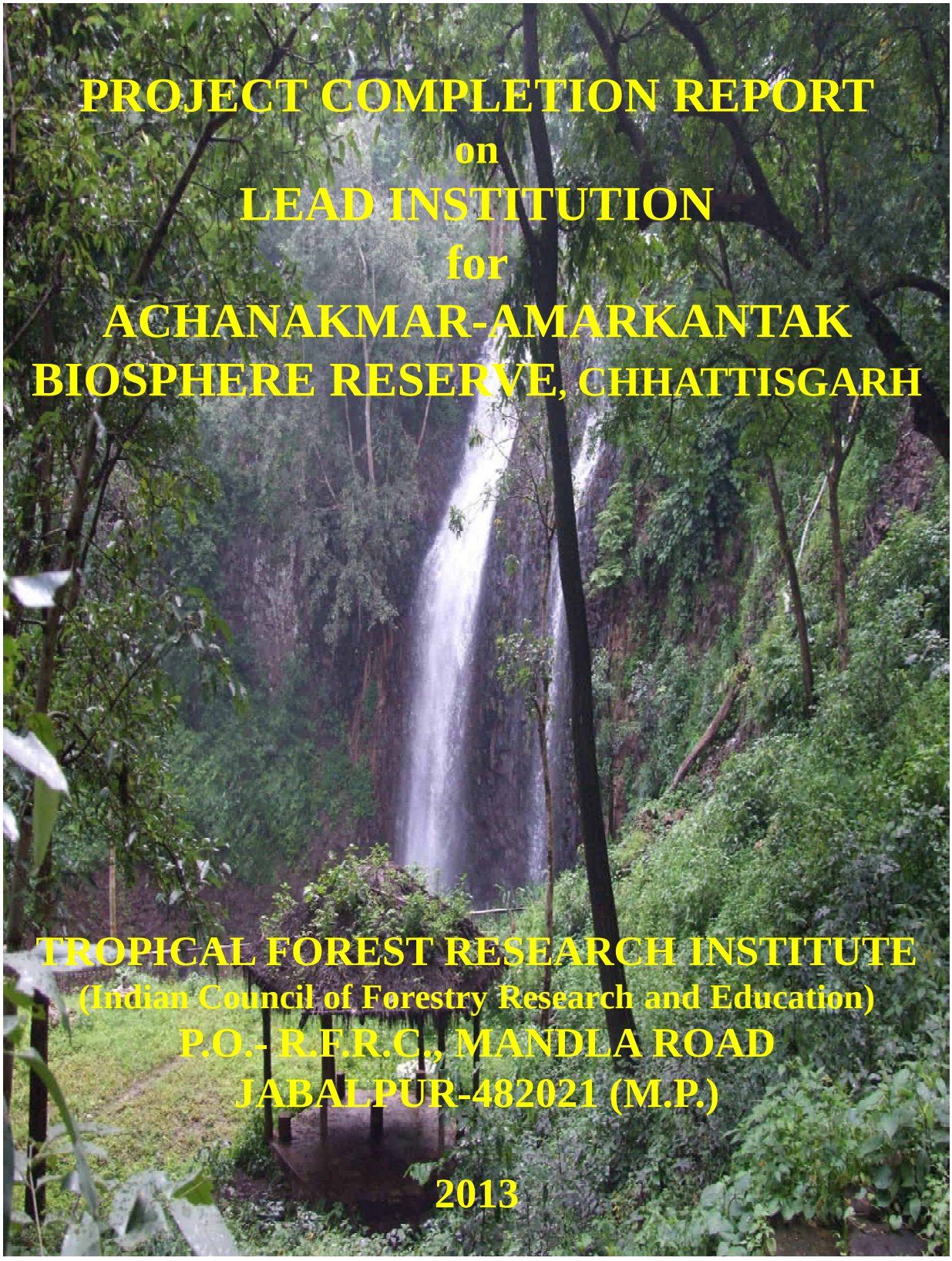

PROJECT COMPLETION REPORT
on
LEAD INSTITUTION
for
ACHANAKMAR-AMARKANTAK BIOSPHERE RESERVE, CHHATTISGARH

TROPICAL FOREST RESEARCH INSTITUTE
(Indian Council of Forestry Research and Education)
P.O.- R.F.R.C., MANDLA ROAD
JABALPUR-482021 (M.P.)

2013

PROJECT COMPLETION REPORT
on
LEAD INSTITUTION
for
ACHANAKMAR-AMARKANTAK BIOSPHERE RESERVE, CHHATTISGARH

Submitted
by
Dr. N. Roychoudhury, Scientist –F
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JABALPUR-482021 (M.P.)

2013

CONTENTS

1. **Project Title and ID No. :** Lead Institution for Achanakmar-Amarkantak Biosphere Reserve, Chhattisgarh.

   ID NO. 148/TFRI/2010/ Ento-2(MoEF) (23)

2. **Duration of the Project:** 3 Years (from April 2010 - March 2013)

3. **Funding source:** Ministry of Environment and Forests, Govt. of India, New Delhi.

4. **Cost of Project:** Sanctioned = Rs. 20, 31, 360/-
   Amount Released = Rs. 15, 32, 007/-
   Expenditure = Rs. 13, 13, 461/-

5. Name of PI and Associates:

Principal Investigator: Dr. N. Roychoudhary, Scientist-F and Head
Forest Entomology Division

Associates: Dr.Ashish D. Tiple, RA (July 2010-December 2010)
Shi Dinesh Khuswaha, JRF (June-June 2012)
Dr. Dheeraj Yadav, RA (April 2011-June 2012)
Dr. Ruby Sharma, RA (February 2013-March 2013)

6. Introduction:

Achanakmar-Amarkantak Biosphere Reserve is the first biosphere reserve of Chhattisgarh State and 14th biosphere reserve of the country, declared by Government of India during the year 2005 (vide No. 9/16/99 CS/BR dated 30th March 2005) (Anon, 2007a) (Fig.1). It lies between latitude 22^0 15' to 20^0 58$^{'}$ N and longitude 81^0 25'N to 82^0 5'E and is spread from Maikal hill ranges to the junction of Vindhyan and Satpura hill ranges in a triangular shape. Achanakmar-Amarkantak biosphere reserve is the most dramatic, ecologically diverse, and least developed and least disturbed area falls under Deccan

Peninsula biogeographic zone of tropical dry and moist deciduous forests biome of India and spread over in Chhattisgarh and Madhya Pradesh with topography ranging from high mountains, shallow valleys and plains (UNESCO-MAB, 2012, http://www.unesco.org/mab). The biosphere reserve supports three major river systems of central Indian region, viz. Narmada, Sone and Johilla and their tributaries. Its boundaries start from Kota and Lormi forest ranges of Bilaspur district in (Chhattisgarh) south to Rajendragram forest range of Anuppur district (Madhya Pradesh) in the north and Belgahana forest range of Chhattisgarh in the east to Dindori forest range of Dindori district in Madhya Pradesh (Fig.2). The total geographical area of biosphere reserve is 38, 35.51 sq. km (Anon, 2007a,b). It consists of three distinct zones, viz. core zone with an area of 551.55 sq. ha. in Chhattisgarh state, buffer zone with an area of 1,95,587.5 sq. ha. in Madhya Pradesh and Chhattisgarh, and outer most transition zone with an area of 132808.5 sq. ha. in both the states. The core zone has 22 villages with a population of 7,709 inhabitants whereas the buffer zone and transition zones have 396 revenue and forest villages in both States with a population of 4,48,021 inhabitants as per population census of 2001. It is home to primitive tribal communities like Baiga, Gonds, Panikas, Kol, Dhanaur, besides other communities. In all, 27 communities, mostly tribal, scheduled castes and other backward classes, live in the biosphere reserve (Anon, 2012). The biosphere reserve has three distinct seasons, viz. monsoon, which begins from July and continues up to October, winter from November to February and summer from March to June. The lowest temperature in winter is -2^{o} C, which rises up to a maximum of 46^{o} C in June. The humidity varies from 39 % to 90%. This climate has enriched a large number of 1527 species of identified flora (Anon, 2007b, 2010), 324 species of identified fauna (Anon, 2008, 2010) and many more undescribed floral and faunal taxa. The annual rainfall is about 1624 mm. A few perennial and many seasonal rivers and a dam called “Khudia dam” also exist in the BR. The forest vegetation is tropical deciduous type and is classified into “Northern Tropical Moist Deciduous and Southern Dry Mixed Deciduous forests (Champion and Seth, 1968). As a whole, Achanakmar-Amarkantak biosphere reserve is a paradise of biodiversity (Roychoudhury *et al*., 2012).

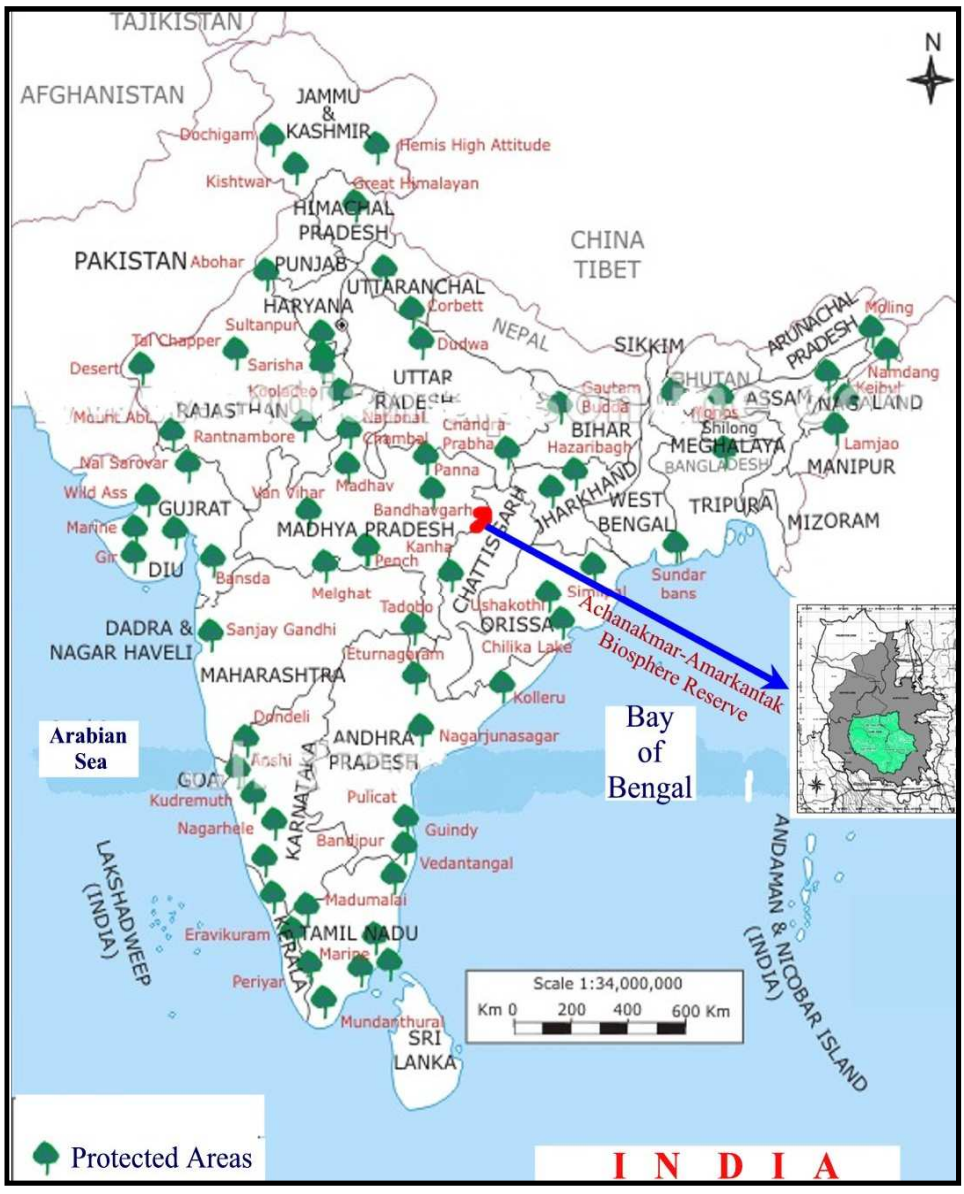


Fig. 1. Map showing the location of Achanakmar-Amarkantak biosphere reserve.

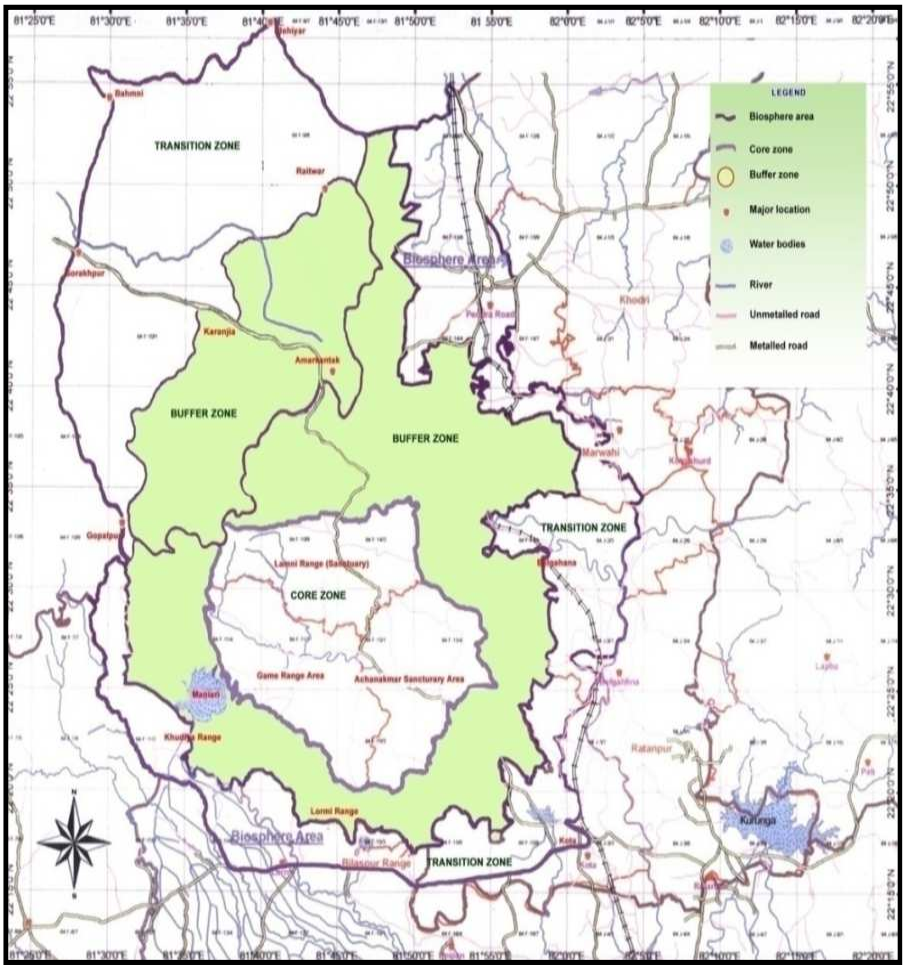


Fig. 2. Map showing the boundaries of Achanakmar-Amarkantak biosphere reserve

7. Objectives:

- Collection, synthesis and dissemination of research based information in respect of biosphere reserve from all sources.
- Interaction with regional research organizations for development of suitable research projects.
- Undertake research and develop data bank.
- Maintain regular interface with the Biosphere Reserve managers to assess the research needs and crucial areas requiring research efforts and providing research inputs for inclusion in Management Action Plan.
- Publication of a compendium of upto date information and bringing biannual publications aimed at educating stakeholders.
- Preparation of project document for designation of new BRs in coordination with concern State Government.
- Formulation of project proposals for designation of Indian Biosphere Reserves on World Network of BR recognized by UNESCO.
- Any other assignments which may be entrusted by Central Government to achieve the larger objectives of the scheme.

8. Physical Targets:

I. Collect and update data on flora, fauna and socio-economic studies.

II. Interaction with regional organizations.

III. Synthesis of data of meteorological observations, regeneration status of tree species, status of threatened flora, seasonal population status of butterflies and moths and villagewise population and movement of inhabitants from inhospitable areas of biosphere reserve.

IV. Dissemination of research based information by holding workshops and trainings to biosphere reserve staff.

V. Publication of biannual literature.

VI. Periodical interface with biosphere reserve manager to assess the research needs.

VII. Submission of biosphere reserve nomination document to UNESCO and creation of a web based information centre.

9. Achievements of Physical Targets:

I. Cunsulted and collected current literature and information on flora, fauna and socio-economic aspects from scientific journals and internet, which used for updating on the basis of new publications.

II. Interacted with scientists and academicians of various organizations and universities and requested for development of suitable research projects.

III. Collected meteorological data of core and buffer zones of the biosphere reserve. Observations recorded on regeneration status of tree species in the established permanent plots in core and buffer zones representing different vegetation types. Recorded status of 28 selected economically important threatened flora from core and buffer zones. Surveyed biosphere resereve during rainy, winter and summer seasons for collection of butterflies and moths. In all, 558 insect samples were collected, out of which 73 species (39 butterflies and 34 moths) were identified. Among the butterflies and moths, 17 and 30 species respectively were recorded for the first time from this biosphere reserve. This is being a new addition to the insect faunal composition of Achanakmar-Amarknatk biosphere reserve. Colllected information on population of different villages as per census 2001 and movement of inhabitants from six villages of core zone to buffer zone of biosphere reserve.

IV. Disseminated research based information by conducting three one day workshop/ training on 26th October, 2010, 3rd March, 2012 and 23th March, 2013, for front line field staff representing all the ranges from the three zones of biosphere reserve.

V. Published Biosphere Research Informations Series (BRIS) Vol. 2 (1-2) and Vol. 3 (1-2). Carried out compilation of Biosphere Reserve Information Series (BRIS) Vol.4 (1-2) for its publication.

VI. Ten meetings were held with BR manager to assess the research needs in crucial areas such as tree mortality in biosphere reserve and other activity like monitoring and evaluation of developmental activities of MAP, 2011-12. Suggestions were

also given to the BR manager with regard to rehabilitating the land through development of grassland in villages shifted from the core zone of biosphere reseve.

VII. Submitted nomination document of Achanakmar-Amarkantak biosphere reserve to United Nations Educational, Scientific and Cultural Organization (UNESCO) for inclusion in World Network of Biosphere Reserves (WNBR). International Coordinating council of UNESCO's man and the Biosphere (MAB) programme, at its 24th session held at UNESCO headquarters in Paris from 9th to 13th July, 2012 approved the inclusion of Achanakmar-Amarkantak biosphere reserve in its world's network of Biosphere Reserves. Designed webpage on Achanakmar-Amarkantak Biosphere Reserve under Lead Institution and linked to the official website of TFRI, Jabalpur (http://tfri.icfre.gov.in/AABR/index.htm) to exchange and share technology.

10. Methodology:

Updated information on flora, fauna and scio-economic studies based on the works published in different scientific journals, bulletins, proceedings, reports, etc. Collected literature on Tropical Moist/Dry Deciduous types of biosphere reserves and collated with the conditions of the Achanakmar-Amrakantak biosphere reserve.

Periodical visits were conducted in Achanakmar-Amarkantak biosphere reserve for collection of daily metereological observation recorded in core zone of biosphere reserve throughout the project period (Fig. 3). Information on these aspects of buffer zone located towards Chhattisgarh and Madhya Pradesh were collected from web site. Regeneration status of tree species was studied in established seven permanent plots laid in core and buffer zones of Achanakmar-Amarkanatak biosphere reserve (Table 1). Saplings (>1m height and 10 cm circumference) regeneration was studied by laying three quadrates of 5m x 5m size in each plot, while seedlings (<1m height and 10 cm circumference) regeneration was studied by laying three quadrates of 1m x 1m size in each plot. The data, thus, collected were computed following standard method (Mishra, 1968) to work out density/ha for finding out the status/trend of regeneration of tree species in core and buffer zones of biosphere reserve. The

previous record of tree species during the year 2006 in the respective plots was used as base line data (Anon, 2007a). Collected information on status of selected economically important threatened flora in Achanakmar-Amarkantak biosphere reserve. Surveyed insect fauna (butterflies and moths) of biosphere reserve as per standard methods by sweeping and light trap. Collected butterflies and moths were killed, oven dried, studied morphologically and systematically to identify them with the help of Fauna of British India as insect manual, available literature published by Zoological Survey of India and determined specimen preserved for reference collection at National Repository for Insects, Forest Entomology Division of this Institute. Collected information on villagewise population and movement of inhabitants form inhospitable ares of biosphere reserve.

Organized annual workshop/training on different aspects of biosphere reserve to educate stakeholders, such as members of State Forest Department and front line staff of biosphere reserve. Disseminated research inputs by publishing periodical biannual literature (BRIS). Conducted periodical interactions with BR manager to assess the research needs and provided suggestions. Submitted project proposal for designation of Achanakmar-Amarkantak biosphere reseveon world network of biosphere reserves recognized by UNESCO and created web page for Achanakmar-Amarkantak biosphere reserve.

Table 1. Details of sample plots

Plot No.	Zone	Range	Comp. No.	Coordinates	Elevation (ft)	Number of tree species*	Dominant species
I	Buffer	Kota	186	N 22°23’38.2” E 081°52’56.7”	1534	23	Sal
II	Core	Achanakmar	159	N 22°23’04.4” E 081°51’34.2”	1543	29	Sal
III	Core	Achanakmar	504	N 22°26’26.6” E 081°47’03.1”	1363	26	Sal
IV	Core	Chaparwa	198	N 22°26’31.5” E 081°46’08.9”	1355	29	Sal
V	Core	Lamni	324	N 22°31’42.2” E 081°44’56.2”	1965	40	Sal
VI	Core	Lamni	311	N 22°33’16.1” E 081°44’34.7”	1833	21	Sal
VII	Buffer	Ataria	285	N 22°34’22.2” E 081°45’33.8”	1867	20	Sal

*Recorded during the year 2006.

Fig. 3. Temperature and humidity recording at core zone, Achanakmar.

