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Original Article

Phytogeographical Affinities of Tree Species of Similipal Biosphere Reserve, Odisha, India

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Abstract

The phytogeography of Similipal Biosphere Reserve (SBR), Odisha, India, reveals very interesting information on distribution of tree species. Phytogeographical affinities of tree species of SBR has been analysed by obtaining the information about the species distribution at local and global scale. A total of 240 tree species were recorded and their phytogeographical affinities were compiled with different countries of the globe. An analysis of the affinities revealed that SBR has strong affinity with Sri-Lanka (46.66%) and Myanmar (45.83%) followed by China, Malaysia, Thailand, Australia and Africa. SBR has also affinity with Himalayan vegetation possessing several trees and orchids find distribution in both the areas. The phytogeographical affinity of SBR supports the migration, establishment and naturalization of flora from/to SBR. This hypothesis needs further study for biogeographical mapping of Indian sub-continent.

Keywords: Biogeographical mapping; conservation of species; distribution of trees; ecological implications; Indian sub-continent

Abbreviations: SBR - Similipal Biosphere Reserve

Introduction

In recent time, remarkable changes have been observed in the environment due to both man-made and natural factors resulting destruction and degradation of natural habitats. Biodiversity loss is a global phenomenon but its impact is greatest in the tropics, where the majority of species are distributed (Collen *et al*., 2008). Tropical forests harbour ca 50% of total species in the world occupying only 7% land area which is getting disappeared at a rate of 0.8 to 2% per year (Sagar *et al*., 2003). The phytogeographical studies are the useful tools for assessment of the geographical distribution, origin and ecological implications of plants of an area (Lausi and Nimis, 1985).

India is a mega biodiversity country where the floral distribution and diversity is highly influenced by its varied climatic, topographic and edaphic conditions. Starting from the north Himalayas to the south Nilgiri hills and Western Ghats a wide range of diversity in flora and their habitat is observed. According to great British botanist Sir JD Hooker (1904), "the Indian flora is more varied than any of the country of equal area in the eastern hemisphere, if not in the globe". Similarly the state of Odisha in Eastern India is rich in diversity and inhabited mixture of north and south Indian flora. JS Gamble (1892) was to comment that Orissa is the meeting ground for the Himalayan and the South Indian Elements of the Indian flora. The available literature also shows significant affinity of Indian floral with other parts of the world. The floristic elements of India share the predominant affinities with the Indo-Malayan elements. It has also affinities with Afro-Tropical and Tropical- Asian elements (Daniel and Nair, 1986). Many workers have contributed moderately on phytogeographical study of Indian sub-continent. Rana *et al*. (2001) studied the phytogeographical affinity of Tons valley, Uttaranchal; Suresh and Sukumar (1999) on Nilgiri Biosphere Reserve and Pragason (2014) on Eastern Ghats, Sukumar *et al*. (1992) on Mudumalai reserve forest; Saravanan *et al*. (2013) on Andaman etc. Globally, studies on phytogeography of several regions are available such as Neotropics (Gentry, 1982), Friulian plain, NE Italy (Nimis and Fonda, 1997), Maxico (Rzedowski,1975)Western Europe and Eastern Greenland (Hubbard and Boulter, 2000), Tasmanian alpine flora (Kirkpatrick, 1982), Sonoran and Chihuahuan deserts (Krings, 2000), Yukon territory, NW Canada (Lausi and Nimis, 1985),Yucatan Peninsula (Manrique *et al*., 2003), arid mountain of Oman (Ghazanfar, 1991) and Coastal vegetation of Yucatan Peninsula (Espejel, 1987).

Phytogeographical study is useful in many aspects like conservation of species, sustainable utilization resources, study of migration of species and speciation, study on phenology and adaptation etc. Based on the phytogeographical data several postulations have been given regarding migration of flora in Indian subcontinent. Takhtajan, (1969) postulated that the angiosperms spread

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from low to high altitudes and not in the opposite direction and Razi, (1955) felt that the vegetation existed in South India comprising Eastern Ghats much before the advent of Himalayas and Similipal was part of Gondwana land mass in the Paleozoic era. Being the meeting point of the northern and southern flora, it is clear that SBR has major role in the migration of flora within Indian subcontinent. Some bio geographers consider Similipal Hill ranges as part of Eastern Ghats of India and some other put the region under Chotanagpur plateau. However, SBR in Odisha is very rich in floral diversity and a grand repository of many rare, endemic and threatened species. But, a comprehensive account of phytogeographical affinity of taxa is lacking. The present study focuses on phytogeographical affinity of tree species of SBR and its significance.

