Contributions to the genus *Riccia* L. (*Ricciaceae*) in Turkey

Hatice ÖZENOĞLU1-*, Mesut KIRMACI2, Ferhat KİREMİT3

1Departement of Mathematics and Science Education, Faculty of Education, Adnan Menderes University, Aydın, Turkey
2Division of Botany, Department of Biology, Faculty of Arts and Sciences, Adnan Menderes University, Aydın, Turkey
3Department of Agricultural Biotechnology, Faculty of Agriculture, Adnan Menderes University, Aydın, Turkey

Abstract: This study provides an identification key to the species of *Riccia* in Turkey and also gives information about detailed morphological and anatomic characters, reproductive forms, detailed photos of *Riccia* species and their spores, ecological preferences, and distribution patterns in the Mediterranean, Europe, and Southwest Asia. The number of *Riccia* taxa in Turkey has reached 27 including *R. atromarginata*, reported for the first time from Turkey in this study. Additionally, the presence of *R. gougetiana* var. *armattissima* and *R. trabutiana* in Turkey is confirmed here. This study reports other distribution areas of the species *R. bicarinata*, *R. ciliata*, *R. cilifera*, *R. crystallina*, and *R. papillosa*, which were added to the country’s flora some years ago, beyond previously known locations. *Riccia rhenana* recorded from Işıklı Lake, Denizli, by Walter has not been reported again from the original locality or other areas in Turkey. Within this study, all previously recorded localities and surroundings were searched in detail for the species without success. Different localities have often led to the expansion of knowledge on where these species particularly disperse all over the Mediterranean climate regions in Turkey. Additionally, in this study, Turkish names are proposed for four newly reported taxa.

Key words: *Riccia*, liverworts, taxonomy, new record, Bryophyte flora, Turkey

1. Introduction

The genus *Riccia* L. is represented by approximately 250 species in the world (Söderström et al., 2016). It is widely distributed in Europe with 36 taxa (33 species and 3 varieties) (Schumacker and Váňa, 2000), in the Mediterranean with 40 taxa (36 species and 4 varieties) (Ros et al., 2007), and Southwest Asia with 33 taxa (31 species, 1 variety, and 1 subspecies) (Frey et al., 2006; Kürschner and Frey, 2011).

*Riccia* is the largest genus among the Turkish liverwort flora with 24 species and 2 varieties (Ros et al., 2007; Özenoğlu Kiremit and Keçeli, 2009; Özenoğlu Kiremit and Hugonnot, 2010; Özenoğlu Kiremit, 2011; Özenoğlu Kiremit et al., 2016).

2. Materials and methods

The materials of this study were collected between 2000 and 2015. Most of the data were obtained during the revision project on Turkish *Riccia* between 2012 and 2015. The specimens were identified using “A revision of the genus *Riccia* (Hepaticae) in Australia” (Na-Thalang, 1980), “Liverworts, mosses and hornworts of Southwest Asia (Marchantiophyta, Bryophyta, Anthocerotophyta)” (Kürschner and Frey, 2011), “Mosses and Liverworts of the Mediterranean” (Frahm, 2010), “Handbook of Liverworts and Hornworts of the Iberian Peninsula and the Balearic Islands” (Casas et al., 2009), “The Liverworts, Mosses and Ferns of Europe” (Frey et al., 2006), and “The Liverworts Flora of the British Isles” (Paton, 1999). The relevant literature was also reviewed (Smith, 1955; Jovet-Ast, 1986; Gökler and Öztürk, 1991; Smith, 1991; Kürschner, 2001; Özenoğlu and Gökler, 2002; Bischler and Jovet-Ast, 2004; Özenoğlu Kiremit, 2007, 2008; Özenoğlu Kiremit et al., 2007; Ros et al., 2007; Özenoğlu Kiremit and Keçeli, 2009). The collected specimens were stored at Adnan Menderes University (AYDN).

At the same time, the specimens collected from Turkey for the first time by Crundwell and Nyholm (1979) [*Riccia bicarinata* (Lindb.), *R. glauca* (L.), *R. gougetiana* (Durieu & Mont.), *R. michelii* (Raddi), *R. nigrella* (DC.), *R. ciliata* (Hoffm.), *R. macrocarpa* (Levier), *R. sorocarpa* (Bisch.), Walter (1967, 1970) [*R. ciliata*, *R. crystallina* (L.), *R. rhenana* (Lorb. ex. Müll. Frib.), *R. sorocarpa*], and Jovet-Ast (1957, 1986) [*R. canaliculata* (Hoffm.), *R. frostii* (Austin), *R. lamellosa* (Raddi)], which are deposited in the Ege Herbarium (EGE), were examined. Almost all type specimens of *Riccia* in Turkey were checked. Additionally, the specimens collected during the study were compared...
to the *Riccia* specimens deposited in the herbaria mentioned above. A number of *Riccia* species were also examined in the Dahlem Botanical Garden and Botanical Museum (Berlin-Germany) (BGBM); in the Botany Unit of the Department of Animal Biology, Plant Biology, and Ecology at the Universitat Autònoma de Barcelona-BCB (Spain); and in the Institute of Biodiversity and Ecology Research, Bulgarian Academy of Sciences (Bulgaria).

The descriptions of taxa given in previous studies of the species are expanded (Jovet-Ast, 1986; Schumacker and Váňa, 2000; Bischler, 2004; Frey et al., 2006; Ros et al., 2007; Kürrshner and Frey, 2011; Özenoğlu Kiremit et al., 2016). Morphological examinations are also included based on the thallus type of rosette; colors of thallus; number of bifurcations, width, and shapes of ultimate branches; median groove width and length; the presence or absence of cilia, numbers, shape, length, structure, or presence of tubercles; and ventral scale color, position, shape, and cell size. Anatomical examinations were based on the thallus section height and width; epidermal and subepidermal cell size, color, and wall thickness; chlorenchyma and parenchyma height; and cell sizes, whether or not air chambers are considered. Moreover, sexual condition and reproductive examinations were based on sporophyte status; capsule, archegonial and antheridial neck lengths; and spore size, color, distal and proximal face shape, and wing size. The related resources were used for the distribution of taxa (Jovet-Ast, 1986; Schumacker and Váňa, 2000; Bischler, 2004; Frey et al., 2006; Ros et al., 2007; Kürrshner and Frey, 2011; Özenoğlu Kiremit et al., 2016; Söderström et al., 2018).

Additionally, a key to the Turkish species of *Riccia* was prepared on the basis of the methods of Casas et al. (2009) and Kürrshner and Frey (2011). All distinguishing characters of the specimens collected in Turkey were used in the key. The list, synonyms (Jovet-Ast, 1986), types, descriptions, habitats, and distributions of the species are given in the Appendix. Although Turkish names were given to all Turkish bryophyte taxa by Güner et al. (2009), we have proposed Turkish names for four newly were given to all Turkish bryophyte taxa by Güner et al. (2009) and Kürschner and Frey (2011). All distinguishing

### 3. Results and discussion

The family Ricciaceae includes two genera, both known in Turkey: *Riccia* and the monotypic *Ricciocarpos* Corda. *Ricciocarpos*, a monotypic genus, with *Ricciocarpos natans* (L.) Corda, was registered in Sakarya Province by Seçmen et al. (1989). *Ricciocarpos* is separated from *Riccia* by its long pendant scales with serrate margins and the presence of oil cells in the scales and the thallus.  

*Riccia* L., Spec. Plant.: 1138 (1753); Steph.: 314 (1898); Sim: 8 (1926); Müller: 416 (1952); S. Arnell: 13 (1963a); Hässel: 208 (1962); Na-Thalang: 71 (1980); Jovet-Ast: 291 (1986).

Turkish name: Çatalcık.  
Lectotype: *Riccia glauca* L., fide Hässel Menendez in Opera Lilloana 7: 208 (1963); Na-Thalang, Brunonia 3: 71 (1980).

*Riccia* plants are mostly small (thalli generally 0.5–4 mm wide, 2–30 mm long), dichotomously branched and often forming rosettes, terrestrial or sometimes floating; upper side and margins are sometimes with cilia or papillae; groove median is deep or shallow, along the length of branches or only apical. Epidermis is persistent or decaying, epidermal pores are more visible among epidermal cells; assimilatory tissue or chlorenchyma is compact, in vertical cell columns, enclosing narrow air channels, open at top, or spongy, with one to three layers of air chambers; storage tissue cells or parenchyma are rounded, occupying ventral 1/2 or less of thallus; oil bodies are absent; scales vestigial to conspicuous, hyaline or variously colored, lateral or ventral, usually imbricate, sometimes absent; rhizoids smooth or tuberculate, usually numerous, absent in floating plants. Typical gemmae are unknown.

In some species, asexual reproduction can be seen with one or several apical or ventral tubers. Monoicous or dioicous; antheridial and archegonial necks are often protruding. The genus has a simple sporophyte that is embedded and virtually hidden in the tissues of the vegetative thallus. There is no foot or seta, and at maturity the spherical sporophyte consists merely of capsule wall without thickenings with spores enclosed that are released when the capsule wall disintegrates. Speres with tetrads are separated at maturity, 40–200 μm in diameter, distal and proximal faces are alveolate, tuberculate or nearly smooth, with distinct triradiate mark; wing has with several dimensions and shapes.

The genus comprises 250 species with a worldwide distribution from the Arctic to the Antarctic (Söderström et al., 2016).

**Key to the species of Riccia in Turkey**

The Turkish *Riccia* key was prepared based on the methods of Kürrshner and Frey (2011) and Casas et al.
1 Dorsal surface of thallus often lacunose or spongiosic with age; thallus in cross-section not compact, photosynthetic tissue loose, forming large polygonal chambers; dorsal surface with a chlorophylllose epidermis; ventral scales absent or rudimentary, in 1 or 2 rows when present; marginal cilia or papillae of thallus absent ............... subg. Ricciella 2

2 Plants terrestrial, sometimes variably pigmented with purplish or reddish; dorsal thallus surface lacunose to spongiosic, at least with age; capsule at maturity not protruding strongly on ventral side of thallus; spores not regularly areolate.......................... subg. Riccia 8

3 Plants dioecious, clearly heterothallic, male plants smaller; thallus segment 1.5–3.0 times as wide as thick; spores 40–65 µm in diameter, without areolae, bearing short, delicate ridges that do not regularly anastomose ....... 6

4 Plants dioicus, light green to pale red, bullosic aspect; lobes 1.7–2.5 mm wide; asexual reproduction by tubers on apical ventral side of thallus ............................................. 4

5 Thallus yellowish green to light green with pink or light violet spots, at maturity copiously and deeply subdivided; dorsal surface with pores soon enlarging from the base, the thalli strongly alveolate; spores (65–)75–85 µm in diameter, light brown, distal face regularly areolate, margins here and there with a pore; on shaded soil in fields, on paths mainly in anthropogenic landscapes but also on mud by ponds ........................................ R. crystallina L. (Figures 1K, 2I1, 2I2)

6 Plants terrestrial; thallus thick, fleshy, 1.5–2.5 times as wide as thick, at least older parts of thallus channeled, not reticulate; thalli little branched, branches few, linear, often ventral; ventral scales deeply pigmented, 2-ranked ....... R. canaliculata Hoffm. (Figure 1E)

7 Thallus branches 0.3–0.8 mm wide or less, 3–6 times as wide as thick, with narrow areolation; branches linear; marginal cells of thallus 12–20 × 30–45 µm; cells of ventral scales to 45 µm long; in pools and on mud at edges of drying-out ponds and lakes ..................... R. fluitans L. (Figure 1L)

8 Thallus glabrous, devoid of marginal or surface cilia or papillae (with cilia, e.g., R. beyrichiana, R. subbifurca, and very rarely with a few cilia, e.g., R. glauca var. ciliaris) .... 9

9 Ventral scales hyaline, projecting above thallus margins ............................................. R. lamellosa Raddi (Figures 1O, 2L1, 2L2)

9* Ventral scales hyaline or colored, not exceeding the thallus margins, projecting or not projecting ..................... 10

10 Ventral scales hyaline ............................................. 11

10* Ventral scales colored, sometimes hyaline but colored cells present ............................................. 12

11 Epidermal cells of thallus consisting of 2 specialized strata, hyaline, rounded, soon collapsing but thickened bases remaining to form well-defined cups, subepidermal cell thick-walled; thallus light green, appearing waxy, with flanks not incurved-connivent; slightly winged .................... R. sorocarpa Bisch (Figures 1U, 2P1, 2P2)

11* Epidermal cells of thallus soon collapsing, but not thickened at base, remaining imperfect cups; thallus light and clear to glaucous, thallus margins obtuse to broadly rounded; unwinged ........................................ R. glauca L. (Figures 1M, 2J1, 2J2)
11*/1 Thallus margin smooth ................................... var. glauca
11*/1* Thallus margin with a few, short cilia ................... ............................................................... 18

12 Thallus lobes thin, sharp, with short wings in cross-section; ventral scales spotted with violet and orange cells .................................................. R. macrocarpa Levier (Figures 1P, 2M1, 2M2)
12* Thallus lobes acute, obtuse to rounded not winged in cross-section; ventral scales without violet and orange cells ........................................................................ 13
13 Thallus broadly grooved or channeled over 0.25 of total segment width ........................................... 14
13* Thallus narrowly grooved or channeled ............... 15
14 Thallus with round and tumid margins; plants in rosettes, light green, segments 1.2–1.5 mm wide; spores 70–90 µm in diameter ....................................................... R. bifurca Hoffm. (Figures 1D, 2D1, 2D2)
14* Thallus with cilia numerous, scattered, to 300 (350) µm long or glabrous margin; plants incompletely rosettes, bluish green to greyish green, segments 1.8–2.6 (3.2) mm wide; spores 100–120 (–140) µm in diameter .............................................. R. beyrichiana Hampe (Figures 1B, 2B1, 2B2)
15 Thallus margins rounded to blunt; spores 80–100 (–110) µm in diameter, not xeromorphic ....................... R. subbifurca Warnst. ex Croz. (Figures 1V, 2Q1, 2Q2)
15* Thallus margins acute to round; spores not 100 µm in diameter, strongly xeromorphic ....................... 16
16 Spores 65–80 µm in diameter, areolate, with 8–10 with incomplete, usually irregularly limited areolae in distal face; thallus in cross-section 1–2 times as wide as thick; dorsal side of thallus dark green with black-purple margins, median groove narrow, distinct, along almost all the length of the dorsal side of lobe; ventral scales imbricate, conspicuous, blackish purple, shining when dry, in drying the dorsal surface hidden, the blackish flanks becoming convivient, thallii then veriform .............................................................. R. nigrella DC. (Figures 1B, 2N1, 2N2)
16* Spores 70–90 µm in diameter, areolate, with 9–15 complete areolae across distal face; thallus in cross-section nearly as wide as thick, lobes V-shaped in section only in the apical part; dorsal side of thallus entirely bluish green, median groove only distinct in the apex of the dorsal side of lobe, wide and flat in midlobe; ventral scales not shining ........................................... R. trabutiana Steph. (R. atromarginata) Levier var. glabra Levier ex Müll. Frib) (Figures 1W, 2R1, 2R2)
17 Thallus papillate ...................................................... 18
17* Thallus ciliate or with few cilia ............................... 19
18 Thallus margins light reddish to bluish; thallus covered on dorsal surface often with curved papillae; bases of subepidermal cells thick-walled; spores 55–70–75 µm in diameter, areolate, with 5–8 areolae across the distal face ............................................. R. papillosa Moris (Figures 1S, 2O1, 2O2)
18* Thallus bluish green, with black-purple narrow lateral margins and ventral scales; thallus margin covered with straight papillae; bases of subepidermal cells thinned-walled; spores 90–110 µm in diameter, areolate, with 12–18 areolae across the distal face ............................................................... R. atromarginata Levier (Figures 1A, 2A1, 2A2)
19 Thallus with thin margins, extending in two lateral wings; spores 110–195 µm in diameter ....................... 20
19* Thallus with blunt margins, not extending in two lateral wings; spores 60–125 µm in diameter ............... 21
20 Thallus bluish green with flanks neither lamellate nor incurved, the wings spotted purplish to violet; spores 110–180 µm in diameter, with 6–8 areolae across the distal face; ventral scales with cells 27–34 × 60–90 µm; on soil .......... R. beyrichiana Warnst. (Figure 1H)
20* Thallus light yellowish green with lamellate flanks, the wings not violet spotted; spores 130–185 (–195) µm in diameter, with 8–20 areolae across the distal face; ventral scales with cells 45–55 × 70–110 µm; on soil among rocks .......... R. gougetiana Durieu & Mont. (Figures 1N, 2K1, 2K2)
21* Thallus dorsal side and margin ciliate ..................... R. gougetiana var. armatissima Levier ex Müll. Frib.
20*1 Thallus glabrous on the dorsal side; margin ciliate .......................................................... R. gougetiana var. gougetiana
21 Cilia triangular, 185–300 (–350) µm long, wide at base, solitary but others united basally in groups of 2–3 .......... R. bicarinata Lindb. (Figures 1C, 2C1, 2C2)
21* Cilia elongated up to 1 mm long, solitary .......... 22
22 Thallus sections with vertical flanks and obtuse margins, 1.5–4.0 times as wide as thick, median sulcus broad; cilia often covering the whole thallus; spores 90–140 µm in diameter, with 6–9 areolae across the distal face ...................... 23
22* Thallus section 1.0–1.5 times as wide as thick, median sulcus narrow; cilia ±confined to the thallus apex, cilia verruculose in upper part; spores 72–88 µm in diameter, with 8–12 areolae across the distal face ........ R. crozalsii Levier (Figures 1J, 2H1, 2H2)
23 Cilia to 1 (1.2) mm long, vertically inserted and spreading horizontally, yellowish or hyaline often reddish tinged, extending also on the sporophyte region ........................................ R. crinita Taylor (R. trichocarpa Howe) (Figures 1I, 2G1, 2G2)
23* Cilia short, 100–500 µm long, obliquely inserted, not reddish tinged, not extending on the sporophyte region ................................................................. 24
24 Cilia papillate, strongly overarching the thalli, crossing when dry; thallus in cross-section 2–3 times as wide as thick; spores 70–85 (–90) µm in diameter, monoicous ......................................... R. ciliata Hoffm. (Figures 1G, 2F1, 2F2)
24* Cilia papillate or smooth in the same plant; thallus in cross-section 2.5–4 times as wide as thick; spores 90–140 µm in diameter; dioicous ........................................................... R. michelii Raddi (Figure 1Q)
Figure 1. Photographs of thallus. A- *Riccia atromarginata*, B- *R. beyrichiana*, C- *R. bicarinata*, D- *R. bifurca*, E- *R. canaliculata*, F- *R. cavernosa*, G- *R. ciliata*, H- *R. ciliifera*, I- *R. crinita*, J- *R. crozalsii*, K- *R. crystallina*, L- *R. fluitans*, M- *R. glauca*, N- *R. gougetiana*, O- *R. lamellosa*, P- *R. macrocarpa*, Q- *R. michelii*, R- *R. nigrella*, S- *R. papillosa*, T- *R. perennis*, U- *R. sorocarpa*, V- *R. subbifurca*, W- *R. trabutiana*. 
Figure 2. SEM photographs of spores of *Riccia* species. 1- Distal faces, 2- proximal faces. A1, A2- *Riccia atromarginata*; B1, B2- *R. beyrichiana*; C1, C2- *R. bicarinata*; D1, D2- *R. bifurca*; E1, E2- *R. cavernosa*; F1, F2- *R. ciliata*; G1, G2- *R. crinita*; H1, H2- *R. crozalsii*; I1, I2- *R. crystallina*; J1, J2- *R. glauca*; K1, K2- *R. gougetiana*; L1, L2- *R. lamellosa*; M1, M2- *R. macrocarpa*; N1, N2- *R. nigrella*; O1, O2- *R. papillosa*; P1, P2- *R. sorocarpa*; Q1, Q2- *R. subbifurca*; R1, R2- *R. trabutiana*. 
This study was planned to determine the status of the Turkish *Riccia*. Additionally, detailed morphologic and anatomic characteristics, reproductive forms, detailed photos of *Riccia* species and spores in SEM, distribution patterns, and ecological preferences are given.

