Mapping diversity of ants and root grubs

T. M. Musthak Ali* and K. N. Ganeshaiah†

*Department of Entomology, and †Department of Plant Genetics and Breeding, University of Agricultural Sciences, GKVK, Bangalore 560 065, India

CONSERVATION of biological resources is viewed as one of the immediate tasks we should embark on, at a global scale. It is prescribed that every country shall consider it a responsibility to conserve its biological resources for a sustained and healthy global posterity[1]. But launching of any such national conservation programme is contingent upon the knowledge of what, where and how to conserve[2]. In this sense it has become very essential that we develop perspective maps of our biological resources that are as detailed as possible.

In fact such atlases are being constructed by different groups[3,4], but it is important to develop a common protocol to integrate them to arrive at national maps of biological diversity. The importance of such maps and ways of integrating them into the national conservation plans are discussed elsewhere[2]. In this article we propose a protocol for mapping the biological diversity of our country and demonstrate its application in two insect groups, namely ants and root grubs. We have utilized data on these two groups (Table 1) for several reasons. Data collection on root grubs was possible through a strong and a nationwide network of All India Co-ordinated Research Projects (AICRP) on root grubs spread over 22 centres including co-operating centres representing different agro-climatic zones across the country. These collections were being sent continuously for over a decade to the AICRP centre on root grubs at Bangalore which has been assigned with the responsibility of root grub taxonomy. The details on the taxonomic status, collector, and place of collection, and such other information are computerized on over 8000 specimen and in this sense it constitutes perhaps one of the best data bases for this insect group in our country. Similarly, ant specimen from all over the country are being sent to Musthak Ali (MA) for identification for the past two decades who has been cataloguing them

