**Appendix S1**

**Title:** Above- and belowground plant pathogens along elevational gradients: patterns and potential mechanisms

**Authors:** Ziyuan Lin, Fletcher W. Halliday, Peng Zhang, Xingxing Wang, Fei Chen, Anya Shi, Juanjuan Shi, Yao Xiao, Xiang Liu

**Journal:** eLife

**Section S1.1:** Supplementary methods.

***Bioinformatic analysis***

We extracted soil total DNA using a TIANGEN Magnetic Soil And Stool DNA Kit (TIANGEN Biotech Co., Ltd., Beijing, China) following the manufacturer’s protocols and assessed the concentration and purity of the DNA using agarose gel electrophoresis.We then amplified The primers internal transcribed spacer 1 (ITS1) region with the forward primer ITS1F (5’-GGAAGTAAAAGTCGTAACAAGG-3’) and the reverse primer ITS1R (5’-GCTGCGTTCTTCATCGATGC-3’) using polymerase chain reactions (PCRs) (Gardes & Bruns, 1993). We performed PCRs in a 30 μL mixture composed of 15 µL of Phusion Master Mix (2 ×), 10 µL of DNA template, 3 µL of primer, and 2 µL of dd H2O, and conducted the PCR reactions as follows: denaturation at 98 ℃ for 1 min, followed by 30 cycles of 30 s at 98 ℃, 30 s at 55 ℃ (for annealing) and 30 s at 72 ℃ (for elongation), concluding with 5 mins at 72 ℃ for extention and reaction termination.

We constructed our library with a TruSeq DNA PCR-Free Library Preparation Kit (Illumina, San Diego, CA), and we then used a Qubit@ 2.0 Fluorometer (Thermo Fisher Scientific, Waltham, MA) and Agilent 2100 Bioanalyzer system (Agilent Technologies, Santa Clara, CA) to assess the quality of the library. We operated the Illumina NovaSeq 6000 platform to quantify and sequence the constructed library for soil fungi. We then used non-clustering direct denoising to generate operational taxonomic units (OTUs) based on the UNOISE3 algorithm (Edgar, 2016), and removed rare sequences (reads < 8) to avoid the possible spurious reads generated by sequencing errors. Then used the UNITE fungal ITS reference database v.7 ( Kõljalg et al., 2013) to identify the fungus at the genus level.

**References**

1. Edgar, R. C. (2016). UNOISE2: improved error-correction for Illumina 16S and ITS amplicon sequencing. *bioRxiv*, https://doi.org/10.1101/081257
2. Gardes, M., & Bruns, T. D. (1993). ITS primers with enhanced specificity for basidiomycetes–application to the identification of mycorrhizae and rusts. *Molecular Ecology*, *2*, 113-118.
3. Kõljalg, U., Nilsson, R.H., Abarenkov, K., Tedersoo, L., Taylor, A.F.S., Bahram, M., Bates, S.T., Bruns, T.D., Bengtsson-Palme, J., Callaghan, T.M., Douglas, B., Drenkhan, T., Eberhardt, U., Dueñas, M., Grebenc, T., Griffith, G.W., Hartmann, M., Kirk, P.M., Kohout, P., ... Larsson, K. H. (2013). Towards a unified paradigm for sequence-based identification of fungi. *Molecular Ecology*, *22*, 5271-5277.

**Table S1.1.** The 41 papers included in the meta-analysis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Author(s) & Published Year** | **Published Journal** | **Pathogen group(s)** | **Associated pathogen species** | **Response Variable** |
| Karlman *et al.*,1994 | *Canadian Journal of Forest Research* | Canker | *Scleroderris* sp. | Disease incidence |
| Hou TJ *et al.*, 1995 | *Inner Mongolia Prataculture* | Rust | *Uromyces striatus* | Disease severity |
| Wilds, 1997 | *Journal of Vegetation Science* | Canker | *Discula destructiva* | Disease severity |
| Sun GZ *et al*., 1998 | *Sichuan Forestry Science and Technology* | Needle cast | *Lophodermium piceae* | Disease incidence |
| Austin & Jackie, 2000 | *Journal of Environmental horticulture* | Anthracnose, Spot, Blight | *Discula destructive*, *Elsinoe corni*, *Botrytis cinerea* | Disease severity |
| Carnegie *et al.*,2004 | *Canadian Journal of Forest Research* | Spot | *Mycosphaerella* spp., *Mycosphaerella* spp. | Disease severity |
| Díaz-Franco & Méndez-Rodriguez, 2005 | *Revista Mexicana de Fitopatologia* | Blight | *Pyricularia* *grisea* | Disease severity |
| Wang BQ *et al*., 2006 | *Forest Pest and Disease* | Mutiple diseases | Mutiple pathogens | Disease severity |
| Zhang X, 2008 | Master Thesis, Sichuan Agricultural University | NA | *Lophodermium conigenum* | Pathogen abundance |
| Mangelsdorff *et al*., 2012 | *Biodiversity and Conservation* | Rust | *Basidiomycota* spp. | Disease incidence |
| Abbate & Antonovics, 2014 | *Oikos* | Smut | *Microbotryum* spp. | Disease incidence |
| Busby *et al*., 2014 | *Journal of Ecology* | NA | *Drepanopeziza populi* | Disease severity |
| Pellissier *et al*., 2014 | *Molecular Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Dantec *et al*., 2015 | *Journal of Ecology* | Powdery mildew | *Erysiphe* spp. | Disease severity |
| Yao GB, 2015 | Master Thesis, Yunnan University | NA | Mutiple pathogens | Pathogen abundance |
| Liu XH, 2016 | Master Thesis, Sichuan agricultural University | Needle cast | *Lophodermium piceae* | Disease incidence |
| Siles & Margesin, 2016 | *Microbial Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Siddique & Unterseher, 2016 | *Fungal Ecology* | NA | NA | *ffpOTUs* |
| Unterseher *et al*., 2016 | *PLoS One* | NA | NA | *ffpOTUs* |
| Peay *et al*., 2017 | *FEMS Microbiology Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Yao F *et al*., 2017 | *Frontiers in Microbiology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Tian JQ *et al*., 2017 | *Journal of Soils and Sediments* | NA | NA | *sfpOTUs* / *sfpRA* |
| Ping YA *et al*., 2017 | *World Journal of Microbiology & Biotechnology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Bowman & Arnold, 2018 | *American Journal of Botany* | NA | NA | *ffpOTUs* |
| Schön *et al*., 2018 | *PLoS One* | NA | NA | *sfpOTUs* / *sfpRA* |
| Nottingham *et al*., 2018 | *Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Merges *et al*., 2018 | *Journal of Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Cobian *et al*., 2019 | *The ISME journal* | NA | NA | *ffpOTUs* |
| Sheng YY *et al.*, 2019 | *Frontiers in Microbiology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Dahl *et al*., 2019 | *Microbial Ecology* | NA | NA | *sfpOTUs* / *sfpRA* |
| Hu RR *et al*., 2020 | *Global Ecology and Conservation* | Blight | *Pestalotiopsis funerea* | Disease incidence |
| Shen CC *et al*., 2020 | *Environmental Microbiology* | NA | NA | *sfpOTUs* |
| Sur *et al*., 2021 | *Fungal Ecology* | NA | NA | *ffpOTUs* |
| Halliday *et al*., 2021 | *eLife* | Mutiple diseases | Mutiple pathogens | Disease severity |
| Ritóková *et al*., 2021 | *Canadian Journal of Forest Research* | Needle cast | *Nothophaeocryptopus gaeumannii* | Disease severity |
| Zhang P *et al*., 2021 | *Global Ecology and Conservation* | NA | NA | *sfpOTUs* / *sfpRA* |
| Yang Y *et al*., 2021 | *Science of The Total Environment* | NA | NA | *sfpOTUs* / *sfpRA* |
| Park *et al*., 2021 | *Environmental Microbiology Reports* | NA | NA | *sfpOTUs* / *sfpRA* |
| Shigyo & Hirao, 2021 | *Fungal Ecology* | NA | NA | *sfpOTUs* |
| Odriozola *et al.*, 2021 | *Soil Biology & Biochemistry* | NA | NA | *sfpOTUs* / *sfpRA* |
| Bernard *et al*., 2021 | *The ISME journal* | NA | NA | *ffpOTUs* |

Notes: NA (not available) = missing information in the literature; *sfpOTUs* = soil fungal pathogen OTU richness; *sfpRA* = soil fungal pathogen relative abundance.

References:

1. Karlman, M., Hansson, P., & Witzell, J. (1994). Scleroderris canker on lodgepole pine introduced in northern Sweden. *Canadian Journal of Forest Research*, *24*, 1948-1959.
2. Hou, T. J., Bai, R., Zhou, S. Q., Liu, Y. L., & Li, Z. H. (1995). The geographical distribution and influence factor of *Uromyces striatus*. *Inner Mongolia Prataculture*, *1*, 4.
3. Wilds, S. P. (1997). Gradient analysis of the distribution of a fungal disease of *Cornus florida* in the southern Appalachian Mountains, Tennessee. *Journal of Vegetation Science*, *8*, 811-818.
4. Sun, G. Z., Yang, Q. H., Zhao, Q., Wang, Z. C., Yang, X. C., & Wang, Y. (1998). The survey of *Lophodermium piceae*. *Sichuan Forestry Science and Technology*, *1*, 33-36.
5. Austin, H., & Jackie, M. (2000). Occurrence of dogwood anthracnose, spot anthracnose, and botrytis blight in native stands of flowering dogwood in North Alabama. *Journal of Environmental horticulture*, *18*, 154-159.
6. Carnegie, A. J., Johnson, I. G., & Henson, M. (2004). Variation among provenances and families of blackbutt (*Eucalyptus pilularis*) in early growth and susceptibility to damage from leaf spot fungi. *Canadian Journal of Forest Research*, *34*, 2314-2326.
7. Díaz-Franco, A., & Méndez-Rodriguez, A. (2005).Leaf blight [*Pyricularia grisea* (Cooke) Sacc.] in buffelgrass (*Cenchrus ciliaris* L.) meadows and reaction of genotypes in northern Tamaulipas, Mexico. *Revista Mexicana de Fitopatologia*, *23*, 232-237.
8. Wang, B. Q., Ai X. R., Lu, Z. R., & Yu, X. Z. (2006). Occurrence regularity of leaf diseases in *Eucommia ulmoides* in the southwest mountainous area of Hubei Province. *Forest Pest and Disease*, *25*, 4.
9. Zhang, X. (2008). Studies on the dendrocola fungi on *Pinus armandi* in Erlangshan Mountain, Sichuan province. Master Thesis, Sichuan Agricultural University, Chengdu, Sichuan, China.
10. Mangelsdorff, R., Piepenbring, M., & Perdomo-Sánchez, O. (2012). Correlation of diversity of rust fungi and their host plants with disturbance and conservation of vegetation in western Panama: A case study in western Panama focused on *Orchidaceae* and pteridophytes as host plants. *Biodiversity and Conservation*, *21*, 2323-2339.
11. Abbate, J. L., & Antonovics, J. (2014). Elevational disease distribution in a natural plant-pathogen system: insights from changes across host populations and climate. *Oikos*, *123*, 1126-1136.
12. Busby, P. E., Newcombe, G., Dirzo, R., & Whitham, T. G. (2014). Differentiating genetic and environmental drivers of plant–pathogen community interactions. *Journal of Ecology*, *102*, 1300-1309.
13. Pellissier, L., Niculita-Hirzel, H., Dubuis, A., Pagni, M., Guex, N., Ndiribe, C., Salamin, N., Xenarios, I., Goudet, J., Sanders, I. R., & Guisan, A. (2014). Soil fungal communities of grasslands are environmentally structured at a regional scale in the Alps. *Molecular Ecology*, *23*, 4274-4290.
14. Dantec, C. F., Ducasse, H., Capdevielle, X., Fabreguettes, O., Delzon, S., & Desprez-Loustau, M. L. (2015). Escape of spring frost and disease through phenological variations in oak populations along elevation gradients. *Journal of Ecology*, *103*, 1044-1056.
15. Yao, G. B. (2015). Genetic diversity of Ageratina adenophora and its numerically dominant foliar fungal endophytes. Master Thesis, Yunnan University, Kunming, Yunnan, China.
16. Liu, X. H. (2016). Study on the effect of needle damage on growth of spruce in the west of Sichuan. Master Thesis, Sichuan Agricultural University, Chengdu, Sichuan, China.
17. Siles, J. A., & Margesin, R. (2016). Abundance and diversity of bacterial, archaeal, and fungal communities along an altitudinal gradient in alpine forest soils: What are the driving factors? *Microbial Ecology*, *72*, 207-220.
18. Siddique, A. B., & Unterseher, M. (2016). A cost-effective and efficient strategy for Illumina sequencing of fungal communities: A case study of beech endophytes identified elevation as main explanatory factor for diversity and community composition. *Fungal Ecology*, *20*, 175-185.
19. Unterseher, M., Siddique, A. B., Brachmann, A., & Peršoh, D. (2016). Diversity and composition of the leaf mycobiome of beech (*Fagus sylvatica*) are affected by local habitat conditions and leaf biochemistry. *PLoS One*,*11*, e0152878
20. Peay, K. G., von Sperber, C., Cardarelli, E., Toju, H., Francis, C. A., Chadwick, O. A., & Vitousek, P. M. (2017). Convergence and contrast in the community structure of bacteria, fungi and archaea along a tropical elevation-climate gradient. *FEMS Microbiology Ecology*, *93*, fix045.
21. Yao, F., Yang, S., Wang, Z. R., Wang, X., Ye, J., Wang, X. G., DeBruyn, J. M., Feng, X., Jiang, Y., & Li, H. (2017). Microbial taxa distribution is associated with ecological trophic cascades along an elevation gradient. *Frontiers in Microbiology*, *8*, 2071.
22. Tian, J. Q., Wu, B., Chen, H., Jiang, N., Kang, X. M., & Liu, X. Z. (2017). Patterns and drivers of fungal diversity along an altitudinal gradient on Mount Gongga, China. *Journal of Soils and Sediments*, *17*, 2856-2865.
23. Ping, Y. A., Han, D. X., Wang, N., Hu, Y. B., Mu, L. Q., & Feng, F. J. (2017). Vertical zonation of soil fungal community structure in a Korean pine forest on Changbai Mountain, China. *World Journal of Microbiology & Biotechnology*, *33*, 12.
24. Bowman, E. A., & Arnold, A. E. (2018). Distributions of ectomycorrhizal and foliar endophytic fungal communities associated with *Pinus ponderosa* along a spatially constrained elevation gradient. *American Journal of Botany*, *105*, 687-699.
25. Schön, M. E., Nieselt, K., & Garnica, S. (2018). Belowground fungal community diversity and composition associated with Norway spruce along an altitudinal gradient. *PLoS One*, *13*, e0208493.
26. Nottingham, A. T., Fierer, N., Turner, B. L., Whitaker, J., Ostle, N. J., McNamara, N. P., Bardgett, R. D., Leff, J. W., Salinas, N., Silman, M. R., Kruuk, L .E. B., & Meir, P. (2018). Microbes follow Humboldt: temperature drives plant and soil microbial diversity patterns from the Amazon to the Andes. *Ecology*, *99*, 2455-2466.
27. Merges, D., Bálint, M., Schmitt, I., Böhning-Gaese, K., & Neuschulz, E. L. (2018). Spatial patterns of pathogenic and mutualistic fungi across the elevational range of a host plant. *Journal of Ecology*, *106*, 1545-1557.
28. Cobian, G. M., Egan, C. P., & Amend, A. S. (2019). Plant-microbe specificity varies as a function of elevation. *The ISME journal*, *13*, 2778-2788.
29. Sheng, Y. Y., Cong, W., Yang, L. S., Liu, Q., & Zhang, Y. G. (2019). Forest Soil Fungal Community Elevational Distribution Pattern and Their Ecological Assembly Processes. *Frontiers in Microbiology*, *10*, 2226.
30. Dahl, M. B., Brejnrod, A. D., Russel, J., Sørensen, S. J., & Schnittler, M. (2019). Different degrees of niche differentiation for bacteria, fungi, and myxomycetes within an elevational transect in the German Alps. *Microbial Ecology*, *78*, 764-780.
31. Hu, R. R., Liang, J., Xie, X., Zhang, Y. J., & Zhang, X. Y. (2020). Incidence of pine needle blight and its relationship with site factors of Japanese red pine forests in the Kunyushan Mountains, East China. *Global Ecology and Conservation*, *22*, e00922.
32. Shen, C. C., Gunina, A., Luo, Y., Wang, J. J., He, J. Z., Kuzyakov, Y., Hemp, A., Classen, A. T., & Ge, Y. (2020). Contrasting patterns and drivers of soil bacterial and fungal diversity across a mountain gradient. *Environmental Microbiology*, *22*, 3287-3301.
33. Sur, G. L., Zahn, G., & Stacy, E. A. (2021). Examination of host-taxon, environment, and distance effects on leaf fungal endophytes in the dominant woody genus, Metrosideros, on Oʻahu. *Fungal Ecology*, *53*, 101093.
34. Halliday, F. W., Jalo, M., & Laine, A. L. (2021). The effect of host community functional traits on plant disease risk varies along an elevational gradient. *eLife*, *10*, e67340.
35. Ritóková, G., Mainwaring, D. B., Shaw, D. C., & Lan, Y. H. (2021). Douglas-fir foliage retention dynamics across a gradient of Swiss needle cast in coastal Oregon and Washington. *Canadian Journal of Forest Research*, *51*, 573-582.
36. Zhang, P., Luan, M. M., Li, X. R., Lian, Z. M., & Zhao, X. M. (2021). The distribution of soil fungal communities along an altitudinal gradient in an alpine meadow. *Global Ecology and Conservation*, *31*, e01838.
37. Yang, Y., Shi, Y., Kerfahi, D., Ogwu, M. C., Wang, J. J., Dong, K., Takahashi, K., Moroenyane, I., & Adams, J. M. (2021). Elevation-related climate trends dominate fungal co-occurrence network structure and the abundance of keystone taxa on Mt. Norikura, Japan. *Science of The Total Environment*, *799*, 149368.
38. Park, K .H., Yoo, S., Park, M. S., Kim, C. S., & Lim, Y. W. (2021). Different patterns of belowground fungal diversity along altitudinal gradients with respect to microhabitat and guild types. *Environmental Microbiology Reports*, *13*, 649-658.
39. Shigyo, N., & Hirao, T. (2021). Saprotrophic and ectomycorrhizal fungi exhibit contrasting richness patterns along elevational gradients in cool-temperate montane forests. *Fungal Ecology*, *50*, 101036.
40. Odriozola, I., Navrátilová, D., Tláskalová, P., Klinerová, T., Červenková, Z., Kohout, P., Větrovský, T., Čížková, P., Starý, M., & Baldrian, P. (2021). Predictors of soil fungal biomass and community composition in temperate mountainous forests in Central Europe. *Soil Biology & Biochemistry*, *161*, 108366.
41. Bernard, J., Wall, C. B., Costantini, M. S., Rollins, R. L., Atkins, M. L., Cabrera, F. P., Cetraro, N., Feliciano, C. K., Greene, A., Kitamura, P. K., Olmedo-Velarde, A., Sirimalwatta, V. N., Sung, H. W., Thompson, L., Vu, H. T., Wilhite, C. J., & Amend, A. S. (2021). Plant part and a steep environmental gradient predict plant microbial composition in a tropical watershed. *The ISME journal*, *15*, 999-1009.

