

THE RANGELAND TYPE AND ITS GEOGRAPHICAL DISTRIBUTION IN TIBET

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ABSTRACT

The area of Tibet is a major component of the Qing-Zang Plateau. The natural conditions are complex with various environmental types. The range of the area is of various types. Almost all the range types found in China are presented here. It is characterized by the geographical distribution on horizontal belts in plateau with vertical differences. Therefore it represents the characteristics of the combination of horizontal and vertical changes.

KEYWORDS

Tibet, range types, geographical distribution, horizontal belts, vertical belts and plateau

INTRODUCTION

The total range area of Tibet is 7084.18 hectares, and it is the largest among the provinces in China (1). The nature conditions are complex with various environmental types. It has its own characteristics. Firstly, it is rich in the variety of plants in the rangeland, there are more than 6000 species, holding the top position in China (2). Besides, the geographical component of the plant zones also is complicated, 15 types which distributed in the whole country are all found here (3). Secondly, the range types are also rich, it is distributed from tropical herbosa to cold-temperate types, from extreme wet to extreme arid areas. It represents all the range types of the country. Thirdly, alpine meadow is well developed, it comprises 94.63% of the total range area. Fourthly, the horizontal belts of the rangeland are combined with vertical belts and symbolized with plateau characteristics (4).

RANGELAND TYPES

(1). Temperate meadow-steppe: it is represented by the temperate semi-arid renascent herbs under temperate semi-wet climate conditions. It is mainly distributed among valley and slope areas from 3000 to 4000 m in the south-east of Tibet. The area is 12.34 ha. and is 0.17% of the total rangeland area. Dominant species are *Poa megalothyrsa*, *P. crymophila*; *Stipa capillacea*; *Artemisia santolinifolia* and *A. austriaca*. It is also rich in companion and forb species. The height of plant layer normally is 20-40 cm, the coverage is 40-80% and the average fresh yield is 3018 kg per ha.

(2). Temperate steppe: It is dominated by temperate arid renascent herbs and small arid shrubs (5). It is mainly distributed among the mid-part of Yaluzangbu river, Zangnan lake and Zangdongnu river, Lancang river, Jinsa river, the valley and lower slope of Sanjiang river. The area is 1,672,900 ha. and it is 2.36% of the total rangeland. The dominant species are *Pennisetum flaccidum*, *Orinus thoroldii*, *Stipa bungeana*, *Artemisia xigazeensis*, *A. wellbyi*, *A. younghusbandii*. The height of plant layer is 15-30 cm, the coverage is 20-50%, the average fresh yield is 416 kg per ha.

(3). Temperate desert-steppe: It is mainly composed of drought or strong drought resistant bunch type grasses and small bushes. It is mainly distributed among Kongque river in west Tibet and slopes and basins of Xiangquan river where altitude is below 4600 m. The area is 432,200 ha. and it is 0.52% of the total rangeland. The dominant species are *Stipa glareosa* and *Caragana versicolor*. The height of plant layer is 5-10 cm, and the height for the bushes is about 30 cm, the coverage is 10-30% and the average fresh yield is 610 kg per ha.

(4). High-cold meadow-steppe: It is mainly composed of cold-arid or cold medium arid renascent herbs. And it is in between high-cold steppe and alpine meadow. It is mainly distributed in the south part of Qiangtang alpine and Yuanhu basin of southern Tibet mountains where altitude is from 4300 to 5000 m. The area is 5939,000 ha. and it is 7.33% of the total rangelands. The dominant species are *Stipa purpurea*, *Tripogon nanus*, *Carex montiseverestii*, *C. moorcroftii*, *C. angustifrustrus* and *Kobresia* spp. The height of plant layer is 5-15 cm, the coverage is 30-50% and average fresh yield is 690 kg per ha.

(5). High-cold steppe: It is mainly composed of renascent herbs or small bushes. It is extensively distributed among Qiangtang plateau of north Tibet, Shanyuanhu basin of south Tibet, Kuan valley and the valley of mid-part of Yaluzangbu river. The altitude is 4300-5100 m. The area is 26,462,000 ha., it is 37.36% of the total rangeland. This is the largest rangeland type in Tibet. The dominant species are *Stipa purpurea*, *Orinus thoroldii*, *Artemisia wellbyi*, *A. stracheyi*. The height of plant layer is 10-15 cm, and some of the plants form two layers and the height of top layer is about 30 cm. The coverage is 20-45%. The average fresh yield is 677 kg per ha.

