Supplementary Information For

Regional occupancy increases for widespread species but decreases for narrowly distributed species in metacommunity time series

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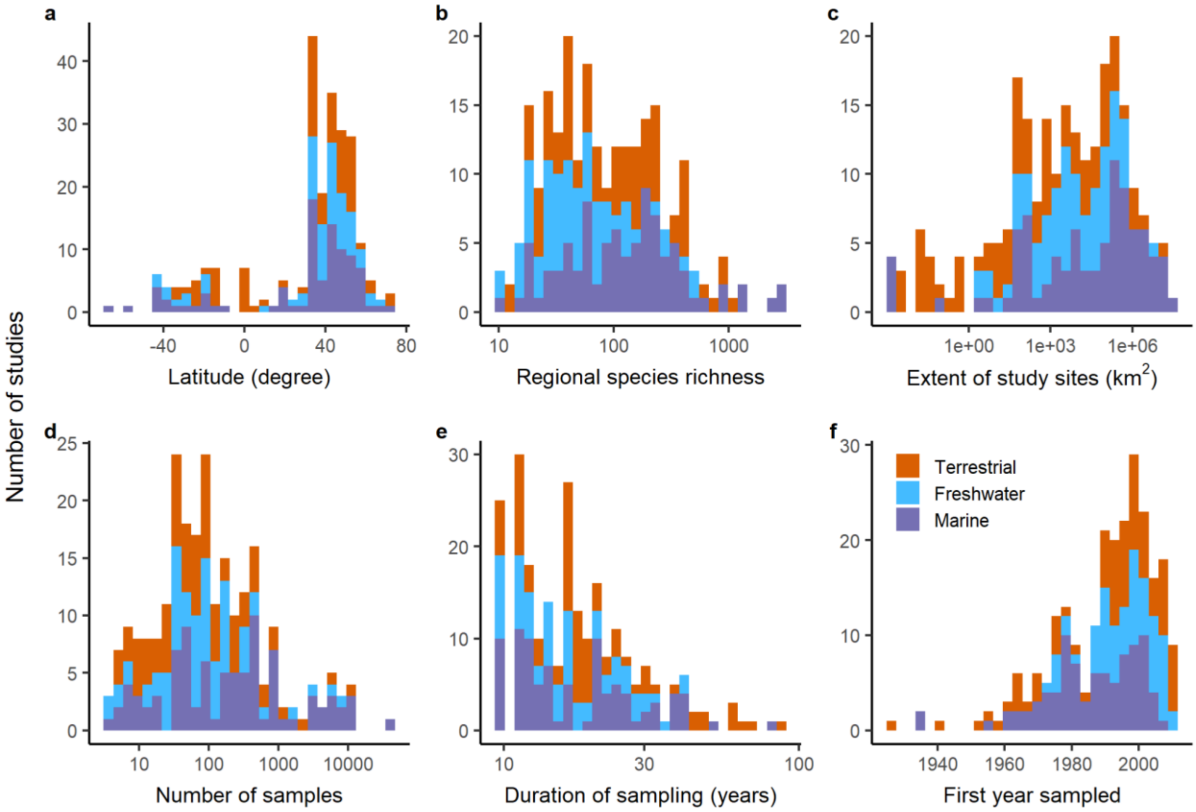
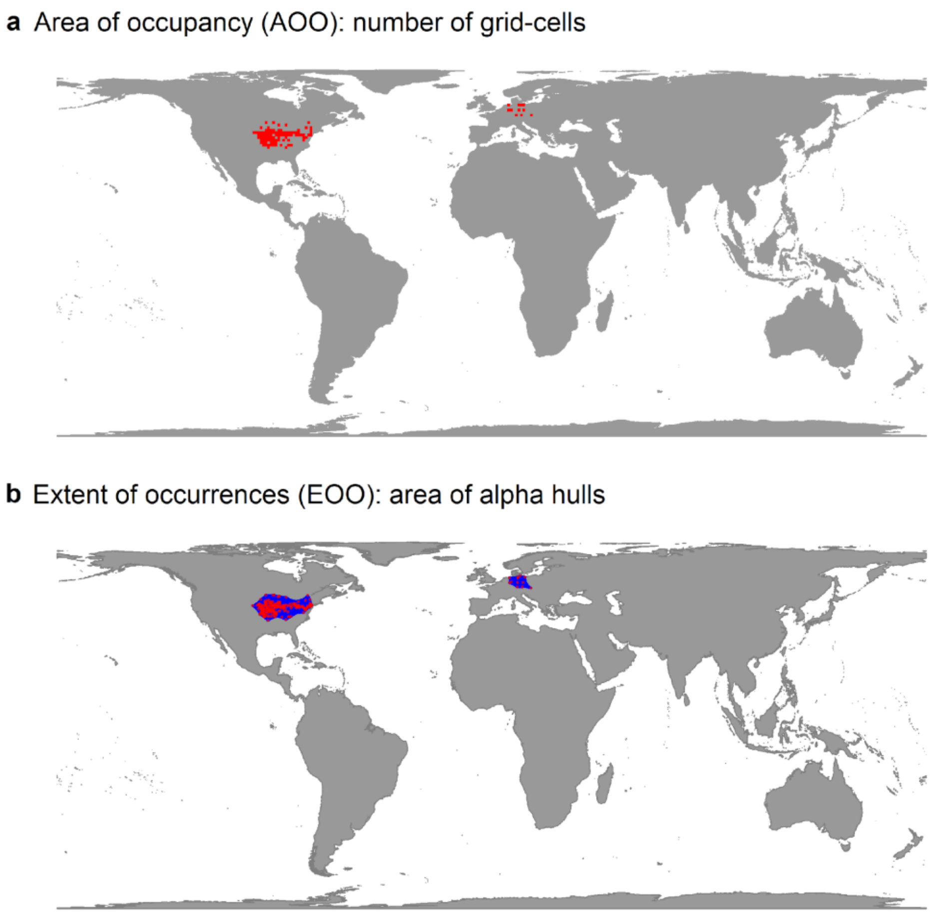
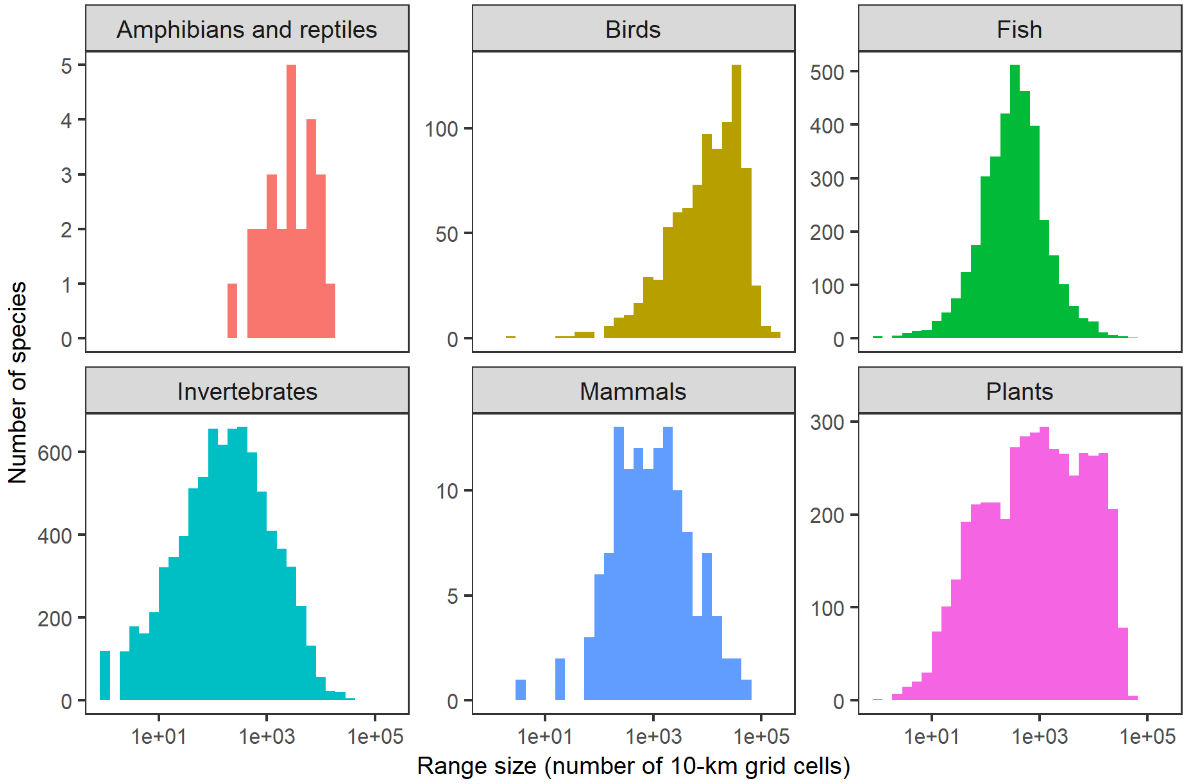