Previous studies on the genus in Turkey reported 26 taxa. Additionally, *R. atromarginata* was recorded for the first time during this study, raising the present number to 27 taxa (25 species and 2 varieties). The presence of *R. gougetiana* var. *armatissima* and *R. trabutiana* in Turkey is also confirmed by this study.

*R. atromarginata* can be distinguished from the rest of the members of the *Riccia* subgenus by its finger-like papilla on thallus. However, it is considerably similar to *R. trabutiana* in spite of some slight differences in comparison of thallus color, the presence of papilla, and rounded margins of lobes and spores.

After Walter (1967) recorded the species *R. rhenana* from İskılı Lake, Denizli, as an aquatic form found in the lake, no new record of the species has been reported. Within this study, all localities and surroundings that were previously recorded for the species were searched in detail for the species; however, nothing was found.

An aquatic form of *Riccia fluitans* has been recorded only in water bodies of Kazan Lake (called Kazangöl) (Selçuk/İzmir). Although we carefully searched for the species in similar water bodies, we never found aquatic forms of the species in any other locations. Kazan Lake is slightly salty. The locality where the species was collected is an area facing pollution under the influence of intense human activities; thus, the known locality is also under threat.

This study reports new localities of species (*R. bicarinata, R. ciliata, R. ciliifera, R. cristallina, and R. papillosa*), which were recorded among the country’s flora a number of years ago. *R. ciliifera*, which was first recorded from Bursa by Bornmüller in 1931, has never been re-collected and recorded until now. Our study reports that the species were found to be widespread on volcanic tuff along with *R. michelii* and *Oxymitra incrassata* and were collected from the hillside of Demirköprü Dam Lake near the town of Sindel (Salihli/Manisa). Thus, the known distribution of the species in Turkey has been expanded. Recording of *R. cavernosa* from the transition zone between the Middle Black Sea and the Central Anatolia regions in Turkey is significantly worth mentioning in terms of the zone having a Mediterranean climate. *R. cavernosa* is easily characterized by its sponge-like structure. Records of *R. crinita* from Turkey filled the distribution gap missing between Europe and the Middle East.

An overall evaluation for all recorded localities in general showed that the genus *Riccia* prefers Mediterranean-type localities. However, it is also observed that species (*R. bifurca, R. papillosa, R. trabutiana*) might be distributed in different habitats with variable climate types, such as alpine zones and plateaus with high altitudes (e.g., Trabzon and Van). Different localities have often led to the expansion of knowledge of species distribution all over the Mediterranean climate regions in Turkey.

*Riccia* species that occur only in the Mediterranean Region and its surroundings in Turkey can be found in the period of time between December and March. On the other hand, the species occurring in alpine zones were found only between June and August, along with their spores. Therefore, this is a significant detail to consider when planning a field study to collect the species. It is also observed that *Riccia* species often prefer to be present in open fields such as roadsides, soil floors, and footpaths, which are under the influence of human activities, but not in dense vegetation. Furthermore, it becomes increasingly difficult to find and collect the species when the open areas in question are covered by other herbaceous plants. Most of the localities recorded in this study face habitat loss due to anthropogenic pressure factors such as migration, urbanization, commercial activities, and pollution along with fire events and also soil drying in relation to global climatic changes.

Studies relevant to *Riccia* are limited and will definitely contribute to studies on the Turkish bryoflora. Moreover, the identification key designed here for the genus in question will be a useful referral source for interested researchers.

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Appendix

Species descriptions, specimens examined, and general distribution

*Riccia atromarginata* Leveir in Martelli 1889, Nuovo Giorn. Bot. Ital. 21: 291 (Figures 1A, 2A1, 2A2; Appendix Figure 1)

**Turkish name:** Boyalı çatalcık.

**Holotype:** Italie, Sicile, ad terram Villae Belmonte Panormi, leg. Martelli, Ross (FI). Isotype, BM (Dr Ross). – Specimen de la loc. originale, Dr Ross, 1892 (US, ex Farlow Herb.).

Plants forming incomplete rosettes or crowded mats; thallus bluish green, dark purplish on the rounded margins (Figure 1A); thalli 2–3 furcate, ultimate branches 1–1.6 mm wide, obovate, narrowed from apex towards base, rounded apically; median groove shallow, often narrow, widening to 1/3 branch width, distinct almost to base; papillae numerous, hyaline, finger-like, rounded at top, intensely on margins, seldom on dorsal side of thallus, 120–180 µm, straight or curved, intensely curved; ventral scales pink or purplish; rhizoids smooth and internally tuberculate. Thallus sections of lobes as wide as high near top of lobes, 1.5 times wider than high below, contain colored idioblast cells; epidermis of 2 layers, subepidermal cell thin-walled; ventral scale cells 20–25 × 28–38 µm. (Appendix Figure 1).

*Dioicous.* Archegonial necks purple; spores 90–110 µm, dark brown, distal face with 12–18 alveoli across diameter, limited by thick walls with tubercles at wall corners (Figure 2A1), proximal faces similarly ornamented (Figure 2A2), without wing, crenulate on margin by projecting tubercles.

*Riccia atromarginata* was found in subalpine vegetation. It was growing on soil in the grassland area near the lake. Accompanying species is *Riccia trabutiana*.

*Riccia atromarginata* can be distinguished from other members of the subgenus *Riccia* by its finger-like papillae on thallus. It is closely allied to *R. trabutiana*, from which it differs in color of the thallus, presence of papillae, and rounded margins of lobes.

**Specimens examined:** Muğla, Köyceğiz, Kartal Lake, in grassland near the lake, 1903 m, 37°05′48.8″N, 28°51′04.2″E, 07.08.2015, Özenoğlu TR/374.

**Distribution:** *Riccia atromarginata* is recorded from Algeria, Baleares, Canary Islands, Crete, Cyprus, Egypt, France, Greece, Iran, Israel, Italy, Libya, Jordan, Madeira, Morocco, Oman, Portugal, Sardinia, Saudi Arabia, Sicilia, Socotra, Spain, Syria, Tunisia, United Arab Emirates, and Yemen in the Mediterranean Region and Southwest Asia. Also in Africa in Cape Verde (Sérgio and Melo, 2015).

**Appendix Figure 1.** *Riccia atromarginata*: 1- thalli; 2–4- cross-sections of lobe; 5- ventral scale; 6–7- papillae; 8- epidermis of 2 layers. e, Epidermal cells; kp, ventral scale; p, papillae; se, subepidermal cells.
2. _Riccia beyrichiana_ Hampe ex Lehm. et Lindenb. in Lehm. 1838, Nov. Stirp. Pug. 7: 1 (Figures 1B, 2B1, 2B2; Appendix Figure 2)

**Syn.:** _Riccia lescuriana_ Aust. 1869 (1870), Proc. Acad. Nat. Sci. Philadelphia 21: 232; _Riccia glaucescens_ Carr. 1878, Grevillea 8 (46): 41. - In Carr. et Pears. Hep. Britannicae Exsicc. 1, n° 66; _R. subinermis_ var. _crassa_ Warnst. 1890, Verh. Bat. Vereins Prov. Brandenburg 41: 20; _R. lesquerueuxii_ Steph. 1898, Spec. Hep. 1: 16; _R. lescuriana_ var. _subinermis_ Warnst. 1902, Kryptog. Fl. mark Brandenburg 1: 71; _R. levierei_ Schöffn. 1906, Verh. K.K. zool-bot. Ges. Wien 56: 271; _R. lescuriana_ var. _glaucescens_ (Carrington) Müll. Frib. 1907, Rabenhorst Kryptog. Fl. ed. 2, 6, 1: 182; _R. levierei_ f. _montana_ Schöffn. 1916, Österr. Bot. Z. 2, 1–2: 8.

Turkish name: Kanallı çatalcık.

**Holotype:** Etats-Unis, Georgie «inter Jefferson and Gainsville», leg. Beyrich, 13 aug. 1833 (S).

The species is one of the largest _Riccia_ species, forming complete rosettes, thallus shiny, grayish-green and frequently violet on sides, usually becoming brown with age (Figure 1B); thallus 3–4 furcate, ultimate branches 1.5–2.5(–3.2) mm wide, oval-rounded, subacute-rounded or emarginate apically; median groove deep, widening to 1/3–1/2 branch width, distinct almost to base, narrow at apex; lateral edges rounded; cilia numerous, scattered, to 300 (350) µm long, erect or incurved, faintly papillate. Jovet-Ast (1986) described the cilia as rare or sometimes absent in Mediterranean specimens. The material collected in Turkey notably had numerous cilia present. From a general point of view, cilia number is changeable in the genus _Riccia_ (Jovet-Ast, 1986; Paton, 1999) depending on ecological conditions. Ventral scales pigmented with orange-brown tinge. Thallus sections 0.7–1(–1.3) mm high and 1.5–2.5 times as wide; internal cells 35–55 µm wide; ventral scale cells 35–42 × 55–60 µm (Appendix Figure 2). Monoicous. Sporogonium common; spores 100–120–(140) µm, pale to dark yellow-brown, 100–120–(140) µm, pale to dark yellow-brown, distal face with 6–8 alveoli across diameter, limited by walls with tubercles at wall corners (Figure 2B1), proximal faces similarly ornamented (Figure 2B2), wing 4–8(–10) µm, irregularly crenulate margin.

The species was growing in quite open Ceratonia siliqua L., _Olea europaea_ L., _Pistacia terebinthus_ L., and Quercus cocifera L. plantations, on soil at roadsides and in streambeds. Accompanying bryophyte species are _Barbula unguiculata_ Hedw., _Fossombronia echinata_ Macvicar, _Microbryum starckeanum_ (Hedw.) R.H. Zander, _Oxymitra incrassata_ (Brot.) Sérgio & Sim-Sim, _Pseudocrossidium hornschuchianum_ (Schultz) R.H. Zander, _Ptychostomum imbricatulum_ (Müll. Hal.) Holyoak & N. Pedersen, _Riccia bicarinata_, _R. crozaisii_, _R. lamellosa_, _R. macrocarpa_, _R. sorocarpa_, and _Sphaerotheca texana_ Austin.

_Riccia beyrichiana_ can be distinguished from other members of the subgenus _Riccia_ by large, channeled, long-persistent, shiny thalli with swollen margins. Spores pale to dark yellow-brown, 100–120(–140) µm in diameter, wing 4–8 µm wide. Jovet-Ast (1986) described the cilia as rare or sometimes absent in Mediterranean specimens. The material collected in Turkey notably had numerous cilia. From a general point of view, cilia number is changeable in the genus _Riccia_ (Jovet-Ast, 1986; Paton, 1999) depending on ecological conditions.

**Specimens examined:** Aydın, Söke, between Gülübahçe and Doğanbey, 2 km to Doğanbey, roadside, on soil, 10 m, 37°37′19.93″N, 27°11′42.52″E, 23.03.2012, AYDN 3452; Ortaklar, Selatin village, on wet soil, 351 m, 37°58′11.57″N, 27°29′57.01″E, 13.01.2013, AYDN 3453; Güzelyamlı, Panionian ancient city, on soil under olive and _Pinus brutia_ Ten. trees, 49 m, 37°42′46.40″N, 27°13′57.50″E, 24.03.2013, AYDN 3454; Muğla, Akkaya Ören road, 10 km to Oren, on soil in streambed, 15 m, 37°03′01.40″N, 27°57′41.40″E, 03.03.2013, AYDN 3455.

**Distribution:** _Riccia beyrichiana_ has a temperate subcircumpolar distribution and in Europe and Africa, occurring mostly in the countries around the western half of the Mediterranean Sea and North Europe (Borovichev and Bakalin, 2016). It is recorded from Afghanistan, Algeria, Azores, Baleares, Belarus, Belgium, Bulgaria, Corsica, Croatia, Czech Republic, Denmark, England, Estonia, Faroes, Finland, France, Germany, Greece, the Netherlands, Iceland, Ireland, Italy, Macedonia, Malta, Norway, Poland, Portugal, Russia, Sardinia, Spain, Sweden, Tunisia, and Turkey in the Mediterranean Region and Europe.

The discovery of _R. beyrichiana_ is a significant extension range to the eastern border of its known range. Easternmost localities of _R. beyrichiana_ (of Greece and Turkey) appear rather isolated compared with the bulk of localities in Portugal, Spain, France, and North Africa. The discovery is also a new record for Southwest Asia.
Appendix Figure 2. Riccia beyrichiana: 1- thalli; 2- cross-section of lobe with archegonia; 3- cross-section of lobe with capsule; 4- cilia; 5- epidermal cells; 6- capsule.

3. Riccia bicarinata Lindb. 1877, Rev. Bryol. 4: 41 (Figures 1C, 2C1, 2C2; Appendix Figure 3)

**Syn.:** Riccia henriquesii Leveir 1894, Bull. Soc. Bot. Ital.: 199; R. lusitanica Levier ex Steph.1898, Spec. Hep. 1: 9; R. henriquesii var. mediterranea C. Massal. 1913, Bull. Soc. Bot. Ital.: 50.

Turkish name: Çiftdişi çatalcık.

**Holotype:** Corsica, leg. E. Bescherelle (H-SOL). Isotype: G.

Plants forming incomplete rosettes, thallus bluish green, brownish-purplish in lateral sides, tinged with yellow-brown or pink in older parts (Figure 1C); thalli 2–3 furcate, ultimate branches 1–1.5 mm wide, oblong or oval, shaped like a spoon, obtuse apically and narrowed below; median groove narrow, deep, widening to about 1/3 branch width, distinct almost to base; lateral edges thick and rounded-subacute; cilia free or connate at base in groups of two to three, (150–)180–300(–340) µm long, acute, on margins of lobes from top to base, smooth; ventral scales hyaline or purplish. Thallus sections 1.5–2 times as wide, upper edge forming a V-shape or with median groove wider, or flat, containing idioblast cells; epidermal cells of groove rounded (Appendix Figure 3). Monoicous. Spores 80–120 µm, dark brown, distal face with 8–9 alveoli across diameter with conspicuous tubercles at wall corners (Figure 2C1), proximal faces similarly ornamented (Figure 2C2), wing 6.5–7(–8) µm wide, with sinuous margin.

**Riccia bicarinata** was growing on wet soil and soil near roadside in olive (*Olea europaea*) plantation and scrubs. Accompanying species are Bryum sp., Fossombronia angulosa (Dicks.) Raddi, Lumularia cruciata (L.) Lindb., Oxymitra incrassata, Phaeoceros laevis (L.) Prosk, Pseudocrossidium hornscluchianum, Reboulia hemisphaerica (L.) Raddi, Riccia crozalsii, R. gougetiana, R. sorocarpa, R. subbifurca, Sphaerocarpus texanus, and Targionia hypophylla L.