**Table S1.2.** List of the 73 host plant species, observed diseases, pathogens, and corresponding disease severity index (*Vi*) along an elevation gradient.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | **3200m** | **3400m** | **3600m** | **3800m** | **4000m** | **Pathogen group(s)** | **Associated pathogen species** |
| *Thalictrum alpinum*  *Lancea tibetica*  *Ajania tenuifolia*  *Potentilla anserina*  *Kobresia humilis*  *Euphrasia pectinata*  *Stellaria media*  *Morina kokonorica*  *Gentiana abaensis*  *Taraxacum mongolicum*  *Potentilla potaninii*  *Deyeuxia flavens*  *Aster tataricus*  *Poa annua*  *Lomatogonium carinthiacum*  *Elymus nutans*  *Tibetia himalaica*  *Gentiana aristata*  *Saussurea pulchra*  *Saussurea nigrescens*  *Stipa aliena*  *Oxytropis caerulea*  *Anemone cathayensis*  *Silene adenantha*  *Oxytropis kansuensis*  *Medicago sativa*  *Gentiana lawrencei*  *Thalictrum rutifolium*  *Ranunculus tanguticus*  *Koeleria litvinowii*  *Anemone geum*  *Astragalus membranaceus*  *Festuca rubra*  *Lonicera humilis*  *Pedicularis kansuensis*  *Gentiana straminea*  *Polygonum sibiricum*  *Carex parva*  *Potentilla bifurca*  *Delphinium grandiflorum*  *Corydalis bungeana*  *Leontopodium leontopodioides* | 6.44 ± 1.71  6.74 ± 2.57  0.11 ± 0.11  8.65 ± 2.51  3.75 ± 0.42  6.89 ± 1.67  0.00 ± 0.00  11.11 ± 1.15  0.00 ± 0.00  15.72 ± 2.08  13.23 ± 2.29  6.00 ± 0.67  13.00 ± 2.28  6.52 ± 2.24  0.93 ± 0.93  10.43 ± 3.57  7.87 ± 2.41  0.00 ± 0.00  10.50 ± 2.17  21.11 ± 2.01  4.00 ± 0.42  4.27 ± 2.09  16.44 ± 5.57  0.00 ± 0.00  5.83 ± 2.91  1.33 ± 0.67  3.70 ± 3.70  2.67 ± 2.67  24.17 ± 17.50  2.30 ± 0.08  0.00 ± 0.00  1.25 ± 1.25  NA | 8.17 ± 1.64  3.19 ± 1.42  NA  6.80 ± 0.74  8.94 ± 1.66  2.00 ± 0.67  0.00 ± 0.00  NA  NA  15.28 ± 4.61  19.92 ± 4.51  9.21 ± 1.21  8.89 ± 2.30  1.19 ± 1.19  4.57 ± 1.46  6.94 ± 3.53  0.00 ± 0.00  NA  24.00 ± 0.67  12.78 ± 2.42  8.93 ± 6.36  12.89 ± 2.70  NA  NA  NA  NA  6.42 ± 3.90  10.83 ± 2.50  6.38 ± 1.62  NA  8.67 ± 3.72  NA  9.33 ± 4.23  NA  13.19 ± 9.48  NA  NA  4.74 ± 3.26 | 6.67 ± 2.18  NA  NA  NA  10.72 ± 0.83  NA  NA  NA  NA  NA  NA  4.26 ± 1.75  NA  0.00 ± 0.00  NA  3.11 ± 2.44  0.00 ± 0.00  23.72 ± 4.71  NA  0.00 ± 0.00  NA  NA  NA  NA  NA  3.79 ± 3.79  NA  NA  NA  9.67 ± 1.34  NA  NA  NA  NA  NA  NA  NA  NA | 15.33 ± 5.00  NA  NA  NA  NA  6.59 ± 3.51  NA  NA  12.60 ± 2.34  NA  5.17 ± 3.22  6.76 ± 2.76  NA  NA  1.67 ± 1.42  NA  NA  NA  2.82 ± 0.41  NA  NA  NA  NA  NA  NA  NA  NA  NA  6.40 ± 2.62  NA  NA  NA  NA  17.14 ± 1.95  NA  NA  NA  3.67 ± 1.74 | 10.80 ± 4.36  NA  NA  NA  18.49 ± 3.64  NA  10.56 ± 0.56  NA  NA  5.44 ± 2.72  9.11 ± 2.00  NA  6.89 ± 1.96  5.00 ± 5.00  NA  NA  NA  0.67 ± 0.47  NA  NA  0.56 ± 0.44  NA  NA  NA  1.00 ± 0.56  NA  9.58 ± 2.92  NA  NA  8.53 ± 1.42  NA  NA  NA  NA  NA  NA  1.00 ± 0.87 | Fungal leaf spot  Unidentified  Fungal leaf spot  Fungal leaf spot, rust  Fungal leaf spot, blight  Fungal leaf spot  Fungal leaf spot  Fungal leaf spot  None  Fungal leaf spot, rust  Unidentified  Unidentified  Fungal leaf spot, rust  Fungal leaf spot, rust  Unidentified  Fungal leaf spot, smut  Fungal leaf spot, downy mildew  Unidentified  Fungal leaf spot, rust  Fungal leaf spot  Fungal leaf spot, rust  Unidentified  Unidentified  Unidentified  None  Unidentified  Fungal leaf spot  Fungal leaf spot  Unidentified  Fungal leaf spot, blight  Unidentified  Unidentified  Fungal leaf spot, rust  None  Unidentified  Fungal leaf spot  Unidentified  Unidentified  Fungal leaf spot  Fungal leaf spot  None  Unidentified | *Alternaria thalivtriicola*  Unidentified  Unidentified  Unidentified, unidentified  *Ascochyta* sp., unidentified  Unidentified  Unidentified  Unidentified  None  Unidentified, *Puccinia hieracii*  Unidentified  Unidentified  Unidentified, *Puccinia* sp.  Unidentified, *Puccinia* sp.  Unidentified  *Ascochyta* sp., *Urocystis dahuricus*  Unidentified, *Peronospora* sp.  Unidentified  *Trichometasphaeria* sp., *Puccinia* sp.  *Trichometasphaeria* sp.  Unidentified, *Puccinia* sp.  Unidentified  Unidentified  Unidentified  None  Unidentified  Unidentified  *Alternaria thalivtriicola*  Unidentified  *Ascochyta* sp., unidentified  Unidentified  Unidentified  *Ascochyta* sp., *Puccinia* sp.  None  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  None  Unidentified |
| *Geranium wilfordii*  *Polygonum viviparum*  *Glaux maritima*  *Galium aparine*  *Plantago depressa*  *Polygonum*sp.  *Cerastium pusillum*  *Potentilla fruticosa*  *Anemone obtusiloba*  *Saussurea neoserrata*  *Viola biflora*  *Silene nepalensis*  *Rheum palmatum*  *Draba nemorosa*  *Viola grypoceras*  *Veronica didyma*  *Coluria longifolia*  *Angelica nitida*  *Koenigia islandica*  *Saxifraga stolonifera*  *Deschampsia caespitosa*  *Gentianopsis paludosa*  *Cardamine tangutorum*  *Ranunculus nephelogenes*  *Kobresia pygmaea*  *Lagotis glauca*  *Stellaria decumbens*  *Saussurea tibetica*  *Alternanthera sessilis*  *Commelina communis*  *Anaphalis sinica* | NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA | 10.18 ± 3.67  15.78 ± 2.86  6.25 ± 6.25  12.22 ± 5.46  6.25 ± 6.25  0.67 ± 0.67  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA | NA  5.84 ± 2.05  NA  NA  NA  NA  NA  NA  9.02 ± 2.30  NA  16.77 ± 1.85  5.88 ± 1.03  5.56 ± 5.56  23.67 ± 16.33  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA  NA | NA  NA  NA  NA  NA  NA  NA  NA  NA  17.94 ± 6.03  NA  2.98 ± 2.98  NA  NA  0.00 ± 0.00  0.00 ± 0.00  NA  NA  2.08 ± 2.08  NA  NA  NA  NA  NA  NA  NA | NA  9.48 ± 3.82  NA  NA  NA  NA  NA  NA  NA  NA  17.33 ± 1.33  NA  9.74 ± 3.86  NA  NA  NA  NA  7.50 ± 5.63  NA  NA  NA  NA  0.00 ± 0.00 | Unidentified  Rusts, smut  None  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Fungal leaf spot  Unidentified  Unidentified  None  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  None  Unidentified  Unidentified  Unidentified  None  None  Unidentified  Unidentified  Unidentified  Unidentified | Unidentified  *Puccinia vivipara*, *Ustiligo bistortarum*  None  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  None  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  Unidentified  None  Unidentified  Unidentified  Unidentified  None  None  Unidentified  Unidentified  Unidentified  Unidentified |

Notes: \* = the standard error (SE) cannot be calculated for this value (i.e. insufficient degrees of freedom); NA (not available) = missing species in this elevation.

