A Strategy for Conserving the Biodiversity of the Uttara Kannada District in South India

by

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INTRODUCTION

Large-scale loss of biological diversity is amongst the most serious of the environmental crises of today and the foreseeable future. Tropical moist forest tracts harbouring the bulk of this diversity are of particular concern in this context. A dozen countries, largely from the tropical belt, have therefore been identified as megadiversity countries that are critical to the ongoing efforts to conserve biodiversity. *India is one of them.*

Conserving as much as possible of India's heritage of biodiversity is a very complex challenge, given the large biomass needs of its huge rural population and the exploding resource-demands of its growing urban-industrial intensive-agriculture sector. Conserving biodiversity is therefore being increasingly viewed as not merely a matter of setting aside areas of natural biological communities from which all people are excluded; instead it is evident that effective action has to be broader-based and more firmly-grounded than at present towards action on the root causes of the erosion of biodiversity. It has to relate to the overall development strategy and be concerned with the whole landscape of natural, semi-natural, and more wholly Man-made, biological communities. It has to involve people — especially of the local rural and tribal communities — as partners in the conservation effort.

The effort to sustain biodiversity in India has accordingly to proceed from its local 'grassroots' upwards instead of being thrust from above (McNeely *et al.*, 1990; Gadgil, 1991). It is the purpose of this paper to present a case-study of one of the moist forest tracts of South India — to provide pointers to show how a strategy for conserving biodiversity might be approached in this new perspective.

THE SETTING

The two biodiversally richest moist-forest tracts of India fall in the biogeographic provinces of Eastern Himalayas and Malabar (Mani, 1974; N.C. Nair & Daniel, 1986). At the centre of Malabar is located the district of Uttara Kannada (13° 52'–15° 30' N lat.; 74° 05'–75° 05' E long.). With an area of 10,200 km^2, it harbours at least a recorded 1,741 species of flowering plants and 420 species of birds (Daniels *et al.*, 1990*a*; S. Saldanha, pers. comm.).

Its many notable taxa include the Tiger (*Panthera tigris*), Gaur (*Bos gaurus*), Elephant (*Elephas maximus*), Lion-tailed Maccaque (*Maccaca silenus*), Travancore Tortoise (*Indotestudo forstenii*), Laughing Thrush (*Garrulax delesserti*), species of legless amphibians (Caecilians), and dipterocarp trees.

The district of Uttara Kannada (also referred to as 'UK') may be divided into five ecological zones: (1) a narrow coastal strip to the west, abutting on the Arabian Sea; (2 & 3) evergreen forests covering the foothills, the slopes, and the crestline, and divided into northern and southern zones — the southern zone being extensively occupied by betelnut orchards; (4) a moist deciduous forest zone; and (5) a dry deciduous forest zone (Daniels, 1989). Table 1 furnishes the details of the topography, rainfall, land-uses, and natural zonal, azonal, and Man-made, communities of each zone. The landscape of the district is made up of an intricate mosaic of different habitat types. Indeed our analysis of 1:50,000-scale topographic sheets prepared by the Survey of India has shown that 25% of the 5 km x 5 km grids have 6 or more major habitat types per grid, the median number being 3.72.

Humans have, evidently, greatly transformed the landscape of Uttara Kannada and in the process have affected the *distribution* of biodiversity. It is likely that *Hubbardia heptaneuron*, a species of grass that was earlier known only from the spray-zone of Sharavathy waterfalls — now dried-up due to a dam — and several species of birds, *e.g.* the large Indian Parakeet (*Psittacula eupatoria*), Scaley-bellied Green Woodpecker (*Picus myrmecophoneus*), Orange-breasted Green Pigeon (*Treron bicincta*), Nilgiri Thrush (*Zoothera dauma*), and Yellow-backed Sunbird (*Aethopyga siparaja*), have all disappeared from the district over the last century (N.C. Nair & Daniel, 1986; Daniels *et al.*, 1990*b*).

The range of distribution of other taxa has shrunk considerably in recent years. Thus wild Elephants, which were once distributed over much of the district, are now confined to two small and widely-separated populations, and the Lion-tailed Maccaque, which once extended up to the River Aghanashini (*cf.* Fig. 1) or beyond, is now confined to Sharavathy Valley (P.V. Nair & Gadgil, 1980; Karanth, 1985; R.J.R. Daniels, pers. obs.). That many evergreen species of plants had in the past much wider distributions into what are now moist deciduous forest tracts, is evident from their occurrence in patches of forests that are protected as sacred groves on grounds of religious belief (Talbot, 1909).