11. Results and Discussion:

The results and discussion of different physical targets of the project are mentioned as here under:

I. Collect and update data on flora, fauna and socio-economic studies

Floral resources

The forest constitutes 63.91% of the total area of biosphere reserve. The BR is very rich with high density of flora. It comprises of 1527 species of identified flora (Anon, 2010). It has more than 317 species of thallophytes that includes 7 species of algae (Tiwari *et al*., 1995), 179 species of fungi (Shettyi, 1957; Soni *et al*., 1984; Harsh *et* al., 1989; Chakraborty *et al*., 1991; Jamaluddin *et al*., 1990, 1993; Dadwal and Jamaluddin, 1991; Jamaluddin and Chandra, 1997) and 130 species of lichen (Tiwari *et al*., 1995; Nayaka *et al*., 2007; Upreti *et al*., 2007) , 44 species of bryophytes (Tiwari *et al*., 1995), 40 species of ferns (Saxena, 1970; Prasad and Pandey, 1987; Panigrahi and Murti, 1989; Pandey *et al*., 1991, Verma *et al*., 1993; Tiwari *et al*., 1995; Chaubey *et al*., 2001; Saini, 2005; Singh and Dixit, 2005). 16 species of gymnosperms (Saxena, 1970; Prasad and Danayak, 1992; Tiwari *et al.*, 1995; Singh *et al*., 2001) and more than 1,111 species of angiosperms with 794 species of dicotyledons and 317 species of monocotyledons (Saxena, 1970; Prasad and Pandey, 1993; Verma *et al*., 1993; Tiwari *et al*., 1995; Mudgal *et al*, 1997; Murti and Panigrahi, 1999; Khanna *et al*., 2001; Chaubey *et al*., 2003; Ved *et al*., 2003). The biosphere reserve shelters 39 globally threatened floral species (categorized as per IUCN) (Anon, 2007, 2009, 2010). For the sake of convenience, the vegetation existing in BR can be grouped as mentioned hereunder.

Fungi:

According to the compiled report on the occurrence of fungi, there are 178 species representing to 109 genera belonging to 47 families distributed in Achanakmar-Amarkanatk biosphere reserve (Anon, 2007, 2009, 2010). Recent collection of literature on this aspect revealed 60 new species of fungi representing to 35 genera belonging to 33 families recorded from sal forests of this biosphere reserve (Table 2) (Soni *et al.*, 2010, 2011; Pyasi *et al.*, 2012), which is a new addition to the fungal composition of Achanakmar-Amarkanatk biosphere reserve. Thus, as per the latest knowledge, a total of 238 species of fungi occurr in Achanakmar-Amarkanatk biosphere reserve.

Table 2. Fungi reported from Achanakmar-Amarkantak biosphere reserve.

Sl. No.	Family	Name of species	Locality	Habitat	Reference
3	Saprolegniaceae	*Achlya debaryana* Hump.	Achanakmar	Sal forest	Soni *et al.* (2011)
4	Pleosporaceae	*Alternaria alternata* Fr. Keissl	Achanakmar	Sal forest	Soni *et al.* (2011)
5	Pleosporaceae	*Alternaria citri* Penz.	Achanakmar	Sal forest	Soni *et al.* (2011)
6	Trichocomaceae	*Aspergillus flavus* Link.	Achanakmar	Sal forest	Soni *et al.* (2011)
7	Trichocomaceae	*Aspergillus fumigates* Fres.	Achanakmar	Sal forest	Soni *et al.* (2011)
8	Trichocomaceae	*Aspergillus niger* Tiegh.	Achanakmar	Sal forest	Soni *et al.* (2011)
9	Trichocomaceae	*Aspergillus terreus* Thom.	Achanakmar	Sal forest	Soni *et al.* (2011)
10	Trichocomaceae	*Aspergillus ustus* Bainier.	Achanakmar	Sal forest	Soni *et al.* (2011)
2	Asterinaceae	*Asterostomella shoreae* Soni, Hosag., Pyasi & R.K. Verma sp. nov.	Achanakmar	Sal forest	Soni *et al.* (2010)
11	Diplocystaceae	*Astraeus hygrometricus* Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
1	Boletaceae	*Boletus fallax* Corner	Amarkantak	Sal forest	Pyasi *et al.*(2012)
13	Botryosphaeriaceae	*Botryodiplodea theobromae* Pat.	Achanakmar	Sal forest	Soni *et al.* (2011)
14	Agaricaceae	*Calvatia elata* (Massee) Morgan	Achanakmar	Sal forest	Soni *et al.* (2011)
15	Chaetomiaceae	*Chaetomium globosus* Kunze ex Fr.	Achanakmar	Sal forest	Soni *et al.* (2011)
17	Mycosphaerellaceae	*Cladosoprium herbarum* Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
18	Mycosphaerellaceae	*Cladosoprium oxysporum* Berk.	Achanakmar	Sal forest	Soni *et al.* (2011)
16	Mycosphaerellaceae	*Cladosporium cladosporioides* Link.	Achanakmar	Sal forest	Soni *et al.* (2011)
19	Glomerellaceae	*Colletotricum dematium* Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
20	Glomerellaceae	*Colletotricum gloeosporioides* (Penz.) Sacc.	Achanakmar	Sal forest	Soni *et al.* (2011)
21	Agaricaceae	*Coprinus aquatilis* Peck.	Achanakmar	Sal forest	Soni *et al.*

					(2011)
22	Atheliaceae	*Corticium rolfsii* Curzi.	Achanakmar	Sal forest	Soni *et al.* (2011)
23	Pleosporaceae	*Curvularia indica* Subram	Achanakmar	Sal forest	Soni *et al.* (2011)
24	Pleosporaceae	*Curvularia lunata* Wakker.	Achanakmar	Sal forest	Soni *et al.* (2011)
25	Pleosporaceae	*Curvularia prasadii* Boedijn	Achanakmar	Sal forest	Soni *et al.* (2011)
26	Pleosporaceae	*Drechslera spicifera* (Bainier) Arx.	Achanakmar	Sal forest	Soni *et al.* (2011)
27	Nectriaceae	*Fusarium concolor* Reinking.	Achanakmar	Sal forest	Soni *et al.* (2011)
28	Nectriaceae	*Fusarium equiseti* (Corda) Sacc.	Achanakmar	Sal forest	Soni *et al.* (2011)
29	Nectriaceae	*Fusarium moniliforme* J. Sheld.	Achanakmar	Sal forest	Soni *et al.* (2011)
30	Nectriaceae	*Fusarium semitectum* Berk.	Achanakmar	Sal forest	Soni *et al.* (2011)
31	Nectriaceae	*Fusarium solani* Sac.	Achanakmar	Sal forest	Soni *et al.* (2011)
33	Geastraceae	*Geastrum fimbriatum* Fr.	Achanakmar	Sal forest	Soni *et al.* (2011)
32	Geastraceae	*Geastrum triplex* Jungh.	Achanakmar	Sal forest	Soni *et al.* (2011)
34	Hypocreaceae	*Gliocladium virens* Corda	Achanakmar	Sal forest	Soni *et al.* (2011)
64	Tubeufiaceae	*Helicosporium phragmitis* Hohn.	Achanakmar	Sal forest	Soni *et al.* (2011)
35	Hysteriaceae	*Lophodermium shoreae* Jamal, Dadwal & Soni	Achanakmar	Sal forest	Soni *et al.* (2011)
36	Marasmiaceae	*Marasmius gordipes* Sacc. & Paol.	Achanakmar	Sal forest	Soni *et al.* (2011)
37	Mucoraceae	*Mucor circinelloides* Tiegh.	Achanakmar	Sal forest	Soni *et al.* (2011)
38	Mycenaceae	*Mycena roseus* Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
39	Trichocomaceae	*Paecilomyces variotii* Banier.	Achanakmar	Sal forest	Soni *et al.* (2011)
40	Trichocomaceae	*Penicillium notatum* Westling.	Achanakmar	Sal forest	Soni *et al.* (2011)
41	Halosphaeriaceae	*Periconia minutissima* Corda	Achanakmar	Sal forest	Soni *et al.* (2011)
42	Amphisphaeriaceae	*Pestalotiopsis versicolor* (Speg.) Steyaert.	Achanakmar	Sal forest	Soni *et al.* (2011)
43	Didymellaceae	*Phoma exigua* Desm.	Achanakmar	Sal forest	Soni *et al.*

					(2011)
44	Didymellaceae	*Phoma macrostoma* Mont.	Achanakmar	Sal forest	Soni *et al.* (2011)
45	Didymellaceae	*Phoma medicaginis* Malbr. & Roum.	Achanakmar	Sal forest	Soni *et al.* (2011)
46	Didymellaceae	*Phoma multirostrata* (P.N. Mathur, S.K. Menon & Thirum.) Dorenb. & Boerema.	Achanakmar	Sal forest	Soni *et al.* (2011)
47	Didymellaceae	*Phoma nebulosa* (Pers.) Berk.	Achanakmar	Sal forest	Soni *et al.* (2011)
48	Pleosporaceae	*Pithomyces cortarum* Berk.	Achanakmar	Sal forest	Soni *et al.* (2011)
49	Mucoraceae	*Rhizopus stolonifer* Enrenb.	Achanakmar	Sal forest	Soni *et al.* (2011)
50	Russulaceae	*Russula emetic* (Schaeff.) Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
51	Sclerodermataceae	*Scleroderma bovista* Fr.	Achanakmar	Sal forest	Soni *et al.* (2011)
52	Sclerodermataceae	*Scleroderma geaster* Fr.	Achanakmar	Sal forest	Soni *et al.* (2011)
53	Sclerodermataceae	*Scleroderma verrucosum* (Bull.) Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
54	Microascaceae	*Scopulariopsis alba* Szilvinyi.	Achanakmar	Sal forest	Soni *et al.* (2011)
59	Hypocreaceae	*Trichoderma harzianum* Rifai.	Achanakmar	Sal forest	Soni *et al.* (2011)
60	Hypocreaceae	*Trichoderma koningii* Oudem.	Achanakmar	Sal forest	Soni *et al.* (2011)
61	Hypocreaceae	*Trichoderma viride* Pers.	Achanakmar	Sal forest	Soni *et al.* (2011)
62	Plectosphaerellaceae	*Verticillium lecanii* Zimm.	Achanakmar	Sal forest	Soni *et al.* (2011)
63	Incertae sedis	*Wiesneriomyces javanicus* Koord.	Achanakmar	Sal forest	Soni *et al.* (2011)

Lichens:

Luxuriant growth of lichens is generally observed in Achanakmar-Amarkanatk biosphere reserve, due to pure sal forests. Earlier reports exhibited 130 species of lichens representing 44 genera belonging to 25 families (Anon, 2007, 2009, 2010). The fragmented literature indicated the existence of 54 new species of lichens (Shukla and Singh, 2011, 2012)

representing 24 genera belonging to 9 families from Achanakmar-Amarkantak biosphere reserve (Table 3) resulting in a total of 184 species.

Table. 3. Lichens reported from Achanakmar-Amarkanatak biosphere reserve.

Sl. No	Family	Name of species	Locality	Habitat	Status	Reference
1	Arthoniaceae	*Arthothelium chiodectoides* (Lyn.) Zahlbr	Sambhudhara	Tree bark	-	Shukla and Singh (2012)
2	Arthoniaceae	*Arthothelium saxicolum* Makhija & Patw	Sonemuda, Mai-Ki-Bagia	Rock	Endemic	Shukla and Singh (2012)
3	Coccocarpaceae	*Coccocarpia palmicola* (Spreng.) Arv. & D.J. Galloway	Kabirchabutra	Tree bark, leaves, rock, soil	-	Shukla and Singh (2012)
4	Collemataceae	*Collema nigrescens* (Huds) Lamarck & Decandolle	Kabirchabutra	Tree bark	-	Shukla and Singh (2012)
5	Collemataceae	*Leptogium asiaticum* M. Jorg, Harzogia	Dhunipani	Tree bark	-	Shukla and Singh (2011, 2012)
6	Lecanoraceae	*Lecanora argentata* (Ach.) Degel	Forest medicinal Garden	Tree bark	-	Shukla and Singh (2012)
7	Lecanoraceae	*Lecanora varia* (Hoffm) D.D. Awasthi & Srivastava	Jagatpur, karanjia	Tree bark and rock	Rare	Shukla and Singh (2011, 2012)
8	Letrouitiaceae	*Letrouitia domingensis* (Pers.) Hefellner & Bellem	Durgadhara	Tree bark	-	Shukla and Singh (2012)
9	Parmeliaceae	*Canoparmelia cinerascens* (Lynge) Elix & Hale	Jagatpur, Karnjia, Tikaritola, Jamunadadar, Sambhudhar, Panchdhara	Tree bark	Common	Shukla and Singh (2011, 2012)
10	Parmeliaceae	*Canoparmelia crozalsiana* (de Lesd) Elix & Hale	Sambhudhara,	Tree bark and rock	-	Shukla and Singh (2011, 2012)
11	Parmeliaceae	*Canoparmelia eruptens* (Kurok) ELix & Hale	Amanala, Jaleswar	Tree bark	-	Shukla and Singh (2012)
12	Parmeliaceae	*Hypotrachyna awasthii*, Hale &	Jamunadader, Tikaritola,	Tree bark	Endemic	Shukla and Singh (2011,

		Patw.	Near Nrmada temple,			2012)
13	Parmeliaceae	*Hypotrachyna crenata* (Kurok) Hale	Karanjia	Tee bark and rock	-	Shukla and Singh (2011, 2012)
14	Parmeliaceae	*Myelochroa aurulenta* (Tuck.) Elix & Hale	Near Nrmada temple,	Tree bark and rock	-	Shukla and Singh (2012)
15	Parmeliaceae	*Parmelinopsis cryptochlora* (Vain.) Elix & Hale	Helipad Forest area.	Tree bark	-	Shukla and Singh (2012)
16	Parmeliaceae	*Parmotrema rampoddense* (Nyl.) Hale & D.D. Awasthi	Panchdhara	Tree bark	-	Shukla and Singh (2012)
17	Parmeliaceae	*Parmotrema saccatilobum* (Taylor) Hale & D.D. Awasthi	Sambhudhara, Jamunadader, Mai-Ki bagia	Tree bark	-	Shukla and Singh (2011, 2012)
18	Parmeliaceae	*Phyllopsora coralline* (Eschw.) Mull. & D.D. Awasthi	Near Narmada Temple	Tree bark	-	Shukla and Singh (2012)
19	Pertusariaceae	*Ochrolechia androgyna* (Hoffm.) D.D. Awasthi & Tiwari	Karanjia	Tree bark	-	Shukla and Singh (2012)
20	Pertusariaceae	*Pertusaria colorata* D.D Awasthi & Srivast	Jamunadader	Tree bark	-	Shukla and Singh (2011, 2012)
21	Pertusariaceae	*Pertusaria depressa* (fee) Mont. & v.d. Bosch	Sonemuda	Tree bark	-	Shukla and Singh (2011, 2012)
22	Pertusariaceae	*Pertusaria granulate* (Ach) Mull . Arg.	Panchdhara, Sonemuda, Jamunadader, Dhunipani, Tikaritola	Tree bark	-	Shukla and Singh (2011, 2012)
23	Pertusariaceae	*Pertusaria leucosora* (Nyl.) D.D. Awasthi	Sambhudhara	Rock	-	Shukla and Singh (2012)
24	Pertusariaceae	*Pertusaria leucosorodes* Nyl	Sambhudhara	Tree bark	-	Shukla and Singh (2011, 2012)
25	Pertusariaceae	*Pertusaria leucostoma* (Bernh.) A. Massal. & Ric. Auton	Karanjia	Tree bark	-	Shukla and Singh (2012)
26	Pertusariaceae	*Pertusaria neilgherrensis*(Mull.	Tikaritola, Karanjia	Tree bark	-	Shukla and Singh (2011,

		Arg.) D.D Awasthi & Srivast				2012)
27	Pertusariaceae	*Pertusaria pertusa* (Weig.) Tuck.	Sonemuda, Dhunipani, Sambhudhara	Tree bark	-	Shukla and Singh (2011, 2012)
28	Pertusariaceae	*Pertusaria tetrathalmia* (Fee) Nyl. D.D. Awasthi	Panchdhara, Karanjia, Sonemuda	Tree bark	-	Shukla and Singh (2012)
29	Pertusariaceae	*Pertusaria tuberculifera* Nyl	Sonemuda, Dhunipani, Tikaritola, Jagatpur, Karanjia	Tree bark	Common	Shukla and Singh (2011)
30	Physciacae	*Amandinea diorista* (Nyl.) Marbach	Forest medicinal Garden	Tree bark	-	Shukla and Singh (2012)
31	Physciacae	*Amandinea Montana* (H. Magn.) Marbach	Jagatpur	Tree bark	-	Shukla and Singh (2012)
32	Physciacae	*Amandinea punctata* (Hoffm.) Coppins & Scheid.	Jagatpur	Tree bark	-	Shukla and Singh (2012)
33	Physciacae	*Buellia betulinoides* R. Schub. & Klement	Forest medicinal Garden	Tree bark	-	Shukla and Singh (2012)
34	Physciacae	*Buellia disciformis* (Fr.)Mudd	Jagatpur, Karanjia	Tree bark	-	Shukla and Singh (2011)
35	Physciacae	*Buellia inornata* Nyl	Sonemuda, Sambhudhara, Panchdhara	Tree bark	-	Shukla and Singh (2011)
36	Physciacae	*Buellia Montana* H. Magn.	Jagatpur	Tree bark	-	Shukla and Singh (2011)
37	Physciacae	*Buellia punctata* (Hoffm.) Massal.	Karanjia, Jagatpur, Panchdhara	Tree bark	-	Shukla and Singh (2011)
38	Physciacae	*Buellia quartziana* S. R. Singh & D. D. Awasthi	Sambhudhara	Tree bark	Endemic	Shukla and Singh (2012)
39	Physciacae	*Cratiria obscurior* Marbach & Kalb	Sambhudhara	Tree bark	-	Shukla and Singh (2012)
40	Physciacae	*Dirinaria applanata* (fee) D.D.Awasthi	Karanjia, Dhonipani, Jamnuadadar, Antaria, Lamni, Jalda, Panchdhara, Jagatpur	Tree bark	Common	Shukla and Singh (2011, 2012)

41	Physciacae	*Hafellia disciformis* (Fr.) Marbach & H. Mayrhofer	Jagatpur, Karanjia	Tree bark	-	Shukla and Singh (2012)
42	Physciacae	*Heterodermia albidiflava* (Kurok) D.D. Awasthi	Panchdhara	Tree bark	-	Shukla and Singh (2012)
43	Physciacae	*Heterodermia boryi* (Fee) Kr. P. Singh & S.R. Singh	Sambhudhara	Tree bark and soil	-	Shukla and Singh (2012)
44	Physciacae	*Heterodermia dactyliza* (Nyl.) Swinsc. & Krog	Karanjia	Tree bark and rock	-	Shukla and Singh (2011, 2012)
45	Physciacae	*Heterodermia leucomela* (L.) Poelt	Sambhudhara	Tree bark	-	Shukla and Singh (2011)
46	Physciacae	*Heterodermia rubescens* (Rasanen) D.D. Awasthi	Panchdhara, Tikaritola	Tree bark and rock	-	Shukla and Singh (2011, 2012)
47	Physciacae	*Heterodermia tremulans* (Mull. Arg.) W.L. Culb.	Amarkantak Heliped area	Tree bark, soil and rock	-	Shukla and Singh (2012)
48	Physciacae	*Phaeophyscia endococcina* (Korb.) Moberg & D.D. Awasthi	Near Nrmada temple	Tree bark and rock	-	Shukla and Singh (2012)
49	Physciacae	*Physcia tribacia* (Ach.) Nyl. D.D. Awasthi	Sambhudhara	Tree bark and rock	-	Shukla and Singh (2012)
50	Physciacae	*Pyxine meissnerina* Nyl. Bull. & D.D. Awasthi	Near Nrmada temple	Tree bark	-	Shukla and Singh (2012)
51	Physciacae	*Pyxine sorediata* (Ach.) Mont. & D.D. Awasthi	Mai-Ki-Bagia	Tree bark and rock	-	Shukla and Singh (2012)
52	Teloschistaceae	*Caloplace flavorubescens* (Hudson) J. Laundon	Jamunadader, Sambhudhara	Tree bark and rock	-	Shukla and Singh (2011, 2012)
53	Teloschistaceae	*Caloplace malaensis* (Rasanen) D.D. Awasthi	Sonemuda	Tree bark	-	Shukla and Singh (2011, 2012)
54	Teloschistaceae	*Caloplaca vitellinula* (Nyl.) H. Oliver & D.D. Awasthi	Kapildhara	Rock	-	Shukla and Singh (2012)

Bryophytes

The bryophytes are multicellular species that grow on rocks, soil or even on bark of standing trees. In all, 16 species of bryophytes belonging to 11 genera and 9 families are known from the biosphere reserve (Anon, 2007, 2009). The literature collected on this aspect revealed the existence of 28 new species of bryphytes (Tiwari *et al*., 1995; Anon, 2010) representing 22 genera belonging to 11 families from Achanakmar-Amarkantak biosphere reserve (Table 4) resulting in a total of 44 species.

Table 4. Bryophytes reported from Achanakmar-Amarkantak biosphere reserve.

