Meta-analysis reveals widespread negative associations between species richness and ecological uniqueness

Supplementary information

(Supplementary notes, tables, figures and references)

Supplementary Note 1: Compiled datasets

The following datasets were compiled from multiple sources by ourselves, some of these datasets have been publicly released.

Study_ID: the corresponding number in the Supporting data

1. Dataset of diatoms from Hawaiian streams

Study_ID: 344
Location: Hawaiian Islands: Hawaii, Oahu and Kauai
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 49
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

2. Dataset of diatoms from China

Study_ID: 345
Location: Xishuangbanna, southern Yunnan Province, China
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 57
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

3. Dataset of macroinvertebrates from China

Study_ID: 346
Location: Xishuangbanna, southern Yunnan Province, China
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 60
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

4. Dataset of diatoms from China

Study_ID: 347
Location: Li River Basin, Guangxi Province, China
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 26
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

5. Dataset of macroinvertebrates from China

Study_ID: 348
Location: Li River Basin, Guangxi Province, China
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 26
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

6. Dataset of diatoms from China

Study_ID: 349
Location: Qiantang River basin, Zhejiang Province, China
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 82
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

7. Dataset of macroinvertebrates from China

Study_ID: 350
Location: Qiantang River basin, Zhejiang Province, China
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 87
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

8. Dataset of diatoms from China

Study_ID: 351
Location: Wei River Basin, central China
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 56
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

9. Dataset of macroinvertebrates from China

Study_ID: 352
Location: Wei River Basin, central China
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 57
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

10. Dataset of fishes from Mediterranean Sea

Study_ID: 353
Location: Mediterranean Sea
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 50
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

11. Dataset of aquatic beetles from central Iberia

Study_ID: 354
Location: Central Iberia, Spain
Taxonomic group: Freshwater macroinvertebrates (Aquatic beetles)
Ecosystem: Freshwater

Number of sampling units: 64
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

12. Dataset of fishes from Finland

Study_ID: 355
Location: Lapland, Finland
Taxonomic group: Fishes
Ecosystem: Freshwater
Number of sampling units: 33
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

13. Dataset of aquatic beetles from the Western Palaearctic

Study_ID: 356
Location: Latitudinal gradient from Morocco to Sweden
Taxonomic group: Freshwater macroinvertebrates (Aquatic beetles)
Ecosystem: Freshwater
Number of sampling units: 246
Data types: Presence absence only
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

14. Dataset of aquatic plants from Hungary

Study_ID: 357
Location: Hungary
Taxonomic group: Aquatic plants
Ecosystem: Freshwater
Number of sampling units: 23
Data types: Presence absence only
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

15. Dataset of fishes from Hungary

Study_ID: 358
Location: Hungary
Taxonomic group: Fishes
Ecosystem: Freshwater
Number of sampling units: 51
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

16. Dataset of diatoms from China

Study_ID: 359
Location: Irtysh River Basin in the Xinjiang autonomous region, northwest China
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 35
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

17. Dataset of macroinvertebrates from China

Study_ID: 360
Location: Irtysh River Basin in the Xinjiang autonomous region, northwest China
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 41
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

18. Dataset of arthropods from Germany

Study_ID: 361
Location: Germany
Taxonomic group: Arthropods
Ecosystem: Terrestrial
Number of sampling units: 43
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

19. Dataset of beetles from Germany

Study_ID: 362
Location: Steigerwald, Germany
Taxonomic group: Terrestrial insects (Saproxylic beetles)
Ecosystem: Terrestrial
Number of sampling units: 69
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

20. Dataset of beetles from Europe

Study_ID: 363
Location: Europe
Taxonomic group: Terrestrial insects (Saproxylic beetles)
Ecosystem: Terrestrial
Number of sampling units: 241
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

21. Dataset of arthropods from Germany

Study_ID: 364
Location: Germany
Taxonomic group: Arthropods
Ecosystem: Terrestrial
Number of sampling units: 137 and 139
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

22. Dataset of phytoplankton from Poland

Study_ID: 365
Location: Western Poland
Taxonomic group: Phytoplankton
Ecosystem: Freshwater

Number of sampling units: 46
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

23. Dataset of aquatic plants from Denmark

Study_ID: 366
Location: Denmark
Taxonomic group: Aquatic plants
Ecosystem: Freshwater
Number of sampling units: 184
Data types: Presence absence only
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

24. Dataset of diatoms from Finland

Study_ID: 367
Location: South-eastern Finland
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 51
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

25. Dataset of macroinvertebrates from Finland

Study_ID: 368
Location: Western Finland
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 105
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

26. Dataset of diatoms from Finland

Study_ID: 369
Location: Western Finland
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 105
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

27. Dataset of diatoms from the Baltic Sea

Study_ID: 370
Location: Gulf of Finland and Gulf of Bothnia
Taxonomic group: Algae (Diatoms)
Ecosystem: Marine
Number of sampling units: 37
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

28. Dataset of aquatic plants from Finland

Study_ID: 371
Location: Finland
Taxonomic group: Aquatic plants
Ecosystem: Freshwater
Number of sampling units: 150
Data types: Presence absence only
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

29. Dataset of aquatic plants from Finland

Study_ID: 372
Location: Finland
Taxonomic group: Aquatic plants
Ecosystem: Freshwater
Number of sampling units: 136
Data types: Presence absence only
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

30. Dataset of diatoms from Iceland

Study_ID: 373
Location: Iceland
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 45
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

31. Dataset of diatoms from Finland

Study_ID: 374
Location: Finland
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 105
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

32. Dataset of diatoms from Finland

Study_ID: 375
Location: Northern Finland
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 28
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

33. Dataset of macroinvertebrates from Finland

Study_ID: 376
Location: Koutajoki drainage basin, Finland
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater

Number of sampling units: 48
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

34. Dataset of macroinvertebrates from Finland

Study_ID: 377
Location: Finland
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 77
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

35. Dataset of diatoms from Finland and Norway

Study_ID: 378
Location: Finland and Norway
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 102
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

36. Dataset of plants from Greenland

Study_ID: 379
Location: Greenland
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 71
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

37. Dataset of fishes from Italy

Study_ID: 380
Location: northern Italy
Taxonomic group: Fishes
Ecosystem: Freshwater
Number of sampling units: 298
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

38. Dataset of birds from Norway

Study_ID: 381
Location: Norway
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 216
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

39. Dataset of plants from Norway

Study_ID: 382
Location: Svalbard, Norway
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 72
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

40. Dataset of fishes from Pacific Ocean

Study_ID: 383
Location: Pacific Ocean
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 84
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

41. Dataset of diatoms from Kenya

Study_ID: 384
Location: Taita Hills, Kenya
Taxonomic group: Algae (Diatoms)
Ecosystem: Freshwater
Number of sampling units: 67
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

42. Dataset of fishes from Atlantic Ocean

Study_ID: 385
Location: Atlantic Ocean
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 195
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

43. Dataset of phytoplankton from Brazil

Study_ID: 386
Location: Paraiba do Sul river, Brazil
Taxonomic group: Phytoplankton
Ecosystem: Freshwater
Number of sampling units: 196
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

44. Dataset of plants from Marion Island

Study_ID: 387
Location: Marion Island
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial

Number of sampling units: 173
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

45. Dataset of plants from Italy

Study_ID: 388
Location: Sicily, Italy
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 67
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

46. Dataset of plants from Middle Asia

Study_ID: 389
Location: Tajikistan, Kyrgyzstan
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 54
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

47. Dataset of plants from Greece

Study_ID: 390
Location: Northern Greece
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 31
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

48. Dataset of plants from Italy

Study_ID: 391
Location: Lazio region, Italy
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 61
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

49. Dataset of plants from Italy

Study_ID: 392
Location: Central Apennines, Italy
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 40
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

50. Dataset of plants from Bulgaria

Study_ID: 393
Location: Northwest Bulgaria
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 98
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

51. Dataset of plants from Spain

Study_ID: 394
Location: Navarre, Spain
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 119
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

52. Dataset of plants from Serbia

Study_ID: 395
Location: Serbia
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 141
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

53. Dataset of plants from Austria

Study_ID: 396
Location: Inneralpine dry valleys, Austria
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 67
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

54. Dataset of plants from Ukraine

Study_ID: 397
Location: Ukraine
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 64
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

55. Dataset of plants from Romania

Study_ID: 398
Location: Transylvania, Romania
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial

Number of sampling units: 82
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

56. Dataset of plants from Ukraine

Study_ID: 399
Location: Central Podolia, Ukraine
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 226
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

57. Dataset of plants from Czech Republic

Study_ID: 400
Location: Czech Republic
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 416
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

58. Dataset of plants from Poland

Study_ID: 401
Location: Southern Poland
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 117
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

59. Dataset of plants from Russia

Study_ID: 402
Location: Khakassia, Russia
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 132
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

60. Dataset of plants from Australia

Study_ID: 403
Location: Australia
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 30
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

61. Dataset of fishes from Mexico

Study_ID: 404
Location: Mexico
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 33
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

62. Dataset of macroinvertebrates from Spain

Study_ID: 405
Location: Spain
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 15
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

63. Dataset of macroinvertebrates from Spain

Study_ID: 406
Location: Ebro River, Spain
Taxonomic group: Freshwater macroinvertebrates
Ecosystem: Freshwater
Number of sampling units: 70
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

64. Dataset of plants from Mediterranean grasslands

Study_ID: 407
Location: Mountain ranges of southern Catalonia (North-Eastern Iberian Peninsula)
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 29
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

65. Dataset of plants from USA

Study_ID: 408
Location: New York State, USA
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 74
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

66. Dataset of plants from France

Study_ID: 409
Location: southern France
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial

Number of sampling units: 52
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

67. Dataset of beetles from France

Study_ID: 410
Location: France
Taxonomic group: Terrestrial insects (Carabid beetles)
Ecosystem: Terrestrial
Number of sampling units: 159
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

68. Dataset of birds from France

Study_ID: 411
Location: France
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 201
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

69. Dataset of birds from France

Study_ID: 412
Location: south-western France
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 20
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

70. Dataset of butterflies from the Czech Republic

Study_ID: 413
Location: Czech Republic
Taxonomic group: Terrestrial insects (Butterflies)
Ecosystem: Terrestrial
Number of sampling units: 122
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

71. Dataset of plants from France

Study_ID: 414
Location: France
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 216
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

72. Dataset of amphibians from France

Study_ID: 415
Location: France
Taxonomic group: Amphibians
Ecosystem: Freshwater
Number of sampling units: 103
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

73. Dataset of bats from Europe

Study_ID: 416
Location: Europe
Taxonomic group: Bats
Ecosystem: Terrestrial
Number of sampling units: 152
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

74. Dataset of birds from Europe

Study_ID: 417
Location: Europe
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 208
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

75. Dataset of butterflies from the Czech Republic

Study_ID: 418
Location: Czech Republic
Taxonomic group: Terrestrial insects (Butterflies)
Ecosystem: Terrestrial
Number of sampling units: 20
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

76. Dataset of insects from Germany

Study_ID: 419
Location: Sachsen-Anhalt, Germany
Taxonomic group: Terrestrial insects
Ecosystem: Terrestrial
Number of sampling units: 34
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

77. Dataset of beetles from Scotland

Study_ID: 420
Location: Scotland
Taxonomic group: Terrestrial insects (Beetles)
Ecosystem: Terrestrial

Number of sampling units: 87
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

78. Dataset of beetles from UK

Study_ID: 421
Location: UK
Taxonomic group: Terrestrial insects (Beetles)
Ecosystem: Terrestrial
Number of sampling units: 44
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

79. Dataset of plants from Europe

Study_ID: 422
Location: Europe
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 56
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

80. Dataset of fishes from Seychelles archipelago

Study_ID: 423
Location: Seychelles archipelago
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 79
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

81. Dataset of fishes from Seychelles archipelago

Study_ID: 424
Location: Seychelles archipelago
Taxonomic group: Fishes
Ecosystem: Marine
Number of sampling units: 78
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

82. Dataset of plants from Sweden

Study_ID: 425
Location: southeast Sweden
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 14
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

83. Dataset of birds from Germany

Study_ID: 426
Location: Germany
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 54
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

84. Dataset of birds from Indonesia

Study_ID: 427
Location: Borneo, Indonesia
Taxonomic group: Birds
Ecosystem: Terrestrial
Number of sampling units: 37
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.*

31, 1399-1421 (2022).

