Studies in the Compositae of the Arabian Peninsula and Socotra — 6. The Hypochaeridinae (Lactuceae) in the Arabian Peninsula

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Source: Willdenowia, 30(2) : 315-337

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.30.30210

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Studies in the *Compositae* of the Arabian Peninsula and Socotra – 6. The *Hypochaeridinae (Lactuceae)* in the Arabian Peninsula

Abstract

Smalla, M.: Studies in the *Compositae* of the Arabian Peninsula and Socotra – 6. The *Hypochaeridinae (Lactuceae)* in the Arabian Peninsula. – Willdenowia 30: 315-337. 2000. – ISSN 0511-9618.

The genera and species of the subtribe *Hypochaeridinae* occurring in the Arabian Peninsula are studied and data on their taxonomy and distribution given. Six genera have been recorded. *Picris* is represented by four species, i.e. *P. babylonica, P. cyanocarpa, P. longirostris* and *P. scabra* (with two subspecies), the other genera are represented by one species each, i.e. *Hedypnois cretica, Hypochaeris glabra, Leontodon laciniatus, Rhagadiolus stellatus* and *Urospermum picroides*. The subtribe is absent from the Socotra archipelago. The new combination *Picris scabra* subsp. *abyssinica* is validated and a neotype designated for *P. scabra*. Chromosome counts are reported for Yemeni origins of *Picris scabra* subsp. *abyssinica* (2n = 10), subsp. *scabra* (2n = 10, first report) and *Urospermum picroides* (2n = 10).

Introduction

The taxonomy of the *Lactuceae* subtribe *Hypochaeridinae* in the Arabian Peninsula is clarified, in particular regarding the problematic taxa of *Picris*. General information on the subtribe *Hypochaeridinae,* of which ten species have been recorded from the Arabian Peninsula but none from the Socotra archipelago, has been provided by Stebbins (1953), Lack (1979b) and Bremer (1994). The present paper is a further contribution to the revision of the genus *Picris* (see also Eig 1938, Agnew 1961, Lack 1973, 1975a, 1975b, 1979a-c, Holzapfel 1993) and at the same time a preparatory work for the treatment of the subtribe in the "Flora of the Arabian Peninsula and Socotra" (cf. Miller & Cope 1996).

Material and methods

This study is based on (1) field observations and specimens collected by the author in Yemen in March 1997, on (2) herbarium material kept at B, BM, C, CAIA, CAIM, E, F, G, HBG, K, KSU, M, ON, RIY, W and WU, and (3) on plants raised in the Botanic Garden Berlin-Dahlem from seeds collected by the author in Yemen. All measurements given in the description of the species

were taken from herbarium specimens. For scanning electron microscopical studies of the achenes, the samples were cool-sputtered with 20 nm gold-palladium. Chromosomes were counted in plants raised from seeds of wild origin in the Botanic Garden Berlin-Dahlem using a standard technique (Vogt & Oberprieler 1993). A Principal Component Analysis (PCA), using the program package BioDiversity Professional (McAleece 1997) was performed with the data of six selected characters of *Picris* to examine the separation of the species in the Arabian Peninsula (see 1.5.). The list of specimens studied from the Arabian Peninsula and immediately adjacent areas is provided at http:/www.bgbm.fu-berlin.de/bgbm/library/publikat/willd30/smalla.htm.

Taxonomic treatment

Key to the genera of *Hypochaeridinae* in the Arabian Peninsula

1. Plants with an indumentum of both unbranched and 2-hooked or biforked hairs 2
– Plants with an indumentum of unbranched hairs only. 3
2. Pappus of marginal achenes a corona of largely fused scales < 1 mm long, pappus of inner achenes consisting of scabrid, 6-7 short, basally fused, and up to 6 mm long, linear-lanceolate bristles . . . . . 2. *Hedypnois*
– Pappus of all achenes consisting of plumose bristles or pappus almost absent in marginal achenes . . . . . 1. *Picris*
3. Phyllaries in more than one row, free 4
– Phyllaries in one row, connate in the basal third. . . . . 6. *Urospermum*
4. Phyllaries in two rows; capitula with c. 10 florets only; achenes without pappus . . . . . 5. *Rhagadiolus*
– Phyllaries in more than two rows; capitula with distinctly more than 10 florets; achenes with a pappus of plumose bristles 5
5. Capitula homocarpous; receptacle epaleaceous . . . . . 4. *Leontodon*
– Capitula heterocarpous; receptacle paleaceous . . . . . 3. *Hypochaeris*

1. *Picris* L.

Annual, biennial or perennial herbs, ascending or decumbent; capitula solitary, terminal. *Indumentum* of mainly 2-hooked anchor hairs among simple multicellular trichomes. *Basal leaves* rosulate, variable, entire to sinuate-dentate or runcinate-pinnatifid. *Stem leaves* few, smaller, sessile, almost entire. *Involucre* consisting of linear-lanceolate, acute phyllaries in two or more rows; outermost phyllaries smaller than the others; all phyllaries tomentose and on the lower midrib with one or two rows of anchor hairs. *Capitula* with bright yellow florets (yellow-green to light brown when dry), sometimes dorsally with reddish stripes, some capitula with a blackish centre of immature florets. *Florets* up to 7 × 2-3 mm. *Receptacle* naked. *Achenes* homo- or heteromorphic; in homocarpous capitula achenes cylindrical to fusiform, curved, attenuate at apex or beaked, with five longitudinal ribs and transversally wrinkled, brownish or grey-violet; in heterocarpous capitula inner achenes as above and marginal achenes more or less pubescent, clasped by the innermost involucral bracts, persistent, attenuate at apex but never beaked. *Pappus* consisting of plumose bristles, marginal achenes in heterocarpous capitula with a reduced, very short pappus.

Note

The present study revealed the occurrence of four species of *Picris* in the Arabian Peninsula, i.e. *P. babylonica* Hand.-Mazz., *P. cyanocarpa* Boiss., *P. longirostris* Sch. Bip. and *P. scabra* Forssk. (incl. *P. abyssinica*).

A fifth species reported, *Picris asplenioides* L. (= *P. radicata* Less.), is actually distributed along the coast of Libya, Egypt and S Israel, and reports of this species for the Arabian Peninsula

(Heller & Heyn 1993: 142; Anonymous 1983, as *P. radicata,* for Qatar; Collenette 1999: 207 *(Collenette 5567!),* 208 as *P. radicata,* for Saudi Arabia) are erroneous and mostly due to confusion with *P. babylonica*. The report of the Mediterranean *P. integrifolia* Desf. (= *P. sprengeriana* (L.) Lam.) for Saudi Arabia (Collenette 1999: 208, as *P. sprengeriana*) is also most likely erroneous and due to confusion with *P. longirostris*.

All four *Picris* species in the Arabian Peninsula are closely related to each other and difficult to distinguish in flowering state, fruiting material being thus necessary for certain identification. Aberrant specimens with a combination of features intermediate between two or three of the four species, and probably at least in part indicating hybridization and introgression, have occasionally been recorded. The results of a principal component analysis including the four species of *Picris* and the aberrant specimens are analysed and discussed in chapter 1.5., below.

Key to the species of *Picris* in the Arabian Peninsula

1. Capitula homocarpous; achenes glabrous, pappus well-developed; beak of the achene as long as to twice as long as the corpus . . . . . 1.4. *P. cyanocarpa*
– Capitula either heterocarpous with glabrous inner and pubescent marginal achenes, the latter with a reduced pappus and clasped by the involucral bracts, or homocarpous and then all achenes glabrous and with a well-developed pappus; beak of the (inner) achenes shorter than the corpus 2
2. Transversally wrinkled surface of the inner achene in profile sinuate-dentate, in top view wavy (Fig. 4a) . . . . . 1.2. *P. babylonica*
– Transversally wrinkled surface of the inner achene in profile serrate, in top view shingled (Fig. 3a) 3
3. Annual herb, basal leaves often auriculate; predominantly a lowland species; occurring in the northern part of the Arabian Peninsula (extending southwards to the Asir) . . . . . 1.3. *P. longirostris*
– Perennial herb, basal leaves never auriculate; a montane species; restricted to the SW of the Arabian Peninsula (W Yemen and S Asir) . . . . . 1.1. *P. scabra*

1.1. *Picris scabra*

Picris scabra Forssk., Fl. Aegypt.-Arab.: 143. 1775 ≡ *Deckera scabra* (Forssk.) Sch. Bip. in Flora 17: 479. 1837. – Neotypus (designated here): [Yemen], Jebal Khudra, by Negd al Ahmar pass (Ibb-Taiz), 2500 m, on grassy slope, 24.10.1979, *J. R. I. Wood 3009* (BM!).

This polymorphic species is distributed in the mountains of the SW Arabian Peninsula and the NE Ethiopian highlands and shows a wide range of variation in achenes length, in the relative length of the beak and in the indumentum. Two names have been applied to this species: *Picris scabra* Forssk. (1775) and *P. abyssinica* Sch. Bip. (1839). Schwartz (1939) was the first to suppose that both are synonymous. Having examined the available material from throughout the range of distribution, I confirm this view but conclude that two infraspecific taxa can be delimited. One taxon has a very dense indumentum and is restricted in its distribution to a small area in the SW Yemeni highlands between Taiz and Yarim, where it grows at altitudes above c. 2400 m. The second taxon has a sparse to moderately dense indumentum and occurs at altitudes of 1500-3100 m throughout the range of distribution of *P. scabra.* Following the established practise that subspecific rank is used when variation is only partly discontinuous, or when only a single character is coupled with a distinctive distribution, the two taxa are treated as subspecies of *P. scabra*.