Materials and Methods

Study area

Similipal Biosphere Reserve (SBR) in Odisha is very rich in floral diversity and a grand repository of many rare, endemic and threatened species. It is situated between 21° 28' to 22° 08' N latitude and 86° 03' to 86° 37' E longitude. SBR exhibits a great degree of topographic variation and thus provides adobe for rich biodiversity (Mishra, 2010). Saxena and Brahmam (1989) categorised SBR into 6 major forest types are Northern tropical moist deciduous forests, Northern tropical semi-evergreen forests, Dry deciduous hill forest, Dry sal forests, High level Sal forests and Grasslands. There are 1076 plants recorded from the area including 60 species of ferns, 92 species of orchids and two gymnosperms (Saxena and Brahmam, 1989; Misra, 2004).The climate is warm and humid with an average rainfall of 173 cm (maximum 225 cm and minimum 110 cm) and maximum temperature during hot weather rise up to 43 degree Celsius while minimum during winter fall as low as 4 degree Celsius (Mishra, 2010).

Extensive field studies were conducted during different seasons of the year in order to access floristic composition of the study area (Fig. 1). Collection of plant samples along with their photographs were made for future references. Collected plant specimens were identified referring regional floras. All the identified plants were processed and deposited at Herbarium of Department of Botany, North Orissa University. A list of tree species had been made and categorised into various phytogeographical groups according to their world distribution (Table 1). The countries considered for the phytogeographical study were Sri-Lanka, Myanmar, China, Thailand, Malaysia, Australia and Africa. The phytogeographical affinity was obtained from in consultation with floras like flora of Madhya Pradesh (Verma *et al*., 1993), flora of Odisha (Saxena and Brahmam, 1994-1996) and flora of Bihar (Singh *et al*., 2001), floral diversity of Similipal Biosphere Reserve, Vol-1 (Biswal *et al*., 2011) and trees of Similipal Biosphere Reserve (Nayak *et al*., 2014).

Results and Discussion

The affinity of tree flora of SBR with other subcontinents is very extensive. The result shows highest similarity of tree species with Sri- Lanka and least with Africa (Fig. 2). The affinity of SBR with Sri- Lanka is found to be 46.66%, Myanmar 45.83%, China 25.00%, Thailand and Malaysia 12.5% each, Australia 7.5% and Africa 4.58%. All the members of Ebenaceae found in SBR are distributed in Sri- Lanka and some of the members of Moraceae are very similar to Sri- Lanka. *Albizia chinensis*, *Albizia odoratissima*, *Carallia branchiate*, *Cipadessa baccifera* etc. are the plants with highest range of distributions among countries. Indo-African and Indo-Australlian affinity found to be very negligible; only 11 and 17 species are found to be common respectively.

