Study of the life form and the biological spectrum of Umananda River Island, Guwahati, Assam, India - a tool for characterization of the phytoclimate

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Abstract: ***The present paper deals with the characterization of the phytoclimate of the Umananda river island in Guwahati, Assam with the help of Raunkiaer's life form and biological spectrum method. A total of 128 species of vascular plants belonging to 122 genera and 60 families have been reported from the island. All the plant species are categorized into different life form based on the position of their perennating bud. Therophytes (Th. = 32.03%) and Mesophanerophytes (Mesoph. = 20.31%) were found to be dominant followed by Chamaephyte (Ch. = 11.72%), Microphanerophyte (Microph. = 9.38%), Hemicryptophytes (H.Cr. = 7.03%), Lianas/climbers and Geophytes (5.47%), Mega and Nanophanerophyte (3.13%) and Epiphytes (2.34%). On the basis of the life form categories, biological spectrum was prepared and compared with Raunkiaer's normal biological spectrum. On comparisons with Raunkiaer's normal spectrum, the area depicts Thero-phanerophytic type of phytoclimate.***

Key words: Life form and biological spectrum, Phytoclimate, Umananda river island.

I. INTRODUCTION

The classification of plants on the basis of similarities in structure and functions is called life form or growth form and the plant climate of a region is characterized by the life form (or forms). Life form portrays the plant adaptation to certain ecological conditions (Meera *et al.*, 1999) and is an important physiognomic attributes that have been widely used in vegetation studies. The concept of life form in the study of vegetation and groupings of vegetation type on the physiognomic basis dated back to the period of Humbolt (1806). A biological spectrum could be formed by categorizing all the species of the higher plants of the community into various life forms and their ratio is expressed as percentage value. In other words, the statistical distribution of the life forms in the flora of a region is expressed in the form of biological spectrum. The biological spectrum reflects the adaptation of plant to environment and primarily climate (Smith, 1980). Since the life forms are related to the environment around the plants, biological spectrum is also regarded as indicative of the prevailing environment (Meher-Homiji, 1981).

Raunkiaer (1934) considered the position of regenerating parts as the most important criterion for life-form system of classification of plants. Depending on this single character, he classified the higher plants into five major categories viz. Phanerophytes (Ph), Chamaephytes (Ch), Hemicryptophytes (HCr), Geophytes (G), and Therophytes (Th). The life-forms are taken as indicator of climate and on the basis of the life-form composition. Raunkiaer recognized three main types of phytoclimate on the earth viz., phanerophytic climate in the tropics, therophytic climate in the desert, and hemicryptophytic climate in the greater part of the cold temperate zone. Raunkiaer's normal spectrum indicates a phanerophytic community for the world and the deviation from it determines the phytoclimate of the habitat.

Raunkiaer's life-form spectrum was modified by Braun-Blanquet (1951) and Ellenberg and Mueller-Dombois (1974). Meher-Homiji (1964, 1981) has recognized ten phyto-climatic regions in India. In the present study, attempt has been made to characterize the phytoclimate of Umananda River Island near Guwahati in the state of Assam with the help of life form and the biological spectrum systems of Raunkiaer. The life form system of categorising plants is based primarily on the methods, by which plants survive the unfavourable season. The proportions of the flora in the various categories i.e. the biological spectrum vary from one climate to another.

II. OBJECTIVES

Plant life form method of vegetation analysis is useful in delineating the phytoclimatic type, particularly in areas that are relatively less disturbed. The present study has been formulated to study the life form and biological spectrum of the flora Umananda river Island - a small island of 4.9 ha in the Brahmaputra river near Guwahati, Assam. Along with recording the life form categories of the plant taxa, attempts are also being made to classify the plants as per the Raunkiaer's life form classification and calculate the biological spectrum that would enable to understand the community structure and adaptation of the plant to the climate of the Island. Raunkiaer (1934) constructed a 'normal spectrum' from the life form categories which could act as null model and different life form spectra could be compared with this. This system is an early and undoubtedly still useful attempt to relate plant morphology and life history to climate. The biological spectrum not only represents the climatic conditions but is also the most potent environmental factor representing the ecosystem and to understand the community structure and adaptation of the plant to the climate of the area.