Lack (1979a) noted a relatively short beak of only c. 0.5 mm in the Ethiopian population of the species (sub *P. abyssinica*). Apart from achenes with such a short beak I found, however, also achenes with a beak of c. 1 mm length (in Yemeni plants 1.1-3.3 mm). Since the beak length shows considerable variation in species of *Picris*, further studies on Ethiopian material seem necessary to decide whether possibly a third infraspecific entity should be distinguished.

Fig. 1. *Picris scabra* subsp. *abyssinica* – A: habit; B: flowering head; C: head closed; D: involucral bracts; E: ligulate floret; F: achene; G: 2-hooked hairs. – Drawn by M. Lünser after live plants cultivated in the Botanic Garden Berlin-Dahlem from seeds collected by J. R. I. Wood in Yemen.

From *P. scabra,* Wood (1997: 307) distinguished some individuals growing in the central N Yemeni highlands, which are small annuals with a sparsely hispid indumentum, he regarded them as a separate species provisionally named *Picris* sp. A. I studied specimens so determined by Wood *(Wood 3234)* and in March 1997 also life plants at a locality quoted by Wood (1997) and found that these plants clearly belong to *P. scabra* subsp. *abyssinica*. Growing in dry places, they remained very small and did not become perennial (see, e.g., also *Smalla 286*). Plants growing nearby in irrigated fields or near natural springs, in contrast possess the same habit as typical plants from the more humid western escarpment. This observation illustrates the plasticity of *P. scabra* subsp. *abyssinica* and the influence of ecological factors on the lifespan.

Typification: Forsskål gives the following diagnosis for *Picris scabra:* "Caulis squamis 3 remotis, linearibus, erectis. Flore saepe unico, terminali. Folia repando-undulata, setis hispida, caput & scapus & calyx. Semina transversim striata. Pappus pedunculatus, plumosus . . . In Monte Chadra" (Forsskål 1775: 143). A specimen referring to this description could not to be found among the extant Forsskål material (Hepper & Friis 1993). The statements "setis hispida ... pappus pedunculatus, plumosus", however, clearly indicates that Forsskål's protologue refers to a species of *Picris* and the collecting locality "Monte Chadra", i.e. Jabal Khudra, makes it almost certain that Forsskål's name is applicable for the taxon endemic to the high mountains in the Taiz-Yarim region. Consequently I have designated a specimen of this taxon collected by Wood at the locus classicus as the neotype of the name *P. scabra* Forssk.

Key to the subspecies of *Picris scabra*

1. Indumentum very dense; anchor hairs on the mid vein of the phyllaries more than 1.5 mm long; always homocarpous; endemic to altitudes above c. 2400 m in the Taiz-Yarim region, SW Yemen . . . . . 1.1b. *P. scabra* subsp. *scabra*
– Indumentum sparse to moderately dense; anchor hairs on the mid vein of the phyllaries less than 1.5 mm long; homocarpous or, very rarely, heterocarpous; mountainous regions of SW Saudi Arabia, W Yemen and NE Ethiopia, at 1500-3100 m . . . . . 1.1a. *P. scabra* subsp. *abyssinica*

1.1a. *Picris scabra* subsp. *abyssinica*

Picris scabra subsp. *abyssinica* (Sch. Bip.) M. Smalla, **comb. & stat. nov.**
≡ *Picris abyssinica* Sch. Bip in Flora 22: 20. 1839. – Holotype: [Ethiopia], inter Halei et Temben, 5.1832, *Rüppel* (FR!; isotype P).
[– *Picris* sp. A Wood, Handb. Fl. Yemen: 307. 1997].

Ic.: Fig. 1, 2, 3a-b. – Chaudhary & Akram 1987: 66 (as *P. abyssinica*); Chaudhary & Revri 1983: fig. 62 (as *P. abyssinica*); Lack 1979a: 39 (as *P. abyssinica*); Migahid 1989: fig. 198 (as *P. abyssinica*).

Perennial herb already flowering in the first year, at anthesis (3)5-30(34) cm high, with strong rootstock and 1 to many, erect, slender, sparsely branched stems, covered sparsely to densely with 2-hooked anchor hairs, with solitary, terminal capitula. *Basal leaves* rosulate, oblanceolate, runcinate-pinnatifid, 3-10 cm long, 0.4-1.2 cm wide, hispid of bristles and anchor hairs. *Stem leaves* few, oblanceolate, 1-10 cm long, 0.2-1 cm wide, sessile and less strongly lobed, hispid of bristles and anchor hairs. *Involucre* campanulate at anthesis, cylindrical at fruiting, with linear-lanceolate, acute phyllaries; outer phyllaries in a few rows, inner ones distinctly longer, mostly equal and in a single row, with a crispate indumentum and along the mid vein hispid of anchor hairs <1.5 mm long. *Capitula* at anthesis 11-17 mm long, 7-15 mm wide, at fruiting 10-12 mm long, 10-12 mm wide. *Florets* yellow, c. 7 × 2-3 mm. *Achenes* homomorphic, very rarely heteromorphic (Fig. 2, 3a-b), light brown to nearly black, 3-5(7) mm long, 0.7-1 mm diam.; inner achenes in homocarpic capitula with the transversally wrinkled surface in profile appearing ser-

Fig. 2. *Picris scabra* subsp. *abyssinica* – a rare heterocarpous head. – Saudi Arabia, *Collenette 6279*.

rate, in top view shingled, with a beak 1.1-3.3 mm long; marginal achenes in heterocarpic capitula persistent and clasped by the inner involucral bracts, 4-5.5 mm long, 1-1.3 mm diam., terete, somewhat curved, not beaked but tapering very gradually towards apex, pubescent, reddish brown. *Pappus* plumose, usually persistent; pappus of marginal achenes in heterocarpous capitula reduced to a short corona (Fig. 2).

Note: In the Asir region, Saudi Arabia, plants occur that show intermediacies between *P. scabra* subsp. *abyssinica* and *P. longirostris,* see 1.5., below.

Chromosome number: 2n = 10; own counts in several Yemeni origins (*M. Smalla 18, 77, 210, 274/1, 275, 275/1, 286,* all B) confirm earlier counts by Podlech (1986).

Distribution: *Picris scabra* subsp. *abyssinica* occurs in the western escarpment of the Arabian Peninsula and in the NE highland of Ethiopia, in relatively humid regions (Fig. 5). In the Arabian Peninsula it grows at altitudes of c. 1500-3100 m, in NE Ethiopia it is also found as far down as c. 500 m.

1.1b. *Picris scabra* subsp. *scabra*

Perennial herb, flowering already in the first year, at anthesis (3)5-24(30) cm high, with strong taproot, stems slender with solitary, terminal capitula. *Basal leaves* rosulate, oblanceolate, runcinate-pinnatifid, 3-10 × 0.4-1.2 cm, densely hispid of bristles and anchor hairs. *Stem leaves* few, oblanceolate, 1-6 × 0.2-1 cm, sessile and less strongly lobed, densely hispid of bristles and anchor hairs. *Involucre* campanulate at anthesis, cylindrical at fruiting, with linear-lanceolate, acute phyllaries; outer phyllaries in a few rows, inner ones distinctly longer, mostly equal, in a single row, with a crispate indumentum and along the mid vein hispid of anchor hairs >1.5 mm long. *Capitula* at anthesis 11-17 mm long, 7-15 mm wide, at fruiting 10-12 mm long, 10-12 mm wide. *Florets* yellow, c. 7 × 2-3 mm. *Achenes* always homomorphic, light brown to nearly black,