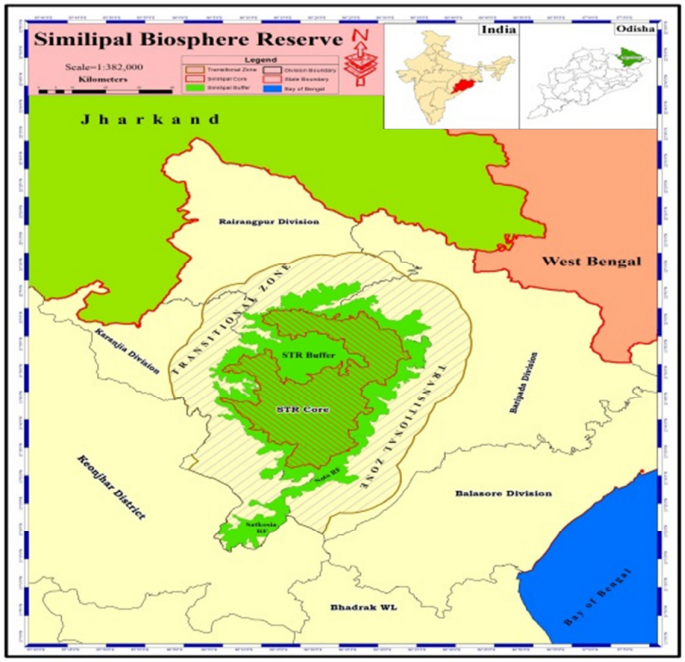

Fig. 1. Map of the study area

Table 1. List of 240 tree species of SBR and their affinity

Sl. No	Plant Name	Family	A	B	C	D	E	F	G
1	*Acacia farnesiana*	Leguminosae	-	-	-	-	-	-	-
2	*Acacia lenticularis*	Leguminosae	-	-	-	-	-	-	-
3	*Acacia nilotica*	Leguminosae	-	-	-	-	-	-	-
4	*Acronychia pedunculata*	Rutaceae	+	-	+	-	+	+	-
5	*Actinodaphne gullavara*	Lauraceae	-	-	+	-	-	-	-
6	*Aegle marmelos*	Rutaceae	-	-	-	-	-	-	-
7	*Alangium salvifolium*	Cornaceae	+	+	-	+	-	-	+
8	*Albizia procera*	Fabaceae	+	-	+	-	+	-	-
9	*Albizia chinensis*	Fabaceae	+	+	+	+	+	-	-
10	*Albizia lebbeck*	Fabaceae	-	-	-	-	-	-	+
11	*Albizia odoratissima*	Fabaceae	+	+	+	+	+	-	-
12	*Alchornea mollis*	Euphorbiaceae	-	-	-	-	-	-	-
13	*Alphonsea lutea*	Annonaceae	+	-	-	-	-	-	-
14	*Alphonsea ventricosa*	Annonaceae	-	-	-	-	-	-	-
15	*Alstonia scholaris*	Apocynaceae	+	+	-	-	+	-	+
16	*Annona reticulate*	Annonaceae	-	-	-	-	-	-	-
17	*Annona squamosa*	Annonaceae	-	-	-	-	-	-	-
18	*Anogeissus acuminate*	Combretaceae	-	-	+	-	-	-	-
19	*Anogeissus latifolia*	Combretaceae	+	-	-	-	-	-	-
20	*Antidesma acidum*	Phyllanthaceae	-	+	+	+	-	-	-
21	*Antidesma bunius*	Phyllanthaceae	+	-	+	-	-	-	-
22	*Antidesma ghaesembilla*	Phyllanthaceae	+	+	-	-	-	+	-
23	*Antidesma montanum*	Phyllanthaceae	+	+	+	-	-	+	+
24	*Aphanamixis polystachya*	Meliaceae	+	-	+	-	-	-	-
25	*Aporosa octandra*	Phyllanthaceae	-	-	+	-	-	-	-
26	*Ardisia solanacea*	Primulaceae	+	+	+	-	-	-	-
27	*Artocarpus heterophyllus*	Moraceae	-	-	-	-	-	-	-
28	*Artocarpus lacucha*	Moraceae	-	-	-	-	-	-	-
29	*Atlantia monophylla*	Rutaceae	+	-	+	-	-	-	-
30	*Azadirachta indica*	Meliaceae	-	+	+	-	-	-	-
31	*Baccaurea ramiflora*	Phyllanthaceae	-	-	+	-	-	-	-
32	*Barringtonia acutangula*	Lecythidaceae	-	-	-	-	-	+	-
33	*Bauhinia purpurea*	Fabaceae	-	-	-	-	-	-	-
34	*Bauhinia semla*	Fabaceae	-	-	-	-	-	-	-
35	*Bauhinia variegata*	Fabaceae	-	+	+	-	-	-	-
36	*Bauhinia malabarica*	Fabaceae	-	-	+	-	-	-	-
37	*Benkara fasciculata*	Rubiaceae	+	-	-	-	-	-	-
38	*Bischofia javanica*	Phyllanthaceae	-	-	+	-	-	-	-
39	*Bombax ceiba*	Malvaceae	-	-	-	-	-	-	-
40	*Boswellia serrata*	Burseraceae	-	-	-	-	-	-	-
41	*Bridelia glauca*	Phyllanthaceae	-	-	+	-	-	-	-
42	*Bridelia retusa*	Phyllanthaceae	+	-	+	-	-	-	-
43	*Buchanania cochinchinensis*	Anacardiaceae	-	-	+	-	-	-	-
44	*Butea monosperma*	Fabaceae	-	-	-	-	+	-	-
45	*Callicarpa tomentosa*	Lamiaceae	+	-	+	+	-	-	-
46	*Canthium glabrum*	Rubiaceae	-	-	+	-	-	-	-
47	*Carallia branchiata*	Rhizophoraceae	+	+	+	+	+	+	-
48	*Careya arborea*	Lecythidaceae	-	-	-	-	-	-	-
49	*Casearia graveolens*	Salicaceae	-	-	+	-	-	-	-
50	*Casearia tomentosa*	Salicaceae	+	-	-	-	-	+	-
51	*Cassia fistula*	Fabaceae	+	+	+	-	-	-	-
52	*Cassine glauca*	Celastraceae	+	+	-	+	-	-	-
53	*Catunaregam spinosa*	Rubiaceae	+	-	-	-	-	-	-
54	*Celtis tetrandra*	Cannabaceae	-	-	-	+	-	-	-
55	*Chionanthus mala-elengi*	Oleaceae	-	-	-	-	-	-	-
56	*Chionanthus ramiflorus*	Oleaceae	-	+	+	-	+	-	-
57	*Chloroxylon swietenia*	Rutaceae	+	-	-	-	-	-	-
58	*Cipadessa baccifera*	Meliaceae	+	+	+	+	+	-	-
59	*Cleistanthus collinus*	Phyllanthaceae	+	-	-	-	-	-	-
60	*Cleistanthus patulus*	Phyllanthaceae	+	-	-	-	-	-	-

