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Distribution and Diversity of Grass Species in Banni Grassland, Kachchh District, Gujarat, India

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ABSTRACT:

Banni, an internationally recognized unique grassland stretch of Western India. It is a predominantly flat land with several shallow depressions, which act as seasonal wetlands after monsoon and during winter its converts into sedge mixed grassland, an ideal dual ecosystem. An attempt was made to document ecology, biomass and community based assessment of grasses in Banni, we surveyed systematically and recorded a total of 49 herbaceous plant species, being used as fodder by livestock. In which, the maximum numbers of species (21 Nos.) were recorded in *Echinochloa* and *Cressa* habitat; followed by *Sporobolus* and *Elussine* habitat (20 species); and *Desmostechia-Aeluropus* and *Cressa* habiat (19 species). A total of 21 highest palatable species were recorded in *Echinochloa-Cressa* communities followed by *Sporobolus-Elussine-Desmostechia* (20 species and 18 palatable species) and *Aeluropus-Cressa* (19 species and 17 palatable species). For long-term conservation of Banni grassland, we also suggest a participatory co-management plan.

KEY WORDS: Banni, Grassland, Palatability, Communities, Conservation.

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INTRODUCTION:

Grassland is a landscape unit dominated by grasses. Grasses are one of the largest and most valuable recognized since time immemorial and mankind is sustained more by grasses than by any other group of plants. The relationship between man and grasses back to Paleolithic time¹. Since the vegetative productivity of grasses is very high, herbivorous animals, especially large mammals, are favored in the grassland community². Grasses are widespread than any other family of flowering plants and the existence of human life and quality would be impossible without grasses. In arid area, rearing of livestock mainly depends on the extent and condition of the available grasslands. The importance of livestock in pastoral systems exceeds their value as sources of milks, meat and hides. In addition to supporting livestock, grassland serves as sources of other significant economic product, as well as medicinal plants, building materials, thatch, fencing, gums and other products important to the economics of rural populations^{3,4}.

In India four types of major grasslands are found viz. Arid and semi-arid grassland, Terai Grassland, Shola grassland and cold desert grassland. Arid and semi- arid grasslands occurring in western Madhyapradesh and part of Uttarpradesh, Haryana, Punjab, Sothern parts of Jammu- Kashmir, eastern Rajasthan and Gujarat. In which, Gujarat about 8490 km² and Kachchh about 5078 km² area is under grassland and it's popularly known as vidis/rakhals, of which 1295 km²^{5,6}. In addition, grassland is one of the major ecosystems of Kachchh and supports over 1.7 million livestock and the grazing pressure ranges from 0.2 to 0.5 ACU per ha per year against 1- 4 ACU (Adult Cattle Unit) per ha per year^{6,7,8}. The only vast stretch of grasslands available in kachchh district is banni grassland about 2600km², which accounts for approximately 45% of the permanent pasture and 10% of the grazing ground available in the state and is located on the northern border of Kachchh^{9,10}. The decrease in biomass, especially of palatable species registered a high grazing pressure by migrant's livestock in grazing areas. Interestingly it was also noted that soil salinity plays a major role in governing the distribution of the grass species in an area. The low palatable species like *Cyperus rotundus*, *Eragrostis* sps., *Cressa cretica*, *Aeluropus logopoides* are not much affected by salinity, however their distribution was mostly restricted within 1.5EC level⁸. The high palatable species like *Dichanthium annulatum*, *Sporobolus helvolus*, and *Cenchrus* sps. had decreased with increasing salinity^{8,6}.

Banni grassland once the finest grassland of Asia, where the major part of the land has been degraded due to overgrazing by immigrant livestock, salinity ingression and invasion by an exotic plant species- *Prosopis juliflora* (Gando Baval) along with climate and other constraints. To reduce the dispersal of invasive species *Prosopis juliflora* is very difficult task because of the seeds are being dispersed by

cattle and it can survive even other plant species failed. Presently the Banni grassland is degraded and converted into *Prosopis* based woodland. In this scenario, it is urgent to generate a data base on various aspects of grasses and status of grassland of Banni. Hence, the present study is to generate distribution, diversity and palatability information on various grasses and grasslands of Banni region.

