**Table S1** Understory vegetation characteristics of different vegetation types at different slope aspect. Values are in the form of the mean ± standard error. Different capital letters indicate significant differences between slope aspects (p<0.05),different lowercase letters indicate significant differences between the four vegetation types (p<0.05).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Slope  aspect | Land use | Site code | Dominated plant  communities | Dominant herbaceous plant | Biomass height （m） | Richness | Biomass coverage (%) | Aboveground biomass (g m-2) | Belowground biomass (g m-2) | Litter biomass (g m-2) |
| W | Degraded  land | WDAA | Artemisia annua | Potentilla chinensis,Artemisia annua | 0.24±0.02aA | 0.71±0.04aA | 20.11±6.88bA | 55.94±3.52aB | 26.48±4.39bB | 54.49±4.42dA |
| grassland | WGAM | Astragalus melilotoides | Astragalus melilotoides | 0.45±0.08aA | 1.15±0.02aA | 49.42±20.53aA | 270.88±56.11aB | 39.19±22.50aB | 96.92±24.63cA |
| WGCP | Capillipedium parviflorum | Capillipedium parviflorum | 0.55±0.11aA | 1.12±0.09aA | 47.61±24.66aA | 253.4±30.09aB | 73.92±17.54aB | 96.45±17.50cA |
| shrubland | WSHR | Hippophae rhamnoides | Artemisia sacrorum,Capillipedium parviflorum | 0.54±0.17aA | 1.14±0.06aA | 28.67±4.73bA | 236.15±36.57aB | 26.61±9.87bB | 141.5±10.99aA |
| WSCK | Caragana korshinskii | Artemisia sacrorum,Capillipedium parviflorum | 0.67±0.39aA | 1.13±0.02aA | 30.94±17.13bA | 312.83±8.12aB | 29.65±1.09bB | 135.2±10.50aA |
| Woodland | WWLG | Larix gmelinii | Astragalus melilotoides，Artemisia sacrorum | 0.71±0.05bA | 1.17±0.07bA | 35.27±18.32bA | 268.23±30.21bB | 76.71±6.07aB | 122±7.99bA |
| WWPS | Pinus sylvestris | Astragalus melilotoides，Artemisia sacrorum | 0.63±0.14bA | 1.11±0.04bA | 32.67±13.05bA | 350.14±12.38bB | 49.17±13.71aB | 113.46±7.43bA |
| N | grassland | NGAM | Astragalus melilotoides | Astragalus melilotoides | 0.55±0.09aA | 1.02±0.17aA | 37.79±1.91aA | 292.97±62.32aAB | 62.75±20.67aAB | 95.08±31.90cA |
| NGBI | Bothriochloa ischaemum | Bothriochloa ischaemum (L.) Keng | 0.56±0.06aA | 1.01±0.17aA | 67.41±1.28aA | 282.81±70.70aAB | 79.76±12.14aAB | 89.55±13.09cA |
| shrubland | NSHR | Hippophae rhamnoides | Astragalus melilotoides,Potentilla chinensis | 0.72±0.06aA | 1.2±0.11aA | 56.78±20.08aA | 305.83±19.11aAB | 46.69±20.66aAB | 175.16±12.81aA |
| NSCK | Caragana korshinskii | Artemisia sacrorum,Capillipedium parviflorum | 0.41±0.05aA | 1.09±0.04aA | 25.11±6.71aA | 300.94±33.44aAB | 43.08±8.75aAB | 167.37±12.24aA |
| Woodland | NWLG | Larix gmelinii | Artemisia sacrorum,Capillipedium parviflorum | 0.77±0.06aA | 1.12±0.08aA | 31.79±28.25aA | 295.86±32.64aAB | 88.27±6.15aAB | 140.2±16.10bA |
