Supplement

Regional distributions of plant sexual systems in a temperate forest and the differential effects of climate change

Supplement S1

Table S1. The sexual systems and distribution types of 69 species in 20 woody plant families in the FIN network.

Species	Family	Sexual systems	Distribution type
Abies_holophylla	Pinaceae	Monoecy	North temperate
Abies_nephrolepis	Pinaceae	Monoecy	North temperate
Acer_barbinerve	Sapindaceae	Dioecy	Pantropic
Acer_ginnala	Sapindaceae	Monoecy	Pantropic
Acer_mandshuricum	Sapindaceae	Dioecy	Pantropic
Acer_mono	Sapindaceae	Monoecy	Pantropic
Acer_pseudosieboldianum	Sapindaceae	Monoecy	Pantropic
Acer_tegmentosum	Sapindaceae	Monoecy	Pantropic
Acer_triflorum	Sapindaceae	Dioecy	Pantropic
Acer_ukurunduense	Sapindaceae	Dioecy	Pantropic
Alnus_mandshurica	Betulaceae	Monoecy	South and north temperate disjuncted
Alnus_sibirica	Betulaceae	Monoecy	South and north temperate disjuncted
Betula_costata	Betulaceae	Monoecy	South and north temperate disjuncted
Betula_dahurica	Betulaceae	Monoecy	South and north temperate disjuncted
Betula_platyphylla	Betulaceae	Monoecy	South and north temperate disjuncted
Carpinus_cordata	Betulaceae	Monoecy	South and north temperate disjuncted
Castanea_mollissima	Fagaceae	Monoecy	North temperate
Celtis_koraiensis	Cannabaceae	Hermaphrodism	Cosmopolitan
Cornus_controversa	Cornaceae	Hermaphrodism	North temperate
Crataegus_maximowiczii	Cornaceae	Hermaphrodism	North temperate
Euonymus_macropterus	Celastraceae	Hermaphrodism	Cosmopolitan
Fraxinus_mandchurica	Oleaceae	Dioecy	Cosmopolitan
Fraxinus_rhynchophylla	Oleaceae	Dioecy	Cosmopolitan
Gleditsia_japonica	Fabaceae	Dioecy	Cosmopolitan
Juglans_mandshurica	Juglandaceae	Monoecy	North temperate
Kalopanax_septemlobus	Araliaceae	Hermaphrodism	Pantropic
Larix_gmelinii	Pinaceae	Monoecy	North temperate
Maackia_amurensis	Fabaceae	Hermaphrodism	Cosmopolitan
Malus_baccata	Rosaceae	Hermaphrodism	Cosmopolitan
Morus_alba	Moraceae	Dioecy	Cosmopolitan
Phellodendron_amurense	Rutaceae	Dioecy	Pantropic
Picea_jezoensis	Pinaceae	Monoecy	North temperate
Picea_koraiensis	Pinaceae	Monoecy	North temperate
Pinus_densiflora	Pinaceae	Monoecy	North temperate
Pinus_koraiensis	Pinaceae	Monoecy	North temperate
Pinus_sylvestris	Pinaceae	Monoecy	North temperate
Pinus_tabuliformis	Pinaceae	Monoecy	North temperate
Populus_davidiana	Salicaceae	Dioecy	Cosmopolitan
Populus_koreana	Salicaceae	Dioecy	Cosmopolitan

