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Phytosociological studies of grasslands in the vicinity of Pataratu thermal power, Hazaribagh, Jharkhand

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Abstract
The study was conducted to assess the phytosociological studies of grasslands of Pataratu, Hazaribagh, Jharkhand. The total number of grassland species was recorded to be 17, 12 and 8 on control and 40, 27 and 19 on polluted grasslands in rainy, winter and summer seasons, respectively. Thero-hemicryptophytic life-forms was comparatively higher on both grasslands. Therophyte was higher on both grasslands than other life-forms classes. The importance value index of *Heteropogon contortus* was recorded to be maximum as compared to other grasslands species present on both types of grasslands in rainy, winter and summer seasons.

Keywords: Phytosociology, Grassland, Pararatu thermal power

INTRODUCTION

The changes in the species population may serve as basis for evaluating the effect of pollution on grasslands of Pataratu, Hazaribagh, Jharkhand. Hence phytosociological analysis of a plant community is the first and foremost basis of the study of any piece of vegetation. A preliminary vegetation analysis of different tropical grasslands have been made by Sant (1961), Vyas (1964), Singh (1967), Gupta (1971), Singh (1972), Singh (1973), Pandey (1977). Raunkiaer (1934) has pointed out the idea of the biological spectrum in relation with the community study on the basis of the population of various life-forms of the plant species. The study reveals the effect of pollution on species composition, life-forms, biological spectrum and sociological characters i.e., frequency, relative frequency, abundance, density, relative density, basal cover, relative dominance and importance value index (IVI) of grasslands of Pataratu, Hazaribagah, Jharkhand.

MATERIAL AND METHODS

The control and polluted grasslands were situated at Pataratu, Hazaribagah, Jharkhand. The control grassland was away from Pataratu, Thermal Power Station where no pollution was recorded. Polluted grasslands–situated near the Pataratu Thermal Power Station, Hazaribagh, Jharkhand. Climate is typically monsoonic which is characterized by three distinct seasons i.e. rainy, winter and summer.

The vegetation of the area was analysed by 50 cm x 50 cm sized quadrats in control and polluted grasslands. The phytosociological observations were made during three different times i.e. September (rainy season), January (winter season) and May (summer season). The quadrats have been spaced at intervals of 5 meters along the line transect. The species present on each quadrat was noted and also their number was counted individual/tiller of each species. For the basal area measurement the diameter of the individual/tiller was considered of each species at the point of emergence. From these data importance value index (IVI) was determined using the standard method (Misra, 1968).

RESULTS

All the plant species present on the control and polluted grasslands are listed in Table 1. Total number of species which were present on control and polluted grasslands in different seasons are given in Table 2.

Most of the annual species complete their life-cycle within one season but in some cases they extend up to the next season. The perennial species were common in each season on control and polluted grasslands. During rainy season the number of species were more as compared to winter and summer. The total number of plant species were more on polluted grassland as compared to control grassland in each season (Table 2). There were some species which were restricted in their distribution. Species like *Alysicarpus monilifer, Aneilema nudiflorum, Boerhaavia diffusa,* Cassia *tora, Convolvulus pluricaulis, Crotolaria medicagenea, Croton bonplandianum, Dactyloctenium aegypium, Eleusine indica, Evolvulus alsinoides, Indigofera linifolia, Justicia simplex, Kyllinga triceps, Panicum psilopodium, Paspalidium flavidum, Paspalum scorbiculatum, Rungia pectinata, Scoparia dulcis, Sida veronicaefolia, sporobolus diander, Tephrosia purpurea, Vernonia cinerea and Zornia diphylla* were found only on polluted grassland, whereas *Tridax procumbens occured* only on control. The remaining species which were common on control and polluted grasslands are listed in Table 1.

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Table 1. List of species occurring on the control and polluted grasslands in different seasons.