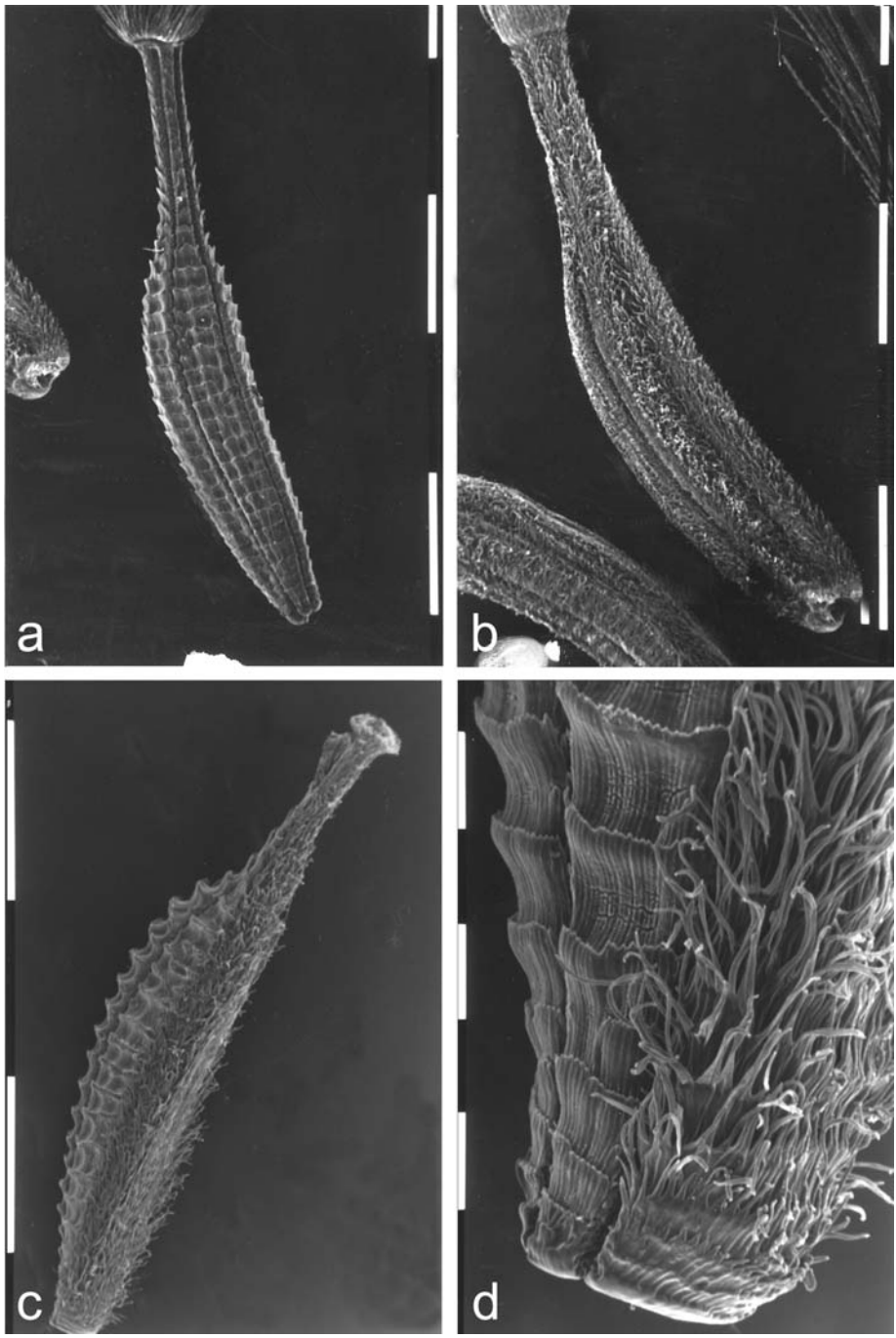

Fig. 3. SEM micrographs of achenes of *Picris* – a-b: *P. scabra* subsp. *abyssinica (M. Smalla 18)*, a rare heterocarpous individual, inner achene (a), marginal achene (b); c-d: *P. babylonica (Collenette 4112),* marginal achene with surface half imbricate, half pubescent (c) and detail (d), see 'Note' in text. – Scale: 1 mm.

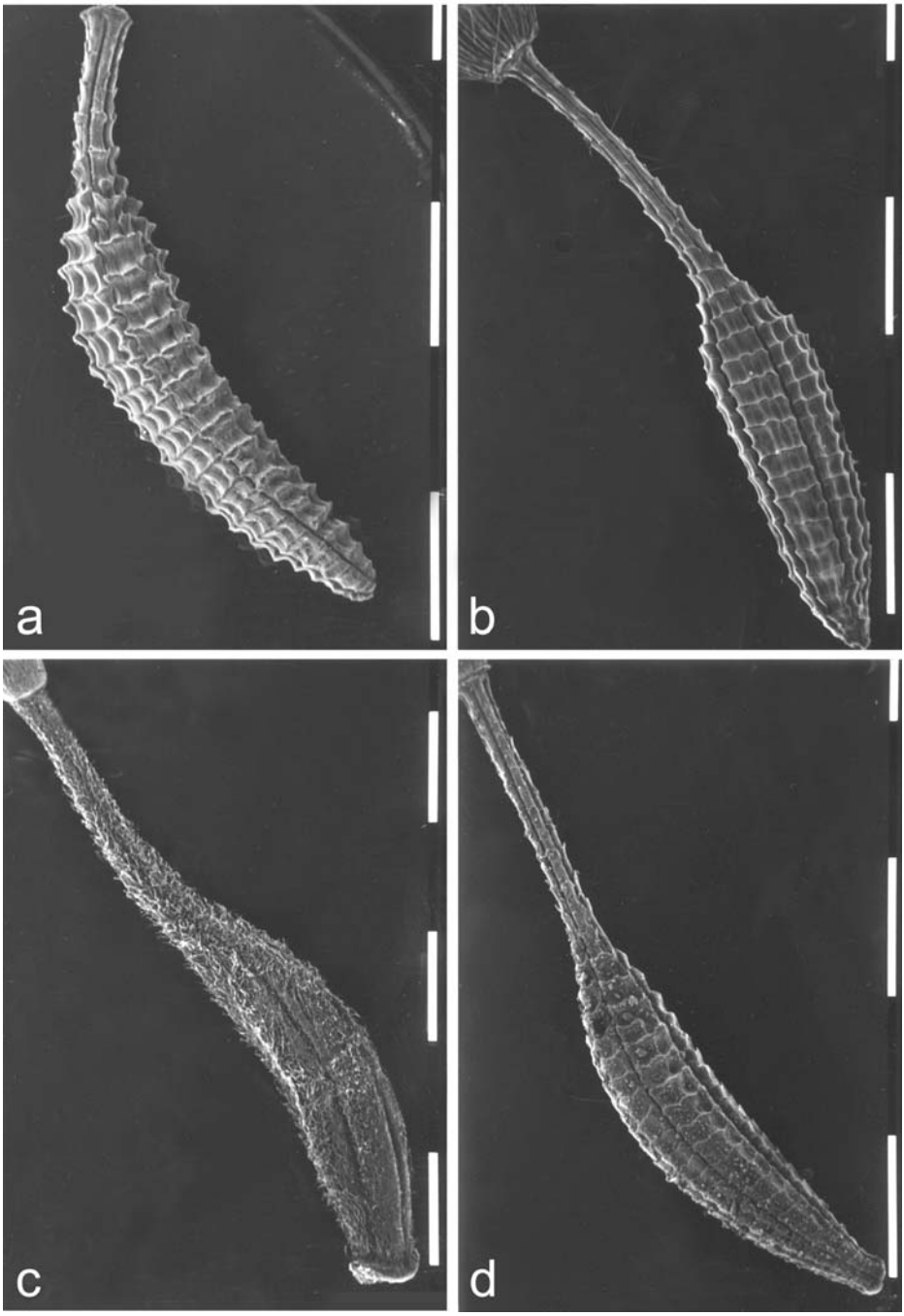

Fig. 4. SEM micrographs of achenes of *Picris* – a: *P. babylonica (Handel-Mazzetti 986),* inner achene; b-c: *P. longirostris (Boulos 14106),* inner achene (b), marginal achene (c); d: *P. cyanocarpa (Collenette 5287),* inner achene. – Scale 1 mm.

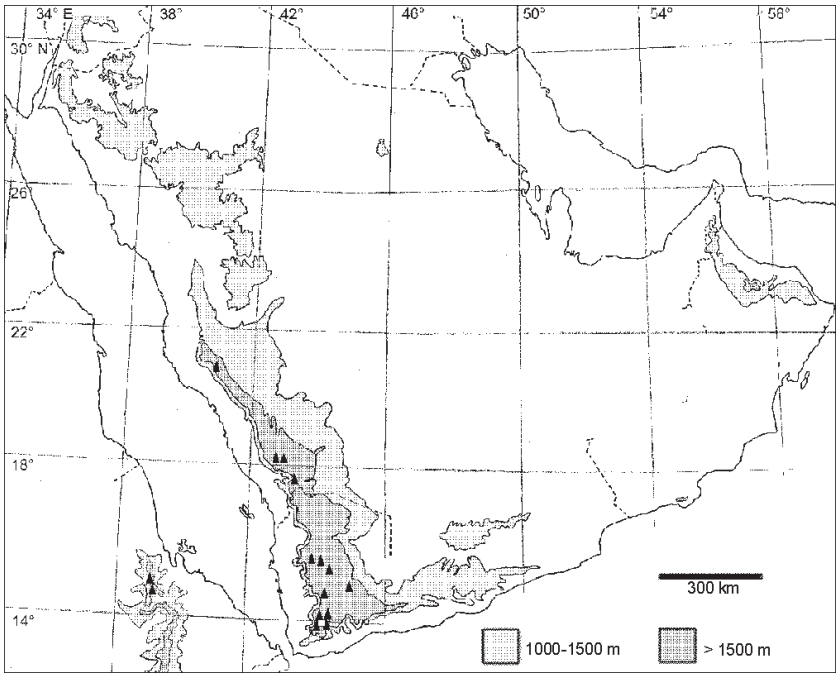

Fig. 5. Distribution of *Picris scabra* subsp. *scabra* (□) and subsp. *abyssinica* (▲).

the transversally wrinkled surface in profile appearing serrate, in top view shingled, 5-6.5 mm long, 1 mm diam., beak 1.3-2.1 mm long. *Pappus* plumose, usually persistent.

Chromosome number: 2n = 10; this is the first report of a chromosome number for this taxon; the number was counted in plants from Jabal Sabir *(M. Smalla 207)*.

Distribution: *Picris scabra* subsp. *scabra* is an endemic of the high mountains above c. 2400 m in the Taiz-Yarim region, in SW Yemen (Fig. 5).

1.2. *Picris babylonica*

Picris babylonica Hand.-Mazz. in Ann. K.K. Naturhist. Hofmus. Wien 27: 453. 1913. – Holotype: [Iraq], "zwischen Samurra und Beled am rechten Tigrisufer nördlich von Baghdad", *Handel-Mazzetti 986* (W!; isotypes: B!, WU!).

Ic.: Fig. 3c-d, 4a. – Al-Rawi 1983: fig. 156, 1987: fig. 289, 290; Collenette 1999: 207 (as *P. babylonica* and, erroneously, as *P. asplenioides*), 208 (erroneously as *Picris radicata*); Dickson 1955: 112; Lipscombe Vincett [s.a.]: 100; Mandaville 1990: t. 226; Shuaib 1995: 112. See also sub *P. cyanocarpa*.

