

*Original research***Macrofungal biodiversity of Reşadiye (Tokat) district****Hakan IŞIK¹**, **İbrahim TÜRKEKUL^{2,*}**, **Mete KOYUNCU³**¹Tokat Science and Art Center, Tokat, Turkey²Department of Biology, Faculty of Arts and Sciences, Gaziosmanpaşa University, Tokat, Turkey³Tokat State Hospital, 60200, Tokat, Turkey

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Abstract: Studies on the identification of the mushrooms diversity in the world have increased in recent years. In this present study, the macrofungal diversity of Reşadiye district of Tokat province has been revealed. Reşadiye district located to the east of Tokat province has about 11 % of the forest area of Tokat. The vegetation of the district shows the characteristic of Europe-Siberia and Iran-Turan floristic regions. Fifty-three species belonging to 2 divisions, 26 families and 42 genera were identified as a result of field and laboratory studies between 2014 and 2017 years. Of them, five species belong to *Ascomycota*, and 48 species belong to *Basidiomycota* divisions. Species collected and consumed by the local people in the Reşadiye district are *Morchella elata*, *Agaricus campestris*, *Amanita vaginata*, *Boletus edulis*, *Marasmius oreades*, *Lactarius deliciosus* and *Lactarius semisanguifluus*.

Keywords: biodiversity, macrofungi, Reşadiye, taxonomy, Tokat

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Introduction

Reşadiye district is located to the east of Tokat province surrounded by Almus (Tokat) in the south; Aybastı (Ordu) and Gökçöy (Ordu) in the north; Koyunhisar (Sivas) and Mesudiye (Ordu) in the east, and Niksar (Tokat) and Başçiftlik (Tokat) in the west (Figure 1).

The being in high altitude is the most distinctive feature of the district (average height: 1500 m). Reşadiye is a transition zone between Central Black Sea Region and Central Anatolia. Reşadiye has a transition climate between the Middle and East Black Sea climate with the continental climate. The temperature of district is at -0.8 °C to 29.6 °C. The average annual temperature is 12.6 °C. The annual precipitation is 449.8 mm and the annual average humidity is 60%. The research area is located in a transitional zone of Euro-Siberian and Irano-Turanian phytogeographical regions. In this study, the research area has about 11% of the forest areas of Tokat province (Tokat: 443.438 ha, Reşadiye: 47.12 ha). The forest

vegetation of Reşadiye is dominated by *Pinus sylvestris* L., *Pinus nigra* J.F. Arnold and members of the genera *Quercus*, *Abies*, *Carpinus*, *Cedrus*. Members of the genera *Corylus*, *Pyrus*, *Crataegus*, *Rosa* also are found in this vegetation. Members of the genera *Populus* and *Salix* are mostly found in the valleys (Yeşil, 2009; Anonymous, 2017).

According to Sesli and Denchev (2014), 2158 macrofungi species, 215 of belonging to *Ascomycota* division and 1943 of belonging to *Basidiomycota* division, were recorded for Turkish mycota between 1915-2014 years. This number is increasing with systematic studies in recent years such as: Acar et al. (2015), Sesli et al. (2015), Taşkın et al. (2015), Türkekul ve Işık (2016a), Akata et al. (2016a, 2016b), Sesli and Topçu Sesli (2016), Uzun and Kaya (2017), Işık and Türkekul (2017), Türkekul (2017), Akata and Uzun (2017), Sesli and Topçu Sesli (2017a, 2017b), Sesli et al. (2017), Uzun et al. (2017), Akata (2017), Uzun and Acar (2018), Sesli et al. (2018),

Işık and Türkekul (2018), Uzun and Kaya (2018). The aim of this study was to determine the diversity of macrofungi of Reşadiye district and contribute for the Turkish mycota.

