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Biodiversity of Western Ghats

Adaptation or fitness of design, and diversity or variety of design are two hallmarks of life. There have been rapid strides in understanding both these facets of life in recent decades. These advances have now focused our attention on the diversity of life as a resource of tremendous economic potential; but also a resource that is being rapidly eroded the world over. While it is realized that the entire spectrum of diversity of life is of interest, particular attention is nevertheless being paid to certain groups of organisms. Amongst them are non-timber forest species including medicinal plants, endangered and threatened flora and fauna, and wild relatives of cultivated crops. India is especially rich in wild relatives of several groups of crops such as minor millets (e.g. ragi), major cereals (e.g. rice), spices (e.g. turmeric, cardamom, pepper) and of several pulse crops (e.g. *Cajanus*, horsegram and field bean). Indeed it was the spices of the hill chain of Western Ghats that brought Europeans to India, an event of much significance in shaping the course of modern world history. Today these Western Ghats are recognized as one of the eighteen hot spots of diversity in the world, and are therefore a focus of great scientific interest.

The diversity of life on these Western Ghats was the theme of a symposium held in Bangalore to commemorate the birth centenary of Salim Ali. Salim Ali was undoubtedly the greatest of students of diversity of life of the Indian subcontinent of this century. While his studies of bird diversity spanned the entire subcontinent, Western Ghats was his special love. Many admirers of Salim Ali got together over a three-day period from 7 to 9 November 1996 to present a series of studies on the Western Ghats Biodiversity. The studies covered a range of organisms, habitats and issues. Prompted by this symposium we have compiled a set of papers representative of the ongoing work in the area of biodiversity in general and that in Western Ghats in particular in this issue of *Current Science*.

Ever since the first use of the term 'Biodiversity', there have been incessant efforts to develop objective estimates of different components of the diversity of the communities. Some of these have become very popular and been frequently used but there have been equally frequent comments on their inability to incorporate the biological heterogeneity of the constituent species. Two papers in this issue (Ganeshaiah *et al.* (**page 128**) and Pramod *et al.* (**page 122**) present two different ways of fulfilling this lacuna of the existing indices.

An important purpose of all our activities in evaluating and monitoring biodiversity is to conserve our natural habitats and the resources therein. However, developing strategies of conservation relies heavily on identifying major spatial and temporal patterns of change in biodiversity. Menon and Bawa (**page 134**) and Subash Chandran (**page 146**) attempt to identify such patterns in Western Ghats using two different kinds of approaches. Using the Geographic Information System technique, Bawa's group traces the major patterns of loss of biodiversity over a time period of seventy years in the Western Ghats and attempts to identify the possible factors driving these changes. They also illustrate other uses of the GIS analysis in biodiversity monitoring, and in mapping the conservation value of habitats. On the other hand, Subash Chandran attempts to reconstruct the ecological changes of Western Ghats based mostly on the historical and archaeological records and, social and biological relics.

Though ideally biodiversity as a whole needs to be conserved, the prohibitive costs associated prevent such a possibility and hence we need to prioritize the groups, populations and habitats that need immediate attention. But there are no easy ways of doing this. The paper by Pramod *et al.* (**page 156**) offers objective ways of assigning conservation values for species based on different criteria and tracking the habitats for planning conservation strategies. Similarly, Uma Shaanker and Ganeshaiah (**page 163**) report isozyme-based techniques for identifying populations for conserving the genetic diversity of a species. Based on their work on an important medicinal plant, they propose a new method of conserving the genetic diversity of forest species in their natural habitats. In another paper, Daniels (**page 169**) comments on the possible difficulties that the taxonomic uncertainties pose while assessing the conservation status of the species.

Identification of the factors driving the erosion of biodiversity, and the extinction of species helps in planning action for preventing further loss and extinctions. The paper by Lokesha and Vasudeva (**page 171**) reports their attempt in tracing the life history traits that predispose plants to become rare and endangered.

Our understanding of the organization of species assemblages is yet incomplete and a set of papers address different issues of community structure in diverse systems. Basu (**page 173**) reports on the role of interference behaviour in structuring ant communities of Western Ghats. While Bhatta (**page 183**) explores the distribution of Caecilians, one of the difficult groups to study. Easa and Shaji (**page 180**) report on the biodiversity of freshwater fishes. Ganeshaiah *et al.* (**page 188**) address the diversity of trees species assemblages of shola forests in Western Ghats.

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How to snuff out cancer cells?

Orthodox treatment for cancer consists of excision of the growth, destroying the tumour using ionizing radiation of decimating the abnormal cells with drugs which interfere with their nutrition, metabolism or multiplication. Surgery and radiotherapy are best suited to localized disease. Anti-cancer drugs are appropriate for disease which has spread to involve multiple sites. Most often patients receive a combination of these therapies either simultaneously or sequentially. A side effect of radiation is that it also destroys the normal tissue surrounding the tumour. Technological innovations such as stereotactic radiotherapy have, however, provided the means to delineate three-dimensional

perspective of the tumour and to reduce damage to the normal tissue. A problem with long-term treatment with drugs is that tumour cells develop resistance to them. Several new compounds like growth factors, hormones and modified forms of known therapeutic agents are being investigated in the search for less toxic, specific and efficacious anti-cancer agents.