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TABLE I

A Summary of the Geography of the Uttara Kannada District

Attributes	Zone 1 Coastal	Zone 2 N. Evergreen forest	Zone 3 S. Evergreen forest	Zone 4 Moist Deciduous forest	Zone 5 Dry Deciduous forest
Area (km^2)	1.200	2 880	3 700	1 600	900
Altitude (m)	0–800	50–1.000	50–800	500–850	500–600
Rainfall (mm)	3.000	3.000–5.000	3 000–5.000	1 500–2 000	1 000–1.500
Percentage of 25 km^2 grids with:					
a) > 75% canopy	0	74	51	55	2
b) 50–75% canopy	5	13	13	23	16
c) Betelnut orchards	25	36	84	34	2
d) Dry cultivation	0	14	29	30	14
e) Freshwater lakes and reservoirs	0	18	8	77	56
f) Habitation (> 1 000 population)	82	11	16	13	58
Natural zonal vegetation	Evergreen	Evergreen	Evergreen	Moist deciduous	Dry deciduous
Natural azonal communities	Sand dune, Littoral Mangrove	Hill stream Riverine forests. Waterfalls Bamboo	Hill stream Riverine forests. Waterfalls *Myristica* swamps. Limestone outcrops Bamboo brakes	Riverine forest, Bamboo brakes*	Bamboo brakes*
Major Man-made communities	Moist thickets/ scrub, Plantations of exotics Casuarina and cashew. Paddy, Saltpans Human settlements	Moist thickets & grasslands Teak/ eucalypt/ exotic (*Acacia auriculi-formis*) Betelnut gardens. Paddy, Dry cultivation Deep freshwater reservoirs Human settlements	Moist thickets & grasslands Teak/ eucalypt/ exotic (*Acacia auriculi-formis*) Betelnut gardens Paddy, Dry cultivation Human settlements	Savanna woodlands Teak/ eucalypt/ exotic Plantation Paddy Dry cultivation Shallow freshwater lakes, Deep freshwater reservoirs. Human settlements	Dry scrub, Teak/ eucalypt/ exotic plantations. Paddy, Dry cultivation, Shallow freshwater lakes. Deep freshwater reservoirs Human settlements

* Thickets — Ed.

Not all human interventions have, however, been deleterious. Thus the many shallow irrigation-tanks, with their aquatic plants, have undoubtedly enhanced the avian diversity. There is also evidence that the Spider-hunter (*Arachnothera longirostris*) and Malabar Whistling Thrush (*Myiophoneus horsefieldii*), denizens of evergreen forests, have adapted themselves well to Man-made habitats such as betelnut orchards (Daniels, 1989; Daniels *et al*., 1990*a*).

THE RATIONALE

Uttara Kannada (UK) has extensive areas under natural and semi-natural communities; none of them is, however, pristine to the extent of being totally undisturbed. Nevertheless, somewhat disturbed areas can and do maintain significant levels of biodiversity. Some Man-made habitats — for example, freshwater lakes and salt-pans too — are valuable for conservation. It is thus possible to reconcile and even marry human utilization interests with maintenance of biodiversity. Such an effort, however, needs careful appraisal, for both biodiversity and human interests have many dimensions.

A logical starting-point for such an endeavour is to enquire what we mean by biodiversity and the reasons for its conservation. By biodiversity we mean the variety and variability among living organisms and the ecological complexes in which they occur. It encompasses all species of plants, animals, and microorganisms, together with the

