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**Electronic supplementary materials**

**Appendix S1** Sources for the data of Zygophyllaceae species distributions

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**Appendix S2** The calculation of climate variables

Climate variables used in this study included three categories, which represent environmental energy, water availability and climate variability.

***Environmental energy***

Variables representing environmental energy included mean annual temperature (MAT, oC), mean annual temperature of coldest quarter (MTCQ, oC) and annual potential evapotranspiration (PET, mm). PET measures the total evapotranspiration that would occur if the supplies of water source were sufficient, and has been widely used to represent ambient energy [1].

***Water availability***

Variables representing water availability included mean annual precipitation (MAP, mm), water deficit (WD) and aridity index (AI). Both AI and WD have been widely used to represent the dryness of a region. WD is calculated as the difference between PET and actual evapotranspiration (AET, the amount of evaporation that actually occur) [2]. AI is defined as the ratio of MAP to PET. In this study, we defined areas with AI less than 0.65 as drylands following the criterion of *World Atlas drylands* [3].

***Climate variability***

Variables representing climate variability included mean diurnal range (MDR, oC), temperature seasonality (TS) and precipitation seasonality (PS). MDR was calculated as the mean difference between monthly minimum and maximum temperature. TS was defined as the mean difference between the minimum temperature of the coldest month and maximum temperature of the warmest month. PS was calculated as the coefficient of variation of monthly precipitation.

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**Appendix S3** Species, voucher information and GenBank accession numbers for the sequence data of the four DNA markers used for the construction of the Zygophyllaceae phylogeny.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Species | Voucher | *rbcL* | *trnL* | *trnL-F* | ITS |
| *Zygophyllum album* L.f. | Thulin *et al.* 7977 (UPS) | AJ133861 | AJ387963 | AJ387963 |  |
| *Zygophyllum aff.* *maritimum* Dold | Dold 4654 (GRA) |  | EF656034 | EF656034 |  |
| *Zygophyllum apiculata* F. Muell. | Greder 18664 (K) |  | AY233384 |  |  |
| *Zygophyllum applanatum* Van Zyl | Bellstedt 870 (STE) |  | EF656012 | EF656012 |  |
| *Zygophyllum atriplicoides* Fisch. & Mey. | Astanova s.n. (K) |  | AY233385 |  |  |
| *Zygophyllum aurantiacum* (Lindl.) F. Muell. | Greder 20900 (K) |  | AY300775 |  |  |
| *Zygophyllum billardierei* DC. | R. 417 (Adelaide B.G.) | AJ133862 | AJ387964 | AJ387964 |  |
