## Chapter - II

# VEGETATION OF THE LITTLE RANN OF KUTCH

## INTRODUCTION

Two zones of semi-arid climate are recognized in India. One, in the north, is contiguous with the Thar desert, extending into Rajasthan, Punjab, parts of Uttar Pradesh and in Gujarat State, Kutch, Saurashtra (excluding Gir) and North Gujarat. The other semi-arid zone is situated in the south. It includes Deccan Plateau, Coimbatore Plateau and extreme south-east corner of Tamil Nadu. The semi-arid zones of north and south are separated by a narrow humid strip (Satpura range and plains of Tapti river) (Bharucha and Meher-Homji 1965).

The Rann of Kutch is phytogeographically interesting, since it is located at the junction of several phytogeographic provinces and is composed of diverse floristic elements (Rao 1981).

Floristically the area is more akin to Sindh (Pakistan) and N.W. Rajasthan. The high percentage of general element is explained by high incidence of biotic factors which is causing the destruction of natural vegetation and facilitating invasion by other plants (Rao 1981).

The pattern of distribution of floral elements is explained on the basis of bioclimatic conditions prevailing in Afro-Asian continents (Bharucha and Meher Homji 1965). The northern semi arid zone is richer in North African-Indian Desert (Saharo-Sindian) element, Northern-African steppe element and in the Mediterranean-Oriental element (Bharucha and Meher-Homji 1965).

**Vegetation Classification**

The vegetation of Little Rann of Kutch (LRK) is classified into Rann saline thorn scrub, *Salvadora* scrub and Tropical Euphorbia scrub (degradation stage) (Champion and Seth 1968) . According to Meher-Homji (1972) the vegetation types present in semi-arid zones of India are characterized according to their degree of aridity. He classified the vegetation of Kutch under the *Prosopis cineraria, Capparis decidua, Zizyphus - Salvadora* type. Gupta and Saxena (1971) categorized this vegetation as Halophytic scrubland.

**Introduction of Exotic Species in LRK**

In the past about 1880 the tree growth in the area was subjected to denudation and excessive destruction by man and livestock (Kutch Gazetteer 1880). The earliest records of mesquite (*Prosopis juliflora*) cultivation in Indian sub-continent dates back to 1877. In areas adjacent to the LRK, mesquite was introduced by the then ruler of Radhanpur during 1899-1900 (Joshi 1959).

In 1954, the plantation of mesquite was taken up by the Department, under the programme "Immobilization of Kutch Desert" in the waste lands around the Little Rann. This shrub has not only secured a foothold but is rapidly spreading and is now by far the most important economic species of the region, and is being increased through afforestation.

The Little Rann of Kutch covers variety of vegetation types representing extremities of climatic conditions. The coast on the south west boundary of LRK has mangroves. North west of the Rann is the Banni grassland. The Rann is a saline mudflat with a few vegetated islands having shrub and grass cover. Around the barren Rann is a vegetation belt mainly having *Prosopis* shrubs and grasses.

This chapter emphasizes on the classification of habitats. The vegetation associations were identified in the fringe and the Bet (the only vegetated islands of the Rann). The vegetation study was conducted keeping in view the wild ass use and ranging pattern.

## METHOD

The vegetation associations were mapped in the intensive study area, so as to relate the wild ass use. The grasses in the area were annuals and germinated only during the monsoon. Senescence commenced just after the rainy days ended.

For vegetation classification and ordination, parallel line transects were laid in the fringes and Bets. In the intensively studied area of the southern fringe Narali 23 transects of length varying between 4-6 kms each laid parallel at 250-500 metres apart (Figure II.1).

On eight Bets a total of 78 transects were laid varying in length from 0.5 to 2.5 kms. The sample points were laid at 100 and 200 metres interval along transects. At each sample point a square quadrat of 0.25 sq m. was laid for estimating per cent grass cover, height of grass and its phenology. A circular plot of 314 sq.m. was laid to count the shrubs on the same sample point.

Two vegetation studies were conducted in the intensive study area, Narali one in monsoon (1989) and the other in winter (1990). The former study has not been considered for any analysis due to the difficulty in identification of the grasses at the shoot level.

Two way indicator species analysis (TWINSPAN) (Hill, 1979a), detrended correspondence analysis (DECORANA) (Hill, 1979b) are the computer soft-ware packages used for the classification and ordination of the vegetation in the area. This

was done using default options. Sorenson's index of similarity (Mueller-Dombois and Ellenberg 1974) was used to compare the Percent similarity among ground vegetation of different habitats. The flora collected from LRK is kept at the Wildlife Institute of India's herbarium.

## RESULTS

A total of 13 species of shrubs (Table II.1) 22 grass and some herb species (Table II.2) were identified out of which 16 species of grasses and six species of herbs were identified in the study area. In the fringes *Prosopis juliflora* was the dominant shrub (Table II.1). *Chloris* species and *Aeluropus lagopoides* were the most dominant grasses while *Dactyloctenium* species, *Aristida* species, *Eragrostis* species and *Sporobolus* species also showed a high frequency of occurrence (Table II.2).

*Suaeda fruticosa* was the dominant shrub on the Dhut Bet, Wasraj Bet and its chain of smaller Bets (Andheri-Wen, Khijadiya, Maharajawali, Miyan and Pancham), the density of *Suaeda fruticosa* was the highest on the Bets formed by the fine dust. Comparatively, the rocky *Bets* i.e. Mardakh, Shedwa, Nanda and Jhilandhar have negligible *Suaeda fruticosa* shrub, *Prosopis juliflora* was predominant only on Jhilandhar Bet. Overall, *Salvadora* species, *P.spicigera* occurred in low frequencies (Table II.3). The checklist of plant species of LRK is given in Table II.5.

### Fringe Vegetation

Twenty transects were laid in the fringe study area. A total of 319 quadrats were laid in scrubland (n=305) and cropland( n=14), 193 quadrats were laid in the Rann with the grassland. 46.08% quadrats had no ground cover when placed in the scrubland

and cropland habitats (n=319). 53.92% quadrats showed the presence of ground vegetation. In the Rann with grassland 66.84% quadrats had no ground cover (n=129) only 33.16% showed presence of cover (n=64).

The similarity of species between scrubland (n=23) and that of cropland (n=8) was 41.38%, between scrubland and the Rann with grassland (n=6) was 44.44%.

A total of 223 plots and 21 grass and herb species were considered for ordination and classification. A three cluster TWINSPAN Normal classification was obtained (Table II.4) having nine associations in the hierarchial diagram (Figure II.2)

Cluster I - Rann saline grassland (Plate II.1).

Cluster II - *Prosopis* Scrubland (Plates II.2 and II.3).

Cluster III - Fallow land.

The Rann saline grassland was a part of the Rann depression (Plate II.4). During monsoon the Rann got inundated for a period of one month. The grassland would also get inundated and it was then that species of *Cyperus* and *Scirpus* grew. Perennials of the Rann grassland were *Cressa cretica* and *Aeluropus lagopoides*. Around the puddle edges species of *Scirpus, Echinochloa* and *Blumea eriantha* grows.

*Prosopis* scrubland was much higher than the Rann depression and so did not get inundated during the monsoon. The annuals occurred entirely in the interspaces amongst the *Prosopis* shrubs. Rivulets passed through the scrubland, thus sandy, pebbly, clayey,loamy soils existed along the rivulet patches. *Chloris, Sporobolus, Eragrostis* grew as interspatial grasses. The area was under pressure due to cattle grazing and fuelwood collection. The disturbed patches were dominated by *Dactyloctenium aegyptium, D. sindicum* and *Aristida* species. Some of the areas were close to fallow land or present cultivation sites.

Fallow land was far from the inland depression and was more in continuation with the scrubland. *Boerhavia spp., E. ciliaris, Corchorus spp.* were the species of this area. The soil was sandy and pebbly.

The first division (Figures II.2 and II.3) separated out the two dominant groups: the **Rann grassland** along with **Prosopis scrubland** plots and the other **Fallow land** associated plots.

The dominant and codominant speices of the fallow land plots having *Boerhavia* and *E.ciliaris* represented 0.89% of the total plots (n=223), this formed one end of the extreme division. The Rann grassland along with *Prosopis* scrubland plots represented 99.11% and were dominated and codominated by *Cyperus* spp., *Aeluropus lagopoides* and *Chloris* spp. These mixed plots at the same level bifurcated into their respective specific groups i.e. **Rann grassland group** and **Prosopis scrubland group** (Figure II.2).

**Rann Grassland Group**: Cyperus and *Aeluropus lagopoides* dominated the Rann grassland plots (39.4%) and were the divisor species separating out one sole association, pure *Cyperus* plots (20.6%) and *Aeluropus lagopoides* + *Cressa cretica* plots (18.8%). Further the division of *A. lagopoides* + *C. cretica* plots formed two associations: *Echinochloa, Scirpus* and *Blumea* plots (0.89%) which contained no *Aeluropus lagopoides/Cressa cretica* and the other was pure *Aeluropus lagopoides* and *Cressa cretica* plots (17.9%).

