Plant Energy Functional Groups and Their Coupling Relationship with the Functional Degradation of Steppe Ecosystem

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Plant energy functional groups and their coupling relationship with the functional degradation of steppe ecosystem

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Introduction Plant functional group (PFG) is a combination of various plant species with some common functional characteristics, Utilizing PFG can more efficiently reveal the general features of the natural ecosystem compared to studies of individual plant species(Gitay & Noble,1997). In this study, we firstly promoted classify functional groups based on the caloric value of plant, and study their dynamics along degradation gradient in three types of steppe of Xilin River Basin in Inner Mongolia. The objective was to investigate the feasibility of this functional classification method and compared the succession pattern of different functional groups with systematic declining at the ecosystem level.

Materials and methods 12 sites were selected along the middle Xilin River Basin in Inner Mongolia of China, including three types of steppe communities consisting the *Leymus chinensis-Stipa baicalensis* meadow steppe, the *Leymus chinensis* typical steppe, and the *Stipa grandis* typical steppe and four degraded intensities sites (undegraded, relatively light, moderate and heavy degraded) in each steppe types. The biomass of each species were determined using quadrate method, aboveground part was clipped and separated by species and caloric vales of each species was determined using a Parr 1281 oxygen bomb calorimeter. Mean caloric value of communities was calculated by weighting caloric value of each plant species according to their relative biomass in each community as follows:

$$\text{Community cal}\ (\%) = \frac{\sum [B_i \times C_i]}{\sum B_i}$$

B_i is i species' relative biomass in a community, C_i is the caloric value of species i.

Results Based on the mean caloric value, the 60 species were divided into three groups: high energy plant functional group (PFG) (caloric value> 18.00 kJ g^{-1}), medium energy PFG (18.00 kJ g^{-1}>caloric value>17.00 kJ g^{-1}), and low energy PFG (caloric value <17.00 kJ g^{-1}). The high-energy PFG has the dominant status, and the medium-and low-energy PFGs are the companion or incidental groups in the primary steppe. There were accordant trends for the three steppe communities, that is biomass proportion of high-energy plant in community decreased gradually, while those of low-energy plant increased with increasing degraded intensities. Moderate-energy plant slightly increased. The aboveground biomass and the mean caloric values of communities showed decreasing trends with increasing degraded intensities at the same time. It is the high-energy plants giving place to low-energy plants that result in degradation of steppe ecosystem function.(Figure 1)

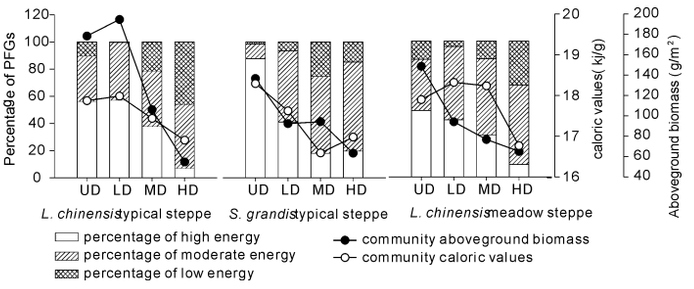

Figure 1 *Proportion of aboveground biomass of three PFGs based on caloric values in 12 sites along 3 degradation gradient.*

Conclusions The substitution of high-energy PFG by low-energy PFG was found to be coupled with the steppe degradation process. A classification system of energy-PFGs was proposed which can provide a reliably approach to characterize the functional status of different plant communities, and explore the mechanisms of steppe degradation at wholesome level.

Reference

Gitay H, Noble I R. (1997). What are functional types and how should we seek them? In: Smith, T.M., H.H. Shugart & F.I. Woodward eds. *Plant functional types*. Cambridge: Cambridge University Press. 3-19.