85. Dataset of spiders from Australia

Study_ID: 428
Location: south-east Australia
Taxonomic group: Arthropods (Spiders)
Ecosystem: Terrestrial
Number of sampling units: 35
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

86. Dataset of spiders from Australia

Study_ID: 429
Location: Sydney, Australia
Taxonomic group: Arthropods (Spiders)
Ecosystem: Terrestrial
Number of sampling units: 115
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

87. Dataset of spiders from Australia

Study_ID: 430
Location: Sydney, Australia
Taxonomic group: Arthropods (Spiders)
Ecosystem: Terrestrial
Number of sampling units: 65
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

88. Dataset of birds from New Zealand

Study_ID: 431
Location: New Zealand
Taxonomic group: Birds
Ecosystem: Terrestrial

Number of sampling units: 26
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

89. Dataset of phytoplankton from Baltic Sea

Study_ID: 432
Location: Baltic Sea
Taxonomic group: Phytoplankton
Ecosystem: Marine
Number of sampling units: 16
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

90. Dataset of phytoplankton from North Sea

Study_ID: 433
Location: North Sea
Taxonomic group: Phytoplankton
Ecosystem: Marine
Number of sampling units: 44
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

91. Dataset of phytoplankton from North Atlantic Ocean

Study_ID: 434
Location: North Atlantic Ocean
Taxonomic group: Phytoplankton
Ecosystem: Marine
Number of sampling units: 24
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

92. Dataset of phytoplankton from South Atlantic Ocean

Study_ID: 435
Location: South Atlantic Ocean
Taxonomic group: Phytoplankton
Ecosystem: Marine
Number of sampling units: 54
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

93. Dataset of phytoplankton from Atlantic

Study_ID: 436
Location: Atlantic Ocean
Taxonomic group: Phytoplankton
Ecosystem: Marine
Number of sampling units: 25
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

94. Dataset of plants from Australia

Study_ID: 437
Location: South-west Australia
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 16
Data types: Both Presence absence and abundance
Reference: Graco-Roza, C. et al. Distance decay 2.0 – A global synthesis of taxonomic and functional turnover in ecological communities. *Glob. Ecol. Biogeogr.* **31**, 1399-1421 (2022).

95. Dataset of plants from China

Study_ID: 438
Location: Hadaling Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 151
Data types: Both Presence absence and abundance
Reference: Unpublished

96. Dataset of plants from China

Study_ID: 439
Location: Liaodong Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 44
Data types: Both Presence absence and abundance
Reference: Unpublished

97. Dataset of plants from China

Study_ID: 440
Location: Longgang Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 178
Data types: Both Presence absence and abundance
Reference: Unpublished

98. Dataset of plants from China

Study_ID: 441
Location: Liaoxi Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 175
Data types: Both Presence absence and abundance
Reference: Unpublished

99. Dataset of plants from China

Study_ID: 442
Location: Laoyelin Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 212
Data types: Both Presence absence and abundance
Reference: Unpublished

100. Dataset of plants from China

Study_ID: 443
Location: Wanda Mountain area, North-east China

Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 121
Data types: Both Presence absence and abundance
Reference: Unpublished

101. Dataset of plants from China

Study_ID: 444
Location: Changbai Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 219
Data types: Both Presence absence and abundance
Reference: Unpublished

102. Dataset of plants from China

Study_ID: 445
Location: Greater Khingan Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 250
Data types: Both Presence absence and abundance
Reference: Unpublished

103. Dataset of plants from China

Study_ID: 446
Location: Longgang Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 174
Data types: Both Presence absence and abundance
Reference: Unpublished

104. Dataset of plants from China

Study_ID: 447
Location: Liaoxi Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 187
Data types: Both Presence absence and abundance

Reference: Unpublished

105. Dataset of plants from China

Study_ID: 448
Location: Changbai mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 219
Data types: Both Presence absence and abundance
Reference: Unpublished

106. Dataset of plants from China

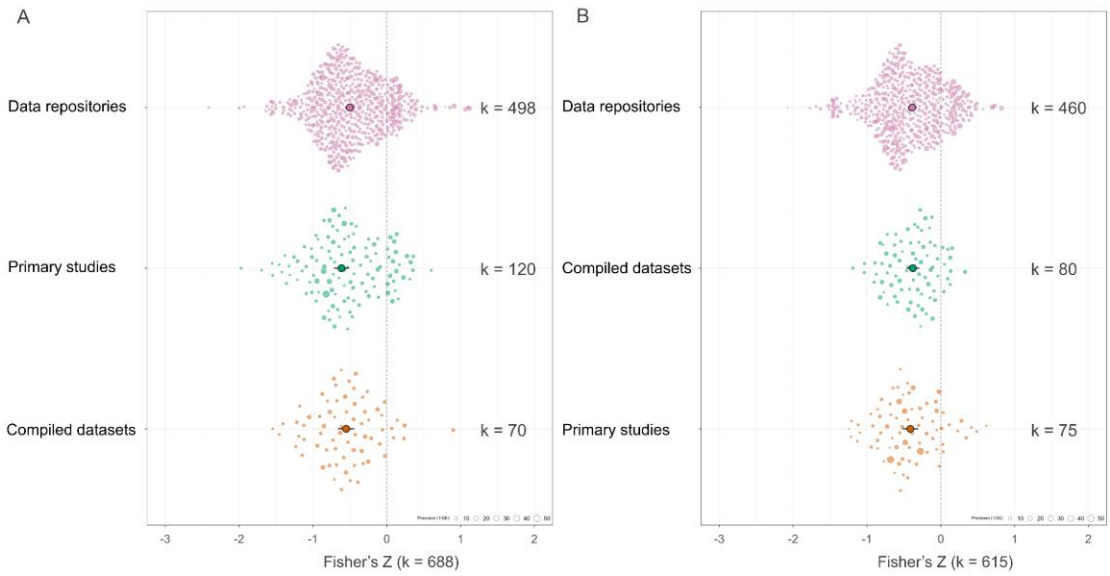
Study_ID: 449
Location: Greater Khingan Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 322
Data types: Both Presence absence and abundance
Reference: Unpublished

107. Dataset of plants from China

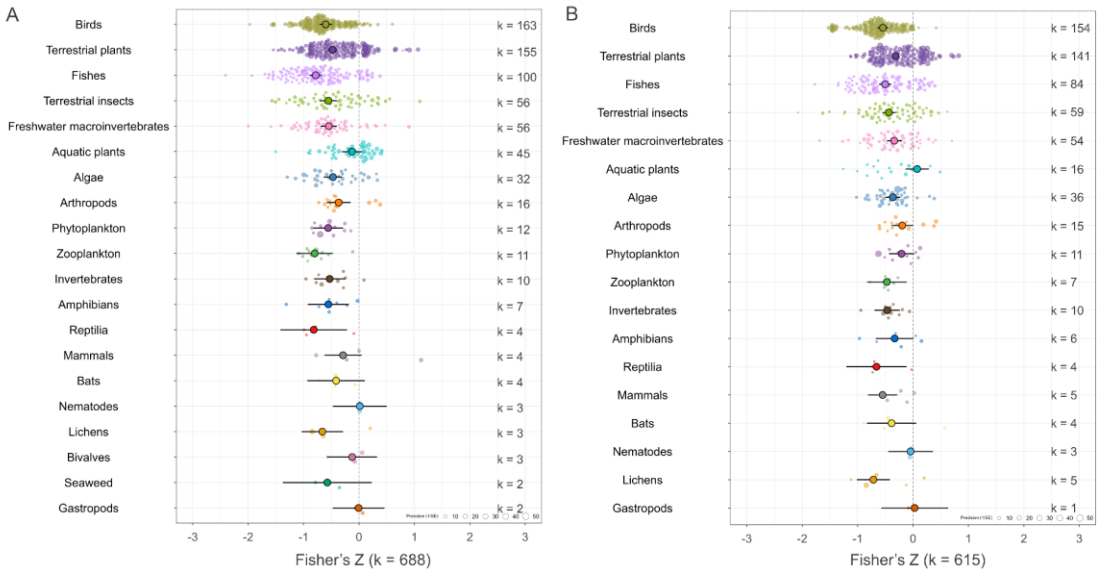
Study_ID: 450
Location: Laoyelin Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 121
Data types: Both Presence absence and abundance
Reference: Unpublished

108. Dataset of plants from China

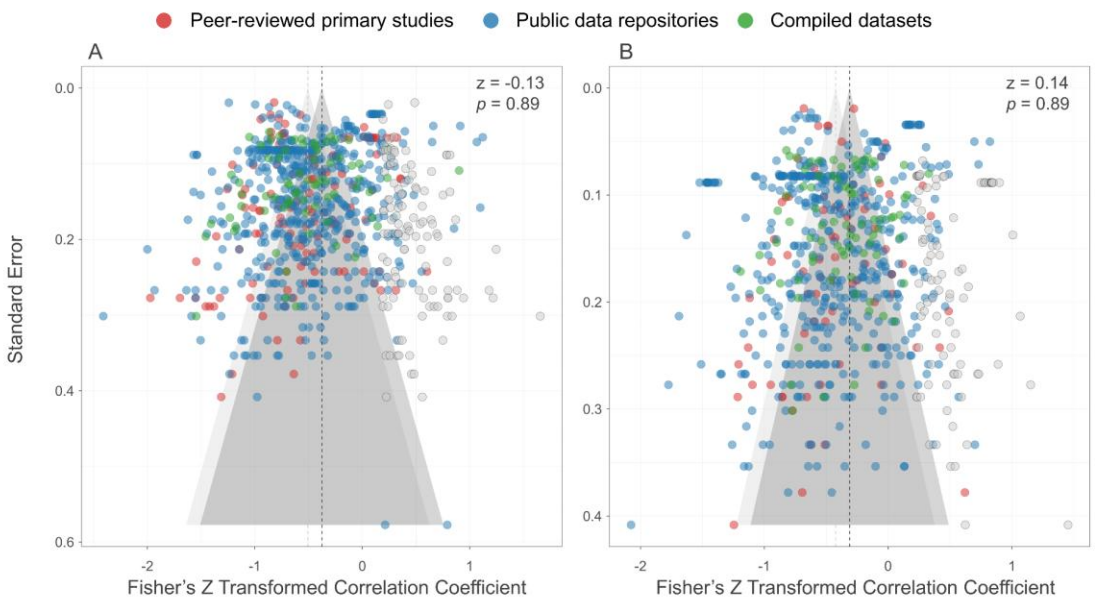
Study_ID: 451
Location: Zhangguangcailin Mountain area, North-east China
Taxonomic group: Terrestrial plants
Ecosystem: Terrestrial
Number of sampling units: 224
Data types: Both Presence absence and abundance
Reference: Unpublished



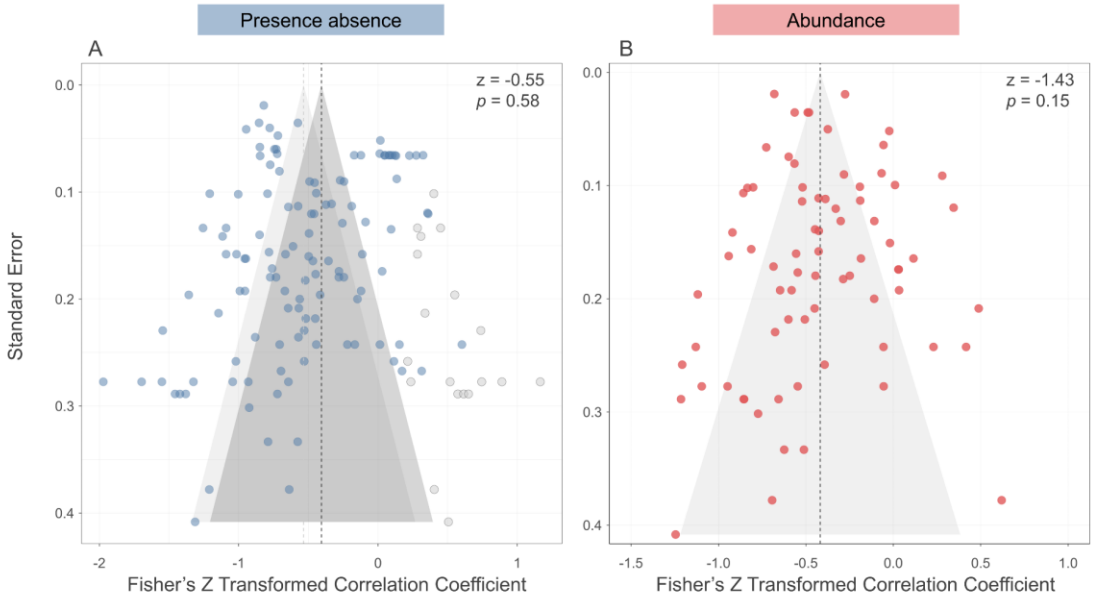
Supplementary Fig. 1 Effect sizes of the species richness–ecological uniqueness (RUR) relationship across different data sources. The effect sizes (Fisher's Z-transformed correlation coefficients) of the relationship between species richness and ecological uniqueness (i.e. RUR) for different data sources (i.e. primary studies, data repositories and compiled datasets) based on presence absence (**A**) and abundance data (**B**). The colored circles represent distributions of RUR of each group while central-points with error bars represent overall mean effect sizes and 95% confidence intervals (bold line). k: Number of data points. Details of model output can be found in Supplementary Table 2 and 3. Source data are provided as a Source Data file.



