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## Supplementary Material

### **A dominant dwarf shrub increases diversity of herbaceous plant communities in a Trans-Himalayan rangeland**

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**1. Figure S1: Pictures of the study site**



## 2. Comparisons of richness and abundance between the core and periphery of the Caragana canopy.

Table S1: Results of ANOVA comparing richness between the core and periphery of the Caragana canopy [ $\log(\text{Richness core} / \text{Richness edge})$ ] across watersheds, area and local slope for 117 pairs of plots across 4 watersheds.

| <b>LRR Richness</b> | <b>Df</b> | <b>Sum Sq</b> | <b>Mean Sq</b> | <b>F value</b> | <b>Pr(&gt;F)</b> |
|---------------------|-----------|---------------|----------------|----------------|------------------|
| Area                | 1         | 0.529         | 0.5285         | 1.7098         | 0.1938           |
| Slope               | 1         | 0.263         | 0.2629         | 0.8507         | 0.3584           |
| Location            | 4         | 15.071        | 3.7677         | 12.1891        | <0.0001          |
| Residuals           | 109       | 33.692        | 0.3091         |                |                  |

Table S2: Results of ANOVA comparing abundance between the core and periphery of the Caragana canopy [ $\log(\text{Abundance core} / \text{Abundance edge})$ ] across watersheds, area and local slope for 87 pairs of plots across 3 watersheds.

| <b>LRR Abundance</b> | <b>Df</b> | <b>Sum Sq</b> | <b>Mean Sq</b> | <b>F value</b> | <b>Pr(&gt;F)</b> |
|----------------------|-----------|---------------|----------------|----------------|------------------|
| Area                 | 1         | 4.016         | 4.0158         | 8.1523         | 0.0055           |
| Slope                | 1         | 0.899         | 0.8991         | 1.8249         | 0.1805           |
| Location             | 3         | 19.242        | 6.4139         | 13.0207        | <0.0001          |
| Residuals            | 80        | 39.408        | 0.4926         |                |                  |

Figure S2 – Log ratio ( $\log(\text{core}/\text{edge})$ ) of plot level a. richness and b. abundance of herbaceous plants in the core and edge of the *Caragana* canopy, split by location. Positive values of the LRR indicate that richness or abundance in the core of the canopy is greater than that in the edge of the canopy, while negative values indicate the opposite. \* indicate populations significantly different from 0, number of plots in each location indicated in brackets. Boxes denote the inter-quartile range, whiskers denote most extreme data point which is no more than 1.5 times the interquartile range from the box. Points represent data outside that range.

