WORLD RECORD MYXOMYCETE *FULIGO SEPTICA* FRUITING BODY (AETHALIUM)

FROM THE BOTANICAL RESEARCH INSTITUTE OF TEXAS, FORT WORTH, TEXAS, USA

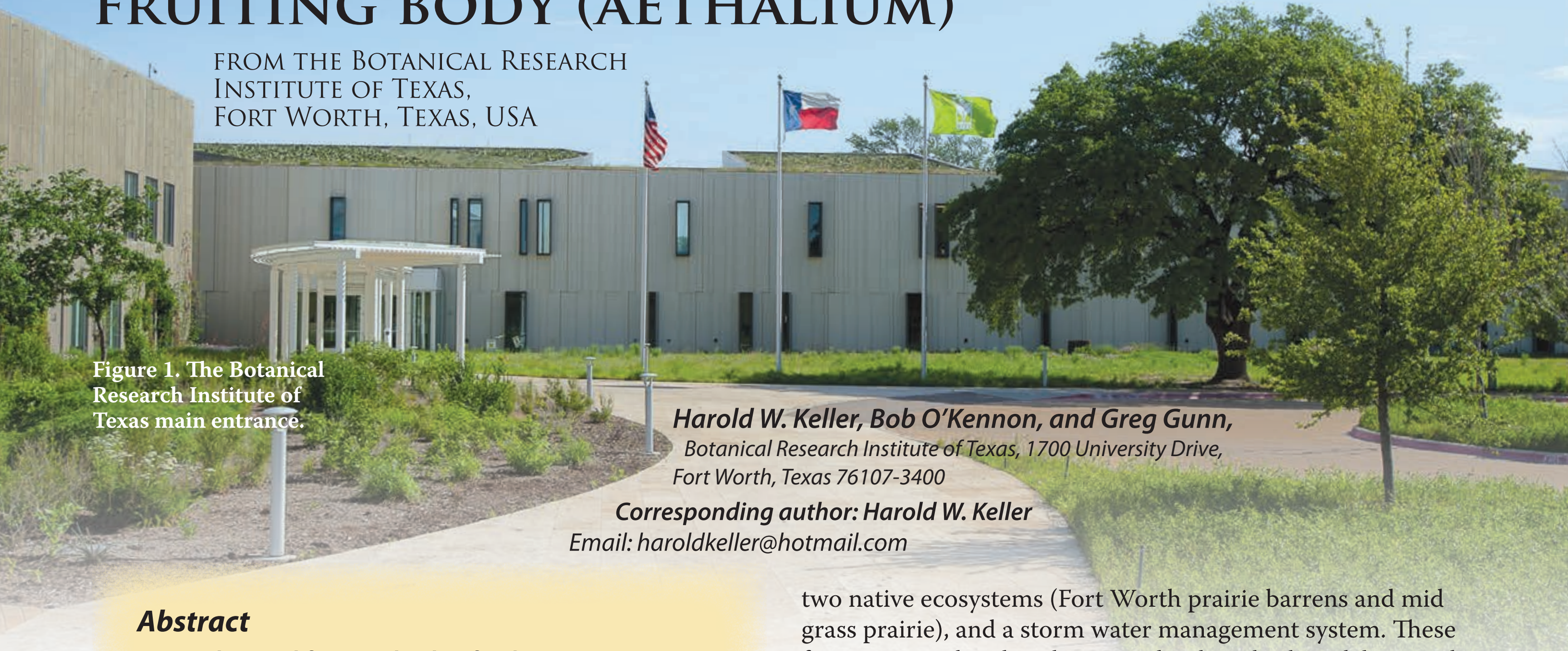

Figure 1. The Botanical Research Institute of Texas main entrance.

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Abstract

A world record fruiting body of *Fuligo septica* was discovered at an urban site in Fort Worth, Texas, USA. Color photographs document the color, shape, and size of the fruiting bodies on shredded bark mulch. Weather data collected before, during, and after the occurrence of the fruiting bodies document the time delay between storm-and temperature-related events and development of the specimen. The morphology of the largest fruiting body was described as well as several of the other 20 fruiting bodies observed in this habitat. Comparisons are discussed between the formation and development of the smallest stalked sporangia on the bark of living trees (corticolous myxomycetes) represented by the genera *Echinostelium* and *Macbrideola* and the largest aethalioid fruiting body types on ground sites represented by *Fuligo septica*.