61	*Cochlospermum religiosum*	Bixaceae	+	-	+	-	+	-	-
62	*Cordia dichotoma*	Boranginaceae	+	-	-	-	-	-	+
63	*Cordia macleodii*	Boranginaceae	-	-	-	-	-	-	-
64	*Cordia monoica*	Boranginaceae	+	-	-	-	-	-	-
65	*Crateva marmelos*	Capparaceae	+	+	+	-	-	-	-
66	*Crateva religiosa*	Capparaceae	+	-	+	-	-	-	-
67	*Croton persimilis*	Euphorbiaceae	+	-	+	-	-	-	-
68	*Dalbergia lanceolaria*	Leguminosae	+	-	+	-	-	-	-
69	*Dalbergia latifolia*	Leguminosae	-	+	-	-	-	-	-
70	*Desmodium oojeinense*	Leguminosae	-	-	-	-	-	-	-
71	*Dillenia aurea*	Dilleniaceae	-	-	+	+	-	-	-
72	*Dillenia indica*	Dilleniaceae	-	+	+	+	-	-	-
73	*Dillenia pentagyna*	Dilleniaceae	-	+	+	+	-	-	-
74	*Dimorphocalyx glabellus*	Euphorbiaceae	+	-	-	-	-	-	-
75	*Diospyros malabarica*	Ebenaceae	+	+	-	-	+	-	-
76	*Diospyros melanoxylon*	Ebenaceae	+	-	-	-	-	-	-
77	*Diospyros Montana*	Ebenaceae	+	-	-	-	+	+	-
78	*Diospyros sylvatica*	Ebenaceae	+	-	-	-	-	-	-
79	*Diospyros vera*	Ebenaceae	+	-	+	-	-	-	-
80	*Ehretia acuminata*	Boranginaceae	-	-	+	-	-	-	-
81	*Ehretia laevis*	Boranginaceae	-	-	-	-	-	-	-
82	*Elaeocarpus stipularis*	Elaeocarpaceae	-	-	-	-	-	-	-
83	*Elaeocarpus tectorius*	Elaeocarpaceae	+	+	-	-	+	-	-
84	*Embelia ribes*	Primulaceae	+	+	-	-	-	-	-
85	*Embelia tsjeriam-cottam*	Primulaceae	+	-	-	-	-	-	-
86	*Erythrina suberosa*	Leguminosae	-	-	+	+	-	-	-
87	*Euonymus glaber*	Celastraceae	-	-	-	-	-	-	-
88	*Falconeria insignis*	Euphorbiaceae	+	+	+	-	-	-	-
89	*Ficus benghalensis*	Moraceae	+	-	-	-	-	-	-
90	*Ficus benjamina*	Moraceae	+	-	+	-	-	-	-
91	*Ficus hispida*	Moraceae	+	+	-	-	-	-	-
92	*Ficus microcarpa*	Moraceae	+	+	+	-	-	-	-
93	*Ficus nervosa*	Moraceae	+	+	+	-	-	-	-
94	*Ficus racemosa*	Moraceae	+	+	-	-	-	-	-
95	*Ficus religiosa*	Moraceae	+	-	+	+	-	-	-
96	*Ficus rumphii*	Moraceae	-	-	+	-	-	-	-
97	*Ficus semicordata*	Moraceae	-	-	+	-	-	-	-
98	*Ficus virens*	Moraceae	+	+	+	-	-	-	-
99	*Ficus exasperata*	Moraceae	+	-	-	-	-	-	+
100	*Firmiana colorata*	Malvaceae	-	-	-	-	-	-	-
101	*Firmiana simplex*	Malvaceae	+	-	-	-	-	-	-
102	*Flacourtia indica*	Salicaceae	-	-	-	-	-	-	+
103	*Flacourtia jangomas*	Salicaceae	-	-	-	-	-	-	-
104	*Flueggea virosa*	Phyllanthaceae	+	-	-	-	-	+	+
105	*Garcinia cowa*	Clusiaceae	-	-	+	+	-	-	-
106	*Garcinia xanthochymus*	Clusiaceae	-	-	+	+	-	-	-
107	*Gardenia latifolia*	Rubiaceae	+	-	-	-	-	-	-
108	*Garuga pinnata*	Burseraceae	-	+	+	-	-	-	-
109	*Glochidion heyneanum*	Phyllanthaceae	-	-	+	-	-	-	-
110	*Glochidion lanceolarium*	Phyllanthaceae	-	-	+	-	-	-	-
111	*Glochidion zeylanicum*	Phyllanthaceae	+	-	-	-	-	-	-
112	*Gmelina arborea*	Lamiaceae	-	-	-	-	-	-	-
113	*Grewia eriocarpa*	Malvaceae	+	-	+	-	-	-	-
114	*Grewia orbiculata*	Malvaceae	-	-	-	-	-	-	-
115	*Grewia serrulata*	Malvaceae	-	-	-	-	-	-	-
116	*Grewia tiliifolia*	Malvaceae	+	-	+	-	-	-	+
117	*Guazuma ulmifolia*	Malvaceae	-	-	+	-	+	-	-
118	*Holarrhena pubescens*	Apocynaceae	-	+	+	-	-	-	-
119	*Haldina cordifolia*	Rubiaceae	+	+	-	+	-	-	-
120	*Heynea trijuga*	Meliaceae	-	-	+	-	-	-	-
121	*Holoptelea integrifolia*	Ulmaceae	+	+	-	-	-	-	-
122	*Homalium napaulense*	Saliaceae	-	-	-	-	-	-	-