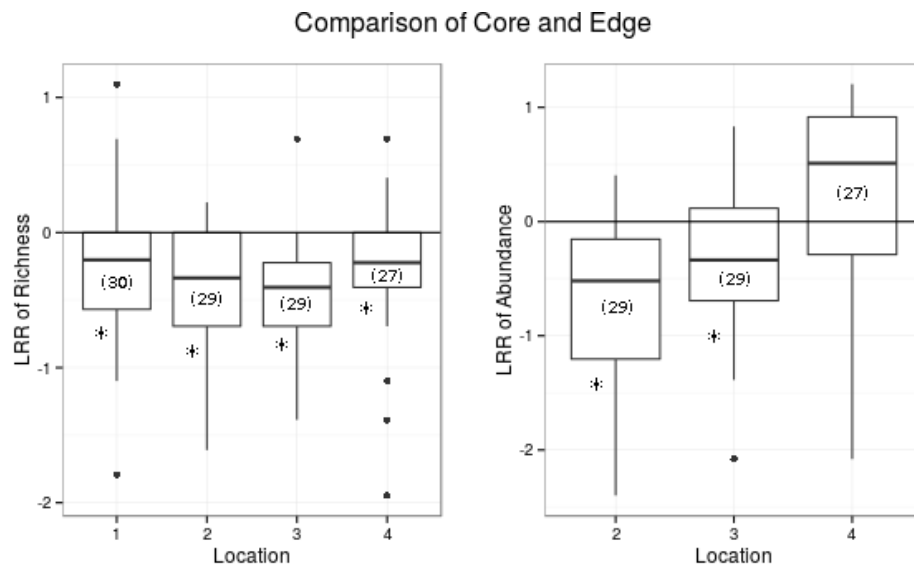
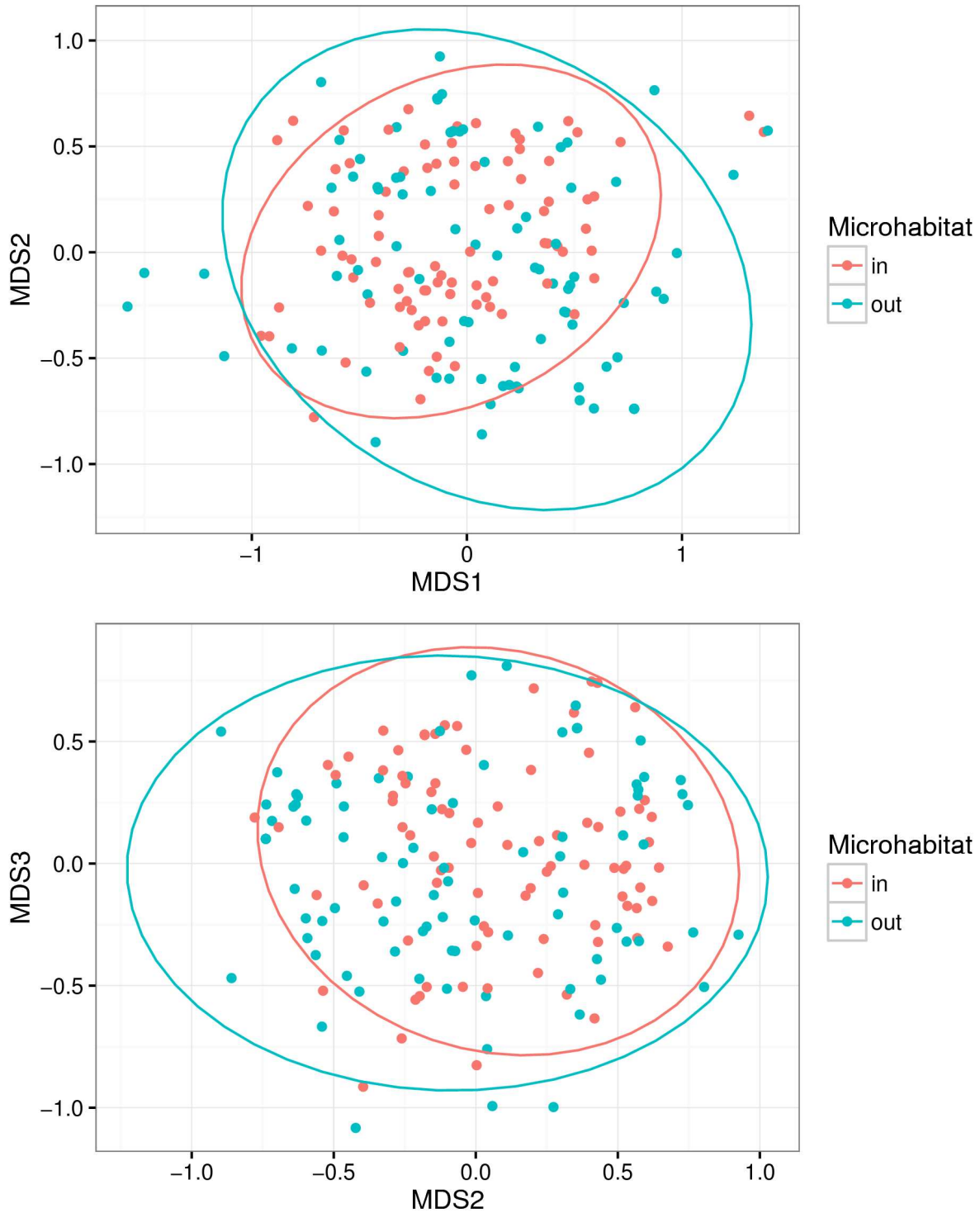