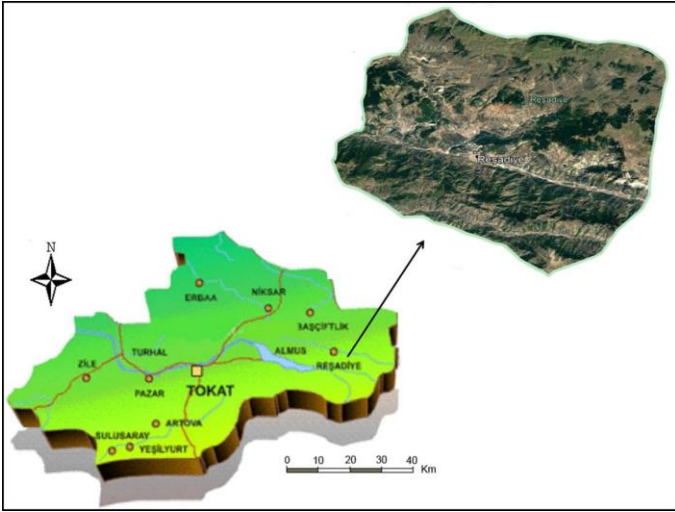


Figure 1. Map of the study area (Anonymous, 2018).

Materials and Methods

The macrofungi samples were collected from Reşadiye (Tokat) district between 2014-2017 years. Color photographs were taken in the natural habitats of the macrofungi samples detected during the field studies and their morphological and ecological characteristics were noted. They were wrapped in aluminium foil or paper bags to prevent damage and carried to the laboratory for chemical tests and determination of microscopic features. The collection numbers were given to the samples brought to the laboratory and spore prints were taken from mature samples. Microscopic measurement of samples was determined using light microscope and some chemical reagents (congo red, melzer's reagent, cotton blue and 5% KOH solution etc.). Samples were identified with the literature (Phillips, 1981; Moser, 1983; Bon, 1987; Breitenbach and Kranzlin, 1984, 1986, 1991, 1995, 2000; Jordan, 1995; Kränzlin, 2005; Beug et al., 2014). The identified samples were dried and stored as fungary material inside of polyethylene bags.

Results

The systematics of the species were given in accordance with the Index Fungorum (Kirk, 2011). An alphabetical list of current names of macrofungi was listed below with habitat, locality, collection date, accession numbers and edibility.

Ascomycota Whittaker

Pezizales J. Schröt.

Helvellaceae Fr.

1. *Helvella acetabulum* (L.) Quél.

Kızılcaören village, on sandy or calcareous soil in woodland, 40° 27' 063" N, 037° 30' 2017" E, 1487 m, 16.05.2015, Mete 12, Edible (when cooked).

Morchellaceae Rchb.

2. *Morchella elata* Fr.

Kızılcaören village, among grass in *Pinus sylvestris* forest, 40° 27' 101" N, 037° 29' 328" E, 1446 m, 25.04.2015, Mete 9, Edible.

3. *Verpa bohemica* (Krombh.) J. Schröt.

Kızılcaören village, among grass, 40° 27' 074" N, 037° 30' 131" E, 1480 m, 25.04.2015, Mete 10, Edible.

Pezizaceae Dumort.

4. *Peziza badia* Pers.

Kızılcaören village, among needle litters in *Pinus sylvestris* forest, 40° 26' 565" N, 037° 30' 401" E, 1494 m, 04.11.2016, Mete 74, Edible (when cooked).

Xylariales Nannf.

Xylariaceae Tul. & C. Tul.

5. *Xylaria hypoxylon* (L.) Grev.

Kızılcaören village, on dead wood of *Quercus* sp., 40° 26' 377" N, 037° 29' 412" E, 1483 m, 08.11.2014, Mete 8, Inedible.

Basidiomycota R.T. Moore

Agaricales Underw.

Agaricaceae Chevall.

6. *Agaricus campestris* L.

Çakırlı village, in grass and pastureland, 40° 27' 103" N, 037° 28' 486" E, 1385 m, 07.06.2015, Mete 19, Edible.

7. *Bovista plumbea* Pers.

Çakırlı village, among grasses, 40° 27' 317" N, 037° 29' 231" E, 16.05.2015, Mete 13, 1397 m, Edible.

8. *Coprinus comatus* (O.F. Müll.) Pers.

Çakırlı village, on sandy soil among grasses, 40° 27' 298" N, 037° 28' 356" E, 1402 m, 07.06.2015, Mete 20, Edible.

9. *Cyathus olla* (Batsch) Pers.

Çakırlı village, on dead wood of broad-leaved trees, 40° 27' 543" N, 037° 29' 032" E, 1354 m, 08.11.2014, Mete 5, Inedible.

