**Fig S1:** Phylogenetic relationship of the 141 plant species used in the current analysis and two outgroups (*Magnolia grandiflora* and *Amborella trichopoda*). Six gene sequences were used: *matk*, *rbcl*, *ndhf*, *its1*, *its2*, and *5.8s* (see **Table S2**). Sequences of each gene were aligned using MUSCLE (Edgar 2004), all genes were concatenated using phylocatenator (Oakley *et al.* 2014). This maximum likelihood phylogeny was estimated using RAxML (Stamatakis & Ott 2008), along with 100 bootstrap pseudoreplications to gauge nodal support. All phylogenetic analyses were conducted using the Osiris package (Oakley *et al.* 2014) of Galaxy.

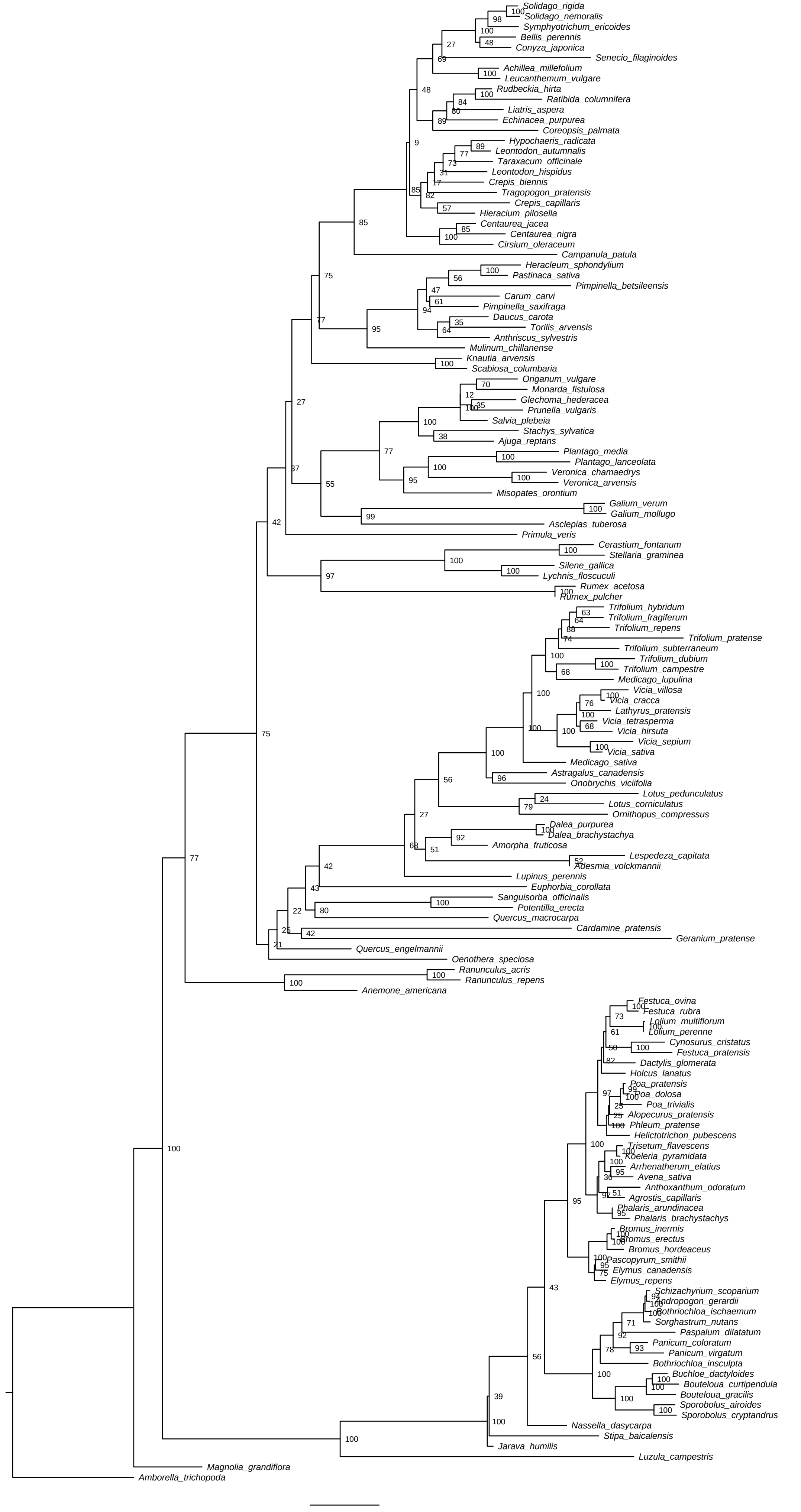

Solidago_rigida
Solidago_nemoralis
Symphyotrichum_ericoides
Bellis_perennis
Conyza_japonica
Senecio_filaginoides
Achillea_millefolium
Leucanthemum_vulgare
Rudbeckia_hirta
Ratibida_columnifera
Liatris_aspera
Echinacea_purpurea
Coreopsis_palmata
Hypochaeris_radicata
Leontodon_autumnalis
Taraxacum_officinale
Leontodon_hispidus
Crepis_biennis
Tragopogon_pratensis
Crepis_capillaris
Hieracium_pilosella
Centaurea_jacea
Centaurea_nigra
Cirsium_oleraceum
Campanula_patula
Heracleum_sphondylium
Pastinaca_sativa
Pimpinella_betsileensis
Carum_carvi
Pimpinella_saxifraga
Daucus_carota
Torilis_arvensis
Anthriscus_sylvestris
Mulinum_chillanense
Knautia_arvensis
Scabiosa_columbaria
Origanum_vulgare
Monarda_fistulosa
Glechoma_hederacea
Prunella_vulgaris
Salvia_plebeia
Stachys_sylvatica
Ajuga_reptans
Plantago_media
Plantago_lanceolata
Veronica_chamaedrys
Veronica_arvensis
Misopates_orontium
Galium_verum
Galium_mollugo
Asclepias_tuberosa
Primula_veris
Cerastium_fontanum
Stellaria_graminea
Silene_gallica
Lychnis_floscuculi
Rumex_acetosa
Rumex_pulcher
Trifolium_hybridum
Trifolium_fragiferum
Trifolium_repens
Trifolium_pratense
Trifolium_subterraneum
Trifolium_dubium
Trifolium_campestre
Medicago_lupulina
Vicia_villosa
Vicia_cracca
Lathyrus_pratensis
Vicia_tetrasperma
Vicia_hirsuta
Vicia_sepium
Vicia_sativa
Medicago_sativa
Astragalus_canadensis
Onobrychis_viciifolia
Lotus_pedunculatus
Lotus_corniculatus
Ornithopus_compressus
Dalea_purpurea
Dalea_brachystachya
Amorpha_fruticosa
Lespedeza_capitata
Adesmia_volckmannii
Lupinus_perennis
Euphorbia_corollata
Sanguisorba_officinalis
Potentilla_erecta
Quercus_macrocarpa
Cardamine_pratensis
Geranium_pratense
Quercus_engelmannii
Oenothera_speciosa
Ranunculus_acris
Ranunculus_repens
Anemone_americana
Festuca_ovina
Festuca_rubra
Lolium_multiflorum
Lolium_perenne
Cynosurus_cristatus
Festuca_pratensis
Dactylis_glomerata
Holcus_lanatus
Poa_pratensis
Poa_dolosa
Poa_trivialis
Alopecurus_pratensis
Phleum_pratense
Helictotrichon_pubescens
Trisetum_flavescens
Koeleria_pyramidata
Arrhenatherum_elatius
Avena_sativa
Anthoxanthum_odoratum
Agrostis_capillaris
Phalaris_arundinacea
Phalaris_brachystachys
Bromus_inermis
Bromus_erectus
Bromus_hordeaceus
Pascopyrum_smithii
Elymus_canadensis
Elymus_repens
Schizachyrium_scoparium
Andropogon_gerardii
Bothriochloa_ischaemum
Sorghastrum_nutans
Paspalum_dilatatum
Panicum_coloratum
Panicum_virgatum
Bothriochloa_insculpta
Buchloe_dactyloides
Bouteloua_curtipendula
Bouteloua_gracilis
Sporobolus_airoides
Sporobolus_cryptandrus
Nassella_dasycarpa
Stipa_baicalensis
Jarava_humilis
Luzula_campestris
Magnolia_grandiflora
Amborella_trichopoda
0.1

**Fig S2:** Comparison of the four phylogenetic diversity measures estimated with the phylogenetic tree developed in the current study (**Fig. S1**, x-axis) and a recently published mega-tree (Zane *et al.* 2014, y-axis).