Sl.No	Family	Name of species	Distribution	Habitat	Reference
1	Brachytheciaceae	*Rhynchostegium celebicum*	-	Soil	Tiwari *et al*. (1995)
2	Bryaceae	*Brachymenium exile*	Amarkantak	Rock	Tiwari *et al*. (1995)
3	Bryaceae	*Bryum capillare*	Amarkantak	Soil	Tiwari *et al*. (1995)
4	Bryaceae	*Pohlia gedeana*	Amarkantak	Rock	Tiwari *et al*. (1995)
5	Calymperaceae	*Octoblepharum albidum*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
6	Entodontaceae	*Entodon rubicundus*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
7	Entodontaceae	*E. scariosus*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
8	Entodontaceae	*Erythrodontium julaceum*	Kabirchabutra, Amarkantak	Tree bark	Tiwari *et al*. (1995)
9	Fabroniaeae	*Levierella fabroniacea*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
10	Fissidentacea	*Fissidens involutus*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
11	Fissidentacea	*F. subpulchellus*	Kabirchabutra	Rock	Tiwari *et al*. (1995)
12	Hypnaceae	*Bryosedgwickia aurea*	Kabirchabutra, Amarkantak	Tree bark	Tiwari *et al*. (1995)
13	Hypnaceae	*Ectropothecium cygnicollum*	Kabirchabutra, Amarkantak	Rock	Tiwari *et al*. (1995)
14	Hypnaceae	*Hypnum aduncoides*	Amarkantak	Tree bark and soil	Tiwari *et al*. (1995)
15	Hypnaceae	*Isopterygium micans*	Amarkantak	Rock and soil	Tiwari *et al*. (1995)
16	Hypnaceae	*Pseudotaxiphy elegans*	Kabirchabutra, Amarkantak	Soil and rock	Tiwari *et al*. (1995)
17	Hypnaceae	*Taxiphyllum giraldii*	Amarkantak	Soil	Tiwari *et al*. (1995)
18	Leskeaceae	*Herpetineuron*	Amarkantak	Tree bark	Tiwari *et al*. (1995)

		toccoae		and rock	
19	Pottiaceae	*Anoectangium clarum*	Amarkantak	Wall	Tiwari *et al*. (1995)
20	Pottiaceae	*Hyophila involuta*	Amarkantak	Soil and rock	Tiwari *et al*. (1995)
21	Racopilaceae	*Racopilum orthocapum*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
22	Stereophyllaceae	*Entodontopsis leucostega*	Amarkantak	Tree bark and rock	Tiwari *et al*. (1995)
23	Stereophyllaceae	*Entodontopsis anceps*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
24	Stereophyllaceae	*E. nitens*	Kabirchabutra, Amarkantak	Tree bark	Tiwari *et al*. (1995)
25	Thuidiaceae	*Thuidium koelzii*	Amarkantak	Rock	Tiwari *et al*. (1995)
26	Thuidiaceae	*T. investe*	Kabirchabutra	Rocks and stem bark	Tiwari *et al*. (1995)
27	Thuidiaceae	*T. kiasense*	Amarkantak	Tree bark	Tiwari *et al*. (1995)
28	Thuidiaceae	*Trachyphyllum infecxum*	Amarkantak	Soil, rock and Tree bark	Tiwari *et al*. (1995)

Pteridophytes

The biosphere reserve is rich in fern flora and many of them are threatened due to their over exploitation or habitat loss. Out of nearly 102 species of ferns existing in Chhattisgarh and Madhya Pradesh, 40 species belonging to 27 genera under 22 familes are reported from Achanakmar-Amarkantak biosphere reserve. The recent literature exhibited the existence of 9 new species of ferns (Shukla and Singh, 2009; Singh and Singh, 2013 representing 8 genera belonging to 5 families from Achanakmar-Amarkantak biosphere reserve (Table 5) resulting in a total of 53 species.

Table 5. Pteridophytes reported from Achanakmar-Amarkantak biosphere reserve.

Sl. No.	Family	Name of species	Locality	Habitat	Reference
1	Athyriaceae	Diplazium macrocarpa (Bory ex Willd.) kaulf.	-	Along water courses and moist places	Shukla and Singh (2009)
2	Davalliaceae	*Nephrolepis cordifolia* (L.) C. Presl	-	-	Singh and Singh (2013)
3	Davalliaceae	*Nephrolepis exaltata*	Sonemuda	Along streams	Shukla and

		(L.) Schott.			Singh (2009)
4	Polypodiaceae	*Pleopeltis macrocarpa* (Bory ex Willd.) Kaulf.	-	-	Singh and Singh (2013)
5	Polypodiaceae	*Lepisorus nudus* (Hook.) ching	Along Narmada river	Epiphytes on tree trunks and branches	Shukla and Singh (2009)
6	Polypodiaceae	*Leptochilus axillaris* (Cav.) Kaulf.	Kapildhara	Creeping on wet rocks	Shukla and Singh (2009)
7	Pteridaceae	*Actiniopteris radiata* (Sw.) Link	Kapildhara	-	Singh and Singh (2013)
8	Thelypteridaceae	*Christella dentata* (Forssk) Brown. et Jermy.	Rudraganga	Along ravines in the edge of flowing water	Shukla and Singh (2009)
9	Thelypteridaceae	*Pseudocyclosorus falcilobus* (Hook.)	Sonemuda	Forest floor	Shukla and Singh (2009)

Angiosperms

The angiosperms are flowering plants having seeds protected within fruits. They are divided into two classes called monocotyledoneae having one cotyledon and dicotyledoneae having two cotyledons.

Monocots

It has already been reported that there are 317 species of monocotyledons belonging to 143 genera under 29 families widely distributed in Achanakmar-Amarkantak biosphere reserve (Anon, 2007b, 2009, 2010). Most of them are common excepting a few rare species or planted. The information collected on this aspect revealed the occurrence of 18 new species of monocot plants representing 16 genera (Anon, 2012) belonging to one family Poaceae from Achanakmar-Amarkantak biosphere reserve (Table 6) (Fig. 4) resulting in a total of 335 species.

Table 6. Monocotyledonous flora reported from Achanakmar-Amarkantak Biosphere Reserve

Sl.No	Species Name	Locality/ Habitat	Status	Reference
1	*Arundinella bengalensis* (Spreng)	Outskirts of forests		Shukla *et al*. (2009), Singh *et al.* (2001)
2	*Arthraxon hispidus* (Thunb.) Makino	Forest valleys, along stream banks,	Common	Sexena (1970) Shukla *et al*. (2009), Singh *et al.*

		Shambhudhara		(2001)
3	*Avena sativa* L.		Cultivated	Shukla *et al*. (2009), Singh *et al.* (2001)
4	*Brachiaria eruciformis* (Sm.) Griseb.	Wasteplaces, Atariya, Mai Ki Bagia, Lamni		Shukla *et al.* (2009)
5	*Brachiaria ramosa* (L.) Stapf	Roadsides and outskirts of forests		Saxena (1970), Shukla *et al*. (2009)
6	*Coelorachis clarkei* (Hack.) Blatt. & McCann, J.	Along roadsides, Damgarh, Amadob, Kapildhara	Rare	Saxena (1970) Shukla *et a.*(2009), Singh *et al.* (2001)
7	*Coix aquatica* Roxb.	Along stream banks, Achanakmar	-	Shukla *et al.* (2009)
8	*Dinebra retroflexa* Paz., Denkschr.	In wastelands, Karanjiya	-	Shukla *et al* .(2009), Singh *et al*. (2001)
9	*Echinochloa crusgalli* (L.) P.Beauv	Along river and stream banks, Ramnagar	-	Shukla *et al.* (2009), Singh *et al*. (2001)
10	*Echinochloa frumentacea* Link, Hort.	Atariya	Cultivated	Shukla *et al.* (2009), Singh *et al*. (2001)
11	*Oropetium roxburghianum* (Steud.) S.M. Phillips	Amarkantak	-	Shukla *et al.* (2009), Singh *et al*. (2001)
12	*Panicum brevifolium* L.	Lamni	Cultivated	Shukla *et al.* (2009), Singh *et al*. (2001)
13	*Paspalum distichum L.*	Marshy places	Common	Saxena (1970), Murti and Panigrahi (1999), Shukla *et al.* (2009), Singh *et al*. (2001)
14	*Phalaris minor* Retz.	Weed in cultivated fields	Common	Shukla *et al*. (2009), Singh *et al*. (2001)
15	*Polypogon monspeliensis* (L.) Desf.	Moist and shady places, along Narmada river	Common	Shukla *et al*. (2009)
16	*Sporobolus tenuissimus* (Schrank) Kuntze	Along water courses and wasteplaces, Atariya	-	Shukla *et al*. (2009), Singh *et al.* (2001)
17	*Triticum aestivium* L.	Cultivated	Cultivated	Shukla *et al.* (2009), Singh *et al*. (2001)
18	*Zea mays* L.	Cultivated Ramnagar	Cultivated	Shukla *et al*. (2009), Singh *et al*. (2001)

Dicot

Previous reports exhibited 794 species of dicotyledonous flora representing 448 genera belonging to 106 families (Anon, 2007, 2009, 2010). Recent literature indicated the

Bothriochloa pertusa

Cyprus rotundus

Dandrocalamus strictus

Eragrostis tenuifolia

Setaria pumila

Thysanolaena maxima

Fig. 4. Grasses of Achanakmar-Amarkantak biosphere reserve

existence of 67 new species of dicot plants (Shukla and Singh, 2010; 2012 representing 60 genera belonging to 41 families from Achanakmar-Amarkantak biosphere reserve (Table 7) (Fig. 5) resulting in a total of 861 species.

Table 7. Dicotyledonous flora reported from Achanakmar-Amarkantak biosphere reserve.

Sl.No.	Family	Name of Species	Locality	Reference
1	Sterculiaceae	*Abroma augusta* (L.) L.f.	Amarkantak	Shukla and Singh (2010)
2	Amaranthaceae	*Alternanthera paronychioides* (St. Hill.)	Antaria	Shukla and Singh (2012)
3	Zingiberaceae	*Alpinia calcarata* Roscore	Antaria	Shukla and Singh (2012)
4	Amaranthaceae	*Alternanthera paronychioides* St. Hill	Rajendragram	Shukla and Singh (2012)
5	Convolvulaceae	*Argyreia nervosa* (Burm.F.) Boj.	Amarkantak	Shukla and Singh (2012)
6	Convolvulaceae	*Argyreia sericea*, Dazell & Gibson	Antaria	Shukla and Singh (2012)
7	Scrophulariaceae	*Bacopa floribunda* (R.. Br.) Wettst.	Along Narmada river	Shukla and Singh (2012)
8	Iridaceae	*Belamcanda chinensis* (L.) DC.	Kabir	Shukla and Singh (2012)
9	Cucurbitaceae	*Bryonopsis laciniosa* (L.) Naud.	Lamni	Shukla and Singh (2012)
10	Verbenaceae	*Caryopteris bicolor* (Roxb. ex. Hardw.) Mabb.	Amarkantak	Shukla and Singh (2012)
11	Flacourtiaceae	*Casearia tomentosa* Roxb.	Tharpathar	Shukla and Singh (2012)
12	Caesalpiniaceae	*Cassia sophera* (L)	Amarkantak	Shukla and Singh (2012)
13	Chenopodiaceae	*Chenopodium murale* (L.)	Antaria	Shukla and Singh (2012)
14	Verbenaceae	*Clerodendrum philippinum* (Schauer)	Mai-Ki-Bagia	Shukla and Singh (2012)
15	Verbenaceae	*Clerodendrum phlomides* (L.f.)	Amarkantak	Shukla and Singh (2012)
16	Verbenaceae	*Clerodendrum splendens*, G. Don ex James	Chaparwa	Shukla and Singh (2012)
17	Brassicaceae	*Cochlearia cochleariodes* (Roth) R. Sant. &Maheshw.	Sonemuda	Shukla and Singh (2012)
18	Combretaceae	*Combretum roxburghii*, Spreng.	Jalda	Shukla and Singh (2012)
19	Nyctaginaceae	*Commicarpus chinensis* (L.) Heimerl	Karanjia	Shukla and Singh (2012)
20	Tilliaceae	*Corchorus capsularis* L.	Kuba	Shukla and Singh

				(2012)
21	Boraginaceae	*Cordia oblique*, Willd.	Dhunipani	Shukla and Singh (2012)
22	Fabaceae	*Crotalaria bialata* Schrank	Ramnagar	Shukla and Singh (2012)
23	Fabaceae	*Crotalaria juncea* L.	Karanjia	Shukla and Singh (2012)
24	Boraginaceae	*Cynoglossum wallichi*, G. Don	Jamunadader	Shukla and Singh (2012)
25	Solanaceae	*Datura innoxa* Mill.	Jaleshwar	Shukla and Singh (2012)
26	Fabaceae	*Desmodium laxiflorum* DC	Kabir Chabutra	Shukla and Singh (2012)
27	Dioscoreaceae	*Dioscorea glabra* Roxb.	Sonemuda	Shukla and Singh (2012)
28	Verbenaceae	*Duranta erecta* L.	Rudraganga	Shukla and Singh (2012)
29	Acanthaceae	*Eranthemum pulchellum* Andrews	Rudraganga	Shukla and Singh (2012)
30	Apiaceae	*Eryngium foetidum*	Sambhudhara	Shukla and Singh (2010)
31	Euphorbiaceae	*Euphorbia nivulia* Buch.-Ham	Damgarh	Shukla and Singh (2012)
32	Molluginaceae	*Glinus latoides* L.	Birarpani	Shukla and Singh (2012)
33	Tiliaceae	*Grewia abutilifolia* Vent. ex Juss.	Panchdhara	Shukla and Singh (2012)
34	Tiliaceae	*Grewia eriocarpa* Juss.	Laxmandhara	Shukla and Singh (2012)
35	Hypericaceae	*Hypericum gaitii* Haines	Chaparwa	Shukla and Singh (2012)
36	Convolvulaceae	*Jacquemontia paniculata* (Burm. f.) Hall.f.	Amarkantak	Shukla and Singh (2012)
37	Euphorbiaceae	*Jatropha integerrima* Jacq.	Antaria	Shukla and Singh (2012)
38	Juncaceae	*Juncus bufonius* L.	Baratinala	Shukla and Singh (2012)
39	Acanthaceae	*Justicia latispica* Gamble	Antaria	Shukla and Singh (2012)
40	Onagraceae	*Ludwigia hyssopifolia* (G. Don) Exell	Panchdhara	Shukla and Singh (2012)
41	Malvaceae	*Malachra capitata* (L.) L.	Achanakmar	Shukla and Singh (2012)
42	Fabaceae	*Medicago polmorpha* L.	Along Narmada river	Shukla and Singh (2012)
43	Nymphaeaceae	*Nymphaea rubra* Roxb. ex Andrews	Kota	Shukla and Singh (2012)
44	Lamiaceae	*Ocimum americanum* L.	Antaria	Shukla and Singh

				(2012)
45	Lamiaceae	*Ocimum basilicum* L.	Mai-Ki-Bagia	Shukla and Singh (2012)
46	Lamiaceae	*Ocimum gratissimum* L.	Karanjia	Shukla and Singh (2012)
47	Oxalidaceae	*Oxalis dehradunesis* Raizada	Along Narmada river	Shukla and Singh (2012)
48	Pandanaceae	*Pandanus odoratissimus* L.f.	Dhunipani	Shukla and Singh (2012)
49	Asteraceae	*Phyllocephalum indicum* (Less.) Kirkman	Antaria	Shukla and Singh (2012)
50	Piperaceae	*Piper longum* L.	Rudraganga	Shukla and Singh (2012)
51	Polygalaceae	*Polygala crotalariodes* Buch.- Ham. ex DC.	Kabir	Shukla and Singh (2012)
52	Portulacaceae	*Portulaca quardrifida* L.	Antaria	Shukla and Singh (2012)
53	Amaranthaceae	*Psilotrichum ferrugineum* (Roxb.) Moq.	Karanjia	Shukla and Singh (2012)
54	Euphorbiaceae	*Putranjiva roxburghii* Wall.	Lamni	Shukla and Singh (2012)
55	Fabaceae	*Rhynchosia rothii* Benth. ex. Aitch	Ramnagar	Shukla and Singh (2012)
56	Apocynaceae	*Rauwolfia tetraphylla* L.	Kapildhara	Shukla and Singh (2010)
57	Solanaceae	*Solanum torvum* Sw.	Laxmandhara	Shukla and Singh (2012)
58	Rubiaceae	*Spermacoce pusilla* Wall.	Along Narmada	Shukla and Singh (2012)
59	Asteraceae	*Spilanthes calva* DC.	Kuba	Shukla and Singh (2012)
60	Verbenaceae	*Stachytarpheta jamaicensis* (L.) Vahi.	Antaria	Shukla and Singh (2012)
61	Fabaceae	*Tephrosia pumila* (Lam.) Pers.	Antaria	Shukla and Singh (2012)
62	Menispermaceae	*Tinospora cardifolia* (Willd.) Miers	Amarkantak	Shukla and Singh (2012)
63	Zygophyllaceae	*Tribulus terrestris* L.	Antaria	Shukla and Singh (2012)
64	Typhaceae	*Typha angustifolia* L.	Barighat	Shukla and Singh (2012)
65	Fabaceae	*Vigna subramanianus* (Babu ex Raizada) Raizada	Karangia	Shukla and Singh (2012)
66	Verbenaceae	*Vitex leucoxylon* L.f.	Tharpather	Shukla and Singh (2012)
67	Solanaceae	*Withania somnifera* (L.) Dunal	Near forest garden Amarkantak	Shukla and Singh (2012)

Shorea robusta

Tectona grandis

Pterocarpus marsupium

Dalbergia sissoo

Terminalia tomentosa

Terminalia chebula

Fig. 5. Tree species of Achanakmar-Amarkantak biosphere reserve

Faunal resources

The faunal resources of Acanakmar-Amarkantak biosphere reserve are very rich and varied. It comprises of 324 species of identified fauna (Anon, 2010), out of which 114 species belong to invertebrate and 210 species belong to vertebrate (Anon, 2008). Among the invertebrates, 5 species belong to Chilopoda (Khanna, 2006), 84 species belong to Lepidoptera (49 butterflies and 35 moths) (Gupta and Mondal, 2005; Singh and Chandra, 2008; Chandra *et al*., 2006; Roychoudhury *et al*., 2007), 24 species belong to Coleoptera (Roychoudhury *et al*., 2004; Joshi *et al*., 2006; Anon, 2008) and only one species belongs to Orthoptera (Chandra and Gupta, 2005). Among the vertebrates, 16 species belong to Pisces (Chandra, 2006), 10 species belong to Amphibia (Das and Chandra, 1997; Chandra and Pandey, 2004; Chandra, 2006b), 15 species belong to Reptilia (Kalaiarasan *et al*., 1991; Chandra and Pandey, 2005; Chandra, 2006b), 142 species belong to Aves (Ali, 1946, 1996; Tiwari, 1997; Chandra, 2006b) and 27 species belong to Mammalia (Tiwari *et al*., 1995, Tiwari, 1997; Harshey and Chandra, 2001, Chandra, 2006b; Akthtar and Chauhan, 2007). Among fauna, there are 2 critically endangered species, viz. *Philautus sanctisilvaticus* (Amphibia: Hylidae), *Gyps bengalensis* (Aves: Accipitridae) and 2 endangered fauna, viz. *Notopterus chitala* (Pisces: Notopteridae), *Panthera tigris* (Mammalia: Felidae) besides, 51 low risk to vulnerable species as per IUCN categorization (Anon, 2010). The area of the BR has a known habitat for animals like tiger, bison, bear, spotted deer, barking deer, panther, wild cat, fox, wild dog, sambhar, four horned antelope, mouse deer, etc (Anon, 2008). It has rugged terrain as well as grasslands giving shelter to wildlife in all seasons. Rich dense forests dominated by sal and its associates give way to high precipitation further enhancing and promoting moist habitat and supported plant diversity.

Among the fauna, the perusal of recent literature revealed only 15 species of beetles (Coleoptera : Scarabaeidae) as new addition to the insect faunal composition of Acanakmar-Amarkantak biosphere reserve (Table 8) (Chandra and Gupta, 2012). Earlier, 26 species of beetles have already been reported (2008, 2009, 2010). Thus, as per the latest knowledge, a total of 41 species of beetles occurr in Achanakmar-Amarkanatk biosphere reserve.

Table 8. Beetles reported from Achanakmar-Amarkantak biosphere reserve.

S.No.	Family	Name of species	Locality	Reference
1	Scarabaeidae	*Adoretus bicolar* Brenske	Atariya, Chhaparwa	Chandra and Gupta (2012)
2	Scarabaeidae	*Alissonotum simile* Arrow	Atariya, Chhaparwa	Chandra and Gupta (2012)
3	Scarabaeidae	*Anomala bengalensis* (Blanchard)	Atariya, Chhaparwa	Chandra and Gupta (2012)
4	Scarabaeidae	*Anomala cantori* (Hope)	Chhaparwa	Chandra and Gupta (2012)
5	Scarabaeidae	*Anomala polita* (Blanchard)	Atariya, Chhaparwa	Chandra and Gupta (2012)
6	Scarabaeidae	*Anomala* spp.	Chhaparwa	Chandra and Gupta (2012)
7	Scarabaeidae	*Anomala varicolor* (Gyllenhal)	Atariya, Chhaparwa	Chandra and Gupta (2012)
8	Scarabaeidae	*Apogonia proxima* Waterhouse	Chhaparwa	Chandra and Gupta (2012)
9	Scarabaeidae	*Heteronychus lioderes* Redtenbacher	Chhaparwa	Chandra and Gupta (2012)
10	Scarabaeidae	*Holotrichia sculpticollis* Blanchard	Chhaparwa	Chandra and Gupta (2012)
11	Scarabaeidae	*Mimela macleayana* (Vigors)	Chhaparwa	Chandra and Gupta (2012)
12	Scarabaeidae	*Oxycetonia versicolor* (Febricius)	Chhaparwa	Chandra and Gupta (2012)
13	Scarabaeidae	*Popillia laevis*, Burmeister	Chhaparwa	Chandra and Gupta (2012)
14	Scarabaeidae	*Schizonycha ruficollis* (Fabricius)	Atariya	Chandra and Gupta (2012)
15	Scarabaeidae	*Xylotrupes gideon* (Linnaeus)	Chhaparwa	Chandra and Gupta (2012)

Socio-economic studies

Indigenous traditional knowledge plays an important role in sustainable development and enhancement of socio-economic status of tribal peoples. Singh *et al*. (2004) have reported ethnomedicinal and indigenous knowledge of pteridophytes, *Dryopteris cochleata* and *Tectaria coadunate* among the tribal communities of Achanakmar-Amarkantak biosphere reserve. Singh and Dixit (2005) have identified and reported ethnomedicinal vaule of 22 species of pteridophytes in Achanakmar-Amarkantak biosphere reserve. Singh *et al*. (2005)

have reported ethnomedicinal usage of eight pteridophytes by the local tribes of Achanakmar-Amarkantak biosphere reserve. Tiwari and Bharat (2008) have studied 33 natural dye-yielding plants and indigenous knowledge of dye preparation in Achanakmar-Amarkantak biosphere reserve. Bondya *et al*. (2009) have collected information on exploitation of 47 ethno-medicinal plants and their marketing status in Achanakmar-Amarkantak biosphere reserve. Bhat and Tiwari (2011) have collected indigenous knowledge of six communities of Achanakmar-Amarkantak biosphere reserve on utilization, conservation and sustainability of 36 species of NTFP. Singh *et al*. (2011) have documented utilization of 26 tree species by local inhabitants of Achanakmar-Amarkantak biosphere reserve. Sahu (2011) has reported 20 plants species used by Gond and Baiga women in ethnogynaecological disorder in Achanakmar-Amarkantak biosphere reserve. Kapale (2012) has documented 55 forest plant species with their different uses Baiga tribes in Achanakmar-Amarkantak biosphere reserve. Malviya *et al*. (2012) has studied antibacterial activity of five ethnomedicinal plants of Achanakmar-Amarkantak biosphere reserve. Shukla *et al*. (2012) have reported applications and uses of 10 threatened medicinal plants of Achanakmar-Amarkantak biosphere reserve. Based on the above information, a long list of 184 species of plants consisting of 24 species of pteridophytes and 160 species of angiosperms showing the ethnobotanical and ethnomedicinal uses are presented in table 9.