**Table S1.3.** Permutational multivariate analysis of variance (PERMANOVA) results for the association between elevation and soil fungal pathogen composition based on 999 permutations.

|  |  |  |  |
| --- | --- | --- | --- |
| **Soil microbiota** |  | **Elevation** | |
| ***F*4,25** | ***P* value** | ***R* squared** |
| Soil fungal pathogen | 2.744 | ＜0.001 | 0.305 |

**Table S1.4** Model selection results for the community pathogen load (*PL*) based on linear mixed-effects models. Shown are the all models ranked by the Akaike information criterion corrected for small sample sizes (AICc). Predictive variables include elevation (*Elevation*), soil properties (Soil PCA1), aboveground biomass (*AGB*), Belowground biomass (*BGB*), Pielou’s evenness index (*Evenness*), community proneness index (*Proneness*) and species richness (*SR*). NA indicates that the predictive variable is not included in the given model. The random effects terms consisted of five elevations. All variables were standardized. *d.f.* = degree of freedom; loglik = log likelihood; **Δ**AICc = the difference in AICc of the given model from the minimum-AICc model; *w*AICc = AICc weights.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Elevation*** | ***Soil PCA1*** | ***AGB*** | ***BGB*** | ***Evenness*** | ***Proneness*** | ***SR*** | **R2** | ***d.f.*** | **logLik** | **AICc** | **ΔAICc** | ***w*AICc** |
| NA | NA | NA | NA | -0.327 | 0.680 | NA | 0.438 | 6 | -33.429 | 82.510 | 0.000 | 0.269 |
| NA | NA | NA | NA | NA | 0.583 | NA | 0.340 | 5 | -35.822 | 84.144 | 1.635 | 0.119 |
| NA | NA | NA | 0.108 | -0.363 | 0.729 | NA | 0.446 | 7 | -33.188 | 85.467 | 2.957 | 0.061 |
| NA | NA | NA | NA | -0.342 | 0.721 | 0.090 | 0.444 | 7 | -33.251 | 85.592 | 3.083 | 0.058 |
| NA | -0.055 | NA | NA | -0.314 | 0.660 | NA | 0.440 | 7 | -33.360 | 85.812 | 3.302 | 0.052 |
| -0.024 | NA | NA | NA | -0.328 | 0.688 | NA | 0.438 | 7 | -33.415 | 85.921 | 3.411 | 0.049 |
| NA | NA | -0.015 | NA | -0.328 | 0.676 | NA | 0.438 | 7 | -33.424 | 85.938 | 3.429 | 0.048 |
| NA | -0.127 | NA | NA | NA | 0.543 | NA | 0.355 | 6 | -35.490 | 86.633 | 4.123 | 0.034 |
| NA | NA | NA | NA | NA | 0.595 | 0.029 | 0.341 | 6 | -35.806 | 87.264 | 4.755 | 0.025 |
| NA | NA | NA | -0.019 | NA | 0.577 | NA | 0.341 | 6 | -35.815 | 87.283 | 4.773 | 0.025 |
| NA | NA | 0.014 | NA | NA | 0.588 | NA | 0.340 | 6 | -35.818 | 87.288 | 4.779 | 0.025 |
| -0.004 | NA | NA | NA | NA | 0.585 | NA | 0.340 | 6 | -35.822 | 87.296 | 4.786 | 0.025 |
| NA | -0.169 | NA | NA | -0.321 | 0.703 | 0.195 | 0.460 | 8 | -32.823 | 88.504 | 5.994 | 0.013 |
| NA | -0.138 | NA | 0.178 | -0.355 | 0.708 | NA | 0.459 | 8 | -32.850 | 88.557 | 6.048 | 0.013 |
| NA | -0.365 | 0.302 | NA | NA | 0.562 | NA | 0.386 | 7 | -34.750 | 88.590 | 6.080 | 0.013 |
| NA | NA | -0.179 | NA | -0.380 | 0.733 | 0.231 | 0.457 | 8 | -32.905 | 88.666 | 6.157 | 0.012 |
| -0.239 | -0.308 | NA | NA | NA | 0.562 | NA | 0.376 | 7 | -34.980 | 89.050 | 6.541 | 0.010 |
| NA | NA | -0.067 | 0.137 | -0.378 | 0.723 | NA | 0.450 | 8 | -33.097 | 89.051 | 6.542 | 0.010 |
| -0.159 | -0.180 | NA | NA | -0.296 | 0.665 | NA | 0.449 | 8 | -33.111 | 89.078 | 6.569 | 0.010 |
| NA | NA | NA | 0.082 | -0.363 | 0.741 | 0.052 | 0.448 | 8 | -33.142 | 89.142 | 6.632 | 0.010 |
| 0.022 | NA | NA | 0.118 | -0.365 | 0.726 | NA | 0.447 | 8 | -33.178 | 89.213 | 6.703 | 0.009 |
| 0.054 | NA | NA | NA | -0.345 | 0.719 | 0.127 | 0.446 | 8 | -33.209 | 89.275 | 6.765 | 0.009 |
| NA | -0.233 | NA | NA | NA | 0.581 | 0.178 | 0.371 | 7 | -35.103 | 89.297 | 6.788 | 0.009 |
| NA | -0.139 | 0.098 | NA | -0.287 | 0.655 | NA | 0.443 | 8 | -33.290 | 89.436 | 6.927 | 0.008 |
| -0.131 | NA | -0.126 | NA | -0.345 | 0.688 | NA | 0.442 | 8 | -33.309 | 89.476 | 6.966 | 0.008 |
| NA | -0.161 | NA | 0.067 | NA | 0.556 | NA | 0.358 | 7 | -35.423 | 89.938 | 7.428 | 0.007 |
| NA | NA | NA | -0.044 | NA | 0.588 | 0.052 | 0.342 | 7 | -35.777 | 90.645 | 8.135 | 0.005 |
| 0.024 | NA | NA | NA | NA | 0.594 | 0.045 | 0.341 | 7 | -35.799 | 90.690 | 8.180 | 0.005 |
| NA | NA | -0.012 | NA | NA | 0.595 | 0.038 | 0.341 | 7 | -35.805 | 90.700 | 8.191 | 0.004 |
| NA | NA | 0.024 | -0.027 | NA | 0.581 | NA | 0.341 | 7 | -35.805 | 90.701 | 8.192 | 0.004 |
| -0.015 | NA | NA | -0.025 | NA | 0.579 | NA | 0.341 | 7 | -35.812 | 90.714 | 8.205 | 0.004 |
| 0.026 | NA | 0.036 | NA | NA | 0.586 | NA | 0.341 | 7 | -35.814 | 90.719 | 8.209 | 0.004 |
| NA | -0.211 | NA | 0.139 | -0.351 | 0.732 | 0.155 | 0.470 | 9 | -32.525 | 92.049 | 9.540 | 0.002 |
| NA | -0.426 | 0.317 | 0.094 | NA | 0.580 | NA | 0.391 | 8 | -34.615 | 92.087 | 9.577 | 0.002 |
| -0.104 | -0.392 | 0.236 | NA | NA | 0.566 | NA | 0.388 | 8 | -34.685 | 92.227 | 9.718 | 0.002 |
| NA | -0.376 | 0.255 | NA | NA | 0.576 | 0.079 | 0.388 | 8 | -34.689 | 92.235 | 9.725 | 0.002 |
| -0.140 | -0.244 | NA | 0.169 | -0.336 | 0.710 | NA | 0.466 | 9 | -32.650 | 92.299 | 9.790 | 0.002 |
| -0.189 | -0.343 | NA | NA | NA | 0.584 | 0.122 | 0.383 | 8 | -34.815 | 92.487 | 9.978 | 0.002 |
| NA | NA | -0.189 | 0.096 | -0.407 | 0.757 | 0.194 | 0.462 | 9 | -32.754 | 92.509 | 9.999 | 0.002 |
| -0.087 | -0.222 | NA | NA | -0.309 | 0.700 | 0.169 | 0.462 | 9 | -32.756 | 92.512 | 10.003 | 0.002 |
| NA | -0.220 | 0.097 | 0.178 | -0.328 | 0.704 | NA | 0.461 | 9 | -32.779 | 92.558 | 10.049 | 0.002 |
| NA | -0.124 | -0.074 | NA | -0.342 | 0.713 | 0.225 | 0.461 | 9 | -32.795 | 92.589 | 10.079 | 0.002 |
| -0.122 | NA | -0.281 | NA | -0.396 | 0.744 | 0.227 | 0.461 | 9 | -32.802 | 92.603 | 10.094 | 0.002 |
| -0.236 | -0.338 | NA | 0.061 | NA | 0.573 | NA | 0.379 | 8 | -34.923 | 92.702 | 10.193 | 0.002 |
| NA | -0.242 | NA | 0.026 | NA | 0.584 | 0.170 | 0.371 | 8 | -35.094 | 93.045 | 10.535 | 0.001 |
| -0.099 | NA | -0.148 | 0.128 | -0.388 | 0.729 | NA | 0.452 | 9 | -33.032 | 93.063 | 10.554 | 0.001 |
| 0.071 | NA | NA | 0.093 | -0.369 | 0.741 | 0.095 | 0.451 | 9 | -33.072 | 93.144 | 10.635 | 0.001 |
| -0.167 | -0.172 | -0.016 | NA | -0.299 | 0.666 | NA | 0.449 | 9 | -33.109 | 93.219 | 10.709 | 0.001 |
| NA | NA | NA | NA | NA | NA | NA | 0.000 | 4 | -42.060 | 93.719 | 11.210 | 0.001 |
| NA | -0.298 | NA | NA | NA | NA | NA | 0.089 | 5 | -40.669 | 93.838 | 11.328 | 0.001 |
| 0.017 | NA | NA | -0.042 | NA | 0.588 | 0.062 | 0.342 | 8 | -35.773 | 94.404 | 11.894 | 0.001 |
| NA | NA | -0.013 | -0.044 | NA | 0.588 | 0.062 | 0.342 | 8 | -35.775 | 94.407 | 11.898 | 0.001 |
| 0.032 | NA | 0.012 | NA | NA | 0.593 | 0.041 | 0.341 | 8 | -35.799 | 94.454 | 11.945 | 0.001 |
| 0.016 | NA | 0.036 | -0.025 | NA | 0.581 | NA | 0.341 | 8 | -35.804 | 94.465 | 11.955 | 0.001 |
| NA | NA | NA | -0.221 | NA | NA | NA | 0.049 | 5 | -41.309 | 95.118 | 12.608 | 0.000 |
| NA | NA | NA | NA | NA | NA | -0.209 | 0.044 | 5 | -41.390 | 95.279 | 12.770 | 0.000 |
| 0.181 | NA | NA | NA | NA | NA | NA | 0.033 | 5 | -41.562 | 95.625 | 13.115 | 0.000 |
| NA | NA | -0.168 | NA | NA | NA | NA | 0.028 | 5 | -41.630 | 95.760 | 13.251 | 0.000 |
| -0.086 | -0.443 | 0.261 | 0.087 | NA | 0.582 | NA | 0.393 | 9 | -34.571 | 96.142 | 13.632 | 0.000 |
| NA | NA | NA | NA | -0.124 | NA | NA | 0.015 | 5 | -41.826 | 96.152 | 13.642 | 0.000 |
| NA | -0.423 | 0.290 | 0.082 | NA | 0.585 | 0.041 | 0.392 | 9 | -34.600 | 96.201 | 13.691 | 0.000 |
| -0.097 | -0.4 | 0.198 | NA | NA | 0.578 | 0.073 | 0.390 | 9 | -34.634 | 96.267 | 13.758 | 0.000 |
| NA | -0.469 | 0.212 | NA | NA | NA | NA | 0.104 | 6 | -40.412 | 96.475 | 13.966 | 0.000 |
| -0.089 | -0.265 | NA | 0.14 | -0.34 | 0.729 | 0.128 | 0.473 | 10 | -32.453 | 96.485 | 13.976 | 0.000 |
| -0.192 | -0.357 | NA | 0.035 | NA | 0.588 | 0.111 | 0.384 | 9 | -34.797 | 96.594 | 14.085 | 0.000 |
| NA | -0.19 | -0.033 | 0.136 | -0.360 | 0.736 | 0.170 | 0.471 | 10 | -32.519 | 96.617 | 14.108 | 0.000 |
| NA | -0.287 | NA | NA | -0.092 | NA | NA | 0.097 | 6 | -40.531 | 96.713 | 14.204 | 0.000 |
| -0.137 | -0.405 | NA | NA | NA | NA | NA | 0.096 | 6 | -40.549 | 96.750 | 14.240 | 0.000 |
| -0.155 | -0.155 | -0.176 | NA | -0.352 | 0.721 | 0.219 | 0.467 | 10 | -32.634 | 96.847 | 14.338 | 0.000 |
| NA | -0.255 | NA | -0.074 | NA | NA | NA | 0.092 | 6 | -40.609 | 96.871 | 14.361 | 0.000 |
| -0.140 | -0.244 | 0.001 | 0.169 | -0.336 | 0.710 | NA | 0.466 | 10 | -32.650 | 96.878 | 14.369 | 0.000 |
| -0.102 | NA | -0.273 | 0.086 | -0.417 | 0.763 | 0.195 | 0.465 | 10 | -32.684 | 96.946 | 14.436 | 0.000 |
| NA | -0.284 | NA | NA | NA | NA | -0.021 | 0.089 | 6 | -40.665 | 96.982 | 14.472 | 0.000 |
| NA | NA | NA | -0.151 | NA | NA | -0.123 | 0.059 | 6 | -41.149 | 97.949 | 15.440 | 0.000 |
| NA | NA | NA | NA | -0.118 | NA | -0.205 | 0.058 | 6 | -41.170 | 97.993 | 15.484 | 0.000 |
| 0.096 | NA | NA | -0.174 | NA | NA | NA | 0.056 | 6 | -41.196 | 98.044 | 15.535 | 0.000 |
| NA | NA | -0.090 | -0.182 | NA | NA | NA | 0.056 | 6 | -41.203 | 98.058 | 15.549 | 0.000 |
| NA | NA | NA | -0.204 | -0.083 | NA | NA | 0.055 | 6 | -41.204 | 98.060 | 15.550 | 0.000 |
| NA | NA | -0.195 | NA | -0.158 | NA | NA | 0.052 | 6 | -41.253 | 98.158 | 15.648 | 0.000 |
| 0.186 | NA | NA | NA | -0.132 | NA | NA | 0.050 | 6 | -41.291 | 98.235 | 15.725 | 0.000 |
| 0.070 | NA | NA | NA | NA | NA | -0.161 | 0.046 | 6 | -41.349 | 98.351 | 15.841 | 0.000 |
| NA | NA | -0.026 | NA | NA | NA | -0.190 | 0.044 | 6 | -41.385 | 98.423 | 15.913 | 0.000 |
| 0.018 | NA | 0.001 | -0.042 | NA | 0.588 | 0.062 | 0.342 | 9 | -35.773 | 98.547 | 16.037 | 0.000 |
| 0.137 | NA | -0.050 | NA | NA | NA | NA | 0.033 | 6 | -41.552 | 98.756 | 16.246 | 0.000 |
| NA | -0.448 | 0.295 | NA | NA | NA | -0.133 | 0.112 | 7 | -40.285 | 99.660 | 17.150 | 0.000 |
| NA | -0.428 | 0.205 | -0.061 | NA | NA | NA | 0.106 | 7 | -40.371 | 99.833 | 17.323 | 0.000 |
| NA | -0.437 | 0.178 | NA | -0.045 | NA | NA | 0.106 | 7 | -40.385 | 99.862 | 17.352 | 0.000 |
| -0.025 | -0.476 | 0.196 | NA | NA | NA | NA | 0.104 | 7 | -40.409 | 99.909 | 17.399 | 0.000 |
| -0.111 | -0.376 | NA | NA | -0.078 | NA | NA | 0.101 | 7 | -40.454 | 100.000 | 17.490 | 0.000 |
| -0.143 | -0.364 | NA | -0.08 | NA | NA | NA | 0.100 | 7 | -40.478 | 100.048 | 17.538 | 0.000 |
| NA | -0.256 | NA | -0.056 | -0.084 | NA | NA | 0.099 | 7 | -40.496 | 100.084 | 17.574 | 0.000 |
| -0.168 | -0.382 | NA | NA | NA | NA | -0.071 | 0.098 | 7 | -40.508 | 100.107 | 17.597 | 0.000 |
| NA | -0.269 | NA | NA | -0.093 | NA | -0.028 | 0.097 | 7 | -40.523 | 100.138 | 17.628 | 0.000 |
| NA | -0.257 | NA | -0.075 | NA | NA | 0.005 | 0.092 | 7 | -40.609 | 100.309 | 17.799 | 0.000 |
| -0.085 | -0.441 | 0.238 | 0.076 | NA | 0.587 | 0.038 | 0.394 | 10 | -34.558 | 100.696 | 18.186 | 0.000 |
| NA | NA | -0.127 | -0.143 | -0.117 | NA | NA | 0.068 | 7 | -41.010 | 101.110 | 18.601 | 0.000 |
| NA | NA | NA | -0.125 | -0.095 | NA | -0.135 | 0.067 | 7 | -41.011 | 101.114 | 18.604 | 0.000 |
| 0.114 | NA | NA | -0.146 | -0.100 | NA | NA | 0.065 | 7 | -41.048 | 101.187 | 18.677 | 0.000 |
| 0.084 | NA | NA | NA | -0.123 | NA | -0.147 | 0.061 | 7 | -41.111 | 101.314 | 18.804 | 0.000 |
| NA | NA | -0.086 | NA | -0.135 | NA | -0.141 | 0.060 | 7 | -41.124 | 101.339 | 18.829 | 0.000 |
| 0.046 | NA | NA | -0.145 | NA | NA | -0.095 | 0.060 | 7 | -41.132 | 101.354 | 18.844 | 0.000 |
| NA | NA | -0.027 | -0.151 | NA | NA | -0.102 | 0.059 | 7 | -41.143 | 101.378 | 18.868 | 0.000 |
| -0.137 | -0.214 | -0.126 | 0.127 | -0.368 | 0.742 | 0.168 | 0.475 | 11 | -32.392 | 101.451 | 18.941 | 0.000 |
| 0.061 | NA | -0.042 | -0.174 | NA | NA | NA | 0.056 | 7 | -41.188 | 101.468 | 18.958 | 0.000 |
| 0.078 | NA | -0.127 | NA | -0.149 | NA | NA | 0.054 | 7 | -41.228 | 101.547 | 19.037 | 0.000 |
| 0.107 | NA | 0.057 | NA | NA | NA | -0.179 | 0.047 | 7 | -41.338 | 101.767 | 19.258 | 0.000 |
| NA | -0.430 | 0.271 | NA | -0.026 | NA | -0.126 | 0.112 | 8 | -40.276 | 103.410 | 20.900 | 0.000 |
| -0.043 | -0.459 | 0.269 | NA | NA | NA | -0.136 | 0.112 | 8 | -40.277 | 103.411 | 20.902 | 0.000 |
| NA | -0.436 | 0.286 | -0.020 | NA | NA | -0.123 | 0.112 | 8 | -40.281 | 103.418 | 20.909 | 0.000 |
| NA | -0.405 | 0.177 | -0.055 | -0.037 | NA | NA | 0.108 | 8 | -40.353 | 103.563 | 21.053 | 0.000 |
| -0.040 | -0.437 | 0.179 | -0.064 | NA | NA | NA | 0.107 | 8 | -40.365 | 103.586 | 21.077 | 0.000 |
| -0.033 | -0.444 | 0.156 | NA | -0.046 | NA | NA | 0.106 | 8 | -40.381 | 103.619 | 21.110 | 0.000 |
| -0.12 | -0.346 | NA | -0.065 | -0.067 | NA | NA | 0.104 | 8 | -40.409 | 103.675 | 21.165 | 0.000 |
| -0.142 | -0.354 | NA | NA | -0.077 | NA | -0.069 | 0.104 | 8 | -40.415 | 103.688 | 21.178 | 0.000 |
| -0.163 | -0.355 | NA | -0.068 | NA | NA | -0.047 | 0.101 | 8 | -40.462 | 103.782 | 21.272 | 0.000 |
| NA | -0.251 | NA | -0.054 | -0.085 | NA | -0.009 | 0.099 | 8 | -40.496 | 103.848 | 21.339 | 0.000 |
| NA | NA | -0.076 | -0.121 | -0.111 | NA | -0.079 | 0.070 | 8 | -40.974 | 104.806 | 22.296 | 0.000 |
| 0.062 | NA | NA | -0.115 | -0.101 | NA | -0.097 | 0.069 | 8 | -40.980 | 104.817 | 22.307 | 0.000 |
| 0.030 | NA | -0.103 | -0.140 | -0.115 | NA | NA | 0.068 | 8 | -41.006 | 104.869 | 22.360 | 0.000 |
| 0.063 | NA | -0.034 | NA | -0.128 | NA | -0.136 | 0.061 | 8 | -41.108 | 105.073 | 22.563 | 0.000 |
| 0.057 | NA | 0.017 | -0.143 | NA | NA | -0.101 | 0.060 | 8 | -41.131 | 105.118 | 22.609 | 0.000 |
| -0.046 | -0.441 | 0.241 | NA | -0.027 | NA | -0.129 | 0.113 | 9 | -40.268 | 107.535 | 25.026 | 0.000 |
| -0.047 | -0.446 | 0.256 | -0.024 | NA | NA | -0.124 | 0.112 | 9 | -40.272 | 107.544 | 25.034 | 0.000 |
| NA | -0.420 | 0.264 | -0.019 | -0.025 | NA | -0.117 | 0.112 | 9 | -40.273 | 107.546 | 25.036 | 0.000 |
| -0.045 | -0.413 | 0.146 | -0.058 | -0.039 | NA | NA | 0.108 | 9 | -40.345 | 107.690 | 25.180 | 0.000 |
| -0.140 | -0.337 | NA | -0.051 | -0.069 | NA | -0.051 | 0.105 | 9 | -40.390 | 107.780 | 25.270 | 0.000 |
| 0.029 | NA | -0.053 | -0.118 | -0.108 | NA | -0.079 | 0.070 | 9 | -40.971 | 108.942 | 26.433 | 0.000 |
| -0.05 | -0.429 | 0.231 | -0.022 | -0.026 | NA | -0.118 | 0.113 | 10 | -40.263 | 112.105 | 29.596 | 0.000 |