**Riccia bicarinata** can be distinguished from other members of the subgenus *Riccia* by its spoon-like thallus lobes, marginal cilia triangular enlarged at base and connate in groups of two to three.
Specimens examined: Aydın, Çine, near Topçam Dam Lake, in a small streambed, on wet soil, 120 m, 37°43’31.4″N, 28°01’32.4″E, 01.05.2013, Özenoğlu TR/59; Çine-Alabanda antique city, Zeus Temple, on soil, 119 m, 37°35’43.1″N, 27°57’21.7″E, 23.02.2013, Özenoğlu TR/159; Yenipazar, 8 km to Yenipazar, Alanli village, on soil, 49 m, 37°48’15.6″N, 28°06’01.6″E, 23.03.2013, Özenoğlu TR/214; Nazilli, Sinekçiler village, in a small streambed, on wet soil, 800 m, 37°59’26.4″N, 28°16’03.9″E, 07.04.2013, Özenoğlu TR/252; Söke, Sazlıköy, olive plantation, on soil, 57 m, 37°46’18.4″N, 27°25’32.4″E, 26.03.2013, Özenoğlu TR/256; Çanakkale, Gülpinar, volcanic area, on wet soil, 181 m, 39°31’04.1″N, 26°07’47.4″E, 28.01.2013, Özenoğlu TR/131; İstanbul, Kuyüköy, near the race track, on soil, 50 m, 40°52’45.2″N, 29°17’53.4″E, 31.01.2015, Özenoğlu TR/340; Catalca, Subaşı, Kabakça-Akören turnout, oak forest, 120 m, 41°14’59.5″N, 28°22’16.01″E, 01.02.2015, Özenoğlu TR/343; İzmir, Yamanlar, in rock cavities, on wet soil, 250 m, 15.04.1970, 688/70 B6; Ödemiş-Köşk road, near the roadside, on soil, 405 m, 38°06’56.8″N, 27°57’57.2″E, 26.06.2012, Özenoğlu TR/22; Muğla, Gümüş, on wet soil, 04.04.1970, 688/70 C11; Akyaka, Akyaka-Ören road, Gökbey village, in olive plantation, on soil, 309 m, 37°02’08.0″N, 27°44’41.8″E, 03.03.2013, Özenoğlu TR/192; Köyceğiz, 10 km to Köyceğiz, Liquidambar orientalis plantation, 31 m, 36°59’28.4″N, 28°38’03.4″E, 18.05.2013, Özenoğlu TR/283.

Distribution: Riccia bicarinata is recorded from Albania, Algeria, Baleares, Bosnia-Herzegovina, Canary Islands, Corsica, Crete, Croatia, Cyprus, France, Greece, Israel, Italy, Malta, Montenegro, Morocco, Portugal, Sardinia, Sicilia, Slovenia, Spain, Syria, Tunisia, and Turkey in the Mediterranean Region and Southwest Asia.
4. *Riccia bifurca* Hoffm. 1795, Deutschl. Fl. 2: 95 (Figures 1D, 2D1, 2D2; Appendix Figure 4)

**Syn.:** *Riccia arvensis* Aust. 1870, Proc. Acad. Nat. Sci. Philadelphia 21: 232; *R. pusilla* Warnst. 1895, Verb. Bot Vereins Prov. Brandenburg 37: 50; *R. minutissima* Stephe. 1898, Spec. Hep. 1: 30; *R. subcrispula* Warnst. 1902, Kryptog. Fl. Mark Brandenburg 1: 76.

**Turkish name:** Ayrık catalcık.

**Holotype:** Germany, in terra limosa, wet (MW) (Herb. Hoffmann).

Plants forming more or less complete rosettes of 1.5–1.8 cm in diameter, thallus light green, brown on sides, yellowish-orange to base (Figure 1D); thalli 1–3(–4) furcate, ultimate branches 1–1.5 mm wide, oblong, rounded apically; median groove narrow at apex of lobes, flat in midlobes, widening to about 1/4 branch width; lateral edges rounded-subacute; cilia 220–250(–300) µm long, in the upper part of lobes, papillate in upper 1/3; ventral scale cells 300–450 µm long; sporogonium common; spores (70–)75–85 µm, dark yellowish-brown, distal face 6–8 alveoli across diameter, sometimes these cells spread to dorsal sides of thalli; ventral scale cells 45–55 µm wide (Appendix Figure 4). Monoicous. Archegonial epidermal cells (42–)45–48 µm wide, parenchymal cells (35–)40–50 µm wide, contains orange-brown idioblast cells in sides of thalli, part of lobes, papillate in upper 1/3; ventral scales whitish or tinged with purple-orange colors. Thallus sections (2–)3–4 times as wide; lobe margins with orange-brown can be distinguished from other members of the subgenus *Riccia* by rounded thallus margins with orange-brown regions of the thalli that become canaliculated with age.

**Specimens examined:** Antalya, Kemer-Kumluca road, Ulupınar village, near the roadside, on wet soil, 250 m, 36°27′640″N, 30°26′32″E, 20.03.2004, Özenoğlu C12/46-036; Aydun, Nazilli, Dereage village, on soil near a streambed, 15.11.1998, Özenoğlu C11/88; Kösök-Ödemiş road, Kuyucular village, near the roadside, on soil, 90 m, 37°53′12.7″N, 28°01′59.2″E, 26.02.2012, Özenoğlu TR/3; Ortağlar, in the valley, in a small streambed, on wet soil, 190 m, 37°53′18.8″N, 27°27′21.2″E, 13.04.2012, Özenoğlu TR/55; Nazilli, Mastaura antique city, olive plantations, on soil, 194 m, 37°57′04.3″N, 28°20′32.8″E, 30.12.2012, Özenoğlu TR/75; Çanakkale, between Biga-Lapseki, 35 km to Lapseki, *Pinus brutia* L., and *Quercus coccifera* plantations. Accompanying species are *Bryum argenteum* Hedw., *Ptychostomum imbricatum*, *C. coriandrina* (Spreng.) Lindenh., *Entosthodon sp.*, *Fossombronia pusilla* (L.) Nees, *F. caespitiformis* De Not. ex Rabenh., *Lunularia cruciata*, *Oxymitra incrassata*, *Petalophyllum ralfsii* (Wils.) Nees & Gottsche, *Tortella squarrosa* (Brid.) Limpr., *Pseudocrossidium hornhuchianum*, *Riccia beyrihichiana*, *R. bicarinata*, *R. glauca*, *R. sorocarpa*, and *R. subbifurca*.

*Riccia bifurca* can be distinguished from other members of the subgenus *Riccia* by rounded thallus margins with orange-brown regions of the thalli that become canaliculated with age.

**Distribution:** *Riccia bifurca* is recorded from Afghanistan, Albania, Algeria, Armenia, Austria, Azores, Baleares, Belgium, Canary Islands, Czech Republic, Corsica, Crete, Croatia, Denmark, England, Estonia, Finland, France, Germany, Greece, the Netherlands, Hungary, Iceland, Italy, Iran, Ireland, Latvia, Lebanon, Lithuania, Luxembourg, Macedonia, Madeira, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Sicilia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.
Appendix Figure 4. Riccia bifurca: 1- thalli; 2–4- cross-sections of lobe; 5- cross-section with archegonial necks; 6- cells in sides of thalli; 7- ventral scale cells; 8- capsule with spores. ar, Archegonia; arb, archegonial neck; dp, parenchyma; ft, chlorenchyma; r, rhizoid.

5. Riccia canaliculata Hoffm. 1795, Deutsch. Fl. 2: 96 (Figure 1E; Appendix Figure 5)

Syn.: Riccia teneriffae S. W. Arnell.; R. nodosa Boucher ex DC. 1805, Lamarck et De Candolle Fl. Franç. éd. 3, 2: 416, n° 1124; R. eudichotoma b canaliculata Bisch. 1835, Nova Acda Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 17, 2: 1069; Ricciella heyeri Hüb. ex Genth 1836, Fl. Herzogth. Nassau 1, 1: 66.

Turkish name: Oluklu çatalcık.

Holotype: Germany «ad terram humidam in fossis» N’existe plus dans l’Herb. Hoffmann (MW).

Plants forming more or less complete rosettes or crowded mats, thallus light green, green on sides, becoming yellowish-brown with age (Figure 1E); thalli 2–4 furcate, ultimate branches 0.8–1 mm wide, lingulate, rounded or subacute apically; dorsal surface of thallus contains pores but areolate areas only appearing towards sides and apex; median groove narrow, widening to about 1/3 branch width, fairly deep at apex but soon becoming obscure; lateral edges rounded; ventral scales distinct, hyaline, covered lobe apical and margins, and extending beyond lobe margins; rhizoids more numerous on lobe base. Thallus sections of lobes 240–320 µm high and 2–2.5(–3) times as wide, chlorenchyma about 1/2 thallus height with 1–2(–3) layers of air-chambers layer, parenchyma open 5–7 cells high; ventral scale cells (17–)21 × 55(–80) µm (Appendix Figure 5). Monoicous. Plant often fertile. The material collected in Turkey was without...
spores. Mature capsules more conspicuous on ventral side of lobes, spores 70–100 µm, yellowish with tinged reddish ornamentation, all surfaces obscurely papillate, distal face with 3–6 alveoli across diameter, proximal faces with irregular lamellae, occasionally forming incomplete alveoli, wing 4–10 µm wide, minutely crenulate (Paton, 1999; Frey et al, 2006).

*Riccia canaliculata* is found in subalpine vegetation. The species was growing on very moist mud in the grassland area. Accompanying species were *Aneura pinguis* (L.) Dumort., *Palustriella falcata* (Brid.) Hedenäs, *Bryum pseudotriquetrum* (Hedw.) J.R.Spence & H.P.Ramsay, *Calliergonella cuspidata* (Hedw.) Loeske, and *Ceratodon purpureus* (Hedw.) Brid.

*Riccia canaliculata* can be distinguished from other members of the subgenus *Ricciella* by the narrow chambered thalli with the apex of the branches distinctly narrowed and covered by the apical ventral scale.

**Specimens examined:** Konya, Hadim, Beyreli Plateau, in grassland, 1956 m, 36°52′06.1″N, 32°25′29.1″E, 21.04.2013, Özenoğlu TR/279 (ADÖ 118).

**Distribution:** *Riccia canaliculata* was given by Jovet-Ast (1986) from West Anatolia without locality details. It was recorded for the second time from Konya, Hadim, Beyreli Plateau (1956 m) by Özenoğlu Kiremit et al. (2014).

*Riccia canaliculata* is recorded from Algeria, Austria, Belarus, Belgium, Canary Islands, Corsica, Crete, Czech Republic, Denmark, England, Finland, France, Greece, Germany, the Netherlands, Hungary, Ireland, Israel, Italy, Lithuania, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Slovakia, Spain, Sweden, Switzerland, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.
6. **Riccia cavernosa** Hoffm. emend Raddi 1818, in Opuscoli Scientifici di Bologna 2: 351–353 (Figures 1F, 2E1, 2E2; Appendix Figure 6)

**Syn.**: *Riccia crystallina* auct. pro parte non L.; *R. mimoriformis* Hoffm. 1776, Deutsch. Fl. 2: 95; *R. cavernosa* Hoffm. 1796, Deutsch. Fl. 2: 95; *R. crystallina* β Lindenb. 1836, Nova Acta, Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 18: 437; *R. crystallina* var. *angustior* Nees 1838, Natugesch. Eur. Leberm. 4: 430; *R. multilamellata* Steph. 1889, Hedwigia, 28: 273; *R. bahiensis* Steph. 1898, Spec. Hep. 1: 50; *R. montagnéi* Steph. 1898, Spec. Hep. 1: 44; *R. rautanenii* Steph. 1898, Spec. Hep. 1: 53; *R. tellinii* Gola.1914, Ann. Bot. (Roma) 13: 60; *R. terracianoi* Gola. 1914, Ann. Bot. (Roma) 13: 61; *Ricciella rautanenii* Steph.1895 in Bulletin Herbier Boisser 3: 374; *Ricciella huebeneriana* var. *cavernosa* (Hoffm.) Caseres-Gil 1919, Fl. Iberica, Briofitas, part. 1 Hepaticas: 233.

**Turkish name**: Delikli çatalcık.

**Holotype**: Germany, in terra limosa, ad piscinas. Herb. Hoffmann. Manque a MW.

Plants in large rosettes, thallus light green frequently with pink or light violet spots, whitish-green to base (Figure 1F); thalli 2–4 furcate, ultimate branches to 2 mm, oblong, rounded to emarginate apically; thallus with irregular perforations on the dorsal surface, especially distinct on thallus base; median groove and ventral scales absent; lateral edges thick and rounded. Thallus sections of lobes 3–5 times wider than high, spongy, chlorenchyma with one air-chamber layer; parenchyma green (Appendix Figure 6). Monoicous. Sporogonium common, mature capsules not conspicuous any side of lobes and open on dorsal side of lobes; spores (65–)75–85 µm, reddish to brownish, distal face with irregularly delimited alveoli with thick wall provided at wall corners with small tubercles (Figure 2E1), proximal faces with similar ornamentation (Figure 2E2), wing 3–6 µm wide, regularly crenulate, distal face with irregular ridges.

*Riccia cavernosa* has been found on wet soils in river banks, in *Populus alba* L., *Rubus* sp., and *Salix* sp. plantations. The species was growing on wet soil and sandy rock ledges in the lowlands (Özenoğlu Kiremit et al., 2016).

*Riccia cavernosa* can be distinguished from other members of the subgenus *Ricciella* by the irregular perforations on dorsal side. *R. crystallina* is a similar species to *R. cavernosa*, but *R. cavernosa* differs from *R. crystallina* as the thalli dorsal surface is strongly alveolate and spore distal face with imperfect areolation. In *R. crystallina*, the thalli dorsal surface is alveolate only with age and spore distal face regularly areolate.

**Specimens examined**: Sinop, Boyabat, Ilıca village, Gökırmak streambed, on wet soil, 300 m, 41°32′47.17″N, 34°42′21.19″E, 10.08.2013, AYDN 3456.

**Distribution**: *Riccia cavernosa* is widely distributed in warmer regions of all continents (Jovet-Ast, 1986). It occurs in various parts of the world with the exception of the high Arctic and Antarctic (Borovichev and Bakalin, 2016).

*Riccia cavernosa* is recorded from Algeria, Austria, Baleares, Belarus, Belgium, Canary Islands, Croatia, Czech Republic, Denmark, Egypt, England, Estonia, Finland, France, Germany, the Netherlands, Hungary, Iceland, Iran, Ireland, Italy, Israel, Libya, Lithuania, Luxemburg, Malta, Montenegro, Morocco, Madeira, Norway, Poland, Portugal, Romania, Russia, Sardinia, Saudi Arabia, Sicilia, Sinai Peninsula, Spain, Slovakia, Sweden, Switzerland, Tunisia, Turkey, Ukraine, and Yemen in the Mediterranean Region, Europe, and Southwest Asia.
Appendix Figure 6. *Riccia cavernosa*: 1- thalli; 2–3- cross-section of thalli with air chambers; 4- cross-section of thalli with irregular perforations on the dorsal surface; 5–6- cells in sides of thalli; 7- capsule and spores. e, Epidermal cells; ho, air chamber; k, capsule; s, spore.

7. *Riccia ciliata* Hoffm. 1795, Deutsch. Fl. 2: 95 (Figures 1G, 2F1, 2F2; Appendix Figure 7)

Syn.: *Riccia affinis* Milde 1864, Bot. Zeitung (Berlin) 22 (Beilage): 17; *R. bischoffii* var. *subtumida* Milde 1864, Bot. Zeitung (Berlin) 22 (Beilage): 17; *R. subtumida* Milde 1864, Bot. Zeitung (Berlin) 22: 192; *R. spinosissima* Steph. 1885, Hedwigia 24: 2.

Turkish name: Kısatıylılı çatalcık.

Holotype: Germany, in terra limosa, agris post messem. (MW, Herb. Hoffmann) Pl. 34, 35.

Plants forming incomplete rosettes, thallus light green, lateral sides and base of lobes green (Figure 1G); thalli 2–3 furcate, ultimate branches to 1 mm wide, oblong, rounded apically; median groove absent; lateral edges rounded; cilia 380–500 µm long, smooth or papillate in upper 2/3, most abundant in the upper part, rolled up when dry; ventral scales hyaline. Thallus sections of lobes 1.5–2 times wider than high (Appendix Figure 7). Monoicous. Spores 85–96 µm, brownish, distal face 7–9 alveoli across diameter (Figure 2F1), proximal faces with complete alveoli, smaller than those of distal face (Figure 2F2), wing 3–5 µm wide, smooth.
Riccia ciliata was growing on soil in streambeds and soil in olive plantations. Accompanying species were Fossombronia angulosa, Lunularia cruciata, Oxymitra incrassata, Riccia bicarinata, R. sorocarpa, R. nigrella, R. subbifurca, Sphaerocarpos texanus, and Targionia hypophylla.

Riccia ciliata can be distinguished from other members of subgenus Riccia by numerous cilia, but the cilia are numerous and as long as in R. crinita.

Specimens examined: Antalya, Çıralı, Yanartaş (Cimera), near the roadside, on soil, 28 m, 36°25′77.9″N, 30°27′73.9″E, 16.11.2003, Özenoğlu C12/44-034; Aydın, İncirliova, Erbeyli, Kızılçagedik village, olive plantation, on soil, 216 m, 37°53′26.5″N, 27°38′51.3″E, 16.03.2013, Özenoğlu TR/199; Nazilli, Sineçüiler village, in a small streambed, on wet soil, 800 m, 37°59′26.4″N, 28°16′03.9″E, 07.04.2013, Özenoğlu TR/253; İzmir, Yamanlar, in rock cavities, on wet soil, 250 m, 15.04.1970, 116/1970.

Distribution: Riccia ciliata is recorded from Albania, Algeria, Austria, Azores, Baleares, Belarus, Belgium, Bulgaria, Canary Islands, Caucasus, Corsica, Crete, Croatia, Czech Republic, Denmark, England, Estonia, Finland, the Netherlands, Hungary, Iceland, Ireland, Spain, France, Germany, Greece, Iran, Israel, Italy, Latvia, Libya, Lithuania, Macedonia, Madeira, Montenegro, Morocco, Norway, Oman, Poland, Portugal, Romania, Russia, Sardinia, Sicilia, Slovenia, Slovakia, Sweden, Switzerland, Tunisia, Turkey, Ukraine, and Yemen in the Mediterranean Region, Europe, and Southwest Asia.

