



The *Cinclidotus* P. Beauv./*Dialytrichia* (Schimp.) Limpr. complex (Bryopsida, Pottiaceae) in Turkey

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ABSTRACT: The hygrophytic *Cinclidotus/Dialytrichia* mosses complex, typical for permanent water flows and sites exposed to desiccation during low water tide, has been studied. For the first time, fully descriptions and illustrations for the species distributed in Turkey are given. In addition, an identification key to all species of the complex is presented. *C. pachylomoides* is recorded for the first time from Turkey and *C. acutifolius*, previously known only from the western Himalayas (Kashmir) and Afghanistan, is synonymised with the widespread species, *C. riparius*.

Key words: Hygrophytes, identification key, mosses, phytogeography, plant anatomy, plant morphology, speciation centre.

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INTRODUCTION

Cinclidotus P. Beauv. and *Dialytrichia* Broth. are two hygrophytic genera of mosses, clearly distinguished by their multistratose leaf margins (*limbidia*) from the other members of the *Pottiaceae*. The family relationships of the two genera had been repeatedly discussed controversially. Whereas CHEN (1941) and EDERRA (2006) placed both in the *Pottiaceae* family, MÖNKEMEYER (1927), HILPERT (1933), SAITO (1975), ZANDER (1993), or CASAS *et al.* (2001) proposed a position in a family of its own, the *Cinclidotaceae*. Recent molecular studies, using sequencing of the chloroplast *rps4*-gene by WERNER *et al.* (2004), however, strongly support the position of *Cinclidotus* in the *Pottiaceae* (cf. also FREY, 2009). This is confirmed by ZANDER (2006) who presents an evolutionary diagram of the *Pottiaceae*, based on molecular and morphological data, he classified both genera in the family *Pottiaceae* subfam. *Barbuloideae* (Herzog) Hilp.

The controversial classifying also holds true for the two genera. Whereas CORLEY *et al.* (1981), CASAS *et al.* (2001), HEYN & HERRNSTADT (2004) or KÜRSCHNER (2008) include *Dialytrichia* within the genus *Cinclidotus*, EDERRA (2006), FREY *et al.* (2006), or HILL *et al.* (2006) kept both in separate genera.

Dialytrichia is characterised by the presence of a central strand, the absence of a differentiated epidermis on the dorsal surface of the costa, a recurved leaf margin, free peristome segments, and the presence of stomata in the capsule. By contrast, in *Cinclidotus* central strand is absent, the leaf margins are mostly plane, the peristome segments are linked by cross-bars at base, and the stomata are lacking in the capsule.

To date, these Old World genera are represented by 12 species within the northern hemisphere: *Dialytrichia mucronata* (Brid.) Broth., *D. saxicola* (Lamy) M. J. Cano [syn. *D. fragillifolia* (Biz. & J. Rozx.) F. Lara, cf. Cano 2007], *Cinclidotus aquaticus* (Hedw.) Bruch & Schimp., *C.*

bistratosus Kürschner & Lübenau-Nestle, *C. confertus* Lüth, *C. danubicus* Schiffn. & Baumgartner, *C. fontinaloides* (Hedw.) P. Beauv., *C. pachyloma* Salmon [syn. *C. nyholmiae* Çetin], *C. pachylomoides* Bizot, *C. riparius* (Brid.) Arn., *C. vardaranus* Erdağ & Kürschner, and *C. vivesii* A. Ederra.

At present, seven taxa of this hygrophytic complex are known from Turkey, among them two species, *Cinclidotus bistratosus* and *C. vardaranus* are endemics. The latter one has been described just recently by ERDAĞ & KÜRSCHNER (2009). Additionally, *C. pachylomoides* is reported here as new record for the country (Erzincan province, Kemaliye area).

In the following study, for the first time fully descriptions and illustrations for the Turkish specimens are given, including an identification key to all taxa. *Cinclidotus acutifolius* Broth., previously known from the western Himalayas (Kashmir, holotype) and Afghanistan is synonymized with the widespread species, *C. riparius*.

MATERIAL AND METHODS

The study is based on herbarium material and additional collections which were carried out by the authors during the last years in Turkey. Turkish specimens seen and analysed are marked by a bold exclamation mark (!). Type specimens are provided by the herbaria of Helsinki (H, type species of *C. acutifolius*), Paris (PC, type species of *C. pachylomoides*), Stockholm (S, type species of *C. nyholmiae*), and the herbarium M. Lüth (Freiburg i. Br., type species of *C. confertus*).

RESULTS

1. Morphological characters used for the study (Table 1). Characters used for the morphological study, the descriptions and the identification key refer to the gametophyte (stem, leaves, leaf border, laminal cells, costa) and sporophyte, if present (seta, capsule, peristome, spores) (Table 1).

Stem – Stem length in the *Cinclidotus/Dialytrichia* complex is highly variable and changes from 2-3 cm to 50 cm. Depending on the site conditions, a strong variation even within the same population may occur. In general, most members of the complex have stem lengths less than 10 cm (e.g., *C. bistratosus*, *C. confertus*, *C. danubicus*, *C. fontinaloides*, *C. pachyloma*, *C. pachylomoides*, *C. riparius*, *C. vardaranus*, *C. vivesii*), however, it may reach up to 50 cm in *C. aquaticus*. By contrast, *Dialytrichia mucronata* and *D. saxicola* have much shorter stems, ca 2-5 cm.

The branching type is not significantly variable in the complex. In general, the main axis bears irregular to somewhat fastigiated branches. In some cases, perigonia bearing shorter branches give the plants a crowded

appearance. This character, however, can not be used as a specific character by lacking of continuity. In *Dialytrichia*, the stems are mostly sparsely branched.

In stem cross-sections, a sclerodermal layer is typical for some species, formed by 2-9 layers of thick-walled, smaller cells. This sclerodermis is thicker at the basal part of the stem anchoring the plants to the substrate. The most common type is 2 to 5 cell layers of the sclerodermis among the species. The size of the cortical cells varies from 10 to 30 µm.

Whereas a central strand (hadrome) is absent in *Cinclidotus*, it is well developed in *Dialytrichia* and can be used as character to separate both genera anatomically.

Leaves – Leaf shape, leaf border, laminal cells and costa anatomy (number of guide cells) provide important characters to distinguish the different species.

Leaf shape – Within the *Cinclidotus/Dialytrichia* complex, leaf shape varies from lingulate, lanceolate, ovate-lanceolate, ovate to elliptic, oblong-lanceolate to slightly or strongly falcate (Table 1). The leaf apex can be blunt, mucronate, bluntly acuminate or shortly or longly excurrent. In some cases, a mixture of some of these characters are found in different populations of the same species (e.g. *C. riparius*).

Leaf lamina – Leaf lamina normally is unistratose in most species, with the exception of *C. bistratosus*, characterised by a 2- to 3-stratose lamina. In a few taxa, however, irregularly bistratose ridges may occur, which can be seen as an adaptation to xeric site conditions by low water tables during summer time (Kürschner & Lübenau-Nestle, 2000). *C. vardaranus* presents a good example for this hypothesis.

Leaf border – An outstanding character within the *Cinclidotus/Dialytrichia* complex is the multicellular leaf margin (*limbidium*), providing a distinctive character to separate both genera from the other taxa of the *Pottiaceae*. Thickened leaf margin is a successful adaptation to protect leaves against disruptions of the lamina by fast flowing streams (Vanderpoorten & Klein, 1999). Thickness of the limbidium may vary from two cells to more than 10 (-16) cells (Table 1). By considering longitudinal sections of the leaf border (Figure 1), one can distinguish two developments: species with inner and outer border cells of more or less similar size and the species with thin-walled, smaller inner border cells (*C. bistratosus*, *C. fontinaloides*, *C. pachyloma*).

Laminal cells – According to the structure of the laminal cells, three developments can be distinguished. (1) species with smooth cells, (2) species with smooth to slightly papillose cells, and (3) species with distinctly or strong papillose cells (Table 1). Leaf papillosity therefore provides a further good character for separating the taxa in the complex.

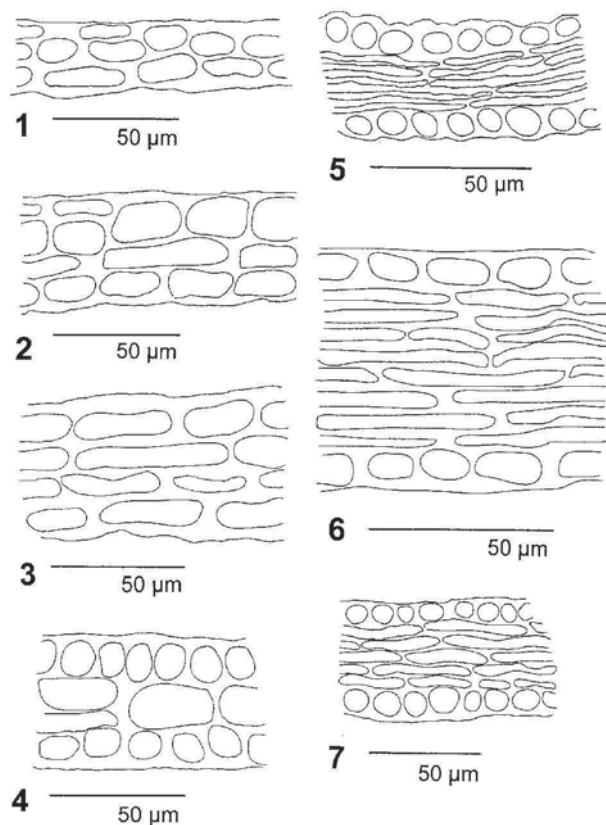


Fig. 1. Longitudinal sections of the limbidium in *Cinclidotus* species. 1 *C. riparius*, 2 *C. danubicus*, 3 *C. aquaticus*, 4 *C. vardaranus*, 5 *C. fontinaloides*, 6 *C. pachyloma*, 7 *C. bistratosus*.