**Prosopis Scrubland Group**: *Dactyloctenium aegyptium, Eragrostis* sps., *Aristida* spp., *Chloris* spp. and *Sporobolus* formed the scrubland group and were represented by 59.6% plots. This group was bifurcated specifically into two divisions:

I. *Eragrostis - Chloris - Sporobolus* spp. having 45.29% plots which were subdivided into 3 associations:

a. *Eragrostis - D.aegyptium - Chloris* represented by 33.18% plots.

b. *Sporobolus* represented by 9.8% plots and

c. *D.sindicum* represented by 2.2% plots.

II. The other division represented 14.34% plots dominated by *Aristida* and its codominants, this was subdivided to form two associations:

a. *Arisitda - D.aegyptium* represented by 13.9% plots

b. *Corchorus* represented by 0.48% plots.

The inverse indicator species analysis identified nine associations (Figure II.3). The difference was negligible in the inverse and normal analysis. *E.ciliaris* was separated in Ist division which was a species of fallow land. *Boerhavia* was separated in IIIrd division which was also a species of the fallow land.

Four associations identified by inverse analysis in the scrubland was nearly similar to that of the normal analysis of the TWINSPAN. The *Eragrostis - D.aegyptium - Chloris* associations of normal analysis had rare species like *Desmostachya, Urochondra* and *Melanocenchrus*, while *Sporobolus* and *D.sindicum* associations were clubbed together into one association and *Aristida - D.aegyptium* associations did not have *D.aegyptium* in case of inverse analysis, but *Elyonurus royleanus* and *Corchorus depressus* represented the association.

In the Rann grassland three associations classified by inverse analysis was similar to that of normal analysis excepting that of *Cyperus* association which had *Suaeda* and *Aeluropus lagopoides*, *Cressa cretica* and also *Scirpus* added to it; while *Blumea - Echinochloa* lacked *Scirpus* in the inverse analysis. Overall the major representation of associations in normal and inverse association showed fidelity to their

groups. In the inverse analysis 3 major groups were identified similar to that in normal analysis i.e. Rann grassland, Scrubland and Fallow land.

Detrended Correspondence analysis (DCA) indicated maximum dispersion of species and plots on Ist and IInd axis, the eigen values being 0.980 and 0.840. Parameters like soil development and a combination of moisture and salinity were represented along the Ist and IInd axis respectively (Figure II.4). The groups derived from TWINSPAN were demarcated on DCA axis thus showed the similarity in associations (Figures II.4 and II.5). DCA clearly formed six associations.

1. *Cyperus* spp.
2. *Aeluropus lagopoides - Cressa cretica.*
3. *Blumea - Scirpus - Echinochloa.*
4. *Aristida - D.aegyptium.*
5. *Boerhavia - E.ciliaris.*
6 *Corchorus.*

The *Chloris-Eragrostis - Sporobolus - D. sindicum*, indicated a homogenous group with gradual change in association forming three more associations viz.

7. *Chloris - Eragrostis - D. aegyptium.*
8. *Sporobolus.*
9. *D.sindicum.*

The Ist DCA axis represented the soil developement. *Boerhavia* and *E.ciliaris* represented a new fallow land while old fallow land which had *Corchorus* and *Aristida* formed extreme end of the DCA axis. *Aristida* was amongst the pioneer species to occupy fallow land. The IInd DCA axis represented moisture and salinity, showed hygrophilous *Blumea, Scirpus* species at one end while *Aristida* which was drought

evading on the other end. (Figure II.4). *Aeluropus lagopoides* and *Cressa cretica* indicated halophytic moist conditions

The DCA of species and plots was similar (Figures II.4 and II.5). In the DCA of species the rare species like *Urochondra setulosa, Desmostachya bipinnata, Melanocenchrus jacquemontii, Apluda mutica, Suaeda fruticosa* had also been represented. The ecological characteristic features of these rare species: *Desmostachya bipinnata* was a tall perennial halophytic grass forming patches along the border of croplands adjoining rivulets. *Urochondra setulosa* was a halophyte and common in sandy saline hard ground habitats. *Apluda mutica* and *Melanocenchrus jacquemontii* were annual grasses occupying sandy gravelly soils.

**Vegetation on Bets**

*Bets* or islands were the only areas having vegetation on the saline mudflat or the Rann. *Bets* like Andheri Wen, Maharajawali, Khijadiya Miyan and Pancham (chain of islands adjoining Wasraj Bet) and Dhut Bets lacked ground cover (Figure I.2). All these islands had *Suaeda fruticosa* as the dominating shrub (Table II.3).The shrub species on the Bets and the fringes differed.

*Salvadora oleoides* was present on Dhut and Andheri-Wen *Bets*. *Prosopis juliflora* plantation was done on Dhut 3-4 decades ago. In 1991, *Salvadora* plantation was carried out by the Forest Department, of which none survived due to poor monsoon. The densities of shrubs on all islands is given in (Table II.3).

**Pung *Bet*:** On the 22-23 sq km. island, 13 transects with a total of 47 quadrats were laid. Two big patches of *Prosopis juliflora* were present, of which one patch had dried due to one of the severe droughts in 1980's. The density of *Prosopis juliflora* on the

Bet was 143.58 shrubs/ha. Regeneration of *Prosopis juliflora* was poor i.e 37.08 saplings/ha. Out of the 29 plots of *Prosopis* only one plot showed regeneration.

A total of 47 plots and nine grass species were considered for the classification and ordination. Three associations were identified at eigen values 0.502, 0.337, and 0.213 in the Normal classification (Figure II.6):

1. *Dactyloctenium* (6.97%)
2. *Suaeda-Eragrostis* (81.40%)
3. *Cyperus-Aeluropus* (11.63%).

In the inverse indicator species analysis (Figure II.7), the same groups were formed as that of the normal classification.

**Wasraj *Bet***: A total of 17 transects were laid having 253 quadrats. Nine shrub and tree species were recorded on this island of 8-9 sq.km. (Table II.3). *Prosopis* had the highest density 132.357 shrubs/ha. The other species occurred in very low densities (Table II.3). The regeneration was 12.83 saplings/ha.

A total of 44 plots and 13 grass species were considered for ordination and classification (Figure II.8). Three divisions were considered at 0.480, 0.343 and 0.630 eigen values, in the Normal classification.

1. *Echinochloa-Cyperus* (22.27%)
2. *Chloris-Dactyloctenium-Eragrostis* (63.64%)
3. *Eragrostis ciliaris-Aristida* (13.63%)

The inverse analysis was similar to that of the plots or normal classification, which formed three associations (Figure II.9).

**Shedwa *Bet*:** Has an area of approximately 7 sq.kms. 36 quadrats were laid along 11 transects. Four shrub species were identified (Table II.3). The density of Prosopis was the highest 163.58 shrubs/ha, having a regeneration of 15.25 saplings/ha.

A total of 32 plots and 12 grass species were considered for the ordination and classification (Figure II.10). Three associations were obtained at the eigen values 0.483, 0.453 and 0.425 (Figure II.10).

1. *Chloris-Eragrostis-Aristida* (40.63%)

2. *Aeluropus-Cyperus* (53.12%) and

3. *Cressa cretica* (6.25%)

Three associations were formed for the inverse analysis (Figure II.11).

The vegetation associations on Pung, Shedwa and Wasraj *Bets* showed affinity with the fringe vegetation associations, the Rann saline grassland and *Prosopis* scrubland. The *Cyperus* species, *Aeluropus lagopoides, Cressa cretica* occupied depressions. While *Eragrostis, Aristida, Chloris* and *Suaeda* occupied the less saline well drained and developed soil.

**Succession**

The succession process was very slow and was susceptible to anthropogenic pressures and with inadequate data on individual species, it was difficult to construct all successional stages accurately. Figure II.12 indicates the successional trend in the area. The fallow land and alluvial plain showed the establishment of *E.ciliaris*, *Boerhavia* and *Corchorus* as pioneer species followed by *Aristida* and *D. aegyptium.*

The Rann grassland shows *Cyperus, Aeluropus lagopoides, Cressa cretica, Scirpus* and *Echinochloa* which were the pioneer species occupying salt encrusted Rann /mudflat. This stage was followed by *Sporobolus, Chloris, D aegyptium, D sindicum*

and *Aristida*. This was further followed by *Prosopis juliflora* plantation which was self propagating in the area.

Further from the scrubland towards the villages on well developed soil devoid of salinity - *Salvadora oleoides, Acacia species, Capparis decidua, Cassia auriculata, C. sepia, Zizyphus* and *Calotropis* sparsely occurred.

## DISCUSSION

There are 10 families represented in the study area (Little Rann of Kutch). Poaceae is represented by maximum number of species followed by Cyperaceae and Fabaceae. In the regions of N. Gujarat, NW Rajasthan, Indus delta and NE Rajasthan, Poaceae shows dominance (Rao 1981).