Appendix Figure 7. Riccia ciliata: 1- thalli; 2–3- cross-sections of thalli; 4- cross-section of thalli with capsule; 5- archegonial neck and epidermal cells; 6- cross-section of apical thalli. arb, Archegonial neck; c, cilia; dp, parenchyma; e, epidermal cells; ft, chlorenchyma; k, capsule; r, rhizoid; s, spore.
8. **Riccia ciliifera** Link 1829, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 14: 119 (Figure 1H; Appendix Figure 8)

**Syn.:** Riccia bischhoffii Huebener, Ann. Pharm. 7: 68, 1833, Hepaticol. Germ: 29; R. bischhoffii var. Fimbriata Gottsche Lindenb. et Nees 1847, Syn HEP.: 793; R. pedomontana Steph. 1883, Hedwigia 22: 51; R. bischhoffii f. montana Steph. 1898, Spec. HEP. 1: 8; R. bischhoffii var. ciliifera (Link ex Lindenb.) Müll. Frib. 1907, Rabenhorst Kryptog Fl. Ed. 2, 6, 1: 159; R. latzeli Schiffn. 1916 Verb K. K. Zool.-Bot. Ges. Wien 66: 188.

Turkish name: Kılli çatalcık.

**Holotype:** Portugal, leg. Link (? Tras os Montes, en Fradizella, Link) (W).

Plants forming complete or incomplete rosettes, thallus bluish green, tinged with dark purple or violet on sides, male thallus lateral sides darker purple, yellowish-violet to base (Figure 1H); thallus 1–2 furcate, female thalli of ultimate branches (1.5–)1.7–2.2 mm wide, male thalli of ultimate branches 1–1.2 mm wide, lobes cordate, wider at apex; median groove narrow, widening to about 1/4 branch width; lateral edges acute; ventral of thallus tinged with pink-purple; cilia numerous in upper part of lobes only, 350–500(–550) µm long; ventral scales tinged with hyaline-purple, imbricate, visible laterally. Thallus sections of lobes with very well-developed and horizontal wings, 1–1.2 mm high and 1.3–1.5 times as wide, parenchyma hyaline-grayish; ventral scale cells 25–35 × (55) 70–95 µm (Appendix Figure 8). Dioicous and heterothallic. The material collected in Turkey was lacking sporogonium. Spores 110–180 µm, dark brown (Kürschner and Frey, 2011), distal and proximal faces with 6–8 alveoli across diameter (Kürschner and Frey, 2011), wing 5–7 µm wide (Casas et al., 2009).

*Riccia ciliifera* was growing on volcanic tuff fall near the lake and on wet soil in streambeds. *Verbascum* sp. was very common in the habitat. Accompanying species were *Oxymitra incrassata* and *R. michelii*.

*Riccia ciliifera* can be distinguished from other members of the subgenus *Riccia* by wide thallus and violet-purple thalli margins, but the *R. ciliifera* spore and ventral scale cells are smaller than in *R. gougetiana*.

**Specimens examined:** İzmir, Yamanlar, on wet soil in *Sarcopoterium spinosum* (L.) Spach scrub, 250 m, 15.04.1970, 688/70 B; Manisa, Salihli, Sindel village, on volcanic tuff, 289 m, 38°38′46.7″N, 28°18′57.4″E, 06.04.2013, Özenoğlu TR/237, TR/238; Salihli, Sindel village, in grassland, in a small streambed, on wet soil, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/247.

**Distribution:** *Riccia ciliifera* was given by Bornmüller (1931) from Bursa without locality details. The species is recorded for the second time from Turkey in this study.

*R. ciliifera* is recorded from Albania, Algeria, Austria, Azores, Belgium, Bosnia-Herzegovina, Bulgaria, Canary Islands, Caucasus, Corsica, Croatia, Cyprus, Czech Republic, England, France, Germany, Greece, the Netherlands, Hungary, Ireland, Iraq, Italy, Lebanon, Luxembourg, Macedonia, Madeira, Malta, Montenegro, Morocco, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Sicilia, Slovakia, Spain, Syria, Sweden, Switzerland, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.
9. **Riccia crinita** Taylor 1846, London J. Bot. 5: 415 (Figures 1I, 2G1, 2G2; Appendix Figure 9)

**Syn.:** Riccia tumida Lindenb., 1836; *R. canescens* Steph. 1898, Spec. Hep. 1: 12; *R. trichocarpa* M. Howe 1898, Bull. Torrey Bot. Club 25: 184; *R. cana* Dur. ex Trab. 1942, Rev. Bryol. Lichenol. (Melenges) 12: 15.

Turkish name: Sakallı çatalcık.

**Holotype:** San Mateo Co. Calif. April 1892, Dr. D.H. Campell (US).

Plants forming crowded mats, thallus bluish green, purple-violet on sides, yellowish-brown to base (Figure 1I); thalli 2–3 furcate, ultimate branches (0.7–)1–1.3(–1.5) mm wide, lingulate, rounded at apex; median groove narrow, widening to about 1/4 branch width, distinct almost to base; flanks slightly convex, lateral edges acute; cilia numerous, from thallus apex to base, shiny-hyaline to orange yellow, to 1 (1.2) mm long, not papillate; ventral scales violet-blackish with hyaline margins; rhizoids numerous and internally tuberculate. Thallus sections of lobes 550–650 µm high and 1.5–2 times as wide; ventral scale cells (45–)50 × 62 µm (Appendix Figure 9).

**Appendix Figure 8.** Riccia ciliifera: 1- thalli; 2–5- cross-sections of thalli; 6- epidermal cells; 7- cilia, 8- cells in sides of thalli. c, Cilia; dp, parenchyma; e, epidermal cells; ft, chlorenchyma; kp, ventral scale; l, well-developed wings; r, rhizoid.
9). Monoicous. Antheridal necks projecting; sporogonium common; spores (105–)110–120(–125) µm, pale brown to dark brown, distal face with 8–12 alveoli across diameter, limited by regular walls provided at wall corners tubercles (Figure 2G1), proximal faces with similar ornamentation but alveoli with thinner walls (Figure 2G2), wing to 2 (3) µm wide, crenulate margin.

*Riccia crinita* was found in Turkey in quite open olive tree and *Pinus brutia* plantations. The species was growing on ground, soil banks, and among rocks at road margins. Accompanying species are *Bryum* sp., *Corsinia coriandrina*, *Fossombronia pusilla*, *Lunularia cruciata*, *Mannia androgyna* (L.) A. Evans, *Oxymitra incrassata*, *Pseudocrossidium hornschuchianum*, *Reboulia hemisphaerica*, *Riccia bicarinata*, *R. crozalsii*, *R. sorocarpa*, *Southbya taphacea* (Spruce) Spruce, *Sphaerocarpus texanus*, and *Targionia hypophylla* (Özenoğlu Kiremit et al., 2016).

*Riccia crinita* can be distinguished from other members of the subgenus *Riccia* by the very long and numerous cilia at margins, on the dorsal side, and above capsule.

**Specimens examined:** *Aydın*, Yenipazar, Alanlı village, on soil and soil bank, 75 m, 37°48′15.60″N, 28°06′01.60″E, 23.03.2013, AYDN 3459; *Nazilli*, Yellice village, roadside, on soil bank, 488 m, 37°46′39.20″N, 28°23′28.60″E, 07.04.2013, AYDN 3460; * Nazilli*, Uzunçam village, roadside, on soil bank, 600 m, 37°46′57.10″N, 28°22′31.50″E, 07.04.2013, AYDN 3461; *Manisa*, Salihli, Sindel village, in grassland, in a small streambed, on wet soil and soil on the rocks, 316 m, 38°38′56.70″N, 28°18′52.60″E, 06.04.2013, AYDN 3457; *Muğla*, Milas, Heraklea ancient city, on soil in ancient city, 49 m, 37°30′10.47″N, 27°30′44.16″E, 22.02.2014, AYDN 3458.

Discovery of *R. crinita* in Turkey has completed the missing piece between Europe and the Middle East.

**Distribution:** *Riccia crinita* is recorded from Algeria, Austria, Baleares, Bosnia-Herzegovina, Canary Islands, Caucasus, Corsica, Crete, Croatia, Czech Republic, France, Germany, Greece, Hungary, Iran, Italy, Lebanon, Libya, Montenegro, Morocco, Oman, Poland, Portugal, Romania, Russia, Saudi Arabia, Serbia, Sicily, Slovakia, Socotra, Spain, Switzerland, Tunisia, Turkey, Ukraine, and Yemen in the Mediterranean Region, Europe, and Southwest Asia. Also in Cape Verde in Africa (Sérgio and Melo, 2015).

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**Appendix Figure 9.** *Riccia crinita:* 1- thalli; 2–5- cross-sections of thalli; 6- cilia; 7- capsule and spores; 8- archegonial neck. arb, Archegonial neck; c, cilia; dp, parenchyma; e, epidermal cells; ft, chlorenchyma; k, capsule; r, rhizoid; s, spore inside capsule.
10. Riccia crozalsii Levier 1902, in Rev. Bryol. & Lichen. 29: 73 (Figures 1J, 2H1, 2H2; Appendix Figure 10)

Syn.: Riccia africana Sim 1926, The Bryophyta of South Africa: 11; R. ciliata Hoffm. var. austroafricana S.W. Arnell: T. XXII, fasc. 1–2 1953; R. crozalsii var. austroafricana S.W. Arnell: 18 (1963).

Turkish name: Ege çatalcığı.

Holotype: France, Herault, prope Roquehaute (Agde), march 1902, Leg. Crozals. s.n. (?Fl), species March-May 1902, Crozals (PC).

Riccia crozalsii was growing on soil, rocky slopes, wet roots, in olive and pine (Pinus brutia) plantations. Accompanying species are Bryum sp., Cheilothela chloropus (Brid.) Broth, Corsinia coriandrina, Didymodon insulanasus (De Not.) M.O. Hill., Fossombronia angulosa, Oxymitra incrassata, Phaeoceros laevis, Pseudocrossidium hornschuchianum, Riccia michelii, R. nigrella, R. sorocarpa, R. subbifurca, and Sphaerocarpus texanus.

Riccia crozalsii can be distinguished from other members of the subgenus Riccia by the numerous cilia curving over the dorsal surface of at least the apex and purplish color of ventral thallus side.

Specimens examined: Aydın, Kuşadası, Dilek Peninsula National Park, Samsun Mountain, Şarlak, on soil, 500 m, 37°38′52.7″N, 27°09′26.3″E, 30.10.1998, Özenoğlu C11/73; Yenipazar-Bozdoğan road, Karaçakal village, on soil, 588 m, 37°47′22.2″N, 28°12′34.4″E, 23.03.2013, Özenoğlu TR/207; ADU Campus, Education Faculty, olive plantation, on soil, 155 m, 37°51′05.3″N, 27°51′14.8″E, 23.03.2013, Özenoğlu TR/221; Yenipazar, 8 km to Yenipazar, Alanlı village, near the road side, on soil, 75 m, 37°48′15.6″N, 28°06′01.6″E, 23.03.2013, Özenoğlu TR/233; Güzelçamlı, Panionion antique city, Pinus brutia and Olea europaea plantations, 45 m, 37°42′46.4″N, 27°13′57.5″E, 24.03.2013, Özenoğlu TR/263; Nazilli, Uzungol village, near the road side, on soil, 600 m, 37°46′57.1″N, 28°22′31.5″E, 07.04.2013, Özenoğlu TR/277; Balikesir, Erdek, Tuğran village, olive plantation, 11 m, 40°29′58.4″N, 27°46′34.6″E, 27.01.2013, Özenoğlu TR/113; İzmir, Incirliova-Tire road, on wet tree roots, rocks and soil near the roadside, 865 m, 38°01′51.7″N, 27°44′35.2″E, 26.02.2012, Özenoğlu TR/43; Manisa, Salihli, Sindel village, in grassland, in a small streambed, on wet soil and soil on the rocks, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013; Özenoğlu TR/244; Mersin, Oren, Karabucak, in grassland, 100 m, 36°02′31.6″N, 32°47′18.8″E, 05.03.2014; Özenoğlu TR/315; Muğla, Akyaka, Akyaka-Oren road to 3 km, Pinus brutia plantation, on soil, 35 m, 37°03′07.2″N, 28°18′09.1″E, 03.03.2013, Özenoğlu TR/186.

Distribution: Riccia crozalsii was newly recorded for the Turkish bryoflora by Gökler et al. (2000). It is recorded from Albania, Algeria, Austria, Azores, Baleares, Belgium, Bosnia-Herzegovina, Canary Islands, Crete, Corsica, Croatia, Cyprus, England, Egypt, France, Germany, Greece, the Netherlands, Hungary, Iran, Ireland, Israel, Italy, Lebanon, Luxembourg, Madeira, Malta, Montenegro, Morocco, Oman, Portugal, Sardinia, Sicilia, Spain, Syria, Switzerland, Tunisia, Turkey, United Arab Emirates, and Yemen in the Mediterranean Region, Europe, and Southwest Asia.
Appendix Figure 10. *Riccia crozalsii*: 1- thalli; 2–5- cross-sections of thalli; 6- cells in sides of thalli; 7- cells of thalli; 8- capsule and spores. arb, Archegonial neck; c, cilia; dp, parenchyma; e, epidermal cells; ft, chlorenchyma; k, capsule; kp, ventral scale; s, spore.

11. *Riccia crystallina* L. 1753 Spec. Plant.: 1138. Opusc. Sci. (Bologna) 2 (12): 351– 353 (Figures 1K, 2I1, 2I2; Appendix Figure 11)

**Syn.**: *Riccia crystallina α vulgaris* Lindenb. 1836, Nova Acda Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 18: 437; *R. plana* Tayl. 1846, London J. Bot. 5: 414; *R. negrii* Gola 1914 (1915), Ann. Bot. (Roma) 13: 60; *R. crystallina subsp. austrigera* Schiffn. 1916, Österr. Bot. Z. 10–12: 341.

**Turkish name**: Parlak çatalcık.

**Holotype**: A very small species, Dillenius Herbarium, Isoviita (1970) (H-SOL).

Plants forming rosettes of 6–10 mm in diameter, thallus glaucous or blue-green, crystalline when moist (Figure 1K); thalli 2–3 furcate, ultimate branches 2–3.5(–4.5) mm wide, broad, truncate or rounded apically, lobe width increases towards the apex; dorsal epidermis without pores in the young parts, perforate in median parts; these perforates not conspicuous as in *Riccia cavernosa*; median groove and ventral scales absent; rhizoids numerous. Thallus sections of lobes 3–5 times wider than high, chlorenchyma with numerous air chambers, compact parenchyma below, chlorenchyma 400–450 µm high, parenchyma 120–180 µm high (Appendix Figure 11). Monoicous. Antheridial necks projecting, archegonial necks not or little projecting; sporogonium common, mature capsules 550–600 × 720–760 µm, more conspicuous on ventral than on dorsal side of lobes. Spores (60–)65–75 µm, light yellow-brown, distal face with 8–10 alveoli across diameter, limited by regular walls provided at wall corners with obtuse and bifid tubercles (Figure 2I1), proximal faces with similar ornamentation (Figure 2I2), wing 4–6 µm wide, finely crenulate margin.
*Riccia crystallina* grows on soil in open areas and was collected from olive grove, citrus garden, and antique city areas with anthropogenic pressure. Especially accompanying species is *Sphaerocarpos texanus*.

*Riccia crystallina* can be distinguished from other members of the subgenus *Ricciella* by glaucous-bluish green color, forming large thinly-shaped and flat rosettes, crystalline dorsal side with small perforation mainly in old parts.

**Specimens examined:** Aydın, Nazilli, on soil in garden, 80 m, 07.02.1999, Özenoğlu C11/110; Söke, Sazlıköy, olive plantation, on soil, 57 m, 37°46′18.4″N, 27°25′32.4″E, 26.03.2013, Özenoğlu TR/211, TR/258; ADU Campus, Science Faculty, on soil under the olive trees, 184 m, 37°51′20.3″N, 27°51′13.8″E, 25.03.2013, Özenoğlu TR/213; Nazilli, Hamzallı village, on soil under the orange trees, 81 m, 37°54′11.4″N, 28°25′24.4″E, Özenoğlu TR/286; Balıkesir, Erdek, Narlı, on soil, 10 m, 40°28′42.2″N, 27°41′20.0″E, 27.01.2013, Özenoğlu TR/107; Mersin, Anamur, Emirşah village, *Eucalyptus* plantation, on soil, 40 m, 36°04′54″N, 32°47′28.7″E, 03.03.2014, Özenoğlu TR/295; Muğla, Datça, Knidos antique city, on soil, 10 m, 36°41′09.3″N, 27°22′24.8″E, 02.03.2013, Özenoğlu TR/176.

**Distribution:** *Riccia crystallina* is recorded from Albania, Algeria, Austria, Azores, Baleares, Bulgaria, Canary Islands, Crete, Croatia, Czech Republic, Denmark, Egypt, England, Finland, France, Germany, Greece, the Netherlands, Hungary, Iraq, Iran, Israel, Italy, Latvia, Lebanon, Libya, Lithuania, Madeira, Malta, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Sicilia, Scotland, Slovenia, Spain, Sweden, Switzerland, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.

**Appendix Figure 11.** *Riccia crystallina*: 1- thalli; 2–5- cross-sections of thalli; 6- air chambers; 7- archegonial neck and epidermal cells. arb, Archegonial neck; ho, air chambers; k, capsule; r, rhizoid; e, epidermal cells; s, spore.
12. *Riccia fluitans* L. 1753, Spec. Plant: 1139 (Figure 1L; Appendix Figure 12)

**Syn.:** *Ricciella fluitans* (L.) A. Braun 1821, Flora n.s. 4: 757; *Riccia eudichotoma a fluitans* Bisch. 1835, Nova Acta Phys.-Med.-Acad. Caes. Leop.-Carol. Nat. Cur. 17, 2: 1068; *R. centrifuga* Arnell 1877, Rev. Bryol. 4: 34; *R. media* Klingmüller 1958, Flora 146: 622.

Turkish name: Yüzer çatalcık.

