= Geopyxis carbonaria =

Geopyxis carbonaria is a species of fungus in the genus Geopyxis , family Pyronemataceae . First described to science in 1805 , and given its current name in 1889 , the species is commonly known as the charcoal loving elf @-@ cup , dwarf acorn cup , stalked bonfire cup , or pixie cup . The small , goblet @-@ shaped fruitbodies of the fungus are reddish @-@ brown with a whitish fringe and measure up to 2 cm (0 @.@ 8 in) across . They have a short , tapered stalk . Fruitbodies are commonly found on soil where brush has recently been burned , sometimes in great numbers . The fungus is distributed throughout many temperate regions of the Northern Hemisphere . It is found in Europe , Turkey , and North America . Although it is primarily a saprotrophic species , feeding on the decomposing organic matter remaining after a fire , it also forms biotrophic associations with the roots of Norway spruce .

= = Taxonomy = =

The fungus was first described scientifically in 1805 by Johannes Baptista von Albertini and Lewis David de Schweinitz as Peziza carbonaria . Mordecai Cubitt Cooke illustrated the fruitbodies , spores , and asci in his 1879 work Mycographia , seu Icones fungorum . Figures of fungi from all parts of the world . In 1889 , Pier Andrea Saccardo transferred the fungus to the genus Geopyxis , giving the species its current name . Pustularia carbonaria , published by Heinrich Rehm in 1884 , is a synonym of G. carbonaria . Louis @-@ Joseph Grélet proposed the variety Geopyxis carbonaria var. sessilis in 1937 , referring to forms producing fruitbodies without a stalk , but the taxon is not considered to have independent taxonomic significance . In 1860 Miles Berkeley and Moses Ashley Curtis described the species Peziza lepida from collections made in Japan as part of the North Pacific Exploring and Surveying Expedition (1853 ? 1856) . This taxon was synonymized with G. carbonaria by Mien Rifai in 1968 , a taxonomic opinion corroborated by Donald Pfister about a decade later .

The specific epithet carbonaria derives from the Latin word for " charcoal " . Common names given to the fungus include " charcoal loving elf @-@ cup " , " dwarf acorn cup " , " pixie cup " , and the British Mycological Society approved " stalked bonfire cup " .

= = Description = =

The fruitbodies (ascocarps) of Geopyxis carbonaris are cup shaped , 1 ? 2 cm wide , and have fringed whitish margins . The inner spore @-@ bearing surface of the cup , the hymenium , is brick red and smooth , while the exterior surface is a dull yellow , and may be either smooth or have blister @-@ like spots (pustules) . The stipe is small (1 ? 1 @.@ 5 mm long and 1 ? 2 mm wide) , whitish in color , and expands abruptly into the cup . The brownish flesh of the fungus is thin and brittle . It does not have any distinctive taste , but has an unpleasant smell when crushed in water . The edibility of the fungus is not known , but the fruitbodies are insubstantial and unlikely to be harvested for eating .

= = = Microscopic characteristics = = =

In mass , the spores are whitish . The spores are elliptical , smooth , hyaline , devoid of oil droplets (eguttulate) , and have dimensions of 13 ? 18 by 7 ? 9 µm . They are thin walled and germinate and grow rapidly in vitro in the absence of external stimuli . The asci are 190 ? 225 by 9 ? 10 µm . The paraphyses are slightly club @-@ shaped , unbranched , and have irregular orange @-@ brown granules , with tips up to 5 µm wide , and are not forked or lobed . The hypothecium , the layer of cells below the hymenium , is made of densely packed , small irregular cells .

= = = Similar species = = =

The closely related vulcan elf cup (Geopyxis vulcanalis) has a pale orange to yellowish fruitbody that is deeply cup shaped before flattening in maturity , and its crushed flesh often has an odor of sulfur . It may be distinguished microscopically by its paraphyses , which lack the orange @-@ brown granules characteristic of G. carbonaria . It also has larger spores , measuring 14 ? 22 by 8 ? 11 µm . Unlike G. carbonaria , it grows on substrates other than burned wood , including mosses , and needle duff . Tarzetta cupularis , which grows habitats similar to G. carbonaria , is distinguished microscopically by its spores that contain two oil droplets . Other genera with similar species with which G. carbonaria may be confused in the field include Aleuria , Caloscypha , Melastiza , and Sowerbyella .

= = Habitat and distribution = =

Geopyxis carbonaria is widespread on burned soil or charcoal in the spring and throughout the growing season . It is one of the most common pioneer species found on burned ground . The charred litter on the forest floor increases the underlying soil pH as well as the availability of minerals . Fruitbodies are produced from 16 to 139 weeks after a forest fire in areas with coniferous trees . Most fruitbodies are produced in the first year after a burn . The fungus prefers fruiting in microhabitats with thin postfire duff near standing burned tree trunks . Geopyxis carbonaria fruitbodies are often found in the same post @-@ fire stands as morels , although the former is usually more abundant . Because the pixie cup fruits earlier than morels , it may serve as an indicator of imminent morel fruiting . Other cup fungi often found fruiting in the same area as G. carbonaria include those from the genera Aleuria , Anthracobia , Peziza , and Tarzetta .

The fungus is found in Europe (from where it was originally described) , and is widespread throughout North America . The North American distribution extends north to Alaska . In 2010 , it was reported for the first time from Turkey .

= = Ecology = =

Although primarily a saprotrophic fungus involved in the post @-@ fire breakdown of duff and coniferous roots , Geopyxis carbonaria has been shown to be capable of forming ectomycorrhizae with Norway spruce (Picea abies) . It had been demonstrated earlier in laboratory experiments that the fungus has a biotrophic interaction with lodgepole pine (Pinus contorta) . The hyphae of G. carbonaria were able to infect the cortex of the tree seedling , but did not penetrate the endodermis . These traits suggest that the fungus is a moderate pathogen , with limited ability to cause reductions in seed germination . Additionally , the fungus produces the enzyme polyphenol oxidase , and can break down the complex organic polymer lignin ? features characteristic of saprotrophic fungi . The formation of a rudimentary Hartig net , a characteristic of mycorrhizal fungi , indicated that G. carbonaria might be capable of forming mutualistic relationships under the right conditions . Vrålstad and colleagues suggest that its below @-@ ground association with spruce roots protects it from physical damage in the event of a fire , and the extensive fruitbody production after a fire may reflect " a successful fungal escape from a dying host where the fungus no longer can maintain its biotrophic association " .

Large fruitings of the fungus are often associated with damage to the host tree , such as that which occurs with burning . A field study conducted in Norway demonstrated that fruit bodies were more likely to be found in areas that were heavily burned , compared to locations with light to moderate burning where the trees remained viable , or in clearcut areas . Fruiting was much denser in spruce forests ? with up to 700 ? 1000 fruitbodies per square meter ? than in pine forests , where fruitbodies were sporadic . Fruitbodies grew by the millions in the year following the Yellowstone fires of 1988 .