### Vegetation Classification.

The proposed classification on the fringe have 9 associations. Saxena (1977) proposed five plant associations in the Ranns of Rajasthan. The species composition of the associations differs from that of Saxena (1977) though the major species represent same ecological conditions. The *Sporobolus* association is fairly stable grassland association.

Ordination interpretation of present study suggests that the soil developement, moisture content and salinity are the major factors determining pattern of vegetation distribution. Livestock grazing and fuelwood collection are important disturbance

factors. The presence of *Aristida, Eragrostis* and *Chloris* species are the indicator of excessive grazing in the area.

**Succession**

The present study indicates the importance of soil developement and disturbance determining the successional trend. An apparent dichotomy of theory exists in addressing the importance of progressive soil developement and availability of soil resource as a possible cause of succession. Authors like Egler (1954), McCormick (1968), Connell and Slatyer (1977), Tilman (1985,1988), Huston and Smith (1987) address soil developement along with life history and disturbance as possible cause of succession. Soil resource and life history approach would be appropriate for an understanding of primary or secondary successions where the soil resources are poor (Tilman 1985,1988).

The low lying Rann having high salt content and clay, *Cyperus* and *Scirpus* species would establish first, this would be followed by *Aeluropus lagopoides* and *Cressa cretica. Blumea* and *Echinochloa colonum* would come up in the area having puddles of fresh water. Most of these species are good soil binders and modify the soil for further succession. In fallow land having sandy gravelly soil, *Boerhavia, E.ciliaris* and *Corchorus* are the first to establish which are gradually replaced by *Aristida.*

*Cyperus, Scirpus, Aeluropus lagopoides, Echinochloa colonum* and *Chloris* are the pioneer species to establish on moist and halophytic soils. On developed and leached soils *Sporobolus, D.aegyptium, D.sindicum, Aristida, Desmostachya bipinnata* establishes. Beyond this stage shrubs like *Tamarix, Capparis, Zizyphus nummularia, Salvadora oleoides, Acacia* sps. will take over. *Sporobolus* species represent the

optimum expression of saline habitats (Saxena,1977). The plantations of *P.juliflora* in the fringe grassland has displaced the natural shrub species.

Severe grazing can cause retrogression in the grassland (Figure II.12). *D. aegyptium, D. sindicum, Corchorus, Fagonia,* are the indicators of heavy grazing. The presence of *Boerhavia diffusa* in grazed areas indicate that the patch has escaped grazing. A good representation of *D. aegyptium* in the area depicts heavy grazing.

The interpretation of sample plot location (intensive study area Narali) in ordination space suggests that successional dynamics beyond *Cyperus* sps, *Aeluropus lagopoides* and *Cressa cretica* stage are a function of time and increasing availability of soil resources (x-axis) and salinity and soil moisture (y-axis) and disturbance (grazing and fuelwood collection) (Figures II.4 and II.5) . Grazing has a predictable, observable effect on maintaining grass associations.

Soil moisture, is recognized as one of the primary determinant of grassland (Dargie & El Demerdash 1991). Measurements were not taken that could confirm the hypothecated soil developement, soil moisture and soil salinity gradients, but field observations and distribution pattern of grass and woody species representing a set of conditions on ordination axis suggest that these are the major influencing factors and forms a complex gradient with anthropogenic disturbances. Increasing nutrient availability is generally considered as the norm (Tilman 1985,1988).

Both allogenic and autogenic processes will effect the succession in the area. Le Houerou (1981) describes autogenic succession due to micro-environmental, effects of the vegetation itself or to the effect of the fauna and allogenic succession due to geomorphic process of glyptogenesis and sedimentation plays an important role in determining vegetation association in arid lands.

**Table II.1**: Density of shrubs in study area Narali.

| Shrubs | Plants/ha. |
|---|---|
| *Prosopis juliflora* | 55.84 (749) |
| *P.juliflora* sapling | 16.48 (221) |
| *Prosopis cineraria* | 0.075 (1) |
| *P.cineraria* sapling | 0.82 (11) |
| *Calotropis* spp. | 0.075 (1) |
| *Dichrostachys cinerea* | 0.075 (1) |
| *Zizyphus* spp. | 0.075 (1) |
| *Acacia jacquemontii* | 5.82 (78) |
| *A. jacquemontii* sapling | 1.93 (16) |
| *A. senegal* | 0.075 (1) |
| *A. nilotica* sapling | 0.15 (2) |
| *Capparis decidua* | 0.596(8) |
| *C.decidua* sapling | 0.75 (10) |
| *Cassia auriculata* | 1.12 (15) |
| *Salvadora oleoides* | 0.075 (1) |
| *Maytenus emarginata* | 0.075 (1) |
| *Commiphora wightii* | 0.075 (1) |

Values in *parentheses* indicates shrub #

**Table II.2**: Frequency of grasses, herbs and sedges in Narali (Fringe area) of Little Rann.

| Fringe Grasses & Herbs | Scrubland n=305 | | Cropland n=14 | | Rann grassland n=193 | |
|---|---|---|---|---|---|---|
| | n | abs.% | n | abs.% | n | abs.% |
| *Aristida* spp. | 34 | 11.15 | 4 | 28.57 | - | - |
| *Sporobolus* spp. | 28 | 9.18 | - | - | - | - |
| *Chloris barbata* | 77 | 25.25 | 3 | 21.43 | - | - |
| *Dactyloctenium aeqyptium* | 43 | 19.48 | 3 | 21.43 | - | - |
| *Eragrostis* spp. | 29 | 9.51 | 1 | 7.14 | 2 | 1.04 - |
| *Aeluropus lagopoides* | 26 | 8.52 | - | - | 25 | 12.95 |
| *Echinochloa colonum* | 8 | 2.62 | - | - | - | - |
| *Cynodon dactylon* | 2 | 0.66 | - | - | - | - |
| *Blumea eriantha* | 2 | 0.66 | - | - | 1 | 0.52 |
| *Eragrostis ciliaris* | 2 | 0.66 | - | - | - | - |
| *Elyonurus royleanus* | - | - | 1 | 7.14 | - | - |
| *Dactyloctenium* spp. | 4 | 1.31 | 1 | 7.14 | - | - |
| *Eragrostis* spp. | 1 | 0.33 | - | - | - | - |
| *Melanocenchrus jacquemontii* | 1 | 0.33 | - | - | - | - |
| *Fagonia* spp | _ | - | 1 | 7.14 | - | - |
| *Corchorus depressus* | 2 | 0.66 | - | - | - | - |
| *Scirpus* spp. | 4 | 1.31 | - | - | - | - |
| *Cressa cretica* | 14 | 4.59 | - | - | 10 | 5.18 |
| *Suaeda nudiflora* | 3 | 0.98 | - | - | 1 | 0.52 |
| *Cyperus* spp. | 3 | 0.98 | - | - | 47 | 24.35 |
| Garjabee * | 1 | 0.33 | - | - | - | - |
| Hatodi * | 1 | 0.33 | 1 | 7.14 | - | - |

* - unidentified species

**Table II.3**: Density (plant/ha.) of shrubs on Bets.

| Shrub | Plants/ha. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Wasraj Bet** | **Bet 1** | **Bet 2** | **Bet 3** | **Bet 4** | **Bet 5** | **Pung** | **Dhut** | **Shedwa** |
| *Prosopis juliflora* | 130 7 (1039) | 13 8 (32) | - | - | - | - | 144 3 (852) | 15 4 (100) | 163 6 (740) |
| *P juliflora* saplings | 10.1 (80) | 1 7 (4) | - | - | - | - | 37.1 (219) | 11.5 (75) | 15 3 (69) |
| *Salvadora persica* | 6 4 (51) | 15 9 (37) | 1 5 (3) | - | - | - | - | 6.8 (44) | - |
| *S persica* saplings | 3.2 (25) | 1 7 (4) | 1 5 (3) | - | - | - | - | 0 8 (5) | - |
| *P cineraria* | 0 6 (5) | - | - | - | - | - | - | - | - |
| *P cineraria* sapling | 0 1 (1) | - | - | - | - | - | - | - | - |
| *Capparis decidua* | 0 8 (6) | - | - | - | - | - | 0 7 (4) | - | 0 4 (2) |
| *C decidua* sapling | 0.9 (7) | - | - | - | - | - | - | - | - |
| *Acacia* spp | 0 4 (3) | - | - | - | - | - | - | - | - |
| Butakani * | 0 4 (3) | - | - | - | - | - | - | - | - |
| *Suaeda fruticosa* | 3 3 (26) | 136.4 (317) | 98 5 (198) | 86.6 (136) | 61.2 (35) | 63.7 (12) | - | 122 3 (795) | 0.2 (1) |
| *Suaeda fruticosa* sapling | - | 15.9 (37) | 162 1 (326) | 85.3 (134) | 42.4 (24) | 106.1 (20) | - | 38.6 (251) | - |
| *Euphorbia* spp | 0.1 (1) | - | - | - | - | - | - | - | - |
| *Tamarix* spp | - | - | - | - | - | - | 2 9 (17) | - | - |
| *Tamarix* sapling | - | - | - | - | - | - | - | - | 0 4 (2) |
| *Calotropis* spp | - | - | - | - | - | - | 0.2 (1) | - | - |

