Vegetation distribution in Naiman, Inner Mongolia, China

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Abstract

The pattern of the vegetation distribution in Naiman, Inner Mongolia, was studied. The 163 quadrats (1 m x 1 m) in 13 sites differing in landform and land use were situated and vegetation surveys were carried out. The samples were divided into five vegetation types corresponding to soil water condition, landform and land use by TWINSPAN classification. DCA ordination also showed a similar trend. On the basis of those results, the possibility of detecting vegetation types by remote sensing techniques in relation to the evaluation of carrying capacity was discussed.

1. Introduction

Recently the degradation of grassland vegetation has been increasing due to destructive land use such as over grazing and over cultivation in semi-arid regions of eastern Inner Mongolia. Sand dune remobilization, which is one of the most significant phenomena of "desertification", has occurred particularly on sandy lands (Zhu *et al.* 1988, Liu *et al.* 1990). Therefore, ecological evaluation of carrying capacity and appropriate land use planning based on detailed investigations of natural conditions including vegetation and soil property, should be needed to maintain sustainable agricultural activities in such regions. This paper focuses on grassland vegetation in Horqin sandy land which is one of the largest rangeland areas, and documents the pattern of vegetation distribution. On the basis of the results, the possibility of detecting vegetation types by remote sensing techniques in relation to the evaluation of carrying capacity was also assessed.

2. Study site and Method

Naiman county which we selected as a field for the study, is located in the southern part of Horqin sandy land and is the most serious county where desertification has spread widely (Zhu *et al.*

1988). The geomorphic frame in Naiman mainly consists of loess hills in southern part and sandy plain of Xiliao river in other part. The latter can be divided into several landform units according to the degree of soil moisture and sand accumulation.

Vegetation surveys were conducted in early September of 1993, 1994 and 1995. The 163 quadrats (1 m x 1 m) in 13 sites differing in landform (loess hill, dune, interdune depression, lowland and flat sandy land) and land use (grazed and mown) were situated and plant height (H) and percent cover (C) of each species were recorded.

Two-way indicator species analysis (TWINSPAN; Hill 1979a) was performed for all samples to classify the floristic data on the basis of species cover values transformed as follows: <2(%); 1, 2-5; 2, 5-10; 3, 10-20; 4, 20<; 5. Detrended correspondence analysis (DCA; Hill 1979b) was also applied using cover values to ordinate those samples. Species which appeared in more than 5 quadrats were used in those analysis.

3. Results and discussion

A total of 125 species were recorded in 163 quadrats and 71 species appeared in more than 5 quadrats. These samples were classified into two types based on the soil water conditions by the first division of TWINSPAN. Those stand groups were divided into 5 stand groups by the second and third division of TWINSPAN corresponding to landform types and land use types (Table 1).

The 5 types of the stand groups are described as follows:

Type 1 (2N) : This type of vegetation occurs in loess hills and is characterized by *Stipa bungeana* and *Thymus mongolicus*. *Stipa* sp. is one of the dominant species that form zonal vegetation in Inner Mongolian grassland.

Type 2 (5N) : This vegetation type occurs in flat sandy lands and is characterized by the dominance of annual grass species such as *Chloris virgata*, *Aristida adscensionis Setaria viridis* and *Digitaria cilliaris*.

Type 3 (5P) : This type occurs in dune areas. Mean vegetation cover is about 40 %, ranging from more than 70 % on the sites dominated by *Artemisia halodendron* to less than 10 % on shifting dunes where only pioneer annuals such as *Agriophyllum squarrosum* occur. 5N and 5P belong to the same stand group (2P) at the second division level of TWINSPAN.

Type 4 (3N) : This type of vegetation mainly occurs in mown lowlands and is dominated by hygrophytes such as *Phragmites australis*, *Puccinellia macranthera* and *Pycreus korshinskyi*.