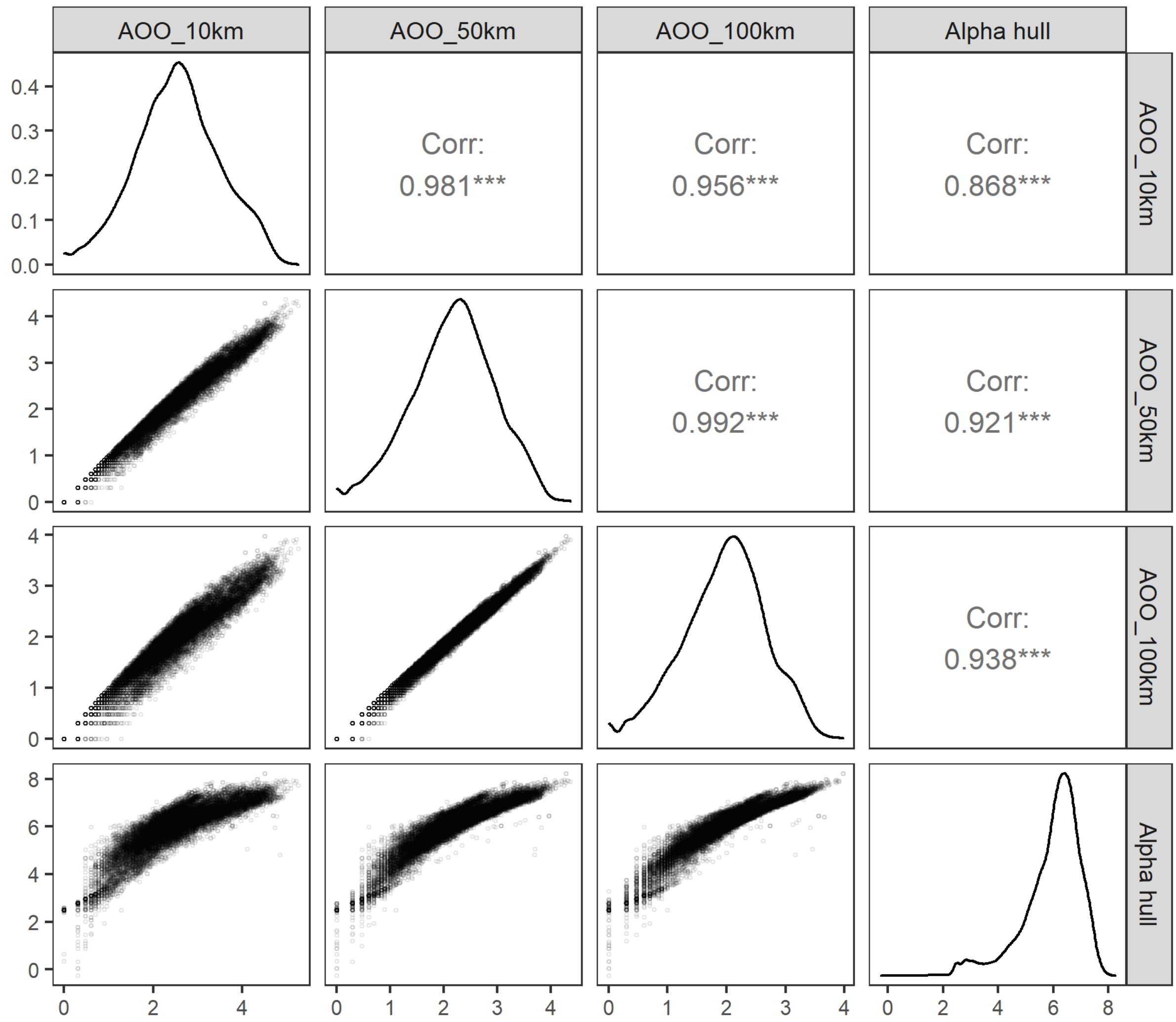
Supplementary Fig. 1 | Frequency distribution of study characteristics. a-f, The characteristics include central latitude of study sites (**a**), regional species richness observed in the study (**b**), extent of study sites (**c**), number of samples used to calculate occupancy in each period (**d**), duration of sampling (**e**), and start year of sampling (**f**). The colors indicate the terrestrial (orange), freshwater (blue) and marine (purple) realms where studies came from. The medians of these variables are 41.2° (based on absolute latitude), 76 species, 4,274 km^2, 84 samples, 16 years, and 1994, respectively.



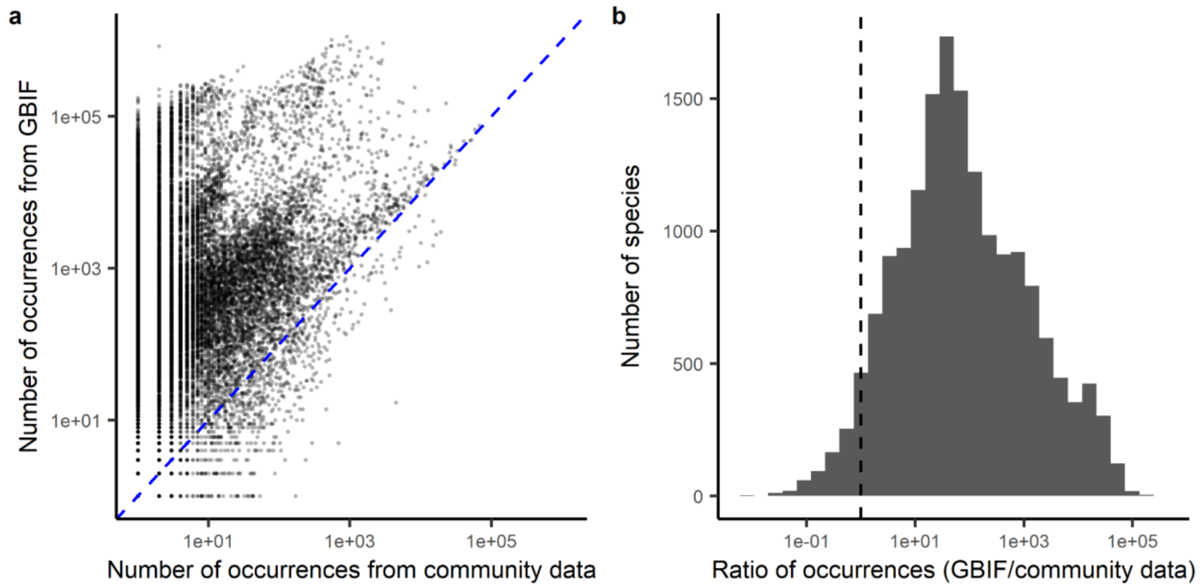
Supplementary Fig. 2 | A diagram showing how a species' geographic range size was measured. We first downloaded and cleaned species distribution occurrences from the Global Biodiversity Information Facility. A species' range size was then measured as the area of occupancy (AOO) which was estimated as the number of grid cells (red cells) occupied by the species (**a**), and the extent of occurrences (EOO) which was estimated as the area of the alpha hulls (blue polygons) containing the species' distribution occurrences (**b**). Red points in **b** were the species' distribution occurrences. We estimated AOO using three grid-cell resolutions: 10 km × 10 km, 50 km × 50 km, and 100 km × 100 km. The alpha hull was constructed using the alpha parameter set to six.



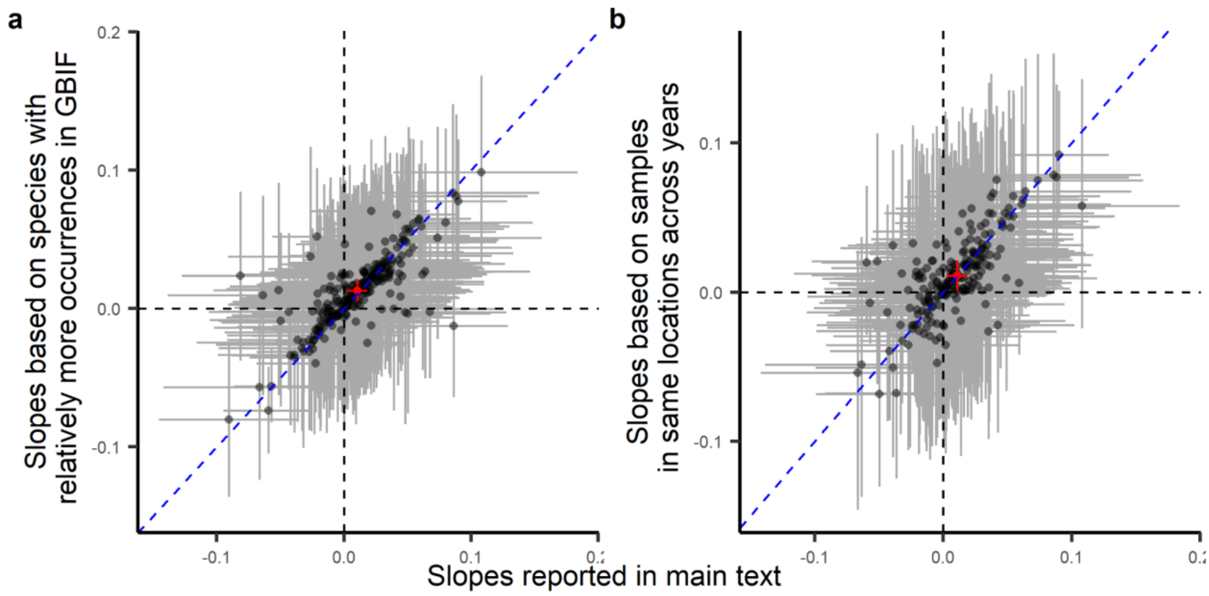
Supplementary Fig. 3 | Range size frequency distribution for each taxonomic group. Range sizes were measured as the number of 10-km grid cells where distribution occurrences were observed.



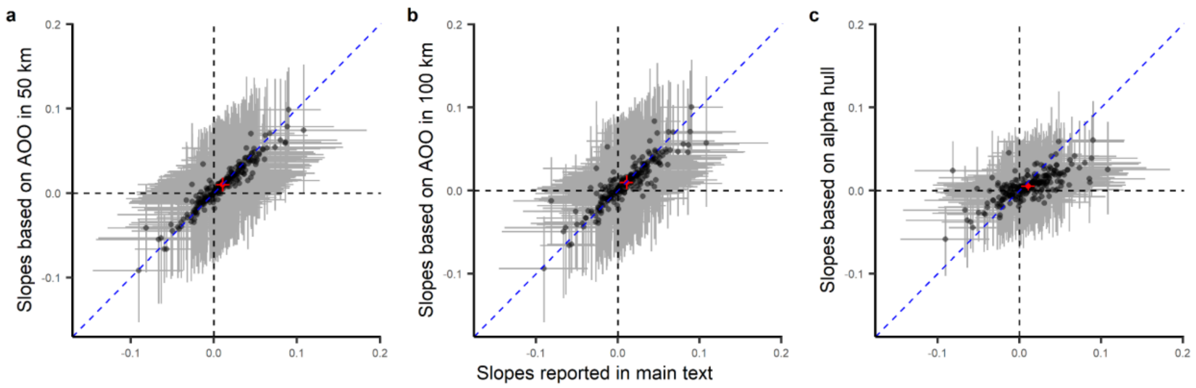
Supplementary Fig. 4 | Pearson correlation between different estimates of species' range size. Range sizes were measured as the area of occupancy (AOO) defined as the number of grid cells where distribution occurrences were observed using three resolutions (10-, 50-, 100-km), and the extent of occurrences (EOO) defined as the area of alpha hulls. There are strong positive correlations among these $\log_{10}$-transformed estimates (Pearson' $r > 0.868$).



