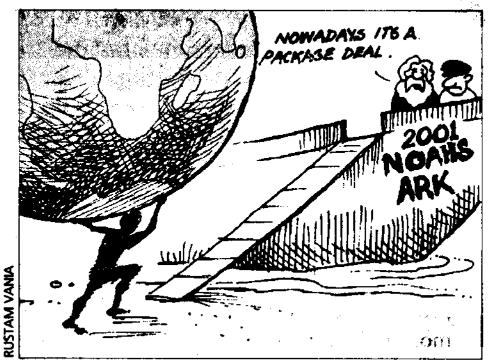
Conservation pays

Preserving all forms of life holds for a more promising eco-future



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THE new buzz word in environment circles is biodiversity which is the diversity of life in all its ramifications — the different communities that make up an ecosystem, the different species that make up communities, the variable individual organisms that belong to each species, and the genetic variation that we see between and within individual organisms.

The strongest arguments yet for conservation are economic: benefits like food and medicines, not to speak of useful genes in the wild plants, animals and microbes which may be useful and even necessary some day. But if that is all there is to it, why really worry about biodiversity *per se*? As long as we have some representative samples of various species surviving somewhere in the world, our needs — present and future — should be satisfied. Is it really necessary to preserve biodiversity in its totality? While there was not much scientific evidence to support this viewpoint earlier, research has now established the importance of preserving biodiversity in its entire whole. The complex network of interrelationships between different species in each ecosystem need to be preserved for the well being of not only our ecosystems and but also the health of their life support systems.

A recent experiment conducted at the Imperial College in England provides convincing evidence that biodiversity *per se* is indeed essential for the well being of ecosystems (*Nature*, No 368, 1994). The experiment used 14 models of terrestrial microcosms maintained in an ecotron. A microcosm, as the name implies, is a miniature ecosystem maintained as naturally as possible and an ecotron is a system of controlled environmental chambers designed for maintaining such microcosms. Each microcosm in the experiment contained producer species, primary consumers, secondary consumers and decomposers. Six of the microcosms had high biodiversity with 31 species each, four microcosms had intermediate levels of biodiversity with 15 species each and another four microcosms had low levels of biodiversity with nine species each.

Self-pollinating herbaceous annual plants represented the producers; mollusks and insects represented the primary consumers; insect parasitoids represented the secondary consumers and collembola and earthworms played the role of decomposers. There was clear evidence that biodiversity levels altered the functioning of the ecosystems. Perhaps the most important finding was that carbon-dioxide consumption as well as plant productivity decreased with decreasing biodiversity. Decomposition, nutrient retention and water retention rates were also significantly affected by levels of biodiversity, although they did not vary between high, intermediate and low biodiversity microcosms in a consistent manner.

Taken together these results provide the first clear demonstration that loss of biodiversity indeed alters the functioning of ecosystems. We can now argue with greater justification that merely saving individual species in different locations is not enough. It is important to preserve the natural levels of biodiversity in different habitats and retain the complex networks of species relationships. ■

On the tiger's trail

Camera-trapping could augur for a more reliable method of tiger census

WHEN Joseph Niepce invented photography in 1816, little did he realise that among the millions of uses his technology would be put to, counting tigers would be one of them! That is precisely what Ullas Karanth has begun to do at Nagarhole National Park near Mysore in Karnataka. (*Biological Conservation*, No 71, 1995).

In a 15 kilometre area, Karanth set up automatic cameras at 15 sites during nine different periods in 1991-92, for a cumulative period of 387 camera trap-nights. The cameras were so designed as to take pictures when any large object moved in front of them. After exposing 15 rolls of film, he obtained 31 usable photographs of 10 unique tigers. Remarkable as it may seem, Karanth has been able to use this data to estimate that Nagarhole has 13.3 to 14.7 tigers per 10,000 kms. This estimate fits impressively well with an independent estimate of 15.1 tigers per 10,000 kms that Nagarhole can be expected to support, based on the availability of prey in the area.