Values in *parentheses* indicate shrub #
1-Andheri Wen, 2-Khijadiya, 3-Maharajwali, 4-Miyan, 5-Pancham
*- unidentified speices

**Table II.4**: Fringe Grass and Herb Association based on TWINSPAN.

| Species | Percentage |
|---|---|
| **Rann Grassland Association** | |
| I *Cyperus* | 5-70 |
| II *Scirpus-Blumea-Echinochloa* | 35 |
| III *Aeluropus-Cressa* | 6-45 |
| **Prosopis Scrubland Associations** | |
| IV *Eragrostis-Dactyloctenium-Chloris* | 15-77 |
| V *Sporobolus* | 15-30 |
| VI *Dactyloctenium sindicum* | 5-25 |
| VII *Aristida-D. aegyptium* | 20-50 |
| VIII *Corchorus depressus* | 10 |
| **Fallow Land Association** | |
| IX *Boerhavia-E.ciliaris* | 17-40 |

**Table II.5**: Checklist of plant species in Little Rann of Kutch

**Sedges, Grasses and Herbs**

**CYPERACEAE**
*Cyperus rotundus*
*Cyperus sp*
*Cyperus alulatus*
*Cyperus bulbosus*
*Bulbostylis barbatus*
*Scirpus tuberosus*

**JUNCACEAE**
*Juncus maritimus*

**CHENOPODIACEAE**
*Suaeda fruticosa*
*Suaeda nudiflora*

**ASCLEPIADACEAE**
*Leptadenia pyrotechnica*

**TILIACEAE**
*Corchorus depressus*

**NYCTAGINACEAE**
*Boerhavia diffusa*

**GERANIACEAE**
*Zygophyllum simplex*

**BORAGINACEAE**
*Heliotropium subulatum*

**POACEAE**
*Eragrostis ciliaris*
*Eragrostis tenella*
*Eragrostis cilianensis*
*Eragrostis viscosa*
*Dactyloctenium aegyptium*
*Dactylactenium sindicum*
*Chloris pallida*
*Chloris montana*
*Aristida setacea*
*Aristida histricula*
*Elyonurus royleanus*
*Sporobolus virginicus*
*Sporobolus fertilis*
*Desmostachya bipinnata*
*Urochondra setulosa*
*Echinochloa colonum*
*Melanocenchrus jacquemontii*
*Cenchrus setigerus*
*Cenchrus ciliaris*
*Peratis (latifolia) indica*
*Bothriochloa pertusa*
*Aeluropus lagopoides*
*Brachiaria* sp

**CONVOLVULACEAE**
*Convolvulus microphyllus*
*Cressa cretica*

**ASTERACEAE**
*Pulicaria wightiana*
*Pulicaria rajputanae*

*Pulicaria crispa*
*Echinops echinatus*
*Luanea* sp

**FABACEAE**
*Indigofera cordifolia*
*Sesbania bispinosa*
*Goniogyna hirta*
*Crotolaria burhia*

**ZYGOPHYLLACEAE**
*Fagona indica*

**RUBIACEAE**
*Borreria stricta*

**COMMELINACEAE**
*Commelina benghalensis*

**CARYOPHYLLACEAE**
*Polycarpaea corymbosa*

**MOLLUGINACEAE**
*Glinus lotoidus*

**AIZOACEAE**
*Trianthema portulacastrum*

**SHRUBS**
*Salvadora persica*
*Salvadora oleoides*
*Tamarix* sp
*Capparis decidua*
*Prosopis juliflora*
*Prosopis cineraria*
*Acacia jacquemontii*
*Acacia leucophloea*
*Acacia senegal*
*Suaeda nudiflora*
*Phoenix dactylifera*
*Cassia auriculata* (senna)
*Cassia italica*
*Maytenus emarginata*
*Grewia tenax*
*Commiphora wightii*
*Ficus amplissima*
*Euphorbia neriifolia*
*Zizyphus* sp

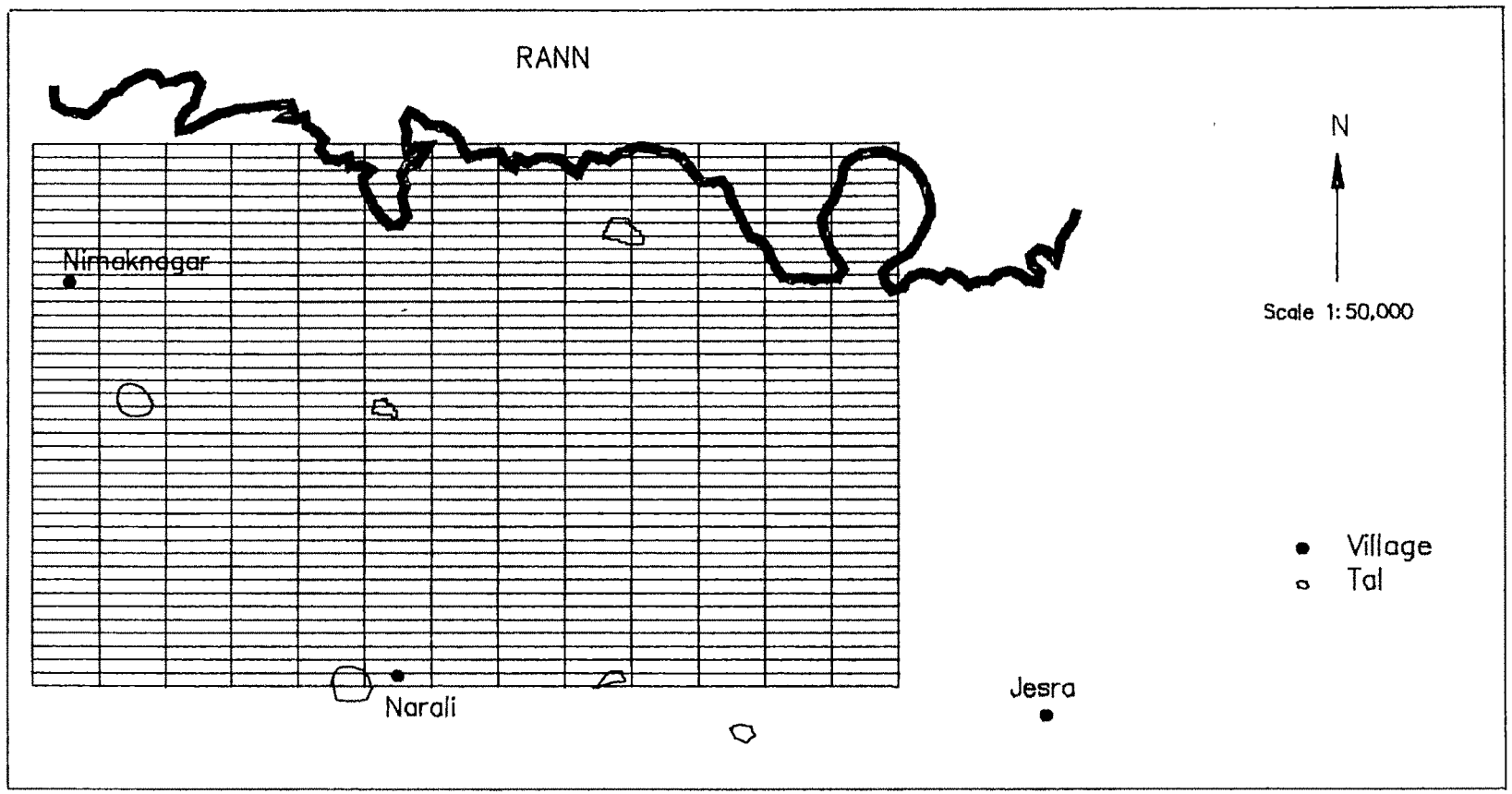


Figure II.1: Transects and Plots Laid for Vegetation Study in the Intensive Study Area – Narali

