International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **2(3),** 1-6, March **(2013)** *Int. Res. J. Biological Sci.*

Current status of endangered Medicinal plant *Hedychium coronarium* and causes of Population decline in the natural forests of Anuppur and Dindori districts of Madhya Pradesh, India

Mishra Manish
Faculty of Ecosystem Management and Technical Forestry, Indian Institute of Forest Management, Bhopal, MP, INDIA

Available online at: www.isca.in
Received 13th August 2012, revised 11th January 2013, accepted 10th February 2013

Abstract

Gulbakawali (Hedychium coronarium J.König*) belongs to family Zingiberaceae, is a rhizomatous herb widely used in India as an febrifuge, eye tonic, anti-rheumatic, anthelmintic and mild tranquilizer in various Ayurvedic medicines. Over-exploitation of its rhizome for medicinal uses and consequent degradation of its natural habitat are reported to be the major threats to this plant. The herb is restricted to Anuppur, Amarkantak region including Chhattisgarh state, India. The results revealed that plant density (2 plant/ha.) and regeneration (< 1/ ha.) in protected areas (Achanakmar- Amarkantak Biosphere Reserve) were found low. On the contrary, in the natural forests the plant population was observed very poor (Avg.0.62/ha.). Almost nil regeneration was observed in the open natural forests of Anuppur and Dindori districts. The major causes for population decline in the study area are habitat destruction, complete uprooting of plants, immature harvesting and increased market demand of Ark (juice) extracted from its flowers. The population status of species and causes of its population decline in central Indian tropical forests is discussed in this paper.*

Keywords: Medicinal, Gulbakawali, harvesting, density, regeneration.

Introduction

The White ginger lily (*Hedychium coronarium*) is originally from the Himalayas region of Nepal and India where it is known as dolan champa. The powdered rhizome and an essential oil derived from it are antibiotic. An essential oil from the roots is carminative and has anthelmintic properties. It is a reasonably hardy plant and occurs up to about 1,900 m in tropical and subtropical Asia, probably from the Himalayan foothills of Nepal east to China and south through Indochina. The rhizome of Gulbakawali is used in Chinese natural medicine and has been prescribed and used in treatment of headache, lancinating pain, contusion, inflammatory and intense pain due to rheumatism etc.

The ecology of *H. coronarium* has been little studied. The species appears to be relatively shade tolerant, capable of growing in exposed sites. Dense colonies arise vegetatively by spread of the rhizomes. The ecological status of a few medicinal plants in Madhya Pradesh was assessed through a Conservation Assessment and Management Plan (CAMP) workshop in 1998, and Threat Assessment of Medicinal Plant workshop (TAMP) in 2003 at the Indian Institute of Forest Management, Bhopal (M.P), has identified *Rauvolfia serpentina, Curcuma caesia, H. coronarium* as a critically endangered species of central India [1,2]. The plant density of *Chlorophytum borivilianum*,*C. caesia, R. serpentina, Dioscorea hispida, Celastrus paniculatus* etc. were gradually declining due to over harvesting and consequently poor regeneration in central India[3-6]. Due to commercial demand and immense biotic pressure, most of these herbs are in danger under wilderness. They also cautioned that if the present condition continues, these species will soon have completely vanished from the natural forests of central India[7,8].

The continuous exploitation of several medicinal plant species from the wild and substantial loss of their habitats during the past 15 years have resulted in the population decline of many high value medicinal plant species over the years[9-14] . The weakening of customary laws, which have regulated the use of natural resources, are among the main causes threatening the medicinal plant species[15,16]. There are many other potential causes of rarity in medicinal plant species, such as habitat specificity, narrow range of distribution, land use disturbances, introduction of non-natives, habitat alteration, climatic changes, heavy livestock grazing, explosion of human population, fragmentation and degradation of population, population bottleneck, and genetic drift[17,18]. Additionally, natural enemies (i.e., pathogens, cattle and forest fires) could substantially limit the abundance of rare medicinal plant species in any given area[19,20].