Costa anatomy – The costa is obvious in all species of the complex. It varies from a weak, 70-150 µm wide at base to the strong one [e.g., 160-250 (-400) µm wide]. The number of guide cells (costa cross-section) is low (3-4) in *Dialytrichia*, and mostly varies from 6 to 8 in *Cinclidotus*. An exception is *C. aquaticus* with up to 20 guide cells which occur in two layers towards the base of the costa (Table 1).

Seta – Seta length is highly variable within the complex and responsible for the position of the capsules (immersed versus exserted). Whereas in *Dialytrichia* the *setae* are long, reaching 8-12 mm in length, most of the *Cinclidotus* species are characterised by shorter *setae*. Seta length varies from very short (0.8 to 1.2 mm, capsules immersed) to longer (2.0 to 5.0 mm, capsules exserted) (Table 1). Only *C. riparius* has a long seta, reaching – as in *Dialytrichia mucronata*, 6.0 to 7.0 mm. Two taxa, *C. vardaranus* and *C. vivesii*, at present are known only in sterile condition. In *C. danubicus*, sporophytes has been recorded more recently (Buter & Nieuwkoop, 2007), however, in insufficient status.

Capsule – Capsule shape varies from elliptic, ovate-cylindrical, to cylindrical in shape (Table 1).

Peristome – A further distinctive character to separate *Dialytrichia* from *Cinclidotus* is provided by the peristome. Whereas the peristome segments are clearly free at base in *Dialytrichia*, they are linked by cross-bars towards the base by *Cinclidotus*, giving to the peristome a lattice-like appearance. The structure of peristome varies from nearly smooth, scarcely papillose, papillose to strongly papillose. It can be complete or incomplete and fragile, or rudimentary (Table 1).

Somewhat problematical, especially in older herbarium specimens, is the colour of the peristome segments, given as yellowish, orange, red, or reddish-brown in literature. A decision about this character often is difficult. An example is *C. riparius*. Its peristome colour is defined as yellowish in some floras (e.g., SMITH 2004), but nearly orange or reddish segments were observed in many of our specimens. The quality of this character therefore remains doubtful.

Spores – Spore size varies from small (11-15 µm) to large (15-30 µm in diameter.) Spore surface is smooth, finely papillose or strongly papillose. Of interest are dimorphic spores, which are found in some species of *Cinclidotus*. The function at present, however, remain unclear.

2. Key to the species of the *Cinclidotus/Dialytrichia* complex.

1 Laminal cells strongly papillose, opaque; stems with central strand; capsules immersed to exserted, terminal on the main shoots, stomata present; peristome teeth filiform, free at base

Dialytrichia (Schimp.) Limpr. ... 2

1* Laminal cells smooth to moderately papillose; stems without central strand; capsules usually immersed, on secondary shoots (lateral); stomata absent; peristome teeth linked by cross-bars at base, lattice-like

Cinclidotus P. Beauv. ... 3

2 Leaf margins smooth; leaves not fragile; leaves oblong-lanceolate to broadly lingulate, obtuse and mucronate; leaf border weak, with 2-3 layers of cells in section; leaf lamina occasionally with bistratose ridges; peristome teeth filiform, papillose, reddish-brown; plants dark green, on rocks periodically submerged in fast-flowing streams and rivers

Dialytrichia mucronata (Brid.) Broth.

[*C. mucronatus* (Brid.) Guim.]

2* Leaf margins distinctly crenulate in upper part; leaves fragile; plants dark green, on rocks periodically submerged in fast-flowing streams and rivers

D. saxicola (Lamy) M. J. Cano

[*D. fragilifolia* (Biz. & J. Rozx) F. Lara]

Table 1. Morphological characters in the *Cinclidotus/Dialytrichia* complex.

	Species	Gametophyte			
		Leaf	Leaf lamina	Laminal cells	Leaf margin
Cinclidotus	<i>C. aquaticus</i>	falcato-secund, linear-lanceolate, acute	unistratose, with bistratose ridges at base	smooth, 8-12 μm	weak, 2- to 4-stratose
	<i>C. bistratosus</i>	erecto-patent, gradually acuminate, blunt	bi- to tristratose rarely unistratose with bistratose ridges	papillose, 7-11 μm	strong, 4- to 6 (7)-stratose
	<i>C. confertus</i>	erecto-patent, ovate-lanceolate to lingulate-ovate	unistratose	smooth, (10)15-20 μm	weak, 2- to 4-stratose
	<i>C. danubicus</i>	slightly falcate, lanceolate, mucronate to acute	unistratose	smooth to weakly papillose, (10) 12-15 (19) μm	weak, 2-stratose
	<i>C. fontinaloides</i>	erecto-patent, oblong-lanceolate, gradually acuminate to bluntly acuminate	unistratose	smooth to papillose, 8-14 μm	strong, 3- to 6-stratose
	<i>C. pachyloma</i>	lanceolate, costa long excurrent	unistratose	papillose, 10-12 μm	strong, > 8-stratose
	<i>C. pachylomoides</i>	lanceolate, acuminate	unistratose, occasionally with bistratose ridges	papillose, 10-12 μm	weak, 2- to 4-stratose
	<i>C. riparius</i>	erecto-patent, oblong-lanceolate, blunt to shortly mucronate	unistratose	smooth to weakly papillose, 6-14 μm	weak, 2- to 4-stratose
	<i>C. vardaranus</i>	ovate to elliptic, obtuse	unistratose with bistratose ridges	papillose, (5) 7-12 μm	strong, 4- to 6 (7)-stratose
	<i>C. vivesii</i>	slightly incurved, falcato-secund, costa excurrent	unistratose	smooth, 10-15 μm	weak, 2- to 4-stratose
Dialytrichia	<i>D. mucronata</i>	erecto-patent, lingulate to oblong-lanceolate, obtuse to mucronate	unistratose, occasionally with bistratose ridges	strongly pluripapillose, 8-12 μm	weak, 2- to 3-stratose
	<i>D. saxicola</i>	erecto-patent, lingulate to oblong-lanceolate, obtuse	unistratose	papillose, 7-11 μm	weak, 2- to 3-stratose

		Sporophyte			
Costa (at base)	Guide cells	Seta	Capsule	Peristome	Spores
stout, 240-400 µm	8-20, in 2 rows at base	short, 2-3 mm	exserted, ovate-lanceolate	fragile, often incomplete, orange, smooth, to 600 µm	finely papillose, 12- 25 µm, dimorphic
weak, (70) 85-100 µm	4-5(-6)	short 1.0-1.2 mm	immersed, ovate-cylindrical	reddish, filiform, strongly papillose, 500 µm	papillose, 10-30 µm, dimorphic
stout, 150-250 µm	5-6	short, 4-5 mm	obloid to cylindrical	reddish-brown, fragile, papillose, 300-400 µm	finely papillose, 20- 25(30) µm
weak 90-150µm	4-5(-6)	short, c. 2 mm	unknown (cf. Buter & Nieuwkoop 2007)		
weak, 100-150 µm	6-8	short, 0.8-1.2 mm	immersed, ovate-cylindrical	reddish, filiform, fragile, papillose, 400-800 µm	papillose, 10-30 µm, dimorphic
strong 180-200 µm	6-8	short, 1.0-1.2 mm	immersed, elliptic	rudimentary or short, orange-red, papillose	finely papillose, 10-26 (32) µm, dimorphic
weak, (70) 100- 120µm	6-8	short, 2-3 mm	elongate-cylindrical	?	finely papillose, 11- 18 µm
weak, 100-140 µm	4-8	long, 3-7 mm	exserted, ovate-cylindrical	yellowish to orange or reddish, filiform, smooth to finely papillose, 500- 600 µm	finely crenulate or ± smooth, 14-30 µm, dimorphic
strong, 180-190 µm	5-9			unknown	
stout, 170-230 µm	5-8			unknown	
weak, 70-130 µm	3-4	long, 8-12 mm	cylindrical	reddish brown, filiform, papillose, 750-850 µm	crenulate to ± smooth, 14-16 µm
weak, 70-110 µm	3-4	short, 0.6-0.8 mm	cylindrical	fragile, papillose, 75-100 µm	finely papillose, 14- 19 µm

3 Leaf lamina bistratose, occasionally 3-stratose; leaves adpressed when dry, short ovate to oblong-lanceolate, entire; leaf apex obtuse, \pm cucullate; margins strongly thickened, with 5-6 layers of cells in section; laminal cells hexagonal, strongly papillose; plants compact, olive green to blackish, on rocks exposed to submergence. Endemic to Turkey