Table 9. Ethnobotanical and ethnomedicinal uses of pteridophytic and angiospermic plant species reported from Achanakmar-Amarkantak biosphere reserve.

Sl. No.	Name of Species	Local Name	Family	Useful part	Uses	Reference
Pteridophyte						
1	*Adiantum capillus-veneris* L.	Hansraj	Adiantaceae	Whole plant	Medicine	Bondya *et al*. (2009)
2	*Adiantum philippense* (L)	Kalijhant	Adiantaceae	Root and Leaf	Medicine	Kapale (2012)
3	*Dryopteris cochleata* (D. Don) C. Chr.	Bhanki	Aspidiaceae	Rhizome	Medicine	Singh *et al.* (2004, 2005), Bondya *et al.* (2009)
4	*Dryopteris* sp.	Jatasankari	Aspidiaceae	Root and leaf	Medicine	Kapale (2012)
5	*Tectaria*	Jata Shankri	Aspidiaceae	Rhizome,	Medicine	Singh *et al.*

	coadunata (Wall. ex Hook. et Grev.) C. Chr.			stem and stripe		(2004, 2005), Bondya *et al.* (2009), Kapale (2012)
6	*Bechnum orientale* L.	Hastajori	Blechnaceae	Leaves	Medicine	Singh *et al.* (2005)
7	*Alsophila balakrishnanii* (Dixit et Tripathi) R.D. Dixit	Jatamanshi	Cyatheaceae	Roots	Medicine	Singh *et al* (2005), Bondya *et al.* (2009)
8	*Nephrolepis exaltata* (L.)Schott.	Fish bone fern	Davalliaceae	Rhizome	Medicine	Singh *et al* (2004, 2005)
9	*Nephrolepis cordifolia* (L.)C.Presl.	Nechii	Davalliaceae	Rhizome	Medicine	Singh *et al.* (2004, 2005)
10	*Dryopteris cochleata* (D.Don) C.Chr.	Jatashankari	Dryopterida-ceae	Rhizome, stem and stripe	Medicine	Singh *et al.* (2004), Singh *et al* (2005)
11	*Equisetum ramossissimum* Desf. Ssp. *debile* (Roxb. Ex Vauch) Hauch	Hadjod	Equisetaceae	Rhizome	Medicine	Singh *et al.* (2004) Singh *et al* (2005), Singh and Dixit (2005)
12	*Lygodium flexuosum* (L.) Sw.	Indrajau Kalijar	Lygodiaceae	Roots Leaf and Stem	Medicine	Bondya *et al.* (2009), Singh *et al.* (2005), Kapale (2012)
13	*Marsilea spp*.	Pan bhajee	Marsileaceae	Leaves	Vegetable	Kapale, 2012
14	*Ophioglossum reticulatum* L.	Van palak	Ophiglossa-ceae	Fresh leaves	Medicine	Singh *et al.* (2005)
15	*Pleopeltis macrocarpa* (Bory ex Willd.) Kaulf	-	Polypodiaceae	Whole plant	Medicine	Singh *et al.* (2004)
16	*Actinopteris radiate*(Sw.)Link	Mayurshikha	Pteridaceae	Leaves paste	Medicine	Singh *et al.* (2004)
17	*Cheilanthes albomarginata* C.B. Clarke	Glade fern	Pteridaceae	fronds	Medicine	Singh *et al.* (2004)
18	*Cheilanthes farinosa* (Forsk.) Kaulf.	Silver fern, Nanha	Pteridaceae	fronds	Medicine	Singh *et al.* (2004, 2005)
19	*Cheilanthes tenuifolia* (Burm.) Sw.	Dodhari	Pteridaceae	Rhizome	Medicine	Singh *et al.* (2005)

20	*Marselia minuta* L.	Caupatiya	Salviniaceae	Whole plant	Medicine	Singh *et al*. (2004)
21	*Selaginella bryopteris* (L.) Baker	Sanjivini	Selaginella-ceae	Leaf	Medicine	Singh *et al*. (2004) Singh and Dixit (2005), Singh *et al*. (2005), Kapale (2012)
22	*Selaginella ciliaris* (Retz.) Spring	Chhoti Sanjivan	Selaginella-ceae	Whole plant	Medicine	Singh *et al*. (2004), Singh and Dixit (2005)
23	*Selaginella repanda* (Desv. Ex Poir.) Spring	Sanjivini	Selaginella-ceae	Fronds	Medicine	Singh *et al*. (2004), Singh and Dixit (2005)
24	*Christella dentata* (Forssk.) Browsey & Jerry	Rakat bilar	Thelypterida-ceae	Roots	Medicine	Bondya *et al.* (2009)
Angiosperms						
25	*Ablemoschus moschatus* Medic	Kasturi Bhindi	Malvaceae	Seeds	Medicine	Bondya *et al*. (2009)
26	*Abroma angusta* Linn.	Ulatkambal	Sterculiaceae	Whole plant	Medicine	Kapale (2012)
27	*Abrus precatorius* Linn.	Gumchi	Fabaceae	Leaves	Medicine	Bondya *et al.* (2009)
28	*Abutilon indicum* (Linn.) Sweet	Kanghi	Malvaceae	Whole plant	Medicine	Kapale (2012)
29	*Acacia arabica* (Lamk.) Willd.	Babool	Mimosaceae	Leave Fruit Bark	Medicine	Bhat and Tiwari (2011)
30	*Acacia catechu* (Linn. f.) Willd.	Khair	Mimosaceae	Bark	Dye	Tiwari and Bharat (2008)
31	*Acacia leucocephloea* (Roxb.) Willd.	Safed kikar	Mimosaceae	Bark and Leaves	Dye	Tiwari and Bharat (2008)
32	*Acacia nilotica* (L.) Benth ex Brenan	Babul	Mimosaceae	Leaves, Fruits and Bark	Medicine	Bhat and Tiwari (2011)
33	*Acacia nilotica* (Linn.) Willd. ex Delile	Babool	Mimosaceae	Seeds	Dye	Tiwari and Bharat (2008)
34	*Achyranthus aspera* L.	Chirchitta	Amaranthaceae	Roots	Medicine	Sahu (2011)
35	*Acorus calamus* L.	Bach	Araceae	Rhizome	Medicine	Bondya *et al*. (2009)
36	*Adhatoda vasica*	Adusa	Acanthaceae	Seed and Fruit	Medicine	Kapale (2012)

37	*Aegle marmelos* (L.) Correa.	Bel	Rutaceae	Fruits	Food and medicine	Singh *et al.* (2011), Bhat and Tiwari (2011)
38	*Allium wallichii*	Van lahsun	Amaryllideceae	Whole plant	Medicine	Kapale (2012)
39	*Aloe vera* L.	Gwarpatha	Liliaceae	Leaves	Medicine	Sahu (2011)
40	*Alstonia scholaris* (L.)	Saptparni	Apocynaceae	Stem bark	Medicine	Sahu (2011)
41	*Amaranthus hybridus* L.	Lal bhajee	Amaranthaceae	Leaves	Vegetable	Kapale (2012)
42	*Amaranthus paniculatus* L.	Van Choulai	Amaranthaceae	Leaves	Vegetable	Kapale (2012)
43	*Amaranthus spinosus* L.	Katbhajee	Amaranthaceae	Leaves	Vegetable	Kapale (2012)
44	*Amaranthus viridis* L.	Purpuri bhajee	Amaranthaceae	Leaves and seeds	Vegetable	Kapale (2012)
45	*Amorphophallus campanulatus* Nicolson	Suran	Araceae	Corm	Food	Kapale (2012)
46	*Andrographis paniculata* Nees	Kalmegh	Acanthaceae	Whole plant	Medicine	Bondya *et al*. (2009), Kapale (2012)
47	*Anogeissus latifolia* (Roxb. ex DC.) Wallich ex Guill. & Perr.	Dhawra	Combretaceae	Roots and Bark	Medicine	Singh *et al.* (2011)
48	*Annona squamosa* (L.)	Sitaphal	Annonaceae	Leaves	Medicine	Sahu (2011)
49	*Argyreia nervosa* (Burm.f.)Boj.	Vidhara	Convolvulaceae	Leaf	Medicine	Kapale (2012)
50	*Ariseama* spp.	Van suran	Araceae	Tuber	Vegetable	Kapale (2012)
51	*Ariseama tortuosum* Schott	Van makka	Araceae	Fruit	Medicine	Kapale (2012)
52	*Artocarpus heterophyllus* Lam.	Kathal	Moraceae	Wood	Dye	Tiwari and Bharat (2008)
53	*Artocarpus lakoocha* Roxb.	Barhal	Moraceae	Wood	Dye	Tiwari and Bharat (2008)
54	*Asparagus racemosus* Willd.	Satavar	Liliaceae	Roots	Medicine	Bondya *et al*. (2009), Sahu (2011)
55	*Bambusa arundinacea* (Willd.)	Kareel	Poaceae	Young shoot	Vegetable	Kapale (2012)
56	*Bambusa vulgaris* Schard. ex-J.C.	Bans	Poaceae	Stem	Foods and	Singh *et al.* (2011)

	Wendl.				Medicine	
57	*Barleria prionitis* Linn.	Katsariya	Acanthaceae	Leaves and roots	Medicine	Kapale (2012)
58	*Bauhinia malabarica* Roxb.	Amti	Caesalpiniaceae	Bark and Leaves	Food	Singh *et al.* (2011)
59	*Bauhinia purpurea* L.	Koliari Bhajee	Caesalpiniaceae	Young leaves	Vegetable	Kapale (2012)
60	*Bauhinia vahlii* Wight. and Arnott.	Mahul	Caesalpiniaceae	Stem bark and leaves	Medicine and Leaves used for making a Cup and plate	Singh *et al.* (2011)
61	*Bauhinia variegata* Linn.	Kachnaar	Caesalpiniaceae	Bark	Medicine	Bhat and Tiwari (2011)
62	*Berberis aristata* DC.	Daru haldi	Berberidaceae	Root and tubers	Dye	Tiwari and Bharat (2008)
63	*Bixa orellana* Linn.	Sinduri	Bixaceae	Seeds	Dye	Tiwari and Bharat (2008)
64	*Boerhaavia diffusa* L.	Patherchatta	Nyctaginaceae	Roots	Medicine	Sahu (2011)
65	*Bridelia retusa* (L.) Spreng.	Kasai	Euphorbiaceae	Fruits	Food	Singh *et al.* (2011)
66	*Bryonia alba*.	Shivlingi	Cucurbitaceae	Leaf	Medicine	Kapale (2012)
67	*Bryonopsis laciniosa* (L.)	Shivlingi	Cucurbitaceae	Seeds	Medicine	Bondya *et al*. (2009)
68	*Buchanania lanzan* Spreng.	Chironji, Char	Anacardiaceae	Fruits and Seed	Medicine and food	Bhat and Tiwari (2011), Singh *et al.* (2011)
69	*Butea monosperma* (Lam.) Kuntze	Palash	Fabaceae	Flowers, Barks	Dye and medicine	Tiwari and Bharat (2008), Bhat and Tiwari (2011), Sahu (2011)
70	*Butea superba* Roxb.	Palash lata	Fabaceae	Root tubers	Dye	Tiwari and Bharat (2008)
71	*Caesalpinia bonduc* (L.) Roxb.	Gataran	Caesalpiniaceae	Seeds	Medicine	Bondya *et al*. (2009)
72	*Cajanus scarabaeoides* (L.) du Petit Theu.	Ban Kurthi	Fabaceae	Seeds	Medicine	Bondya *et al*. (2009)
73	*Careya arborea* Roxb.	Kumbhi	Lecythidaceae	Flowers	Medicine	Bhat and Tiwari (2011)

74	*Casearia graveolens* Dalzell	Chilhi	Flacourtiaceae	Fruits	Beads, fish poison	Singh *et al.* (2011)
75	*Cassia alata*	Higlaj	Caesalpiniaceae	Bark	Medicine	Kapale (2012)
76	*Cassia fistula* Linn.	Amaltas	Caesalpiniaceae	Flowers, Leaves	Medicine	Bhat and Tiwari (2011), Sahu (2011)
77	*Cassia tora* L.	Charota bhaji	Caesalpiniaceae	Leaves	Vegetable and medicine	Kapale (2012), Sahu (2011)
78	*Celastrus paniculatus* Willd.	Kujri	Celastraceae	Seeds	Medicine	Bondya *et al.* (2009)
79	*Celosia argentea* Linn.	Phul bhajee	Amaranthaceae	Leaves	Vegetable	Kapale (2012)
80	*Centella asiatica* (Linn.)Urban syn. *Hydrocotyle asiatica* Linn.	Brahmi	Apiaceace	Leaf	Medicine	Kapale (2012), Bondya *et al.* (2009), Kapale (2012)
81	*Centratherum anthelminticum*	Vanjira	Asteraceae	Whole plants	Medicine	Kapale (2012)
82	*Chloroxylon swietenia* DC	Buruta	Rutaceae	Leaves	Medicine	Bhat and Tiwari (2011)
83	*Citrus aurantium* Linn.	Khatta nibu	Rutaceae	Fruits	Medicine	Bhat and Tiwari (2011)
84	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f.	Karra	Euphorbiaceae	Bark, Leaves, Roots and Fruits	Fish poison and medicine	Singh *et al.* (2011), Bhat and Tiwari (2011)
85	*Coccinia grandis* L.	Kundru	Cucurbitaceae	Fruits	Vegetable	Kapale (2012)
86	*Cocculus hirsutus* L. Diels	Jaljamni	Menispermaceae	Leaves	Medicine	Sahu (2011)
87	*Colocasia esculantum* L.	Boda kand	Araceae	Tuber	Vegetable	Kapale (2012)
88	*Coriandrum sativum* Linn.	Dhania	Umbelliferae	Leaves	Medicine	Bhat and Tiwari (2011)
89	*Costus speciosus* Linn.	Kevkand	Costaceae	Tuber	Vegetable	Kapale (2012)
90	*Crinum asiaticum* Linn.	Sudarshan	Amaryllidaceae	Whole plants	Medicine	Kapale (2012)
91	*Curculigo orchioides* Gaertn.	Kali musli	Hypoxidaceae	Tuberous root	Medicine	Bondya *et al.* (2009), Sahu (2011), Singh *et al.* (2011)
92	*Curcuma*	Tikhur	Zingiberaceae	Tubers	Dye and	Tiwari and

	angustifolia Roxb.				food	Bharat (2008), Singh *et al.* (2011)
93	*Curcuma aromatica* Salisb.	Ban haldi	Zingiberaceae	Tubers	Dye	Tiwari and Bharat (2008)
94	*Curcuma longa* Linn.	Haldi	Zingiberaceae	Tubers	Dye	Tiwari and Bharat (2008)
95	*Cuscuta reflexa* Ro xb.	Amarbel	Convolvulaceae	Seeds	Medicine	Sahu (2011)
96	*Cyperus rotundus* L.	Motha	Cyperaceae	Tuberous roots	Medicine	Bondya *et al.* (2009)
97	*Dalbergia sissoo* Roxb.	Sisham	Fabaceae	Bark	Medicine	Bhat and Tiwari (2011)
98	*Datura metel* Linn.	Kala Datura	Solanaceae	Roots	Medicine	Sahu (2011)
99	*Datura stramonium* Linn.	Dhatura	Solanaceae	Fruits	Medicine	Bhat and Tiwari (2011)
100	*Dendrocalamus strictus* Roxb.	Lathi bans	Poaceae	Whole plant	Medicine	Bhat and Tiwari (2011)
101	*Desmodium gangeticum* (L.) DC.	Saptaparni	Fabaceae	Roots	Medicine	Bondya *et al.* (2009)
102	*Dioscorea bulbifera* L.	Ganthiana	Dioscoreaceae	Tubers	Medicine	Bondya *et al.* (2009)
103	*Dioscorea globosa* Roxb.	Suari kand	Dioscoreaceae	Tuber	Vegetable	Kapale (2012)
104	*Dioscorea hispida*	Baichandi	Dioscoreaceae	Tuber	Vegetable	Kapale (2012)
105	*Diospyros melanoxylon* Roxb.	Tendu	Ebenaceae	Fruits and leaves	Food and Medicine	Singh *et al.* (2011), Bhat and Tiwari (2011)
106	*Dolichos biflorum* Linn.	Kulthi	Leguminosae	Seeds	Medicine	Sahu (2011)
107	*Dolichos* spp.	Jangali sem	Fabaceae	Fruits	Vegetable	Kapale (2012)
108	*Eclipta prostrata* (L.)	Gotari	Asteraceae	Whole plant	Medicine	Bondya *et al.* (2009)
109	*Elephantopus scaber* L.	Minjur jhuti	Asteraceae	Roots	Medicine	Bondya *et al.* (2009)
110	*Emblica officinalis* Gaertn. syn *Phyllanthus emblica* Linn.	Aonla	Euphorbiaceae	Fruit	Dye	Tiwari and Bharat (2008)
111	*Eulophia nuda*	Villai kand	Orchidaceae	Roots	Medicine	Kapale (2012)
112	*Euphorbia hirta* L.	Dudhi	Euphorbiaceae	Leaves	Medicine	Sahu (2011)
113	*Ficus bengalensis*	Bargad	Moraceae	Fruits,	Medicine	Bhat and Tiwari

	L.			Leaves, bark		(2011)
114	*Ficus carica* L.	Anjir	Moraceae	Fruits	Medicine	Sahu (2011)
115	*Ficus glomerata* Roxb.	Dumar	Moraceae	Fruit	Food and fruits	Singh *et al.* (2011), Kapale (2012)
116	*Ficus* spp.	Pakri	Moraceae	Young leaves	Vegetable	Kapale (2012)
117	*Gloriosa superba* L.	Kalihari	Liliaceae	Tubers	Medicine	Bondya *et al*. (2009)
118	*Gossypium arboreum* L.	Kapas	Malvaceae	Root bark	Medicine	Sahu (2011)
119	*Gymnema sylvestre* (Retz.) R. Br. ex Retz.	Gurmar	Asclepiadaceae	Leaf and Stem	Medicine	Kapale (2012)
120	*Hedychium coronarium* J.Koeing ex Retz.	Gulbakawli	Zingiberaceae	Flowers	Medicine	Bondya *et al*. (2009), Kapale (2012)
121	*Helicteres isora* L.	Maror phali	Sterculiaceae	Fruits	Medicine	Bondya *et al*. (2009)
122	*Heliotropium ovalifolium*	Jangali mooli	Boraginaceae	Leaves	Vegetable	Kapale (2012)
123	*Hemidesmus indicus* (L.) R. Br.	Anantmool	Asclepiadaceae	Roots	Medicine	Bondya *et al*. (2009), Sahu (2011)
124	*Holarrhena pubescens* (Buch-Ham) ex G. Don.	-	Apocynaceae	Seeds	Medicine	Bondya *et al*. (2009)
125	*Indigofera cassioides* Rottl. ex DC.	Neel	Fabaceae	Leaves and flowers	Dye	Tiwari and Bharat (2008)
126	*Indigofera tinctoria* Linn.	Neel	Fabaceae	Leaves and flowers	Dye	Tiwari and Bharat (2008)
127	*Kydia calycina* Roxb.	Barga	Bombacaceae	Leafs	Medicinal	Singh *et al.* (2011)
128	*Lagerstroemia parviflora* Roxb.	Senha	Lythraceae	Tender leaves Bark and Leaves are used in tanning.	Vegetable	Singh *et al.* (2011)
129	*Lannea coromandelica* (Houtt.) Merr.	Gunja	Anacardiaceae	Resin	Gum	Singh *et al.* (2011)