***Key Words*—bioswale, BRIT, myxomycetes, plasmodial slime molds, weather**

The Location

The Botanical Research Institute of Texas, often referred to by the acronym BRIT, is located in the Cultural District of Fort Worth, Texas, USA. The BRIT building and campus serve the surrounding area as a model for environmental sustainability exemplified by site design and landscape management. BRIT staff moved into the new 70,000-square-foot building in February, 2011, and the dedication and grand opening for the public was held 21 May 2011 (Fig. 1). At that time it was one of only eight buildings in Texas awarded the Platinum Certification in the US Green Building Council's LEED® (Leadership in Energy and Environmental Design) Green Building Rating System®. This includes in part a living roof of native plant species, re-introduction of two native ecosystems (Fort Worth prairie barrens and mid grass prairie), and a storm water management system. These features are related to the grounds where bark mulch is used for various landscaping functions. More details are available at the BRIT web site (www.brit.org).

The Habitat

The BRIT landscape is designed to prevent water runoff, surface flooding, erosion, and loss of valuable water resources by practicing bioretention with a series of bioswales. These bioswales are sloped depressions in the ground that serve as storm water filtration systems using plants, soil, and bark mulch to absorb, retain, and filter storm water. The parking lots at BRIT are sloped so that rainfall is captured in each of the bioswales located between each paved parking area.

The site of the *Fuligo septica* fruiting bodies (Fig. 2) was bioswale #3. This site is covered by hardwood shredded bark mulch (oak and maple) and is deep enough (2–4 in) to hold water from storm events for varying periods of time, facilitating the growth of myxomycetes, with the remaining water captured in a French drain that runs to a retention pond on the campus. This mulch was applied on or about 14 Nov 2015. The site was last irrigated on 19 Feb 2016, with all subsequent precipitation coming from storm events. During this 3-mo time period, no *Fuligo* fruiting bodies were observed.

Weather conditions (precipitation and temperature) during the period from March 1 to April 15 were recorded from a weather station located within 100 yd of the site. The growth and development of the myxomycete plasmodia and fruiting bodies were the result of storm events that occurred during this time period (see weather graphs). A combination of storm events (March 17 and March 30) and elevated temperatures (April 3 to April 5) triggered plasmodial and fruiting body formation on April 4 to April 6. Note the post-storm delay of 19 days and 6 days before the aethalioid fruiting body type was initiated. These data have significance in documenting the lengthy time periods required for the development and formation of larger fruiting body types in the myxomycetes.

What is a myxomycete?

This information is available, including life cycle illustrations, in previous publications (Everhart and Keller, 2008; Keller et al., 2008; Keller and Everhart, 2010). Myxomycetes often are referred to by mushroom collectors as "slime molds" or "slimes" when observed as plasmodia in the field, but are also known as acellular slime molds, plasmodial slime molds, or true slime molds.

Myxomycetes first were considered as more animal-like because of their motile plasmodial stage and microscopic motile myxamoebae and swimming swarm cell stages; then more plant-like because of the spore-producing fruiting body stage; and finally more fungus-like because of the similarity of the plasmodium and fruiting body stage to fungi, hence the name myxomycetes. Based on molecular evidence, they are now considered not closely related to any of these groups but are rather a separate group in the Protista Kingdom (Keller and Everhart, 2010).

General information about Fuligo septica

Martin and Alexopoulos (1969) cite 35 synonyms for this species and note it as "one of the commonest and most widely distributed of myxomycetes. Its extraordinary variability in size, shape, and color is reflected in the numerous names which it has received" (Martin and Alexopoulos, 1969). A brief species description is modified and taken from Martin and Alexopoulos (1969) and Keller and Braun (1999): Aethalia (fruiting bodies) are pulvinate, usually large, 0.8–7.9 in long, 1–1.2 in thick, with a whitish to yellowish, thick cortex composed of calcium carbonate granules. The capillitium usually consists of white, calcareous, fusiform nodes connected by hyaline threads. Spores are black in mass, spherical, minutely spinulose, and 6–9 µm in diameter. The plasmodium is large and conspicuous, usually yellow, sometimes white or creamy, and referred to as a phaneroplasmodium. This plasmodium is the largest and often the most colorful and most frequently seen plasmodial type in the field and may cover several square feet usually on ground litter.