123	*Hymenodictyon orixense*	Rubiaceae	-	-	+	-	-	-	-
124	*Ixora pavetta*	Rubiaceae	+	-	+	-	-	-	-
125	*Kydia calycina*	Malvaceae	-	+	+	-	-	-	-
126	*Lagerstroemia parviflora*	Lythraceae	-	-	-	-	-	-	-
127	*Lagerstroemia speciosa*	Lythraceae	+	+	+	-	-	-	-
128	*Lannea coromandelica*	Anacardiaceae	-	-	-	-	+	-	-
129	*Lasiococca comberi*	Euphorbiaceae	-	-	-	-	-	-	-
130	*Lepisanthes rubiginosa*	Sapindaceae	-	-	-	-	-	+	-
131	*Ligustrum gamblei*	Oleaceae	-	-	-	-	-	-	-
132	*Litsea glutinosa*	Lauraceae	+	+	+	-	+	-	-
133	*Litsea monopetala*	Lauraceae	-	+	+	-	-	-	-
134	*Litsea nitida*	Lauraceae	-	-	+	-	-	-	-
135	*Macaranga denticulata*	Euphorbiaceae	-	-	+	-	-	-	-
136	*Macaranga peltata*	Euphorbiaceae	-	-	-	-	-	-	-
137	*Madhuca longifolia*	Sapotaceae	+	-	+	-	-	-	-
138	*Magnolia champaca*	Magnoliaceae	-	+	+	+	-	-	-
139	*Mallotus nudiflorus*	Euphorbiaceae	+	+	+	-	-	-	-
140	*Mallotus philippensis*	Euphorbiaceae	+	+	+	-	-	+	-
141	*Mangifera indica*	Anacardiaceae	-	-	-	-	-	-	-
142	*Maytenus bailadillana*	Celastraceae	-	-	-	-	-	-	-
143	*Melia azedarach*	Meliaceae	-	+	+	-	-	-	-
144	*Meliosma pinnata*	Sabiaceae	-	-	+	-	-	-	-
145	*Meliosma simplicifolia*	Sabiaceae	+	+	+	-	-	-	-
146	*Memecylon umbellatum*	Melastomataceae	+	-	+	+	-	-	-
147	*Mesua ferrea*	Calophyllaceae	-	-	-	-	-	-	-
148	*Meyna spinosa*	Rubiaceae	-	-	+	-	-	-	-
149	*Micromelum minutum*	Rutaceae	+	-	-	-	+	-	-
150	*Miliusa tomentosa*	Annonaceae	-	-	-	-	-	-	-
151	*Miliusa velutina*	Annonaceae	-	-	-	-	-	-	-
152	*Mimusops elengi*	Sapotaceae	-	-	-	-	-	+	-
153	*Mitragyna parvifolia*	Rubiaceae	+	-	+	-	-	-	-
154	*Morinda citrifolia*	Rubiaceae	+	-	-	-	-	+	-
155	*Morinda pubescens*	Rubiaceae	+	-	-	-	-	-	-
156	*Murraya paniculata*	Rutaceae	+	-	-	-	-	+	-
157	*Naringi crenulata*	Rutaceae	+	+	+	-	-	-	-
158	*Neocinnamomum caudatum*	Lauraceae	-	-	+	-	-	-	-
159	*Neolamarckia cadamba*	Rubiaceae	+	-	-	-	-	-	-
160	*Nothopegia heyneana*	Anacardiaceae	-	-	-	-	-	-	-
161	*Nyctanthes arbor-tristis*	Oleaceae	-	-	+	-	-	-	-
162	*Ochna obtusata*	Ochnaceae	+	-	-	-	-	-	-
163	*Ocotea lancifolia*	Lauraceae	-	-	+	-	-	-	-
164	*Oroxylum indicum*	Bignoniaceae	+	-	+	-	-	-	-
165	*Pavetta crassicaulis*	Rubiaceae	-	-	-	-	-	-	-
166	*Persea villosa*	Lauraceae	-	-	-	-	-	-	-
167	*Phyllanthus emblica*	Phyllanthaceae	+	+	-	-	-	-	-
168	*Pittosporum wightii*	Pittosporaceae	-	-	-	-	-	-	-
169	*Plumeria rubra*	Apocynaceae	-	-	-	-	-	-	-
170	*Polyalthia cerasoides*	Annonaceae	-	-	-	-	-	-	-
171	*Polyalthia suberosa*	Annonaceae	+	-	+	-	-	-	-
172	*Polyanthia simiarum*	Annonaceae	-	-	-	-	-	-	-
173	*Pongamia pinnata*	Leguminosae	+	-	+	-	-	+	-
174	*Premna barbata*	Lamiaceae	-	-	-	-	-	-	-
175	*Premna mollissima*	Lamiaceae	+	-	-	-	-	-	-
176	*Proebe wightii*	Lauraceae	-	-	-	-	-	-	-
177	*Protium serratum*	Burseraceae	-	-	-	-	-	-	-
178	*Prunus ceylanica*	Rosaceae	+	-	+	+	-	-	-
179	*Prunus pygeoides*	Rosaceae	-	-	-	-	-	-	-
180	*Psidium guajava*	Myrtaceae	-	-	-	-	-	-	-
181	*Psydrax dicoccos*	Rubiaceae	+	+	-	-	+	-	-
182	*Pterocarpus marsupium*	Leguminosae	+	-	-	-	-	-	-
183	*Pterospermum acerifolium*	Malvaceae	-	-	-	-	-	-	-
184	*Pterospermum xylocarpum*	Malvaceae	-	-	-	-	-	-	-