Habitat loss and degradation are believed to threaten 91% of the rare plants in the world. Many of the world's rare plant species are edaphic endemic, whose unique soil needs, habitats, and restricted distribution make them especially vulnerable to human activities[21,22]. *H. coronarium* is a critically endangered species in central India[23]. The present estimation is also questioned for its validity for the task of threat categories to the species for a specific area. Most of the available data have been collected from the easily accessible areas of the selected

districts. Local communities and gatherers also raid same areas for collection of medicinal plants. Therefore, the estimated population density of this rare medicinal plant is not precise because it differs in the areas that have never or hardly undergone any collection of this species.

Material and Methods

Study area: **Anuppur:** Amarkantak is situated in Anuppur district of Madhya Pradesh in India. It is a unique natural heritage area in eastern Madhya Pradesh. This is the meeting point of the Vindhyas and the Satpuras, with the Maikal Hills being the fulcrum. Holy Narmada River originates from this place. Its latitude and longitude are 22°44' North and 81°54' East. The altitude is 1060.70 m. The beauty of the plateau can well be gauged from the fact that it lies 1000 m msl. in the midst of a moist Sal and mixed forest. Climatically Amarkantak is temperate. July, August and September are the real monsoon months, but there is also some winter rain. There are very few such spots in India and this makes Amarkantak a natural heritage area of national and even international importance. The place has some extremely valuable medicinal plants, which are now gravely endangered. Gulbakawali grows on marshy land, with pure water and under dense shade on deep soil. Its natural habitat is Mai-ki-bagia, Sonemuda, Kabir Chabutara, Dudhdhara and some private nurseries, gardens in Amarkantak city[24,25].

Protected Area: Achanakmar-Amarkantak Biosphere Reserve (Madhya Pradesh, Chhattisgarh) established in 2005 is rich in plant diversity. It lies between lat. $22^{o}15'$ to $22^{o}58'$ N and long. $81^{o}25'$ to $82^{o}50'$ E , having an area 3835.51 km 2 , partly falling in Madhya Pradesh and partly in Chhattisgarh state. Out of the total area, 68.10 % lies in Bilaspur district followed by Anuppur (16.20 %) and Dindori (15.70 %). The entire area of 551.15 sq. km of Achanakmar sanctuary has been designated as core zone and remaining area of 3284.36 km ^{2} serves as buffer zone. Out of this an area of 1224.98 km^2 falls in Madhya Pradesh and the rest of the area of 2059.38 km^2 fall in Chhattisgarh state. The forest area of the reserve represents tropical deciduous vegetation and can be classified into Northern Tropical Moist Deciduous and Southern Dry Mixed Deciduous forests. The area is "Genetic Express Highway" linking two biological Hot Spots namely Western Ghats and Eastern Himalayas. A total of more than thousand species spread over 151 plant families have been reported from the area[26].

Dindori: The Dindori district is situated at the eastern part of Madhya Pradesh touching Chhattisgarh state. The district touches Shahdol in east, Mandla in west, Umaria in north, and Bilaspur district of Chhattisgarh State in south. It is located at 81.34^{0} long. and 21.16^{0} lat. It is situated at a height of 1100 m above sea level amongst herbal-rich, Maikal mountain ranges. The district is covered in seven block namely Dindori, Shahpura, Mehandwani, Amarpur, Bajag, Karanjiya and Samnapur. The Baigas are very particularly vulnerable tribal groups found in this district.

Secondary information was used to trace out the occurrence in the natural forests of Anuppur and Dindori forest division including AABR. To assess the availability of the species in a particular area, the field staff of the forest department, local healers (*vaidyas*), local tribal medicine men (Baiga's) and herb collectors were consulted before laying quadrants for estimating density, regeneration etc. The field investigations and forest survey have been conducted during October 2010 to November 2011, with the assistance of local people and forest department officials. A thorough survey was done to collect information on the occurrence of plant in various forest ranges of two districts.

