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Developing Educational Material on the Western Ghats, a Global Biodiversity Hotspot, for Local Schools and Libraries

Technical Report Submitted to

The Rufford Foundation

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EXECUTIVE SUMMARY

This project developed an educational CD-ROM and posters on the biodiversity of the Western Ghats in India. The main aim of this project was to generate awareness about biodiversity of the region as well as environmental issues pertaining to this hotspot. A great deal of research has been carried out in the region, however, awareness about biological diversity and the consequences of its loss are minimal, despite the public being largely literate. As the current educational system does not adequately cover the aspects of local biodiversity, the primary target of the exercise are school children who would benefit from learning about these issues and become responsible stewards of the environment. Although the content is primarily aimed at high school students, we have designed the level of the output in such a way that this would also be a supplementary source of information on the Western Ghats for laypersons and educationists.

The primary outputs of this effort are an educational CD-ROM and a set of posters that are being distributed to schools in southern India. The topics that are covered in the CD-ROM include descriptions of important species and taxonomic groups, landscapes, parks and people and ecological issues. For making the product more attractive to a student audience, a flythrough developed from digital elevation models and satellite images has been designed and inserted in the beginning. The greater part of the content of the CD was developed by the team members. In addition, we have received over forty short write-ups sourced from other researchers working in the region, which adds tremendously to the quality of the product and enables the reader to experience a more diverse set of research and viewpoints. The product has been reviewed by a team of reviewers for quality, accuracy and suitability for the target audience. The five posters that have been designed highlight specific issues of importance to the region such as diversity and endemism, ecosystem engineers, the flagship species concept, etc.

We aim to distribute the CD-ROM and posters (1000 copies) during the current academic year that begins in July. Initial responses from reviewers have been very encouraging. It has also been suggested by a number of individuals that the product be translated into the major local languages. This is being explored.

OVERVIEW

A storehouse of high diversity and endemism, the Western Ghats or the *Sahyadri* of southern India (along with the island of Sri Lanka which is ecologically similar) is regarded as one of the eight 'hottest' hotspots in the world (Myers et al 2000). The mountain range runs parallel to the west coast of peninsular India stretching from Cape Comorin (or Kanyakumari) in the south to the Surat Dangs in Gujarat in the North (a latitudinal extent of 80 N to 210 N). The Sahyadri has wide-ranging physical, biogeographical and cultural impacts. In addition to its biological wealth provides critical ecosystem services. All major rivers in the peninsula have their origins in the Western Ghats and much of the climate in peninsular India is regulated by this mountain chain. Historical and cultural aspects of human populations living in southern India can be related to these mountains.

A geologically old mountain range, the Western Ghats boasts exceptional endemism for many taxonomic groups, including plants (35%), fishes (42%), reptiles (48%) and amphibians (75%) (GOI 1997). Endangered, endemic species are found in this region including the lion tailed macaque (*Macaca silenius*), the nilgiri *tahr* (*Hemitragus hylocrius*) and the recently discovered purple frog (*Nasikabatrachus sahyadryensis).* The latter has been classified as the single representative of an entirely new family, the closest relatives of which are found among the ancient Sooglossid frogs of the Seychelles and Madagascar. Apart from high diversity and endemism, flagship species such as the Asian elephant and the tiger occur here. Over a third of the country's elephant population is found in the forests here and significant numbers of large carnivores and their prey species are also found.

In addition to endemic species, some unique ecosystems are situated in the Western Ghats. The *shola*-grassland matrices of the higher elevations and the *Myristica* swamps of the low-lying water logged areas support large numbers of endemic species and are found nowhere else. The same is true of the sacred groves, unique patches of human protected forest that have religious and cultural significance that have received protection for hundreds of years.

The total area of forests of the Western Ghats ecosystems once covered over 160,000 km2. As is the case in most tropical areas, much of these, especially the rainforests in the region have disappeared, and currently only 17,000 km2 is covered under the protected area network.

High population densities and intense pressure on the natural resources by way of conversion of rainforests to agricultural land, timber extraction, and the development of hydroelectric projects has resulted in extensive habitat loss and fragmentation. Much of this loss in forests took place in the last 100 years by way of expansion of agriculture, especially commercial plantations. Currently, human and livestock population densities in this region are amongst the highest when compared with other global hotspots.

Species and ecosystem research in India is relatively new. Still, much research has been carried out on species and ecosystems in the Western Ghats in the past few decades and the region is probably the best studied biogeographic zone in the country. Research in this region includes new taxonomic descriptions and discoveries, rediscoveries; species based research as well as that of taxonomic groups, and the study of processes especially relating to rainforest dynamics and impacts such as forest fragmentation. However, like many research outputs, much of this still remains locked within scientific papers and reports out of reach of the general public. Although there are a number of small initiatives involving the public, concerted efforts involving a large number of people from the younger generation are few and far between.