| *Zygophyllum botulifolium* Van Zyl | Marais 451 (STE) |  | EF656026 | EF656026 |  |
| *Zygophyllum brachypterum* Kar. & Kir. | H65 (KUN)¹; XJBIZLJ021 (XJBI)2 | JF944800¹ | KR0019872 | KR0020142 | KR0020242 |
| *Zygophyllum calcicola* Van Zyl | Dreyer s.n. (STE) |  | EF656030 | EF656030 |  |
| *Zygophyllum chrysopteron* Retief | Marais 427 (STE) |  | EF656013 | EF656013 |  |
| *Zygophyllum clavatum* Schltr. & Diels | Bellstedt 878 (STE) | EF655986 | EF656010 | EF656010 |  |
| *Zygophyllum coccineum* L. | Ryding 1347 (K) | AJ133863 | AJ387965 | AJ387965 |  |
| *Zygophyllum compressa* J. M. Black | Nicholls 809 (K) |  | AY300776 |  |  |
| *Zygophyllum cordifolium* L. f. | Marais 446 (STE) | EF655993 | EF656022 | EF656022 |  |
| *Zygophyllum cornutum* |  |  | KP408839 | KP408839 |  |
| *Zygophyllum cretaceum* Van Zyl | Bellstedt 856 (STE) |  | EF656028 | EF656028 |  |
| *Zygophyllum cuneifolium* Eckl. & Zeyh. | Marais 455 (STE) |  | EF656024 | EF656024 |  |
| *Zygophyllum cylindrifolium* Schinz | Craven 3800 (WIND) | AJ133864 | AJ387966 | AJ387966 |  |
| *Zygophyllum debile* Cham. | Bellstedt 796 (STE) |  | EF656041 | EF656041 |  |
| *Zygophyllum decumbens* Delile | Thulin *et al.* 7981 (UPS) | AJ133865 | AJ387967 | AJ387967 |  |
| *Zygophyllum divaricatum* Eckl. & Zeyh. | Dold 4655 (GRA) |  | EF656031 | EF656031 |  |
| *Zygophyllum eichwaldii* |  |  | KP408843 | KP408843 |  |
| *Zygophyllum eremaea* Diels | Beier s.n. (UPS) |  | AY300777 |  |  |
| *Zygophyllum eurypterum* |  |  | KP408846 | KP408846 |  |
| *Zygophyllum fabago* L. | Chase 516 (K)¹; XJBIZLJ025 (XJBI)2 | Y15030¹ | KR0019842 | KR0020112 | KR0020292 |
| *Zygophyllum fabagoides* |  | KU047971 | KU047957 | KU047957 |  |
| *Zygophyllum ferganense* |  |  | KP408851 | KP408851 |  |
| *Zygophyllum flexuosum* Eckl. & Zeyh. | Bellstedt 794 (STE) | EF655995 | EF656032 | EF656032 |  |
| *Zygophyllum foetidum* Schrad. & J. C. Wendl. | Marais 423 (STE) |  | EF656039 | EF656039 |  |
| *Zygophyllum fruticulosum* DC. | Chase 2203 (K) | AJ133866 | AJ387969 | AJ387969 |  |
| *Zygophyllum fulvum* L. | Van Zyl 4605 (STE) |  | EF656044 | EF656044 |  |
| *Zygophyllum fuscatum* Van Zyl | Bellstedt 892 (STE) |  | EF656045 | EF656045 |  |
| *Zygophyllum fusiforme* Van Zyl | Bellstedt 857 (STE) |  | EF656023 | EF656023 |  |
| *Zygophyllum gaetulum* |  |  | KP408852 | KP408852 |  |
| *Zygophyllum geslinii* |  |  | KP408853 | KP408853 |  |
| *Zygophyllum giessii* Merxm. & A. Schreib. | Bellstedt 874 (STE) | EF655980 | EF656000 | EF656000 |  |
| *Zygophyllum glaucum* F. Muell. | Chase 2204 (K) | AJ133867 | AJ387970 | AJ387970 |  |
| *Zygophyllum gobicum* Maxim. | XJBIZLJ022 (XJBI) |  | KR001995 | KR002008 | KR002031 |
| *Zygophyllum gontscharovii* Boriss. | Astanova s.n. (K) |  | AY300787 |  |  |
