Journal of Experimental Sciences 2011, 2(9): 27-30
ISSN: 2218-1768
www.scholarjournals.org

journal of experimental sciences

www.jexpsciences.com

JES-Life Sciences

Ecological Assessment of the Plant Communities inside Kangla Fort, Manipur

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Article Info

Article History

Received : 05-05-2011
Revised : 11-08-2011
Accepted : 12-08-2011

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Abstract

The ecological assessment of the plant communities inside Kangla Fort, an ancient historical site in Manipur (24^0 N latitudes and 94^0 E longitudes) have been carried out with details of the floristic study i.e. habitat, heights, and natures of the perennating buds together with the seasonal changes in the diversity of the plant species during the period of one year at monthly intervals. For the present study, two study sites were selected inside Kangla viz. Site I (protected, by barb-wire fencing, from grazing and other biotic influences), and Site II (unprotected area exposed to grazing and other biotic influences). Altogether 54 plant species belonging to 24 families were recorded from the grassland communities in the two study sites. Out of the 54 plant species, maximum number of 33 species belonged to Therophytes (61.11%), 9 species to Hemicryptophytes (16.67%), and 8 species to Geophytes (14.81%). Chamaephytes were represented by only 4 species (7.41%) while Phenerophytes were absent. As the present study showed the predominance of therophytes and geophytes over other life forms, the study site could be categorised as a Thero-geophytic phytoclimate indicating a hot and humid climate.

Key Words: Kangla Fort, Manipur, Life form

Introduction

In recent years, concerns for the extinction of species and natural habitats have served to focus international attention on the issue of biodiversity. Scientist have turned their attention towards biodiversity with its heterogeneous distribution across the earth. As grassland constitutes about 25% of the vegetation cover of the earth's surface), the study of vegetation characteristics of this biome is necessary for understanding the biosphere. Moreover, grasslands-as highly dynamic ecosystems-provide goods and services to support flora, fauna and human populations.The World wide Fund-US has identified 232 ecoregions wordwide as "outstanding examples of the word's diverse ecosystems priority targets for conservation actionOf the 136 terrestrial ecoregions within this "Global 200", 35 are characterised as grassland ecoregions.

Ecological studies on the grasslands of India are limited to a few states only. Some notable works have been studied in the grasslands of North East India by Sharma (2003) in the grassland ecosystems of Manipur. However, no comprehensive information about the grassland ecosystem of the whole state could be ascertained so far. So, extensive studies on grassland ecosystem were necessitated to fill up this ecological lacuna. In the present study, an attempt has been made to fill up this ecological lacuna by assessing the diversity and life form of plant communities found at the protected and unprotected grassland ecosystems inside Kangla Fort, Imphal.

Study site

The study site, Kangla is located at the heart of Imphal city, the capital of Manipur. It is the most important historical and archaeological site in Manipur. It has served as the ancient palace of Manipur since 33 A.D. The area is extended within the geographical coordination of 24^{0}N latitude and 94^{0}E longitude at an elevation of 2,619 feet above mean sea level. During the study period the maximum temperature ranged from 22^{0}C to33^{0}C while the minimum temperature ranged from 4^{0}C to 26^{0}C. Highest total rainfall was observed in the month of May with164mm. However, no precipitation was observed in the month of January, 2007.

Vegetation inside the Kangla Fort is of mixed type. The area has been provided with many trees and shrubs. Some of these trees are endemic species while others are introduced at different periods. Some of the major trees observed in the terrestrial habitats inside Kangla Fort are *Acacia arauculiformis, Alnus nepalensis, Amoora rohituca, Artocarpus integrefolia, Bauhinia purpurea, Bischofia javanica, Cassia fistula, Castanopsis indica, Celtis austarlis, Eucalyptus rubra, Ficus hispida, Ficus religiosa, Grevillea robusta, Mangifera indica, Lagerstromia speciosa, Pinus khasiana, Plumeria acuminate, Tamarindus indica, Tectona grandis, Tuna ciliate, Ziziphus jujube,* etc. Many large stretches of grasslands are in many places not covered by trees and shrubs. The present study was carried out in these grasslands. These grasslands were divided into two study sites, viz. Site I and Site II. Site I is an area enclosed by wire fencing which protects the area from grazing and biotic influences. Site was exposed to heavy grazing and other biotic influences.