STUDY AREA:

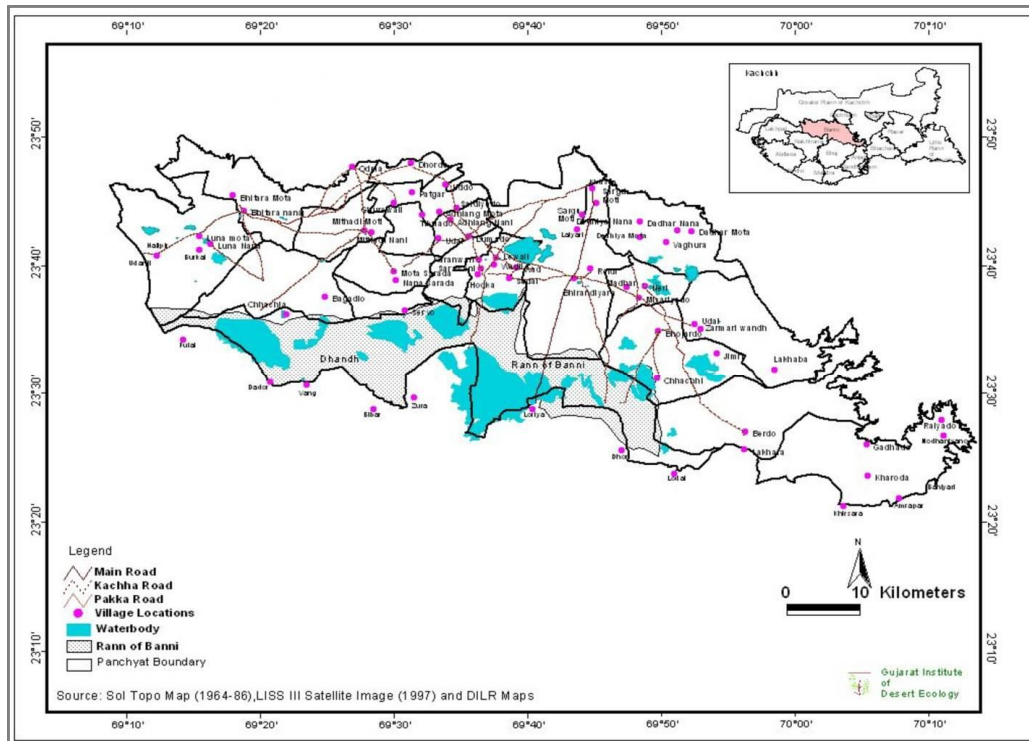


Figure 1: location of study area with villages

Banni (between North latitudes of 23°19' and 23°52' N and East longitudes of 68°56' to 70°32' E) refers to an arid region in the western most end of the Gujarat state in India and is approximately located 60 kms. from Bhuj- a district headquarters. Banni was derived from a *Kachchhi* word “*Bani*”, which means “*Banni hui*” in *Gujarati* (made up); it signifies that the land has been formed by detritus. At present, that is covered with coarse and low perennial grasses like *Desmostachya bipinnata* (Dhrab), *Sporobolus marginatus* (Dhrabad), *Dichanthium annulatum* (Jinjvo), *Cenchrus ciliaris* (Dhaman), *Sporobolus fertilis* (Khevai), and *Chloris barbata* (Siyarpuchha); and sparsely distributed colonies of *Cynodon dactylon* (Chhabar), *Dactyloctenium indicum* (Madhanu), *Eleusine compressa* (Nanu Mandhanu); besides sedge like *Eleocharis sp.* (Nano Chiyo), *Cyperus rotundus* (Chiyo), *Scirpus affinis* (Kal), *Cyperus alopecuroides* (Kaluro), *Fimbristylis miliacea* and coarse and pioneer

colonising grasses like *Aeluropus lagopoides* (Khariyu) and *Cressa cretica* (Oin) occur extensively. Under shrub like *Suaeda fruticosa* (Unt morar), *Suaeda maritimum* (Lano), *Suaeda nudiflora* (Lano), and *Tamarix aphylla* (Lai), occur abundantly all over especially in the places where water logging occurs in pools during the rainy season and sedges with annual grasses also occur around the fringes of such pooling spots^{11, 10}.