The aethalioid myxomycetes typically have large, round or mound-shaped fruiting bodies formed from one plasmodium, and they represent the largest of the fruiting body types, readily visible to the naked eye. The plasmodium and fruiting bodies of *Fuligo septica* may be found usually on bark mulch, wood chips, sawdust piles, decaying logs, piled grass clippings, compost piles, decomposing tree stumps, living grass in yards, and even at the base of tree trunks on bark of living trees.

A large plasmodium thought to be *Fuligo septica* discovered growing in a yard in Garland, Texas, USA, made headlines in a Dallas, Texas, newspaper as the "Texas Blob," and the homeowner was horrified that a mutant bacterium would take over the earth (Alexopoulos et al., 1996). The same theme was

Figure 2. Ground level photograph showing *Fuligo septica* fruiting body in foreground, sloping sides of the bioswale, and bark mulch.

featured in the science fiction film The Blob released in 1958 starring Steve McQueen in his film debut. This jelly-like blob comes from outer space via a meteorite that falls to earth and then consumes people, getting bigger and bigger until it is finally controlled by freezing and transferring it to the Arctic (Keller and Everhart, 2010).

The general public may know this species by its common names, "dog vomit" and "scrambled egg slime mold," the former because of the lumpy, white fruiting body and the latter because of the bright yellow plasmodial mass. In the state of Veracruz, Mexico, the yellow plasmodium is known by the popular name "caca de luna" by native people and is prepared as a fried food with onions and peppers, very much like scrambled eggs, and folded into a tortilla. However, we hesitate to recommend this as an edible food item (Keller and Braun, 1999).

Figure 3. A. World record *Fuligo septica* aethalium (fruiting body) showing length of 30 in and pancake shape. B. Same specimen showing width of 22 in. C. Same specimen two days later (April 8) with more weathering and exposure of black spore mass and breaking up of cortex (scale = George Washington Head quarter = 1 in).

Observations

The previous world record fruiting bodies for *Fuligo septica* were recorded from sawmill sites on the island of Gotland, southeast of mainland Sweden, during the period 1969–1973 (Sunhede, 1974). These fruiting bodies were quite often found on sawdust and debris of bark and wood of *Pinus silvestris* waste from sawmills. The surface layer of the site was dry, but a few centimeters deeper the material was moist. The plasmodia were pale yellow, welling up to the surface, and had the consistency of very soft butter. Plasmodia were also observed migrating short distances on the surface of the sawdust pile to higher and drier sites, finally maturing in 72 hr. Four fruiting bodies were observed, the largest being 27.6 × 21.3 in with a thickness of 1.2 in. This paper has been cited as the source for the previous world record largest fruiting body (Keller and Braun, 1999).

The American fruiting bodies of *Fuligo septica* at BRIT were first observed as a large plasmodium on 4 Apr 2016 and were mature in 48–72 hr when photographed beginning April 6. There were 20 different fruiting bodies in the same general area within 20 yd of the largest specimen, which was photographed with the following dimensions: 30 in (Fig. 3A) by 22 in (Fig. 3B) (see tape measure) and a thickness of 0.4 in. All of these bright yellow plasmodia developed into fruiting bodies in situ with no apparent migration. The largest specimen had an overall pancake appearance with a whitish cortex composed of calcium carbonate granules, a powdery black spore mass, and a capillitium including white calcareous nodes. Photographs taken on April 8 show the very thin cortex starting to deteriorate, exposing millions of spores as part of the blackish spore mass (Fig. 3C).

Sometimes the yellow plasmodium surrounds portions of the substratum (bark and living grass), and remnants of the yellow plasmodium are present in our specimens (Fig. 4). Sunny warmer days with daily high temperatures of 77–89°F (see weather graphs) during the period April 4 to 7 resulted in aethalia that had prematurely dried with sclerotized plasmodia on the surface of the cortex (Fig. 5). It is possible that these sclerotized plasmodial remains could regenerate the plasmodial stage again given the appropriate environmental conditions.

The presence of a coleopterid ladybird beetle appears to be fortuitous since it is not known to feed on *Fuligo* spores (Fig.