**Table S1.5** Model selection results for the soil fungal pathogen OTU richness (*sfpOTUs*) based on linear mixed-effects models. Shown are the all models ranked by the Akaike information criterion corrected for small sample sizes (AICc). Predictive variables include elevation (*Elevation*), soil properties (Soil PCA1), aboveground biomass (*AGB*), Belowground biomass (*BGB*), Pielou’s evenness index (*Evenness*), community proneness index (*Proneness*) and species richness (*SR*). NA indicates that the predictive variable is not included in the given model. The random effects terms consisted of five elevations. All variables were standardized. *d.f.* = degree of freedom; loglik = log likelihood; **Δ**AICc = the difference in AICc of the given model from the minimum-AICc model; *w*AICc = AICc weights.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Elevation*** | ***Soil PCA1*** | ***AGB*** | ***BGB*** | ***Evenness*** | ***Proneness*** | ***SR*** | **R2** | ***d.f.*** | **logLik** | **AICc** | **ΔAICc** | ***w*AICc** |
| -1.070 | -0.533 | NA | NA | NA | NA | NA | 0.534 | 6 | -30.595 | 76.842 | 0.000 | 0.294 |
| -1.092 | -0.513 | NA | NA | NA | 0.119 | NA | 0.547 | 7 | -30.186 | 79.464 | 2.622 | 0.079 |
| -1.102 | -0.569 | NA | NA | 0.095 | NA | NA | 0.543 | 7 | -30.319 | 79.730 | 2.888 | 0.069 |
| -1.089 | -0.497 | NA | -0.1 | NA | NA | NA | 0.539 | 7 | -30.442 | 79.974 | 3.133 | 0.061 |
| -0.652 | NA | NA | NA | NA | NA | NA | 0.425 | 5 | -33.761 | 80.023 | 3.181 | 0.060 |
| -1.102 | -0.519 | NA | NA | NA | NA | -0.063 | 0.536 | 7 | -30.547 | 80.186 | 3.344 | 0.055 |
| -1.016 | NA | -0.426 | NA | NA | NA | NA | 0.473 | 6 | -32.437 | 80.526 | 3.685 | 0.047 |
| -0.766 | NA | NA | -0.233 | NA | NA | NA | 0.461 | 6 | -32.794 | 81.241 | 4.399 | 0.033 |
| -0.701 | NA | NA | NA | NA | 0.157 | NA | 0.447 | 6 | -33.174 | 82.001 | 5.159 | 0.022 |
| -1.110 | NA | -0.411 | -0.219 | NA | NA | NA | 0.505 | 7 | -31.506 | 82.104 | 5.262 | 0.021 |
| -0.786 | NA | NA | NA | NA | NA | -0.190 | 0.442 | 6 | -33.307 | 82.267 | 5.425 | 0.020 |
| -1.192 | -0.45 | -0.176 | NA | NA | 0.116 | NA | 0.554 | 8 | -29.962 | 82.781 | 5.940 | 0.015 |
| -1.042 | NA | -0.405 | NA | NA | 0.139 | NA | 0.491 | 7 | -31.938 | 82.966 | 6.124 | 0.014 |
| -1.132 | -0.525 | NA | -0.133 | 0.113 | NA | NA | 0.551 | 8 | -30.061 | 82.979 | 6.137 | 0.014 |
| -1.100 | -0.491 | NA | -0.061 | NA | 0.107 | NA | 0.549 | 8 | -30.129 | 83.116 | 6.274 | 0.013 |
| -1.207 | -0.411 | -0.208 | -0.114 | NA | NA | NA | 0.548 | 8 | -30.142 | 83.141 | 6.300 | 0.013 |
| -0.652 | NA | NA | NA | 0.013 | NA | NA | 0.425 | 6 | -33.757 | 83.166 | 6.325 | 0.012 |
| -1.098 | -0.509 | NA | NA | NA | 0.116 | -0.015 | 0.547 | 8 | -30.183 | 83.223 | 6.382 | 0.012 |
| -1.164 | -0.515 | -0.123 | NA | 0.07 | NA | NA | 0.546 | 8 | -30.229 | 83.316 | 6.474 | 0.012 |
| -1.127 | -0.551 | NA | NA | 0.095 | NA | -0.056 | 0.544 | 8 | -30.270 | 83.397 | 6.555 | 0.011 |
| -1.177 | -0.466 | -0.178 | NA | NA | NA | -0.01 | 0.542 | 8 | -30.354 | 83.565 | 6.723 | 0.010 |
| -1.125 | -0.490 | NA | -0.098 | NA | NA | -0.06 | 0.540 | 8 | -30.401 | 83.659 | 6.817 | 0.010 |
| -1.036 | NA | -0.451 | NA | -0.049 | NA | NA | 0.476 | 7 | -32.373 | 83.837 | 6.995 | 0.009 |
| -1.025 | NA | -0.394 | NA | NA | NA | -0.053 | 0.475 | 7 | -32.402 | 83.895 | 7.054 | 0.009 |
| -0.782 | NA | NA | -0.195 | NA | 0.107 | NA | 0.470 | 7 | -32.525 | 84.141 | 7.299 | 0.008 |
| -0.839 | NA | NA | -0.205 | NA | NA | -0.121 | 0.467 | 7 | -32.621 | 84.333 | 7.491 | 0.007 |
| -0.783 | NA | NA | -0.259 | 0.076 | NA | NA | 0.466 | 7 | -32.652 | 84.395 | 7.553 | 0.007 |
| -0.782 | NA | NA | NA | NA | 0.130 | -0.129 | 0.455 | 7 | -32.952 | 84.995 | 8.153 | 0.005 |
| -0.703 | NA | NA | NA | -0.035 | 0.168 | NA | 0.448 | 7 | -33.144 | 85.379 | 8.537 | 0.004 |
| -1.113 | NA | -0.401 | -0.180 | NA | 0.097 | NA | 0.512 | 8 | -31.285 | 85.427 | 8.585 | 0.004 |
| -0.790 | NA | NA | NA | 0.027 | NA | -0.193 | 0.443 | 7 | -33.289 | 85.669 | 8.827 | 0.004 |
| -1.106 | NA | -0.44 | -0.227 | NA | NA | 0.047 | 0.506 | 8 | -31.486 | 85.830 | 8.988 | 0.003 |
| -1.109 | NA | -0.409 | -0.22 | 0.003 | NA | NA | 0.505 | 8 | -31.506 | 85.870 | 9.028 | 0.003 |
| -1.086 | NA | -0.451 | NA | -0.097 | 0.168 | NA | 0.499 | 8 | -31.700 | 86.258 | 9.416 | 0.003 |
| NA | NA | NA | NA | NA | NA | NA | 0.217 | 4 | -38.393 | 86.387 | 9.545 | 0.002 |
| -1.206 | -0.409 | -0.196 | -0.070 | NA | 0.102 | NA | 0.557 | 9 | -29.862 | 86.724 | 9.882 | 0.002 |
| -1.043 | NA | -0.404 | NA | NA | 0.138 | -0.002 | 0.491 | 8 | -31.938 | 86.732 | 9.891 | 0.002 |
| -1.185 | -0.472 | -0.150 | NA | 0.030 | 0.106 | NA | 0.554 | 9 | -29.942 | 86.883 | 10.041 | 0.002 |
| -1.128 | -0.515 | NA | -0.096 | 0.085 | 0.070 | NA | 0.554 | 9 | -29.950 | 86.900 | 10.058 | 0.002 |
| -1.196 | -0.463 | -0.133 | -0.131 | 0.086 | NA | NA | 0.554 | 9 | -29.959 | 86.919 | 10.077 | 0.002 |
| -1.165 | -0.519 | NA | -0.130 | 0.113 | NA | -0.055 | 0.552 | 9 | -30.025 | 87.050 | 10.208 | 0.002 |
| -1.119 | -0.534 | NA | NA | 0.065 | 0.092 | -0.025 | 0.550 | 9 | -30.067 | 87.134 | 10.292 | 0.002 |
| -1.105 | -0.490 | NA | -0.061 | NA | 0.105 | -0.009 | 0.549 | 9 | -30.128 | 87.257 | 10.415 | 0.002 |
| -1.20 | -0.407 | -0.230 | -0.116 | NA | NA | 0.033 | 0.548 | 9 | -30.134 | 87.267 | 10.425 | 0.002 |
| -1.167 | -0.514 | -0.103 | NA | 0.074 | NA | -0.030 | 0.546 | 9 | -30.217 | 87.434 | 10.592 | 0.001 |
| -1.040 | NA | -0.424 | NA | -0.043 | NA | -0.039 | 0.476 | 8 | -32.355 | 87.568 | 10.726 | 0.001 |
| -0.829 | NA | NA | -0.181 | NA | 0.09 | -0.085 | 0.473 | 8 | -32.444 | 87.745 | 10.904 | 0.001 |
| -0.852 | NA | NA | -0.229 | 0.073 | NA | -0.118 | 0.472 | 8 | -32.484 | 87.825 | 10.984 | 0.001 |
| -0.787 | NA | NA | -0.213 | 0.035 | 0.09 | NA | 0.471 | 8 | -32.500 | 87.857 | 11.015 | 0.001 |
| NA | NA | NA | -0.199 | NA | NA | NA | 0.247 | 5 | -37.811 | 88.122 | 11.281 | 0.001 |
| NA | -0.386 | NA | NA | NA | NA | NA | 0.239 | 5 | -37.957 | 88.414 | 11.572 | 0.001 |
| -0.780 | NA | NA | NA | -0.019 | 0.137 | -0.124 | 0.455 | 8 | -32.943 | 88.743 | 11.901 | 0.001 |
| NA | NA | NA | NA | NA | 0.097 | NA | 0.227 | 5 | -38.192 | 88.883 | 12.042 | 0.001 |
| NA | NA | 0.224 | NA | NA | NA | NA | 0.226 | 5 | -38.216 | 88.932 | 12.091 | 0.001 |
| NA | NA | NA | NA | NA | NA | -0.039 | 0.217 | 5 | -38.382 | 89.265 | 12.423 | 0.001 |
| NA | NA | NA | NA | 0.016 | NA | NA | 0.217 | 5 | -38.388 | 89.276 | 12.434 | 0.001 |
| -1.109 | NA | -0.458 | -0.199 | NA | 0.112 | 0.096 | 0.516 | 9 | -31.189 | 89.378 | 12.536 | 0.001 |
| -1.125 | NA | -0.423 | -0.158 | -0.044 | 0.116 | NA | 0.514 | 9 | -31.242 | 89.484 | 12.642 | 0.001 |
| -1.106 | NA | -0.441 | -0.227 | -0.002 | NA | 0.047 | 0.506 | 9 | -31.486 | 89.972 | 13.131 | 0.000 |
| NA | -0.35 | NA | -0.202 | NA | NA | NA | 0.273 | 6 | -37.268 | 90.188 | 13.346 | 0.000 |
| -1.085 | NA | -0.484 | NA | -0.108 | 0.179 | 0.049 | 0.500 | 9 | -31.675 | 90.350 | 13.509 | 0.000 |
| NA | -0.416 | NA | NA | NA | 0.111 | NA | 0.255 | 6 | -37.637 | 90.927 | 14.085 | 0.000 |
| NA | NA | 0.053 | -0.216 | NA | NA | NA | 0.253 | 6 | -37.677 | 91.007 | 14.165 | 0.000 |
| NA | NA | NA | -0.222 | NA | NA | -0.020 | 0.253 | 6 | -37.684 | 91.019 | 14.178 | 0.000 |
| NA | NA | NA | -0.184 | NA | 0.073 | NA | 0.253 | 6 | -37.686 | 91.024 | 14.182 | 0.000 |
| NA | -0.409 | 0.231 | NA | NA | NA | NA | 0.249 | 6 | -37.756 | 91.163 | 14.322 | 0.000 |
| -1.203 | -0.404 | -0.241 | -0.091 | NA | 0.111 | 0.075 | 0.558 | 10 | -29.797 | 91.172 | 14.330 | 0.000 |
| NA | -0.451 | NA | NA | NA | NA | -0.124 | 0.249 | 6 | -37.772 | 91.196 | 14.354 | 0.000 |
| -1.200 | -0.439 | -0.156 | -0.087 | 0.049 | 0.082 | NA | 0.558 | 10 | -29.811 | 91.201 | 14.360 | 0.000 |
| NA | NA | NA | -0.205 | 0.036 | NA | NA | 0.248 | 6 | -37.780 | 91.213 | 14.371 | 0.000 |
| -1.141 | -0.513 | NA | -0.098 | 0.086 | 0.063 | -0.023 | 0.554 | 10 | -29.944 | 91.468 | 14.626 | 0.000 |
| -1.196 | -0.464 | -0.131 | -0.131 | 0.086 | NA | -0.003 | 0.554 | 10 | -29.959 | 91.498 | 14.656 | 0.000 |
| NA | -0.387 | NA | NA | 0.018 | NA | NA | 0.240 | 6 | -37.949 | 91.550 | 14.708 | 0.000 |
| NA | NA | 0.215 | NA | NA | 0.093 | NA | 0.235 | 6 | -38.040 | 91.732 | 14.890 | 0.000 |
| -0.839 | NA | NA | -0.201 | 0.043 | 0.068 | -0.091 | 0.475 | 9 | -32.406 | 91.812 | 14.971 | 0.000 |
| NA | NA | 0.269 | NA | 0.065 | NA | NA | 0.230 | 6 | -38.144 | 91.940 | 15.099 | 0.000 |
| NA | NA | NA | NA | -0.029 | 0.109 | NA | 0.228 | 6 | -38.176 | 92.005 | 15.163 | 0.000 |
| NA | NA | NA | NA | NA | 0.096 | -0.003 | 0.227 | 6 | -38.192 | 92.036 | 15.194 | 0.000 |
| NA | NA | 0.234 | NA | NA | NA | -0.052 | 0.227 | 6 | -38.197 | 92.046 | 15.204 | 0.000 |
| NA | NA | NA | NA | 0.015 | NA | -0.037 | 0.218 | 6 | -38.378 | 92.408 | 15.566 | 0.000 |
| NA | -0.378 | NA | -0.177 | NA | 0.078 | NA | 0.281 | 7 | -37.104 | 93.300 | 16.458 | 0.000 |
| NA | -0.361 | NA | -0.222 | 0.063 | NA | NA | 0.278 | 7 | -37.174 | 93.439 | 16.598 | 0.000 |
| NA | -0.372 | 0.093 | -0.189 | NA | NA | NA | 0.275 | 7 | -37.231 | 93.552 | 16.711 | 0.000 |
| -1.127 | NA | -0.499 | -0.180 | -0.062 | 0.139 | 0.116 | 0.518 | 10 | -31.104 | 93.787 | 16.945 | 0.000 |
| NA | -0.45 | 0.198 | NA | NA | 0.108 | NA | 0.264 | 7 | -37.471 | 94.033 | 17.191 | 0.000 |
| NA | -0.443 | 0.374 | NA | 0.111 | NA | NA | 0.261 | 7 | -37.530 | 94.151 | 17.309 | 0.000 |
| NA | NA | 0.154 | -0.223 | 0.085 | NA | NA | 0.259 | 7 | -37.562 | 94.215 | 17.374 | 0.000 |
| NA | NA | 0.055 | -0.199 | NA | 0.063 | NA | 0.258 | 7 | -37.585 | 94.261 | 17.420 | 0.000 |
| NA | -0.425 | NA | NA | NA | 0.105 | -0.050 | 0.257 | 7 | -37.612 | 94.315 | 17.473 | 0.000 |
| NA | -0.418 | NA | NA | -0.032 | 0.124 | NA | 0.256 | 7 | -37.615 | 94.322 | 17.480 | 0.000 |
| NA | NA | NA | -0.235 | 0.052 | NA | -0.011 | 0.256 | 7 | -37.624 | 94.339 | 17.497 | 0.000 |
| NA | -0.469 | 0.254 | NA | NA | NA | -0.122 | 0.256 | 7 | -37.631 | 94.354 | 17.512 | 0.000 |
| NA | NA | 0.059 | -0.213 | NA | NA | -0.026 | 0.254 | 7 | -37.672 | 94.435 | 17.593 | 0.000 |
| NA | NA | NA | -0.186 | NA | 0.076 | 0.023 | 0.253 | 7 | -37.681 | 94.454 | 17.612 | 0.000 |
| NA | NA | NA | -0.185 | 0.006 | 0.071 | NA | 0.253 | 7 | -37.685 | 94.461 | 17.619 | 0.000 |
| NA | -0.453 | NA | NA | 0.022 | NA | -0.122 | 0.249 | 7 | -37.760 | 94.611 | 17.769 | 0.000 |
| NA | NA | 0.242 | NA | 0.028 | 0.083 | NA | 0.236 | 7 | -38.029 | 95.149 | 18.307 | 0.000 |
| NA | NA | 0.218 | NA | NA | 0.091 | -0.018 | 0.235 | 7 | -38.038 | 95.166 | 18.324 | 0.000 |
| NA | NA | 0.292 | NA | 0.069 | NA | -0.062 | 0.231 | 7 | -38.116 | 95.323 | 18.481 | 0.000 |
| NA | NA | NA | NA | -0.029 | 0.108 | -0.003 | 0.228 | 7 | -38.176 | 95.444 | 18.602 | 0.000 |
| -1.197 | -0.426 | -0.205 | -0.096 | 0.036 | 0.096 | 0.062 | 0.559 | 11 | -29.770 | 96.206 | 19.365 | 0.000 |
| NA | -0.409 | 0.105 | -0.163 | NA | 0.081 | NA | 0.284 | 8 | -37.055 | 96.967 | 20.125 | 0.000 |
| NA | -0.405 | NA | -0.174 | NA | 0.067 | -0.067 | 0.283 | 8 | -37.064 | 96.986 | 20.144 | 0.000 |
| NA | -0.454 | 0.143 | -0.175 | NA | NA | -0.131 | 0.282 | 8 | -37.092 | 97.041 | 20.199 | 0.000 |
| NA | -0.378 | NA | -0.188 | 0.026 | 0.065 | NA | 0.282 | 8 | -37.092 | 97.041 | 20.199 | 0.000 |
| NA | -0.398 | NA | -0.212 | 0.055 | NA | -0.086 | 0.281 | 8 | -37.103 | 97.064 | 20.222 | 0.000 |
| NA | -0.373 | 0.230 | -0.151 | 0.083 | NA | NA | 0.273 | 8 | -37.275 | 97.406 | 20.565 | 0.000 |
| NA | -0.538 | 0.234 | NA | NA | 0.091 | -0.135 | 0.272 | 8 | -37.291 | 97.440 | 20.598 | 0.000 |
| NA | -0.452 | 0.247 | NA | 0.033 | 0.094 | NA | 0.264 | 8 | -37.457 | 97.770 | 20.929 | 0.000 |
| NA | -0.487 | 0.369 | NA | 0.087 | NA | -0.119 | 0.262 | 8 | -37.495 | 97.847 | 21.006 | 0.000 |
| NA | NA | 0.13 | -0.211 | 0.061 | 0.036 | NA | 0.260 | 8 | -37.542 | 97.941 | 21.099 | 0.000 |
| NA | NA | 0.159 | -0.220 | 0.084 | NA | -0.023 | 0.259 | 8 | -37.558 | 97.973 | 21.132 | 0.000 |
| NA | NA | 0.056 | -0.199 | NA | 0.063 | -0.002 | 0.258 | 8 | -37.585 | 98.028 | 21.186 | 0.000 |
| NA | -0.428 | NA | NA | -0.034 | 0.118 | -0.054 | 0.258 | 8 | -37.586 | 98.029 | 21.188 | 0.000 |
| NA | NA | NA | -0.188 | 0.007 | 0.073 | 0.023 | 0.253 | 8 | -37.680 | 98.218 | 21.376 | 0.000 |
| NA | NA | 0.251 | NA | 0.031 | 0.078 | -0.025 | 0.236 | 8 | -38.025 | 98.907 | 22.065 | 0.000 |
| NA | -0.508 | 0.282 | -0.190 | 0.116 | NA | -0.133 | 0.294 | 9 | -36.844 | 100.687 | 23.846 | 0.000 |
| NA | -0.468 | 0.148 | -0.153 | NA | 0.068 | -0.104 | 0.288 | 9 | -36.970 | 100.940 | 24.099 | 0.000 |
| NA | -0.567 | 0.326 | NA | 0.069 | 0.061 | -0.154 | 0.275 | 9 | -37.231 | 101.462 | 24.621 | 0.000 |
| NA | -0.352 | NA | -0.142 | -0.004 | 0.087 | -0.022 | 0.274 | 9 | -37.260 | 101.519 | 24.677 | 0.000 |
| NA | NA | 0.134 | -0.210 | 0.062 | 0.034 | -0.010 | 0.260 | 9 | -37.541 | 102.082 | 25.240 | 0.000 |