(6). High-cold desert-steppe: It is mainly composed of cold-arid or strong cold-arid renascent herbs and small semi-frutex. It is extensively distributed in the north-west part of Qiangtang alpine and north-west alpine of Tibet. The altitude is 4300-5300 m. The area is 8,678,700 ha., it is 9.88% of the total rangelands. It is one of the three major range types in Tibet. The dominant species are *Carex moorcroftii*, *Ceratoides compacta*, *Stipa glareosa*, *Orinus thoroldii*. The height of plant layer of former type is 5-10 cm, the coverage is 5-10%; the height of plant layer of the latter is 10-20 cm, the coverage is 10-30%. The average fresh yield is 554 kg per ha.

(7). Temperate steppe-desert: It is the rangeland type which is between temperate desert and temperate desert-steppe. It is mainly distributed around sandy area and valley of Shiquan river of west Tibet. The area is 9,4000 ha. and it is 0.13% of the total rangeland. The dominant species are *Ceratoides layens*, *Ajanía fruticulosa* and *Stipa glareosa*. The height of plant layer is 10-20 cm, the coverage is 10-20% and the fresh yield is 615 kg per ha.

(8). Temperate desert: It is mainly composed of strong drought resistant semi-shrub and shrub which are under extremely arid conditions. It is mainly distributed in the arid slopes of altitude below 4400 m among Shiquan river of west Tibet, Xiangquan river and Bangong lake. The area is 44,400 ha. and it is 0.06% of the total rangeland. The dominant species are *Ceratoides letens* and *Ajanía fruticulosa*. The coverage is low and normally is 5-20%, and the fresh yield is 680 kg per ha.

(9). High-cold desert: It is developed under cold and extremely arid conditions. It is mainly distributed in the plateau area of north-west Tibet and Huxiang plains of north Qiangtang plateau. The altitude is 4300-5300 m. The area is 4,195,500 ha. and it is 5.92% of the total rangeland. The dominant species are *Ceratoides compacta*, *C. latens*, *Christolea crassifolia*. The environment is harsh, the coverage is 5-10%, the height of plant layer is 5-15 cm and the fresh yield is 338 kg.

(10). Temperate herbosa: It is developed by temperate renascent

grasses and sagebrush of semi-shrubs, secondary community is formed under broad leaved evergreen. It is mainly distributed in slopes and table lands of latitude 2500-3200 m among lower part of Niyang river of south-east Tibet, upper part of Cayu river and lower part of Nujiang river. The area is 10,400 ha. and it is 0.01% of the total rangeland. The dominant species are *Artemisia tanacetifolia*, *Eragrostis pilosa*, *Pennisetum flaccidum*. Normally, there are two plant layers, the height of top layer is 30-40 cm, the lower layer is 10-20 cm, the coverage is 50-90%, the average fresh yield is 3356 kg per ha.

(11). Warm-temperate shrub herbosa. It is developed as the same conditions as temperate herbosa. The only difference is that shrub is growing in this area. The area is 124,700 ha. and it is 0.18% of the total rangeland. There are two layers, the height of shrub is 80-100 cm, the dominant species are *Sophora viciifolia*, *Bauhinia faberi* var. *microphylla*, *Ceratostigma*. The height of herbosa is 20-50 cm, the dominant species are *Arthraxon prionodes*, *Andropogon tristis*, *Eragrostis ferraginea*, *Themeda trianda*. The coverage is 60-80% and the average fresh yield is 2307 kg per ha.

(12). Tropical herbosa: It is formed by tropical-season or medium drought resistant herbosa, it is a secondary type which is developed in the area of destroyed rain forest and seasonal rain forest. It is mainly distributed in sub-tropical and tropical belts of south slope (2200 m) of east Zhumulangma. The area is 9100 ha. and it is 0.01% of the total rangeland. The dominant species are *Imperata cylindrica* var. *major*, *Heteropogon contortus* and *Miscanthus sinensis*. The height of plant layer is 80-100 cm, the highest can reach 150-200 cm. The coverage is 80-100%, the average fresh yield is 8337 kg per ha.

(13). Tropical shrub herbosa: The formation and distribution is the same as tropical herbosa, the only difference is that shrub and trees are also distributed. The dominant species are *Bauhinia faberi* var. *microphylla*, *Heteropogon contortus*, *Cymbopogon goerigii*. The height of shrub is above 100 cm, the closed rate is 0.2-0.3; the height of herbosa is 30-65 cm, the coverage is 60-75%. The average fresh yield is 3000 kg per ha.

