FLORISTIC COMPOSITION, LIFE-FORMS AND BIOLOGICAL SPECTRUM OF RENUKA WILDLIFE SANCTUARY, HIMACHAL PRADESH

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Introduction

Renuka Wildlife Sanctuary is situated in Sirmour District, Himachal Pradesh and lies between 30° 35' 58" to 30° 37' 08" North latitudes and 77° 26' 34" to 77° 28' 21" East longitudes, with a total area of 402.80 ha. It derives its name from Renuka, a famous pilgrimage destination of the region much recognized by its religious and cultural values. The sanctuary is also known for the famous lion safari, besides the lake. Renuka is the abode of temples devoted to the mother and son duo of Renukaji and Lord Parushuramji, and as such the entire area of this sanctuary has been declared as 'abhayaranya' (Sanctum sanctorum). A lake named after the goddess Renuka lies in the heart of the sanctuary. The altitude of the area varies from 200-900 m amsl and the vegetation type is northern subtropical dry mixed deciduous forests 5B/C2 and dry deciduous scrub 5B/DS1 (Champion and Seth, 1968; Singh *et al.,* 1990). In general, the vegetation is herbaceous and shrubby. Dominant herbaceous flora found in the area are *Bidens biternata, Eclipta prostrata, Eupatorium chinense, Cassia tora, Evolvulus alsinoides, Acorus calamus, Phyllanthus* spp., *Crotalaria* spp., *Sida* spp., *Oxalis corniculata, Solanum* spp., *Clerodendrum philippinum* etc. Among the climbers and lianas, *Bauhinia vahlii, Chonemorpha fragrans, Cryptolepis buchanani, Tinospora cordifolia, Trachelospermum lucidum* are frequent. Among shrubs, *Adhatoda zeylanica, Berberis chitria, Dodonaea angustifolia, Euphorbia royleana, Flacourtia indica, Roylea cinerea, Murraya koenigii, M. paniculata* and *Woodfordia fruticosa* were the dominant species. In case of trees, *Anogeissus latifolia, Acacia catechu, Cassia fistula, Grewia optiva, Kydia calycina, Lannea coromandelica, Sapium insigne, Mallotus philippensis* and *Terminalia alata* are the major species.

Generally, a complete list of plants called 'floristic composition' and their life forms cause appearance of a plant community. The structure and rate of change in composition are sensitive indicators of the whole environment. Therefore, it is important to study the floristic composition and life forms of different plants to find out the phytoclimatic zones of the area. In India, several workers have studied floristic composition and biological spectra of different regions. In Himachal Pradesh, only a few attempts have been made so far. Among these are Kapoor and Singh (1990) in temperate grasslands of Shimla hills; Sharma and Singh (1990, 1995) for

Chamba District, Sharma and Dhaliwal (1997) for the flora of Kullu District. Besides, no work on life forms has so far been carried out in Renuka Wildlife Sanctuary. Verma *et al*. (2005) studied the status of plant diversity around Renuka Lake. In continuation, the present communication describes and analysis the floristic composition and biological spectrum of Renuka Wildlife Sanctuary.

Material and Methods

Extensive field surveys were conducted in the Renuka Wildlife Sanctuary from February 1999 to October 2003 to assess the plant diversity and to find out their floristic composition. Data on habit, phenology, biotic associations, species distribution and frequency were recorded. Plant specimens collected were identified using the published local floras (Collet, 1902; Kanjilal, 1979, Kaur and Sharma, 2004). The voucher specimens were deposited at herbarium of HFRI, Shimla. Plant species collected were assigned to various life forms of Raunkiaer's (1934) system, as modified by Ellenberg and Mueller-Dombios (1976) according to the position of their regenerating parts. Based on the life forms with sub-type recorded the biological spectrum was prepared.

