

Ecological modeling of *Cistanche deserticola* Y.C.Ma in Alxa, China

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Supplementary Material

Appendix 1. Information about *Cistanche deserticola* Y.C.Ma samples

| No. | East Longitude | Northern Latitude | Sampling Time | Sample Collection Area |
|-----|----------------|-------------------|---------------|------------------------|
| Y-1 | 102°77'27" | 40°50'20" | 2015.04 | Alxa Right Banner |
| Y-2 | 102°69'71" | 40°49'55" | 2015.04 | Alxa Right Banner |
| Y-3 | 102°71'10" | 40°43'83" | 2015.04 | Alxa Right Banner |
| Y-4 | 102°74'28" | 40°56'15" | 2015.04 | Alxa Right Banner |
| Y-5 | 102°86'45" | 40°49'76" | 2015.04 | Alxa Right Banner |
| Y-6 | 102°63'28" | 40°46'29" | 2015.04 | Alxa Right Banner |

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|------|------------|-----------|---------|-------------------|
| Y-7 | 102°93'65" | 40°54'03" | 2015.04 | Alxa Right Banner |
| Y-8 | 103°18'04" | 40°48'20" | 2015.04 | Alxa Right Banner |
| Y-9 | 103°66'99" | 41°13'83" | 2015.04 | Alxa Right Banner |
| Y-10 | 102°51'34" | 40°48'27" | 2015.04 | Alxa Right Banner |
| Y-11 | 102°55'33" | 40°39'70" | 2015.04 | Alxa Right Banner |
| Y-12 | 102°67'71" | 40°37'80" | 2015.04 | Alxa Right Banner |
| Y-13 | 102°78'64" | 40°39'32" | 2015.04 | Alxa Right Banner |
| Y-14 | 102°77'49" | 40°45'89" | 2015.04 | Alxa Right Banner |
| Y-15 | 102°83'43" | 40°44'81" | 2015.04 | Alxa Right Banner |
| Y-16 | 102°63'86" | 40°42'02" | 2015.04 | Alxa Right Banner |
| Y-17 | 102°86'53" | 40°39'46" | 2015.04 | Alxa Right Banner |
| Y-18 | 102°91'53" | 40°40'18" | 2015.04 | Alxa Right Banner |
| Y-19 | 102°88'37" | 40°43'86" | 2015.04 | Alxa Right Banner |
| Y-20 | 102°89'86" | 40°46'60" | 2015.04 | Alxa Right Banner |
| Y-21 | 102°92'89" | 40°51'18" | 2015.04 | Alxa Right Banner |
| Y-22 | 102°81'41" | 40°48'62" | 2015.04 | Alxa Right Banner |
| Y-23 | 102°99'08" | 40°51'60" | 2015.04 | Alxa Right Banner |
| Y-24 | 102°73'06" | 40°46'86" | 2015.04 | Alxa Right Banner |
| Y-25 | 102°75'39" | 40°42'57" | 2015.04 | Alxa Right Banner |
| E-1 | 100°89'49" | 40°87'52" | 2015.04 | Ejin Banner |
| E-2 | 100°93'48" | 40°88'46" | 2015.04 | Ejin Banner |
| E-3 | 101°94'72" | 41°48'10" | 2015.04 | Ejin Banner |
| E-4 | 98°38'62" | 41°04'25" | 2015.04 | Ejin Banner |
| E-5 | 100°89'79" | 41°05'28" | 2015.04 | Ejin Banner |
| E-6 | 100°90'95" | 40°90'74" | 2015.04 | Ejin Banner |
| E-7 | 102°95'14" | 41°38'90" | 2015.04 | Ejin Banner |

