

RESEARCH ARTICLE

THE FLORISTIC CATALOGUE OF THE BANAS RIVER CORRIDOR, GUJARAT

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ABSTRACT

The Banas River is an important source of water and biodiversity in Gujarat, India. In this study, we conducted a floristic survey of the Banas River corridor in Gujarat to document the plant species richness, composition, and distribution patterns in the area. We compiled a comprehensive floristic catalog of 520 species belonging to 340 genera and 101 families, based on field surveys, herbarium collections, and a literature review. The families with the highest number of species were Poaceae, Fabaceae, and Acanthaceae. The most common life forms were herbs and trees. We also identified 08 species listed as Rare, Vulnerable & Data Deficient in the area. This study provides a baseline dataset for the conservation and management of the Banas River corridor and highlights the need for further research and monitoring of the area's plant diversity.

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INTRODUCTION

Floristic surveys are essential in understanding the status, extent, and assessment of plant biodiversity (WCMC, 1992). Floristic studies have acquired increasing importance in recent years in response to the need of developing and under-developing countries to assess their plant wealth (Koshy and Mathew, 2009). By compiling comprehensive lists of plant species within a given area, floristic surveys and catalogs help us to better understand the distribution and abundance of different taxa, as well as their ecological relationships and interactions (Serrano-Meneses *et al.*, 2016; Govaerts *et al.*, 2018). Floristic surveys and catalogs have become increasingly important in the face of global biodiversity loss, providing critical baseline data for monitoring and conservation efforts, as well as for assessing the impacts of climate change and other environmental stressors (Kattge *et al.*, 2020). The Banas River, a tributary of the Chambal River, plays a vital role in sustaining the ecological and economic well-being of Gujarat State, India (Yadav *et al.*, 2020). The river and its surrounding riparian habitats provide important ecosystem services, including water supply, irrigation, and flood regulation, as well as a habitat for a rich diversity of plant and animal species (Panwar *et al.*, 2016). The Banas River and its associated flora are of significant cultural and religious importance to the people of Gujarat State, who have traditionally relied on the river for agriculture, fishing, and spiritual practices (Mehta *et al.*, 2020). The aim of this study is to provide a Floristic catalog of the Banas River corridor in Gujarat.

METHODOLOGY

Study site: River Banas originates in the Khamnor hills of the Aravali range and flows along its entire length through Rajasthan to the Banaskantha district in Gujarat. Only the River Corridor of Gujarat state is considered as a study site.

The Banas flows in the Palanpur, Dhanera, Deesa, Radhanpur, and Santalpur talukas in the district. In the Palanpur taluka, it flows past Aval, Amirgadh, JuniRoh, Kidotar, Lakhmipura, Balundra, Umarkot, Chekhla, and Ranavas villages. In the Dhanera taluka, it passes by Vadvas, and Jorapura villages while in the Dantiwada taluka, it passes by Dantiwada itself, Gadh, Sikariya, and Mandotra Brahmanvas villages, and thereafter in Deesa and Bodal. In the Kankrej taluka, it flows near Arnivada, Bukali, Golia, Umbaria, Kamboi, Shihori, Amblivas, Mangalpura, Vada, Thal, Nava, Shiya, Valpura, Totana, and Meta Jampur villages. Thereafter the river enters the Radhanpur taluka and traverses the villages of Kamalpur, Meghapura, Subdalpura, Amirpura, Najapura, Dholakda, and Delana. Lastly, the river enters the Santalpur taluka and flows past the Gadsai and Amarpur villages of the Patan district. Out of its total length of 258 km., the river flows for 142 km., in the Banaskantha and the Patan districts. The river disappears into the little Rann of Kutch near the village Gadsai of Santalpur taluka.



Fig. 1. Study site

METHOD

The fieldwork was carried out within three years from January 2019 to December 2022. Floristic analysis was especially carried out during mid-monsoon and post-monsoon seasons when the majority of the plants were at the peak of their growth. Pre-monsoon data were also collected from the sites. Plants were collected and identified using the local floras (Shah, 1978 & Bhandari, 1978). Herbariums were deposited at the Department of Botany, M. D. Science College, Porbandar for future reference.

