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The Moss Flora of Kocaçay Delta (Karacabey-Bursa) Floodplain Forest in Turkey

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Abstract

In this study, the moss flora of Kocaçay Delta (Bursa-Karacabey) floodplain forest in Turkey were investigated in 2017. Three hundred eighty three moss samples, were collected and identified from Kocaçay-Delta. A total of 112 taxa belonging to 25 families and 60 genera were determined. In terms of taxa number, the riches six families are; Pottiaceae (26), Brachytheciaceae (15), Bryaceae (10), Hypnaceae (8), Orthotrichaceae (6), Polytrichaceae (5). In terms of genera number, the riches five genera are; *Tortula* (7), *Hypnum* (6), *Orthotrichum* (6), *Weissia* (5), *Ptychostomum* (5). 13 moss taxa are new record for (A1) square.

Key words: Moss, flora, Bursa, Karacabey, A1, Turkey.

Kocaçay Deltası Longoz Ormanlarının (Karacabey-Bursa) Karayosunu Florası

Öz

Bu çalışmada, 2017 yılları arasında Kocaçay Deltası (Bursa-Karacabey) longoz ormanlarının karayosunu florası araştırılmıştır. Kocaçay Deltasından toplanan 383 karayosunu örneğinin incelenmesi sonucu; 25 familyaya ve 60 cinse ait 112 takson belirlenmiştir. Taksonlar açısından en zengin altı familya şu şekildedir; Pottiaceae (26), Brachytheciaceae (15), Bryaceae (10), Hypnaceae (8), Orthotrichaceae (6) ve Polytrichaceae (5)'dir. Takson sayısı bakımından en zengin beş cins; *Tortula* (7), *Hypnum* (6), *Orthotrichum* (6), *Weissia* (5) ve *Ptychostomum* (5). 13 karayosunu taksonu A1 karesi için yeni kayıttır.

Anahtar kelimeler: Karayosunu, flora, Bursa, Karacabey, A1, Türkiye.

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1. Introduction

Owing to rapid population growth and human activities, coastal areas have very intensively been used for tourism, agricultural purposes, the industry sector, and therefore, they have deteriorated irreparably. Coastal areas are also affected by some natural disasters and events, such as extreme storm waves, tsunamis, tides and sea level changes. Ecologically, sustainability of coastal areas is crucial. In particular, lagoon groups, which are constitute about 13 percent of the coasts in the world, are very valuable ecosystems (Saçın, 2010).

Wenger et al. (1990) accentuated the importance and primacy of the studies to characterize the useful structures and plant diversity of this forest owing to decrease in the area for the longoze forest ecosystem in Europe. Additionally, wooded wetlands as a forest stock are the important component to define the bryophyte biodiversity (Schuck et al., 1994; Kavgaci et al., 2007; Işın and Ursavaş, 2018). Even though Kocaçay Delta is a noteworthy area in terms of ecosystem variation, no bryo-floristic study have been conducted in this area until now.

1.1 Study area

Kocaçay Delta (Karacabey-Bursa-) Floodplain Forest has an area of 42.000 hectares. Kocaçay Delta, approximately 25 kilometers north of Bursa-Karacabey, is located on the southern coast of the Marmara Sea. Delta has a great importance for the natural life since there are two shallow lagoons named Dalyan and Arapçiftliği, floodplain forest, lake, swamp, large sand dunes in the area (URL1). There is a wildlife development area (140.000 ha) with hills covered with deciduous forests in the south of the delta (Eken et al., 2006). In this wildlife area, there are Celal Acar Wildlife Rescue and Rehabilitation Training Center (28.611 ha.), Karadere-Pheasant Production Station (annual capacity 5.000) and Orhaneli public hunting area (4.955 ha). Dalyan and Poyraz lakes, which are located in the western part of the Delta and have a total area of 194 hectares, are fed by Malic Creek. There are also reeds covering 600 ha area, floodplain forests consisting of ash, alder and willows spread over an area of 730 hectares, and a large dune band with a wide variety of flora in the western part of the Delta (URL2).

Kocaçay Delta ecosystem diversity in terms of importance in Turkey has a place (Figure 1). The floodplains have many different ecosystems, including open areas, meadows, pastures, dunes, especially deciduous and coniferous forest areas. The vegetation encountered in the area is as follows: *Acer campestre, Alnus glutinosa, Arbutus unedo, Asplenium scolopendrium, Cardamine bulbifera, Carpinus orientalis, C. betulus, Castanea sativa, Centaurium erythraea, Cistus creticus, Cirsium hypoleucum, Cota tinctoria, Cornus sanguinea, Corylus avellana Erica arborea, Ficus carica, Fraxinus angustifolia, F. ornus, Daphne pontica, Lavandula pedunculata* subsp. *cariensis, Periploca graeca, Paliurus spina-christi, Sarcopoterium spinosum, Smilax excelsa, Ruscus aculeatus, Ruscus hypoglossum, Populus alba, Leucojum aestivum, Phillyrea latifolia, Hypericum calycinum, Hypericum perforatum, Quercus coccifera, , Q. frainetto, Q. pubescens, Q. cerris, Vitis sylvestris, Laurus nobilis, Pistacia terebinthus, Pteridium aquilinum, Pinus brutia, P. pinea, Styrax officinalis, Viburnum tinus, Olea eropaea, Calicotome villosa, Spartium junceum, Osyris alba, Hedera helix, Ilex colchica, Prunella vulgaris, Fagus orientalis, Populus tremula, Laurocerasus officinalis, Silene compacta, Tilia tomentosa, Mespilus germanica, Phytolacca americana, Sambucus nigra, Asplenium scolopendrium, Sorbus torminalis, Polypodium vulgare, Taxus baccata, Styrax officinalis.*