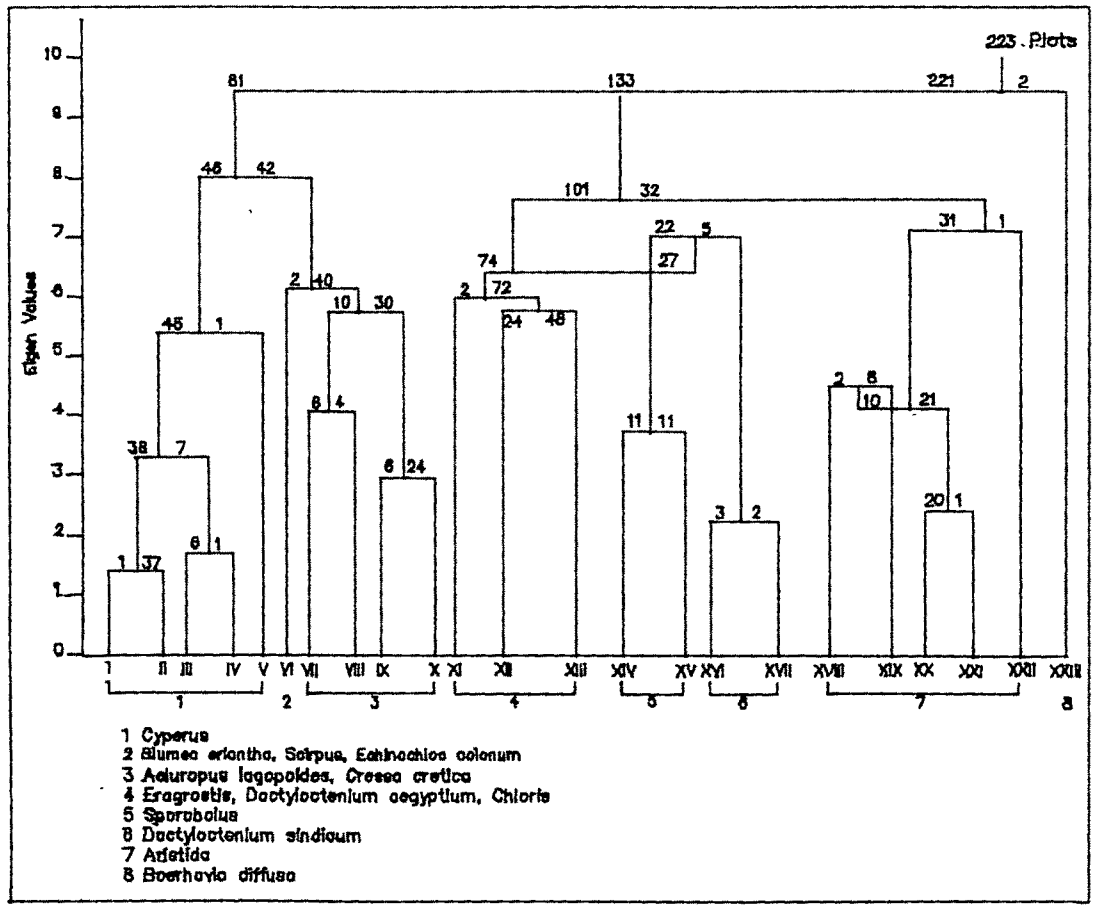


Figure II.2: Narali Stands Classification Based on TWINSPAN

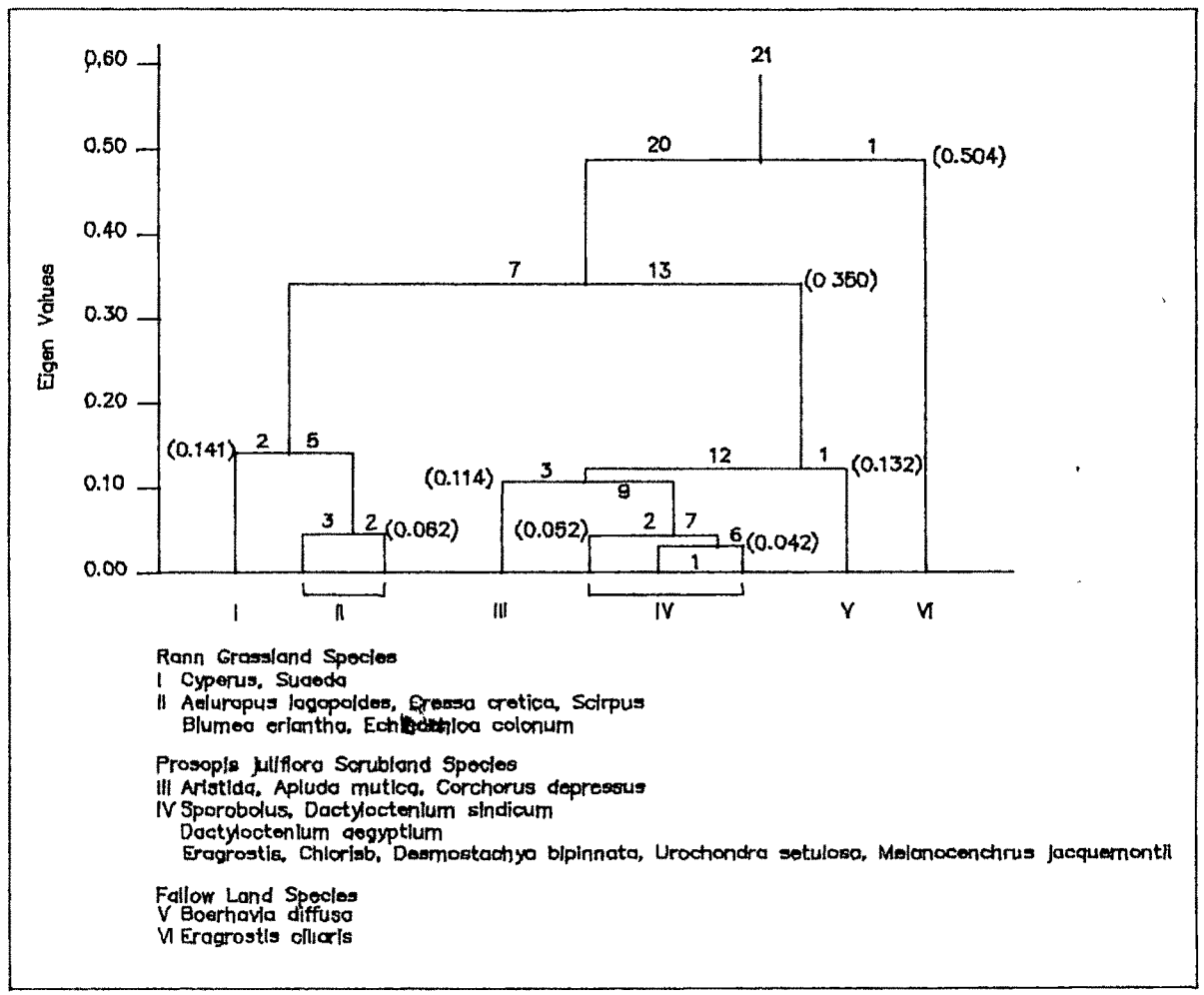


Figure II.3: Narail Species Classification Based on TWINSPAN
(Eigen values at each Division are given in parentheses)