It is important that this information reaches the public and the younger generation, in particular to create awareness about local biodiversity and problems associated with forest loss. Another lacuna is within the education system, which has so far failed to give adequate importance to the wildlife heritage of the country or environmental issues. General information about the environment is also lacking, and an environmental science courses in schools are still in their rudimentary stages and not given due importance.

A number of factors prompted the CD-ROM based design of this project. In comparison with the rest of India, literacy rates within southern India are much higher. A large percentage of children finish high school. Computer technology and internet facilities are also better developed as the region is a source pool for IT cities such as Bangalore and Hyderabad. Many schools and educational facilities have good computer labs and parents encourage children to learn using computers. At present there are a considerable number of NGOs and responsible government organisations that would help in the distribution of such a product and may even provide translation facilities.

This project has enabled us to develop the urgently needed supplementary material for distribution in schools and libraries in the region. We have developed an educational CD-ROM as well as a set of posters aimed at high school children and the general public. This product has been developed with the active involvement of a number of researchers and has brought together people involved in different fields (ranging from wildlife research, education and the audio-visual media) in the Western Ghats. In many ways this has been a pilot exercise and has been useful in exploring the feasibility of further developing a website for the Western Ghats as well as in developing educational material for other biogeographic zones in India.

OBJECTIVES

This project developed an interactive CD-ROM as well as a set of posters for the Western Ghats. The primary objectives behind developing these products were to:

- *Increase awareness and knowledge among high school students and the general public about the Western Ghats and its ecological heritage.*

Our objective was to develop a product of the highest quality both in terms of the accuracy and breadth of knowledge as well as in terms of visual superiority and attractiveness. In terms of the academic level of output, the information provided is suitable for both students and the general public. The material provided in the CD-ROM is written in simple language and the content has been verified by experts working in the field.

- *Develop educational material that would supplement the environmental science curricula in high schools.*

As mentioned earlier, environmental education in schools is a new subject and at present there is not enough material for students or educationists to rely on for further development of this field. This CD-ROM can be an attractive learning experience for students as well as a resource for teachers and educationists who want to know more about the Western Ghats.

- *To serve as a basis for other such exercises relating to environmental conservation in India.*

This project is one of the first exercises of its kind where inputs from a variety of people have been incorporated. In addition to a large number of people who contributed by way of write-ups,

photographs and design, a larger group of people and organisations have expressed interest in carrying this further by helping with the distribution, networking, translation and also in helping with the development of educational material (such as CD-ROMs and websites) for other biogeographic zones of India.

METHODS

The main technical components identified for the project were: compiling content, research and development of the flythrough module, acquisition of photographs, design and assembly of the CDROM, design of posters, review and production.

Data collection and compilation

Compilation of information was carried out during the first phase of the project. This was done by accessing research publications, natural history writing and related material from journals and field guides, libraries and websites. A short list of key publications is given in the following pages.

Journals

- Conservation Biology
- Current Science
- Conservation and Society
- Journal of the Bombay Natural History Society
- Hornbill

Websites

- The Western Ghats Forum
- Centre of Ecological Sciences
- Ashoka Trust for Research in Ecology and the Environment
- ENVIS Centre, Wildlife Institute of India

Natural History Writing

- Fall of a Sparrow – Salim Ali
- Snakeman – Zai Whittaker

- Eye in the Jungle – Ashish and Shanti Chandola and TNA Perumal (containing the writings of M. Krishnan)
- Sahyadri – Sandesh Kadur and Kamaljit Bawa
- Stones of Silence – George B. Schaller

Field-guides and Similar Publications

- The Book of Indian Mammals – S.H. Prater
- The Book of Indian Birds – Salim Ali
- Handbook of the Birds of India and Pakistan – Salim Ali and S. Dillon Ripley
- An Atlas of Endemics of the Western Ghats B.R. Ramesh et al.
- Freshwater Fishes of Peninsular India – RJR. Daniels
- Snakes of India – Romulus Whittaker and Ashok Captain
- Project Reports submitted to/by institutions such as the Wildlife Institute of India (WII), Ashoka Trust for Research in Ecology and the Environment (ATREE), Salim Ali School of Ornithology (SACON).

Writing & Review

The text for each of the modules were prepared by the team members or assistants and reviewed by an expert who was familiar with the topic. It is important to mention here that the type and quality of the information available on different topics of interest are highly variable. For example, as is the case in most ecosystems, mammals are the best studied group and therefore information on this group is considerably more. Additionally, we have devoted the largest section towards mammals as they are large, charismatic vertebrates and therefore more likely to capture the attention of a young reader than would a lesser charismatic group such as plants. In some cases more detailed attention to a topic is intentional. For example, the ecological issues and conservation initiatives section has been written with the help of examples of each type of initiative.