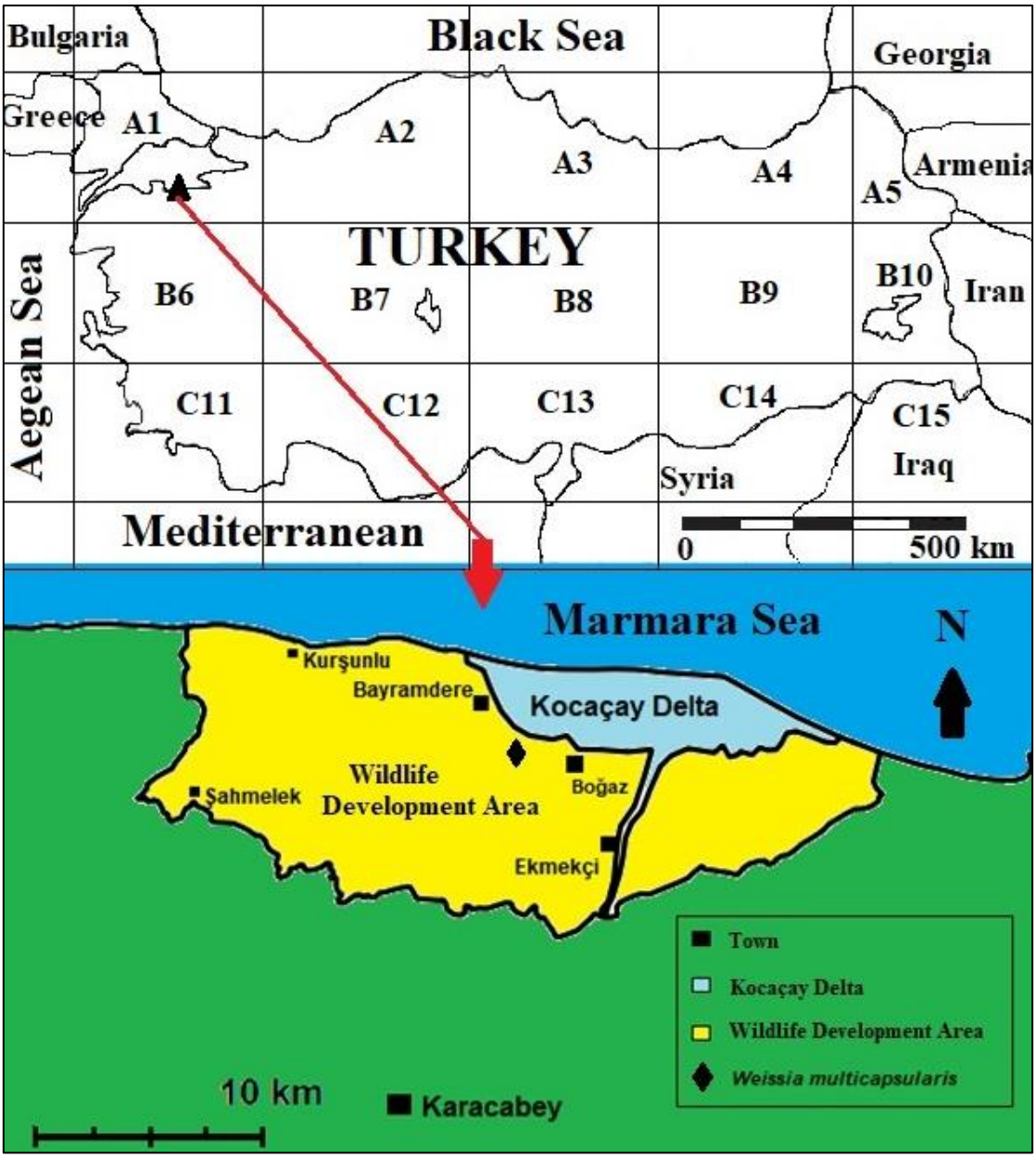

Figure 1. The location of the research area (▲) according to the grid system of Turkey (Henderson, 1961), and locality of *Weissia multicapsularis* (♦).

2. Materials and Methods

This study was carry out in Kocaçay delta longoze forest of Turkey in 2017. During the bryological survey held in the region of Bursa-Karacabey specimens were collected by S. URSAVAŞ and T. KEÇELİ. A total of 383 specimens from 49 locality were collected and kept in the private Herbarium of Serhat Ursavas at Çankırı Karatekin University, Faculty of Forestry. *Weisse multicapsularis* with this study were identified as new records for Turkey (Ursavaş and Keçeli, 2018).

The moss samples were scrutinized with Leica EZ4 HD stereomicroscop and Olympus BX50 light microscope. Identifications were determined by consulting various keys (Lawton 1971; Crum, 1973; Crum and Anderson, 1981; Smith, 1980, 2004; Watson, 1981; Pedrotti, 2001, 2006; Heyn and Herrnstadt, 2004; Greven, 2003; Lüth, 2006a, 2006b, 2006c, 2007, 2008, 2009, 2010).

According to Henderson (1961) grid square, Kocaçay Delta floodplain forests are located in A1 square. Two bryophyte studies have been carried out in Bursa. The first study; was carried

out by Çetin (1999) "The Moss Flora of the Uludağ National Park (Bursa/Turkey). The second study was carried out by Can Gözcü et al. (2018) "Epiphytic bryophyte vegetation of the Samanlı Mountains (Sakarya-Kocaeli-Yalova-Bursa) in Northwest Turkey".

3. Findins

3.1. Abreviations:

■: Second record for Turkish bryophyte flora
*: New record for A1 grid square
**: New record for Bursa
U: Collection number for Serhat URSAVAŞ
Loc: Locality number