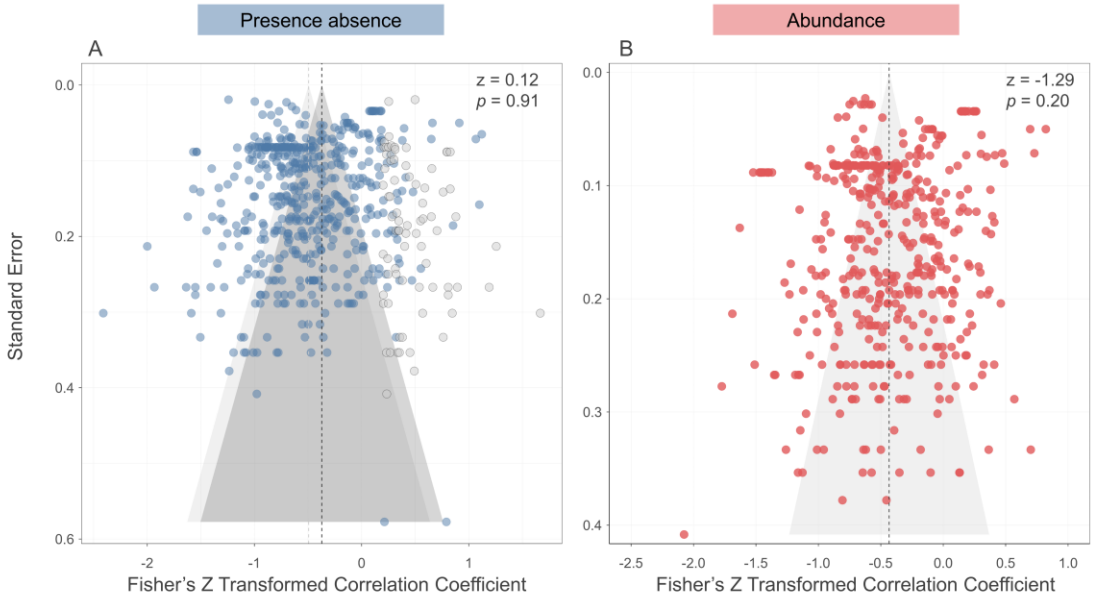
Supplementary Fig. 2 Effect sizes of the species richness–ecological uniqueness (RUR) relationship across different taxa groups. The effect sizes of (Fisher's Z-transformed correlation coefficients) of the relationship between species richness and ecological uniqueness (i.e. RUR) for different taxa groups based on presence absence (**A**) and abundance data (**B**). The colored circles represent distributions of RUR of each group while central-points with error bars represent overall mean effect sizes and 95% confidence intervals (bold line). k: Number of data points. Details of model output can be found in Supplementary Table 4 and 5. Source data are provided as a Source Data file.



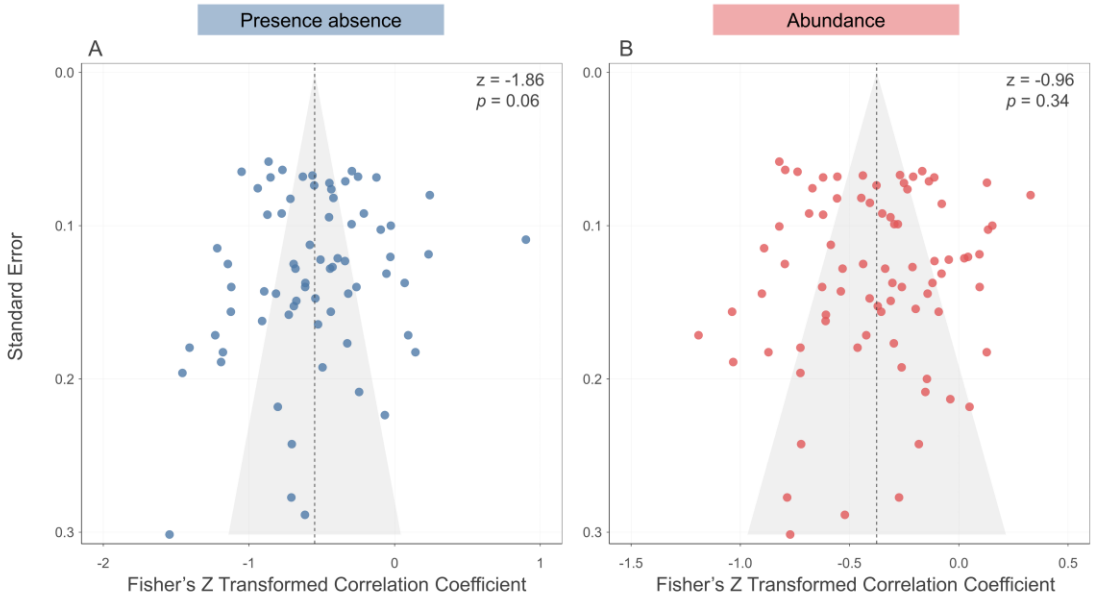
Supplementary Fig. 3 Test of publication bias for the entire dataset. Funnel plot showing effect sizes of RUR (Fisher's Z-transformed correlation coefficients) against their standard error in all studies (Peer-reviewed primary studies, public data repositories and compiled datasets) based on presence absence (**A**) and abundance data (**B**). The result of Egger's regression test for funnel plot asymmetry is given at the top right corner (z and *p* values). Different colors represent different data sources. The symmetrical distribution of studies in the plots and $p > 0.05$ indicate the absence of publication bias. The number of missing studies imputed (grey circles) was 113 and 90 on the right side for presence absence and abundance data records by performing "trim and fill" method. Source data are provided as a Source Data file.



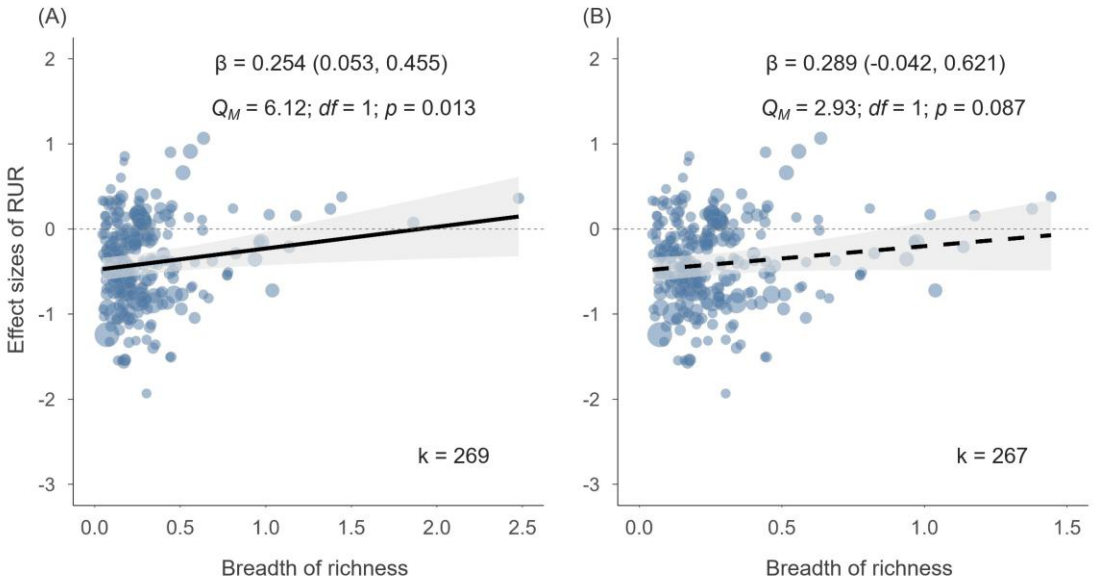
Supplementary Fig. 4 Test of publication bias for primary studies. Funnel plot showing effect sizes of RUR (Fisher's Z-transformed correlation coefficients) against their standard error in peer-reviewed primary studies based on presence absence (**A**) and abundance data (**B**). The result of Egger's regression test for funnel plot asymmetry is given at the top right corner (i.e. z and *p* values). The symmetrical distribution of studies in the plots and $p > 0.05$ indicate the absence of publication bias. The number of missing studies imputed (grey circles) was 19 for presence absence data records by performing "trim and fill" method. Source data are provided as a Source Data file.



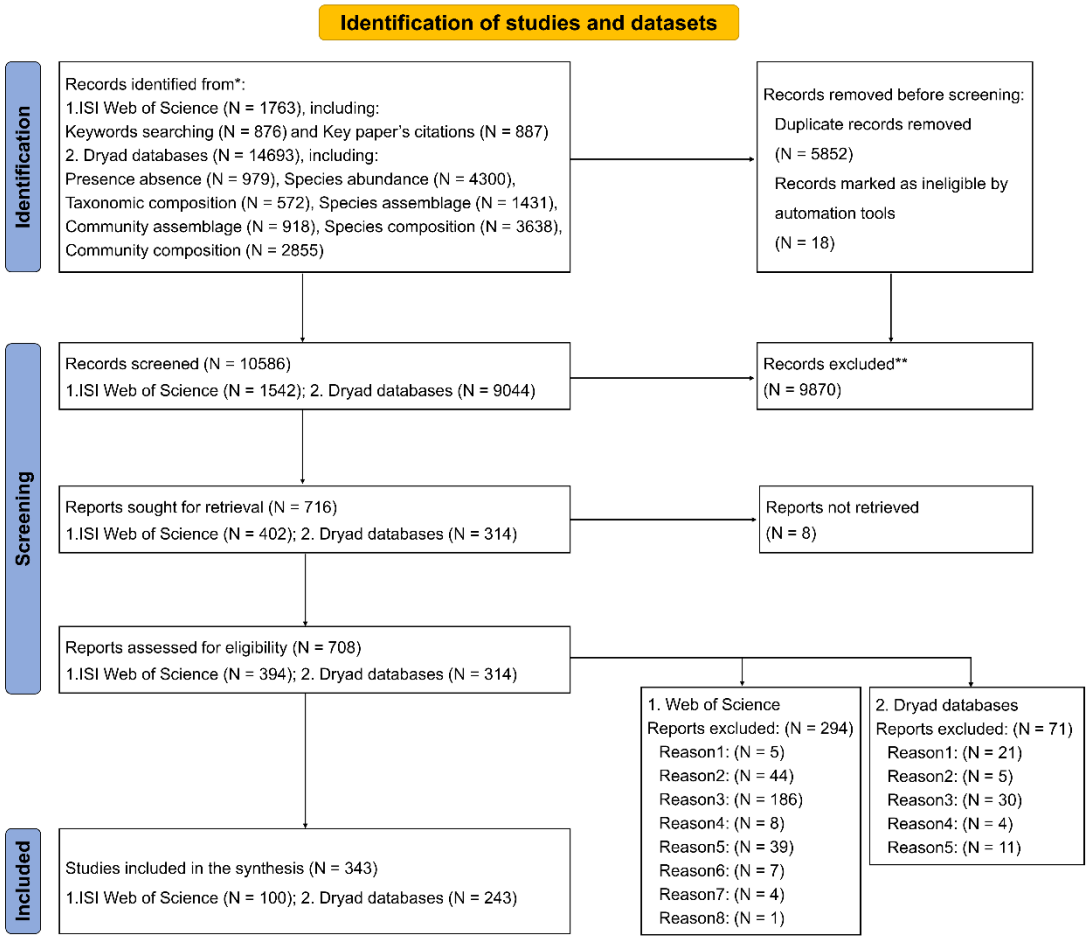
Supplementary Fig. 5 Test of publication bias for datasets from data repositories. Funnel plot showing effect sizes of RUR (Fisher's Z-transformed correlation coefficients) against their standard error in public data repositories based on presence absence (**A**) and abundance data (**B**). The result of Egger's regression test for funnel plot asymmetry is given at the top right corner (i.e. z and *p* values). The symmetrical distribution of studies in the plots and $p > 0.05$ indicate the absence of publication bias. The number of missing studies imputed (grey circles) was 77 for presence absence data records by performing "trim and fill" method. Source data are provided as a Source Data file.



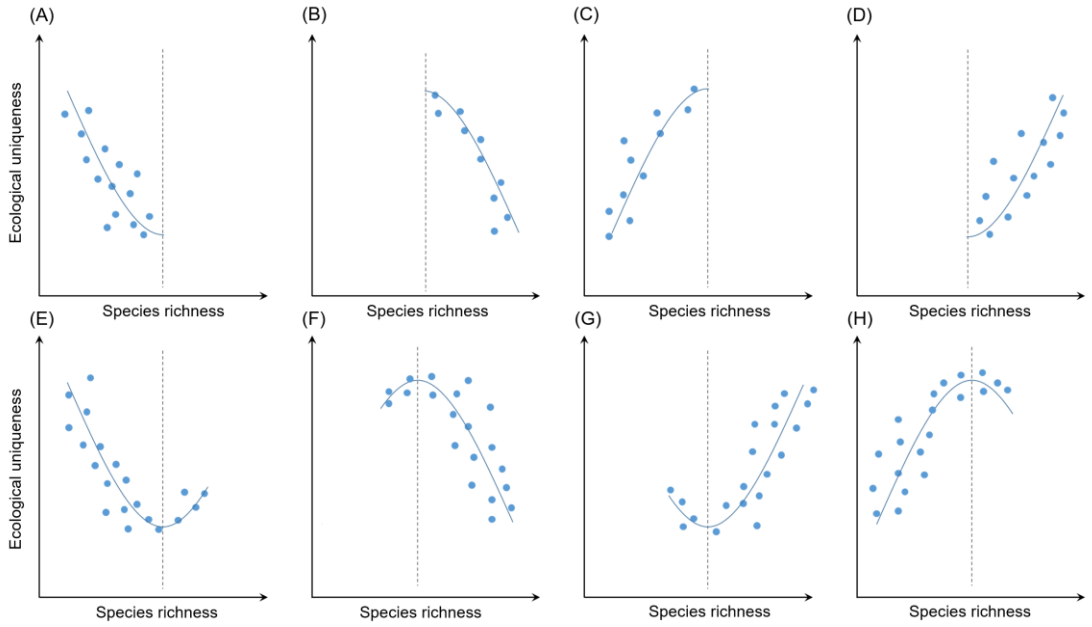
Supplementary Fig. 6 Test of publication bias for compiled datasets. Funnel plot showing effect sizes of RUR (Fisher's Z-transformed correlation coefficients) against their standard error in compiled datasets based on presence absence (**A**) and abundance data (**B**). The result of Egger's regression test for funnel plot asymmetry is given at the top right corner (i.e. z and *p* values). The symmetrical distribution of studies in the plots and $p > 0.05$ indicate the absence of publication bias. Source data are provided as a Source Data file.