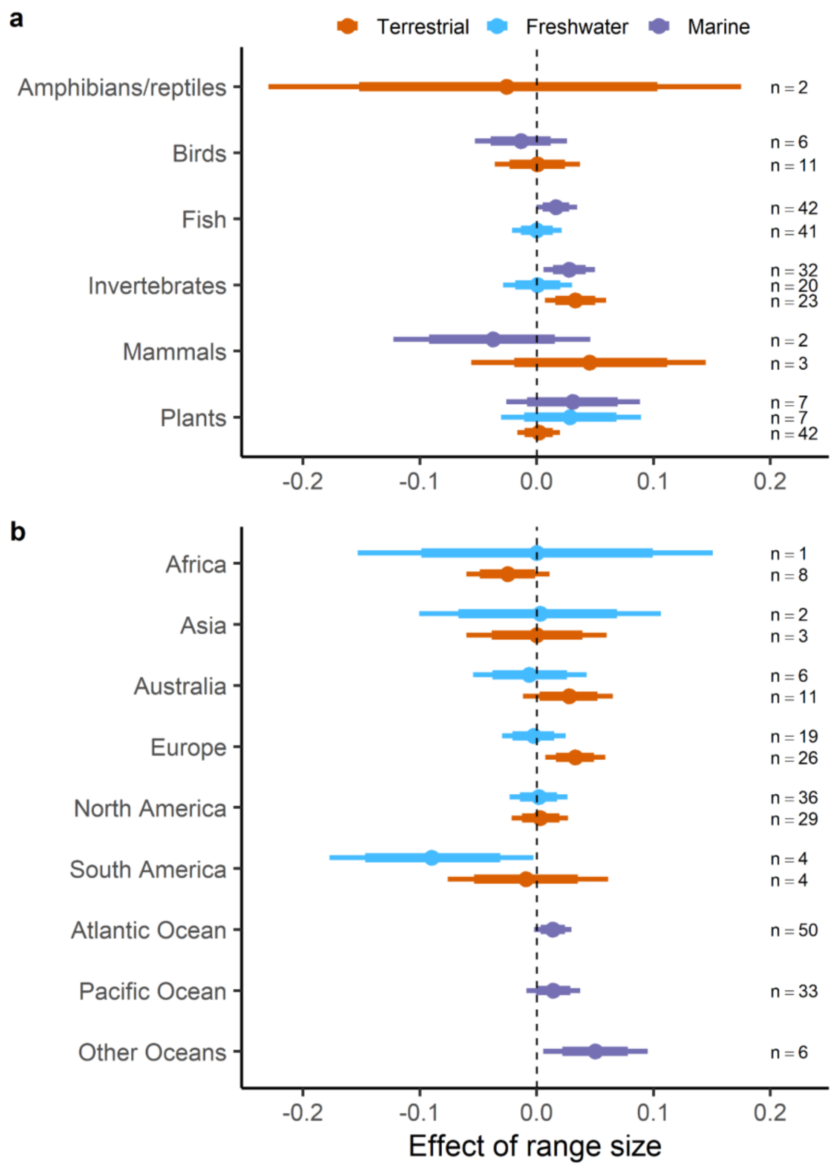
Supplementary Fig. 5 | Comparison of the number of occurrences from GBIF and assemblage datasets (a) and frequency distribution of the ratio between them (b). The number of occurrences was measured as the number of occupied grid-cells in 0.01°. The blue dashed line in panel **a** is the identity line. The vertical dashed line in panel **b** shows the same number of occurrences from GBIF and the assemblage dataset (*ratio* = 1).



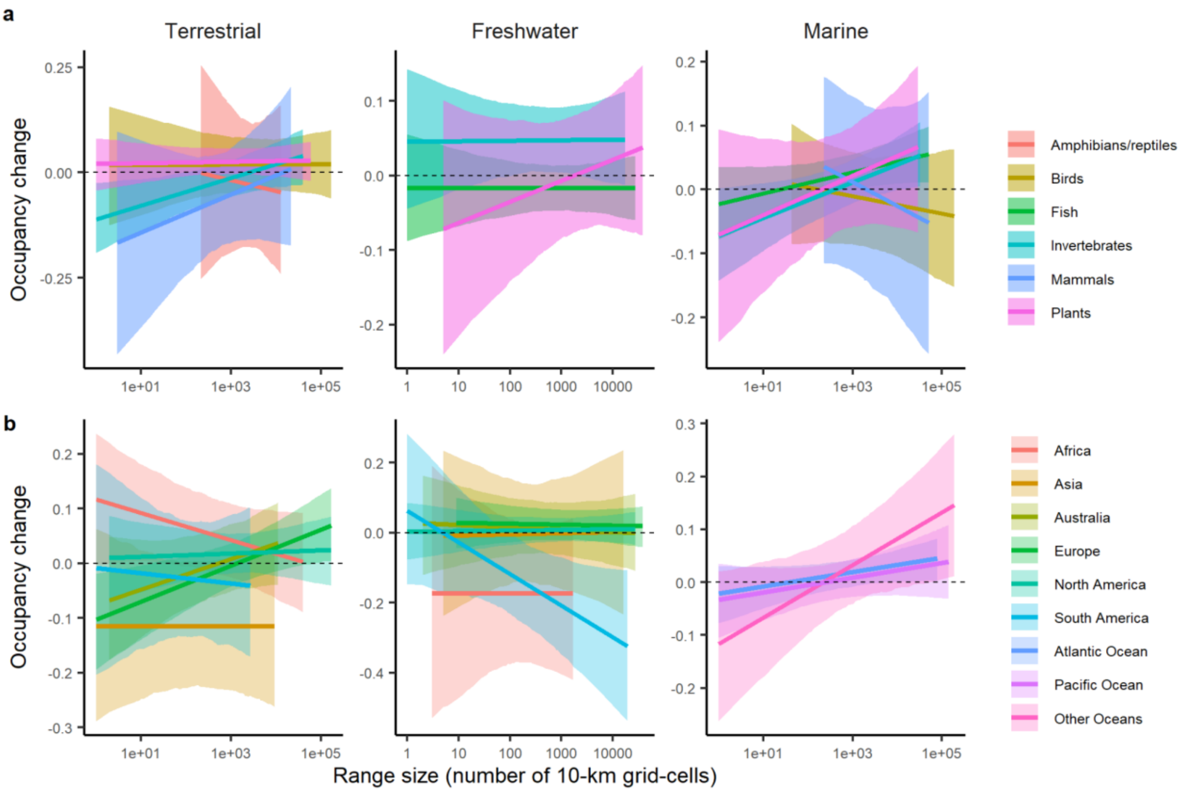
Supplementary Fig. 6 | Sensitivity analyses for using different data subsets. Comparison of the slopes reported in the main text (x-axis) with those obtained from analyses using data subsetted in different ways (y-axis). **a** Slopes in the y-axis were from an analysis including only the species that had at least five times more occurrences in GBIF than in the assemblage dataset (24,520 observations across 237 studies); **b** slopes in the y-axis were from an analysis using assemblage data with sites in the same locations across years (18,331 observations across 206 studies). Black points and gray lines indicate the study-level slope estimates and their 95% credible intervals; the red point and line indicate the overall slope estimate and its 95% credible interval. The blue dashed line indicates the identity line.



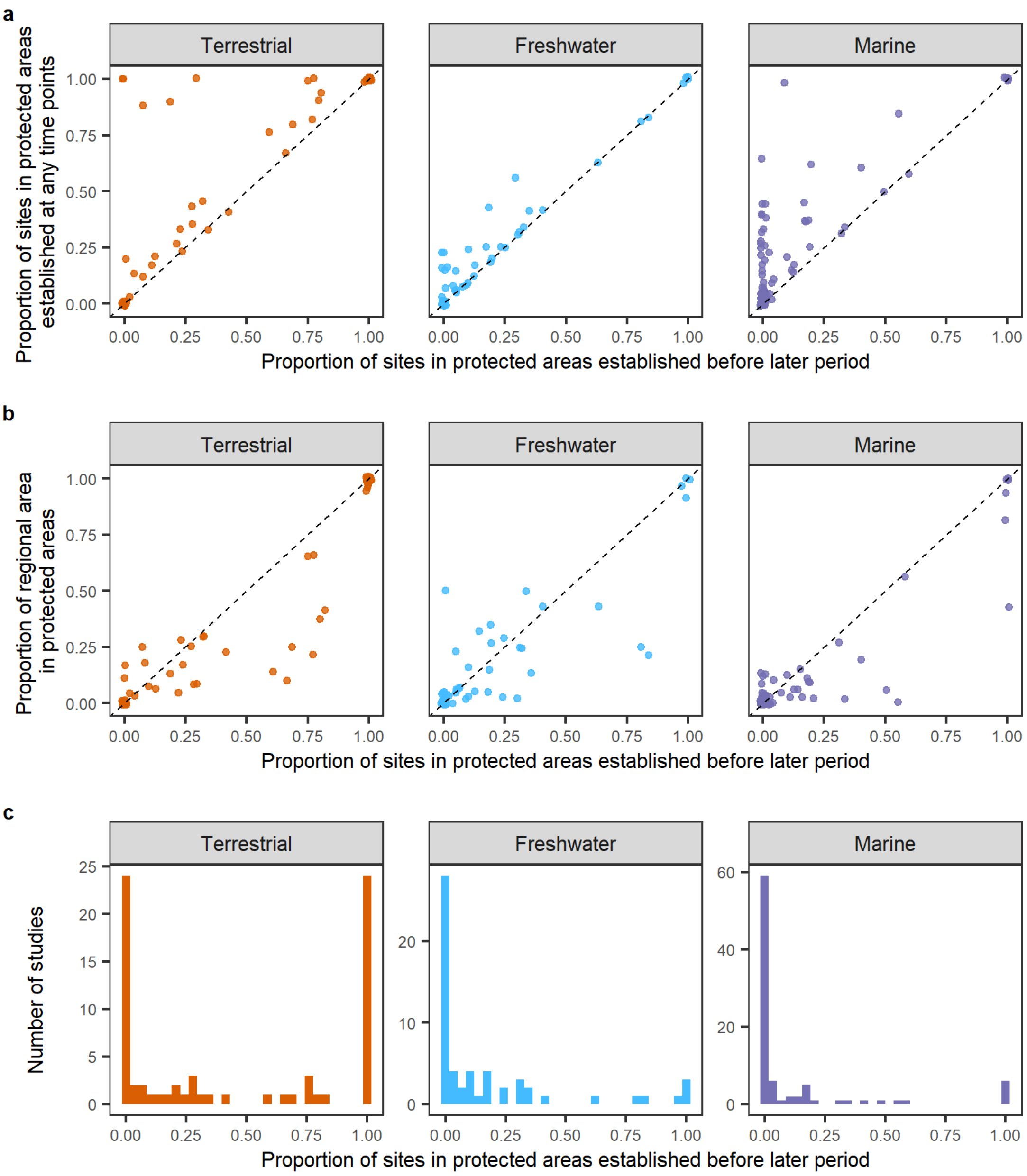
Supplementary Fig. 7 | Sensitivity analyses for using different estimates of range size. Comparison of the slopes reported in the main text (x-axis) with those obtained from analyses using different estimates of range size (y-axis). The main analyses used the area of occupancy (AOO) defined as the number of 10-km grid cells where distribution occurrences were observed. The sensitivity analyses used the AOO in the resolution of 50 km (**a**) and 100 km (**b**) and the area of alpha hulls (**c**). All analyses used 30,103 observations across 238 studies. Black points and gray lines indicate the study-level slope estimates and their 95% credible intervals; the red point and line indicate the overall slope estimate and its 95% credible interval. The blue dashed line indicates the identity line.



