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Floristic diversity of climbing plants in tropical forests of Similipal Biosphere Reserve, Odisha, India

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Abstract

Climbers influence the diversity and composition of forest ecosystem immensely. We have investigated the floristic composition of climbing plants in tropical forests of Similipal Biosphere Reserve (SBR), Odisha, India. A total of 120 climber plant species belonging to 74 genera and 33 families were documented in all forests. Among families, the most speciose families were Fabaceae (25 species) and Convolvulaceae (22 species) followed by Cucurbitaceae (11 species), Vitaceae (8 species), Dioscoreaceae (7 species) etc. Similarly, dominant genera were *Ipomoea* possessing the highest number of species i.e., 9 species followed by *Dioscorea* (7 species), *Vigna* (6 species) and *Cissus* (4 species) etc. There was a remarkable difference noted in the structure and climbing mechanism of different climbers. The climbing plants diversity of SBR not only contributing to the overall forest biodiversity significantly but also maintain the ecological balance of the whole ecosystem. Climbers are the major resource of economic value in and around the biosphere reserve and thus their use and sustainable management must be given principal attention.

Keywords: climber's diversity; climbing mode; conservation; ecosystem; tropical forests
Abbreviations: SBR- Similipal Biosphere Reserve; WV- Woody Vines; HV- Herbaceous Vines, PV- Parasitic Vines

Introduction

Tropical forest constitutes 52% of the total forest of the globe and it is the most important ecosystem for biodiversity. Lianas are most diverse and abundant group of plants in the world representing nearly 25% of the woody stem density and species diversity in tropical forests (Gentry, 1991a). In the Indian subcontinent, 15010 km^2 of the area is occupied by tropical wet evergreen forests, which constitute about 10% of total tropical forest cover in the country (IIRS, 2002). Climbers are the plants which grow by climbing on bigger plants and different objects with the help of their tendrils. Tendrils are the special structures present in climbers which provides support for climbing over other. The climbers, creepers, vines and lianas are some separate groups of flora, which are differentiated based on their climbing habit and nature of stem organisation. Twiners are the specialised climbers which use their stem and leaves as tendrils and coils around a plant. The stems are slender and due to their twining habit, these are called as twiner or stem climber. Creepers are another group of life forms different from others because they don't grow vertically, they grow horizontally and spread. Lianas are the woody vines which have a long and woody stem and sometimes climb from one plant to another with the

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help of tendrils, sucker root following the sunlight. Lianas are one of the most important understudied life forms found mainly in tropical forests although usual in many forests of the world (Schnitzer and Bongers, 2002). The great ecological and functional differences among the species are described by the variation in species composition of lianas in different forests. Despite of having similar forms of growth between lianas, they vary in functional traits like procedure of climbing (Putz, 1984; Putz and Mooney, 1991), size of flower and type of diaspore (Gentry, 1991a; Bullock, 1995; Cai *et al.*, 2009;) and the need of light (Putz, 1984; Baars *et al.,* 1998; Gianoli *et al.*, 2010). Some biotic and abiotic factors like annual rainfall, seasonal rainfall, fertility of soil, structure of forest, regimes of disturbances represent the species diversity, abundance and distribution of lianas (Ibarra-Manriquez and Martinez-Ramos, 2002; Schnitzer and Bongers, 2002; Poulsen *et al.*, 2005; Schnitzer *et al.*, 2005; Addo-Fordjour *et al.*, 2009a, 2009b; DeWalt *et al.*, 2010; Toledo, 2010; Addo-Fordjour *et al.*, 2012).

Lianas cause compression and sometimes squeeze the host plant, as a result, the water movement, sap moment and rate of other physical and biological processes inside the host plant decreases (Dalling *et al.*, 2012). Hence, constriction of a long time on the plant may cause the death of the host plants. They damage physically the young plants and causes death whereas in case of matured plants they affect adversely both physically and compete with them in their biological processes. Lianas compete with host plants in nutrition, absorption of light and water and the growth rate of host plant decreases than the normal rate (Maria *et al.*, 2017). They cause bending and squeezing of plants, as a result, the timber value of the plant decreases. Every living and non-living object produce both the positive and negative impacts on their surrounding environment. In this manner lianas also have both positive and negative impacts on surrounding environment. If we consider both the impacts of lianas, it has a huge positive impact on living organisms and the negative impacts are very low (Bonger *et al.*, 2002). Besides adverse effects of lianas over the trees on which they climb, lianas cannot be neglected due to their ethnomedicinal values and importance in ecosystem functioning (Schnitzer and Bongers, 2002). They fulfil various purposes of human beings by providing edible fruits, vegetables and also have a great medicinal value. In distant or remote areas where the various advanced products and modern western medicines are unavailable and remain unreached, lianas play an important role for survival (Abbiw, 1990; Van Andel, 2000; Arnold and Ruiz Perez, 2001). But in some regions due to rapid human interference and exploitation, many of the valuable plants including lianas are coming towards extinction.