Type 5 (3P) : This type occurs in grazed lowlands. Species composition is similar to 3N although vegetation height and cover is lower because of grazing effects. In some sites halophilous plants such as *Iris lactea* var. *chinensis*, *Suaeda corniculata* and *Kochia scoparia* occur.

Figure 1 shows the DCA ordination diagram of all samples. Stand groups of wet sites (3N and 3P) were separated from other groups along axis 1, and that of loess hills (2N) were separated along axis 2. These results suggested that axis 1 and 2 represent the gradient of soil moisture and the difference in bedrock, respectively.

Table 1 Species composition, percentage of the number of quadrats included in six types of landform and land use, mean vegetation cover and height in each stand group classified by the TWINSPAN. Numerals in the body of the table indicate mean transformed cover values (see text).

Species	2N	5N	5P	3N	3P
Agriophyllum squarrosum	-	1	3	-	-
Artemisia halodendron	-	1	4	1	-
Cynanchum thesioides	-	1	1	-	-
Ferula bungeana	-	1	1	-	-
Inula salsoloides	-	-	3	-	-
Melissitus ruthenicus	1	1	1	-	-
Corispermum macrocarpum	-	1	1	-	-
Chloris virgata	-	4	-	-	-
Euphorbia esula	-	1	1	-	-
Gueldenstaedtia stenophylla	-	1	1	-	-
Kummerowia stipulacea	1	1	1	1	-
Aristida adscensionis	-	3	1	-	-
Salsola collina	-	1	1	-	-
Bassia dasyphylla	-	1	1	-	-
Convolvulus arvensis	-	1	-	-	-
Digitaria cilliaris	1	5	1	1	-
Tragus mongolorum	-	1	-	-	-
Tribulus terrestris	-	1	-	-	-
Echinops gmelini	-	1	-	-	-
Eragrostis pilosa	1	1	1	-	-
Pennisetum centrasiaticum	-	1	-	-	-
Artemisia scoparia	1	1	-	1	-
Euphorbia humifusa	1	1	1	-	-
Setaria viridis	2	3	2	2	1
Lespedeza davurica	2	2	1	-	-
Cleistogenes squarrosa	2	1	-	-	-
Asparagus dauricus	1	-	-	-	-
Astragalus sp.	1	-	-	-	-
Glycyrrhiza uralensis	1	1	-	-	-
Gnaphalium sp.	1	-	-	-	-
Heteropappus altaicus	1	-	-	-	1
Oxytropis sp.	1	-	-	-	-
Polygala tenuifolia	1	-	-	-	-
Polygonum divaricatum	2	-	-	-	-
Potentilla tanacetifolia	1	-	-	-	-
Stipa bungeana	4	-	-	-	-
Thymus mongolicus	5	-	-	-	-
Artemisia frigida	2	1	-	-	-
Ixeris chinensis	1	1	1	1	-
Xanthium sibiricum	1	1	-	1	1
Aneurolepidium dasystachys	1	1	-	-	1
Saussurea amara	1	1	-	1	1
Chenopodium glaucum	-	-	-	1	1
Echinochloa crusgalli	1	-	-	1	1
Lactuca tatarica	-	-	-	1	1
Polygonum hydropiper	-	-	-	1	1
Artemisia gmelinii	-	-	-	1	-
Calamagrostis epigeios	-	-	2	4	1
Equisetum ramosissimum	-	-	1	1	1
Populus simonii	-	1	1	1	-
Salix gordejevii	-	-	1	1	-
Salix matsudana	-	-	1	2	1
Inula salicina	-	-	1	3	-
Melilotus suaveolens	-	-	-	1	-
Plantago depressa	1	-	-	1	1
Puccinellia macranthera	-	-	-	4	1
Pycreus korshinskyi	-	-	-	2	1
Typha minima	-	-	-	4	1
Potentilla anserina	-	-	-	1	1
Potentilla chinensis	-	-	-	1	1
Agropyron cristatum	1	-	-	2	2
Phragmites australis	-	1	1	4	3
Suaeda corniculata	-	-	-	1	1
Iris lactea var. chinensis	-	-	-	-	2
Kochia scoparia	-	-	-	1	1
Polygonum sibiricum	-	-	-	-	1
Carex duriuscula	-	-	-	2	5
Crypsis aculeata	-	-	-	1	1
Halerpestes ruthenica	-	-	-	1	1
Triglochin palustre	-	-	-	1	1
Taraxacum sp.	-	-	-	1	1
Number of quadrats	20	48	42	24	29
Percentage of the number of quadrats included in					
Loess hill*	12.3	0	0	0	0
Flat sandy land*	0	27.0	0	0	0
Sand dune*	0	2.5	22.7	0	0
Inter dune depression*	0	0	3.1	3.7	0
Lowland **	0	0	0	11.0	2.5
Lowland*	0	0	0	0	15.3
Total cover (%)	76.3	65.7	41.9	87.7	49.9
±	±	±	±	±	±
standard deviation	14.8	17.4	27.5	12.9	29.4
Community height (cm)	46.5	31.8	55.3	105.2	42.9
±	±	±	±	±	±
standard deviation	11.0	16.1	18.7	29.4	23.7