3.2. List of collections site

1) Longoz coast, 35T0624870, 4472397, *Fraxinus angustifolia*, sand-reeds field, 4 m, 28.04.2017.
2) Longoz-Dalyan lake, 35T0626566, 4472511, *Paliurus spina-christi*, sand-reeds and bushes field, 3 m, 28.04.2017.
3) Longoz-bird observation tower, 35T0624120, 4472115, *Fraxinus angustifolia, Alnus glutinosa,* reeds and bushes field, 3 m, 29.04.2017.
4) Longoze-northern part, 35T0622245, 4471895, *Fraxinus angustifolia*, swamp-reeds field, 5 m, 29.04.2017.
5) Longoze, 35T0621526, 4471631, *Fraxinus angustifolia, Populus alba,* openness area, 9 m, 29.04.2017.
6) Dalyan lake, 35T0622123, 4471593, *Fraxinus angustifolia,* openness-reeds field, 3 m, 29.04.2017.
7) The inland swamp, 35T0620746, 4471574, *Fraxinus angustifolia, Laurus nobilis, Paliurus spina-christi,* reeds and bushes field, 5 m, 29.04.2017.
8) Hayırlar district, 35T0624636, 4463020, *Pinus brutia, Quercus coccifera, Phillyrea latifolia, Paliurus spina-christi, Arbutus unedo, Erica arborea*, 30 m, 30.04.2017.
9) Ballıkaya district, 35T0625443, 4466986, *Paliurus spina-christi, Styrax officinalis, Arbutus unedo, Quercus coccifera, Laurus nobilis, Cornus sanguinea, Pistacia terebinthus*, 33 m, 30.04.2017.
10) Ekinli district, 35T0628370, 4469124, *Tilia* sp., *Paliurus spina-christi, Styrax officinalis, Arbutus unedo, Quercus coccifera, Fraxinus ornus, Laurus nobilis, Cornus sanguinea, Carpinus orientalis, Pistacia terebinthus, Erica arborea*, 47 m, 30.04.2017.
11) Arapçiftliği, 35T0629993, 4470062, *Fraxinus angustifolia,* swamp-reeds field, 0 m, 01.05.2017.
12) Mesudiye district, 35T0634631, 4470177, *Phillyrea latifolia, Laurus nobilis, Ficus carica*, seaside, 7 m, 01.05.2017.
13) Between Mesudiye and Ballıkaya district, 35T0632003, 4470264, 18 m, *Pinus pinea, Fraxinus ornus, Phillyrea latifolia, Styrax officinalis, Laurus nobilis*, wooded area, 18 m, 01.05.2017.
14) South of longoze, 35T0625537, 4469238, *Quercus cerris, Quercus pubescens, Phillyrea latifolia, Olea eropaea, Paliurus spina-christi, Styrax officinalis, Arbutus unedo, Arbutus andrachne, Quercus coccifera, Fraxinus ornus, Laurus nobilis, Cornus sanguinea, Carpinus orientalis, Pistacia terebinthus, Spartium junceum, Daphne pontica, Erica arborea,* Forest and Pseudo-maquis, 12 m, 13.06.2017.
15) Boğazköy district, 35T0623334, 4469115, *Quercus robur, Quercus cerris, Fraxinus angustifolia, Paliurus spina-christi,* Forest area, 2 m, 13.06.2017.
16) Boğazköy district, 35T0623150, 4469223, *Fraxinus angustifolia, Populus alba, Quercus cerris, Crataegus* sp., *Laurus nobilis*, swamp area, 1 m, 14.06.2017.
17) Boğazköy district, 35T0623323, 4469347, *Fraxinus angustifolia, Paliurus spina-christi,* bush and grassland area, 0 m, 14.06.2017.
18) Boğazköy district, 35T0623415, 4469402, *Fraxinus angustifolia*, thickets, meadows, swamps, wetlands, 0 m, 14.06.2017.
19) South of Bogazköy, 35T0623117, 4468858, *Castanea sativa, Carpinus betulus, Phillyrea latifolia, Styrax officinalis, Ilex colchica, Laurus nobilis, Daphne pontica, Ficus carica*, Forest area, 25 m, 14.06.2017.
20) South of Bogazköy, 35T0623097, 4468713, *Carpinus betulus, Castanea sativa, Styrax officinalis, Ilex colchica, Laurus nobilis, Daphne pontica,* Forest area, 59 m, 14.06.2017.
21) Celal Acar Wildlife Rescue and Rehabilitation Center, Ovakorusu Bear Shelter, 35T0620431, 4469093, *Pinus pinea* plantation forest, 12 m, 14.06, 2017.
22) Şahmelek district, 35T0605896, 4465671, *Carpinus betulus, Fagus orientalis,* 459 m, 15.06.2017.
23) Between Şahmelek and Kurşunlu district, 35T0607293, 4467186, *Fagus orientalis, Carpinus betulus, Alnus glutinosa, Castanea sativa, Populus tremula, Erica arborea, Laurocerasus officinalis*, 504 m, 15.06.2017.
24) Between Şahmelek and Kurşunlu district, 35T0608350, 4466943, *Fagus orientalis, Carpinus betulus, Castanea sativa, Alnus*

glutinosa, Populus tremula, Erica arborea, Daphne pontica, 498 m, 15.06.2017.

25) Between Şahmelek and Kurşunlu district, 35T0608379, 4466981, *Fagus orientalis, Carpinus betulus, Castanea sativa, Alnus glutinosa, Populus tremula, Erica arborea, Daphne pontica,* 487 m, 15.06.2017.

26) Between Şahmelek and Kurşunlu district, 35T0609283, 4466650, *Castanea sativa, Fagus orientalis, Carpinus betulus, Daphne pontica,* 448 m, 15.06.2017.

27) Between Şahmelek and Kurşunlu district, 35T0606795, 4468164, *Fagus orientalis ormanı, Daphne pontica,* 690 m, 15.06.2017.

28) Between Şahmelek and Kurşunlu district, 35T0606758, 4469698, *Fagus orientalis ormanı, Laurocerasus officinalis, Ilex colchica, Sambucus nigra,* 769 m, 15.06.2017.

29) Between Şahmelek and Kurşunlu district, 35T0607757, 4470829, *Fagus orientalis, Carpinus betulus, Sambucus nigra,* 567 m, 15.6.2017.

30) Kurşunlu district, 35T0607742, 4471178, *Fagus orientalis, Carpinus betulus, Castanea sativa, Populus tremula, Erica arborea, Daphne pontica, Sambucus nigra,* 436 m, 15.06.2017.

31) Yeniköy district, 35T0611295, 4472668, *Fagus orientalis, Castanea sativa, Carpinus betulus,* 8 m, 15.06.2017.

32) Yarış district, 35T0615491, 4462380, *Carpinus betulus, Sorbus torminalis, Daphne pontica,* 389 m, 16.06.2017.

33) Güngörmez district, 35T0614686, 4464451, *Fagus orientalis* ormanı, *Quercus cerris, Quercus. frainetto, Carpinus betulus, Castanea sativa, Sorbus torminalis, Populus tremula, Erica arborea, Daphne pontica,* 461 m, 16.06.2017.

34) Güngörmez district, 35T0615160, 4465961, *Fagus orientalis ormanı, Carpinus betulus, Castanea sativa, Sorbus torminalis, Populus tremula, Erica arborea, Daphne pontica, Sambucus ebulus, Hypericum calycinum, Cirsium hypoleucum,* 452 m, 16.06.2017.

