

BIOLOGICAL SPECTRUM OF THE FLORA OF GUJARAT STATE

G. L. SHAH, S. S. YADAV AND A. R. MENON

Sardar Patel University, Vallabh Vidyanagar

INTRODUCTION

The description of the vegetation of an area, based on visual observations, is found in research papers dealing with the floristics. However, a simpler but meaningful system of vegetation description on a physiognomic basis is the life form system first proposed by Humboldt (1805) and subsequently by a number of workers (Grisebach, 1884; Kraus, 1891; Drude, 1897; Pound and Clements, 1898; Warming, 1909 etc.). Raunkiaer's (1934) system is based on the principle of protection of buds during unfavourable season(s). It is most compact, consistent and widely used as such or with a few modifications (Braun-Blanquet, 1932; Cain, 1950; Danserau, 1951, 1957; Phillips, 1956; Kershaw, 1973; Muller-Dombois & Ellenberg, 1974). Raunkiaer (1934) worked out the life form spectrum or biological spectrum of the entire phanerogamic flora of the world which is known as the normal spectrum. According to him, the plant climate of a region is characterised by the life form(s) which in the biological spectrum of the region exceed the percentage of the same life form(s) in the normal spectrum.

Biological spectra have been worked out for the flora of restricted localities in India by Ferriera (1940), Bharucha & Ferriera (1941 a, 1941 b), Bharucha & Dave (1944) Das & Sarup (1951), Sarup (1952), Lakshmanan (1962),

Meher-Homji (1962, 1964), Trivedi & Sharma (1965), Rao (1968) and Agarwal (1975). For Gujarat, Borgesen (1929) studied the vegetation of Dwarka in Saurashtra with reference to Raunkiaer's life forms. This work is followed by an account of the biological spectrum of the vegetation of Bhavnagar also in Saurashtra (Murthy, 1957) and Dangs (Shah & Yadav, 1979). But this information is meagre because no data of this type are available for many forest divisions of Gujarat and the State of Gujarat as a whole. An attempt is now made to present a comparative account on the biological spectra of different forest divisions as well as the whole State of Gujarat as an adjunct to the FLORA OF GUJARAT (Shah, 1978). The biological spectrum of Gujarat is also compared with the biological spectra of Madhya Pradesh, Rajasthan, Mount Abu, Bombay and Mahabaleshwar.

The biological spectra, where data are not available, are carefully worked out from the published literature on floristics for Madhya Pradesh (Misra, 1956; Maheshwari, 1960; Rao & Sastry, 1964; Panigrahi *et al.*, 1965, 1966a, 1966b, 1967; Ramlal & Panigrahi, 1967; Sankaran, 1967a, 1967b; Shukla & Panigrahi, 1967; Agarkar, 1969; Kaushik, 1969; Saxena, 1970; Saxena & Shukla, 1970), for Rajasthan (Jain & Kotwal, 1960; Puri *et al.*, 1964; Verma *et al.*, 1935; Dhillon & Bajwa, 1969) and Sal-

sette Island (Malad-Madh area), Bombay (Shah, 1961). A detailed account of the edaphic and climatic conditions of Gujarat is given by Shah (1978) and hence omitted here.

OBSERVATIONS

A comparison of the biological spectra of different forest divisions of Gujarat reveals that of all the life forms, therophytes constitute the highest percentage which in turn is relatively much higher than their percentage in the normal spectrum. Among the forest divisions, Northern Gujarat has the highest percentage followed by that in Pavagadh. In other forest divisions their percentage are 30.2-39.2.

The phanerophytes (meso-, micro-, and nano-) become next abundant life form in Panchmahals, Chhotaudepur, Pavagadh, Rajpipla, Dangs, Bulsar and Dharampur (23.1-29.77%), the highest and the lowest percentage in Dangs and Pavagadh making up 29.77% and 17% respectively against 43% in the normal spectrum.

The mesophanerophytes are relatively more than the microphanerophytes except in Saurashtra, North Gujarat and Panchmahals where the converse is true. The nanophanerophytes are almost equal or slightly more than the mesophanerophytes in Rajpipla, Dangs, Bulsar and Dharampur.

On the other hand the chamaephytes become the next abundant life form in Saurashtra and North Gujarat. The phanerophytes are relatively less in these divisions because of unfavourable climatic conditions like longer periods of dry months, relatively less annual rainfall and therefore, less humidity and also,

in general, absence of dense forests over most of these divisions.