Materials and Methods

Life form analysis was done in the area after detailed floristic studies. The form, habit, height and nature of perennating bud of each species was studied. Classification of vegetation on physiognomic basis was done according to Raunkier,s system. The biological spectrum for the study site was compared with the Raunkiaer's Normal Biological Spectrum as well as with the spectra available for other localities. Field survey and collection of data was carried out at monthly intervals during the study period.

Result and Discussion

1. Floristic Composition

Study of floristic composition is necessary as they provide knowledge about the species diversity in a community since each species has its own range of ecological amplitude and habitat condition. The nature of the plant community at a place is determined by the species that grows and develops in such environments (Bliss, 1962). The study of the grassland flora requires knowledge of taxonomy which can be determined by periodic observation of the flora, collection of plant materials, systematic studies, herbarium preparation etc. (Ambasht, 1988).

For studying the floristic composition of the grassland ecosystem inside the Kangla, two study sites were sites were selected. One site is protected by fencing and has minimum biotic influences, whereas the other site is heavily influenced by biotic factors. Field surveys were conducted at these sites for every fortnight during the study period of three months. Herbaria for collected species were prepared after proper identification, comparing with other herbaria and taking reference with literature. During the study period 54 (fifty four) plant species belonging to 24 families were recorded in the selected grassland study site inside the kangla (Table 1). Out of the 54 species, 41 species were found to be common in both the study sites. Out of the remaining species*, Commelina benghalensis, Eryngium foetidum, Impatiens balsamina, Leucas indica, Solanum ferox and Urena lobata* were recorded only in the protected site and three species namely *Desmodium triflorum, Fragaria indica, Pennisetum glaucum* were found only in unprotected site.

Table (1)

Sl no	Name of the species	Family	Life Form	Site I*	Site II**
1	*Ageratum conyzoides* Linn	Asteraceae	Th	+	+
2	*Adiantum capillus veneris*	Polypodiaceae	G	+	-
3	*Alternanthera philoxeroides* (Mart) Griseb	Amaranthaceae	G	+	+
4	*Alternanthera sessile* R.Br. Ex DC	Amaranthaceae	Th	+	+
5	*Arundinella nepalensis* Trin	Poaceae	H	+	+
6	*Axonopus compressus* (Swartz) P. Beauv	Poaceae	H	+	+
7	*Bidens biternata* (Lour) Merr & Sheriff	Asteraceae	Th	+	+
8	*Carex cruciata* Wahlenb	Cyperaceae	Th	+	+
9	*Centella asiatica* (Linn) Urban	Apiaceae	H	+	+
10	*Chrysopogon aciculatus* (Retz) Trin	Poaceae	G	+	+
11	*Cassia tora* Linn	Caesalpiniaceae	Th	+	+
12	*Commelina apendiculata* C.B.C.I	Commelinaceae	Th	+	+
13	*Commelina benghalenis* Linn	Commelinaceae	Th	+	-
14	*Cynodon dactylon* (Linn) Pers	Poaceae	G	+	+
15	*Cyperus difformis* Linn	Cyperaceae	Th	+	+
16	*Cyperus rotundus* Linn	Cyperaceae	G	+	+
17	*Dactyloctenium aegyptium* (Linn) Willid	Poaceae	H	+	+
18	*Desmodium triflorum* (Linn) DC	Papilionaceae	Ch	-	+
19	*Digitaria longiflora* (Retz) Pers	Poaceae	Th	+	+
20	*Digitaria sanguinalis* (Linn) Scop	Poaceae	Th	+	+
21	*Dryopteris flix-mas*	Polypodiaceae	H	+	-
22	*Echinochloa colona* (Linn) Link	Poaceae	Th	+	+
23	*Ecilpta prostrata* (Linn) Link	Asteraceae	Th	+	+
24	*Equisetum debile*	Equisetaceae	G	+	-
25	*Eryngium foetidum*	Apiaceae	H	+	-
26	*Euphorbia hirta* Linn	Euphorbiaceae	Th	+	+
27	*Fimbristylis ferruginea* (Linn) Lamk	Cyperaceae	G	+	+
28	*Fragaria indica*	Rosaceae	H	-	+
29	*Gynura angulosa*	Asteraceae	Ch	+	+
30	*Hydrocotyle nepalensis* Hook	Apiaceae	H	+	+
31	*Imperata cylindrical* (Linn) Raeusch	Poaceae	G	+	+
32	*Impatiens balsamina* Linn	Balsaminaceae	Th	+	-
33	*Juncus effuses* Linn	Juncaceae	Th	+	+
34	*Knoxia mollis* R Br	Rubiaceae	Ch	+	+
35	*Kyllinga tenuifolia* Steaud	Cyperaceae	Th	+	+
36	*Leersia kexandra* Swartz	Cyperaceae	Th	+	+
37	*Leucas plukenetil* (Roth) Spreng	Lamiaceae	Th	+	+
38	*Leucas indica*	Lamiaceae	Th	+	-
39	*Mazus pumilus* (Burm.f.) steenis	Scrophulariaceae	Th	+	+
40	*Mimosa pudica* Linn	Mimosaceae	Ch	+	+
41	*Oxalis corniculata* Linn	Oxalidaceae	H	+	+