The soil of Banni is inherently saline and consists of recent alluvium mixed at places with Aeolian sandy deposit and the entire area has deep to very deep clayey and coarse textured soils in discontinuous patches. The climate of the Banni is arid therefore, the temperature is high during most of the time and it reaches a maximum of 48-49⁰C during May-June (the hottest months). The winter temperature goes down to 10⁰C with January and February being the coldest months. The total annual rainfall, occurring through southwest monsoon between June and September, is very low with an average of 317mm/year, with a coefficient of variation of 65%^{11, 10, 9}.

MATERIALS AND METHODS:

The present study is the outcome of 2 years intensive survey with critical examine and standard quantitative assessment techniques like belt transect and circular plots^{12, 13, 10} and perambulation^{14, 10} of different size were used. In addition, species were also documented by simple survey method to make a checklist of entire surveyed and samples areas. As we know, this survey was attempt to study of herbaceous vegetation including grasses, herbs, climbers, twiners, sedges etc., we used two 1x1 m² plots at every 200m interval along the transect which extended to the length of grassland patches.

In addition, various methods had been employed to collect the data on palatability of each species, saline tolerant, capacity and performance against soil erosion and staidness against low to medium rainfall. To collate above information we used published and unpublished literature, interview with local pastoralist group and also discuss with scientists and researchers whose are being worked on similar aspects. The nomenclature of the plant species are used in this paper on based on available floras i.e. Flora of Gujarat State¹⁵, The Flora of Indian Desert¹⁶ etc. In addition, the collected plant specimens were also deposited into Herbaria of Gujarat Institute of Desert Ecology (GUIDE), Bhuj-Kachhh, Gujarat.

RESULT AND DISCUSSION:

A total of nine dominant grass communities were recorded i.e. *Aeluropus* and *Chloris*; *Aeluropus* and *Cress*; *Aeluropus* and *Cyperus*; *Cyperus* and *Cressa* and *Fimbristylis*; *Echinocloa* and *Cressa*;

Elussine and *Aristida*; *Sporobolus* and *Aeluropus*; *Sporobolus* and *Elussine* and *Desmostechia*; *Aristida* and *Chloris* and *Elussine*. Which *Aeluropus* and *Cressa* (12 study sites) were dominated habitats followed by *Cyperus* and *Cressa* (10 study sites) and *Fimbristylis* and *Echinochloa* and *Cressa* (7 study sites) and so on. *Aeluropus* formed colonies in association with sedges and *Cressa* are found in saline marshes at Berdo, Chachhla, Raiyado and fringes areas of Little Rann of Banni. *Sporobolus* and *Elussine* and *Desmostechia* association was observed in low saline areas at Bhirandiyara, Gorewali and Luna panchayat. Other some valuable grass patches are scattered distributed in Banni area such as *Cynodon dactylon* communities are found in Luna Panchayat with approximately covering 3 km² area and *Urochondra setulosus* communities covering an area of about 0.5 km² to 1 km² was observed in high saline area at Udai, Sadai, Behind Dumado Panchayat.