**Holotype:** «Scania» Fide Isovita (1970). (H-SOL).

Plants aquatic or terrestrial, aquatic form usually forming crowded mats, terrestrial form usually forming more or less rosettes, thallus light yellowish-green, yellowish-brown at base, becoming pale brown-red brown with age (Figure 1L); thalli more than 4 furcate, aquatic thalli with ultimate branches 0.5–1 mm wide, terrestrial thalli with ultimate branches up to 1.5 wide, oblong to linear, thin rounded apically; dorsal epidermis divided areolate areas with pores at center; median groove absent or only narrow at apex; lateral edges subacute; ventral scales white-hyaline, sometimes tinged, not covering lobe apex; rhizoids absent on floating thalli. Thallus sections of lobes 4–6 times wider than high, chlorenchyma with 1–2 air-chamber layers; epidermal cells with chloroplast, parenchymal cells 12–20 × 30–45 µm to thalli sides; ventral scale cells to 45 µm long (Appendix Figure 12). Dioicous. The material collected in Turkey was notably without antheridia, archegonia, and sporogonium. Sporogonium rare (Paton, 1999). Spores 56–75 µm, yellowish red with reddish brown ornamentation, distal face with 5–7 incomplete alveoli, proximal faces with irregular lamellae occasionally forming incomplete alveoli, wing 4–7 µm wide, minutely crenulate margin (Paton, 1999).

In Turkey, the aquatic form of *Riccia fluitans* is only known from İzmir, Selçuk, Kazangöl. Kazangöl is a brackish water lake (Cl = 1.179 mg mL⁻¹, Na⁺ = 1540 mg L⁻¹, 88 mg CaCO₃ 100 mL⁻¹ water) (Aysel et al., 1998). Plant locality has a very narrow water basin and is under anthropogenic pressure. Compared to previous years, there is a marked reduction in *R. fluitans* population. Possible reason for this decrease in the lake is that the water comes from areas with heavy human exploitation, thus exposed to pollutants. Terrestrial form was collected on soil in a small streambed in *Pinus brutia* plantation. Accompanying species of terrestrial form are *Lunularia cruciata*, *Reboulia hemisphaerica*, *Targionia hypophylla*, *Timmiella barbuloides* (Brid.) Mönk., *Didymodon insulanus*, *Didymodon acutus* (Brid.) K. Saito, and *Bryum* sp. (Özenoğlu Kiremit and Kırmacı, 2012).

Terrestrial form of *Riccia fluitans* can be distinguished from other members of the subgenus *Ricciella* as the dorsal surface of dry plants is generally plane in *R. fluitans*, unlike the dry thalli of *R. canaliculata*, which are canaliculated with branch apices covered by ventral scales. *R. perennis* thalli are wider than in this species, with stalked terminal tubercules, which are for vegetative reproduction and not found in *R. fluitans*.

**Specimens examined:** Aydın, Koçarlı, Mersinbelen, *Pinus brutia* forest, in a small streambed, on soil, 800 m, 37°41′35″N, 27°41′23″E, 05.01.2015, Özenoğlu TR/375 (AYDN 2893) (terrestrial form); İzmir, Selçuk, Zeytinköy, Kazan Lake, on the surface of the lake, 5 m, 37°59′12.5″N, 27°16′31.7″E, Gökler and Aysel, 01.04.1998 (EGE 19099) (Gökler and Aysel, 1998), 16.03.2013, Özenoğlu TR/371 (aquatic form).

**Distribution:** *Riccia fluitans* is recorded from Afghanistan, Algeria, Armenia, Austria, Azores, Baleares, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Canary Islands, Corsica, Crete, Croatia, Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Greece, the Netherlands, Hungary, Iceland, Iran, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Macedonia, Madeira, Montenegro, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Sicilia, Slovenia, Spain, Sweden, Switzerland, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia. The species has a subcosmopolitan distribution.
13. *Riccia frostii* Austin, 1875 Bull. Torrey Bot. Cl. 6: 17

**Syn.:** *Riccia watsonii* Aust. 1875, Bull. Torrey Bot. Club 6: 17; *R. microspora* Steph. 1898, Spec. Hep. 1: 43; *R. beckeriana* Steph. 1898, Spec. Hep. 1: 49; *R. sanguinea* Kash. 1916, J. Bombay Nat. Hist. Soc. 24: 349; *R. palaestina* S. W. Arnell, 1957, Bull. Res. Counc. Israel, Sect. D, 6: 56.

**Turkish name:** Gök çatalcık.

**Holotype:** Etats-Unis, Nevada, leg. S. Watson, comm. Frost (NY).

Female plants forming rosettes up to 8 mm in diameter, female thallus blue-green with pink spots on borders, 2–4 times larger than male thallus; male thallus often found near female, tinged with pink on borders or on the whole of dorsal side; thalli 2–4 furcate, ultimate female branches 0.5–2.5(–3) mm wide, male branches 0.3–1.2 mm wide, lobes rounded or truncate, faintly incised apically; dorsal surface of thallus crystalline, perforations small in younger parts, wide open in older; median groove very short or absent; ventral scales absent. Thallus sections of lobes 1.5–3 times wider than high, chlorenchyma with one to two layers of air chambers, compact and consisting of large cells. Dioicus. The material collected in Turkey was not devoid of spores. Spores 40–60 µm, yellow-brown, distal face vermiculate; proximal faces less vermiculate, wing 2 µm wide, crenulate margin (Heyn and Herrnstadt, 2004).

*Riccia frostii* grows on soil in open areas with *Sphaerocarpos texanus*.

It can be distinguished from other members of the subgenus *Ricciella*, especially *R. crystallina*, by the difference in size between male and female thalli and spores with distal face vermiculate, not alveolate.

**Specimens examined:** Aydin; Orta neighborhood, on soil, 57 m, 37°50′50.4″N, 27°51′20.4″E, 17.04.2013, Özenoğlu TR/268.

**Distribution:** *Riccia frostii* is recorded from Algeria, Arabian Peninsula, Austria, Bulgaria, Croatia, Egypt, the Netherlands, Hungary, Iraq, Iran, Israel, Italy, Morocco, Romania, Russia, Serbia, Sinai, Spain, Syria, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.

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**Appendix Figure 12. Riccia fluitans: 1- thalli; 2–3- cross-sections of thalli. ho, Air chambers.**
14. Riccia glauca L. 1753, Spec. Plant.: 1139 (Figures 1M, 2J1, 2J2; Appendix Figure 13)

**Syn.:** Riccia major Roth 1798, Arch. Bot. (Leipzig) 1,3: 52; R. venosa Roth 1800, Tentamen Fl. Germ. 3: 433; R. glauca-major (Roth) Lindenb. 1836, Nova Acta Phys.-Med. Acad. Caes. Leop.-carol. Nat. Cur. 18 (1): 418; R. ruppinensis Warnst. 1902, Kryptog. Fl. Mark Brandenburg 1: 71; R. glauca var. major Lindenb.; R. glauca var. minor Lindenb.

**Turkish name:** Çatalcık.

**Syntype:** Habitat in Anglia. Italy. Gallia. H-SOL: fragments, fide Isoviita 1970.

Plants usually forming more or less rosettes up to 5–7(–9) cm in diameter, thallus dull-bluish green (Figure 1M); thalli 2–3 furcate, ultimate branches (1.2–)1.5–2.5 mm wide, (2.5–)3–5(–6) mm long, obovate or shortly oblong, rounded-subacute at apex; median groove narrow at apex, widening to about 1/4 branch width, distinct almost to base; ventral scales hyaline; rhizoids numerous and internally tuberculate or not. Thallus sections of lobes 700–850 µm high and 3–4 times as wide; chlorenchyma 350–450 µm high, parenchyma 300–350 µm high, subepidermal cells walls hyaline and not thickened, epidermal cells 65–85 × 70–90 µm, subepidermal cells 30–35 × 45–50 µm, parenchyma cells 65–70 × 75–85 µm, ventral scale cells 35–45 × 75–95 µm (Appendix Figure 13).

Monoicous. Spores 75–90 µm, yellowish to dark brown, distal face with 7–9 alveoli across diameter, lamellae rather thin with papillae (Figure 2J1), proximal faces similarly ornamented but alveoli and tubercles smaller (Figure 2J2), wing 5–7 µm wide, margin smooth.

**Riccia glauca** var. **ciliaris** Warnst. 1901, Krypt. Fl. Brandenburg 1: 70.

**Turkish Name:** Kıt çatalcık.

Margin of lobes with short, 110–220 µm long, sparse cilia. Cilia numerous at the apex, scattered to sporogonial part of thalli, smooth.

**Riccia glauca** grows on soil in arable fields, roadside, and open areas. It was usually collected in olive plantations with vascular plants found in some locations such as *Malva sylvestris* L., *Erodium* L. sp., *Geranium* L. sp. Accompanying bryophyte species are *Bryum* sp., *Fossombronia pusilla*, *Lunularia cruciata*, *Riccia sorocarpa*, *R. subbifurca*, and *Sphaerocarpos texanus*.

**Riccia glauca** can be distinguished from other members of the subgenus **Riccia** by flat thallus, which is thin at the apex and margins. **R. sorocarpa** differs from **R. glauca** in the longer median groove, the discontinuous row of marginal cells, and thick-walled subepidermal cells. **R. subbifurca** differs from **R. glauca** in the narrower and thicker thalli with more conspicuously tumid, unequal lateral ridges.

**Specimens examined:** **Antalya;** Kemer, Olympos antique city, on soil between ruins, 8 m, 36°23′70.5″N, 30°28′32.2″E, 15.11.2003, Özenoğlu C12/32-029; Çıralı, 50–60 m to beach, on soil, 4 m, 36°25′34.2″N, 30°2′97.9″E, 20.03.2004, Özenoğlu C12/51-040; **Aydın,** Söke, Samsun Mountain, on soil, 15 m, 1979, C11; Nazilli, Mastaura antique city, on soil, 100 m, 02.04.1999, Özenoğlu C11/113; **Çine,** Alabanda antique city, Apollon Temple, on soil, 87 m, 37°35′55.5″N, 27°57′27.8″E, 23.02.2013, Özenoğlu TR/226; **Denizli,** Babadağ, on soil in streambed, 1300 m, 17.04.1986, Gökler 705/108; **İzmir,** 12th km of the Menemen-Manisa road, near the streambed, on soil under the oak, 188 m, 38°35′55.5″N, 27°07′38.4″E, 21.03.1998, Özenoğlu B6/47.

**Distribution:** Riccia glauca is recorded from Albania, Algeria, Austria, Azores, Baleares, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Canary Islands, Caucasus, Corsica, Crete, Croatia, Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Greece, the Netherlands, Hungary, Iceland, Iran, Ireland, Israel, Italy, Latvia, Lebanon, Lithuania, Luxembourg, Madeira, Malta, Moldova, Montenegro, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Serbia, Sicilia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.

**R. glauca** var. **ciliaris** Warnst. is only recorded from Turkey in Southwest Asia.
Riccia gougetiana Durieu & Mont. 1849, Ann. Sci. Nat. Bot. ser. 3, 11: 35 (Figures 1N, 2K1, 2K2; Appendix Figure 14)
Syn.: Riccia zachariae Lorb. ex Müll. Frib. 1941, Hedwigia 80: 102.
Turkish name: Koca çatalcık.

Holotype: Algerie, circa Blida, leg. Gouget (PC).

Plants gregarious, rarely forming rosettes; thallus light green, brown-yellowish on sides and in older parts (Figure 1N); thalli 1–2 furcate, ultimate branches to 6 (6.5) mm wide, male branches smaller (1.5–2.5 mm wide), oval-rounded and sometimes strongly thickened apically; lobes thick in median part, expanded into two thin lateral wings; median groove narrow at top, broad at base, widening to about 1/4 branch width; lateral edges rounded-subacute or retuse; margins often with numerous cilia at apex, cilia single, 150–350(–500) µm long; ventral scales hyaline to female thallus, tinged with red-purple to male thallus, scarcely reaching thallus margins; rhizoids numerous and internally tuberculate. Thallus sections of lobes 1.5–3 times wider than high, containing orange idioblast cells; epidermal cells (35–)40–50 × 55–75 µm., parenchyma cells 28–40 × 34–42 µm., ventral scale cells 40–50 × 80–110(–160) µm in female thalli, 28–35 × 50–75 µm in male thalli (Appendix Figure 14). Dioicous and heterothallic, female thallus larger than male thallus. Antheridial necks 230–380 µm long, archegonial necks purplish and 250–350 µm long, spores 150–184(–200) µm, dark brown, distal face 10–12 alveoli across diameter, limited by incomplete walls (Figure 2K1), proximal faces with incomplete alveoli (Figure 2K2), wing 9–12 µm wide, crenulate margin.

Appendix Figure 13. Riccia glauca: 1- thalli; 2–4- cross-sections of thalli; 5- epidermal cells. ft, Chlorenchyma; dp, parenchyma; e, epidermal cells; k, capsule; r, rhizoid.
*Riccia gougetiana var. armatissima* Lever ex Müll. Frib. 1907, Kryptogamenfl. Deutschlands 6: 161

Syn.: *Riccia erinacea* Schiffn. 1902, Hedwigia 41: 270; *R. armatissima* (Levier ex Müll. Frib.) Trab. 1942, Rev. Bryol. Lichenol. 12: 12.

Turkish name: Yoz çatalcık.

Holotype: Lamoure, près de Montpellier, leg. Crozals. s.n.

Dorsal side of thallus especially on capsules and margin ciliate.

*Riccia gougetiana* grows on soil in/near streambeds, wet grassland, and on soil. The plant is usually collected from wet soil and muddy areas in olive and pine plantations. Accompanying species are *Ptychostomum imbricatulum*, *Didymodon* sp., *Tortula cuneifolia* (Dicks.) Turner, *Gymnostomum viridulum* Brid., *Oxymitra incrassata*, *Riccia sorocarpa*, *R. papillosa*, *Fossombronia angulosa*, *Sphaerocarpos michelii* Bellardi, *Corsinia coriandrina*, and *Lunularia curicata*.

*Riccia gougetiana* can be distinguished from other members of the subgenus *Riccia* by wider thallus and well-developed lateral wings. The species is closely allied to *R. ciliifera*. The thallus of *R. ciliifera* is bluish, purple in older parts, and the spores have a different ornamentation pattern. Cells of ventral scales are larger than in *R. ciliifera*.

Specimens examined: Aydın, Koçarlı; Çakırbeyli village, on wet soil in a small streambed, 594 m, 37°41′55.4″N, 27°48′33.4″E, 24.03.2012, ÖzENOĞLU TR/37, TR/40; Ortaklar, Selatin village, on wet soil bund, 289 m, 37°57′54.5″N, 27°30′17.3″E, 13.01.2013, ÖzENOĞLU TR/81, TR/88; Köşk, Küre village, on wet soil in a small streambed, 599 m, 38°03′00.1″N, 27°59′34.9″E, 27.01.2013, ÖzENOĞLU TR/101; Nazilli, Kavakçı village, on soil, 647 m, 37°38′51.2″N, 28°16′25.1″E, 14.12.2014, ÖzENOĞLU TR/327, TR/328, TR/329, TR/331; Balkesir, Erdek, Şahinburgaz, Kakışkalı Local, on soil, 5 m, 40°29′28.6″N, 27°57′24.2″E, 27.01.2013, ÖzENOĞLU TR/115; Bursa; Çobankaya Plain, on soil near Abies sp., *Philonotis* and *Calliorgenalla* plants, 1750 m, 40°06′57.5″N, 29°08′34.7″E, 20.06.2015, ÖzENOĞLU TR/359, TR/361, TR/362, TR/363, TR/365; Çanakkale, Ezine, Kemalli village, on soil in scrub area, 156 m, 39°44′31.7″N, 26°13′30.8″E, 28.01.2013, ÖzENOĞLU TR/126; Gülpinar, Tuzla, on wet soil, 20 m, 39°33′30.7″N, 26°09′34.1″E, 28.01.2013, ÖzENOĞLU TR/128; İzmir, Camlık, Kirazlı village road, on soil near olive, grape, and figs plants, 190 m, 37°51′59.5″N, 27°23′15.4″E, 10.03.2012, ÖzENOĞLU TR/53; Mersin, Ören, Karabucak, on soil in grassland area, 100 m, 36°02′31.6″N, 32°47′18.8″E, 05.03.2014, ÖzENOĞLU TR/311; Muğla, Ula, on wet soil, 630 m, 31.03.1971, 413′/71 C11; Milas, Kapıkırı village, Heraklea antique city, theater area, on soil, 56 m, 37°30′22.2″N, 27°31′53.6″E, 04.03.2012, ÖzENOĞLU TR/11, TR/13; Akyaka, Gökbey village, on soil under the olive plantation, 309 m, 37°02′08.0″N, 27°44′41.8″E, 03.03.2013, ÖzENOĞLU TR/194.

Specimens examined of *R. gougetiana var. armatissima*:

Manisa, Salihli, Sindel village, in grassland, in a small streambed, on wet soil, 316 m; 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, ÖzENOĞLU TR/246.

The species is very common in the western part of Turkey. *R. gougetiana var. armatissima* was given by Jovet-Ast (1986) from Turkey without locality details. The taxon is recorded for the second time from Turkey (Salihli/Manisa) with this study.

**Distribution:** *Riccia gougetiana* is recorded from Algeria, Baleares, Bosnia-Herzegovina, Bulgaria, Canary Islands, Caucasus, Corsica, Crete, Croatia, Czech Republic, France, Germany, Greece, Hungary, Iran, Israel, Italy, Lebanon, Libya, Madeira, Macedonia, Montenegro, Morocco, Portugal, Romania, Russia, Sardinia, Serbia, Sicilia, Slovakia, Spain, Switzerland, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.
16. **Riccia lamellosa** Raddi 1818, Opusc. Sci. (Bologna) 2: 351 (Figures 1O, 2L1, 2L2; Appendix Figure 15)

**Syn.**: Riccia dufourii Nees 1838, Naturgesch. Eur. Leberm. 4: 390, 415; R. austinii Steph. 1898, Spec. Hep. 1: 28; *R. lamellosa* var. americana Howe 1898, Bull. Torrey Bot. Club 25: 189; *R. americana* (Howe) Howe 1899, Mem. Torrey Bot. Club 7: 24.

Turkish name: Akçatalcık.