For sections where content was lacking, first hand information was acquired from researchers working on various topics and included in the CD as invited submissions. In addition to filling gaps in knowledge, these contributions provide a unique opportunity for students to read the actual contributions and identify with researchers and scientists currently working in the region. Given below are the list of topics and their contributors.

Photograph Acquisition and Design

Photograph acquisition, scanning and archiving as well as design of the CD-ROM was carried out at Ecotone, Chennai.

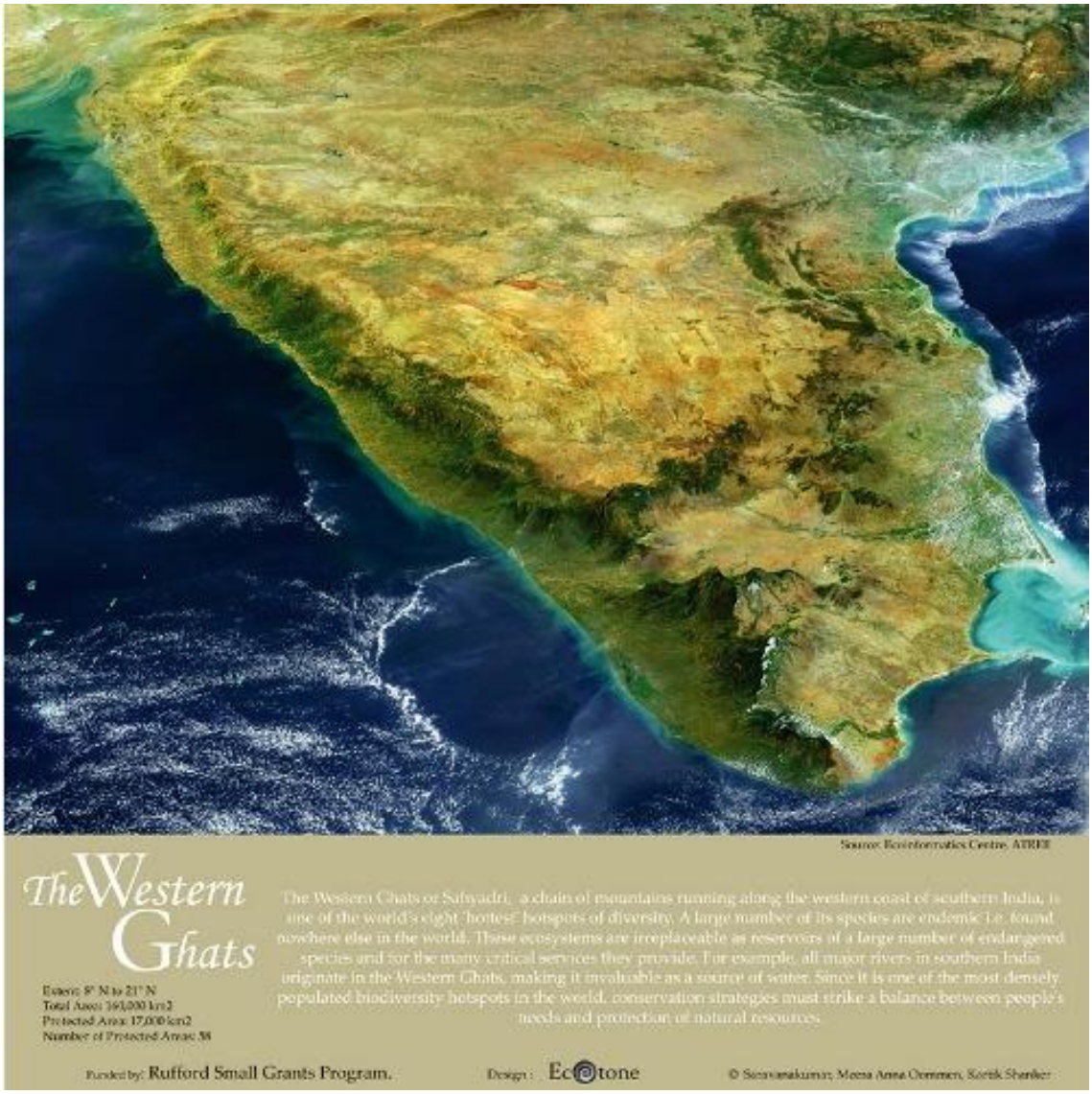
Flythrough

A unique flythrough module for this project was developed by some members of the Eco-informatics team of the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore. Digital elevation models of peninsular India were overlaid with truce colour composites of satellite images of the region to develop a short movie flythrough depicting the location, physical features and places of importance in the Western Ghats.