130	*Lawsonia inermis* Linn.	Mehndi	Lythraceae	Leaves	Dye	Tiwari and Bharat (2008)
131	*Litsea glutinosa* (Lour.) C.R. Robins.	Maida	Lauraceae	Bark	Medicine	Bhat and Tiwari (2011)
132	*Madhuca indica* J.f.Gmel	Mahua	Sapotaceae	Flower and Fruits	Vegetable and medicine	Kapale (2012), Bhat and Tiwari (2011)
133	*Madhuca longifolia* (J. Koenig) Macbrm var. latifolia (Roxb.) Chevalier	Mahua	Sapotaceae	Flower and Seeds	Oil and beverage	Singh *et al.* (2011)
134	*Mallotus philippensis* (Lam.) Muell. Arg.	Rori	Euphorbiaceae	Fruit and capsules	Dye and medicine	Tiwari and Bharat (2008), Singh *et al.* (2011)
135	*Mangifera indica* L.	Mango	Anacardiaceae	Fruits	Food	Singh *et al.* (2011)
136	*Melia azadirachta* Linn.	Bakain	Meliaceae	Bark, Fruits	Medicine	Bhat and Tiwari (2011)
137	*Michelia champaca* Linn.	Champa	Magnoliaceae	Wood	Dye	Tiwari and Bharat (2008)
138	*Miliusa tomentosa* (Roxb.) Finet & Gagnep.	Kari	Annonaceae	Gum and Bark	Medicine	Singh *et al.* (2011)
139	*Mimusops elengi* Linn.	Maulshri	Sapotaceae	Seed	Dye	Tiwari and Bharat (2008)
140	*Moringa oleifera* L.	Munga	Moringaceae	Flower, Fruit and Leaves	Vegetable	Kapale (2012)
141	*Moringa oleifera* Lan	Munga	Moringaceae	Fruits, Leaves	Medicine	Bhat and Tiwari (2011)
142	*Mucuna prurita* Hook.	Kewanch	Fabaceae	Seeds	Medicine	Bondya *et al.* (2009)
143	*Murraya paniculata* (L.) Jack.	Hatil	Rutaceae	Leaves	Medicine	Bondya *et al.* (2009)
144	*Myrica esculenta* Buch.-Ham. ex D.Don	Kay phal	Myricaceae	Bark	Dye	Tiwari and Bharat (2008)
145	*Oroxylum indicum* (L.) Vent.	Sanparan	Bignoniaceae	Seeds	Medicine	Bondya *et al.* (2009)
146	*Ougeinia*	Tinsa	Fabaceae	Bark and	Fish	Singh *et al.*

	oojeinensis (Roxb.) Hochr.			gum	poison and Medicine	(2011)
147	*Peucedanum nagpurense* (Clarke) Prain	Tejraj	Apiaceae	Roots	Medicine	Bondya *et al*. (2009)
148	*Phyllathus emblica* Linn.	Amla	Euphorbiaceae	Bark, leaves and Fruits	Medicine	Bhat and Tiwari (2011), Singh *et al.* (2011)
149	*Pisidium guajava* L.	Bihi	Myrtaceae	Leaves	Medicine	Bhat and Tiwari (2011)
150	*Plumbago zeylanica* L.	Chitrak	Plumbaginaceae	Roots and leaves	Medicine	Bondya *et al*. (2009), Kapale (2012)
151	*Pterocarpus marsupium* Roxb.	Beejasal	Fabaceae	Bark, Pods, Flower	Dye and medicine	Tiwari and Bharat (2008), Singh *et al.* (2011), Bhat and Tiwari (2011)
152	*Pueraria tuberosa* DC.	Patal kumhda	Fabaceae	Leaf and tubers	Medicine	Kapale (2012), Bondya *et al*. (2009)
153	*Punica granatum* Linn.	Anar	Punicaceae	Rind and Flower	Dye	Tiwari and Bharat (2008)
154	*Ricinus communis* Linn.	Arandi	Euphorbiaceae	Leaves, Fruits	Medicine	Bhat and Tiwari (2011)
155	*Rubia cordifolia* Linn. syn. *Rubia manjith* Roxb. ex Fleming	Pili, Manjistha, Maddar	Rubiaceae	Whole plant and roots	Medicine and dye	Kapale (2012), Bondya *et al*. (2009), Tiwari and Bharat (2008)
156	*Sapindus laurifoliatus* Linn.	Reetha	Sapindaceae	Leaves, Bark	Medicine	Bhat and Tiwari (2011)
157	*Schleichera oleosa* (Lour.) Oken.	Kusum	Sapindaceae	Leaf, fruits and seeds	Food and medicine	Singh *et al.* (2011), Bhat and Tiwari (2011)
158	*Schrebera swietenioides* Roxb.	Eksirafal	Oleaceae	Fruits	Medicine	Bondya *et al*. (2009)
159	*Semecarpus anacardium* L.f.	Bhilwa	Anacardiaceae	Resin and fruits	Medicine and dye	Singh *et al.* (2011), Tiwari and Bharat (2008), Bondya *et al* (2009), Bhat and Tiwari (2011)

160	*Shorea robusta* Gaertn.	Sal, Sarai	Dipterocarpaceae	Seeds, Shoots and Resin	Medicine, Fish poison	Bhat and Tiwari (2011), Singh *et al*. (2011)
161	*Smilax zeylanica* L.	Ram	Smilacaccae	Roots	Medicine	Bondya *et al*. (2009)
162	*Smithia conferta* Sm.	Fahu	Fabaceae	Leaves	Medicine	Bondya *et al*. (2009)
163	*Spilanthus paniculata* Wall. ex DC.	Akarkara	Asteraceae	Leaf	Medicine	Kapale (2012)
164	*Strychnos nux-vomica* L.	Kulcha	Loganiaceae	Seeds	Medicine	Bondya *et al*. (2009)
165	*Syzygium cuminii* (L.) Skeels	Jamun	Myrtaceae	Leaves, seeds, fruits and seeds	Food, medicine and dye	Singh *et al.* (2011), Tiwari and Bharat (2008), Bhat and Tiwari (2011)
166	*Tamarindus indica* Linn.	Imli	Caesalpiniaceae	Fruits	Medicine	Bhat and Tiwari (2011)
167	*Terminalia alata* Heyne ex Roth	Saja	Combretaceae	Bark and gum	Dye and Medicine	Tiwari and Bharat (2008), Singh *et al*. (2011)
168	*Terminalia arjuna* (Roxb.) Wight & Arn.	Arjuna, Kahua	Combretaceae	Bark	Dye and medicine	Tiwari and Bharat (2008), Bhat and Tiwari (2011)
169	*Terminalia bellirica* Roxb.	Behera	Combretaceae	Fruits	Medicine and dye	Singh *et al.* (2011), Tiwari and Bharat (2008), Bondya *et al*. (2009)
170	*Terminalia chebula* Retz.	Harra, Harad	Combretaceae	Fruits	Dye and medicine	Tiwari and Bharat (2008), Singh *et al.*(2011), Bhat and Tiwari (2011), Bondya *et al*. (2009)
171	*Thespesia lampas* (Cav.) Dalz. & Gibs.	Ban kapas	Malvaceae	Seeds	Medicine	Bondya *et al*. (2009)
172	*Uraria lagopodioides* (L.) Desv.	Iswarjata	Fabaceae	Roots	Medicine	Bondya *et al*. (2009)
173	*Urginea indica*	Van piyag	Liliaceae	Whole	Medicine	Kapale (2012)

				plant		
174	*Vanda tessellata* (Roxb.) Hook. ex G. Don	Rasna	Orchidaceae	Whole plants	Medicine	Bondya *et al*. (2009)
175	*Ventilago denticulata* Willd.	Keonti	Rhamnaceae	Bark and roots	Dye	Tiwari and Bharat (2008)
176	*Vitex negundo* (Linn.)	Nirgundi	Verbenaceae	Roots	Medicine	Sahu (2011)
177	*Woodfordia fruticosa* (L.) Kurz.	Fulchuhi, Dhawai	Lythraceae	Flower and Leaves	Medicine	Bondya *et al*. (2009), Bhat and Tiwari (2011)
178	*Woodfordia fruticosa* (Linn.) Kurz.	Dhawai	Lythraceae	Flowers	Dye	Tiwari and Bharat (2008)
179	*Wrightia tinctoria* R.Br.	Indrajau	Apocynaceae	Seeds	Dye	Tiwari and Bharat (2008)
180	*Zanthoxylum alatum* Roxb.	Van dhania	Apiaceae	Leaf	Medicine	Kapale (2012)
181	*Zingiber roseum* (Roxb.) Rose.	Jangli adrak	Zingiberaceae	Rhizome	Medicine	Bondya *et al*. (2009)
182	*Zingiber zerumbet* (L.)	Van adrak	Zingiberaceae	Root	Medicine	Kapale (2012)
183	*Ziziphus mauritiana* lam.	Ber	Rhamnaceae	Leaves and bark	Dye	Tiwari and Bharat (2008)
184	*Zizyphus numularia* (Burm. f.) Wt. & Arn. Prodr.	Ber	Rhamnaceae	Bark	Medicine	Bhat and Tiwari (2011)

II. Interaction with regional organizations:

Scientific organizations including various universities of Madhya Pradesh and Chhattisgarh were visited for interaction with scientists and academicians. They were encouraged to submit research project proposal on Achanakmar-Amarkantak biosphere reserve to Ministry of Environment and Forests, Government of India for funding. In all conferences/symposia/seminar/ workshop, special presentation was made on Achanakmar-Amarkantak biosphere reserve and requested to develop suitable research project proposals based on the mandates for benefit of local peoples of biosphere reseve. Scientists of this Institute submitted two research project proposals on Achanakmar-Amarkantak biosphere reserve to Ministry of Environment and Forests, Government of India, for financial assistance.

III. Synthesis of data:

Meteorological observations

The meteorological data of core zone of Achanakmar-Amarkantak biosphere reserve were collected from manual observatory at Achanakmar during the project period, 2010-13. The data on these aspects are presented in table 10. The data revealed that the temperature varied from 0-38^{0}C and relative humidity (RH) varied from 25-100%. The monthly average temperature varied from 4-30^{0}C and 32-90% RH. The annual rainfall reported in core zone was 1256 mm during the year 2012 (http://www.accuweather.com/en/in/achanakmar /192459/weather-forecast/192459). In Kota, buffer zone towards Chhattisgarh, the monthly average temperature varied from 11-42^{0}C and RH varied from 24-78% (http://en.climate-data.org/location/173798). The annual rainfall reported in this buffer zone was 721 mm during the year 2012. In Anuppur, buffer zone towards Madhya Pardesh, the monthly average temperature varied from 11-42^{0}C and RH varied from 30-80% ((http://www.accuweather.com /en/in/anuppur/198871/march-weather/1988712). The annual rainfall reported in this buffer zone was 1278 mm during the year 2012. Earlier, it has been mentioned that in Achanakmar-Amarkantak biosphere reserve, the lowest temperature in winter is -2^{0}C, which rises up to a maximum of 46^{0}C in summer and the RH varies from 39-90% (Anon, 2009). Further, it has also been mentioned that the annual rainfall is about 1624 mm.

Table 10. Meteorological data of core zone of Achanakmar-Amarkantak biosphere reserve

Year	Month	Temperature (^{0}C)		Relative humidity (%)*
		Minimum*	Maximum*	
2010	April	19 (14-23)	30 (26-33)	32 (25-50)
	May	18 (8-26)	30 (19-34)	48 (31-69)
	June	20 (11-24)	28 (23-33)	64 (31-86)
	July	17 (16-20)	23 (21-26)	85 (73-95)
	August	17 (15-19)	21 (17-23)	87 (78-98)
	September	17 (14-27)	21 (19-24)	87 (70-100)
	October	15 (9-17)	21 (14-24)	80 (68-96)
	November	13 (6-16)	17 (13-21)	81 (71-97)
	December	7 (3-11)	13 (4-16)	78 (62-100)
2011	January	4 (0-9)	12 (8-16)	66 (39-81)
	February	7 (2-11)	18 (10-20)	60 (51-73)
	March	13 (5-20)	23 (11-26)	45 (30-68)

	April	14 (11-20)	24 (15-28)	55 (32-70)
	May	18 (15-23)	30 (27-33)	49 (30-70)
	June	16 (5-21)	23 (10-30)	75 (46-98)
	July	15 (5-20)	21 (14-27)	85 (66-99)
	August	15 (12-19)	19 (16-25)	90 (78-100)
	September	15 (12-19)	20 (16-25)	86 (69-99)
	October	13 (10-16)	20 (15-23)	76 (66-86)
	November	10 (7-13)	17 (14-20)	80 (69-85)
	December	6 (3-10)	12 (6-15)	75 (63-89)
2012	January	8 (3-11)	12 (9-16)	77 (41-99)
	February	8 (3-10)	16 (9-22)	68 (40-85)
	March	10 (6-14)	22 (10-27)	45 (27-69)
	April	16 (13-22)	28 (18-38)	45 (31-53)
	May	17 (14-23)	30 (21-34)	41 (28-57)
	June	19 (16-24)	27 (18-34)	64 (37-89)
	July	16 (15-20)	20 (17-27)	85 (73-96)
	August	16 (15-18)	20 (17-24)	86 (74-95)
	September	16 (14-18)	20 (17-24)	83 (70-90)
	October	12 (7-18)	19 (13-24)	76 (67-86)
	November	8 (4-13)	15 (13-18)	81 (73-96)
	December	5 (1-10)	13 (8-17)	80 (70-88)
2013	January	5 (2-8)	14 (10-16)	69 (42-93)
	February	7 (5-10)	18 (14-21)	74 (57-91)
	March	11 (5-19)	23 (16-27)	55 (42-64)

*Average value of the month. Figure inside parentheses indicate range values.

Regeneration status of tree species

The density of seedling and sampling is considered as an indicator of the regeneration potential. The status of regeneration of species was determined based on population size of seedling and sampling. Good regeneration, i.e. if particular species is present in seedling>sapling> tree; fair regeneration, i.e present in seedling>sapling<tree; poor regeneration, i.e. if a species survives only in sampling stage, but not as seedling; if a species present only in adult form it is considered as not regeneration. A species is considered as not abundant if the species has no tree representative, but only sampling and/ or seedling (Shankar, 2001)

The density of seedlings and saplings of tree species in different sample plots of both core and buffer zones of Achanakmar-Amarkantak biosphere reserve varied greatly (Fig. 6).

Established sample plot in Achanakmar-Amarkantak biosphere reserve

Regeneration of seedlings

Regeneration of saplings

Fig. 6. Regeneration of tree species in Achanakmar-Amarkantak biosphere reserve

The data on these aspects are summarized in tables 11-17 and the details of which are mentioned as hereunder.

In Plot-I, located in buffer zone of Kota range (Compartment No.186), recorded 23 tree species with density of 565 trees/ha, four species however did not record as adult trees (Table 11). *Shorea robusta* and *Diospyros melanoxylon* showed good regeneration consistently, while *Terminalia alata* showed good regeneration in the year 2012. Fourteen species did not show regeneration. Species like *Butea monosperma* and *Cassia fistula* did not record adult trees but were found regenerating using seedbank from the surrounding area. The overall maximum regeneration was recorded 86300 seedlings/ha and 9240 saplings/ ha.

Table 11. Data on regeneration status of tree species (density/ha) in Plot-I (Buffer zone-Compartment No. 186)

Sl. No.	Species name	2006	2011			2012		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	166	10000	267	G	70000	3600	G
2	*Terminalia alata*	104				6000	400	G
3	*Diospyros melanoxylon*	61	3333	222	G	13000	800	G
4	*Casearia graveolens*	43		178	P		800	P
5	*Buchnania lanzan*	39			N			
6	*Anogeissus latifolia*	32	3333		P			
7	*Lagerstoemia parviflora*	22			N		240	NA
8	*Terminalia chebula*	20			N			
9	*Ougenia oojeinensis*	14			N	3000		
10	*Phyllanthus emblica*	13			N			
11	*Lannea grandis*	10			N			
12	*Bauhinia malabarica*	8			N			
13	*Semecarpus anacardium*	7			N			
14	*Syzygium cumini*	7		89	P		80	P
15	*Miliusa tomentosa*	5		44	P	3000		P
16	*Dolichandrone atrovirens*	3			N			
17	*Antidesma acidum*	2			N			
18	*Dalbergia paniculata*	2			N			
19	*Madhuca indica*	2		44	P			
20	*Ziziphus xylopyra*	2			N			
21	*Bombax ceiba*	1			N			
22	*Holarrhena antidysentrica*	1					240	P
23	*Kydia calycina*	1			N			

24	*Butea monosperma*						120	NA
25	*Cassia fistula*						120	NA
26	*Stereospermum chelonoides*					3000		NA
27	*Grewia tiliefolia*						120	NA
Total		565	16666	844		86300	7480	

G=Good. P=Poor N=No regeneration NA= Not abundant

In Plot-II, located in core zone of Achanakmar range (Compartment No.159), recorded 29 species of trees with density of 915 trees/ha, while four species were represented as regenerating units in the plot (Table 12). Of these, only *Shorea robusta* and *Diospyros melanoxylon* were found having good regeneration in both the years of observations. Three species viz. *Casearia graveolens*, *Anogiessus latifolia* and *Mallotus philippensis* recorded good regeneration in the year 2012, whereas *Grewia tiliefolia*, recorded good regeneration in the year 2011, but did not record seedling or sapling in the year 2012. In all, 16 species exhibited seedling and sapling regeneration in both the years of observations. The overall regeneration was increased with maximum number of seedlings and saplings of 216700 plants/ha and 6640 plants/ha respectively recorded during the year 2012. Twelve species were found with no regeneration.

Table 12. Data on regeneration status of tree species (density/ha) in Plot-II (Core zone-Compartment No. 159)

Sl. No.	Species name	2006	2011			2012		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	308	10000	710	G	186700	400	G
2	*Lagerstoemia parviflora*	126			N		120	P
3	*Casearia graveolens*	115		270	P	3000	240	G
4	*Anogeissus latifolia*	99	3300		P	3000	520	G
6	*Lannea grandis*	57			N		120	P
7	*Terminalia alata*	56	3300		P		240	P
8	*Diospyros melanoxylon*	47	10000	180	G	3000	400	G
9	*Terminalia chebula*	20			N			N
10	*Phyllanthus emblica*	19			N		240	P
12	*Buchnania lanzan*	13			N			N
13	*Madhuca indica*	10			N			N
14	*Bauhinia malabarica*	9			N			N

15	*Grewia tiliaefolia*	5	6700	90	G			N
16	*Mallotus phillipinensis*	5		130	P	3000	400	G
17	*Syzygium cumini*	5	3300		P			N
18	*Bombax ceiba*	4			N			N
19	*Haldinia cordifolia*	4			N			N
20	*Ougeinia oogeinensis*	4			N			N
21	*Careya arborea*	2			N			N
22	*Pterocarpus marsupium*	2	26700		P	6000		P
23	*Cassia fistula*	1			P		240	P
24	*Dalbergia paniculata*	1			N			N
26	*Kydia calycina*	1			N			N
27	*Litsea glutinosa*	1			N			N
29	*Mitragyna parviflora*	1			N			N
30	*Hymenodictyon excelsum*					3000		NA
31	Parsa					6000	120	NA
32	*Schleichera oleosa*				N	3000		NA
Total		915	63300	1380		216700	6640	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

In Plot-III, located in core zone of Achanakmar range (Compartment No. 198), recorded 29 species of trees of 1025 trees/ha density with four species recording regeneration with no adult individuals (Table 13). Tree species namely, *Shorea robusta*, *Diospyros melanoxylon* and *Casearia graveolens* recorded fair to good regeneration while species like *Lagestoemia parviflora, Phyllanthus emblica, Schleichera oleosa and Terminalia chebula* exhibited poor regeneration. The overall regeneration was 34000 seedlings/ha and 5120 saplings/ha during the year 2012. Sixteen species were found not regenerating in both the years 2011 and 2012.

Table 13. Data on regeneration status of tree species (density/ha) in Plot-III (Core zone-Compartment No. 504)

Sl. No.	Species name	2006	2011 Density/ha.			2012 Density/ha.		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	514	533	6667	P	90000	920	G
2	*Terminalia alata*	120		3333	P		120	P
3	*Casearia graveolens*	115	844		P	6000	1700	G
4	*Lagerastoemia parviflora*	105			N			
5	*Diospyros melanoxylon*	82	178		P		120	P

6	*Terminalia chebula*	52			N			
7	*Mallotus phillipinensis*	47	133		P	3000	4668	P
8	*Miliusa tomentosa*	40					520	P
9	*Syzygium cumini*	40			N	3000	640	G
10	*Madhuca indica*	24			N			
11	*Phyllanthus emblica*	24			N			
12	*Anogeissus latifolia*	22		6667	P			
13	*Lannea grandia*	22			N			
14	*Buchnania lanzan*	18			N			
15	*Antidesma acidum*	7		6667	P			
16	*Cassia fistula*	7					120	P
17	*Schleichera oleosa*	7			N			
18	*Semecarpus anacardium*	5			N			N
19	*Hymenodictyon excelsum*	3			N			
20	*Haldinia cordifolia*	2					120	P
21	*Ziziphus xylopyra*	2			N			
22	Aurai	1			N			
23	*Careya arborea*	1			N			
24	*Dalbergia paniculata*	1			N			
25	*Garuga pinnata*	1			N			
26	*Mitragyna parviflora*	1			N			
27	*Aegle marmelos*			6667	NA			
28	*Dolichandron atrovirens*			3333	NA			
29	*Ougenia oojeinensis*		44		P			NA
30	*Stereospermum chelonoides*					3000		NA
31	*Randia* sp.						120	NA
32	*Wrightia tinctoria*						120	NA
Total		1263	1732	33334		105000	9168	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

In Plot-IV, located in core zone of Chaparwa range (Compartment No. 504), recorded 26 species of trees with density of 1263 trees/ha , while five species were represented as an escape from surrounding vegetation as seedling and saplings (Table 14). Good regeneration was recorded by only *Shorea robusta*, whereas *Casearia graveolens* and *Syzygium cumini* recorded fair to good regeneration in the year 2012. Fifteen species did not show regeneration, that includes species like *Terminalia chebula*, *Schliechera oleosa* and *Semecarpus*

anacardium. The overall regeneration was recorded 1,05,000 plants/ha and 9,168 plants/ha for seedlings and saplings respectively during the year 2012.

Table 14. Data on regeneration status of tree species (density/ha) in Plot-IV (Core zone-Compartment No. 198)

Sl. No.	Species name	2006	2011 Density/ha.			2012 Density/ha.		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Mallotus phillipinensis*	372					400	P
2	*Shorea robusta*	187	10000		P	3000	1200	G
3	*Syzygium cumini*	119	3333		P		120	P
4	*Miliusa tomentosa*	73					120	P
5	*Terminalia alata*	56			N			
6	*Lagerstoemia parviflora*	51		222	P			
7	*Ziziphus nummularia*	48			N			
8	*Diospyros melanoxylon*	21	3333	44	G	6000	800	G
9	*Cassia fistula*	13			N			
10	*Casearia graveolens*	12		533	P	6000	1600	G
11	*Buchnania lanzan*	10			N			
12	*Ficus religiosa*	9			N			
13	*Lannea grandis*	9					120	P
14	*Phyllanthus emblica*	8		133	P		120	P
15	*Schleichera oleosa*	7	10000		P			
16	*Terminalia chebula*	6				3000		P
17	*Haldinia cordifolia*	5			N			
18	*Madhuca indica*	3					120	P
19	*Aegle marmelos*	2			N			
20	*Antidesma acidum*	2			N			
21	*Butea monosperma*	2			N			
22	*Cordia dichotoma*	2			N			
23	*Kydia calycina*	2			N			
24	*Bombax ceiba*	1			N			
25	*Careya arborea*	1			N			
26	*Dalbergia paniculata*	1			N			
27	*Ougenia oojeinensis*	1			N			
28	*Pterocarpus marsupium*	1			N			
29	*Randia* sp.	1				13000		P
30	*Anogeissus latifolia*						120	NA
31	*Mitragyna parviflora*			44	NA	3000		NA
32	*Diospyros montanum*						400	NA
33	*Schrebera swietenioides*			89	NA			
Total		1025	26666	1065		34000	5120	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

In Plot-V located in core zone of Lamni range (Compartment No. 324), recorded 40 species of trees having density of 1,704 trees/ha and four species with no adult individuals (Table 15). Two species, viz. *Shorea robusta* and *Schleichera oleosa* showed good regeneration having seedling > sapling > trees. Nearly 19 species of trees did not exhibit regeneration. The overall regeneration trend was 69,000 plants/ha and 4,280 plants/ha for seedlings and saplings recorded during the year 2012.