**Holotype:** In ambulacris horti agrarii Academia Georgophylorum, nec non aliis umbrosis humentibusque locis aequo intra, atque extra Florentiae moenia, Firenze. PI (Herbier Raddi).

Plants forming complete or incomplete rosettes, thallus bluish green-pale green, lateral sides of lobes entirely covered with large, pure white scales, rounded apically and extending beyond lobe margins (Figure 1O); thalli 3–4 furcate, ultimate branches 2–2.5(–2.8) mm wide, obovate, rounded or obtuse apically; median groove shallow, distinct all along the lobes, widening to about 1/4 branch width; lateral edges subacute; ventral scales white, imbricate. Thallus sections of lobes 800–900 µm high and 2–2.5 times as wide, upper edge divided into three convex parts, lateral edges erect and in upper part spread out; chlorenchyma made up of short, rectangular cells, epidermal cells persistent in groove, 32–38(–42) µm, ventral scale cells 30–37 × 35–40 µm (Appendix Figure 15). Monoicous. Spores 90–105 µm, brown, distal face 9–11 alveoli across diameter, limited by thick walls with tubercles at wall corners (Figure 2L1), proximal faces with numerous incomplete alveoli (Figure 2L2), wing 6–8 µm wide, crenulate margin.

**Appendix Figure 14.** Riccia gougetiana: 1- thalli; 2–4- cross-sections of thalli; 5- well-developed wing in sides of thalli; 6- cells of thallus tissue; 7- cells in wing tissue; 8- cilia. c, Cilia; dp, parenchyma; ft, chlorenchyma; k, capsule; kp, ventral scale; l, well-developed wing; r, rhizoid.
Riccia lamellosa grows on soil near roadside and on soil in olive plantations and some scrubs. Accompanying species are Aloina aloides (Koch ex Schultz) Kindb., Bryum argenteum, B. caespiticium Hedw., Barbula unguiculata, Dicranella varia (Hedw.) Schimp., Didymodon acutus, D. luridus Spreng., D. vinealis (Brid.) R. H. Zander, Fossombronia angulosa, Lunularia cruciata, Riccia sorocarpa, Sphaerocarpos texanus, Targionia hypophylla, and Timmiella barbuloides (Özenoğlu Kiremit and Kırmacı, 2012).

Riccia lamellosa can be distinguished from other members of the subgenus Riccia by its pale green-bluish color and its pure white scales covering the lateral lobe sides and extending beyond the lobe margins.

Specimens examined: Aydın, İncirliova, Şirinköy, on soil bund near the road, 237 m, 37°55′57.0″N, 27°46′53.7″E, 26.02.2012, Özenoğlu TR/25; Güllübahçe-Doğanbey road, 5 km to Doğanbey, on soil near the road, 1 m, 37°37′16.9″N, 27°11′58.7″E, 23.03.2012, Özenoğlu TR/34; Sultanhisar, Nysa antique city, on soil in the theater area, 230 m, 37°54′12.5″N, 28°08′43.3″E, 24.03.2013, Özenoğlu TR/200; İzmir, Selçuk, Zeytinköy, Gebekir Lake, on soil near the lake, 10 m, 37°58′31.5″N, 27°15′52.3″E, 16.03.2013, Özenoğlu TR/196; Mersin, Tarsus, Çamlıyayla road, Keşbüük Local, on soil under the olive plantation, 556 m, 37°01′29.5″N, 34°46′03.5″E, 03.03.2014, Özenoğlu TR/292.

Distribution: In Turkey, R. lamellosa was reported by Jovet-Ast (1986) from West Anatolia without locality details. Riccia lamellosa was recorded a second time (Sultanhisar/Aydın) by Özenoğlu Kiremit and Kırmacı (2012).

Riccia lamellosa is recorded from Albania, Algeria, Baleares, Canary Islands, Caucasus, Crete, Corsica, Cyprus, Egypt, France, Greece, Iran, Israel, Italy, Jordan, Lebanon, Libya, Madeira, Malta, Morocco, Portugal, Russia, Sardinia, Saudi Arabia, Sicilia, Spain, Syria, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.

Appendix Figure 15. Riccia lamellosa: 1- thalli; 2–4- cross-sections of thalli; 5- lateral sides of thalli covered with ventral scales; 6- epidermal cells. dp, Parenchyma; e, epidermal cells; ft, chlorenchyma; kp, ventral scale; r, rhizoid.
**17. Riccia macrocarpa** Lever 1894, Bull. Soc. Bot. Ital. 5: 114 (Figures 1P, 2M1, 2M2; Appendix Figure 16)

**Syn.:** Riccia campbelliana Howe 1898, in Memoirs of the Torrey Botanical Club 7: 26.

Turkish Name: İri çatalcık.

**Holotype:** Italy, Toscane, Poggio Santo Romolo 1888 (FI).

Plants forming gregarious, thallus gray-bluish green, orange or orange-brown on sides, red-brown in older parts (Figure 1P); thalli 2–3 furcate, ultimate branches 1.5–2.2 mm wide and to 8–9 mm long, lobes sublinear, narrowed from apex towards base, rounded-retuse apically; median groove distinct all along the lobes, lateral sides tinged with orange-brown, folded up when dry, lateral edges erect with upper part extending into a short wing; ventral scales with groups of colorless, isodiometric cells intermixed with groups of cells with purplish and bright orange, hardly reaching thallus margins; rhizoids numerous. Thallus sections of lobes 2–3 times wider than high, forming an open V below, in older parts with upper edge nearly flat, chlorenchyma and parenchyma dense, with scattered cells with orange content (idioblasts), parenchyma light green to light brown and reaching to lobes' edges, epidermal cells in median groove spherical or obtuse, 30–50 × 35–45 µm, ventral scale cells 25–30(–35) × 50–70(–90) µm (Appendix Figure 16). Dioicous. Archegonial necks 100–170 µm long, yellowish-orange, mature sporophytes conspicuous on dorsal surface with blackish spots, spores 90–100(–110) µm, light brown-brown, distal face with 9–12 alveoli across diameter limited by very thin and big tubercles (Figure 2M1), proximal faces similarly ornamented (Figure 2M2), wing 5–7 µm wide, crenulate at margin.

**Riccia macrocarpa** grows on wet soil in streambeds and on soil near ponds and lakes. The plant was usually collected in olive and pine plantations. *Berberis* sp., *Eriophorum* sp., *Carex* sp., and *Sarcopterium spinosum* (L.) Spach are vascular plants growing together with it in some habitats. Accompanying bryophyte species are *Bryum* sp., *Corisnia coriandrina*, *Didymodon acutus*, *Fossombronia pusilla*, *Lunularia cruciata*, *Oxymitra incrustata*, *Philonotis* sp., *Calliergonella* sp., *Riccia gougetiana*, *R. subbifurca*, *Southbya topacea*, and *Sphagnum* sp.

**Riccia macrocarpa** can be distinguished from other members of the subgenus *Riccia* by long and narrow lobes with orange-brown borders, orange spots in its scales, and short lateral wings on lobes.

**Specimens examined:** Aydın, Kocarlı, Çakırbeyli village, on wet soil in the streambed, 594 m, 37°41′55.4″N, 27°48′33.4″E, 24.03.2012, Özenoğlu TR/41; Ortaklar, Selatin village, on soil, 289 m, 37°57′54.5″N, 27°30′17.3″E, 13.01.2013, Özenoğlu TR/89; Mersinbelen; Bağcilar village, on soil near the a small pond, 513 m, 37°33′33.6″N, 27°39′07.4″E, 03.02.2013, Özenoğlu TR/149; Cine Kavşit village, Madran Mountain, near the wind turbines, 1697 m, 37°38′51.2″N, 28°12′25.1″E, 14.12.2014, Özenoğlu TR/332; Bursa; Uludağ, hotels locality, on soil in subalpinic area with *Carex* sp., *Sphagnum* sp., *Eriophorum* sp., 1990 m, 40°05′32.4″N, 29°09′03.3″E, 21.06.2015, Özenoğlu TR/350, TR/351, TR/352; Cobankaya Plain, on soil, 1760 m, 40°06′56.1″N, 29°08′30.2″E, 21.06.2015, Özenoğlu TR/355, TR/366, TR/367, TR/368, TR/369; İstanbul; Kurtköy, on soil near the race track, 50 m, 40°52′45.2″N, 29°17′53.4″E, 31.01.2015, Özenoğlu TR/341; Manisa, Salihi, Sindel village, on soil in a small streambed, on wet soil, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/240; Mersin, Oren, Karabucak, on soil in a grassland area, 100 m, 36°02′31.6″N, 32°47′18.8″E, 04.03.2014, Özenoğlu TR/289; Anamur, Emirşah village, on soil under the orange trees, 32 m, 36°04′54″N, 32°47′28.7″E, 04.03.2014, Özenoğlu TR/303; Muğla, 2 km north of Ula, on wet soil, 630 m, 31.03.1971, 424/71 C/11; Milas, Kapkı village, Heraklea antique city, on wet soil bund near the lake, 15 m, 37°30′22.2″N, 27°31′53.6″E, 04.03.2012, Özenoğlu TR/19; Akyaka, 3rd km of Akyaka-Oren road, on soil under the *Pinus brutia* plantation, 35 m, 37°03′07.2″N, 28°18′09.1″E, 03.03.2013, Özenoğlu TR/185.

**Distribution:** *Riccia macrocarpa* was reported from West Anatolia without locality details by Schiffner (1908). The plant was later found in Bursa, Uludağ, 1990 m a.s.l., as well as Mediterranean localities.

*Riccia macrocarpa* is recorded from Albania, Algeria, Baleares, Canary Islands, Crete, Corsica, Croatia, France, Greece, Israel, Italy, Jordan, Madeira, Montenegro, Morocco, Portugal, Sardinia, Sicilia, South Africa, Spain, Tenerife, Tunisia, and Turkey in the Mediterranean Region, Europe, and Southwest Asia. Also North America in California, Cape Verde, and South Africa (Sérgio and Melo, 2015).
18. Riccia michelii Raddi 1818, Opusc. Sci. (Bologna) 2: 352 (Figure 1Q; Appendix Figure 17)

Syn.: Riccia ciliata Raddi 1818, Opus Sci. (Bologna) 2 (12): 352; R. tumida Lindenb. 1829, Nova Acda Acad. Caes. Leop.-Carol. Nat. Cur. 14, suppl: 120; R. paradoxa De Not. 1839, Primit. Hep. Ital.: 69 Mem. Reale Acad. Sci. Torino Cl. Sci. Fis. Ser. 2, 1: 349, 1839.

Turkish name: Paslı çatalcık.

Holotype: Italy, Florence «in terra limosa per Fesulanum montem» (PI, Herbier Raddi).

Plants forming often dense rosettes of 1.5–3.5 cm in diameter, thallus green or pale green, rarely purple on borders and lateral sides, yellowish-brown to base (Figure 1Q); thalli 2–3 furcate, ultimate branches 1.3–2 mm wide, to 12 mm long, lobes oblong, rounded-subacute apically, gradually narrowed from apex to base; median groove wide, widening to about 1/3 branch width, distinct at apex but soon becoming obscure; flanks convex, especially in the upper part, lateral edges rounded; cilia on margins of lobes from apex to base but more numerous at apex, sometimes scarce, usually arranged in two opposite rows, 180–450(–550) μm long and wide at base, papillate in upper 2/3, but others not papillate; ventral scales small, white or tinged with purple; rhizoids internally tuberculate. Thallus sections of lobes 2.5–3(–4) times wider than high, upper edge with three convexities in the younger part of lobes, nearly flat in older; chlorenchyma 300–350 μm, parenchyma 350–500 μm, parenchyma cells 35–48 × 45–62 μm, epidermal cells persistent in groove, convex, ovate or pyriform, 34–50 μm wide, ventral scale cells 24–32 × 52–65 μm (Appendix Figure 17). Dioicous. The material collected in Turkey was lacking spores but the antheridia and archegonia were present. Archegonial necks orange-brown and 130–150 μm long, spores 90–140 μm, light brown (Kürschner and Frey, 2011), distal face with 7–9 alveoli across diameter, limited by thin walls.
with tubercles at wall corners (Heyn and Herrnstadt, 2004), proximal faces with incomplete alveoli with walls reduced to tubercles or sinuous lines (Heyn and Herrnstadt, 2004), wing 5–7 µm wide, covered with granules, finely papillate on margin (Jovet-Ast, 1986; Heyn and Herrnstadt, 2004).

*Riccia michelii* grows on soil in scrub and open areas near ponds, lakes, and streams. Pine and olive plantations are dominant habitats. Accompanying species are *Bryum* sp., *Cheilothela chloropus*, *Fossombronia pusilla*, *Funaria hygrometrica* Hedw., *Lunularia cruciata*, *Oxymitra incrassata*, *Riccia ciliifera*, *R. gougetiana*, and *Scleropodium cespitans* (Wilson ex Müll. Hal.) L. F. Koch.

*Riccia michelii* can be distinguished from other members of the subgenus *Riccia* by its pale green thallus, wide median groove, and long cilia in two rows.

**Specimens examined:** Antalya; Kemer, Olympos antique city, on soil under *Pinus brutia* trees, 45 m, 36°23’11.8″N, 30°27’54.8″E, 15.11.2003, Özenoğlu C12/30-028; Aydın, Zeytinköy-Tire road, on soil near the streambed, 502 m, 37°56’27.7″N, 27°52’07.1″E, 20.01.2013, Özenoğlu TR/96; İzmir, 32nd km of Incirliova-Tire road, on soil and tree roots near the road, 865 m, 38°01’51.7″N, 27°44’35.2″E, 01.04.2012. Özenoğlu TR/42; Manisa, Salihli, Sindel village, on volcanic tuffs, 289 m, 38°38’46.7″N, 28°18’57.4″E, 06.04.2013, Özenoğlu TR/238 and on soil in streambed, 316 m, 38°38’56.7″N, 28°18’52.6″E, 06.04.2013, Özenoğlu TR/248; Muğla, Güllük, on wet soil, 04.04.1970, 688/70 C11; Fethiye, Farahlya Köyü, Kabak Cove, on soil in the grassland area, 30 m, 07.01.2001, Özenoğlu C11/176; Milas, Kapıkırı village, Hareklea antique city, on soil near lake, 75 m, 02.02.2011, Özenoğlu C11/211, C11/215; Bodrum, Güvercinlik, on soil bund near the sea, 2 m, 37°07’37.5″N, 27°33’42.3″E, 25.11.2012, Özenoğlu TR/70; Marmaris, Boncuk Cove, Azmakbaşı Local, on soil under the *Pinus brutia* plantation, 11 m, 36°59’10.0″N, 28°15’06.9″E, 03.03.2013, Özenoğlu TR/180.

**Distribution:** *Riccia michelii* is recorded from Albania, Algeria, Austria, Bosnia-Herzegovina, Canary Islands, Caucasus, Corsica, Crete, Croatia, Cyprus, Czech Republic, England, France, Greece, Israel, Italy, Jordan, Libya, Lebanon, Montenegro, Morocco, Portugal, Sardinia, Sicilia, Slovakia, Spain, Syria, Switzerland, Tunisia, and Turkey in the Mediterranean Region, Europe, and Southwest Asia.

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**Appendix Figure 17. Riccia michelii:** 1- thalli; 2–4- cross-sections of thalli; 5–6- epidermal cells; 7–8- archegonial neck. arb, Archegonial neck; c, cilia; dp, parenchyma; e, epidermal cells; ft, chlorenchyma; k, capsule; r, rhizoid.
19. *Riccia nigrella* DC. 1815 in Lam. & DC in Fl. France 5, ed. 6: 193 (Figures 1R, 2N1, 2N2; Appendix Figure 18)  
**Syn.:** *Riccia aggregata* Underw. 1894, Bot. Gaz. (Grawfordsville) 19: 275; *R. pearsonii* Steph. 1898, in Bull. Herb. Boissier 6: 335; *R. capensis* Auct. non Steph. 1952, S. W. Arnell in Botaniska Notiser 105: 312.

Turkish name: Kara çatalcık.  
**Holotype:** France, in sylva Grammont prope Monspesulanum, leg. Bouchet. 1807 (PC).

Plants forming rosettes of 4–6 cm in diameter or gregarious and intermingled, thallus dark green on dorsal side, orange-brown or red-brown on borders and basally, rolled up when dry and showing only the black lateral sides, appearing then as black threads (Figure 1R); thalli 2–3(–4) furcate, ultimate branches 0.5–1(–1.2) mm wide, to 5 mm long, sublinear, lobes obtuse or rounded apically; median red-brown on borders and basally, rolled up when dry and showing only the black lateral sides, appearing then as black threads (Figure 1R).

*Pinus nigra* is the dominating habitat. Also *subsp. pallasiana* (Lamb) Holmboe., *Angeládus sp., Asphodelus austivus Brot., Palüthis spinchristi* Miller, and *Erica* sp. are found in the habitats. Accompanying bryophyte species are *Bryum* sp., *Cheiòthela chloropus, Corsinia coriandriana, Entosthodon sp., Fissidens sp., Fossombronia angulosa, Lunularia cruciata, Mannia androgyna, Oxymitra incrassata, Riccia bifurca, R. sorocarpa, R. papilosa,* and *Phaeoceros laevis."

*Riccia nigrella* is very common in Turkey and grows on soil in streambeds, scrub lands, and open areas. Olive and pine plantations is the dominating habitat. Also *Pinus nigra* subsp. *pallasiana* (Lamb) Holmboe., *Angeládus sp., Asphodelus austivus Brot., Palüthis spinchristi* Miller, and *Erica* sp. are found in the habitats. Accompanying bryophyte species are *Bryum* sp., *Cheiòthela chloropus, Corsinia coriandriana, Entosthodon sp., Fissidens sp., Fossombronia angulosa, Lunularia cruciata, Mannia androgyna, Oxymitra incrassata, Riccia bifurca, R. sorocarpa, R. papilosa,* and *Phaeoceros laevis."