**Table S1.6** Model selection results for the soil fungal pathogen relative abundance (*sfpRA*) based on linear mixed-effects models. Shown are the all models ranked by the Akaike information criterion corrected for small sample sizes (AICc). Predictive variables include elevation (*Elevation*), soil properties (Soil PCA1), aboveground biomass (*AGB*), Belowground biomass (*BGB*), Pielou’s evenness index (*Evenness*), community proneness index (*Proneness*) and species richness (*SR*). NA indicates that the predictive variable is not included in the given model. The random effects terms consisted of five elevations. All variables were standardized. *d.f.* = degree of freedom; loglik = log likelihood; **Δ**AICc = the difference in AICc of the given model from the minimum-AICc model; *w*AICc = AICc weights.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Elevation*** | ***Soil PCA1*** | ***AGB*** | ***BGB*** | ***Evenness*** | ***Proneness*** | ***SR*** | **R2** | ***d.f.*** | **logLik** | **AICc** | **ΔAICc** | ***w*AICc** |
| NA | NA | NA | NA | NA | NA | NA | 0.000 | 4 | -42.060 | 93.719 | 0.000 | 0.122 |
| NA | NA | NA | NA | NA | NA | -0.317 | 0.075 | 5 | -40.892 | 94.284 | 0.565 | 0.092 |
| -0.385 | NA | NA | NA | NA | NA | -0.544 | 0.140 | 6 | -39.799 | 95.250 | 1.530 | 0.057 |
| NA | NA | NA | NA | 0.174 | NA | NA | 0.030 | 5 | -41.600 | 95.699 | 1.980 | 0.045 |
| NA | NA | -0.154 | NA | NA | NA | NA | 0.024 | 5 | -41.700 | 95.900 | 2.181 | 0.041 |
| NA | -0.095 | NA | NA | NA | NA | NA | 0.009 | 5 | -41.923 | 96.345 | 2.626 | 0.033 |
| NA | NA | NA | NA | 0.175 | NA | -0.308 | 0.104 | 6 | -40.404 | 96.461 | 2.742 | 0.031 |
| NA | NA | NA | 0.225 | NA | NA | -0.389 | 0.102 | 6 | -40.449 | 96.551 | 2.832 | 0.030 |
| -0.007 | NA | NA | NA | NA | NA | NA | 0.000 | 5 | -42.059 | 96.618 | 2.899 | 0.029 |
| NA | NA | NA | NA | NA | -0.006 | NA | 0.000 | 5 | -42.059 | 96.618 | 2.899 | 0.029 |
| NA | NA | NA | 0.002 | NA | NA | NA | 0.000 | 5 | -42.060 | 96.619 | 2.900 | 0.029 |
| -0.517 | NA | -0.596 | NA | NA | NA | NA | 0.095 | 6 | -40.556 | 96.765 | 3.045 | 0.027 |
| NA | NA | NA | NA | NA | -0.137 | -0.38 | 0.092 | 6 | -40.615 | 96.882 | 3.163 | 0.025 |
| NA | 0.151 | NA | NA | NA | NA | -0.403 | 0.086 | 6 | -40.706 | 97.063 | 3.344 | 0.023 |
| NA | NA | 0.121 | NA | NA | NA | -0.400 | 0.081 | 6 | -40.797 | 97.246 | 3.527 | 0.021 |
| -0.378 | NA | NA | NA | 0.205 | NA | -0.527 | 0.176 | 7 | -39.160 | 97.410 | 3.691 | 0.019 |
| -0.585 | NA | -0.359 | NA | NA | NA | -0.394 | 0.162 | 7 | -39.408 | 97.907 | 4.188 | 0.015 |
| -0.324 | NA | NA | 0.182 | NA | NA | -0.588 | 0.156 | 7 | -39.521 | 98.133 | 4.414 | 0.013 |
| -0.382 | NA | NA | NA | NA | -0.13 | -0.601 | 0.155 | 7 | -39.535 | 98.162 | 4.442 | 0.013 |
| NA | NA | -0.128 | NA | 0.152 | NA | NA | 0.046 | 6 | -41.352 | 98.356 | 4.637 | 0.012 |
| NA | -0.116 | NA | NA | 0.187 | NA | NA | 0.044 | 6 | -41.391 | 98.435 | 4.716 | 0.012 |
| NA | NA | NA | NA | 0.257 | -0.234 | -0.409 | 0.147 | 7 | -39.678 | 98.447 | 4.728 | 0.011 |
| -0.449 | -0.102 | NA | NA | NA | NA | -0.524 | 0.143 | 7 | -39.740 | 98.572 | 4.852 | 0.011 |
| NA | NA | NA | NA | 0.193 | -0.064 | NA | 0.034 | 6 | -41.543 | 98.737 | 5.018 | 0.010 |
| NA | NA | NA | -0.035 | 0.181 | NA | NA | 0.031 | 6 | -41.582 | 98.816 | 5.097 | 0.010 |
| -0.014 | NA | NA | NA | 0.174 | NA | NA | 0.030 | 6 | -41.597 | 98.846 | 5.126 | 0.009 |
| NA | NA | -0.189 | 0.082 | NA | NA | NA | 0.029 | 6 | -41.616 | 98.883 | 5.164 | 0.009 |
| NA | NA | -0.172 | NA | NA | -0.06 | NA | 0.027 | 6 | -41.650 | 98.953 | 5.234 | 0.009 |
| -0.213 | -0.262 | NA | NA | NA | NA | NA | 0.026 | 6 | -41.657 | 98.966 | 5.247 | 0.009 |
| NA | 0.085 | -0.223 | NA | NA | NA | NA | 0.026 | 6 | -41.662 | 98.976 | 5.257 | 0.009 |
| NA | NA | NA | 0.184 | 0.148 | NA | -0.371 | 0.123 | 7 | -40.096 | 99.283 | 5.563 | 0.008 |
| NA | NA | 0.213 | NA | 0.214 | NA | -0.452 | 0.121 | 7 | -40.120 | 99.330 | 5.611 | 0.007 |
| NA | -0.145 | NA | 0.085 | NA | NA | NA | 0.014 | 6 | -41.849 | 99.351 | 5.632 | 0.007 |
| NA | -0.108 | NA | NA | NA | -0.040 | NA | 0.011 | 6 | -41.900 | 99.453 | 5.734 | 0.007 |
| NA | 0.121 | NA | NA | 0.164 | NA | -0.378 | 0.112 | 7 | -40.282 | 99.655 | 5.936 | 0.006 |
| NA | NA | NA | 0.206 | NA | -0.102 | -0.419 | 0.110 | 7 | -40.307 | 99.705 | 5.985 | 0.006 |
| -0.006 | NA | NA | NA | NA | -0.005 | NA | 0.000 | 6 | -42.059 | 99.769 | 6.050 | 0.006 |
| -0.008 | NA | NA | -0.002 | NA | NA | NA | 0.000 | 6 | -42.059 | 99.770 | 6.051 | 0.006 |
| NA | NA | NA | -0.001 | NA | -0.007 | NA | 0.000 | 6 | -42.059 | 99.770 | 6.051 | 0.006 |
| -0.389 | NA | NA | NA | 0.265 | -0.228 | -0.636 | 0.214 | 8 | -38.457 | 99.771 | 6.052 | 0.006 |
| NA | NA | 0.098 | 0.225 | NA | NA | -0.463 | 0.106 | 7 | -40.379 | 99.850 | 6.130 | 0.006 |
| -0.478 | NA | -0.545 | NA | 0.099 | NA | NA | 0.105 | 7 | -40.403 | 99.897 | 6.178 | 0.006 |
| NA | 0.066 | NA | 0.205 | NA | NA | -0.422 | 0.104 | 7 | -40.413 | 99.917 | 6.197 | 0.005 |
| NA | 0.15 | NA | NA | NA | -0.136 | -0.466 | 0.103 | 7 | -40.430 | 99.950 | 6.231 | 0.005 |
| NA | NA | 0.12 | NA | NA | -0.137 | -0.462 | 0.098 | 7 | -40.520 | 100.131 | 6.411 | 0.005 |
| -0.537 | -0.058 | -0.566 | NA | NA | NA | NA | 0.096 | 7 | -40.539 | 100.169 | 6.449 | 0.005 |
| -0.511 | NA | -0.601 | NA | NA | -0.031 | NA | 0.096 | 7 | -40.542 | 100.175 | 6.456 | 0.005 |
| -0.514 | NA | -0.597 | 0.007 | NA | NA | NA | 0.095 | 7 | -40.556 | 100.202 | 6.483 | 0.005 |
| NA | 0.137 | 0.025 | NA | NA | NA | -0.412 | 0.086 | 7 | -40.703 | 100.497 | 6.778 | 0.004 |
| -0.501 | -0.193 | NA | NA | 0.231 | NA | -0.485 | 0.188 | 8 | -38.929 | 100.714 | 6.995 | 0.004 |
| -0.528 | NA | -0.239 | NA | 0.168 | NA | -0.450 | 0.187 | 8 | -38.956 | 100.769 | 7.050 | 0.004 |
| -0.354 | NA | NA | 0.129 | 0.180 | NA | -0.584 | 0.186 | 8 | -38.971 | 100.799 | 7.080 | 0.004 |
| -0.287 | -0.346 | NA | NA | 0.224 | NA | NA | 0.074 | 7 | -40.907 | 100.905 | 7.186 | 0.003 |
| -0.532 | NA | -0.316 | 0.152 | NA | NA | -0.477 | 0.177 | 8 | -39.139 | 101.136 | 7.417 | 0.003 |
| -0.572 | NA | -0.350 | NA | NA | -0.108 | -0.434 | 0.172 | 8 | -39.233 | 101.323 | 7.604 | 0.003 |
| NA | NA | 0.253 | NA | 0.31 | -0.252 | -0.587 | 0.170 | 8 | -39.262 | 101.381 | 7.662 | 0.003 |
| -0.44 | -0.199 | NA | 0.225 | NA | NA | -0.561 | 0.169 | 8 | -39.291 | 101.439 | 7.720 | 0.003 |
| NA | NA | -0.157 | NA | 0.179 | -0.108 | NA | 0.056 | 7 | -41.196 | 101.484 | 7.764 | 0.003 |
| NA | -0.160 | NA | NA | 0.229 | -0.125 | NA | 0.056 | 7 | -41.197 | 101.485 | 7.766 | 0.003 |
| -0.319 | NA | NA | 0.166 | NA | -0.092 | -0.612 | 0.163 | 8 | -39.397 | 101.652 | 7.932 | 0.002 |
| -0.588 | -0.008 | -0.355 | NA | NA | NA | -0.394 | 0.162 | 8 | -39.408 | 101.673 | 7.953 | 0.002 |
| NA | NA | -0.144 | 0.034 | 0.142 | NA | NA | 0.047 | 7 | -41.338 | 101.768 | 8.048 | 0.002 |
| NA | -0.032 | -0.101 | NA | 0.16 | NA | NA | 0.046 | 7 | -41.348 | 101.786 | 8.067 | 0.002 |
| -0.445 | -0.100 | NA | NA | NA | -0.129 | -0.58 | 0.158 | 8 | -39.479 | 101.815 | 8.096 | 0.002 |
| NA | -0.144 | NA | 0.048 | 0.18 | NA | NA | 0.045 | 7 | -41.368 | 101.826 | 8.107 | 0.002 |
| NA | 0.104 | NA | NA | 0.245 | -0.229 | -0.468 | 0.152 | 8 | -39.586 | 102.030 | 8.310 | 0.002 |
| NA | NA | NA | -0.077 | 0.218 | -0.098 | NA | 0.038 | 7 | -41.472 | 102.034 | 8.315 | 0.002 |
| NA | NA | NA | 0.090 | 0.234 | -0.214 | -0.446 | 0.151 | 8 | -39.597 | 102.052 | 8.332 | 0.002 |
| 0.006 | NA | NA | NA | 0.193 | -0.066 | NA | 0.034 | 7 | -41.542 | 102.175 | 8.456 | 0.002 |
| -0.041 | NA | NA | -0.056 | 0.187 | NA | NA | 0.033 | 7 | -41.562 | 102.215 | 8.496 | 0.002 |
| NA | NA | -0.197 | 0.07 | NA | -0.043 | NA | 0.031 | 7 | -41.592 | 102.274 | 8.555 | 0.002 |
| -0.207 | -0.301 | NA | 0.076 | NA | NA | NA | 0.030 | 7 | -41.598 | 102.286 | 8.567 | 0.002 |
| NA | 0.037 | -0.214 | 0.071 | NA | NA | NA | 0.030 | 7 | -41.610 | 102.311 | 8.591 | 0.002 |
| NA | 0.075 | -0.231 | NA | NA | -0.054 | NA | 0.029 | 7 | -41.621 | 102.333 | 8.614 | 0.002 |
| -0.208 | -0.266 | NA | NA | NA | -0.024 | NA | 0.027 | 7 | -41.649 | 102.389 | 8.669 | 0.002 |
| NA | NA | 0.180 | 0.175 | 0.185 | NA | -0.502 | 0.136 | 8 | -39.874 | 102.606 | 8.887 | 0.001 |
| NA | -0.149 | NA | 0.079 | NA | -0.026 | NA | 0.014 | 7 | -41.841 | 102.772 | 9.053 | 0.001 |
| NA | 0.055 | NA | 0.169 | 0.146 | NA | -0.398 | 0.124 | 8 | -40.070 | 102.997 | 9.278 | 0.001 |
| NA | -0.014 | 0.224 | NA | 0.218 | NA | -0.451 | 0.121 | 8 | -40.119 | 103.095 | 9.375 | 0.001 |
| -0.007 | NA | NA | -0.004 | NA | -0.005 | NA | 0.000 | 7 | -42.058 | 103.208 | 9.489 | 0.001 |
| NA | NA | 0.095 | 0.207 | NA | -0.101 | -0.491 | 0.114 | 8 | -40.240 | 103.337 | 9.617 | 0.001 |
| -0.52 | -0.237 | NA | NA | 0.309 | -0.234 | -0.565 | 0.229 | 9 | -38.168 | 103.337 | 9.617 | 0.001 |
| NA | 0.063 | NA | 0.188 | NA | -0.101 | -0.450 | 0.112 | 8 | -40.273 | 103.403 | 9.684 | 0.001 |
| -0.515 | -0.15 | -0.45 | NA | 0.134 | NA | NA | 0.110 | 8 | -40.304 | 103.465 | 9.746 | 0.001 |
| -0.457 | NA | -0.545 | NA | 0.118 | -0.066 | NA | 0.108 | 8 | -40.344 | 103.545 | 9.825 | 0.001 |
| NA | 0.009 | 0.092 | 0.223 | NA | NA | -0.463 | 0.106 | 8 | -40.379 | 103.615 | 9.896 | 0.001 |
| -0.486 | NA | -0.541 | -0.024 | 0.105 | NA | NA | 0.105 | 8 | -40.397 | 103.650 | 9.931 | 0.001 |
| NA | 0.136 | 0.026 | NA | NA | -0.136 | -0.476 | 0.103 | 8 | -40.427 | 103.711 | 9.992 | 0.001 |
| -0.478 | NA | -0.173 | NA | 0.24 | -0.199 | -0.547 | 0.215 | 9 | -38.420 | 103.840 | 10.121 | 0.001 |
| -0.532 | -0.063 | -0.569 | NA | NA | -0.034 | NA | 0.097 | 8 | -40.522 | 103.901 | 10.181 | 0.001 |
| -0.531 | -0.074 | -0.559 | 0.026 | NA | NA | NA | 0.097 | 8 | -40.532 | 103.921 | 10.201 | 0.001 |
| -0.356 | NA | NA | 0.074 | 0.252 | -0.197 | -0.634 | 0.213 | 9 | -38.468 | 103.937 | 10.217 | 0.001 |
| -0.511 | NA | -0.601 | -0.001 | NA | -0.031 | NA | 0.096 | 8 | -40.542 | 103.941 | 10.222 | 0.001 |
| -0.507 | -0.254 | NA | 0.177 | 0.204 | NA | -0.549 | 0.207 | 9 | -38.589 | 104.178 | 10.459 | 0.001 |
| -0.279 | -0.380 | NA | NA | 0.262 | -0.116 | NA | 0.084 | 8 | -40.736 | 104.329 | 10.609 | 0.001 |
| -0.494 | NA | -0.220 | 0.118 | 0.148 | NA | -0.507 | 0.195 | 9 | -38.798 | 104.595 | 10.876 | 0.001 |
| -0.284 | -0.359 | NA | 0.028 | 0.220 | NA | NA | 0.074 | 8 | -40.899 | 104.656 | 10.936 | 0.001 |
| -0.562 | -0.138 | -0.153 | NA | 0.200 | NA | -0.447 | 0.192 | 9 | -38.863 | 104.726 | 11.007 | 0.000 |
| -0.526 | NA | -0.313 | 0.137 | NA | -0.090 | -0.502 | 0.184 | 9 | -39.019 | 105.037 | 11.318 | 0.000 |
| -0.557 | -0.108 | -0.257 | 0.181 | NA | NA | -0.483 | 0.180 | 9 | -39.083 | 105.166 | 11.447 | 0.000 |
| NA | -0.087 | -0.086 | NA | 0.205 | -0.121 | NA | 0.058 | 8 | -41.165 | 105.187 | 11.468 | 0.000 |
| NA | NA | -0.153 | -0.009 | 0.182 | -0.111 | NA | 0.056 | 8 | -41.196 | 105.248 | 11.529 | 0.000 |
| NA | -0.164 | NA | 0.008 | 0.227 | -0.123 | NA | 0.056 | 8 | -41.197 | 105.250 | 11.531 | 0.000 |
| -0.436 | -0.199 | NA | 0.209 | NA | -0.092 | -0.585 | 0.175 | 9 | -39.166 | 105.332 | 11.612 | 0.000 |
| NA | NA | 0.245 | 0.073 | 0.290 | -0.236 | -0.613 | 0.173 | 9 | -39.207 | 105.415 | 11.696 | 0.000 |
| NA | -0.102 | 0.335 | NA | 0.338 | -0.263 | -0.587 | 0.173 | 9 | -39.216 | 105.432 | 11.713 | 0.000 |
| -0.569 | -0.019 | -0.278 | NA | NA | -0.125 | -0.507 | 0.172 | 9 | -39.226 | 105.452 | 11.733 | 0.000 |
| NA | -0.059 | -0.1 | 0.047 | 0.154 | NA | NA | 0.048 | 8 | -41.325 | 105.507 | 11.788 | 0.000 |
| -0.029 | NA | NA | -0.09 | 0.221 | -0.094 | NA | 0.039 | 8 | -41.462 | 105.781 | 12.061 | 0.000 |
| NA | 0.036 | -0.222 | 0.060 | NA | -0.043 | NA | 0.031 | 8 | -41.586 | 106.029 | 12.310 | 0.000 |
| -0.205 | -0.302 | NA | 0.073 | NA | -0.011 | NA | 0.030 | 8 | -41.596 | 106.050 | 12.330 | 0.000 |
| NA | 0.082 | NA | 0.068 | 0.231 | -0.215 | -0.484 | 0.154 | 9 | -39.545 | 106.090 | 12.371 | 0.000 |
| NA | -0.126 | 0.282 | 0.206 | 0.211 | NA | -0.513 | 0.139 | 9 | -39.808 | 106.616 | 12.897 | 0.000 |
| -0.497 | -0.187 | -0.427 | NA | 0.168 | -0.090 | NA | 0.117 | 9 | -40.197 | 107.394 | 13.674 | 0.000 |
| NA | 0.007 | 0.091 | 0.205 | NA | -0.101 | -0.491 | 0.114 | 9 | -40.240 | 107.479 | 13.760 | 0.000 |
| -0.522 | -0.275 | NA | 0.122 | 0.282 | -0.209 | -0.600 | 0.237 | 10 | -38.008 | 107.595 | 13.876 | 0.000 |
| -0.513 | -0.153 | -0.449 | 0.006 | 0.133 | NA | NA | 0.110 | 9 | -40.304 | 107.607 | 13.888 | 0.000 |
| -0.471 | NA | -0.536 | -0.054 | 0.136 | -0.083 | NA | 0.110 | 9 | -40.313 | 107.625 | 13.906 | 0.000 |
| -0.527 | -0.230 | -0.019 | NA | 0.304 | -0.232 | -0.559 | 0.229 | 10 | -38.167 | 107.914 | 14.194 | 0.000 |
| -0.528 | -0.073 | -0.564 | 0.018 | NA | -0.031 | NA | 0.098 | 9 | -40.518 | 108.037 | 14.318 | 0.000 |
| -0.462 | NA | -0.167 | 0.069 | 0.222 | -0.183 | -0.573 | 0.218 | 10 | -38.367 | 108.314 | 14.595 | 0.000 |
| -0.280 | -0.376 | NA | -0.011 | 0.265 | -0.119 | NA | 0.085 | 9 | -40.734 | 108.469 | 14.750 | 0.000 |
| -0.535 | -0.226 | -0.071 | 0.168 | 0.191 | NA | -0.528 | 0.207 | 10 | -38.575 | 108.730 | 15.010 | 0.000 |
| NA | -0.091 | -0.086 | 0.008 | 0.203 | -0.119 | NA | 0.058 | 9 | -41.164 | 109.329 | 15.610 | 0.000 |
| -0.551 | -0.109 | -0.255 | 0.166 | NA | -0.090 | -0.508 | 0.187 | 10 | -38.961 | 109.501 | 15.782 | 0.000 |
| NA | -0.159 | 0.370 | 0.109 | 0.325 | -0.246 | -0.627 | 0.179 | 10 | -39.109 | 109.796 | 16.077 | 0.000 |
| -0.501 | -0.176 | -0.429 | -0.024 | 0.174 | -0.097 | NA | 0.117 | 10 | -40.191 | 111.961 | 18.242 | 0.000 |
| -0.510 | -0.287 | 0.031 | 0.125 | 0.289 | -0.212 | -0.610 | 0.237 | 11 | -38.006 | 112.678 | 18.959 | 0.000 |

