

HABITAT APPROACH FOR CONSERVATION OF HERBS, SHRUBS, AND CLIMBERS IN THE SHARAVATHI RIVER BASIN

G.R. Rao, M.D. Subhashchandran and T.V. Ramachandra

Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012

Address for Correspondence:

Dr. T.V. Ramachandra
Energy & Wetlands Research Group, CES RNO 215
Centre for Ecological Sciences
Indian Institute of Science
Bangalore 560 012, India

E Mail: cestvr@ces.iisc.ernet.in
 cestvr@hamsadvani.serc.iisc.ernet.in
 energy@ces.iisc.ernet.in

Telephone: 91-080-3600985 / 293 3099/ 293 2506
Telefax: 91-080-3601428 / 3600085 / 3600683 [CES TVR]

URL: <http://ces.iisc.ernet.in/energy/Welcome.html>

HABITAT APPROACH FOR CONSERVATION OF HERBS, SHRUBS, AND CLIMBERS IN THE SHARAVATHI RIVER BASIN

Summary:

Sharavathi river basin (upper catchment) falls in one of the megacentres of endemism (Shimoga-Kanara) harbouring diverse kinds of flora and fauna, which are adapted to various kinds of habitats. Study was carried out to know the habitat preferences of the endemic species particularly of herbs, shrubs, orchids, and climbers excluding the trees. Field survey covered 21 micro and macro habitats and the results show that the macrohabitats (such as grasslands, evergreen-semievergreen forests and marshy areas) have higher species richness and endemism. To prioritise habitats for conservation, micro and macro habitats were ranked according to their richness in species and endemism. The result reveals that grasslands, evergreen-semievergreen forests and marshy areas deserve higher conservation priorities. Micro-habitats such as wet tree trunks, wet-rocks etc., have distinctive species very much different from other habitats. All these habitats also harboured economically useful species including medicinal plants vital for human survival.

Introduction

The flora of Western Ghats comprises about 12,000 species ranging from unicellular cyanobacteria to angiosperms. In this spectrum the flowering plants constitutes about 27% of Indian flora with 4000 species of which about 1,500 species are endemic. Most of the endemic plants of peninsular India are paleoendemics having found favourable ecological niches in the hill ranges on either side of the Western and Eastern ghats. The ecological niches in Western Ghats resemble islands so far as the distribution of endemic species is concerned (Nayar, 1996). Many of these species are traditional source of medicines. Majority of the medicinal plants in India are higher flowering plants with trees 33 %, shrubs 20 %, herbs 32 %, climber 12 % and others 3 %. They also play a significant role in the economy of the country, providing raw materials for a variety of industries. Depletion of biodiversity at an alarming rate due to anthropogenic activities has necessitated inventorying, monitoring and management. Hence, vegetation and floristic studies have gained increasing importance and relevance in recent years. The present study has been carried out in upper catchment area (Sharavathi river) spread over Sagar, Hosanagar and small part of Theerthahalli taluks of Shimoga district in Karnataka.

Habitats in the study area include evergreen to semi-evergreen, moist deciduous, scrub savanna, grasslands, marsh lands, aquatic ecosystems, waste lands and open fields.

The evergreen to semi-evergreen habitats have poor ground flora (herbs, shrubs etc.) except in canopy gaps (and mountain tops) where more light reaches. Different types of ferns and several herbs like, *Begonia spp.*, *Curcuma spp.*, *Impatiens spp.*, *Aeginetia indica*, *Ophiorrhiza hirsutula*, *Costus speciosus*, members of Gesneriaceae, Balsaminaceae, etc. are associated with these habitats. Terrestrial orchids are very rare but epiphytic orchids and other epiphytes such as species of *Piper*, *Pothos*, *Peperomia* etc. are present. Shrubs, like species of *Croton*, *Nilgirianthus*, *Barleria*, *Ixora*, *Leea* etc. and a number of woody climbers (species of *Gnetum*, *Entada*, *Artabotrys* etc.) are also found here.