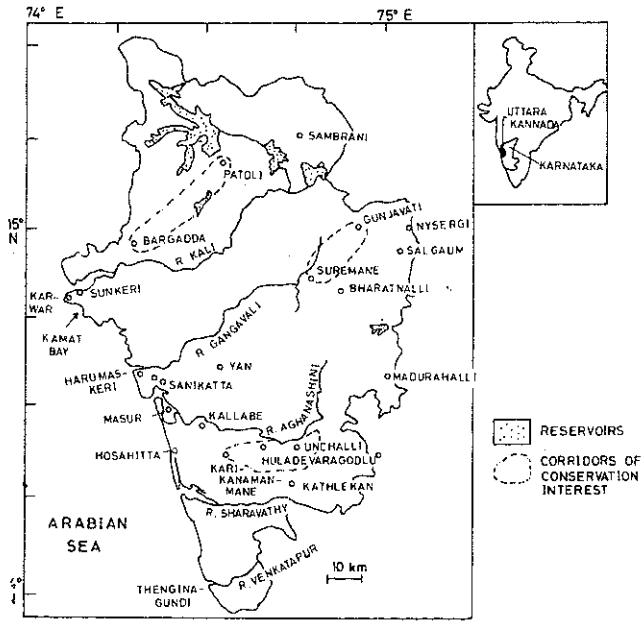

FIG. 1. *Sketch-map of the Uttara Kannada district in South India showing the major rivers, reservoirs, and the localities of conservation interest — but not the limits of its 5 ecological zones indicated on page 131, concerning which* see *Table I.*

ecosystems and ecological processes of which they are a part, and also the wider ecocomplexes and all of a vital nature that occurs in them

A variety of reasons have been advanced for valuing biodiversity. These include use for subsistence purposes (*e.g.* self-gathered fuel-wood) and as a commodity (*e.g.* timber sold on the market) as well as non-consumptive uses such as watershed conservation. It has been valued because its conservation would leave options open for use in future, *e.g.* as sources of drugs or genetic material conferring disease-resistance on cultivated plants or even on humans. Biodiversity has, moreover, been valued for its transformative effect, as its application can help humans to acquire a view of Nature as a habitat to be preserved for humanity on a long-term basis rather than as a storehouse of commodities to be exploited as dictated by market forces. Finally, it has been suggested that biodiversity should be valued for the sake of its own existence, because all creatures have a right to exist (Naess, 1986; Norton, 1987; McNeely *et al.*, 1990).

We do not propose to enter into discussion of the relative merits of these different-value ascriptions. Instead we would accept all of them as being valid at least in some context, and consider their implications in the context of the different possible options for the conservation of biodiversity in the Uttara Kannada district (Table II).

The most inclusive of these considerations are the option- and concomitant existence-values which imply need for conservation of the totality of biodiversity. But we are in no position to halt all ongoing changes and the consequent likely losses of biodiversity. It is therefore necessary to assign further priorities to certain biological communities and taxa as being more significant than others in our attempts at the ideal of overall conservation of biodiversity (Nature Conservancy, 1983; Usher, 1986)

TABLE II

Implications of Different Kinds of Values Ascribed to Biodiversity for Deriving a Conservation Strategy for the Uttara Kannada District

a) **Subsistence Use-value:** — The mangrove forests and two other legal categories of forests, namely the minor forests and *soppinabettas*, should be maintained together with diverse stands of species to provide a variety of produce needed by the local communities to fulfil their own subsistence biomass needs under good community-based management systems.

b) **Commodity Use-value:** — The reserve forests should be maintained under diverse stands of indigenous vegetation geared to produce a variety of non-wood forest products that are in commercial demand. Privately-owned hilly lands should be geared to produce the wood that is required by industry and urban consumers.

c) **Non-consumptive Use-value:** — Maintain reserve and protected forests that are important for their watershed services primarily, and for production of non-wood produce with fuel largely derived from loppings or dead and fallen wood.

d) **Option Value:** — Apart from maintenance of overall biodiversity, lay special emphasis on conservation of wild relatives and "land" races of locally-cultivated plants.

e) **Transformative Value:** — Pay special attention to continued conservation of the widespread network of sacred groves and trees that brings experience of Nature to local communities throughout the district.

f) **Existence Value:** — Attempt to maintain the totality of biodiversity within the district.