**Table S1.7.** Coefficients extracted from the final structure equation model of associations between elevation and community pathogen load (*PL*) and soil fungal pathogen OTU richness (*sfpOTUs*) through plausible pathways include soil properties (*Soil PCA1*), Pielou's evenness index (*Evenness*) and community proneness index (*Proneness*). Shown are the standardized path coefficients (scaled by their mean and standard deviation), standard error of coefficients, and the levels of significance for corresponding pathways (*P* value). Significant pathways (at *P* < 0.1 level) are in bold.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Predictor** |  | **Response** | **Standard coefficient** | **Standard error** | ***P*** |
| ***Soil PCA1*** | **→** | ***sfpOTUs*** | **-0.540** | **4.426** | **0.026** |
| *Proneness* | **→** | *sfpOTUs* | 0.097 | 8.215 | 0.529 |
| *Evenness* | **→** | *sfpOTUs* | 0.063 | 41.837 | 0.672 |
| ***Elevation*** | **→** | ***sfpOTUs*** | **-1.109** | **0.010** | **0.015** |
| *Soil PCA1* | **→** | *PL* | -0.180 | 0.144 | 0.482 |
| *Proneness* | **→** | ***PL*** | **0.665** | **0.266** | **< 0.001** |
| *Evenness* | **→** | ***PL*** | **-0.296** | **1.356** | **0.082** |
| ***Elevation*** | **→** | *PL* | -0.159 | 0.000 | 0.563 |
| ***Elevation*** | **→** | ***Soil PCA1*** | **-0.768** | **0.001** | **0.038** |
| ***Elevation*** | **→** | *Evenness* | 0.065 | 0.000 | 0.798 |
| ***Elevation*** | **→** | *Proneness* | 0.316 | 0.000 | 0.176 |