In moist deciduous habitat a dense undergrowth develops during the south-west monsoon, with herb species such as *Curculigo*, *Dioscorea*, *Phaulopsis*, *Sida*, *Impatiens*, *Justicia*, *Biophytum sensitivum*, *Scoparia dulcis*, *Smilax zeylanica* etc. and climbers - *Calycopteris floribunda*, *Asparagus racemosus*, *Cocculus hirsutus*, species of *Dioscorea*, *Abrus precatorius* etc.

In scrub – savanna habitat the early monsoon shower brings the terrestrial orchids such as *Habenaria grandifloriformis* (onset of monsoon) and *Habenaria heyneana* (as monsoon progresses) and blossoms of epiphytic orchids. Receding monsoon allows species - *Swertia corymbosa*, *Sophubia delphinifolia*, *Striga densiflora*, *Exacum bicolor* etc. (in large numbers) and blossoms of epiphytic orchids - *Dendrobium ovatum*, *D.nanum* etc. Slightly drier areas in this habitat consist of species such as *Asparagus racemosus*, *Hemidesmus indicus*, *Ichnocarpus frutescens*, *Ixora coccinea* etc.

Grasslands at lower elevations (lowland grasslands) are habitats for numerous herb species. Moisture loving species such as *Lindernia anagallis*, *L. ciliata* etc. are more during monsoon months. The ground flora also consists of *Desmodium triflorum*, *Oxalis corniculata*, *Zornia diphylla*, *Centranthera indica* and species of *Phyllanthus*, *Hedyotis*, *Spermocoe* etc. along with numerous short grass species. Grasslands at higher elevations (montane grasslands) such as at Kodachadri (1343 m) and Karni areas support terrestrial orchids such as *Habenaria*

longicorniculata, *H.heyneana*, *Peristylis secundus*, etc. and other herbs like *Exacum pedunculatum*, *Impatiens lawii*, *Swertia corymbosa*, etc. with various tall grass species. Shrubs, such as *Phoenix humilis*, are present along the slopes of regularly burnt grasslands.

Early monsoon species of *Utricularia* such as *U.striatula* and species of *Impatiens*, *Begonia* etc. cover the montane streamside rocks and wet tree trunks. Herbs, such as *Centella asiatica* and *Eclipta alba*, are found near the streams. Marshy areas near the lakes, ponds, rivers, paddyfields etc. are colonised by plants such as *Geissaspis cristata*, *Limnophila spp.*, *Lindernia spp.*, *Ludwigia spp.*, *Lobelia alsinoides*, *Bacopa monnieri*, etc. as well as species of *Nymphaea*, *Nymphaoides*, *Utricularia*, *Aeschynomene* etc.

Waste Lands and open fields are inhabited by hardier species such as *Spermacoce herbacea*, *Scoparia dulcis*, *Leucas linifolia*, *Desmodium triflorum*, *Evolvulus nummularius*, and weeds - *Eupatorium spp.*, *Cassia tora* etc.

Literature review

Forest trees of Shimoga district were catalogued first in 1888 (Loverly, 1888) and subsequently by Fyson (1915) who worked on the plants of South Indian hill stations describing 58 species of orchids in 24 genera with illustrations. Cooke (1901-1908), Gamble (1915-1936), Pascal (1988), Talbot (1909-1911), Ramasamy et al. (2001), Saldanha et al. (1976) and Yoganarasimhan et al. (1982) in their publications gave brief account of the district flora. Kadambi (1939,1941) documented flora of the evergreen forests of Western Ghats giving precise description of the formations between Hassan and Agumbe. Flora of Agumbe-Theerthahalli region was documented by Raghavan (1970, 1983). Saldanha's work (1984) on Orchidaceae of Hassan district provides description of 95 spp. in 41 genera. In flora of Karnataka, Sharma et al. (1984) listed 173 species of orchids in 51 genera. Ramaswamy et al. (2001) gave a comprehensive detail of the flora of Shimoga.