Supplementary Fig. 7 Robust test of specific predictor. The association between effect sizes of RUR (Fisher's Z-transformed correlation coefficients) and breadth of richness before (**A**) and after (**B**) outlier removal. The regression lines represent the response to the above factors, with their 95% confidence intervals shown as shaded areas from hierarchical mixed-effects meta-regressions. The values of the estimated coefficients (β), 95% confidence intervals, Q_M statistics (one-sided chi-square test) and degree of freedom (*df*) are shown in each panel. The solid and dashed lines represent significant ($p < 0.05$) and non-significant ($p > 0.05$) relationships. The points have radii relative to the inverse variance of each observation (i.e., observations with larger points have lower variance in effect size). k: Number of effect sizes. Source data are the same as the Source Data file of Fig. 3C in the main text.



Supplementary Fig. 8 Data collection processes for this meta-analysis. PRISMA diagram showing the process of locating Peer-reviewed primary studies from ISI Web of Science and datasets from Dryad repository included in this synthesis. N: number of studies.



Supplementary Fig. 9 Schematic illustration of classification based on the quadratic richness-uniqueness relationship (RUR). Negative association: all data points were distributed on the same side of the axis of symmetry, and ecological uniqueness decreases with increasing species richness (**A, B**). Positive association: all data points were distributed on the same side of the axis of symmetry, and ecological uniqueness increases with increasing species richness (**C, D**). General negative association: over 80% of data points were distributed on the same side of the axis of symmetry, and ecological uniqueness decreases with increasing species richness in the same side of the axis of symmetry (**E, F**). General positive association: over 80% of data points were distributed on the same side of the axis of symmetry, and ecological uniqueness increases with increasing species richness (**G, H**). See Appendix 2 for details (which is available on figshare at: https://doi.org/10.6084/m9.figshare.29270048).

Supplementary Table 1 Model fit statistics of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) using data type (i.e. Presence absence (PA) and abundance (AB) data) as moderators in the meta-regression.

τ^2_T: between-taxa variance.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_T: between-taxa heterogeneity.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

Factors	τ^2_T	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_T	I^2_S	I^2_ω
Data Type	0.027	0.124	0.038	154.70	2	< 0.001	95.80	13.62	62.73	19.45

Supplementary Table 2 Model fit statistics of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) using data sources (i.e. primary studies, data repositories, compiled datasets) as moderators in the meta-regression (sub-group analyses for different data sources).

Data type: PA (Presence absence); AB (abundance)

k: number of effect sizes.

τ^2_T: between-taxa variance.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

***I^2*:** the total heterogeneity of effect sizes.

***I^2*_T:** between-taxa heterogeneity.

***I^2*_S:** between-study heterogeneity.

***I^2*_ω:** within-study heterogeneity (i.e., observations nested within studies).

Data type	k	Factors	τ^2_S	ω^2	τ^2_T	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	I^2_T
PA	688	data sources	0.125	0.054	0.025	97.64	3	< 0.001	96.04	59.01	25.26	11.77
AB	615	data sources	0.080	0.043	0.023	58.78	3	< 0.001	94.66	51.75	27.94	14.97

Supplementary Table 3A Model outputs of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for different data sources (i.e. primary studies, data repositories and compiled datasets) in the meta-regression. Groups with significant effect sizes are indicated in **bold**.

k: Number of effect sizes.

Effect size: Fisher's Z-transformed correlation coefficients.

CI lower: Lower limit of 95% confidence interval for effect size.

CI upper: Upper limit of 95% confidence interval for effect size.

Data type	Data sources	k	Effect size	CI lower	CI upper
Presence absence (PA)	**Primary studies**	**120**	**-0.556**	**-0.688**	**-0.424**
	Data repositories	**498**	**-0.443**	**-0.552**	**-0.334**
	Compiled datasets	**70**	**-0.527**	**-0.665**	**-0.388**
Abundance (AB)	**Primary studies**	**75**	**-0.389**	**-0.520**	**-0.259**
	Data repositories	**460**	**-0.345**	**-0.449**	**-0.242**
	Compiled datasets	**80**	**-0.391**	**-0.511**	**-0.270**

Supplementary Table 3B Differences in effect sizes of RUR among data sources based on Pair-wise comparisons. Non-significant *p*-values ($p > 0.05$) suggest no differences between the data sources in their RUR effect sizes. The *p*-values are obtained from one-sided chi-square test.

Pair-wise comparison	*p*-value for presence absence data	*p*-value for abundance data
Primary studies v.s. Compiled datasets	0.70	0.98
Primary studies v.s. Data repositories	0.072	0.48
Compiled datasets v.s. Data repositories	0.19	0.40

Supplementary Table 4 Model fit statistics of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) using taxa group as moderators in the meta-regression (sub-group analyses for different taxa groups).

Data type: PA (Presence absence); AB (abundance)

k: number of effect sizes.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

Data type	k	Factors	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω
PA	688	Taxa group	0.127	0.053	567.49	20	< 0.001	95.55	67.37	28.18
AB	615	Taxa group	0.082	0.042	381.25	18	< 0.001	93.77	61.98	31.79

Supplementary Table 5 Model outputs of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for different taxa groups in the meta-regression. Groups with significant ($p < 0.05$) effect sizes are indicated in **bold**.

k: Number of effect sizes.

Effect size: Fisher's Z-transformed correlation coefficients.

CI lower: Lower limit of 95% confidence interval for effect size.

CI upper: Upper limit of 95% confidence interval for effect size.

Data type	Taxa groups	k	Effect size	CI lower	CI upper
Presence absence (PA)	**Birds**	**163**	**-0.600**	**-0.708**	**-0.491**
	Terrestrial plants	**155**	**-0.475**	**-0.556**	**-0.395**
	Fishes	**100**	**-0.781**	**-0.895**	**-0.667**
	Terrestrial insects	**56**	**-0.552**	**-0.701**	**-0.403**
	Freshwater macroinvertebrates	**56**	**-0.545**	**-0.690**	**-0.400**
	Aquatic plants	45	-0.128	-0.311	0.055
	Algae	**32**	**-0.470**	**-0.637**	**-0.302**
	Arthropods	**16**	**-0.367**	**-0.582**	**-0.151**
	Phytoplankton	**12**	**-0.556**	**-0.824**	**-0.288**
	Invertebrates	**10**	**-0.530**	**-0.811**	**-0.248**
	Zooplankton	**11**	**-0.799**	**-1.130**	**-0.469**
	Amphibians	**7**	**-0.553**	**-0.922**	**-0.184**
	Reptilia	**4**	**-0.817**	**-1.417**	**-0.217**
	Mammals	4	-0.288	-0.624	0.048
	Bats	4	-0.413	-0.932	0.106
	Nematodes	3	0.014	-0.471	0.500
	Bivalves	3	-0.123	-0.572	0.326
	Lichens	**3**	**-0.661**	**-1.034**	**-0.288**
	Seaweed	2	-0.572	-1.373	0.229
	Gastropods	2	-0.007	-0.474	0.460
Abundance (AB)	**Birds**	**154**	**-0.544**	**-0.641**	**-0.446**
	Terrestrial plants	**141**	**-0.316**	**-0.388**	**-0.244**
	Fishes	**84**	**-0.504**	**-0.613**	**-0.394**
	Terrestrial insects	**59**	**-0.435**	**-0.558**	**-0.313**
	Freshwater macroinvertebrates	**54**	**-0.338**	**-0.470**	**-0.206**
	Aquatic Plants	16	0.074	-0.136	0.284
	Algae	**36**	**-0.363**	**-0.495**	**-0.230**
	Arthropods	**15**	**-0.195**	**-0.388**	**-0.001**
	Phytoplankton	11	-0.207	-0.433	0.020
	Invertebrates	**10**	**-0.467**	**-0.695**	**-0.239**
	Zooplankton	**7**	**-0.473**	**-0.831**	**-0.115**

Amphibians	6	-0.332	-0.673	0.009
Reptilia	**4**	**-0.660**	**-1.202**	**-0.118**
Mammals	**5**	**-0.549**	**-0.813**	**-0.285**
Lichens	**5**	**-0.716**	**-1.013**	**-0.419**
Bats	4	-0.387	-0.832	0.058
Nematodes	3	-0.045	-0.449	0.359
Gastropods	1	0.028	-0.575	0.632

Supplementary Table 6 Output of meta regression models including single factor for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) across taxa groups with more than or equal to 5 effect sizes of RUR based on PA and AB data. Significant effects ($p < 0.05$) are indicated in **bold**.

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_T: between-taxa variance.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

***I^2*:** the total heterogeneity of effect sizes.

***I^2*_T:** between-taxa heterogeneity.

***I^2*_S:** between-study heterogeneity.

***I^2*_ω:** within-study heterogeneity (i.e., observations nested within studies).

***R^2_m*:** the amount of variance explained by the fixed factor.

PC1 & PC2 of climatic variables: the first two principal components of bioclimatic variables from the WorldClim database.

Data Type	Factors	k	β	CI	τ^2_T	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_T	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	**Gamma diversity**	**269**	**-0.197**	**(-0.344, -0.049)**	**0.022**	**0.156**	**0.047**	**6.81**	**1**	**0.009**	**97.59**	**9.57**	**67.57**	**20.45**	**0.035**
	Breadth of richness	**269**	**0.254**	**(0.053, 0.455)**	**0.017**	**0.162**	**0.046**	**6.12**	**1**	**0.013**	**97.58**	**7.49**	**70.22**	**19.87**	**0.022**
	Proportion of rare	**269**	**0.400**	**(0.123, 0.677)**	**0.009**	**0.155**	**0.048**	**8.03**	**1**	**0.005**	**97.44**	**4.19**	**71.29**	**21.96**	**0.040**
	Dispersal limitation	114	-0.182	(-0.633, 0.269)	0.002	0.145	0.070	0.63	1	0.43	97.21	0.87	65.13	31.21	0.006
	Spatial grain size	**165**	**-0.056**	**(-0.102, -0.011)**	**< 0.001**	**0.140**	**0.044**	**5.82**	**1**	**0.016**	**97.54**	**< 0.001**	**74.23**	**23.31**	**0.065**
	PC1 of climatic variables	252	-0.006	(-0.029, 0.017)	0.012	0.165	0.048	0.23	1	0.63	97.54	5.27	71.47	20.80	0.001
	PC2 of climatic variables	252	0.024	(-0.013, 0.060)	0.012	0.162	0.049	1.60	1	0.21	97.52	5.23	71.03	21.26	0.009
Abundance (AB)	Gamma diversity	342	-0.075	(-0.205, 0.055)	0.021	0.116	0.040	1.27	1	0.26	96.81	11.48	63.62	21.71	0.006
	Breadth of richness	342	-0.068	(-0.325, 0.190)	0.019	0.123	0.038	0.26	1	0.61	96.86	10.19	66.07	20.60	0.001
	Proportion of rare	342	0.618	(-0.040, 1.276)	0.018	0.117	0.039	3.39	1	0.066	96.77	10.01	65.06	21.70	0.012
	Dispersal limitation	**149**	**-0.554**	**(-0.903, -0.206)**	**< 0.001**	**< 0.001**	**0.135**	**9.74**	**1**	**0.002**	**94.50**	**< 0.001**	**< 0.001**	**94.50**	**0.072**
	Spatial grain size	**197**	**-0.052**	**(-0.098, -0.007)**	**< 0.001**	**0.123**	**0.037**	**5.06**	**1**	**0.025**	**97.10**	**< 0.001**	**74.76**	**22.34**	**0.067**
	PC1 of climatic variables	317	-0.014	(-0.033, 0.005)	0.026	0.126	0.036	2.12	1	0.15	96.98	13.63	64.81	18.54	0.010
	PC2 of climatic variables	317	-0.017	(-0.048, 0.015)	0.027	0.125	0.036	1.08	1	0.30	96.98	14.12	64.51	18.35	0.005

Supplementary Table 7 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for each taxa group with more than or equal to 5 effect sizes of RUR (using Gamma diversity as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