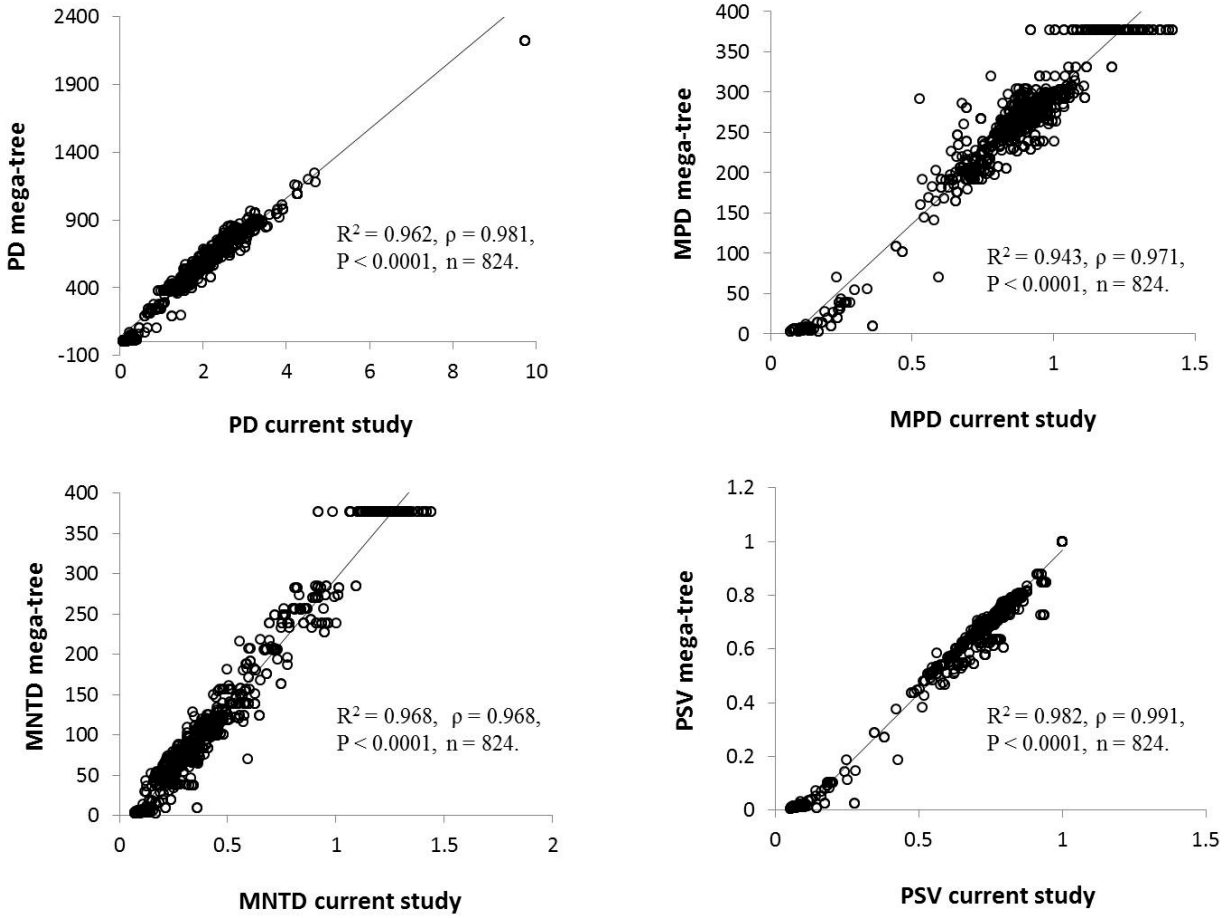


**Table S1:** List of the 16 studies included in this data synthesis presenting the reference study (authors and year of publication) with the name of the project and details on different treatments when available in parenthesis, the geographic location of the original study (locality or state and country), the number of time points over which biomass was measured and the total number of plots with different species compositions. Asterisks represent studies in which data for percentage coverage instead of biomass were available. n.a. refers to non-available project names.

| | Reference study (name) | Location | Time points | Mixture plots |
|---|---|---|---|---|
| 1 | Reich *et al.* 2001 (BioCon) | Minnesota, USA | 11 | 33 |
| 2 | Reich *et al.* 2001 (BioCon, High N) | Minnesota, USA | 11 | 31 |
| 3 | Reich *et al.* 2001 (BioCon, High CO2) | Minnesota, USA | 11 | 33 |
| 4 | Reich *et al.* 2001 (BioCon , High CO2, High N) | Minnesota, USA | 11 | 29 |
| 5 | Hector *et al.* 2010 (BioDepth) | Germany | 3 | 40 |
| 6 | Hector *et al.* 2010 (BioDepth) | Ireland | 3 | 50 |
| 7 | Hector *et al.* 2010 (BioDepth) | Portugal | 3 | 28 |
| 8 | Hector *et al.* 2010 (BioDepth) | Sheffield, England | 3 | 30 |
| 9 | Hector *et al.* 2010 (BioDepth) | Silwood, England | 3 | 44 |
| 10 | Hector *et al.* 2010 (BioDepth) | Sweden | 3 | 34 |
| 11 | Tilman *et al.* 2001 (Biodiversity II) | Minnesota, USA | 8 | 123 |
| 12* | Tilman *et al.* 1996 (Biodiversity I) | Minnesota, USA | 7 | 127 |
| 13 | Van Ruijven & Berendse 2005 (n.a.) | The Netherlands | 4 | 54 |
| 14 | Isbell *et al.* 2009 (n.a.) | Texas, USA | 10 | 36 |
| 15* | Flombaum & Sala 2008 (n.a.) | Patagonia, Argentina | 3 | 66 |
| 16 | Weigelt *et al.* 2010 (Jena) | Jena, Germany | 6 | 66 |

**Fig S3**: For the *Type 2 analysis* we attempted to hold phylogenetic distance (PD) relatively constant and examine the impacts of species richness (SR) on community stability, biomass production, and the S.D. of biomass production through time. For this, we searched through all plots from all studies and found 1417 instances where PD was relatively similar among two plots in the same experiment, but where the two plots differed in species richness. For each of these 1417 contrasts, we calculated the log ratio of PD for the higher vs. lower PD species richness plots: $\ln(Pd_{high}/PD_{low})$. The histogram of log ratios for the 1417 actual contrasts is plotted in blue (LRACT), which is a highly constrained range of variation in PD compared to the dataset as a whole (red histogram shows the log ratio of PD-values for 50,000 random draws among plots, LRRAND). Positive values represent larger PD in the plot with more species, and negative values the inverse. As such, these contrasts come as close as we can come to holding PD constant so that we can examine the impacts of SR on stability and its components.