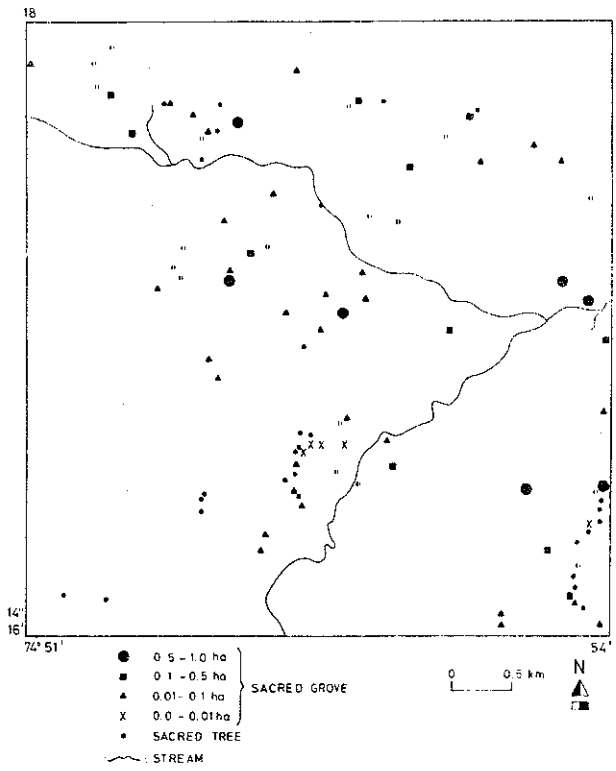

FIG. 2. *A typical network of sacred groves and sacred trees as observed on a 5 km x 5 km grid in the Uttara Kannada district.*

TABLE III

Attributes of Localities that are Relevant to Attempts to Sustain Overall Biodiversity and the Resultant Prescriptions for Uttara Kannada

	Attribute	Criterion	Prescriptions for UK	The only or best representative localities of conservation interest
1	Species richness of constituent biological communities	Greater value attached to communities with larger numbers of species	Evergreen forests harbouring the largest numbers of species of flowering plants and all vertebrates except birds; moist deciduous forests and marshes for birds	Kulgi-Virnoli, Gunjavati, Bargadda-Patoli, Hulithevaragodlu, Unchalli, Aghanashini estuary, Bharatnalli, Madurahalli
2	Geographical range of constituent biological communities	Greater value attached to communities with relatively restricted range	*Myristica* swamps harbour communities with a restricted range	Kathlekan
3	Spatial occurrence of constituent communities within their range	Greater value attached to communities with more restricted spatial occurrence	Communities of spray zones of waterfalls are of very restricted occurrence; Limestone outcrops	Unchalli waterfalls, Yan
4	Identity of species making up constituent biological communities	The more distinct the component of a species is, the greater will be its value	Mangrove vegetation and beaches harbour a highly distinct set of species	Sunkeri, Thenginagundi Aghanashini estuaries; Kamat-Karwar Bay
5	Endangerment due to human pressures	The more endangered communities are of greater value	Riverine forests are greatly endangered by human pressures	Hulidevara-godlu Unchalli waterfalls
6	Attributes of component species			
	a) Restricted geographical range	Greater value attached to species with more restricted range	Evergreen forests harbour birds with more restricted range	Suremane, Hulidevara-godlu
	b) Narrow habitat preference	Greater value attached to species with narrow habitat preferences	Freshwater ponds and estuaries harbour birds with narrow habitat preferences	Madurahalli, Sambrani, Nyasergi, Salgaum, Sanikatta-Masur
	c) Taxonomic uniqueness	Greater value attached to a species with fewer related species	*Gnetum*, a gynospermous climber of evergreen forests, is the only member of its order in UK	Hulidevara-godlu
	d) Endangerment due to human pressures	Greater value attached to species subject to greater pressures	Wintering waterfowl in marshes are hunted extensively	Aghanashini estuary and Nyasergi
	e) Ecological role	Species serving as keystone resources would have greater value attached	*Ficus* species are keystone resources of tropical forests	*Ficus* trees protected on religious grounds are scattered throughout the district
7	Interaction with adjacent communities	Greater value attached to communities serving as links in maintaining higher diversity	Betelnut plantations serve as links between patches of evergreen forests	

Table III presents such an exercise of identifying relevant attributes of biological communities and taxa, suggesting criteria on the basis of which priorities may be assigned, and the conservation prescriptions — including specific localities that follow The localities have been selected as harbouring the only or best representative examples of the particular biological communities or taxa of interest. In this selection the size of the locality as well as practical feasibility of long-term conservation have been given due weight.

Table IV goes on to add four other issues of relevance in deciding on the most desirable conservation strategy: these are primarily human considerations We wish the conservation efforts to be (1) socially acceptable; (2) be rooted in, and supportive of, cultural diversity; (3) to include elements with aesthetic appeal; and (4) to promote long-range economic benefits (McNeely *et al* , 1990) This Table suggests implications of these principles in terms of broad resource-use strategies as well as specific localities etc that may need to be protected.