Plant Density and Regeneration estimations: More than 100 quadrants of 2 m. X 2 m. size were laid randomly in the natural forest of selected forest division. The target species was localized and not distributed uniformly in the study areas. Hence, the calculated plant density represents the density of the species in its habitats. The individuals of species in each quadrant were noted (i.e. density no./ha.) in PAs as well as in natural forests. Seedlings of the species were recorded within each of quadrant in the selected site[27]. For regeneration data, the quadrant of 1m. X 1m. size was laid on random basis at each site and individuals were noted.

Reasons of population decline: A personal interview method was followed to get an insight into the various causes of depletion of the selected species in the natural forest of study area. A standard questionnaire method was used to collect information such as current harvesting practices, biotic and abiotic factors, man-made factors, forest fire, grazing etc. The data was also collected from different sources, such as forest department personnel, local people, NTFP collectors, herbal practitioners etc.

Habitat suitability and geographical description: The selected species requires a specific habitat for growth and regeneration in the natural forest areas. Species usually grows on limited patches of well drained and moist soil with sparse undergrowth, particularly less grass. The site-specific characteristics, habitat and various anthropogenic factors were noted after surveying study area including protected areas of AABR. The natural occurrence of this herb in any other part of Madhya Pradesh is not reported. The herb is limited to very moist areas only and found in abundance specifically in Mai Ki Bagia of Amarkantak town. Flower yields Ark (extract) of therapeutic and industrial importance. Locals and traditional healers use yellow fragrant flowers to prepare eye tonic. The rhizomes are also the source of essential oil that is used in perfumery and Ayurvedic medicine making.

Results and Discussion

The data presented in table-1 show various ecological observations like density, regeneration and tuber yield of *H. coronarium* in the natural forests and protected areas (AABR). Average plant density and regeneration per hectare (2.0 and >1.0) was found low in AABR as compared to very poor in natural forests (0.62/ha. and Nil) of Anuppur and Dindori

districts. The average per plant rhizome yield (0.237 g/ha.) was noted more in AABR whereas it was considerably low in the natural forest (0.127 kg./ha.). However, almost nil regeneration was observed in the natural forests of Dindori and Anuppur district.

Causes of population decline in the natural forests: Immature collection: To meet the demand, the local people resort to over-harvesting of this species from the natural forests of Amarkantak region. People harvest its flowers and rhizome in the natural forests during the month of September. Not a single rhizome has been left for future regeneration. The people have hardly any alternative means to earn a livelihood from other sources. The local peoples mostly depend on the forest products (NTFPs) including medicinal plants. The area is full of different kind of rare and commercial plants. It is one of the major reasons for population decline of selected species.

Human interference: Amarkantak is well known tourist place of Madhya Pradesh and holy Narmada River originates from this place. Construction of temples, check dams and other developmental works on species natural occurrence sites is severely affecting its population and growth. After getting knowledge from *Vaidyas*, locals etc. about its usefulness in curing various eye ailments various tourists, local peoples as well as saints (*sadhus*) uproot this species while visiting this place.

Market pressure: It was also found during the study that Ayurvedic manufacturers, local traders and *vaidyas* play an important role in over-harvesting of this valuable species. When demands from big Ayurvedic companies come, the local traders offer advance money to the local collectors for rhizome collection. In return local tribal people collect as much as possible to repay their advances. This ultimately increases the competition among the villagers to collect more and more, destroying the wild population in the natural forests. It was also observed that due to increasing demand of its Ark, rates have increased many folds in last few years. The state forest department and few Ayurvedic manufacturers installed distillation units at Amarkantak and selling its Ark (extract) at high rates. Industrial demand is putting pressure on natural population of Gulbakawali in the region. Many peoples started commercial cultivation of this valuable species. On the other hand, due to restrictions on NTFP removals from protected areas of AABR, the people are not allowed to harvest and sell any forest products.

