

LIFE-FORMS AND BIOLOGICAL SPECTRUM OF THE FLORA OF THE
PUNJAB STATE, INDIA

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A B S T R A C T

1, 119 species of spermatophytes recorded from the Punjab State have been analysed as to their exact life-forms. These include 243 (21.7%) phanerophytes, 49 (4.4%) chamaephytes, 83 (7.4%) hemicryptophytes, 215 (19.2%) cryptophytes and 529 (47.3%) therophytes. Similar analyses have also been made for the two floristic sub-units of the Punjab State, namely semi-arid Punjab and Punjab Shivaliks. These have been compared with Raunkiaer's normal and other spectra of contiguous and comparable areas. The phytoclimate of the State and its floristic sub-units have been found to be therocryptophytic which is characteristic of semi-arid and intensively cultivated areas. The results support Raunkiaer's concept of correlation between the phytoclimate and statistical distribution of life-forms in the flora of a region.

GENERAL FEATURES OF THE AREA

Covering an area of 50,362 sq. km, the Punjab State (India) lies between 29°30' and 32°32' N lat. and 73°54' and 76°50' E long. (Map). Three floristic sub-units, namely semi-arid Punjab (mainly southern part), Moist plains (central part) and Shivaliks (north-eastern hilly tract) have been recognized. The moist plains have mixed or the general flora of the State. In general it supports the flora distributed throughout the State. However, in the areas contiguous with the other two regions, typical elements of these zones ingress in the moister plain making the flora a mixed one. The other sub-units are not only two disjunct zones but they also show differences in physiography

and climate and possess their own characteristic flora (*cf.* Sharma, 1987). Height above m.s.l. of the three zones varies between 190-230 m, 230-300 m and 300-800 m in the order mentioned above. Average annual rainfall is 43 cm, 60 cm and 90 cm in the respective tracts. The summers are extremely hot and the winters intensely cold. During the last decade, the absolute maximum temperature recorded at Bhatinda was 49°C on 26th-28th May 1984 and the absolute minimum temperature registered was -2.8°C at Amritsar on 24th January, 1989.

MATERIALS AND METHODS

From the list of 1,879 species published by Sharma (1990), 1,119 wild and naturalized species have been taken into account. The rest being cultivated have been excluded. The included species of angiosperms have been grouped into five basic life-form classes of Raunkiaer as advocated by Mueller-Dombois and Ellenberg (1974).

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RESULTS

Table 1 depicts the numerical strength of the life-form classes of the Punjab State and its two well-marked floristic sub-units. Out of 243 phanerophytes (Ph) of the Punjab, 36 are mesophanerophytes, 66 microphanerophytes, 95 nanophanerophytes, 41 lianas and 5 epiphytes. The contribution of the Punjab Shivaliks to the respective sub-divisions of Ph is 35, 53, 59, 32 and 3; the corresponding

figures for the semi-arid Punjab are 9, 16, 24, 13 and 3 respectively. Similarly cryptophytes include geophytes (136, 77 and 32 respectively in the flora of the Punjab State, Punjab Shivaliks and semi-arid Punjab) and aquatics. Among aquatics of the Punjab State, the true water plants are 26 and helophytes or marsh plants are 53. The corresponding numbers for the Shivalik hills and semi-arid Punjab are 11, 23 and 9, 11 res-

Table 1: Major life-form classes of the different floristic regions/sub-units of the Punjab State