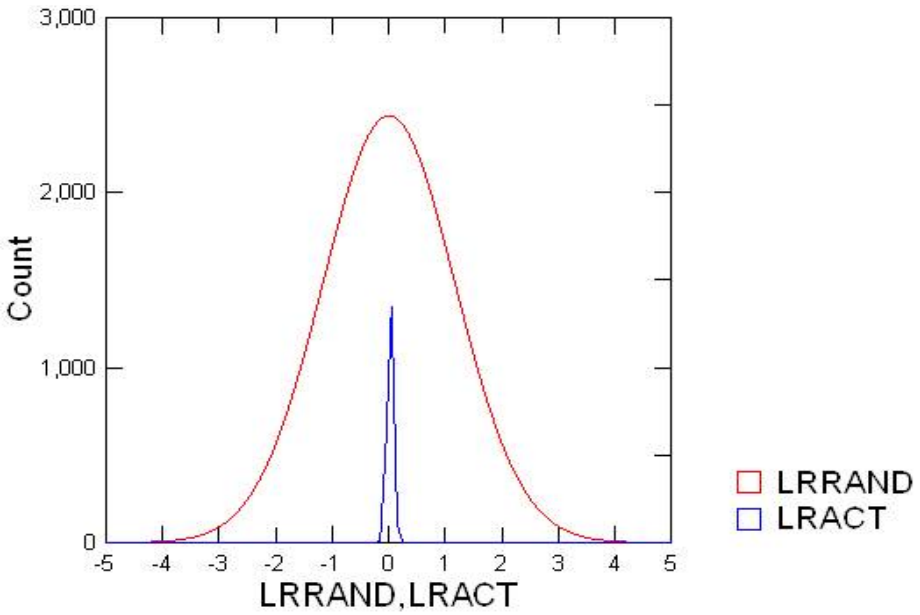
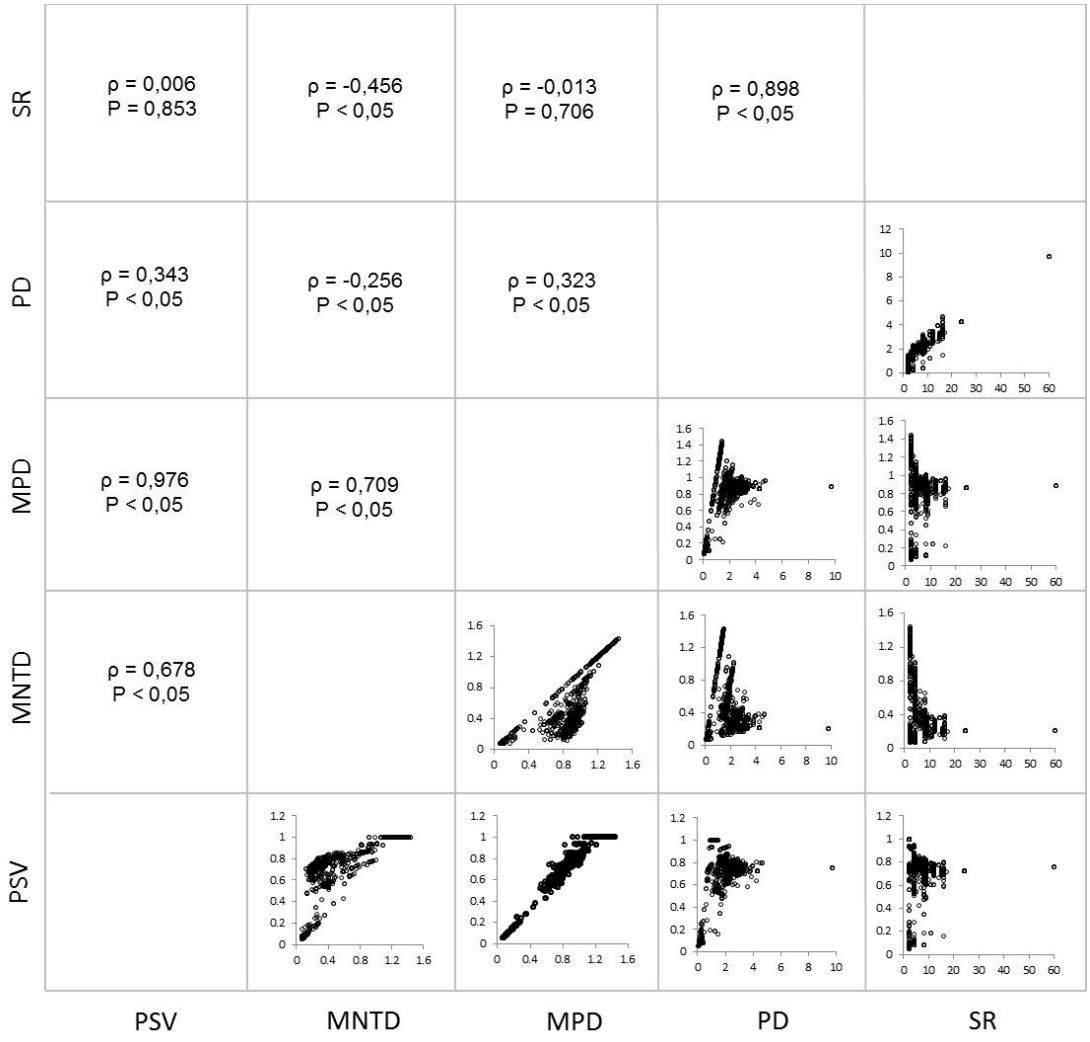


**Fig S4:** Correlations between 5 different metrics of biodiversity: species richness (SR); phylogenetic diversity (PD); mean phylogenetic distance (MPD); mean nearest taxon distance (MNTD) and phylogenetic species variability (PSV). Top left panels show correlation coefficients and significance values. Bottom right panels show actual correlation plots.



## Table S2. GenBank Accession numbers for genes used in phylogenetic analyses.

| Species | 5.8s | its1 | its2 | matk | ndhf | rbcl |
|---|---|---|---|---|---|---|
| **Achillea_millefolium** | HE687356 | AF046939 | AF046939 | JN894883 | AF153633 | L13641 |
| **Adesmia_volckmannii** | U59893 | | | AF142690 | | |
| **Agrostis_capillaris** | DQ146767 | AF498395 | AF498395 | FJ231112 | | AY395527 |
| **Ajuga_reptans** | JQ638909 | EF508061 | EF508061 | AY840130 | L36391 | U32163 |
| **Alopecurus_pratensis** | | | | EU434293 | | AY395528 |
| **Amborella_trichopoda** | | | | DQ185522 | AJ506156 | L12628 |
| **Amorpha_fruticosa** | JF491249 | U59890 | | AY391785 | | U74212 |
| **Andropogon_gerardii** | | | | AF144577 | AF117391 | AJ784818 |
| **Anemone_americana** | | | | AF542590 | | EU053901 |
| **Anthoxanthum_odoratum** | FJ010630 | FJ010630 | FJ010630 | DQ786884 | DQ786812 | AJ746282 |
| **Anthriscus_sylvestris** | AY548228 | EU236159 | EU236159 | U58547 | | JN893702 |
| **Arrhenatherum_elatius** | FM179388 | DQ995405 | DQ995405 | EU434292 | U71019 | AY395529 |
| **Asclepias_tuberosa** | | | | GQ248084 | | GQ248553 |
| **Astragalus_canadensis** | | L10770 | L10771 | AY386875 | | |