| *Zygophyllum hamiense* Schweinf. | Thulin *et al.* 9840 (UPS) |  | AY300783 |  |  |
| *Zygophyllum hildebrandtii* Engl. | Thulin *et al.* 9012 (UPS) | AJ133868 | AJ387971 | AJ387971 |  |
| *Zygophyllum hirticaule* Van Zyl | Van Zyl 3894 (STE) | AJ133869 | AJ387973 | AJ387973 |  |
| *Zygophyllum iliense* Popov | XJBIZLJ023 (XJBI) |  | KR001993 | KR002006 | KR002032 |
| *Zygophyllum incrustatum* E. Mey. ex Sond. | Bellstedt 509 (STE) |  | EF656019 | EF656019 |  |
| *Zygophyllum inflatum* Van Zyl | HK 1490 (WIND) |  | EF656005 | EF656005 |  |
| *Zygophyllum iodocarpum* F. Muell. | Symon 4607 (K) |  | AY300779 |  |  |
| *Zygophyllum jaxarticum* Popov | XJBIZLJ026 (XJBI) |  |  |  | KR002034 |
| *Zygophyllum kansuense* Y. X. Liou | XJBIZLJ024 (XJBI) |  | KR001996 | KR002010 | KR002022 |
| *Zygophyllum kaschgaricum* Boriss. | XJBIZLJ012 (XJBI) |  | KR001981 | KR002000 | KR002018 |
| *Zygophyllum lehmannianum* Bunge | June s.n. 1972 (K) |  | AY300788 |  |  |
| *Zygophyllum leptopetalum* E. Mey. ex Sond. | Marais 422 (STE) |  | EF656040 | EF656040 |  |
| *Zygophyllum leucocladum* Diels | Van Zyl 4479 (STE) |  | EF656029 | EF656029 |  |
| *Zygophyllum lichtensteinianum* Cham. | Van Zyl 4594 (STE) |  | EF656020 | EF656020 |  |
| *Zygophyllum loczyi* Kanitz | XJBIZLJ019 (XJBI) |  | KR001988 | KR002015 | KR002021 |
| *Zygophyllum longicapsulare* Schinz | Bellstedt 879 (STE) | EF655981 | EF656001 | EF656001 |  |
| *Zygophyllum longistipulatum* |  |  | KP408867 | KP408867 |  |
| *Zygophyllum macropodum* Boriss. | CPG13080 | MH990646 | MH990647 | MH990648 | MH990649 |
| *Zygophyllum macropterum* C. A. Mey. | XJBIZLJ017 (XJBI) |  | KR001991 | KR002003 | KR002026 |
| *Zygophyllum maculatum* Aiton | Marais 433 (STE) |  | EF656033 | EF656033 |  |
| *Zygophyllum madagascariensis* (Baill.) Stauffer | Keating Miller 2236 (K) |  | AY300784 |  |  |
| *Zygophyllum madecassum* H. Perrier | Lorence s.n. (K) |  | AY300785 |  |  |
| *Zygophyllum maritimum* Eckl. & Zeyh. | Dold 4656 (GRA) |  | EF656035 | EF656035 |  |
| *Zygophyllum microcarpum* E. Mey. | Van Zyl 4591 (STE) | EF655983 | EF656002 | EF656002 |  |
| *Zygophyllum migiurtinorum* Chiov. | Thulin *et al.* 9553 (UPS) |  | AY300786 |  |  |
| *Zygophyllum miniatum* Cham. | June s.n. 1965 (K) |  | AY300789 |  |  |
| *Zygophyllum morgsana* L. | Bellstedt 890 (STE) | EF655994 | EF656021 | EF656021 |  |
| *Zygophyllum mucronatum* Maxim. | XJBIZLJ030 (XJBI) |  | KR001997 | KR002009 | KR002023 |
| *Zygophyllum namaquanum* Van Zyl | Marais 440 (STE) |  | EF656036 | EF656036 |  |
| *Zygophyllum neglectum* |  |  | KP408875 | KP408875 |  |
| *Zygophyllum obliquum* Popov | H67 (KUN)¹; XJBIZLJ028 (XJBI)2 | JF944808¹ | KR0019892 | KR0020022 | KR0020282 |
| *Zygophyllum orbiculatum* Welw. ex Oliv. | Craven 5096 (WIND) | EF655979 | EF655999 | EF655999 |  |