Figure 4. Aethalium with bark mulch fragment, living grass, and portion of yellow plasmodium included in fruiting body formation.

Figure 5. Close-up of prematurely dried aethalium surface showing sclerotized plasmodial remnants and presence of *Coccinella septempunctata* (the seven-spotted ladybird beetle).

5). No beetles were observed feeding on the plasmodia or exposed spore mass in any of the aethalia.

Several more aethalia in the area showed telltale signs of premature drying. They exhibited extensive shrinkage, with a more flattened and thinner habit instead of being heaped and mound-shaped, with patches of sclerotized plasmodium on the cortex (Fig. 6).

Fuligo septica plasmodia sometime migrate over great distances (> 3 ft) to higher and drier sites to form fruiting bodies, as in the example seen in Figure 7 on the bark of a living sweet gum tree (*Liquidambar styraciflua*) in the Great Smoky Mountains National Park. No evidence of plasmodial migration was found at the current site.

Discussion

The immature plasmodia were not photographed, but in every case the plasmodia were yellow. The first author has

Figure 6. Two aethalia showing premature drying, shrinkage, and aberrant development due to direct rays of the sun.

observed and collected hundreds of *Fuligo septica* fruiting bodies, and in every case the plasmodia have been yellow, not white. It is possible that past references to transparent and white plasmodia for this species may have been confused with *Mucilago crustacea*, another aethalioid myxomycete that has the general appearance of *Fuligo septica*, but has a transparent to milky-white plasmodium, a crystalline calcium carbonate cortex, and different spore ornamentation. *Fuligo septica* is a common and cosmopolitan species found worldwide; however, it is possible that local environmental conditions could influence plasmodia color which can be quite variable in the myxomycetes. These fruiting bodies sometimes persist for several weeks if left undisturbed.

How did this myxomycete species get to this site and develop so many fruiting bodies in such a relatively small area? Wind-blown myxomycete spores are one possible source, but the likelihood that so many point inocula could develop at the same time suggests that the bark mulch may have imported

Below: Weather Graphs. Temperatures, precipitation, and fruiting body formation (shaded area) for the period 1 March–15 April 2016 at the observation site in Fort Worth, Texas, U.S.A.

