Table 1 Community structure

Time period	Herbivorous species	Entomophagous species	Total no. of species
1	H_1, H_2	E_1, E_2, E_3, E_4	6
2	H_3, H_4, H_5	$E_5, E_6, \ldots, E_{10}$	9
3	H_6, H_7, H_8, H_9	$E_{11}, E_{12}, \ldots, E_{18}$	12
			27

well with the observed number for each fortnight. However, such an agreement can equally arise if the insect community did in fact possess a stable trophic structure. For example, consider the season divided into (say) three time periods and let the exact community structure be as shown in Table 1. Here, each H_i and E_j is a distinct species. There is a complete and known turnover of species, and for each time period the ratio of the number of herbivorous to entomophagous species is exactly 1/2. An assumption like Cole's, that all species are present at all times, will give n = total species = 27, n_1 = number of herbivores = 9, $r_1 = 6$, $r_2 = 9$, $r_3 = 12$; and, for each time period, the expected and observed number of herviborous species will agree exactly.

Cole's conclusion that the ratio of herbivores to predators, in the insect community studied by Evans and Murdoch, is maintained at a constant level by no other force than a statistical one is thus possible but not proven. The value of Cole's letter is that it gives a warning that an apparent observed trophic structure may not only be due to the background fact of nature, it can also arise for other reasons.

Obviously, much detailed work on the life history of individual species is required before it is possible to assess adequately the extent of species turnover in a given community. Also, even if energy, biomass or nutrients are undeniably transferred from one trophic level to another, it is perhaps an over-simplification to search for general patterns in terms of the number of species, ignoring abundance, average size and requirements of the members of each species.

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Thermoluminescence dating of sand dunes

SINGHVI *ET AL.*[1] have recently suggested that the thermoluminescence (TL) technique can be used successfully to date aeolian sand dunes. These authors use the TL signal from the 1–8 μm fraction of dune sediments in Rajasthan to suggest dune ages of between 2,000 and 20,000 yr. This procedure implicitly assumes that the 1–8 μm particles are entirely a primary detrital component, and that secondary additions of fines after dune stabilization are unimportant. This assumption warrants close examination, since significant secondary input could result in TL dates which are too young.

Active desert dunes usually contain <3% silt, whereas stabilized and weathered dunes may contain >30%. Goudie *et al.*[2] have reported 20–30% fines in stabilized dunes from Rajasthan. Post-depositional addition of fines may reflect aeolian dust input[3–5], introduction by surface wash from higher ground[6,7], surficial deposition of biogenic silica[8] or the effects of *in situ* weathering on sand grains[9]. Dust input is probably the most significant factor in terms of errors in TL dating of desert dune deposits. The dust, deposited on a dune surface, may be rapidly eluviated by rainwater percolating through the dune sand column. Wright and Foss[10] demonstrated experimentally that 8 g of fine silt placed on top of a 33-cm column of medium sand was completely leached by <1 litre of water. In sealed sand columns the eluviated fines are deposited as an illuvial sub-surface horizon which grows vertically with time.

As a result of the efficacy of this process, TL dating of 1–8 μm-sized particles may simply reflect rates of aeolian dust addition rather than the age of a dune sand body in which they occur. Where such dust eluviation and deposition occurs, a TL age gradient up the profile is to be expected. Singhvi *et al.* demonstrate such an age gradient in the dunes they studied, but suggest that it may reflect slow vertical accretion of aeolian sand over a substantial period of time. However, in the absence of independent supportive evidence it would be equally valid to suggest that the dune sand bodies were formed entirely in the late Pleistocene, and that TL dates on the upper parts of the dune profiles investigated are artificially low due to contamination. Geomorphological and palaeoenvironmental evidence also suggest that dune formation in Rajasthan has occurred as a series of discrete events in response to periodic climatic changes in the late Pleistocene and Holocene, rather than by slow vertical accretion[2,11].

^{14}C and TL dates on associated archaeological artefacts are of limited value as a cross-check on the reliability of TL dates of silt particles because of the uncertainty surrounding the time relationship between the artefacts and adjacent or surrounding sediment. The best solution to the problem would be to apply the TL dating technique to the sand grains themselves. Both quartz and alkali feldspar inclusions in pottery have been dated using various grain sizes in the range 0.1–0.5 mm and the methodology could be adapted for application to sand dunes. Indeed, several TL laboratories involved in sediment dating already use grains of ≥0.1 mm (ref. 12). Singhvi *et al.* should examine the TL of sand grains at various levels in the dune profiles to establish whether or not they indicate increasing age with depth.

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SINGHVI REPLIES—I thank Dr Pye for his valued comments. In fact, some of the studies he suggested are already in progress and the results will be presented at the Third International Specialist Seminar on Thermoluminescence Dating (Denmark, July 1982) and will be published elsewhere[1]. In the meantime, I hope the following information will suffice:

(1) In the field, the permeability of a stabilized dune is circumscribed by factors such as vegetation, carbonate crust and the original fine grain population of the dune sand. In such an arid environment, the experiments of Wright and Foss[2] (where almost 15 cm of standing water was constrained to move unidirectionally), do not have much relevance. In fact, at Amarpura the average rainfall is $<300 \text{ mm yr}^{-1}$.

(2) The archaeological evidence of a habitation and radiocarbon/TL dates indeed validate fine-grain TL dates as being the dates of accumulation of dune sand. Certainly the archaeological material (pottery, charred bone, and so on) cannot percolate down to 1–2 m depths and therefore the overlying sediment has to be post-archaeological debris.

(3) We agree that a comparison between the coarse-sand fraction and the fine-grain TL dates is useful. The same has been attempted with encouraging results for Langhnaj samples. These analyses will be completed shortly and the results will be presented at the TL seminar in Denmark.

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