Investigation and Study on Vegetation of Qinghai-Tibet Highway

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Abstract. Since the dominant species of original vegetation and the distribution patterns of the bi-diversities are essential to vegetation recovery and restoration along the Qinghai-Tibet Highway. A vegetation survey was conducted on the Lhasa-Tuo tuo River section of the Qinghai-Tibet Highway, and 30 sample points were set to analyze the vegetation community along the Highway. Analysis of vegetation Community along Highway. The results show that there are 18 families, 26 genera, and 32 species of plants in the Qinghai-Tibet Highway Corridor. Compared with the world, China, and Tibet, the plant families belong to 3.26% of the total in the world, 5.341% of the total in China and 8.491% of the total in Tibet, but the species only accounted for 0.542% of the total number of Tibetan plant species. The dominant species of flowering ground cover are Astragalus strictus, Potentilla, etc. the species richness reduced closely with the altitude, and more species in southward than in northward. The variation of vegetation community diversity index is not directly related to elevation, but related to microclimate change along the highway.

1 Introduction

Qinghai-Tibet Plateau is an unique natural geographical unit, known as the “third pole” of the earth, is “the total sheltered umbrella of all types of ecosystems in Southeast Asia”[1], is an important gene pool in the world, but also the birthplace of rivers in China and Southeast Asian countries, is the “water tower”[2] of our country and even Asia. Therefore, it has a great impact on the ecological security of our country and its surrounding countries.

The Qinghai-Tibet Highway crosses the center of the Qinghai-Tibet Plateau, and the vegetation along the line is inevitably affected by some degree during the construction and operation of the highway. The natural geography and climate of Qinghai-Tibet Plateau are unique, and the ecological environment is very fragile. Once disturbed and destroyed, it is difficult to restore[3-4]. So the study of vegetation recovery along the highway is very important[5-8]. This paper takes the native flowering ground cover vegetation along the Qinghai-Tibet Highway Corridor as an object, and conducts vegetation research on the Qinghai-Tibet Highway Corridor, with a view to providing theoretical basis for the vegetation restoration and construction along the proposed Qinghai-Tibet Highway Corridor and the entire Qinghai-Tibet Plateau.

2 Study on area general situation

The land forms along the Qinghai-Tibet Highway mainly include: Piedmont flood plains, high plains, and river valleys, with an average elevation of more than 4000m. The highways have unique climatic characteristics of the Qinghai-Tibet Plateau with various types. The northern part is a plateau temperate arid climate zone and the central region is formed above 4000m Climate characteristics of the plateau sub-frigid zone. The multi-year average minimum temperature is -14.5 ~-17.4 ℃, and the annual precipitation gradually decreases from 480mm (Lhasa) to the north along the corridor to 40mm (Golmud). The rainfall is unevenly distributed throughout the year, mainly concentrated in May to September, accounting for the entire year. The precipitation is 97%, and the water system along the Qinghai-Tibet Highway is developed. The soil types are: alpine meadow soil, alpine grassland soil, etc. This paper takes the Lhasa-Qinghe section of the Qinghai-Tibet Highway as the main research object and conducts vegetation surveys.

3 Research method

3.1 Investigation method and sample point layout

The vegetation of flowering ground was investigated within 50m on both sides of the highway along Lhasa-Tuo tuo River section of Qinghai-Tibet Highway in August 2016, and the sample plot was 1×1 m². The sample plot was positioned with a GPS instrument and the surrounding environment characteristics detailed record.

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3.2 data processing method

SPSS 19.0 and EXCEL were used for data analysis and icon production. The analysis and calculation methods of vegetation survey data are as follows:

\[
SR = \frac{S - 1}{\ln N}
\]

SR is species richness index; S is number of species; N is total number of individuals

\[
H = - \sum Pi(\ln Pi) \quad (i = 1,2,3, \ldots s)
\]

H is Shannon - Wiener index; Pi is the ratio of the number of individuals of the ith species to the total number of individuals; S is number of species

\[
D = 1 - \sum Pi \quad (i = 1,2,3, \ldots s)
\]

D is Simpson index; Pi is the ratio of the number of individuals of the ith species to the total number of individuals N.

\[
E = \frac{\sum P_i(\ln P_i)}{\ln S} \quad (i = 1,2,3, \ldots s)
\]

E is Pielou Evenness index; Pi is the ratio of the number of individuals of the ith species to the total number of individuals N; S is number of species.