35) Between Güngörmez and Yarış district, 35T0614729, 4467594, *Fagus orientalis ormanı, Carpinus orientalis, Castanea sativa, Sorbus torminalis, Laurocerasus officinalis, Erica arborea, Daphne pontica,* 472 m, 16.06.2017.

36) Between Güngörmez and Yarış district, 35T0614860, 4468612, *Fagus orientalis, Carpinus betulus, Castanea sativa, Sorbus torminalis, Laurocerasus officinalis, Erica arborea, Daphne pontica,* 454 m, 16.06.2017.

37) Yarış district, 35T0614673, 4469097, *Fagus orientalis* ormanı, *Carpinus betulus, Castanea sativa, Sorbus torminalis, Laurocerasus officinalis, Erica arborea, Vaccinium arctostaphylos,* 491 m, 16.06.2017.

38) Çeşme district, 35T0616828, 4461887, *Quercus cerris, Quercus frainetto, Carpinus betulus, Sorbus torminalis, Erica arborea, Daphne pontica, Cistus creticus,* 387 m, 16.06.2017.

39) Çamlıca district, 35T0626459, 4463108, *Pinus brutia, Quercus pubescens, Q. cerris, Phillyrea latifolia, Pistacia terebinthus, Arbutus unedo, Laurus nobilis, Erica arborea, Daphne pontica,* 46 m, 16.06.2017.

40) Wind Power Plant, 35T0633853, 4467980, *Quercus pubescens, Q. cerris, Q. coccifera, Phillyrea latifolia, Styrax officinalis, Pistacia terebinthus, Pyrus elaeagniifolia, Paliurus spina-christi, Spartium junceum,* 309 m, 16.06.2017.

41) Between Boğazköy and Yenice district, 35T0619771, 4469010, *Pinus brutia, Quercus cerris, Q. frainetto, Q. coccifera, Acer campestre, Carpinus betulus, Styrax officinalis, Populus tremula, Paliurus spina-christi, Erica arborea, Cistus creticus, Phillyrea latifolia, Pistacia terebinthus, Arbutus unedo, Laurus nobilis, Erica arborea, Ruscus aculeatus,* 44 m, 17.06.2017.

42) Bayramdere district, 35T0618415, 4467705, *Fagus orientalis, Carpinus betulus, Castanea sativa, Quercus frainetto, Q. cerris, Platanus orientalis, Alnus glutinosa, Acer campestre, Styrax officinalis, Populus tremula, Paliurus spina-christi, Erica arborea, Cistus creticus, Phillyrea latifolia, Laurus nobilis, Pistacia terebinthus, Arbutus unedo, Laurus nobilis, Erica arborea,* 166 m, 17.06.2017.

43) Bayramdere dam pond, 35T0617857, 4466964, *Fagus orientalis, Carpinus betulus, Castanea sativa, Quercus cerris, Platanus orientalis, Laurocerasus officinalis, Acer campestre, Styrax officinalis, Populus tremula, Paliurus spina-christi, Erica arborea, Laurus nobilis, Pistacia terebinthus,* 244 m, 17.06.217.

44) Bayramdere dam pond, 35T0617244, 4465671, *Quercus cerris, Q. frainetto, Fagus orientalis, Carpinus betulus,* 325 m, 17.06.2017.

45) Çeşme district, 35T0617182, 4466355, *Fagus orientalis, Carpinus betulus, Castanea sativa, Erica arborea, Cistus creticus,* 315 m, 17.06.2017.

46) The northern part of Bayramdere, 35T0616657, 4470496, *Castanea sativa,*

Carpinus betulus, Fagus orientalis, Platanus orientalis, Taxus baccata, Corylus avellana, Styrax officinalis, Laurocerasus officinalis, Laurus nobilis, Populus tremula, Arbutus unedo, Erica arborea, Sambucus ebulus, 152 m, 17.06.2017.

47) Bayramdere district, 35T0615043, 4470694, *Fagus orientalis, Castanea sativa, Carpinus betulus, Platanus orientalis, Ficus carica, Pteridium aquilinum, Sorbus torminalis, Erica arborea*, 344 m, 17.06.2017.

48) Bayramdere district, 35T0614407, 4471119, *Fagus orientalis, Castanea sativa, Carpinus betulus, Daphne pontica*, 430 m, 17.06.2017.

49) Between Yeniköy and Kurşunlu, 35T0613572, 4473027, *Laurus nobilis, Styrax officinalis,* 83 m, 17.06.2017.

3.3 Plant list

The bryoploristic list Nomenclature of the species follows Ros et al. (2013), Plášek et al. (2015) and Lara et al. (2016).

BRYOPHYTA Schimp.

Polytrichaceae Schwägr.

**Atrichum tenellum* (Röhl.) Bruch & Schimp.
Loc: 112, 120, on soil, U2854; U2853;
Atrichum undulatum (Hedw.) P. Beauv.
Loc: 107, 112, on soil, U2852; U2851;
Pogonatum aloides (Hedw.) P. Beauv.
Loc: 107, 112, 114, 118, on soil, U2857; U2856; U2858; U2855;
***Polytrichum formosum* Hedw.
Loc: 112, on soil, U2849;
Polytrichum juniperinum Hedw.
Loc: 129, on rock, U2850;

Funariaceae Schwägr.

Funaria hygrometrica Hedw.
95, 100, on soil, U2835; U2836;

Grimmiaceae Arn.

Grimmia pulvinata (Hedw.) Sm.
Loc: 128, on soil, U2888;
Grimmia trichophylla Grev.
Loc: 122, on concrete, U2890; Loc: 103, 109, on rock, U2892; U2891;
***Grimmia lisae* De Not.
Loc: 103, on rock, U2889;
Schistidium confertum (Funck) Bruch & Schimp.
Loc: 122, on concrete, U2887;

Fissidentaceae Schimp.

***Fissidens bryoides* Hedw.
Loc: 107, 109, 116, 117, 118, on soil, U2897; U2898; U2896; U2899; U2900;
***Fissidens taxifolius* Hedw.
Loc: 103, 107, 125,126, 132, on soil, U2860; U2862; U2894; U2895; U2893;
**Fissidens viridulus* var. *viridulus* (Sw. ex anon.) Wahlenb.
Loc: 92, 106, on soil, U2859; U2864;
***Fissidens viridulus* var. *incurvus* (Starke ex Röhl.) Waldh.
Loc: 113, on soil, U2861;

Ditrichaceae Limpr.

