Ecosphere

Richness, phylogenetic diversity, and abundance all have positive effects on invader performance in an arid ecosystem

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Appendix S1
Table S1. A list of gene number of the four sequenced genes (rbcl, matK, 5.8s and ITS1) on the gene bank data base for the 18 experimental species including the invader (*Ipomoea carnea*).

| Species name          | rbcl       | matK       | 5.8s       | ITS1       | Congeneric species                  |
|-----------------------|------------|------------|------------|------------|-------------------------------------|
| *Apium graveolens*    | KF613097.1 | HM850719.1 | KJ473893.1 | KJ473893.1 | NA                                  |
| *Amborella trichopoda*| L12628.2   | AF543721.1 | NA         | NA         | NA                                  |
| *Beta vulgaris*       | AY270065.1 | JN895701.1 | AY858597.1 | HE577334.1 | NA                                  |
| *Centaurea calcitrapa*| NA         | KC969480.1 | AY826252.1 | L35864.1   | NA                                  |
| *Chenopodium album*   | KJ204316.1 | KC474467.1 | JF976146.1 | FN561552.1 | NA                                  |
| *Chenopodium ficifolium* | KM360714.1 | HE855666.1 | HE577466.1 | HE577466.1 | NA                                  |
| *Emex spinosa*        | HM849974.1 | AY042582.1 | KJ004358.1 | JQ288755.1 | NA                                  |
| *Ipomoea carnea*      | GU135243.1 | GU135080.1 | AF110920.1 | AF110920.1 | NA                                  |
| *Juncus acutus*       | HM850083.1 | HM850944.1 | AY727782.1 | AY727782.1 | *Juncus subulatus*                  |
| *Melilotus indicus*   | JN376005.1 | AF522111.2 | KJ004336.1 | NA         | NA                                  |
| *Polypogon monspeliensis* | KF713058.1 | KF713154.1 | KF850575.1 | JN040633.1 | NA                                  |
| *Rumex dentatus*      | NA         | JX444530.1 | NA         | NA         | NA                                  |
| *Spergularia marina*  | HM850381.1 | AY936309.1 | NA         | NA         | NA                                  |
| *Trifolium resupinatum* | HM850421.1 | AF522117.1 | DQ307477.1 | AF154361.1 | NA                                  |
| *Urospermum picroides*| NA         | AJ633227.1 | AJ633346.1 | AJ633346.1 | NA                                  |
| *Epilobium hirsutum*  | HQ590078.1 | JN894073.1 | KX166116.1 | KX166116.1 | NA                                  |
| *Cenchrus echinatus*  | AM849359.1 | HF558494.1 | KF850611.1 | KF850611.1 | NA                                  |
Table S2. The different treatments (A, B, C, D). (A) Low species richness with low phylogenetic distances (PD), (B) Low species richness with high phylogenetic distances, (C) High species richness with low phylogenetic distances, (D) High species richness with high phylogenetic distances. For each treatment there are three different combinations and two levels of invader density (highly invaded=1, lower invaded=2).

| Treatments | Species1        | Species 2        | Faith's PD | Invader density |
|------------|-----------------|------------------|------------|-----------------|
| A11        | Centaurea_calcitrapa | Urospermum_picroides | 1.3062344  | 1               |
| species abundance | 5              | 5                |            |                 |
| A21        | Emex_spinosa    | Rumex_dentatus   | 1.05901232 | 1               |
| species abundance | 5              | 5                |            |                 |
| A31        | Rumex_dentatus  | Beta_vulgaris    | 1.10427939 | 1               |
| species abundance | 5              | 5                |            |                 |
| A12        | Centaurea_calcitrapa | Urospermum_picroides | 1.3062344  | 2               |
| species abundance | 5              | 5                |            |                 |
| A22        | Emex_spinosa    | Rumex_dentatus   | 1.05901232 | 2               |
| species abundance | 5              | 5                |            |                 |
| A32        | Rumex_dentatus  | Beta_vulgaris    | 1.10427939 | 2               |
| species abundance | 5              | 5                |            |                 |
| B11        | Emex_spinosa    | Epilobium_hirsutum | 1.90308458 | 1               |
| species abundance | 5              | 5                |            |                 |
| B21        | Urospermum_picroides | Apium_graveolens | 1.90308458 | 1               |
| species abundance | 5              | 5                |            |                 |
| B31        | Rumex_dentatus  | Urospermum_picroides | 1.90308459 | 1               |
| species abundance | 5              | 5                |            |                 |
| B12        | Emex_spinosa    | Epilobium_hirsutum | 1.90308458 | 2               |
| species abundance | 5              | 5                |            |                 |
| B22        | Urospermum_picroides | Apium_graveolens | 1.90308458 | 2               |
| species abundance | 5              | 5                |            |                 |
| B32        | Rumex_dentatus  | Urospermum_picroides | 1.90308459 | 2               |
| species abundance | 5              | 5                |            |                 |
| Treatments | Species 1           | Species 2           | Species 3           | Species 4           | Species 5           | Faith's PD | Invader density |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------|-----------------|
| C11        | *Urospermum_picroides* | *Spergularia_marina* | *Rumex_dentatus*    | *Chenopodium_album* | *Chenopodium_ficifolium* | 2.86284    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| C21        | *Rumex_dentatus*     | *Chenopodium_ficifolium* | *Centaurea_calcitrapa* | *Spergularia_marina* | *Emex_spinosa*    | 2.81757    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| C31        | *Trifolium_resupinatum* | *Melilotus_indicus* | *Centaurea_calcitrapa* | *Rumex_dentatus*    | *Emex_spinosa*    | 2.65031    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| C12        | *Urospermum_picroides* | *Spergularia_marina* | *Rumex_dentatus*    | *Chenopodium_album* | *Chenopodium_ficifolium* | 2.86284    | 2               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| C22        | *Rumex_dentatus*     | *Chenopodium_ficifolium* | *Centaurea_calcitrapa* | *Spergularia_marina* | *Emex_spinosa*    | 2.81757    | 2               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| C32        | *Trifolium_resupinatum* | *Melilotus_indicus* | *Centaurea_calcitrapa* | *Rumex_dentatus*    | *Emex_spinosa*    | 2.65031    | 2               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| D11        | *Melilotus_indicus*  | *Juncus_subulatus*  | *Epilobium_hirsutum* | *Rumex_dentatus*    | *Urospermum_picroides* | 4.04002    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| D21        | *Epilobium_hirsutum* | *Juncus_subulatus*  | *Polypogon_monspeliensis* | *Urospermum_picroides* | *Rumex_dentatus* | 4.03562    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| D31        | *Centaurea_calcitrapa* | *Cenchrus_echinatus* | *Emex_spinosa*     | *Juncus_subulatus*  | *Trifolium_resupinatum* | 4.03562    | 1               |
| species abundance | 2                   | 2                   | 2                   | 2                   | 2                   |            |                 |
| Location | Species |                   |                   |                   |                   | Species Abundance |
|----------|---------|-------------------|-------------------|-------------------|-------------------|------------------|
| D12      | Melilotus_indicus | Juncus_subulatus  | Epilobium_hirsutum | Rumex_dentatus    | Urospermum_picroides | 2                |
|          | 2       | 2                 | 2                 | 2                 | 2                 | 2                |
| D22      | Epilobium_hirsutum | Juncus_subulatus  | Polypogon_monspeliensis | Urospermum_picroides | Rumex_dentatus    | 2                |
|          | 2       | 2                 | 2                 | 2                 | 2                 | 2                |
| D32      | Centaurea_calcitrapa | Cenchrus_echinatus  | Emex_spinosa       | Juncus_subulatus  | Trifolium_resupinatum | 2                |
|          | 2       | 2                 | 2                 | 2                 | 2                 | 2                |
Table S3. Full and Top Mixed Linear Models with different aspects of invader performance as response variables (height, shoot biomass, root biomass, photosynthetic rate and leaf production) regressed on (~) the fixed effects: - (resident richness of each combination without the invader (SR community), mean phylogenetic distance between the invader and residents in each combination (Relatedness), phylogenetic diversity of each combination without the invader (PD. without), invader density (INV.L) and the random effect is pot identity (POTID). These models were weighted by the lower value of AIC and the highest value of Akaike weight (AW).