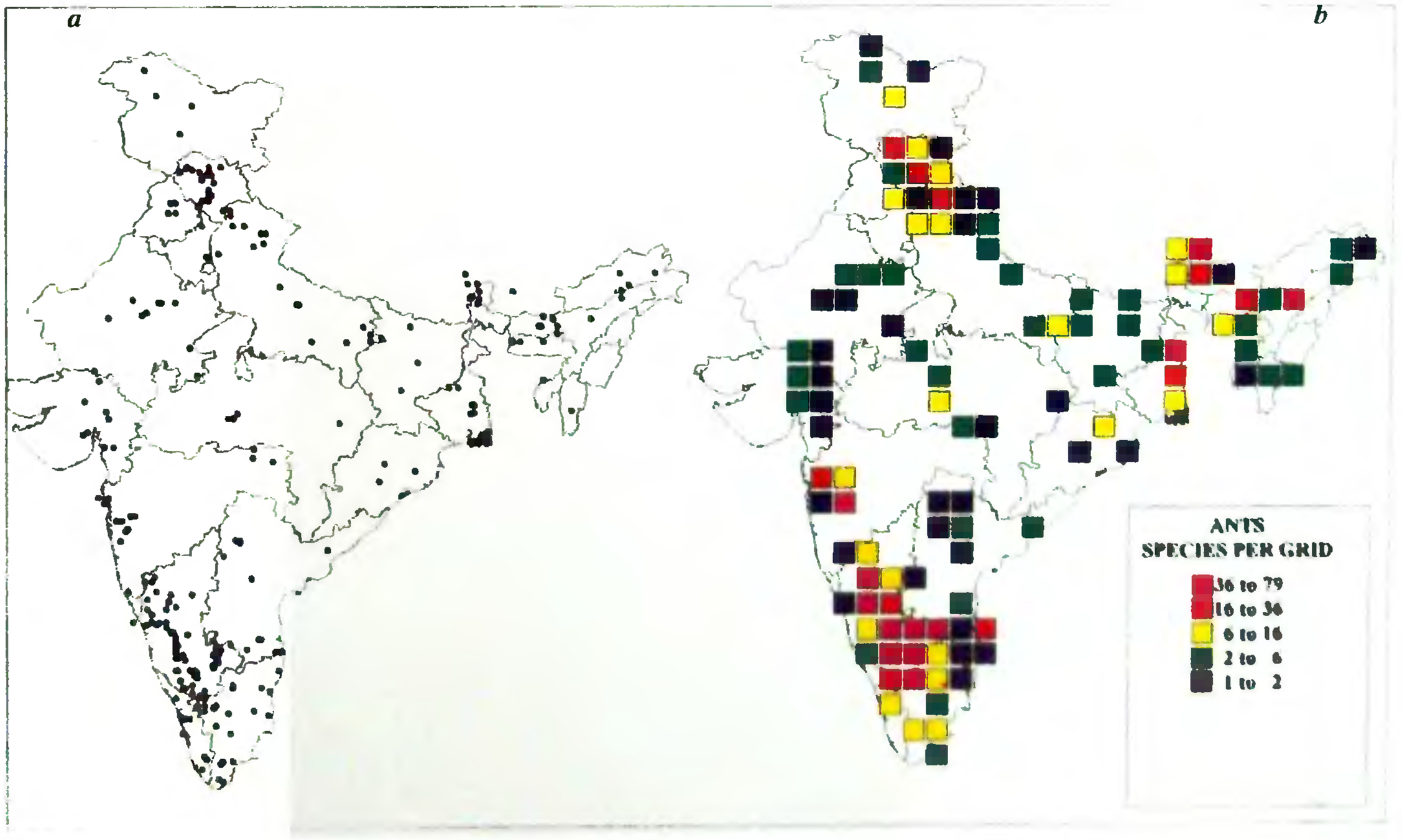

Figure 1. The distribution of ants in India (*a*) and their density in grids of 1 × 1 degree (*b*). Areas without grids represent no ants or no records available on ants.

along with his own collections. This, along with the data base of the ants from *Fauna of British India*[5] and specimens studied by MA in different museums and institutes, constitutes probably the best available data base on ants for our country.

The longitude and latitude of the place of collection for the recorded specimens were assigned up to first decimal of the minute using several sources of maps and data bases[6,7]. Every record was thus mapped to arrive at the distribution maps (Figure 1 *a* for ants). The Indian continent was divided into grids of 1 × 1 degree, and the number of species collected or recorded in each grid was computed and density maps of the species developed (Figure 1 *b*). Using 3-D Mapper module of ERSIS for Map Info, contours were constructed for this grid data; from these contours, the three-dimensional density maps were constructed for the entire country (Figures 2 and 3).

Table 1. Data used for constructing the maps of ants and root grubs

	Root grubs	Ants		
		MA†	Bingham*	Total
No. of records/specimens	> 8000	1155	1270	2425
No. of species	285	160	495	603
No. of genera	44	47	79	88
No. of locations	1500	> 500	#	> 1000

*Data from Bingham[5]; †Data base maintained by Musthak Ali.
#, Exact locations not always available and hence only those which we were certain of were used.