Species	Rainy		Winter		Summer		Life form
	C	P	C	P	C	P	
Alysicarpus monilifer DG	–	+	–	+	–	+	He
Aneilema nudiflorum Br.	–	+	–	–	–	–	Th
Blumea oxyodonta DC.	+	+	+	+	+	+	He
Boerhaavia diffusa L.	-	+	-	+	-	+	He
Bonnaya brachiata Link. & Otto.	+	+	+	–	–	–	Th
Bothriochloa pertusa (L.) A. camus	-	+	-	+	-	–	Cr
Cassia tora L.	–	+	–	+	–	–	Th
Convolvulus pluricaulis Chois	-	+	-	+	-	+	He
Crotolaria medicagina Lamk.	-	+	-	+	-	+	Th
Croton bonpandianum Baill.	-	+	-	+	-	+	Th
Cynodon dactylon Pers.	+	+	+	+	+	+	Ch
Cyperus rotundus L.	+	+	+	+	+	+	Cr
Dactyloctenium aegyptium (L.) P. Beauv.	-	+	-	-	-	-	Th
Desmodium triflorum DC.	–	+	+	+	+	+	He
Heteropogon contortus	–	+	+	+	+	+	He
Digitaria marginata Link.	–	+	–	–	–	–	Th
Digiteria sanguinalis (L.) Scop.	+	+	–	–	–	–	Th
Echinochloa colonum (L.) Link.	–	+	–	–	–	–	Th
Eleusine indica (L.) Gaertn.	-	+	-	+	-	-	Th
Eragrostis tenella (L.) P. Beauv.	+	+	+	+	–	–	Th
Eragrostis viscosa (Retz.) Trin.	+	+	+	+	–	–	Th
Euphorbia hirta L.	+	+	+	+	+	+	Th
Evolvulus alsinoides L.	–	+	–	+	–	+	He
Evolvulus nummularius L.	+	+	+	+	+	+	Ch
Indigofera linifolia Retz/	-	+	-	+	-	+	He
Justicia simplex L.	-	+	-	+	-	-	Th
Kyllinga triceps Rottb.	–	+	–	–	–	–	Th
Panicum psilopodium Trin.	-	+	-	-	-	-	Th
Paspalidium flavidum Stapf.	-	+	-	-	-	-	Th
Paspalum scorbiculatum L.	-	+	-	-	-	-	Th
Phyllanthus simplex Retz.	+	+	+	+	-	-	Th
Rungia pectinata Cl.	-	+	-	+	-	+	Th
Scoparia dulcis L.	-	+	-	+	-	+	Th
Setaria glauca Hack.	+	+	+	+	-	-	Th
Sidaveronicae folia Lank.	–	+	–	+	-	+	Th
Sporobolus diander (Retz.) P. Beauv.	-	+	-	-	-	-	He
Tephrosia purpurea L.	–	+	-	+	-	+	Th
Tridax procumbens L.	+	+	+	-	+	-	Ch
Vandellia crustacea Benth.	+	+	-	-	-	-	Th
Vernonia cinerea Less.	-	+	-	+	-	+	He
Zornia diphylla Pers.	-	+	-	-	-	-	Th

Ch	=	Chamaephyte	Cr	=	Cryptophyte
He	=	Hemicrytophyte	Th	=	Therophyte
P	=	Polluted grassland	C	=	Control grassland
+	=	Present	-	=	Absent

Table 2. Number of species occurring on the control and polluted grasslands in different seasons.

Season	Control grassland	Polluted grassland
Rainy	17	40
Winter	12	27
Summer	8	19

Table 3. Number of species under different life-form classes on control and polluted grasslands.

Life-form class	Control	Polluted	Total flora
Chamaephte	3	2	5
Hemicryptophyte	3	10	13
Cryptophyte	1	2	3
Therophyte	10	26	36
Total no. of species	**17**	**40**	**57**

Table 4. Biological spectrum of control and polluted grasslands and Raunkiaer's normal spectrum (percentage of total species)

Grassland	Chamae Phyte	Hemicrypto Phyte	Crypto phyte	Thero phyte
Control	17.64	17.64	5.88	58.82
Polluted	5.00	25.00	5.00	65.00
Total flora of the grassland	8.77	22.80	5.26	63.15
Raunkiaer's normal spectrum*	9.00	26.00	6.00	13.00

*Only those classes are given which were present on the study sites.

Table 5. Important value index of the species on control and polluted grassland in rainy, winter and summer seasons.

Species	Control			Polluted		
	Rainy	Winter	Summer	Rainy	Winter	Summer
Alysicarpus monilifer	-	-	-	5.76	11.11	17.40
Aneilema nudiflorum	-	-	-	27.39	-	-
Blumea oxyodonta	5.19	7.01	7.45	0.90	2.11	2.43
Bonnaya brachiata	1.68	-	-	11.84	-	-
Boerhaavia diffusa	-	-	-	0.75	7.63	10.28
Bothriochloa pertusa	-	-	-	3.01	3.50	-
Cassia tora	-	-	-	3.07	1.22	-
Convolvulus pluricaulis	-	-	-	7.69	6.44	8.53
Crotolaria medicagine	-	-	-	5.38	2.31	3.25
Croton bonpandianum	-	-	-	0.35	1.24	1.43
Cynodon dactylon	69.35	75.34	76.84	10.47	14.82	14.05
Cyperus rotundus	5.44	5.58	5.11	23.67	11.98	11.37
Dactyloctenium aegyptium	-	-	-	16.54	-	-
Desmodium triflorum	13.52	13.99	14.80	8.40	22.66	31.53
Heteropogon contortus	157.93	169.30	174.90	64.91	84.08	87.08
Digitaria marginata	1.93	-	-	3.52	-	-
Digitaria sanguinalis	2.39	-	-	1.26	-	-
Echinochloa colonum	2.12	-	3.13	2.11	-	-
Eleusine indica	-	-	-	1.69	3.15	-
Eragrostis tenella	5.06	4.23	12.57	3.76	10.65	-
Eragrostis viscosa	2.77	4.46	-	4.34	4.56	-
Euphorbia hirta	1.53	2.86	-	2.29	6.02	6.70
Evolvulus alsinoides	-	-	-	2.90	13.71	12.61
Evolvulus nummularius	10.456	10.44	-	17.49	45.28	66.32
Indigofera linifolia	-	-	-	1.40	3.77	6.82
Justicia simplex	-	-	-	1.63	3.69	-
Kyllinga triceps	-	-	-	4.21	-	-
Panicum psilopodium	-	-	-	14.83	-	-
Paspalidium flavidum	-	-	-	12.62	-	-
Paspalum scorbiculatum	-	-	-	5.61	-	-
Phyllanthus simplex	667	4.16	-	0.68	1.33	-
Rungia pectinata	-	-	-	3.10	4.20	5.62
Scoparia dulcis	-	-	-	1.81	3.45	4.85
Setaria glauca .	1.71	3.66	-	3.77	5.26	-
Sida veronicaefolia	-	-	-	1.48	3.62	2.96
Sporobolus diander	-	-	-	10.36	-	-
Tephrosia purpurea	-	-	-	2.39	0.69	1.76
Tridax procumbens	2.83	3.89	5.14	-	-	-
Vandellia crustacea	3.08	-	-	7.30	-	-
Vernonia cinerea	-	-	-	1.26	3.14	3.70
Zornia diphylla	-	-	-	4.56	-	-