RESULT AND DISCUSSION

Synoptic analysis: During the study, it was found that floral diversity in the Banas basin is remarkable. Since various macro and micro habitats like dense forests, grassland, scrubland, farmland, water bodies, rocky zone, cool and moist pockets, etc. are available in catchments area hence various life forms of plants grow over here. The total number of angiosperm species reported from the area is 520 belonging to 340 genera spread over 101 families.

Table 1. The number and percentage of dicotyledon and monocotyledon families, genera, and species

Class	No. of Families	No. of Genera	No. of Species
(i) Polypetalae	48	135	214
(ii) Gamopetalae	26	114	159
(iii) Monochlamydae	11	30	54
Total Dicotyledons	85	279	427
%	84.15	82.05	82.11
Monocotyledons	16	61	93
%	15.84	18	18
Grand Total	101	340	520

It shows that dicot families, genera, and species dominate over monocot families, genera, and species. With reference to families, dicots families (84.15%) were higher in number compared to monocot families (15.84%). With reference to genera, dicots genera (82.05%) were also higher in number as compared to monocot genera (18.0%). Similarly, dicot species (82.11%) were also higher in number as compared to monocot species (18.0%). Hence, it shows that dicots are dominant over monocots with reference to their numerical strength. Among the dicots, Polypetalae was the largest group as compared to gamopetalae and monochlamydae. The next dominant group is gamopetalae. It consists of families 26.0%, genera 33.52% and species 30.57%. Polypetalae and Gamopetalae are almost equal in floral composition and together constitute more than 85%. Monocots are poorly represented, constituting 15% (Table 1).

Ratio of Monocot to Dicots: Dicots dominate over Monocots at all levels and the ratio of Monocot and Dicots are 1:5.31, 1:4.57, and 1:4.59 at family, genus, and species levels respectively (Table 2).

Table 2. Ratio of Monocot to Dicots

Rank	Monocot	Dicot	Total	Ratio
Families	16	85	101	1:5.31
Genera	61	279	340	1:4.57
Species	93	427	520	1:4.59

Dominant Families: The order of the ten dominant families and their comparison with Saurashtra, North Gujarat, Gujarat State, and West Rajasthan is described here (Table 3). It is evident that the ten dominant families of the Banas corridor are almost the same with a few exceptions. Poaceae is the most dominant family in the Banas corridor, Saurashtra, North Gujarat, Gujarat State, and West Rajasthan. A comparison between orders of dominant families reported from the Banas corridor and other floristic regions of Gujarat state and the rest of India has been also carried out (Table 4). These results indicate that the order of dominance of families from one to

two is almost the same with a few exceptions in all the regions. The list of poorly represented families is as follows: Amaranthaceae represents the 10th position in Rajasthan. Cucurbitaceae in Rajasthan at 9th position. Lamiaceae at 10th position, in Saurashtra and Gangetic plain. Rubiaceae at 10th position in Indus plain flora which are not represented in the rest of the regions. The family Fabaceae occupies at 2nd position in Saurashtra, Gujarat, Rajasthan, and Gangetic Plain which indicates dominance in the natural flora. The most dominant family of the world Asteraceae is occupying 3rd position in the flora of Saurashtra, Rajasthan, and Indus Plain, and at 4th position in Gujarat, Gangetic Plain, and Banas Corridor, this is to be expected as a large number of the composite are found in natural flora. Cyperaceae is having 9th place in the Banas corridor and Saurashtra is 3rd in Gujarat and Gangetic Plain. Patel *et al.* in (2010) worked on Shiri river corridor surrounding the Ambaji range Forest areas of the Banaskantha district. Results of the study show that Poaceae represents 1st position, Asteraceae in 2nd position, Cyperaceae in 3rd position, Amaranthaceae at 4th, and Acanthaceae at 5th position. As compared to the Shiririver, Poaceae stands in the 1st position for Banas also. Thus, comparative status suggests an abundance of water in these regions. The similarities and variations in the position of the dominant families may be attributed to the geography, topography, climate, size of areas, and biotic interferences.