| **Avena_sativa** | HQ600525 | DQ995434 | FJ794718 | DQ786886 | AF267663 | L15300 |
| **Bellis_perennis** | AF046950 | JN315918 | AF493996 | JN893935 | L39446 | AY395530 |
| **Bothriochloa_insculpta** | AF190756 | AF190756 | AF190756 | | | |
| **Bothriochloa_ischaemum** | | | | HE574006 | AM849131 | AM887873 |
| **Bouteloua_curtipendula** | GU359281 | GU359281 | GU359281 | AF144578 | EF422911 | JN681654 |
| **Bouteloua_gracilis** | GU359285 | GU359285 | GU359285 | HE575865 | HE575771 | AJ784829 |
| **Bromus_erectus** | AY367907 | AY367907 | AY367907 | AM234570 | U71033 | AJ746286 |
| **Bromus_hordeaceus** | AF494347 | AF494347 | AF494346 | JN895538 | AM849134 | AY395531 |
| **Bromus_inermis** | HQ600546 | AY367915 | JN998985 | AF164398 | DQ786821 | HQ600445 |
| **Buchloe_dactyloides** | | | | FR821320 | FR821354 | FR821337 |
| **Campanula_patula** | FM212739 | | | JN894553 | | JN892767 |
| **Cardamine_pratensis** | X98637 | AF265170 | AF265191 | HM850749 | | HM849848 |
| **Carum_carvi** | AF077878 | AF077878 | AF077878 | U58553 | | |
| **Centaurea_jacea** | JN808258 | DQ319125 | DQ319125 | HQ593227 | | HQ590025 |
| **Centaurea_nigra** | JQ360436 | DQ319138 | DQ319138 | JN895934 | | JN892339 |
| **Cerastium_fontanum** | | AY936241 | AY286525 | JN894934 | | JN893675 |
| **Cirsium_oleraceum** | AY780402 | AY780402 | AY780402 | | | |
| **Conyza_japonica** | JN315938 | JN315938 | JN315938 | | | |
| **Coreopsis_palmata** | | AY553673 | AY553674 | AY551480 | | |
| **Crepis_biennis** | JF978846 | AJ633355 | | JN895401 | AF218345 | JN891592 |
| **Crepis_capillaris** | JF978846 | AJ633381 | HQ161936 | AJ633142 | | HM849923 |

