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Author's Response

Sir:

In his commentary (1) concerning our technical note Taphonomic Mycota: Fungi with Forensic Potential (2), Britt Bunyard makes several comments some of which contribute towards the development of the taphonomic mycota as a forensic tool. While apparently intrigued by the article, Bunyard seems to find fault in several areas. We feel many of his comments need to be refuted or placed into a proper perspective. In other areas, he makes a useful contribution and these need to be recognized. We have tried to distil the salient points made by Bunyard (1) and we have then addressed each one. We have also developed a short scenario outlining how the concept might be practically used and tried to clarify the intent of the article in order to develop the forensic potential of the taphonomic mycota.

1. Overstated usefulness of Taphonomic Mycota—We do not overstate the usefulness of fungi in detecting clandestine gravesite location and post-burial interval determination but simply introduce the concept as one that might be developed as a potential tool following "much more detailed experimental work" (2). The fungi might be used as one of many techniques employed by forensic scientists and crime scene investigators to investigate woodland and forest ecosystems by evident changes in their natural communities caused by an otherwise unseen cadaver.
2. Bunyard states in his commentary that ". . . it would be safe to assume that most fungi will occur anywhere, terrestrially, where there is a high nitrogen source."—In fact, this assumption is unsafe. It is well known that high N supply can have significant negative effects on the fruiting abundance of some species of fungi (e.g., 3,4). This supposition, of changes in mycological community composition under increased nitrogen levels, is at the core of the concept of the taphonomic mycota.
3. Bunyard points out that only two fungi (*Hebeloma syrjense* P. Karst. and *H. radicosum* (Bull.: Fr.) Rick.) ". . . are routinely described as reported with corpses"—He supports this by citing three field guide books yet appears to ignore our Table 1 (2) which is well supported by peer-reviewed scientific articles. He further states that he "has seen no first hand claims . . . and that most authors are likely reiterating the claims of previous authors" (1). This may be entirely true or entirely false and is unsupported conjecture.
4. Identification of some taxa, particular *Hebeloma*, is difficult. With this we quite agree, but this is not a good reason to exclude these fungi. Indeed, for all species we would envisage that identification would require a specialist (field mycologist) on site or to whom dried samples would be sent. Materials are sent off routinely in forensic investigations for specialist analysis and we see no difference here.
5. Some fungi are barely macroscopic—This is no reason they cannot be used; it is just more difficult. In any event, we were trying to be as comprehensive and inclusive as possible in reviewing an eclectic and diverse literature base in order to formulate and support the concept. Had we omitted the microfungi we might have been criticized for a narrow and incomplete analysis.
6. Bunyard states that "all species of *Coprinus* are found on dung"—Many species of *Coprinus* are associated with dung (5), however, many other species including *Coprinus echinosporus, C. lagopus, C. narcoticus, C. phlyctidosporus, C. lagopides, C. impatiens, C. atramentarius, C. picaceus, C. comatus, C. micaceus, C. domesticus, C. silvaticus, and C. plicatilis* fruit on materials other than dung (6,7). Decomposing dung has not dissimilar nitrogen dynamics to a corpse when compared with the bulk soil, so the very fact that many *Coprinus* spp. fruit on dung is a good indication that they are a marker of elevated nitrogen and hence worth investigation, especially when dung is apparently absent.
7. Many of the fungi listed fruit unpredictably and their fruiting structures are short lived—While true, this only reduces the chances of a successful survey and does not preclude success. Some fungi are known to fruit at unusual times of the year or out of the temporal sequence typically associated with their phylum (see point 8) and this can be used to survey "out of season." Furthermore, it is worth bearing in mind most of the fungi we cite have been recorded while fruiting in forests (2).
8. Errors in Table 1—We acknowledge missing headings for *Mitrula sp*. and *Tephrocybe tesquorum*. These species were properly placed in terms of successional sequence; however, they are unique in that *Mitrula sp*. (an ascomycete) fruits at a similar time as the taphonomic basidiomycetes while *Tephrocybe tesquorum* (a basidiomycete) fruits during the time period associated with taphonomic ascomycetes. These have been correctly classified elsewhere (8).

Many of the comments made by Bunyard have some relevance to our article; some are useful but most are either unsupported or wrong. He provides not one peer reviewed citation to support his arguments whereas our article cited over 50 peer-reviewed papers in support of our concept. Unfortunately, Bunyard has misused the term saprophyte, which is a plant feeding by external digestion of dead organic matter (commonly misapplied to fungi) where saprobe or saprotroph is the preferred form (9). This misuse of mycological terminology and misunderstanding of fungal ecology has not been helpful.

Conversely, Bunyard has correctly pointed out the difficulty of identifying many of the proposed taphonomic mycota and makes some useful comments of the habitat and substrate types in which he believes the fungi might be found. We feel that this information is an useful addition the points discussed in Carter and Tibbett (1).

We (1,2) have emphasized that the taphonomic mycota is little more than a concept at this stage and requires further research and development prior to practical application. In order to clarify how the taphonomic mycota might be employed, we illustrate a potential use of fungi in the following scenario.

A burial in woodland is believed to have occurred six months to four years ago alongside a one-mile stretch of road. Conventional methods of grave location (e.g., visual ground cover search, cadaver dogs) have proven fruitless. A simple, timely survey by a field mycologist could give rapid indication of whether taphonomic mycota are present. Once established, the consultant mycologist could give two or three indicator species that might be surveyed for by the investigating police in a zone within the woodland identified as a possible burial area (e.g., 10 to 50 m from the road side). The officers concerned might be trained to crudely identify (by general shape, color, gills, stipe, pileus etc.), sample and dry mushrooms (for later expert identification) as well as record and mark locations (e.g., marking flags and

GPS) of fruiting. Of the (for example) 37 locations of "little brown mushrooms" identified by the police, only five might be taphonomic mycota and hence be worth further, more detailed investigation.

We see this as one of many such potential applications, useful months or years after the suspected burial of a cadaver. In principle, this proposed protocol is no different than the survey and collection of (for example) a hair sample that is sent to a laboratory for DNA analysis.

Our technical note (2) was not intended to be a full and detailed review of fungi resulting in immediate forensic application. The information was introduced formally to forensic science as a platform for experimental work and discussion (where it has certainly succeeded) that might lead to the development of the taphonomic mycota. We hope others will take up the challenge of developing the concept into a functional technique that might help conclude open investigations and bring closure to friends and relatives of victims.

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