Specific habitat conditions: The species occur in special habitat conditions and is found in moist surroundings preferably near to seasonal streams, dense canopy trees, shrubs etc. The species occurs mostly in swampy areas, where moisture is high and well drained soil. The rhizome does not go beyond one and a half feet of depth and spreads less than one foot.

Low plant density and regeneration: The species is mostly found in patches and does not spread much in the vicinity. Due to over-harvesting of this species density and regeneration is very poor in all the sites and sometimes nil in the whole forest, where it was earlier reported to be most abundant. During the survey very few flowering and fruiting plants were observed. No seed or any vegetative part, rhizome etc. of the plant was found on the forest floor. This indicates extremely low seeding and germination of this species in the study area.

Table-1
Ecological observations of *H. coronarium* in the natural forests of Anuppur and Dindori Forest division

Name of District/ Division	Forest Range	Forest Range/ Village	Plant Density /Hectare	Plant regeneratio /Ha.	Per plant rhizome (wet) yield (Kg./Ha.)
Achanakmar-Amarkantak Biosphere Reserve (AABR)					
Anuppur	Amarkantak	Mai ki bagia Sonemuda Antaria Jaleshwar	3.00 Se ±0.16 2.00 Se ±0.13 2.00 Se ±0.11 1.00 Se ±0.07	>1.00 Se ±0.07 1.00 Nil Nil	0.285 Se ±0.80 0.254 Se ±0.56 0.200 Se ±0.21 0.210 Se ±0.19
Average of AABR			**2.00**	**>1.00**	**0.237**
Natural Forest					
Anuppur	Amarkantak forest range	Mai-ki-bagia, Dudhdhara Kapildhara Sambhudhara	2.00 Se ±0.03 >1.00Se±0.09 >1.00Se±0.09 Nil	Nil Nil Nil Nil	0.207Se ±0.15 0.098Se ±0.25 0.103Se ±0.25 Nil
Dindori	Karanjiya forest range	Kabir–Chabutara Kharidih Chauradadar Jogigwara	>1.00Se ±0.07 Nil Nil Nil	Nil Nil Nil Nil	0.100Se ±0.23 Nil Nil Nil
Average of natural forest			**0.62**	**Nil**	**0.127**

Habitat destruction: Habitat destruction is a major external factor affecting plant population under wild conditions. Loss of habitat is also a threat to selected plant growing in the natural forest. Smaller populations of *H. coronarium* and other herbaceous medicinal plants are more prone to extinction and attract fewer pollinators, less reproductive success and less gene flow.

Over-grazing: Uncontrolled cattle's grazing is highly detrimental to the selected species. It was found that a huge population of livestock depends for grazing on the forest particularly near villages. However, due to fencing and protected boundaries, the cattle of adjoining villages were not entering in the sanctuary AABR/protected areas.

H. coronarium occurs in special habitat conditions in the study area. The presence of plants in the limited area indicates suitability of site as well as geo-climatic conditions and moisture availability in the region that are favorable to the species. The plant density is negligible and very deficient in the natural forest areas of both the districts which are otherwise known as the good medicinal plant bearing forests of Central India. The selected plant is getting depleted in the natural forests because of habitat destruction, deforestation and uprooting of the whole plant by the people. High market demand for its Ark, extracted from its flower has also created immense pressure on this particular species. The forest floor has no chance of receiving mature and viable seeds due to immature plant collection. Developmental works like construction of check dams, temples, permanent structures etc adversely impacting natural occurrence of species in the study area.

