

# Applications of geographic information systems, remote-sensing, and a landscape ecology approach to biodiversity conservation in the Western Ghats

Shaily Menon\* and Kamaljit S. Bawa\*,†

\*Department of Biology, University of Massachusetts, Boston, MA 02125, USA

†Ashoka Trust for Research in Ecology and Environment, No. 11, 4th Main, 1st Stage, MSH Layout, Bangalore 560 024, India

The mountains along the west coast of peninsular India, the Western Ghats, constitute one of the unique biological regions of the world. Rapidly occurring land-cover and land-use change in the Western Ghats has serious implications for the biodiversity of the region. Both landscape changes as well as the distribution of biodiversity are phenomena with strong spatial correlates. Recent developments in remote-sensing technology and Geographic Information Systems (GIS) allow the use of a landscape ecology and spatial analysis approach to the problem of deforestation and biodiversity conservation in the Western Ghats. Applications of this approach include analyses of land-cover and land-use change; estimation of deforestation rates and rates of forest fragmentation; examination of the spatial correlates of forest loss and the socioeconomic drivers of land-use change; modelling of deforestation; analysis of the consequences of land-cover and land-use change in the form of climate change and change in distribution of biodiversity; biomass estimation; gap analysis of the effectiveness of the protected area network in conserving areas of importance for biodiversity conservation; and conservation planning. We present examples from our work in the Western Ghats, in general, and in the Agastyamalai region and Biligiri Rangan Hills, in particular, as well as that of other researchers in India on various aspects of applications of GIS, remote sensing, and a landscape ecology approach to biodiversity conservation.

THE mountains along the west coast of peninsular India, the Western Ghats, constitute one of the unique biological regions of the world. The Western Ghats extend from the southern tip of the peninsula (8°N) northwards about 1600 km to the mouth of the river Tapti (21°N). The mountains rise to average altitudes between 900 and 1500 m above sea level, intercepting monsoon winds from the south-west and creating a rain shadow in the region to their east. The varied climate and diverse to-

pography create a wide array of habitats that support unique sets of plant and animal species. The level of endemism is high and the region is considered one of the world's biodiversity hot spots. Apart from biological diversity, the region boasts of high levels of cultural diversity as many indigenous people inhabit its forests.

The Western Ghats region, like other parts of the tropics, is undergoing rapid transformation. The deforestation rate is high and forests are being transformed into agriculture and monoculture plantations. Hydroelectric projects, mining, and extraction of forest products are also altering the landscape. The changes in land use and land cover have profound consequences for the biodiversity and economic well-being of the people. Although change in the Western Ghats is occurring at a rapid pace, the exact magnitude and patterns of change are not well understood. Moreover, drivers as well as consequences of change remain unexplored.

Recent developments in remote-sensing technology and Geographic Information Systems (GIS) allow us to use a landscape ecology and spatial analysis approach to address the problem of deforestation and biodiversity conservation in the Western Ghats. The landscape ecology approach departs from traditional approaches by focusing on the structure, function, and spatial patterns of landscape elements and on changes in the landscape mosaic through time. Furthermore, this approach has numerous applications to conservation planning because the total area, patchiness, and connectivity of ecosystems and habitats, and their representation in the protected area network are all important for biodiversity conservation. Moreover, the spatial data, when integrated with socioeconomic data, have the potential to reveal the complex role of social and economic factors underlying change.

GIS are computer-based systems that efficiently store, retrieve, manipulate, analyse, and display spatial data according to user specifications<sup>1,2</sup>. GIS is used as a decision support system involving integration of spatially