C. bistratosus Kürschner & Lübenau-Nestle

3* Leaf lamina unistratose throughout, occasionally with some bistratose ridges in lower part of leaf ...4

4 Leaf margin strongly thickened, often with more than (6-) 8 layers of cells in section; costa strong and long excurrent, leaves spreading and slightly twisted when dry; plants dark green to blackish, on rocks in fast-flowing streams and rivers. Endemic to Southwest Asia (Israel, Lebanon, Turkey)

C. pachyloma Salmon
(*C. nyholmiae* Çetin)

4* Leaf margin weakly thickened or thickened only up to 6 (-8) layers of cells in section ...5

5 Laminal cells papillose, opaque ...6

5* Laminal cells smooth or faintly papillose, pellucid ...7

6 Leaf border weak, with 2-4 layers of cells in section; leaves lanceolate, acuminate, unistratose (similar to *C. riparius*, but leaves shorter, densely papillose, opaque); plants dark green to blackish, on rocks exposed to submergence. Known from Lebanon (type) and Greece

C. pachylomoides Biz.

6* Leaf border strong, with 4-7 layers of cells in section; leaves ovate to elliptic, obtuse, unistratose with some bistratose ridges; leaf base subamplexical, with undulate basal margins; plants rigid, moderately robust, in dark green compact and dense patches on wet boulders and rocks exposed to submergence. Endemic to Turkey

C. vardaranus Erdağ & Kürschner

7 Leaf margins \pm parallel, scarcely tapering towards apex, leaves lanceolate, ovate lanceolate, lingulate to oblong; peristome well developed ...8

7* Leaf margins not parallel, leaves broadest at base, gradually tapering towards apex; leaves linear-

lanceolate; peristome rudimentary or unknown (*C. danubicus*)

...11

8 Leaves oblong lanceolate to lingulate, obtuse to bluntly acute, about 3 times as long as wide, adpressed when dry, erecto-patent when moist; margins slightly thickened

... 9

8* Leaves elongate lingulate, distinctly acute or lanceolate, obtuse to acute, about 4 times as long as wide; margins weakly or strongly thickened

... 10

9 Peristome teeth yellowish or reddish, \pm smooth; spores 14-30 μm in diameter; laminal cells smooth to weakly papillose, 6-14 μm in diameter; plants blackish green, on rocks and stones in the flood-zone of rivers

C. riparius (Brid.) Arn. [*C. acutifolius* Broth. syn. nov.,
C. nigricans (Brid.) Wijk & Margad.]

9* Peristome teeth reddish-brown, papillose; spores 20-25 (-30) μm in diameter; laminal cells smooth, (10-) 15-20 μm in diameter; plants blackish-green, on limestone boulders in episodically dry fallen rivers. Endemic to Greece

C. confertus Lüth

10 Leaf border weak, with 2-4 layers of cells in section; leaves slightly incurved, falcato-secund; costa excurrent; plants robust, brownish to olive green, rather rigid and stiff in appearance. Endemic to the Iberian Peninsula

C. vivesii A. Ederra

10* Leaf border strong, with 3-6 layers of cells in section; leaves lanceolate, crisp when dry, patent when moist; capsule immersed; peristome teeth long, filiform, purplish red, papillose; spores c. 10-30 μm in diameter; plants olive green to blackish, on basic rocks and on wood floating in fast-flowing streams and rivers

C. fontinaloides (Hedw.) P. Beauv.

11 Leaves strongly falcate, secund; leaf lamina occasionally with bistratose ridges; laminal cells (8) 9-10 (12) μm in diameter; plants very tall, 10-40 cm long or more, flooding, on calcareous rocks in fast-flowing streams and rivers

C. aquaticus (Hedw.) Bruch & Schimp.

11* Leaves not or slightly falcate; laminal cells (10) 12-15 (19) μm in diameter; plants up to 5 cm; plants blackish green, on rocks and stones in the flood-zone of rivers

C. danubicus Schiffn. & Baumgartner
(*C. herzogii* Pavletic)

3. Description of the Turkish taxa.

Cinclidotus P. Beauv.

Cinclidotus aquaticus (Hedw.) Bruch & Schimp.,
Bryol. Eur. 3: 170. 1842 (Figure 2)

Plants robust, up to 50 cm long, with numerous short branches; central strand absent; sclerodermal cells in 4-6 layers, 4-8 μm wide, cortical cells 10-25 μm ; leaves falcato-secund, linear-lanceolate, 3-4 mm; apex acute; leaf lamina unistratose, sometimes with bistratose ridges towards base; leaf margin 2- to 4-stratose; costa stout, 240-400 μm wide at base; guide cells numerous, 8-20, in 2 rows at base; laminal cells hexagonal, 8-12 μm wide, smooth; seta short, 1.5-2.0 (3.0) mm long; capsule exserted, ovate-lanceolate, to 2 mm long; operculum conical-rostrate; peristome fragile, rudimentary or incomplete, 500-600 μm long, orange to reddish, smooth; spores dimorphic, finely papillose, 12-25 μm in diameter.

Distribution in Turkey (Figure 2.12)

39/2N 27/1E Balıkesir: Edremit, Şahindere, 30 m, on submerged rocks, 6 September 1994 A. Erdağ EGE 19174 (ERDAĞ & YAYINTAŞ 1999, as *C. riparius*) !

39/1N 38/2E Erzincan: Kemaliye, Kadıgözü waterfall 39°15.5'0.4"N, 38°29.5'1.9"E, 850 m, submers on rocks, 13 April 2006 A. Erdağ Erd. 06/99 !

39/1N 39/1E Tunceli: Kuzudere village, on submerged rocks, 14 August 2000 Ö. Arat !

37/1N 28/2E Muğla: Yatağan, 50-150 m, near stream, 1994 Ö. Tonguç T.257 (TONGUÇ-YAYINTAŞ 2001).

37/1N 31/1E Antalya: Köprülü Kanyon National Park, 200 m, 17. July 1987, B. Çetin 473, (ÇETİN 1989).

36/2N 31/2E Antalya: Manavgat Şelalesi, between Alanya and Antalya, submers on rocks, 2 April 1955, H. Walter 3881, (HENDERSON & PRENTICE 1969).

General distribution: Europe (DÜLL 1984; FREY *et al.* 2006; HILL *et al.* 2006), SW Asia (FREY & KÜRSCHNER 1991; KÜRSCHNER, 2008), Africa (ROS *et al.* 1999).

Cinclidotus bistratosus Kürschner & Lübenau-Nestle, Nova Hedwigia 70: 472. 2000 (Figure 3)

Plants compact, up to 5 cm long; central strand absent; sclerodermal cells in 4-6 (7) layers, 3-8 (10) μm wide, cortical cells 10-25 μm ; leaves adpressed when dry, erectopatent, when moist, shortly ovate to oblong-lanceolate, up to 2.5 (3.0) mm long in upper part of stem, 1.0-1.5 mm in lower part; apex bluntly obtuse; leaf margin (4) 6-7 cells wide, inner border cells smaller than the outer cells; costa

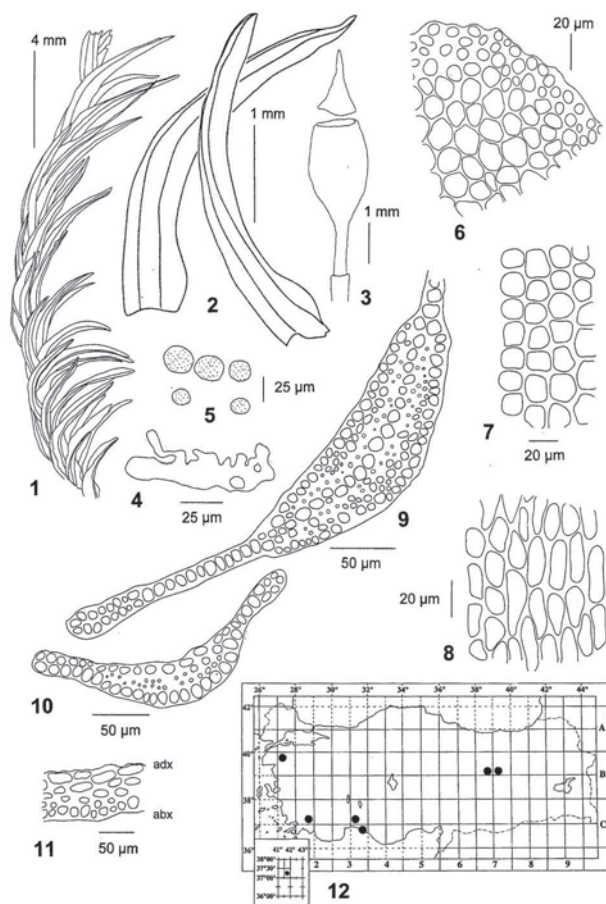


Fig. 2. *Cinclidotus aquaticus* (Erd. 06/99). 1 habit; 2 leaves; 3 capsule; 4 rudimentary peristome; 5 spores; 6 cross-section of stem; 7 mid-leaf laminal cells; 8 basal laminal cells; 9 cross-section of leaf (basal part); 10 cross-section of leaf (upper part); 11 longitudinal section of leaf margin (adx = adaxial site; abx = abaxial site); 12 distribution in Turkey (based on own and published records).

weak, (70) 85-100 μm wide at base, guide cells 4-6; leaf lamina bistratose throughout, often with 3-stratose ridges; laminal cells hexagonal, 7-11 μm wide, papillose; basal cells shortly rectangular, 7-9 x 20-32 μm ; seta short, 1.0-1.2 mm long; capsule immersed, ovate to cylindrical, up to 3 mm long; calyptra cucullate, 2.0-2.5 mm long; peristome well developed, reddish, filiform, strongly papillose, to 500 μm long; spores dimorphic, finely papillose, 10-30 μm in diameter.