Ten largest families with the maximum number of species: Among the 101 families, Poaceae is the largest family with respect to genera while Fabaceae is the 2nd largest family with respect to species. Whereas Asteraceae, Acanthaceae, Euphorbiaceae, Convolvulaceae, Mimosaceae, Malvaceae, Cyperaceae and Cucurbitaceae, Caesalpinaceae, and Tiliaceae are in 10th position with respect to species. Cucurbitaceae, Caesalpinaceae, and Tiliaceae are representing a similar number of species and are in the 10th position (Table 5) Thus, the total number of 12 families were reported as the largest families in the study area.

Floristic Composition at Family Level: A critical analysis of the floristic composition of the area (Table 6) indicates that Monogeneric families dominate with the largest number, i.e. 47 families (46.53%) than in the order of dominance Bigeneric and Penta or Multigeneric families occupy 2nd position with 21 families (20.79%), followed by Trigeneric 09 (8.91%) and Tetrageneric 03 (2.97%).

Floristic Composition at Generic Level: At the generic level, the Monospecific genera constitute (39.60%) followed by Penta or Multispecific genera (27.72%) Bispecific (17.82%), Trispecific (7.92%) and Tetraspecific (6.93%). The Tetraspecific constitute comparatively less number (Table 7). This analysis clearly reveals the species diversity in the flora of the present area.

Categories of Flora: Out of 520 species, 438 species are in wild form with respect to 84.23%, 54 (10.38%) species are as cultivated, and 28 (5.38%) species are as ornamental which were reported during the survey (Table 8).

Distribution Pattern: Species distribution refers to the spatial arrangement of a biological taxon and is influenced by various factors such as resource availability, seasonal changes, and scale of observation (Krebs, 2014). This distribution pattern is not permanent and can change over time, especially during the time of reproduction, when populations of a species disperse through various methods such as wind, water, animals, and human activities.

Types of Distribution Patterns: There are three types of distribution 1. Contagious 2. Random and 3. Regular or uniform, which is described as follows:

Contagious Distribution: Contagious distribution is the most common type of dispersion found in nature. In contagious distribution, the distance between neighboring individuals is minimized. This type of distribution is found in environments that are characterized by patchy resources.

Table 3. Ten most dominant families of Banas Corridor in order of species number are listed in the table and their relative positions compared with the flora of Banas Corridor (2022) Saurashtra (Santapau, 1966), North Gujarat (Saxton & Sedgwick, 1918), Gujarat state (Shah, 1978) and West Rajasthan (Bhandari, 1978).

Sr. No.	Saurashtra	North Gujarat	Gujarat	W. Rajasthan	Banas corridor
1	Poaceae	Poaceae	Poaceae	Poaceae	Poaceae
2	Fabaceae	Fabaceae	Fabaceae	Fabaceae	Fabaceae
3	Asteraceae	Cyperaceae	Cyperaceae	Asteraceae	Acanthaceae
4	Malvaceae	Asteraceae	Asteraceae	Cyperaceae	Asteraceae
5	Convolvulaceae	Convolvulaceae	Acanthaceae	Convolvulaceae	Euphorbiaceae
6	Acanthaceae	Euphorbiaceae	Euphorbiaceae	Malvaceae	Convolvulaceae
7	Euphorbiaceae	Acanthaceae	Malvaceae	Euphorbiaceae	Mimosaceae
8	Cyperaceae	Malvaceae	Convolvulaceae	Acanthaceae	Malvaceae
9	Scrophulariaceae	Scrophulariaceae	Lamiaceae	Cucurbitaceae	Cyperaceae
10	Lamiaceae	Amaranthaceae	Scrophulariaceae	Amaranthaceae	Cucurbitaceae

Table 4. Comparative position of dominant families in (1) Gujarat (2) Rajasthan (3) Indus Plain (4) Gangetic Plain (5) Shiri River and (6) Banas Corridor