The flora of the control and polluted grasslands were analysed for life-forms classes on the basis of position and degree of protection to perennating bud during the adverse seasons which is the principal feature of plant adaptation to climate. The number of species under each life-form and percentage of total species under different life-form classes are given in Table 3 and 4 for the control and polluted grasslands. It may be seen from the Table 4 that the percentage of therophyte was higher and that of cryptophytes were lowest in control grassland. In case of polluted grassland the higher percentage was observed that of therophyte and lowest in case of crytophytes and chamaephytes. The percentage of chamaephates and hemicryptophyes showed greater number in control than polluted grasslands. The hemicryptothytes and therophytes are more in polluted as compared to protected control grasslands. The percentage of therophytes in control and polluted grasslands and that of chamaephytes only control grasslands shows greater number when compared with normal biological spectrum. The percentage of chamaephytes, hemicryptophytes, cryptophytes in polluted grassland was less as compared with normal spectrum of Raunkiaer (Table 4). The sociological character i.e. importance value index

(IVI) of control and polluted grasslands is given in Table 5.

DISCUSSION

The present study of floristic composition of the vegetation on control and polluted grasslands of Pataratu, Haziribag Jharkhand disclosed that the number of species on polluted grassland was more as compared to the dominant species on control which is due to rainy and winter annuals. There was higher coverage of the dominant species on control, therefore, there is less chance of rainy and winter annuals. In polluted grasslands, the number of annuals was more but in control due to continuous herbage cover all the times throughout the year, the annuals do not get sufficient space, light to come up. Increase in dominance of grassland vegetation leads to decrease in their diversity (Singh 1967; Singh, 1972). The total number of species increases on account of heavy biotic interferences on the polluted grassland (Ellison, 1960; Pandeya, 1964; Singh, 1967, Singh, 1972; Singh, 1973; Singh and Yadava, 1974 and Pandey 1977).

The life-forms classes indicated a thero-hemicryptophytic flora. The preponderance of therophytes in Indian grasslands have been reported by Bharucha and Dave (1944) and Pandeya (1953). The high values for therophtes are an indicator of the amount of influence of man and animals. The percentage of therophytes on polluted grassland was higher due to pollution as well as periodicity in climate owing to monsoonic conditions results in the abundance of rainy season weeds. The number of cryptophytes and hemicryptophytes were higher on polluted grassland than control one. High percentage of cryptophyts is due to herbage removal and subsurface hidden position of the buds. Hemicryptophytes are able to withstand the pollution pressure and the therophytes survive as seeds. Therefore, the therophytes are most abundant during rainy season on both types of grassland. The percentage of therophytes was about 4.48 times in control and 5 times in polluted grasslands as compared to Raunkiaer's (1934) normal spectrum. Thus, the therophytes are able to survive the hot and xeric conditions of summer in the form of seed.

Seasonal study of the grassland vegetation reveals that the density as well as the total number of species during rainy season shows higher values as compared to winter and summer seasons. In winter season most of the rainy annuals disappear. The density decreased due to loss of aerial portion of annuals and disappearance of some parts of perennials also. During summer the density value decreased due to dry condition. It has been observed that the density of few species viz. *Bonnaya brachiata, Cyperus rotundus, Desmodium triflorum, Echinochloa colonum, Euphorbia hirta, Evolvulus nummularius, Phyllanthus simplex, Setaria glauca and Vandellia crustacea increased* due to pollution and that of *Dichanthium annulatum, cynodon dactylon* decreased.

The general vegetational cover decreases greatly on account of the hervage removal through pollution. Due to pollution there appears more bare space for the growth of annuals (Pandeya 1964b; Singh 1972; Singh, 1973 and Pandey 1977). On polluted grassland more hospitable situation is created for rainy season annuals to exist and increase in their population. Protected grassland favours perennials vegetation and their dominance is maintained throughout the year, thereby decreasing the incidence of annuals.

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