There are so many floristic, ethnobotanical and phytosociological studies were done in Similipal Biosphere Reserve (SBR) in recent past (Behera, 2006; Mishra *et al.*, 2008; Dash and Behera, 2013; Panda, 2014). Most of the studies emphasized on trees, medicinal plants and other groups of plants in general. However, a study on the climber, in particular, has not been done so far. Therefore, here is an attempt taken to study in detail on climber diversity in SBR along with its uses, habit and climbing mode. This data will be helpful for gaining knowledge on climbers and their values in forest ecosystems, which may have implications for conservation of climbers in tropical forests.

Materials and Methods

Study area

Similipal Biosphere Reserve (SBR) is located in Mayurbhanj district of Odisha, India (Figure 1). It extends between 20° 17' to 22° 34' N. latitude and 85° 40' to 87° 10' E. longitude, located in the centre of Mayurbhanj district and altitude ranges between 40 m to 1166 m above the sea level. The temperature here becomes minimum at 2 °C during winter and becomes maximum at 43 °C during summer. The average rainfall is 2200 mm. It stretches over an area of 5569.00 km^2 divided into a core area of ca 1194.75 km^2, buffer area ca 1335.88 km^2 and transition area *ca* 3038.39 km^2. It is a portion of Chhotanagpur biotic province of Deccan plateau and constituted in Mahanadian Biogeographic region. SBR is known as a prominent ecological hotspot and is one of the eighteen biosphere reserves of India because of its rich diversity and cultural significance.

Similipal exerts a large influence over the climatic conditions of Odisha and its neighbourhood and is an asset of floristic diversity of the state. Hence, it is also called as Himalayas of Odisha.

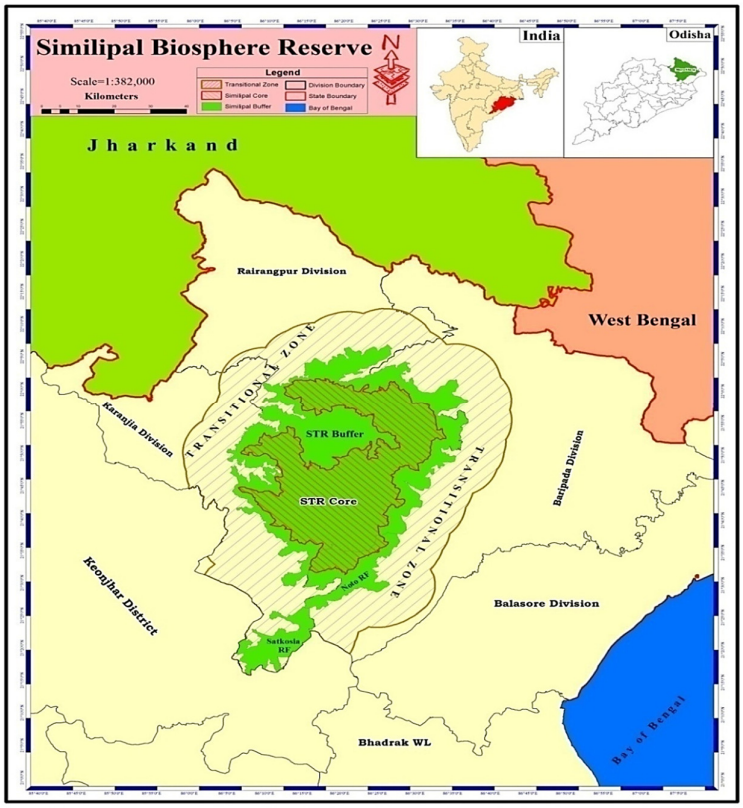


Figure 1. Map of Similipal Biosphere Reserve (SBR), Odisha, India

The largest compact Sal bearing forest, Similipal is a Tiger Reserve, a proposed National Park, a Sanctuary and a Biosphere Reserve. Major rivers like Budhabalanga, Salandi, Baitarani and many rivulets flow through Similipal. It constitutes floral and faunal elements both from the Western Ghats and Eastern Himalaya. The forest supports more than 1200 plant species, with 300 species of medicinal plants and 94 species of Orchids (Sexena and Brahmam, 1989; Misra, 2004). It constitutes 8% of Orchids and 7% of flowering plants of the whole country, India. *Shorea robusta* Gaertn.*, Terminalia tomentosa* Wight & Arn.*, Haldinia cordifolia* (Roxb.) Ridsdale*, Anogeissus latifolia* (Roxb. Ex DC) Wall. Ex Bedd*, Schleichera oleosa* (Lour.) Merr. etc. are the main tree species of SBR.

Field method and data collection

The objective of the present study is to survey and document the diversity of climbers in SBR. The various species of lianas were collected from different parts of SBR with the help of local people and forest guards who had maximum knowledge about this. We had visited different parts of Similipal Biosphere Reserve from December 2017 to March 2018 for the collection of specimens and its uses practised by the local indigenous people. We have also tried to investigate the economic importance of the climbing plants by consulting the local communities residing in and around the biosphere reserve. The photographs of some specimens were taken as good as possible to figure out a clear view of those plants (Figure 3). The plant materials were collected in plastic bags and handled very carefully. The specimens were identified with the help of regional floras (Saxena and Brahmam, 1994-1996; Haines, 1921-1925; Gamble and Fischer, 1915-1935) and other available literatures. Further, the specimens were processed and preserved in the herbarium of

Biosystematics laboratory, Department of Botany, Maharaja Sriram Chandra Bhanja Deo University, Baripada, Odisha. All the species were enumerated with its botanical name, family, local name, habit, climbing mode, and uses.