10. *Lepiota clypeolaria* (Bull.) P. Kumm.

Çakırlı village, on soil in mixed forest, 40° 27' 128" N, 037° 28' 362" E, 1431 m, 28.05.2017, Mete 79, Inedible.

11. *Lycoperdon molle* Pers.

Çakırlı village, among leaf litters in mixed forest, 40° 26' 453" N, 037° 28' 053" E, 1432 m, 10.06.2017, Mete 96, Inedible.

12. *Lycoperdon perlatum* Pers.

Çakırlı village, among conifer debris, 40° 26' 453" N, 037° 27' 469" E, 1413 m, 07.06.2015, Mete 23, Edible.

Amanitaceae E.-J. Gilbert

13. *Amanita pantherina* (DC.) Krombh.

Çakırlı village, among leaf litters under oak tree, 40° 27' 128" N, 037° 28' 362" E, 1431 m, 28.05.2017, Mete 84, Poisonous.

14. *Amanita vaginata* (Bull.) Lam.

Kuzbağı village, among herbaceous plants in the open area of mixed forest, 40° 26' 116" N, 037° 26' 261" E, 1305 m, 28.05.2017, Mete 83, Edible.

Hydnangiaceae Gäum. & C.W. Dodge

15. *Laccaria laccata* (Scop.) Cooke

Kuzbağı village, among conifer debris, 40° 26' 065" N, 037° 26' 275" E, 1295 m, 10.06.2017, Mete 97, Edible.

Hymenogastraceae Vittad.

16. *Psilocybe coronilla* (Bull.) Noordel.

İslamlı village, among grasses, 40° 25' 218" N, 037° 25' 173" E, 1264 m, 28.05.2017, Mete 90, Inedible.

Inocybaceae Jülich

17. *Crepidotus variabilis* (Pers.) P. Kumm

Kuzbağı village, on dead twig of oak tree, 40° 25' 506" N, 037° 26' 193" E, 1273 m, 24.10.2015, Mete 32, Inedible.

18. *Inocybe bongardii* (Weinm.) Quéf.

Kuzbağı village, among conifer debris, 40° 26' 209" N, 037° 26' 127" E, 1305 m, 10.06.2017, Mete 99, Poisonous.

19. *Phaeomarasmium erinaceus* (Fr.) Scherff. ex Romagn.

Kuzbağı village, on fallen twig of broad-leaved tree, 40° 25' 460" N, 037° 26' 315" E, 1306 m, 08.11.2014, Mete 3, Inedible.

Marasmiaceae Roze ex Kühner

20. *Marasmius oreades* (Bolton) Fr.

Kuzbağı village, among grasses, 40° 25' 350" N, 037° 26' 034" E, 1264 m, 28.05.2017, Mete 91, Edible.

Mycenaceae Roze

21. *Mycena epipterygia* (Scop.) Gray

Kuzbağı village, among needle litters, 40° 25' 271" N, 037° 26' 122" E, 1332 m, 08.11.2014, Mete 6, Edible.

22. *Mycena inclinata* (Fr.) Quéf.

İslamlı village, around stump in the pine forest, 40° 25' 372" N, 037° 25' 317" E, 1157 m, 24.10.2015, Mete 31, Inedible.

23. *Xeromphalina caudicinalis* (Fr.) Kühner & Maire

İslamlı village, among leaf litters oak tree, 40° 25' 292" N, 037° 25' 368" E, 1245 m, 24.10.2015, Mete 33, Inedible.

Omphalotaceae Bresinsky

24. *Gymnopus androsaceus* (L.) Della Magg. & Trassin.

Kuzbağı village, on fallen leaf of *Quercus* sp., 40° 25' 367" N, 037° 26' 460" E, 1354 m, 10.06.2017, Mete 98, Inedible.

25. *Gymnopus dryophilus* (Bull.) Murrill

İslamlı village, among conifer debris, 40° 25' 178" N, 037° 25' 155" E, 1243 m, 08.11.2014, Mete 2, Edible.

26. *Rhodocollybia butyracea* (Bull.) Lennox

İslamlı village, among needle litters, 40° 25' 179" N, 037° 25' 148" E, 1240 m, 24.10.2015, Mete 34, Edible.