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|---|---|---|---|---|---|---|
| **Cynosurus_cristatus** | HM453199 | HM453199.1 | HM453199 | HM453075_pt9974 | DQ786829 | JN890889 |
| **Dactylis_glomerata** | AF393013 | AF393013 | AF393013 | AM234595 | AM849145 | AJ746268 |
| **Dalea_brachystachya** | | | | EU025886 | | |
| **Dalea_purpurea** | AY426794.1 | AY426794 | AY426794.1 | AY391798 | | |
| **Daucus_carota** | | JQ290121 | GQ434704 | DQ898156 | | DQ898156 |
| **Echinacea_purpurea** | EU785937 | U73148 | U74418 | | AB530929 | AB530963 |
| **Elymus_canadensis** | EF396960 | EF396960 | EF396960 | HM770807 | HM770846 | HM770840 |
| **Elymus_repens** | FJ793079 | FJ793077 | FJ793094 | HQ593279 | U71027 | HQ600453 |
| **Euphorbia_corollata** | JQ750900.1 | JQ750900.1 | JQ750900.1 | | EU022038 | |
| **Festuca_ovina** | AF147170.2 | AF147170.1 | AF147170.3 | JN894019 | JX871940 | JN891705 |
| **Festuca_pratensis** | AJ240151 | HM453173 | HM453173 | HM850535 | JN187627 | AY395536 |
| **Festuca_rubra** | AJ240158 | AF303422 | JN999219 | DQ786911 | DQ786839 | AJ746261 |
| **Galium_mollugo** | AM503885 | AM503885 | | AM503814 | | AY395538 |
| **Galium_verum** | | | | HQ593309 | | HQ590115 |
| **Geranium_pratense** | | | | JN895981 | | JN892282 |
| **Glechoma_hederacea** | JQ280772 | JQ669099 | | AY840143 | | AB266226 |
| **Helictotrichon_pubescens** | FM956100 | AY870326 | | FM957003 | | JN891444 |
| **Heracleum_sphondylium** | EU169285 | EU594914 | EU169285 | JN894478 | | AY395540 |
| **Hieracium_pilosella** | AM946982 | HQ161945 | HQ161945 | JN896101 | | HQ590133 |
| **Holcus_lanatus** | HQ600532 | HQ600531 | HQ600533 | JN894905 | AM849157 | AM235062 |
| **Hypochaeris_radicata** | AJ633310 | GU011987 | GU011987 | AJ633231 | | AY395542 |
| **Jarava_humilis** | FN434548 | EU489120 | EU489120 | EU489198 | | |
| **Knautia_arvensis** | | | | JN894671 | AF161298 | HE574586 |
| **Koeleria_pyramidata** | | Z96912 | | | | AJ746262 |
| **Lathyrus_pratensis** | | | | JN894102 | | AY395544 |
| **Leontodon_autumnalis** | HM627314 | HQ161932 | | AJ633222 | | |
| **Leontodon_hispidus** | GU116531 | Z93830 | | AJ633218 | | AY395545 |
| **Lespedeza_capitata** | GU572172.1 | GU572172.1 | GU572172.1 | | | |
| **Leucanthemum_vulgare** | EF577315 | AB359706 | EF577315 | HM850667 | EU334481 | AY395546 |
| **Liatris_aspera** | HQ416346 | HQ416346 | HQ416346 | | HQ416219 | |
| **Lolium_multiflorum** | HQ600550 | EF379072 | | | | |
| **Lolium_perenne** | AJ240138 | AF303401 | AF303401 | JN895693 | | HQ600426 |
| **Lotus_corniculatus** | JN861088 | DQ312207 | | | | U74213 |
| **Lotus_pedunculatus** | JQ858258 | DQ166222 | | | | |
| **Lupinus_perennis** | | Z72162.1 | Z72163.1 | | | Z70058 |
| **Luzula_campestris** | FJ213882.1 | FJ213882.1 | FJ213882.1 | HM850953 | | AY395548 |
| **Lychnis_floscuculi** | | U30957 | | | | AY395549 |
| **Magnolia_grandiflora** | | | | AF548640 | AF107940 | AY008925 |
| **Medicago_lupulina** | | AB546798 | | | | AY395551 |