Populus_ussuriensis	Salicaceae	Dioecy	Cosmopolitan
Prunus_maackii	Rosaceae	Hermaphrodism	Cosmopolitan
Prunus_mandshurica	Rosaceae	Hermaphrodism	Cosmopolitan
Prunus_maximowiczii	Rosaceae	Hermaphrodism	Cosmopolitan
Prunus_padus	Rosaceae	Hermaphrodism	Cosmopolitan
Prunus_serrulata	Rosaceae	Hermaphrodism	Cosmopolitan
Pyrus_ussuriensis	Rosaceae	Hermaphrodism	Cosmopolitan
Quercus_acutissima	Fagaceae	Monoecy	North temperate
Quercus_aliena	Fagaceae	Monoecy	North temperate
Quercus_dentata	Fagaceae	Monoecy	North temperate
Quercus_mongolica	Fagaceae	Monoecy	North temperate
Quercus_variabilis	Fagaceae	Monoecy	North temperate
Quercus_wutaishanica	Fagaceae	Monoecy	North temperate
Rhamnus_davurica	Rhamnaceae	Dioecy	Cosmopolitan
Robinia_pseudoacacia	Fabaceae	Hermaphrodism	Cosmopolitan
Salix_koreensis	Salicaceae	Dioecy	Cosmopolitan
Salix_matsudana	Salicaceae	Dioecy	Cosmopolitan
Salix_raddeana	Salicaceae	Dioecy	Cosmopolitan
Salix_rorida	Salicaceae	Dioecy	Cosmopolitan
Sorbus_alnifolia	Rosaceae	Hermaphrodism	Cosmopolitan
Sorbus_dacica	Rosaceae	Hermaphrodism	Cosmopolitan
Styrax_obassis	Styracaceae	Hermaphrodism	Tropical Asia and tropical America disjuncted
Syringa_reticulata	Oleaceae	Hermaphrodism	Cosmopolitan
Tilia_amurensis	Malvaceae	Hermaphrodism	Pantropic
Tilia_mandshurica	Malvaceae	Hermaphrodism	Pantropic
Toxicodendron_vernicifluum	Anacardiaceae	Dioecy	Pantropic
Ulmus_japonica	Ulmaceae	Hermaphrodism	Cosmopolitan
Ulmus_laciniata	Ulmaceae	Hermaphrodism	Cosmopolitan
Ulmus_macrocarpa	Ulmaceae	Hermaphrodism	Cosmopolitan
Ulmus_pumila	Ulmaceae	Hermaphrodism	Cosmopolitan

Table S2 Definition, unit and summary statistics of the variables used in this study.

Definition		Unit	Max	Min	Mean	SD	Source	Resolution
Climate covariates								
MAT	Annual mean temperature	℃	15.40	−6.30	4.93	4.93	Hijmans et al. (2017)	1 km^2
PWQ	Precipitation of wettest quarter	mm	941.00	265.00	512.74	177.51	Hijmans et al. (2017)	1 km^2
PDQ	Precipitation of driest quarter	mm	203.00	8.00	48.52	41.24	Hijmans et al. (2017)	1 km^2
Soil covariates								
SOC	Soil organic carbon stock	t/ha	86	37	64.5	9.6	https://soilgrids.org/	1 km^2
N	Nitrogen	cg/kg	577	107	315.5	92.5	https://soilgrids.org/	1 km^2
pH	pH water	mol/L	72	55	61.4	2.8	https://soilgrids.org/	1 km^2
SOIL	Soil depth	cm	4	120	50.37	25.74	FAO et al. (2012)	1 km^2
Topography covariates								
ELE	Elevation	m	79	1255	440.19	212.18	Field recorded	1 km^2
SLO	Slope	Degree	0	47	13.77	10.49	Field recorded	1 km^2
Geographic coordinates and classification								
LON	Longitude in WGS84 datum	Degree	134.02	119.80	127.75	1.58	Field recorded	
LAT	Latitude in WGS84 datum	Degree	53.37	33.27	38.23	4.10	Field recorded	

Table S3 Phylogenetic signal (Pagel's λ) for 9 environmental variables.

Environmental Trait	Number of species	Pagel's λ	P_value
MAT	69	0.69	0.0012
PWQ	69	0.866	0.0016
PDQ	69	0.879	0.0012
SOC	69	0.765	0.0003
N	69	0.713	0.0016
pH	69	0	1
SOIL	69	0	1
SLO	69	0.689	0.0062
ELE	69	0.52	0.0859

Table S4 The results of the Wilcoxon signed-rank test between current and future (SSP245 and SSP585) proportions of each sexual system across the same 456 plots.

	Dioecy		Hermaphroditism		Monoecy	
	SSP245	SSP585	SSP245	SSP585	SSP245	SSP585
SR	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$
BIO	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$
PRO	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

Table S5 Ranking table of the relative importance of each environmental factor.