**Ceratodon conicus* (Hampe) Lindb.
Loc: 129, on rock, U2903;
Ceratodon purpureus (Hedw.) Brid.
Loc: 128, on rock, U2906;
***Ditrichum heteromallum* (Hedw.) E.Britton
Loc: 94, 113, on soil, U2907; U2908;
***Pleuridium subulatum* (Hedw.) Rabenh.
Loc: 108, on soil, U2911;

Dicranaceae Schimp.

***Dicranella heteromalla* (Hedw.) Schimp.
Loc: on soil, U2902;
**Dicranella subulata* (Hedw.) Schimp.
Loc: 112, 118, on soil, U2914; U2913;
Dicranum scoparium Hedw.
Loc: 106, 117, on soil, U2909; U2910;

Rhabdoweisiaceae Limpr.

***Dicranoweisia cirrata* (Hedw.) Lindb.
Loc: 126; on oak bark, U3091;

Pottiaceae Schimp.

***Barbula convoluta* Hedw.
Loc: 119, on bark, U3064; Loc: 133, on rock, U3065;
Barbula unguiculata Hedw.
Loc: 94, 133, on soil, U3064; U3067;
Didymodon ferrugineus (Schimp. ex Besch.) M.O.Hill
Loc: 93, on concrete, U3052;
***Didymodon sinuosus* (Mitt.) Delogne
Loc: 92, on soil, U3061; Loc: 117, on bark, U3060;
***Didymodon tophaceus* (Brid.) Lisa
Loc: 105, 115, on soil, U3056;U3057;
***Gymnostomum aeruginosum* Sm.
Loc: 118, on log, U3050;
***Leptobarbula berica* (De Not.) Schimp.
Loc: 87, on soil, U3048;
**Stegonia latifolia* (Schwägr.) Venturi ex Broth.
Loc: 94, on soil, U3049;
***Syntrichia laevipila* Brid.
Loc: 85, 99, 101, on bark, U3076; U3074; U3075;
**Syntrichia latifolia* (Bruch ex Hartm.) Huebener
Loc: 101, on bark, U3045;
***Syntrichia papillosa* (Wilson) Jur.
Loc: 99, on bark, U3046;
Syntrichia ruralis var. *ruraliformis* (Besch.) Delogne
Loc: 78, on soil, U2803;
***Tortella flavovirens* (Bruch) Broth.
Loc: 87, on bark, U3047;
***Tortella squarrosa* (Brid.) Limpr.
Loc: 85, on soil, U3051;
**Tortula canescens* Mont.

Loc: 124, rock crevices, U3043;
****Tortula marginata** (Bruch & Schimp.) Spruce
Loc: 118, on soil, U3055;
****Tortula muralis** Hedw.
Loc: 94, 122, on concrete, U3053; U3054;
****Tortula muralis** var. *aestiva* Brid. ex Hedw.
Loc: 110, 117, on soil, U3077; U3078;
Tortula subulata Hedw.
Loc: 118, on soil, U3058; Loc: 128, on rock, U3059;
****Tortula truncata** (Hedw.) Mitt.
Loc: 87, 95, on soil, U3084; U3083;
***Tortula vahliana** (Schultz) Mont.
Loc: 89, on bark, U3044;
****Trichostomum brachydontium** Bruch
Loc: 92, 103, 125, on soil, U3089; U3087; U3085; Loc: 94, 98, on rock, U3086; U3088;
****Weissia brachycarpa** (Nees & Hornsch.) Jur.
Loc: 94, 106, 108, 119, on soil, U3080; U3079; U3081; U3082;
****Weissia condensa** (Voit) Lindb.
Loc: 105, 117, 128, on soil, U3072; U3073; U3071;
****Weissia controversa** Hedw.
Loc: 91, 104, on soil, U3070; U3069; Loc: 123, on bark, U3068;
Weissia multicapsularis (Sm.) Mitt.,
Loc: 105, on soil, U3090;
****Weissia rutilans** (Hedw.) Lindb.
Loc: 127, 129, on rock, U3063; U3062;
Bryaceae Schwägr.
****Bryum dichotomum Hedw.**
Loc: 98, on soil, U2968; Loc: 128, on rock, U2967;
****Bryum gemmiparum** De Not.
Loc: 100, on wet soil, U2962;
****Bryum subapiculatum** Hampe
Loc: 87, 117, on soil, U2969; U2963,
Imbribryum alpinum (Huds. ex With.) N. Pedersen
Loc: 85, 86, 90, 106, on soil, U2977; U2978; U2979; U2976;
Ptychostomum capillare (Hedw.) Holyoak & N. Pedersen
Loc: 88, 116, on decayed log, U2987; U2989; Loc: 108, 111, on soil, U2983; U2990; Loc: 87, 106, 117, U2988, U2986, U2984;
****Ptychostomum imbricatulum** (Müll. Hal.) Holyoak & N. Pedersen
Loc: 93, 88, 123, on soil, U2964; U2973; U2974; Loc: 106, on bark, U2975;
Ptychostomum pallens (Sw.) J.R. Spence
Loc: 116, on bark, U2965;
****Ptychostomum pseudotriquetrum** (Hedw.) J.R.Spence & H.P.Ramsay
Loc: 85, on soil, U2972;
Ptychostomum torquescens (Bruch & Schimp.) Ros & Mazimpaka
Loc: 93, 117, on soil, U2982; U2981; Loc: 116, on bark, U2980;
Mniaceae Schwägr.
****Epipterygium tozeri** (Grev.) Lindb.
Loc: 104, 131, on soil, U2970; U2971;
****Plagiomnium affine** (Blandow ex Funck) T.J. Kop.
Loc: 109, on rock, U2841;
****Plagiomnium elatum** (Bruch & Schimp.) T.J.Kop.
Loc: 87, 109, on soil, U2844; U2842; Loc: 127, on rock, U2843;
Plagiomnium undulatum (Hedw.) T.J. Kop.
Loc: 114, on soil, U2840;
Rhizomnium punctatum (Hedw.) T.J.Kop.
Loc: 114, 119, 131, on soil, U2848; U2847;U2846; Loc: 114, on rock, U2845;
Orthotrichaceae Arn.
Orthotrichum affine Schrad. ex Brid.
Loc: 91, 94, 101, 103, 106, 108, 109, 116, 119, 122, on bark, U2924; U2930; U2926; U2931; U2929; U2927; U2928; U2925; U2923; U2932;
****Orthotrichum anomalum** Hedw.
Loc: 104, on rock, U2915;
****Orthotrichum diaphanum** Brid.
Loc: 85, 92, 98, on bark, U2922; U2921; U2920;
****Orthotrichum lyellii** Hook. & Taylor (pulvigeria)
Loc: 110, on bark, U2917;
***Orthotrichum patens** Bruch & Brid.
Loc: 89, on bark, U2916;
****Orthotrichum stramineum** Hornsch. ex Brid.
Loc: 87, 99, on bark, U2919; U2918;
Amblystegiaceae G. Roth.
Amblystegium serpens var. *juratzkanum* (Schimp.) Rau & Herv.
Loc: 101, on bark, U2831;
****Drepanocladus aduncus** (Hedw.) Warn
Loc: 85, on soil, U2830;
****Leptodictyum riparium** (Hedw.) Warnst.
Loc: 90, on bark, U2833; Loc: on decayed log, U2834;
***Campylopus subulatus** Schimp. ex Milde
Loc: 106, 121, on soil, U2901; U2912;
***Pseudoleskeella catenulata** (Brid. ex Schrad.) Kindb.
Loc: 125, on soil, U2828;
****Pseudoleskeella rupestris** (Berggr.) Hedenäs & L. Söderstr.
Loc: 94, on rock, U2829;
Brachytheciaceae G. Roth.
■ *Brachythecium capillaceum* (F.Weber & D.Mohr) Giacom.
Loc: 93, on rock, U2995;
Brachythecium rutabulum (Hedw.)Schimp.
Loc: 87, 88, 100, on soil, U3019, U3020; U3018;
****Cirriphyllum crassinervium** (Taylor) Loeske & M.Fleisch.