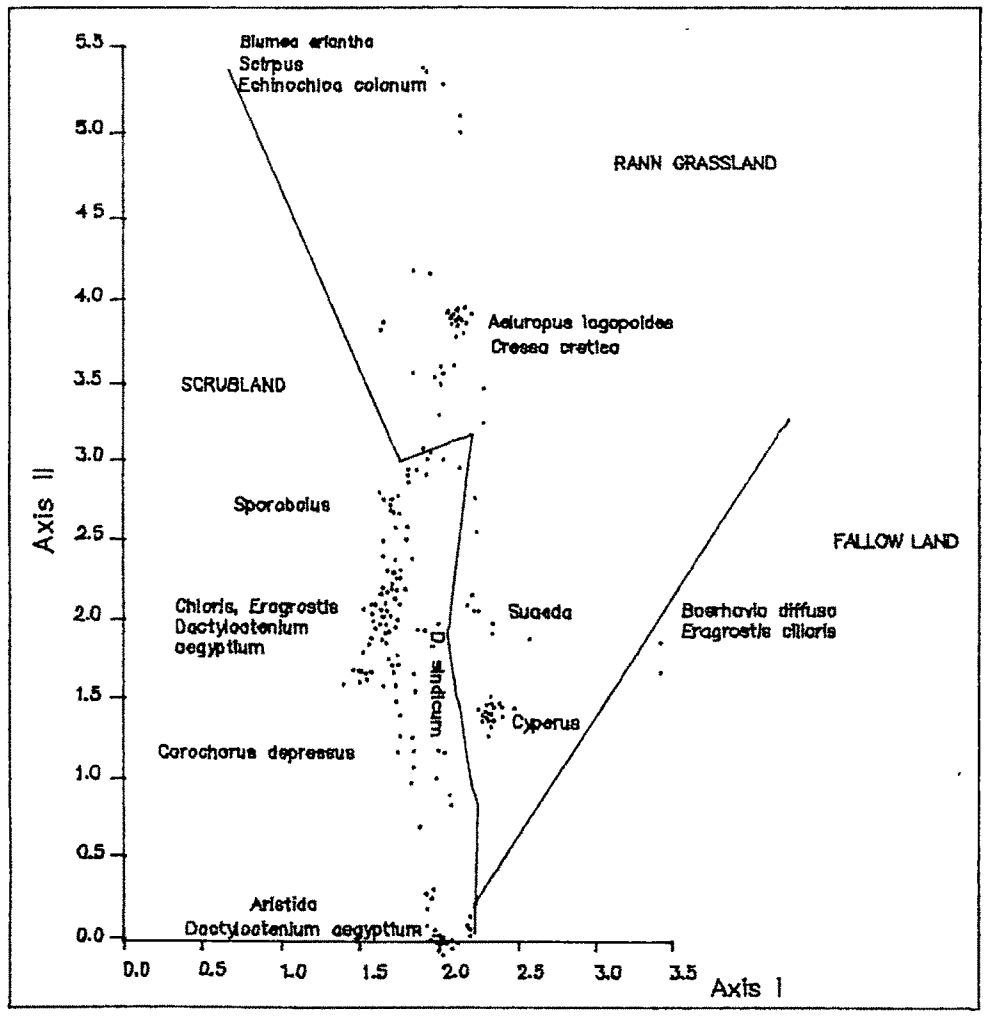


Figure II.4 : Narali Stand Classification Based on DECORANA

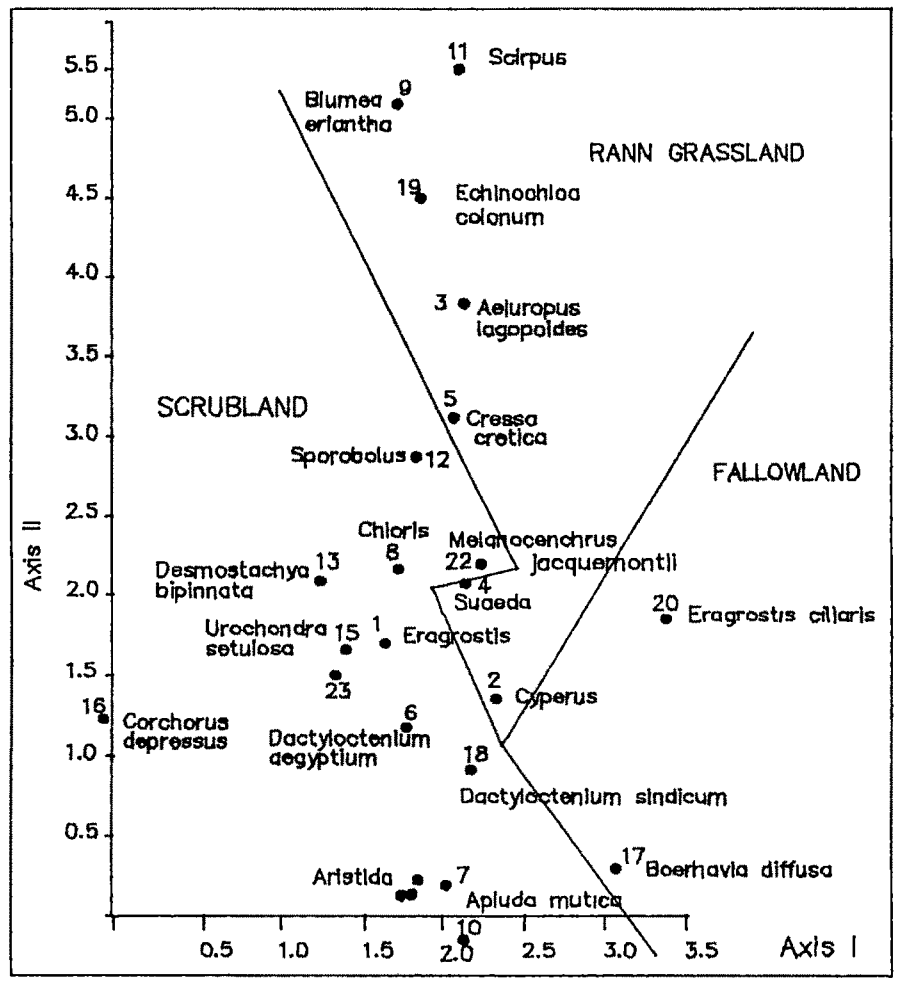


Figure II.5 : Narali Species Classification Based on DECORANA

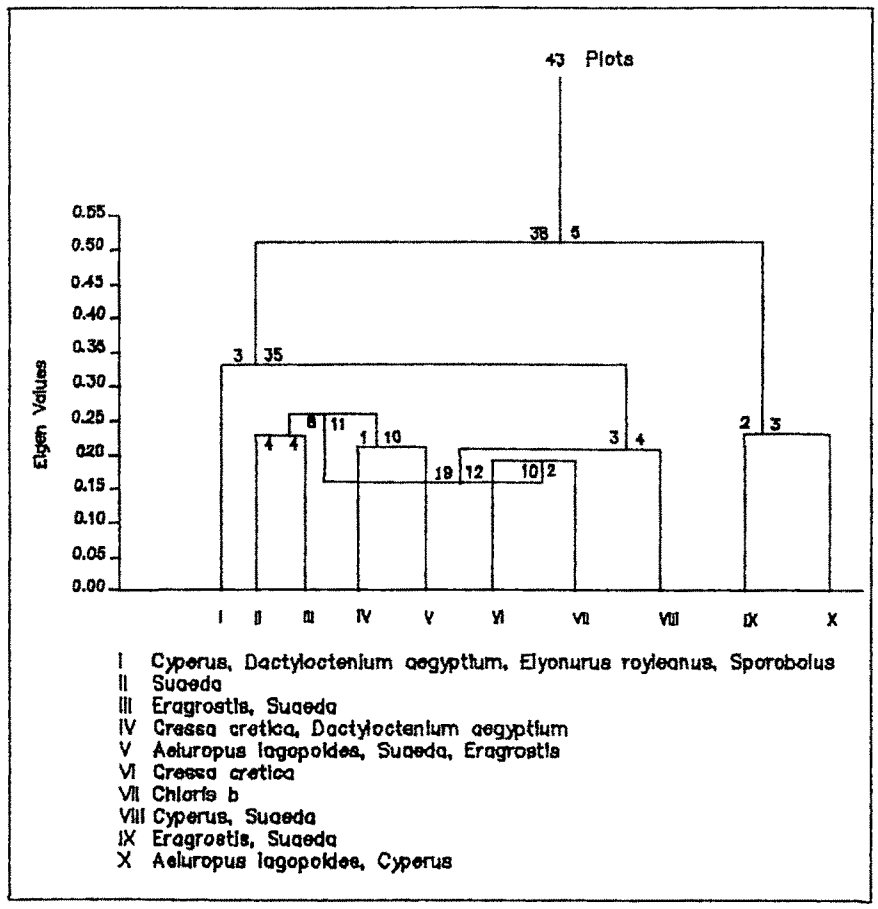


Figure II.6 : Pung Bet Stand Classification Based on TWINSPAN

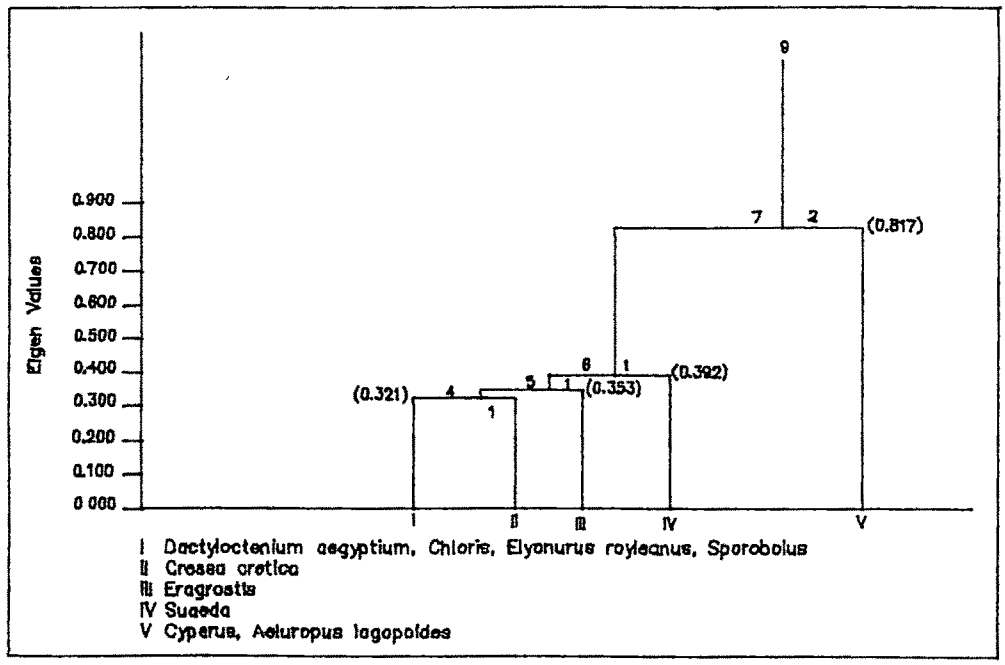


Figure II.7 : Pung Bet Species Classification Based on TWINSPAN

(Eigen values at each Division is given in parentheses)