This whole range of prescriptions is further discussed in the next section as regards each of the five ecological zones indicated in Table I. The discussion focuses on two relevant aspects, namely (1) specific localities that need to be protected, in decreasing order of size, and (2) appropriate management strategies for localities from which biomass harvests or other uses may be continued. The paper concludes with a broadened discussion of the implications of development policies from the perspective of biodiversity.

Conservation Prescriptions

Coastal Zone

The coastal zone, with its beaches, estuaries, and mangrove and lowland evergreen forests, is potentially the richest in biodiversity As Table I shows, it is also profoundly affected by human activity Obviously, no large Nature reserves excluding people are feasible in this zone; it would nevertheless be worth while for us to set up a series of smaller reserves The largest amongst these should protect the estuary of Aghanashini (5,840 ha), the only major river of the district that has neither been dammed nor receives any industrial or urban effluents. This is especially desirable as there are few other protected wetlands on the entire Indian West Coast today (Rodgers & Panwar, 1988) Part of this estuary is used for salt production; the resultant salt-pans serve to attract a large number of migrant wading birds The estuary also harbours patches of mangrove vegetation; these could serve as nuclei for further expansion of mangrove to areas in which it has been destroyed in the last few decades This waterfowl-cum-mangrove sanctuary would thus include extensive areas under private ownership, which situation need not be changed Indeed the private farmers can be motivated to develop mangrove vegetation on their own land. Some farmers at Baad have already taken such an initiative (Gadgil *et al* , 1990)

Two other, smaller estuarine areas (*cf* Fig. 1), Sunkeri (800 ha) and Thenginagundi (480 ha), also merit protection So also do three beaches which still retain some of their protective mantle of binding vegetation of *Ipomoea biloba*, *Spiniflex littoralis*, and *Salvadora* sp., namely the Kamat bay (31 ha) near Karwar, Harumaskeri (90 ha) near Kumta, and Hosahitta (180 ha) near Honnavar (*cf.* Fig. 1, although Kumta and Honnavar are not named on it)

The natural vegetation of the coastal evergreen type now remains in only a few patches that are protected as sacred groves, or as remnant sacred trees especially belonging to the genus *Ficus* The largest patch retaining the natural composition is that of the village forest of Kallabe (100 ha), from which regulated harvests have been going on All these remnants need to be protected on a long-term basis because, although individually small in size, the network which they constitute is still supportive of quite substantial levels of biodiversity (*cf.* Fig 1)

Despite the high population-densities, exceeding 400 humans per km^2, large areas of the coastal zone remain as 'common' lands which are used by the local people for meeting a diversity of their biomass and other needs — including fuel, fodder, leaf manure, and raw materials for artisanal activity. Unfortunately, consequent on the destruction of community-based management systems during British times, and increasing forces of commercialization and politicization following independence, these 'common' lands have suffered from the severe exploitation that is to be expected of open-access resources under intense pressure (Gadgil & Iyer, 1989) Nevertheless the traditional community-based management systems remain alive and well in a few villages such as Halkar, and there is every hope of revitalizing them. Furthermore, the local people value a very wide range of plant and animal species for a variety of uses, and would support revegetation of 'common' lands with a diversity of indigenous species.

Given their living tradition of protection of sacred groves, a few hectares of each village forest could also be dedicated to re-establishment of a totally undisturbed patch of natural vegetation At the same time the emphasis of production from reserve forests should be changed from monoculturing of a few species such as Teak (*Tectona grandis*) or species of *Eucalyptus*, to encouraging a multiplicity of indigenous species for the production of non-wood produce of commercial value These include a very large number of possibilities, ranging over fruits (*Mangifera indica* and *Myristica malabarica*), leaves (*Butea monosperma*), bark (*Cinnamomum* spp), resin (*Vateria indica* and *Canarium strictum*), and also bamboo, cane, palms, etc. Vigorous attempts must therefore be made in these directions — not only in the coastal zone, but throughout the district (Gadgil *et al.*, 1990)

The coastal as well as the northern and southern evergreen forest zones are characterized by the cultivation of a

TABLE IV

Some Further Considerations of Relevance to Developing a Conservation Strategy for the Uttara Kannada District