185	*Radermachera xylocarpa*	Bignoniaceae	-	-	-	-	-	-	-
186	*Rhus chinensis*	Anacardiaceae	-	+	-	-	-	-	-
187	*Salix tetrasperma*	Salicaceae	-	+	-	-	+	-	-
188	*Saraca asoca*	Leguminosae	+	-	+	-	-	-	-
189	*Schleichera oleosa*	Sapindaceae	+	-	+	-	+	-	-
190	*Schrebera swietenioides*	Oleaceae	-	-	+	-	-	-	-
191	*Semecarpus anacardium*	Anacardiaceae	-	-	-	-	-	+	-
192	*Shorea robusta*	Dipterocarpaceae	-	-	-	-	-	-	-
193	*Sloanea sterculiacea*	Elaeocarpaceae	-	+	+	-	-	-	-
194	*Soymida febrifuga*	Meliaceae	+	-	-	-	-	-	-
195	*Sterculia villosa*	Malvaceae	-	-	+	-	-	-	-
196	*Stereospermum chelonoides*	Bignoniaceae	+	+	-	-	+	-	-
197	*Stereospermum tetragonum*	Bignoniaceae	+	+	-	-	+	-	-
198	*Streblus asper*	Moraceae	+	+	+	+	-	-	-
199	*Streblus taxoides*	Moraceae	+	+	+	+	-	-	-
200	*Strychnos nux-vomica*	Loganiaceae	-	-	-	-	-	-	-
201	*Strychnos potatorum*	Loganiaceae	+	-	+	-	-	-	-
202	*Styrax serrulatum*	Styracaceae	-	-	+	-	-	-	-
203	*Suregada multiflora*	Euphorbiaceae	-	+	+	+	-	-	-
204	*Symplocos cochinchinensis*	Symplocaceae	+	+	-	-	-	-	-
205	*Symplocos racemosa*	Symplocaceae	-	+	-	-	-	-	-
206	*Syzygium cumini*	Myrtaceae	+	-	-	+	+	-	-
207	*Syzygium fruticosum*	Myrtaceae	-	-	+	-	-	-	-
208	*Syzygium jambos*	Myrtaceae	-	-	-	-	-	+	-
209	*Syzygium nervosum*	Myrtaceae	-	-	-	-	-	-	-
210	*Syzygium praecox*	Myrtaceae	-	-	-	-	-	-	-
211	*Tamarindus indica*	Leguminosae	+	-	-	-	+	-	+
212	*Tamilnadia uliginosa*	Rubiaceae	+	-	+	-	-	-	-
213	*Tarenna asiatica*	Rubiaceae	+	-	-	-	+	-	-
214	*Tectona grandis*	Lamiaceae	-	-	-	-	+	-	-
215	*Terminalia arjuna*	Combretaceae	+	-	-	-	-	-	-
216	*Terminalia bellirica*	Combretaceae	+	-	+	-	-	-	-
217	*Terminalia chebula*	Combretaceae	+	-	+	+	+	-	-
218	*Terminalia tomentosa*	Combretaceae	+	-	+	-	-	-	-
219	*Toona ciliata*	Meliaceae	-	-	+	-	+	+	-
220	*Trema orientalis*	Cannabaceae	-	-	-	-	-	-	+
221	*Trevesia palmata*	Araliaceae	-	-	-	-	-	-	-
222	*Triadica cochinchinensis*	Euphorbiaceae	-	+	+	+	-	-	-
223	*Turpinia cochinchinensis*	Staphyleaceae	+	+	+	-	-	-	-
224	*Vitex glabrata*	Lamiaceae	-	+	-	+	-	+	-
225	*Vitex leucoxylon*	Lamiaceae	+	-	+	-	-	-	-
226	*Vitex peduncularis*	Lamiaceae	-	+	+	+	-	-	-
227	*Vitex pinnata*	Lamiaceae	+	+	+	-	-	-	-
228	*Walsura trifoliata*	Meliaceae	+	-	-	-	-	-	-
229	*Wendlandia gamblei*	Rubiaceae	-	-	-	-	-	-	-
230	*Wendlandia tinctoria*	Rubiaceae	+	-	+	-	+	-	-
231	*Wrightia arborea*	Apocynaceae	+	+	-	+	-	-	-
232	*Wrightia tinctoria*	Apocynaceae	-	-	+	-	-	-	-
233	*Xantolis tomentosa*	Sapotaceae	+	-	+	-	-	-	-
234	*Xylia xylocarpa*	Leguminosae	-	-	+	-	+	-	-
235	*Xylosma longifolia*	Salicaceae	-	-	-	-	-	-	-
236	*Zanthoxylum rhetsa*	Rutaceae	+	-	+	+	-	-	-
237	*Ziziphus rugosa*	Rhamnaceae	+	-	+	-	-	-	-
238	*Ziziphus glabrata*	Rhamnaceae	-	-	-	-	-	-	-
239	*Ziziphus jujuba*	Rhamnaceae	+	-	-	-	-	-	-
240	*Ziziphus xylopyrus*	Rhamnaceae	+	-	-	-	-	-	-