Physalacriaceae Corner

27. *Hymenopellis radicata* (Relhan) R.H. Petersen

İslamlı village, among leaf litters, 40° 25' 302" N, 037° 25' 224" E, 1242 m, 10.06.2017, Mete 93, Inedible.

28. *Strobilurus tenacellus* (Pers.) Singer

İslamlı village, attached to buried pine cones, 40° 25' 106" N, 037° 25' 268" E, 1262 m, 25.04.2015, Mete 11, Inedible.

Psathyrellaceae Vilgalys

29. *Coprinellus conocybeus* (Bull.) Vilgalys

İslamlı village, near the log of broad-leaved tree, 40° 25' 293" N, 037° 25' 186" E, 1245 m, 16.05.2015, Mete 15, Inedible.

30. *Coprinopsis atramentaria* (Bull.) Redhead, Vilgalys & Moncalvo

İslamlı village, among grasses out of wood, 40° 25' 265" N, 037° 25' 131" E, 1248 m, 11.06.2016, Mete 67, Poisonous.

31. *Coprinopsis picacea* (Bull.) Redhead
İslamlı village, on soil among leaf litters, 40° 25' 266" N, 037° 25' 086" E, 1217 m, 11.06.2016, Mete63, Inedible.

Schizophyllaceae Quéf.

32. *Schizophyllum commune* Fr.
İslamlı village, attached to branch of oak tree, 40° 25' 232" N, 037° 25' 128" E, 1253 m, 24.10.2015, Mete 29, Inedible.

Tricholomataceae Lotsy

33. *Lepista nuda* (Bull.) Cooke
İslamlı village, among bushes, 40° 25' 139" N, 037° 25' 216" E, 1260 m, 21.05.2016, Mete 54, Edible (when cooked).

34. *Tricholoma terreum* (Schaeff.) P. Kumm.
İslamlı village, under conifer, 40° 25' 069" N, 037° 25' 332" E, 1278 m, 08.11.2014, Mete 1, Edible.

Auriculariales J. Schröt.

Auriculariaceae Fr.

35. *Exidia glandulosa* (Bull.) Fr.
İslamlı köyü, on dead wood of broad-leaved trees, 40° 25' 019" N, 037° 25' 295" E, 1285 m, 28.05.2017, Mete 86, Inedible.

Boletales E.-J. Gilbert

Boletaceae Chevall.

36. *Boletus edulis* Bull.
Kızılcaören village, on soil in *Pinus sylvestris* forest, 40° 25' 127" N, 037° 26' 097" E, 1340 m, 28.05.2017, Mete 87, Edible.

Diplocystidiaceae Kreisel

37. *Astraeus hygrometricus* (Pers.) Morgan
Kızılcaören village, on sandy soil in the open area of woods, 40° 25' 175" N, 037° 26' 156" E, 1339 m, 06.05.2017, Mete 76, Inedible.

Gomphidiaceae Maire ex Jülich

38. *Chroogomphus rutilus* (Schaeff.) O.K. Mill.
Kızılcaören village, on soil in *Pinus sylvestris* forest, 40° 25' 172" N, 037° 26' 204" E, 1360 m, 28.05.2017, Mete 89, Edible.

Rhizopogonaceae Gäum. & C.W. Dodge

39. *Rhizopogon luteolus* Fr.

Kızılcaören village, in sandy soil in conifer wood, 40° 25' 273" N, 037° 26' 199" E, 1308 m, 28.05.2017, Mete 94, Edible.

40. *Rhizopogon roseolus* (Corda) Th. Fr.

Kızılcaören village, on sandy and calcareous soil in conifer wood, 40° 25' 252" N, 037° 26' 132" E, 1298 m, 04.11.2016, Mete 75, Edible

Sclerodermataceae Corda

41. *Pisolithus arhizus* (Scop.) Rauschert

Kızılcaören village, on sandy soil roadside, 40° 25' 279" N, 037° 26' 579" E, 1348 m, 24.10.2015, Mete 35, Inedible.

Suillaceae Besl & Bresinsky

42. *Suillus luteus* (L.) Roussel

Kızılcaören village, under pine tree, 40° 25' 222" N, 037° 26' 564" E, 1361 m, 24.10.2015, Mete 27, Edible.

Polyporales Gäum.

Polyporaceae Fr. ex Corda

43. *Lentinus brumalis* (Pers.) Zmitr.

