

= Mycenastrum =

Mycenastrum is a fungal genus in the family Agaricaceae . The genus is monotypic , containing one widely distributed species , Mycenastrum corium , known by various common names : the giant pasture puffball , leathery puffball , or tough puffball . The roughly spherical to turnip @-@ shaped puffball @-@ like fruit bodies grow to a diameter of 6 ? 24 cm (2 ? 9 in) . Initially covered by a thick , felted , whitish layer , the puffballs develop a characteristic checkered skin (peridium) in age . When the internal spore mass , the gleba , is firm and white , the puffball is edible , although some individuals may suffer mild gastrointestinal symptoms after eating it . As the spores mature , the gleba turns first yellowish then purplish brown . Spores are released when the peridium eventually splits open into irregularly shaped sections . Microscopically , the gleba consists of spherical , dark brown spores with rounded bumps on their surfaces , and a capillitium ? intricately branched fibers that form long thorn @-@ like spines . The puffball grows on or in the ground in prairie or desert habitats . Although widely distributed , it is not commonly encountered . Mycenastrum corium is a threatened species in Europe .

= = Taxonomy = =

The species was originally described in 1805 as Lycoperdon corium in the second volume of Augustin Pyramus de Candolle and Jean @-@ Baptiste Lamarck 's Flore Française . They attributed authorship to French botanist Louis Ben Guersent , who discovered it in an alfalfa field between the town of La Sotte and Rouen in northern France . Synonyms include Scleroderma corium published by Arthur Harmount Graves in 1830 , and Steerbekia corium published by Elias Magnus Fries in 1849 . The species was given its current name by Nicaise Auguste Desvaux in 1842 , who circumscribed the genus Mycenastrum to contain it . Generic synonyms are Vassili? Matveievitch Czernajew 's 1845 Endonevrum and Stephan Schulzer von Muggenburg 's 1876 Pachyderma .

In 1948 , Sanford Myron Zeller circumscribed the new family Mycenastraceae , containing both Mycenastrum as the type genus , and Bovista . A 2001 molecular study supported the inclusion of Mycenastrum corium in the Lycoperdales , where it was traditionally placed . In a more recent (2008) cladistic analysis , Mycenastrum was shown to be a sister group to the Lycoperdaceae ; authors Larsson and Jeppson agreed with Zeller (1949) and Pilat 's (1958) decision to regard Mycenastrum as a monotypic genus in the separate family Mycenastraceae . Despite this , several taxonomic authorities prefer to fold Mycenastraceae into the Agaricaceae .

It is commonly known as the " leathery puffball " , the " tough puffball " , or the " giant pasture puffball " .

María Homrich & Jorge E. Wright published the variety Mycenastrum corium var. diabolicum in 1973 from South America . M. corium subspecies ferrugineum was described in 2005 from Jefferson County , Colorado , by Orson K. Miller .

= = = Former Mycenastrum = = =

Most species historically named as Mycenastrum have since been transferred to other genera , usually Scleroderma , but also Glyptoderma , Bovista , and Gastropila . Many , including those species that have not been reclassified are poorly known ; the nomenclatural authority Index Fungorum considers only four of these former Mycenastrum species to be currently valid : Bovista bovistoides , B. lycoperdoides , Gastropila fragilis , and Glyptoderma coelatum .

= = Description = =

The fruit body usually grows to a diameter of 6 ? 15 cm (2 ? 6 in) , although extremes of 3 cm (1 @.@ 2 in) and 27 cm (11 in) have been reported . Its shape ranges from roughly spherical , to obovate (egg @-@ shaped) or pyriform (pear @-@ shaped) , sometimes plicate (crumpled ,

wrinkled) around a somewhat fibrous , persistent tuft of mycelium . The puffball is initially covered by a thick , felted , whitish layer (the exoperidium) . This is continuous at first but eventually cracks and peels away in thin flakes , exposing a leathery to corky , nearly smooth , light brown to dark pinkish @-@ brown surface . This tough layer of tissue (the endoperidium) measures about 2 mm thick , encloses the gleba . In maturity , the endoperidium opens by irregular splits that eventually extend towards the base in a star @-@ shaped manner . These torn segments of endoperidium sometimes turn inside out , sometimes drying rigid , exposing a felt @-@ like internal surface . The gleba is white when young and has a cheesy appearance and consistency . As the puffball matures , it undergoes a lytic process involving water loss . Subsequently , the gleba becomes olivaceous , olive @-@ brown , and finally dark olive when dry , and then develops a characteristic pungent smell . Fruit bodies that grow underground have a conspicuously different morphology ? a smooth , chocolate @-@ brown coloured surface that lacks the patches characteristic of above @-@ ground fruit bodies , and their capillitia are bifurcate with stumpy spines . The fungus is edible when the gleba is white . Its odor and taste have been described as pungent or earthy and its taste astringent .