*A= Sri- Lanka, B= China, C= Myanmar, D= Thailand, E= Malaysia, F= Australia, G= Africa

Environmental barriers and geographical distance are the major factor. *Albizia lebbeck* and *Tremna orientalis* are the plants with only Indo-African affinity and *Barringtonia acutangula, Lepisanthes rubiginosa, Mimusops elengi, Semicarpus anacardium* and *Syzygium jambos* have only Indo-Australian affinity. There are 20 tree species like *Alphonsea lutea, Gardenia lotifolia, Cordia monoica* etc. are found to have only Indo-Lankan affinity. Among all SBR trees, there are 38 species found similar between Sri- Lanka and china, 35 species among China and Myanmar and 39 among Sri- Lanka and Myanmar.

Affinity with Sri- Lanka

Tree species of SBR show highest affinity (46.66%) with Sri- Lanka (Table 2). Out of 240 tree species of Similipal Biosphere Reserve, 112 species find the distribution in Sri-Lanka. Noteworthy tree species are *Morinda citrifolia*, *Grewiaeriocarpa, Premna mollissima, Vitex pinnata, Stereospermum chelonoides, Benkara fasciculata, Tarenna asiatica, Cordia dichotoma, Symplocos cochinchinensis, Syzygium cumini* and *Tamarindus indica* etc.

Affinity with Myanmar

SBR also exhibits very strong affinity to Myanmar having 110 tree species (45.83%) similar to both the region. Some of the common species are *Turpinia cochichinensis, Sterculia villosa, Mallotus nudiflorum, Mallotus philippensis, Meliosoma simplicifolia, Meyna spinosa, Mitragyna parvifolia, Naringi crenulata, Ocotea lancifolia, Oroxylum indicum, Saraca asoca, Streblus asper,* etc.

Affinity with China

There are 60 tree species found common to the China and of the study area which is 25% of the total tree species of SBR. The tree species like *Cassine glauca, Streblus taxoides, Streblus asper, Rhus chinensis, Psydrax dicoccos, Wrightia arborea, Symplocos cochinchinensis, Suregada multifolia, Abizia chinensis, Ficus hispida, Ficus microcarpa, Salix tetrasperma, Falconeria insignis, Cassine glauca* etc. are wildly distributed species in both the areas.

Affinity with Thailand

A total of 30 tree species is found to be distributed in both Thailand and the study area. The affinity percentage is 12.5%. The common tree species are *Dillenia indica*, *Albizia chinensis, Xylosma longifolia, Garcinia cowa, Carallia branchiate, Streblus taxoides, Dillenia indica, zanthoxylum rhetsa, Wrightia arborea, Triadica cochinchinensis, Terminalia chebula, Syzygium cumini, Vitex glabrata, Vitex peduncularis* etc.