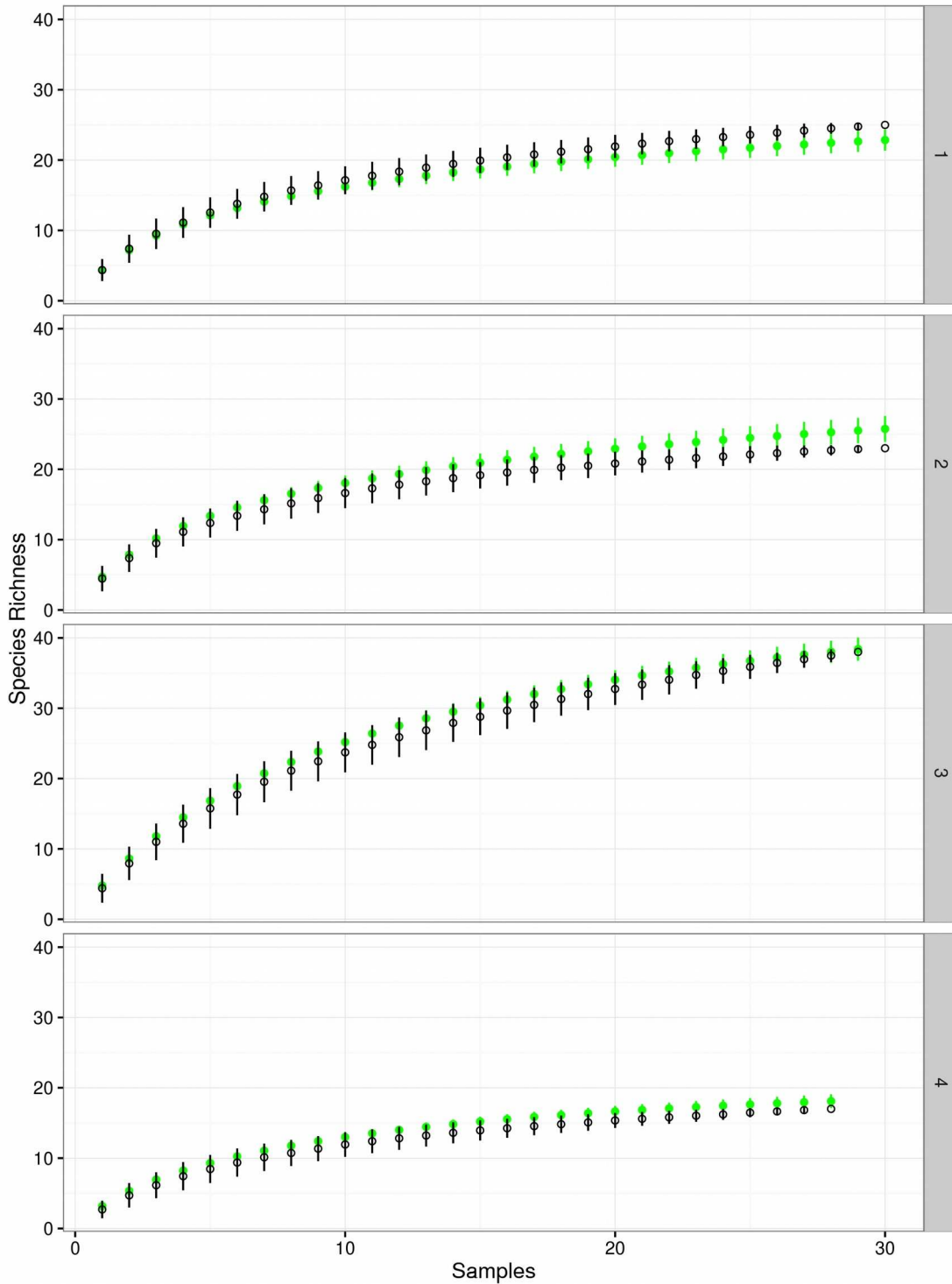