Results

The present study documented a total of 120 climber plant species belonging to 74 genera and 33 families (Table 1). Among the families, the most speciose families were Fabaceae (25 species) followed by Convolvulaceae (22 species), Cucurbitaceae (11 species), Vitaceae (8 species), Dioscoreaceae (7 species) etc. Similarly, dominant genera were *Ipomoea* possessing the highest number of species i.e., 9 species followed by *Dioscorea* (7 species), *Vigna* (6 species), *Clematis* (3 species) and *Cissus* (3 species) etc. Out of 120 climbing plant species, 62 species were woody vines, 57 species were herbaceous vines and one parasitic vine representing 52.10%, 46.05% and 0.83%, respectively. The climbing plants of SBR were classified according to their habits i.e. woody vines, herbaceous vines and parasitic vines (Table 1). Local communities were using these climbers for various purposes. It had been observed that out of 120 species, 48 species had medicinal properties (39.669%), 16 species are edible (13.34%), 13 species had ornamental value (10.83%) and the remaining 43 had other uses (35.83%). The enumerated climbing plants showed 6 different climbing mode mechanisms which were stem twiners (63.02%), tendril climbers (21.84%), hook climbers (3.36%), straggler unarmed (8.4%), straggler armed (2.52%) and root climbers (0.84%) (Figure 2).

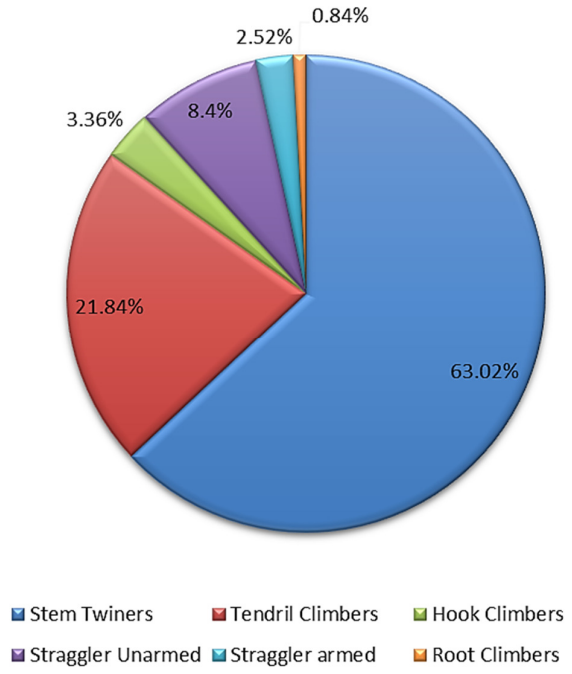


Figure 2. Percentage of different climbing modes found in climbers of SBR, Odisha, India

With the compilation of survey data and available literatures, we found a total of 97 species which had medicinal value. Out of these, 14 species were directly taken as food as well. The species which had both medicinal as well as nutritional values were *Lasia spinosa* (L.) Thw., *Basella alba* L., *Ipomoea aquatic* Forsk., *Dioscorea oppositifolia* L. etc. There were 24 species found edible in the study. There were 5 species in the study generally used in domestic and ornamental aspects. *Ipomoea turbinate* Lag. was the only species which is edible as well as ornamental value. *Bauhinia vahlii* W & A. was the only species which had house hold uses in

preparation of ropes. The present study could not report any economic value for 8 species and such information is also lacking in the previous literature for these species. The species without any economic values were *Rhaphidophora glauca* (Wall.) Schott., *Ipomoea barlerioides* (Choisy) Benth. Ex C.B.Cl., *Ipomoea sinensis* (Desr.) Choisyssp., *Dolichos trilobus* L., *Mucuna nigricans* (Lour.) Steud., *Vigna pilosa* Baker., *Clematis roylei* Rehder. and *Ampelocissus divaricata* (Wall. ex Lawson) Planch.

The most abundant climber species in the study area were *Combretum roxburghii* Spreng. (Combretaceae), *Bauhinia vahlii* W. & A. (Fabaceae), *Mikania micrantha* Kunth (Asteraceae), *Hemidesmus indicus* (L.) R. Br. (Apocynaceae), *Asparagus racemosus* Willd. (Asparagaceae) etc. The rare climber species were *Gnetum ula* Brongn. (Gnetaceae), *Thalictrum foliolosum* DC. (Ranunculaceae), *Smilax perfoliata* Lour. (Smilacaceae) etc. Among the studied species, four are considered as locally threatened according to the CAMP report (Ved *et al.*, 2007). The species were *Celastrus paniculatus* Willd. (Celastraceae), *Gnetum ula* Brongn. (Gnetaceae), *Paederia foetida* L. (Rubiaceae), *Pueraria tuberosa* (Roxb. ex Willd.) DC. (Fabaceae), *Scindapsus officinalis* (Roxb.) Schott. (Araceae) which are coming under the vulnerable category.