42	*Paspalum scrobiculatum* Linn	Poaceae	Th	+	+
43	*Pennisetum glaucum* (Linn) R. Br	Poaceae	Th	-	+
44	*Phyllanthus fraternus* Webster	Euphorbiaceae	Th	+	+
45	*Phyllanthus simplex* Retz	Euphorbiaceae	Th	+	+
46	*Plantago erosa* Wall	Plantaginaceae	Th	+	+
47	*Polycarpon indicum* (Retz) Merr	Caryophyllaceae	Th	+	+
48	*Scrophularia elatior* Benth	Scrophulariaceae	Th	+	-
49	*Sida rhombifolia* Linn	Malvaceae	Th	+	+
50	*Solanum ferox* Linn	Solanaceae	Th	+	-
51	*Spilanthes paniculata* Wall ex DC	Asteraceae	Th	+	+
52	*Triumfetta annua* Linn	Tiliaceae	Th	+	+
53	*Urena lobata* Linn	Malvaceae	Th	+	-
54	*Xanthium indicum* Koenig	Asteraceae	Th	+	+

Note: (The signs "+" or "-"represents presence or absence of the species respectively)
Th – Therophytes; H – Hemicryptophytes; G – Geophytes; Ch–Chamaephytes

Life Forms

Life-form study is an important part of vegetation description, ranking next to floristic composition (Cain, 1950). Plants can be grouped in life-form classes based on their similarities in structure and function. A life-form is characterized by plant adaptation to certain ecological conditions . The occurrence of a particular plant life-form could reflect the characteristic feature of the climatic condition in a given area to which the species have adapted. Plant species can be grouped into life-form and growth-form on the basis of their structure and function. A plant life-form reflects the relationship of the plant to the environmental conditions. The similarity in structure and form of the plants indicate a similarity in adaptation to the utilization of the environmental resources available in a given space. Many basic elements of the life history of plants are strongly affected or even largely determined by the life form. As such, study of life-form composition was taken up to assess the grassland ecosystem of the Kangla.

The concept of plant life-form was originally developed for a non-taxonomical comparison of vegetation types in different regions of the earth. The system of life-forms as morphological-ecological categories became soon complicated and difficult to use. Raunkiaer's system became most widely used system and applied in comparative vegetation studies. For the present study, the classification of the vegetation on physiognomic traits is done according to Raunkiaer's system (1934) modified by Braun-Blanquet (1951). Percentage distribution of the different life form in the two study sites were presented in the table 2.Out of the 54 plant species recorded for the whole grassland, maximum number of species belonged to Therophytes 33(61.11%). It was followed by Hemicryptophytes 9 species (16.67%) and Geophytes 8 species (14.81) respectively. Chamaeophytes contributed only 4 species (7.41%). Phanerophytes were absent from the study site.