Though results with current treatment modalities are encouraging, limitations still persist. Multi-model therapies are logistically difficult. Both radiotherapy and chemotherapy are hampered by the narrow safety margin between toxicity for the tumour and toxicity to the patient. Many a time the complications are troublesome and even life threatening. Moreover, many solid tumours do not respond to conventional management.

Progress in understanding tumour biology has prompted oncologists to explore imaginative strategies for treatment of cancer. Recent approaches aim to rectify the molecular defects that transform normal cells into malignant ones, arrest the growth and destroy blood vessels which supply nutrients to the tumour or harness body's own defenses against cancer.

Several targets have been identified for treating cancer at the molecular level. These include the altered versions of normal genes that affect cell growth (oncogenes), genes that usually suppress the development of tumours (suppressor genes), genes involved in the repair and maintenance of integrity of DNA and gene products which are altered in quantity or structure in the cancer cells. Gene therapy intends to restore normal gene function by replacing the mutated genes with the normal ones. Inhibitors of altered enzymes in critical pathways and agents which block the synthesis of abnormal proteins are also employed to re-establish normal function in the cells. A fascinating point is that tumours with multiple molecular defects respond even when only one among these faults is corrected.

Malignant cells can switch on the development of new blood vessels (neovascularization or angiogenesis). Neovascularization is a crucial step in the transition of a tumour to malignancy. It also promotes progression of the disease and its spread. Anti-angiogenic treatment aims at decreasing synthesis of angiogenic growth factors, increasing the production of angiogenic inhibitors, blocking the cellular enzymes that assist tissue migration, hindering the action of growth factors on endothelial cells lining the blood vessels or suppressing the proliferation of endothelial cells. Several anti-angiogenic drugs have been evaluated for toxicity, safety and efficacy in small clinical trials. They are likely to be used for long-term treatment since they have low toxicity and cancer cells do not appear to develop resistance against them. However, no anti-angiogenic drug has been approved for use in cancer patients.

Yet another treatment option is immunotherapy. Nearly a century ago, William Coley, a surgeon in New York, observed regression of cancer in a patient who developed streptococcal infection of the facial skin. Coley devoted his entire life to lay the foundations of an immune-based therapy for cancer. He attempted to strengthen the general immune status of his patients (non-specific immunotherapy). New insights in tumour immunology have prompted attempts to activate specific components of the immune system. Antibodies against tumour antigens are being investigated as therapeutic agents. Humanized antibodies produced by refashioning mouse antibodies have entered clinical trials. Antibodies can themselves destroy the cancer cells. They can also be used as vehicles to guide toxic agents (radioactive compounds, plant or bacterial toxins, enzymes that convert a prodrug into a dangerous compound at the tumour site) to the tumour. Most impressive results with antibody-based therapy have been seen in patients with leukemia and lymphoma.

Recognition of the importance of lymphocytes in tumour immunology led to vaccine therapies against cancer. What led to this approach was the discovery that patients with the malignant skin cancer melanoma had antibodies and lymphocytes which reacted with their own cancerous cells; which meant that these patients could launch a specific immune attack against their tumour cells. Antigens recognized by T lymphocytes were soon isolated. The list of protein and peptide tumour antigens has rapidly grown over the years. All these molecules are candidates for production of vaccines. Products of oncogenes and tumour suppressor genes are also attractive targets for vaccines. The use of antigens presenting dendritic cells isolated from blood as cellular adjuvants and viral or bacterial vectors incorporated with genes which code for tumour antigens are promising tactics in vaccination against cancer.

Another curative measure under scrutiny is adoptive immunotherapy. The technique involves stimulating blood T lymphocytes by exposing them to tumour cells or antigens *in vitro* and then transfusing the treated cells back into the patients. The patient himself is the donor as well as the recipient of the lymphocytes. Steven Rosenberg and colleagues at National Cancer Institute, USA pioneered the clinical trials with adoptive immunotherapy. They demonstrated that lectins and cytokines can also be used to activate peripheral blood lymphocytes. Lymphocytes incubated with the cytokine interleukin-2 generate a population of cells which can lyse cancer cells but not normal cells. Tumours resistant to standard chemotherapy and radiotherapy were found to show the best response to these activated cells. Interleukin-2 has serious toxic effects and some patients experience severe respiratory, central nervous system and cardiovascular problems thanks to leakage of fluid into tissues resulting from damage to blood vessels. Adoptive immunotherapy does not have many enthusiastic supporters.

Ashim Chakravarty and Shubra Jha report (**page 201**) encouraging results of adoptive immunotherapy in a mouse model with a malignant tumour of the connective tissue. They have used T lymphocytes activated polyclonally with concanavalin A and speculate: 'the use of polyclonally activated T cells has possibly certain advantages'.

Cancerous cells are notorious for the devious ways they devise to evade immune attack. Does adoptive immunotherapy have potential as an effective cancer cure? May be it has, as an adjuvant.

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