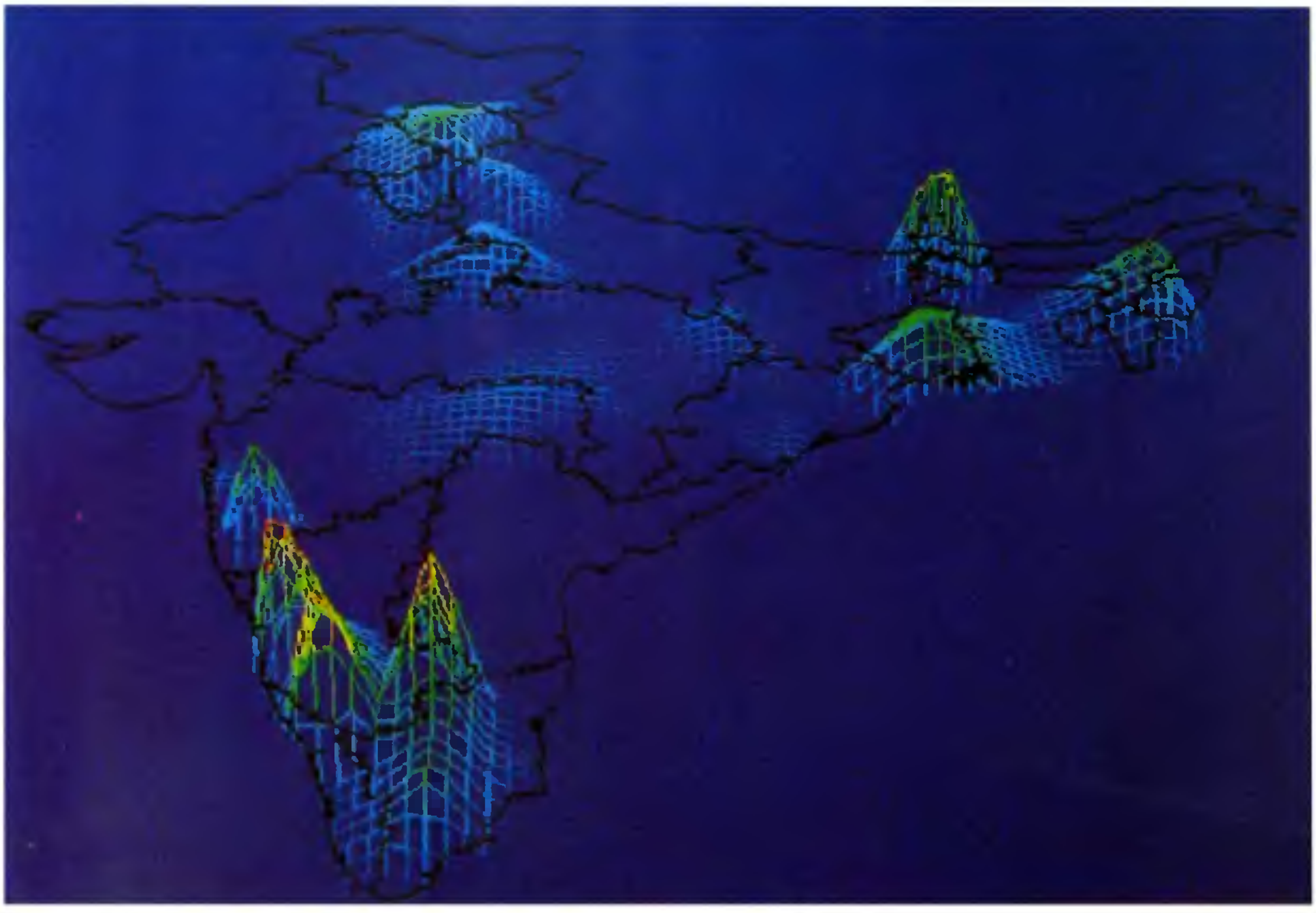

Figure 2. An hypsographic view of the species richness of ants. The peaks are only relative; the highest number of species recorded in any grid was 79.

There are two to three major centres of diversity for ants and root grubs and their distribution corresponded fairly well with the identified hot spots and with the vegetation map of the country (Figures 2 and 3). Nevertheless a few important issues emerge:

1. The Vindhya range appears to be relatively impoverished and this is unexpected considering that this range has very good vegetation and bio-climatic conditions that favour rich biota[8]. The poor diversity could reflect merely lack of serious efforts to study the biodiversity of this area than a true gap in the biological diversity. Unfortunately, it is difficult to resolve this unless a systematic survey is done or until a national effort to collate the data from all studies is attempted.
2. Though there is a general correspondence between the identified hot spots of diversity of the country and the species richness peaks of the two groups, within each hot spot there are specific spots where each group shows distinct peaks. In other words, the hot spots of diversity for each group could be different; the two groups themselves differed in the spatial patterns of species diversity.
3. There are species sets within each group that show distinctly different and mutually exclusive areas of importance or richness. For instance in ants, members of *Lasius, Formica* and *Myrmica* are restricted mainly to sub-Himalayan range while certain members of *Leptogenys* are predominant in the Western Ghats (maps not shown).

These maps and the information conveyed have to be taken only as indicative because of the following reasons: (i) These maps are based on a very minimal data compared to that potentially available country wide. It is important to collate all such data and we are now attempting to compile such data from different sources and are working towards appropriate safeguards required to assign the responsibilities and rights over the data ownership. In any case, such maps are always open

Figure 3. An hypsographic view of the species richness of root grubs. The peaks are only relative; the highest number recorded in any grid was 66.

ended for data inclusion and have the potential for improvement. (ii) These maps are developed using a very basic algorithm based on simple assumptions. It should be possible to develop algorithms appropriate for each group with a set of defined constraints such that the maps reflect as much reality as possible. For instance, it is possible to build in the vegetation distribution as a primary driver for the distribution of root grubs; the resultant map would then be more realistic.