Results and Discussion

A total of 395 species belonging to 316 genera and 115 families were collected and identified. Of these, 390 species are angiosperms (335 spp of dicots, 55 spp of monocots), 4 ferns (4 spp and 4 genera) and 1b gymnosperm (Table 1). The ratio of monocotyledons to dicotyledons family, genera and species are 1 : 4.23, 1 : 5.61 and 1 : 6.09 respectively. Among the species, the ratio of family to genera is 1 : 2.75 family to species is 1 : 3.43 and genera to species is 1 : 1.25 which is lower than derived for world - 1 : 13, for British India - 1 : 7 (Hooker, 1872-97), India alone - 1 : 6 (Chaterjee, 1939), Valley of Flowers - 1 : 4.3 (Kala and Rawat, 2004), Himachal Pradesh - 1 : 2.93 (Chowdhry and Wadhwa, 1984), Bashahr Himalaya - 1 : 2.29 (Nair, 1977), Lahaul-Spiti 1 : 2.5 (Aswal and Mahrotra, 1994) and for Simla - 1 : 2 (Collett, 1902). On the other hand, the ratio tends to match with the floristic composition of Great Himalayan National Park - 1 : 1.94 (Singh and Rawat, 2000), Kullu - 1 : 1.84 (Dhaliwal and Sharma, 1999), Kangra - 1 : 1.72 (Kapur, 1985), Mussoorie - 1 : 1.87 (Raizada and Saxena,

Table 1

Relative proportion of taxa in different groups

Groups	Families	%	Genera	%	Species	%
Angiosperms :						
Dicots	89	77.39	264	83.55	335	84.82
Monocots	21	18.26	47	14.87	55	13.92
Gymnosperms	1	0.87	1	0.31	1	0.25
Pteridophytes	4	3.48	4	1.27	4	1.01
Total	115		316		395	

1978), Sirmour - 1 : 1.65 (Kaur and Sharma, 2004) and Trikuta Hills - 1 : 1.42 (Kapur and Sarin, 1990). This low value lends support to the generalization that smaller the flora, the genera-species ratio should decline within the same floral region.

Out of total 110 families of angiosperms in the study area, the eight dominant families i.e. Fabaceae (31 species), Asteraceae (26), Euphorabiaceae (20), Poaceae (15), Lamiaceae and Apocynaceae (each 12), Rubiaceae (11) and Acanthaceae (10) accounted for 137 (34.68%) species and 110 (34.81%) genera. Among the total families, 54 were monotypic and 63 families were monogeneric.

The collection included two endemic plant species to North-West Himalayas, *Berberis chitria* Lindl. And *Notholiron thomsonianum* (Royle) Stapf. (Nayar, 1996). A total of 228 (59.84%) plants were reported to have medicinal value (Chopra *et al*., 1956; Kirtikar and Basu, 1987). Red listed medicinal species *Acorus calamus* L., *Aegle marmelos* (L.) Corr, *Celastrus paniculata* Wild, *Chonemorpha fragrans* (Moon) Alston, *Gloriosa superba* L., *Hedychum coronarium* J. Koenig and *Oroxylum indicum* (L.) Vent. *Roylea cinerea* (D.Don) Baill. and *Zanthoxylum armatum* DC. have also been recorded (Ravikumar and Ved, 2000; Ved *et al.,* 2003). This assumes greater significance from the conservation point of view.

A total of 85 exotic taxa (21.52%) belonging to 79 genera and 34 families of angiosperms were recorded (Table 2), of which 14 were ornamental species that were recorded besides the Renuka Lake. The remaining species were naturally distributed in the forest along with other indigenous flora. Some of these species grow much faster than the native species, thereby posing a threat to the native forest biodiversity. Species such as *Xanthium strumarium, Stachytarpheta mutabilis, Cassia tora, Sida cordata, Ageratum conyzoides, Eupatorium chinense, Parthenium hysterophorus, Lantana camara, Phyllanthus urinaria* and *Cynodon dactylon* have aggressively dominated the ground vegetation, replacing the indigenous ground forest flora at some places. The exotic taxa have arrived from different phytogeographycal regions of the world, with a majority from different parts of American continent (39 spp.), followed by Eastern Asiatic region (13 spp.), Pantropical (7 spp.), Tropical African region (6 spp.), Australian region (5 spp.), and Central European region (4 spp).