(14). Lowland meadow: It is formed by renascent herbs under appropriate soil moisture content. The distribution is extensive, but it is not consistent. Its distribution is closely associated with the supply of underground water. The area is 48,600 ha. and it is 0.07% of the total rangeland. The dominant species are *Leymus secalinus*, *Phragmites australis*, *Carex doniana*, *Cyperus amuricus*. The height of plant layer varies greatly, normally it is 20-30 cm, *P. australis* and *C. amuricus* can reach 40-60 cm. The coverage is 70-95%, the coverage for *P. australis* is 40-45%. The average fresh yield is 3498 kg per ha.

(15). Mountain meadow: It is formed by renascent herbs in temperate, cold-temperate mountain under damp or semi-damp conditions. Its distribution is not limited by the supply of underground water, and it is closely associated with the rainfall, air moisture content(5). It is mainly distributed in the mountains of south-east Tibet and sub-plateau of south slope of Ximalaya, the altitude is 2800-4400 m. The area is 1,269,900 ha. and it is 1.79% of the total rangeland. The environment is good with many different plant species. The dominant species are *Elymus nutans*, *Poa annus*, *Kobresia setchwanensis*, *K. macrantha*, *Polygonum macrophyllum*, *Potentilla anaserina*, *Anaphalis* spp. The height of plant layer is 20-50 cm, the coverage is 80-95%. The average fresh yield is 3510 kg per ha.

(16). Alpine meadow: It is formed by cold-born renascent herbs. It is extensively distributed in Tibet. The altitude of distribution varies greatly, it is from 3800 (4000) to 4400 (4800) m in south-east of Tibet and 4300-5300 in north-west of Tibet. The area is 24,185,200 ha. and it is 34.14% of the total rangeland. This represents the second largest range type in Tibet. The dominant species are *Kobresia pygmaea*, *K. humilis*, *K. littledalei*, *Blysums sinocmpressus*, *Polygonum macrophyllum*, *Carex oxyleca*, *C. atrofusca*. The height of plant layer is 5-15 cm, the height of *K. pygmaea* is only 3-5 cm, the height of *K. littledalei* is 20-30 cm. The coverage is 70-90%. The average fresh yield is 1597 kg per ha., and it is 3780 kg per ha. for *K. littledalei* range.

(17). Marsh: It is formed by marsh plants, and it can be utilized by grazing or cutting. The distribution is relatively small, and it is mainly distributed in lake area, valley, low land in which water is rich. The area is 13,100 ha., and it is 0.02% of the total rangeland. The dominant species are *Triglochin palustre*, *Carex doniana*, *Eleocharis valliculosa*, *Juncus effusus*. The height of plant layer is 10-25 cm, the height for *Carex doniana* range is 30-35 cm. The coverage is 50-90%. The fresh yield is 4676 kg per ha.

GEOGRAPHICAL DISTRIBUTION PATTERNS OF THE RANGELAND

Tibet is located in plateau of average altitude from 4000 to 5000 m and is the main part of Qingzang plateau. It is situated in low-medium latitude which is between 27°-36° north latitude, 79°-99° east longitude. Weather varies from place to place which is controlled in turn by the south-west wind from Indian Ocean and west wind. It is characterized by warm-humid conditions in summer and dry-cold conditions in winter. The weather changes from warm-humid; cold, semi-humid to cold, semi-arid with rises of altitude from south-east (south) to north-west (north) in the plateau. The distribution of rangeland types also are changed respectively. This normally happens in the plateau of which average altitude is 4500 m or higher, and it is different from horizontal belts and also different from the common sense of vertical belts. Its distribution is influenced by the combination of horizontal and vertical belts. And it contains both characteristics of horizontal and vertical belts. It is characterized as plateau regional distribution (4). The weather varies as a result of rise and fall of relief, such as it is warm and humid in the south slope of east Ximalaya and the valley of high mountains in south-east Tibet. The rangeland types change vertically and represent as tropical and sub-tropical distribution. The weather changes to dry and cold inside the plateau area, although the absolute altitude is high, the relative altitude is lower when it is compared with the mountains in south-east Tibet. As a result, the vertical distribution of rangeland types is simple, and it belongs to vertical distribution of plateau. Therefore, the geographical distribution of rangeland in Tibet is unique in both horizontal and vertical belts.

