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Floristic composition, life-forms and biological spectrum of Bagdara forest in Singrauli District, Madhya Pradesh, India

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Abstract
Floristic studies were conducted in Bagdara forest. A total of 83 species belonging to 72 genera and 34 families of angiosperm were recorded during the sampling of vegetation. Based on species contribution Fabaceae, Asteraceae, Rubiaceae, Combretaceae, Malvaceae, Mimosaceae and Euphorbiaceae were found as dominant families. Life-forms in order of importance were Phanerophytes (55%), Therophytes (32.5%), Chamaephytes (6.25%), Geophytes (3.75%), Hemicryptophytes and Epiphytes both (1.25%). The dominance of phanerophytes and therophytes reveals that phytoclimate of the area as phanero-therophytic.

Keywords: Floristic composition - life-forms - biological spectrum - phytoclimate

Introduction
Floristic richness of an area gives the design and functioning of the natural communities and also adds to complete understanding of the pattern and process of their structure. The floristic richness of an area depends upon the type, quality and stratification of its vegetation Whittaker (1972) [58]. Quantitative floristic inventories of forest ecosystems provides necessary context for understanding, planning and interpreting long-term ecological research (Phillips *et al.* 2003, Baithalu *et al.* 2013) [33, 2]. The information resulting from forest inventories not only provides data on the floristic composition and abundance of individual species, but also on detailed structural attributes of the vegetation (Palomino & Alvarez 2009) [28]. The information also serves as an invaluable research base for diverse aspects of tropical ecology while providing information crucial for their conservation and management (Ayyappan & Parthasarthy 1999) [1].
Raunkier (1934) [39] defined the life-forms as the sum of adaptions of plants to climate and Raunkier's system of classification of life-forms is the most widely accepted one and has been universally followed. The ratio of lifeforms of different species in term of number or percentage in any floristic community is called Biological spectrum or the spectrum of life-forms (Milne & Milne 1971) [23], which can be used to indicate the stratification and layering pattern of the community (Rao 1968, Krebs 1994) [38, 18], to indicate the prevailling environment (Kotiwar *et al.* 1996) [17], its aridity or humidity (Meher-Homji 1964) [21], to monitor the impact of ambient stress factors on climate (Palit *et al.* 2002) [27], and to determine the nature of bioclimate or phytoclimate (Malik *et al.* 2006) [20].
Several workers have studied floristic composition and biological spectrum of different regions in India (Meher-Homji 1964, 1981, Pandey & Parmar 1993, Sharman & Dhakre 1993, Singh & Arora 1994, Reddy *et al.* 1999, 2002, Rana *et al.* 2002, Thakur 2003, Shukla & Mishra 2006, Patel *et al.* 2010, Pharswan *et al.* 2010, Thakur & Khare 2011, Reddy *et al.* 2011, Bajpai *et al.* 2012, Desai & Ant 2012, Thakur *et al.* 2012a, Thakur *et al.* 2012b, Sindhuja *et al.* 2012, Sarkar & Devi 2014, Radha 2014, Chauhan *et al.* 2014, Kargjam 2014, Kensa & Pramila 2014, Sharma *et al.* 2014, Sundarapandian & Subbiah 2015, Dwivedi, Pradeep Kumar and Salim, M. 2016) [21-22, 29, 47, 50, 40, 37, 53, 48, 31, 32, 3, 8, 55, 56, 49, 43, 35, 6, 13, 15, 46, 51, 10].

Materials and Methods

Bagdara wild life sanctuary was established in the year 1978. Bagdara sanctuary is located in the Singrauli district of Madhya Pradesh. It lies on latitude N 24°30'-N24°42' and longitude E82°20'-E82°42'

There is a Bagdara revenue village inside the sanctuary and also Bagdara Kalan revenue village in the southern periphery of the sanctuary previously, this area had lot of tigers. So the name 'Bagdara' has been derived from Bag = Tiger, Dhara = Earth *viz*., the homeland of the tiger. It was a famous shooting block of Rewa State.

