in food webs could reduce the likelihood of over-exploitation of a particular resource leading to species extinction; alternatively, a multitude of physiological adaptations among the members of a community would give the whole ecosystem a better chance of coping with catastrophe.

This type of reasoning is known as the 'insurance hypothesis'. It went out of favour for many years, because theoretical modelling[2] seemed to contradict the gut feelings of ecologists. Many models indicated that high levels of complexity could lead to dynamic fragility, meaning that the ecosystem would be stable only within a very limited range of environmental conditions. Controlled field observations[3], coupled with laboratory and field experiments[4], have provided a possible means of settling the question. But simple conclusions have been elusive, partly because measuring stability, or even defining it, has proved difficult.

One way forward is to look at the influence of diversity on how efficiently an ecosystem functions[5]. For example, it is relatively easy to measure plant productivity, especially above the soil surface. This is a fundamental process in an ecosystem on which the flow of energy to other ecosystem components ultimately depends. So it is reasonable to think that the stability of the ecosystem depends on the maintenance of this function. The results from studies involving ecosystem diversity and productivity have differed, however; sometimes diversity seems to have led to increased productivity[6] and sometimes to inherent instability[7].

Kahmen and colleagues[1] have also adopted this functional approach in their studies of grassland stability in central Germany. They selected 19 sites within mountain grassland, all situated on the same soil type but differing in their plant diversity. The sites had a similar land-use history, having been ungrazed but harvested for hay twice a year for the past ten years. Within each site, control plots were matched with plots in which a transparent cover prevented rainfall reaching the ground from April to June, thus simulating drought. The use of drought as a stress factor is ecologically reasonable given the recent climatic trends towards drier summers and, especially, the increasing frequency of short-term episodes of extreme drought.

Kahmen *et al.* subsequently measured above-ground productivity, and also used soil-coring techniques to measure the productivity of the root systems. They found no relationship between grassland diversity (estimated by a measure known as the Shannon index) and above-ground productivity. But they show that below-ground productivity increased as a response to drought in the more diverse sites. Under these stressed conditions, the plant community as a whole is evidently diverting more of its fixed carbon to root production than to shoot production.

In Kahmen and colleagues' experiment, it was not possible to separate root biomass into its component species, so there is no information about which species of plants are shifting their resources to root growth. But it seems likely that in a diverse system there is a greater probability that some species react to drought by changing their resource-allocation strategies. Such a change is clearly advantageous to individual plants because it gives them a better chance of competing for the limited water in the stressed conditions. Viewing the community as a whole, therefore, one can argue that a diverse system will be better able to cope with drought and to survive the experience relatively intact.

The insurance hypothesis thus gains support from this study. Beyond that, plant ecologists are again reminded that processes occurring underground, although less apparent, matter as much as those occurring above the soil surface. ■

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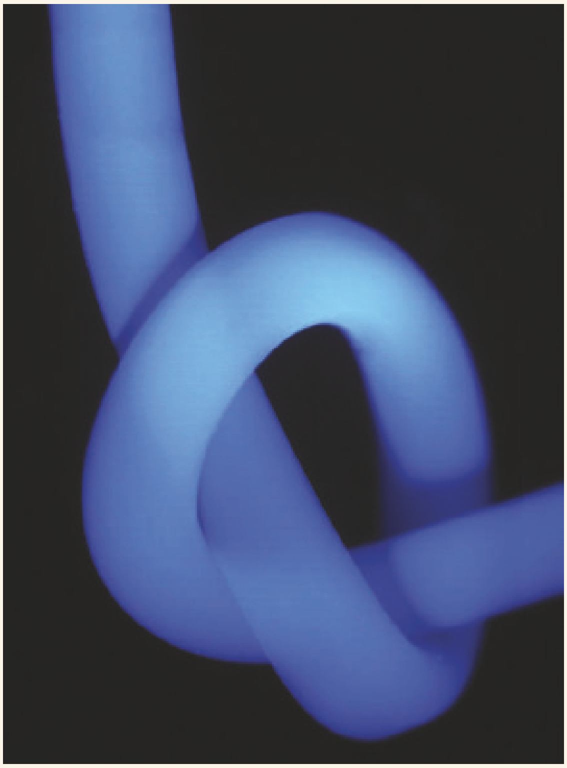
MATERIALS SCIENCE

At a stretch



A polymer based on the elastic protein that enables fleas to perform their extraordinary jumping feats has been synthesized. The material, described by C. M. Elvin *et al.* in this issue (*Nature* **437**, 999–1002; 2005), is, perhaps unsurprisingly, rubbery and highly resilient; indeed, some of its properties exceed those of a material used to make bouncy balls for the playground.

The elastic protein resilin, the source of the authors' inspiration, comes from the same family of biomacromolecules as spider silk and elastin (a protein that makes animal tissues flexible). It is, in fact, found in most insects, where it facilitates not just jumping, but also many actions requiring efficient energy storage and rapid repetitive movement — the chirping of cicadas and the flapping of dragonflies' wings being other examples.

Elvin *et al.* produced their polymer by first cloning part of a *Drosophila* fruitfly gene and expressing it in *Escherichia coli* bacteria. They thus produced large quantities of a peptide found in a precursor molecule to resilin that contains 17 repeats of an amino-acid sequence thought to be responsible for elasticity. A photochemical reaction established crosslinks in the peptide to produce a solid material.

The result, a thread about one millimetre across, glowed blue when bathed in ultraviolet light (see image), and was easily cast into a range of shapes. Its ability to recover from deformation (the property known as resilience) was as good as that of natural resilin taken from a wing tendon of a dragonfly. It was also similar to that reported for elastin, and far higher than that of several synthetic rubbery polymers. A strip of the crosslinked resilin could be stretched to more than three times its original length without breaking.

The authors attribute the mechanical properties of the polymer to the three-dimensional amorphous nature of the crosslinked protein matrix. They also believe that a clearer understanding of the part played by water as a solvent and plasticizer could lead to the development of a whole new range of rubbery materials. Meanwhile, they suggest, their jumping-flea polymer could be a leap forward for biomedical and other engineering fields.

Rosamund Daw