| *Zygophyllum ovatum* Ewart & J. White | Melville 451 (K) |  | AY300782 |  |  |
| *Zygophyllum oxianum* |  |  | KP408877 | KP408877 |  |
| *Zygophyllum oxycarpum* Popov | XJBIZLJ031 (XJBI) |  | KR001992 | KR002007 | KR002033 |
| *Zygophyllum patenticaule* Van Zyl | Bellstedt 868 (STE) | EF655989 | EF656008 | EF656008 |  |
| *Zygophyllum pinnatum* |  |  | KP408879 | KP408879 |  |
| *Zygophyllum porphyrocaule* Van Zyl | Bellstedt 800 (STE) | EF655992 | EF656018 | EF656018 |  |
| *Zygophyllum potaninii* Maxim. | XJBIZLJ020 (XJBI) |  | KR001986 | KR002013 | KR002020 |
| *Zygophyllum prismatocarpum* Sond. | Bellstedt 860 (STE) | EF655990 | EF656009 | EF656009 |  |
| *Zygophyllum propinquum* |  |  | KP408885 | KP408885 |  |
| *Zygophyllum pterocarpum* Bunge | H64 (KUN)¹; XJBIZLJ016 (XJBI)2 | JF944809¹ | KR0019852 | KR0020122 | KR0020252 |
| *Zygophyllum pterocaule* Van Zyl | Mucina 270806/25 (STE) |  | EF656007 | EF656007 |  |
| *Zygophyllum pubescens* Schinz | Bellstedt 881 (STE) |  | EF656042 | EF656042 |  |
| *Zygophyllum pygmaeum* Eckl. & Zeyh. | Marais 424 (STE) |  | EF656046 | EF656046 |  |
| *Zygophyllum qatarense* |  |  | KP408889 | KP408889 |  |
| *Zygophyllum ramosissimum* Popov | Granitov s.n. (K) |  | AY300790 |  |  |
| *Zygophyllum retrofractum* Thunb. | Marais 430 (STE) |  | EF656014 | EF656014 |  |
| *Zygophyllum rigidum* Schinz | Van Zyl 4590 (STE) | EF655982 | EF656003 | EF656003 |  |
| *Zygophyllum robecchii* Engl. | Chase 636 (K) | AJ133870 | AJ387972 | AJ387972 |  |
| *Zygophyllum rogersii* Compton | Marais 432 (STE) |  | EF656037 | EF656037 |  |
| *Zygophyllum rosowii* Bunge | H62 (KUN)¹; XJBIZLJ027 (XJBI)2 | JF944811¹ | KR0019942 | KR0020052 | KR0020352 |
| *Zygophyllum schreiberanum* Merxm. & Giess | Bellstedt 871 (STE) |  | EF656027 | EF656027 |  |
| *Zygophyllum segmentatum* Van Zyl | Bellstedt 861 (STE) | EF655987 | EF656015 | EF656015 |  |
| *Zygophyllum sessilifolium* L. | Marais 434 (STE) | EF655997 | EF656047 | EF656047 |  |
| *Zygophyllum simplex* L. | Chase 806 (K) | Y15031 | AJ387974 | AJ387974 |  |
| *Zygophyllum sinkiangense* |  | KU047982 | KU047968 | KU047968 |  |
| *Zygophyllum spinosum* L. | Bellstedt 801 (STE) | AJ133871 | EF656038 | EF656038 |  |
| *Zygophyllum spitskopense* Van Zyl | Van Zyl 4606 (STE) |  | EF656048 | EF656048 |  |
| *Zygophyllum spongiosum* Van Zyl | HK 1573 (WIND) | EF655985 | EF656006 | EF656006 |  |
| *Zygophyllum subtrijugum* C. A. Mey. | 1955.07.30 s. leg. s.n. (K) |  | AY300792 |  |  |
| *Zygophyllum swartbergense* Van Zyl | Bellstedt 798 (STE) | EF655996 | EF656043 | EF656043 |  |
| *Zygophyllum tenue* R. Glover | Van Zyl 4593 (STE) |  | EF656017 | EF656017 |  |
| *Zygophyllum teretifolium* Schltr. | Marais 447 (STE) |  | EF656025 | EF656025 |  |
| *Zygophyllum tesquorum* |  |  | KP408896 | KP408896 |  |