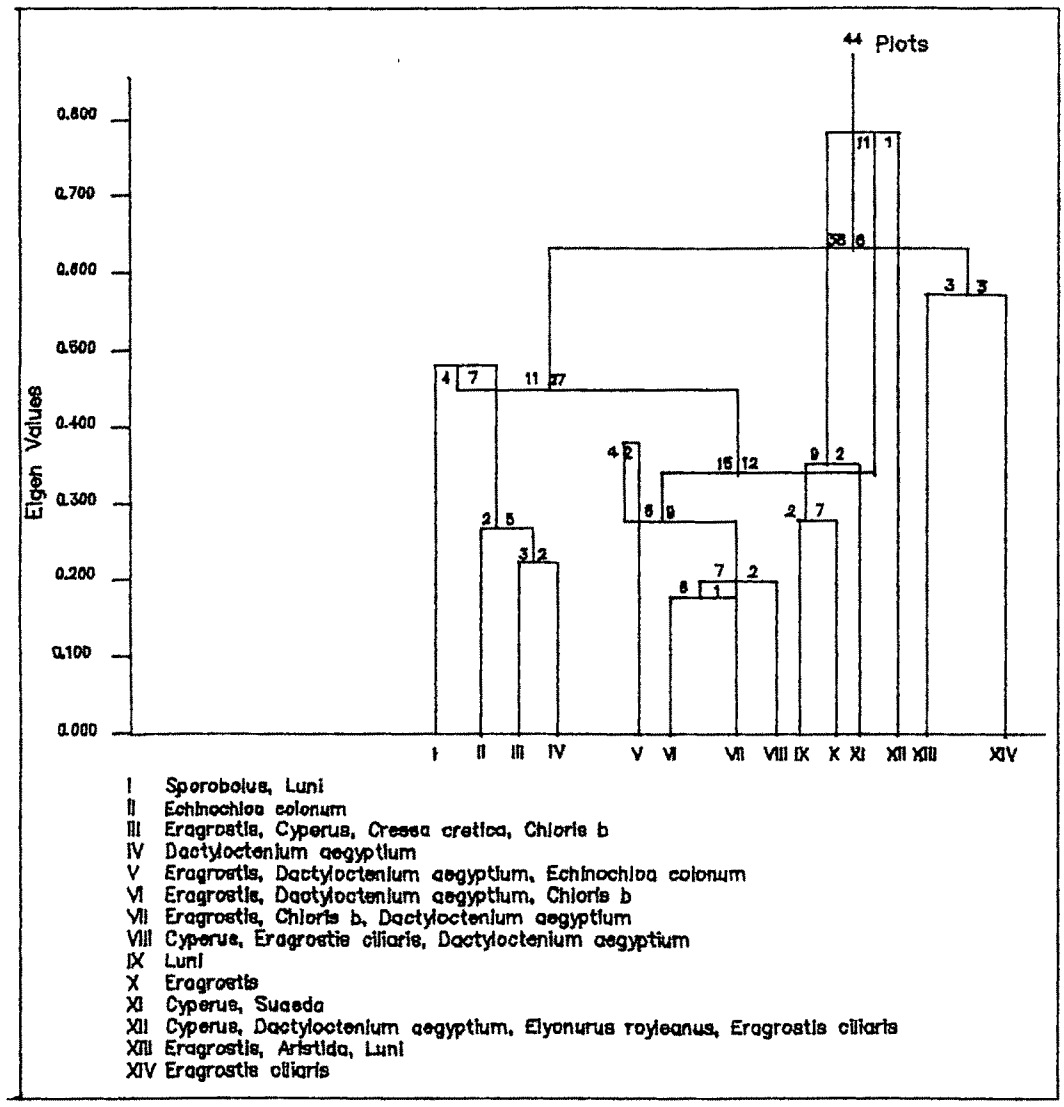


Figure II.8 : Wasraj Bet Stand Classification Based on TWINSPAN

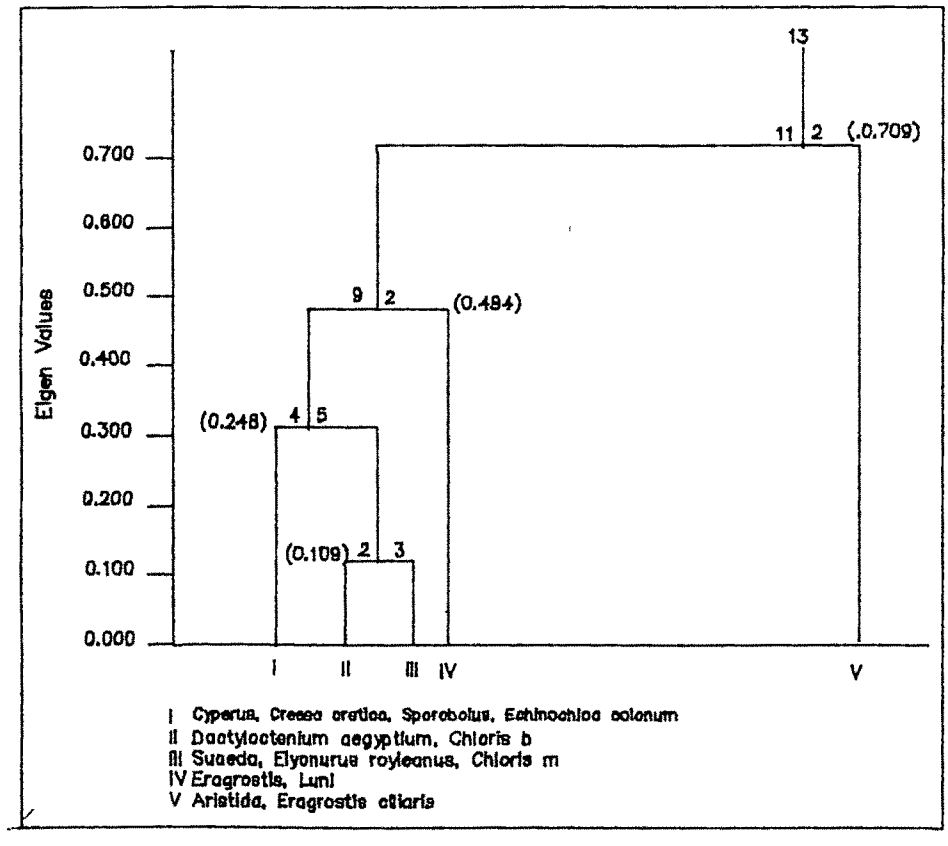


Figure II.9 : Wasraj Bet Species Classification Based on TWINSPAN
(Eigen values at each Division is given in parentheses)