Table 1. List of climbers in SBR, Odisha, India

Family	Scientific Name	Local Name	Habit	Climbing mode	Economic importance
Acanthaceae	*Thunbergia fragrans* Roxb.	Chakrakedar	HV	Stem Twiner	Ornamental
Apocynaceae	*Aganosma caryophyllata* (Roxb.exSims.) G.Don.	Gandhamalati	WV	Stem Twiner	Medicinal
	Cryptolepis dubia (Burm.f.) M.R. Almeida	Dudhi	WV	Stem Twiner	Medicinal
	Hemidesmus indicus (L.) R. Br.	Thapa	HV	Tendril Climber	Medicinal
	Ichnocarpus frutescens (L.) W.T.Aiton	Dudhi lata	HV	Stem Twiner	Medicinal
	Tylophora indica (Burm. f.) Merr.	Banbanka	HV	Stem Twiner	Medicinal
Araceae	*Lasia spinosa* (L.) Thw.	Kanta Saru	HV	Stem Twiner	Edible & Medicinal
	Rhaphidophora glauca (Wall.) Schott.	-	WV	Stem Twiner	-
	Scindapsus officinalis (Roxb.) Schott.	Girudhuni	WV	Root Climbers	Medicinal
Aristolochiaceae	*Aristolochia indica* L.	Iswar Mula	HV	Stem Twiner	Medicinal
Asclepiadaceae	*Pergularia daemia* (Forsk.)Chiov.	Iturhi	HV	Stem Twiner	Medicinal
Asparagaceae	*Asparagus racemosus* Willd.	Iswar Jata	HV	Stem Twiner	Medicinal
Asteraceae	*Mikania micrantha* Kunth	-	HV	Stem Twiner	Medicinal
Basellaceae	*Basella alba* L.	Poi	HV	Stem Twiner	Edible & Medicinal
Bignoniaceae	*Pyrostegia venusta* (Ker Gawl.) Miers	-	HV	Tendril Climber	Medicinal
Capparaceae	*Capparis zeylanica* L.	Sabbi	WV	Straggler armed	Medicinal
Celastraceae	*Celastrus paniculatus* Willd.	Pengu	WV	Stem Twiner	Medicinal