Kızılcaören village, on dead branch of broad-leaved tree, 40° 25' 234" N, 037° 26' 500" E, 1359 m, 10.06.2017, Mete 102, Inedible.

44. *Pycnoporus cinnabarinus* (Jacq.) P. Karst.

Kızılcaören village, on dead branch of broad-leaved tree, 40° 25' 253" N, 037° 26' 472" E, 1343 m, 21.05.2016, Mete 39, Inedible.

45. *Trametes versicolor* (L.) Lloyd

Kızılcaören village, on dead wood of broad-leaved tree, 40° 25' 231" N, 037° 26' 528" E, 1367 m, 21.05.2016, Mete 40, Inedible.

Russulales Kreisel ex P.M. Kirk

Russulaceae Lotsy

46. *Lactarius deliciosus* (L.) Gray

Kızılcaören village, among needle litters, 40° 25' 322" N, 037° 26' 471" E, 1334 m, 11.06.2016, Mete 69, Edible.

47. *Lactarius semisanguifluus* R. Heim & Leclair

Kızılcaören village, on the soil in *Pinus sylvestris* forest, 40° 25' 350" N, 037° 26' 508" E, 1345 m, 11.06.2016, Mete 73, Edible.

48. *Russula albonigra* (Krombh.) Fr.

Kızılcaören village, among leaf litters under broad-leaved tree, 40° 25' 365" N, 037° 27' 022" E, 1352 m, 10.06.2017, Mete 95, Edible.

49. *Russula exalbicans* (Pers.) Melzer & Zvára

Kızılcaören village, among needle litters in *Pinus sylvestris* forest, 40° 25' 385" N, 037° 27' 057" E, 1357 m, 21.05.2016, Mete 48, Inedible.

50. *Russula maculata* Quéf.

Kızılcaören village, on the soil in *Pinus sylvestris* forest, 40° 25' 437" N, 037° 26' 445" E, 1326 m, 21.05.2016, Mete 43, Inedible.

51. *Russula rosea* Pers.

Kızılcaören village, on the soil in mixed forest, 40° 26' 078" N, 037° 29' 432" E, 1595 m, 11.06.2016, Mete 60, Edible.

52. *Russula vinosa* Lindblad

Kızılcaören village, on acidic soil in *Pinus sylvestris* forest, 40° 26' 060" N, 037° 29' 465" E, 1603 m, 11.06.2016, Mete 59, Inedible.

Tremellales Dumort.

Tremellaceae Fr.

53. *Tremella mesenterica* Retz.

Kızılcaören village, attached to branch, 40° 26' 031" N, 037° 29' 500" E, 1618 m, 16.05.2015, Mete 16, Inedible.

Conclusion and Discussion

The 53 species belonging to 2 divisions, 26 families and 42 genera were detected from Reşadiye (Tokat) district. Five species of the identified macrofungi belong to *Ascomycota*, other 48 species belong to *Basidiomycota*. Of these, 25 were edible (47.2%), 25 inedible (47.2%), 3 poisonous (5.6%) (Figure 2).

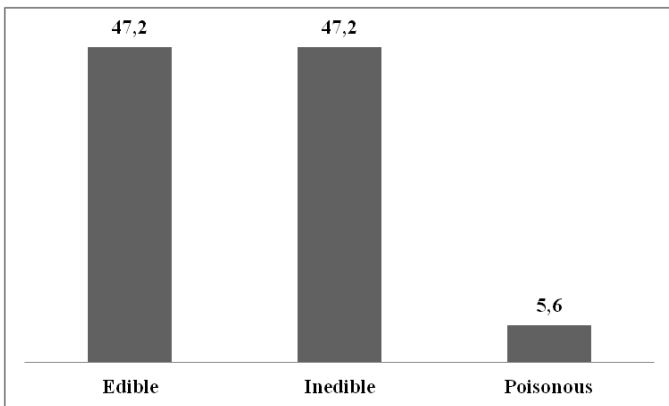


Figure 2. Edibility percentage of species.

The family distribution of detected macrofungi is given in Figure 3. According to this, families with the most species are *Russulaceae* (7 species-13.2%) and

Agaricaceae (7 species-13.2%). The genus represented by most species is *Russula* (5 species-9.4%).