| *Zygophyllum turbinatum* Van Zyl | Bellstedt 799 (STE) |  | EF656016 | EF656016 |  |
| *Zygophyllum xanthoxylum* (Bunge) Maxim. | Chase 1700 (K)¹; XJBIZLJ013 (XJBI)2 | AJ133872¹ | KR0019822 | KR0020012 | KR0020192 |
| *Fagonia acerosa* Boiss. | Davis 56261 (E) |  | AY641579 |  | AY641617 |
| *Fagonia arabica* L. | Leonard 4887 (S) |  | AY641580 |  | AY641618 |
| *Fagonia bruguieri* DC. | Thulin *et al.* 9986 (UPS) |  | AY641582 |  | AY641619 |
| *Fagonia charoides* Chiov. | Thulin *et al.* 10587 (UPS) |  | AY641583 |  |  |
| *Fagonia chilensis* Hook. & Arn. | Penailillo s.n. (UTALCA) |  | AY641584 |  | AY641622 |
| *Fagonia cretica* L. | Chase 3432 (K)¹ | AJ1338551 | AJ387942¹ | AJ387942¹ |  |
| *Fagonia densa* I. M. Johnst. | Rebman 3171 (SD) |  | AY641587 |  | AY641625 |
| *Fagonia glutinosa* Delile | Davis 49654 (K) |  | AY641588 |  | AY641627 |
| *Fagonia gypsophila* Beier & Thulin | Thulin *et al.* 9473 (UPS) |  | AY641589 |  | AY641626 |
| *Fagonia hadramautica* Beier & Thulin | Thulin *et al.* 9808 (UPS) |  | AY641590 |  | AY641628 |
| *Fagonia harpago* Emb. & Maire | Podlech 40630 (RSA) |  | AY641591 |  | AY641629 |
| *Fagonia indica* Burm. f. | Thulin *et al.* 9835 (UPS) | Y15018 | AY300769 | AJ387943 | AY641630 |
| *Fagonia laevis* Standl. | Beier 97 (UPS) |  | AY641595 |  | AY641633 |
| *Fagonia lahovarii* Volkens & Schweinf. | Thulin *et al.* 9522 (UPS) |  | AY641596 |  | AY641635 |
| *Fagonia latifolia* Delile | Scholz 174 (B) |  | AY641597 |  |  |
| *Fagonia latistipulata* Beier & Thulin | Thulin *et al.* 10833 (UPS) |  | AY641598 |  | AY641636 |
| *Fagonia longispina* Batt. | Podlech 53369 (M) |  | AY641599 |  | AY641637 |
| *Fagonia luntii* Baker | Thulin *et al.* 9881 (UPS) | AJ133856 | AJ387944 | AJ387944 | AY641638 |
| *Fagonia mahrana* Beier | Thulin *et al.* 9682 (UPS) |  | AY641600 |  | AY641639 |
| *Fagonia minutistipula* Engl. | Giess and Müller 13952 (K) |  | AY300771 |  | AY641641 |
| *Fagonia mollis* Delile | Townsend 86/12 (K) |  | AY641601 |  |  |
| *Fagonia olivieri* DC. | Samuelsson 4357 (S) |  | AY641602 |  | AY641646 |
| *Fagonia orientalis* C. Presl | Collenette 7516 (E) |  | AY641603 |  | AY641648 |
| *Fagonia pachyacantha* Rydb. | Beier 93 (UPS) |  | AY641604 |  | AY641649 |
| *Fagonia palmeri* Vasey & Rose | Hastings 75 (SD) |  | AY641605 |  | AY641653 |
| *Fagonia paulayana* J. Wagner & Vierh. | Thulin *et al.* 9515 (UPS) |  | AY641608 |  | AY641654 |
| *Fagonia rangei* Loes. ex Engl. | Leistner 3388 (K) |  | AY641609 |  | AY641647 |
| *Fagonia scabra* Forssk. | Davis 49662 (E) |  | AY300768 |  |  |
| *Fagonia scoparia* Brandegee | Johnston 9461 (SD) |  | AY300773 |  | AY641644 |
| *Fagonia subinermis* Boiss. | Grey-Wilson & Hewer 285 (W) |  | AY641610 |  | AY641642 |