Distribution in Turkey (Figure 3.14).

37/1N 31/1E Antalya: Köprülü Kanyon National Park, ca. 15 km north of Beşkonak, between Oluk bridge and Çaltepe, at the end of the steep canyon, ca. 250 m, on rocks exposed to submergence, flood zone of the Köprü Irmağı, 21 April 1999, R. & H. Panzer, s.

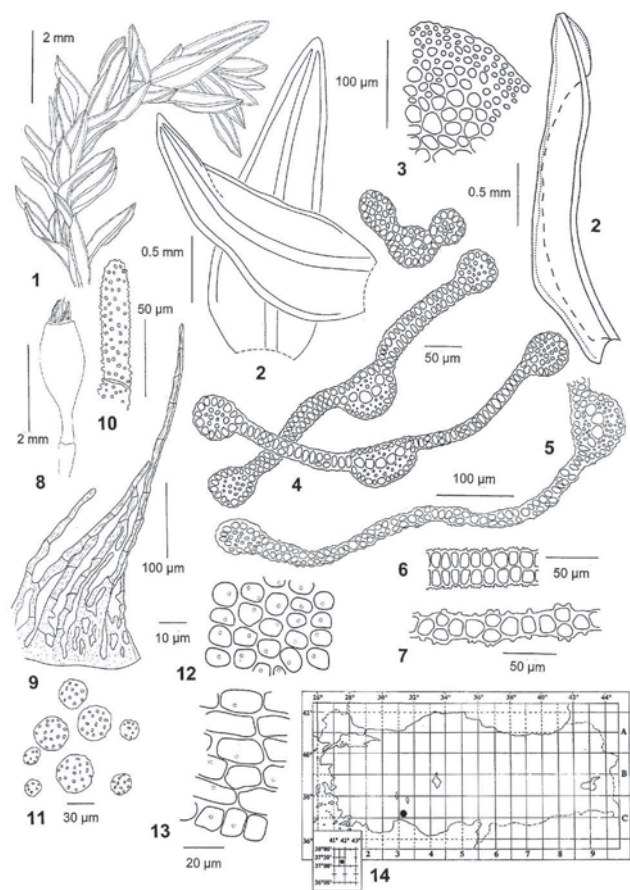


Fig. 3. *Cinclidotus bistratosus* (MKIR 1849). 1 habit; 2 leaves; 3 cross-section of stem; 4 cross-sections of leaves; 5 cross-section of leaf (basal part); 6 leaf lamina (middle part); 7 leaf lamina (basal part); 8 capsule; 9 peristome; 10 peristome (detail); 11 spores; 12 mid-leaf laminal cells; 13 basal laminal cells; 14 distribution in Turkey (based on own and published records); [2, 4, 6, 7 from Kürschner & Lübenau-Nestle (2000), type].

n. (KÜRSCHNER & LÜBENAU-NESTLE 2000, holotype)!

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Bolhasan bridge, 37°17'N, 31°10'E, in water on rock, 12 December 2004 *M. Kırmacı* MKIR 1849!

General distribution: Endemic to Turkey

Cinclidotus danubicus Schiffn. & Baumgartner, Oesterr. Bot. Zeitschr. 56: 154. 1906 (Figure 4)

[*C. herzogii* Pavletic, Mitt. Thüring. Bot. Ges. 1: 14. 1955]

Plants robust, up to 15 cm long; stems irregularly branched; central strand absent; sclerodermal cells in 2-3 layers, 3-8 µm wide, cortical cells large, up to 40 µm; leaves contorted and slightly incurved when dry, erecto-

patent to slightly falcate when moist, narrowly lanceolate, up to 3.5 mm long; apex mucronate to acute; leaf lamina unistratose throughout; leaf margin weak, 2- (3) stratose; costa weak, 90-150 µm wide at base; guide cells 4-6; laminal cells large, (10) 15-18 (20) µm wide, smooth to slightly papillose; basal cells longly rectangular, 20-50 (65) µm; seta c. 2mm long; well developed sporophytes unknown.

BUTER & NIEUWKOOP (2007) recorded sporophytes in different states of development from a population in the Netherlands, similar to those of *C. riparius*. Unfortunately, no detailed description can be given due to the insufficient states of capsule and peristome development. The species was very recently collected from Amanus Mountain and identified by the senior author (BLOCKEEL *et al.* 2010).

Distribution in Turkey (Figure 4.8)

39/1N 38/2 E Erzincan: Kemaliye, Kekikpınarı, 39°07'17.4"N, 38°32'40.9"E, 1020 m, on *Platanus orientalis* roots and lower trunks, 15 May 2006 A. Erdağ 06/316!

36/2N 36/1 E Hatay: Dört Yol, Amanus Mountain, Suyungözü locality, Deliçay river, 36°50'615"N, 36°15'581"E, 160 m .Recep Kara 1384! (BLOCKEEL *et al.* 2010)

General distribution: Europe (DÜLL 1984; FREY *et al.* 2006; HILL *et al.* 2006), SW Asia (FREY & KÜRSCHNER 1991; KÜRSCHNER 2008). According to HEYN & HERRNSTADT (2004), it is difficult to decide if the records from Israel are not within the range of variability of *C. riparius*. AHMED & FRAHM (2003), however, have shown by an isozyme electrophoretic study that both taxa genetically are clearly separated.

Cinclidotus fontinaloides (Hedw.) P. Beauv., Prodr. Aethéogam.: 52. 1805 (Figure 5)

Plants robust, up to 15 cm long; stems fastigiately branched; central strand absent; sclerodermal cells in 2-4 (6) layers, < 10 µm wide, cortical cells larger, up to 25 µm; leaves, laxely spaced along stem, imbricate to slightly incurved when dry, patent to spreading when moist, oblong to narrowly lanceolate, up to 4 mm long; apex mucronate, acute to acuminate; leaf margin strong, 3- to 6-stratose, inner border cells of smaller size than cells of outermost layer; leaf lamina unistratose throughout; costa weak, 100-150 µm wide at base; guide cells 6-8; laminal cells hexagonal, 8-12 (14) µm wide, smooth to papillose; basal cells irregularly short rectangular to quadrate, 10-25 µm; seta short, 0.8-1.2 mm long; capsule immersed, ovate-cylindrical, c. 3 mm long; peristome well developed, filiform, reddish to reddish-brown, densely papillose, to 800 µm long; spores dimorphic, 10-30 µm in diameter.

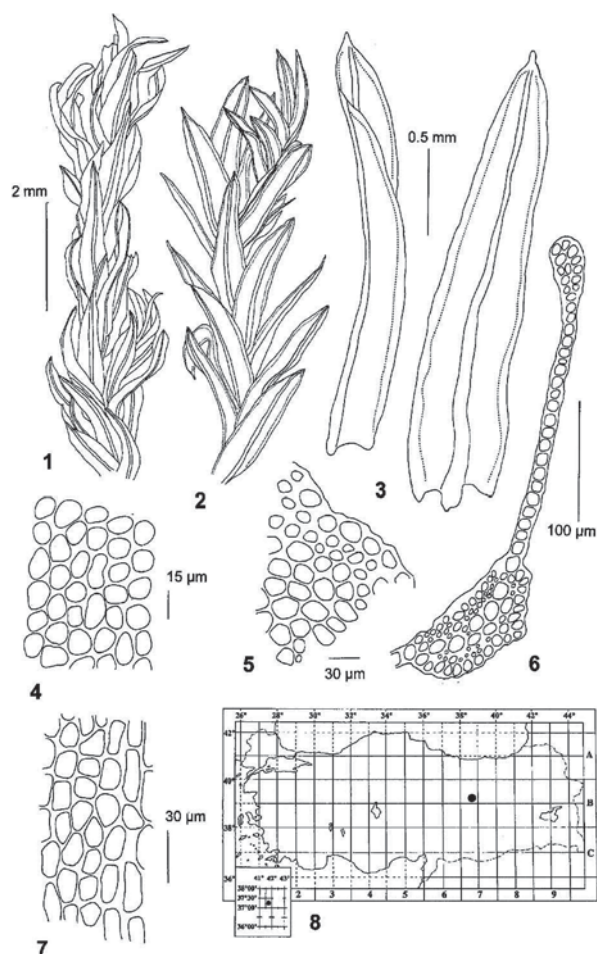


Fig. 4. *Cinclidotus danubicus* (Erd. 06/316). 1 habit (dry); 2 habit (wet); 3 leaves; 4 mid-leaf laminal cells; 5 cross-section of stem; 6 cross-section of leaf; 7 basal laminal cells; 8 distribution in Turkey (based on own and published records).