Life forms and Biological spectrum

Life form is an important character in describing vegetation, which will present a preliminary picture of the ecological character of the vegetation (Cain, 1950). The life form classes reflects the stratification of different layers above the ground and further indicate how a plant passes the unfavorable seasons for growth (Rao, 1968). The life form is assumed to have evolved in direct response to the environment and accordingly, the proportion of life forms in an area can give a good indication of its phyto-climatic zone. Raunkiaer's (1934) classification of five major life forms e.g. Phanerophytes (Ph), Chamaephytes (Ch), Hemi-cryptophytes (H), Cryptophytes (Cr) and Therophytes (Th) in plants is the most widely understood and used throughout the world. The ratio of life forms of different species in terms of numbers or

Table 2

List of exotics with origin

Sl. No.	Botanical Name	Family	Habit	Place of origin
1	2	3	4	5
1	*Barleria cristata* L.	Acanthaceae	Hb	China, Malaysia
2	*Dicliptera bupleuroides* Nees	,,	Hb	Afghanistan
3	**Yucca gloriosa* L.	Agavaceae	US	Mexico, W. Indies
4	*Agave angustifolia Haw.* L.	,,	S	Tropical America
5	**Catharanthus roseus* (L.) G.Don	Apocynaceae	Hb	Madagascar
6	**Nerium indicum* Mill.	,,	S	Mediterranean region, Eastern Europe
7	**Thevetia peruviana* (Pers.) Merr.	,,	ST	Tropical America
8	*Calotropis gigantea* (L.) R. Br.	Asclepiadaceae	S	Tropical Africa
9	*Acanthospermum hispidum* DC.	Asteraceae	Hb	South America
10	*Ageratum conyzoides* L.	,,	Hb	Tropical America
11	*Ageratum houstonianum* Miller.	,,	Hb	Mexico
12	*Bidens biternata* (Lour.) Merrill & Scheriff	,,	US	Pantropical
13	*Blainvillea acmella* (L.) Philipson	,,	Hb	Pantropical
14	*Cirsium arvense* (L.) Scop.	,,	Hb	West Asia and Europe
15	*Conyza japonica* (Thunh.) Less.	,,	Hb	East Asia
16	*Eclipta prostrata* (L.) L.	,,	Hb	Pantropical
17	*Emilia sonchifolia* (L.) DC.	,,	Hb	Tropical Asia, Africa
18	*Eupatorium chinense* L.	,,	US	China and Japan
19	*Parthenium hysterophorus* L.	,,	Hb	North America
20	*Sigesbeckia orientalis* L.	Asteraceae	Hb	Old & New World Tropics
21	*Synedrella nudiflora* (L.) Gaertner	,,	Hb	West Inidies
22	*Tagetus minuta* L.	,,	US	South America
23	*Tridax procumbens* L.	,,	Hb	Tropical America
24	*Xanthium strumarium* L.	,,	US	South America
25	**Zinnia peruviana* (L.) L.	,,	Hb	Mexico, Central America, W. Indies, Columbia
26	*Impatiens balsamina* L.	Balasminaceae	Hb	China, Malaysia
27	*Jacaranda mimosifolia* D.Don	Bignoniaceae	T	NW Argentina

Contd...

1	2	3	4	5
28	**Pyrostegia ignea* (Vell.) C. Presl.	,,	Cl	Brazil
29	*Tecoma stans* (L.) Kunth.	,,	ST	South Florida
30	*Bauhinia variegate* L.	Caesalpiniaceae	ST	China, Burma
31	*Cassia occidentalis* L.	,,	Hb	South America
32	*Cassia siamea* Lam.	,,	T	SE Tropical Asia
33	*Cassia tora* L.	,,	Hb	Australia
34	*Cleome viscosa* L.	Cleomaceae	Hb	Tropical Africa
35	*Ipomoea carnea* Jacq. ssp. *fistulosa* (Choisy) D. Austin	Convolvulaceae	US	Tropical America
36	*Ipomoea nil* (L.) Roth.	,,	Cl	North America
37	*Ipomoea purpurea* (L.) Roth.	,,	Cl	Tropical America
38	**Ipomoea quamoclit* L.	,,	Cl	Tropical America
39	*Coriaria nepalensis* Wall.	Coriariaceae	S	China, Japan
40	*Kalanchose spathulata* DC.	Crassulaceae	Hb	Burma, China and Java
41	*Euphorbia heterophylla* L.	Euphorbiaceae	Hb	Central America
42	*Euphorbia hirta* L.	,,	Hb	Pantropical
43	*Euphorbia prostrata* Ait.	,,	Hb	Tropical America
44	*Jatropha curcas* L.	,,	S	Tropical America
45	**Pedilanthes tithymaloides* (L.) Poit.	,,	US	West Indies
46	*Phyllanthus urinaria* L.	,,	Hb	Pantropical
47	**Ricinus communis* L.	,,	S	NE Tropical America
48	*Alysicarpus monilifer* (L.) DC.	Fabaceae	Hb	Pantropical
49	*Crotalaria albida* Heyne *ex* Roth.	,,	Hb	SE Asia and Malaysia
50	*Desmodium gangeticum* (L.) DC.	,,	Hb	Tropical Africa and Australia
51	*Phaseolus vulgaris* L.	,,	Hb	America
52	*Geranium lucidum* L.	Geraniaceae	Hb	South America, Europe, Britain
53	*Ocimum americanum* L.	Lamiaceae	Hb	Paleotropical
54	*Woodfordia fruticosa* (L.) Kurz.	Lythraceae	S	China, Africa and Madagascar
55	*Abutilon crispum* (L.) Medikus	Malvaceae	Hb	America and Malaysia
56	*Sida acuta* Burm.f.	,,	Hb	Pantropical
57	*Sida cordata* (Burm.f.) Borssum Waalkes	,,	Hb	Tropical America
58	*Sida rhombifolia* L.	,,	Hb	Old & New World Tropics