Total geographical area of the sanctuary is 478 sq. km. The protected forest area is 231.047 sq.km. and rest 248.953 sq. km. is the revenue area there is no reserve forest area in the sanctuary.

Forest communities were analysed by selecting uniform stands at study sites. Specimen of all species occurring in these plots belonging to trees, shrubs, herbs, climbers and epiphytes were collected and identified. These species provided a general floristic view of the vegetation. However, the collections are underestimate the floristics as the species occurring outside the sample plots were not considered. The generic coefficient of flora was calculated according to Jacord (1912) [12]. Biological spectrum was prepared on the basis of percentage species composition in each life-form following Raunkier (1934) [39] and Muller-Dombois & Ellenberg (1974) [25].

Results and Discussion

Table 1: Habit classification and life forms of plants observed at Bagdara forest

S. No.	Name of plant species	Family	Habit	Life form	Sub-sites				Bagdara Forest
					I	II	III	IV	
1.	*Acacia catechu* (L.f.) Willd.	Mimosaceae	Tree	Ph			+		+
2.	*Acacia leucophloea* Willd.	Mimosaceae	Tree	Ph			+		+
3.	*Achyrathes aspera* Linn.	Amranthaceae	Herb	Th		+		+	+
4.	*Adina cordifolia* Hook. f.	Rubiaceae	Tree	Ph	+	+		+	+
5.	*Aegle marmelos* Correa.	Rutaceae	Tree	Ph	+	+	+	+	+
6.	*Ageratum conyzoides* Linn.	Asteraceae	Herb	Th	+	+			+
7.	*Albizia lebbek* Benth.	Mimosaceae	Tree	Ph	+				+
8.	*Albizia odoratissima* (L.f.) Benth.	Mimosaceae	Tree	Ph			+		+
9.	*Alysicarpus monilifer* DC.	Fabaceae	Herb	Th	+	+	+	+	+
10.	*Anogeissus latifolia* (Roxb. ex DC) Wall.	Combretaceae	Tree	Ph	+	+	+		+
11.	*Anogeissus pendula* Edgew.	Combretaceae	Tree/ Shrub	Ph		+	+		+
12.	*Barleria prionitis* Linn.	Acanthaceae	Herb	Ch	+				+
13.	*Bidens biternata* (Lour.) Merr. & Sherff.	Asteraceae	Herb	Ch	+			+	+
14.	*Biophytum sensitivum* DC.	Geraniaceae	Herb	Th		+	+	+	+
15.	*Blepharis boerhaaviaefolia* Pers.	Acanthaceae	Herb	Ch	+				+
16.	*Boerhaavia diffusa* Linn.	Nyctaginaceae	Herb	G		+			+
17.	*Borreria stricta* Linn. F.	Rubiaceae	Herb	Th	+	+	+	+	+
18.	*Boswellia serrata* Roxb. ex Colebr.	Burseraceae	Tree	Ph	+				+
19.	*Bridelia retusa* (L.) Spreng.	Euphorbiaceae	Tree	Ph	+		+		+
20.	*Buchanania lanzan* Spreng.	Anacardiaceae	Tree	Ph	+			+	+
21.	*Butea monosperma* (Lamk.) Taub.	Fabaceae	Tree	Ph		+	+		+
22.	*Carissa spinarum* Linn.	Apocynaceae	Shrub	Ph		+	+	+	+
23.	*Casearia graveolens* Dal.	Bixaceae	Tree	Ph				+	+
24.	*Cassia fistula* Linn.	Caesalpiniaceae	Tree	Ph	+	+	+	+	+
25.	*Cassia pumila* Lamk.	Caesalpiniaceae	Herb	Th	+	+			+
26.	*Cassia tora* Linn.	Caesalpiniaceae	Herb	Th	+	+	+		+
27.	*Celosia argentea* Linn.	Amaranthaceae	Herb	Th				+	+
28.	*Corchorus actangulus* Lam.	Tiliaceae	Herb	Th	+	+	+	+	+
29.	*Cordia vestita* Hook. f. & Thoms.	Boraginaceae	Tree	Ph	+				+
30.	*Crotalaria prostrata* Roxb.	Fabaceae	Herb	Th	+				+
31.	*Desmodium gangeticum* DC.	Fabaceae	Herb	Th	+				+
32.	*Desmodium triflorum* DC.	Fabaceae	Herb	Th	+	+	+	+	+
33.	*Diospyros melanoxylon* Roxb.	Ebenaceae	Tree	Ph	+	+	+	+	+
34.	*Ehretia laevis* Roxb.	Boraginaceae	Tree	Ph	+				+
35.	*Elaeodendron glaucum* Pers.	Celastraceae	Tree	Ph	+	+	+		+
36.	*Elephantopus scaber* Linn.	Asteraceae	Herb	G	+	+	+	+	+
37.	*Eragrostis pilosa*	Poaceae	Herb (Grass)	Th	+	+	+		+
38.	*Erythrinia variegata* L.	Fabaceae	Tree	Ph	+				+
39.	*Euphorbia hirta* Linn.	Euphorbiaceae	Herb	Th	+	+	+	+	+
40.	*Flacourtia indica* (Burm. F.) Merr.	Bixaceae	Tree	Ph	+	+	+	+	+
41.	*Gardenia latifolia* Aiton.	Rubiaceae	Tree	Ph	+	+	+	+	+
42.	*Helicteres isora* Linn.	Sterculiaceae	Shrub	Ph	+				+
43.	*Hemidesmus indicus* (Linn.) Schultz	Asclepiadaceae	Climber	Ph					+
44.	*Hibiscus solandra* L.Herist.	Malvaceae	Herb	Th	+	+	+	+	+
45.	*Holarrhena antidysentrica* Wall.	Apocynaceae	Shrub	Ph	+		+	+	+
46.	*Ipomaea coccinea* Linn.	Convolvulaceae	Climber	G					+
47.	*Iseilema anthephoroides* Hack.	Poaceae	Herb (Grass)	G	+				+
48.	*Justicia simplex* Don.	Acanthaceae	Herb	Th	+	+	+	+	+

