike. *Spike* (1)2- or 3-flowered; branchlets 1–3-flowered; bracts translucent brown, 8–13 mm long, outer bract shortly 3-toothed, inner \pm as long as outer, forked at apex. *Flowers* borne horizontally, zygomorphic with declinate stamens, white suffused with blue-mauve, pale yellow in throat, with age veins becoming dark-coloured, faintly sweet-scented; perianth tube funnel-shaped, 13–15 mm long; tepals 16–21 \times 8.5–11.0 mm, spreading, inner slightly wider than outer. *Stamens*: filaments 11–12 mm long, unilateral, exserted 8–10 mm from tube; anthers 4–5 mm long, well exserted from flower, parallel and facing upward. *Style* dividing just

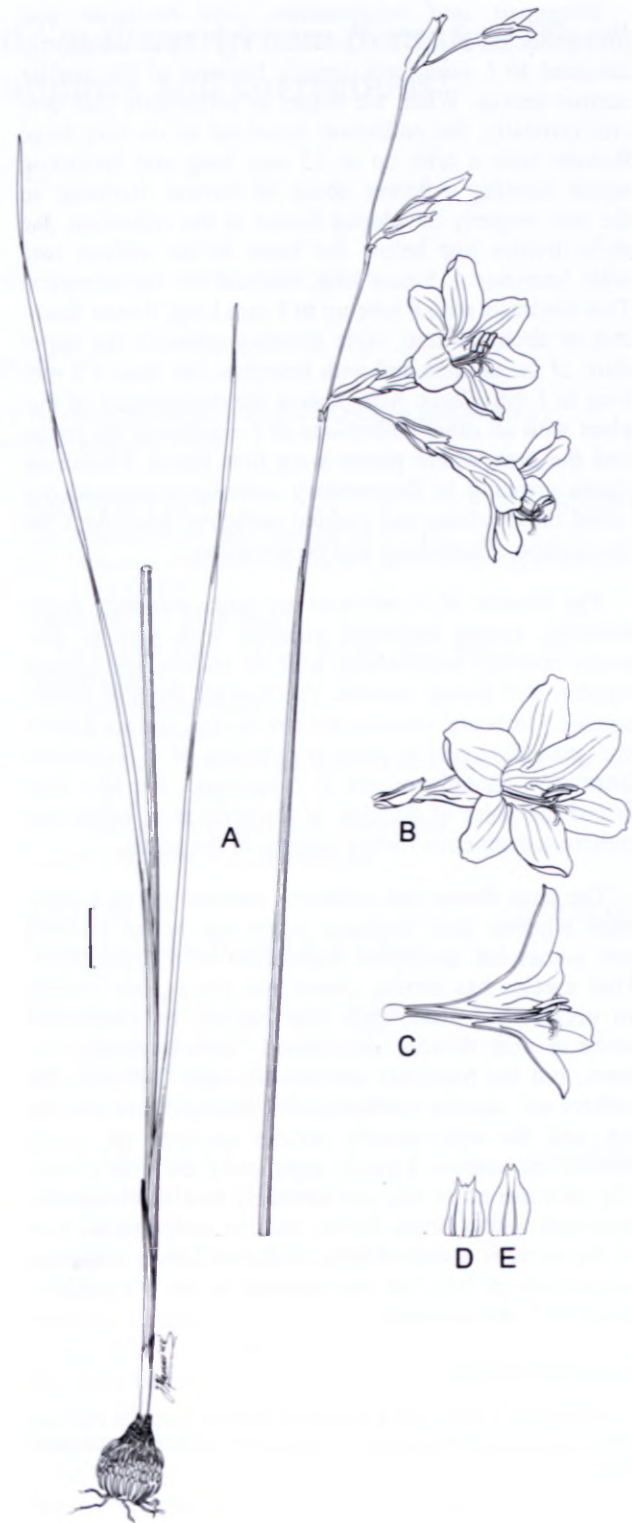


FIGURE 6.—*Ixia reclinata*, Goldblatt, Manning & Porter 12686 (MO, NBG): A, whole plant; B, front view of flower; C, 1/5 flower; D, outer bract; E, inner bract. Scale bar: 10 mm. Artist: J.C. Manning.

below to opposite lower third of anthers, branches 4.5–5.0 mm long. *Capsules* and *seeds* unknown. *Flowering time*: mid-August to early September. Figure 6.

Distribution and habitat: with a narrow range in the low hills south of Theewaterskloof Dam, *Ixia reclinata* ranks as one of the most threatened species in the genus (Figure 4). Populations we have seen are reduced today to narrow strips of native renosterveld in rough and rocky clay ground among ploughed land and pasture.