The present study reveals that population density, regeneration and per plant rhizome yield is low in the multiple use forests of selected districts as compared to protected areas of AABR. This may be due to restrictions on collection in the protected areas. Habitat suitability and less anthropogenic factors are the causes of its presence in protected forest while natural forests are more disturbed due to human activities. Scientists [28] highlighted the role of protected areas in the conservation of biodiversity and reported that *Gentiana kurroo* is fast heading towards local extinction in the Kashmir Himalaya due to anthropogenic pressure; the species is distributed throughout the region, but is currently represented by only a single wild growing population, found in a protected area. Developmental activities, human interferences and market pressure from Ayurvedic companies as well as competition among villagers to collect more plants leads to overharvesting of this species. Such activities may be adversely affecting the plant population and regeneration in the natural forests. However, protected areas are not much affected due to human interference, trade, grazing and non-removal of wild products, tubers etc. The threatened medicinal plant species were found in distinct habitats and showed specific distribution, which is supported by various workers [29,30,31] .

Population status and ecological limitations of endemic population to localized niches are factor responsible for extinction of various herbaceous plants. Recently, Scientist [32,33,34] working on critically endangered medicinal plant (i.e. *Acorus calamus, Curcuma caesia)* in the Mandla and Dindori districts of Madhya Pradesh reported almost nil regeneration and very poor density of both the plants. Paper suggests uprooting of tubers need to be immediately stopped and proper training of peoples for collecting tubers by scientific methods should be given to collectors. The present harvesting system is ecologically and socio-economically unsustainable. There is no mechanism by which to discourage premature harvesting. Gulbakawali plant is also localized to particular moist regions of Amarkantak plateau.

Conclusion

The present deteriorating condition of the *H. coronarium* in the natural forests of selected districts of Madhya Pradesh state is very precarious and needs immediate attention not only for conservation but also for its propagation. The wild germplasm of this endangered species may become extinct if protection measures are not initiated. The plant has become a critically endangered species due to habitat destruction and extensive utilization by the Ayurvedic Industry and the local medicinal system. These factors, coupled with over- harvesting, overgrazing and ecological restriction of endemic population to a particular habitat conditions, indicate that the herb is in danger of extinction in the wild. The natural regeneration is also adversely affected due to immature harvesting of this plant. The competition for early collection among the locals living around the forests has become more intense. The method of collection in study area was not scientific and it affects the growth and occurrence of the plant.

For the sake of appropriate and efficient management of plant wealth in the natural forests, following point come out from the present study- the plant should be allowed to mature up to December and thereafter some rhizomes should necessarily be left behind for further regeneration. At least 1/3 of the plants should be left on the ground after harvesting. Ex-situ gene banks of the selected species need to be encouraged and a germ plasm bank should be developed at the regional level. Large scale cultivation using bio-fertilizers provides good quality produce in the market as well as for industry but is also helpful in curtailing the pressure on natural forests; Active protection measures and continuous monitoring of the existing population should be given top priority. Government agencies such as the forest department, NGOs and other conservation agencies may take initiatives in developing, distributing as well as planting nursery grown plants in suitable habitats. There is a need to conduct detailed field trials in other similar locations in Madhya Pradesh. These trials will help Gulbakawali to establish as potential medicinal crop and encourage the farmers to start its commercial cultivation. The commercial cultivation will reduce the pressure on natural population; Plantation in traditional

agricultural lands, home gardens and protected areas are also recommended.

Acknowledgement

The author is thankful to the Divisional Forest Officers (DFO) of Dindori and Anuppur district and the field staff of the forest department for providing field facilities, data collection and necessary assistance during field work. I am extremely thankful to the local peoples of Anuppur and Dindori district for providing valuable information's. I am also thankful to the than Director, Dr. R. B Lal for his kind inspiration.