Undoubtedly, such maps are immensely important in understanding the 'biognomy' of the country and in designing the conservation plans for the entire country[2]. We, therefore, suggest that such an activity needs to be taken up at the national level as an open-ended project just as we have the population survey of India. *There is an urgent need for all the interested scientists to work towards this and we invite comments and co-operation from all those interested in participating in this activity at a national level. We also welcome the participation of all the workers in sharing this responsibility.*

1. UNEP Convention on Biological Diversity, United Nations Environmental Program, Nairobi, Kenya, 1992.
2. Uma Shaanker, R. and Ganeshaiah, K. N., *Curr. Sci.*, 1998, **75**, (this issue).
3. Ved, D. K., Vijay Barvae, Noorunnisa, S. and Latha, R., *Curr. Sci.*, 1998, **75**, (this issue).
4. Ramesh, B. R. *et al.*, *Atlas of Endemic Species*, French Institute of Pondicherry, Pondicherry, 1997.
5. Bingham, C. T., *The Fauna of British India including Ceylon and Burma, Hymenoptera, vol. 2: Ants and Cuckoo-Wasps*, Taylor and Francis, London, 1903, pp. 506.
6. Anonymous, *The Oxford School Atlas*, Oxford University Press, New Delhi, 1976, 23rd edition.
7. Anonymous, Co-ordinates of different places and stations by Survey of India, Map Publication, SOI, Dehra Dun, 1976.
8. Anonymous, The State of Forest Report 1995, by Forest Survey of India, Govt of India, Dehra Dun, 1995.

ACKNOWLEDGEMENTS. We acknowledge FRI (Dehra Dun), ZSI (Calcutta), IARI (New Delhi), TNAU (Coimbatore), for co-operation while collecting data. K.N.G. acknowledges McArthur Foundation, CIFOR and IPGRI for partial financial support.

Eco-distribution mapping of the priority medicinal plants of southern India

D. K. Ved, Vijay Barve*, S. Noorunnisa Begum and R. Latha

Foundation for Revitalisation of Local Health Traditions, 50 MSH Layout, Anand Nagar, Bangalore 560 024, India

THE Indian subcontinent is one of the most distinct biogeographic regions of the world, with a rich repository of medicinal plant species. Over 7000 species of plants are used from the earliest times by various health care systems in the country. The traditional knowledge regarding these plants and their utilization is being increasingly realized and put to use by modern medicine. For the pharmaceutical industries, these plants form a major source of their raw material requirement. As a consequence of unregulated use of these plants, their populations are heading towards alarming depletion, coupled with fragmentation of their natural habitats. Human interference, destruction of medicinal plants during harvesting, trade in high quantities and harvesting for other uses such as timber and firewood is accelerating the pace of disappearance of many valuable plant species.

Understanding the natural distribution and eco-climatic limits of these taxa, helps in formulation of their conservation strategies[1]. With the help of data on distribution pattern and availability of the species, historic as well as current, the causes for its reduction in number and rarity can be diagnosed. Systematic mapping of the occurrence of the species also provides insight into the regions where the conservation has to be initiated; such maps offer information on the extent of protection required and how efficiently and effectively it could be carried out. In this paper we present the efforts at FRLHT towards mapping the distribution of certain prioritized medicinal plants in the three states of Karnataka, Kerala and Tamil Nadu of southern India[2]. The process started with prioritization of wild medicinal plants of southern India based on the data relating to the trade (volume, value and plant parts/products in trade), endemism and reported rarity, etc. A short list of around 300 such prioritized species was finalized and the data on them were gathered from the following three major sources.

Literature study

Published floras pertaining to the region under study as well as floras of other regions of the country, research papers, atlas, etc., were used. Compilation has been done from these sources to tabulate district-level presence of each selected taxon and the information has been presented on maps. Whenever the information available in the literature is precise enough in terms of locations of collection of taxon the same has been converted into latitude, longitude co-ordinates to plot the distribution of the taxon on a digitized map of the region.

Herbarium records

About 20,000 voucher specimen of prioritized medicinal plant species housed in more than 20 herbaria of the region were referred and data were compiled in a standardized format and computerized. The data recorded on voucher specimen sheets incorporate the location of collection site. The latitude and longitude co-ordinates of each location were derived using the relevant topographical sheets of Survey of India (1 : 50,000 scale as well as 1 : 25,000 scale).

MPCA data

The herbarium records of plant collections from the 30 Medicinal Plant Conservation Areas (MPCAs) were obtained. These voucher specimen are housed in FRLHT Herbarium and the data are being maintained in computerized form. The MPCA locations, with precise latitude and longitude values are put in the maps in red colour flags to indicate their relevance.

Distribution maps

The digitization of district and state boundaries, rail and road network as well as streams and water bodies has been done using 1 : 1 million map published by Survey of India. The distribution maps were generated using 'MapInfo Professional v4.0', software. The presence of the species has been shown as 'flags' of three different colours, black, red and blue. Black flags represent the herbarium specimens collected from the 22 herbaria visited during the study. The collections from the MPCA network are shown as red flags. The locations from the

*For correspondence. (e-mail: root@frlht.ernet.in)