Supporting Online Material

Rapid and recent changes in fungal fruiting patterns

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Information on responses of higher organisms to climate change is dominated by events in spring. Far less is known about autumnal events and virtually nothing about communities of microorganisms. We analysed autumnal fruiting patterns of macrofungi over the last 56 years and found that average first fruiting date of 315 species is earlier, while last fruiting date is later. Fruiting of mycorrhizal species that associate with both deciduous and coniferous trees is delayed in deciduous, but not in coniferous forests. Many species are now fruiting twice a year, indicating increased mycelial activity and possibly greater decay rates in ecosystems.

Materials and methods

The data set consists of 52,382 records of sporophores gathered over a 56 y period. A total of 201 observers contributed records from 1,391 different localities, all within a 30 km radius of Salisbury, Wiltshire, UK. To avoid bias, localities were not searched on a systematic basis and each was selected at random on any date. Each locality was visited at least once per year and each searched for at least 3 h at a time. A sporophore was only recorded if it was freshly produced; perennial species with permanent sporophores were excluded from the analysis. EG collated all records and performed all identifications, with 'difficult' species confirmed by Royal Botanic Gardens, Kew. At least one collection was made in every week of every year and dates are accurate to the nearest 3 d. Collections occurred with equal frequency over the years, with no significant trend in the number of collections per year ($F_{1,53}$ = 2.3, P > 0.05).

A total of 315 species were assigned to one of six habitat types: i) grassland saprotrophs (n = 44); ii) deciduous litter saprotrophs (n = 50); iii) coniferous litter saprotrophs (n = 9); iv) wood (e.g. twig, log or stump) decayers (n = 118); v) mycorrhizal with deciduous trees (n=82) and vi) mycorrhizal with coniferous trees (n = 12) (identified using *1*). The average date of first and last fruiting, (expressed as Julian day with adjustment for leap years) of all species was calculated for each year. The average fruiting date of each species in each year was calculated as the mean of all records for that species in each year. We used the conservative method of linear regression to relate mean fruiting date to year, with the number of records for a species in each year used as a weighting factor, to avoid bias from 'bad' fruiting years. Data from all habitat categories represent only Basidiomycota with the exception of wood decaying fungi, in which 20% were Ascomycota. We compared the regression coefficients of these two groups and found no significant difference ($F_{1,114}$ = 2.5, P > 0.05) and so included both in the analysis.

The underlying pattern in mean first and last fruiting dates was examined using a distance weighting smoothing technique (lowess) followed by Pearson correlation. Stepwise multiple regression was used to determine which months displayed a significant relation with average fruiting date of every species, across the 56 y. Mean monthly temperature and rainfall data were obtained from Southampton Weather Centre (www.metoffice.gov.uk/climate/uk/stationdata/southamptondata.txt), supplemented by

personal observations from 2000 when the station closed. A heterogeneity of regression test was used to compare slopes of average fruiting date v. year in the comparison of mycorrhizal species in deciduous and coniferous forests. A complete list of species used in the analysis may be obtained from the correspondence author (a.gange@rhul.ac.uk).

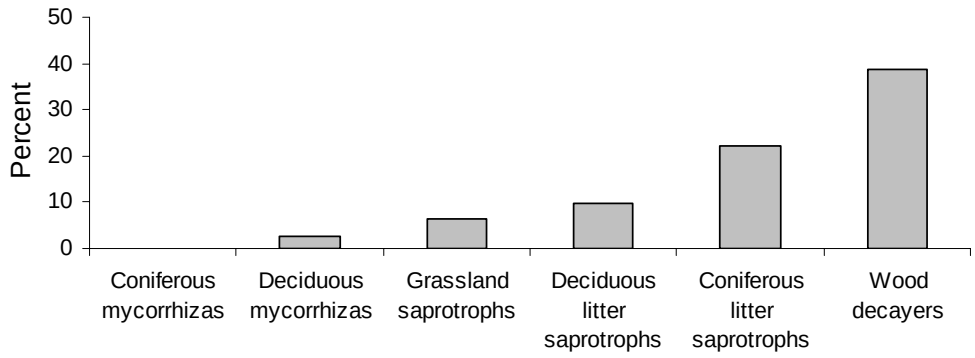

Fig. S1. Since 1975, many fungal species have started to fruit twice a year. Bars represent the proportion of species in each habitat group that, before 1975, were not recorded as fruiting in spring, but after this time did so in at least one year. 1975 was the first year in which spring fruiting of any species occurred.

Reference

1. B. M. Spooner, P. Roberts, *Fungi* (Harper Collins, London, 2005).