III. METHODS

To study the life forms, several exploration tours to the island have been undertaken during the year 2011 to 2013. Accordingly, the growth form, habit, height and location of the perennating buds of the plant species were recorded and they were grouped into life-forms according to Raunkiaer (1934) and subsequent modification by Braun-Blanquet (1951). Parasites and liana/climbers were put under separate class as done by other workers (Rajendraprasad *et al*. 1998, Chattopadhyay 1998, Verma & Shukla 1993, Pandey & Parmer 1993 and Sharma & Rajpal 1991). For preparation of biological spectrum, the number of species in each life-form is calculated and the percentage of species belonging to each life-form is determined by following formula –

$$\% \text{ Life-form} = \frac{\text{Number of species in any life-form}}{\text{Total number of species in all life-forms}} \times 100$$

IV. STUDY AREA

The temple of Umananda is located on the Peacock Island in the middle of the river Brahmaputra at Guwahati. There are many permanent and temporary islands and beaches in the river. However, Umananda is a permanent island covering an area of 4.9 ha with a unique picturesque environment. This small island of the river Brahmaputra has a Siva temple. The patch of land on which the temple has been built is known as Bhasmacala. The history of the temple dates back to TAI AHOM rules of Assam as the temple was constructed by them in 1694 A.D. by the Bar Phukan Garhganya Handique by the order of His Majesty Swargadeo Gadadhar Singh (1681- 1696), one of the ablest and strongest rulers of the Tai Ahom dynasty.

Situated in the river basin of Brahmaputra, the Island supports lush vegetation. The golden langur population of the island is the only existing provisioned and semi-free-ranging population of the species. The major soil type of the study area is clayey soil. The physical and chemical properties of the soil samples of the island indicate that the soil is slightly basic in nature with pH 8.12.

V. RESULT

The floristic composition of the Island is remarkable in its diversity and luxuriance. The flora also supplements diets of endangered golden langur population inhabiting the island. The flora of Umananda River Island was found to consist of 128 species of vascular plants belonging to 122 genera and 60 families. There are 123 species of phanerogams. The dicotyledonous plants belong to 46 families, 99 genera and 105 species and the monocotyledonous to 9 families, 18 genera and 18 species (Table 1). In addition to this 2 (two) species of gymnosperm viz. *Cryptomeria japonica* (Taxodiaceae) and *Cycas pectinata* (Cycadaceae) and 3 (three) species of fern (*Adiatum* sp., *Dryopteris* sp. and *Drynaria quercifolia*) were also recorded from the island (Bujarbarua, 2015).

Classification of the flora on the basis of Raunkiaer (1934) life form classes reveal that, 46 species belong to Phanerophytes (Ph= 35.94%). This major class is further divided into 4 subclasses with species content viz. 4 species of Nanophanerophyte (Nanoph = 3.13%), 12 Species of Microphanerophyte (Microph = 9.38%), 26 species of Mesophanerophytes (Mesoph = 20.31%), and 4 species of Megaphanerophytes (Megaph = 3.13%). Besides, 15 species of Chamaephyte (Ch = 11.72%), 9 species of Hemicryptophytes (H.Cr = 7.03%), 41 species of Therophytes (Th = 32.03%), 7 species of Geophyte (G = 5.47%), 7 species of Lianas/climbers (L/Cl = 5.47%) and 3 Epiphytic species (E = 2.34%) are recorded during the study period.

A comparison of the percentage of the life form classes of the flora of the Umananda river island with Raunkiaer's normal spectrum is shown in the table 1 and graphically presented in figure 1. It reveals that the biological spectrum of the flora of Umananda River Island is deviated from the normal spectrum of Raunkiaer and major deviation is observed in hemicryptophytes and in therophytes. The occurrence of lianas/climbers is also very high in the present study.