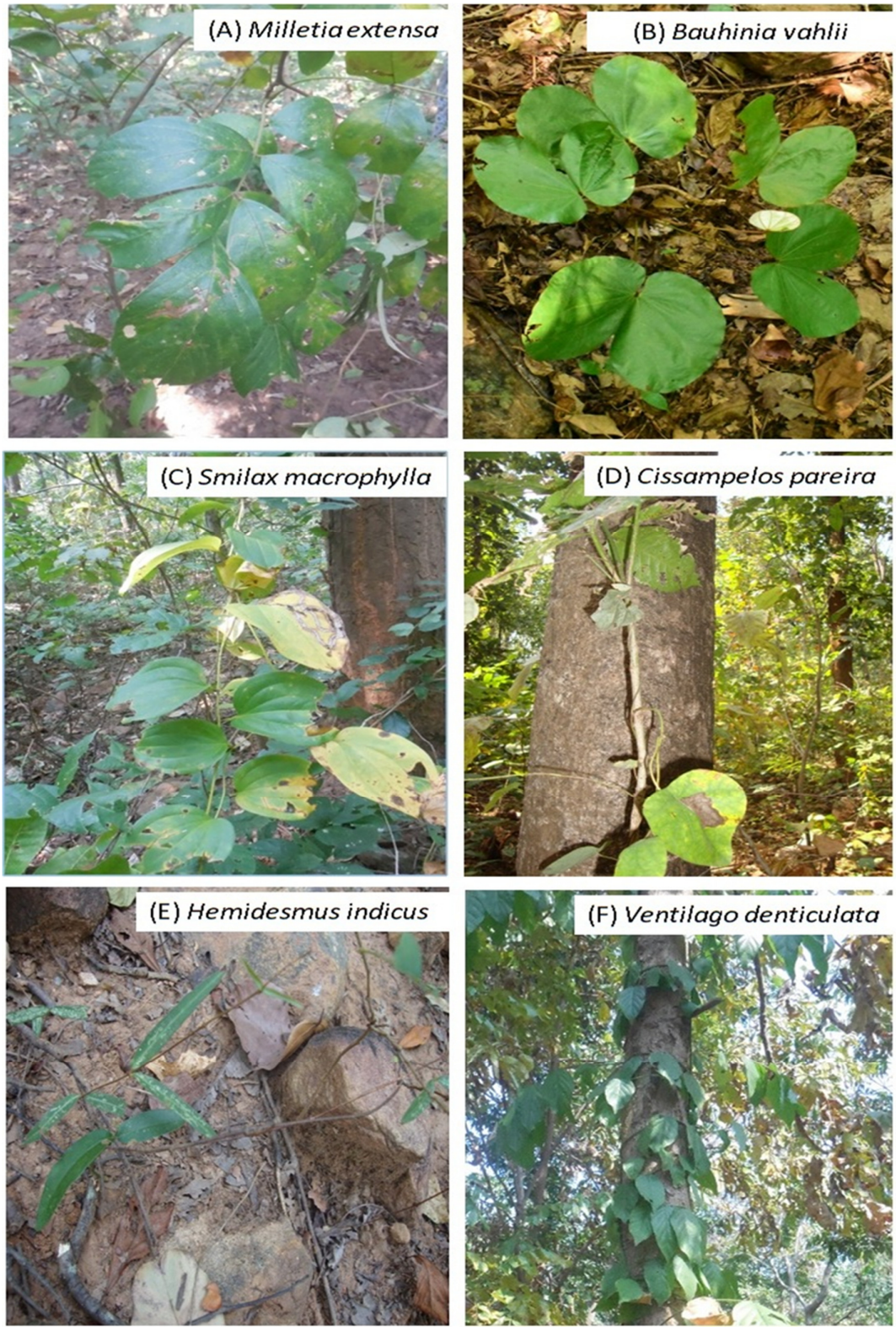
Combretaceae	*Combretum roxburghii* Spreng.	Atundi	WV	Stem Twiner	Medicinal
Convolvulaceae	*Argyreia bella* (C.B.CI.) Raizada.	-	WV	Stem Twiner	Medicinal
	Argyreia daltonii C.B.CI.	-	WV	Stem Twiner	Medicinal
	Evolvulus nummularius (L.) L.	-	HV	Stem Twiner	Medicinal
	Ipomoea aquatica Forssk.	Kalma Saga	HV	Stem Twiner	Edible & Medicinal
	Argyreia nervosa (Burm. f.) Bojer	Mundanoi	HV	Stem Twiner	Medicinal
	Convolvulus arvensis L.	-	HV	Stem Twiner	Medicinal
	Cuscuta reflexa Roxb.	Nirmuli	PV	Stem Twiner	Medicinal
	Erycibe paniculata Roxb.	Joda Koli	WV	Stem Twiner	Edible & Medicinal
	Ipomoea barlerioides (Choisy) Benth.ExC.B.Cl.	-	HV	Stem Twiner	-
	Ipomoea carnea Jacq. ssp.	Amari	WV	Stem Twiner	Edible & Medicinal
	Ipomoea eriocarpa R.Br.	Panioi	WV	Stem Twiner	Edible & Medicinal
	Ipomoea nil (L.) Roth.	Khondo	HV	Stem Twiner	Medicinal
	Ipomoea pes-tigridis L.	Billeinandi	HV	Stem Twiner	Medicinal
	Ipomoea quamoclit L.	-	HV	Stem Twiner	Ornamental
	Ipomoea biflora (L.) Pers.	-	HV	Stem Twiner	-
	Ipomoea turbinata Lag.	Bina	WV	Stem Twiner	Edible & Ornamental
	Merremia hederacea (Burm. f.) Hallier f.	-	HV	Stem Twiner	Medicinal
	Merremia hirta (L.) Merr.	-	HV	Stem Twiner	Medicinal
	Merremia tridentata (L.) Hallier f.	-	HV	Stem Twiner	Medicinal
	Merremia umbellate (L.) Hall.f.	Paninoi	HV	Straggler unarmed	Edible & Medicinal
	Merremia vitifolia (Burm.f.) Hall.f.	-	WV	Stem Twiner	Medicinal
	Operculina turpethum (L.) Silva Manso	Dudhaloma	WV	Stem Twiner	Medicinal
Cucurbitaceae	*Coccinia grandis* (L.) Voigt	Kunduri	HV	Tendril Climber	Edible
	Cucumis melo L.	Kharbhuj	HV	Tendril Climber	Medicinal
	Cucumis sativus L.	Kakudi	HV	Tendril Climber	Medicinal