| *Fagonia villosa* D. M. Porter | K. 5915 (RSA) |  | AY641611 |  | AY641640 |
| *Fagonia zilloides* Humbert | Davis 49047 (E) |  | AY641612 |  | AY641655 |
| *Augea capensis* Thunb. | Bellstedt 934 (STE) | EF655978 | EF655998 |  |  |
| *Tetraena mongolica* Maxim. | Sheahan 1994 (K)¹; XJBIZLJ015 (XJBI)² | Y15027¹ | KR001983² | KR001999² | KR002017² |
| *Bulnesia arborea* (Jacq.) DC. | Chase 641 (K) | EU644676 | AJ387947 | AJ387947 |  |
| *Guaiacum angustifolium* Engelm. | J. R. Dertien 534 (DEK) |  | EU253465 | EU253465 | JX486127 |
| *Guaiacum coulteri* A. Gray | L. Lopez & M. Martinez 196 (DEK) |  | EU253466 | EU253466 | JX486715 |
| *Guaiacum guatemalense* Planch. ex Rydb. & Vail | Chase 640 (K) | Y15019 | AJ387948 | AJ387948 | JX486717 |
| *Guaiacum officinale* L. | J.R. Dertien 505 (DEK) |  | EU253467 | EU253467 | JX901024 |
| *Guaiacum sanctum* L. | L. Lopez & M. Martinez 204 (DEK) | JQ594515 | EU253458 | EU253461 | JX486719 |
| *Guaiacum unijugum* Brandegee | R. McCauley s.n. (DEK) |  | JX682629 | JX682629 | JX486721 |
| *Porlieria chilensis* I.M. Johnst | Chase 643 (K) | Y15024 | AJ387955 | AJ387955 | JX901026 |
| *Porlieria microphylla* | CPG11627 | MH990650 | MH990651 | MH990652 | MH990653 |
| *Larrea ameghinoi* Speg. | J.H.H.13246 (SI) | AF333329 |  |  | AF334825 |
| *Larrea cuneifolia Cav.* | CUNE | AF200471 |  |  | JF267296 |
| *Larrea divaricata* Cav. | J.H.H.9886 (SI) | AF200472 |  |  | AF334821 |
| *Larrea nitida* Cav. | J.H.H.13240 (SI) | AF200473 |  |  | AF334823 |
| *Larrea tridentata* (Sessé & Moc. ex DC.) Coville | Chase 636 (K)¹;  R. Laport 766242 (RSA)² | AY935748 | AJ387951¹ | AJ387951¹ | JF267306² |
| *Pintoa chilensis* Gay | Teillier 859 (NY) | AJ133858 | AJ387954 | AJ387954 |  |
| *Plectrocarpa tetracantha* Gillies ex Hook. & Arn. | J. H. Hunziker and V. Lia 13269 | AF333330 |  |  |  |
| *Seetzenia lanata* (Willd.) Bullock | Herman 3964 (K) | Y15025 | AJ387956 | AJ387956 |  |
| *Tribulopis pentandra* R.Br. | Wilson 4719 (NSW) | AJ133860 | AJ387960 | AJ387960 |  |
| *Tribulus cistoides* L. | J.R. Abbott 24857 (FLAS) | GU135188 |  |  |  |
| *Tribulus lanuginosus* L. | Sathishkumar *et al.* (2010, unpublished) |  |  |  | HM236860 |
| *Tribulus macropterus* Boiss | Collenette 3/93 (K) | Y15028 | AJ387961 | AJ387961 |  |
| *Tribulus subramanyamii* P. Singh, G.S. Giri & V. Singh | Sathishkumar *et al.* (2010, unpublished) |  |  |  | HM236858 |
| *Tribulus terrestris* L. | XJBIZLJ014 (XJBI) | AM235167 | KR001980 | KR001998 | KR002016 |
| *Kallstroemia maxima* (L.) Hook. & Arn. | Magellanes 3806 (K) | Y15020 | AJ387949 | AJ387949 |  |
| *Kelleronia revoilii* | Barbier s.n. (K) | Y15021 | AJ387950 | AJ387950 |  |
| *Sisyndite spartea* E.Mey. ex Sond. | Chase 637 (K) | Y15026 | AJ387958 | AJ387958 |  |
