Cave communities and the future

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ABSTRACT

Caves abd the life they contain face constant pressure from a worldw demand for cement, hydro-eletric power and land for building a agriculture. The 8th International Congress of Speleology held in Kentu two years ago passed a resolution on behalf of the IUCN "Cave Speci Group" which called for "...biological surveys of threatened caves, mos in the tropics, and ecological studies to solve specific managem provlems on the causes of endangerment and how these can be remov or mitigated". This final article in the "Cave Life" series explains the n for an ecological approach to cavelife conservation.

I. INTRODUCTION

Bob Stebbings drew attention in part 7 of this series (caves and Caving 20) to the rapid disappearance of cave-roosting bats in Britain. While distribance of roosting bats by cavers has probably made only a minor contribution to this decline, we should still support any more to protect important bat roosts, even if it involves restriction or loss of access to a few caves or mines. Extinction is forever ; restriction of our enjoyment is trivial by comparison.

While the long-running decline of bats has now become so obvious that government money is being poured into research and conservation measures, virtually nothing is known about the state of health of invertebrate communities in our caves. In a report to the Nature Conservancy Council in 1979, BCRA president Jeff Jefferson wrote : "the cave ecosystem is perhaps the only truly natural ecosystem available for syudy in a country such as Britain." Certainly in 1979 it was difficult to imagine a living community more sheltered from human disturbance than one hidden deep below ground in solid bedrock. Then, in 1980, a shory scientific paper published in France challenged this view of cave life. The authors(Huberthie, Delay and Bouillon) had found "cave limited" beetles in rock cracks and screes just below the soil. Soom they were reporting that all sorts of other "cave" animals could be found in large numbers in this "Superficial Understanding Compartment" or SUC(their pharse, not mine!), not only in karst, but in shales and sandstones too. So the few, thinly scattered animals we meet in the depths of caves are just frontier-pushers of a much less in the depths of a much less in the depths of caves are just frontier-pushers of a much less deep-ranging underground community. This is not to say that all cave animals are also found in the SUC - some creatures really are cave-limited. One useful generalization is that hypogen(sub-soil ;iving) animals which are larger and longer-legged than their surface relatives are probably cave-adapted, while those which are smaller, thinner and shorter-legged are probably SUC or crack-adapted(there are doubtless exceptions). The British cave fauna probably includes very few cave-adapted creatures - the only one which springs to mind is the web-spinning fungus gnat Speolepta leptogaster(Caves and Caving 17).

The implications of the discovery of the SUC for cavelife conservation are profound. To understand them, it is essential to know something about tje food supply and workings of the cave ecosystem. So far, the articles in this series have managed to stay fairly simple and straightforward. But now, for all you non-biologist readers (I hope there are still a few of you by this stage in the series!), the time has comme to get to grips with some basic ecological ideas ...

II. ECOSYSTEMS

An ecosystems is a community of organisms together with its phyical habitat. Within the community, energy and useful chemicals are passed around in a fairly organized way. Energy usually enters the system as sunlight, is trapped and packged into chemical goodies by plants, which are eaten by animals, which are themselves eaten, by other animals, and so on. In this way the energy is passed along a chain of animals ending up with the bidggest and fiercest of them. Each consumer on the way wastes energy (mostly as heat) so that the length of food chains is limited by how much energy enters the system to start with. The whole process depends on raw materials being recycled by decomposers which clean up the casualities and detritus of the living community.

III. FOOD SUPPLY

Cave communities depend mainly on the detrius, or left overs, from surface ecosystems. Food chains in British caves are generally based on decomposers : bacteria and fungi, or on bits of fresh detrius, or even visiting insects. Though not much is known about the feeding habits of animals at the bottom of cave food chains, it is possible that they specialize to some extent. Some may eat bacteria, others fungi, and the dung - eaters may even specialize to feed on a particular size of animal dropping. Stream - dwelling predators such as *Niphargus* shrimps may perhaps themselves be eaten by trout, though I know of no evidence of this. Land - based food chains usually end with the first level of predatorsmites, cave beetles and spiders. In bat - infested tropical caves where food is often much more plentiful, food chains may stretch to the extravagnt length of 3 or even 4 links, but even then tne number of species in the cave community is always far less than in the sunlit world outside. This is what gives caves their main biological importance - life in caves works on the same principles as in the highly complex outside world, but there are fewer variables in the ecological equations. Caves therefore provide ecologists with relatively simple, easily studied "model ecosystems".

IV. A DISTURED COMMUNITY?

I have said that cave communities depend on detritus, but so far haven't discussed how it gets into caves. Most American biospeleologists have stressed the importance of streams which carry bits of vegetation, etc, underground, providing food for aquatic cave animals and dumping organically - rich mud onto their banks during follds. Certainly streams are important - particularly in cave systems developed in massive, horizontally bedded limestone. But in caves of southern Britain (and presumably elsewhere!) there is a quite different entry route for food. It was first publicized by Pete Bull in his syudy of the sediments in Agen Allwedd (paper published 1981). He found that most cave sediment is carried into caves by water trickling down vertical joints and steeply inclined bedding planes from the soil above. This is without doubt the source of food for animals living in the SUC. It is a food supply which varies in energy richness and chemical composition according to the nature of the soil from which it comes. That in turn owes its character partly to the vegetation and of course to human activity. There are virtually no natural, unmodified areas of vegetation left in Britain. Certainly the moorland or limestone grassland which covers our main caving areas is man - made, not natural. In some areas of Hawaii, whole cave communities have been wiped out in recent times by forest clearnace and crop planting, and I cannot help but wonder whether our own cave communities may have been profoundly changed by human activity, long before their existence was even suspected.