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|---|---|---|---|---|---|---|
| **Medicago_sativa** | JX017337 | JX017335 | | AF522108 | | Z70173 |
| **Misopates_orontium** | AY707075 | AY707075 | AY707075 | JN894172 | | JN893438 |
| **Monarda_fistulosa** | DQ667318.1 | DQ667318.1 | DQ667318.1 | | | Z37419 |
| **Mulinum_chillanense** | | | | AY188402 | | AY188428 |
| **Nassella_dasycarpa** | | EU489148 | EU489148 | EU489222 | | |
| **Oenothera_speciosa** | DQ075636.1 | DQ075636.1 | DQ075636.1 | | | HQ644058 |
| **Onobrychis_viciifolia** | GQ246078 | GQ246078 | GQ246078 | JQ669629 | | |
| **Origanum_vulgare** | JQ389515 | AY506647 | | AY840165 | | Z37427 |
| **Ornithopus_compressus** | HM468335 | HM468335 | HM468335 | HM851142 | | HM850215 |
| **Panicum_coloratum** | | | | HE574090 | | AM849415 |
| **Panicum_virgatum** | AM404348 | AM404348 | | | | AY632368 |
| **Pascopyrum_smithii** | | | | | AF056172 | |
| **Paspalum_dilatatum** | | AY771871 | AY771904 | HM850547 | | HM850238 |
| **Pastinaca_sativa** | EU169305 | U30546 | U30547 | JN895118 | | JN893745 |
| **Phalaris_arundinacea** | | | | | | AJ784827 |
| **Phalaris_brachystachys** | JF951057 | JF951057 | JF951057 | HM850514 | | HM850250 |
| **Phleum_pratense** | | | | AF164397 | | AY395554 |
| **Pimpinella_betsileensis** | DQ647626 | DQ647626 | DQ647626 | | | |
| **Pimpinella_saxifraga** | HM176655 | AY581801 | | U58576 | | U50229 |
| **Plantago_lanceolata** | FJ024622 | FJ024622 | | | | L36454 |
| **Plantago_media** | AJ548964 | AJ548964 | | AY667474 | | AJ389596 |
| **Poa_dolosa** | GQ324502 | GQ324502 | GQ324502 | | | |
| **Poa_pratensis** | JF786337 | JF786328 | JF786337 | AF164402 | | JN892391 |
| **Poa_trivialis** | AF532932 | AF532932 | AF532932 | JN895711 | | AJ746301 |
| **Potentilla_erecta** | FN430780 | | | JN896010 | | JN893738 |
| **Primula_veris** | AM920484 | JX231022 | AF323701 | JN896058 | | JN893423 |
| **Prunella_vulgaris** | JQ669130 | AY506653 | | | | AY395556 |
| **Quercus_engelmannii** | AF098420 | AF098420 | AF098420 | | | |
| **Quercus_macrocarpa** | | | | EU749362 | | HQ590229 |
| **Ranunculus_acris** | | FM242864 | | AY954199 | | AY395557 |
| **Ranunculus_repens** | | AY680152 | | AY954182 | | |
| **Ratibida_columnifera** | | U73145 | U74415 | | | |
| **Rudbeckia_hirta** | | | U74407 | HQ593421 | | AB530973 |
| **Rumex_acetosa** | | | | | | AY395559 |
| **Rumex_pulcher** | | | | HM851087 | | HM850323 |
| **Salvia_plebeia** | | | FJ883524 | | | HM590084 |
| **Sanguisorba_officinalis** | AY635041 | AY635041 | AY635041 | AB073696 | | AY395560 |
| **Scabiosa_columbaria** | AY236188 | AY236188 | AY236188 | AF446918 | AF447038 | AF446948 |
| **Schizachyrium_scoparium** | | | | HE586094 | AF117420 | HE577863 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Senecio_filaginoides** | EF538334 | EF538334 | EF538334 | | | |
| **Silene_gallica** | X86847 | U30959 | U30985 | JN894574 | | M83544 |
| **Solidago_nemoralis** | EU125357 | HQ142596 | HQ142596 | EU749419 | | EU677026 |
| **Solidago_rigida** | HQ142603 | HQ142603 | HQ142603 | | | |
| **Sorghastrum_nutans** | | | | FR821326 | AF117421 | EF125121 |
| **Sporobolus_airoides** | AF019842 | AF019842 | AF019842 | HE573973 | | |
| **Sporobolus_cryptandrus** | GU359208 | GU359208 | GU359208 | HQ593457 | GU359674 | HQ590286 |
| **Stachys_sylvatica** | | | | JN895203 | | AF502022 |
| **Stellaria_graminea** | | | | JN895064 | | JN890625 |
| **Stipa_baicalensis** | FN434508 | FN434508.1 | FN434508.1 | FN434242 | | |
| **Symphyotrichum_ericoides** | JQ360392 | JQ360392 | JQ360392 | EU749432 | | EU677040 |
| **Taraxacum_officinale** | JN407436 | JN407436 | | AJ633157 | AF218346 | AY395562 |
| **Torilis_arvensis** | FJ415110 | FJ415110 | AF164869 | JN893950 | | AM234827 |
| **Tragopogon_pratensis** | HQ456261 | HQ456270 | AY508167 | JN893953 | | AY395563 |
| **Trifolium_campestre** | DQ312025 | AF154403 | AF154627 | HE970749 | | JN891072 |
| **Trifolium_dubium** | DQ312047 | DQ312047 | DQ312047 | JN894454 | | JN892755 |
| **Trifolium_fragiferum** | | AF154366 | AF154590 | JN894249 | | HM850413 |
| **Trifolium_hybridum** | HM470609 | EU348779 | AF154600 | AF522125 | | |
| **Trifolium_pratense** | FJ554461 | EU348780 | AF154620 | FJ395384 | | AY395564 |
| **Trifolium_repens** | HM470609 | FJ980291_pt9958 | AF053172 | AF522131 | | HQ644078 |
| **Trifolium_subterraneum** | EU348779 | AF154407 | AF053177 | AF522135 | EU849487 | HM850426 |
| **Trisetum_flavescens** | | Z96898 | | JN895340 | | AY395565 |
| **Veronica_arvensis** | DQ227328 | DQ227328 | DQ227328 | AF052003 | | HQ619782 |
| **Veronica_chamaedrys** | FJ024624 | AF313003 | AF313003 | FJ395446 | | FJ395581 |
| **Vicia_cracca** | JQ309787 | AF335189 | AF335190 | JN894329 | | AY395566 |
| **Vicia_hirsuta** | JQ309794 | HM470620 | DQ351827 | AF522157 | | JN893460 |
| **Vicia_sativa** | JQ309794 | DQ312198 | DQ312198 | AF522160 | | JN893683 |
| **Vicia_sepium** | JQ309794 | AM087144 | | JN896142 | | JN891169 |
| **Vicia_tetrasperma** | JQ309794 | DQ351828 | DQ351828 | JN894335 | | HQ590329 |
| **Vicia_villosa** | JQ309794 | HM470637 | DQ312199 | AF522161 | | HM850464 |