Affinity with Malaysia

Like Thailand, Malaysia shows 12.5% affinity but its floristic distribution is different. It has 30 tree species similar to SBR which are *Albizia chinensis*, *Albizia odoratissima, Albizia procera, Alstonia scholaris, Butea monosperma, Chionanthus ramiflorus, Diospyros malabarica, Elacocarpus tectorius, Lanneacoro mandelica, Litsea glutinosa, Micromelum minutum, Schleichera oleosa* etc.

Affinity with Australia

Australia has only 18 tree species similar to SBR with affinity 7.5%. The tree species namely *Morinda citrifolia*, *Vitex glabrata, Antidesma ghaesembilla, Casearia tomentosa, Flueggea virosa, Mallotus philippensis, Mimusops elengi, Pongamia pinnata, Toona ciliata, Carallia branchiata, Syzygium jambos* etc. are distributed in both the areas.

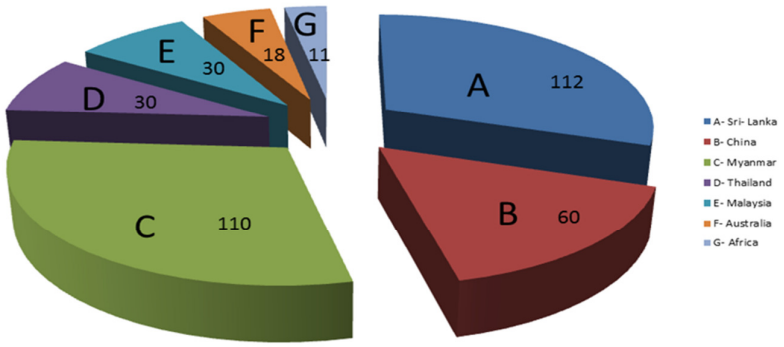

Fig. 2. Phytogeographical affinities of SBR

Table 2. Analytical result of affinities of different countries with SBR tree species

Sl. No.	Country	No. of species	Percentage (%)
1	Sri-Lanka	112	46.66
2	Myanmar	110	45.83
3	China	60	25.00
4	Thailand	30	12.5
5	Malaysia	30	12.5
6	Australia	18	7.5
7	Africa	11	4.58

*Percentage is calculated out of 240 tree species of SBR

Affinity with Africa

Affinity of tree species of SBR with African sub-Continent is poorly represented. Only 11 species are found common between the areas which is 4.58% of total tree species of SBR. Some of the representative species are *Cordia dichotoma*, *Flacourtia indica, Alangium salviifolium, Crateva marmelos, Alstonia scholaris, Catunaregam spinosa, Ficus benjamina, Flueggea virosa, Grewia tilifolia, Tamarindus indica* and *Trema orientalis*.

Himalayan plants in SBR

SBR possesses several numbers of tree species and orchids similar to Himalaya. Among them the noteworthy plant species are *Psychotria denticulata*, *Rubia cordifolia*, *Albizia chinensis*, *Baccaurea ramiflora*, *Ficus semicordata*, *Phoebe lanceolata* and *Phoebe wightii.* Two endemic orchids are also found in SBR namely *Cirrhopetalum panigrahinum* and *Eria meghasaniensis* (Misra, 2004).

Different anthropogenic forces cause destruction of the forests of tropical regions worldwide. Eastern Ghats of India is under such anthropogenic stress like cattle grazing, collection of fuel wood and non-timber forest products, illegal extraction of timber, soil mining etc (Muthuramkumar *et al*., 2014). So there is an urgent need for develop effective conservation strategies to maintain the species diversity in the world. Phytogeographical study is important in conservation aspect because it reflects the status of floral distribution in the world. In the present study, the tree species of Similipal biosphere reserve showed significant affinity with other subcontinents. Sri- Lanka has the highest similarity on tree species distribution with SBR. Muthuramkumar *et al.* (2014) has also described the affinity of Eastern Ghats trees and found highest affinity with Sri-Lanka. So migration of flora to/from Similipal Biosphere Reserve is not restricted within Indian sub-continent but it is throughout the globe. Neighbouring countries like Sri-Lanka, China, Bangladesh, Pakistan etc. shares several numbers of species. The migration of species is highly influenced by different ecological barrier and environmental conditions. The various postulations such as Pleistocene relicts, Hora's hypothesis on migration of floras from Himalayas to South Indian Hills etc. are yet to establish the phytogeographic characteristics of Similipal Biosphere Reserve.

Conclusions

Inventory and assessment of floristic composition of an area are prerequisites for planning and implementation of conservation strategies. The origin, distribution and ecological significance of the taxa extend in the area are vital for protected area network. More ever, it will add to biogeographical significance of the locality. The phytogeographical affinity of SBR supports the migration, establishment and naturalization of flora from/to SBR. This hypothesis needs further study for biogeographical mapping of Indian sub-continent.

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