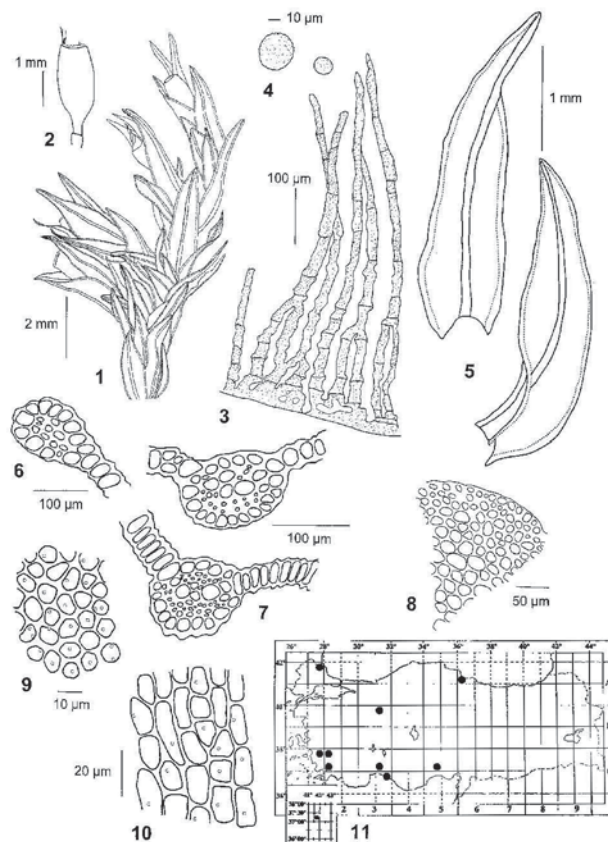


Fig. 5. *Cinclidotus fontinaloides* (Erd. 1252). 1 habit; 2 capsule; 3 peristome; 4 spores; 5 leaves; 6 cross-section of leaf margin; 7 cross-section of costa; 8 cross-section of stem; 9 mid-leaf laminal cells; 10 basal laminal cells; 11 distribution in Turkey (based on own and published records).

Distribution in Turkey (Figure 5.11)

- 41/2N 27/2E Kırklareli: Between Kiyıköy and Saray, 300 m, near river, 14 February 1990, A. Yayıntaş A 3243 (YAYINTAŞ *et al.* 1996).
- 41/1N 36/1E Samsun: Baruthane, 80 m, 18 April 1992 G. Akarsu 16 (Gönüloğlu & Akarsu 1994).
- 39/2N 31/1E Eskişehir: Sündiken Mts., near Karakütük, 1420 m, on rock near water, 26 August 2000 F. Savaroğlu 591 (SAVAROĞLU & TOKUR 2006) !
- 37/2N 27/2E Aydın: Karpuzlu, eastern slopes of Abak köyü, 200 m, on wet rocks, 2 June 2000 M. Kırmacı MKIR 1786 !
- 37/2N 28/1E Aydın: Çine valley, Kayırlidere, 250 m, wet roots of *Liquidambar orientalis*, 18 May 1999 A. Erdağ Erd.1252 (ERDAĞ 2002) !
- 37/1N 28/1E Muğla: near Ula, 650 m, submers, 1 August 1997 H. Kürschner 97-308 !

- 37/1N 31/1E Antalya: Köprülü Kanyon Milli Parkı, Köprü Irmağı, submers, 9 September 2004 M. Kırmacı MKIR 2421 !
- 37/1N 31/1E Antalya: Köprülü Kanyon Milli Parkı, Ballıbucağ bridge, submers on rocks, 15 June 2003 M. Kırmacı AYDN 1367, 1368 !
- 37/1N 34/2E Adana: Ciliciae, Bulgar dağ (Bolkar Dağları), T. Kotschy (TCHIHATCHEFF 1860).
- 36/2N 31/2E Antalya: Manavgat Şelalesi, 100 m, submers on rocks, B. Çetin 636 (ÇETİN 1989).

General distribution: Europe (DÜLL 1984; FREY *et al.* 2006; HILL *et al.* 2006), SW Asia (FREY & KÜRSCHNER 1991; KÜRSCHNER 2008), C & SE Asia (IGNATOV & AFONINA 1992), Africa (ROS *et al.* 1999; O'SHEA 2006).

Cinclidotus pachyloma Salmon, Rev. Bryol. 27: 59. 1900 (Figure 6)

(*C. nyholmiae* Çetin, J. Bryol. 15: 269. 1988, cf. HEYN & HERRNSTADT 2004)

Plants robust, to 8 cm long; stems fastigiately branched, branches shorter towards apex; sclerodermal cells in 3-5 layers, (5) 8-10 (12) μm wide, cortical cells larger, 25-30 μm ; leaves slightly contorted when dry, patent to erectopatent when moist, oblong-lanceolate to lanceolate, 3-4 mm long; apex longly cuspidate; leaf lamina unistratose throughout; leaf margin multistratose, with a very thick border up to 16 cell layers; inner border cells small, always smaller than the incrassate cells of the outer layers; costa strong, 180-200 μm wide at base, in cross-section with 2 stereid bands formed by 5-8 layers of stereid cells; guide cells numerous, 6-8, sometimes up to 10; laminal cells isodiametric, \pm hexagonal, 10-12 μm wide, papillose; basal cells short rectangular, (6) 10-20 (30) μm ; seta short, 1.0-1.2 mm long; capsule immersed, elliptic, up to 3 mm long; calyptra largely cucullate, very thick, up to 80 μm wide; peristome short, incomplete or rudimentary, orange to reddish, finely papillose; spores dimorphic, larger spores up to 30 μm in diameter, the smaller ones 10-12 μm .

Distribution in Turkey (Figure 6.13)

37/1N 31/1E Antalya: Köprülü Kanyon National Park, 200 m, in Köprü river on roots of *Platanus orientalis*, 31 July 1987, B. Çetin 400 (Çetin 1988, holotype of *C. nyholmiae*) !

37/1N 31/1E Antalya: Köprülü Kanyon National Park, 230 m, in Köprü river on rocks, 12 January 1988, B. Çetin 580 (Çetin 1988, as *C. nyholmiae*).

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Uluköprü, Büğrünköprü, 37°11'24"N, 31°10'76"E, submers on rock, 2 September 2004 M. Kırmacı MKIR 2452 !

General distribution: Endemic to the E Mediterranean area and known from Israel, Lebanon (Salmon 1900, holotype), and Turkey (FREY & KÜRSCHNER 1991; HEYN & HERRNSTADT 2004; KÜRSCHNER 2008).

Cinclidotus pachylomoides Bizot, Rev. Bryol. Lichén. 21: 11. 1952 (Figure 7)

Plants moderately robust, up to 5 cm long; central strand absent; sclerodermal cells in 2-3 layers, 5-10 μm wide, cortical cells 20-30 μm ; leaves lanceolate, slightly acute to acuminate; leaf lamina unistratose throughout, sometimes with bistratose ridges; leaf margin weak, 2- to 4-stratose, inner border cells of similar cells than outer ones; costa weak, (70) 100-120 μm wide at base; guide cells 6-8; laminal cells hexagonal to quadrate, 10-12 μm ,

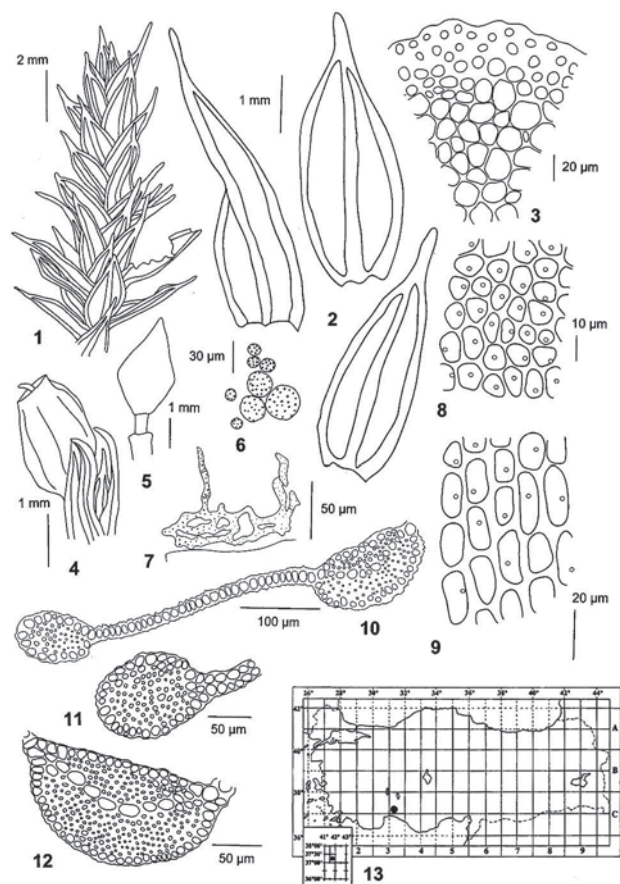


Fig. 6. *Cinclidotus pachyloma* (MKIR 2452). 1 habit; 2 leaves; 3 cross-section of stem; 4 capsule; 5 young sporophyte; 6 spores; 7 rudimentary peristome; 8 mid-leaf laminal cells; 9 basal laminal cells; 10 cross-section of leaf; 11 cross-section of leaf margin; 12 cross-section of costa; 13 distribution in Turkey (based on own collections); [1-3, 11, 12 drawn from the type (PC)].

papillose; seta short, 2-3 mm long; capsule elongate-cylindrical; peristome characters unknown; spores finely papillose, 11-18 μm in diameter.