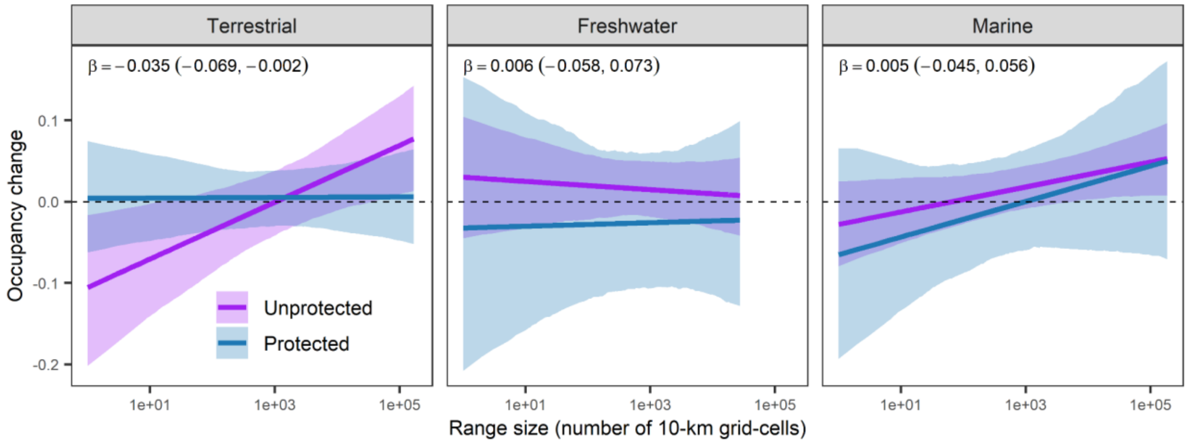
Supplementary Fig. 8 | Effect of range size on occupancy change across groups of studies. Studies were grouped by taxon group (**a**), and geographic region (continent and ocean; **b**) for terrestrial (orange), freshwater (blue) and marine (purple) realms. Mean (points), 95% (thick lines) and 80% (thin lines) credible intervals are shown for each group. The dashed line shows the zero slope (no effect of range size). The numbers on the right indicate the number of studies included in each group. We note that each study has at least 10 species-level observations (see Supplementary Table 5 for the number of species in each study), and we thus can estimate the uncertainty in the effects of range size even for groups with only one or two studies.



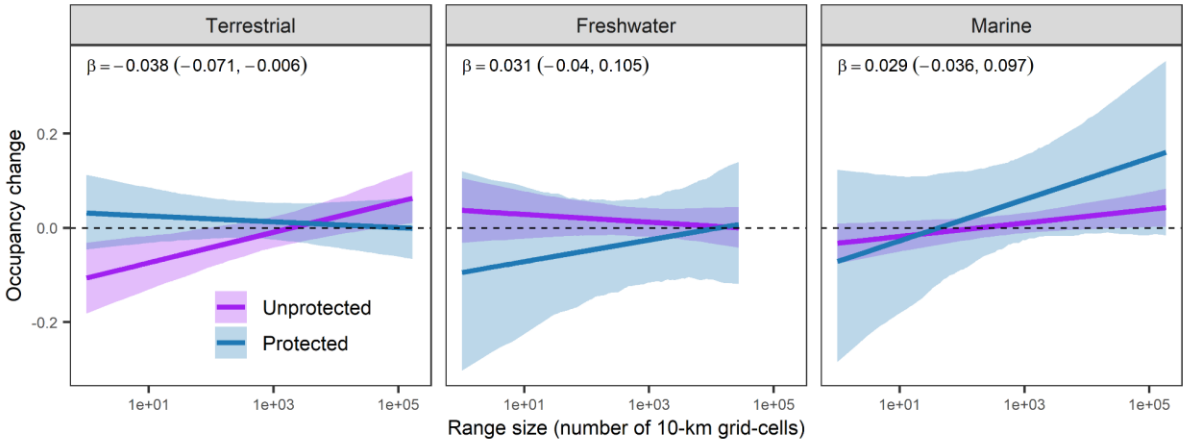
Supplementary Fig. 9 | The relationship between range size and occupancy change across groups of studies. Studies were grouped by taxon group (**a**), and geographic region (continent and ocean; **b**) for terrestrial, freshwater and marine realms. Occupancy change is the difference in occupancy between the late and early periods, shown as the square root transformed for the absolute magnitude. Solid lines and shading show the range size-occupancy change relationships and 95% credible intervals, respectively.



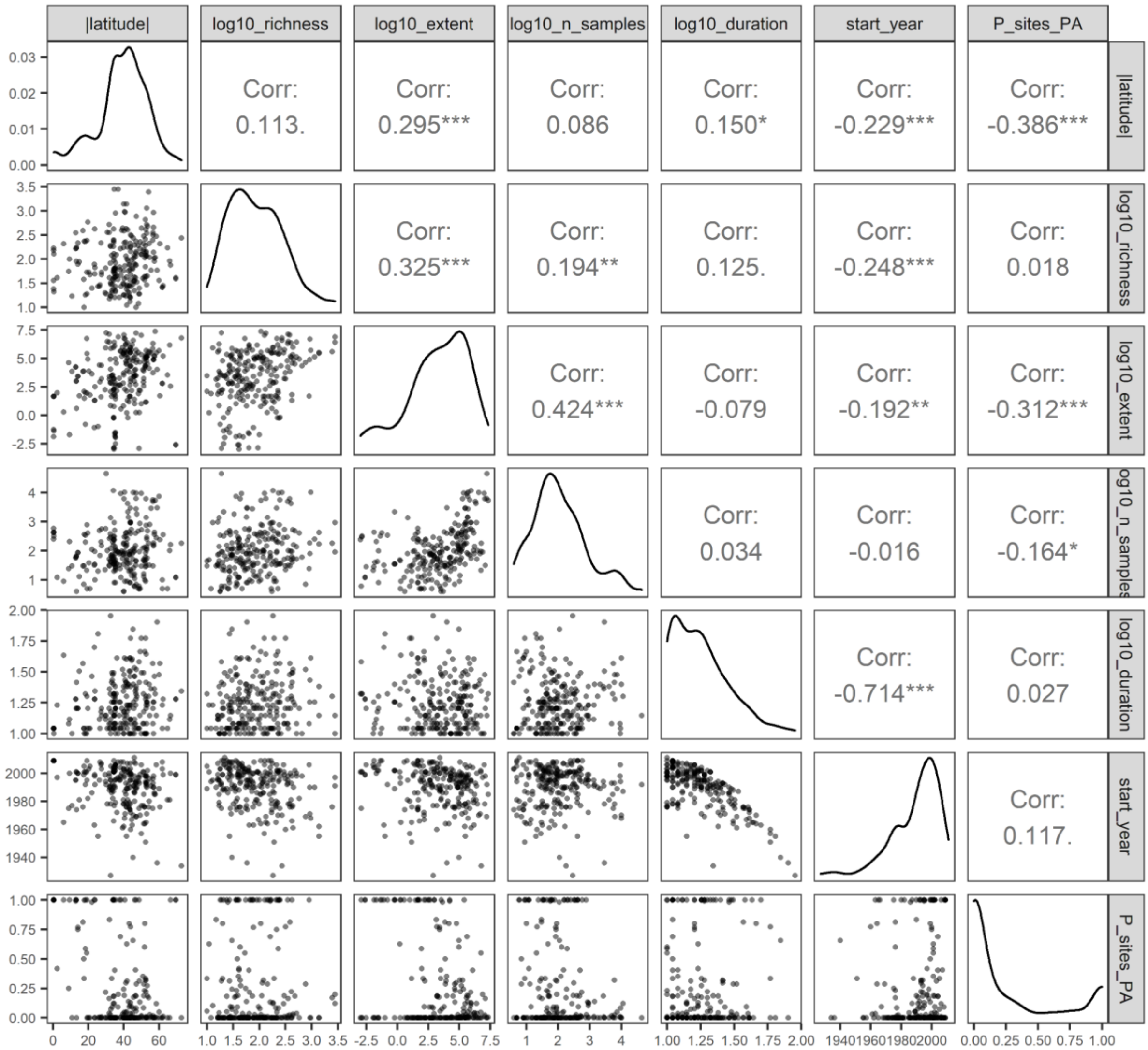
Supplementary Fig. 10 | Comparison of different estimates measuring the degree to which a metacommunity is protected. a Comparison of the proportion of sites in protected areas established at any time point and those that were established before the sampling in the late period. **b** Comparison of the proportion of local sites and the proportion of the spatial extent of each metacommunity in protected areas that were established before the sampling in the late period. **c** Frequency distribution of the proportion of sites in protected areas that were established before the sampling in the late period. The dashed lines in panels **a** and **b** are the identity line. The comparison was performed for terrestrial (orange), freshwater (blue) and marine (purple) realms, respectively.



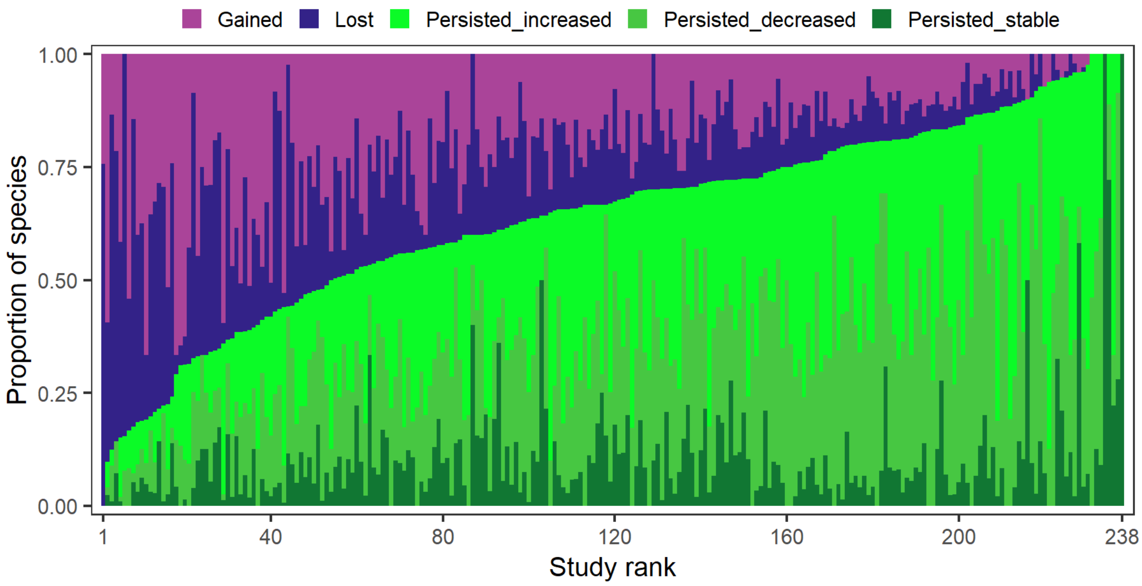
Supplementary Fig. 11 | Effect of habitat protection on the relationship between range size and occupancy change for terrestrial, freshwater and marine realms. This result was based on the proportion of sites in protected areas established at any time point, including those that were established more recently. Note that Fig. 3 shows results based on protected areas established before the sampling in the late period. The coefficient (β) of the interaction between range size and protection level for each realm and its 95% credible interval are shown at the top. The purple solid lines show the predicted relationship when no sites within a metacommunity are protected, while the blue solid lines show the predicted relationship when all sites within a metacommunity are protected; the shading shows the 95% credible intervals.