	Cucurbita maxima Duchesne	Kakharu	HV	Tendril Climber	Medicinal
	Diplocyclos palmatus (L.) C. Jeffrey	Kaudia	WV	Tendril Climber	Medicinal
	Lagenaria siceraria (Molina) Standl.	Lau	HV	Tendril Climber	Medicinal
	Momordica charantia L.	Kalara	HV	Tendril Climber	Medicinal
	Mukia maderaspatana (L.) M.Roem.	Bilari	WV	Tendril Climber	Medicinal
	Trichosanthes cucumerina L.	Chichendra	HV	Tendril Climber	Medicinal
	Trichosanthes dioica Roxb.	Patal	HV	Tendril Climber	Medicinal
	Trichosanthes tricuspidata Lour	Mehankala	WV	Tendril Climber	Medicinal
Dioscoreaceae	*Dioscorea glabra* Roxb.	Kanta Alu	HV	Stem Twiner	Edible
	Dioscorea hamiltonii Hook.f.	Suta Alu	HV	Stem Twiner	Edible & Medicinal
	Dioscorea hispida Dennst.	Bainya Alu	HV	Stem Twiner	Medicinal
	Dioscorea oppositifolia L.	Pitli Kanda	HV	Stem Twiner	Edible & Medicinal
	Dioscorea pentaphylla L.	Mundi Kanda	HV	Stem Twiner	Edible & Medicinal
	Dioscorea puber Bl.	Kosa Kanda	HV	Stem Twiner	Edible
	Dioscorea wallichii Hook.f.	Pita Alu	HV	Stem Twiner	Edible
Fabaceae	*Abrus precatorius* L.	Runja	HV	Stem Twiner	Medicinal
	Cajanus crassus (King) Maesen	Bankandul	WV	Stem Twiner	Medicinal
	Bauhinia vahlii W.&A.	Siali Lata	WV	Straggler unarmed	Domestic
	Butea superba Roxb.	Noi Palas	WV	Straggler unarmed	Medicinal
	Cajanus scarabaeoides (L.) Thouars	Arhar	HV	Stem Twiner	Medicinal
	Clitoria ternatea L.	Aparajita	WV	Stem Twiner	Medicinal
	Derris indica (Lam.) Bennet.	Karanjo	WV	Stem Twiner	Medicinal
	Derris scandens (Roxb.) Benth.	Kentia	WV	Stem Twiner	Medicinal
	Dolichos trilobus L.	-	HV	Stem Twiner	-
	Entada rheedi Spreng.	Hanuman Mara	WV	Stem Twiner	Medicinal
	Lablab purpureus (L.) Sweet ssp.	Simbo	WV	Stem Twiner	Medicinal

	Millettia extensa (Benth) Baker.	Garul	WV	Stem Twiner	Medicinal
	Mimosa himalayana Gamble.	Kirkichi	WV	Stem Twiner	Medicinal
	Mimosa pudica L.	Lajkuli	HV	Stem Twiner	Medicinal
	Mucuna gigantea (Willd.) DC.	-	WV	Stem Twiner	Medicinal
	Mucuna nigricans (Lour.) Steud.	Bada Baidanka	WV	Stem Twiner	-
	Mucuna puriens (L.) DC.	Baidanka	WV	Stem Twiner	Medicinal
	Pueraria tuberosa (Roxb. ex Willd.) DC.	Bhui Kakharu	WV	Stem Twiner	Medicinal
	Vigna adenantha (G.F.Meyer) Marechal, Mascherpa & Stainer.	-	HV	Stem Twiner	Edible
	Vigna mungo (L.) Hepper.	Biri	HV	Stem Twiner	Edible
	Vigna pilosa Baker.	Jhikrai	HV	Stem Twiner	-
	Vigna radiata (L.) R. Wilezek var. radiate	Munga	HV	Stem Twiner	Edible
	Vigna umbellate (Thunb.).	Bana Munga	HV	Stem Twiner	Edible
	Vigna unguiculata (L.) Walpssp.	Bargudi	WV	Stem Twiner	Edible
Gnetaceae	*Gnetum ula* Brongn.	Mirig Lendi	WV	Straggler unarmed	Medicinal
Linaceae	*Hugonia mystax* L.	Chulijinka	WV	Straggler unarmed	Medicinal
Lygodiaceae	*Lygodium flexuosum* (L.) Sw.	Kala Mahajal	HV	Stem Twiner	Medicinal
	Lygodium scandens Sw.	-	HV	Stem Twiner	Edible & Medicinal
Menispermaceae	*Cissam pelospareira* L. var. *hirsuta* (DC.) Forman.	-	HV	Stem Twiner	Medicinal
	Stephania japonica (Thunb.) Miers.	Sondhimali	HV	Stem Twiner	Medicinal
	Tinospora cordifolia (Willd.) Miers.	Tihadi	WV	Stem Twiner	Medicinal
Primulaceae	*Embelia ribes* Burm.f.	-	WV	Straggler unarmed	Medicinal
	Embelia tsjeriam-cottam A. DC.	Nununia	WV	Stem Twiner	Medicinal
Nyctaginaceae	*Boerhavia diffusa* L.	Goudapuruni	HV	Hook Climber	Edible & Medicinal
	Bougainvillea glabra Willd.	-	WV	Hook Climber	Medicinal
	Bougainvillea spectabilis Willd.	Kagaji Phula	WV	Hook Climber	Edible & Medicinal
Olacaceae	*Olax scandens* Roxb.	-	WV	Straggler unarmed	Medicinal