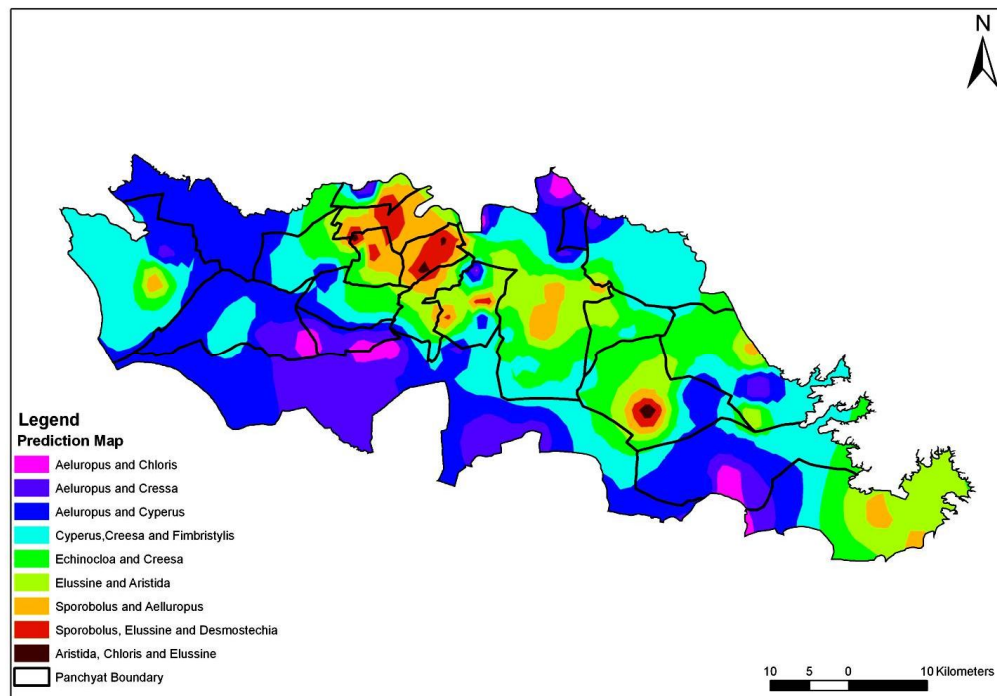


Figure 2: distribution of the grass communities

A total of 49 fodder herbaceous plant species belonging to 29 genera and 3 families were recorded from the various grassland habitats of Banni. In which, the maximum numbers of species (21 species) were recorded in *Echinochloa* and *Cressa* habitat; followed by *Sporobolus* and *Elussine* (20 species) and *Desmostechia*-*Aeluropus* and *Cressa* (19 species) and so on. (Table 3).

The status of individual grass species was assessed based on the occurrence and its showed that 77.55% (n=38) species were common, 16.33% (n= 8) were not common, 2.04% (n=1) were rare and 4.08% (n=2) were not very frequent (Table 1).

Table 1: Life from status of plants species:

Life From	Common	Not Common	Not very Frequent	Rare	Total
Herb	1	0	0	0	1
Grasses	33	7	1	1	42
Sedges	4	1	0	1	6
Total	38	8	1	2	49

As we know, the plant species have quite different palatability's depending on various drivers like soil characteristics, water availability, threat and conservation status of areas. During our study, we recorded a total of 49 fodder herbaceous plant species and all the collected information with available resources been compiled and able to produce a list of various characteristics of each species like palatability, saline tolerant, soil binder and drought tolerant etc. A total of 21 with highest palatable species (20 numbers) were recorded in *Echinocloa-Cressa* communities followed by *Sporobolus-Elussine-Desmostechia* (20 species and 18 palatable species) and *Aeluropus-Cressa* (19 species and 17 palatable species) and other communities. While, the maximum numbers of saline and drought tolerant as well as soil binders species were recorded under *Aeluropus-Cressa* communities with eight, four and two plant species, respectively (Table 2).

CONCLUSION:

Various drivers like rainfall intensity and interval between two showers; salinity in soil; status and distribution of invasive species- *Prosopis juliflora*; and grazing pressure by immigrant livestock in Banni had played a key role in changing the botanical composition as well as palatability and diversity of fodder species. Recently, with changes in climatic and rainfall scenario in Banni, it is very urgent to study an autecology of each fodder species for their long term restoration as well as conservation plan. With available scientific information and also collate the traditional knowledge from local pastoralist communities, which residing since historically in Banni, is also important for understanding of species ecology and performance against various drivers. In addition, for long term survival of any grazing

areas are depending on existing traditional management practices as well as local people's rights on its for sustainability of their livelihood based on natural resources- like Banni. Hence, we recommended developing a participatory co-management plan for conservation and management of Banni grassland.