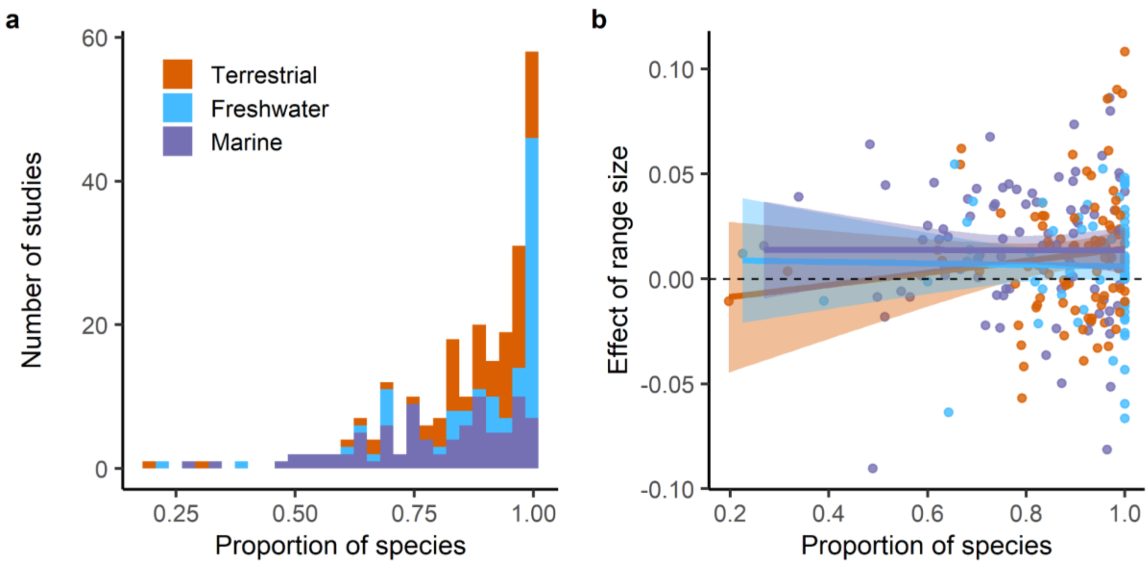
Supplementary Fig. 12 | Effect of habitat protection on the relationship between range size and occupancy change for terrestrial, freshwater and marine realms. This result was based on the proportion of the spatial extent of each metacommunity falling within protected areas that were established before the sampling in the late period. Note that Fig. 3 shows results based on the proportion of local sites in protected areas. The coefficient (β) of the interaction between range size and protection level for each realm and its 95% credible interval are shown at the top. The purple solid lines show the predicted relationship when no sites within a metacommunity are protected, while the blue solid lines show the predicted relationship when all sites within a metacommunity are protected; the shading shows the 95% credible intervals.



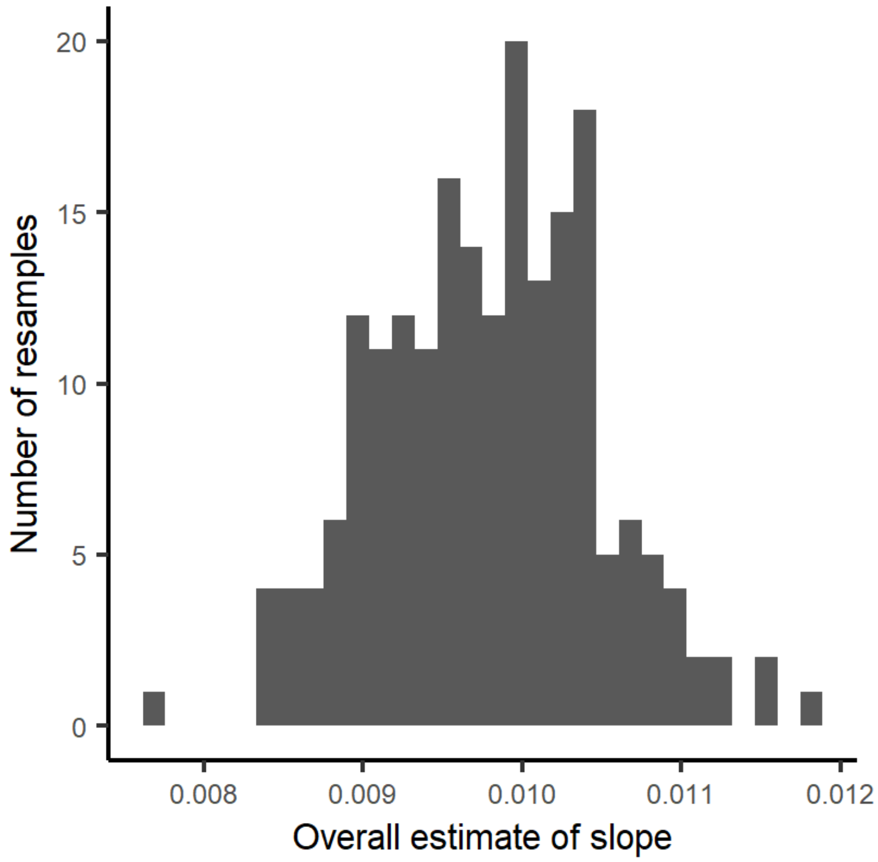
Supplementary Fig. 13 | Pearson correlations among study characteristics. The characteristics include absolute central latitude of study sites (|latitude|), regional species richness observed in the study ($\log_{10}$-transformed, richness), extent of study sites ($\log_{10}$-transformed, extent), number of samples used to calculate occupancy in each period ($\log_{10}$-transformed, n_samples), duration of sampling ($\log_{10}$-transformed, duration), start year of sampling (start_year), and proportion of sites in protected areas (P_sites_PA).



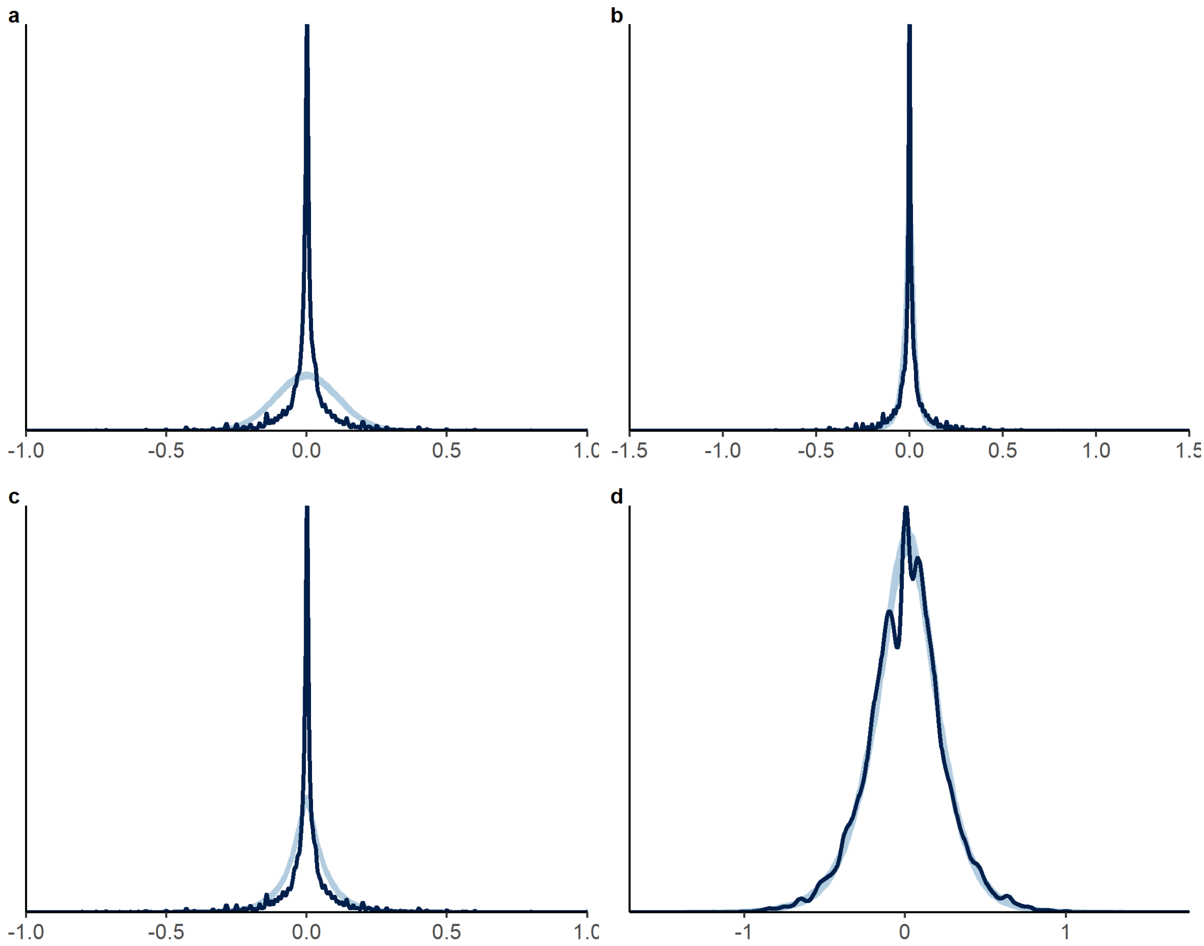
Supplementary Fig. 14 | Proportion of species experiencing different dynamics within studies. Dynamics of species were classified as gained (purple), lost (dark blue), persisted with increased occupancy (light green), decreased occupancy (green), and no changed (stable; dark green) occupancy. Each bar represents a study. The medians of the proportion of species in different dynamics are 0.167, 0.120, 0.265, 0.243, and 0.073, respectively. Fifty-four of 238 studies have gained and lost species accounting for more than 50% of total recorded species.



Supplementary Fig. 15 | Proportion of species within studies that have data on estimates of range size. (a) Frequency distribution of the proportion of species that have range size estimates and (**b**) its association with study-level effects of range size on occupancy change. Solid lines and shading in panel **b** show the linear relationship and 95% credible interval. The colors indicate the terrestrial (orange), freshwater (blue) and marine (purple) realms where studies come from. All linear relationships are not significant (two-sided *t*-test, *p*-value = 0.25, 0.88 and 0.99 for terrestrial, freshwater and marine realm, respectively).



Supplementary Fig. 16 | Frequency distribution of the overall slope estimate of the relationship between range size and occupancy using datasets from 200 iterations of rarefaction.