Oleaceae	*Jasminum arborescens* Roxb.	Banamali	WV	Stem Twiner	Medicinal
	Jasminum azoricum L.	-	WV	Stem Twiner	Ornamental
	Jasminum scandens Vahl.	Bana Malli	WV	Stem Twiner	Medicinal
Passifloraceae	*Passiflora foetida* L.	Bisripi	HV	Tendril Climber	Medicinal
Piperaceae	*Piper trioicum* Roxb.	Chai katha	WV	Stem Twiner	Medicinal
Ranunculaceae	*Clematis gouriana* Roxb. ex DC.	Bariamal	WV	Straggler unarmed	Medicinal
	Clematis roylei Rehder.	Ganamari	WV	Straggler unarmed	-
	Clematis smilacifolia Wall.	-	WV	Straggler unarmed	Medicinal
	Thalictrum foliolosum DC.	Bharda	WV	Tendril Climber	Medicinal
Rubiaceae	*Paederia foetida* L.	Prasaruni	WV	Stem Twiner	Medicinal
Rhamnaceae	*Ventilago denticulata* Willd.	Kantamali	WV	Stem Twiner	Medicinal
	Ziziphus oenopolia (L.) Mill.	Kanakoli	WV	Straggler armed	Medicinal
	Ziziphus rugosa Lam.	Kanteikali	WV	Straggler armed	Medicinal
Rutaceae	*Toddalia asiatica* (L.) Lam.	Tundpora	WV	Hook Climber	Medicinal
Sapindaceae	*Cardiospermum halicacabum* L.	Kanphuta	HV	Tendril Climber	Medicinal
Smilaceae	*Smilax perfoliata* Lour.	Mothuri	HV	Tendril Climber	Edible
	Smilax macrophylla Roxb.	Rajdantni	HV	Tendril Climber	Medicinal
Vitaceae	*Ampelocissus divaricata* (Wall. ex Lawson) Planch.	-	WV	Tendril Climber	-
	Ampelocissus latifolia Planch.	Kanjinoi	WV	Tendril Climber	Medicinal
	Ampelocissus tomentosa (B.Heyne & Roth) Planch.	Katobangonoi	WV	Tendril Climber	Medicinal
	Cayratia pedata (Lam.) Gagnep.	Pitapotala	WV	Tendril Climber	Medicinal
	Cissus adnata Roxb.	-	WV	Tendril Climber	Medicinal
	Cissus assamica (Lawson) Craib.	-	WV	Tendril Climber	Medicinal
	Cissus quadrangularis L.	Hadasinkuda	WV	Tendril Climber	Medicinal
	Cissus repens Lam.	Diboria	WV	Tendril Climber	Edible & Medicinal

(WV: Woody vines; HV: Herbaceous Vines, PV: Parasitic Vines)


(A) *Milletia extensa*
(B) *Bauhinia vahlii*
(C) *Smilax macrophylla*
(D) *Cissampelos pareira*
(E) *Hemidesmus indicus*
(F) *Ventilago denticulata*


(G) Combretum roxburghii
(H) Puraria tuberosa
(I) Dioscorea glabra
(J) Entada rheedi
(K) Asaparagus racemosus
(L) Butea superba