49.	*Kydia calycina* Roxb.	Malvaceae	Tree	Ph	+				+
50.	*Lagascea mollis* Cav.	Asteraceae	Herb	Th		+	+	+	+
51.	*Lagerstroemia parviflora* Roxb.	Lythraceae	Tree	Ph	+	+	+	+	+
52.	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	Tree	Ph	+	+	+	+	+
53.	*Lantana camara* Linn.	Verbenaceae	Shrub	Ph		+	+	+	+
54.	*Loranthus longiflorus* Desr.	Proteaceae	Epiphyte	E					+
55.	*Madhuca indica* Gmel.	Sapotaceae	Tree	Ph	+			+	+
56.	*Malvastrum tricuspidatum* A. Grey.	Malvaceae	Herb	Th	+				+
57.	*Miliusa tomentosa* (Roxb.) J. Sinclair.	Annonaceae	Tree	Ph	+			+	+
58.	*Mitragyna parvifolia* (Roxb.) Korth.	Rubiaceae	Tree	Ph	+	+			+
59.	*Mitreola oldenlandioidea* Wall.	Loganiaceae	Herb	Th	+	+	+		+
60.	*Ophlismemus burmannii* (Retz.) P. Beauv.	Poaceae	Herb (Grass)	Th	+	+	+	+	+
61.	*Ougeinia oojeinensis* (Roxb.) Hochr.	Fabaceae	Tree	Ph	+				+
62.	*Phyllanthus debilis* Ham.	Euphorbiaceae	Herb	Th	+	+	+		+
63.	*Phyllanthus urinaria* Linn.	Euphorbiaceae	Herb	Th	+	+	+	+	+
64.	*Randia spinosa* (Thumb.) Keay.	Rubiaceae	Shrub	Ph	+	+	+		+
65.	*Schleichera oleosa* (Lour.) Oken.	Sapindaceae	Tree	Ph		+	+	+	+
66.	*Shorea robusta* Gaertn. f.	Dipterocarpaceae	Tree	Ph		+	+	+	+
67.	*Sida spinosa* Linn.	Malvaceae	Herb	Th	+	+	+	+	+
68.	*Sida veronicaefolia* Lamk.	Malvaceae	Herb	Ch	+	+	+	+	+
69.	*Sporobolus diander* (Retz.) P. Beauv.	Poaceae	Herb (Grass)	Th	+	+	+	+	+
70.	*Terminalia arjuna* W. & A.	Combretaceae	Tree	Ph			+		+
71.	*Terminalia belerica* (Gaearth.) Roxb.	Combretaceae	Tree	Ph	+	+	+		+
72.	*Terminalia tomentosa* (DC.) W.& A.	Combretaceae	Tree	Ph	+		+	+	+
73.	*Tridax procumbens* Linn.	Asteraceae	Herb	Th	+	+	+	+	+
74.	*Ventilago maderaspatana* Gaerth.	Rhamnaceae	Climber	Ph					+
75.	*Vernonia cinerea* Linn.	Asteraceae	Herb	Th	+		+	+	+
76.	*Wendlandia puberula* DC.	Rubiaceae	Tree	Ph	+				+
77.	*Xanthium strumarium* Linn.	Asteraceae	Herb	Th		+			+
78.	*Xylia xylocarpa* (Roxb.) Taub.	Fabaceae	Tree	Ph			+		+
79.	*Zizyphus oenoplia* Mill.	Rhamnaceae	Shrub	Ph	+	+	+	+	+
80.	*Zizyphus xylopyrus* Willd.	Rhamnaceae	Tree/ Shrub	Ph	+				+