***I^2*:** the total heterogeneity of effect sizes.

***I^2*_S:** between-study heterogeneity.

***I^2*_ω:** within-study heterogeneity (i.e., observations nested within studies).

***R^2_m*:** the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	106	-0.113	(-0.316, 0.091)	0.131	0.049	1.18	1	0.28	97.62	70.83	26.79	0.017
	Birds	**60**	**-0.644**	**(-1.054, -0.234)**	**0.131**	**0.013**	**9.48**	**1**	**0.002**	**96.14**	**87.71**	**8.43**	**0.18**
	Fishes	**34**	**-0.519**	**(-0.973, -0.065)**	**0.190**	**0.067**	**5.03**	**1**	**0.025**	**97.76**	**72.37**	**25.39**	**0.19**
	Algae	17	-0.008	(-1.066, 1.051)	0.192	0.026	0.0002	1	0.99	93.73	82.57	11.16	< 0.001
	Aquatic plants	17	0.006	(-0.697, 0.709)	0.127	0.080	0.0003	1	0.99	96.03	58.89	37.14	< 0.001
	Freshwater macroinvertebrates	17	-0.396	(-1.038, 0.246)	< 0.001	0.259	1.46	1	0.23	94.32	< 0.001	94.32	0.092
	Terrestrial insects	13	-0.019	(-0.650, 0.613)	0.320	NA	0.003	1	0.95	95.21	95.21	NA	< 0.001
	Arthropods	5	2.279	(-0.984, 5.542)	0.134	0.009	1.87	1	0.17	94.40	88.57	5.83	0.34
Abundance (AB)	**Birds**	**92**	**-0.777**	**(-1.132, -0.423)**	**0.093**	**0.011**	**18.50**	**1**	**< 0.001**	**93.17**	**83.40**	**9.77**	**0.27**
	Terrestrial plants	92	-0.003	(-0.216, 0.210)	0.141	0.029	0.0007	1	0.98	98.16	81.57	16.59	< 0.001
	Fishes	34	0.041	(-0.399, 0.482)	0.187	0.073	0.034	1	0.85	97.18	69.90	27.28	0.001
	Terrestrial insects	34	-0.428	(-0.907, 0.052)	0.262	0.041	3.05	1	0.08	93.00	80.48	12.52	0.12
	Freshwater macroinvertebrates	28	0.514	(-0.217, 1.246)	< 0.001	0.197	1.90	1	0.17	90.91	< 0.001	90.91	0.077
	Algae	27	0.072	(-0.243, 0.387)	0.060	0.008	0.20	1	0.66	89.54	79.38	10.16	0.008
	Arthropods	**12**	**0.607**	**(0.060, 1.154)**	**0.057**	**0.014**	**4.72**	**1**	**0.30**	**85.08**	**68.42**	**16.66**	**0.40**
	Aquatic plants	6	0.651	(-0.905, 2.256)	0.016	0.277	0.67	1	0.41	89.98	5.02	84.96	0.13
	Phytoplankton	6	0.072	(-1.232, 1.375)	0.115	NA	0.012	1	0.91	93.93	93.93	NA	0.003

Supplementary Table 8 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for taxa groups with more than or equal to 5 effect sizes of RUR (using breadth of species richness as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

R^2_m: the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	**Terrestrial plants**	**106**	**0.318**	**(0.075, 0.560)**	**0.133**	**0.043**	**6.56**	**1**	**0.010**	**97.56**	**73.90**	**23.66**	**0.037**
	Birds	60	-0.267	(-1.093, 0.559)	0.208	0.011	0.40	1	0.53	97.45	92.58	4.87	0.006
	Fishes	34	0.322	(-0.192, 0.835)	0.189	0.091	1.51	1	0.22	97.95	66.20	31.75	0.075
	Algae	17	-2.146	(-5.298, 1.007)	0.165	0.024	1.78	1	0.18	92.87	80.94	11.93	0.13
	Aquatic plants	17	0.621	(-1.159, 2.400)	0.117	0.078	0.47	1	0.49	95.79	57.59	38.20	0.024
	Freshwater macroinvertebrates	17	2.125	(-0.632, 4.881)	< 0.001	0.237	2.28	1	0.13	93.82	< 0.001	93.82	0.14
	Terrestrial insects	13	-0.018	(-1.208, 1.173)	0.320	NA	0.0008	1	0.98	95.20	95.20	NA	< 0.001
	Arthropods	5	-1.867	(-5.656, 1.925)	0.127	0.025	0.93	1	0.33	94.75	78.98	15.77	0.21
Abundance (AB)	Birds	92	-0.238	(-0.745, 0.268)	0.164	0.011	0.85	1	0.36	95.84	89.82	6.02	0.01
	Terrestrial plants	92	0.263	(-0.397, 0.922)	0.144	0.027	0.61	1	0.44	98.18	82.70	15.48	0.008
	Fishes	34	-0.231	(-0.896, 0.434)	0.186	0.070	0.46	1	0.50	97.14	70.54	26.60	0.022
	Terrestrial insects	34	0.105	(-0.530, 0.741)	0.295	0.046	0.11	1	0.75	93.74	81.15	12.59	0.003
	Freshwater macroinvertebrates	28	-1.409	(-3.085, 0.267)	< 0.001	0.193	2.71	1	0.10	90.73	< 0.001	90.73	0.10
	Algae	27	-1.012	(-2.480, 0.456)	0.047	0.014	1.82	1	0.18	88.41	68.81	19.60	0.14
	Arthropods	12	-1.265	(-2.776, 0.246)	0.069	0.018	2.69	1	0.10	87.38	69.43	17.95	0.25
	Aquatic plants	6	-0.999	(-4.714, 2.716)	< 0.001	0.315	0.28	1	0.60	90.61	< 0.001	90.61	0.058
	Phytoplankton	6	1.887	(-0.903, 4.678)	0.076	NA	1.76	1	0.19	91.14	91.14	NA	0.28

Supplementary Table 9 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for taxa groups with more than or equal to 5 effect sizes of RUR (using the proportion of rare species as moderator in the model) based on PA and AB data. NA means that we omitted the nested structure and only specified random effects at the study level. The groups with significant effects ($p < 0.05$) are indicated in **bold**. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

R^2_m: the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	106	0.330	(-0.118, 0.777)	0.133	0.047	2.08	1	0.15	97.62	72.13	25.49	0.034
	Birds	**60**	**0.778**	**(0.170, 1.385)**	**0.152**	**0.011**	**6.29**	**1**	**0.012**	**96.59**	**90.21**	**6.38**	**0.12**
	Fishes	34	0.608	(-0.199, 1.414)	0.195	0.087	2.18	1	0.14	97.96	67.69	30.27	0.078
	Algae	17	0.102	(-1.719, 1.922)	0.195	0.024	0.012	1	0.91	93.77	83.42	10.35	0.001
	Aquatic plants	17	0.742	(-0.702, 2.186)	0.102	0.078	1.01	1	0.31	95.44	53.94	41.50	0.075
	Freshwater macroinvertebrates	17	-0.293	(-1.460, 0.874)	< 0.001	0.288	0.24	1	0.62	94.85	< 0.001	94.85	0.017
	Terrestrial insects	13	0.682	(-0.455, 1.820)	0.278	NA	1.38	1	0.24	94.54	94.54	NA	0.11
	Arthropods	**5**	**-5.372**	**(-10.07, -0.672)**	**< 0.001**	**0.070**	**5.02**	**1**	**0.025**	**89.29**	**< 0.001**	**89.29**	**0.59**
Abundance (AB)	Birds	92	0.696	(-0.593, 1.984)	0.135	0.012	1.12	1	0.29	95.08	87.27	7.81	0.009
	Terrestrial plants	92	0.294	(-1.012, 1.600)	0.139	0.029	0.19	1	0.66	98.14	81.14	17.00	0.003
	Fishes	34	2.775	(-0.320, 5.869)	0.195	0.054	3.09	1	0.08	97.07	75.93	21.14	0.070
	Terrestrial insects	34	0.153	(-1.422, 1.727)	0.288	0.049	0.036	1	0.85	93.66	80.03	13.63	0.001
	Freshwater macroinvertebrates	28	-0.863	(-5.558, 3.831)	< 0.001	0.211	0.13	1	0.72	91.47	< 0.001	91.47	0.005
	Algae	27	0.956	(-1.068, 2.980)	0.068	0.002	0.86	1	0.35	89.74	87.09	2.65	0.041
	Arthropods	12	0.559	(-3.335, 4.452)	0.101	0.016	0.079	1	0.78	90.32	78.16	12.16	0.009
	Aquatic plants	6	-2.422	(-12.27, 7.43)	< 0.001	0.320	0.23	1	0.63	90.74	< 0.001	90.74	0.05
	Phytoplankton	6	3.093	(-12.27, 18.46)	0.110	NA	0.16	1	0.69	93.72	93.72	NA	0.035

Supplementary Table 10A Full model statistics including multiple factors for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) across four different taxa groups (i.e. Terrestrial plants, freshwater macroinvertebrates, birds and terrestrial insects).

k: Number of effect sizes.

β: Model estimate of each factor.

SE: Standard error of model estimate.

τ^2_T: Taxonomic-level variance.

τ^2_S: Study-level variance.

ω^2: Estimate-level variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

***I^2*:** the total heterogeneity of effect sizes.

***I^2*_T:** between-taxa heterogeneity.

***I^2*_S:** between-study heterogeneity.

***I^2*_ω:** within-study heterogeneity (i.e., observations nested within studies).

***R^2_m*:** the amount of variance explained by the fixed factor.

Data type	k	τ^2_T	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_T	I^2_S	I^2_ω	R^2_m
PA	59	0.036	0.012	0.101	30.25	7	< 0.001	95.88	23.29	7.53	65.06	0.33
AB	67	< 0.001	< 0.001	0.137	18.58	7	0.010	93.51	< 0.001	< 0.001	93.51	0.25

Supplementary Table 10B Output of full models including multiple factors for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) across four different taxa groups (i.e. Terrestrial plants, Freshwater macroinvertebrates, Birds and Terrestrial insects).

k: Number of effect sizes.

β_s: Standardized model estimate of each factor.

SE: Standard error of model estimate.

CI lower: Lower limit of 95% confidence interval for model estimate.

CI upper: Upper limit of 95% confidence interval for model estimate.

***p* value:** The *p* values obtained from one-sided chi-square test.

Importance: The relative importance of each factor in explaining the total variations of RUR.

PC1 & PC2 of climatic variables: The first two principal components of bioclimatic variables from the WorldClim database.

Data type	Variables	β_s	SE	CI lower	CI upper	*p* value	Importance (%)
Presence	**PC1 of climatic variables**	**0.114**	**0.054**	**0.008**	**0.221**	**0.035**	8.60
absence	PC2 of climatic variables	-0.043	0.059	-0.158	0.073	0.47	3.20
(PA)	Spatial grain size	-0.078	0.076	-0.227	0.071	0.30	5.90
(k = 59)	Dispersal limitation	0.010	0.052	-0.091	0.111	0.84	0.80
	Gamma diversity	**-0.458**	**0.098**	**-0.651**	**-0.265**	**< 0.001**	34.50
	Breadth of richness	**-0.217**	**0.078**	**-0.371**	**-0.064**	**0.006**	16.40
	Proportion of rare species	**0.407**	**0.089**	**0.232**	**0.582**	**< 0.001**	30.60
Abundance	PC1 of climatic variables	-0.103	0.054	-0.209	0.003	0.057	16.60
(AB)	PC2 of climatic variables	-0.053	0.054	-0.159	0.053	0.32	8.60
(k = 67)	Spatial grain size	-0.094	0.055	-0.202	0.013	0.086	15.20
	Dispersal limitation	**-0.131**	**0.053**	**-0.235**	**-0.027**	**0.014**	21.10
	Gamma diversity	-0.104	0.056	-0.213	0.006	0.063	16.80
	Breadth of richness	-0.025	0.063	-0.149	0.099	0.69	4.0
	Proportion of rare species	0.110	0.058	-0.005	0.224	0.060	17.70

Supplementary Table 11 Output of meta regression models including single factor for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for each taxa group with more than or equal to 5 effect sizes of RUR (using dispersal limitation as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

***I^2*:** the total heterogeneity of effect sizes.

***I^2*_S:** between-study heterogeneity.

***I^2*_ω:** within-study heterogeneity (i.e., observations nested within studies).

***R^2_m*:** the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	45	-0.109	(-0.840, 0.621)	0.084	0.074	0.086	1	0.77	95.37	50.57	44.80	0.003
	Fishes	19	-0.163	(-1.171, 0.844)	0.259	0.033	0.10	1	0.75	98.64	87.58	11.06	0.005
	Birds	15	0.202	(-0.634, 1.037)	0.169	< 0.001	0.22	1	0.64	96.56	96.56	< 0.001	0.016
	Freshwater macroinvertebrates	**12**	**-1.914**	**(-3.607, -0.220)**	**0.048**	**0.163**	**4.91**	**1**	**0.027**	**93.03**	**21.08**	**71.95**	**0.36**
	Algae	11	0.453	(-1.348, 2.254)	0.214	NA	0.24	1	0.62	94.55	94.55	NA	0.027
	Terrestrial insects	7	-0.455	(-2.893, 1.983)	0.440	NA	0.13	1	0.71	97.12	97.12	NA	0.027
	Aquatic plants	5	0.667	(-4.122, 5.457)	< 0.001	0.129	0.075	1	0.78	89.72	< 0.001	89.72	0.022
Abundance (AB)	Terrestrial plants	39	-0.539	(-1.012, 0.025)	0.128	< 0.001	3.51	1	0.061	94.65	94.65	< 0.001	0.06
	Freshwater macroinvertebrates	**20**	**-1.886**	**(-2.994, -0.779)**	**< 0.001**	**0.134**	**11.14**	**1**	**< 0.001**	**86.81**	**< 0.001**	**86.81**	**0.42**
	Fishes	19	-0.636	(-1.608, 0.335)	< 0.001	0.204	1.65	1	0.20	96.53	< 0.001	96.53	0.09
	Terrestrial insects	**19**	**-1.946**	**(-3.446, -0.446)**	**< 0.001**	**0.189**	**6.46**	**1**	**0.011**	**90.46**	**< 0.001**	**90.46**	**0.31**
	Algae	18	0.441	(-0.064, 0.945)	0.028	< 0.001	2.93	1	0.087	80.04	80.04	< 0.001	0.22
	Birds	18	-0.084	(-0.907, 0.740)	0.128	0.035	0.040	1	0.84	89.75	70.50	19.25	0.002
	Arthropods	6	-1.029	(-2.692, 0.634)	0.012	NA	1.47	1	0.23	42.83	42.83	NA	0.39
	Phytoplankton	5	1.419	(-0.525, 3.362)	0.080	NA	2.05	1	0.15	92.14	92.14	NA	0.39