| Response Variable | Model       | Model Structure                                                                 | AIC       | logLik    | Df | BIC       | Deviance  | R²marginal | R²conditional | AW         |
|-------------------|-------------|---------------------------------------------------------------------------------|-----------|-----------|----|-----------|-----------|------------|---------------|------------|
| Height (log)      | Full model  | Log (Height) ~ Relatedness + PD.without + SR community + INV.L + Date + (1 | 250.75228 | -113.37614 | 12 | 293.93    | 226.75228 | 0.2366     | 0.542319     | 0.04523    |
|                   | Best model  | Log (Height) ~ Phylogenetic relatedness + Date + (1 | 248.39386 | -115.19693 | 9  | 280.78    | 230.39386 | 0.1914     | 0.5465558    | 0.19639    |
| Shoot biomass (log) | Full model  | log(shoot biomass) ~ Relatedness + PD.without + SR community + INV.L + Date + (1 | -176.07504 | 100.03752  | 12 | -132.89   | -200.07504 | 0.5786     | 0.5465558    | 0.02298    |
|                   | Best model  | log(shoot biomass) ~ SR community + Date + (1 | -180.23872 | 99.11936   | 9  | -147.85   | -198.23872 | 0.5755     | 0.5774       | 0.22532    |
|                   |             | log(shoot biomass) ~ PD.without + Date + (1 | -180.64122 | 99.32069   | 9  | -148.26   | -198.64122 | 0.5755     | 0.5705       | 0.22532    |
| Root biomass (log) | Full model  | Log (root biomass) ~ Relatedness + PD.without + SR without + INV.L + Date + (1 | 477.40685 | -226.70342 | 12 | 520.59    | 453.40685 | 0.7792     | 0.7840274    | 0.02675    |
|                   | Best model  | Log (root biomass) ~ Relatedness + Date + (1 | 472.10732 | -227.05366 | 9  | 504.49    | 454.10732 | 0.7785     | 0.7842119    | 0.22945    |
|                   |             | Log (root biomass) ~ PD.without + Date + (1 | 472.1328  | -227.0664  | 9  | 504.52    | 454.1328  | 0.7786     | 0.7833352    | 0.21842    |
| Photosynthetic rate (log) | Full model  | Log (photosynthetic rate) ~ Relatedness + PD.without + SR community + INV.L + Date + (1 | 210.79413 | -93.397067 | 12 | 245.3     | 186.79413 | 0.4611     | 0.4610875    | 0.04943    |
|                   | Best model  | Log (photosynthetic rate) ~ INV.L + Date + (1 | 206.23233 | -94.116166 | 9  | 232.11    | 188.23233 | 0.4551     | 0.455135    | 0.48368    |
| Leaf production   | Full model  | S.leaves ~ Relatedness + PD.without + SR without + INV.L + Date + (1 | 1506.1708 | -741.08538 | 12 | 1549.4    | 1482.1708 | 0.3003     | 0.5347198    | 0.03229    |
|                   | Best model  | S.leaves ~ SR without + Date + (1 | 1500.4496 | -741.22482 | 9  | 1532.8    | 1482.4496 | 0.2984     | 0.5335941    | 0.21842    |