Note: + = Presence, Ph = Phanerophyte, Ch = Chamaephyte, H = Hemicryptophyte, G = Geophyte, Th = Therophyte, E = Epiphyte

A total of 80 species belonging to 69 genera and 33 families of angiosperm were encountered during the sampling of vegetation (Table 1). Out of these total 34 tree species belongs to 29 genera; 06 shrubs species to 06 genera, 02 tree/shrubs species to 02 genera and 34 herbs species to 30 genera. Three climbers and one of epiphyte species also recorded. The number of herb species is less than expected it is due to that only those species included in sampling that fell within the sampling unit and sampling was done after the rainy season when dry period began. The dicotyledons comprise 32 families 65 genera and 76 species and monocotyledons comprise 01 family 04 genera and 04 species. Out of the total 80 species dicotyledons represents 96.97% and monocotyledons 03.03%. The ratio of monocotyledons to dicotyledons family, genera and species were 1:03, 1:05 and 1:05 respectively (Table 2). Out of total 33 families of angiosperms in study area, the dominant families were Fabaceae (08 species), Asteraceae (07), Rubiaceae (06), Combretaceae (05), Malvaceae (05), Mimosaceae (04) and Euphorbiaceae (04) accounted for 39 (47.56%) species and 31 (43.05%) genera. Among the total families 17 families were monogeneric (Table 1).

Table 2: Comparative account of floristic composition of Bagdara forest

Category	Dicotyledons		Monocotyledons		Total
	Number	%	Number	%	
Family	32	96.97	01	3.03	33
Genera	65	94.20	04	5.80	69
Species	76	95.00	04	5.00	80

Present study area falls in a comparatively drier climate and most of the species shed their foliage during the winter season, render these forests naked. Comparative analysis of floristic composition with other studies done in Central India (Prasad & Pandey 1992, Thakur & Khare 2009) [34, 52] envisaged that in this region floristic composition is poor. On the whole, it appears that long dry spell is perhaps the one of the major reason for the poor floristic structure.

Generic coefficient as 87.80% was determined for the vegetation of Bagdara forest. On the basis of high percentage of generic coefficient, it can be inferred more intergeneric competitions exist in the area.