Now how does Karanth get such an apparently precise and accurate (accurate because of the close fit to the independent estimate of tigers that can be supported at Nagarhole) estimate? That is where the power of statistics comes in. Mark-recapture or capture-recapture is

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a standard technique for estimating the density of mobile animal populations. For example, of Karanth's 10 tigers, two were captured (by the camera of course) only once each, five were captured twice each, two were captured five times each and one tiger was captured six times. Karanth was able to individually identify the tigers by studying the pattern of stripes on their bodies.

Reliable methods are available to fit a statistical distribution to the observed and/or expected distribution of individuals captured once, twice, thrice, four times and so on. Once this is done, the number of individuals captured zero times, such that those not captured at all can be estimated. From the number not captured and the number captured, the total population can be estimated.

Karanth's effort at using camera trap data and application of capture-recapture models for estimating population densities is the first such attempt for tigers. If used widely, it promises to yield an independent and more reliable estimate of tiger populations in India, compared to the presently available, rather unreliable estimates, based as they are on the traditional method of pug-mark census. ■

Foes forever

Battle lines between the insects and flowers date back to nearly 100 million years

INSECTS, today make up the vast majority of living organisms. Although insects appeared almost 350 million years ago, they really began to diversify only after flowering plants came on the scene about 150 million years ago. The catalytic role played by flowering plants in the diversification of insects stems from the myriad ways in which plants offer themselves as food for insects.

A rather elegant example of this is the case of leaf mining insects — larvae of some beetles, flies and moths. Leaf miners burrow under the surface of leaves and eat their way through as they grow, often making exquisite patterns on the leaves. The pattern in which they mine the leaves is helpful in identifying the miner species from the damaged leaf. The same can be done through fossil records of damaged leaves.

Using precisely this technique, C.C.Labandeira and colleagues at the Smithsonian Institution in Washington DC and the Universities of Florida and Connecticut (*Proceedings of the US National Academy of Sciences*, No 91, 1994) have come up with new evidence that the insect-plant association of leaf miners with their hosts dates back to at least 97 million years ago. The fossils used in this study came from the Dakota deposits in the states of Kansas and Nebraska, US. Two cases of leaf damage have been attributed to known living genera *Stigmella* and *Ectodemia* of the family Nepticulidae and a third one has been identified to belong to the Gracillaridae family. Since the suspected agents of the fossil leaf damage have been identified as present-day moth larvae, it appears that these particular insect-plant associations go back unbroken to at least 97 million years. ■

BRIEFS

Sperm sense

In the animal kingdom, males often try to mate with more females and produce more offspring. In many insects, however, the testes weaken by the time the male reaches sexual maturity resulting in a low sperm count. But, in ant species such as *Cardiocondyla nuda*, there are two kinds of males — 'normal' winged males and 'abnormal' large headed, wingless, called ergatoid males. Winged males have a limited supply of sperms but the ergatoid males can produce sperms throughout their life. Ergatoid males are thus extremely aggressive, killing other males in their attempt to possess all virgin queens in their colony.

Killing bites

It takes the right amount of venom from the snake to kill its prey in one go. Larger the prey, more the venom and vice versa. William Hayes of the University of Wyoming, US, in a series of laboratory experiments demonstrated that rattlesnakes indeed 'meter' the quantity of venom they inject into mice of different sizes. This is especially done better by experienced snakes. Hayes used the enzyme linked immunoabsorbant assay or ELISA technique to measure the quantity of venom injected by estimating the venom in the body of the struck mice (*Animal Behaviour*, No 50, 1995).

Fig facts

Fig trees are pollinated by fig-wasps who in turn lay eggs in the flowers so that wasp babies can grow there. This, however, does not lead to extinction of fig trees as many of the fig flowers that get pollinated escape oviposition. The reason: two kinds of styles, short ones meant to be sacrificed for the fig wasps and long ones meant to make fig seeds are produced. The sizes of the styles are far more variable than the lengths of the wasp ovipositors leading to a symbiotic relationship (*Current Science*, No 68, 1995).