| *Neoluederitzia sericeocarpa* Schinz | Chase 642 (K) | Y15023 | AJ387953 | AJ387953 |  |
| *Balanites glabra* | CPG11474 | MH990654 | MH990655 | MH990656 | MH990657 |
| *Balanites maughamii* Sprague | SM2012 | MH990658 | MH99065 | MH990660 | MH990661 |
| *Balanites pedicellaris* Mildbr. & Schltr. | OM901 | JF265297 |  |  |  |
| *Morkillia mexicana* (DC.) Rose & Painter | Anderson 13526 (MICH, NY) | AJ133857 | AJ387952 | AJ387952 |  |
| *Viscainoa geniculata* (Kellogg) Greene | Chase 634 (K) | Y15029 | AJ387962 | AJ387962 |  |
| *Sericodes greggii* A. Gray | Rollins & Roby 76014  (NY, H) | AJ387962 | AJ387957 | AJ387957 |  |
| *Krameria lanceolata* Torr. | Simpson 88-05-1-1 (MICH) | Y15032 |  |  | AY261080 |
| *Krameria ixine* L. | Fernandez 22529 | EU644679 |  |  | AY260995 |

**Appendix S4** Explanatory power (R2) of the predictors for diversity patterns of the 154 Zygophyllaceae species with phylogenetic information evaluated by Generalized Linear Models (GLM) with Poisson residuals.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | World | Afrotropics | Australasia | Palearctics | Nearctics | Neotropics |
| **MAT****(**oC**)** | 0.4% (+) | 15.4% (+) | 0.2% (+) | 0.4% (+) | 47.5% (+) | 15.1% (+) |
| **MTCQ****(**oC**)** | 0.0% (+) | 32.8% (+) | 4.4% (+) | 0.1% (+) | 53.3% (+) | 14.9% (+) |
| **PET(mm)** | 5.0% (+) | 1.2% (+) | 25.3% (+) | 9.4% (+) | 71.5% (+) | 9.7% (+) |
|  |  |  |  |  |  |  |
| **MAP****(mm)** | 35.3% (-) | **42.3%**(-) | 53.8%(-) | 46.3%(-) | 17.1% (-) | 4.1% (-) |
| **WD(mm)** | 30.1% (+) | 18.1%(+) | 48.6%(+) | 34.0%(+) | **75.8%** (+) | 2.7%(+) |
| **AI** | **41.4%** (-) | 35.8%(-) | **66.8%**(-) | **50.0**%(-) | 45.9% (-) | 3.8%(-) |
|  |  |  |  |  |  |  |
| **MDR****(**oC**)** | 19.3%(+) | 7.7%(+) | 59.9%(+) | 37.3%(+) | 39.2%(+) | **11.8%(+)** |
| **TS** | 4.1%(+) | 12.2%(+) | 58.8%(+) | 12.1%(+) | 27.3%(-) | 9.9%(+) |
| **PS** | 5.9%(+) | 0.0%(-) | 4.7%(+) | 3.7%(+) | 60.5%(+) | 4.1%(+) |
|  |  |  |  |  |  |  |
| **Grid size** | 7.9%(+) | 8.2%(+) | 25.6%(+) | 8.6%(+) | 0.2%(+) | 0.3%(+) |
|  |  |  |  |  |  |  |
| **DIV** | 10.7%(+) | **54.4%(+)** | 53.0%(+) | **71.1%(+)** | 0.1%(-) | 4.5%(+) |
|  |  |  |  |  |  |  |

Variable abbreviations: MAT, mean annual temperature; MTCQ, mean temperature of the coldest quarter; PET, potential evapotranspiration; MAP, mean annual precipitation; WD, water deficit; AI, aridity index; MDR, mean diurnal range of temperature; TS, temperature seasonality; PS, precipitation seasonality; DIV, mean net diversification rate per geographical unit.**Appendix S5** The time-calibrated phylogeny of Zygophyllaceace. The phylogeny includes 174 Zygophyllaceae species and 2 outgroups from Krameriaceae. Dated phylogeny of Zygophyllaceae was generated using the Bayesian clock method implemented in BEAST version 1.8.0