Supplementary Table 12 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for taxa groups with more than or equal to 5 effect sizes of RUR (using spatial grain size as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

R^2_m: the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	104	-0.010	(-0.078, 0.058)	0.135	0.050	0.085	1	0.77	97.72	71.47	26.25	0.001
	Birds	**43**	**-0.218**	**(-0.372, -0.063)**	**0.154**	**0.011**	**7.62**	**1**	**0.006**	**97.11**	**90.61**	**6.50**	**0.19**
	Aquatic plants	11	-0.103	(-0.798, 0.592)	0.119	0.077	0.084	1	0.77	96.77	58.77	38.00	0.017
	Freshwater macroinvertebrates	7	0.359	(-0.227, 0.945)	< 0.001	0.205	1.44	1	0.23	87.47	< 0.001	87.47	0.22
Abundance (AB)	Terrestrial plants	89	-0.003	(-0.087, 0.086)	0.147	0.028	< 0.001	1	0.99	98.26	82.34	15.92	< 0.001
	Birds	**71**	**-0.350**	**(-0.609, -0.091)**	**0.121**	**0.012**	**7.02**	**1**	**0.008**	**95.21**	**86.74**	**8.47**	**0.30**
	Freshwater macroinvertebrates	22	-0.049	(-0.288, 0.191)	< 0.001	0.270	0.16	1	0.69	92.93	< 0.001	92.93	0.008
	Terrestrial insects	9	0.231	(-0.376, 0.837)	0.057	0.116	0.55	1	0.46	85.66	28.28	57.38	0.10
	Arthropods	6	-0.025	(-0.224, 0.174)	0.022	NA	0.06	1	0.80	59.24	59.24	NA	0.027

Supplementary Table 13 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for taxa groups with more than or equal to 5 effect sizes of RUR (using PC1 of climatic variables as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

R^2_m: the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	106	0.028	(-0.008, 0.063)	0.128	0.050	2.32	1	0.13	97.58	70.27	27.31	0.043
	Birds	59	-0.028	(-0.075, 0.019)	0.194	0.012	1.34	1	0.25	97.32	91.71	5.61	0.036
	Fishes	24	0.001	(-0.090, 0.092)	0.257	0.111	0.0008	1	0.98	97.32	67.90	29.42	< 0.001
	Freshwater macroinvertebrates	17	0.002	(-0.095, 0.099)	< 0.001	0.291	0.001	1	0.97	94.90	< 0.001	94.90	< 0.001
	Aquatic plants	17	0.054	(-0.008, 0.109)	0.048	0.077	3.73	1	0.054	93.58	35.83	57.75	0.22
	Algae	16	-0.006	(-0.089, 0.076)	0.166	0.026	0.022	1	0.88	93.04	80.42	12.62	0.002
	Terrestrial insects	13	-0.028	(-0.130, 0.075)	0.309	NA	0.29	1	0.59	95.05	95.05	NA	0.028
Abundance (AB)	Birds	92	-0.011	(-0.047, 0.024)	0.147	0.012	0.39	1	0.53	95.45	88.32	7.13	0.009
	Terrestrial plants	92	0.013	(-0.026, 0.051)	0.141	0.028	0.42	1	0.52	98.15	81.74	16.41	0.011
	Terrestrial insects	**34**	**-0.100**	**(-0.166, -0.034)**	**0.222**	**0.037**	**8.74**	**1**	**0.003**	**91.93**	**78.66**	**13.27**	**0.26**
	Freshwater macroinvertebrates	28	-0.046	(-0.102, 0.010)	0.0001	0.190	2.57	1	0.11	90.60	0.03	90.57	0.099
	Fishes	24	-0.016	(-0.076, 0.043)	0.175	0.059	0.29	1	0.59	95.81	71.67	24.14	0.013
	Algae	24	0.007	(-0.030, 0.043)	0.035	0.005	0.12	1	0.72	83.91	73.93	9.98	0.009
	Arthropods	11	-0.015	(-0.094, 0.064)	0.109	0.019	0.14	1	0.71	91.44	78.13	13.31	0.017
	Aquatic plants	6	-0.085	(-0.197, 0.026)	< 0.001	0.179	2.24	1	0.13	84.60	< 0.001	84.60	0.36

Supplementary Table 14 Output of meta regression models including single moderator for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) for each taxa group with more than or equal to 5 effect sizes of RUR (using PC2 of climatic variables as moderator in the model) based on PA and AB data. The groups with significant effects ($p < 0.05$) are indicated in **bold**. NA means that we omitted the nested structure and only specified random effects at the study level. We did not construct separate models for taxa groups with low effect size heterogeneity ($I^2 < 0.25$).

k: Number of effect sizes.

β: Model estimate of each factor.

CI: 95% confidence interval of the model estimate.

τ^2_S: between-study variance.

ω^2: within-study variance.

Q_M: The Q_M statistics of one-sided chi-square test.

df: degree of freedoms.

***p* value:** The *p* values obtained from one-sided chi-square test.

I^2: the total heterogeneity of effect sizes.

I^2_S: between-study heterogeneity.

I^2_ω: within-study heterogeneity (i.e., observations nested within studies).

R^2_m: the amount of variance explained by the fixed factor.

Data Type	Taxa	k	β	CI	τ^2_S	ω^2	Q_M	*df*	*p* value	I^2	I^2_S	I^2_ω	R^2_m
Presence absence (PA)	Terrestrial plants	106	-0.039	(-0.093, 0.016)	0.128	0.050	1.96	1	0.16	97.59	70.15	27.44	0.027
	Birds	59	-0.025	(-0.095, 0.045)	0.203	0.012	0.49	1	0.49	97.43	92.03	5.40	0.012
	Fishes	24	0.115	(-0.029, 0.259)	0.184	0.117	2.44	1	0.12	96.76	59.16	37.60	0.11
	Freshwater macroinvertebrates	17	-0.078	(-0.197, 0.042)	< 0.001	0.264	1.62	1	0.20	94.41	< 0.001	94.41	0.11
	Aquatic plants	17	-0.060	(-0.189, 0.071)	0.161	0.071	0.80	1	0.37	96.44	66.90	29.54	0.075
	Algae	16	0.037	(-0.078, 0.151)	0.163	0.026	0.39	1	0.53	92.96	80.05	12.91	0.033
	Terrestrial insects	13	0.033	(-0.145, 0.212)	0.316	NA	0.13	1	0.72	95.16	95.16	NA	0.012
Abundance (AB)	Birds	92	0.003	(-0.044, 0.050)	0.147	0.012	0.013	1	0.91	95.44	88.25	7.19	< 0.001
	Terrestrial plants	92	-0.025	(-0.089, 0.040)	0.139	0.028	0.56	1	0.45	98.13	81.47	16.66	0.010
	Terrestrial insects	34	-0.038	(-0.160, 0.084)	0.317	0.037	0.38	1	0.54	93.97	84.07	9.90	0.018
	Freshwater macroinvertebrates	28	0.056	(-0.050, 0.162)	< 0.001	0.203	1.07	1	0.30	91.15	< 0.001	91.15	0.043
	Fishes	**24**	**0.102**	**(0.001, 0.203)**	**0.146**	**0.047**	**3.93**	**1**	**0.047**	**94.95**	**71.99**	**22.96**	**0.15**
	Algae	**24**	**-0.044**	**(-0.085, -0.004)**	**0.021**	**0.007**	**4.65**	**1**	**0.031**	**78.41**	**59.16**	**19.25**	**0.26**
	Arthropods	11	0.013	(-0.097, 0.122)	0.114	0.018	0.051	1	0.82	91.64	79.41	12.23	0.007
	Aquatic plants	6	-0.136	(-0.420, 0.148)	< 0.001	0.268	0.88	1	0.35	89.15	< 0.001	89.15	0.16

Supplementary Table 15 Details of taxonomic groups in the datasets collected from peer-reviewed primary studies, public data repositories and Compiled datasets, we provided number of data records (observations) for each group from different data sources. Prop of Quadratic: The proportions of Non-linear (quadratic) form of species richness-ecological uniqueness relationship (RUR) examined across taxa groups with more than 10 estimates were given.

Taxa	Primary studies	Data repositories	Compiled datasets	Overall	Prop of Quadratic
Presence absence data (PA)	**186**	**780**	**110**	**1076**	**36.1%**
Terrestrial plants	26	207	40	273	43.2%
Birds	14	238	7	259	37.1%
Fishes	35	99	9	143	30.1%
Freshwater macroinvertebrates	24	47	12	83	32.5%
Terrestrial insects	17	58	8	83	32.5%
Aquatic plants	27	38	4	69	34.8%
Algae	15	23	14	52	40.4%
Arthropods	2	13	7	22	27.3%
Phytoplankton	7	7	7	21	42.9%
Zooplankton	8	6	0	14	21.4%
Invertebrates	5	7	0	12	16.7%
Mammals	1	8	0	9	
Amphibians	1	6	1	8	
Lichens	0	7	0	7	
Bivalves	1	4	0	5	
Bats	1	3	1	5	
Reptilia	0	4	0	4	
Nematodes	2	1	0	3	
Gastropods	0	2	0	2	
Seaweed	0	2	0	2	
Abundance data (AB)	**102**	**635**	**105**	**842**	**27.0%**
Terrestrial plants	18	163	40	221	36.2%
Birds	5	202	7	214	28.0%
Fishes	18	83	9	110	23.6%
Freshwater macroinvertebrates	13	47	11	71	23.9%
Terrestrial insects	17	45	8	70	15.7%
Algae	14	20	14	48	25.0%
Arthropods	2	10	7	19	21.1%
Aquatic plants	2	16	0	18	11.1%
Phytoplankton	2	7	7	16	31.3%
Invertebrates	5	7	0	12	16.7%
Mammals	1	7	0	8	
Zooplankton	2	6	0	8	

Amphibians	1	5	1	7
Lichens	0	7	0	7
Bats	0	3	1	4
Reptilia	0	4	0	4
Nematodes	2	1	0	3
Bivalves	0	1	0	1
Gastropods	0	1	0	1

Supplementary Table 16A Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis across different taxa groups based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (51.8%)	PC2 (18.3%)
Presence absence (PA) (n = 252)	Bio1 (Annual Mean Temperature)	-0.292	-0.189
	Bio2 (Mean Diurnal Range)	0.050	-0.342
	Bio3 (Isothermality)	-0.287	-0.077
	Bio4 (Temperature Seasonality)	0.277	-0.0002
	Bio5 (Max Temperature of Warmest Month)	-0.186	-0.333
	Bio6 (Min Temperature of Coldest Month)	-0.299	-0.082
	Bio7 (Temperature Annual Range)	0.266	-0.068
	Bio8 (Mean Temperature of Wettest Quarter)	-0.185	-0.201
	Bio9 (Mean Temperature of Driest Quarter)	-0.271	-0.127
	Bio10 (Mean Temperature of Warmest Quarter)	-0.220	-0.285
	Bio11 (Mean Temperature of Coldest Quarter)	-0.301	-0.119
	Bio12 (Annual Precipitation)	-0.263	0.231
	Bio13 (Precipitation of Wettest Month)	-0.245	0.108
	Bio14 (Precipitation of Driest Month)	-0.142	0.390
	Bio15 (Precipitation Seasonality)	-0.034	-0.331
	Bio16 (Precipitation of Wettest Quarter)	-0.252	0.125
	Bio17 (Precipitation of Driest Quarter)	-0.163	0.386
	Bio18 (Precipitation of Warmest Quarter)	-0.138	0.178
	Bio19 (Precipitation of Coldest Quarter)	-0.231	0.209
	Bioclimatic variables	**PC1 (52.3%)**	**PC2 (18.1%)**
Abundance (AB) (n = 317)	Bio1	0.292	0.172
	Bio2	-0.0001	0.387
	Bio3	0.286	0.067
	Bio4	-0.263	0.073
	Bio5	0.200	0.326
	Bio6	0.297	0.035
	Bio7	-0.243	0.152
	Bio8	0.196	0.253
	Bio9	0.274	0.056
	Bio10	0.227	0.285
	Bio11	0.301	0.082
	Bio12	0.267	-0.196
	Bio13	0.256	-0.071
	Bio14	0.132	-0.374
	Bio15	0.048	0.370
	Bio16	0.259	-0.088
	Bio17	0.156	-0.370
	Bio18	0.162	-0.050
	Bio19	0.215	-0.241

Supplementary Table 16B Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the full-model analysis across four taxa groups (i.e. Terrestrial plants, Freshwater macroinvertebrates, Birds and Terrestrial insects) based on PA and AB data. n: number of data points.