| | | | | |
|------|------------|-----------|---------|------------------|
| E-8 | 101°41'93" | 41°06'88" | 2015.04 | Ejin Banner |
| E-9 | 101°47'53" | 41°07'20" | 2015.04 | Ejin Banner |
| E-10 | 100°99'18" | 41°79'49" | 2015.04 | Ejin Banner |
| E-11 | 98°90'83" | 41°93'12" | 2015.05 | Ejin Banner |
| E-12 | 97°41'97" | 42°41'51" | 2015.05 | Ejin Banner |
| E-13 | 98°73'13" | 40°95'12" | 2015.05 | Ejin Banner |
| E-14 | 102°06'82" | 41°40'57" | 2015.05 | Ejin Banner |
| E-15 | 98°57'17" | 41°83'19" | 2015.05 | Ejin Banner |
| E-16 | 98°43'69" | 41°01'40" | 2015.05 | Ejin Banner |
| E-17 | 100°95'80" | 40°91'21" | 2015.05 | Ejin Banner |
| E-18 | 101°51'69" | 41°47'53" | 2015.05 | Ejin Banner |
| E-19 | 101°36'77" | 40°97'13" | 2015.05 | Ejin Banner |
| E-20 | 101°79'06" | 41°50'28" | 2015.05 | Ejin Banner |
| E-21 | 101°94'69" | 41°53'33" | 2015.05 | Ejin Banner |
| E-22 | 102°91'91" | 41°41'47" | 2015.05 | Ejin Banner |
| Z-1 | 106°21'61" | 40°30'44" | 2015.05 | Alxa Left Banner |
| Z-2 | 105°25'43" | 40°28'35" | 2015.05 | Alxa Left Banner |
| Z-3 | 105°30'52" | 40°27'48" | 2015.05 | Alxa Left Banner |
| Z-4 | 105°31'71" | 40°22'53" | 2015.05 | Alxa Left Banner |
| Z-5 | 105°25'74" | 40°20'34" | 2015.05 | Alxa Left Banner |
| Z-6 | 105°21'86" | 40°21'86" | 2015.05 | Alxa Left Banner |
| Z-7 | 105°28'57" | 40°31'90" | 2015.05 | Alxa Left Banner |
| Z-8 | 105°17'19" | 40°26'00" | 2015.05 | Alxa Left Banner |
| Z-9 | 106°22'78" | 40°33'60" | 2015.05 | Alxa Left Banner |
| Z-10 | 105°26'71" | 40°25'24" | 2015.05 | Alxa Left Banner |
| Z-11 | 105°16'86" | 40°21'29" | 2015.05 | Alxa Left Banner |

| | | | | |
|------|------------|-----------|---------|------------------|
| Z-12 | 106°25'45" | 40°31'78" | 2015.05 | Alxa Left Banner |
| Z-13 | 105°52'74" | 40°75'59" | 2015.05 | Alxa Left Banner |
| Z-14 | 106°28'46" | 40°32'87" | 2015.05 | Alxa Left Banner |
| Z-15 | 105°67'76" | 39°93'35" | 2015.05 | Alxa Left Banner |
| Z-16 | 105°22'06" | 40°25'06" | 2015.05 | Alxa Left Banner |
| Z-17 | 104°66'46" | 41°35'47" | 2015.05 | Alxa Left Banner |
| Z-18 | 106°29'82" | 40°30'16" | 2015.05 | Alxa Left Banner |

Note: Y stands for Alxa Right Banner, E stands for Ejin Banner and Z stands for Alxa Left Banner.

Appendix 2. Contribution of Ecological Factors to *Cistanche deserticola*

| No. | Ecological Factors | Contribution (%) |
|------------|--|-------------------------|
| 1 | Soil Type | 25.3 |
| 2 | Annual Sunshine Duration | 23.2 |
| 3 | Temperature Seasonality (standard deviation × 100) | 22.5 |
| 4 | Vegetation Type | 6.8 |
| 5 | Mean Temperature in July | 3.7 |
| 6 | Altitude | 3.5 |
| 7 | Sunshine Duration in the Growing Season | 3.1 |
| 8 | Mean precipitation in August | 2.5 |
| 9 | Max Temperature of Warmest Month | 1.7 |
| 10 | Humid Index | 1.6 |
| 11 | Sunshine Duration in June | 1.6 |
| 12 | Slope | 1.4 |

| | | |
|----|------------------------------------|-----|
| 13 | Mean Temperature in March | 0.7 |
| 14 | Soil Clay Content | 0.7 |
| 15 | Soil Available Water Content Level | 0.6 |
| 16 | Mean Precipitation in May | 0.3 |
| 17 | Mean Temperature in May | 0.3 |
| 18 | Annual Mean Temperature | 0.2 |
| 19 | Soil Sand Content | 0.1 |
| 20 | Isothermality | 0.1 |
| 21 | Aspect | 0.1 |