**Table S1.8.** Results of Kendall's rank correlation test for each meta-regression in the meta-analysis. Shown are Kendall's τ value and corresponding *P*. Here, no significantly negative correlation means that the corresponding funnel plot is symmetrical, indicating no potential publication bias.

|  |  |  |  |
| --- | --- | --- | --- |
| **Response variable** | **Number of effect sizes** | **Kendall's τ** | ***P*** |
| 1. **Overall effect** | | | |
| Foliar fungal pathogen OTU richness | 6 | -0.200 | 0.719 |
| Foliar fungal disease | 24 | -0.114 | 0.441 |
| Soil fungal pathogen OTU richness | 17 | -0.140 | 0.433 |
| Soil fungal pathogen relative abundance | 15 | 0.153 | 0.428 |
| 1. **Ecosystem type (only for foliar fungal disease)** | | | |
| Forest | 14 | -0.034 | 0.869 |
| Grassland | 10 | -0.180 | 0.473 |

**Table S1.9.** Estimated regression coefficient, standard error, 95% confidence intervals (95% CI) and *P* value of meta-regression relating the associations between elevation and foliar fungal pathogen OTU richness, foliar fungal diseases, soil fungal pathogen OTU richness and soil fungal pathogen relative abundance and across different ecosystem type (i.e. forest vs. grassland, only for foliar fungal disease) in the meta-analysis. The fail-safe number for significance tests is given.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Response variable** | **Number of effect sizes** | **Estimate regression coefficient** | **Standard error** | **Lower 95% CI** | **Upper**  **95% CI** | ***P*** | **Fail-safe number** |
| 1. **Overall effect** | | | | | | | |
| Foliar fungal pathogen OTU richness | 6 | -0.157 | 0.134 | -0.419 | 0.106 | 0.242 | N.A. |
| Foliar fungal disease | 24 | -0.047 | 0.124 | -0.289 | 0.195 | 0.703 | N.A. |
| Soil fungal pathogen OTU richness | 17 | -0.257 | 0.088 | -0.429 | -0.085 | **0.003\*\*** | 278 |
| Soil fungal pathogen relative abundance | 15 | -0.101 | 0.093 | -0.283 | 0.082 | 0.281 | N.A. |
| 1. **Ecosystem type (only for foliar fungal disease)** | | | | | | | |
| forest | 14 | -0.127 | 0.225 | -0.567 | 0.313 | 0.571 | N.A. |
| grassland | 10 | 0.023 | 0.078 | -0.130 | 0.175 | 0.772 | N.A. |