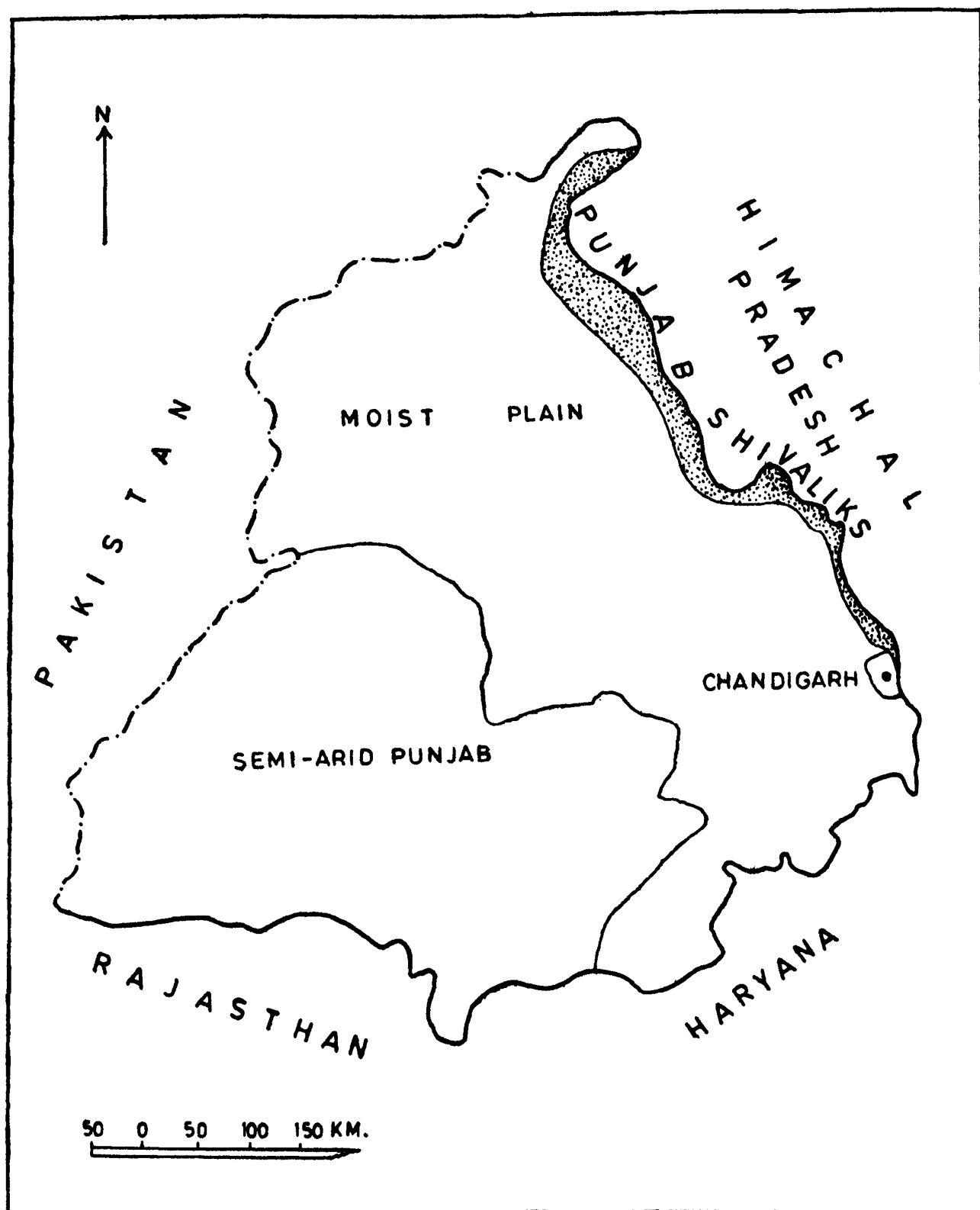
Region/Sub-unit	Life-form classes				
	Ph	Ch	H	Cr	Th
1. Punjab State (Present study)	243	49	83	215	529
2. Punjab Shivaliks (Sharma, 1990 a)	182	21	51	111	242
3. Semi-arid Punjab (Sharma, <i>et al.</i> , 1987)	65	32	66	52	260

pectively. Following the procedure suggested by Pandeya *et al.* (1968), the biological spectra have been drawn for three floristic regions/sub-units of the Punjab State. These and some others of contiguous or comparable areas have been given in Table 2 along with their respective phytoclimates.

DISCUSSION

The physiognomic form produced as a result of all life processes in response to the environment constitutes the life-form of the plant. An ecological interpretation of the vegetation depends upon the consideration of life-forms of a given flora. Geographically widely separated plant communities can be very usefully compared with one another on the basis of their biological spectra. Since the life-form is related to the environment, the biological spectrum is also regarded as

an indicator of the prevailing environment. Occurrence of a similar biological spectrum in different regions indicates similar climatic conditions. 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. This indicates the predominance of a particular type of climate that favours the development of that life-form in higher proportion. It must be argued, however, that due to biotic disturbances the proportion of life-form may be changed. Biotic influence like agricultural practices and grazing etc. may materially alter the biological spectrum by the introduction of therophytes like annual weeds. Using Raunkiaer's life-form classification Mcher-Homji (1964, 1981) compared the biological spectra of various regions of India and showed that these spectra were related to the bioclimate (phytoclimate) of the region.