Appendix 3. Echinoid and Acteoside content in *C. deserticola* samples ($\bar{x} \pm s, n = 3$)

| No. | Content of Echinoid (%) | Content of Acteoside (%) | No. | Content of Echinoid (%) | Content of Acteoside (%) |
|------|-------------------------|--------------------------|------|-------------------------|--------------------------|
| Y-1 | 0.26±0.04 | 0.14±0.03 | E-9 | 0.39±0.06 | 0.35±0.06 |
| Y-2 | 0.90±0.13 | 0.19±0.02 | E-10 | 0.42±0.07 | 0.47±0.11 |
| Y-3 | 0.75±0.17 | 0.47±0.07 | E-11 | 0.27±0.05 | 0.15±0.03 |
| Y-4 | 0.28±0.09 | 0.19±0.02 | E-12 | 0.24±0.07 | 0.14±0.02 |
| Y-5 | 1.21±0.22 | 0.22±0.03 | E-13 | 0.31±0.02 | 0.91±0.07 |
| Y-6 | 0.54±0.12 | 0.57±0.04 | E-14 | 0.99±0.10 | 0.63±0.04 |
| Y-7 | 0.24±0.10 | 0.22±0.04 | E-15 | 0.26±0.01 | 0.14±0.02 |
| Y-8 | 1.33±0.08 | 0.32±0.05 | E-16 | 0.37±0.02 | 0.15±0.01 |
| Y-9 | 0.83±0.02 | 0.59±0.03 | E-17 | 0.97±0.06 | 1.15±0.16 |
| Y-10 | 0.70±0.04 | 0.31±0.02 | E-18 | 1.91±0.23 | 0.67±0.09 |
| Y-11 | 1.30±0.06 | 0.98±0.07 | E-19 | 1.11±0.04 | 1.08±0.16 |
| Y-12 | 0.23±0.04 | 0.18±0.01 | E-20 | 0.18±0.01 | 0.52±0.08 |

| | | | | | |
|------|-----------|-----------|------|-----------|-----------|
| Y-13 | 0.93±0.13 | 0.54±0.01 | E-21 | 0.16±0.02 | 0.63±0.08 |
| Y-14 | 0.53±0.11 | 1.10±0.09 | E-22 | 0.30±0.02 | 0.23±0.02 |
| Y-15 | 1.28±0.27 | 0.33±0.03 | Z-1 | 1.14±0.09 | 0.39±0.03 |
| Y-16 | 1.16±0.07 | 0.61±0.07 | Z-2 | 0.16±0.01 | 0.09±0.03 |
| Y-17 | 1.02±0.20 | 0.92±0.04 | Z-3 | 0.29±0.03 | 0.30±0.07 |
| Y-18 | 1.89±0.12 | 0.56±0.01 | Z-4 | 1.37±0.07 | 0.34±0.03 |
| Y-19 | 0.64±0.09 | 0.60±0.04 | Z-5 | 1.07±0.04 | 1.0±0.16 |
| Y-20 | 0.71±0.02 | 0.34±0.08 | Z-6 | 0.31±0.01 | 0.05±0.01 |
| Y-21 | 1.40±0.33 | 1.00±0.08 | Z-7 | 0.36±0.03 | 0.72±0.12 |
| Y-22 | 0.34±0.04 | 0.86±0.10 | Z-8 | 0.76±0.10 | 1.12±0.21 |
| Y-23 | 1.94±0.25 | 0.78±0.04 | Z-9 | 0.84±0.17 | 0.61±0.07 |
| Y-24 | 1.07±0.12 | 0.70±0.06 | Z-10 | 0.21±0.02 | 0.18±0.02 |
| Y-25 | 1.07±0.09 | 0.75±0.14 | Z-11 | 0.71±0.06 | 0.75±0.09 |
| E-1 | 0.31±0.01 | 0.93±0.04 | Z-12 | 0.31±0.05 | 0.08±0.01 |
| E-2 | 0.77±0.11 | 0.80±0.09 | Z-13 | 0.38±0.02 | 0.10±0.01 |
| E-3 | 0.74±0.01 | 0.22±0.06 | Z-14 | 0.22±0.01 | 0.10±0.01 |
| E-4 | 0.83±0.13 | 0.31±0.10 | Z-15 | 0.27±0.02 | 0.05±0.02 |
| E-5 | 0.16±0.04 | 0.66±0.17 | Z-16 | 0.32±0.01 | 0.05±0.01 |
| E-6 | 1.24±0.11 | 0.19±0.04 | Z-17 | 0.19±0.01 | 0.11±0.03 |
| E-7 | 0.24±0.04 | 0.53±0.07 | Z-18 | 0.33±0.03 | 0.10±0.02 |
| E-8 | 0.42±0.06 | 1.67±0.26 | | | |