THE POSTERS

Poster 1 – The Western Ghats

The Western Ghats or Sahyadri, a chain of mountains running along the western coast of southern India, is one of the world's eight 'hottest' hotspots of diversity. A large number of its species are endemic i.e. found nowhere else in the world. These ecosystems are irreplaceable as reservoirs of a large number of endangered species and for the many critical services they provide. For example, all major rivers in southern India originate in the Western Ghats, making it invaluable as a source of water. Since it is one of the most densely populated biodiversity hotspots in the world, conservation strategies must strike a balance between people's needs and protection of natural resources.

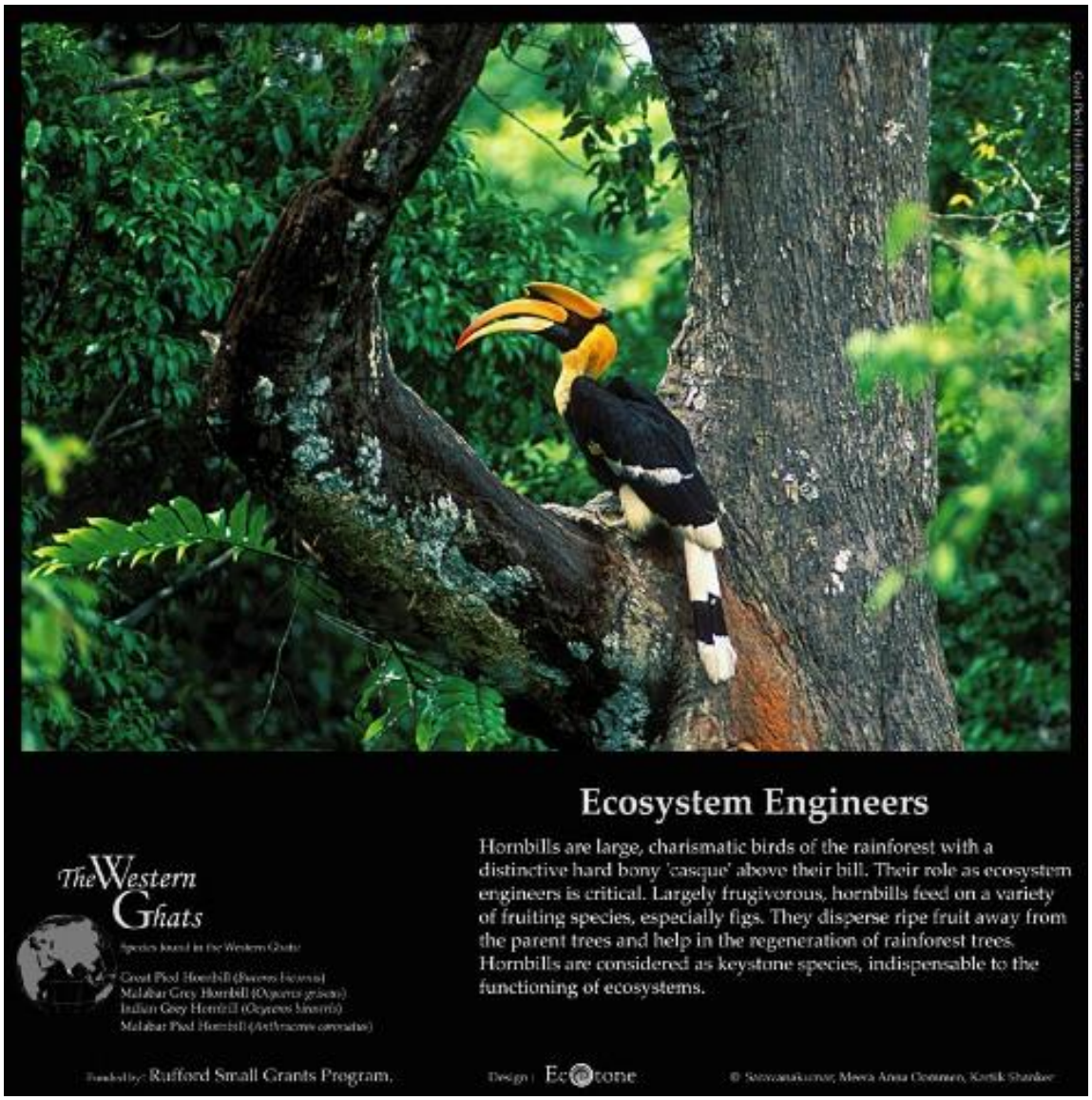


Poster 2 – Rarity, Diversity and Endemism

The recently discovered Purple frog *Nasikabatrachus sahyadryensis* is the only species in a 100 million year old family of amphibians. It is a living fossil whose closest relatives are in the Seychelles and Madagascar. The frog spends its entire life under ground and only surfaces during the monsoon to breed. Nearly 90% of the amphibians in the Western Ghats are endemic i.e. found nowhere else in the world. Many new species are still being discovered adding to the already high diversity of the region.