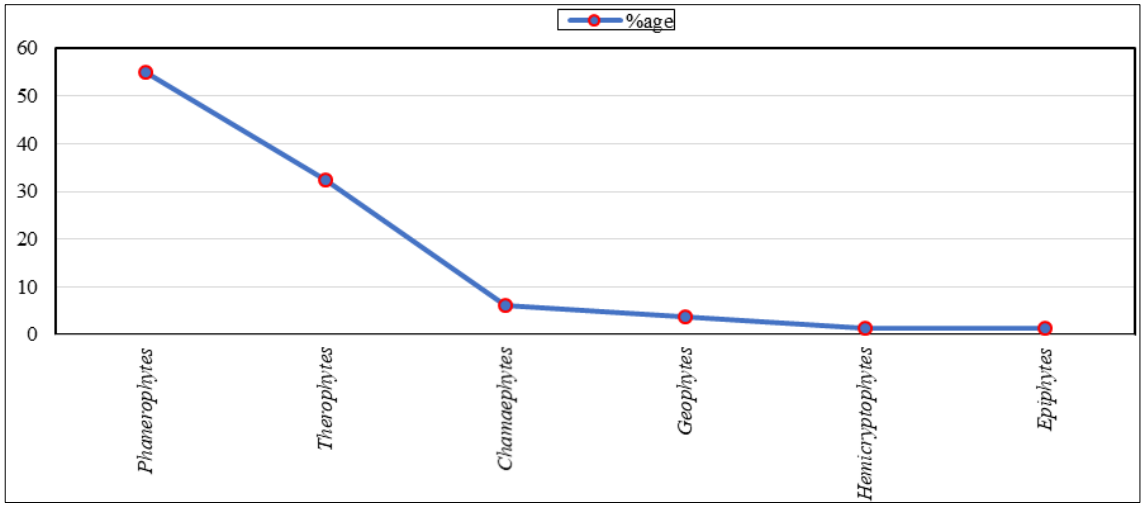

Fig 1: Graph analysis of biological spectrum of Bagdara forest

The vegetation of Bagdara forest showed highest percentage of Phanerophytes (55%), other groups of Life forms in order of importance were Therophytes (32.5%), Chamaephytes (6.25%), Geophytes (3.75%), Hemicryptophytes and Epiphytes both (1.25%) (Table 1 & Fig. 1). The Phanerophytes and Therophytes together constitute 87.5% of the life-forms proportion. Phanerophytes showed maximum divergence from the normal spectrum as given by Raunkier, accordingly the phytoclimate of the area may be termed as phanero-therophytic. Similar phytoclimatic association has also been reported by other workers (Rajendraprasad *et al*. 1998, Lakshmanan 1962, Misra *et al*. 1979, Saxena 1980, Saxena *et al*. 1982, Khatri 2000, Thakur & Khare 2011, Dwivedi, Pradeep Kumar and Salim, M. 2016) [36, 19, 24, 44, 45, 16, 53, 10].

In the present study therophytes stand next to phanerophytes. The predominance of therophytes due to grazing is a common phenomenon (Yadav & Singh 1977) [59]. It is also an indicator of biotic pressures (Barucha & Dave 1944) [4]. Gupta and Lal (1973) [11] observed that the life-forms of the flora of different grassland association of Singrauli were maintained by intensity of grazing. The high percentage of therophytes in grassland is due to overgrazing resulting in the introduction and spread of weedy grasses (Cain 1950, Down 1973) also recorded higher number of therophytes in bare and early successional stands. According to Dansereau (1957) [7] the predominance of therophytes indicates warm climate. The growth of therophyte was much favoured in disturbed areas (Keeley & Albert 1977, Vora & George 1987) [14, 57].

It is experienced that vegetation in a stress of biotic pressure gradually increase the percentage of therophytes. It is pertinent to state that composition of phanerophytes and therophytes is close in this area, an increase in biotic pressure would change the biological spectrum to therophytic-phanerophytic.

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