Note: Y stands for Alxa Right Banner, E stands for Ejina Banner and Z stands for Alxa Left Banner.

Appendix 4. Correlation among Echinoid, Acteoside, pHGs and Ecological factors

| Ecological factors | Index ingredients | | |
|--|-------------------|-----------|----------|
| | Echinoid | Acteoside | pHGs |
| Soil Type | 0.149 | 0.187 | 0.202 |
| Annual Sunshine Duration | 0.129 | 0.125 | 0.155 |
| Temperature Seasonality (standard deviation × 100) | 0.187 | 0.105 | 0.184 |
| Vegetation Type | -0.158 | 0.001 | -0.109 |
| Mean Temperature in July | 0.230 | 0.153 | 0.240 |
| Altitude | -0.223 | -0.112 | -0.213 |
| Sunshine Duration in the Growing Season | 0.217 | 0.135 | 0.221 |
| Mean precipitation in August | -0.441** | -0.149 | -0.384** |
| Max Temperature of Warmest Month | 0.246* | 0.168 | 0.259* |
| Humid Index | -0.389** | -0.115 | -0.330** |
| Sunshine Duration in June | 0.434** | 0.424** | 0.524** |
| Slope | -0.031 | 0.053 | 0.006 |
| Mean Temperature in March | 0.392** | 0.426** | 0.549** |
| Soil Clay Content | 0.250* | 0.200 | 0.278* |
| Soil Available Water Content Level | -0.035 | -0.159 | -0.108 |
| Mean Precipitation in May | -0.599** | -0.374** | -0.612** |
| Mean Temperature in May | 0.243 | 0.169 | 0.258* |
| Annual Mean Temperature | 0.220 | 0.129 | 0.221 |
| Soil Sand Content | -0.128 | -0.187 | -0.187 |
| Isothermality | 0.219 | 0.113 | 0.211 |
| Aspect | -0.196 | -0.064 | -0.170 |

** Correlation significant at the 0.01 (bilateral) level.

* Correlation significant at the 0.05 (bilateral) level.

Appendix 5. Total Variance Explained

| component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|-----------|---------------------|---------------|--------------|-------------------------------------|---------------|--------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 9.549 | 45.471 | 45.471 | 9.549 | 45.471 | 45.471 |
| 2 | 3.670 | 17.474 | 62.945 | 3.670 | 17.474 | 62.945 |
| 3 | 1.956 | 9.314 | 72.258 | 1.956 | 9.314 | 72.258 |
| 4 | 1.079 | 5.140 | 77.399 | 1.079 | 5.140 | 77.399 |
| 5 | .976 | 4.645 | 82.044 | | | |
| 6 | .827 | 3.940 | 85.984 | | | |
| 7 | .679 | 3.233 | 89.217 | | | |
| 8 | .560 | 2.666 | 91.884 | | | |
| 9 | .483 | 2.300 | 94.184 | | | |
| 10 | .350 | 1.668 | 95.852 | | | |
| 11 | .271 | 1.289 | 97.141 | | | |
| 12 | .201 | .957 | 98.098 | | | |
| 13 | .131 | .626 | 98.724 | | | |
| 14 | .113 | .536 | 99.260 | | | |
| 15 | .071 | .339 | 99.599 | | | |
| 16 | .058 | .274 | 99.873 | | | |
| 17 | .013 | .062 | 99.935 | | | |
| 18 | .008 | .037 | 99.972 | | | |
| 19 | .004 | .020 | 99.992 | | | |
| 20 | .002 | .007 | 100.000 | | | |
| 21 | 9.260E-005 | .000 | 100.000 | | | |

Extraction method: Principal Component Analysis.