Materials and Methods:

The present work is based on a study carried out in Linganamakki catchment area (Sharavathi river upper catchment) in 21 different habitats (covering both micro and macro) for a period of 3

months during post monsoon season. The habitats were chosen so as to represent the entire upper basin and the data pertaining to the habit, habitat associations, phenology and other general features were recorded. Rare and unidentified specimens have been pressed into herbarium. Photographs and geographical co-ordinates of occurrence using Global Positioning System (GPS) were noted. Specimens were identified with the help of regional floras and authenticated herbarium specimens (at CES herbarium, Indian Institute of Science).

STUDY AREA – Habitat types

Sampling was done in macro habitats (different forest types, grasslands etc.) and micro habitats (ditches, wet rocks, tree trunks etc.); these include:

1. *Evergreen-Semievergreen forests (SE)*: These include both high canopy covered evergreen forests and slightly lower canopied semi-evergreen forests with latter having denser undergrowth owing to the higher availability of sunlight.
2. *Moist Deciduous forests (MD)*: Most of the tree species are deciduous and have no clear stratification. Herbs and shrubs are more in number and density due to lesser canopy cover and higher exposure to light.
3. *Scrub Savannah (SSA)*: These are moist grasslands with scattered stunted trees with large number of herbs during wet months. These are also rich in orchids.
4. *Scrub (SC)*: These are dry stunted forests with hardy deciduous trees, shrubs and climbers. These support large number of grasses and other herb species during the monsoon.
5. *Forest openings (FO)*: These are mainly canopy gaps inside the forest, either natural or caused by human disturbances.
6. *Grasslands (GR)*: These include both lowland and high altitude grasslands. The former types have shorter grass species (lengthwise) and found in plains, while the latter have taller and denser grass species found growing in higher altitudes (above 1000 m).
7. *Barren lands (BL)*: Uncultivable lands with scattered grass and other herb species.
8. *Plantations (PL)*: These include gardens of Arecanut, Coconut, and Banana, as well as Rubber plantations.
9. *Roadside (RS)*: Sides of roads passing through diverse habitats.
10. *Roadcuts (RC)*: Road cuttings in hilly terrain are habitats for characteristic communities.
11. *Roadside avenues (RSA)*: Large number of epiphytic orchids and other herbs prefer the roadside-planted avenue trees as they get ample sunlight for growth.
12. *Open fields (OF)*: These are fallow agricultural fields.
13. *Hedges (HD)*: Plants associated with hedges.
14. *Compound wall (CW)*: Plants growing on moist, clay, stone or brick compound walls.
15. *Habitations (HB)*: Associated with human habitations in homegardens etc.

16. Marsh (MS): Aquatic bodies and wetlands such as lakes, tanks, ponds, river etc., with plants growing either inside the water or periphery of water or all along the marshy shores.
17. Stream sides (SS): Along either side of the streams.
18. Ditches (DT): Small puddles, near small bridges for rainwater drainage along the road, etc.
19. Wet soil (WS): Moist soil in different vegetation types.
20. Wet tree trunks (WT): Tree trunks with thin film of water mostly during the rainy seasons.
21. Wet rocks (WR): Rocks and boulders along the mountain streams, falls, torrents etc.

RESULTS AND DISCUSSION

A total of 232 species (herbs, shrubs, ferns, climbers, and orchids) distributed in 60 families were documented during field investigations as discussed in methodology. The results show that family Scrophulariaceae had the highest number of species (20), followed by Orchidaceae (18), Fabaceae and Rubiaceae (17), Acanthaceae (12), Lamiaceae (8), Asteraceae and Euphorbiaceae (8), Balsaminaceae and Gentianaceae (6), Malvaceae (5), Convolvulaceae and Liliaceae (4), Boraginaceae and Commelinaceae (3), and rest of the families (with 1 or 2 species).

Distribution status of herbs, shrubs, and climbers in the catchment areas is given in Figure 1. Based on the extent of distribution and frequency of occurrence, the species are categorised as common, frequent, abundant, fairly common, scattered, occasional and rare.