Contd...

1	2	3	4	5
59	*Urena lobata* L. var. sinuata (L.) Brossum Waalke	,,	US	Africa
60	*Albizia lebbek* (L.) Benth.	Mimosaceae	T	North Australia and Tropical Asia
61	*Leucaena leucocephala* (Lam.)de Wit.	,,	T	Tropical America
62	**Callistemon citrinus* (Curtis) Skeels	Myrtaceae	ST	East Australia
63	*Eucalyptus camaldulensis* Dehnh.	,,	T	Australia and Tasmania
64	*Boerhavia diffusa* L.	Nyctaginaceae	Hb	Pantropical
65	**Bougainvillea glabra* Choisy	,,	S	Brazil
66	*Mirabilis jalapa* L.	,,	US	Peru
67	*Raimannia drummondii* (Hook.f.) Rose	Onagraceae	Hb	America
68	*Oxalis corniculata* L.	Oxalidaeae	Hb	Britain
69	*Sesamum orientale* L.	Pedaliaceae	Hb	Tropical Africa
70	*Plumbago zeylanica* L.	Plumbaginaceae	US	Tropical regions of the Old World
71	*Cynodon dactylon* (L.) Pers.	Poaceae	Hb	Europe
72	*Grevillea robusta* A.Cunn.*ex* R.Br.	Proteaceae	T	East Australia
73	*Punica granatum* L.	Punicaceae	S	Mediterranean Region and South America
74	*Richardia scabra* L.	Rubiaceae	Hb	South America
75	*Populus deltoidea* Marsh.	Salicaceae	T	North America
76	*Bacopa monnieri* (L.) Pennell	Scrophulariaceae	Hb	Palaeotropical
77	*Torenia cordifolia* Roxb.	,,	Hb	China, Japan
78	*Vernonia cinerea* (L.) Less.	,,	Hb	Tropical Asia, Africa, Australia
79	*Nicandra physaloides* (L.) Gaertner	Solanaceae	Hb	Central America
80	*Solanum nigrum* L.	,,	Hb	Europe
81	*Corchours aestuans* L.	Tiliaceae	Hb	Australia, Central America and W. Indies
82	*Triumfetta rhmboidea* Jacq.	,,	US	Pantropical
83	*Clerodendrum philippinum* Schauer	Verbenaceae	US	China
84	*Lantana camara* L.	,,	S	Tropical America
85	*Stachytarpheta mutabilis* (Jacq.) Vahl.	,,	US	Tropical America

*Species planted around the Renuka Lake

Hb-Herb, Cl-Climber, US-Undershrub, S-Shrub, ST-Small tree, T-Tree.

percentage in any floristic communtiy is called the Biological spectrum of Phyto-climatic spectrum. Thus, the biological spectrum is one useful parameter for comparison on a geographical scale and is valuable in expressing the

differences and similarities among plant communities.