*Riccia nigrella* can be distinguished from other members of the subgenus *Riccia* by dark blue-green tinge with orange-brown on borders and older parts, forms nearly black and shiny threads when dry.

**Specimens examined:** **Antalya,** Alaýya, Seki village, Syédra antique city, on soil under olive trees, 250 m, 36°26′32.8″N, 32°08′58.2″E, 04.03.2014, Özenoğlu TR/301; **Doğuşmeali,** Yağca village, Karain Cave, on wet soil near entrance to cave, 376 m, 37°04′66″N, 30°34′23′′E, 29.04.2004, Özenoğlu C12/61-050; **Aydınn, Nazilli,** Dereağz village, on soil near a streambed, 105 m, 15.11.1998, Özenoğlu C11/87; **Nazilli,** Mastaura antique city, on soil under olive trees near the roadside, 194 m, 37°57′04.3″N, 28°20′32.8″E, 30.12.2012, Özenoğlu TR/74; **Ortaklar,** Selatin village, on soil, 289 m, 37°57′54.5″N, 27°30′17.3″E, 13.01.2013, Özenoğlu TR/85; **Kösk,** Ahatlar village, on soil, 733 m, 37°59′18.4″N, 28°05′32.3″E, 27.01.2013, Özenoğlu TR/100; **Karpuzlu-Koçarlı** road, Akçabat village, on wet soil near the roadside, 399 m, 37°36′44.5″N, 27°46′58.3″E, 23.02.2013, Özenoğlu TR/164; **İncirliova,** Erbeyli, Kızılcagedik village, olive plantation, on soil bund near the roadside, 263 m, 37°53′26.5″N, 27°38′51.3″E, 16.03.2013, Özenoğlu TR/197; **Yenipazar-Bozdoğan** road, Karaçakal village, on soil, 554 m, 37°47′22.2″N, 28°12′34.4″E, 23.03.2013, Özenoğlu TR/206; **Güzeliçamlı,** Panionion antique city, *Pinus brutia* and *Olea europeae* plantation, on soil, 45 m, 37°42′46.4″N, 27°13′57.5″E, 24.03.2013, Özenoğlu TR/254; **Naziili,** Sinekçiler village, on soil bund near the roadside, 800 m, 37°59′26.4″N, 28°16′39.9″E, 07.04.2013, Özenoğlu TR/269; **Çine,** Ovacık village, on soil, 215 m, 37°32′38.5″N, 28°05′21.3″E, 04.10.2013, Özenoğlu TR/285; **Kavuş village,** Madran Mountain, near the wind turbines, 1697 m, 37°38′51.1″N, 28°12′25.1″E, 14.12.2014, Özenoğlu TR/325; **Çanakkale,** Ezine, Kemallı village, on soil in scrubs, 156 m, 39°44′31.7″N, 26°13′30.8″E, 28.01.2013, Özenoğlu TR/125; **Çan,** Söğütalan Local, on soil under *Pinus nigra* subsp. *pallasiana, Erica* sp., 328 m, 39°54′30.8″N, 26°55′38″E, 10.04.2015, Özenoğlu TR/348; **İzmir,** Aslanlar, on roadside, 30.10.1971, 978/71 C11; **İncirliova-Tire** road, on soil in a small streambed, 347 m, 37°57′45.6″N, 27°45′61.8″E, 26.02.2012, Özenoğlu TR/10; **Manisa,** Salihli, Sindel village, on soil in a small streambed, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/239; **Mersin,** Anamur, Emirşaş village, on soil under *Eucalyptus* trees, 40 m, 36°04′54″N, 32°47′28.7″E, 03.03.2014, Özenoğlu TR/296; **Mugla,** Datca-Marmaris road, on soil under *Pinus brutia* trees near the roadside, 13 m, 36°49′44.2″N, 28°10′06.9″E, 03.03.2013, Özenoğlu TR/178; **Milas,** Kapkı village, Heraklea antique city, on soil near the lake, 75 m, 09.03.2011, Özenoğlu C11/206, C11/212, C11/231, C11/239.

**Distribution:** *Riccia nigrella* is recorded from Albania, Algeria, Azores, Baleares, Bosnia-Herzegovina, Bulgaria, Canary Islands, Corsica, Crete, Croatia, Cyprus, England, France, Greece, Ireland, Italy, Jordan, Libya, Madeira, Malta, Montenegro, Morocco, Portugal, Sardinia, Serbia, Sicilia, Spain, Syria, Switzerland, Tunisia, and Turkey in the Mediterranean Region, Europe, and Southwest Asia.
20. *Riccia papillosa* Moris 1828, App. Elench. Stirp. Sard.: 2 (Figures 1S, 2O1, 2O2; Appendix Figure 19)

**Syn.:** *Riccia pseudopapillosa* Levier ex Steph.1898, Spec. Hep. 1: 14.

Turkish name: Siğilli çatalcık.

**Holotype:** Circa stagna maritima, Cagliari alla Maddalena, locis limosis, Sardaigne (TO).

**Isotype:** S, Herb. Lehmannianum.

Plants forming incomplete rosettes, thallus dark green-bluish green, lobe margins with pink or light violet, yellowish-brown to base (Figure 1S); thalli 3–5 furcate, ultimate branches 0.5–0.7(–1) mm wide, obovate-lingulate, rounded apically; median groove narrow, widening to about 1/3 branch width, distinct almost to base; flanks thick, rounded, convex, lateral edges subacute; papillae scattered at margins and dorsal side of thallus, 100–120 µm high, straight or curved; ventral scales pink or light violet. Thallus sections of lobes as wide as high at apex, 1.5–2 times wider than high at middle of the lobe, containing colorful idioblast cells, parenchyma cells 32–42 × 28–35 µm, part of base walls of epidermal cells thickened, subepidermal cell walls thickened, epidermal cells 30–40 × 30–45 µm, subepidermal cells 20–25 × 35–42 µm, ventral scale pink-light violet, cells 22–27 × 35–45 µm (Appendix Figure 19). Dioicous. Archegonial necks purple-violet, 110–140 µm long, spores 60–72(–82) µm, light brown-reddish, distal face with 5–8 alveoli across diameter, limited by walls with tubercles at wall corners (Figure 2O1), proximal faces with numerous alveoli (Figure 2O2), wing 3–4 µm wide, crenulate margin.

*Riccia papillosa* grows on soil in streambeds, in grassland areas, and near roadsides. Olive, *Berberis* sp., and *Sarcopterium spinosum* are some vascular plants found in the habitats. Accompanying bryophyte species are *Bryum* sp., *Didymodon acutus*, *Cheilothela chloropus*, *Funaria hygrometrica*, *Lunularia cruciata*, *Oxymitra incrassata*, *Riccia bifurca*, *R. gougetiana*, *R. macrocarpa*, *R. michelii*, *R. nigrella*, *R. sorocarpa*, *R. subbifurca*, *Scleropodium cespitans*, and *Sphaerocarpos texanus*.

**Appendix Figure 18.** *Riccia nigrella*: 1- thalli; 2–4- cross-sections of thalli; 5- sides of thalli and epidermal cells; 6- ventral scale, 7- cells of ventral scale, 8- cross-section of median groove; 9- epidermal cells. e, Epidermal cells; k, capsule; kp, ventral scale; tk, side of thalli.
Riccia papillosa can be distinguished from other members of the subgenus Riccia by papillae scattered at margins and dorsal side of thallus, bluish-green color, and epidermis of 2 layers.

Specimens examined: Antalya; Alanya, Seki village, Syedra antique city, on soil under the olive trees, 50 m, 36°26'32.8"N, 32°08'58.2"E, 04.03.2014, Özenoğlu TR/302; Aydın, Ortaklar-Selatin road, Balatçık village, on soil near the roadside, 167 m, 37°54'49.3"N, 27°29'09.7"E, 13.01.2013, Özenoğlu TR/84; Karpuzlu, Çobanisa village, on soil near the roadside, 158 m, 37°33'21.5"N, 27°52'21.3"E, 23.02.2013, Özenoğlu TR/165; 1–2 km to Yenipazar, on soil bund near the roadside, 46 m, 37°48'49.8"N, 28°10'20.3"E, 23.03.2013, Özenoğlu TR/219; Nazilli, Kavacik village, on soil near the a small stream, 647 m, 37°59'15.2"N, 28°16'30.8"E, 07.04.2013; Özenoğlu TR/271; Çine, Kavşit village, Madran Mountain, wine turbines, 1697 m, 37°38'51.2"N, 28°12'25.1"E, 21.12.2014, Özenoğlu TR/335; Bursa; Çobankaya Plain, on soil, 1750 m, 40°06'57.5"N, 29°08'34.7"E, 20.06.2015, Özenoğlu TR/364; Manisa, Salihli, Sindel village, on soil in a small streambed, 316 m, 38°38'56.7"N, 28°18'52.6"E, 06.04.2013, Özenoğlu TR/241; Mersin, Ören, Karabucak, on soil in grassland, 100 m, 36°02'31.6"N, 32°47'188"E, 04.03.2014; Özenoğlu TR/312; Rize, İkizdere, Ovit Mountain, on soil in grassland, 2650 m, 40°37'29.3"N, 40°46'53.8"E, 23.07.2012, Özenoğlu TR/63; İkizdere, Kozan Çukuru Plateau, on soil in grassland near the small streams, 2400 m, 40°37'13.3"N, 40°50'09.5"E, 24.07.2012, Özenoğlu TR/65.

Distribution: Riccia papillosa was reported from Turkey without locality details by Çetin (1988). The plant was reported from Aydın, Savrandere, by Kürschner et al. (2007). In this study, specimens are collected from Rize, Ovit Mountain (2650 m), and Bursa, Uludağ (1760 m), as well as Mediterranean localities.

Riccia papillosa is recorded from Albania, Algeria, Austria, Azores, Baleares, Bosnia-Herzegovina, Bulgaria, Canary Islands, Corsica, Crete, Croatia, Czech Republic, France, Greece, Hungary, Italy, Montenegro, Morocco, Portugal, Romania, Russia, Sardinia, Sicilia, Slovakia, Spain, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe, and Southwest Asia.
21. *Riccia perennis* Steph. 1898, Bull. Herb. Boissier 6: 372 (Figure 1T; Appendix Figure 20)

**Syn.:** *Riccinia perennis* (Steph) Trab. 1916, Bull. Soc. Hist. Nat. Afrique Nord 7: 87; *R. heyeri* (Huebener ex Genth) Müll. Frib. 1940, Dr. L. Rabenhorst’s Kryptogamen - Flora von Deutschland, Oesterreich und der Schweiz (ed. 2). 6: 302.

Turkish name: Hoş çatalcık.

**Holotype:** Algeria, in vicinis urbis Alger, associated with *R. gougetiana*, Dr Trabut (G).

Plants usually forming crowded mats, thallus light green to yellow tinge (Figure 1T); thalli 2–3 furcate, ultimate branches 1.7–2.5(–2.7) mm wide, inflated, narrowed to apex; dorsal surface appearing areolate and bullose towards apex with distinct pores, parchment-like when dry; median groove narrow, widening to about 1/4 branch width; lateral edges subacute; ventral scales whitish, covered lobe apex; rhizoids smooth. Thallus sections of lobes 600–800 µm high and 3–4 times as wide, parenchyma dense, often with small cells (Appendix Figure 20). Dioicous and heterothallic. Jovet-Ast and Bischler (1970) provided a description of the stalked apical tubercules and emphasized their importance in the biology and life history strategy of the species. The material collected in Turkey was without spores but the typical tubercules were present. More studies are needed locally to determine whether *R. perennis* relies solely on vegetative reproduction or if spores have been missed. From a general point of view, vegetative reproduction is perhaps underestimated in the genus *Riccia* (Jovet-Ast, 1986), where spore investment is largely predominant. Spores light yellowish, 115–120 µm in diameter, wing 10–13 µm wide, crenulate margin (Jovet-Ast, 1986; Casas et al., 2009).

*Riccia perennis* grows in grasslands, in small streambeds, on wet soil that most probably are exposed to severe drought during hot months. *Riccia perennis* has been found in quite open olive tree and oak (*Quercus* L. sp.) plantation. The thalli grow often exposed to direct sun in imperfectly shaded localities. Direct associates include *Corsinia coriandrina*, *Lunularia cruciata*, *Gongylanthus ericetorum* (Raddi) Nees, *Phaeoceros laevis*, *Riccia gougetiana* var. *armatissima*, and *R. subbifurca*.

*Riccia perennis* can be distinguished from other members of the subgenus *Ricciella* by the size (very robust), color (yellowish tinge), lobe width (more than 1.7 mm wide), and tubers on apical ventral face of the thallus. No other species of the subgenus *Ricciella* has a thallus of more than 1.5 mm wide so identification is almost immediately possible even in the field.

**Specimens examined:** Manisa, *Salihli*, Sindel village, in grassland, in a small streambed, on wet soil, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/243; Muğla, *Milas*, Kapikiri village, Heraklea antique city, Bafa Lake Natural Park, in grassland, in a small streambed, on wet soil, 75 m, 37°30.222′N, 27°31.936′E, 21.02.2009, Özenoğlu C11/246 and 37°30′22.2″N, 27°31′53.6″E, 04.03.2012, Özenoğlu TR/6.

**Distribution:** *Riccia perennis* is recorded from Algeria, Azores, Corsica, France, Greece, Italy, Morocco, Portugal, Russia, Sardinia, Spain, Tunisia, Turkey, and Ukraine (?) in the Mediterranean Region, Europe, and Southwest Asia (Hugonnot and Offerhaus, 2009; Özenoğlu Kiremit and Hugonnot, 2010).

The discovery of *R. perennis* is a significant extension of the range to the east. Possibly due to the lack of systematic floristic exploration, the easternmost localities of *R. perennis* (of Greece and Turkey) appear rather isolated compared with the bulk of localities of Portugal, Spain, Sardinia, and North Africa.

The species was until now considered a western Mediterranean endemic. The locality of Ukraine (Düll, 1983; Söderström et al., 2002), which appeared somewhat dubious (Jovet-Ast, 1986), should be reevaluated (if the specimen can be traced) in the light of the discovery of the species in Turkey. Taking into consideration the new locality provided in the present work, the species must be considered as a Mediterranean and Southwest Asiatic element.
Appendix Figure 20. *Riccia perennis*: 1- thalli; 2–4- cross-sections of thalli. ho, Air chambers; r, rhizoid.

22. *Riccia rhenana* Lorb. ex Müll. Frib. 1941, Hedwigia 80: 94  
Turkish Name: Yaş çatalcık.

Plants aquatic or terrestrial (Paton, 1999); aquatic plant forming thin or dense intricate mats, terrestrial plant forming partial or complete rosettes, thallus pale green (Paton, 1999); ultimate branches to 2 mm wide, thalli 2–4 furcate with the angle between 80° and 105°; dorsal surface with areolae (Paton, 1999); ventral scales hyaline (Kürschner and Frey, 2011). Thallus sections of lobes 5–8 times wider than high, chlorenchyma with air chambers in 1–2 layers, parenchyma mostly obsolete, ventral scale cells to 65 µm wide (Kürschner and Frey, 2011). Dioicous. Archegonia known only from laboratory conditions, antheridia and sporophytes unknown (Paton, 1999).

Aquatic form of the species was recorded from Denizli-Işıklı Lake by Walter (1967), but the species has not been recorded after that. The locality was searched in detail, but the species was not recorded during our project.

*Riccia rhenana* and *R. fluitans* are very similar species. *Riccia rhenana* can be distinguished from other members of the subgenus *Ricciella*, especially *R. fluitans*, by wider thallus, larger ventral scale cells, and epidermal cells. Also, *R. rhenana* branch angles are wider than in *R. fluitans*.

Specimens examined: The plant not recorded in the our project.

Distribution: *Riccia rhenana* is recorded from France and Turkey in the Mediterranean Region (Ros et al., 2007); Belgium, Czech Republic, Denmark, England, Finland, France, Germany, the Netherlands, Hungary, Ireland, Luxembourg, Romania, Russia, Poland, Portugal, Slovakia, Sweden, Switzerland, Turkey, and Ukraine in Europe and Southwest Asia.
Riccia sorocarpa  

Plants usually forming rosettes of 0.6–1.5 cm in diameter; thallus dark green or pale green, rarely with lateral sides and margins tinged with purple, dorsal side with narrow, hyaline margin, pale brown to base (Figure 1U); thalli 2–3 furcate, ultimate branches 0.5–1.5–(2.2) mm wide, oval-rounded, rounded-subacate apically; median groove narrow, widening to about 1/4 branch width, deep at apex, becoming shallower towards base; lateral edges subacute; ventral scales pale, usually reaching the lobe margins but not extending beyond it, upper surface reaching more or less the level of subepidermis. Thallus section of lobes forming a very open V, 2–3 times wider than high, chlorenchyma 300–350 µm high, parenchyma 250–300 µm high, epidermal cells convex or pyriform, decaying early; lateral walls of broken epidermal cells and subepidermal cells strongly thickened, epidermal cells 30–45 × 40–55 µm, subepidermal cells 20–35 × 35–55 µm, ventral scale rarely tinged with purplish, cells 30–45 × 40–55 µm (Appendix Figure 21). Monoicous. Antheridial walls of broken epidermal cells and upper subepidermal cells strongly thickened, epidermal cells 30–45 × 40–55 µm, subepidermal cells 30–45 × 50–70 µm (Appendix Figure 21). Monocious. Antheridial walls of broken epidermal cells and upper subepidermal cells strongly thickened, epidermal and subepidermal cells with thickened walls.