4 Results and analysis

4.1 Dominant species distribution

The Qinghai-Tibet Highway Corridor covers different vegetation types, mainly including alpine grassland, alpine shrub, alpine meadow and swamp meadow, as well as cushion vegetation and sparse vegetation of Alpine flow stone slope.

The results showed that in the Lhasa-Tuotuo River section of the Qinghai-Tibet Highway corridor, there were a total of 18 families, 26 genera and 32 species of plants, which accounted for 3.226% of the world's total, 5.341% of China's total and 8.491% of Tibet's total. But the species only accounted for 0.542% of the total number of Tibetan plant species.

According to the dominant species in sampling place, the dominant flowering ground in the Lhasa-Tuoto River are Astragalus strictus and Potentilla, etc.

| Plot number | stake number | Geographical position | Altitude | Dominant species | dominance |
|-------------|--------------|-----------------------|----------|------------------|-----------|
| 1           | K3832+900    | 29°55'10" 90°54'55" | 3944.0m  | Astragalus strictus R. Grah. ex Benth. | 0.551     |
| 2           | K3821        | 30°32'11" 91°19'32" | 4366.0m  | Potentilla bifurca L | 0.455     |
| 3           | K3804+150    | 30°5'29" 90°32'39"  | 4288.0m  | Ligularia rumicicfolia (Drumm) S.W. Liu. comb. nov. | 1.000     |
| 4           | K3804+150    | 30°5'29" 90°32'39"  | 4288.0m  | Astragalus strictus R. Grah. ex Benth. | 0.974     |
| 5           | K3804+150    | 30°5'29" 90°32'39"  | 4288.0m  | Anaphalis hancockii Maxim. | 1.000     |
| 6           | K3800+200    | 30°5'29" 90°32'39"  | 4339.6m  | Arenaria densissima Wall. ex Edgew et Hook. f. | 0.375     |
| 7           | K3798+500    | 30°15'51" 90°38'51"  | 4581.5m  | Eriogonum brevicaule (Vant.) Hand. -Mazz. | 0.677     |
| 8           | K3786+100    | 30°12'56" 90°37'32"  | 4595.7m  | Urtica tibetica W. T. Wang | 0.476     |
| 9           | K3786+100    | 30°12'56" 90°37'32"  | 4595.7m  | Potentilla bifurca L | 0.341     |
| 10          | K3785        | 30°13'21" 90°37'48"  | 4611.7m  | Astragalus strictus R. Grah. ex Benth. | 0.550     |
| 11          | K3776        | 30°16'13" 90°43'25"  | 4460.2m  | Astragalus strictus R. Grah. ex Benth. | 0.914     |
| 12          | K3759        | 30°20'11" 90°51'37"  | 4256.4m  | Potentilla saundersiana Royle | 0.592     |
| 13          | K3759        | 31°24'52" 91°58'38"  | 4460.0m  | Potentilla saundersiana Royle | 0.542     |
| 14          | K3759        | 31°18'09" 91°50'01"  | 4594.5m  | Anaphalis hancockii Maxim. | 0.553     |
| 15          | K3759        | 31°18'09" 91°50'01"  | 4460.0m  | Potentilla saundersiana Royle | 0.726     |
| 16          | K3735        | 30°26'52" 91°3'11"   | 4247.5m  | Astragalus strictus R. Grah. ex Benth. | 0.539     |
| 17          | K3710+800    | 30°31'26" 91°16'32"  | 4313.7m  | Potentilla saundersiana Royle | 0.489     |
| 18          | K3663+300    | 31°46'38" 91°36'02"  | 4645.6m  | Braya rosea | 0.606     |
4.2 Effects of elevation on vegetation index

4.2.1 Changes Species richness

Due to the special ecological environment, there are basically no trees in the native vegetation along the Lhasa-Tuotuo River section of Qinghai-Tibet Highway, and the vegetation has a single life type. Shrubs also only appear in a few sample zones, and are mostly in the shape of cushion, with low species abundance, and most of the vegetation along the line is low herbaceous. Therefore, this paper calculated the richness of all plant species investigated, so as to fully reflect the impact of environmental gradient along the highway on vegetation distribution.