V. COMMUNITY STABILITY AND EVOLUTION

The routes along which energy travels in most ecosystems have been refined over many thousands of years of evolutionary selection. The process of natural selection favours individuals within a population which are best suited to their role in the ecosystem in which they live. Some animals perform a number of different roles and take part in a number of different food chains. Put another way, separates food chains often meet and cross to form a network of routes along which energy flows through the community. These networks are called "food webs". An example of a cave food web is shown Fig. 1.

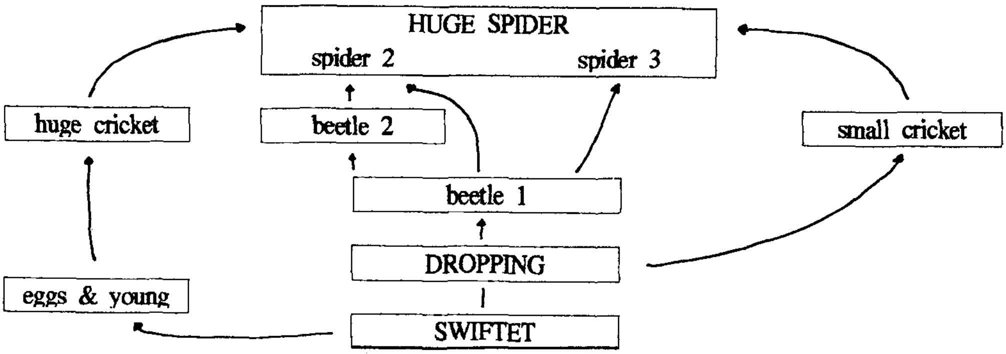

Fig. 1 A Simplified food web from a cave in the G. Mulu National Park, Sarawak

Three food chains start with swiftlets and end with the "huge spider" :
(1) swiftlet dropping are eaten by small crickets which are eaten by the spider,
(2) swiftlet droppings are eaten by huge crickets, which are eaten by the spider,
(3) swiftlet eggs and young are eaten by huge crickets which are eaten by the spider.
Energy flow (shown by arrows) from swiftlets to huge spiders can take any one of these routes.

As any commuter knows, the more routes that are available into town, the quicker the journey. A blocks to one route can be bypassed, and the traffic kept flowing. in the same way, complex food webs allow continuous uninterrupted flow of energy through the ecosystem, so that if the numbers of one particular organism fall dangerously, its predators can switch to another food source rather than starve. This allows the community to survive minor upsets such as are caused by disease, epidemic or a drought. Of course, every now and then an established ecosystem may get such a hefty bash in the form of a climatic change, human disturbance or whatever, that it is thrown out of balance. If this happens, it is the highly specialized species which are generally the first casualties, as they are often slower to respond to a forced change in role than less specialized species which have more variation in their fene pools and can therefore evolve faster in response to changed circumstance. In the evolutionary dogfight which follows a major upset, the winners, or rather the survivors, are those creatures which can adapt themselves most quickly to a new niche, or lifestyle. This process is what produces the characteristic fossil record of dramatic sudden bursts of evolutionary change, followed by long periods of no change. "Saltational evolution", which the press has recently made such a fuss about, is simply evolutionary readjustment after a major disaster hits a community.

VI. COMMUNITY CONSERVATION

The argument I am lesding upto is this : Individual animals survive only as long as they have a place in their community. Damage to the ecosystem is repaired by an adjustment in the numbers of individual species in a way which maintains an efficient flow of energy through the system. A big jolt may result in extinction of some species in the community, and it is often the most specialized (and therefore most interesting!) creaturess which are lost. If my guess - that human impact on the surface environment may already have deeply affected the SUC dommunity - is correct, perhaps even causing local extinctions of some cave animals, then our cave faunas may not be so safe after all. It is not much good protecting individual rare animals if they no linger have a place in their scosystem. This is what "popular" conservation efforts have often done - keeping spectacular animals in captivity while their habitat is destroyed. But there is increasing public awareness that whole ecosystems need to be protected. For example, at present rates of felling, all the world's tropical rainforest will be gone in about 15 years, leaving a few tigers and birds as curiosities in zoos.

While most of us do actually care that the diversity of our natural environment should be preserved for future generations to enjoy, cave communities probably do not come high on the list of most people's conservation concerns! Their main importance, as I have tried to show in this article, is as easily understood "model ecosystems", whose study can lead to a better knowledge of how to manage our natural environment.

VII. CONCLUSION

One effective way of increasing awareness of threats facing wildlife in recent years has been the publication of the "Red Data Books" by the World Wildlife Fund. So far they have covered a wide range of individual plant and animal species under threat. WWF are anxious to promote habitat and ecosystem conservation, and there are plans afoot to produce a "Cave Red Data Book" in the near future. This will deal with examples of threatened cave biology, moving it towards the forefront of conservation awareness. If any readers know of caves, or more signicantly, of cave - rich areas in imminent danger of destruction or major disturbance through hydroelectric schems, quarrying, forest clearance, industrialization, groundwater pollution, etc, please let me know about them in as much detail as you can (published references to the caves, their faunas, maps, local contacts, land ownership, political sensitivity, etc). I will make sure this information is passed on to the compilers of the RDB, and you will have (hopefully) made a positive contribution to the syrvival of cave life. My address is : City Musenm, Queen's Road, Bristol BS8 ! RL.