= Geastrum triplex =

Geastrum triplex is an inedible fungus which is found in the detritus and leaf litter of hardwood forests in many parts of the world . It is commonly known as the collared earthstar , the saucered earthstar , or the triple earthstar ? and less commonly by the alternative species name Geastrum indicum . It is the largest member of the genus Geastrum (or earthstar fungi) and expanded mature specimens can reach a tip @-@ to @-@ tip length of up to 12 centimeters (4 @.@ 7 in) .

Immature fruit bodies are spherical ? somewhat resembling puffballs with pointed beaks ? and are partially or completely buried in the ground . As the fungus matures , the outer layer of tissue (the exoperidium) splits into four to eight pointed segments that spread outwards and downwards , lifting and exposing the spherical inner spore sac . The spore sac contains the gleba , a mass of spores and fertile mycelial tissue that when young is white and firm , but ages to become brown and powdery . Often , a layer of the exoperidium splits around the perimeter of the spore sac so that it appears to rest in a collar or saucer . Atop the spore sac is a small pointed beak , the peristome , which has a small hole from which spores may be released .

The species is widespread and can be found in Asia , Australasia , Europe , and both North and South America . The fungus has a history of use in the traditional medicines of native North America and China . Fruit bodies have been analyzed chemically to determine their lipid content , and various chemical derivatives of the fungal sterol ergosterol have been identified .

= = Taxonomy and classification = =

The species was first described scientifically , by German botanist Franz Wilhelm Junghuhn , as Geaster triplex in 1840 . The earlier genus name Geaster , introduced by Italian botanist Pier Antonio Micheli in 1727 in Nova Plantarum Genera , is considered an orthographical variant of Geastrum . Junghuhn , who was living in Indonesia and extensively surveyed its fungal flora , discovered the type specimen on Mount Panggerangi on the island Java , at an elevation between 3 @,@ 000 to 5 @,@ 000 feet (910 to 1 @,@ 520 m) . Today , the type specimen is kept at the National Herbarium of the Netherlands in Leiden . The morphological feature used by Junghuhn to differentiate G. triplex from other similar earthstars was the collar @-@ like structure of the inner layer of the exoperidium . American mycologist Curtis Gates Lloyd would later erroneously suggest that the species was a " giant form " of Geastrum saccatum .

Several authors have regarded Geastrum indicum as the correct name for G. triplex . This is because G. indicum ? a species described by Johann Friedrich Klotzsch in 1832 as Cycloderma indicum and then moved to Geastrum by Stephan Rauschert in 1959 ? may be the same species as Geastrum triplex . If it is in fact the same species , the first published name (i.e. , G. indicum) has nomenclatorial priority according to the rules of the International Code of Botanical Nomenclature . More recently , several authors argue that G. indicum should be rejected as a nomen dubium and G. triplex maintained as the correct name for the species .

Stellan Sunhede 's 1989 monograph of European species of Geastrum follows V. J. Stan?k 's concept for the infrageneric (below the level of genus) placement of Geastrum , and places G. triplex with species that do not incorporate and encrust forest debris (section Basimyceliata) . G. triplex is further categorized in subsection Laevistomata , which includes species with a fibrillose peristome ? that is , made of parallel , thin , thread @-@ like filaments . Within subsection Laevistomata it is in stirps Triplex , due to its delimited (with a distinct restricting edge) or irregularly torn peristome .

The specific epithet triplex means " threefold " , and refers to the three @-@ layered peridium . Geastrum triplex has acquired several vernacular names , including the collared earthstar , the saucered earthstar , and the triple earthstar .

= = Description = =

Like all mushrooms , the fruit body of Geastrum triplex is the visible part of a larger organism .

Hidden from sight are masses of nearly invisible fungal threads called mycelium , which form the active feeding and growing structures of the fungus . The fruit body ? created when environmental conditions such as temperature , moisture , and nutrient availability are optimal ? is designed to produce and disseminate spores . Geastrum triplex has the largest fruit body of the earthstar mushrooms . The immature fruit body is typically 1 to 5 cm (0 @.@ 4 to 2 @.@ 0 in) in diameter , and up to 8 to 9 cm (3 @.@ 1 to 3 @.@ 5 in) broad (Roody gives a larger value here , up to 11 @.@ 5 cm) after the rays have spread out . It is composed of a roughly spherical to egg @-@ shaped structure , the endoperidium , topped by an opening , the ostiole , covered by fragments of tissue that form a small pointed beak (a peristome) . The endoperidium is typically lacking any sort of stem (it is sessile) grayish @-@ brown to " wood brown " when young but light yellow @-@ brown in dried , unopened specimens . The outer tissue layer , the exoperidium , develops splits which radiate from the apex and form between four and eight rays that separate from the endoperidium . The latter 's thin and papery envelope surrounds a mass of spores and fertile tissue known as the gleba . The central part of the gleba contains a pseudocolumella (a columella not attached to the stalk) , that is typically cylindrical or club @-@ shaped , and extends up from the base . Because of the variability in columella persistence , size , structure and shape within the genus , its value for identification is limited .

The exoperidium 's rays are 2 to 4 cm (0 @.@ 8 to 1 @.@ 6 in) long and up to 4 mm (3 / 16 in) thick . The outer surface of the rays (the lower surface , after expansion) and unopened specimens have a rough texture . In several Geastrum species , dirt and debris adhere to the underside , this is not the case in G. triplex . The inner fleshy layers (upper surface) of these rays are near " wood brown " in color when dried , and have a layer of surface tissue that cracks into patches . There is a great deal of variation , however , to the extent in which the upper surface tissue of the rays crack : this tissue layer may also remain closely attached as a sheet over the unsegmented part of the outer wall with the part adhering to the rays variously cracked and sometimes finally peeling off in places .