**Table S1.10.** Meta-regression results for the effects of mean annual temperature, mean annual precipitation, latitude and elevation range of sampling on the effect size (*Z*) of elevation on: (a) foliar fungal pathogen OTU richness; (b) foliar fungal disease; (c) soil fungal pathogen OTU richness and (d) soil fungal pathogen relative abundance in the meta-analysis.Shown are the estimated regression coefficient, standard error, 95% confidence intervals (95% CI) and *P* value for each effect. Significant results are in bold at the *P* = 0.05 level.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fixed effects** | **Number of**  **effect size** | **Estimated regression coefficient** | | **Standard error** | **Lower**  **95% CI** | **Upper**  **95% CI** | ***P*** | |
| 1. **Foliar fungal pathogen OTU richness** | | | | | | | |
| Mean annual temperature | 6 | | 0.0134 | 0.0202 | -0.0262 | 0.0531 | 0.5071 |
| Mean annual precipitation | 6 | | -0.0002 | 0.0004 | -0.0010 | 0.0006 | 0.6014 |
| **Latitude** | **6** | | **-0.0201** | **0.0097** | **-0.0392** | **-0.0009** | **0.0397** |
| Elevation range of sampling | 6 | | -0.0003 | 0.0007 | -0.0017 | 0.0011 | 0.6983 |
| 1. **Foliar fungal disease** | | | | | | | |
| Mean annual temperature | 24 | | 0.0101 | 0.0267 | -0.0423 | 0.0624 | 0.7065 |
| Mean annual precipitation | 24 | | 0.0003 | 0.0002 | -0.0002 | 0.0007 | 0.2725 |
| Latitude | 24 | | 0.0092 | 0.0153 | -0.0207 | 0.0392 | 0.5465 |
| Elevation range of sampling | 24 | | -0.0001 | 0.0002 | -0.0005 | 0.0003 | 0.5196 |
| 1. **Soil fungal pathogen OTU richness** | | | | | | | |
| Mean annual temperature | 17 | | 0.0044 | 0.0129 | -0.0208 | 0.0296 | 0.7321 |
| Mean annual precipitation | 17 | | -0.0002 | 0.0002 | -0.0005 | 0.0001 | 0.2087 |
| Latitude | 17 | | 0.0076 | 0.0068 | -0.0057 | 0.0209 | 0.2609 |
| **Elevation range of sampling** | **17** | | **-0.0002** | **0.0001** | **-0.0003** | **-0.0000** | **0.0325** |
| 1. **Soil fungal pathogen relative abundance** | | | | | | | |
| Mean annual temperature | 15 | | -0.0070 | 0.0141 | -0.0347 | 0.0207 | 0.6184 |
| Mean annual precipitation | 15 | | -0.0002 | 0.0002 | -0.0005 | 0.0001 | 0.1324 |
| Latitude | 15 | | 0.0106 | 0.0083 | -0.0056 | 0.0268 | 0.1994 |
| **Elevation range of sampling** | **15** | | **-0.0002** | **0.0001** | **-0.0004** | **-0.0000** | **0.0345** |

**Figure S1.1.** The (a) Geographical and (b) environmental locations of the field survey study and 62 studies (from 41 papers) included in the meta-analysis, across Whittaker’s biomes. The red star represents field survey study. The blue, green, orange and red dots represent studies on the foliar fungal pathogen OTU richness, foliar fungal diseases, soil fungal pathogen OTU richness and soil fungal pathogen relative abundance, respectively. The size of dots indicates the sample size of studies.



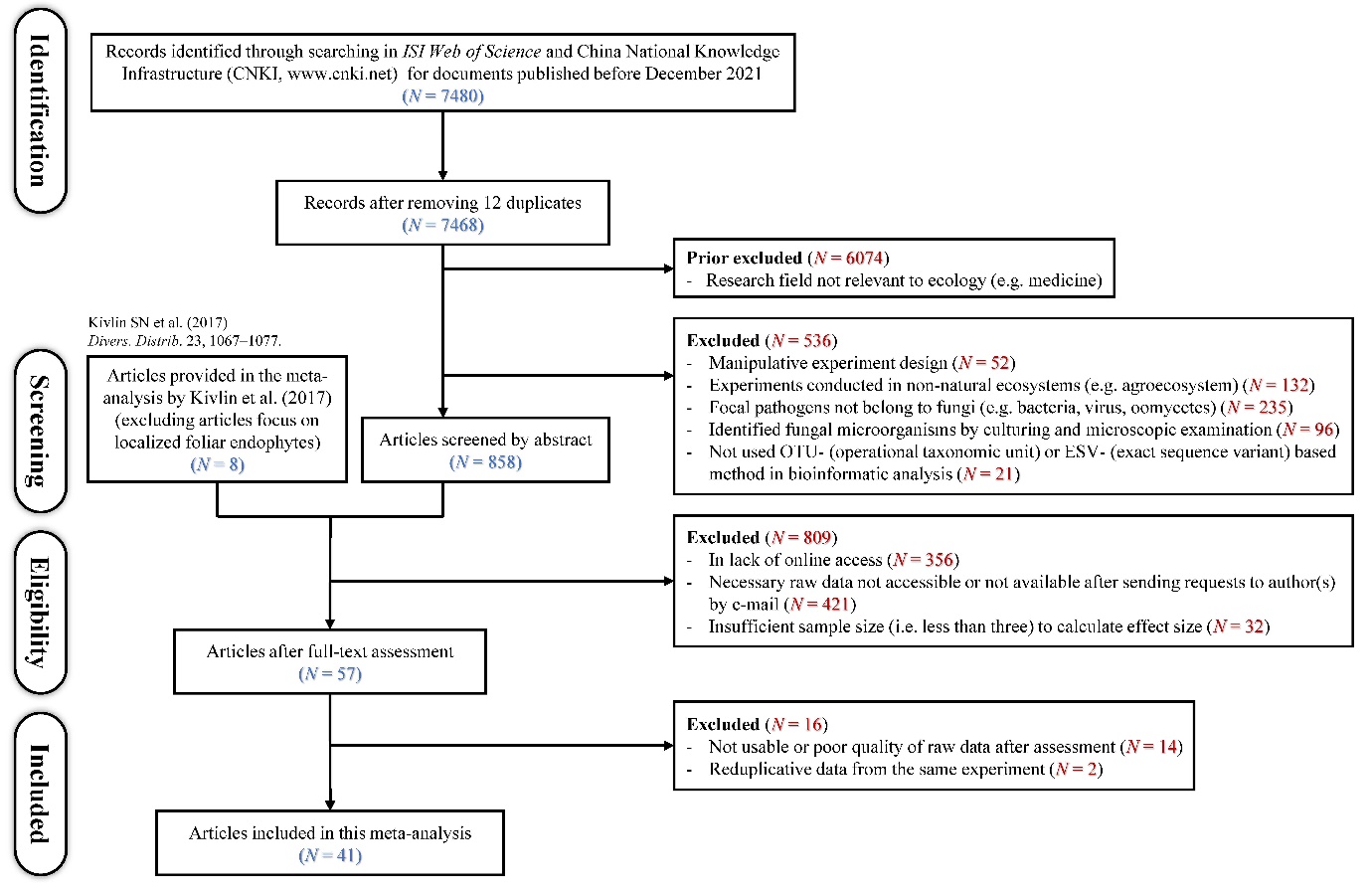
**Figure S1.2.** The biplot result for principal component analysis (PCA) of soil properties. Shown are the percentage variation explained by the first two principal components (PC1 and PC2) and arrows indicate the eigenvector values of five soil properties including: soil moisture content (W), soil pH (pH), soil conductivity (C), nitrate-nitrogen (NO3-) and ammonium-nitrogen (NH4+).



**Figure S1.3.** Correlation matrix of variables. Variables include elevation (*Elevation*), soil properties (*Soil PCA1*), community proneness index (*Proneness*), Pielou's evenness index (*Evenness*), aboveground biomass (*AGB*), belowground biomass (*BGB*), plant species richness (*SR*), mean daily temperature (*MDT*), mean daily humidity (*MDH*), community pathogen load (*PL*), soil fungal pathogen OTU richness (*sfpOTUs*) and soil fungal pathogen relative abundance (*sfpRA*). (a) Pearson’s correlation analysis results; (b) mantel test results for soil fungal pathogen OTU richness (*sfpOTUs*). Red circles indicate positive correlations while blue circles indicate negative correlations; colour depth and the size of the circles indicate the strength of correlation. Width of the lines corresponds to the size of Pearson’s *r* statistic and line colour represents the statistical significance.



**Figure S1.4.** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram for the process of filtering publications in this meta-analysis. The quantity of articles (*N*) contained studies focused on foliar and soil fungal pathogens and foliar fungal diseases in each procedure.

****

**Figure S1.5.** Linear mixed-effects model results for the relationship between elevation and various plant community indices, soil properties and environmental factors. Shown are (a) aboveground biomass; (b) belowground biomass; (c) plant species richness; (d) Pielou’s evenness index; (e) community proneness index; (f) soil properties (*Soil PCA1*). The solid lines and shadowed areas represent fit lines and 95% confidence intervals for significant results (*P* < 0.05).

**Figure S1.6.** Linear mixed-effects model results for the relationship between elevation and (a) community pathogen load (*PL*); (b) soil fungal pathogen OTU richness (*sfpOTUs*); (c) soil fungal pathogen relative abundance (*sfpRA*). The solid lines and shadows represent fit lines and 95% confidence intervals for significant results (*P* < 0.05). 

**Figure S1.7.** Linear mixed-effects model results for the relationship between community pathogen load (*PL*) and various plant community indices, soil properties and environmental factors. Shown are (a) aboveground biomass; (b) belowground biomass; (c) plant species richness; (d) Pielou’s evenness index; (e) community proneness index; (f) soil properties (*Soil PCA1*). The solid lines and shadows represent fit lines and 95% confidence intervals for significant results (*P* < 0.05). 

**Figure S1.8.** Linear mixed-effects model results for the relationship between soil fungal pathogen OTU richness (*sfpOTUs*) and various plant community indices, soil properties and environmental factors. Shown are (a) aboveground biomass; (b) belowground biomass; (c) plant species richness; (d) Pielou’s evenness index; (e) community proneness index; (f) soil properties (*Soil PCA1*).

**Figure S1.9.** Linear mixed-effects model results for the relationship between soil fungal pathogen relative abundance (*sfpRA*) and various plant community indices, soil properties and environmental factors. Shown are (a) aboveground biomass; (b) belowground biomass; (c) plant species richness; (d) Pielou’s evenness index; (e) community proneness index; (f) soil properties (*Soil PCA1*)

**Figure S1.10.** The partial correlation results for the associations between elevation and community pathogen load and soil fungal pathogen OTU richness through plausible pathways including: community proneness index (a, e); Pielou's evenness index (b, f); soil properties (c, g) The solid lines and shadowed areas represent fit lines and 95% confidence intervals for significant results (*P* < 0.05).

****

**Figure S1.11.** Funnel plot results of relationship between effect size (*Z*) and standard error in the meta-analysis. (a) All studies; (b) foliar fungal pathogen OTU richness; (c) foliar fungal diseases; (d) soil fungal pathogen OTU richness and (e) soil fungal pahtogen relative abundance. Vertical dotted lines indicate mean effect size (*Z*) based on the random effect model. If there is no publication bias, points from each study should be distributed in the white funnel area. The background colors from deep blue to light gray show the level of the pseudo confidence interval region (at 0.99, 0.95 and 0.10 level) of random effect model.



**Figure S1.12.** The relationships between effect size (*Z*) and: (a) literatures published year: for foliar fungal pathogen OTU richness (*n* = 6, *P* = 0.114); for foliar fungal diseases (*n* = 24, *P* = 0.347); for soil fungal pathogen OTU richness (*n* = 17, *P* = 0.859); and for soil fungal pathogen relative abundance (*n* = 15, *P* = 0.500); (b) journal impact factor: for foliar fungal diseases (*n* = 6, *P* = 0.326); for foliar fungal diseases (*n* = 19, *P* = 0.237); for soil fungal pathogen OTU richness (*n* = 17, *P* = 0.836); and for soil fungal pathogen relative abundance (*n* = 15, *P* = 0.060). Here, no significantly correlation means no potential publication bias.

**Figure S1.13.** Forest plot results for all studies in the meta-analysis. The blue, green, orange and red dots represent studies on the foliar fungal pathogen OTU richness, foliar fungal diseases, soil fungal pathogen OTU richness and soil fungal pathogen relative abundance, respectively. Effect sizes (*Z*) with 95% confidence intervals for each study (in light colors) and overall effects (in deep colors) are shown.

****

**Figure S1.14.** Metaregression results for the effects of multiple explanatory variables on effect size (*Z*) in the meta-analysis. (a) Mean annual temperature: for foliar fungal pathogen OTU richness (*Q*m = 0.440, *P* = 0.507); for foliar fungal diseases (*Q*m = 0.142, *P* = 0.707); for soil fungal pathogen OTU richness (*Q*m = 0.117, *P* = 0.732); for soil fungal pathogen relative abundance (*Q*m = 0.248, *P* = 0.618); (b) mean annual precipitation: for foliar fungal pathogen OTU richness (*Q*m = 0.273, *P* = 0.601); for foliar fungal diseases (*Q*m = 1.204, *P* = 0.273); for soil fungal pathogen OTU richness (*Q*m = 1.581, *P* = 0.209); for soil fungal pathogen relative abundance (*Q*m = 2.264, *P* = 0.132); (c) absolute latitude: for foliar fungal pathogen OTU richness (*Q*m = 4.231, *P* = 0.040); for foliar fungal diseases (*Q*m = 0.364, *P* = 0.547); for soil fungal pathogen OTU richness (*Q*m = 1.264, *P* = 0.261); for soil fungal pathogen relative abundance (*Q*m = 1.647, *P* = 0.199); (d) elevation range of sampling: for foliar fungal pathogen OTU richness (*Q*m = 0.150, *P* = 0.698); for soil fungal diseases (*Q*m = 0.415, *P* = 0.520); for soil fungal pathogen OTU richness (*Q*m = 4.572, *P* = 0.033); for soil fungal pathogen relative abundance (*Q*m = 4.469, *P* = 0.035). The blue, green, orange and red dots represent studies on the foliar fungal pathogen OTU richness, foliar fungal diseases, soil fungal pathogen OTU richness and soil fungal pathogen relative abundance, respectively, and the size of dots corresponds to the sample size of each study. The solid lines and shadowed areas indicate the fit lines and 95% confidence intervals for significant effects at the *P* = 0.05 level. ****