Annual herb, decumbent, stems simple or branched, 4-40 cm long, with an indumentum of bristles and 2-hooked anchor hairs. *Basal leaves* oblong-oblanceolate, runcinate-pinnatifid, 2-10 × 0.3-2.5 cm, hispid of bristles and 2-hooked anchor hairs. *Stem leaves* ± reduced to bracts, subequal in shape. *Peduncles* slender, longitudinally striate, with sparse indumentum of anchor hairs. *Capitula* solitary, terminal, at anthesis 7-20 mm long, 5-15 mm wide, yellow-flowered, sometimes with a blackish centre of immature florets, at fruiting 8-15 mm long, 8-12 mm wide, homocarpous or heterocarpous. *Involucre* of linear-lanceolate, acute phyllaries; outer phyllaries

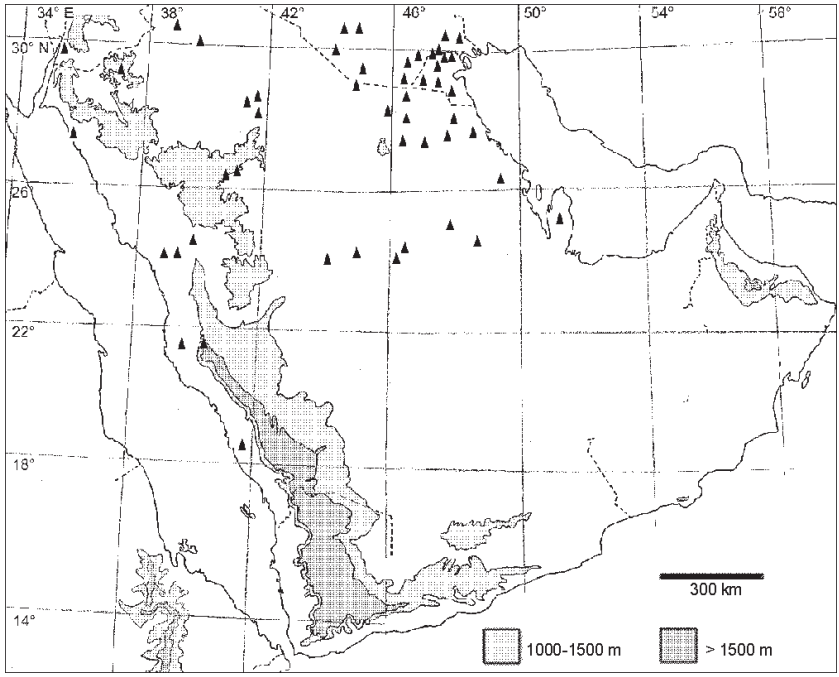

Fig. 6. Distribution of *Picris babylonica* in the Arabian Peninsula and adjacent regions. The distribution area of the species extends further N in Iraq and W Iran.

very short, inner mostly equal, in a single row, on the back crisp-tomentose and with anchor hairs along the mid vein. *Achenes* in homocarpous capitula all subfusiform, curved, tapering towards apex, brown to black, the transversally wrinkled surface in profile appearing sinuate-dentate, in top view wavy (Fig. 4a), (2.9)4-6 (6.6) mm long, 0.7-1 mm diam., with beak 1.1-2.8 mm long; in heterocarpous capitula inner achenes as in homocarpous capitula, marginal achenes persistent, clasped by the inner involucral bracts, terete, curved, attenuate at apex, 4-6 mm long, brown, pubescent. *Pappus* plumose, on the achenes of homocarpous capitula and the inner achenes of heterocarpous capitula as long as the achene, on the marginal achenes of heterocarpous capitula reduced to a short crown.

Note: *Picris babylonica* can savely be distinguished from the other *Picris* species of the Arabian Peninsula by the wavy (versus shingled) surface of its (inner) achenes. For the occasional occurrence of putative hybrids with other annual *Picris* species, see 1.5., below.

As already stated by Lack (1975b: 133) and Mandaville (1990: 317-318), the capitula in an individual plant of *Picris babylonica* may all be homocarpous, or both homocarpous and heterocarpous, or all heterocarpous. In the heterocarpous individuals the inner achenes with a well-developed pappus are dispersed by wind, while the marginal achenes with a reduced pappus, clasped by the phyllaries and persistent on the receptacle remain on the mother plant and thus in the habitat which had already successfully been colonized. Among the rich material from Iraq studied by Lack (1975b), only few species with heterocarpous capitula were present. Lack expected that the percentage of heterocarpous individuals would be larger among the populations in the Arabian Peninsula due to the desert climate and this was later confirmed by Mandaville (1990: 317-318). The present study revealed that the majority of the gatherings from the Arabian Peninsula are heterocarpous plants. Homocarpous plants are, however, present throughout the

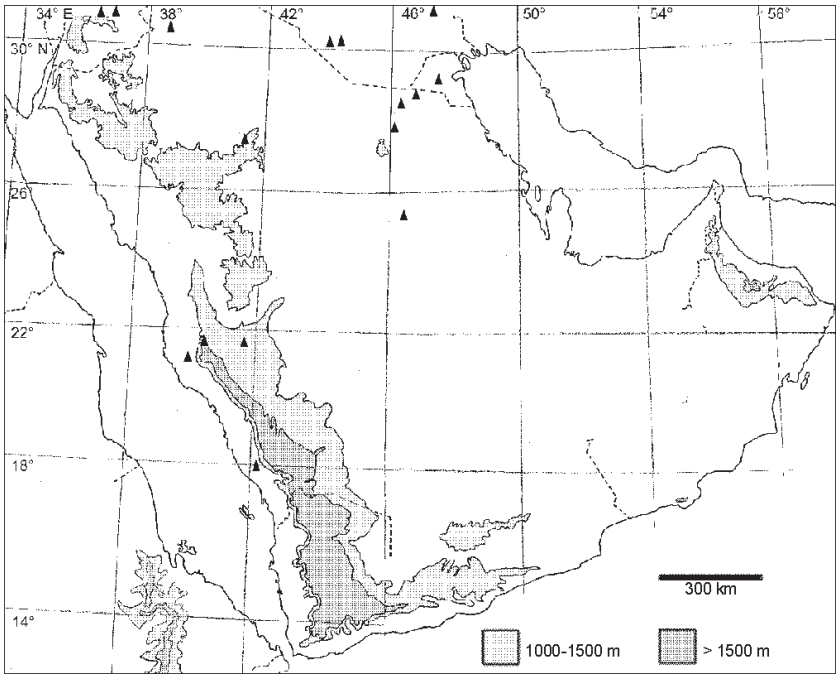

Fig. 7. Distribution of *Picris longirostris* in the Arabian Peninsula and adjacent regions.

range of *P. babylonica* in the Arabian Peninsula and it appears possible that many populations contain both homocarpous and heterocarpous plants.

Rarely, a single achene exhibits partly the surface texture of the inner and partly of the marginal achenes, whereby the two different surface textures are delimited by the grooves between the main ribs (Fig. 3c-d). Achene heteromorphy is obviously induced by the position of the achene on the receptacle (see also Bachmann 1983). In *Picris* the borderline between these receptacle areas inducing inner and marginal achene morphs seems to be clear-cut and the induction bipolar without transitions since no intermediate morphs occur. The differentiation is apparently induced along the five vascular bundles supplying the five achene ribs.

Chromosome number: not known.

Distribution: *Picris babylonica* is distributed from Sinai(?) and S Jordan across Iraq to W Iran (Lack 1975b: map 14 & 18) and in the lowland of the northern half of the Arabian Peninsula (>24°N) but extending south to almost 18°N in the west (Fig. 6). The species grows on dry, sandy and calcareous soils, occurs abundantly after rains and is the most common species of *Picris* in the lowlands.

1.3. *Picris longirostris*

Picris longirostris Sch. Bip. in Mus. Senckenberg. 3: 60. 1839. – Holotype: "Arabia", *Rueppell* (FR). – For synonymy see Lack (1975).

Ic.: Fig. 4b-c. – Feinbrun-Dothan 1977: t. 708 (as *P. damascena*); Collenette 1999: 207, 208 (as *Picris* sp. 933 and, erroneously, as *Picris sprengeriana*).

Annual herb, 3-30 cm high, branched at or near base, stems erect to decumbent with a sparse indumentum of bristles and 2-hooked anchor hairs. *Basal leaves* oblong-oblanceolate, run-

cinate-pinnatifid, often auriculate, 3-15 × 0.5-2 cm, hispid of bristles and 2-hooked anchor hairs. *Stem leaves* mostly equal in shape, a few shorter near stem base, 1-6 × 0.2-1 cm, sparsely covered with bristles and 2-hooked anchor hairs. *Peduncles* slender, longitudinally striate, with sparse indumentum of anchor hairs. *Capitula* terminal, solitary, at anthesis 6-9 mm long, 5-12 mm wide, at fruiting 10-12 mm long, 10-12 mm wide with yellow florets. *Involucre* of linear-lanceolate, acute bracts; outer bracts very short, inner mostly equal, in one row, on the back crisp-tomentose and with anchor hairs along the mid vein. *Achenes* heteromorphic (Fig. 4b-c); inner achenes subfusiform, curved, tapering at apex, brown to black, 4.4-6.5 mm long, 0.6-1 mm diam., cuspidate, beak 1.6-2.8 mm long, the transversally wrinkled surface in profile appearing serrate, in top view shingled; marginal achenes clasped by the inner involucral bracts, terete, curved, not beaked, 4.4-5.5 mm long, 0.4-0.8 mm diam., brown, pubescent. *Pappus* of inner achenes plumose, as long as the achenes, pappus of marginal achenes a short crown of hairs.