Diagnosis and relationships: *Ixia reclinata* was first collected in 1976 (Goldblatt 4001) and tentatively assigned to *I. capillaris*, largely because of the similar narrow leaves. When we began to investigate that species critically, the collection stood out in its very large flowers with a tube up to 15 mm long and spreading tepals forming a flower about 40 mm in diameter. In the one properly developed flower in the collection, the style divides just below the bases of the anthers into style branches \pm 5 mm long, unusual for the complex. This contrasts with a tube up to 8 mm long, flower diameter of about 20 mm, style dividing opposite the upper third of the anthers and with branches less than 1.5 mm long in *I. capillaris*. After noting the discordance of this plant with all other collections of *I. capillaris*, we revisited the area where plants were first found. Flowering plants growing in fragmentary colonies confirmed our initial observations and yielded sufficient specimens for description, illustration, and preservation.

The flowers of *I. reclinata* are quite evidently zygomorphic, having unilateral stamens with parallel filaments extended horizontally, with the anthers held closely together and facing upward. The flowers are also faintly scented. Unilateral stamens are rare in *Ixia*, and are known in *I. pauciflora* and in some populations of *I. fucata*, the latter only distantly related to *I. reclinata*. We also confirmed the point of division of the style at or below the anthers, a distinctive feature unusual in the genus.

The large flower and unilateral stamens led us to consider whether *Ixia reclinata* might not be an isolated and somewhat divergent population of *I. pauciflora*. That species has similar corms and leaves, but usually an unbranched stem, pale blue-mauve, or sometimes white or pink flowers, occasionally with unilateral stamens, but the filaments are exerted only 2–5 mm, the anthers are usually symmetrically arranged and diverging, and the style usually divides opposite the lower third of the anthers. Equally significant, the stem is usually unbranched or has one or rarely two short branchlets, each with a single flower, and the underground part of the stem is sheathed by a collar of fibres, a feature uncommon in *Ixia*, but also present in the *I. capillaris* group in *I. dieramoides*.

Selected specimen

WESTERN CAPE.—3419 (Caledon): between Eseljacht Pass and Queen Anne, clay slope, (–AA), 31 August 1976, Goldblatt 4001 (MO, NBG).

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REFERENCES

- BROWN, N.E. 1928. The South African Iridaceae of Thunberg's herbarium. *Journal of the Linnean Society, Botany* 48: 15–55.
- DE VOS, M.P. 1999. *Ixia*. In M.P. de Vos & P. Goldblatt, *Flora of southern Africa* 7, part 2, fascicle 1: 3–87.
- FORBES, V.S. 1986. *Carl Peter Thunberg: travels at the Cape of Good Hope 1771–1775*. Van Riebeeck Society, Cape Town.
- GOLDBLATT, P. & MANNING, J.C. 1998. *Gladiolus in southern Africa: systematics, biology, and evolution*. Fernwood Press, Cape Town.
- GOLDBLATT, P. & MANNING, J.C. 1999. New species of *Sparaxis* and *Ixia* (Iridaceae: Ixioidae) from Western Cape, South Africa, and taxonomic notes on *Ixia* and *Gladiolus*. *Bothalia* 29: 59–63.
- GOLDBLATT, P. & MANNING, J.C. 2000. Cape plants. A conspectus of the Cape flora of South Africa. *Strelitzia* 9. National Botanical Institute, Cape Town and Missouri Botanical Garden, St Louis.
- GOLDBLATT, P. & MANNING, J.C. 2008. Systematics of the southern African genus *Ixia* (Iridaceae). 1. The *I. rapunculoides* complex. *Bothalia* 38: 1–23.
- HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. 1990. *Index herbariorum, Part 1: the herbaria of the World*, edn 8. New York Botanical Garden, New York.
- KER GAWLER, J. 1802. *Ixia capillaris* (var. γ *gracillima*). *Slender ixia*. *Curtis's Botanical Magazine* 16: t. 570.
- KLATT, F.W. 1882. Ergänzungen und Berichtigungen zu Baker's Systema Iridacearum. *Abhandlungen der Naturforschenden Gesellschaft zu Halle* 15: 44–404.
- LEWIS, J. 1962. South African Iridaceae: the genus *Ixia*. *Journal of South African Botany* 27: 45–195.
- LINNAEUS, C. fil. 1782 [as 1781]. *Supplementum plantarum*. Orphanotropheus, Brunswick.
- MANNING, J.C., GOLDBLATT, P. & SNIJMAN, D. 2002. *The color encyclopedia of Cape bulbs*. Timber Press, Portland, OR.
- SALISBURY, R.A. 1796. *Prodromus stirpium in horto ad Chapel Allerton vigentium*. London.