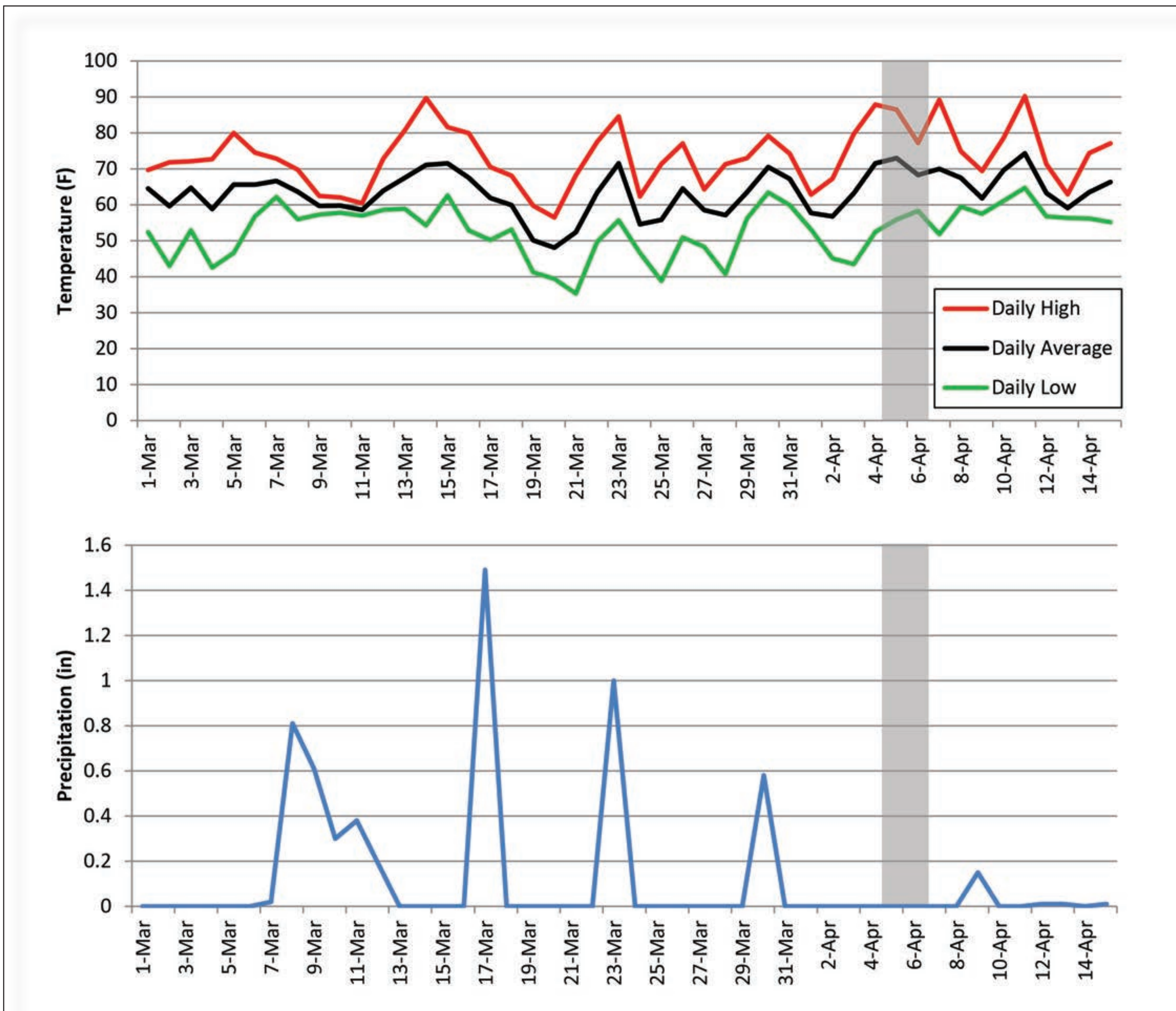

Figure 7. *Fuligo septica* aethalia that have formed 3 ft above ground level on the bark surface of a living sweetgum tree at a separate site in Great Smoky Mountains National Park. The plasmodium had left a clear trail from ground leaf litter as it migrated up the bark surface.

the spores. This same habitat, such as bark mulch around trees with *Fuligo septica* aethalia, has been repeated many times in many places (HWK, pers. obs.).

The aethalioid fruiting body type is the largest found in the myxomycetes, and examples include the order Physarales and all species in the genera *Fuligo* and *Mucilago*; the order Stemonitales and the genus *Brefeldia*; the order Liceales and all species in the genera *Lycogala* and *Reticularia*. These fruiting bodies are characterized by having the largest plasmodia with the largest surface-to-volume ratios; single, sessile (not stalked), larger fruiting bodies measuring inches; many spores in the millions; lengthy developmental times of 4–7 days or even weeks; and moist habitats of decaying ground litter or logs as previously described, eventually forming fruiting bodies as the habitat gradually becomes drier, persisting for longer periods of time. Such development is common in K-selected species that have more favorable environmental conditions with longer moist periods and optimal moderate temperatures, taking much longer to develop fruiting bodies (Everhart and Keller, 2008; Keller and Everhart, 2010).

In contrast, the stalked sporangium and the protoplasmodium found on the bark surface of living trees (corticolous myxomycetes) is the smallest fruiting body type and has the smallest plasmodium with the smallest surface-to-volume ratio. Species in the genera *Echinostelium* and *Macbrideola* are perhaps the best examples of r-selected species with the following life cycle strategy: short-lived; rapid sporulation in 6–24 hrs; quick spore release via an evanescent peridium; tiny (< 0.04 in diameter); can survive longer periods of extreme hot, dry, and cold periods much like desert ephemeral plants; and take advantage of brief periods of rain to complete their life cycle (Everhart and Keller, 2008; Keller and Everhart, 2010).

Conclusions

Fuligo septica represents one of the best examples of a K-selected species in the myxomycetes. Weather data collected near the myxomycete fruiting bodies documents the environmental parameters associated with the development and formation of the aethalioid fruiting body type. Daily field observations over time of this kind provide additional evidence of a time course that is not evident when single field trips are made to single sites that fail to record these data.

Acknowledgments

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About the authors

The first two authors are Resident Research Associates at BRIT. The third author is the BRIT Facilities Manager. Additional biographical details are available at www.brit.org.

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