Specimens examined: Antalya, Kemer, Çıralı road to 5–6 km, on wet soil near stream, 42 m, 36°25′38″N, 30°27′136″E, 20.03.2004, Özenoğlu C12/49–39, C12/50–039; Kemer–Kumluca road, Olympos road to 3rd km, on soil bund near roadside, 35 m, 36°22′853″N, 30°26′809″E, 20.03.2004, Özenoğlu C12/56–045; Dösemalı, Karain Cave, on soil near cave-in, 391 m, 37°04′40.1″N, 30°34′15.5″E, 17.03.2012, Özenoğlu TR/31; Aydınlık, Kuyucular village, on soil under the oak trees, 90 m, 37°53′12.7″N, 28°01′59.2″E, 26.02.2012, Özenoğlu TR/2; Davutlar, Dilek Peninsula and B. Menderes National Park, Bademlik Local, on soil, 138 m, 37°39′51″N, 27°02′52″E, 27.12.12, Özenoğlu TR/72; Nazilli, Mastaura antique city, on soil near roadside, 126 m, 37°56′28.9″N, 28°22′32.3″E, 30.12.2012, Özenoğlu TR/76; Ortaklar, Selatin village, on plants, 289 m, 37°57′54.5″N, 27°30′17.3″E, 13.01.2013, Özenoğlu TR/87; Kösk, Ketenyeri, on soil bund on road, 610 m, 37°58′39.2″N, 28°05′39.9″E, 27.01.2013, Özenoğlu TR/98; Mersinbelen, Bağcılar village, on soil near pond, 513 m, 37°33′36.3″N, 27°39′07.4″E, 03.02.2013, Özenoğlu TR/150; Cine, Alabanda antique city, on soil, 87 m, 37°35′55.5″N, 27°57′27.8″E, 23.02.2013, Özenoğlu TR/154; Incirliova, Erbayli, Kızılcadık village, on soil, on plants, on soil, 216 m, 37°53′26.5″N, 27′38′51.3″E, 16.03.2013, Özenoğlu TR/198; Sultanhisar, Nysa antique city, in soil in theater area, 230 m, 37°54′12.5″N, 28°08′43.3″E, 24.03.2013, Özenoğlu TR/201; Yenipazar, Dereköy Local, on soil near pathway, 52 m, 37°47′45.7″N, 28°03′22.8″E, 23.03.2013, Özenoğlu TR/203–TR/224; Nazilli, Sinekçiler village, on soil bund in a small streambed, 800 m, 37°59′26.4″N, 28′16′03.9″E, 07.04.2013, Özenoğlu TR/251; Güzelcamlı, Quercus ilex and Pinus brutia forest, on wet soil, 415 m, 37°41′06.2″N, 27°13′36.1″E, 12.04.2013, Özenoğlu TR/265; Artvin, Savsat, Meydanlık village, Missırli Local, on soil near stream, 1100 m, 41°14′31″N, 42°21′52″E, 24.07.2014, Özenoğlu TR/319 and Özenoğlu A51 (Özenoğlu Kiremit, 2008); Balıkesir, Erdek, Ocaklar, olive plantation, on soil, on soil, 25 m, 40°25′36.3″N, 27°46′27.3″E, 27.01.2013, Özenoğlu TR/106, TR/108, TR/114, TR/116; Çanakkale, Biga–Lapseki road, 35 km to Lapseki, Pinus brutia plantation, on soil, 150 m, 40°20′07.6″N, 27°00′26.3″E, 28.01.2013, Özenoğlu TR/121; Ezine, Kemalli village, on soil in scrub, 156 m, 39°44′31.7″N, 26°13′30.8″E, 28.01.2013, Özenoğlu TR/124; Can, Söğütalan Local, on soil under Pinus nigra subsp. pallassiana, Erica sp., 328 m, 39°55′30.8″N, 26°55′38″E, 10.04.2015, Özenoğlu TR/347; Denizli, Cenneti, Karabayar village, on soil, 1100 m, 36°55′27.3″N, 29°08′46.7″E, 01.05.2013, Özenoğlu TR/282; Hatay, Merkez, on soil in St. Peter Church’s garden, 119 m, 36°12′32.7″N, 36°10′38.8″E, 30.01.2015, Özenoğlu TR/337; Hatay–Reynahli road, Narlıca Local, on soil bund near road, with Olea europaea, Euphorbia sp., Urginea maritima, Sarcopoterium spinosum, 121 m, 36°14′36.2″N, 36°14′01.3″E, 30.01.2015, Özenoğlu TR/338; İzmir, Ornekköy, on soil in canyon, 02.05.1997, Özenoğlu B6/20; Selçuk, Sirince, on soil bund near road, 600 m, 23.03.1997, Özenoğlu C11/6; Odemis–Kösk road, on soil near road, 405 m, 38°06′56.8″N, 27°57′52.7″E, 26.02.2012, Özenoğlu TR/9; Konya, Erenler (Özyurt) Mountain, Yeşildere village, on soil, 1820 m, 37°34′20.0″N, 32°08′53.2″E, 17.05.2014, Özenoğlu TR/317; Manisa, Salihli, Sündel village, on soil in a small streambed, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/242; Mersin, Erdemli, on soil in scrub, 70 m, 36°31′06.3″N,
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34°11'58.2″E, 03.03.2014, Özenoğlu TR/293; Mersin-Mezitli road, on soil near road, 150 m, 36°45'51.1″N, 34°29'27.6″E, 04.03.2014, Özenoğlu TR/298; Anamur, Emirşah village, on soil under Eucalyptus, 40 m, 36°04'54″N, 32°47'28.7″E, 03.03.2014, Özenoğlu TR/308, TR/309; Muğla, Ula, 2 km north of Ula, on wet soil, 630 m, 31.03.1971, 424/71 C/11; Fethiye, Faralya village, Kabak Cove, on soil under the Pinus brutia near the stream, 30 m, 19.12.1998, Özenoğlu C11/96; Milas, Kapıkırı village, Heraklea antique city, on soil near small streams, 75 m, 37°30'22.2″N, 27°31'53.6″E, 04.03.2012, Özenoğlu TR/7, TR/16, TR/17; Bodrum, Güvercinlik, on soil near sea, 2 m, 37°07'37.5″N, 27°33'42.3″E, 25.11.2012, Özenoğlu TR/69; Akyaka, Gökbəl village, on soil under the olive trees, 309 m, 37°02'08.0″N, 27°44'41.8″E, 03.03.2013, Özenoğlu TR/193; Şanlıurfa, Urfa Castle, on soil near castle entrance, 543 m, 37°08'44.6″N, 38°47'05.8″E, 02.02.2015, Özenoğlu TR/339.

Distribution: Riccia sorocarpa is a cosmopolitan species (Borovich and Bakalin, 2016). It is the most common Riccia species in Turkey.

Riccia sorocarpa is recorded from Albania, Algeria, Austria, Azores, Baleares, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Canary Islands, Corsica, Crete, Croatia, Cyprus, Czech Republic, Denmark, Egypt, England, Estonia, Finland, France, Germany, Greece, the Netherlands, Hungary, Iceland, Iraq, Iran, Ireland, Israel, Italy, Jordan, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Macedonia, Madeira, Malta, Montenegro, Morocco, Norway, Poland, Portugal, Romania, Russia, Sardinia, Saudi Arabia, Serbia, Sicilia, Slovakia, Slovenia, Spain, Syria, Sweden, Switzerland, Tunisia, Turkey, and Ukraine in the Mediterranean Region, Europe and Southwest Asia.

Appendix Figure 21. Riccia sorocarpa: 1- thalli; 2–5- cross-sections of thalli; 6- epidermal and subepidermal cells; 7–8- epidermal cells; 9- rhizoid. dp, Parenchyma; e, epidermal cells; ft, chlorenchyma; k, capsule; r, rhizoid; s, spore; se, subepidermal cells; tr, rhizoids internally tuberculate.
24. **Riccia subbifurca** Warsn. ex Croz. 1903, Rev. Bryol. Lichen. 30: 62 (Figures 1V, 2Q1, 2Q2; Appendix Figure 22)

**Syn.:** Riccia baumgartneri Schiffn. 1904, Österr. Bot. Z. 54, 3: 88; R. commutata auct. non J. B. Jack ex Levier; R. warnstorfi auct. non Limp. ex Warnst.

Turkish name: Üzun catalcık.

**Holotype:** La Roche l'Abeille, Haute Vienne, leg. G. Lachenaud, 17 mars 1902 (PC).

Plants usually forming incomplete rosettes or crowded, thallus bluish green, green, sometimes tinged with purple on dorsal and lateral sides, pale brown to base, becoming whitish with age (Figure 1V); thallii 2–4 furcate, ultimate branches 0.5–1.2 (–1.5) mm wide, to 7 mm long, oblong, rounded apically, lobes wider at apex; median groove narrow, widening to about 1/4 branch width, fairly deep and distinct at apex; lateral edges rounded; margin glabrous or with cilia, cilia on margins of lobes from apex to base, few, 120–210–270 µm long, papillate in upper 1/2; ventral scales hyaline or with pale purplish spots; rhizoids numerous and smooth. Thallus sections of lobes 1.8–2.3 (–3) times wider than high with 2–3 convexities on upper edge near apex, in older parts asymmetrical, parenchyma cells 35–45–(52) × 25–38–(46) µm, epidermal cells in groove rounded or pyriform and 40–60 × 38–55 µm, ventral scale cells 20–34 × 45–70 µm (Appendix Figure 22). Monoicous. Antheridial and archegonial necks red-purplish, archegonial necks 180–220 µm long, spores 80–96 µm, brown, distal face 9–13 alveoli across diameter, with rather thin walls and big tubercles at wall corners (Figure 2Q1), proximal faces similarly ornamented (Figure 2Q2), wing 6–8–(9) µm wide, smooth margin.

*Riccia subbifurca* grows on wet soil in streambeds, on soil in grassland, and in open areas. Olive plantation dominates in habitat. *Pinus brutia*, *Ouercus sp.*, *Typha sp.*, *Sarcopoterium spinosum*, *Erica arborea* L., *Arbutus andrachne* L., *Quercus cocciifera*, *Cistus* sp., *Asphodelus aestivalis* Brot., and *Corylus* sp. are some vascular taxa growing in the same habitats. Accompanying bryophyte species are *Ptychosporum imbricatum*, *Calypogeia pflagea* (L.) Raddi, *Chelyoletha chloropus*, *Corsinia coriandrina*, *Fossombronia pusilla*, *Gongylanthus ericetorum*, *Gymnostomum viridulum*, *Hypnum* sp., *Lunularia cruciata*, *Phaeoceros laevis*, *Pseudocrossidium hornhuchianum*, *Riccia barricata*, *R. bifurca*, *R. crozalsii*, *R. gougetiana*, *R. macrocarpa*, *R. nigrella*, *R. papillosa*, *R. perennis*, *R. sorocarpa*, *Timmiella barbuloides*, and *Tortula cuneifolia*.

*Riccia subbifurca* can be distinguished from other members of the subgenus *Riccia* by oblong thallus and asymmetrical shapes of thallus sections and large spores with large wing (6–8–9 µm).

**Specimens examined:** Aydin, Davutlar, Dilek Peninsula and B. Menderes National Park, Bademlik Local, on soil, 118 m, 37°29′51.4″N, 27°02′52.3″E, 27.12.2012, Özenoğlu TR/72; **Tralleis** antique city, on soil near road, 148 m, 37°52′19.2″N, 27°48′39.4″E, 12.01.2013, Özenoğlu TR/77; **Ortaklar**, Balatçık village, on soil near road, 167 m, 37°54′49.3″N, 27°29′09.7″E, 13.01.2013, Özenoğlu TR/83; **Kocarlı**, Akmesit village, on soil near road, 562 m, 37°35′08.4″N, 27°40′55.9″E, 03.02.2013, Özenoğlu TR/144; **Çine**, Esentepe village, on wet soil, 108 m, 37°36′03.8″N, 27°56′25.2″E, 23.02.2013, Özenoğlu TR/172; **Yenipazar**, on soil bund near pathway, 46 m, 37°48′49.8″N, 28°10′20.3″E, 23.03.2013, Özenoğlu TR/217; **Balkesir**, Gönen-Bandırma road, Buğdaylı, on wet soil, 163 m, 40°12′19.7″N, 27°44′18.6″E, 26.01.2013, Özenoğlu TR/104; **Erdek**, Büyüköva village, on soil on rock, 28 m, 40°13′54.7″N, 27°44′10.4″E, 28.01.2013, Özenoğlu TR/111; **Canakkale**, Boga-Lapseki road, 37 km to Lapseki, on red soil in scrub, 85 m, 40°19′37.9″N, 27°01′20.0″E, 28.01.2013; Özenoğlu TR/117, TR/122; ** Gülpinar-Tuzla** road, on wet soil, 20 m, 39°33′30.7″N, 26°09′34.1″E, 28.01.2013, Özenoğlu TR/129; **Behramkale-Ayarlık** road, *Pinus brutia* plantation, on soil near a small stream, 190 m, 39°30′52.1″N, 26°23′16.5″E, 28.01.2013, Özenoğlu TR/134; **Düzce**, Akşakoca, Dadali village, Fakılı Cave entrance, on wet soil bund under nut tree, 104 m, 41°03′10.1″N, 31°10′43.8″E, 28.04.2013, Özenoğlu TR/281; **İstanbul**, Kurkçayı, on soil near race track, 50 m, 40°52′45.2″N, 29°17′53.4″E, 31.01.2015, Özenoğlu TR/342; **İzmir**, Incirliova-Tire road of 32nd km, on wet soil on tree roots and rock, 865 m, 38°01′51.7″N, 27°44′35.2″E, 26.02.2012, Özenoğlu TR/32; **Karabük**, Safranbolu, on soil in field, 528 m, 41°14′44.8″N, 32°39′19.6″E, 25.03.2014, Özenoğlu TR/306; **Manisa**, Salihli, Sindel village, on soil in a small streambed, 316 m, 38°38′56.7″N, 28°18′52.6″E, 06.04.2013, Özenoğlu TR/249; **Muğla**, Milas, Kapıkın village, Heraklea antique city, on wet soil near small streams in theater area, 75 m, 37°30′22.2″N, 27°31′53.6″E, 21.02.2009, Özenoğlu C11/256 and 04.03.2012, Özenoğlu TR/8; **Aykaya**, Akıyaka-Ören road, on soil under *Pinus brutia* trees, 32 m, 37°03′18.2″N, 28°18′36.4″E, 03.03.2013, Özenoğlu TR/181.

**Distribution:** *Riccia subbifurca* was added to the Turkish flora by Özenoğlu Kiremit (2011). The plant prefers Mediterranean type localities, but it is also found in the West Black Sea Region (Düzce and Karabük).

*Riccia subbifurca* is recorded from Albania, Austria, Azores, Belgium, Canary Islands, Corsica, Crete, Croatia, England, France, Germany, the Netherlands, Hungary, Iran, Ireland, Italy, Israel, Luxembourg, Macedonia, Madeira, Montenegro, Morocco, Portugal, Slovakia, Spain, Syria, Sweden, Switzerland, Turkey, and United Arab Emirates in the Mediterranean Region, Europe, and Southwest Asia.
25. **Riccia trabutiana** Steph. 1889, Rev. Bryol. Lichen. 16: 65 (Figures 1W, 2R1, 2R2; Appendix Figure 23)

**Syn.**: *Riccia atromarginata* Levier var. *glabra* Levier ex Müll. Frib., Rabenhorst’s Krypt.-Fl., Edition 2, 6: 203 (1907). Jovet-Ast & Bischler (1966): 102, Bischler & Jovet-Ast (1975): 19.

Turkish name: Koyu çatalcık.

**Holotype**: Algerian, Dr Trabut, 1890. Fragment (BM).

Plants rarely forming rosettes, usually gregarious and crowded. Thallus bright blue-green on dorsal side, sometimes tinged with purple-black on acute margins, red-brown at base (Figure 1W); unfolded when dry and showing the black-purplish lateral sides that are whitish at base; thalli 2–3 furcate, ultimate branches 0.5–1(–1.3) mm wide, rounded-obtuse apically; median groove long and narrow, widening to about 1/4 branch width, distinct almost to base. Lateral edges subacute; ventral scales purplish, reaching thallus margin or shorter. Thallus sections of lobes 1–1.5 times wider than high, epidermal layer by a purplish tip, epidermal cells in groove convex or pyriform (Appendix Figure 23). Monoicous. Spores 70–85 µm, red-brown, distal face with 10–12 alveoli across diameter, usually with thin walls and strongly projecting tubercles (Figure 2R1), proximal faces similarly ornamented (Figure 2R2), spore without wing.

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**Appendix Figure 22.** *Riccia subbifurca*: 1- thalli; 2–3- cross-sections of thalli; 4- side of thalli with cilia; 5- cross-section of thalli with capsule; 6- epidermal cells; 7- cells of ventral scale. c, Cilia; dp, parenchyma; ft, chlorenchyma; k, capsule; kp, ventral scale; r, rhizoid.
Riccia trabutiana was collected from subalpine vegetation. It grows on soil in a grassland area near the lake. Accompanying species is R. atromarginata.

Riccia trabutiana can be distinguished from other members of the subgenus Riccia, especially R. atromarginata, by the absence of papillae, deeper blue-green color of thallus, the acute lobe margins, and the smaller size of the spores.

Specimens examined: Muğla, Köyceğiz, Kartal Lake, on soil in grassland near lake, 1903 m, 37°05′48.8″N, 28°51′04.2″E, 07.08.2015, Özenoğlu TR/373.

Distribution: In Turkey, R. trabutiana was reported by Gökler and Öztürk (1991) from West Anatolia without locality details. Riccia trabutiana was recorded for the second time from Turkey (Köyceğiz/Muğla) by Özenoğlu Kiremit and Kırmacı.

Riccia trabutiana is recorded from Albania, Algeria, Baleares, Canary Islands, Crete, Cyprus, France, Greece, Israel, Jordan, Lebanon, Libya, Madeira, Montenegro, Morocco, Oman, Portugal, Saudi Arabia, Sicilia, Socotra, Spain, Tunisia, Turkey, and Yemen in the Mediterranean Region, Europe, and Southwest Asia.

Appendix Figure 23. Riccia trabutiana: 1- thalli; 2–4- cross-sections of thalli; 5- cells of ventral scale. dp, Parenchyma; ft, chlorenchyma; tk, side of thalli.