References

1. Prasad R. and Patnaik S. Conservation Assessment and Management Planning. Proceeding of the Conservation Assessment and Management Planning (CAMP) workshop for Non timber forest products in Madhya Pradesh, Indian Institute of Forest Management, Bhopal (M.P), 1-99 **(1998)**

2. Ved D.K., Kinhal G.A., Ravikumar M., Karnat R.V., Sankar S. and Indresha J.H., Threat Assessment and Management Prioritization (TAMP) for the medicinal plants of Chattisgarh and Madhya Pradesh, Workshop proceedings Medicinal plant taxonomy and distribution, Proceedings of the TAMP workshop jointly organized by FRLHT-IIFM, published by FRLHT, Bangalore, India, 1-98 **(2003)**

3. Mishra M., Harvesting practices and management of two critically endangered medicinal plants in the natural forests of central India. Proceedings of the International seminar on Harvesting of Non wood Forest Products, Held at Menemen-Izmir, Turkey on October 2-8, 2000, 335-341 **(2000)**

4. Prasad R., Kotwal P.C. and Mishra M., Harvesting practices of Safed musli (Chlorophytum spp.) and its ecological impact on the natural forests of central India, *Jour. of Trop. For*., **18(1),** 9-24 **(2002)**

5. Mishra M., Kotwal P.C. and Mishra R.P., Sustainable management of critically endangered species of Medicinal plants in central India. Research project report submitted to Research cell, Indian Institute of Forest Management, Bhopal (M.P), India, 1-110 **(2004)**

6. Kotwal P.C. and Mishra M., Recent harvesting practices and causes of population decline of critically endangered species Malkangni (Celastrus paniculatus) in the two districts of central India, *Van. Sand*., **31(1)**, 4-13 **(2007)**

7. Mishra M. and Kotwal P.C., Traditional harvesting and processing methods of *Dioscorea daemona* (Baichandi) tubers in the forests of Madhya Pradesh, India, *J. of Trop. Med. Plants*, **10(1)**, 113-118 **(2009)**

8. Mishra M., Conservation of biodiversity in the natural forests of central India: a case of critically endangered medicinal species Safed musli in Bhopal forest (M.P) India, *Bios. Disc.,* **2(3)**, 299-308 **(2011)**

9. Shah N.C. and Kapoor L.D., Depletive medicinal plants of Kumaon Himalayas, *Jour. of Res. on Ind. Med. Yoga and Homeo*., **13(3)**, 38-43 **(1978)**

10. Shah N.C., Conservation of wild medicinal plants: need for a comprehensive strategy, *Kurukshetra*, **XLVI(3)**, 15-18 **(1997)**

11. Shah N.C., The status of medicinal plants in Indian Himalayas, Workshop on Himalayan Medicinal Plants, held at G.B. Pant Institute of Himalayan Environment and Development, Katarmal-Kosi, Almora. Gyanodaya Prakashan, Nainital, 325 **(1998)**

12. Shah N.C., Present status constraints and future strategy of medicinal and aromatic plants in Kumaon Himalaya, National seminar on Drugs from Himalayan herbs: present status and future strategies held at Deptt. of Chemistry, Kumaon University, Nainital (U.P), 55 **(1999)**

13. Kala C.P., Commercial exploitation and conservation status of high value medicinal plants across the borderline of India and Nepal in Pithoragarh, *Ind. For*., **129**, 80-84 **(2003)**

14. Kala C.P., Medicinal plants of the high altitude cold desert in India: Diversity, distribution and traditional uses, *Int. Jour. of Biod. Sci. and Manag*., **2**, 1-14 **(2006)**

15. Ghimire S.K., McKey D., Aumeeruddy-Thomas Y., Heterogeneity in ethnoecological knowledge and management of medicinal plants in the Himalayas of Nepal: Implication for conservation, *Ecol. and Soci*., **9(3),** 6, **(2005)**

16. Kala C.P., Status and conservation of rare and endangered medicinal plant in the Indian trans-Himalaya, *Biol. Conserv.,* **93**, 371-379 **(2000)**

17. Weekley C.W. and Race T., The breeding system of *Ziziphus celata* Judd and D.W. Hall (Rhamnaceae), a rare endemic plant of the Lake Wales Ridge, Florida, USA: implications for recovery, *Biol. Conserv*., **100**, 207-213 **(2001)**