Table 15. Data on regeneration status of tree species (density/ha) in Plot-V (Core zone-Compartment No. 324)

Sl. No.	Species name	2006	2011			2012		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	690	6667	178	G	50000	800	G
2	*Casearia elliptica*	435		622	P		240	P
3	*Lagerstoemia parviflora*	74			N	3000	120	G
4	*Semecarpus anacardium*	56			N		120	P
5	*Schleichera oleosa*	51				3000	240	G
6	*Helicteres isora*	46					400	P
7	*Lannaea coromandelica*	37			N			
8	*Phyllanthus emblica*	30				3000		P
9	*Mallotus phillipinensis*	26		267	P		400	P
10	*Buchanania lanzan*	20					120	P
11	*Dalbergia paniculata*	19			N			
12	*Terminalia alata*	19			N			
13	*Syzygium cumini*	17		88	P		120	P
14	*Grewia tiliefolia*	15	3333		P		120	P
15	*Terminalia chebula*	15					120	P
16	*Miliusa tomentosa*	14		178	P	10000	120	
17	*Bridelia retusa*	11	3333	44	G		120	P
18	*Bauhinia malabarica*	10			N			
19	*Diospyros melanoxylon*	10					240	P
20	*Kydia calycina*	10			N			
21	*Sterculia urens*	10		267	P			
22	*Bombax ceiba*	8		44	P			
23	*Careya arborea*	8			N			
24	*Embelia tsjeriam cottam*	8			N			
25	*Nyctanthes arbortristis*	8					120	P
26	*Litsea glutinosa*	7		44	P		120	P
27	*Haldinia cordifolia*	6			N			
28	*Ougeinia oojeinensis*	6			N			
29	*Wendlandia heynei*	6			N			
30	*Albizia lebeck*	5			N			
31	*Anogeissus latifolia*	5	3333		P			
32	Khursi	5			N			
33	*Pterocarpus marsupium*	5	3333		P			
34	*Dolichandrone falcatum*	3			N			
35	*Wrightia tinctoria*	3		89	P		400	P

36	Kuntuk	2			N			
37	*Antidesma acidum*	1			N			
38	*Cochlospermum religiosum*	1			N			
39	*Dolochandrone falcatum*	1			N			
40	*Terminalia bellirica*	1			N			
41	Amoori						120	NA
42	*Cassia fistula*			44	NA			
43	*Madhuca latifolia*			120	NA			
44	Paprel		20000		NA			
Total		1704	39999	1985		69000	4280	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

In Plot-VI located in core zone of Lamni range (Compartment No. 311), recorded 21 species of trees with density of 521 trees/ha and revealed two regenerating species having seed source outside the plot area (Table 16). No species showed good regeneration in both the years 2011 and 2012. However, *Shorea robusta* exhibited good regeneration during the year 2012, followed by *Syzygium cumini* with good to poor regeneration from 2011 to 2012. Nine species did not exhibit regenerating unit among others include *Mitragyna parviflora, Semecarpus anacardium* and *Schliechera oleosa.* The total regeneration recorded in the plot was 1,48,700 seedlings/ha and 3,104 saplings/ha.

Table 16. Data on regeneration status of tree species (density/ha) in Plot-VI (Core zone-Compartment No. 311)

Sl. No.	Species name	2006	2011 Density/ha.			2012 Density/ha.		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	335				136700	932	G
2	*Syzygium cumini*	46	20000	356	G		1332	P
3	*Madhuca indica*	35			N			
4	*Lagerastoemia parviflora*	21			N		240	P
5	*Terminalia alata*	19	3333		P	3000		P
6	*Lannea grandis*	13					240	P
8	*Phyllanthus emblica*	11			N			
9	*Buchnania lanzan*	9			N			
10	*Diospyros melanoxylon*	9				3000		P
11	*Casearia graveolens*	6		356	P	3000	240	G
12	*Cassia fistula*	5			N			
13	*Miliusa tomentosa*	3			N			
14	*Anogeissus latifolia*	1			N			
15	*Antidesma acidum*	1			N			
16	*Bridelia retusa*	1				3000		P

17	*Dolichandrone falcatum*	1	3333		P			
18	*Mitragyna parviflora*	1			N			
19	*Pterocarpus marsupium*	1	3333					
20	*Schleichera oleosa*	1			N			
21	*Semecarpus anacardium*	1			N			
22	*Randia* sp.				N		120	NA
Total		520	29999	712		148700	3104	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

In Plot-VII located in buffer zone of Ataria range (Compartment No. 285), recorded 20 species of trees having 386 trees/ha density and two regenerating species with no adult individuals (Table 17). Species, viz. *Shorea robusta, Diospyros melanoxylon, Terminalia alata and Syzygium cumini* showed poor to good regeneration during the year of observations 2011 and 2012. However, *Casearia graveolens* exhibited good regeneration in 2011r but no regeneration in 2012. Eight species did not record any regeneration in the plot. Species like *Dolichandrone falcatum* and *Lannea grandis* showed regeneration but did not record adult tree. This plot also recorded total regeneration of 1,11,700 seedlings/ha and 4988 saplings/ha during the year 2012.

Table 17. Data on regeneration status of tree species (density/ha) in Plot-VII (Buffer zone-Compartment No. 285)

Sl. No.	Species name	2006	2011			2012		
		Tree	Seedling	Sapling	Status	Seedling	Sapling	Status
1	*Shorea robusta*	221	3333		P	90000	520	G
2	*Diospyros melanoxylon*	36		222	P	3000	1468	G
3	*Terminalia alata*	27	3333		P	3000	120	G
4	*Syzygium cumini*	23		267	P	3000	240	G
5	*Ougenia oojeinensis*	22		44	P			
6	*Buchanania lanzan*	21			N			
7	*Lagerstoemia parviflora*	16		44	P			
8	*Casearia graveolens*	5	3333	756	G	6700	2400	P
9	*Phyllanthus emblica*	5	3333		P			
10	*Anogeissus latifolia*	2			N			
11	*Bauhinia malabarica*	1			N			
12	*Casearia elliptica*	1			N			
13	*Cassia fistula*	1			N			
15	*Cleistanthus collinus*	1			N			

16	*Haldinia cordifolia*	1					120	P
17	*Mallotus phillipensis*	1					120	P
18	*Semecarpus anacardium*	1			N			
20	*Terminalia chebula*	1			N			
26	*Dolichandrone falcatum*		3333		NA			
27	*Lannea grandis*					3000		NA
Table		386	16665	1333		111700	4988	

G=Good. P=Poor. N=No regeneration. NA= Not abundant.

The data on density of tree species, species richness and their regeneration status in different sample plots of Achanakmar-Amarkantak biosphere reserve are presented in table 18. Results revealed that good regeneration in all the sample plots studied. The average data on density of tree species, species richness and their regeneration status in core and buffer zones (Table 19) also indicated the same view. Bhat and Tiwari (2012) have studied the regeneration status of important tree species in Achanakmar-Amarkantak biosphere reserve and come to the conclusion that regeneration of a species is dependenmt on internal forest process and also on canopy density, soil moisture, soil nutrient etc, but greatly affected by exogenic disturbances including fire, grazing, light and antropogenic pressure.

Table 18. Data on density of tree species, species richness and their regeneration status in Achanakmar-Amarkantak biosphere reserve

Plot	**2006**	**Year 2011**		**2012**		**Status**
	Tree /ha	**Seedling/ha**	**Sapling/ha**	**Seedling/ha**	**Sapling/ha**	
I*	565 (23)	16666 (3)	844 (6)	86300 (6)	9240 (10)	Good
II**	915 (29)	63300 (7)	1380 (5)	216700 (9)	6640 (11)	Good
III**	1025 (29)	26666 (4)	1065 (4)	34000 (6)	5120 (11)	Good
IV**	1263 (26)	33334 (5)	1732 (6)	105000 (5)	9168 (11)	Good
V**	1704 (40)	39999 (6)	1985 (12)	69000 (5)	4280 (18)	Good
VI**	520 (21)	29999 (4)	712 (2)	148700 (5)	3104 (6)	Good
VII*	386 (20)	16665 (5)	1333 (5)	111700 (6)	4988 (7)	Good

*Core zone **Buffer zone. Figures inside parentheses indicate number of tree species.

Table 19. Average data on density of tree species, species richness and their regeneration status in core and buffer zones of Achanakmar-Amarkantak biosphere reserve

Plot	2006	Year 2011		2012		Status
	Tree/ha	Seedling/ha	Sapling/ha	Seedling/ha	Sapling/ha	
Core zone	1085 (29)	38660 (5)	1375 (6)	114680 (6)	5662 (11)	Good
Buffer zone	476 (22)	16666 (4)	1089 (6)	99000 (6)	7114 (9)	Good

Figures inside parentheses indicate number of tree species.

Status of threatened flora

As per the floral documentation of Achanakmar- Amarkantak biosphere reserve (Anon, 2009, 2010), 28 species are found under various categories of threats (Table 20) (Fig. 7). As per IUCN norms they have been categorized as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). The BR has one critically endangered, five endangered and twenty two vulnerable plants species.

Table 20. List of threatened flora in Achanakmar-Amarkantak biosphere reserve

Sl. No.	Name of species	Common name	Family	Category
1	*Adiantum capillus veneris* L.	Hansraj	Adiantaceae	EN
2	*Lygodium flexuosum* (L.) Sw.	-	Lygodiaceae	EN
3	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Kalmegh	Acanthaceae	VU
4	*Peucedanum nagpurense* Prain	Tejraj	Apiaceae	VU
5	*Rauvolfia serpentina* (L.) Benth.ex Kurz	Sarpagandha	Apocynaceae	CR
6	*Gymnema sylvestre* (Retz.) R.Br. ex Schult.	Gurmar	Asclepiadaceae	VU
7	*Oroxylum indicum* (L.) Vent.	Sheonag	Bignoniaceae	VU
8	*Boswellia serrata* Roxb.	Salai	Burseraceae	VU
9	*Celastrus paniculata* Willd.	Malkangni	Celastraceae	VU
10	*Terminalia chebula* Retz.	Harra	Combretaceae	VU
11	*Phyllanthus emblica* L. (syn. *Emblica officinalis* J. Gaertn.)	Aonla	Euphorbiaceae	VU
12	*Pterocarpus marsupium* Roxb.	Bija	Fabaceae	VU
13	*Uraria picta* (Jacq.) Desv. ex DC.		Fabaceae	VU
14	*Litsea glutinosa* (Lour.) CR.Robins	Maida	Lauraceae	VU
15	*Piper longum* L.	Lendi peper	Piperaceae	VU
16	*Plumbago zeylanica* DC.	Chitrak	Plumbaginaceae	VU
17	*Thalictrum foliolosum* DC.	Mameri	Ranunculaceae	VU
18	*Sterculia urens* Roxb.	Kullu	Sterculiaceae	VU
19	*Clerodendrum serratum* (L.) Moon.	Bharangi	Verbenaceae	EN
20	*Acorus calamus* L.	Buch	Araceae	EN
21	*Dioscorea bulbifera* L.	Ratalu	Dioscoreaceae	VU
22	*D. hispida* Denn.	Karuakanda	Dioscoreaceae	VU
23	*Chlorophytum tuberosum* Baker	Safed musali	Liliaceae	VU

Acorus calamus (EN)

Adiantum capillus veneris (EN)

Celastrus paniculatus(VU)

Costus speciosus (VU)

Lygodium flexuosum (EN)

Rauwolfia serpentina (CR)

Fig. 7. Threatened medicinal plants in Achanakmar-Amarkantak biosphere reserve

24	*Drimia indica* (Roxb.) I.P. Jessop (syn.*Urgenia indica* (Roxb.) Kunth)	Jangali Pyaj	Liliaceae	VU
25	*Gloriosa superba* L.	Kaliyari	Liliaceae	VU
26	*Eulophia herbacea* Lindl.		Orchidaceae	EN
27	*Costus speciosus* Sm.	Keokand	Zingiberaceae	VU
28	*Curcuma angustifolia* Roxb.	Tikhur	Zingiberaceae	VU

CR= Critically endangered. EN=Endangered. VU= Vulnerable

Seasonal population status of butterflies and moths

During the project period, seven field visits to the core, buffer and transition zones of the biosphere reserve were conducted in rainy, winter and summer seasons, 2010-13, for collection of butterflies and moths. In all, 558 insect samples were collected from these areas. Of these, 400 specimens were identified, while 158 are being identified and confirmed. The list of identified insects collected during different seasons of the year are mentioned in tables 21-27. In total, the identified specimens include 73 insects belonging to the Order Lepidoptera, out of which 39 butterflies and 34 moths (Table 28). Literature is being cunsulted to examine their previous record that already existing in inventory of insect fauna of Achanakmar-Amarkantak biosphere reserve (Anon, 2008, 2010).

Table 21. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the rainy season (August, 2010)

Sl. No.	Name of Species*	Family
Butterflies		
1	*Abisara echerius* (Stoll)	Erycinidae
2	*Badamia exclamationis* (Fabricus)	Hesperiidae
3	*Catopsilia crocale* (Cramer)	Pieridae
4	*Catopsilia pyranthe pyranthe* (Linnaeus)	Pieridae
5	*Danaus genutia* (Cramer)	Danaidae
6	*Euploea core* (Cramer)	Danaidae
7	*Hypolimnas bolina* (Linnaeus)	Nymphalidae
8	*Hypolimnas misippus* (Linnaeus)	Nymphalidae
9	*Melanitis leda ismene* (Cramer)	Satyridae
10	*Phalanta phalantha* (Drury)	Nymphalidae
11	*Precis lemonias* (Linnaeus)	Nymphalidae
12	*Ypthima avanta* Moore	Satyridae

Moths		
13	*Agrotis ipsilon* Hufnagel	Noctuidae
14	*Agrotis segetis* Hubner	Noctuidae
15	*Antheraea paphia* (Linnaeus)	Saturniidae
16	*Chaerocampa boerhaviae* Fabricius	Sphingidae
17	*Creatonotus gangis* (Linnaeus)	Arctiidae
18	*Cyana peregrina* Walker	Arctiidae
19	*Dasychira mendosa* (Hubner)	Lymantriidae
20	*Estigena pardalis* Walker	Lasiocampidae
21	*Eusemia adlatatrix* Kollar	Agaristidae
22	*Gramodes mygdon* Cramer	Noctuidae
23	*Hamodes unilinea* Swinhoe	Noctuidae
24	*Harse convolvuli* Linnaeus	Sphingidae
25	*Macroglossum belis* Linnaeus	Sphingidae
26	*Metanastria repanda* Walker	Lasiocampidae
27	*Nephele hespera* Fabricius	Sphingidae
28	*Nyctipao macrops* Linnaeus	Noctuidae
29	*Pericallia ricini* (Fabricius)	Arctiidae
30	*Plusia orichalcea* (Fabricius)	Noctuidae
31	*Polytela gloriosa* Fabricius	Noctuidae
32	*Psilogramma menephron* (Cramer)	Sphingidae
33	*Remigia archesia* Cramer	Noctuidae
34	*Semiothisa elconora* Cramer	Geometridae
35	*Spodoptera litura* Fabricius	Noctuidae

Table 22. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the winter season (December, 2010)

Sl. No.	Name of species	Family
Butterflies		
1	*Acraea violae* (Fabricius)	Nymphalidae
2	*Danaus limniace* (Butler)	Danaidae
3	*Melanitis leda* (Cramer)	Satyridae
Moths		
4	*Agrotis ipsilon* Hufnagel	Noctuidae
5	*Agrotis segetis* Hubner	Noctuidae
6	*Anomis flava* Fabricius	Noctuidae
7	*Ascotis imparata* Walker	Geometridae
8	*Creatonotos transiens* Walker	Arctiidae
9	*Cyana peregrine* (Walker)	Arctiidae
10	*Hetiothis armigera* Hubner	Noctuidae

Table 23. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the summer season (March, 2011)

Sl. No.	Name of species	Family
Butterflies		
1	*Delias eucharis* (Drury)	Pieridae
2	*Euploea core* (Cramer)	Danaidae
3	*Eurema hecabe* Linnaeus	Pieridae
4	*Hypolimnas misippus* (Linnaeus)	Nymphalidae
5	*Melanitis leda* (Cramer)	Satyridae
6	*Mycaelesis visala* Moore	Nymphalidae
7	*Neptis hylas* Moore	Nymphalidae
8	*Papilio demoleus* Linnaeus	Papilionidae
9	*Pantaporia selenophora* Kollar	Nymphalidae
10	*Papilio polytes* Cramer	Papilionidae
11	*Precis atlites* (Linnaeus)	Nymphalidae
12	*Ypthima avanta* Moore	Satyridae
Moths		
13	*Cyana peregrine* (Walker)	Arctiidae
14	*Diacrisia obliqua* (Walker)	Arctiidae
15	*Creatonotos transiens* Walker	Arctiidae
16	*Heliothis armigera* Hubner	Noctuidae
17	*Hyposidra talaca* (Walker)	Geometridae
18	*Semiothisa elconora* Cramer	Geometridae

Table 24. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the rainy season (August, 2011)

Sl. No.	Name of species	Family
Butterflies		
1	*Abisara echerius* (Stoll)	Ericinidae
2	*Catopsilia crocale* Cramer	Pieridae
3	*Catopsilia pomona* Fabricius	Pieridae
4	*Catopsilia pyranthe* (Linnaeus)	Pieridae
5	*Danais genutia* (Cramer)	Danaidae
6	*Danais limniace* (Butler)	Danaidae
7	*Euploea core* (Cramer)	Danaidae
8	*Eurema blanda* Boisduval	Pieridae
9	*Hypolimnas bolina* (Linnaeus)	Nymphalidae
10	*Jamides celeno* Cramer	Lycaenidae
11	*Mycaelesis mineus* (Linnaeus)	Satyridae
12	*Mycaelesis visala* Moore	Satyridae
13	*Pantoporia perius* Linnaeus	Nymphalidae
14	*Papilio polytes* Cramer	Papilionidae

15	*Precis atlites* (Linnaeus)	Nymphalidae
16	*Precis iphita* (Cramer)	Nymphalidae
17	*Phananta phalantha* Drury	Nymphalidae
18	*Symphaedra nais* (Forster)	Nymphalidae
19	*Tros aristolochiae* Fabricius	Papilionidae
20	*Udaspes folus* Cramer	Hesperiidae
21	*Ypthima avanta* Moore	Satyridae
Moths		
22	*Botyodes asialis* Guenee	Crambidae
23	*Eusemia adulatrix* Kollar	Noctuidae
24	*Eutectona mecheralis* (Walker)	Pyralidae
25	*Glyphodes bicolor* (Swainson)	Crambidae
26	*Hyblaea puera* Cramer	Hyblaeidae
27	*Lymantria beatrix* Stoll	Lymantridae
28	*Nephele hespera* (Fabricius)	Sphingidae
29	*Plusia eriosoma* Doubleday	Noctuidae
30	*Semiothisa elconora* Cramer	Geometridae

Table 25. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the winter season (November, 2011).