As compared to the normal spectrum, the hydrophytes are better represented in all forest divisions. Their occurrence in variable proportion depends on the abundance of puddles, ditches, ponds and river beds. Their lowest percentage (0.41%) in Pavagadh seems to be due to lack of puddles and ditches and only 3 to 4 ponds.

The geophytes are fairly represented in the areas studied except Saurashtra, North Gujarat, Pavagadh and Chhotaudepur. The higher percentage of geophytes at Bulsar (6.43%) as against the normal spectrum (4%) may be due to slightly more humid and warm conditions as compared to other regions and also due to loose, fertile upper soil horizon which favours the development of the rhizome geophytes, while considerable shading of leaves hinders the growth of therophytes as in hilly regions (Braun-Blanquet, 1932).

The epiphytes, succulents and parasites are poorly represented in all divisions and even their aggregate percentage is lower than that in the normal spectrum. However, the lianas are more than ten percent in all regions except North Gujarat, the highest percentage being at Rajpipla.

The hemicytrophytes are much less in all forest divisions than those in normal spectrum but among the forest divisions of Gujarat the highest percentage is in Panchmahals followed by Rajpipla.

Thus the phytoclimate is chamae-therophytic in Saurashtra and North Gujarat, mesophanero-chamae-therophytic in Panchmahals, Pavagadh, Rajpipla and Bulsar and mesopha-

nero-therophytic in Chhotaudepur, Dangs and Dharampur.

Gujarat State has on the whole a chamae-therophytic plant climate. A comparison of this biological spectrum with those of the adjacent States, shows that Rajasthan and Madhya Pradesh also have similar plant climate, but it is variable for some parts in Maharashtra State, chamaetherophytes in Salsette-Island (Malad-Madh area)—Bombay and phanerophytic-therophytic in Vihar lake—Bombay but only phanerophytic in Mahabaleshwar.

DISCUSSION

From the above data it is evident that the dominant life form is therophytes indicating a warm dry climate (Danserau, 1951, 1957). According to Pandeya (1961, 1964) and Pandeya *et al.* (1968) their higher percentage indicates a pronounced biotic or anthropogenic influence which maintains the vegetation open for further invasion of annuals with a result that a good phanerophytic flora may be very much reduced in course of time. Beadle (1951) and Agarwal (1975) concluded that in such affected areas the phytoclimate is not likely to give a correct indication of the vegetation. A similar conclusion is also drawn by Meher-Homji & Misra (1973) while discussing the biological spectra of Mount Abu, Bombay (Vihar lake), Allahabad and Karamnsa (Varanasi District). One of us (Shah, 1961) who has studied the flora and vegetation of Salsette Island—Bombay has also made similar observations.

In the eastern and south-eastern forest divisions of Gujarat, though the indiscriminate cutting of trees, overgrazing of herbaceous vegetation and seedlings of tree and shrub species, fair season or permanent road cons-

tructions and shifting cultivation have affected the vegetation, the phanerophytes are next abundant life forms. This may suggest that the biotic interference is not too intense and the favourable climate especially the rainfall accompanied by relatively more humidity and less temperatures during summer months prevails as yet (*see also* Meher-Homji & Misra, 1973).

Meher-Homji & Misra (1973), have traced the gradual evolution of the biological spectrum from therophytic of the desert with extreme aridity to the phanerophytic of the humid tropics. Our data also indicate a change in phytoclimate from chamae-therophytes in semi-arid regions of Saurashtra and North Gujarat to the mesophanero-therophytic of humid regions of Dharampur and Dangs with mesophanero-chamae-therophytic as an intermediate phytoclimate in Panchmahals, Pava-gadh and Rajpipla forest divisions.

An uniform type of phytoclimate in Rajasthan, Gujarat and Madhya Pradesh indicates the dominant semi-arid conditions in these States. In Maharashtra a similar climate does prevail in drier parts (*e.g.* Pune) but in hilly regions which are more humid, it is phanerophytic. There seems to be a change from mesophanero-therophytic phytoclimate in southern hilly parts of Gujarat to phanero-therophytic and phanerophytic phytoclimate in hilly parts of Maharashtra (*e.g.* Mahabaleshwar, Vihar). But there exists a gap in the information about the phytoclimate in the regions between the southern most limits of Gujarat and Bombay in Maharashtra. This lacuna can be bridged up by the floristic studies of the unexplored areas,

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