Figure S3 – NMDS ordination of plant communities observed inside and outside Caragana, across watersheds 2,3 and 4. Points denote individual plots, ellipses cover 95% of the density of points. The ordination space contained 3 axes, fitted by the metaMDS function in the R package ‘vegan’ (Oksanen et al. 2016)



**3. Figure S4 - Sample-based rarefaction curves at each sampling size (with standard errors) for Caragana and open ground habitats, at each watershed. Green points correspond to the synthetic landscape datasets, while black, open points correspond to rarefactions of only the plots on open ground.**



3. Table S3 - List of plant species observed, total number of individuals observed, source for naming, growth form classification and RII value. Sources for identification listed at the end.

| Name  | Family          | Source        | Growth Form | Total | RII   |
|---|-----------------|---------------|-------------|-------|-------|
| <i>Aconogonum tortuosum</i>                       | Polygonaceae    | FOH 1179      | Erect forb  | 10    | -0.40 |
| <i>Allium carolinianum</i>                        | Liliaceae       | FOH 1404      | Erect forb  | 62    | -0.65 |
| <i>Allium wallichi</i>                            | Liliaceae       | FOH 1405      | Erect forb  | 45    | 0.42  |
| <i>Astragalus grahamianus</i>                     | Fabaceae        | FOH 359       | Prostrate   | 28    | -0.21 |
| <i>Astragalus rhizanthus</i>                      | Fabaceae        | FOH 366       | Prostrate   | 92    | -0.02 |
| <i>Carex infusata</i>                             | Cyperaceae      | Mishra (2001) | Graminoid   | 119   | 0.31  |
| <i>Carex melanantha</i>                           | Cyperaceae      | Mishra (2001) | Prostrate   | 853   | -0.49 |
| <i>Carex</i> sp.                                  | Cyperaceae      | Mishra (2001) | Graminoid   | 558   | -0.06 |
| <i>Cousinia thomsonii</i>                         | Compositae      | FOH 709       | Erect forb  | 64    | -0.50 |
| <i>Dracocephalum heterophyllum</i>                | Labiatae        | FOH 1153      | Prostrate   | 3     | -0.33 |
| <i>Elymus longae-aristatus</i>                    | Poaceae         | Mishra (2001) | Graminoid   | 1612  | 0.53  |
| <i>Ephedra gerardiana</i>                         | Ephedraceae     | FOH 1305      | Prostrate   | 43    | -0.26 |
| <i>Eritrichium nanum</i>                          | Boraginaceae    | FOH 981       | Erect forb  | 27    | 0.93  |
| <i>Festuca olgae</i>                              | Poaceae         | Mishra (2001) | Graminoid   | 31    | 0.10  |
| <i>Gentianella moorcroftiana</i>                  | Gentianaceae    | FOH 959       | Erect forb  | 1     | 1.00  |
| <i>Geranium pratense</i>                          | Geraniaceae     | FOH 241       | Erect forb  | 242   | 0.60  |
| <i>Heracleum thomsonii</i>                        | Umbelliferae    | Mishra (2001) | Erect forb  | 52    | 0.12  |
| <i>Kobresia royleana</i>                          | Cyperaceae      | Mishra (2001) | Graminoid   | 83    | 0.20  |
| <i>Krascheninikoviaceratoides</i>                 | Chenopodiaceae  | FOH 1176      | Erect forb  | 170   | 0.47  |
| <i>Leontopodium franchetii</i>                    | Compositae      |               | Prostrate   | 17    | -0.53 |
| <i>Leymus secalinus</i>                           | Poaceae         | Mishra (2001) | Graminoid   | 1055  | 0.47  |
| <i>Lindelia anchusoides</i>                       | Boraginaceae    | FOH 977       | Erect forb  | 26    | 0.38  |
| <i>Nepeta discolor</i>                            | Labiatae        | FOH 1139      | Prostrate   | 188   | 0.02  |
| <i>Oxytropis williamsii</i>                       | Fabaceae        | FOH 373       | Prostrate   | 180   | -0.58 |
| <i>Poa lahulensis</i>                             | Poaceae         | Mishra (2001) | Graminoid   | 271   | 0.67  |
| <i>Poa</i> sp.                                    | Poaceae         |               | Graminoid   | 32    | 0.38  |
| <i>Polygonum paronychioides</i>                   | Polygonaceae    | FOH 1192      | Prostrate   | 65    | -1.00 |
| <i>Polygonum</i> sp.                              | Polygonaceae    | Mishra (2001) | Prostrate   | 1101  | -0.50 |
| <i>Potentilla bifurca</i>                         | Rosaceae        | Mishra (2001) | Prostrate   | 804   | -0.58 |
| <i>Potentilla nivea</i>                           | Rosaceae        | Mishra (2001) | Erect forb  | 37    | 0.89  |
| <i>Potentilla</i> sp.                             | Rosaceae        |               | Erect forb  | 7     | 0.14  |
| <i>Ranunculus</i> sp.                             | Ranunculaceae   |               | Erect forb  | 144   | 0.04  |
| <i>Salsola</i> sp.                                | Amaranthaceae   |               | Erect forb  | 5     | 0.20  |
| <i>Saussurea</i> sp.                              | Compositae      |               | Prostrate   | 208   | -0.14 |
| <i>Scorzonera virgata</i>                         | Compositae      | FOH 746       | Erect forb  | 5     | -0.60 |
| <i>Silene gnosperrma</i> ssp. <i>Himalayensis</i> | Caryophyllaceae | FOH 194       | Erect forb  | 9     | 0.56  |
| <i>Silene tenuis</i>                              | Caryophyllaceae | FOH 199       | Erect forb  | 3     | 0.33  |
| <i>Stipa Jacquemontii</i>                         | Poaceae         | Mishra (2001) | Graminoid   | 71    | 0.18  |
| <i>Stipa orientalis</i>                           | Poaceae         | Mishra (2001) | Graminoid   | 45    | 0.38  |
| <i>Taraxacum tibetanum</i>                        | Compositae      |               | Erect forb  | 10    | 1.00  |
| <i>Thermopsis inflata</i>                         | Fabaceae        | FOH 330       | Erect forb  | 24    | -0.75 |