Note: *Picris longirostris* is the only *Picris* species in the Arabian Peninsula with auriculate basal leaves. This feature is, however, not always present and achene features are then necessary for identification: from *P. babylonica* the species clearly differs by the shingled (versus wavy) surface of the (inner) achenes; *P. cyanocarpa* has a beak longer than the corpus, its capitula are always homocarpous, and it is furthermore distinguished by a dense stem indumentum of conspicuously long trichomes. Distinction between the annual *P. longirostris* and the perennial *P. scabra* subsp. *abyssinica* is, in contrast, sometimes problematic in their contact area in the Asir region, Saudi Arabia, since both are very similar in habit and achene features; see also 1.5., below.

Chromosome number: unknown.

Distribution: *Picris longirostris* is distributed in the E Mediterranean region (Lack 1975b: maps 12, 16, 19). In the Arabian Peninsula it occurs mainly in the northern lowland northwards to Iraq but extending along the western escarpment southward to the Asir Mts (Fig. 7).

1.4. *Picris cyanocarpa*

Picris cyanocarpa Boiss., Diagn. Pl. Orient., ser. 1, 11: 37. 1849. – Holotype: "In valle Mokatteb Arabiae Petreae", *Boissier* (G).

Ic.: Fig. 4d. – Collenette 1999: 207; Feinbrun-Dothan 1977: t. 706. – The illustrations of *'P. cyanocarpa'* in Chaudhary & Akram (1987: 67) and Chaudhary & Zawawi (1983: 99) are probably erroneous for homocarpous forms of *P. babylonica* as judged from the beak length; the same holds perhaps true also for the illustrations in Chaudhary & Al-Jowaid (1999: 286, 288).

Annual herb, 5-30 cm high, branched at and near base, stems erect to decumbent with a dense indumentum of very long bristles and 2-hooked anchor hairs >1.5 mm long. *Basal leaves* oblong-oblanceolate, runcinate-pinnatifid, 3-8 × 0.5-1 cm, hispid of very long bristles and 2-hooked anchor hairs. *Stem leaves* rare, mostly reduced to scales, sparsely pubescent of bristles and 2-hooked anchor hairs. *Peduncles* slender, striate longitudinally, with sparse indumentum of anchor hairs. *Capitula* solitary, terminal, at anthesis 10-16 mm long, 7-12 mm wide, at fruiting 13 -16 mm long, 7-10 mm wide, florets yellow. *Involucre* of linear-lanceolate, acute bracts; outer bracts very short, inner mostly equal, in one row, at the back crisp-tomentose and with anchor hairs along the mid vein. *Achenes* homomorphic, subfusiform, curved, brown to black, 5.6-7 mm long, with very long beak up to twice as long as the corpus, the transversally wrinkled surface in profile appearing serrate, in top view shingled, pappus present.

Note: Because of the dense indumentum of conspicuously long, simple and 2-hooked trichomes on the stems, the achene beak longer than the corpus and its always homocarpous capitula *P. cyanocarpa* can be clearly distinguished from all other species of the genus in the Arabian Peninsula.

Distribution: *Picris cyanocarpa* is distributed on sandy to calcareous soils from the Sinai southward along the western escarpments and from the central parts of Saudi Arabia to the northern

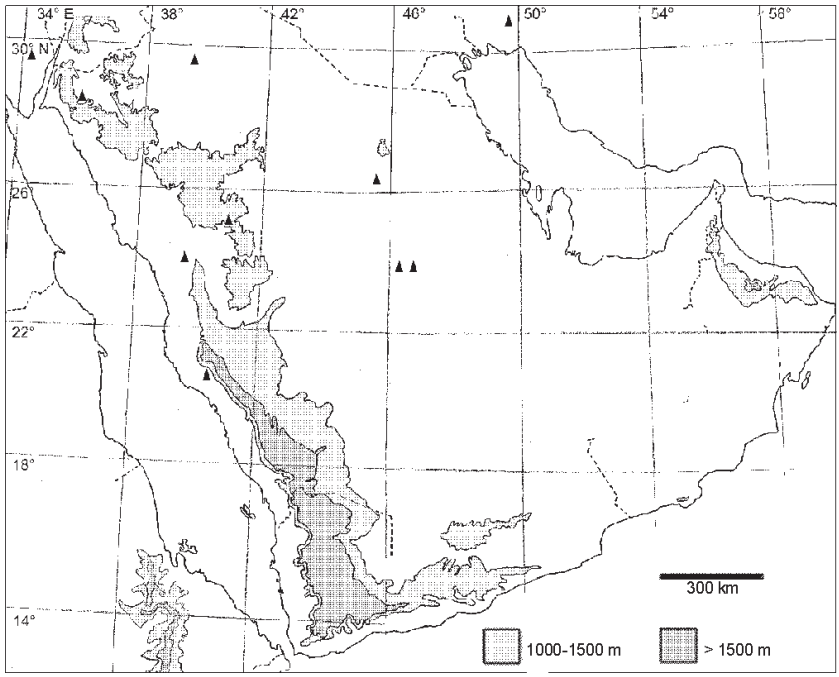

Fig. 8. Distribution of *Picris cyanocarpa.*

lowland (Fig. 8). It is the rarest species of the genus in the area. Chaudhary & Akram (1987: 67), perhaps due to confusion with homocarpous plants of *P. babylonica,* classify it as a common desert annual and weed of land brought newly under cultivation.

1.5. Putative hybridization and introgression between *Picris* species in the Arabian Peninsula

Among the material studied, several specimens from different regions of the Arabian Peninsula are aberrant, not matching one of the four species present but showing intermediate combinations of features. These are:

(A) Saudi Arabia, Taif region [Asir], 1985, *A. Fayed 1325* (K): Annual; achenes homomorphic, 6.8 mm long, surface partly wavy, partly imbricate, beak 2.8 mm long; indumentum dense, stems with very long hairs (to 2.5 mm).

(B) Saudi Arabia, [Asir], near Hadat ash Sham, N of Jumum, 1986, *J. S. Collenette 5612* (K): Annual; achenes heteromorphic, 5.1 mm long, surface partly wavy, partly imbricate, beak 2.8 mm long; basal leaves auriculate, indumentum sparsely hispid, with up to 150 trichomes/cm².

(C) Saudi Arabia, [Asir], 8 km W of Al Qaha, off the Taif - Jabal Ibrahim road, on edge of small field near lip of scarp, 7000 ft, 2.6.1987, *J. S. Collenette 5996* p.p. (E): Perennial; achene heteromorphic, 5.4 mm long, surface imbricate, beak 2.5 mm long; basal leaves auriculate; indumentum sparsely hispid, with up to 150 trichomes/cm².

(D) Saudi Arabia, [Asir], 8 km W of Al Qaha, off the Taif - Jabal Ibrahim road, on edge of small field near lip of scarp, 7000 ft, 2.6.1987, *J. S. Collenette 5996* p.p. (K): Perennial; achenes heteromorphic, 4.9 mm long, surface imbricate, beak 2.5 mm long; basal leaves not auriculate; indumentum very sparsely hispid, with up to 80 trichomes/ cm².

(E) Saudi Arabia, Umm Nukaylah Camp, SW of Al Jauf [29°28'N, 30°32'E], 18.4.1987, *J. S.*

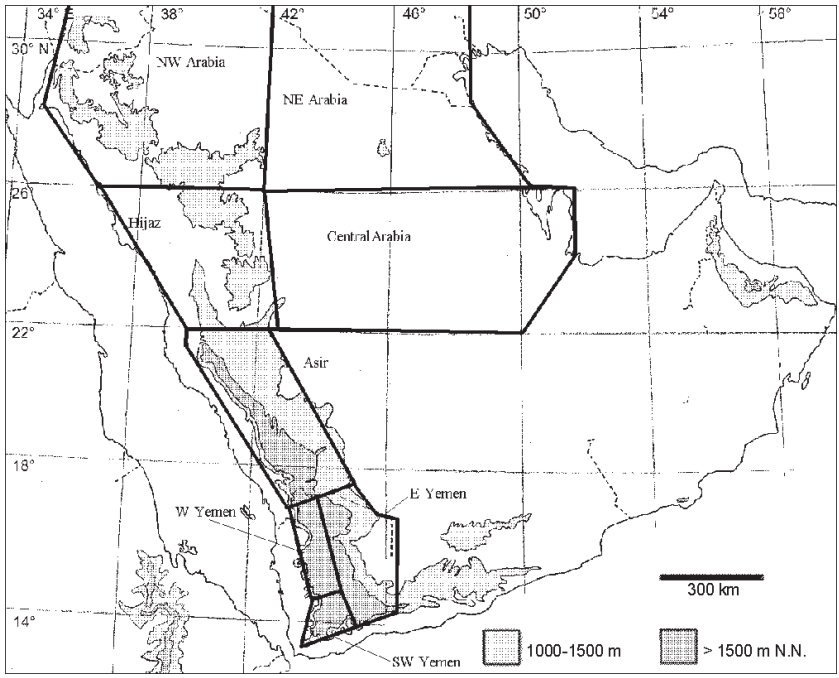

Fig. 9. Geographical regions of the Arabian Peninsula with occurrence of *Picris* species.