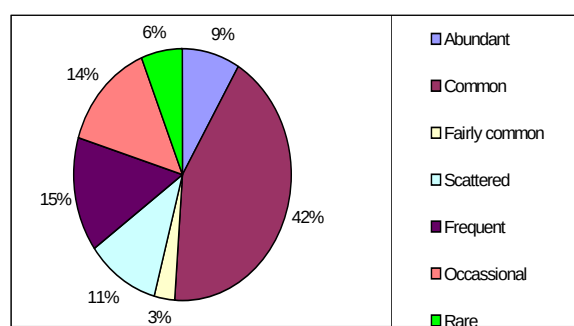


Figure 1: Distribution status of herbs, shrubs and climbers in the catchment area.

This analysis shows that common species which are mostly non-specialist species and those thriving in most types of open habitats such as roadsides, open fields, open disturbed forests, habitations etc. constituted 42 %. Compared to this, the rare species accounted for 6%. These are either specialist species on habitats such as wet tree trunks, shady places in evergreen to

semievergreen forests, marshes etc., or species such as *Plantanthera susanne* in open grasslands etc. with least human disturbance.

Species richness across different habitat types is depicted in Figure 2. It shows that Roadsides (RS) have highest species richness with 56 species. However, this does not represent any habitat type as a road passes through diverse habitats.

Grasslands, evergreen to semi-evergreen forests, moist deciduous forests and marshes harbour a high level of species richness as compared to scrubs, human habitations etc. These are also important macrohabitats serving as niche for rich faunal diversity in the catchment area part of which is under two sanctuaries-Sharavathi and Settihalli wildlife sanctuaries. These habitats are to be conserved, as they constitute rich repository of flora and fauna with habitat preferences. Microhabitats in these habitats support many endemic and specialist species.

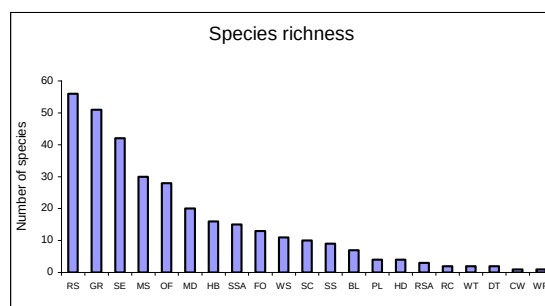


Figure 2: Species richness across 21 different habitats. (abbreviations in Annexure 1)

There are many endemic species in the study area, which may be characterised as Endemic to India, confined to Western Ghats and Western Ghats-Sri Lanka. The habitat preference investigations revealed that habitats with higher species richness (i.e., grasslands, evergreen-semievergreen and marshes) also harbour large number of endemics. This is illustrated in **Figure 3**. Compared to this, human habitations, barren land, hedges, roadside avenues, roadcuts, and compound walls were devoid of endemic species.

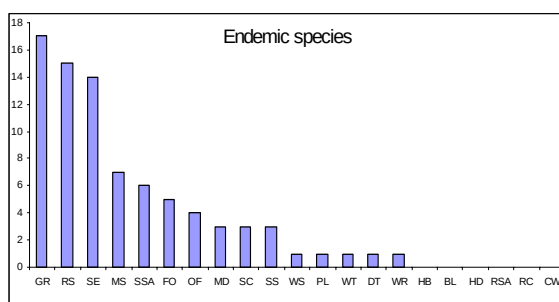


Figure 3: Endemic species richness across different habitats (abbreviations in Annexure 1)

Based on species richness and endemism, habitats are ranked for prioritising them for conservation. Habitat is ranked '1' for highest number of species and endemic richness, and 21 for the low species richness and endemism (Table1). The ranking shows that grasslands, evergreen to semi-evergreen forests and marshes (wetlands) with highest ranking (ranging from 1 to 4) are the candidate habitats for conservation on priority. Considering the economic and conservation values of these habitats, these can also be categorised as 'high conservation value ecosystems'.