Supplementary Fig. 17 | Comparing kernel density estimates of the observed occupancy changes (black curves) and predicted occupancy changes (blue curves) drawn from the posterior predictive distribution. a-c Predicted occupancy changes came from models regressing occupancy change as a function of range size using Gaussian (**a**), Student's t (**b**), and asymmetric Laplacian (**c**) error distributions, respectively. **d** Predicted occupancy changes came from the model regressing sign*square-root-transformed occupancy change as a function of range size using Gaussian error distribution.

Supplementary Table 1 | Summary of the model testing the overall effect of range size on temporal occupancy change across 238 studies. Range size was log_{10}-transformed and centered before fitting models. n_samples was the log_{10}-transformed number of samples in each period, which was used to fit variation in the standard deviation of occupancy changes across studies. For each parameter, the mean estimate, the standard deviation (sd), and the 95% credible interval (Q2.5 and Q97.5) were shown. Rhat is the Gelman-Rubin convergence diagnostic; Bulk- and Tail-ESS are the number of independent samples (i.e., effective sample sizes). The model used 30,103 observations across 238 studies.

Parameter	Estimate	sd	Q2.5	Q97.5	Rhat	Bulk_ESS	Tail_ESS
Intercept	0.008	0.006	-0.005	0.020	1.00	1324	1819
sigma_Intercept	-0.680	0.011	-0.702	-0.658	1.00	4067	3849
Range	0.011	0.004	0.003	0.019	1.00	3318	3463
sigma_n_samples	-0.436	0.005	-0.445	-0.426	1.00	4034	3930

Supplementary Table 2 | Summary of the model testing the variation in effects of range size on temporal occupancy change among terrestrial, freshwater and marine realms. The model included interaction between range size and realm. Range size was $\log_{10}$-transformed and centered before fitting models. n_samples was the $\log_{10}$-transformed number of samples in each period, which was used to fit variation in the standard deviation of occupancy changes across studies. For each parameter, the mean estimate, the standard deviation (sd), and the 95% credible interval (Q2.5 and Q97.5) were shown. Rhat is the Gelman-Rubin convergence diagnostic; Bulk- and Tail-ESS are the number of independent samples (i.e., effective sample sizes). The model used 30,103 observations across 238 studies, with 11,714, 4,223 and 14,166 observations in 81, 68 and 89 terrestrial, freshwater and marine studies, respectively.

Parameter	Estimate	sd	Q2.5	Q97.5	Rhat	Bulk_ESS	Tail_ESS
sigma_Intercept	-0.680	0.011	-0.702	-0.658	1.00	3648	3471
Terrestrial	0.006	0.011	-0.017	0.028	1.00	2358	2956
Freshwater	0.004	0.012	-0.020	0.029	1.00	3033	3566
Marine	0.013	0.010	-0.007	0.033	1.00	1308	2036
Terrestrial:Range	0.012	0.007	-0.002	0.025	1.00	3753	3970
Freshwater:Range	0.000	0.009	-0.016	0.017	1.00	3400	3546
Marine:Range	0.017	0.006	0.004	0.029	1.00	3366	3175
sigma_n_samples	-0.436	0.005	-0.445	-0.426	1.00	3728	3809

Supplementary Table 3 | Summary of the model testing the effect of habit protection on the relationship between range size and temporal occupancy change for terrestrial, freshwater and marine realms, respectively. The model included interactions among range size, protection level and realm. The protection level was measured as the proportion of sites in protected areas that were established before the sampling in the late period. Range size was log_{10}-transformed and centered before fitting models. n_samples was the log_{10}-transformed number of samples in each period, which was used to fit variation in the standard deviation of occupancy changes across studies. For each parameter, the mean estimate, the standard deviation (sd), and the 95% credible interval (Q2.5 and Q97.5) were shown. Rhat is the Gelman-Rubin convergence diagnostic; Bulk- and Tail-ESS are the number of independent samples (i.e., effective sample sizes). The model used 25,603 observations across 218 studies, with 8,440, 3,072 and 14,091 observations in 72, 58 and 88 terrestrial, freshwater and marine studies, respectively.

Parameter	Estimate	sd	Q2.5	Q97.5	Rhat	Bulk_ESS	Tail_ESS
sigma_Intercept	-0.648	0.012	-0.671	-0.624	1.00	3559	3700
Terrestrial	-0.016	0.018	-0.053	0.019	1.00	2847	3764
Freshwater	0.013	0.016	-0.019	0.043	1.00	2916	3519
Marine	0.012	0.011	-0.012	0.034	1.00	1153	1849
Terrestrial:Range	0.035	0.012	0.012	0.059	1.00	3597	3921
Freshwater:Range	-0.006	0.011	-0.027	0.015	1.00	3981	3970
Marine:Range	0.015	0.007	0.001	0.028	1.00	2998	3629
Terrestrial:Protection	0.027	0.028	-0.026	0.081	1.00	2702	3132
Freshwater:Protection	-0.032	0.048	-0.126	0.062	1.00	3769	3680
Marine:Protection	-0.005	0.041	-0.084	0.076	1.00	2839	3529
Terrestrial:Range:Protection	-0.039	0.017	-0.073	-0.005	1.00	3543	3811
Freshwater:Range:Protection	0.014	0.034	-0.054	0.080	1.00	3911	3962
Marine:Range:Protection	0.015	0.029	-0.043	0.073	1.00	3940	4101
sigma_n_samples	-0.438	0.005	-0.448	-0.428	1.00	3609	3772

Supplementary Table 4 | Summary of the model testing the effects of range size, seven study characteristics (including protection level) and their interactions on temporal occupancy changes for terrestrial, freshwater and marine realms, respectively. These study characteristics include the proportion of sites in protected areas (protection), absolute central latitude of study sites (latitude), regional species richness (richness), duration of sampling (duration), start year of sampling (start_year), extent of study sites (extent), and number of samples used to calculate occupancy in each period (n_samples). The model included an interaction between the realm and all other variables. Range size, richness, duration, extent, and n_samples were log_{10}-transformed. All explanatory variables except the protection variable were centered by subtracting the mean value. For each parameter, the mean estimate, the standard deviation (sd), and the 95% credible interval (Q2.5 and Q97.5) were shown. Rhat is the Gelman-Rubin convergence diagnostic; Bulk- and Tail-ESS are the number of independent samples (i.e., effective sample sizes). The parameters with 95% credible interval non-overlapped with zero were shown in bold. The model used 25,603 observations across 218 studies, with 8,440, 3,072 and 14,091 observations in 72, 58 and 88 terrestrial, freshwater and marine studies, respectively.

Parameter	Estimate	sd	Q2.5	Q97.5	Rhat	Bulk_ESS	Tail_ESS
sigma_Intercept	**-0.6482**	**0.0118**	**-0.6718**	**-0.6260**	1.00	4064	3850
Terrestrial	-0.0174	0.0191	-0.0537	0.0198	1.00	3179	3563
Freshwater	0.0345	0.0211	-0.0069	0.0755	1.00	3342	3702
Marine	0.0028	0.0146	-0.0255	0.0322	1.00	2726	3416
Terrestrial:Range	**0.0398**	**0.0127**	**0.0147**	**0.0650**	1.00	3727	3739
Freshwater:Range	0.0104	0.0134	-0.0152	0.0376	1.00	3486	3776
Marine:Range	**0.0279**	**0.0106**	**0.0073**	**0.0487**	1.00	3436	3663
Terrestrial:Protection	0.0190	0.0321	-0.0448	0.0811	1.00	3202	3637
Freshwater:Protection	-0.0518	0.0490	-0.1497	0.0448	1.00	3735	3777
Marine:Protection	0.0272	0.0449	-0.0608	0.1176	1.00	3278	3630
Terrestrial:Latitude	-0.0010	0.0009	-0.0027	0.0007	1.00	3513	3739
Freshwater:Latitude	**0.0031**	**0.0015**	**0.0001**	**0.0061**	1.00	3630	3845
Marine:Latitude	0.0013	0.0010	-0.0005	0.0032	1.00	2740	3249
Terrestrial:Richness	-0.0467	0.0309	-0.1067	0.0141	1.00	3264	3668
Freshwater:Richness	0.0407	0.0431	-0.0470	0.1215	1.00	3365	3158
Marine:Richness	0.0197	0.0217	-0.0228	0.0624	1.00	2787	3335
Terrestrial:Duration	-0.0355	0.1252	-0.2699	0.2141	1.00	3660	3692
Freshwater:Duration	0.0461	0.1172	-0.1849	0.2797	1.00	3590	3813
Marine:Duration	0.0812	0.0761	-0.0707	0.2295	1.00	2685	3603
Terrestrial:Start_year	-0.0004	0.0017	-0.0037	0.0028	1.00	3711	3727
Freshwater:Start_year	-0.0007	0.0017	-0.0041	0.0027	1.00	3794	4015
Marine:Start_year	0.0001	0.0011	-0.0019	0.0023	1.00	2769	3631

Parameter	Estimate	sd	Q2.5	Q97.5	Rhat	Bulk_ESS	Tail_ESS
Terrestrial:Extent	-0.0030	0.0060	-0.0143	0.0088	1.00	3278	3659
Freshwater:Extent	-0.0096	0.0108	-0.0306	0.0114	1.00	3418	3814
Marine:Extent	-0.0093	0.0062	-0.0218	0.0028	1.00	2893	3694
Terrestrial:n_samples	0.0101	0.0201	-0.0305	0.0493	1.00	3423	3800
Freshwater:n_samples	-0.0033	0.0304	-0.0616	0.0571	1.00	2836	3545
Marine:n_samples	**0.0295**	**0.0139**	**0.0026**	**0.0567**	1.00	2629	3631
Terrestrial:Range:Protection	**-0.0473**	**0.0217**	**-0.0900**	**-0.0050**	1.00	3713	3853
Freshwater:Range:Protection	0.0288	0.0360	-0.0419	0.0995	1.00	3744	3510
Marine:Range:Protection	0.0031	0.0320	-0.0603	0.0657	1.00	3779	3575
Terrestrial:Range:Latitude	-0.0005	0.0006	-0.0017	0.0007	1.00	3919	3712
Freshwater:Range:Latitude	-0.0019	0.0010	-0.0038	0.0001	1.00	3876	3971
Marine:Range:Latitude	-0.0007	0.0006	-0.0019	0.0005	1.00	3599	3569
Terrestrial:Range:Richness	0.0014	0.0189	-0.0373	0.0394	1.00	3656	3835
Freshwater:Range:Richness	**0.0540**	**0.0268**	**0.0007**	**0.1056**	1.00	3684	3546
Marine:Range:Richness	-0.0003	0.0133	-0.0260	0.0262	1.00	3356	3552
Terrestrial:Range:Duration	-0.0233	0.0793	-0.1833	0.1324	1.00	3644	4055
Freshwater:Range:Duration	-0.0743	0.0799	-0.2314	0.0824	1.00	3919	4059
Marine:Range:Duration	-0.0400	0.0459	-0.1335	0.0495	1.00	3529	3813
Terrestrial:Range:Start_year	-0.0010	0.0010	-0.0031	0.0010	1.00	3630	3833
Freshwater:Range:Start_year	-0.0012	0.0012	-0.0035	0.0012	1.00	3911	3738
Marine:Range:Start_year	**-0.0012**	**0.0006**	**-0.0024**	**-0.0001**	1.00	3604	3675
Terrestrial:Range:Extent	0.0019	0.0039	-0.0056	0.0095	1.00	3769	3571
Freshwater:Range:Extent	-0.0087	0.0073	-0.0228	0.0058	1.00	3837	3852
Marine:Range:Extent	-0.0055	0.0041	-0.0139	0.0025	1.00	3683	3617
Terrestrial:Range:n_samples	-0.0196	0.0121	-0.0429	0.0043	1.00	4015	3930
Freshwater:Range:n_samples	0.0246	0.0203	-0.0150	0.0637	1.00	3755	3739
Marine:Range:n_samples	-0.0133	0.0085	-0.0301	0.0033	1.00	3563	3776
sigma_n_samples	**-0.4374**	**0.0049**	**-0.4468**	**-0.4276**	1.00	**4065**	**3927**

Supplementary Table 5 | Details on the datasets used in this study.