Collenette 6241[a] (K): Annual; achenes homomorphic, 7 mm long, surface imbricate, beak 4 mm long, indumentum sparsely hispid.
(F) Saudi Arabia, Umm Nukaylah Camp, SW of Al Jauf [29°28'N, 30°32'E], 18.4.1987, *J. S. Collenette 6241[b]* (K): Annual; achenes homomorphic, 5.6 mm long, surface wavy, partly imbricate, beak 2.3 mm long; indumentum sparsely hispid.
(G) Saudi Arabia, [Asir], Abha, on the Dhilla Pass, 5000-6000 ft, 1.6.1946, *W. Thesiger* (BM 81334): Annual; achenes homomorphic, 5 mm long, surface wavy, beak 2.5 mm long; basal leaves obvoid; indumentum sparsely hispid.

Principal Component Analysis

In order to examine the similarity of the *Picris* taxa in the Arabian Peninsula and the affinities of the aberrant specimens, a Principal Component Analysis (PCA) was performed. The PCA reduces n characteristics to a few main components or principal axes (PC1, PC2, ..., PCn). The coordinates of these axes are linear combinations of the original variables and summarize the major dimensions of variation. The principal axis corresponding to the largest eigenvalue is the dimension that accounts for the greatest amount of variance from the sample. The second principal axis accounts for the second largest amount of variance from the sample, the third axis for the third largest amount of variance. Plotting the taxonomic units in the space produced by the three axes gives a graphical representation of the similarity of the taxa. For the mathematical procedure see Abott & al. (1985).

The characters used for the PCA of the different taxa of *Picris* were (1) achene length, (2) beak length, (3) the achene surface condition, (4) the density of the indumentum, (5) heterocarpy (or homocarpy) and (6) perseverance. After the calculation of the means of 25 datasets of *Picris* taxa in several regions of the Arabian Peninsula (made out of the whole dataset of 125 individuals), including seven datasets of aberrant individuals and 18 datasets of the different *Picris* spe-

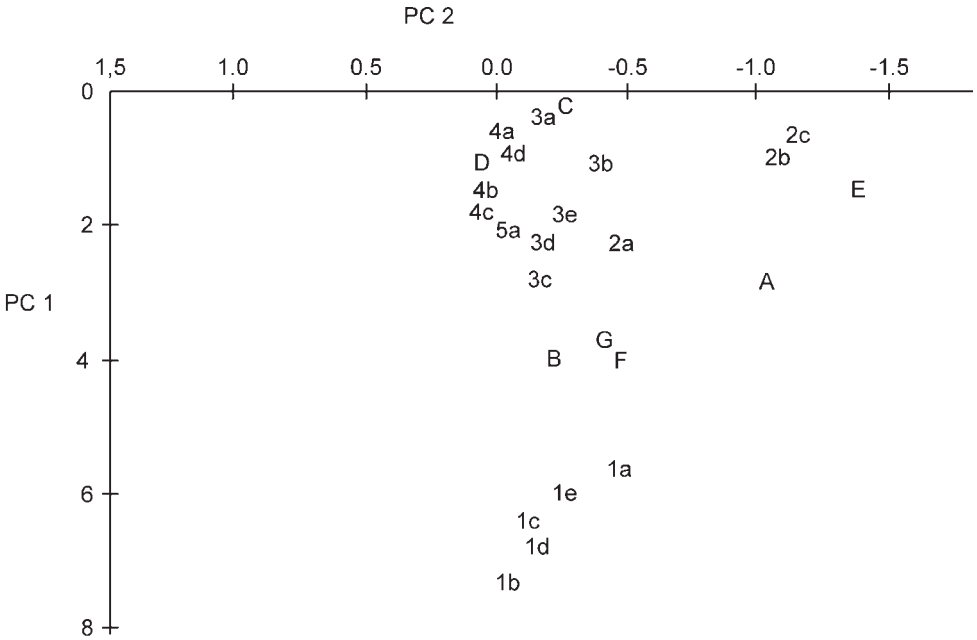

Fig. 10. PCA – plot of the first two principal components (PCI and PC2).

Signs:

1a *P. babylonica* / Asir
1b *P. babylonica* / Hijaz
1c *P. babylonica* / NE Arabia
1d *P. babylonica* / NW Arabia
1e *P. babylonica* / central Arabia

2a *P. cyanocarpa* / Asir
2b *P. cyanocarpa* / NW Arabia
2c *P. cyanocarpa* / central Arabia

3a *P. longirostris* / Asir
3b *P. longirostris* / Hijaz
3c *P. longirostris* / NE Arabia
3d *P. longirostris* / NW Arabia
3e *P. longirostris* / central Arabia

4a *P. scabra* subsp. *abyssinica* / Asir
4b *P. scabra* subsp. *abyssinica* / central N Yemen
4c *P. scabra* subsp. *abyssinica* / W. Yemen
4d *P. scabra* subsp. *abyssinica* / SW Yemen
5a *P. scabra* subsp. *scabra* / SW Yemen

A *A. Fayed 1325*
B *Collenette 5612*
C *Collenette 5996* (E)
D *Collenette 5996* (K)
E Collenette 6241 [a]
F *Collenette 6241* [b]
G *Thesiger* (BM 81334)

cies in eight regions, the PCA was accessed. The eight regions (Fig. 9) were determined by the climatic conditions and geographical features.

Results and discussion

Each investigated species covers a more or less discret area in the plot (Fig. 10). *Picris babylonica,* present in five regions (1a-e), is clearly separated from all other species, apparently by its typical achene surface. *P. cyanocarpa* in NW Arabia (2b) and in central Saudi Arabia (2c) is well separated by its achene and trichome length. Individuals of *P. cyanocarpa* from the Asir region (2a) with shorter achenes and beaks come out near *P. longirostris*. The individuals of the latter, homocarpous species form a distinct cloud except the individuals from the Asir region (3a), which are near to *P. scabra* subsp. *abyssinica* from the same region (4a) (perennial!). The positions of the dots representing *P. scabra* subsp. *abyssinica* (4a-d) and subsp. *scabra* (5a) are fairly close together, confirming the close relationship and minor differences between both taxa.

The aberrant individuals (A-G) are placed either within or near the cloud of one of the four species, or inbetween the cloudes of different species. The specimen *Collenette 5996[a]* (C) is situated close to *P. longirostris* from the Asir (3a), apparently because of its auriculate basal leaves and perenniality. The specimen *Collenette 5996[b]* from the Asir (D) is nested within the cloud of *P. scabra* subsp. *abyssinica* and close to the plants of the latter from the same region (4a) because of heterocarpy. The specimens *Fayed 1325* (A) and *Collenette 6241[a]* (E) are grouped next to *P. cyanocarpa* (2a-c), whereas *Collenette 6241[b]* (F) forms a group together with *Thesiger* (BM 81334) (G) and *Collenette 5612* (B) in the centre of the diagram in about equal distance to the annuals *P. longirostris* (3), *P. cyanocarpa* (2) and *P. babylonica* (1).

The PCA analysis indicates different cases where the morphological distance between the species is blurred by the occurrence of intermediate combinations of features, which may be due to hybridization or introgression.

(1) *Picris longirostris* and *P. scabra* (see 3,4,5), and in particular the plants of *P. longirostris* and *P. scabra* subsp. *abyssinica* from the Asir (3a and 4a) are remarkably near to each other. The exceptional occurrence of perennial *P. longirostris* individuals and the equally exceptional occurrence of heterocarpous individuals of *P. scabra* subsp. *abyssinica* in this region is responsible for this. Presuming a migration of *Picris* from the north into the northern lowlands and along the western mountain range into the south of the Arabian Peninsula, an explanation could be that the differentiation between both taxa took place in the context of the climatic differentiation between the more humid southern part of the mountain range (Asir and farther south, precipitation >500 mm p.a.) and its more arid northern part. Heterocarpy and annuality of *P. longirostris* in the more northern part and perennation and homocarpy of *P. scabra* in the southern part may thus be interpreted as contrary adaptations. The Asir region geographically and ecologically mediates between both parts of the mountain range and may be the region where the differentiation took place and may also be the contact area where hybridization and introgression has occurred. It is noteworthy in this context that the Asir is the only region where all *Picris* species of the Arabian Peninsula meet and from where the majority of the aberrant specimens originate.

(2) The grouping of the deviating annual specimens B, F, G in close neighbourhood and between the three annual species appears remarkable. They show, moreover, different combinations of features of the three annual species. B, which is separated from F and G by its heterocarpy, obviously exhibits a combination of features of all three annual species: it has auriculate basal leaves like *P. longirostris,* a beak longer than the corpus like *P. cyanocarpa,* an achene surface partly imbricate as in the former two species and partly wavy as in *P. babylonica,* and heterocarpous achenes like *P. longirostris* and *P. babylonica.* Partly wavy, partly imbricate achene surfaces may be a strong indication for introgression with *P. babylonica,* and this feature is found also in E, and moreover in A, in the latter in combination with a beak-corpus ratio also typical for *P. babylonica,* but otherwise combined with features of *P. cyanocarpa,* such as the stem indumentum of very long hairs and the achene length.

2. *Hedypnois* Mill.

2.1. *Hedypnois cretica*

Hedypnois cretica (L.) Dum.-Cours., Bot. Cult. 2: 339. 1802 ≡ *Hyoseris cretica* L., Sp. Pl.: 810. 1753.
= *Hedypnois rhagadioloides* (L.) F. W. Schmidt, Samml. Phys. Aufs. 1: 279. 1795 ≡ *Hyoseris rhagadioloides* L., Sp. Pl.: 1139. 1753.