Table 2: Various characteristics of recorded plant species

Habitat	No. of Species	Palatability			Salt Tolerant	Soil Binder	Drought Tolerant
		PA	NP A	Total			
<i>Aeluropus</i> and <i>Chloris</i>	17	9	1	10	7	1	1
<i>Aeluropus</i> and <i>Cressa</i>	19	17	2	19	8	2	4
<i>Aeluropus</i> and <i>Cyperus</i>	7	6	1	7	4	0	1
<i>Cyperus</i> and <i>Cressa</i> and <i>Fimbristylis</i>	15	15	0	15	5	1	2
<i>Echinochloa</i> and <i>Cressa</i>	21	20	1	21	6	1	2
<i>Elussine</i> and <i>Aristida</i>	16	15	1	16	3	2	2
<i>Sporobolus</i> and <i>Aeluropus</i>	17	15	2	17	7	1	2
<i>Sporobolus</i> and <i>Elussine</i> and <i>Desmostechia</i>	20	18	2	20	6	2	2
<i>Aristida</i> and <i>Chloris</i> and <i>Elussine</i>	17	16	1	17	5	2	1
Overall Total	49	131	11	142	51	12	17
Relative %	100%	92.25	7.75	100%			

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Table 3: Checklist of fodder species recorded in Banni region

S. No.	Scientific Name	Local Name	Habit	Family	Status	Habit	Palatability	Remarks
1	<i>Aeluropus lagopoides</i> (L.) Trin. ex Thw.	Khario Ga, Lolar	Grass	Poaceae	Common	P	PA	ST
2	<i>Apluda mutica</i> L.	Bhungario Ga, Fulari Ga	Grass	Poaceae	Common	P	PA	
3	<i>Aristida adscensionis</i> L. subsp. <i>adscensionis</i>	Jandhar Lambha Ga, Lampdo	Grass	Poaceae	Common	A	NPA	
4	<i>Aristida funiculata</i> Trin. & Rupr.	Laso Lambh	Grass	Poaceae	Common	A	PA	
5	<i>Bothriochloa pertusa</i> (L) A. Camus In Ann. Soc. Linn. Lyon.	Zenzvo Gha	Grass	Poaceae	Common	P	PA	
6	<i>Brachiaria ramosa</i> (L.) Stapf	-	Grass	Poaceae	Common	A	PA	
7	<i>Cenchrus biflorus</i> auct.	Dhaman Gha	Grass	Poaceae	Common	A	PA	
8	<i>Cenchrus ciliaris</i> L.	Dhaman Gha	Grass	Poaceae	Common	P	PA	DT
9	<i>Cenchrus setigerus</i> Vahl	Anajaniyo	Grass	Poaceae	Common	A	PA	ST
10	<i>Chloris barbata</i> Sw.	Rusad Gha	Grass	Poaceae	Common	P	PA	
11	<i>Chloris virgata</i> Sw.	Rusad Gha	Grass	Poaceae	Common	A	PA	ST

S. No.	Scientific Name	Local Name	Habit	Family	Status	Habit	Palatability	Remarks
12	<i>Cressa cretica</i> L.	Oin, Bukan	Herb	Convolvulaceae	Common	P	PA	ST
13	<i>Cynodon dactylon</i> (L.) Pers.	Chhabbar Gha	Grass	Poaceae	Common	P	PA	ST,DT.SB
14	<i>Cyperus alopecuroides</i> Rottb.	-	Sedge	Cyperaceae	Not common	P	PA	ST
15	<i>Cyperus bulbosus</i> Vahl,Enum.	Kal	Sedge	Cyperaceae	Common	P	PA	
16	<i>Cyperus</i> sp.	Chiyo	Sedge	Cyperaceae	Common	A	PA	
17	<i>Cyperus haspan</i> L.	Chiyo, Nidan moth	Sedge	Cyperaceae	Rare	P	PA	
18	<i>Cyperus rotundus</i> L. subsp. <i>rotundus</i>	Kaluro, Mutha, Moth	Sedge	Cyperaceae	Common	P	PA	
19	<i>Dactyloctenium aegypticum</i> (L.) P. Beauv.	Kagatango Gha, Vado Mandanu	Grass	Poaceae	Common	A	PA	DT,ST
20	<i>Dactyloctenium indicum</i> Boiss.	Sano Madanu	Grass	Poaceae	Not common	P	PA	ST
21	<i>Desmostachya bipinnata</i> (L.) Stapf	Darab, Gha, Dab	Grass	Poaceae	Common	P	NPA	SB
22	<i>Dichanthium annulatum</i> (Forak.) Stapf	Denai, Jinjvo Ga	Grass	Poaceae	Common	P	PA	DT,ST