18. Kala C.P., Indigenous uses, population density, and conservation of threatened medicinal plants in protected areas of the Indian Himalayas, *Conserv. Biol.,* **19**, 368-378 **(2005)**

19. Bevill R.L., Louda S.M. and Stanforth L.M., Protection from natural enemies in managing rare plant species, *Cons. Biol.,* **13,** 1323-1331 **(1999)**

20. Dhyani P.P. and Kala C.P., Current research on medicinal plants: Five lesser known but valuable aspects, *Curr. Sci*., **88**, 335, **(2005)**

21. Hopper S.D. Van-Leeuwen S., Brown A.P. and Patrick S.J., Western Australia's Endangered Flora and other plants under consideration for declaration, Department of Conservation and Land Management, 139 **(1990)**

22. Briggs J.D. and Leigh J.H., Rare and Threatened Australian Plants. Revised edition, CSIRO publishing, Melbourne, Australia, 446 **(1996)**

23. Shukla A.N. Srivastava S.K. and Kumar B., *Hedychium coronarium* J.König (Zingiberaceae) in Achanakmar-Amarkantak Biosphere Reserve, Central India, ENVIS News letter, **15(2)**, 5 **(2010)**

24. Oudhiya P., Gulbakawali (*Hedychium coronarium*, family Zingiberaceae) as medicinal herb in Chhattisgarh, India, http//www. botanical.com/site/column_poudhia/ 196 _gulbakawali.html, website accessed on 25/6/2011 **(2005)**

25. Dubey K., Amarkantak at a glance. Ma Narmada Sahitya Sadan, Amarkantak, 1-78 **(2005)**

26. E.P.C.O. Guidelines for Protection, Research and Development of Biosphere Reserves with Special Attributes of Pachmarhi and Achanakmar-Amarkantak Biosphere Reserves, Project report by Environmental Planning and Coordination Organization (EPCO), Bhopal (MP), 1-124 **(2005)**

27. Misra R., Ecological workbook. Oxford and IBH, New Delhi, 31–51 **(1968)**

28. Khuroo A.A., Dar G.H., Khan Z.S., Reshi Z.A., Observations on Gentiana kurroo royle, a critically endangered medicinal plant from the Kashmir himalaya, India, In Endangered Species Update. October 1, **(2005)**

29. Dhar U., Rawal R.S. and Upreti J., Setting priorities for conservation of medicinal plants - a case study of the Indian Himalaya, *Biol. Conserv*., **95**, 57-65 **(2000)**

30. Dhar U., Conservation implications of plant endemism in high altitude Himalaya, *Curr. Sci.,* **82(2)**, 141-148 **(2002)**

31. Uniyal S.K., Kumar A., Brij L. and Singh R.D., Quantitative assessment and traditional uses of high value medicinal plants in Chota Bhangal and Himachal Pradesh, Western Himalaya, *Curr. Sci.,* **91(9)**, 1238-1242 **(2006)**

32. ENVIS, FRLHT, Medicinal Plant species of conservation concern identified for Madhya Pradesh (MP http://envis.frlht.org – ENVIS Centre on Conservation of Medicinal Plants, FRLHT, Bangalore, http://frlhtenvis.nic.in. Website viewed on 22 September 2011 **(2011)**

33. Mishra M., Wild harvesting and management of some medicinal plants in the natural forests of central India, *Ind. Jour. of Fund. and Appl. Life Sci.*, **1(2)**, 90-97 **(2011)**

34. Sharma J.R., Verma R. and Verma A., Ethno-botanical studies of *Mallotus philippinensis* L. Murg. Arg. on tribes of Bhopal, Madhya Pradesh, India, *Int.J.Med. Arom.Plants,* **2(3)**, 434-436 **(2012)**