Variables	Dioecy (%)			Hermaphroditism (%)			Monoecy (%)		
	SR	BIO	PRO	SR	BIO	PRO	SR	BIO	PRO
MAT	39.87	30.76	33.61	82.04	67.29	44.25	36.9	23.07	33.47
PWQ	65.03	49.44	29.8	70.06	53.62	34.29	55.14	21.35	34.5
PDQ	29.39	17.32	19.69	30.39	29.8	22.01	23.28	13.65	22.75
SOC	33.86	27.11	17.47	32.67	23.51	22.24	24.14	16.13	21.68
N	14.56	18.23	15.84	23.32	12.43	16.1	26.86	19.77	27.04
pH	18.89	8.89	18.43	20.49	9.17	7.99	25.24	21.52	15.34
SOIL	1.96	1.28	1.79	8.56	6.8	5.29	2.43	0.63	6.91
SLO	20.6	21.26	15.3	23.54	24.24	14.37	23.42	14.99	15.96
ELE	18.93	24	23.65	14.83	7.22	0	15.84	18.9	23.13

Table S6 The rho's of the Pearson correlation test of species richness (SR), biomass (BIO) and productivity (PRO) among three sexual systems.

Variable	Dioecy × Hermaphroditism	Dioecy × Monoecy	Hermaphroditism × Monoecy
SR	0.64	0.56	0.46
BIO	0.18	-0.21	-0.23
PRO	0.24	-0.22	-0.20

