Appendix S1 for the manuscript entitled “Variability in Nomadism: Environmental gradients modulate the movement behaviors of dryland ungulates”.

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Ecosphere
Table S1. GPS movement dataset for calculation of movement metrics

| Species                      | Individual ID | Habitat type | Sex | Year of data | Monthly GPS positions | Total |
|------------------------------|---------------|--------------|-----|--------------|-----------------------|-------|
| Mongolian gazelle (Procapra gutturosa) | 61561370      | Steppe       | F   | 2016         | April: 180, 180, 180, 186 | 732   |
|                              | 62676240      |              | F   | 2016         | May: 180, 180, 180, 186  |       |
|                              | 62940480      |              | F   | 2016         | June: 180, 180, 180, 186 |       |
|                              | 62947480      |              | F   | 2016         | July: 180, 180, 180, 186 |       |
|                              | 62674330      |              | F   | 2017         | April: 180, 180, 180, 186 | 732   |
|                              | 62943640      |              | F   | 2017         | May: 180, 180, 180, 186  |       |
|                              | 62946690      |              | F   | 2017         | June: 180, 180, 180, 186 |       |
|                              | 63995810      |              | F   | 2017         | July: 180, 180, 180, 186 |       |
|                              | 64520520      |              | F   | 2017         | April: 180, 180, 180, 186 | 732   |
|                              | 64525510      |              | F   | 2017         | May: 180, 180, 180, 186  |       |
|                              | 64527510      |              | F   | 2017         | June: 180, 180, 180, 186 |       |
|                              | 64461040      |              | M   | 2015         | July: 180, 180, 180, 186 |       |
| Goitered gazelle (Gazella subgutturosa) | 60593620      | Gobi desert  | F   | 2015         | April: 180, 180, 180, 186 | 732   |
|                              | 61152400      |              | F   | 2015         | May: 180, 180, 180, 186  |       |
|                              | 61157410      |              | F   | 2015         | June: 180, 180, 180, 186 |       |
|                              | 61320910      |              | M   | 2015         | July: 180, 180, 180, 186 |       |
|                              | 61561400      |              | M   | 2015         | April: 180, 180, 180, 186 | 732   |
|                              | 61564490      |              | M   | 2015         | May: 180, 180, 180, 186  |       |
|                              | 13549         |              | F   | 2014         | April: 180, 180, 180, 186 | 732   |
|                              | 13557         |              | F   | 2014         | May: 180, 180, 180, 186  |       |
|                              | 13741         |              | M   | 2014         | June: 180, 180, 180, 186 |       |
|                              | 13743         |              | M   | 2014         | July: 180, 180, 180, 186 |       |
|                              | 13744         |              | F   | 2014         | April: 180, 180, 180, 186 | 732   |
|                              | 13745         |              | F   | 2014         | May: 180, 180, 180, 186  |       |
| Khulan (Equus hemionus)      | 13747         | Gobi desert  | M   | 2014         | June: 180, 180, 180, 186 |       |
|                              | 34407         |              | M   | 2014         | July: 180, 180, 180, 186 |       |
|                              | 34413         |              | M   | 2014         | April: 180, 180, 180, 186 | 730   |
|                              | 3             |              | F   | 2010         | May: 180, 180, 180, 186  |       |
|                              | 4             |              | M   | 2010         | June: 180, 180, 180, 186 |       |
|                              | 7             |              | M   | 2010         | July: 180, 180, 180, 186 |       |
|                              | 6441          |              | M   | 2010         | April: 180, 180, 180, 186 | 661   |
|                              | 6446          |              | F   | 2010         | May: 180, 180, 180, 186  |       |
|                              | 7376          |              | F   | 2010         | June: 180, 180, 180, 186 |       |
| Saiga antelope (Saiga tatarica mongolica) | 111           | Gobi desert  | F   | 2007         | April: 135, 146, 137, 146 | 564   |
|                              | 112           |              | F   | 2007         | May: 141, 142, 132, 134  | 549   |
|                              | 113           |              | F   | 2007         | June: 133, 139, 131, 136 | 539   |
|                              | 62060790      |              | F   | 2016         | July: 180, 180, 180, 186 |       |
|                              | 62068770      |              | F   | 2016         | April: 180, 180, 180, 186 | 783   |
|                              | 62670350      |              | F   | 2016         | May: 180, 180, 180, 186  |       |
|                              | 62673340      |              | M   | 2016         | June: 180, 180, 179, 36   | 581   |
|                              | 62679330      |              | F   | 2016         | July: 180, 180, 180, 36   | 582   |
| Total GPS positions          |               |              |     |              |                       | 27368 |
Figure S1. The distribution of 4-h step lengths across species. The median distance across species was ~ 1km that leads us to select radius of 1 km for recursion analysis.