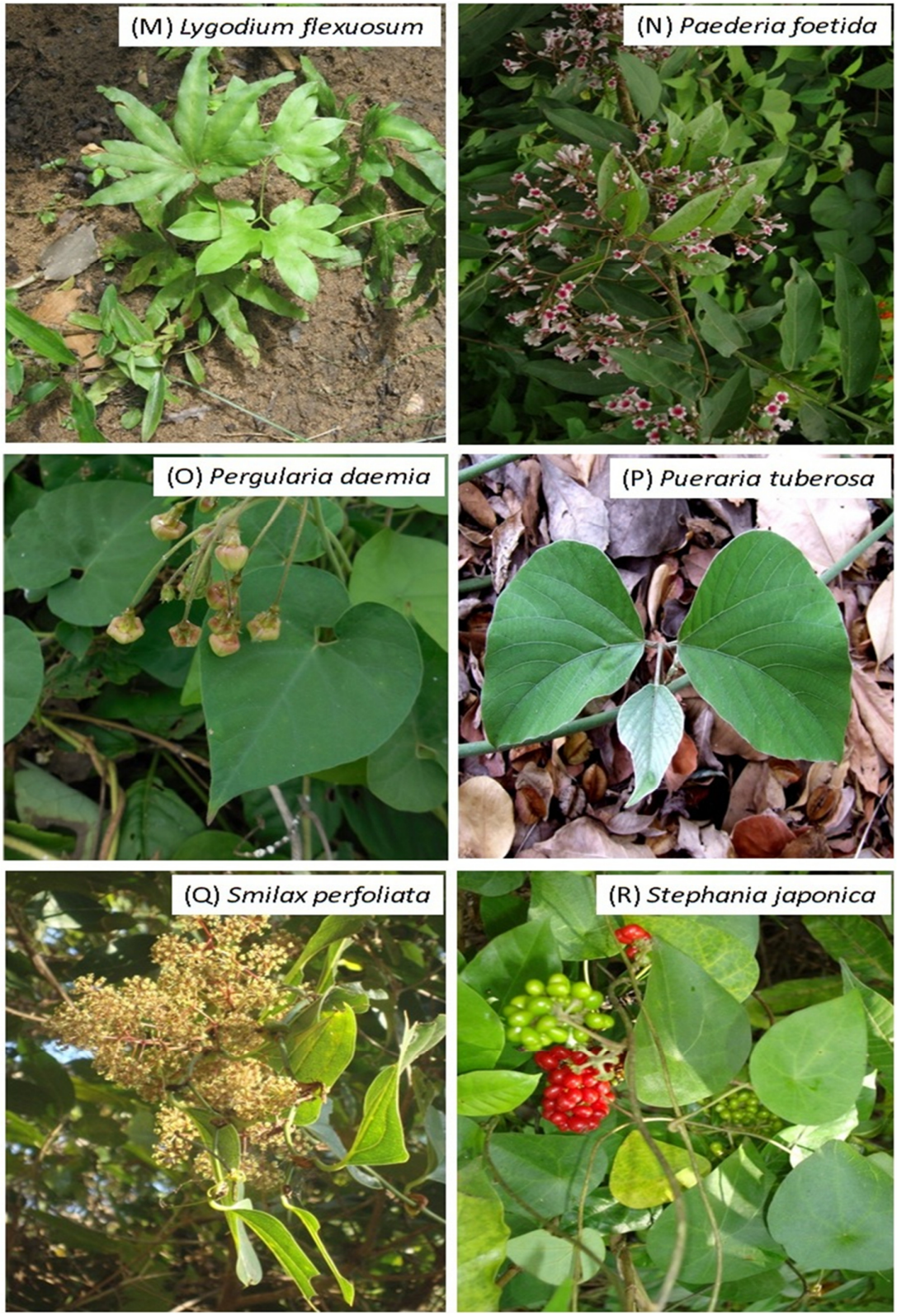


Figure 3. Photographs of some climbers in SBR, Odisha, India

Discussion

SBR is known for its unique ecological conditions, species richness and biodiversity. Climbers plays an important role in the maintenance of several ecological processes in forest ecosystem. Although there are several observations and researches carried out in the area, still much more is remaining to be explored. During our survey out of climbing plants, 62 were lianas and other 58 were herbaceous climbers. The number is very less as compared to tropical evergreen forests of Peninsular India, Tropical forests of Northern Eastern Ghats of Andhra Pradesh and tropical forest of Southern Eastern Ghats of Tamilnadu in India which bears 148, 170, 175 species, respectively (Parthasarathy *et al.*, 2004; Muthumperumal and Parthasarathy, 2009; Naidu *et al.*, 2014). However, compared to few other forests in India, our numbers seem to be very high. Those are tropical forests of Coromandel coast of South India and tropical lowland evergreen forest of Agumbe in the central Western Ghats which have 39 and 40 number of species, respectively (Padaki and Parthasarathy, 2000; Reddy and Parthasarathy, 2003). Considering the species richness of different dry forests globally, the present value is much higher than several other forests. The liana species richness of the dry rain forest of New South Wales was 27 species in 21 ha area (Chalmers and Turner 1994). The tropical island sites of the West Indies harboured 3-14 liana species with an abundance of 6-34 in 0.1 ha area (Gentry 1991b). In the Central American Nicaraguan and Costa Rican dry forests, liana species richness was 16-24 in 0.1 ha area (Gillespie *et al.*, 2000). The Mexican dry forest liana diversity, ranged from 8 to 22 species in 0.1 ha area. (Lott *et al.*, 1987). Though the present study was not conducted within a particular area of SBR, it seems to be higher in species richness than the above discussed forests. Hence, the higher species richness of SBR indicates the importance of the forest in the country and globally.

Twinning habit of climbers is dominated in this study area followed by tendril habit. Twining habit of climbers is most common in tropical forests. Similar results were found in Malayasian forests (Putz and Chai, 1987). Disturbance usually leads to the proliferation of lianas (Wyatt-Smith, 1954; Webb, 1958; Putz, 1984; Putz and Chai, 1987). The present study revealed that due to rapid human interference, over exploitation of plant resources, habitat destruction and forest fires in the peripheral regions of SBR, many of the valuable climbing plants are coming towards extinction regionally and coming under threatened category. The invasion of weed species, *Mikania micrantha* is frequently observed during our study, which has negative impact on the diversity and supressing the host plant in many aspects. It is one of the 100 worst invasive alien species in the world (Lowe *et al.*, 2001). Further, in some regions of SBR, such as Hatitop and Kachudhan, the dominance of climbers caused squeezing and compressing the host plant. Since, the climbers have significant impacts on the biodiversity. Hence, in such regions, the abundance of climbers must be checked for proper management of biological diversity. Therefore, sustainable use of forest biodiversity may be required especially in those forest zones where human utilization of the forest resources for different purposes is evident and inevitable.

Conclusions

The present study revealed that the climbing plants diversity of SBR not only contributing to the overall forest biodiversity significantly but also maintains the ecological balance of the whole ecosystem. However, the sites such as Hatitop, Kachdhan etc. the dominance of climbers have deleterious effects on the host plants. Many other tree species were suppressed and showing stunted growth due to the negative impact of these climbers. Therefore, management and sustainable use of climbers is required for which adequate knowledge of their diversity, biology and ecology is essential. Further research is required for better understanding of the dynamics and reproductive biology of climbing plants in order to recommend conservation strategies.

Authors' Contributions

DR: Field work, data collection and manuscript writing; MRM: Field work and help in manuscript writing; SCS: Study design, field work and manuscript review. All authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

Not applicable.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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