Data type	Bioclimatic variables	PC1 (49.1%)	PC2 (18.9%)
Presence absence (PA) (n = 59)	Bio1 (Annual Mean Temperature)	0.306	-0.113
	Bio2 (Mean Diurnal Range)	-0.104	-0.332
	Bio3 (Isothermality)	0.303	-0.096
	Bio4 (Temperature Seasonality)	-0.298	-0.067
	Bio5 (Max Temperature of Warmest Month)	0.180	-0.292
	Bio6 (Min Temperature of Coldest Month)	0.309	0.015
	Bio7 (Temperature Annual Range)	-0.290	-0.114
	Bio8 (Mean Temperature of Wettest Quarter)	0.134	-0.298
	Bio9 (Mean Temperature of Driest Quarter)	0.282	-0.003
	Bio10 (Mean Temperature of Warmest Quarter)	0.223	-0.278
	Bio11 (Mean Temperature of Coldest Quarter)	0.312	-0.030
	Bio12 (Annual Precipitation)	0.255	0.082
	Bio13 (Precipitation of Wettest Month)	0.211	-0.139
	Bio14 (Precipitation of Driest Month)	0.124	0.411
	Bio15 (Precipitation Seasonality)	-0.059	-0.440
	Bio16 (Precipitation of Wettest Quarter)	0.223	-0.117
	Bio17 (Precipitation of Driest Quarter)	0.141	0.393
	Bio18 (Precipitation of Warmest Quarter)	0.068	-0.087
	Bio19 (Precipitation of Coldest Quarter)	0.236	0.185
	Bioclimatic variables	**PC1 (52.3%)**	**PC2 (18.9%)**
Abundance (AB) (n = 67)	Bio1	0.301	0.061
	Bio2	-0.118	0.305
	Bio3	0.284	0.053
	Bio4	-0.284	0.101
	Bio5	0.169	0.226
	Bio6	0.300	-0.071
	Bio7	-0.280	0.142
	Bio8	0.147	0.293
	Bio9	0.282	-0.097
	Bio10	0.206	0.218
	Bio11	0.303	-0.021
	Bio12	0.276	0.035
	Bio13	0.229	0.241
	Bio14	0.153	-0.353
	Bio15	-0.039	0.469
	Bio16	0.243	0.223
	Bio17	0.170	-0.324
	Bio18	0.136	0.296
	Bio19	0.204	-0.156

Supplementary Table 16C Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for terrestrial plants based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (55.5%)	PC2 (17.2%)
Presence absence (PA) (n = 106)	Bio1 (Annual Mean Temperature)	0.283	0.200
	Bio2 (Mean Diurnal Range)	-0.123	0.264
	Bio3 (Isothermality)	0.285	0.085
	Bio4 (Temperature Seasonality)	-0.28	-0.024
	Bio5 (Max Temperature of Warmest Month)	0.188	0.342
	Bio6 (Min Temperature of Coldest Month)	0.292	0.101
	Bio7 (Temperature Annual Range)	-0.278	0.014
	Bio8 (Mean Temperature of Wettest Quarter)	0.177	0.238
	Bio9 (Mean Temperature of Driest Quarter)	0.270	0.113
	Bio10 (Mean Temperature of Warmest Quarter)	0.218	0.303
	Bio11 (Mean Temperature of Coldest Quarter)	0.292	0.129
	Bio12 (Annual Precipitation)	0.262	-0.239
	Bio13 (Precipitation of Wettest Month)	0.238	-0.108
	Bio14 (Precipitation of Driest Month)	0.157	-0.392
	Bio15 (Precipitation Seasonality)	0.017	0.320
	Bio16 (Precipitation of Wettest Quarter)	0.244	-0.139
	Bio17 (Precipitation of Driest Quarter)	0.174	-0.389
	Bio18 (Precipitation of Warmest Quarter)	0.132	-0.170
	Bio19 (Precipitation of Coldest Quarter)	0.231	-0.230
	Bioclimatic variables	**PC1 (59.1%)**	**PC2 (15.5%)**
Abundance (AB) (n = 92)	Bio1	0.275	0.198
	Bio2	-0.131	0.283
	Bio3	0.278	0.095
	Bio4	-0.270	0.062
	Bio5	0.194	0.377
	Bio6	0.284	0.047
	Bio7	-0.265	0.099
	Bio8	0.172	0.399
	Bio9	0.273	0.003
	Bio10	0.215	0.357
	Bio11	0.285	0.089
	Bio12	0.262	-0.165
	Bio13	0.233	-0.067
	Bio14	0.186	-0.299
	Bio15	-0.052	0.337
	Bio16	0.234	-0.107
	Bio17	0.203	-0.300
	Bio18	0.166	0.119
	Bio19	0.231	-0.261

Supplementary Table 16D Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for birds based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (51.9%)	PC2 (22.6%)
Presence absence (PA) (n = 59)	Bio1 (Annual Mean Temperature)	0.294	0.169
	Bio2 (Mean Diurnal Range)	0.049	0.353
	Bio3 (Isothermality)	0.297	0.035
	Bio4 (Temperature Seasonality)	-0.264	0.031
	Bio5 (Max Temperature of Warmest Month)	0.209	0.297
	Bio6 (Min Temperature of Coldest Month)	0.297	0.072
	Bio7 (Temperature Annual Range)	-0.228	0.131
	Bio8 (Mean Temperature of Wettest Quarter)	0.229	0.126
	Bio9 (Mean Temperature of Driest Quarter)	0.260	0.159
	Bio10 (Mean Temperature of Warmest Quarter)	0.242	0.250
	Bio11 (Mean Temperature of Coldest Quarter)	0.301	0.107
	Bio12 (Annual Precipitation)	0.252	-0.264
	Bio13 (Precipitation of Wettest Month)	0.266	-0.162
	Bio14 (Precipitation of Driest Month)	0.095	-0.390
	Bio15 (Precipitation Seasonality)	0.089	0.319
	Bio16 (Precipitation of Wettest Quarter)	0.267	-0.162
	Bio17 (Precipitation of Driest Quarter)	0.128	-0.386
	Bio18 (Precipitation of Warmest Quarter)	0.157	-0.227
	Bio19 (Precipitation of Coldest Quarter)	0.191	-0.206
	Bioclimatic variables	**PC1 (56.1%)**	**PC2 (22.1%)**
Abundance (AB) (n = 92)	Bio1	0.290	0.138
	Bio2	0.146	0.358
	Bio3	0.283	-0.018
	Bio4	-0.232	0.138
	Bio5	0.234	0.264
	Bio6	0.294	0.034
	Bio7	-0.169	0.256
	Bio8	0.251	0.116
	Bio9	0.262	0.130
	Bio10	0.252	0.224
	Bio11	0.297	0.064
	Bio12	0.254	-0.245
	Bio13	0.273	-0.116
	Bio14	0.081	-0.406
	Bio15	0.124	0.357
	Bio16	0.273	-0.118
	Bio17	0.111	-0.398
	Bio18	0.155	-0.227
	Bio19	0.188	-0.149

Supplementary Table 16E Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for Fishes based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (60.4%)	PC2 (15.6%)
Presence absence (PA) (n = 24)	Bio1 (Annual Mean Temperature)	0.289	-0.036
	Bio2 (Mean Diurnal Range)	0.091	-0.280
	Bio3 (Isothermality)	0.234	-0.010
	Bio4 (Temperature Seasonality)	-0.261	0.006
	Bio5 (Max Temperature of Warmest Month)	0.263	-0.086
	Bio6 (Min Temperature of Coldest Month)	0.288	-0.012
	Bio7 (Temperature Annual Range)	-0.254	-0.056
	Bio8 (Mean Temperature of Wettest Quarter)	0.257	0.107
	Bio9 (Mean Temperature of Driest Quarter)	0.273	0.057
	Bio10 (Mean Temperature of Warmest Quarter)	0.271	-0.043
	Bio11 (Mean Temperature of Coldest Quarter)	0.289	-0.015
	Bio12 (Annual Precipitation)	0.252	-0.133
	Bio13 (Precipitation of Wettest Month)	0.256	0.036
	Bio14 (Precipitation of Driest Month)	-0.016	-0.565
	Bio15 (Precipitation Seasonality)	0.169	0.432
	Bio16 (Precipitation of Wettest Quarter)	0.257	0.030
	Bio17 (Precipitation of Driest Quarter)	0.009	-0.560
	Bio18 (Precipitation of Warmest Quarter)	0.161	-0.006
	Bio19 (Precipitation of Coldest Quarter)	0.148	-0.232
	Bioclimatic variables	**PC1 (60.4%)**	**PC2 (17.2%)**
Abundance (AB) (n = 24)	Bio1	-0.280	0.131
	Bio2	-0.123	0.173
	Bio3	-0.274	0.020
	Bio4	0.258	-0.104
	Bio5	-0.240	0.154
	Bio6	-0.279	0.119
	Bio7	0.240	-0.064
	Bio8	-0.209	0.086
	Bio9	-0.258	0.153
	Bio10	-0.249	0.130
	Bio11	-0.283	0.131
	Bio12	-0.253	-0.265
	Bio13	-0.262	-0.070
	Bio14	-0.132	-0.483
	Bio15	-0.088	0.393
	Bio16	-0.268	-0.083
	Bio17	-0.144	-0.473
	Bio18	-0.193	-0.215
	Bio19	-0.183	-0.307

Supplementary Table 16F Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for Freshwater macroinvertebrates based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (48.9%)	PC2 (28.5%)
Presence absence (PA) (n = 17)	Bio1 (Annual Mean Temperature)	-0.225	0.299
	Bio2 (Mean Diurnal Range)	0.153	0.338
	Bio3 (Isothermality)	-0.261	0.178
	Bio4 (Temperature Seasonality)	0.267	-0.073
	Bio5 (Max Temperature of Warmest Month)	-0.029	0.361
	Bio6 (Min Temperature of Coldest Month)	-0.281	0.190
	Bio7 (Temperature Annual Range)	0.274	0.016
	Bio8 (Mean Temperature of Wettest Quarter)	-0.172	0.038
	Bio9 (Mean Temperature of Driest Quarter)	-0.145	0.341
	Bio10 (Mean Temperature of Warmest Quarter)	-0.092	0.328
	Bio11 (Mean Temperature of Coldest Quarter)	-0.267	0.235
	Bio12 (Annual Precipitation)	-0.289	-0.161
	Bio13 (Precipitation of Wettest Month)	-0.283	-0.118
	Bio14 (Precipitation of Driest Month)	-0.257	-0.229
	Bio15 (Precipitation Seasonality)	0.020	0.320
	Bio16 (Precipitation of Wettest Quarter)	-0.285	-0.127
	Bio17 (Precipitation of Driest Quarter)	-0.264	-0.219
	Bio18 (Precipitation of Warmest Quarter)	-0.181	-0.228
	Bio19 (Precipitation of Coldest Quarter)	-0.297	-0.032
	Bioclimatic variables	**PC1 (51.7%)**	**PC2 (15.3%)**
Abundance (AB) (n = 28)	Bio1	0.296	-0.146
	Bio2	0.007	-0.066
	Bio3	0.262	-0.037
	Bio4	-0.274	-0.018
	Bio5	0.191	-0.263
	Bio6	0.303	-0.082
	Bio7	-0.276	-0.038
	Bio8	0.187	-0.233
	Bio9	0.273	-0.033
	Bio10	0.218	-0.231
	Bio11	0.305	-0.095
	Bio12	0.250	0.302
	Bio13	0.267	0.093
	Bio14	0.097	0.476
	Bio15	0.172	-0.236
	Bio16	0.267	0.108
	Bio17	0.102	0.504
	Bio18	0.183	-0.003
	Bio19	0.163	0.361