Loc: 104, on rock, U3014; Loc: 130, on log, U3013;
****Eurhynchium striatum** (Hedw.) Schimp.
Loc: 95, on soil, U3000;
****Homalothecium lutescens** (Hedw.) H. Rob.
Loc: 90, 99, 119, on bark, U3029; U3026; U3027; Loc: 130, on rock, U3028;
****Homalothecium philippeanum** (Spruce) Schimp.
Loc: 106, 126, on bark, U3002; U3003; Loc: 132, U3004;
Homalothecium sericeum (Hedw.) Schimp.
Loc: 93, 118, 128, on bark, U3016; U3015; U3017;
****Kindbergia praelonga** (Hedw.) Ochyra
Loc: 90, 91, on bark, U3040; U3042; Loc: 118, on decayed log, U3038; Loc: 91, 94, on soil, U3041; U3036; Loc: 114, 122, on wet rock, U3039; U3001;
****Microeurhynchium pumilum** (Wilson) Ignatov & Vanderp.
Loc: 93, 94, 126, on soil, U3032; U3035; Loc: 93, on bark, U3034; Loc: 130, on rock, U3031;
****Oxyrrhynchium schleicheri** (R.Hedw.) Röll
Loc: 86, 92, on soil, U3025; U3023; Loc: 103, on bark, U3024;
****Pseudoscleropodium purum** (Hedw.) M. Fleisch.
Loc: 92, 125, on soil, U2994; U2999;
****Rhynchostegium confertum** (Dicks.) Schimp.
Loc: 98, on bark, U2992; Loc: 103, 127, on rock, U2993, U2998;
***Sciuro-hypnum starkei** (Brid.) Ignatov & Huttunen
Loc: 92, 123, on soil, U3012, U3011;
****Scleropodium cespitans** (Müll. Hal.) L.F. Koch
Loc: 94, 123, on soil, U3009; U3007; Loc: 93, 127, on rock, U3008, U3010;
****Scleropodium touretii** (Brid.) L.F. Koch
Loc: 93, on rock, U3022;
Hypnaceae Schimp.
****Calliergonella cuspidata** (Hedw.) Loeske
Loc: 91, on soil, U2832;
****Hypnum cupressiforme** Hedw. var. *cupressiforme*
Loc: 106, 111, 117, on bark, U2960; U2961; Loc: 94, on soil, U2956; Loc: 121, 131, on decayed log, U2958; U2959;
****Hypnum cupressiforme** Hedw. var. *filiforme* Brid.
Loc: 94, 109, 116, 119, 128, on bark, U2941; U2945; U2943; U1942; U2944;
****Hypnum cupressiforme** Hedw. var. *lacunosum* Brid.
Loc: 87, 123, on bark, U2952; U2950; Loc: 90, on log, U2949; Loc: 117, on soil, U2953;
****Hypnum cupressiforme** Hedw. var. *resupinatum* (Taylor) Schimp.
Loc: 87, 106, 110, on bark, U2947; U2948; U2946;
***Hypnum cupressiforme** Hedw. var. *subjulaceum* Molendo
Loc: 85, on bark, U2955; Loc: 117, on soil, U2954;
****Hypnum imponens** Hedw.
Loc: 108, on bark, U2940;
■ *Pseudotaxiphyllum elegans* (Brid.) Z.Iwats
Loc: 111, on bark, U2935;
Hylocomiaceae M. Fleisch.
****Ctenidium molluscum** (Hedw.) Mitt
Loc: 120, on roil, U2475;
Plagiotheciaceae (Broth.) M. Fleisch.
****Plagiothecium cavifolium** (Brid.) Z.Iwats.
Loc: 111, 112, on bark, U2938, U2937;
****Plagiothecium laetum** Schimp.
Loc: 113, 131, on soil, U2934; U2936;
Cryphaeaceae Schimp.
****Cryphaea heteromalla** (Hedw.) D. Mohr
Loc: 92, 99, on bark, U2838; U2839;
Leucodontaceae Schimp.
****Antitrichia curtipendula** (Hedw.) Brid.
Loc: 109, 117, on bark, U2991; U2866;
Leucodon sciuroides (Hedw.) Schwägr.
Loc: 87, 90, 99, 100, 113, on bark, U2868; U2837; U2870; U2867;
Leptodontaceae Schimp.
****Leptodon smithii** (Hedw.) F.Weber & D.Mohr
Loc: 89, 93, 99, 126, on bark, U2877; U2875; U2874; U2878; Loc: 103, on rock, U2876;
Neckeraceae Schimp.
****Alleniella besseri** (Lobarz.) S.Olsson, Enroth & D.Quandt
Loc: 103, 131, on rock, U2872; U2873;
****Alleniella complanata** (Hedw.) S. Olsson, Enroth & D.Quandt
Loc: 112, on bark, U2879; Loc: 132, on soil, U2880;
****Neckera pumila** Hedw.
Loc: 99, on bark, U2871;
Thamnobryum alopecurum (Hedw.) Gangulee
Loc: 103, 127, on rock, U2883, U2885; Loc: 130, on soil, U2884;
Lembophyllaceae Broth.
Isothecium alopecuroides (Lam. ex Dubois) Isov.
Loc: 93, on bark, U3006; Loc: 113, on rock, U3005;
****Isothecium holtii** Kindb.
Loc: 108, on rock, U2996; Loc: 111, on bark, U2997;
Anomodontaceae Kindb.
****Anomodon viticulosus** (Hedw.) Hook. & Taylor
Loc: 131, on rock, U2882;