1) **Social Acceptability:** — Revitalization of community-based systems of sustainable resource-use and conservation of biodiversity will have a wide measure of social acceptance

2) **Cultural Diversity:** — Incorporate the traditional systems of sacred groves and trees into the present-day systems of resource management. Support the wide diversity of traditional uses of plant material for artisanal purposes

3) **Aesthetic Appeal:** — Protect the environs of the limestone outcrops of Yan, a landscape feature of outstanding beauty

4) **Long-range Economic Benefits:** — Sustainable use of protected and reserved forest to bolster rural economy would lead to long-range economic benefits to the local communities

very large number of species of plants in the home gardens — species that occur themselves, or have close relatives, in the natural vegetation. Prominent amongst these are *Mangifera indica* (Mango), *Artocarpus integrifolia*, *A. hirsuta*, and *A. gomezianus* (Bread-fruits), *Garcinia indica* and *G. cambogea*, *Spondias mangifera*, *Myristica malabarica* (Nutmeg), *Piper nigrum* (Black Pepper), *Elatteria cardomomi*, *Zingiber* spp. (gingers), *Curcuma* spp., etc. This district is exceedingly rich in the wild as well as cultivated varieties of these species, many of which are today threatened by commercial demand — *e.g.* trees of *Mangifera indica* for the plywood industry. The district also has a number of cultivars of Rice (*Oryza sativa*). We must launch special efforts to encourage the local people to protect this genetic diversity *in situ* through all means, including special financial incentives.

Northern Evergreen Zone

The evergreen forest zones are clearly the most significant zones for conserving the district's biodiversity (*cf.* Tables II–IV). Indeed a sanctuary of over 5,730 km^2 in the northern evergreen and moist deciduous zones was established around Dandeli in 1953 to conserve these biota (Kamath, 1985). Unfortunately it is now a sanctuary only on paper, for a major paper-factory came up in 1958 right inside the sanctuary and a series of hydel projects on Kali River and its tributaries liquidated what remained of the northern evergreen and moist deciduous forests through the 1970s. Although there are a few good pockets left within the sanctuary that deserve continued protection, it would be better to dispense with the illusion of a huge sanctuary that serves no purpose!

Rodgers & Panwar (1988) suggest retention of the Kulgi–Virnoli range within the moist deciduous zone. We believe that Bargadda–Anishighat–Patoli (11,520 ha) and Kulgi–Virnoli (7,680 ha) blocks represent better the finest of remaining natural evergreen–semievergreen and deciduous vegetation in the region and should accordingly be protected. These areas would also provide a valuable link to the protected areas in the Cotigao wildlife sanctuary in the State of Goa lying immediately to the north of 'UK'. Apart from these sizeable patches, we recommend the protection of sacred groves and trees, maintenance of diverse indigenous multi-species plantations coupled to small undisturbed areas within village forests, and the dedication of reserve forests to production of a variety of non-wood produce. We also recommend that special protection be given to relatives and cultivars of cultivated plants.

Southern Evergreen Zone

The vegetation of the southern evergreen zone is an excellent example of the *Persea–Holigarna–Diospyros* series of evergreen forest which is not represented in other Nature reserves (Gadgil & Meher-Homji, 1986). It should therefore be protected in a reserve running across the slopes of the Western Ghats between the Aghanashini and Sharavathy valleys (7,040 ha). Aghanashini, the only undammed, unpolluted river of the entire Uttara Kannada district, preserves some excellent riverine habitats — including the Unchalli waterfall of 100 m height and its spray-zone. This proposed Nature reserve would also protect some of the smaller moist valleys characterized by the presence of such ferns as species of *Cyathea* and *Osmunda*. Unfortunately the Sharavathy valley itself, with some of the best evergreen forests, is now slated to go under the Sharavathy Tail-race Hydel Project.

This zone harbours a unique natural habitat in the immense limestone outcrops of Yan, and supports huge colonies of the Rock Bee (*Apis dorsata*). Some of the last-remaining stands of the palm *Corypha umbraculifera* are around these rocks, and it would be worthwhile to constitute a small Nature reserve (625 ha) in this locality. This zone is also very rich in sacred groves, three of which deserve special mention. That of Kathlekan (1,280 ha) includes the few remaining natural swamps with *Myristica magnifica* and the endemic palm *Pinanga dicksoni*. The sacred grove at Karikanamanmane (320 ha) harbours the best stand of *Dipterocarpus indicus* trees in 'UK', and that at Suremane (2,080 ha) supports a magnificent growth of *Diospyros microphylla* (*cf.* Fig. 1).