*grazed, **mown

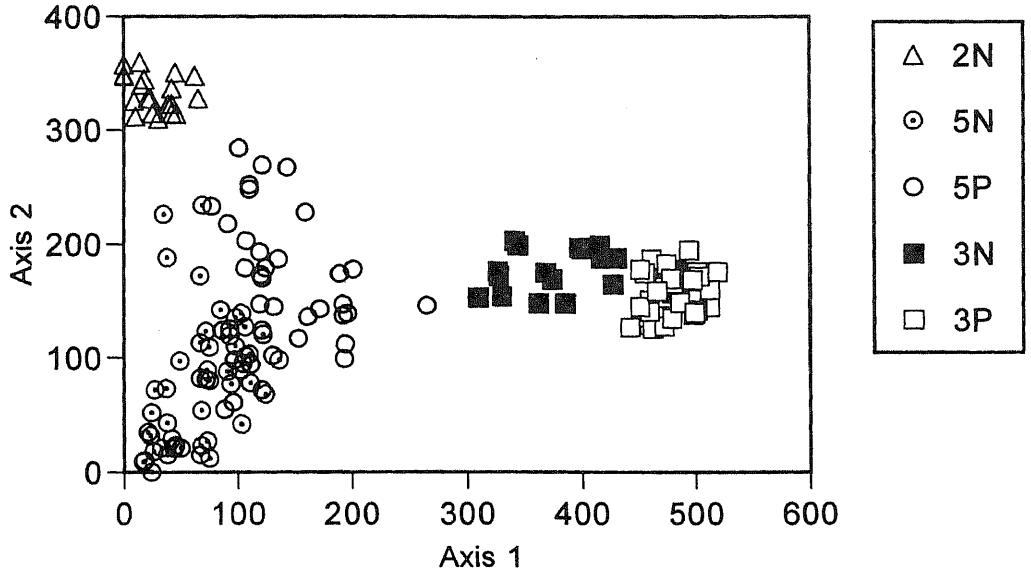

Fig.1 DCA ordination diagram of samples. Symbols indicate stand groups classified by TWINSPAN.

The results of the field surveys revealed that vegetation types in Naiman clearly correspond to physical conditions such as soil moisture and geomorphic frame. Sand dune remobilization has occurred mainly on dune areas and flat sandy lands (Zhu *et al.* 1988), which correspond to 5P and 5N, respectively. However, vegetation dynamics and carrying capacity would be different between the two types even if these sites show the same biomass, because of the differences in the dominant species and the effect of grazing (Ohkuro *et al.*, unpublished). Therefore, it would be important to detect the micro landform patterns which correspond to the above-mentioned vegetation types to develop detailed land evaluation and land use planning using remote sensing techniques in the surveyed regions.

4. References

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