Ic.: Collenette 1985: 155, 1999: 194 (as *Hedypnois rhagadioloides*).

Annual herb, 10-40 cm high, with a sparse indumentum of both simple and apically biforked to 2-hooked multicellular trichomes, up to c. 1.5 mm long. *Basal leaves* rosulate, ovate to lanceolate, coarsely dentate. *Stems* erect to decumbent, sparsely branched, with only few leaves similar to basal leaves. *Peduncles* hollow, at the apex swollen. *Capitula* campanulate at anthesis, almost globose at fruiting, heterocarpous. *Involucre* 9-11 mm long, of two rows of lanceolate phyllaries,

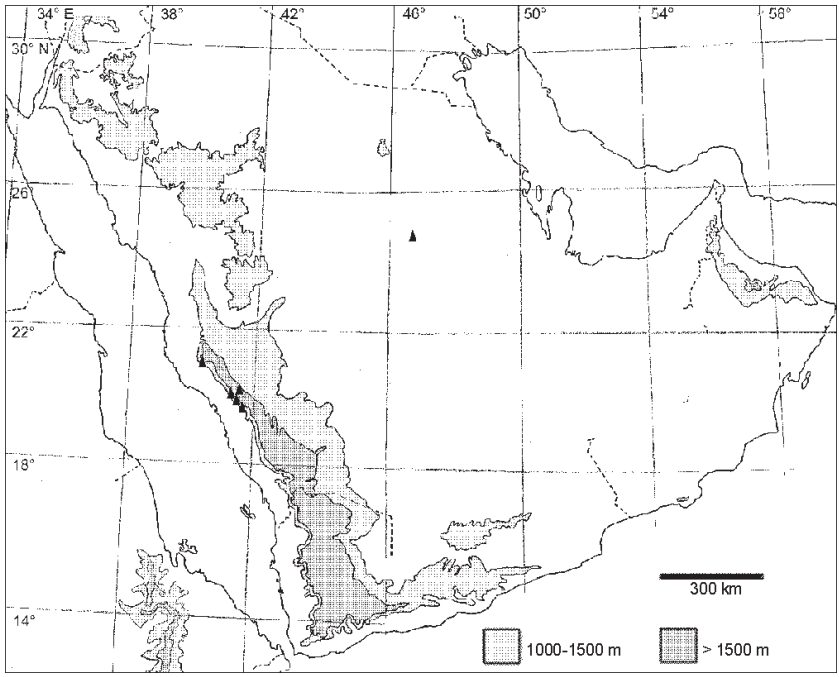

Fig. 11. Distribution of *Hedypnois cretica* in the Arabian Peninsula.

the outer ones less than a third of the length of the inner; the inner ones hardened and incurved at fruiting, each clasping a marginal achene. *Receptacle* epaleaceous. *Florets* yellow. *Achenes* 5-7 mm long, with five weak longitudinal grooves, surface imbricately shingled, every shingle hairlike acuminate giving the impression of a hispid indumentum; marginal achene terete, somewhat curved; inner achenes more slender, slightly curved and terete or sometimes laterally flattened. *Pappus* of inner achenes consisting of short, basally fused scabrid bristles and 6-7 up to 6 mm long, scabrid, lanceolate-acuminate bristles; pappus of the marginal achenes a coronula of largely fused scales less than 1 mm long.

Chromosome number: *Hedypnois cretica* forms a polymorphic complex with various chromosome numbers (2n = 8, 12, 13, 14, 16; Nordenstam 1971). No numbers are known from plants in the Arabian Peninsula.

Distribution: *Hedypnois cretica* is a chiefly Mediterranean-W Irano-Turanian species. In the Arabian Peninsula it is known only from Saudi Arabia, where it occurs in the N Asir Mts and near Riyadh (Fig. 11). It grows on dry soils as well as in irrigated fields. The species has a strong weedy tendency and is probably anthropogenous at least in the Riyadh area.

3. *Hypochaeris* L.

3.1. *Hypochaeris glabra*

Hypochaeris glabra L., Sp. Pl.: 811. 1753.

Ic.: Feinbrun-Dothan, N. 1977: t. 700; Collenette 1999: 196.

Annual herb, 20-40 cm high, basal leaves rosulate, entire to dentate, pinnatifid to spatulate, glabrous to sparsely hispid. *Stems* almost without bracts, with few branches. *Peduncles* with scaly

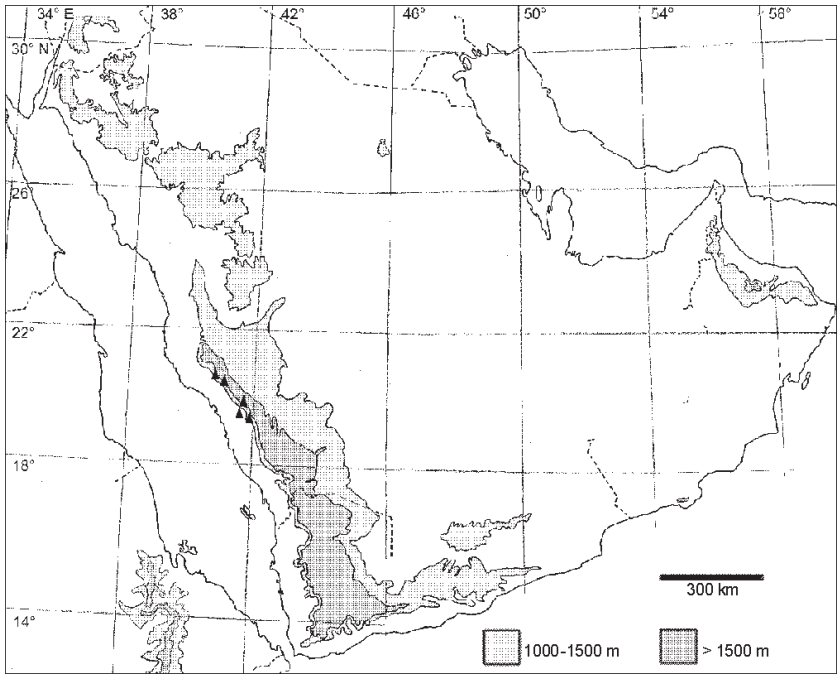

Fig. 12. Distribution of *Hypochaeris glabra* in the Arabian Peninsula.

bracts, solitary, somewhat thickened at apex. *Capitula* heterocarpous. *Involucre* of few rows of glabrous phyllaries, outer ones scaly, inner ones 1-2 cm long, lanceolate, glabrous. *Flowers* yellow. *Receptacle* paleaceous. *Marginal achenes* 3-4 mm long, cylindrical, truncate, with striate-imbricate surface. *Inner achenes* terete, 10-11 mm long, tapering into a beak, 6-7 mm long, with striate-imbricate surface. *Pappus* of inner and marginal achenes plumose.

Chromosome number: 2n = 10 (Stebbins & al. 1953, Shetty 1967).

Distribution: *Hypochaeris glabra* is widespread in the Euro-Siberian, Mediterranean and W Irano-Turanian region, and introduced as a ruderal to tropical Africa and South America. In the Arabian Peninsula the species is only found in the N Asir Mts, Saudi Arabia, at medium altitudes (Fig. 12). It is not known at present, whether the Asir population is introduced or a relict of a former wider distribution (see also *Rhagadiolus stellatus*).

4. *Leontodon* L.

4.1. *Leontodon laciniatus*

Leontodon laciniatus (Bertol.) Widder in Beih. Bot. Centralbl., Abt. 2, 60: 217. 1939 ≡ *Oporina laciniata* Bertol., Misc. Bot. 2: 21. 1843.
= *Leontodon hispidulum* var. *tenuilobum* Boiss., Fl. Orient. 3: 728. 1875.

Ic.: Feinbrun-Dothan 1977: t. 703; Dickson 1955: 110; Collenette 1985: 162, 1999: 203.

Annual herb, 10-35 cm high, erect to decumbent, with sparsely hispid indumentum. *Basal leaves* rosulate, 5-12 cm long, linear-lanceolate, pinnatifid or lobed. *Stems* 1-3, branched, with only few cauline leaves, in shape similar to basal leaves. *Peduncles* somewhat thickened at apex. *Capitula* homocarpous. *Receptacle* epaleate. *Involucre* of several rows of lanceolate phyllaries, the outer

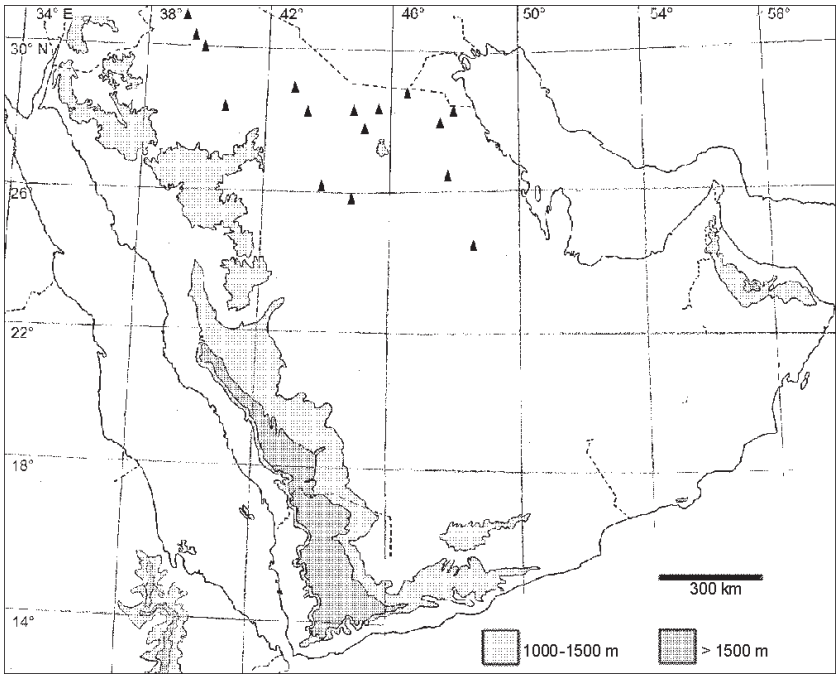

Fig. 13. Distribution of *Leontodon laciniatus* in the Arabian Peninsula.

ones scaly. *Florets* yellow. *Achenes* 9-12 mm long, with five longitudinal grooves, terete, somewhat curved, continuously tapering into a beak as long as the corpus. *Pappus* plumose, c. 10 mm long.