Raunkiaer (1934) prepeared a normal biological spectrum (NBS) for the Phanerogamic flora of the world, working on the smae lines a biological spectrum of the flora of Renuka Wildlife Sanctuary has been prepared. Out of 395 species, 14 ornamental species planted around the lake are excluded in the preparation of biological spectrum, as they do not form a part of the natural vegetation. The number of different life forms has been given for each family on the basis of study of 381 species. The species belonging to different families are arranged alphabetically (Table 3) in twelve life forms classes, which are :

Megaphanerophyte	(2, 0.52%)
Mesophnerophyte	(47, 12.34%)
Microphanerophyte	(63, 16.54%)
Nanophanerophyte	(73, 19.16%)
Chamaephyte	(29, 7.61%)
Hemicryptophyte	(21, 5.51%)
Geophyte	(8, 2.10%)
Hydrophyte or marsh plants	(13, 3.41%)
Therophyte	(119, 31.24%)
Liana	(3, 0.79%)
Parasite	(2, 0.52%)
Epiphyte	(1, 0.26%).

The biological spectrum of the study area as compared with Raunkiaer's NBS shows that chamaephyte, hemicryptophyte, geophyte, and epiphyte have a lower percentage. The life forms of the area, which show higher percentage than those of normal spectrum, are therophytes, nanophanerophyte, hydrophyte, liana and parasite (Table 4). The higher percentage of therophytes (31.24%), which occupies the first position in the area, is characteristic of the subtropics and often related to soil conditions and climate (Dadhich, 1982), that is favourable for the growth of annuals and therophytes, thereby best adapted to tide over the unfavorable condition in the form of seeds. Nanophanerophytes (19.16%) occupying the second position against NBS (15%) reveals that among phanerophytes shrubs are more dominant than the medium and small sized trees. It is also suggested that the dominance of therophytes and nanophanerophytes may have party resulted from disturbance in vegetation and grazing in higher ground. The mega-, meso- and micro-phanerophytes (29.4%) are slightly higher to NBS (28%) being the characteristics of mixed forest with less foliage. Since the study area is in the hivalik range, it receives more rainfall and temperature, which favours the growth of phanerophytes more distributed in low areas around the lake. The hydrophyte has a little high percentage as it is restricted to low lying ground, especially in and around Renuka lake. The percentage of chamaeophyte, hemi-cryptophyte and geophytes are lower, mainly due to biotic interference of animals as well as of humans.

In the present investigation, therophytes showed maximum divergence followed by nanophanerophytes. The According to Raunkiaer's terminology, the phytoclimate of the area may nbe called as thero-nanophanerophyte. Similar phyto-climatic association has also been reported by Trivedi and Sharma (1965) for Lucknow flora, Sharma and Dhakre (1993) from District Shahjahanpur, Uttar Pradesh.

Table 3

Number of life forms in different families of Renuka Wildlife Sanctuary

Sl. No.	Family	Ph							Ch	H	Cr		Th
		MMM	MM	M	N	L	P	E			G	HH	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Acanthaceae	-	-	1	3	-	-	-	-	-	-	-	5
2	Acoraceae	-	-	-	-	-	-	-	1	-	-	-	-
3	Adiantaceae	-	-	-	-	-	-	-	-	-	-	-	1
4	Agavaceae	-	-	-	1	-	-	-	-	-	-	-	-
5	Alismataceae	-	-	-	-	-	-	-	-	-	-	1	-
6	Amaranthaceae	-	-	-	2	-	-	-	-	-	-	-	-
7	Amaryllidaceae	-	-	-	-	-	-	-	-	-	1	-	-
8	Anacardiaceae	-	2	2	-	-	-	-	-	-	-	-	-
9	Apiaceae	-	-	-	-	-	-	-	-	1	-	-	-
10	Apocynaceae	-	-	4	4	1	-	-	-	-	-	-	-
11	Araceae	-	-	-	-	-	-	-	-	1	2	-	-
12	Araliaceae	-	-	1	-	-	-	-	-	-	-	-	-
13	Arecaceae	-	-	1	-	-	-	-	-	-	-	-	-
14	Asclepiadaceae	-	-	-	3	-	-	-	-	-	-	-	-
15	Asparagaceae	-	-	-	1	-	-	-	-	-	-	-	-
16	Asteraceae	-	-	-	3	-	-	-	3	1	-	-	18
17	Balsaminaceae	-	-	-	-	-	-	-	-	-	-	-	3
18	Bambusaceae	-	1	-	-	-	-	-	-	-	-	-	-
19	Begoniaceae	-	-	-	-	-	-	-	-	-	-	-	1
20	Berberidaceae	-	-	-	-	2	-	-	-	-	-	-	-
21	Bignoniaceae	-	2	1	-	-	-	-	-	-	-	-	-
22	Bombaceae	1	-	-	-	-	-	-	-	-	-	-	-
23	Boraginaceae	-	-	-	-	-	-	-	1	-	-	-	-
24	Brassicaceae	-	-	-	-	-	-	-	-	-	-	-	2
25	Burseraceae	-	1	-	-	-	-	-	-	-	-	-	-
26	Caesalpiniaceae	-	2	1	-	1	-	-	-	-	-	-	3
27	Cannabaceae	-	-	-	-	-	-	-	-	-	-	-	1
28	Celastraceae	-	2	1	1	-	-	-	-	-	-	-	-
29	Chenopodiaceae	-	-	-	-	-	-	-	1	-	-	-	-
30	Cleomaceae	-	-	-	-	-	-	-	-	-	-	-	1
31	Colchicaceae	-	-	-	1	-	-	-	-	-	-	-	-