As can be seen from figur, there is a strong similarity between the variation law of species richness and the variation law of elevation, and the variation trend of species richness and elevation is basically the same. Therefore, elevation is the main factor affecting species richness. But the variation of species richness is much larger than the variation of altitude, indicating that species richness is not only influenced by altitude, but also by other factors.

| No. | K1465+600  | 30°35′55″ | 91°30′32″ | 4650.7m | Anaphalis margaritacea (L.) Benth. et Hook. f. | 0.194 |
|-----|-------------|-----------|-----------|---------|---------------------------------|-------|
| 20  | K3638+700   | 30°59′14″ | 91°39′38″ | 4735.2m | Anaphalis margaritacea (L.) Benth. et Hook. f. | 0.311 |
| 21  | K3642+600   | 31°6′59″ | 91°41′42″ | 4644.4m | Astragalus strictus R. Grah. ex Benth. | 0.308 |
| 22  | K3612       | 31°9′33″ | 91°46′14″ | 4644.4m | Potentilla fruticose L. var. pumila Hook. f. | 0.507 |
| 23  | K3554+300   | 31°32′24″ | 91°59′59″ | 4537.5m | Astragalus strictus R. Grah. ex Benth. | 0.259 |
| 24  | K3516+300   | 31°10′15″ | 91°45′33″ | 4650.5m | Ephedra minuta Florin | 0.661 |
| 25  | K3500       | 31°45′39″ | 91°46′23″ | 4644.4m | Anaphalis hancockii Maxim. | 0.502 |
| 26  | K3444.50    | 31°10′49″ | 91°42′54″ | 4905.5m | Duchesnea indica (Andr.) Focke | 0.778 |
| 27  | K3378       | 31°35′33″ | 91°51′45″ | 5113.8m | Astragalus strictus R. Grah. ex Benth. | 0.863 |
| 28  | K3343+500   | 32°11′21″ | 91°42′37″ | 4700.0m | Potentilla saundersiana Royle | 0.424 |
| 29  | K3169       | 34°6′12″ | 91°20′58″ | 4755.6m | Potentilla bifurca L | 0.378 |
| 30  | K3169       | 34°6′12″ | 91°20′58″ | 5031.6m | Anaphalis hancockii Maxim. | 0.562 |

4.2.2 Changes species diversity and species evenness

The vegetation diversity index along the Qinghai-Tibet Highway corridor shows a gradual increase from north to south, while the water and heat conditions along the corridor also show a gradual improvement from north to south, indicating that the main factor for the vegetation diversity index along the Qinghai-Tibet Highway corridor is the water and heat conditions. However, the differences in microclimate along the corridor due to topography and landform lead to differences in species diversity. For example, sample points 3, 4 and 5 are located in YangbaJin with an altitude of 4230 m and are in the draught with strong wind, large evaporation and low temperature. The growth environment of vegetation is relatively poor, resulting in a low diversity index of vegetation here. However, No.8-9 sample land (altitude: 4543 m) is located in the Dang-Xiong River valley and has a high vegetation diversity index. The reason is that the water condition in the valley is better, so the vegetation growth condition is better. As can be seen from the trend line in the figure, the change trend of species diversity is not necessarily related to the change trend of altitude, but is more related to the microclimate along the corridor.
5 Conclusion

(1) According to the vegetation survey of the Lassa-Tuotuo River section of the Qinghai-Tibet Highway corridor, there are total of 18 families, 26 genera and 32 species of plants, which account for 3.226% of the world's total, 5.341% of China's total and 8.491% of Tibet's total. However, the species only account for 0.542% of the total plant species in Tibet. The dominant species in the main flowering ground are Astragalus strictus, Potentilla bifurca, etc. With strong adaptability to the environment and strong reproduction ability of the Qinghai-Tibet plateau, the native dominant species with strong reproduction ability can be considered as the application of vegetation restoration species.

(2) According to the vegetation survey results, the species richness of the Lassa-Tuotuo River section showed a tendency of less in the north and more in the south, and gradually decreased with the elevation. The variation of vegetation community diversity index is not directly related to elevation, but is related to microclimate change along the corridor.

Acknowledgments

Authors wishing to acknowledge assistance or encouragement from colleagues, special work by technical staff or financial support from organizations should do so in an unnumbered Acknowledgments section immediately following the last numbered section of the paper.

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