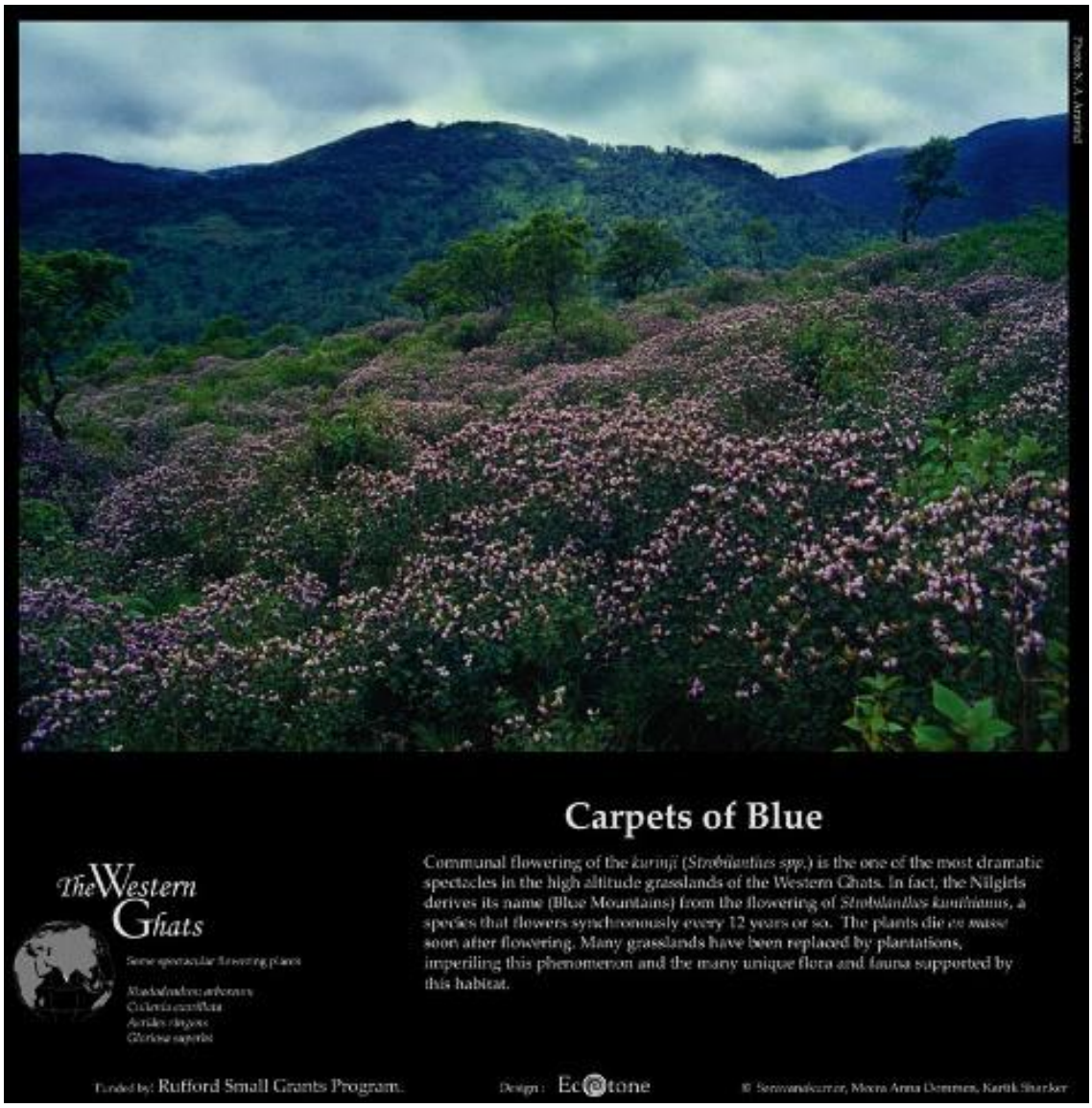
Poster 3 – Ecosystem Engineers

Hornbills are large, charismatic birds of the rainforest with a distinctive hard bony 'casque' above their bill. Their role as ecosystem engineers is critical. Largely frugivorous, hornbills feed on a variety of fruiting species, especially figs. They disperse ripe fruit away from the parent trees and help in the regeneration of rainforest trees. Hornbills are considered as keystone species, indispensible to the functioning of ecosystems.