New to Turkey. Distribution in Turkey (Figure 7.7)

39/1N 38/2E Erzincan: Kemaliye, at the end of Kadıgözü stream spilling to Karasu 39°15'55" N, 38°29'52.01"E, 850 m, on wet boulders, 13 April 2006 A. Erdağ Erd. 06/98 !

General distribution: Hitherto known only from Lebanon (type locality, BIZOT *et al.* 1952), Syria (BIZOT *et al.* 1952), and Greece (Corfu Island, DÜLL 1995).

Cinclidotus riparius (Brid.) Arn., Mem. Soc. Linn. Paris 7: 247. 1827 (Figures 8, 9)

[*C. nigricans* (Brid.) Wjick & Margad., Buxbaumia 1: 51. 1947]

[*C. acutifolius* Broth., Act. Soc. Sci. Fenn. 24: 14. 1899, **syn. nov.**] (Figure 9)

Plants robust, up to 8 cm long; stems densely fastigiately branched; sclerodermal cells in 2-4 layers, (2) 3-5 (8) μm wide, cortical cells 10-20 μm ; leaves imbricate to incurved when dry, erecto-patent when moist, oblong-lanceolate to lingulate, to 3 mm long; apex bluntly to shortly mucronate, acuminate; leaf lamina unistratose throughout; leaf margin 2- to 4-stratose (rarely 5-stratose) inner border cells of similar size than the outer cells; costa weak, 100-140 μm wide at base, in cross-section with (4) 6-8 guide cells; laminal cells hexagonal, (6) 10-12 (15) μm wide, smooth to slightly papillose; basal cells short rectangular, 7-8 x 20-25 μm ; seta long, to 7 mm; capsule exserted, erect, elliptic to ovate-cylindrical; peristome relatively short, varying in colour from yellowish to orange and red, nearly smooth to slightly papillose, 600 μm long; spores somewhat dimorphic, papillose, 14-30 μm in diameter.

Distribution in Turkey (Figure 8.9)

41/1N 31/2E Zonguldak: 41°22'N 31°43'E, 200 m, on soil near river bank, G. Uyar 738 (UYAR & ÇETİN 2006).

39/2N 26/2E Balıkesir: Südhang des Kaz Dag, 1200-1300 m, Bachufer, 6. Juni 1965, K. Walther Nr. 2148, 2168 (WALTHER 1967).

39/1N 38/2E Erzincan: Kemaliye, İkisü (Venk) stream, road to Kabataş village, 39°18'45.9"N, 38°33'39.9"E, 1400 m, on wet rocks exposed to submergence, 4 June 2007 A. Erdağ 07/100!

38/1N 38/2E Adıyaman: Kjachta (Kahta), Taurus Cataonicus, 800 m, an zeitweise überrieselten Kalkfelsen in einem Bach gegen Kasas, 1910 Frh. H. v. Handel-Mazzettii Nr. 2175 (SCHIFFNER 1913).

38/1N 43/2E Van: Başkale - Hakkari, 50 km from Başkale, 1800 m, boulders beside river under flood level, 31 August 1956, J. McNeill 706 (HENDERSON 1958).

38/1N 27/1E İzmir: Nif Dağ, Kuruköy südlich Kemal Pasa, 300 m, auf Steinen im Bach, 9. März 1969 K. Walther Nr. 7105b (B, BRYO 227210)!

37/1N 28/2E Muğla: Yılanlı Mts. east of Muğla, Yemişen Dere, Dipsiz, 600 m, submerged, 13 March 1997, H. Kürschner, Ö. Tonguç & A. Yayintaş 97-109!

37/1N 28/2E Muğla: Muğla area, 1994 Ö. Tonguç T.3527 (TONGUÇ-YAYINTAŞ 2000).

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Olukköprü, 200 m, 17 July 1987, B. Çetin 472 (ÇETİN 1989).

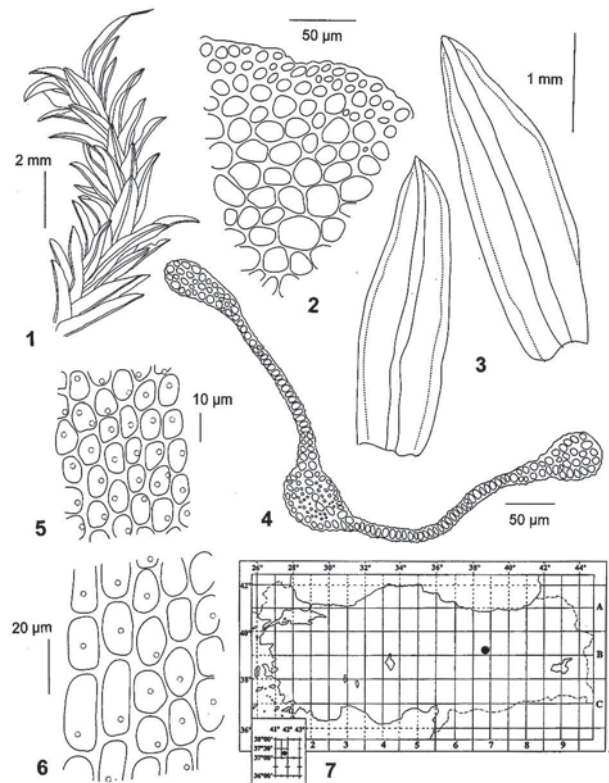


Fig. 7. *Cinclidotus pachylomoides* (Erd. 06/98). 1 habit; 2 cross-section of stem; 3 leaves; 4 cross-section of leaf; 5 mid-leaf laminal cells; 6 basal laminal cells; 7 distribution in Turkey (based on own and published records).

37/1N 31/1E Antalya: Köprülü Kanyon National Park, on wet rock, 7 June 2003 M. Kırmacı AYDN 2143, det. M. Çetin!

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Bolhasan bridge, 400 m, on wet rock, 8 June 2004 M. Kırmacı AYDN 2135, det. M. Çetin!

37/1N 31/2E Antalya: Akseki, gorge below Erenkaya between Manavgat and Akseki, 700 m, limestone rocks partly submerged in stream, 10 April 1956, P. H. Davis & O. Polunin 25800 (HENDERSON 1958).

36/2N 31/2E Antalya: Antalya - Alanya, Manavgat Şelalesi, 11. April 1955, H. Walter 3878, 3882 (ÜNAL 1973).

36/1N 32/2E İçel: Anamur, Çaltıbüğü, on bark, A. Everest 838, 866 (EVEREST & ELLIS 2003).

General distribution: Europe (DÜLL 1984; FREY *et al.* 2006; HILL *et al.* 2006), SW Asia (FREY & KÜRSCHNER 1991; KÜRSCHNER 2008), C Asia (IGNATOV & AFONINA 1992), Africa (ROS *et al.* 1999).

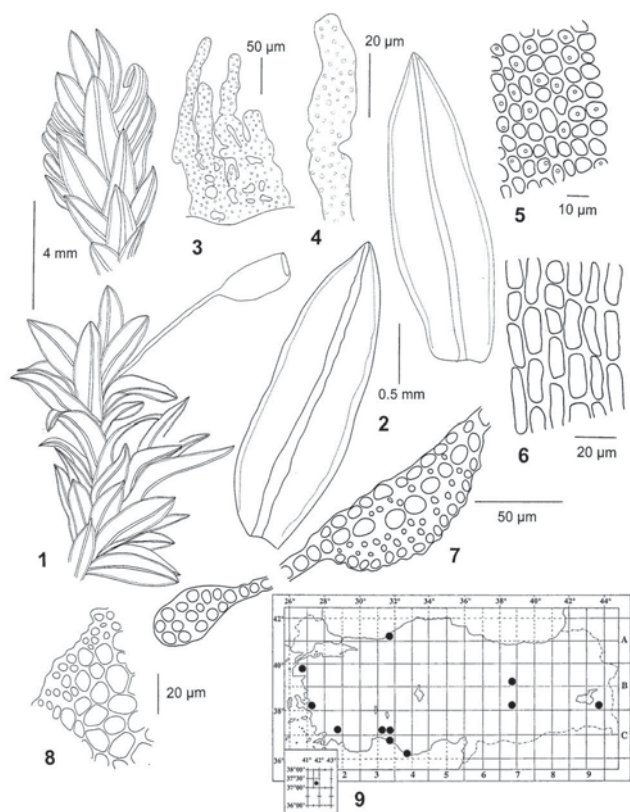


Fig. 8. *Cinclidotus riparius* [K. Walther Nr. 7105b (*B. BRYO* 227210)]. 1 habit; 2 leaves; 3 peristome; 4 peristome (detail); 5 mid-leaf laminal cells; 6 basal laminal cells; 7 cross-section of leaf; 8 cross-section of stem; 9 distribution in Turkey (based on own and published records).