Contd...

1	2	3	4	5	6	7	8	9	10	11	12	13	14
32	Combretaceae	-	3	-	-	-	-	-	-	-	-	-	-
33	Commelinaceae	-	-	-	-	-	-	-	-	-	-	-	4
34	Convolvulaceae	-	-	-	-	-	-	-	1	-	-	-	2
35	Cordiaceae	-	-	2	-	-	-	-	-	-	-	-	-
36	Coriariaceae	-	-	1	-	-	-	-	-	-	-	-	-
37	Cornaceae	-	1	1	-	-	-	-	-	-	-	-	-
38	Crassulaceae	-	-	-	-	-	-	-	-	-	-	-	1
39	Cucurbitaceae	-	-	-	1	-	-	-	1	-	-	-	1
40	Cupressaceae	-	-	1	-	-	-	-	-	-	-	-	-
41	Cuscutaceae	-	-	-	-	-	1	-	-	-	-	-	-
42	Cyperaceae	-	-	-	-	-	-	-	-	1	2	3	3
43	Dioscoreaceae	-	1	-	-	-	-	-	-	-	-	-	-
44	Dipterocarpaceae	-	-	-	2	-	-	-	-	-	-	-	-
45	Ebenaceae	-	-	1	-	-	-	-	-	-	-	-	-
46	Ehretiaceae	-	-	2	-	-	-	-	-	-	-	-	-
47	Equisetaceae	-	-	-	-	-	-	-	-	-	-	1	-
48	Euphorbiaceae	-	3	5	2	-	-	-	-	-	-	-	8
49	Fabaceae	-	5	1	10	1	-	-	4	-	-	-	10
50	Flacourtiaceae	-	-	2	-	-	-	-	-	-	-	-	-
51	Gentianaceae	-	-	-	-	-	-	-	1	-	-	-	-
52	Geraniaceae	-	-	-	-	-	-	-	-	2	-	-	-
53	Gesneriaceae	-	-	-	-	-	-	-	-	3	-	-	-
54	Hydrocharitaceae	-	-	-	-	-	-	-	-	-	-	2	-
55	Hypericaceae	-	-	-	2	-	-	-	-	-	-	-	-
56	Hypoxidaceae	-	-	-	-	-	-	-	2	-	-	-	-
57	Lamiaceae	-	-	2	2	-	-	-	-	-	-	-	8
58	Lauraceae	-	-	3	-	-	-	-	-	-	-	-	-
59	Liliaceae	-	-	-	-	-	-	-	-	-	1	-	1
60	Linaceae	-	-	-	1	-	-	-	-	-	-	-	-
61	Loranthaceae	-	-	-	-	-	1	-	-	-	-	-	-
62	Lythraceae	-	-	1	1	-	-	-	-	-	-	-	-
63	Malpighiaceae	-	-	-	1	-	-	-	-	-	-	-	-
64	Malvaceae	-	1	-	1	-	-	-	1	-	-	-	4
65	Marseliaceae	-	-	-	-	-	-	-	-	-	-	1	-
66	Meliaceae	-	2	-	-	-	-	-	-	-	-	-	-
67	Menispermaceae	-	-	2	1	-	-	-	1	-	-	-	-
68	Mimosaceae	-	3	2	-	-	-	-	-	-	-	-	-

Contd...