(1). Characteristics of Tibet ranges on horizontal belts: Rich rainfall is formed in Ximalaya mountain, especially in south parts of east Ximalaya mountain, due to the blocking of warm-humid south-east seasonal wind from Indian Ocean in Ximalaya mountain. Even in winter, the weather is still warm and humid due the high mountains and plateau in the north in which cold air is blocked and low pressure zones. Tropical evergreen rain forest and seasonal rain forest are developed in valley and slopes of altitude bellows 1100 m. This is the rain forest which is the farthest north in China. This area belongs to tropical rain forest. Tropical herbosa and shrub herbosa are developed in the area where forest was destroyed. South-east part of Tibet belongs to sub-tropical area and is characterized as high

mountains and valley. Although the altitude is high, the valley normally ranges from 2000-3000 m. The weather is warm and humid due to the Menjala gulf nearby and influence of south-west seasonal wind. The area is covered by evergreen, wide-leaved forest. Tropical herbosa and shrub herbosa is also developed. The climate change from warm to humid in Sanjiang valley which is north part of Zuogong, Mangkang and Zubalong. Shrub herbosa is distributed, mountain meadow-steppe is extensively distributed in slopes where forest is sparse.

Tibet is a mountainous plateau area, two features of the range in the horizontal belts mentioned above are not typical when compared with the tropical and sub-tropical conditions in the southern part of China. It only represents a small area in Tibet, and most of the rangeland in Tibet is distributed in the plateau area.

The plateau rangeland of north Ximalaya mountain and west part of the forest in south-east Tibet can be divided by Nianqintanggula and Gangdis mountain into south and north areas which are parallel to latitude. The former includes the area of upper part of Yaluzangbujiang river which is between middle-west Ximalaya mountain and Gangdis mountain, Hu basin of south Tibet and middle-south of Ali district in west Tibet. The relief is low and characterized as wide valley and basin. The climate is mild and belongs to temperate alpine. The rangeland belongs to temperate meadow. The latter includes the area of Nujiang river of east-north part of Tibet, Qiangtang plateau and north-west plateau of Tibet. The relief is high, weather is cold and belongs to sub-cold and cold plateau climate. The rangeland is alpine meadow. In these two areas, rainfall is reduced and the drought condition is increased with the change from east to west and to north-west.

The rangeland types are changed with the variation of longitude. The relief is low in the area of upper and middle part of Yaluzangbu river of south Gangdis mountain and Hu basin of south Tibet. It is situated in the north part of Ximalaya mountain, therefore, the rainfall is far less than the south part. In winter, the pressure is low as a result of west wind, the climate is fine and dry. In summer, rainfall is produced due to the influence of south-west seasonal wind from valley and seasonal plateau wind (4), the climate is mild and semi-arid. The rangeland is classified as temperate meadow. The rainfall is reduced where in the west as it reaches Pulan, Zada, this situation is worsened with the influence of rain-shadow which circulates from south and west slopes of west Ximalaya mountain. Therefore, the range types are changed.

Temperate desert-steppe is developed in the wide valley, basin and lower part of slopes. From the west part of the plateau mentioned above, its north-west is the area of middle-west part of Ali district where Gerl river, Shiquan river, Bangong lake and Xiangquan river pass through. It is surrounded by west Ximalaya mountain, Kalakunlun mountain, Gangdis mountain, and a wide valley and basin is in the middle. The altitude of bottom of the valley is about 3800-4300 m. It is located in the center of the mainland and it is hardly influenced by the seasonal south-west wind from Indian Ocean, the damp air of Atlantic Ocean cannot reach here. Besides, it is the center of hot-low pressure in the summer. Although the air is also moved up, rainfall is hardly formed, the annual rainfall is only 50 mm. The climate in this area is temperate and dry. Temperate desert and steppe-desert is the major range types in here.

The geographical distribution of rangeland becomes more remarkable in the high cold area of Gangdis mountain and north Qinzangtanggula mountain. High cold meadow, high cold meadow-steppe, high cold

steppe, high cold desert steppe which controlled by water factor is respectively distributed from south-east to north-west in the plateau of north Tibet. It represents distinctive series of range types of high cold steppe in plateau area.