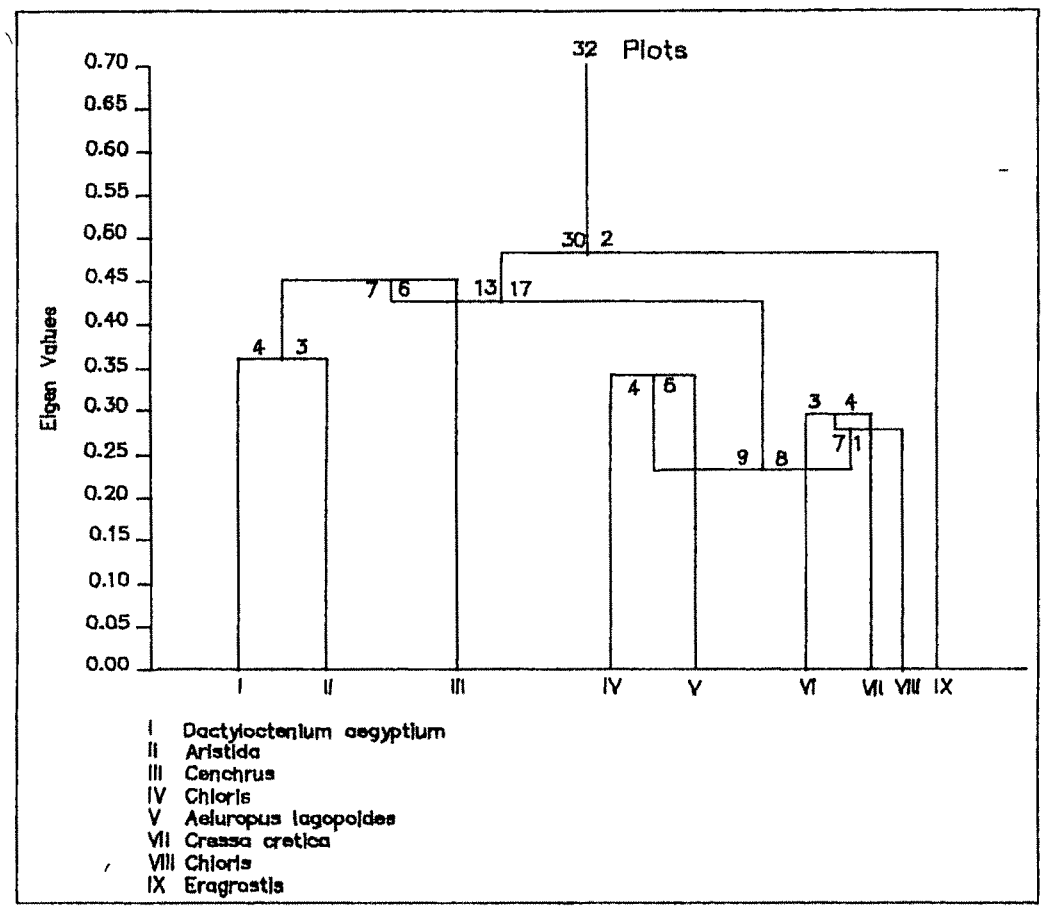


Figure II.10 : Shedwa Bet Stand Classification Based on TWINSPAN

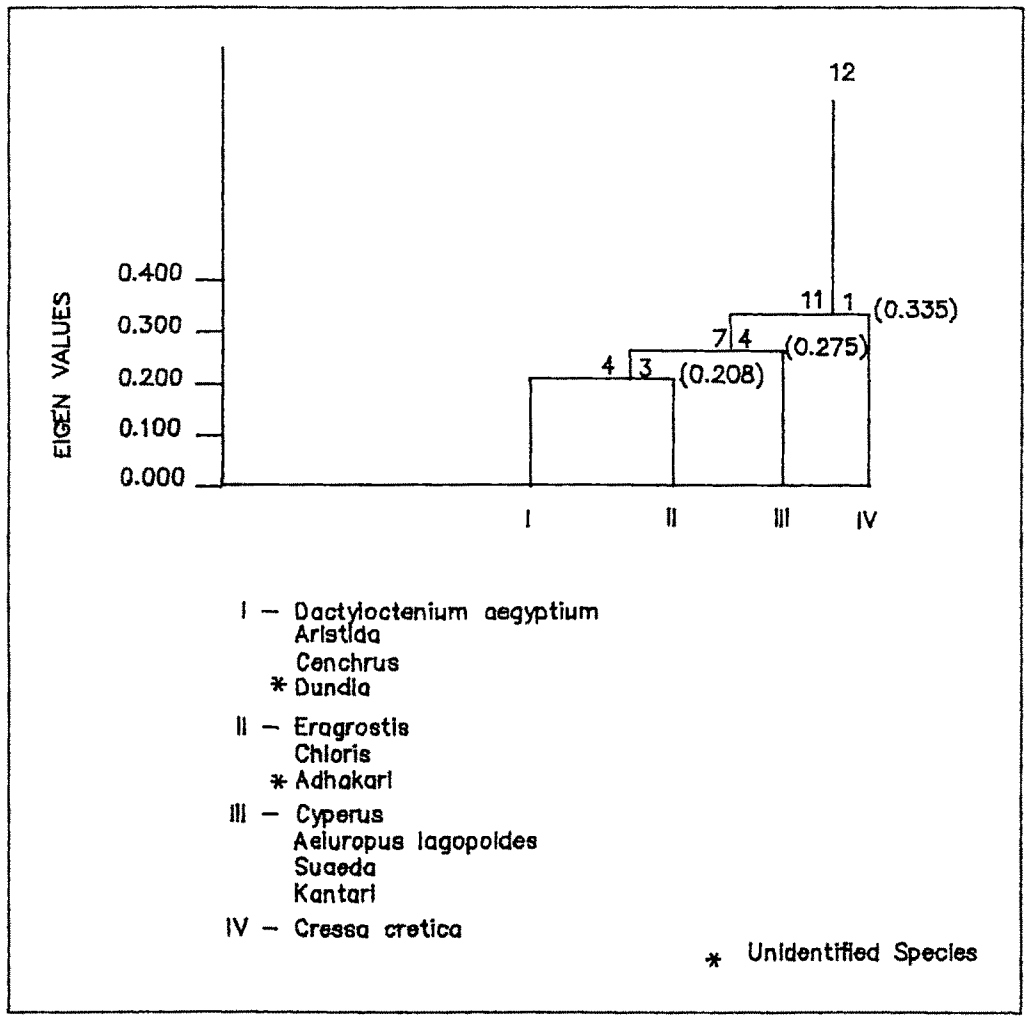


Figure II.11 : Shedwa Bet Species Classification Based on TWINSPAN
(Eigen values at each Division is given in parentheses)

**Figure II.12:** Successional Trend in the Study Area Little Rann of Kutch.

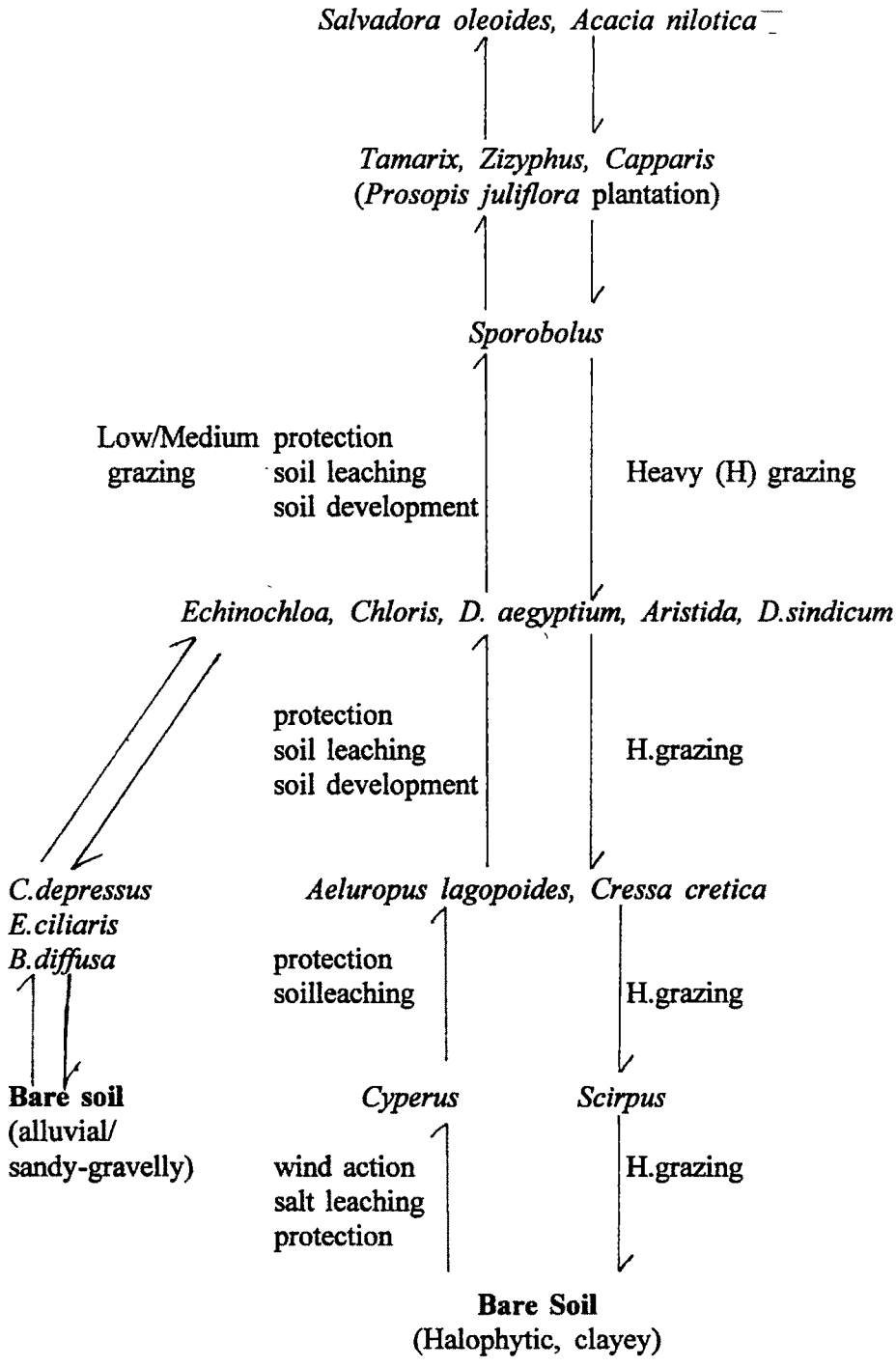

**Plate II.1** Rann - The saline mudflat.

**Plate II.2** Rann - Grassland.

Plate II.3 Prosopis Scrubland - Low

Plate II.4 Medium/Dense Prosopis Scrubland