Supplement S2

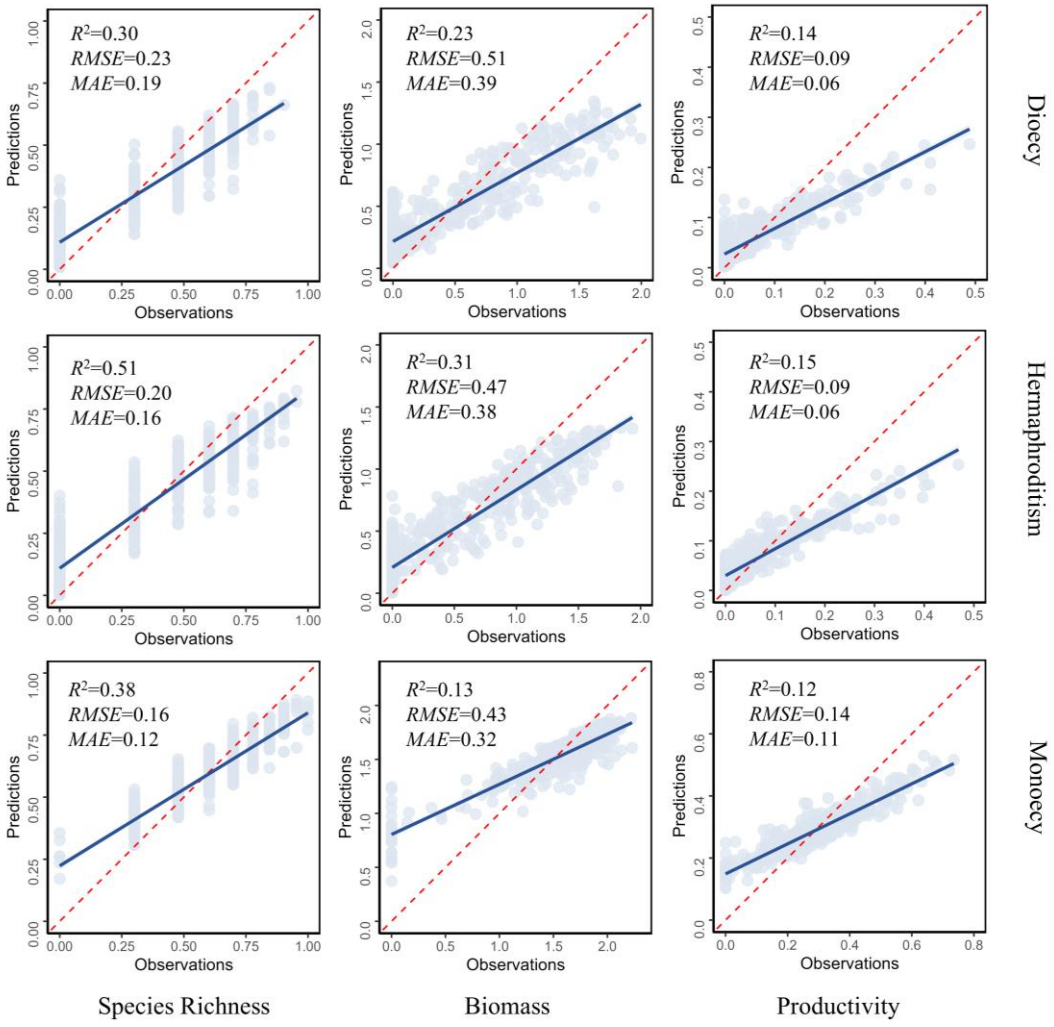

Fig. S1 Species richness, biomass and productivity predicted for different sexual systems by the RF model. The blue lines are the predictions. Effect sizes are represented by the root mean square error (*RMSE*), mean absolute error (*MAE*), and R^2.