Habitat types	sp.richness	endemism
Grassland	2	1
Road sides	1	2
Evergreen/S.E.green	3	3
Marshy areas	4	4
Scrub savanna	8	5
Forest openings	9	6
Open fields	5	7
Moist deciduous	6	8
Scrub	11	9
Stream sides	12	10
Plantations	14	11
Wet soil	10	12
Rocky	17	16
Barren land	13	17
Hedges	15	18
Habitations	7	20

Road sides avenues	16	21
Wet trunks	18	14
Ditches	19	15
Compound wall	20	19
Wet rocks	21	13

Table 1: Ranking habitat types according to their species richness and endemism for conservation priorities.

Jaccard's Similarity Index:

To understand how close each habitat types were, Jaccard's similarity index was computed and is illustrated in Figure 4. Jaccard's index is given by:

$$= C/(A+B)-C$$

Where A= Number of species in habitat A

B= Number of species in habitat B

C= Number of species present in both the habitats.

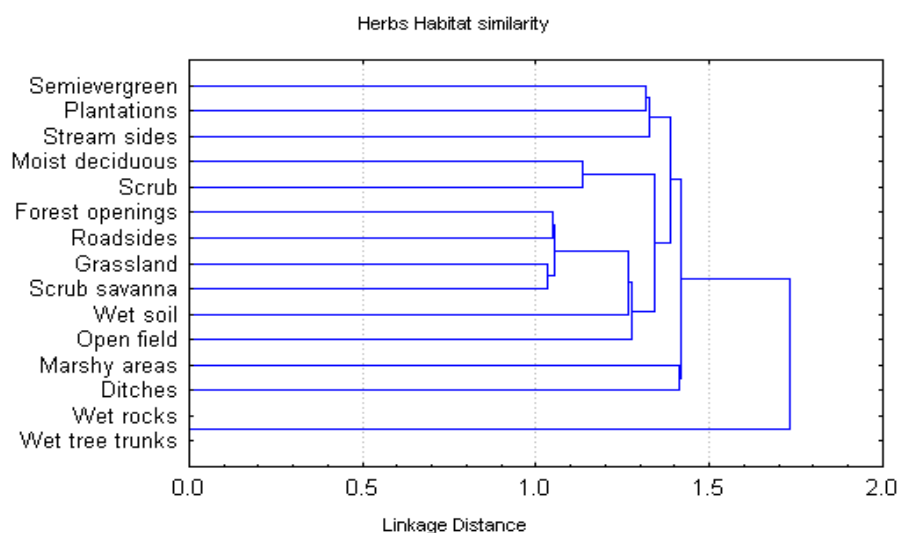


Figure 4: Jaccard's similarity index for different habitats in the catchment area.

This analysis shows that grassland habitats are closely related to scrub-savanna in sharing endemic species distribution. This can be true with many of the terrestrial orchid species such as *Habenaria*, which comes in large carpets in both these habitats. Moist deciduous forests have much in common with scrub while marsh with ditches. Species preferring roadsides are also seen in forest openings. Large number of plantations, such as Areca, are seen adjacent to or many times in between evergreen to semi-evergreen forests (due to encroachment) and, hence, these plantations also harbour some species associated with evergreen to semi-evergreen forests. Wet rocks and tree trunks are specialised habitats with no sharing with other habitat types.

CONSERVATION

One of the criteria for selecting habitats for conservation is the degree of endemism. Scientifically planned protected areas should include endemic centres, however small they are, and this would ensure saving species of restricted distribution (Nayar, 1996). The result has shown that the majestic evergreens, pristine grasslands and marshes in the catchment area harbour diverse kinds of herbs, shrubs, climbers and orchids that are endemic to Western Ghats. Some of the orchids that are endemics occurring in the catchment are *Aerides maculosum*, *Dendrobium nanum*, *Eria dalzelli*, *Habenaria crinifera*, *H.grandifloriformis*, *Dendrobium ovatum* etc., and other endemic plants are *Heliotropium scabrum*, *Impatiens scapiflora*, *Moullava spicata*, *Neanotis foetida*, *Nilgirianthus heyneanus*, *N.barbatus*, *Ophiorrhiza hirsutula*, *Eriocaulon stellatum*, *Argyreia involucrata*, *Begonia integrifolia*, *B.malabarica*, *Dictyospermum*