Sr. No.	Name of Families	Gujarat	Rajasthan	Indus plain	Gangetic plain	Shiri River	Banas Corridor
1	Poaceae	1	1	2	1	1	1
2	Fabaceae	2	2	2	2	-	2
3	Asteraceae	4	3	3	4	2	4
4	Acanthaceae	5	8	-	7	5	3
5	Euphorbiaceae	6	7	9	8	-	5
6	Caesalpinaceae	-	-	7	-	-	11
7	Convolvulaceae	8	5	10	9	-	6
8	Malvaceae	7	6	7	6	-	8
9	Cypreaceae	3	4	4	3	3	9
10	Cucurbitaceae	-	9	-	-	-	10
11	Amaranthaceae	-	10	-	-	4	-
12	Lamiaceae	9	-	6	10	-	-
13	Mimosaceae	-	-	-	-	-	7
14	Rubiaceae	-	-	10	-	-	-
15	Scrophulariaceae	10	-	9	5	-	-

Table 5. Ten Largest Families with Maximum Number of Species

Sr. No.	Family	No. of Genus	No. of Species
1	Poaceae	36	56
2	Fabaceae	23	43
3	Acanthaceae	18	23
4	Asteraceae	21	22
5	Euphorbiaceae	10	22
6	Convolvulaceae	6	19
7	Mimosaceae	8	16
8	Malvaceae	7	15
9	Cyperaceae	4	14
10	Caesalpinaceae	7	13
	Cucurbitaceae	8	13
	Tiliaceae	3	13

Table 6. Number and percentage of families with reference to the number of genera

Sr. No.	Category	Total	%
1	Monogeneric	47	46.53
2	Bigeneric	21	20.79
3	Trigeneric	9	8.91
4	Tetrageneric	3	2.97
5	Penta or Multi generic	21	20.79
	Total	101	100

Random Distribution: Random distribution, also known as unpredictable spacing is the least common form of distribution in nature and occurs when the members of a given species are found in homogeneous environments in which the position of each individual is independent of the other individuals: they neither attract nor repel one another. Random distribution is rare in nature as biotic factors, such as the interactions with neighboring individuals, and abiotic factors, such as climate or soil conditions, generally cause organisms to be either clustered or spread apart. Random distribution usually occurs in habitats where environmental conditions and resources are consistent.

Regular or Uniform Distribution: Less common than clumped distribution, uniform distribution, also known as even distribution, are evenly spaced. Uniform distributions are found in populations in which the distance between neighboring individuals is maximized. The need to maximize the space between individuals generally arises from competition for a resource such as moisture or nutrients, or as a result of direct social interactions between individuals within the population, such as territoriality.

Distribution Pattern of the Recorded Plant Species: The ratio of abundance to frequency (Whitford, 1949) was calculated where distribution was considered regular: below 0.025, random: 0.0125-

0.05, and contagious: if > 0.05 (Curtis & Cottam, 1962). There were 401 species are noted in a total of 207 transects. 400 (99.75%) species had shown contagious distribution, whereas only 1 species (0.24%) had shown random distribution while regular distribution was not found in the area as per the ratio of abundance to frequency (Table 9).

Threatened/Rare & Endangered Species within the Area: There is a total number of 08 species listed as Rare, Vulnerable & Data Deficient in the area (Table 10). From the given list, *Commiphora wightii* (Arn.) Bhandari and *Dalbergia latifolia* Roxb. are listed as Data Deficient & Vulnerable worldwide as per the IUCN categories of the Red List.

Floristic Composition at Family Level: A critical analysis of the floristic composition of the area (Table 6) indicates that Monogeneric families dominate with the largest number, i.e. 47 families (46.53%) than in the order of dominance Bigeneric and Penta or Multigeneric families occupy 2nd position with 21 families (20.79%), followed by Trigeneric 09 (8.91%) and Tetrageneric 03 (2.97%).

Floristic Composition at Generic Level: At the generic level, the Monospecific genera constitute (39.60%) followed by Penta or Multispecific genera (27.72%) Bispecific (17.82%), Trispecific (7.92%) and Tetraspecific (6.93%). The Tetraspecific constitute comparatively less number (Table 7). This analysis clearly reveals the species diversity in the flora of the present area.