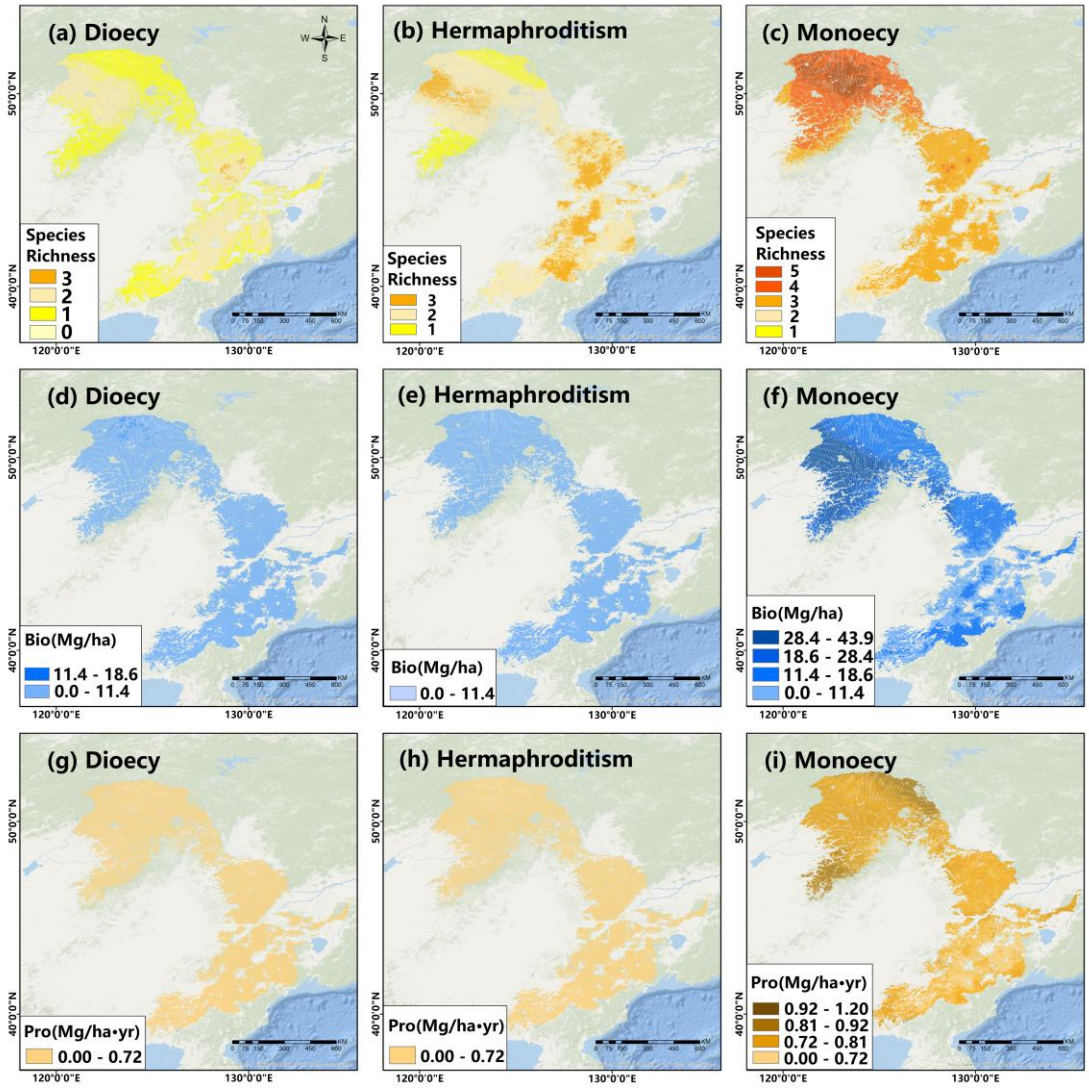

Fig. S2 Future (2100) distributions of species richness, biomass and productivity of hermaphroditic, monoecious and dioecious species in the forested regions of northeastern China under SSP585 scenario in 2100.

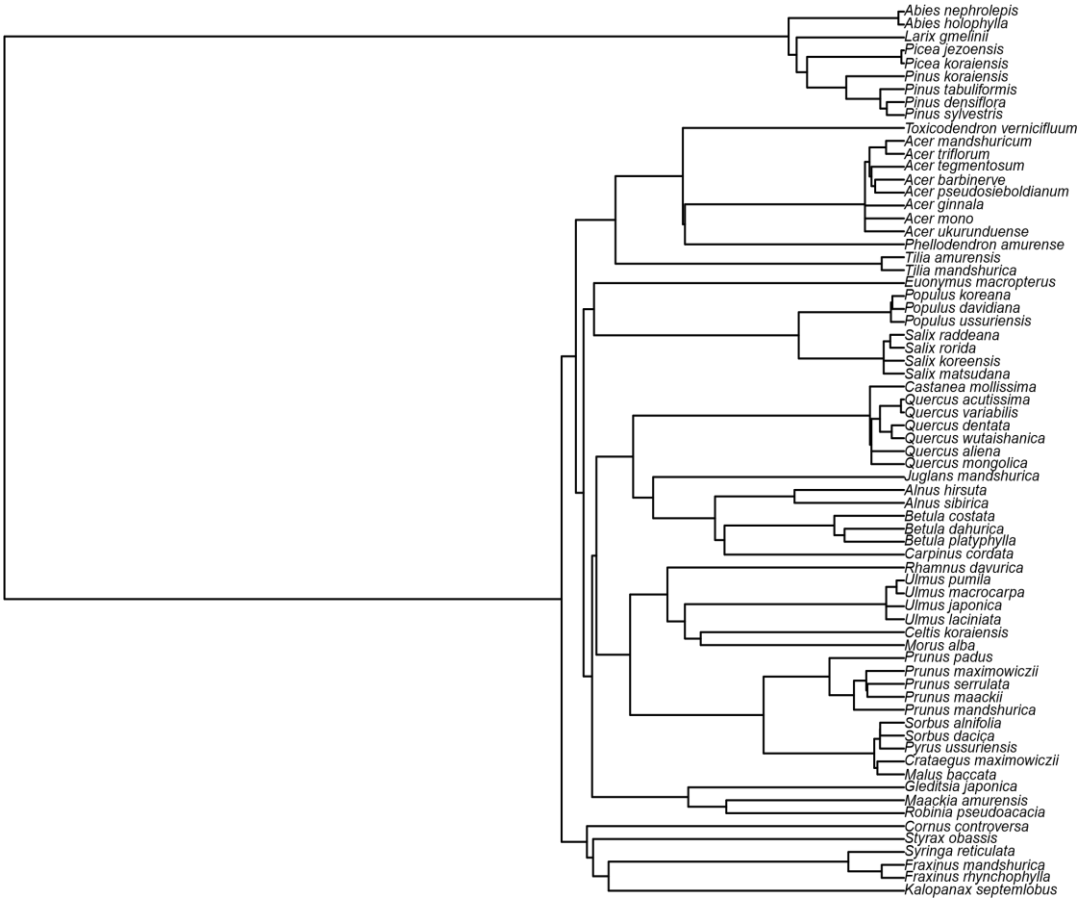

Fig. S3 Phylogenetic tree of the 69 woody plant species included in this study.