Remarks. *C. acutifolius*, known only from the type (Kashmir, near Gurais, 8-9,000 ft., 5 September 1892 J. F. Duthie Nr. 12701 (H, no. 1011001), cf. BROTHÉRUS 1899) and a single collection from Afghanistan (Ghorat: in faucibus septentriones versus spectantibus Mollah Allah, 12 km south-west of Taiwara, 33°30'N, 64°24'E, 2200-2300 m, substr. calc., 29. Juli 1962 K. H. Rechinger 19.779, cf. FRÖHLICH 1964), fully matches the characters given for *C. riparius* (Figures 8, 9). Diagnostic characters given by BROTHÉRUS (1899), ... *species a C. ripario proxima rigidatae foliisque acutis nec obtusis, mucronatis facillime dignoscenda* ..., that mainly refer to the acute leaf tip are within the range of variability of *C. riparius*. Often, the leaves of *C. riparius* show the typical acute to mucronate leaf tip mentioned as a diagnostic character by BROTHÉRUS (1899; cf. Fig. 74c in MÖNKEMEYER 1927, p. 338). The leaf apex therefore can not be used as a reliable character. The reddish colour of the peristome teeth of *C. acutifolius* (BROTHÉRUS 1899) can not be confirmed when studying the type material (H, no. 1011001). The holotype includes a single sporophyte, with a (meanwhile ?) broken and incomplete peristome, which is not reddish

but yellowish and nearly smooth, as those of *C. riparius*. We therefore consider *C. acutifolius* as a synonym to the widely distributed and common *C. riparius*.

Cinclidotus vardaranus Erdağ & Kürschner, *Nova Hedwigia* 87: 185. 2009 (Figure 10)

Plants rigid, moderately robust, up to 8 cm long; stems ± fastigiate branched, rhizoids restricted to extreme base of stems, occasionally with a few reddish-brown rhizoids among the leaves in lower part of stem; central strand absent; sclerodermal cells narrow, consisting of 2-5 layers of thick-walled cells, cortical cells larger, (10) 15-25 (35) µm; leaves imbricate when dry, erecto-patent, ± spreading when moist, ovate to elliptic, 1.4-1.6 mm wide, 2.5-3.0 (3.5) mm long, basal part of leaves somewhat clasping to subamplexicaul, lower margins undulate; apex obtuse to weakly acute; leaf margins strongly bordered, 4- to 6- (7) stratose, inner and outer border cells more or less of similar size; costa stout, 180-190 µm wide at base, ending in apex and generally confluent with the marginal

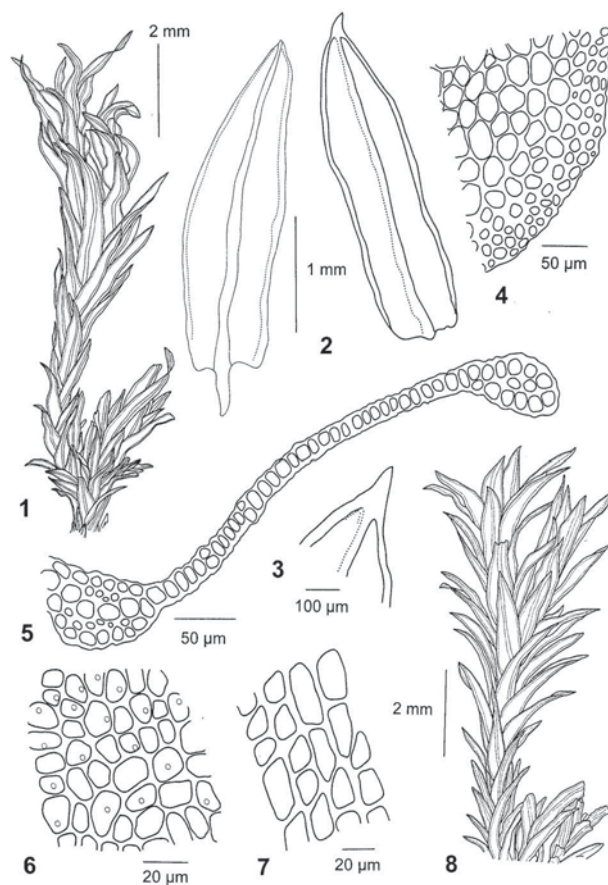


Fig. 9. *Cinclidotus riparius* [*C. acutifolius* syn. nov.; J. F. Duthie no. 12701 (H, Nr. 1011001, type)]. 1 habit (dry); 2 leaves; 3 leaf apex; 4 cross-section of stem; 5 cross-section of leaf; 6 mid-leaf laminal cells; 7 basal laminal cells; 8 habit (wet).

border at extreme apex; in cross-section with 2 stereid bands, and (4) 5-7 (9) guide cells; leaf lamina unistratose, with numerous bistratose ridges; laminal cells regularly hexagonal to roundish, (5) 7-10 (12) μm wide, strongly papillose, papillae blunt, 2-4 per leaf cell; basal cells roundish to shortly rectangular, 8-12 x (12) 15-20 (25) μm ; sporophyte unknown.

Distribution in Turkey (Figure 10.10)

39/1N 38/2E Erzincan: Kemaliye, İkisü (Venk) stream, road to Kabataş village, 39°18'45.9"N, 38°33'39.9"E, 1400 m, on wet rocks exposed to submergence, 4 June 2007 A. Erdağ 07/113 (ERDAĞ & KÜRSCHNER 2009, holotype) !

General distribution: Endemic to Turkey and known only from the type.

Dialytrichia Broth.

Dialytrichia mucronata (Brid.) Broth., Nat. Pflanzenfam. 1: 412. 1902 (Figure 11)

[*Cinclidotus mucronatus* (Brid.) Mach., Cat. Descr. Briol. Portug. 57. 1919]

Plants relatively small, stems erect, 1-3 cm long, with irregular short lateral branches; central strand present; sclerodermal cells in (2) 3-4 (5) layers, 5-10 μm wide, cortical cells larger, up to 30 (35) μm ; leaves crispate, flexuose when dry, erecto-patent when moist, 2-3 mm long, lingulate to oblong-lanceolate; apex mucronate to obtuse; leaf margin recurved, 2- to 3-stratose, inner border cells of similar size as cells of outermost layer; costa relatively weak, (50) 70-80 (130) μm wide, lacking an epidermal cell layer; ventral stereids few; guide cells 3-4 (5); laminal cells irregularly hexagonal to quadrate, (6) 8-10 (12) μm wide, opaque, densely pluripapillose; basal cells rectangular to longly hexagonal, (20) 25-30 (45) μm ; seta erect, up to 12 mm long; capsule exserted, erect, cylindrical, to 2 mm long; operculum conical-rostrate; peristome well developed, reddish-brown, papillose, up to 850 μm long, consisting of 16 filiform segments, free at base; spores smooth, crenulate or weakly papillose, 15-20 μm in diameter.

Distribution in Turkey (Figure 11.11)

41/2N 33/1E Kastamonu: 41°30'N 33°23'E, 1440 m, on alluvial sand, *G. Uyar* 350 (UYAR & ÇETİN 2006).

41/1N 31/2E Düzce: 41°02'N 33°23'E, 1440 m, on alluvial sand, *G. Uyar* (UYAR & ÇETİN 2006).

39/2N 27/2E Balıkesir: Manyas, Değirmenboğazı, Başdeğirmendere, 39°59'N 27°49'E, 30 m, on *Platanus* bark, 15 September 2002 G. Abay 491 (ABAY & URSAVAŞ 2005).

37/2N 28/1E Aydın: Çine valley, Kayırlıdere, 250 m, on trunks of *Liquidambar orientalis*, 18 May 1999 A. Erdağ AYDN 266 (ERDAĞ 2002) !

37/2N 35/1E Niğde: Aladağlar, Sokulu Pınar, 2120 m, submers an Felsen, 13 August 1992, P. Hein 92-A-276 !

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Göller, Yeşil Vadi road, 300 m, on conglomerate in a dry stream bed, 14 April 2003, M. Kırmacı AYDN 1334 !

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Ballıbucağ bridge, 400 m, on trunk of *Platanus orientalis*, 15 June 2003, M. Kırmacı AYDN 1437 !

37/1N 31/1E Antalya: Köprülü Kanyon National Park, Bolhasan bridge, 400 m, on wet rocks, 8 June 2004, M. Kırmacı AYDN 2017 !