Table 7. Number and percentage of genera with reference to the number of species

Sr. No.	Category	Total	%
1	Monospecific	40	39.60
2	Biospecific	18	17.82
3	Trispecific	8	7.92
4	Tetraspecific	7	6.93
5	Penta or Multispecific	28	27.72
	Total	101	100

Categories of Flora: Out of 520 species, 438 species are in wild form with respect to 84.23%, 54 (10.38%) species are as cultivated, and 28 (5.38%) species are as ornamental which were reported during the survey (Table 8).

Table 8. Categories of Flora

Sr. No.	Categories of Flora	Total Numbers	%
1	In wild	438	84.23
2	Cultivated	54	10.38
3	Ornamental	28	5.38
	Total	520	100

Distribution Pattern: Species distribution refers to the spatial arrangement of a biological taxon and is influenced by various factors such as resource availability, seasonal changes, and scale of observation (Krebs, 2014). This distribution pattern is not permanent and can change over time, especially during the time of reproduction, when populations of a species disperse through various methods such as wind, water, animals, and human activities.

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Table 9. Distribution Pattern of the Recorded Plant Species

Sr. No.	Distribution Pattern	No. of Species	%
1	Regular (<0.025)	0	0
2	Random (0.025 to 0.05)	1	0.24
3	Contagious (if >0.05)	400	99.75
	Total	401	100

Threatened/rare & endangered species within the area: There is a total number of 08 species listed as Rare, Vulnerable & Data Deficient in the area (Table 10). From the given list, *Commiphora wightii* (Arn.) Bhandari and *Dalbergia latifolia* Roxb. are listed as Data Deficient & Vulnerable worldwide as per the IUCN categories of the Red List.

Table 10. Threatened/Rare & Endangered Species

Sr. No.	Species Name	Category
1	<i>Anisochilus carnosus</i> Wall. Pl. As. Rar.	Rare
2	<i>Commiphora wightii</i> (Arn.) Bhandari	Data Deficient
3	<i>Dalbergia latifolia</i> Roxb.	Vulnerable
4	<i>Gloriosa superba</i> L.	Rare
5	<i>Leptadenia pyrotechnica</i> (Forsk.) Decne.	Rare
6	<i>Passiflora foetida</i> L.	Rare
7	<i>Tecomella undulata</i> (Sm.) Seem	Rare

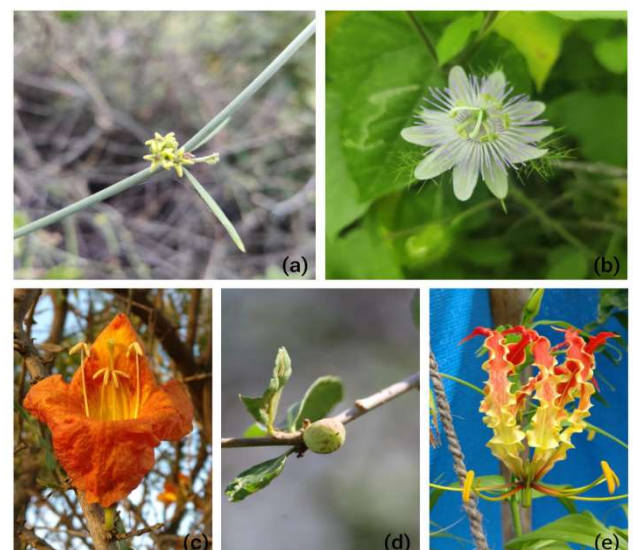


Fig. 2. Some Threatened/Rare & Endangered Species (a. Leptadenia pyrotechnica, b. Passiflora foetida, c. Tecomella undulata, d. Commiphora wightii, e. Gloriosa superba)

CONCLUSION

The flora of the Banas River corridor accounts for 520 plant species of which 105 plant species have expanded their range within the area under the human influence either as naturalized Indian Species or area non-Indian origin (exotic species) consisting of 85 exotic species forming a diverse group in terms of their taxonomic composition and geographic origin. Most of the species are litter from Asia(36.92%), America (22.88%), and Africa(20.38%) which concludes that the species range size distribution differs between naturalized Indian and exotic species, the latter on average being more widespread within a span of ten decades.

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