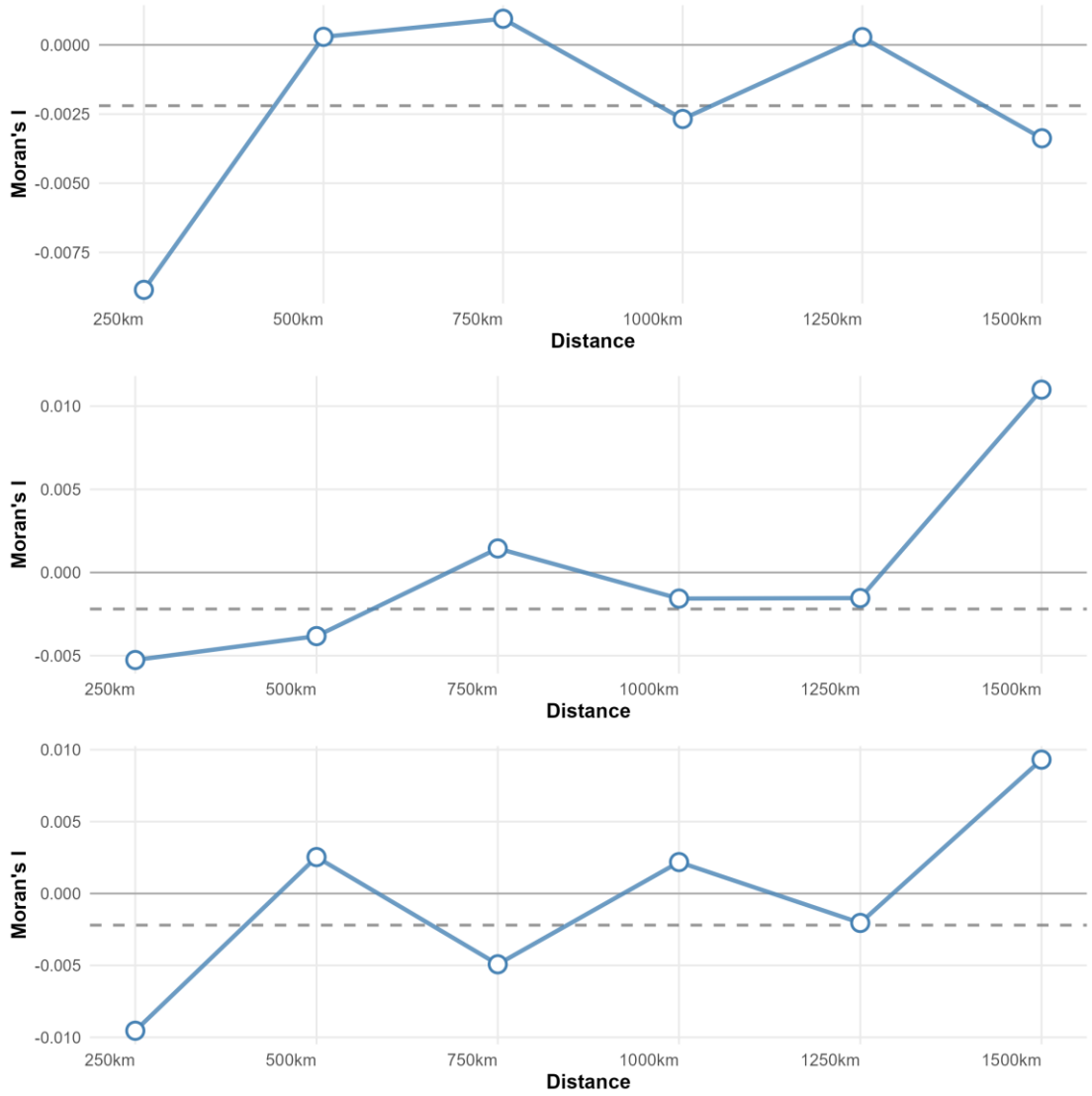

Fig. S4 Moran's I test on the residuals of random forest models (species richness, biomass and productivity) of monoecy.