Figure S2. Recursion estimates at radii of 0.1 to 5 km in increments of 0.1 km.
Figure S3. Movement metrics derived from radius of 1 km and 4-h threshold and the resulting relationship of PC1 and PC2 from the PCA.

Figure S4. Movement metrics derived from radius of 1 km and 12-h threshold and the resulting relationship of PC1 and PC2 from the PCA.

Table S2. The one-way ANOVA test was significant for movement metrics of daily
displacement ($F_{(3,33)} = 20.45, p < 0.05$), 10-day displacement ($F_{(3,34)} = 12.52, p < 0.05$), revisit rates ($F_{(3,36)} = 7.12, p < 0.05$), and residence time ($F_{(3,36)} = 5.76, p < 0.05$) indicating that some of group means are different. The ANOVA test was not significant for return time ($F_{(3,36)} = 2.32, p = 0.09$), indicating there were no statistically significant differences between species means for the return time. The pairwise comparisons between species for each of the movement metrics were performed using the Tukey post-hoc test. Significant codes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. p-values are shown for non-significant comparisons. Note that we did not use Tukey post hoc analysis for return time because ANOVA test did not show significant difference among species.

| Species          | Daily displacement (km) | 10-day displacement (km) | Revisits | Residence time (days) | Time to return (days) |
|------------------|-------------------------|--------------------------|----------|-----------------------|-----------------------|
|                  | Mean | Std. Deviation | Mean | Std. Deviation | Mean | Std. Deviation | Mean | Std. Deviation | Mean | Std. Deviation |
| Mongolian gazelle | 4.6  | 1.4           | 20.9 | 10.4          | 3.6  | 3.2           | 1.9  | 1.6           | 5.8  | 2.8           |
| Goitered gazelle | 2.3  | 0.8           | 7.9  | 7.1           | 3.6  | 3.2           | 12   | 6.8           | 3    | 1.4           |
| Saiga antelope   | 4.9  | 1.2           | 14.8 | 6.9           | 3.6  | 3.2           | 4.6  | 3.9           | 4.7  | 4.2           |
| Khulan           | 7    | 1.3           | 31   | 8.7           | 3.6  | 3.2           | 4.6  | 5.8           | 4.2  | 1.9           |
| Goitered gazelle | ***  | 0.93          | ***  | 0.46          | ***  | 0.79          | ***  | 0.65          | ***  | 1.0           |
| Saiga antelope   | ***  | 0.93          | ***  | 0.05          | *    | 0.98          | **   | 0.98          | *    |              |
| Khulan           | ***  | 0.93          | ***  | 0.05          | *    | 0.98          | **   | 0.98          | *    |              |

**Table S3.** Model coefficients, $r^2$ and sample sizes of linear mixed effects models predicting the variability in movement behavior. The predictor variable was NDVI and the random variable was species. We calculated the marginal $r^2$ (variance explained by the fixed effects) and conditional $r^2$.
(variance explained by both fixed and random factors) values for the model using the “MuMIn” R package. *p<0.05, **p<0.01, ***p<0.001.

| Covariate      | Estimate | Std.Error | df  | t value | p value |
|----------------|----------|-----------|-----|---------|---------|
| (Intercept)    | -4.91    | 2.45      | 15.77 | -2.002  | 0.06    |
| log NDVI       | -2.46    | 1.09      | 20.66 | -2.25   | 0.03*   |
| r2 Marginal    | 0.21     |           |      |         |         |
| r2 Conditional | 0.59     |           |      |         |         |
| Species        | 4        |           |      |         |         |
| Individuals    | 40       |           |      |         |         |

**Table S4.** Model coefficients, r² and sample sizes of linear mixed effects models, which does not include Mongolian gazelle in the mesic steppe, predicting the variability in movement behavior. The predictor variable was NDVI and the random variable was species. We calculated the marginal r² (variance explained by the fixed effects) and conditional r² (variance explained by both fixed and random factors) values for the model using the “MuMIn” R package. *p<0.05, **p<0.01, ***p<0.001

| Covariate      | Estimate | Std.Error | df  | t value | p value |
|----------------|----------|-----------|-----|---------|---------|
| (Intercept)    | -13.43   | 6.13      | 26.97 | -2.192  | 0.037   |
| log NDVI       | -6.03    | 2.565     | 26.77 | -2.35   | 0.026*  |
| r2 Marginal    | 0.12     |           |      |         |         |
| r2 Conditional | 0.63     |           |      |         |         |
| Species        | 3        |           |      |         |         |
| Individuals    | 29       |           |      |         |         |