**Table S3**: Detailed results of the structural equation model (Type 3 analysis, **Figure 4**) exploring the effect of phylogenetic diversity (PD) and species richness (SR) on average community biomass (biom) and standard deviation (sd) as components of community stability (stab). Values in bold correspond to the values included in **Figure 4**.

| | |
|---|---|
| Number of observations | 222 |
| Minimum Function Test Statistic | 1.185 |
| Degrees of freedom | 2 |
| P-value (Chi-square) | 0.553 |

Parameter estimates:

| Information / Standard Errors | | Estimate | Std.err | Z-value | P(>\|z\|) | Std.lv | Std.all |
|---|---|---|---|---|---|---|---|
| Expected / Standard | | | | | | | |
| **Regressions:** | | | | | | | |
| biom ~ | | | | | | | |
| SR | (a) | 27.810 | 6.423 | 4.330 | 0.000 | 27.810 | **0.386** |
| PD | (b) | 0.843 | 24.402 | 0.035 | 0.972 | 0.843 | **0.003** |
| sd ~ | | | | | | | |
| SR | (c) | 7.134 | 3.360 | 2.123 | 0.034 | 7.134 | **0.197** |
| PD | (d) | 14.009 | 12.765 | 1.098 | 0.272 | 14.009 | **0.102** |
| stab ~ | | | | | | | |
| biom | (e) | 0.007 | 0.001 | 13.228 | 0.000 | 0.007 | **0.783** |
| sd | (f) | -0.019 | 0.001 | -18.061 | 0.000 | -0.019 | **-1.069** |
| **Covariances:** | | | | | | | |
| biom~sd | | 15856.694 | 1923.964 | 8.242 | 0.000 | 15856.694 | **0.664** |
| SR~PD | | 1.966 | 0.226 | 8.710 | 0.000 | 1.966 | **0.721** |
| **Variances:** | | | | | | | |
| biom | | 45653.645 | 4333.252 | | | 45653.645 | 0.849 |
| sd | | 12492.508 | 1185.736 | | | 12492.508 | 0.922 |
| stab | | 1.700 | 0.161 | | | 1.700 | 0.404 |
| SR | | 10.368 | 0.984 | | | 10.368 | 1.000 |
| PD | | 0.718 | 0.068 | | | 0.718 | 1.000 |

Defined parameters (Indirect effects of x -> y, via z):

| | | | | | | |
|---|---|---|---|---|---|---|
| SR->Stab,Biom | 0.192 | 0.047 | 4.115 | 0.000 | 0.192 | 0.302 |
| SR->Stab,SD | -0.134 | 0.064 | -2.109 | 0.035 | -0.134 | -0.211 |
| PD->Stab,Biom | 0.006 | 0.169 | 0.035 | 0.972 | 0.006 | 0.002 |
| PD->Stab,SD | -0.264 | 0.241 | -1.095 | 0.273 | -0.264 | -0.109 |

R-Square:

| | |
|---|---|
| biom | **0.151** |
| sd | **0.078** |
| stab | **0.596** |

**Table S4**: Results of linear models linking phylogenetic diversity (mean phylogenetic distance, MPD) and species richness (SR) to stability, average biomass, standard deviation (SD), sum of species variances (sum. var.) and synchrony (called *Type 4 analysis* in main text). Study was included as random effect. Cases with significant effects are in grey for visual clarity.

| | **Stability** | | **Average biomass** | | **S.D.** | | **Sum. var.** | | **Synchrony** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | F-value | P-value | F-value | P-value | F-value | P-value | F-value | P-value | F-value | P-value |
| **SR** | 11.02 | < 0.001 | 55.05 | <0.0001 | 4.64 | 0.03 | 0.55 | 0.46 | 8.36 | <0.01 |
| **MPD** | 1.52 | 0.22 | 2.83 | 0.09 | 6.58 | 0.01 | 6.09 | 0.01 | 2.93 | 0.07 |

**Data S1:** The current data-synthesis suggests that, after correcting for species richness, phylogenetic diversity is not a good predictor of community biomass (see Summary Table 2 in main document). This lack of effect was consistent over the three different statistical methods we used to test it. In contradiction, another meta-analysis using a similar dataset from grassland studies by Cadotte *et al.* (2008) showed that phylogenetic diversity was a good predictor of community biomass. In addition to a different dataset, both studies used different phylogenies to measure the phylogenetic diversity of each plot, used different measures of community biomass and applied different types of statistical analyses. These four factors may have influenced the observed differences. In order to determine the reasons for the discrepancies in the results among both studies we performed a series of permutations on: 1) the dataset, 2) the descriptive variables (x-variables), 3) the dependent variables (y-variables) and 4) the statistical analyses between Cadotte *et al.*'s study and ours. We started by collating data that contained the explanatory (phylogenetic diversity) and dependent variables (community biomass) from both studies, resulting in an overlapping dataset that included 318 plots. This collated dataset represents 24% of the 1318 plots included in Cadotte's paper and 39% of the 824 plots included in the current study.