Sl. No.	Name of species	Family
Butterflies		
1	*Abisara echerius* (Stoll)	Ericinidae
2	*Catopsilia pomona* Fabricius	Pieridae
3	*Catopsilia pyranthe* (Linnaeus)	Pieridae
4	*Danais chrysipus* (Linnaeus)	Danaidae
5	*Delias eucharis* (Drury)	Pieridae
6	*Ergolis ariadne* (Johanssen)	Nymphalidae
7	*Euploea core* (Cramer)	Danaidae
8	*Eurema blanda* Boisduval	Pieridae
9	*Jamides celeno* Cramer	Lycaenidae
10	*Mycaelesis mineus* (Linnaeus)	Satyridae
11	*Mycaelesis visala* Moore	Satyridae
12	*Neptis hylas* Moore	Nymphalidae
13	*Neptus jumbah* Moore	Nymphalidae
14	*Pantaporia selenophora* Kollar	Nymphalidae
15	*Pareronia valeria* (Cramer)	Pieridae
16	*Phalanta phalantha* Drury	Nymphalidae
17	*Precis almana* (Linnaeus)	Nymphalidae
18	*Precis atlites* (Linnaeus)	Nymphalidae
19	*Précis iphita* (Cramer)	Nymphalidae
20	*Précis lemonias* (Linnaeus)	Nymphalidae

21	*Symphaedra nais* (Forster)	Nymphalidae
Moths		
22	*Ascotis selenaria imparata* Walker	Geometridae
23	*Plusia eriosoma* Doubleday	Noctuidae
24	*Spodoptera litura* (Fabricius)	Noctuidae

Table 26. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the winter season (November, 2012)

Sl. No.	Name of species	Family
Butterflies		
1	*Abisara echerius* (Stoll)	Ericinidae
2	*Amblypodia amantes* Hewitson	Lycaenidae
3	*Catopsilia crocale* Cramer	Pieridae
4	*Danais genutia* (Cramer)	Danaidae
5	*Delias eucharis* (Drury)	Pieridae
6	*Euploea core* (Cramer)	Danaidae
7	*Eurema blanda* Boisduval	Pieridae
8	*Eurema hacabe* Linnaeus	Pieridae
9	*Lethe drypetis* (Hewitson)	Nymphalidae
10	*Hypalimnas bolina* (Linnaeus)	Nymphalidae
11	*Hypolimnas misippus* (Linnaeus)	Nymphalidae
12	*Melanitis leda* (Cramer)	Satyridae
13	*Mycaelesis mineus* (Linnaeus)	Satyridae
14	*Mycaelesis visala* Moore	Satyridae
15	*Neptis hylas* Moore	Nymphalidae
16	*Neptis jumbah* Moore	Nymphalidae
17	*Papilio demoleus* Linnaeus	Papilionidae
18	*Precis iphita* (Cramer)	Nymphalidae
19	*Precis lemonias* (Linnaeus)	Nymphalidae
20	*Symphaedra nais* (Forster)	Nymphalidae
Moths		
21	*Agrotis segetis* Hubner	Noctuidae
22	*Anomis flava* Fabricius	Noctuidae
23	*Creatonotos gangis* (Linnaeus)	Arctiidae
24	*Creatonotos transiens* Walker	Arctiidae
25	*Euproctis subnotata* Walker	Lymantridae
26	*Hyposidra successaria* Walker	Geometridae
27	*Hyposidra talaca* (Walker)	Geometridae
28	*Lymantria Beatrix* Stoll	Lymantridae
29	*Trypanophora semihyalina* Kollar	Zygaenidae

Table 27. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during the winter season (January, 2013)

Sl. No.	Name of species	Family
Butterflies		
1	*Abisara echerius* (Stoll)	Ericinidae
2	*Amblypodia amantes* Hewitson	Lycaenidae
3	*Catopsilia crocale* Cramer	Pieridae
4	*Danais genutia* (Cramer)	Danaidae
5	*Delias eucharis* (Drury)	Pieridae
6	*Euploea core* (Cramer)	Danaidae
7	*Eurema blanda* Boisduval	Pieridae
8	*Eurema hacabe* Linnaeus	Pieridae
9	*Lethe drypetis* (Hewitson)	Nymphalidae
10	*Hypolimnas bolina* (Linnaeus)	Nymphalidae
11	*Hypolimnas misippus* (Linnaeus)	Nymphalidae
12	*Melanitis leda* (Cramer)	Satyridae
13	*Mycaelesis mineus* (Linnaeus)	Satyrudae
14	*Mycaelesis visala* Moore	Satyridae
15	*Neptis hylas* Moore	Nymphalidae
16	*Neptis jumbah* Moore	Nymphalidae
17	*Papilio demoleus* Linnaeus	Papilionidae
18	*Precis iphita* (Cramer)	Nymphalidae
19	*Precis lemonias* (Linnaeus)	Nymphalidae
20	*Symphaedra nais* (Forster)	Nymphalidae
Moths		
21	*Agrotis segetis* Hubner	Noctuidae
22	*Anomis flava* Fabricius	Noctuidae
23	*Creatonotos gangis* (Linnaeus)	Arctiidae
24	*Creatonotos transiens* Walker	Arctiidae
25	*Euproctis subnotata* Walker	Lynmantridae
26	*Hyposidra successaria* Walker	Geometridae
27	*Hyposidra talaca* (Walker)	Geometridae
28	*Lymantria beatrix* Stoll	Lymantridae
29	*Trypanophora semihyalina* Kollar	Zygaenidae

Table 28. Butterflies amd moths collected form Achanakmar-Amarkantak biosphere reserve during rainy, winter and summer seasons, 2010-13

Sl. No.	Name of species	Family	Accession Number*	Reference
Butterflies				
1	*Abisara echerius* (Stoll)	Ericinidae	419	Singh and Chandra (2006)
2	*Acraea violae* (Fabricius)**	Nymphalidae	159	New record

3	*Amblypodia amantes* Hewitson**	Lycaenidae	371	New record
4	*Badamia exclamationis* Fabricius	Hesperiidae	160	Singh and Chandra (2006)
5	*Catopsilia crocale* Cramer	Pieridae	38	Singh and Chandra (2006)
6	*Catopsilia pomona* Fabricius	Pieridae	334	Singh and Chandra (2006)
7	*Catopsilia pyranthe* (Linnaeus)	Pieridae	346	Singh and Chandra (2006)
8	*Danaus chrysippus* (Linnaeus)	Danaidae	292	Singh and Chandra (2006)
9	*Danaus genutia* (Cramer)	Danaidae	295	Singh and Chandra (2006)
10	*Danaus limniace* (Butler)	Danaidae	355	Singh and Chandra (2006)
11	*Delias eucharis* (Drury)**	Pieridae	481	New record
12	*Ergolis ariadne* (Johanssen)**	Nymphalidae	696	New record
13	*Euploea core* (Cramer)	Danaidae	15	Singh and Chandra (2006)
14	*Eurema blanda* Boisduval**	Pieridae	40	New record
15	*Eurema hacabe* Linnaeus**	Pieridae	288	New record
16	*Lethe drypetis* (Hewitson)**	Satyridae	533	New record
17	*Hypolimnas bolina* (Linnaeus)	Nymphalidae	386	Singh and Chandra(2006)
18	*Hypolimnas misippus* (Linnaeus)	Nymphalidae	154	Gupta and Mondal (2005) Singh and Chandra (2006)
19	*Jamides celeno* Cramer**	Lycaenidae	487	New record
20	*Leptosia xiphia* Fabricius**	Pieridae	659	New record
21	*Melanitis leda* (Cramer)	Satyridae	382	Singh and Chandra (2006)
22	*Mycaelesis mineus* (Linnaeus)	Satyridae	372	Singh and Chandra (2006)
23	*Mycaelesis visala* Moore**	Satyridae	425	New record
24	*Neptis hylas* Moore	Nymphalidae	49	Singh and Chandra (2006)
25	*Neptis jumbah* Moore	Nymphalidae	523	Singh and Chandra (2006)
26	*Pantaporia perius* Linnaeus**	Nymphalidae	335	New record
27	*Pantaporia selenophora* Kollar**	Nymphalidae	521	New record
28	*Papilio demoleus* Linnaeus**	Papilionidae	18	New record

29	*Papilio polytes* Cramer	Papilionidae	387	Singh and Chandra (2006)
30	*Pareronia valeria* (Cramer)**	Pieridae	660	New record
31	*Phalanta phalantha* Drury*	Nymphalidae	45	New record
32	*Precis almana* (Linnaeus)	Nymphalidae	51	Singh and Chandra (2006)
33	*Precis atlites* (Linnaeus)	Nymphalidae	50	Singh and Chandra (2006)
34	*Precis iphita* (Cramer)	Nymphalidae	353	Singh and Chandra (2006)
35	*Precis lemonias* (Linnaeus)	Nymphalidae	52	Singh and Chandra (2006)
36	*Symphaedra nais* (Forster)	Nymphalidae	352	Singh and Chandra (2006)
37	*Tros aristolochiae* Fabricius**	Papilionidae	577	New record
38	*Udaspes folus* Cramer	Hesperiidae	216	Singh and Chandra (2006)
39	*Ypthima avanta* Moore*	Satyridae	422	New record
Moths				
40	*Agrotis ipsilon* Hufnagel**	Noctuidae	28	New record
41	*Agrotis segetis* Hübner	Noctuidae	586	New record
42	*Anomis flava* Fabricius**	Noctuidae	230	New record
43	*Antheraea paphia* Linnaeus	Saturniidae	440	Chandra *et al*. (2006)
44	*Ascotis imparata* Walker**	Geometridae	337	New record
45	*Botyodes asialis* Guenee**	Pyralidae	7	New record
46	*Creatonotos gangis* (Linnaeus)**	Arctiidae	60	New record
47	*Creatonotos transiens* Walker**	Arctiidae	61	New record
48	*Cyana peregrine* (Walker)**	Arctiidae	408	New record
49	*Diacrisia obliqua* Walker**	Arctiidae	182	New record
50	*Estigena pardalis* Walker**	Lasiocampidae	403	New record
51	*Euproctis subnotata* Walker**	Lymantriidae	391	New record
52	*Eusemia adulatrix* Kollar**	Agaristidae	388	New record
53	*Eutectona mechaeralis* (Walker)**	Pyralidae	9	New record
54	*Glyphodes bicolor* (Swainson)**	Pyralidae	685	New record
55	*Grammodes mygdon* Cramer**	Noctuidae	566	New record
56	*Hamodes unilinea* Swinhoe**	Noctuidae	428	New record
57	*Heliothis armigera* Hubner**	Noctuidae	303	New record
58	*Hyblea puera* Cramer**	Hyblaeidae	1	New record
59	*Hymenia recurvalis* Fabricius**	Pyralidae	657	New record
60	*Hyposidra successaria* Walker**	Geometridae	536	New record

61	*Hyposidra talaca* (Walker)	Geometridae	200	Chandra *et al*. (2006)
62	*Lymantria beatrix* Stoll**	Lymantriidae	571	New record
63	*Metanastria repanda* Walker**	Lasiocampidae	471	New record
64	*Nephele hespera* (Fabricius)**	Sphingidae	484	New record
65	*Pericallia ricini* Fabricius**	Arctiidae	42	New record
66	*Plusia eriosoma* Doubleday**	Noctuidae	420	New record
67	*Plusia orichalcea* (Fabricius)**	Noctuidae	173	New record
68	*Polytela glariosae* Fabricius	Noctuidae	349	Chandra *et al*. (2006)
69	*Psilogramma menephron* (Cramer)	Sphingidae	450	Chandra *et al*. (2006)
70	*Remigia archesia* Cramer**	Noctuidae	379	New record
71	*Semiothisa elconora* Cramer**	Geometridae	491	New record
72	*Spodoptera litura* (Fabricius)**	Noctuidae	35	New record
73	*Trypanophora semihyalina* Kollar**	Zygaenidae	684	New record

*All insect species maintained under separate Accession numbers and deposited in National Repository for Insects, Forest Entomology Division of this Institute. ** New record.

Earlier reports on insect faunal composition of Achanakmar-Amarkantak biosphere reserve reveals 112 species of insects, out of which 83 lepidopteran insects consisting of 49 species of butterflies belonging to 32 genera under 8 families and 34 species of moths belonging to 32 genera under 13 families (Anon, 2008, 2010). During the present study, out of 39 butterflies collected belonging to 26 genera under 8 families, 17 species (Fig. 8,9) are being found to be new record and out of 34 moths collected belonging to 30 genera under 11 families, 30 species (Fig. 10,11) are recorded for the first time from this biosphere reseve. This is a new addition to the insect faunal composition of Achanakmar-Amarkanatk biosphere reserve. Further, it was observed that seasonal population abundance is more during the rainy season of the year followed by winter and summer. It was also observed that population of butterfly is always more than moth population, irrespective of seasons.

Thus, as per the latest knowledge, a total of 186 species of insects occurr in Achanakmar-Amarkanatk biosphere reserve, out of which 157 species belong to the Order Lepidoptera that includes 88 species of butterflies and 68 species of moths.

Badamia exclamationis

Catopsilia pomana

Catopsilia pyranthe

Danaus chrysippus

Danaus genutia

Euploea core

Hypolimnas misippus (Male)

*Hypolimnas misippus (*Female)

Fig. 8. Butterflies of Achanakmar-Amarkantak biosphere reserve

Hypolimnas bolina

Melanitis leda

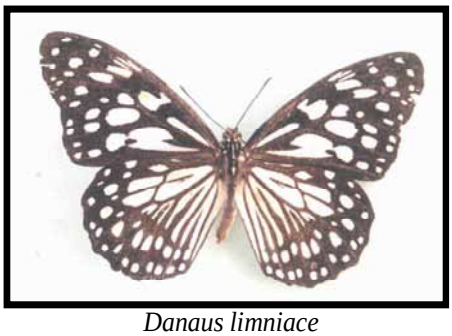
Mycalesis mineus

Neptis columella

Papilio demoleus

Papilio polytes

Precis lemonias



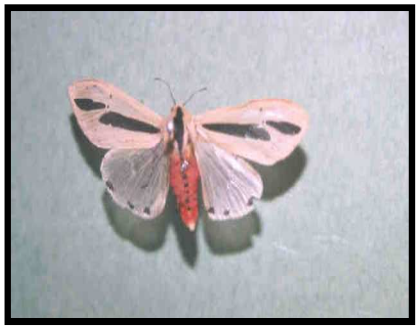
Danaus limniace

Fig. 9. Butterflies of Achanakmar-Amarkantak biosphere reserve

Agrotis segetis

Agrotis ipsilon

Antheraea paphia



Creatonotos gangis

Cyana perigrinae

Eusemia adulatatrix

Hyblaea puera

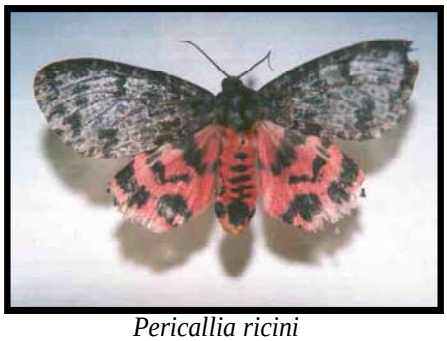
Harse convolvuli

Fig.10. Moths of Achanakmar-Amarkantak biosphere reserve

Hyposidra talaca

Metanastria repanda

Nephele hespera



Pericallia ricini

Polytela gloriosa

Psilogramma menephron

Spodoptera litura

Trypanophora semihyalina

Fig. 11. Moths of Achanakmar-Amarkantak biosphere reserve

Study on newly recorded moth fauna of Achanakmar-Amarkanatk biosphere reserve

Recent survey conducted in Achanakmar-Amarkanatk biosphere reserve during the rainy season (August-October, 2012), it was observed that *Casearia tomentosa* Roxb. (syn. *C. elliptica* Wild) (family Samidaceae) (Anon, 1992), growing in sal forests were severely attacked and defoliated by some lepidopteran larvae. These caterpillars were then collected and reared on its host plant in laboratory under the prevailing environmental conditions of August-September (temperature 30-35^0 C and RH 50-67%). Larvae were provided with *ad libitum* feeding until pupation. The observations, measurements and weight of different developmental stages were recorded throughout the rearing period till emergence of adult moths. The moths emerged were killed, oven dried, studied morphologically and systematically to identify them with the help of available literature (Hampson, 1896) and determined specimen preserved for reference collection at Forest Entomology Division of this Institute.

The present survey revealed that *C. tomentosa* suffers seriously from the attack of a defoliator, identified after comparing the morphology of adult moth with determined specimen preserved for reference collection under the Accession No. 7 at Forest Entomology Division of this Institute as *Botyodes asialis* Guen. (Lepidoptera : Pyraustinnae : Pyralidae) (Fig. 12). In regard to the genus, *Botyodes* Guen., that includes six species (Hampson, 1896). *B. asialis* has been reported from Africa, through Asia to the Pacific, including Fiji, Hong Kong, Thailand, India, Siam, Sri Lanka, the Philippines, New Guinea, Samoa, Malay Peninsula and Queensland.

The food plant of *B. asialis* is *Ficus* (Hampson, 1896; Lefroy, 1909). According to Beeson (1941), *B. asialis* is widely distributed in Asia and recorded as a defoliator of *Casearia graveolens*, *C. tomentosa*, *Diospyros tupra*, *Glycosmis pentaphylla* and *Urena lobata*. The damage intensity of this pest was found to be very high (more than 25% based on defoliation percentage/plant) and in a few cases leaves of the whole plant was noticed to be infested by *B. asialis*. The period of infestation of this defoliator was recorded to be August-October, the rainy season of the year.

Developmental stages of *B. asialis*

The linear measurements of larvae, pupae and wing expense of male and female moths of *B. asialis* developed after rearing in laboratory are presented in table 29. It was observed that the larvae are generally olive green with reddish lateral band, small hair bearing dorsal and sublateral and two series of large lateral black spots, head black and the yellow vertex.

Table 29 . Data on linear measurements of developmental stages of *Botyodes asialis* and wing expanse of adults developed after rearing in laboratory

Stage	Length (mm)	
	Range	Mean ± SE
Larva		
Ante-penultimate	15-20	17.50 ± 2.50
Penultimate	18-30	22.50 ± 3.99
Ultimate*	30-40	33.20 ± 2.79
Pupa	17-22	20.25 ± 1.11
Adult**		
Male	42-45	43.20 ± 1.25
Female	46-48	46.50 ± 0.81

*Full grown. **Wing expanse of oven dried specimen.
Data based on 10 observations.

It was recorded that pupa is obtect and green in colour with short anal point and antennal sheath. The pupal period was found to exist for 7-10 days (mean 8.40 ± 0.98 days). Beeson (1941) has mentioned that the pupal period is 12 days in October and as much as 19 days in November.

The diagnostic features of moth of this species have been described by Hampson (1896). It is characterised by orange-yellow moth, male with black anal tuft, fore wing with fulvous speck below median nervure near base, an oblique maculate fulvous antemedial line, a speck in cell and discocellular ocellus, an interrupted sinuous postmedial line inwardly oblique from vein 5 to 2, a highly sinuous submarginal line, with the area beyond it fulvous except at apex, hind wing with discellular ocellus, a post medial sinuous line highly bent outwards between veind 5 and 3, the marginal area fulvous with a grey tinge, narrowing to anal angle and with its inner edge sinuous, both wings with the cilia fuscous and grey colour at tips.

Defoliated *Casearia. tomentosa*

Full grown larva of *B. asialis*

Pupa of *B. asialis*

Moth of *B. asialis*

Fig . 12. Host plant and developmental stages of *Botyodes asialis*

Growth and development of *B. asialis*

Concomitant growth and development proceed simultaneously in the ontogeny of insects, although the end of growth and the rate at which it proceeds is limited (Sehnal, 1985). Moulting is primarily a mechanism of growth (Wigglesworth, 1972) and larval moulting is an essential process for salutatory growth in insects (Williams, 1980), to gain the critical size necessary for subsequent metamorphosis (Nijhout, 1991). Growth shows a progressive increase throughout the larval instars, steady increase throughout a stage of development, then falls slightly at the time of moulting due to loss of body moisture and following the moult the growth rapidly increases above its previous level (Chapman, 1982). In the present insect, *B. asialis*, the growth curve (Fig. 13) based on the live weight showed steady increase from ante-penultimate to penultimate instar then exhibited an exponential growth following food intake after last larval ecdysis with a peak on the ultimate instar, then a sudden fall occurred with the formation of pupa. This finding corroborates the observations of Roychoudhury *et al*. (1994) on *Bombyx mori*.

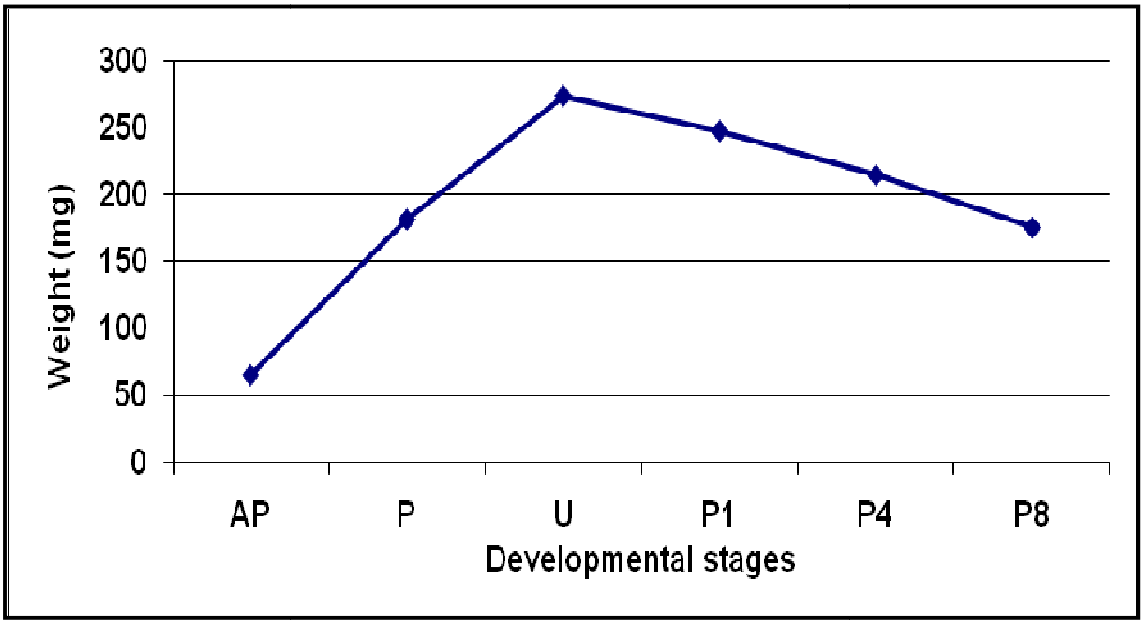


Fig. 13. Growth curve of *B.asialis*, based on live weight.
AP=Ante-penultimate larva. P=Penultimate larva. U=Ultimate larva. P1, P4 and P8=Pupa 1st, 4th and 8th day old pupa.

Thus, the present information is a new addition of moth to the insect faunal composition of Achanakmar-Amarkantak biosphere reserve. Further, the study reports the pest status, outbreak period, growth and development and description of *B. asialis*, a major defoliator of *C. tomentosa*.

Villagewise population and movement of inhabitants from inhospitable areas

Nearly, 7,617 traditional primitive tribal inhabitants ar per the population census of the year 2001 are settled in 22 villages of the core zone whereas 4,40,404 inhabitants live in 396 villages and suburban areas of buffer and transition zones of the biosphere reserve. Recent information on population of different villages of biosphere reserve collected from different sources (Table 30) revealed that there are 418 villages with a total population of 4,36,128 in biosphere reserve. Six villages with a total population of 1,177 of core zone of biosphere reserve namely Bankul, Bokrakachar, Sambhardhasan, Bahawal, Jalda and Kuba were shifted to other locations in buffer zone. There are 27 communities living in different zones. These are Baiga, Gond, Dhanwar, Kol, Kanwar, Oraon, Chamar, Sais, Basora, Lonia, Muslim, Sindhi, Brahmin, Rajput, Goswami, Baraith, Kolar, Kumhar, Kewat, Nai, Ahir, Panika, Sondhiya, Lohar, Maratha, Sonar and Bania. The inhabitants are poor and depend mainly on agriculture and partially on biosphere reserve for fuel, fodder, food, medicine, etc.

Table 30. Distribution of population in the core, buffer and transition zones of Achanakmar-Amarkantak biosphere reserve

Zone	State	District	Number of villages	Population
Core zone	Chhattisgarh	Bilaspur	22*	7617*
Buffer zone	Chhattisgarh	Bilaspur	55	79913
	Madhya Pradesh	Anuppur	25	22677
		Dindori	13	12121
Total buffer zone			93	114711
Transition zone	Chhattisgarh		170	210108
	Madhya Pradesh		49	32984
	Dindori		84	70708
Total transition zone			303	313800
Grand total of biosphere reserve			418	436128

*Six villages with a total polation of 1177 shifted from core zone to buffer zone.