Poster 4 – Carpets of Blue

Communal flowering of the *kurinji* (*Strobilanthes* spp.) is the one of the most dramatic spectacles in the high altitude grasslands of the Western Ghats. In fact, the Nilgiris derives its name (Blue Mountains) from the flowering of *Strobilanthes kunthianus*, a species that flowers synchronously every 12 years or so. The plants die *en masse* soon after flowering. Many types of grassland have been replaced by plantations, imperilling this phenomenon and the many unique flora and fauna supported by this habitat.



Poster 5 – Flagship of the Highlands

The Nilgiri *tahr* inhabits the cliffs and slopes of the shola-grassland ecosystems of the higher reaches of the Western Ghats. Once abundant throughout its range, the *tahr* fell victim to hunting and habitat loss, mainly the conversion of vast tracts of montane grasslands into tea estates and other plantations. Like forests, grasslands are unique ecosystems with many such endemic and endangered species. A few *tahr* populations have recovered due to the effective protection of some large tracts of grassland.

The Nilgiri *tahr* is closely related to a species found in the temperate Himalaya (the Himalayan *tahr*). Many other plants and animals in the Western Ghats have close relatives in the Himalayas due to connectivity between the regions during cooler glacial periods.

THE CD-ROM

The Structure of the CD-ROM

For the CD ROM, the content was developed on the following themes:

1. An introduction to the Western Ghats

2. Flora and fauna

3. Important protected areas

4. People and lifestyles

5. Ecological issues in the Western Ghats

A brief description of the content is provided in the following pages.

1. An introduction to the Western Ghats

   A movie flythrough of the Western Ghats has been developed with the help of the Eco-informatics Centre at ATREE. In this flythrough, the a viewer gets to scroll over the entire length of the Western Ghats and literally gets a bird's-eye view of the mountain range from Kanyakumari in the South to the Gujarat Dangs in the north. This exciting module has been developed by draping a true colour composite satellite image over a high resolution digital elevation model of the region. Visually, this would be very appealing to a student as well as lay person and would be an ideal introduction to the physical and geographical aspects of the region. This module has been developed by Aditya Singh of ATREE with contributions from Mohammed Irfanullah and Jagdish Krishnaswamy.

2. Flora and fauna

   The rich diversity of plants and animals are illustrated with the help of photographs. Simple summaries of the ecology, distribution and behaviour of important species and groups are included as are distributional extents of important species will be illustrated. Among the various taxonomic groups a large section is devoted to mammals. As a taxonomic group, they are comparatively better researched and more information is available for presentation. In addition, being mostly large and charismatic they are an ideal group to introduce and generate interest among a young audience.

List of Mammal Groups Covered

Primates

Carnivores

- Felids
- Canids
- Mustelids
- Vivverids
- Herpestids

Ungulate

- Bovids
- Cervids
- Suidae

Insectivores

Rodents

Scandentia

Bats

Other Groups Covered

- Birds
- Reptiles
- Amphibians
- Fishes
- Invertebrates
- Plants

3. Important protected areas

The location and salient features of the various types of protected areas, their history and the purpose for which they were instituted are described. A map of the region showing the location of the 58 protected areas and specific information such as their date of establishment, nearest road and railhead, airport, etc. has been provided. Short write-ups are included for the major protected areas.

List of Major Protected Areas

- Nilgiri Biosphere Reserve, Tamil Nadu, Kerala and Karnataka
- Bhagwan Mahavir Wildlife Sanctuary and Mollem National Park, Goa
- Anshi National Park, Karnataka
- Bandipur National Park, Karnataka
- Bhadra Wildlife Sanctuary, Karnataka
- Biligiri Rangaswamy Temple (BRT)Wildlife Sanctuary, Karnataka
- Kudremukh National Park, Karnataka
- Rajiv Gandhi National Park (Nagarhole), Karnataka

- Sharavati Valley Wildlife Sanctuary, Karnataka
- Chinnar Wildlife Sanctuary, Kerala
- Eravikulam National Park, Kerala
- Senduruney Wildlife Sanctuary, Kerala
- Parambikulam Wildife Sanctuary, Kerala
- Periyar National Park, Kerala
- Silent Valley National Park, Kerala
- Wyanad Wildlife Sanctuary, Kerala
- Indira Gandhi (Anamalai) National Park, Tamil Nadu
- Kalakad-Mundanthurai Tiger Reserve (KMTR), Tamil Nadu
- Mudumalai National Park, Tamil Nadu

4. People and lifestyles

The history of human habitation in the Ghats and surrounding areas is described. A number of hunter-gatherer tribes still occupy many areas in these mountains. Information about their lifestyles, including traditional crops and cropping patterns, knowledge about wildlife and medicinal plants are included.