S. No.	Scientific Name	Local Name	Habit	Family	Status	Habit	Palatability	Remarks
23	<i>Digitaria adscendens</i> (H.B.&K.) Henr.	-	Grass	Poaceae	Common	A	PA	
24	<i>Digitaria pennata</i> (Hochst.) Cooke	-	Grass	Poaceae	Not common	P	PA	
25	<i>Dinebra retroflexa</i> (Vahl) Panz	-	Grass	Poaceae	Common	A	PA	
26	<i>Echinochloa colonum</i> (L.) Link	Sanvadha Sau, Samu	Grass	Poaceae	Common	A	PA	
27	<i>Eleusine compressa</i> (Forsk.) Aschers. & Schweinf.	Mandanu Gha	Grass	Poaceae	Common	A	PA	SB
28	<i>Eleusine indica</i> (L.) Gaertn.	Adbau Madanu	Grass	Poaceae	Common	A	PA	SB
29	<i>Elyonurus royleanus</i> Nees ex A. Rich.	-	Grass	Poaceae	Not common	A	PA	
30	<i>Eragrostis ciliaris</i> (L.) R. Br. var. <i>ciliaris</i>	Fuliyu Gah	Grass	Poaceae	Common	A	PA	
31	<i>Eragrostis minor</i> Host. Icon.Deser.Gram.	-	Grass	Poaceae	Not common	A	PA	
32	<i>Eragrostis tenella</i> (L.) P. Beauv. ex R. & S.	Limor, Kalavo	Grass	Poaceae	Common	A	PA	

S. No.	Scientific Name	Local Name	Habit	Family	Status	Habit	Palatability	Remarks
33	<i>Eragrostis tremula</i> Hochst.	-	Grass	Poaceae	Common	A	PA	
34	<i>Eragrostis uniolooides</i> (Retz.) Nees ex Steud	-	Grass	Poaceae	Common	A	PA	
35	<i>Fimbristylis dichotoma</i> (L.) Vahl var. <i>dichotoma</i>	Nidhi Mothi	Sedge	Cyperaceae	Common	P	PA	
36	<i>Melanocenchrus</i> <i>jacquemontii</i> J. & S.	Vekar	Grass	Poaceae	Common	A	PA	
37	<i>Panicum miliaceum</i> L.	Moraiyo	Grass	Poaceae	Common	A	PA	DT,ST
38	<i>Panicum antidotale</i> Retz.	Gum Gha, Dham Gha	Grass	Poaceae	Not common	P	PA	DT
39	<i>Saccharum spontaneum</i> L.		Grass	Poaceae	Common	P	PA	DT
40	<i>Setaria glauca</i> (L.) P. Beauv.	Sani Bhichdi, Sani Zipti	Grass	Poaceae	Common	A	PA	
41	<i>Setaria verticillata</i> (L.) P. Beauv.	Bhichti Gha, Gepti, Vadi Zipti	Grass	Poaceae	Common	A	PA	
42	<i>Sporobolus</i> <i>coromandelianus</i> (Retz.) Kunth	Khariyu Ga	Grass	Poaceae	Common	A	PA	

S. No.	Scientific Name	Local Name	Habit	Family	Status	Habit	Palatability	Remarks
43	<i>Sporobolus fertilis</i> (Steud.) Clayton	Ganthiar, Khari Ga, Palangi	Grass	Poaceae	Not common	P	PA	
44	<i>Sporobolus helvolus</i> (Trin.) Th. Dur. et Sch	Khevai	Grass	Poaceae	Common	P	PA	ST,DT
45	<i>Sporobolus marginatus</i> Hochst. ex A. Rich.	Khevai Ga	Grass	Poaceae	Not common	P	PA	ST,DT
46	<i>Tetrapogon tenellus</i> (Roxb.) Chiove	-	Grass	Poaceae	Not Very Frequent	A	PA	
47	<i>Themeda triandra</i> Forsk.	Fulio Gah	Grass	Poaceae	Common	P	PA	DT
48	<i>Tragus biflorus</i> (Roxb.) Schult.	Gah	Grass	Poaceae	Common	A	PA	
49	<i>Urochondra setulosus</i> (Trin.) Hubb	Kkariyu Gah	Grass	Poaceae	Rare	P	NPA	ST