ovalifolium, *Blepharis asperrima*, *Crotalaria filipes*, *Croton gibsonianus*, *Curcuma neilgherrensis* etc. Nevertheless, many of these endemic species are of medicinal value, wild relatives of cultivated plants or of ornamental importance. It is necessary to understand and appreciate the future gains to country through conserving and maintaining our endemic species. These habitats are constantly under pressure to cater the needs of burgeoning population. Sagacious and equitable decisions have to be taken in addition to the sustainable management approaches to ensure conservation of these fragile ecosystems.

Medicinal plants

Out of nearly 17,500 flowering plants species found in India, over 1600 are used in traditional medicinal system (Kumar et al., 2002). Sharavathi river basin is rich in medicinal plants (122 of the total plant list) used in traditional system of Ayurveda. Medical practitioners often visit these natural areas such as Kodachadri, Nagavalli, Karni etc. Some of the important medicinal herbs, shrubs, climbers and orchids are species of *Curcuma*, *Dioscorea*, *Drosera*, *Piper*, *Lindernia*, *Lobelia*, *Malaxis*, *Nilgirianthus*, *Phyllanthus*, *Limnophila*, *Sida*, *Centella asiatica*, *Bacopa monnieri*, *Adathoda zeylanica*, *Asparagus racemosus*, *Canscora deccusata*, *Costus speciosus*, *Curculigo orchiodes*, *Gloriosa superba*, *Helicteres isora*, *Ichnocarpus frutescens*, *Hibiscus aculeatus*, *Rauvolfia serpentina*, *Tephrosia pulcherrima*, *Tricholepis glaberrima* etc. The habitat preferences of these plants as evident from these investigations depend on soil and watershed conditions. This also decides the quality and efficacy of the biologically active principles of medicinal plants. Hence, it is a vital necessity to save these habitats for the survival of life saving plants and humankind.

Orchids

Of the 259 species of endemic orchids in India, about 72 species are vulnerable and 26 species are endangered (Nayar, 1996). The present study documents 18 species of orchids with majority of them are endemic to Western Ghats. In the catchment area orchid species such as *Aerides*, *Dendrobium*, *Rhynchostylis retusa*, *Plantanthera susanne* etc. have ornamental value. Species of *Nervilia*, *Cymbidium aloifolium*, *Dendrobium ovata*, *Flickingeria nodosa*, *Malaxis rheedi*, *M.acuminata* etc. have medicinal property and high economic returns. Due to these and for ecosystem values, it is necessary to conserve in their original habitat, which acts as gene pool.

However, these orchids can be artificially propagated and hybridised, and used in flower trade, which is a multimillion-dollar business globally. Whereas a rose flower fetches Rs. 3-10, an orchid spray easily gets Rs. 30-200 depending on the variety (Kumar, 2001).

Conclusions

Sharavathi river basin harbours diverse kind of herbs, shrubs, climbers and orchids of which many are endemic to Western Ghats and thrive in grasslands, evergreen to semi-evergreen and marsh land habitats. These ecosystems apart from supporting wild flora and fauna also perform numerous ecological functions like controlling erosion etc. Due to anthropogenic pressures, large-scale destruction of forests is taking place in the watershed areas, river belts, lake margins, water reservoirs and the sloppy hills resulting in disappearance of valuable endemic species. Loss of habitat due to encroachment and land use changes is the main reason for loss of biodiversity in the study area. Hence it is necessary to conserve these fragile habitats as nature reserves to ensure sustainability of the ecosystem and thereby conserving the fast dwindling wild life and germplasm.

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