Table S3 (continued)

| Name         | Family  | Source | Growth Form | Total | RII   |
|--------------|---------|--------|-------------|-------|-------|
| Unknown 2-1  |         |        | Graminoid   | 1     | 1.00  |
| Unknown 2-2  |         |        | Graminoid   | 17    | 0.29  |
| Unknown 2-3  |         |        | Erect forb  | 7     | 1.00  |
| Unknown 2-4  |         |        | Erect forb  | 2     | 1.00  |
| Unknown 2-5  | Poaceae |        | Graminoid   | 2     | 1.00  |
| Unknown 3-1  |         |        | Erect forb  | 47    | 0.15  |
| Unknown 3-2  |         |        | Prostrate   | 6     | -1.00 |
| Unknown 3-3  |         |        | Prostrate   | 24    | -0.67 |
| Unknown 3-4  |         |        | Erect forb  | 22    | 0.73  |
| Unknown 3-5  |         |        | Prostrate   | 2     | 1.00  |
| Unknown 3-6  |         |        | Erect forb  | 1     | 1.00  |
| Unknown 3-7  | Poaceae |        | Graminoid   | 4     | 0.00  |
| Unknown 3-8  |         |        | Prostrate   | 9     | -1.00 |
| Unknown 3-9  |         |        | Erect forb  | 2     | -1.00 |
| Unknown 3-10 |         |        | Prostrate   | 6     | 0.33  |
| Unknown 3-11 |         |        | Erect forb  | 2     | -1.00 |
| Unknown 3-12 |         |        | Prostrate   | 4     | 1.00  |
| Unknown 3-13 |         |        | Erect forb  | 4     | 1.00  |
| Unknown 3-14 | Poaceae |        | Graminoid   | 16    | 0.88  |
| Unknown 4-1  |         |        | Erect forb  | 17    | 0.41  |
| Unknown 4-2  |         |        | Prostrate   | 12    | 0.67  |
| Unknown 4-3  |         |        | Erect forb  | 2     | 0.00  |
| Unknown 4-4  |         |        | Erect forb  | 1     | 1.00  |
| Unknown 4-5  |         |        | Prostrate   | 1     | 1.00  |
| Unknown 4-6  |         |        | Prostrate   | 1     | -1.00 |
| Unknown 4-7  |         |        | Prostrate   | 15    | 1.00  |

#### Species identification sources

FOH - Polunin, O., and Stainton, A. (1984). *Flowers of the Himalaya* (New Delhi: Oxford University Press) – Numbers correspond to entries in the book

Mishra (2001) - Mishra, C. (2001). *High altitude survival: conflicts between pastoralism and wildlife in the Trans-Himalaya*. Dissertation. Wageningen University.

Remaining identified species were identified by knowledge of local field assistants.