But apart from these specific groves, what is striking is the entire network of sacred groves and sacred trees that still survives in parts of this zone. An example of this is provided in Fig. 2, based on a detailed field-study of a 25 km^2 area. Even today, after substantial disturbance, this area retains 54 sacred groves and 45 individual sacred trees accounting for 0.31% of the land surface. All of this remaining network *must* now be brought under proper protection.

This zone has extensive areas under Betelnut (*Areca catechu*) orchards in sheltered valleys, and the use of much of the forest on the hills abutting these valleys is in the hands of the orchard owners. Steps need to be taken to motivate the orchard owners to maintain species-rich tree cover on these hills. In addition, it is important to promote good management of village forests, reorientation of reserve forests to maintenance of multi-species stands for generation of non-wood produce, and maintenance of genetic diversity of cultivated plants as mentioned above for the earlier two zones.

Deciduous Forest Zones

The moist deciduous forest zone, with its natural Teak, has been most drastically affected by commercial overfellings followed by conversion to Teak and eucalypt monocultures. It has also been converted into Betelnut plantations and disturbed by several reservoirs of the Kali hydel project. But in spite of all this, its remaining forests as well as freshwater lakes support a high level of avian species-diversity. The only good patch of natural vegetation in this zone is around Gunjavati in the Mundgod-Kirvatti range of the Dandeli wildlife sanctuary (16,000 ha). This tract harbours the only resident population of wild Elephants in 'UK' (R.J.R. Daniels, pers. obs.). We concur with the suggestion of Rodgers & Panwar (1988) that this area be set aside as a Nature reserve. Two freshwater lakes — that at Bharatnalli with the adjacent high forest block of Yellapur in the Manchikere range (3,520 ha), and that at Madurahalli (15 ha) with a rich bird fauna, also deserve full protection (*cf.* Fig. 1).

The relatively flat country of the dry deciduous forest zone has been extensively brought under cultivation of millets and, more recently, cotton. It does not offer the possibility of any large Nature reserves. However, three freshwater lakes — Sambrani (12 ha), Salgaum (18 ha), and Nysergi (66 ha), with rich bird-life — ought to be set up as Nature reserves (cf. Fig. 1).

Even apart from these desirable reserves, the conservation of sacred trees and groves, reorientation of reserve-forest use to production of a variety of non-wood produce, good management of village common lands, and maintenance of genetic diversity of cultivated plants, deserves full attention in these zones. There is also good scope for planting up the sides of highways and other roads, and the campuses of schools and colleges, as well as the premises of factories and offices, with hundreds of local varieties of *Mangifera indica* and other fruit-trees such as *Artocarpus* spp. and *Garcinia* spp., wild palms such as *Corypha umbraculifera* and *Caryota urens*, throughout the district instead of the exotics as is being done today. There could be extensive community participation in identifying such local species/varieties, and in raising and maintaining them for the long run.

The Broader Context

We have attempted to sketch above an approach to conservation of biodiversity that would be broader and more effective than to focus on setting aside a few large areas as Nature reserves from which people are excluded. The heavy-handed bureaucratic attempts at such exclusion inevitably render people hostile to official conservation efforts, the irony being that these same people have a rich 'grassroots' tradition of conservation — a tradition that has protected primates and *Ficus* trees throughout the district. It has also been responsible for the last good stand of *Diperocarpus indicus* and the last well-preserved *Myristica* swamps of 'UK' (Gadgil, 1989).

The larger development policies that have shaped the pattern of resources' use in the Indian 'UK', have been greatly detrimental to biodiversity. These policies have equated development with organizing subsidized outflows of resources to the urban–industrial–intensive agriculture sectors (Gadgil, 1989, 1991). Thus the once-magnificent Dandeli wildlife sanctuary was liquidated to supply subsidized electric power to urban industrial sectors, and for pump-sets of farmers with access to irrigation. Moreover the giant Mango trees of the evergreen forests were supplied at throw-away prices to the plywood industry; and the same vested interests have been responsible for the felling of large-sized sacred groves such as Menasikan (of 40 ha).