The area of upper part of Nujiang river is from east-north Tibet to north Tanggula mountain and south Nianqintanggula mountain. The average altitude is 4500 m. It is close to Changjiang river and Yellow river, and is the center of low pressure in summer, at latitude 32°, the air is combined, gale and storm weather is formed. The storm of Menjala gulf also can reach here and bring a lot of rain. It is cold and snowing in winter. The annual rainfall is 400-700 mm. Cold and semi-humid is basic climatic condition here. High cold meadow is extensively developed with the accompaniment of shrubs. Watershed in north Tibet and Qiangtang plateau is the transitional area from high cold meadow to high cold steppe. Climate is changing from semi-humid to semi-arid. High cold meadow-steppe is distributed. Qiangtang plateau is in hinterland of Qing-Zang plateau and is 4400-5000 m above sea level. It is high in the north and low in the south and is a hilly plateau with many lakes. The climate is cold and semi-arid which is under the control of west-wind circulation and seasonal plateau wind. The vegetation is mainly composed by *Stipa purpurea* and distributed in the hills, mountains, riverbed with sea level around 4500-5100 m.

Besides the distribution of *Stipa purpurea* in high-cold steppe in the north of Heihe-Ali road, with the increasing latitude and altitude, the climate becomes colder and a large area of *Carex mooreroftii* is developed in the high-cold steppe. It is well developed further north and transited to sedge high-cold steppe. This type of range is also distributed in the slopes above 5000 m sea level with the characteristics of vertical distribution. High-cold desert-steppe is distributed in the transitional area from high-cold steppe in north and north-west of Qiangtang plateau to high-cold desert. Zangbei plateau and north part of Qiangtang plateau which is in between Kalakunlun mountain and Kunlun mountain is the highest area in Tibet. The climate is extremely dry with influence of air irradiation and reduced rainfall. It is the most cold and dry area in Tibet. High-cold desert is the typical rangeland type. Although the horizontal distribution of rangeland in Tibet shows the changes from altitude to longitude, the pattern is more remarkable with the change from south-east to north-west. This indicated that the horizontal distribution is controlled by water and heat factors while the water is a major component. And it also reflects the effects of orogenesis and climate on distribution of range types (6).

(2). Characteristics of Tibet range in vertical belts: The most remarkable characteristic of the mountainous steppe is the distribution of different rangeland types with the increasing altitude. So it is called characteristics of vertical distribution of rangeland. This kind of distribution is influenced by the horizontal position of the mountain, the height, direction of the mountain, the position and direction of slopes and also the regional climate. Therefore the characteristics of vertical distribution of the range in different area vary greatly.

The multiple types of the range in Tibet are largely attributed to the large area and the complexity of the topography. The range types in vertical belts are complex in Tibet. Every horizontal belt has its own vertical type: tropical shrub herbosa is the major type in the vertical belt of south part of east Ximalaya mountain; warm-temperate shrub herbosa is the major type in the vertical belt of south-east Tibet, temperate steppe is the major type in the valley area. Besides, the multiple types of vertical belt are represented by high-cold steppe, temperate desert and high-cold desert. The composition of vertical

belts varies greatly. The composition of vertical belts of tropical mountains in the south part of Ximalaya mountain and warm-humid mountains in south-east Tibet is complicated, south and north slope also varies greatly.

The range types in the most complicated area of south slope of east Ximalaya mountain include tropical herbosa, tropical shrub herbosa, warm-temperate herbosa, warm-temperate shrub herbosa, mountainous meadow, alpine steppe, etc. The range type in vertical belts of large plateau becomes simple, in the mountainous area of Naqu-Nielamu and Qiangtangamugong mountain. Alpine meadow or high-cold steppe is the only range type in these areas, and not many differences are found between south and north slopes. All these indicate the trend of range types in Tibet simplifies from south-east to north-west. The distributive height of the same vertical belt from south-east to north-west is increased with the reduced rainfall and increasing continental climate. The top limit of alpine meadow in south part of east Ximalaya mountain is 4400 m above sea level, it reaches 4800 m in Hengduan mountain, it reaches 5000 m in wide valley of north-east plateau in Tibet and it reaches 5200 m further west, such as Naqu-Nierong area. The top limit of high-cold steppe in south slope of Gangdis mountain is 4600 m (Lasa) to 4800 m (Lazi), but it reaches 5300 m in Qiangtang plateau. And these indicate the distributive height of vertical range types in Tibet is increased from south-east (south) to north-west (north).

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