In G. triplex , the bases of the rays usually break around the perimeter of the endoperidium to form a saucerlike platform or receptacle in which the endoperidium rests . However , not all specimens form this receptacle , leading to possible confusion with other Geastrum species . Curtis Gates Lloyd claimed that in tropical regions , with an abundance of high temperatures and humidity , the fungus expands rapidly , which is more conducive to the fleshy layer breaking away to form a receptacle ; in more temperate areas this effect would not be as pronounced and " usually does not occur at all " .

The endoperidium is 1 to 3 cm (0 @.@ 4 to 1 @.@ 2 in) in diameter by 0 @.@ 9 to 2 @.@ 0 cm (0 @.@ 4 to 0 @.@ 8 in) high , sessile , and a dull grayish @-@ brown . The peristome is made of radially arranged fibrils that clump together at the apex in groups of unequal length to form an opening that appears jagged or torn . The circular area bordering the peristome is a paler color . Spores are thought to be dispersed by the wind sucking them out when it blows over the hole , or when falling raindrops hit the flexible endoperidium , creating a puff of air that forces the spores through the ostiole .

= = = Microscopic characteristics = = =

The spore sac contains the gleba , which is composed of a pseudocolumella , unbranched threads (the capillitium) , the spore @-@ bearing cells (basidia) and the spores themselves ; all of these microscopic elements have certain characteristic features that help distinguish G. triplex from other superficially similar earthstars .

The spores are spherical , and 3 @.@ 5 ? 4 @.@ 5 µm in diameter . They are covered with short narrow abruptly terminating projections of a translucent (hyaline) substance , which turn a pale cinnamon brown in potassium hydroxide , and a dark dull brown (nearly sepia) when stained with iodine . The capillitium is made of what appears to be encrusted cylindrical filaments 3 ? 6 µm in diameter , of a color varying from hyaline to dull yellowish brown in potassium hydroxide , and yellowish in iodine ; its walls are thickened to the point where the interior (lumen) appears as only a line . Either two or four spores are attached to the basidia , and the sterigmata (extensions of the

basidia that attach the spores) are long , up to 20 µm . Geastrum triplex does not have cystidia .

= = = Similar species = = =

Geastrum triplex may be confused with G. saccatum or G. fimbriatum , as the rays do not always crack around the perimeter to form a bowl under the spore case . However , it is larger than either of these species . The combination of characteristics which distinguish G. triplex from other earthstars include the lack of debris adhering to the outer surfaces , the saucer @-@ like base in which the spore case is seated , the relatively large size , the fibrillose peristome and the paler area surrounding the peristome separating it from the rest of the endoperidium . Unlike some other Geastrum species , the rays of G. triplex are not hygroscopic : they do not open and close in response to changes in humidity .

= = Habitat and distribution = =

Geastrum triplex is a saprobic fungus : it derives nutrients from decomposing organic matter . The fruit bodies are usually found growing singly or more commonly in groups in hardwood forests where much humus has accumulated ; in Mexico , they have been collected in tropical deciduous forest . Fruit bodies are often found around well @-@ rotted tree stumps ; they are initially almost buried in the loose duff , but emerge during maturity as the downward curling of the rays exposes the spore sac . Old fruit bodies are persistent , and may survive the winter to be found the following spring or summer . A Dutch study reported a propensity for G. triplex to grow on soil made calcium @-@ rich from washed @-@ out chalk of crushed shells on bicycling paths . It is described as common in North America and Europe . One author states it is commonly found under beech trees .
Geastrum triplex has a widespread distribution , and has been collected in Asia (China , Korea Iran , and Turkey) , Australia , Europe (Belgium , Czech Republic , Sweden , and the Canary Islands) , and Africa (Congo , South Africa) . In North America , its range extends north to Canada and south to Mexico , including the whole continental United States and Hawaii . In Central and South America the fungus has been reported from Panama , Trinidad and Tobago , Argentina , Brazil , and Chile .

= = Uses = =

= = = Edibility = = =

Although the fruit bodies of Geastrum triplex are nonpoisonous , they are tough and fibrous , and of " no alimentary interest " . Mycologist David Arora says that they are reputed to be edible when immature ? when the gleba is still white and firm ? but adds that they are rarely found in this form .

= = = In traditional medicine = = =

Earthstars were used medicinally by Native American Indians . The Blackfoot called them ka @-@ ka @-@ toos , meaning " fallen stars " , and according to legend , they were an indication of supernatural events . The Cherokee put fruit bodies on the navels of babies after childbirth until the withered umbilical cord fell off , " both as a prophylactic and a therapeutic measure " . In traditional Chinese medicine , G. triplex is used to reduce inflammation in the respiratory tract , and to staunch bleeding and reduce swelling .

= = = Chemistry = = =

The fruit bodies of Geastrum triplex have been chemically analyzed and shown to contain a number of bioactive compounds , including fungal sterols such as ergosta @-@ 4 @,@ 6 @,@ 8 , (14) , 22 @-@ tetraen @-@ 3 @-@ one , 5 @,@ 6 @-@ dihydroergosterol , ergosterol , and

peroxyergosterol . The fungus also contains various fatty acids , notably myristic , palmitic , stearic , oleic , alpha @-@ linolenic , and linoeic acid .