If possible worse still in the criminality of environmental desecration, mangrove forests have been the victims of the policy of promoting export of prawns by subsidizing bunding of estuaries and setting up canning factories. Factories such as West Coast Paper Mills have not only received bamboo at down to one-thousandth of the market price, but have also been permitted to pollute the air and waters of the region with impunity, while agricultural development has stressed the introduction of a few high-yielding varieties at the cost of a rich diversity of indigenous cultivars. The overall result has often been disastrous; as an example, the entire pepper crop has been wiped out by fungal diseases (caused by *Phytophthora* spp.) after initial higher yields from newer varieties (Gadgil *et al.*, 1985–86; Gadgil & Chandran, 1988).

This pampering of a narrow elite that promotes wasteful and exhaustive resource-use, has gone hand in hand with alienation of masses of people from access to the natural resource-base on which their quality of life depends so intimately. Their traditional conservation systems, such as sacred groves, have been assaulted by commercial interests; their traditional systems of community-based regulation of resource-use from common lands have been similarly undermined by the state machinery (Gadgil & Iyer, 1989). However, we are fortunate that both these traditions of conservation and sustainable use of a diversity of resources still survive, albeit in an attenuated form.

A new approach to conservation of biodiversity would have to be based on revitalizing these traditions and incorporating them in a modern framework. At the same time the development policies would have to reorient themselves radically by halting a subsidized outflow of resources to people in power. This does not at all imply a halt to industrial or agricultural development, but only that such development should cease to be parasitic and thereby the main catalyst for the erosion of biodiversity! In its stead, attempts should be made to develop genuine links between healthy industrial development and conservation — for instance through promoting industrial wood-production on marginal farmlands and non-wood commodities' production on reserve-forest lands.

Finally, we also believe that the detailed plan for good management of natural resource-bases and conservation of biodiversity, must be developed from the 'grassroots' upwards. We have been active in promoting such an approach for the Uttara Kannada district. This was initiated by the preparation of a document that was somewhat similar to the present paper but had a focus on sustainable use of biological resources rather than on conservation of biodiversity (Gadgil *et al.*, 1985–86). This document was made available not only in English but in the local language, Kannada, as well. It was widely debated in many forums ranging from gatherings of peasants, basket-weavers, and fishermen, to members of the district council and heads of departments at the State Government level, and is slowly generating its own spinoffs. We now contemplate using similarly the present document as a basis for a widespread debate within the district as to how we may conserve the heritage of this beautiful land of hills and forests, rivers and beaches, for the benefit of all segments of society not only for the present, but also for the generations to come.

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Summary

Taking the various values ascribed to biodiversity as its point of departure rather many years ago, the present study aims at deriving a conservation strategy for Uttara Kannada. This hilly district, with the highest proportion of its area under forests in South India, is divided into five ecological zones: coastal, northern evergreen, southern

evergreen, moist deciduous, and dry deciduous. The heavily-populated coastal zone includes mangrove forests and estuarine wetlands The evergreen forests are particularly rich in the diversity of plant species which they support — including wild relatives of a number of cultivated plants. They also serve a vital function in watershed conservation The moist deciduous forests are rich in bird species; both moist and dry deciduous forests include a number of freshwater ponds and lakes that support a high diversity of aquatic birds.

Reviewing the overall distribution of biodiversity, we identify specific localities — including estuaries, evergreen forests, and moist deciduous forests — which should be set aside as Nature reserves. These larger reserves must be complemented by a network of traditionally-protected sacred groves and sacred trees that are distributed throughout the district and that protect today, for instance, the finest surviving stand of dipterocarp trees.

We also spell out the necessary policy-changes in overall development strategy that should stem the ongoing decimation of biodiversity These include (1) revitalizing community-based systems of sustainable management of village forests and protection of sacred groves and trees; (2) reorienting the usage-pattern of reserve forests from production of a limited variety of timber and softwood species for industrial consumers, to production of a larger diversity of non-wood forest produce of commercial value to support the rural economy; (3) utilizing marginal lands under private ownership for generating industrial wood supplies; and (4) provision of incentives for *in situ* maintenance of land-races of cultivated plants — especially evergreen, fruit-yielding trees — by the local people.

It is proposed that this broad framework be now taken to the local communities, and that an action-plan be developed on the basis of inputs provided — and initiatives taken — by them

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