5. Ecological issues in the Western Ghats

Despite having high rates of literacy in the southern states, awareness about problems concerning local environmental issues is minimal. Immediate problems facing the ecoregions such as habitat loss, poaching and forest fragmentation are explained. Different types and levels of conservation efforts in the region are explained in detail.

Major Ecological Issues

- Fragmentation & Deforestation
- Plantations
- Hydroelectric Projects
- Mining
- Invasion by Exotic Species
- Fire

Conservation Initiatives

- People's Biodiversity Register
- The Western Ghats Forum
- A Peoples' Movement – Silent Valley
- Benefit Sharing – The TBGRI and Kani Tribals
- Developing Enterprises – ATREE and tribal communities
- Rainforest Restoration – The Nature Conservation Foundation
- Conservation of Sacred Groves
- The Gurukula Botanical Sanctuary
- Initiatives in Urban Environmental Education
- Revitalisation of Rural Health Traditions – FRLHT
- Preserving Indigenous Knowledge Systems - CIKS
- Wildlife Societies
- Snakes and Crocodiles – The Madras Crocodile Bank Trust
- Conservation Research
- Popular Writing and Audio-Visual Media

SAMPLES OF INVITED CONTRIBUTIONS

Gekkonid lizards of the Western Ghats: Geckos are the second most numerous of living lizards represented by about 900 species (=distinct forms) worldwide. They are primarily tropical in distribution and often come in bizarre forms that also include the smallest living species among reptiles, birds and mammals (just 33 mm in total length!). They are notable for their nocturnal habits, exceptional climbing ability, frequent vocalizations, and ready tendency to lose their tails to evade predators and for laying only one or two calcareous eggs at a time. Most of us have seen these critters chasing insects around lights in our houses. These urban ones are *Hemidactylus* species, one among the six genera (=coherent group of distinct forms), which together with about 40 species occur in and around the Western Ghats. Geckos of the Western Ghats are dominated by primarily diurnal, endemic species of the genus *Cnemaspis*. Except *Cnemaspis* and *Geckoella*, all regional species possess well developed toe pads required for typical gecko-like climbing agility. Hardly anything is known about the ecology and behaviour of the Western Ghats geckos. The idea that people may die from eating food in which a gecko fell is unsubstantiated. Except those which occur in and around human habitations most geckos are

susceptible to destruction and disturbance of their natural habitats that not only include forests but rocky formations in open areas.

Sayantan Biswas is associated with the George Washington University and ATREE and is currently investigating evolutionary history of species and their distributions in the Western Ghats, using selected endemic frogs and lizards as a part of his Ph.D. research. (sayantan@gwu.edu)

Global amphibian decline: Global Amphibian Decline (GAD) is one of the most talked about events, which together with others constitute the man made biodiversity extinction crisis of our times. First becoming well known in the 1980's, the wide scale occurrence of this phenomenon is now well documented. However, GAD has proven difficult to negotiate as no single factor seems to be critical across all the areas and species concerned adding to the intractability of the problem, unless local factors and their influence on the biology of the species are known. Documented factors among others include increased ultra-violet radiation, predation often by novel introduced species, habitat modification, increased acidity and toxicants in the environment, fungal, bacterial and viral diseases, and change and fluctuations in patterns of climate and weather due to global warming. GAD has been best recorded from both protected and unprotected habitats in Western Europe, North and South America and Australia. However, poor or no records of GAD from other areas for example the Western Ghats is more due to unavailability of data than anything else. South Asia including the Western Ghats is probably one of the most ill-equipped areas to handle a phenomenon like GAD, due to lack of knowledge of species distribution, population estimates, critical environmental factors that is further complicated by few or no professional herpetologists (=those who study amphibians and reptiles) in most areas, poor appreciation of the complexity and impact of such phenomenon, and rapid habitat destruction and fragmentation in the region.