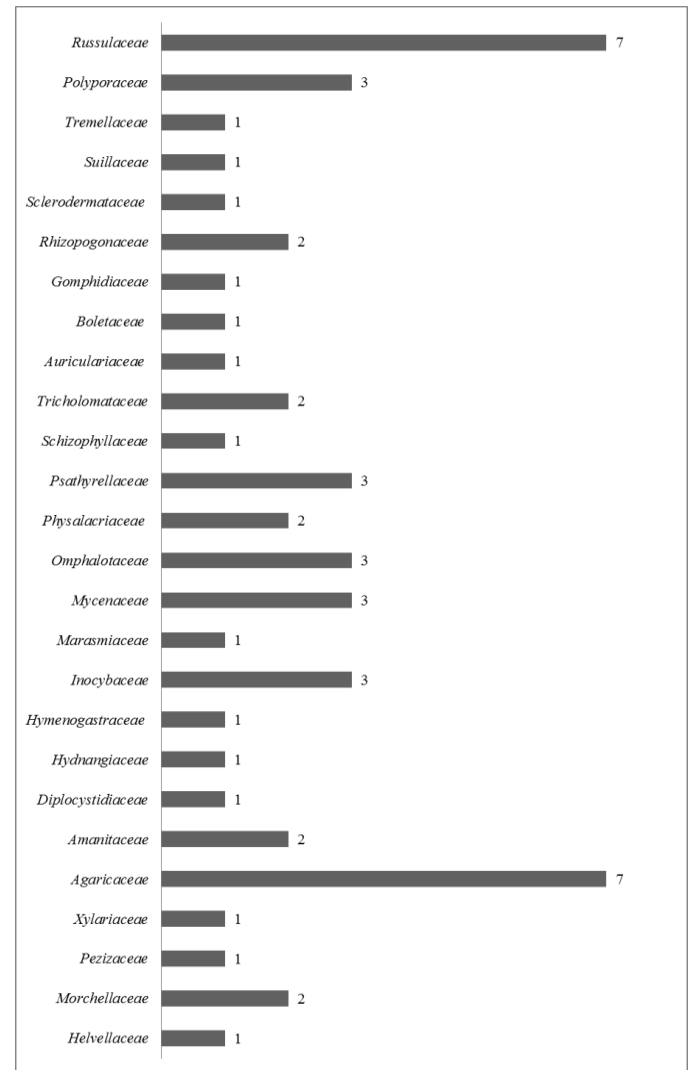


Figure 3. The distribution of the species and their families.

Species collected and consumed by local people are *Morchella elata*, *Agaricus campestris*, *Amanita vaginata*, *Boletus edulis*, *Marasmius oreades*, *Lactarius deliciosus*, *Lactarius semisanguifluus*. The ratio of these to determined edible species is 28%. The names given by the local people to the macrofungi they have collected were shown in Table 1.

The results obtained in this study were showed similarity with studies conducted in close regions. Made studies and similarity percentages are given in Table 2.

Table 1. Macrofungi species and local names.

Species	Local Names
<i>Morchella elata</i>	Kuzugöbeği
<i>Agaricus campestris</i>	İçi kızıl, çayır mantarı, çanak mantarı
<i>Amanita vaginata</i>	Yer yaran
<i>Boletus edulis</i>	Ayı mantarı
<i>Marasmius oreades</i>	Cüçül
<i>Lactarius deliciosus</i>	Kanlıca
<i>Lactarius semisanguifluus</i>	Kanlıca

Table 2. Similarity percentages of neighbouring studies with Reşadiye (Tokat) basin.

References	Study area	≠ taxa	Σ taxa	Similarity (%)
Türkecul (2003)	Tokat	20	59	33.9
Türkecul and Sesli (2003)	Tokat	15	47	31.9
Pekşen and Karaca (2003)	Samsun	26	169	15.4
Aktaş (2006)	Amasya	35	303	11.5
Uzun et al. (2006)	Giresun	11	105	10.5
Türkecul (2008)	Tokat	22	52	42.3
Türkecul and Zülfükaroğlu (2010)	Tokat	20	51	39.2
Türkecul and Işık (2016b)	Tokat	21	82	25.6
Pekşen and Kaplan (2017)	Ordu	5	22	22.7

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