Map showing the floristic sub-units of Punjab State

A scrutiny of Table 1 reveals that the therophytes constitute the major life-form in all the three floristic regions/sub-units of the Punjab. Their percentage (Table 2) is 3-4-times more than that of the therophytes in the normal spectrum. The cryptophytes too

are substantial in number ; percentage-wise they exceed the value in the normal spectrum by one and a half to more than three times. The percentages of the remaining three major life-form classes are much lower than in the normal spectrum in all the three floristic areas. Among phanerophytes, megaphanerophytes are totally lacking in the area. Mesophanerophytes are very poorly represented by nine species only in the semi-arid Punjab though their number is much higher in the other two regions. Microphanerophytes are relatively well represented among phanerophytes

as are the nanophanerophytes. Though the epiphytes are poorly represented everywhere, the number of lianas is substantial. The lowest number is that of chamaephytes in all the three zones. These plants are found in cold regions at high latitudes. This may explain their poor occurrence in the Punjab State.

It is inferred from Talbe 2 that the phytoclimate in all the three regions is therocryptophytic. Therophytes are well represented only in climate with a fairly long dry season or when the anthropogenic

Table 2 : Comparison of biological spectra and phytoclimates in certain parts of India based on major life-form classes...

Region	Percentage distribution of life-forms					Phytoclimate
	Ph	Ch	H	Cr	Th	
1. Normal spectrum (Raunkiaer, 1934)	46	9	26	6	13	—
2. Indian desert (Das & Sarup, 1951)	22.1	18.9	15.5	3.4	40	Therophytic
3. Semi-arid zone of N. India (Meher-Homji, 1964)	30.3	18.3	10.4	8.2	33	Therochamaephytic
4. Semi-arid zone of S. India (Meher-Homji, 1964)	38.3	12.4	11	10	28	Therochamaephytic
5. W. Rajasthan desert (Charan <i>et al.</i> , 1978)	24	19	9	2	45	Therophytic
6. Extreme arid regions of Indian desert (Mertia & Bhandari, 1978)	34	9	6	2	49	Therophytic
7. N-E Rajasthan (Sharma & Tiagi, 1979)	20	8.8	9.7	15.3	46.2	Therocryptophytic
8. N-E Haryana (Jain & Singh, 1984)	23.9	22.8	5.1	5.2	42.5	Therochamaephytic
9. Rajasthan desert (Pandey <i>et al.</i> , 1985)	31	3	13	14	39	Therocryptophytic
10. Punjab State (Present study)	21.7	4.4	7.4	19.2	47.3	Therocryptophytic
11. Semi-arid Punjab (Sharma <i>et al.</i> , 1987)	13.7	6.7	13.9	10.9	54.8	Therocryptophytic
12. Punjab Shivaliks (Sharma, 1990a)	29.9	3.5	8.1	18.3	39.9	Therocryptophytic

interference is pronounced. These conditions are very conspicuous throughout the Punjab State, especially in the semi-arid Punjab where the proportion of therophytes is higher than in the Shivalik hills which receive on an average almost double the amount of precipitation compared to the semi-arid Punjab. Meher-Homji (1981) has made a reassessment of 38 biological spectra described from different parts of India and has concluded that therophytic phytoclimate exists in arid zones and intensively cultivated areas which are deprived of their original natural vegetation. The present findings and comparisons (Table 2) fully concur with these conclusions. His observation that therocryptophytic type of phytoclimate is found where rainfall is of the order of 600 mm with 8 dry months in the year is applicable also to the floristic areas under discussion. The poor representation of phanerophytes, chamaephytes and hemicryptophytes and their smaller percentage relative to normal spectrum indicates that edaphoclimatic conditions are not conducive to their development. Amongst the phanerophytes, microphanerophytes and nanophanerophytes are relatively well represented compared to the mesophanerophytes. This and the total absence of megaphanerophytes may be attributed to the adverse climatic conditions and excessive biotic pressure. Thus the present results support Raunkiaer's concept of correlation between the phytoclimate and statistical distribution of life-forms in the flora of a region.

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