| NWPS | Pinus sylvestris | Astragalus melilotoides | 0.63±0.05aA | 1.13±0.02aA | 63.67±14.98aA | 411.27±49.26aAB | 47.07±9.84aAB | 130.38±14.98bA |
| S | grassland | SGAM | Astragalus melilotoides | Astragalus melilotoides | 0.51±0.08bA | 1.12±0.01aA | 43.46±13.38abA | 304.11±14.56bAB | 77.84±42.56aAB | 110.62±23.76cA |
| SGCP | Capillipedium parviflorum | Capillipedium parviflorum | 0.42±0.15bA | 1.18±0.09aA | 40.55±12.51abA | 276.32±63.54bAB | 76.38±49.01aAB | 108.54±6.02cA |
| shrubland | SSHR | Hippophae rhamnoides | Artemisia sacrorum,Potentilla chinensis | 0.66±0.12bA | 1.19±0.11aA | 28.33±18.58bA | 397.55±19.17aAB | 56.71±6.77aAB | 207.31±14.62aA |
| SSCK | Caragana korshinskii | Capillipedium parviflorum,Lespedeza bicolor | 0.41±0.05bA | 1.1±0.03aA | 25.11±5.42bA | 361.4±11.68aAB | 47.7±7.11aAB | 198.08±13.97aA |
| Woodland | SWLG | Larix gmelinii | Artemisia sacrorum | 0.75±0.01aA | 1.09±0.12aA | 54.67±21.36aA | 317.5±20.12aAB | 91.97±3.46aAB | 149.14±12.11bA |
| SWPS | Pinus sylvestris | Astragalus melilotoides，Artemisia sacrorum | 0.69±0.10aA | 1.1±0.11aA | 60±17.58aA | 459.27±38.92aAB | 73.73±7.92aAB | 138.7±11.27bA |
| E | grassland | EGAS | Astragalus melilotoides | Artemisia sacrorum | 0.54±0.12aA | 0.9±0.06aA | 55.87±14.29aA | 337.29±56.74bA | 109.63±18.71aA | 106.87±15.61cA |
| EGSM | Astragalus melilotoides | Artemisia sacrorum | 0.55±0.12aA | 0.96±0.11aA | 51.75±23.80aA | 350.39±37.68bA | 103.14±3.28aA | 114.63±2.93cA |
| shrubland | ESHR | Hippophae rhamnoides | Artemisia sacrorum,Potentilla chinensis | 0.7±0.24aA | 1.27±0.08aA | 37.22±6.74aA | 428.69±34.74abA | 63.33±3.28cA | 214.75±32.17aA |
| ESCK | Caragana korshinskii | Capillipedium parviflorum,Lespedeza bicolor | 0.69±0.38aA | 1.05±0.01aA | 35.42±17.95aA | 414.61±34.58abA | 49.49±13.33cA | 205.19±30.74aA |
| Woodland | EWLG | Larix gmelinii | Artemisia sacrorum | 0.77±0.11aA | 1.03±0.25aA | 40.1±12.90aA | 364.47±53.42aA | 92.56±5.59bA | 152.01±9.17bA |
| EWPS | Pinus sylvestris | Astragalus melilotoides | 0.6±0.15aA | 0.9±0.22aA | 59±13.89aA | 552.13±32.97aA | 73.8±13.84bA | 141.37±8.53bA |

**Table** **S2** Soil characteristics of different vegetation types at different slope aspect. Values are in the form of the mean ± standard error. SWC: soil water content; SBD: soil bulk density; SOC: soil organic carbon; TN: text Normalization; TP: total phosphorus. Different capital letters indicate significant differences between slope aspects (p<0.05), different lowercase letters indicate significant differences between the four vegetation types (p<0.05).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Slope  aspect | Land use | Site code | SWC (%) | BD (g cm-3) | Clay (%) | Silt (%) | Sand (%) | pH |
| W | Degraded  land | WDAA | 0.08±0.03cC | 1.63±0.03aA | 10.25±0.23dD | 9.12±0.12bB | 80.63±0.32abAB | 8.5±0.11aA |