Chromosome numbers: not known.

Distribution: *Leontodon laciniatus* is distributed in the Saharo-Arabian and W Irano-Turanian region (Heller & Heyn 1993); in the Arabian Peninsula it is restricted to the northern parts (Fig. 13).

5. *Rhagadiolus* Juss.

5.1. *Rhagadiolus stellatus*

Rhagadiolus stellatus (L.) Gaertn., Fruct. 2 : 354.1791.
= *Lapsana stellata* L., Sp. Pl.: 811. 1753.
= *Lapsana rhagadiolus* L., Sp. Pl.: 812. 1753.

Ic.: Feinbrun-Dothan 1977: t. 696; Collenette 1985: 170, 1999: 213.

Annual herb, 20-60 cm high, with a tomentulose indumentum. *Basal leaves* rosulate, linear-lanceolate to lyrate, with dentate margin. *Stems* ascending to erect or diffuse, with obovoid, lobed, dentate or entire cauline leaves. *Capitula* heterocarpous. *Involucre* with lanceolate phyllaries in two rows, the outer ones minute, the inner ones 6-8 mm long at anthesis and to 15 mm long at fruiting, with short bristles along the mid-vein. *Receptacle* naked. *Achenes* heteromorphous; *inner achenes* 1-3, somewhat shorter than marginal, strongly curved, tomentulose or glabrous; *marginal achenes* 6-8, 1-1.5 cm long, terete, somewhat curved, tapering, glabrous, persistent, clasped by persistent phyllaries; *Pappus* absent.

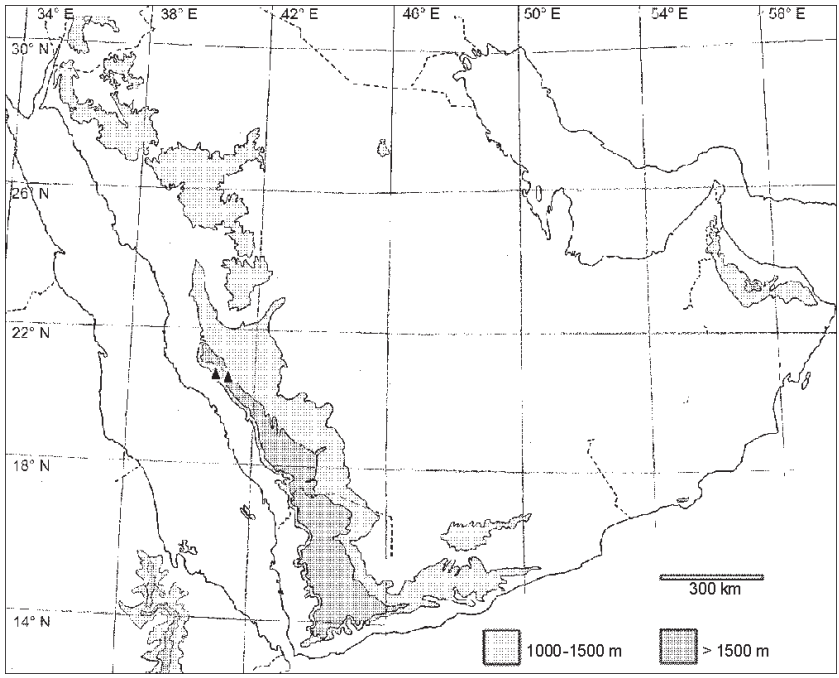

Fig. 14. Distribution of *Rhagadiolus stellatus* in the Arabian Peninsula.

Chromosome number: 2n = 10 (Oberprieler & Vogt 1993)

Distribution: The Mediterranean-W Irano-Turanian *Rhagadiolus stellatus* is found in the Arabian Peninsula only in the Asir Mts, Saudi Arabia (Fig. 14), thus showing a similar distribution as *Hypochaeris glabra*.

6. *Urospermum* Scop.

6.1. *Urospermum picroides*

Urospermum picroides (L.) F. W. Schmidt, Samml. Phys.- Ök. Aufs. 1: 275. 1759 ≡ *Tragopogon picroides* L., Sp. Pl.: 790. 1753.

Ic.: Boulos 1988: 38; Chaudhary & Akram 1987: 73; Chaudhary & Al-Jowaid 1999: 306; Collenette 1985: 177, 1999: 222; Dickson 1955: 108; Feinbrun 1977: t. 702; Shuaib 1995: 108.

Annual herb, up to c. 40 cm high. *Basal leaves* rosulate, up to c. 14 cm long and 4 cm wide, obovate to oblanceolate, almost entire to pinnatifid, hispid to spinulose of simple bristles, in particular on the veins. *Stems* sparingly branched. *Cauline leaves* lanceolate, auriculate, smaller than basal ones, otherwise similar. *Capitula* terminal, solitary, growing distinctly larger towards fruiting, then up to 3-4 cm diam. *Involucre* c. 15 mm long at anthesis, more than 20 mm long at fruiting; phyllaries subequal, spinulose of simple bristles, in one row, connate in basal third. *Flowers* pale yellow. *Receptacle* epaleaceous. *Achenes* almost straight to s-shaped, with a long, slender beak; corpus 4-5 mm long, laterally compressed, smooth in inner achenes to sculptured with obtuse projections; beak distinctly longer than the corpus, with short, antrorse bristles, attenuate from an ovoid, hollow basal part broader than and constricted above the apex of the corpus. *Pappus* plumose, 9-12 mm long, deciduous.

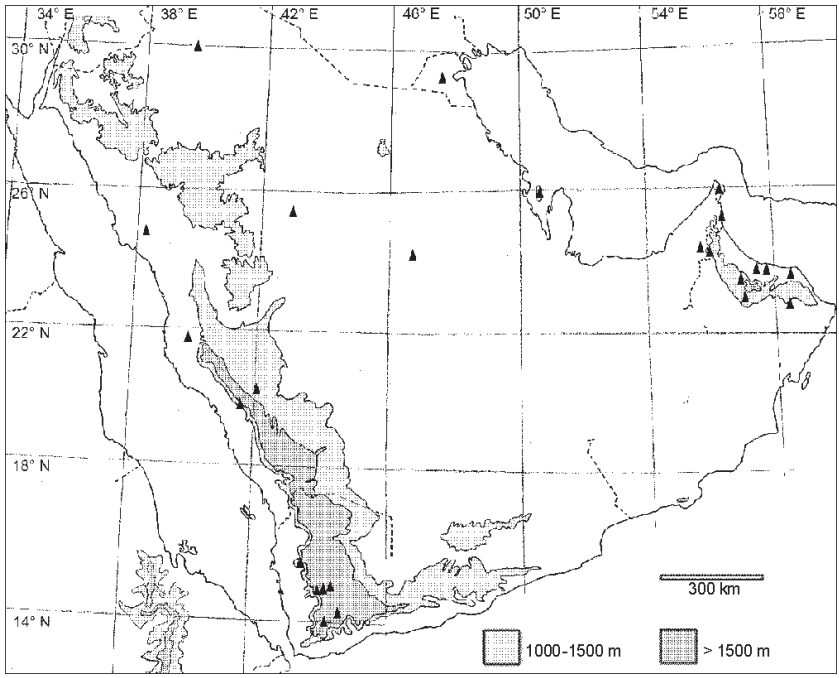

Fig. 15. Distribution of *Urospermum picroides* in the Arabian Peninsula.

Distribution: Originating from the E Mediterranean, *Urospermum picroides* is today anthropogoneously settled in cultivated areas of the entire Mediterranean and adjacent regions, in the Middle East eastwards to Pakistan, scattered in Africa south of the Sahara and in South America (Lack & Leuenberger 1979). In the Arabian Peninsula it occurs in irrigated places, particularly in the highlands of Yemen and the Hajar Mts of Oman (Fig. 15). The species may cause serious infestigations of cultivations (Chaudhary & Akram 1987: 73).

Chromosome number: Own counts in material from Machwiet, Yemen *(M. Smalla 278),* revealed 2n = 10 corroborating previous counts reported, e.g., by Ruiz de Clavio (1993).

Acknowledgements

My sincere thanks are due to Prof. H. Walter Lack for supervising my diploma thesis. Special thanks go to Dr Norbert Kilian for valuable discussions and for his patient editing this abridged version for publication; him and Peter Hein I also thank for their fellowship during the field trip to Yemen in 1997. I am grateful to the curators of B, C, CAIA, CAIM, BM, E, F, G, HBG, K, KSU, M, ON, W, WU and RIY for the loan of herbarium specimens. I thank Mrs Lüchow for her technical assistance in scanning electron microscopy and Mr Schiers and his colleagues for cultivating the live plants.

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