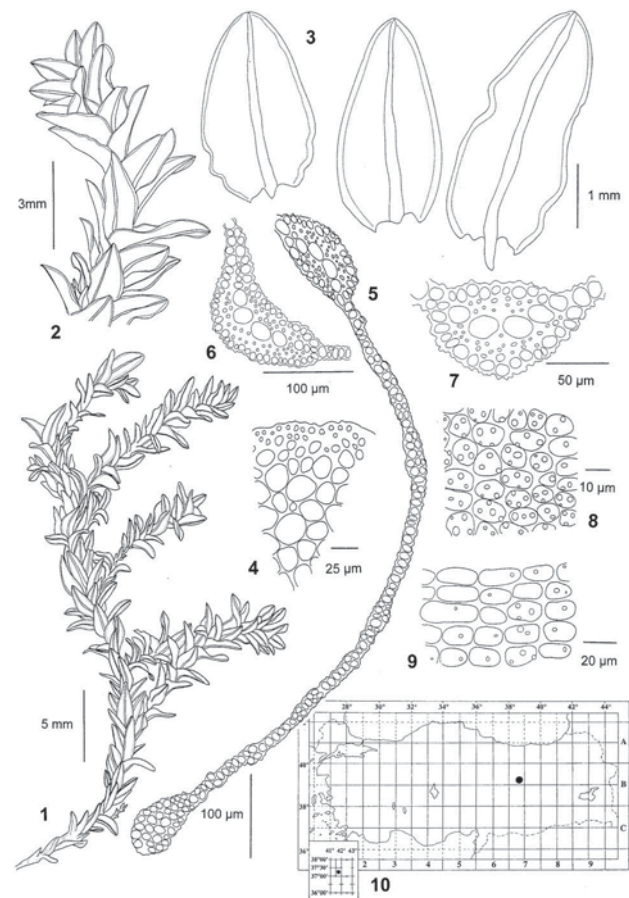


Fig. 10. *Cinclidotus vardaranus*. 1 habit; 2 upper part of stem; 3 leaves; 4 cross-section of stem; 5 cross-section of leaf; 6 cross-section of costa (basal part of leaf); 7 cross-section of costa (middle part of leaf); 8 mid-leaf laminal cells; 9 basal laminal cells; 10 distribution in Turkey (type locality); (from Erdağ & Kürschner 2009, type).

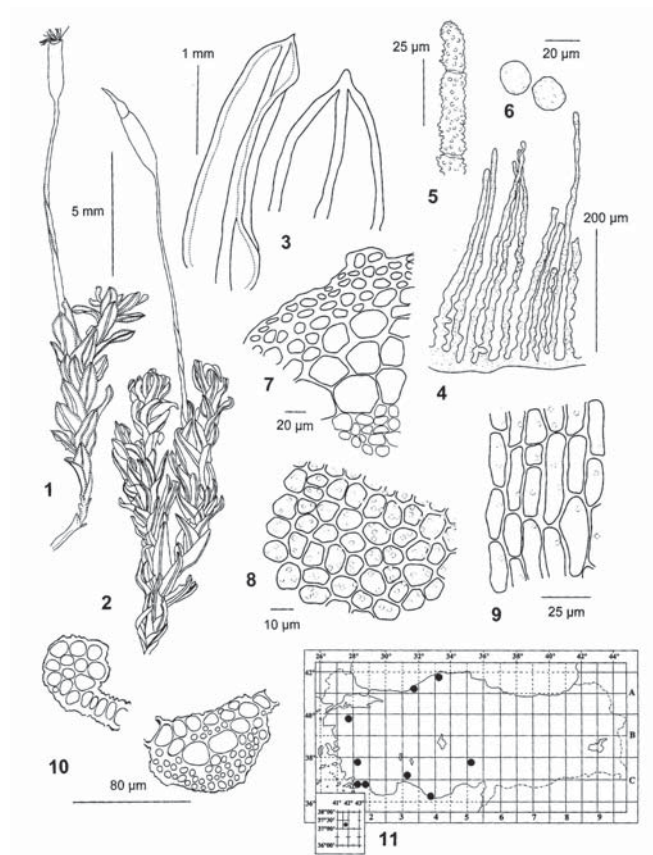


Fig. 11. *Diallytrichia mucronata*. 1 habit (wet); 2 habit (dry); 3 leaf; 4 peristome; 5 peristome (detail); 6 spores; 7 cross-section of stem; 8 mid-leaf laminal cells; 9 basal laminal cells; 10 cross-section of leaf; 11 distribution in Turkey (based on own and published records); (drawn from AYDN 266).

- 36/2N 28/1E Muğla: Çamlıköy, between Marmaris and Çetibeli, 50 m, submers in *Liquidambar orientalis* forest, 15 March 1997, H. Kürschner, Ö. Tonguç & A. Yayıntaş 97-142 (Kürschner et al. 1998) !
- 36/2N 28/2E Muğla: Zwischen Marmaris und Fethiye, July 1969, K. Walther (WALTHER 1975).
- 36/2N 28/2E Muğla: Östlich von Doğuşbelen, 10 m, July 1969, K. Walther (WALTHER 1975).
- 36/2N 28/2E Muğla: Bei Dalaman, 10 m, July 1969, K. Walther (WALTHER 1975).
- 36/1N 32/2E İçel: Anamur, Çaltıbükü, on bark, A. Everest 834 (EVEREST & ELLIS 2003).

General distribution: Europe (DÜLL 1984, FREY *et al.* 2006, HILL *et al.* 2006), SW Asia (FREY & KÜRSCHNER 1991, KÜRSCHNER 2008), Africa (O`SHEA 2006).

4. Phytogeographical and ecological remarks. Major centre of diversity and speciation of the *Cinclidotus/Diallytrichia* complex is the Mediterranean – SW Asian



Fig. 12. Species diversity centre of the *Cinclidotus/Diallytrichia* complex (numbers refer to recorded taxa; cf also ERDAĞ & KÜRSCHNER 2009)

territory (Greece, Iberian Peninsula, Israel, Lebanon, Turkey). A concentration of species (nine taxa, cf. Figure 12) can be observed in Turkey, where the Miocene (Tertiary) orogenesis and the last Quaternary glaciations created many isolated niches in the vast and steep mountain systems, supporting species radiation (ERDAĞ & KÜRSCHNER 2009). Especially the south and east Anatolian Taurus Mts. (Toroslar) harbour many deep gorges, stream valleys, stream and river sites, carstic sinter terraces, and flood plains that provide excellent site conditions for a main speciation centre for this hygrophytic complex. According to ZANDER (1993), ‘... It is possible that *Diallytrichia* represents a largely palearctic representative of a now longly extinct (possible Andean assemblage) ... genus ... that has a few northern much reduced outlier species in the N Hemisphere.’ The two species of this genus regarded at present may have survived through adaptations to a specialized (hygrophytic) habitat. By contrast, *Cinclidotus* seem to be an Old World genus. Although FREY (2009, p. 179) mentioned a distribution in southern S America, this disjunction remain highly doubtful and probably is a confusion with Africa. A reference or voucher specimen citation for S America unfortunately is not given. Of interest, however, is the somewhat disjunct distribution of one species, *Cinclidotus fontinaloides*, recorded from Africa (Kenya, Tanzania, Uganda, cf. O`SHEA 2006). This may indicate a dispersal by water birds like cranes that follow the European – SE Mediterranean – African migration route (Figure 12).

The Turkish species of the *Cinclidotus/Diallytrichia* complex all grow submerged on rocks and/or on rocks (rarely on exposed roots of trees) exposed to submergence. They are concentrated in cold to temperate, fast flowing, carbonate rich mountain streams and slow flowing rivers

of the alluvial lowlands. Preferred sites are wet boulders and rocks which are temporarily – at low water tide during summer time – exposed to desiccation and high irradiation. As an adaptation to these temporarily xeric sites, many species evolved bistratose ridges or a multistratose leaf lamina (*C. bistratosus*), strongly papillose laminal cells, as well as short setae and immersed capsules. These – on a first view paradoxical life syndromes for hygrophytes – can be seen as xeromorphic adaptations to summer drought (LAZARENKO 1955; VITT 1981; KÜRSCHNER & LÜBENAU-NESTLE 2000). A high species diversity can be observed in the southern Toroslar (Köprülü Canyon National Park, six species) and the eastern Toroslar (Kemaliye area, six species). These areas belong to one of the main centres of endemism and species radiation (DAVIS & HEDGE 1975). However, further areas with high diversity may be added after further and thoroughly investigations.

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Botanica SERBICA



REZIME

Kompleks *Cinclidotus* P. Beauv./*Dialytrichia* (Schimp.) Limpr. (Bryopsida, Pottiaceae) u Turskoj

Adnan ERDAĞ, Harald KÜRSCHNER

Izučavan je higrofitni kompleks mahovina *Cinclidotus/Dialytrichia* u Turskoj. Vrste ovog kompleksa su tipične za stalne vodene tokove i staništa gde nivo vode stagnira naročito u sušnom delu godine. Prvi put se navode opisi i distribucija za sve vrste iz ovog kompleksa u Turskoj, zajedno sa ključem za identifikaciju. *C. pachylomoides* je zabeležen po prvi put za Tursku, dok je *C. acutifolius*, od ranije poznat sa Himalaja (Kašmir) i iz Avganistana i sinonimiziran sa široko rasprostranjenom *C. riparius*.

Ključne reči: Higrofitne, ključ za identifikaciju, mahovine, fitogeografija, anatomija, morfologija, centar specijacije.