Supplementary Table 16G Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for Algae based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (46.7%)	PC2 (25.3%)
Presence absence (PA) (n = 16)	Bio1 (Annual Mean Temperature)	0.309	-0.048
	Bio2 (Mean Diurnal Range)	-0.028	0.002
	Bio3 (Isothermality)	0.242	-0.293
	Bio4 (Temperature Seasonality)	-0.226	0.312
	Bio5 (Max Temperature of Warmest Month)	0.150	0.251
	Bio6 (Min Temperature of Coldest Month)	0.299	-0.186
	Bio7 (Temperature Annual Range)	-0.229	0.301
	Bio8 (Mean Temperature of Wettest Quarter)	0.238	0.135
	Bio9 (Mean Temperature of Driest Quarter)	0.295	-0.198
	Bio10 (Mean Temperature of Warmest Quarter)	0.195	0.228
	Bio11 (Mean Temperature of Coldest Quarter)	0.300	-0.180
	Bio12 (Annual Precipitation)	0.277	0.223
	Bio13 (Precipitation of Wettest Month)	0.282	0.141
	Bio14 (Precipitation of Driest Month)	0.149	0.340
	Bio15 (Precipitation Seasonality)	0.048	-0.335
	Bio16 (Precipitation of Wettest Quarter)	0.283	0.133
	Bio17 (Precipitation of Driest Quarter)	0.148	0.340
	Bio18 (Precipitation of Warmest Quarter)	0.107	0.191
	Bio19 (Precipitation of Coldest Quarter)	0.253	0.134
	Bioclimatic variables	**PC1 (46.0%)**	**PC2 (25.5%)**
Abundance (AB) (n = 24)	Bio1	-0.326	-0.047
	Bio2	-0.089	-0.063
	Bio3	-0.247	0.253
	Bio4	0.233	-0.260
	Bio5	-0.214	-0.253
	Bio6	-0.314	0.094
	Bio7	0.213	-0.260
	Bio8	-0.275	-0.137
	Bio9	-0.307	0.114
	Bio10	-0.245	-0.241
	Bio11	-0.322	0.079
	Bio12	-0.232	-0.271
	Bio13	-0.255	-0.143
	Bio14	0.046	-0.383
	Bio15	-0.162	0.292
	Bio16	-0.255	-0.142
	Bio17	0.016	-0.396
	Bio18	-0.187	-0.167
	Bio19	-0.005	-0.308

Supplementary Table 16H Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for Aquatic plants based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (63.8%)	PC2 (27.9%)
Presence absence (PA) (n = 17)	Bio1 (Annual Mean Temperature)	0.285	0.030
	Bio2 (Mean Diurnal Range)	-0.122	-0.240
	Bio3 (Isothermality)	0.261	-0.173
	Bio4 (Temperature Seasonality)	-0.282	-0.063
	Bio5 (Max Temperature of Warmest Month)	0.263	-0.060
	Bio6 (Min Temperature of Coldest Month)	0.283	0.062
	Bio7 (Temperature Annual Range)	-0.277	-0.096
	Bio8 (Mean Temperature of Wettest Quarter)	0.116	-0.370
	Bio9 (Mean Temperature of Driest Quarter)	0.276	0.118
	Bio10 (Mean Temperature of Warmest Quarter)	0.276	-0.008
	Bio11 (Mean Temperature of Coldest Quarter)	0.285	0.045
	Bio12 (Annual Precipitation)	0.280	-0.045
	Bio13 (Precipitation of Wettest Month)	0.209	-0.282
	Bio14 (Precipitation of Driest Month)	0.152	0.361
	Bio15 (Precipitation Seasonality)	-0.051	-0.397
	Bio16 (Precipitation of Wettest Quarter)	0.217	-0.270
	Bio17 (Precipitation of Driest Quarter)	0.152	0.362
	Bio18 (Precipitation of Warmest Quarter)	0.021	0.363
	Bio19 (Precipitation of Coldest Quarter)	0.257	-0.180
	Bioclimatic variables	**PC1 (74.6%)**	**PC2 (15.1%)**
Abundance (AB) (n = 6)	Bio1	-0.261	-0.049
	Bio2	-0.118	0.530
	Bio3	-0.255	0.060
	Bio4	0.265	-0.030
	Bio5	-0.255	-0.073
	Bio6	-0.264	0.005
	Bio7	0.264	-0.048
	Bio8	-0.246	-0.115
	Bio9	-0.264	-0.055
	Bio10	-0.251	-0.107
	Bio11	-0.264	-0.026
	Bio12	-0.258	-0.005
	Bio13	-0.255	-0.040
	Bio14	-0.037	0.552
	Bio15	-0.248	-0.204
	Bio16	-0.252	-0.017
	Bio17	-0.100	0.500
	Bio18	-0.062	-0.260
	Bio19	-0.207	0.100

Supplementary Table 16I Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for terrestrial insects based on PA and AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (59.6%)	PC2 (19.0%)
Presence absence (PA) (n = 13)	Bio1 (Annual Mean Temperature)	-0.279	-0.137
	Bio2 (Mean Diurnal Range)	0.004	-0.477
	Bio3 (Isothermality)	-0.283	-0.115
	Bio4 (Temperature Seasonality)	0.277	0.026
	Bio5 (Max Temperature of Warmest Month)	-0.173	-0.384
	Bio6 (Min Temperature of Coldest Month)	-0.284	0.009
	Bio7 (Temperature Annual Range)	0.264	-0.146
	Bio8 (Mean Temperature of Wettest Quarter)	-0.147	-0.152
	Bio9 (Mean Temperature of Driest Quarter)	-0.262	-0.086
	Bio10 (Mean Temperature of Warmest Quarter)	-0.222	-0.234
	Bio11 (Mean Temperature of Coldest Quarter)	-0.284	-0.088
	Bio12 (Annual Precipitation)	-0.266	0.153
	Bio13 (Precipitation of Wettest Month)	-0.251	-0.057
	Bio14 (Precipitation of Driest Month)	-0.201	0.314
	Bio15 (Precipitation Seasonality)	0.063	-0.447
	Bio16 (Precipitation of Wettest Quarter)	-0.251	-0.061
	Bio17 (Precipitation of Driest Quarter)	-0.204	0.316
	Bio18 (Precipitation of Warmest Quarter)	-0.183	0.203
	Bio19 (Precipitation of Coldest Quarter)	-0.218	0.090
	Bioclimatic variables	**PC1 (48.1%)**	**PC2 (23.8%)**
Abundance (AB) (n = 34)	Bio1	0.311	-0.124
	Bio2	0.050	-0.385
	Bio3	0.305	-0.036
	Bio4	-0.301	-0.025
	Bio5	0.182	-0.289
	Bio6	0.318	-0.002
	Bio7	-0.267	-0.153
	Bio8	0.163	-0.024
	Bio9	0.276	-0.129
	Bio10	0.220	-0.217
	Bio11	0.320	-0.068
	Bio12	0.248	0.267
	Bio13	0.273	0.107
	Bio14	0.024	0.398
	Bio15	0.073	-0.391
	Bio16	0.273	0.116
	Bio17	0.043	0.403
	Bio18	0.121	0.242
	Bio19	0.158	0.174

Supplementary Table 16J Output from the Principal Component Analysis (PCA) on the 19 bioclimatic variables from WorldClim database used in the single-factor analysis for Arthropods and Zooplankton based on AB data. The numbers in parentheses indicate the explanatory power of each axis. n: number of data points.

Data type	Bioclimatic variables	PC1 (51.0%)	PC2 (29.5%)
Arthropods Abundance (AB) (n = 11)	Bio1 (Annual Mean Temperature)	0.230	0.290
	Bio2 (Mean Diurnal Range)	-0.161	0.196
	Bio3 (Isothermality)	0.270	0.186
	Bio4 (Temperature Seasonality)	-0.299	-0.100
	Bio5 (Max Temperature of Warmest Month)	0.043	0.402
	Bio6 (Min Temperature of Coldest Month)	0.266	0.217
	Bio7 (Temperature Annual Range)	-0.294	0.005
	Bio8 (Mean Temperature of Wettest Quarter)	0.034	0.224
	Bio9 (Mean Temperature of Driest Quarter)	0.174	0.244
	Bio10 (Mean Temperature of Warmest Quarter)	0.150	0.363
	Bio11 (Mean Temperature of Coldest Quarter)	0.258	0.246
	Bio12 (Annual Precipitation)	0.282	-0.189
	Bio13 (Precipitation of Wettest Month)	0.280	-0.172
	Bio14 (Precipitation of Driest Month)	0.249	-0.229
	Bio15 (Precipitation Seasonality)	0.035	0.186
	Bio16 (Precipitation of Wettest Quarter)	0.285	-0.161
	Bio17 (Precipitation of Driest Quarter)	0.245	-0.226
	Bio18 (Precipitation of Warmest Quarter)	0.222	-0.216
	Bio19 (Precipitation of Coldest Quarter)	0.260	-0.214
	Bioclimatic variables	**PC1 (84.3%)**	**PC2 (15.7%)**
Zooplankton Abundance (AB) (n = 6)	Bio1	0.250	-0.012
	Bio2	0.203	-0.337
	Bio3	0.250	0.014
	Bio4	-0.244	-0.124
	Bio5	0.189	-0.378
	Bio6	0.245	0.117
	Bio7	-0.236	-0.192
	Bio8	0.226	0.248
	Bio9	0.250	-0.025
	Bio10	0.219	-0.278
	Bio11	0.249	0.056
	Bio12	0.187	-0.383
	Bio13	0.240	-0.161
	Bio14	-0.212	-0.305
	Bio15	0.244	0.126
	Bio16	0.238	-0.176
	Bio17	-0.215	-0.295
	Bio18	0.238	-0.173
	Bio19	-0.207	-0.324

Supplementary Table 17 Number of effect sizes for taxa groups included in single-factor analysis for explaining effect size of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) across full datasets based on PA and AB data. We selected those taxa groups with more than or equal to 5 effect sizes of RUR in the analysis. The numbers in parentheses indicate the number of effect sizes for each group. See Quantifications of different hypotheses for the definition of each factor.

Data Type	Factors	Total number	Taxa groups (number of effect sizes)
Presence absence (PA)	Gamma diversity	269	Terrestrial plants (106); Birds (60); Fishes (34); Algae (17); Aquatic plants (17); Freshwater macroinvertebrates (17); Terrestrial insects (13); Arthropods (5)
	Breadth of richness	269	Terrestrial plants (106); Birds (60); Fishes (34); Algae (17); Aquatic plants (17); Freshwater macroinvertebrates (17); Terrestrial insects (13); Arthropods (5)
	Proportion of rare species	269	Terrestrial plants (106); Birds (60); Fishes (34); Algae (17); Aquatic plants (17); Freshwater macroinvertebrates (17); Terrestrial insects (13); Arthropods (5)
	Dispersal limitation	114	Terrestrial plants (45); Fishes (19); Birds (15); Freshwater macroinvertebrates (12); Algae (11); Terrestrial insects (7); Aquatic plants (5)
	Spatial grain size	165	Terrestrial plants (104); Birds (43); Aquatic plants (11); Freshwater macroinvertebrates (7)
	PC1 of climatic variables	252	Terrestrial plants (106); Birds (59); Fishes (24); Freshwater macroinvertebrates (17); Aquatic plants (17); Algae (16); Terrestrial insects (13)
	PC2 of climatic variables	252	Terrestrial plants (106); Birds (59); Fishes (24); Freshwater macroinvertebrates (17); Aquatic plants (17); Algae (16); Terrestrial insects (13)
Abundance (AB)	Gamma diversity	342	Birds (92); Terrestrial plants (92); Fishes (34); Terrestrial insects (34); Freshwater macroinvertebrates (28); Algae (27); Arthropods (12); Aquatic plants (6); Phytoplankton (6); Zooplankton (6); Invertebrates (5)
	Breadth of richness	342	Birds (92); Terrestrial plants (92); Fishes (34); Terrestrial insects (34); Freshwater macroinvertebrates (28); Algae (27); Arthropods (12); Aquatic plants (6); Phytoplankton (6); Zooplankton (6); Invertebrates (5)
	Proportion of rare species	342	Birds (92); Terrestrial plants (92); Fishes (34); Terrestrial insects (34); Freshwater macroinvertebrates (28); Algae (27); Arthropods (12); Aquatic plants (6); Phytoplankton (6); Zooplankton (6); Invertebrates (5)
	Dispersal limitation	149	Terrestrial plants (39); Freshwater macroinvertebrates (20); Fishes (19); Terrestrial insects (19); Algae (18); Birds (18); Arthropods (6); Phytoplankton (5); Zooplankton (5)
	Spatial grain size	197	Terrestrial plants (89); Birds (71); Freshwater macroinvertebrates (22); Terrestrial insects (9); Arthropods (6)
	PC1 of climatic variables	317	Birds (92); Terrestrial plants (92); Terrestrial insects (34); Freshwater macroinvertebrates (28); Fishes (24); Algae (24); Arthropods (11); Aquatic plants (6); Zooplankton (6)
	PC2 of climatic variables	317	Birds (92); Terrestrial plants (92); Terrestrial insects (34); Freshwater macroinvertebrates (28); Fishes (24); Algae (24); Arthropods (11); Aquatic plants (6); Zooplankton (6)

Supplementary Table 18 The variance inflation factor (VIF) for each variable used in full model analyses for predicting effect sizes of species richness-ecological uniqueness relationship (RUR, using Fisher's Z-transformed correlation coefficients as effect size) based on presence absence (PA) and abundance (AB) data. See Quantifications of different hypotheses for the definition of each factor.

Data type	Factors	VIF
Full model across different taxa groups		
Presence absence (PA)	Gamma diversity	3.91
	Breadth of richness	2.25
	Proportion of rare	3.00
	Dispersal limitation	1.13
	Spatial grain size	1.42
	PC1 of climatic variables	1.24
	PC2 of climatic variables	1.45
Abundance (AB)	Gamma diversity	1.26
	Breadth of richness	1.45
	Proportion of rare	1.26
	Dispersal limitation	1.17
	Spatial grain size	1.19
	PC1 of climatic variables	1.22
	PC2 of climatic variables	1.23