4. Results and Discussion

As a results of bryofloristic study in the area; in a total 112 taxa belonging to 22 families and 60 genera were determined. Among them *Weissia multicapsularis* (Sm.) Mitt. (Figure 2) was recorded the first time from Turkey with the this study (Ursavaş and Keçeli, 2018). And also *Pseudotaxiphyllum elegans* (Brid.) Z.Iwats and *Brachythecium capillaceum* (F.Weber & D.Mohr) Giacom are recorded for the second time from Turkey.

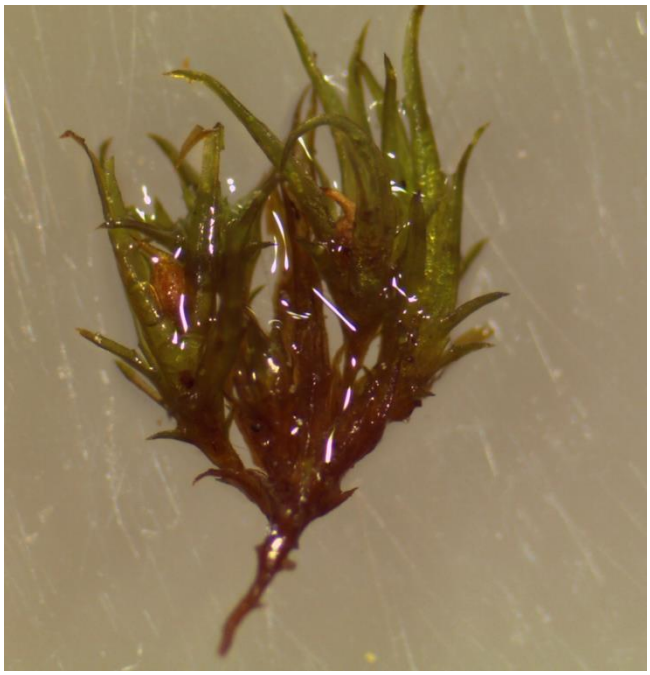

Figure 2. Photo of *Weissia multicapsularis* (original)

Furthermore, according to the Henderson (1961)'s Turkey grid system, 13 of these taxa are new records for the A1 grid square: *Atrichum tenellum* (Röhl.) Bruch & Schimp., *Ceratodon conicus* (Hampe) Lindb., *Campylopus subulatus* Schimp. ex Milde, *Dicranella subulata* (Hedw.) Schimp., *Fissidens viridulus* var. *viridulus* (Sw. ex anon.) Wahlenb., *Orthotrichum patens* Bruch & Brid., *Pseudoleskeella catenulata* (Brid. ex Schrad.) Kindb., *Stegonia latifolia* (Schwägr.) Venturi ex Broth., *Sciuro-hypnum starkei* (Brid.) Ignatov & Huttunen, *Syntrichia latifolia* (Bruch ex Hartm.) Huebener, *Tortula canescens* Mont., *Tortula vahliana* (Schultz) Mont., *Hypnum cupressiforme* Hedw. var. *subjulaceum* Molendo (Çetin and Uyar, 1997; Çetin, 1999; Uyar and Çetin, 2006; Keçeli and Çetin, 2006; Ören et al., 2010, 2012; Keçeli et al., 2012; Ros et al., 2013).

So far, there has been only two bryophyte study in the province of Bursa (Çetin, 1999 and Can Gözcü et al., 2018). Bryophyte studies in Bursa were examined and 69 taxa from these studies are new records for the Bursa province.

According to Table 1. the richest families in terms of a number of taxa, respectively, are: Pottiaceae (27), Brachytheciaceae (15), Bryaceae (9), Hypnaceae (8), Amblystegiaceae (6), Orthotrichaceae (6), Polytrichaceae (5), Mniaceae (5). *Tortula* (Pottiaceae) is the most species rich genus in the sutdy area. The present study compared with the other studies that are closest to the study area. The comparison of the floristic studies according to the families is given in Table 2 and the genus level is given in Table 3.