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
bt	108	1985	2005	10	93	Marine	Birds	Indian Ocean	1
bt	††110	1976	1995	13	1889	Marine	Invertebrates	Atlantic	2
bt	112	1992	2005	14	17	Marine	Fish	Atlantic	3
bt	113	1971	1997	6	675	Marine	Invertebrates	Atlantic	4
bt	117	1963	2002	7	57	Marine	Invertebrates	Pacific	5
bt	119	1978	2009	32	171	Marine	Fish	Atlantic	6
bt	121	2001	2010	6	47	Marine	Fish	Pacific	7
bt	123	2000	2009	10	127	Marine	Fish	Atlantic	8
bt	125	1990	2000	9	77	Marine	Fish	Atlantic	9
bt	135	1977	1986	3	13	Marine	Fish	Atlantic	10
bt	147	1961	1993	16	372	Marine	Invertebrates	Pacific	11
bt	148	1981	2004	18	380	Marine	Fish	Pacific	12
bt	152	1979	1988	8	12	Marine	Invertebrates	Pacific	13
bt	††162	1991	2004	9	1390	Marine	Invertebrates	Atlantic	14
bt	††163	1993	2004	12	241	Marine	Fish	Pacific	15
bt	†166	1969	1987	9	101	Marine	Birds	Atlantic	16,17
bt	†169	1987	2006	18	152	Marine	Birds	Pacific	18-20
bt	171	1995	2007	13	20	Marine	Mammals	Atlantic	21
bt	†172	1998	2009	12	33	Marine	Mammals	Atlantic	22,23
bt	173	2000	2011	9	139	Marine	Invertebrates	Pacific	24
bt	176	1999	2010	12	165	Marine	Invertebrates	Atlantic	25
bt	178	1977	2007	14	307	Marine	Fish	Pacific	26
bt	180	1970	1994	24	269	Marine	Fish	Atlantic	27
bt	†182	1990	2009	19	32	Marine	Fish	Atlantic	28
bt	183	1999	2011	13	13	Marine	Invertebrates	Atlantic	29
bt	††187	1997	2006	5	1645	Marine	Invertebrates	Atlantic	30
bt	189	2001	2010	9	205	Marine	Fish	Atlantic	31
bt	190	2001	2010	10	201	Marine	Fish	Atlantic	32
bt	191	1955	1968	11	810	Marine	Invertebrates	Atlantic	33
bt	195	1978	2007	30	378	Terrestrial	Birds	North America	34
bt	††196	1976	2012	35	131	Marine	Invertebrates	Atlantic	35
bt	197	1985	2013	28	101	Marine	Fish	Atlantic	36
bt	198	1991	2013	22	55	Marine	Fish	Atlantic	37
bt	200	1962	1985	10	888	Marine	Invertebrates	Atlantic	33
bt	††204	1977	1997	6	155	Marine	Invertebrates	Atlantic	38

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
bt	206	1993	2008	16	107	Marine	Fish	Atlantic	39
bt	208	1997	2007	11	181	Marine	Fish	Atlantic	40
bt	209	1991	2007	17	129	Marine	Fish	Atlantic	41
bt	210	1975	2011	37	185	Marine	Fish	Atlantic	42
bt	††213	1968	2008	41	678	Marine	Fish	Atlantic	43
bt	214	1940	2009	42	29	Terrestrial	Plants	North America	44
bt	215	1985	2008	22	16	Terrestrial	Birds	North America	45
bt	217	1994	2004	7	205	Terrestrial	Birds	North America	46
bt	219	1995	2011	17	11	Terrestrial	Amphibians and reptiles	North America	47
bt	220	1995	2011	14	180	Terrestrial	Birds	North America	47
bt	229	1990	2013	19	61	Freshwater	Fish	North America	48
bt	232	1981	1993	7	68	Marine	Fish	Southern Ocean	49
bt	237	1976	1985	10	54	Freshwater	Invertebrates	North America	50
bt	244	1999	2012	14	142	Marine	Birds	Pacific	51
bt	247	1975	2006	31	18	Freshwater	Invertebrates	North America	52
bt	252	1978	1989	11	31	Marine	Fish	Atlantic	53
bt	253	1986	2014	29	72	Freshwater	Invertebrates	North America	54
bt	256	1996	2009	14	100	Marine	Fish	Atlantic	41
bt	271	2001	2014	14	54	Marine	Fish	Pacific	55
bt	272	2004	2014	11	32	Marine	Invertebrates	Pacific	56
bt	273	2004	2014	11	20	Marine	Invertebrates	Pacific	57
bt	†274	2001	2014	14	81	Marine	Invertebrates	Pacific	58
bt	278	1979	1990	7	216	Marine	Fish	Pacific	12
bt	286	2000	2009	9	18	Marine	Fish	Atlantic	8
bt	288	1972	1995	20	142	Marine	Fish	Atlantic	6
bt	290	1978	1988	4	170	Marine	Fish	Pacific	59
bt	291	1978	1988	2	349	Marine	Fish	Indian Ocean	59
bt	292	1978	1989	4	98	Marine	Fish	Pacific	59
bt	297	2005	2015	11	10	Marine	Invertebrates	Pacific	60
bt	300	1989	2013	25	14	Terrestrial	Invertebrates	North America	61
bt	304	1966	1996	2	418	Terrestrial	Plants	Africa	62-64
bt	309	1976	1985	10	42	Terrestrial	Invertebrates	Europe	65
bt	321	1995	2007	13	16	Terrestrial	Mammals	North America	66
bt	331	1998	2009	4	35	Terrestrial	Plants	North America	67-70
bt	354	1998	2013	4	174	Marine	Plants	Pacific	71
bt	356	1976	2012	21	372	Terrestrial	Plants	Australia	72

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
bt	359	2001	2012	12	46	Marine	Fish	Pacific	56
bt	374	2004	2014	11	61	Marine	Birds	Pacific	73
bt	375	2004	2014	11	115	Terrestrial	Invertebrates	Asia	74
bt	418	1995	2014	16	241	Marine	Fish	Pacific	75
bt	428	1936	2015	75	49	Marine	Fish	Atlantic	76-79
bt	430	1992	2016	22	47	Freshwater	Fish	Australia	80
bt	431	1997	2011	13	34	Freshwater	Fish	Australia	80
bt	432	1998	2012	14	25	Freshwater	Fish	Australia	80
bt	466	1986	2008	20	89	Marine	Fish	Atlantic	81
bt	467	1987	1999	4	71	Marine	Fish	Atlantic	82-85
bt	††468	1986	2011	21	73	Marine	Invertebrates	Pacific	86
bt	††469	1982	2011	30	37	Marine	Invertebrates	Pacific	87
bt	499	1985	1999	9	116	Marine	Invertebrates	Atlantic	88
bt	500	2001	2012	11	203	Marine	Invertebrates	Atlantic	89
bt	†505	1991	2011	7	164	Marine	Fish	Atlantic	90
bt	507	1988	2010	19	32	Marine	Fish	Atlantic	91
bt	512	1964	1994	2	136	Terrestrial	Plants	Europe	92,93
bt	516	1997	2013	4	41	Terrestrial	Mammals	South America	94-97
bt	525	1986	2014	4	25	Freshwater	Plants	Asia	98
bt	†527	2006	2015	10	95	Marine	Birds	Atlantic	99
bt	67	1994	2006	13	57	Terrestrial	Birds	Africa	100
bt	††78	1980	2004	20	192	Marine	Invertebrates	Atlantic	101
bt	84	1967	2005	5	95	Marine	Plants	Atlantic	102
bt	85	1992	2003	11	256	Marine	Invertebrates	Atlantic	103
bt	86	1986	1998	5	135	Marine	Plants	Atlantic	104
bt	90	1995	2004	3	21	Marine	Invertebrates	Atlantic	105
bt	††92	1981	1991	4	165	Marine	Invertebrates	Arctic Ocean	106
bt	97	1934	1955	2	140	Marine	Invertebrates	Arctic Ocean	107
bt	99	1982	1997	10	557	Marine	Fish	Indian Ocean	108
ft	1	2003	2017	3	27	Freshwater	Fish	Europe	109-111
ft	10	1988	2018	28	22	Freshwater	Fish	North America	112,113
ft	11	1988	2005	16	20	Freshwater	Fish	North America	114
ft	14	1999	2014	14	20	Freshwater	Fish	Asia	115
ft	15	2001	2017	5	93	Freshwater	Fish	North America	116
ft	16	1991	2008	2	34	Freshwater	Fish	Europe	117
ft	17	1975	1986	12	55	Freshwater	Fish	Africa	118
ft	18	1977	1988	6	57	Freshwater	Fish	North America	119