Table 2: Percentage distribution of different life-forms in the study site

Life-form	Whole		Site I		Site II	
	No	P.C	No	P.C	No	P.C
Phanerophytes	-	-	-	-	-	-
Chamaephytes	4	7.41	3	5.88	4	9.09
Geophytes	8	14.81	8	15.69	6	13.64
Hemicryptophytes	9	16.67	8	15.69	7	15.91
Therophytes	33	61.11	32	62.75	27	61.36
Total	54	100.00	51	100.00	44	100.00

Table 3 Comparison of the Biological Spectrum of the present study site with those of other grasslands

Location	Ph	Ch	H	G	Th	Reference
Normal Biological Spectrum of Raunkiaer	46.0	9.0	26.0	6.0	13.0	Raunkiaer (1934)
Varanasi, India -	3.1	20.3	7.8	68.7		Pandeya (1964)
Karamnasa, Varanasi, India	40.0	6.0	1.0	10.0	43.0	Rao (1968)
Kurukshetra, India	2.0	10.4	18.7	16.2	62.5	Singh & Yadava (1974)
Varanasi, India	-	4.2	19.1	6.3	70.2	Singh & Ambasht (1976)
Tulihal Airport, Manipur, India	2.0	6.1	25.5	20.4	44.9	Kakati (1985)
Rajasthan Deserts, India (1985)	31.0	3.0	13.0	14.0	39.0	Pandey *et.al*
Ganganagar, Rajasthan, India	19.4	5.8	11.4	11.2	52.2	Singh & Arora (1994)
Tiger Hill, Darjeeling, India	2.3	22.7	18.2	18.2	32.6	Das & Lahiri (1997)
Alpine meadow, Tehri Himalayas	-	24.5	20.0	30.4	25.1	Pandey *et.al.* (1999)
Canchipur, Manipur, India	-	9.3	11.1	14.8	64.4	Devi *et.al.* (2000)
Porompat, Imphal, India						
(a) Site I Protected	-	5.0	11.7	15.0	68.3	
(b) Site II Unprotected	-	5.9	11.8	13.7	38.6	Sharma (2003)
Kangla, Imphal, India						
(a) Protected Site	-	3	8	8	32	
(b) Unprotected Site	-	4	6	7	27	Present Study

Note;
Ph – Phanerophytes
H – Hemicryptophytes
G – Geophytes
Ch – Chamaephytes
Th – Therophytes

Therophytes contributed maximum number of species in the protected site with 32 species. It was followed by Hemicryptophytes and Geophytes contributing 8 species each. Chamaeophytes contributed only 3 species. In the unprotected site also, Therophytes contributed maximum number of species with 27 species. Hemicryptophytes and Geophytes also contributed 7 and 6 species respectively. Chamaeophytes contributed 4 species exceeding the contribution of this plant group in the protected site. The life form classification and biological spectrum of the present study can be compared with the normal biological spectrum of Raunkiaer and also with the spectra available for other localities in different climatic zones as shown in Table 3.

The biological spectrum of the present study exhibited predominance of therophytes. Yadav and Singh (1984) attributed higher percentage of therophytes to the influence of heavy grazing or biotic interferences. Similar findings have been reported by Devi et al. (2000) from the grasslands of Canchipur with therophytes percentage of 64.8%, Sharma (2003) also reported 69.2% therophyte from the study of grassland ecosystem at Porompat, Manipur. Next to therophyte, geophytes (14.81%) showed high percentage contribution could be attributed to the moist soil conditions as have been observed by Raunkiaer (1934). Hemicryptophytes exhibit lower percentage than those of the normal biological spectrum. Though grasslands are generally rich in hemicryptophytes, the influence of biotic disturbance and intensity of grazing may change the hemicryptophytic dominance into therophytic nature (Bharucha and Dave, 1944). As the present study showed predominance of therophytes and geophytes over other life-forms, the study site could be assigned to the Thero-geophytic phytoclimate indicating hot and humid climate congenial for the growth of annuals and perennial herbs.

In most spectra, there is at least one life-form whose percentage value is much higher than that of the same life-form in the normal spectrum (Singh and Arora, 1994).

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