1	2	3	4	5	6	7	8	9	10	11	12	13	14
69	Moraceae	1	3	3	-	-	-	-	-	-	-	-	-
70	Moringaceae	-	-	1	-	-	-	-	-	-	-	-	-
71	Myrsinaceae	-	-	-	1	-	-	-	-	-	-	-	-
72	Myrtaceae	-	2	-	-	-	-	-	-	-	-	-	-
73	Nyctaginaceae	-	-	-	-	-	-	-	1	-	-	-	1
74	Nymphaeaceae	-	-	-	-	-	-	-	-	-	-	1	-
75	Oleaceae	-	3	2	-	-	-	-	-	-	-	-	-
76	Onagraceae	-	-	-	-	-	-	-	-	-	-	-	1
77	Orchidaceae	-	-	-	-	-	-	1	-	1	-	-	1
78	Oxalidaceae	-	-	-	-	-	-	-	1	-	-	-	-
79	Pedaliaceae	-	-	-	-	-	-	-	-	-	-	-	1
80	Piperaceae	-	-	-	-	-	-	-	-	-	-	-	1
81	Plantaginaceae	-	-	-	-	-	-	-	-	1	-	-	-
82	Plumbaginaceae	-	-	-	1	-	-	-	-	-	-	-	-
83	Poaceae	-	-	-	1	-	-	-	-	4	1	-	9
84	Polygalaceae	-	-	-	-	-	-	-	-	-	-	-	1
85	Polygonaceae	-	-	-	-	-	-	-	2	-	-	1	3
86	Portulacaceae	-	-	-	-	-	-	-	1	-	-	-	-
87	Proteaceae	-	1	-	-	-	-	-	-	-	-	-	-
88	Pteridaceae	-	-	-	-	-	-	-	-	1	-	-	-
89	Punicaceae	-	-	1	-	-	-	-	-	-	-	-	-
90	Ranunculaceae	-	-	-	1	-	-	-	1	-	-	-	-
91	Rhamnaceae	-	-	3	1	-	-	-	-	-	-	-	-
92	Rosaceae	-	-	1	4	-	-	-	-	1	-	-	1
93	Rubiaceae	-	-	2	4	-	-	-	-	-	-	-	5
94	Rutaceae	-	1	4	2	-	-	-	-	-	-	-	-
95	Salicaceae	-	1	1	-	-	-	-	-	-	-	-	-
96	Santalaceae	-	-	1	-	-	-	-	-	-	-	-	-
97	Sapindaceae	-	1	-	1	-	-	-	-	-	-	-	1
98	Sapotaceae	-	-	1	-	-	-	-	-	-	-	-	-
99	Sauruaeae	-	-	-	-	-	-	-	-	-	-	1	-
100	Scrophulariaceae	-	-	-	-	-	-	-	1	1	1	1	2
101	Simaroubaceae	-	1	-	-	-	-	-	-	-	-	-	-
102	Smilacaceae	-	-	-	1	-	-	-	-	-	-	-	-
103	Solanaceae	-	-	-	2	-	-	-	-	-	-	-	7
104	Sterculiaceae	-	1	-	-	-	-	-	-	-	-	-	-
105	Tiliaceae	-	2	-	-	-	-	-	-	-	-	-	4

Contd...

1	2	3	4	5	6	7	8	9	10	11	12	13	14
106	Typhaceae	-	-	-	-	-	-	-	-	-	-	1	-
107	Ulmaceae	-	2	1	-	-	-	-	-	-	-	-	-
108	Urticaceae	-	-	1	1	-	-	-	2	-	-	-	1
109	Verbenaceae	-	-	2	6	-	-	-	1	-	-	-	-
110	Violaceae	-	-	-	-	-	-	-	-	1	-	-	-
111	Vitaceae	-	-	1	1	-	-	-	-	-	-	-	-
112	Zingiberaceae	-	-	-	-	-	-	-	-	1	-	-	-
113	Zygophyllaceae	-	-	-	-	-	-	-	-	1	-	-	-

Table 4

Biological spectra and phytoclimate of some North-West Himalayan regions based on sub life-form classes