Its spores are spherical , measuring 8 ? 13 μm , and have a surface of irregular , coarse warts . The capillitium refers to late @-@ maturing , thick @-@ walled cells in the gleba . The main axes of these branched cells are 20 ? 30 μm thick , and they are covered with numerous spines .

Mycenastrum corium subsp. *ferrugineum* has a deep rusty red to reddish orange gleba , clearly distinguishing it from the gleba coloring of the main subspecies . *M. corium* var. *diabolicum* has an extremely spiny capillitium .

== Uses ==

The puffball is edible when the gleba is still firm and white . They are reportedly consumed by the tribal people of Madhya Pradesh . In Mexico , a large collection was consumed by several people who confused the species with *Calvatia* , a puffball genus containing popular edible members . Of the five who ate the fungus , two had gastrointestinal symptoms including stomachache , flatulence , and diarrhea ; the other three did not have symptoms . The large European bird great bustard (*Otis tarda*) has been recorded feeding on the puffball .

Because of their thick outer peridium , *Mycenastrum corium* puffballs can withstand hard blows without breaking , and children have used them as replacements for balls . The puffballs have also been used medicinally in Mexico as a hemostatic , as a throat and lung tonic , and for their purported anti @-@ inflammatory properties .

== Puffball maturation ==

The manner in which the puffball splits open (dehisces) has been described by 19th @-@ century American mycologist William Henry Long . The thick and leathery peridium of the mature puffball remains unopened for several months without splitting . After several alternating cycles of wetting and drying , fissures develop across the top . These fissures usually radiate from a common center near the top of the fruit body and finally produce very irregular star @-@ like teeth . In time , the entire upper half of the puffball is open and exposed during dry weather . In this condition , the spores are blown out by the wind and widely distributed . During every rainy spell the puffball promptly closes only to open again when dry weather returns . At each alternate opening and closing the peridium is split more and more , until finally it is expanded into a flat shape , or even curls backward . In the puffball , the outer layer of the peridium comprises cells arranged so that when wet they adsorb water and expand , thus closing the top of the puffball . Upon drying , these outer cells lose water and gradually shrink , thus producing an unequal tension between the outer and inner cells of the peridium . This tension causes the irregular star @-@ like pieces of the peridium to gradually separate and curve outward , thus opening the top of the puffball during dry weather .

= = Ecology and distribution = =

Mycenastrum corium is a saprobic species , consuming dead organic debris . It is usually found fruiting on the ground singly , scattered , in rings , or in clusters , but it can also grow underground . Fruiting occurs at low elevations in groups in open habitats dominated by sagebrush and saltbrush , or in grassy or shrubby wet areas in dry prairie . Other reported habitats include old haystacks , on silage , and roadsides . Mature fruit bodies can be broken loose from attachment to the substrate and be rolled around by wind , similar to some *Bovista* puffballs . Although the species is not frequently encountered , it has been suggested that this is because it grows in locations " rather seldom visited by mycologists " . *M. corium* could be a useful indicator species for climate change .

The puffball is widely distributed , and has been recorded in Africa (Zimbabwe) , Asia (China , India , Iran , Mongolia , and Yemen) , South America (Argentina , Chile and Uruguay) , North America , Australia , and New Zealand . In Europe it is found in southern Scandinavia and is widespread to the south of the continent . Although it was reported in Scotland in 2010 (its first appearance on the British mainland) , the grassland habitat where it was found has since become heavily eroded , and may be unsuitable for future appearances of the species . *Mycenastrum corium* is a threatened species in Europe , and is listed as vulnerable in the Regional Red List of Poland . In North America , it is most common in western regions of the United States and Canada , but it has also been recorded in eastern Canada . Poorly known in Mexico , it has been recorded from Baja California , Chihuahua , Nuevo León , San Luis Potosi , Sonora , Mexico City . The variety *M. corium* var. *diabolicum* occurs in Sub-Saharan Africa , tropical Asia , the Caribbean , and South America .