Sayantan Biswas is associated with the George Washington University and ATREE and is currently investigating evolutionary history of species and their distributions in the Western Ghats, using selected endemic frogs and lizards as a part of his Ph.D. research. (sayantan@gwu.edu)

Mining in a rainforest: Mining of mining low grade iron ore in one of the finest stretches of rainforests in Kudremukh has finally stopped. The Supreme Court upheld the petition filed by save the Bhadra, Tunga and Netravati Rivers on which depended the lives of several million marginal farmers. Kudremukh was not another clichéd development versus environment case. This was about a mindless development mistake of the past which was perpetrating grave damage

to valuable biodiversity and river systems. The consequences of habitat fragmentation and biodiversity loss were poorly understood when the decision to mine was taken in 1969. Open cast mining by its very nature is an extremely destructive activity. The average rainfall of over 7000 mm in Kudremukh greatly accentuates the impacts of sedimentation. Peer reviewed scientific studies have accurately estimated that mining has caused massive sedimentation in excess of 15 lakh tons since 1980. Today, it is well recognized that Rainforests and Rivers are more valuable to our society than iron ore. Biodiversity rich landscapes like Kudremukh, which form less than one percent of India's landscape, should not be sacrificed at the altar of economic development. These fragile landscapes are to be viewed as 'Sacred Groves' for the crucial role they play in stabilizing climate, soil and water resources.

Praveen Bhargav is a trustee of Wildlife First, and co-ordinates its conservation advocacy activities focused on saving wildlife and wild landscapes in the Western Ghats (pbsolus@vsnl.com>

Understanding Tigers: Tracking tigers and studying the awesome predator is not all fun and pure thrill. But entering their secret world and understanding their ecological needs provides valuable insights on how to conserve and manage tigers. Biologist Ullas Karanth's long term scientific study in Nagarahole has provided us with fascinating information. Radio telemetry studies have shown that adult females are the pivots of tiger societies with an exclusive home range of just 10-15 sq km in well protected reserves like Nagarahole stocked with abundant prey; the home range of a breeding male overlaps three female home ranges; young tigers disperse from their mothers at about two years and try to establish their own home range. Radio tracking has also revealed that tigers are solitary stalkers and hunt primarily between dusk and dawn. A mother needs to kill around 50 deer to survive and bring up her cubs. Tigers are also prolific breeders and produce three to four cubs every third year. Karanth's insightful research has enlightened us on the fact that even relatively small but well protected reserves can support high densities of tigers as in the case of Nagarahole and Bandipur and other similar sites across the Western Ghats landscape.

Praveen Bhargav is a trustee of Wildlife First, and co-ordinates its conservation advocacy activities focused on saving wildlife and wild landscapes in the Western Ghats (pbsolus@vsnl.com>

Giant Squirrels: Giant squirrels are the largest tree squirrels in the world and three of the four species of giant squirrels occur in India, with two species being found in the Western Ghats. The

Indian or Malabar giant squirrel *Ratufa indica* is rusty red and cream coloured and occurs in moist deciduous and wet evergreen forests. Malabar giant squirrels in the southern Western Ghats are darker in colour, almost black, while those in the northern Western Ghats are paler in colour. This colour variation may be related to a gradient in rainfall and temperature from south to north. The grizzled giant squirrel *Ratufa macroura* is found in the drier forests of the eastern slopes of the southern Western Ghats. It is smaller, has a salt and pepper coloured coat, and is well camouflaged in the dry forest. Giant squirrels are solitary and territorial, with each squirrel defending an exclusive area of the forest. They build several leafy dome-shaped nests and sleep within them during the night and sometimes during the heat of the day. Squirrels are entirely herbivorous and feed on fruit, flowers, leaves, and bark. Females are sexually receptive once a year, and produce a single pup. Predators of the squirrel include crested serpent and black eagles, owls, pine martens, lion-tailed macaques, snakes and leopards. They are loudly vocal and give territorial and predator-related calls. Since these squirrels are arboreal and need forests with continuous canopy cover, they are extremely vulnerable to forest fragmentation and discontinuities in forest due to roads.

Renee Borges is Faculty at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore where she studies the behavioural ecology of species interactions, including plant-animal interactions and the interactions between ants and ant-mimicking spiders (renee@ces.iisc.ernet.in)

Crickets: Crickets are a group of nocturnal insects best known for their ability to produce sound. Male crickets produce sound by rubbing their forewings together in order to attract mates. Each species of cricket has a distinct song. This allows female crickets to tell males of their own species apart from the others. They also use the song to choose among different males of their own species. They can find a calling male using the song alone in the absence of all visual cues. There are two main kinds of crickets, the field crickets and the bush crickets. Field crickets are usually small and brown to black in colour, dorso-ventrally flattened and they live largely in cracks and holes in the ground. Bush crickets are laterally flattened and closely resemble leaves and usually live in bushes and tall grasses. The exact number of crickets in the Western Ghats is not known, but is believed to be quite large and there are likely to be several new species waiting to be found there.

Natasha Mhatre works with Rohini Balakrishnan at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore on the behaviour of crickets (natasha@ces.iisc.ernet.in)