Table 1: Biological spectrum of the flora of Umananda River Island

	Percentage distribution of life forms						
	Ph	**Ch**	**H.Cr**	**Th**	**G**	**L**	**E**
Normal spectrum (Raunkiaer, 1934)	43.0	9.0	27.0	13.0	4.0	-	3.0
Umananda River Island	35.94	11.72	7.03	32.03	5.47	5.47	2.34
Deviation	+7.06	-2.72	+19.97	-19.03	-1.47	+5.47	+0.66

Ph- Phanerophytes, Ch- Chamaephyte, H.Cr- Hemicryptophytes, Th- Therophytes, G- Geophyte, L/Cl- Lianas/climbers, E- Epiphytes

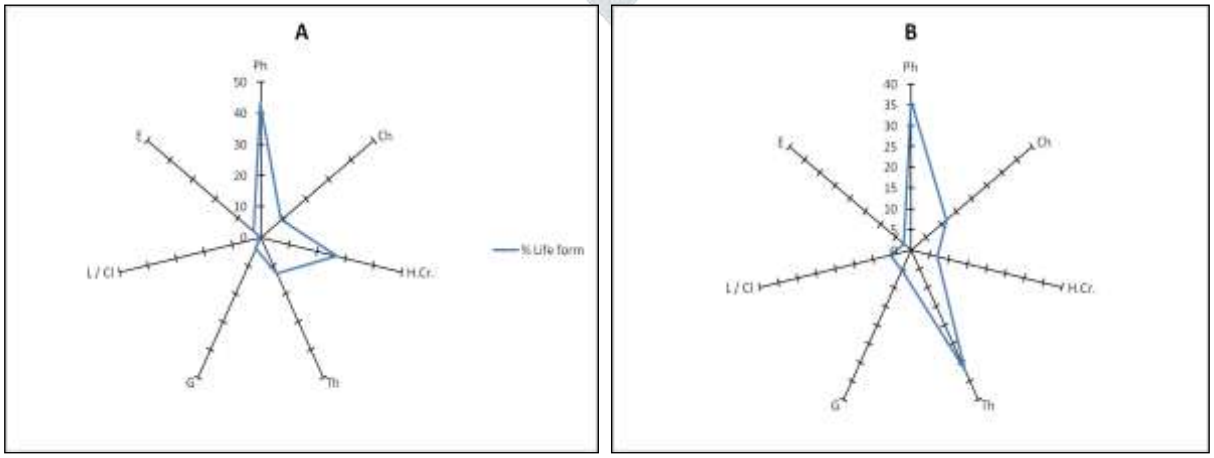

Figure 1: Comparisons of (A) normal spectrum of Raunkiaer with the (B) biological spectrum of Umananda River Island

VI. DISCUSSION

. The basic concept of biological spectrum is that the same life form will occur in regions having similar environmental conditions. In the climax vegetation or even in developing communities, dominant species are at equilibrium with their environment. Thus biological spectra help in delimiting the broad phytogeographic regions (Fekete & Lacza, 1971). Here, biological spectrum of Umananda River island deviates significantly in case of hemicryptophytes and therophytes with that of normal spectrum of Raunkiaer. In other categories too, some variation have been observed. The deviation of occurrence of hemicryptophytes and therophytes from the normal spectrum may be due to the anthropogenic pressure as a large number of devotees and tourists visit the island every day. Life form differences also influence habitat and other resources available to other species. This in turn may influence the distribution of different species within the community. According to Shimwell (1971), life form indicates micro and macroclimate as well as human disturbance of a particular area.

From the study it is evident that phanerophyte and therophyte constitute the highest percentage of life forms. Among phanerophytes, mesophanerophytes were well represented followed by microphanerophytes. Nanophanerophytes and megaphanerophytes are comparatively poorly represented. In most of the cases, phanerophytes and therophytes are dominant when compared to other life forms. A good percentage of phanerophytes is characteristic of tropical humid bioclimate and the predominance of therophytes is attributed to various factors like prevalent microclimate of the area coupled with anthropogenic activities (Sharma, 2003; Khan et al. 2011). Therefore, the bioclimate of Umananda river island can be termed as therophanerophytic and the vegetation is relic of tropical evergreen/semievergreen forest. The therophanerophytic spectrum has been discerned for disturbed areas. Cain (1950) reported that therophytes occupy an area where native vegetation has been disturbed. In Umananda island, the vegetation is severely affected due to anthropogenic disturbances mainly because of large number of tourists and pilgrims. Moreover, lack of proper management of the vegetation contributed towards a thero-phanerophytic spectrum. Although the study site is a sacred area and is a habitat of endangered golden langur, the area should be protected. The present scenario of the island reveals that it needs protection so as to maintain the equilibrium of entire environmental complex.

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