IV. Dissemination of research based information by holding workshops and trainings to biosphere research staff

Disseminated research based information by conducting three one day workshop/ training during the project period for front line field staff representing all the ranges from the three zones of biosphere reserve and provided training materials (Fig. 13).

One day workshop/training during the first year was organized on 26th October, 2010, on the following themes :

- Identification of butterflies found in biosphere reserve.
- Identification of birds found in biosphere reserve.
- Importance of sustainable harvesting in biosphere reserve.

One day workshop/training during the second year was organized on 3rd March, 2011, on the following themes:

- Achanakmar-Amarkantak biosphere reserve - An introduction.
- Medicinal plants of Achanakmar-Amarkantak biosphere reserve, their uses and conservation.
- Moths of Achanakmar-Amarkantak biosphere reserve and their importance.
- Vermicompost production technology and its importance.

One day workshop/training during the third year was organized on 23rd March, 2012, on the following themes :

- Achanakmar-Amarkantak biosphere reserve – Member of word network of biosphere reserve.
- Importance of wildlife conservation in Achanakmar- Amarkantak biosphere reserve.
- Developmental activities of Achanakmar-Amarkantak biosphere reserve.
- Rare medicinal plants of Achanakmar-Amarkantak biosphere reserve and their possibilities of conservation and regeneration.
- Rearing of tasar silkworm as an alternative for enhancement of livelihood.
- Mortality of tree species in Achanakmar-Amarkantak Biosphere Reserve.

(October. 2010)

(March 2012)

(March 2013)

Fig. 13. Workshop / training on Achanakmar-Amarkantak biosphere reserve

V. Publication of biannual literature

Published Biosphere Research Informations Series (BRIS) Vol. 2 (1-2) : 158 pages devoted to floral and faunal resources of Achanakmar- Amarkantak biosphere reserve and Biosphere Research Informations Series (BRIS) Vol. 3 (1-2) : 93 pages devoted to grasses of Achanakmar-Amarkantak biosphere reserve. Both the issues were distributed to managers of all BRs of the country. Carried out compilation of Biosphere Reserve Information Series (BRIS) Vol.4 (1-2) : 54 pages, devoted to wild mammals of Achanakmar- Amarkantak biosphere reserve, for its publication.

VI. Periodical interface with biosphere reserve manager to assess the research needs.

Frequent interactions were made with BR manager from time to time to work out the needs of Achanakmar-Amarkantak biosphere reseve. Aoround 10 meetings were held with BR manager to assess the research needs in crucial areas such as tree mortality in biosphere reserve and other activity like monitoring and evaluation of developmental activities of MAP, 2011-12. Suggestions were also given to the BR manager with regard to rehabilitating the land through development of grassland in villages shifted from the core zone of biosphere reseve.

VII. Submission of biosphere reserve nomination document to UNESCO and creation of a web based information centre.

Submitted nomination document of Achanakmar-Amarkantak biosphere reserve to United Nations Educational, Scientific and Cultural Organization (UNESCO) for inclusion in World Network of Biosphere Reserves (WNBR). International Coordinating council of UNESCO's man and the Biosphere (MAB) programme, at its 24th session held at UNESCO headquarters in Paris from 9th to 13th July, 2012 approved the inclusion of Achanakmar-Amarkantak biosphere reserve in its world's network of Biosphere Reserves (WNBR) (Fig. 14). The World Network of Biosphere Reserves of the Man and Biosphere Programme consists of a dynamic and interactive net work of sites of excellence. It fosters integration of people and nature for sustainable development through participatory dialogue, knowledge sharing, poverty reduction and human well-being improvements, respect for cultural values and society’s ability to cope with change, thus contributing to the Millennium Development

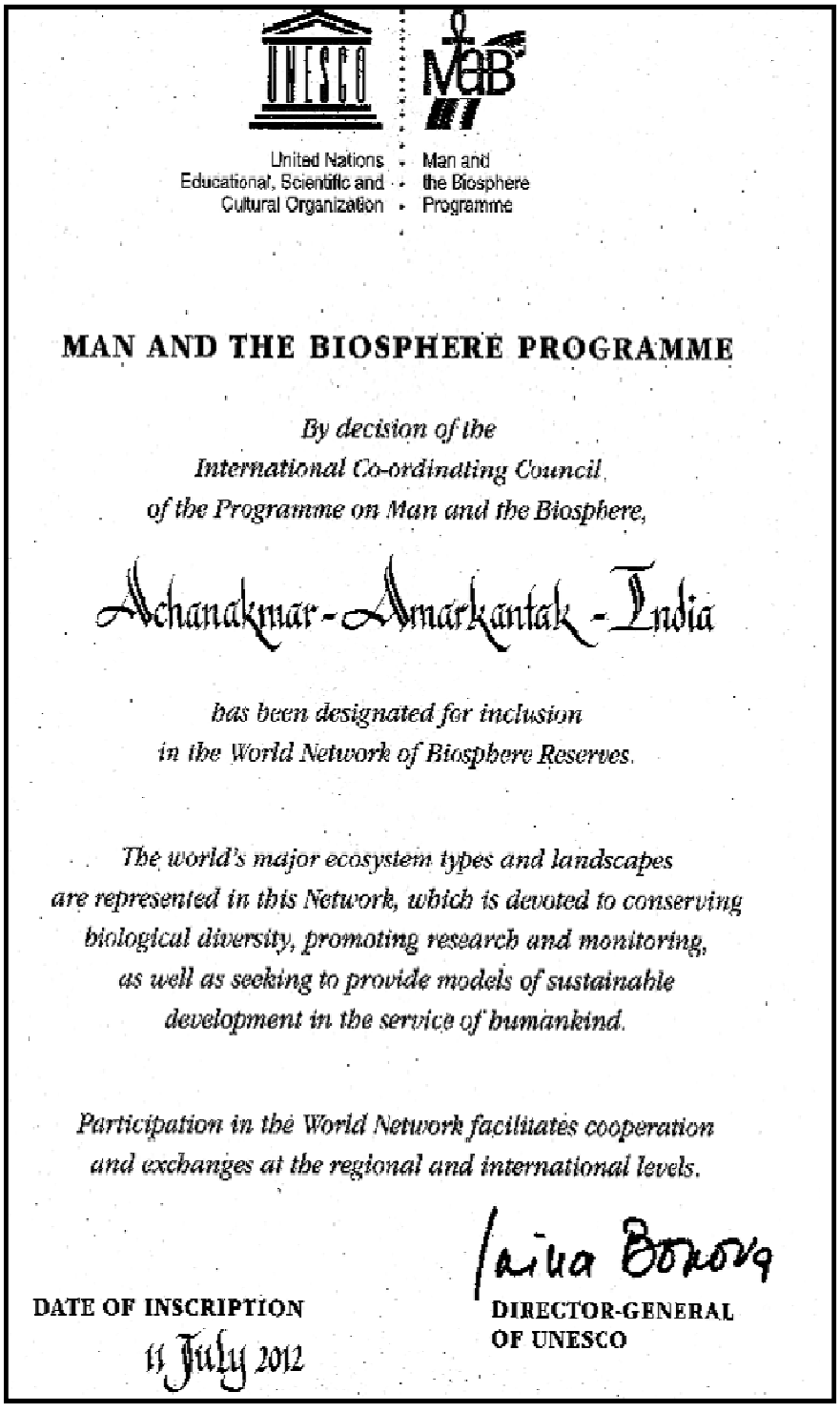
Goals (MDGs). With this recognition from UNESCO, the Achanakmar-Amarkantak Biosphere Reserve enters into new realm of developmental activities which will usher in biodiversity conservation and socio-economic improvement of nearby tribals and open-up for international scientific cooperation and funding.

Designed webpage on Achanakmar-Amarkantak Biosphere Reserve under Lead Institution and linked to the official website of TFRI, Jabalpur (http://tfri.icfre.gov.in/AABR/index.htm) (Fig. 15), to exchange and share technology.

12. Conclusion

Achanakmar- Amarkantak biosphere reserve is a paradise of biodiversity. The biosphere reseve is blessed with a total of 1738 identified floral species consisting of 7 species of algae, 238 species of fungi, 184 species of lichens, 44 species of bryophyte, 53 species of pteridophytes, 16 species of gymnosperms and 1196 species of angiosperms that include 335 species of monocot and 861 species of dicot. They yield spices, food, ayurvedic medicines and timbers. Around 184 species of plants have been identified for their ethnobotanical and ethnomedicinal uses. Besides these, there are 389 identified faunal species consisting of 179 species of invertebrates that include 5 species of centipedes, 66 species of butterflies, 66 species of moths, 41 species of beetles and one species of cricket, and 210 species of vertebrates that include 16 species of pisces, 10 species of amphibians, 15 species of reptiles, 144 species of aves and 27 species of mammals. Further, 192 species of plants have been identified for their ethnobotanical (73 species) and ethnomedicinal uses (119 species).

Interaction with regional research organization is important to develop suitable research project for the benefit of the local peoples of the biosphere reserve. Synthesis of data of meteorological observations of biosphere reseve are necessary to understand climate change and global warming. The data on density of tree species, species richness and their regeneration status indicated good regeneration both in core and buffer zones of biosphere reserve. Recorded status of 28 selected economically important threatened flora from core and buffer zones. Survey of biosphere resereve in different seasons revealed 73 species of lepidopteran insects (39 butterflies and 34 moths), of which 17 species of butterflies and 30



United Nations Educational, Scientific and Cultural Organization

Man and the Biosphere Programme

MAN AND THE BIOSPHERE PROGRAMME

By decision of the
International Co-ordinating Council
of the Programme on Man and the Biosphere,

Achanakmar - Amarkantak - India

has been designated for inclusion
in the World Network of Biosphere Reserves.

The world's major ecosystem types and landscapes
are represented in this Network, which is devoted to conserving
biological diversity, promoting research and monitoring,
as well as seeking to provide models of sustainable
development in the service of humankind.

Participation in the World Network facilitates cooperation
and exchanges at the regional and international levels.

Irina Bokova

DATE OF INSCRIPTION
11 July 2012

DIRECTOR-GENERAL OF UNESCO

Fig.14. Certificate of UNESCO for consideration of Achanakmar-Amarkantak biosphere reserve on WNBR

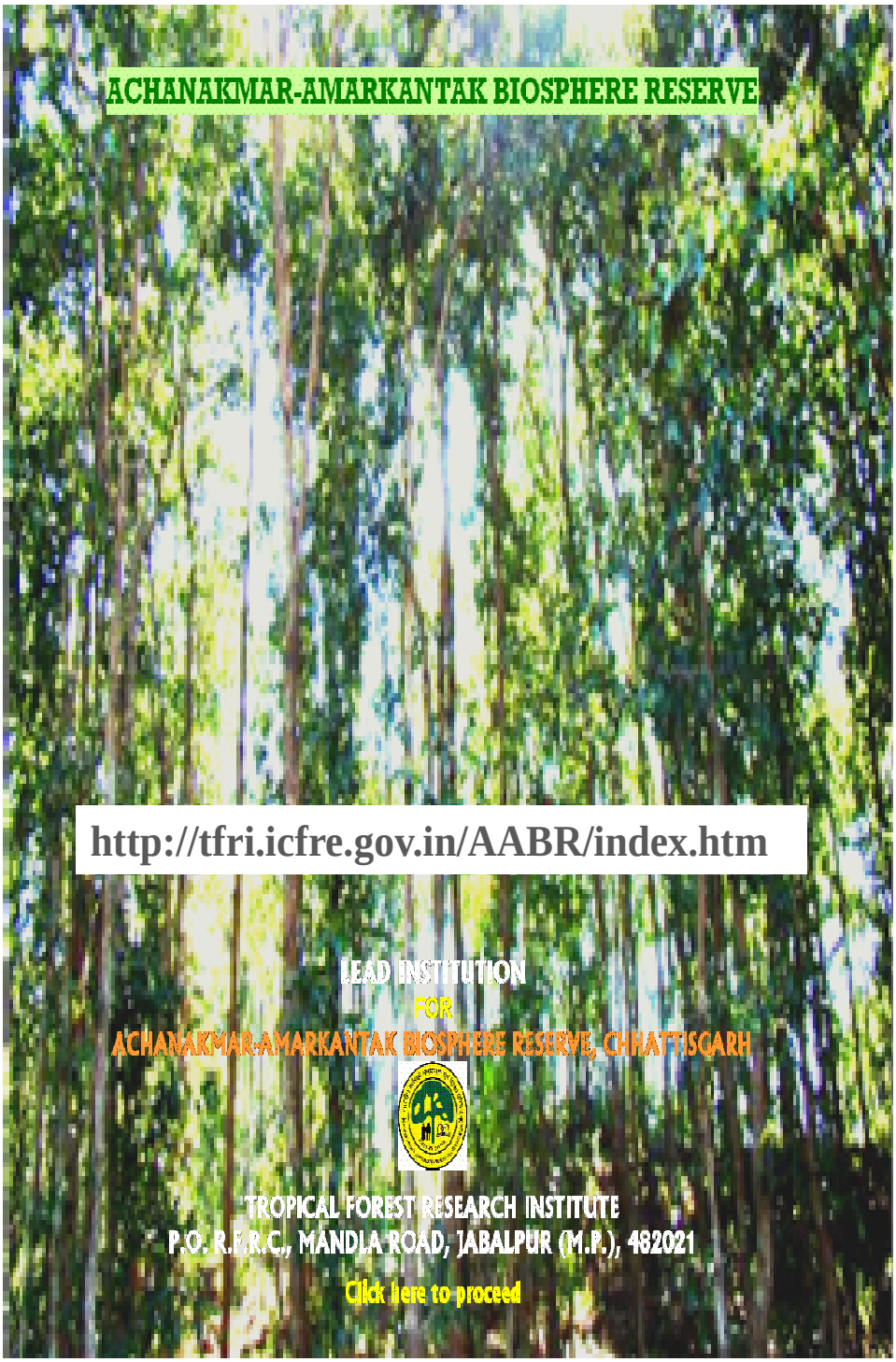


Fig.. 15. Web page of Achanakmar-Amarkantak biosphere reserve

species of moths recorded for the first time from this biosphere reserve. This is being a new addition to the insect faunal composition of Achanakmar-Amarknatk biosphere reserve. Provided information on population of biosphere reseve and movement of inhabitants from six villages of core zone to buffer zone.

Dissemination research based information by conducting workshop/ training for front line field staff and publication of Biosphere Research Informations Series (BRIS) for stakeholder are important to reach the latest knowledge. Research projects are continued on various aspects of Achanakmar-Amarkantak biosphere reseve. Hence, regular collection of scientific information and then disseminate it to BR manager to incorporate in management plan, is essential need of the hour. The present system should continue in the near future also.

The inclusion of Achanakmar-Amarkantak biosphere reserve in its world's network of Biosphere Reserves (WNBR) by UNESCO's man and the Biosphere (MAB) programme enters into new realm of developmental activities for biodiversity conservation and socio-economic improvement of tribals and opened-up international cooperation. To provide all these information, webpage on Achanakmar-Amarkantak Biosphere Reserve under Lead Institution has been designed and linked to the official website of TFRI, Jabalpur (http://tfri.icfre.gov.in/AABR/index.htm), to exchange and share technology.

13. Publications:

Anonymous (2010). Biosphere Reserve Information Series (BRIS), Vol. **2**(1-2) : 158 pp.

Anonymous (2012). Biosphere Reserve Information Series (BRIS), Vol. **3**(1-2) : 93 pp.

Anonymous (2013). Biosphere Reserve Information Series (BRIS), Vol. **4**(1-2) : prepared for publication.

Kushwaha, D.K., Barve, S.K. and Roychoudhury, N. (2011). Diversity of butterflies and moths in buffer zone of Achanakmar-Amarkantak biosphere reserve. National Seminar on Progress in Life Sciences for Human Welfare, 5-6 February 2011, Govt. Model Science College, Jabalpur, p. 47 (abstract).

Kushwaha, D.K., Barve, S.K. and Roychoudhury, N. (2012). *Ypthima avanta* Moore (Lepidoptera : Satyridae) – a new addition to the butterfly fauna of Achanakmar-Amarkantak biosphere reserve. *Indian J. Forestry* **35**(2) : 231-234.

Prakasham, U., Roychoudhury, N. and Sharma, R. (2012). Achanakmar-Amarkantak biosphere reserve on world network : scope and challenges. Seminar "Achanakmar-Amarkantak Biosphere Reserve on World Network : Prospects and Challenges", 21 November, 2012, Bilaspur Forest Division, Bilaspur, Chhattisgarh (Invited lecture).

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Roychoudhury, N., Chandra, S. and Deepa, M. *Botyodes asialis* Guen. (Lepidoptera : Pyralidae) - a new addition to the moth fauna of Achanakmar-Amarkantak biosphere reserve. *Indian J. Forestry* (communicated).

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Sharma, R. and Roychoudhury, N. (2012). Mapping populations of threatened medicinal plant species in Amarkantak forest range in Madhya Pradesh. National Conference on Biodiversity Assessment, Conservation and Utilization, 9-11 February, 2012, Abasaheb Garware College, Pune, pp. 45-46 (abstract).

Sharma, R. and Roychoudhury, N. (2012). Achanakmar-Amarkantak biosphere reserve. National Conference on Biodiversity & Biotechnology : Biological Resources Conservation Management and Sustainable Uses, March 13-14, 2012, Govt. M. S. Golwalker College, Rewa (M.P.), p. 23 (abstract of invited paper).

Sharma, R., Roychoudhury, N. and Prakasham, U. (2012). An updated list of grasses of Achanakmar-Amarkanatak biosphere reserve. *Vaniki Sandesh* **3**(2) : 17-42.

Sharma, R., Yadav, D. K., Kushwaha, D.K. and Roychoudhury, N. (2011). Need for conservation of medicinal plants in Achanakmar-Amarkantak biosphere reserve. National Symposium on Conservation of Forest Genetic Resource through Biotechnological Interventions, 19-20 December, 2011, Institute of Forest Productivity, Ranchi, p. 23 (abstract).

Tiple, A.D., Kushwaha, D.K., Joshi, K.C. and Roychoudhury, N. (2010). Composition of flora and fauna from Achanakmar-Amarkantak biosphere reserve. National Seminar on Current Advances in Biosciences : Application in Health, Environment and Agriculture, 23-24 November 2010, Hitkarini Mahila Mahavidyalaya, Jabalpur, p. 76 (abstract).

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14. Suggestions for follow-up study:

- The gathered information from various sources still appears incomplete, due to lack of identity of many species of algae, and beetles belonging to the different families.

- The information about other group of arthropods like millipedes and insects like bees, wasps, dragon and mayflies, grasshoppers, crickets, mantids, termites, flies and others like crustaceans, spiders and mites, etc. is still unexplored. No work has been reported so far on ento fauna of biosphere reserve and their host plants relation.

- Similarly, molluscs existing in biosphere reserve are also untouched and provide ample scope for their taxonomical and ecological studies.

- There is a dearth of literature about the occurrence of forest invasive spescies (FIS) that includes both flora and fauna and their impact in biosphere reserve. There is a wide scope to undertake research to prepare inventory and management of major FIS.
- There is an urgent need for the protection of threatened flora and fauna, especially those that belongs to critically endangered and vulnerable category.

- Beneficial insects like tasar silkworm, lac insect and honey bee and their host plants needs to be introduced in buffer and transitional zones for rearing/culture of target insects to enhance livelihood of tribal peoples.

- There is a wide scope to explore the wild fauna like fish, frog, snake, lizard, bird and mammals like bat, panther, mangoose, civet, etc.

15. Summary of the project

The Achanakmar-Amarkantak biosphere reserve is very rich with high density of flora and fauna. It comprises of 1734 species of identified flora. It has 429 species of thallophytes that includes 7 species of algae, 238 species of fungi and 184 species of lichens, 44 species of bryophytes, 49 species of pteridophytes, 16 species of gymnosperms and 1196 species of angiosperms. They yield spices, food, ayurvedic medicines and timbers. Around 184 species of plants have been identified for their ethnobotanical and ethnomedicinal uses. Besides these, there are 389 identified faunal species consisting of 179 species of invertebrates that include 5 species of centipedes, 66 species of butterflies, 66 species of moths, 41 species of beetles and one species of cricket, and 210 species of vertebrates that include 16 species of pisces, 10 species of amphibians, 15 species of reptiles, 144 species of aves and 27 species of mammals.

Interacted with regional research organization to develop suitable research project on biosphere reserve. Synthesised data of meteorological observations of biosphere reseve. The data on density of tree species, species richness and their regeneration status indicated good regeneration both in core and buffer zones of biosphere reserve. Recorded status of 28 selected economically important threatened flora from core and buffer zones. Survey of biosphere resereve in different seasons revealed 73 species of lepidopteran insects (39 butterflies and 34 moths), of which 17 species of butterflies and 30 species of moths recorded for the first time from this biosphere reserve. This is being a new addition to the insect faunal composition of Achanakmar-Amarknatk biosphere reserve.

Information on population of different villages of biosphere reserve collected from different sources revealed that there are 418 villages with a total population of 4,36,128 in biosphere reserve. Six villages with a total population of 1,177 of core zone of biosphere

reserve namely Bankul, Bokrakachar, Sambhardhasan, Bahawal, Jalda and Kuba were shifted to other locations in buffer zone. There are 27 communities living in different zones. The inhabitants are poor and depend mainly on agriculture and partially on biosphere reserve for fuel, fodder, food, medicine, etc.

Disseminated research based information by conducting workshop/ training for front line field staff and published Biosphere Research Informations Series (BRIS) and distributed to all stakeholders. Research projects are continued on various aspects of Achanakmar-Amarkantak biosphere reseve.

Included Achanakmar-Amarkantak biosphere reserve in its world's network of Biosphere Reserves (WNBR) by UNESCO's man and the Biosphere (MAB) programme. To provide all these information, webpage on Achanakmar-Amarkantak Biosphere Reserve under Lead Institution has been designed and linked to the official website of TFRI, Jabalpur (http://tfri.icfre.gov.in/AABR/index.htm), to exchange and share technology.

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