| grassland | WGAM | 0.1±0.01bcC | 1.58±0.01aA | 13.63±0.09bD | 5.22±0.17cB | 81.15±0.14aAB | 7.6±0.19bA |
| WGCP | 0.1±0.03bcC | 1.66±0.03aA | 13.19±0.09bD | 5.52±0.17cB | 81.29±0.14aAB | 7.44±0.19bA |
| shrubland | WSHR | 0.11±0.02abC | 1.25±0.02bA | 12.42±0.23cD | 8.36±0.21bB | 79.21±0.28bAB | 6.97±0.07cA |
| WSCK | 0.13±0.01abC | 1.23±0.03bA | 12.86±0.23cD | 8.06±0.21bB | 79.07±0.28bAB | 6.99±0.07cA |
| Woodland | WWLG | 0.12±0.01aC | 1.26±0.02bA | 20.11±0.34aD | 18.77±0.43aB | 61.12±0.77cAB | 7.53±0.02bA |
| WWPS | 0.16±0.01aC | 1.24±0.01bA | 20.55±0.26aD | 18.47±0.17aB | 60.98±0.43cAB | 7.55±0.02bA |
| N | grassland | NGAM | 0.1±0.03bBC | 1.56±0.01aA | 13.45±0.36bB | 7.49±0.33bC | 79.06±0.28bA | 7.48±0.05aB |
| NGBI | 0.1±0.01bBC | 1.63±0.13aA | 13.01±0.36bB | 7.79±0.33bC | 79.2±0.28bA | 7.33±0.05aB |
| shrubland | NSHR | 0.12±0.04abBC | 1.22±0.13bA | 10.79±0.46cB | 7.62±1.88bC | 81.59±1.45cA | 6.83±0.10bB |
| NSCK | 0.12±0.02abBC | 1.2±0.07bA | 11.23±0.46cB | 7.32±1.88bC | 81.45±1.45cA | 6.85±0.10bB |
| Woodland | NWLG | 0.13±0.01aBC | 1.25±0.07bA | 18.38±0.08aB | 28.19±0.28aC | 53.43±0.29aA | 7.48±0.05aB |
| NWPS | 0.16±0.01aBC | 1.22±0.02bA | 18.82±1.00aB | 27.89±0.28aC | 53.29±0.72aA | 7.5±0.05aB |
| S | grassland | SGAM | 0.1±0.01bAB | 1.53±0.02aB | 14.73±0.22bC | 4.45±0.39cB | 80.82±0.61aB | 7.35±0.04aC |
| SGCP | 0.11±0.02bAB | 1.6±0.08aB | 14.29±0.22bC | 4.75±0.39cB | 80.96±0.61aB | 7.2±0.03aC |
| shrubland | SSHR | 0.12±0.02aAB | 1.21±0.08bB | 11.56±0.09cC | 8.03±0.15bB | 80.42±0.24bB | 6.56±0.04bC |
| SSCK | 0.13±0.01aAB | 1.19±0.13bB | 12±0.09cC | 7.73±0.15bB | 80.28±0.24bB | 6.58±0.04bC |
| Woodland | SWLG | 0.13±0.03aAB | 1.24±0.13bB | 20.09±0.23aC | 29.93±0.29aB | 49.98±0.13cB | 7.29±0.05aC |
| SWPS | 0.16±0.01aAB | 1.22±0.07bB | 20.53±0.35aC | 29.63±0.29aB | 49.84±0.62cB | 7.3±0.05aC |
| E | grassland | EGAS | 0.11±0.01aA | 1.34±0.11aB | 13.44±0.13bA | 6.55±0.12bA | 80.01±0.01bC | 7.16±0.02bB |
| EGSM | 0.11±0.02aA | 1.41±0.12aB | 13±0.13bA | 6.85±0.12bA | 80.15±0.01bC | 7.01±0.01bB |
| shrubland | ESHR | 0.11±0.01abA | 1.14±0.09bB | 10.65±1.04cA | 6.15±1.22bA | 83.2±1.30aC | 6.34±0.27cB |
| ESCK | 0.14±0.02abA | 1.12±0.05bB | 11.09±1.04cA | 5.85±1.22bA | 83.06±1.30aC | 6.36±0.27cB |
| Woodland | EWLG | 0.13±0.01bA | 1.2±0.03bB | 18.94±0.20aA | 25.01±0.22aA | 56.05±0.02cC | 7.26±0.04aB |
| EWPS | 0.17±0.01bA | 1.17±0.03bB | 19.38±0.20aA | 24.71±0.22aA | 55.91±0.02cC | 7.28±0.04aB |