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
ft	2	2003	2013	2	53	Freshwater	Fish	South America	120,121
ft	20	1995	2013	15	56	Freshwater	Fish	North America	122
ft	21	1993	2018	26	115	Freshwater	Fish	North America	123
ft	23	2005	2019	8	30	Freshwater	Fish	Australia	124
ft	24	2008	2018	3	80	Freshwater	Fish	North America	125
ft	25	1989	2009	12	10	Freshwater	Fish	North America	126
ft	26	2002	2015	11	217	Freshwater	Fish	North America	127
ft	27	1993	2018	24	43	Freshwater	Fish	Europe	128
ft	28	1996	2016	7	123	Freshwater	Fish	North America	129
ft	29	2009	2019	3	19	Freshwater	Fish	South America	130
ft	30	1979	1994	15	83	Freshwater	Fish	North America	131,132
ft	32	1994	2017	24	74	Freshwater	Fish	Europe	133
ft	34	2002	2018	17	28	Freshwater	Fish	Europe	134
ft	36	1992	2018	20	30	Freshwater	Fish	North America	135
ft	37	1999	2012	2	19	Freshwater	Fish	South America	136
ft	39	2003	2015	5	48	Freshwater	Fish	North America	137
ft	4	2007	2018	11	41	Freshwater	Fish	Europe	138
ft	41	1990	2000	11	15	Freshwater	Fish	North America	139
ft	42	1989	2018	30	36	Freshwater	Fish	Europe	140
ft	43	2001	2017	17	11	Freshwater	Fish	Europe	141,142
ft	45	1995	2008	12	16	Freshwater	Fish	North America	143
ft	46	2001	2012	7	40	Freshwater	Fish	Europe	144,145
ft	5	1981	2002	21	57	Freshwater	Fish	North America	146
ft	6	2003	2018	16	53	Freshwater	Fish	Australia	147
ft	7	1999	2017	16	28	Freshwater	Fish	Europe	148
ft	9	2008	2018	9	27	Freshwater	Fish	North America	149
ic	1006	1993	2012	18	398	Terrestrial	Invertebrates	Europe	150
ic	1102	1965	2008	12	134	Terrestrial	Invertebrates	Europe	151
ic	1263	1994	2011	17	41	Terrestrial	Invertebrates	Europe	152
ic	1267	1994	2012	13	112	Terrestrial	Invertebrates	Europe	153
ic	1340	1969	2001	4	755	Terrestrial	Invertebrates	Europe	154
ic	1367	1980	2008	2	36	Terrestrial	Invertebrates	Europe	155
ic	1408	2000	2013	14	73	Freshwater	Invertebrates	Europe	156
ic	1444	1989	2008	17	22	Freshwater	Invertebrates	Australia	157
ic	1474	1951	2009	2	190	Terrestrial	Invertebrates	Europe	158
ic	1475	1964	2009	2	104	Terrestrial	Invertebrates	Europe	159
ic	1488	2006	2019	13	287	Freshwater	Invertebrates	Europe	160

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
ic	1520	1976	2015	36	38	Freshwater	Invertebrates	North America	161
ic	1525	2008	2019	12	29	Freshwater	Invertebrates	North America	162
ic	1526_1	2008	2018	10	19	Freshwater	Invertebrates	North America	163
ic	1526_2	2007	2020	9	38	Freshwater	Invertebrates	North America	164
ic	1533	1955	2018	2	17	Terrestrial	Invertebrates	South America	165
ic	1542	2002	2018	17	472	Freshwater	Invertebrates	Europe	166
ic	1547	2006	2017	8	820	Terrestrial	Invertebrates	Asia	167,168
ic	1553	1989	2004	15	29	Freshwater	Invertebrates	North America	169
ic	1554	2008	2018	11	38	Freshwater	Invertebrates	North America	170
ic	1555	2007	2019	13	16	Freshwater	Invertebrates	North America	171
ic	502	1971	1988	18	18	Terrestrial	Invertebrates	Europe	172
ic	79	1976	1985	9	36	Terrestrial	Invertebrates	Europe	172
mr	*sfd_11	2009	2019	9	23	Terrestrial	Plants	Africa	173,174
mr	sfd_12	2009	2018	8	20	Terrestrial	Plants	Africa	173,174
mr	sfd_13	2009	2019	9	33	Terrestrial	Plants	Africa	173,174
mr	sfd_131	2003	2012	2	15	Freshwater	Plants	North America	175,176
mr	sfd_156	1999	2017	8	38	Terrestrial	Plants	North America	177,178
mr	sfd_157	1999	2017	8	32	Terrestrial	Plants	North America	177,178
mr	sfd_158	2000	2015	4	389	Terrestrial	Plants	North America	179
mr	sfd_159	2001	2021	21	57	Marine	Fish	Pacific	180
mr	sfd_160	2001	2021	21	79	Marine	Invertebrates	Pacific	180
mr	sfd_161	2001	2021	21	26	Marine	Plants	Pacific	180
mr	sfd_163	1995	2013	3	312	Terrestrial	Plants	Australia	181
mr	sfd_164	2001	2016	4	155	Terrestrial	Plants	Australia	181
mr	sfd_165	2000	2015	4	193	Terrestrial	Plants	Australia	181
mr	sfd_166	1995	2013	3	158	Terrestrial	Plants	Australia	181
mr	sfd_167	2001	2016	4	86	Terrestrial	Plants	Australia	181
mr	sfd_168	2000	2015	4	74	Terrestrial	Plants	Australia	181
mr	sfd_169	1995	2012	3	58	Terrestrial	Birds	Europe	182
mr	sfd_17	2009	2019	11	134	Terrestrial	Plants	Africa	173,174
mr	sfd_170	1995	2012	5	66	Terrestrial	Birds	Europe	182
mr	sfd_172	2006	2020	12	187	Terrestrial	Plants	North America	183
mr	sfd_173	1974	2014	4	29	Marine	Plants	Atlantic	184
mr	sfd_174	1974	2014	4	19	Marine	Invertebrates	Atlantic	184
mr	sfd_175	2007	2017	2	166	Terrestrial	Plants	Europe	185
mr	sfd_176	1993	2018	4	14	Marine	Plants	Pacific	98

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
mr	sfd_178	1987	2020	4	24	Freshwater	Plants	North America	186
mr	sfd_179	2011	2020	2	18	Freshwater	Invertebrates	North America	186
mr	sfd_18	2009	2019	11	112	Terrestrial	Plants	Africa	173,174
mr	sfd_180	1963	2012	27	44	Marine	Invertebrates	Pacific	187
mr	sfd_183	1957	2015	2	122	Terrestrial	Plants	Europe	188
mr	sfd_186	1998	2016	15	133	Terrestrial	Plants	Australia	189
mr	sfd_187	1999	2017	7	46	Terrestrial	Mammals	Australia	190
mr	sfd_19	2009	2019	11	152	Terrestrial	Plants	Africa	173,174
mr	sfd_194	1992	2012	20	14	Terrestrial	Invertebrates	South America	191
mr	sfd_195	2002	2019	16	183	Terrestrial	Invertebrates	North America	192
mr	sfd_196	2002	2019	16	190	Terrestrial	Invertebrates	North America	192
mr	sfd_197	2002	2019	16	196	Terrestrial	Invertebrates	North America	192
mr	sfd_20	1999	2009	2	24	Marine	Invertebrates	Atlantic	193
mr	sfd_21	1974	1999	2	157	Marine	Fish	Pacific	194
mr	sfd_27	1997	2007	3	15	Marine	Plants	Pacific	195
mr	sfd_28	1981	2012	2	75	Marine	Fish	Pacific	196
mr	sfd_29	1990	2018	4	30	Freshwater	Invertebrates	North America	197
mr	sfd_30	1996	2009	2	16	Freshwater	Fish	North America	198
mr	sfd_31	1965	2007	2	139	Terrestrial	Invertebrates	Asia	199
mr	sfd_32	1927	2016	17	137	Terrestrial	Plants	North America	200
mr	sfd_33	1970	2015	2	218	Terrestrial	Plants	Europe	201
mr	sfd_34	1998	2007	2	351	Freshwater	Invertebrates	Europe	202-204
mr	sfd_35	1990	2007	3	308	Freshwater	Invertebrates	Europe	202-204
mr	sfd_36	1998	2007	2	180	Freshwater	Invertebrates	Europe	202-204
mr	sfd_37	1998	2007	2	107	Freshwater	Plants	Europe	205,206
mr	sfd_38	1998	2007	2	126	Freshwater	Plants	Europe	205,206
mr	sfd_39	1998	2007	2	59	Freshwater	Plants	Europe	205,206
mr	sfd_40	1990	2007	3	902	Terrestrial	Plants	Europe	207
mr	sfd_41	1990	2007	3	725	Terrestrial	Plants	Europe	207
mr	sfd_42	1998	2007	2	524	Terrestrial	Plants	Europe	207
mr	sfd_44	2009	2019	10	100	Terrestrial	Birds	North America	208
mr	sfd_47	1996	2011	6	247	Marine	Invertebrates	Atlantic	209
mr	sfd_48	1991	2006	3	102	Terrestrial	Birds	Europe	210
mr	sfd_49	1993	2009	7	76	Terrestrial	Birds	Europe	210
mr	sfd_50	1990	2011	4	111	Terrestrial	Birds	Europe	210
mr	sfd_51	1992	2013	5	13	Terrestrial	Invertebrates	Australia	211
mr	sfd_53	1975	2012	4	17	Marine	Fish	Pacific	212

Database	StudyID	Start year	End year	Nr yrs	Nr spp	Realm	Taxon	Region	Reference
mr	sfd_54	1990	2014	10	54	Terrestrial	Plants	Australia	213
mr	sfd_55	2008	2018	3	25	Terrestrial	Invertebrates	Europe	214
mr	sfd_56	2003	2019	2	24	Terrestrial	Invertebrates	Europe	214
mr	sfd_57	1976	2001	2	354	Terrestrial	Plants	North America	215
mr	sfd_58	1960	2018	2	314	Terrestrial	Plants	Europe	216
mr	sfd_59	1995	2004	10	14	Terrestrial	Amphibians and reptiles	North America	217
mr	sfd_60	2005	2015	2	45	Freshwater	Fish	South America	218
mr	sfd_62	1994	2004	2	10	Terrestrial	Plants	North America	219
mr	sfd_63	1972	2012	6	43	Freshwater	Fish	North America	220
mr	sfd_64	2000	2012	2	96	Terrestrial	Plants	South America	221
mr	sfd_65	2004	2021	9	44	Terrestrial	Plants	North America	222
mr	sfd_66	2004	2015	10	37	Terrestrial	Plants	North America	222
mr	sfd_67	2002	2016	14	54	Terrestrial	Plants	North America	222
mr	sfd_74	2006	2015	6	18	Terrestrial	Plants	North America	222
mr	sfd_75	2002	2021	19	51	Terrestrial	Plants	North America	222
mr	sfd_76	2006	2021	15	36	Terrestrial	Plants	North America	222
mr	sfd_78	2006	2021	14	20	Terrestrial	Plants	North America	222
mr	sfd_81	2006	2021	5	25	Terrestrial	Plants	North America	222
mr	sfd_82	1993	2015	20	32	Freshwater	Invertebrates	North America	223
mr	sfd_86	2003	2012	2	16	Freshwater	Plants	North America	175,176

Note: four databases were used: bt - BioTIME, ft - RivFishTIME, it - InsectChange, mr-Metacommunity Resurveys. † These studies were classified as ‘multiple taxa’ in the original data sources; †† These studies were classified as ‘benthos’ in the original data sources. * The prefix ‘sfd’ of StudyID indicates the self-defined ID in this study to keep the format of these datasets consistent with other datasets. Nr yrs: number of years that a given metacommunity was sampled; Nr spp: number of species with range size estimates in a given metacommunity.

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