**Table S5:** Summary of the results of a permutation exercise about the effect of phylogenetic diversity on community biomass.

| **Test** | **Dataset** | **Studies (plots)** | **x-variable** | **y-variable** | **Is PD significant?** | |
|---|---|---|---|---|---|---|
| | | | | | LME | $WZ_r$ |
| 1 | Cadotte | 29 (1318) | ML_UM | Log ratios | **Yes** | Yes |
| 2 | Venail | 16 (824) | PD | Average Biomass | Yes | **No** |
| 3 | Combined | 12 (318) | ML_UM | Log ratios | Yes | Yes |
| 4 | Combined | 12 (318) | ML_UM | Average Biomass | Yes | No |
| 5 | Combined | 12 (318) | PD | Log ratios | Yes | Yes |
| 6 | Combined | 12 (318) | PD | Average Biomass | Yes | No |

We first tested if the reduced combined dataset reproduced Cadotte *et al.*'s main results. We ran all the same analyses as in their study (linear mixed effect models, LME models), using their same metric of phylogenetic diversity (ML_UM) and their same measure of community biomass (log ratios at the final point). We found exactly the same results as in their manuscript

(line 1 vs. line 3 in **Table S5**), which was a positive effect of phylogenetic diversity on community biomass.

Similarly, we also tested if this reduced dataset reproduces our main results. We ran the *Type 1* analyses using weighted Zr ($WZ_r$), PD values and the average biomass over time as measure of community biomass. We found the same results as in our main study (line 2 vs. line 6 in **Table S5**), which is no effect of phylogenetic diversity on community biomass. Thus, using a reduced combined dataset we were able to reproduce the results from both studies.

Then, we used this collated reduced dataset to perform three series of tests.

**1) Testing the effect of "phylogenetic diversity", the explanatory variable (x-variable).**

Despite being based on two different phylogenies, the values of phylogenetic diversity from the two studies were highly correlated ($\rho = 0.946$, $P < 0.0001$, $n = 318$). A permutation of ML_UM by PD and vice-versa (line 3 vs. line 5 and line 4 vs. line 6 in **Table S5**) produced the same results as in the original studies, suggesting that changes in the measures of phylogenetic diversity were not responsible for the discrepancies among both studies.

**2) Testing the effect of "community biomass", the response variable (y-variable).**

Cadotte *et al.* used as response variable the biomass of the entire community at a single final point converted into a log ratio relative to the average biomass as monocultures of the species present in a plot. In the current study we used community biomass averaged over time. The two measures of community biomass were poorly correlated ($\rho = 0.153$, $P = 0.006$, $n = 318$). A permutation of the response variable (average biomass instead of log ratio) using LME models (line 3 vs. line 4 in **Table S5**) produced the same result as in Cadotte *et al.*'s. However, a permutation of the response variable (log ratio instead of average biomass) using type 1 analysis ($WZ_r$, line 6 vs. line 5 in **Table S5**) led to a result that is different from the one in our main study. This suggests that the discrepancies in the results among both studies can be (at least partially) explained by differences in the response variable.

The fact that the type 1 analysis revealed a positive effect of PD on log ratios (last column in line 5 from **Table S5**) but not on average biomass (last column in line 6 from **Table S5**) raised another question. Were those differences in the results due to the log ratio transformation *per se*

or to the fact that log ratios were estimated only at the final point of a time series data? To answer this question, we ran a *type 1 analysis (*$WZ_r$) on the combined dataset using PD as explanatory variable and final biomass as response variable. As shown in the table below (test 5*), the *test 1 analysis* showed no effect of PD on final biomass. This means that it's the log ratio transformation and not the use of a single final time point that explains at least part of the differences in the results from both studies.

| **Test** | **Dataset** | **Studies (plots)** | **x-variable** | **y-variable** | **Is PD significant? ($WZ_r$)** |
|---|---|---|---|---|---|
| 5 | Combined | 12 (318) | PD | Average Biomass | No |
| 5* | Combined | 12 (318) | PD | Final biomass | No |
| 6 | Combined | 12 (318) | PD | Log ratios | Yes |

Indeed, Average biomass and Final biomass were highly correlated ($\rho = 0.752$, $P < 0.0001$, $n = 318$), whereas Average biomass and Log ratios were poorly correlated ($\rho = 0.153$, $P < 0.01$, $n = 318$).

**3) Testing the effect of the statistical test.**

Cadotte *et al.*'s results were based on linear mixed effect models (LME) whereas the results of the current study are based on weighted and averaged linear correlations between phylogenetic diversity and community biomass at each level of species richness (WZr). Switching statistical methods ($WZ_r$ instead of LME) but keeping all other factors equal as in Cadotte *et al*. produced the same result as in their study (line 3 in **Table S5**). However, switching statistical methods (LME instead of $WZ_r$) but keeping all other factors equal as in our study led to a different result (line 6 in **Table S5**).

In conclusion, this permutation exercise revealed that using a different measure of community biomass (the log transformation *per se*) and a different statistical technique explain the observed differences in the results about the effect of phylogenetic diversity on community biomass among Cadotte *et al.*'s study and ours.