Table 1. The distributions of taxa on the family level in the study area

Family No	Family	The number of genus	Genus	The number of taxa
1	**Brachytheciaceae**	11	*Brachythecium*	2
			Cirriphyllum	1
			Eurhynchium	1
			Homalothecium	3
			Kindbergia	1
			Microeurhynchium	1
			Oxyrrhynchium	1
			Pseudoscleropodium	1
			Rhynchostegium	1
			Sciuro-hypnum	1
			Scleropodium	2
2	**Pottiaceae**	10	*Barbula*	2
			Didymodon	3
			Gymnostomum	1
			Leptobarbula	1
			Stegonia	1
			Syntrichia	4
			Tortella	2
			Tortula	7
			Trichostomum	1
			Weissia	5
3	**Amblystegiaceae**	5	*Amblystegium*	1
			Drepanocladus	1
			Leptodictyum	1
			Campylopus	1
			Pseudoleskeella	2
4	**Polytrichaceae**	3	*Atrichum*	2
			Pogonatum	1
			Polytrichum	2
5	**Ditrichaceae**	3	*Ceratodon*	2
			Ditrichum	1
			Pleuridium	1
6	**Bryaceae**	3	*Bryum*	3
			Imbribryum	1
			Ptychostomum	5
7	**Mniaceae**	3	*Epipterygium*	1
			Plagiomnium	3
			Rhizomnium	1
8	**Hypnaceae**	3	*Calliergonella*	1
			Hypnum	6
			Pseudotaxiphyllum	1
9	**Neckeraceae**	3	*Alleniella*	2
			Neckera	1
			Thamnobryum	1
10	**Grimmiaceae**	2	*Grimmia*	3
			Schistidium	1
11	**Dicranaceae**	2	*Dicranella*	2
			Dicranum	1
12	**Leucodontaceae**	2	*Antitrichia*	1
			Leucodon	1
13	**Orthotrichaceae**	1	*Orthotrichum*	6
14	**Hylocomiaceae**	1	*Ctenidium*	1
15	**Plagiotheciaceae**	1	*Plagiothecium*	2
16	**Cryphaeaceae**	1	*Cryphaea*	1
17	**Leptodontaceae**	1	*Leptodon*	1
18	**Funariaceae**	1	*Funaria*	1
19	**Fissidentaceae**	1	*Fissidens*	4
20	**Rhabdoweisiaceae**	1	*Dicranoweisia*	1
21	**Lembophyllaceae**	1	*Isothecium*	2
22	**Anomodontacea**	1	*Anomodon*	1
	TOTAL	**60**		**112**

Table 2. Comparison with the families in some bryophyte flora studies in A1 square.

Bryophyte Studies	The Moss Flora of Kocaçay Delta Floodplain Forest in Turkey (2019)		The Moss Flora of İğneada Floodplain Forests National Park (2018)		Contribution to The Bryophyte Flora of European (2008)		Contribution to The Bryophyte Flora of Turkish Thrace (2003)	
Families	**The number of taxa**	**%**	**The number of taxa**	**%**	**The number of taxa**	**%**	**The number of taxa**	**%**
Pottiaceae	27	24	20	19	33	26.2	46	36.8
Brachytheciaceae	15	13	14	13.3	19	15.1	18	14.4
Bryaceae	9	8	6	5.7	14	11.1	11	8.8
Hypnaceae	8	7	6	5.7	3	2.4	4	3.2
Amblystegiaceae	6	5.3	2	1.9	5	4	4	3.2
Orthotrichaceae	6	5.3	9	8.6	10	7.9	10	8
Polytrichaceae	5	4.4	9	8.6	4	3.2	4	3.2
Mniaceae	5	4.4	4	3.9	4	3.2	1	0.8
Fissidentaceae	4	4.5	4	3.9	7	5.6	-	-
Neckeraceae	4	4.5	2	1.9	3	2.4	-	-
Grimmiaceae	4	4.5	4	3.9	5	4	4	3.2
Dicranaceae	4	4.5	2	1.9	2	1.6	4	3.2
Ditrichaceae	3	2.6	2	1.9	5	4	5	4
Leucodontaceae	2	1.7	2	1.9	2	1.6	1	0.8
Plagiotheciaceae	2	1.7	2	1.9	2	1.6	-	-
Lembophyllaceae	2	1.7	1	0.9	1	0.8	1	0.8
Hylocomiaceae	1	0.8	-	-	-	-	-	-
Cryphaeaceae	1	0.8	1	0.9	-	-	-	-
Leptodontaceae	1	0.8	-	-	-	-	-	-
Funariaceae	1	0.8	4	3.9	1	0.8	1	0.8
Anomodontacea	1	0.8	2	1.9	1	0.8	-	-
Rhabdoweisiaceae	1	0.8	-	-	-	-	-	-

Table 3. Compared with the genus in some bryophyte flora studies in A1 square

Bryophyte Studies	The Moss Flora of Kocaçay Delta Floodplain Forest in Turkey (2019)		The Moss Flora of İğneada Floodplain Forests National Park (2018)		Contribution to The Bryophyte Flora of European (2008)		Contribution to The Bryophyte Flora of Turkish Thrace (2003)	
Families	**The number of taxa**	**%**	**The number of taxa**	**%**	**The number of taxa**	**%**	**The number of taxa**	**%**
Tortula	7	6.2	5	4.8	5	4	15	12
Hypnum	6	5.4	4	3.8	2	1.6	2	1.6
Orthotrichum	6	5.4	9	8.6	9	7.1	9	7.2
Weissia	5	4.4	4	3.8	3	2.4	4	3.2
Ptychostomum	5	4.4	3	2.9	-	-	-	-
Syntrichia	4	3.6	4	3.8	5	4	-	-
Fissidens	4	3.6	4	3.8	7	5.6	10	8
Homalothecium	3	2.6	2	1.9	4	3.2	3	2.4
Didymodon	3	2.6	-	-	-	-	-	-
Bryum	3	2.6	2	1.9	14	11	11	8.8
Dicranella	3	2.6	1	1	1	0.8	2	1.6
Grimmia	3	2.6	3	2.9	2	1.6	3	2.4
Plagiomnium	3	2.6	3	2.9	1	0.8	-	-
Brachythecium	2	1.8	4	3.8	3	2.4	3	2.4
Scleropodium	2	1.8	2	1.9	1	0.8	3	2.4
Barbula	2	1.8	2	1.9	1	0.8	2	1.6
Tortella	2	1.8	-	-	-	-	-	-
Pseudoleskeella	2	1.8	-	-	-	-	-	-
Atrichum	2	1.8	4	3.8	2	1.6	-	-
Polytrichum	2	1.8	3	2.9	2	1.6	1	0.8
Ceratodon	2	1.8	-	-	-	-	-	-
Alleniella	2	1.8	-	-	-	-	-	-

According to Table 2, it is expected that the families of Pottiaceae and Brachytheciaceae will share the first two places. The Orthotrichaceae family is highly represented in the European continent (9-10), while the Kocaçay Delta (6) remains low (Asia). This may be due to continental differences or tree species diversity and age differences.

According to Table 3, there are differences in the number of taxa determined from research areas. This can probably be related to the size of the study areas.

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