Region/ Phyto-climate	Life form classes (Percentage)											
	MMM	MM	M	N	Ch	H	G	HH	Th	L	P	E
Normal spectrum (Raunkiaer, 1934)			28.00	15.00	9.00	26.00	4.00	2.00	13.00			3.00
Lolab valley (Wali, 1966) Geochamaephytic			11.00	17.20	17.20	17.60	23.80	0.40	7.90	3.00	1.30	
Trikuta Hills (Kapur and Sarin, 1985) Therochamae-phytic			9.44	14.45	22.94	13.87	4.62	1.73	31.02	1.55	0.19	0.19
Chamba District (Sharma and Singh, 1995) Therocrypto-phytic	0.30	3.30	4.41	8.12	4.71	15.03	16.94	2.81	39.28	4.11		1.00
Renuka WLS Theronano-phanerophytic (Present study)	0.52	12.34	16.54	19.16	7.61	5.51	2.10	3.41	31.24	0.79	0.52	0.26

MMM- Megaphanerophyte, MM- Mesophanerophyte, M- Microphanerophyte, N- Nanophanerophyte. Ch-Chamaephyte. G-Geophyte, HH-Hydrophyte and Halophyte, H-Hemicryptophyte, Th-Therophyte, P-Parasite, L-Liana and E-Epiphyte.

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SUMMARY

Floristic studies were conducted in Renuka Wildlife Sanctuary from 1999 to 2003. A total of 395 species belonging to 316 genera and 115 families were collected and identified. It includes 228 species of medicinal and aromatic plants, 85 species of exotics. The biological spectrum of study area reveals that the vegetation is theronanophanerophytic. The life forms of the area are Megaphanerophyte (0.52%), Mesophanerophyte (12.34%), Microphanerophyte (16.54%), Nanophanerophyte (19.16%), Chamaephyte (7.61%), Hemicryptophtye (5.51%), Geophyte (2.10%), Hydrophyte or marsh plants (3.41%), Therophyte (31.24%), Liana (0.79%), Parasite (0.52%) and Epiphyte (0.26%). The higher percentage of therophyte when compared to normal biological spectrum is due to the climate being favourable for growth of annuals. It is also presumed that the dominance of therophytes and nanophanerophytes may have partly resulted from disturbance in vegetation and grazing.

रेणुका वन्यप्राणि अभयारण्य, हिमाचल प्रदेश की पापद रचना, जीवरूप और जैविकीय वर्णपट

एस०पी० सुब्रमणि, विनीत जिष्टु, आर०के० वर्मा व के०एस० कपूर

सारांश

रेणुका वन्यप्राणि अभयारण्य में 1999 से 2003 तक पादप अध्ययन किया गया। वहां से कुल मिलाकर 115 कुलों की 316 प्रजातियों की 395 पादप जातियां इकट्ठा करके पहचानी गई। इनमें से 228 जातियां औषध और सौरभिक पादपों की है तथा 85 जातियां परदेशीय हैं। अधीत क्षेत्र के जैविकीय वर्णपट से पता चलता है कि यहां की वनस्पतियां बीजातिजीव क्षुद्र उन्मृदोद्भिक हैं। इस क्षेत्र में जीवरूप महाउन्मृदोद्भिद (0.25%) मध्य उन्मृदोद्भिद (12.34%) लघुउन्मृदोद्भिद (16.54%) क्षुद्र उन्मृदोद्भिद (19.16%), मृदोद्भिद (7.61%), तलोद्भिद् (5.51%), भूम्योद्भिद (2.10%) जलोद्भिद या दलदली पादप (3.41%) बीजातिबीजोद्भिद (31.24%), काष्ठारोही (0.79%) परजीवी (0.52%) और पररोही (0.26%) हैं। सामान्य जैविकीय वर्णपट की तुलना में बीजातिबोजोद्भिदों का अधिक प्रतिशत यहां की जलवायु के वार्षिक पादपों की वृद्धि के अनुकूल होने के कारण हैं। यह भी अनुमान लगाया गया है कि बीजातिबीजोद्भिदों और क्षुद्र उन्मृदाद्भिदों की अधिरोहिता वनस्पतियों में हुए विक्षोभ और चराई की जाने के कारण से हो सकती है।

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