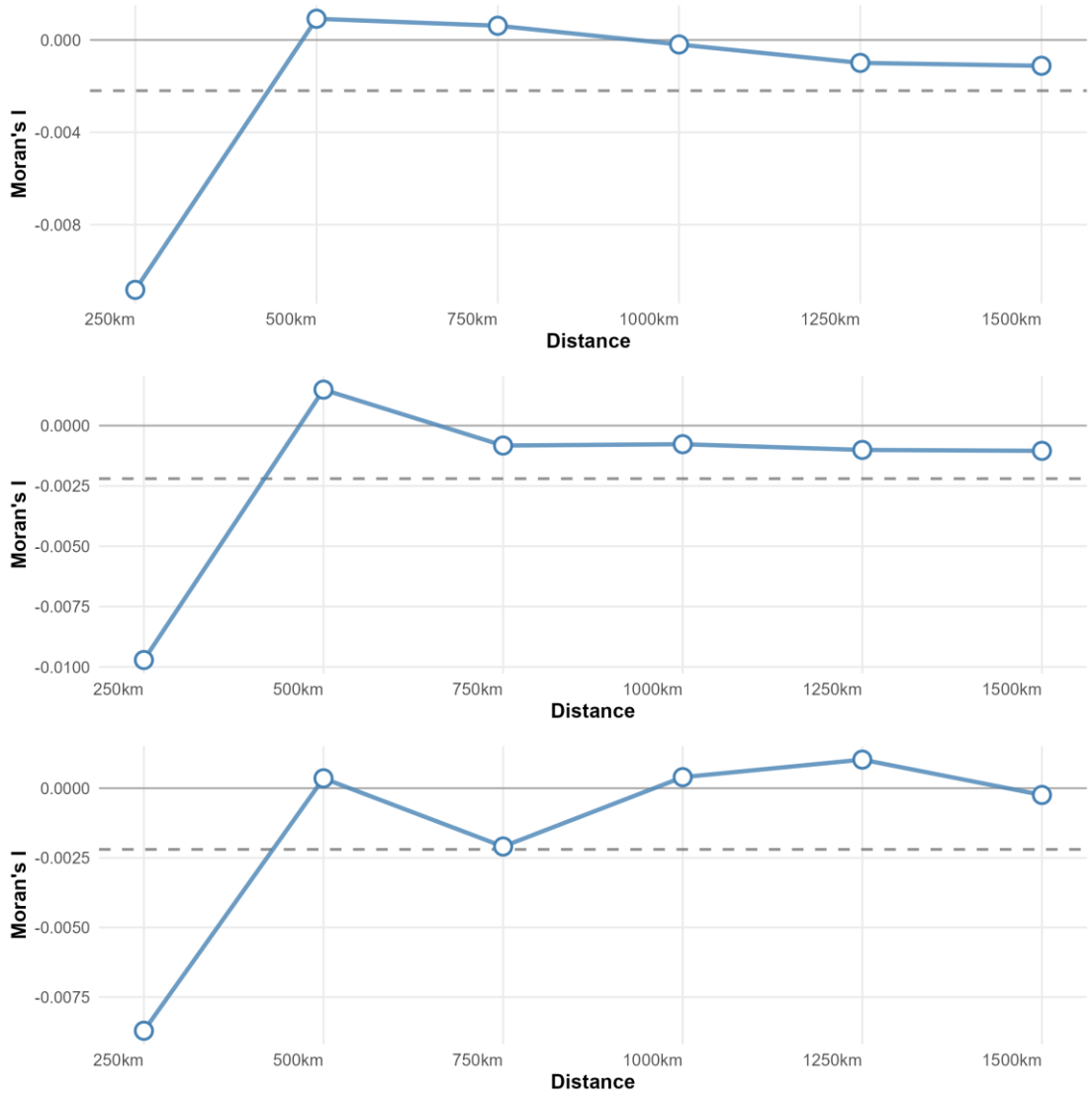

Fig. S5 Moran's I test on the residuals of random forest models (species richness, biomass and productivity) of hermaphroditism.

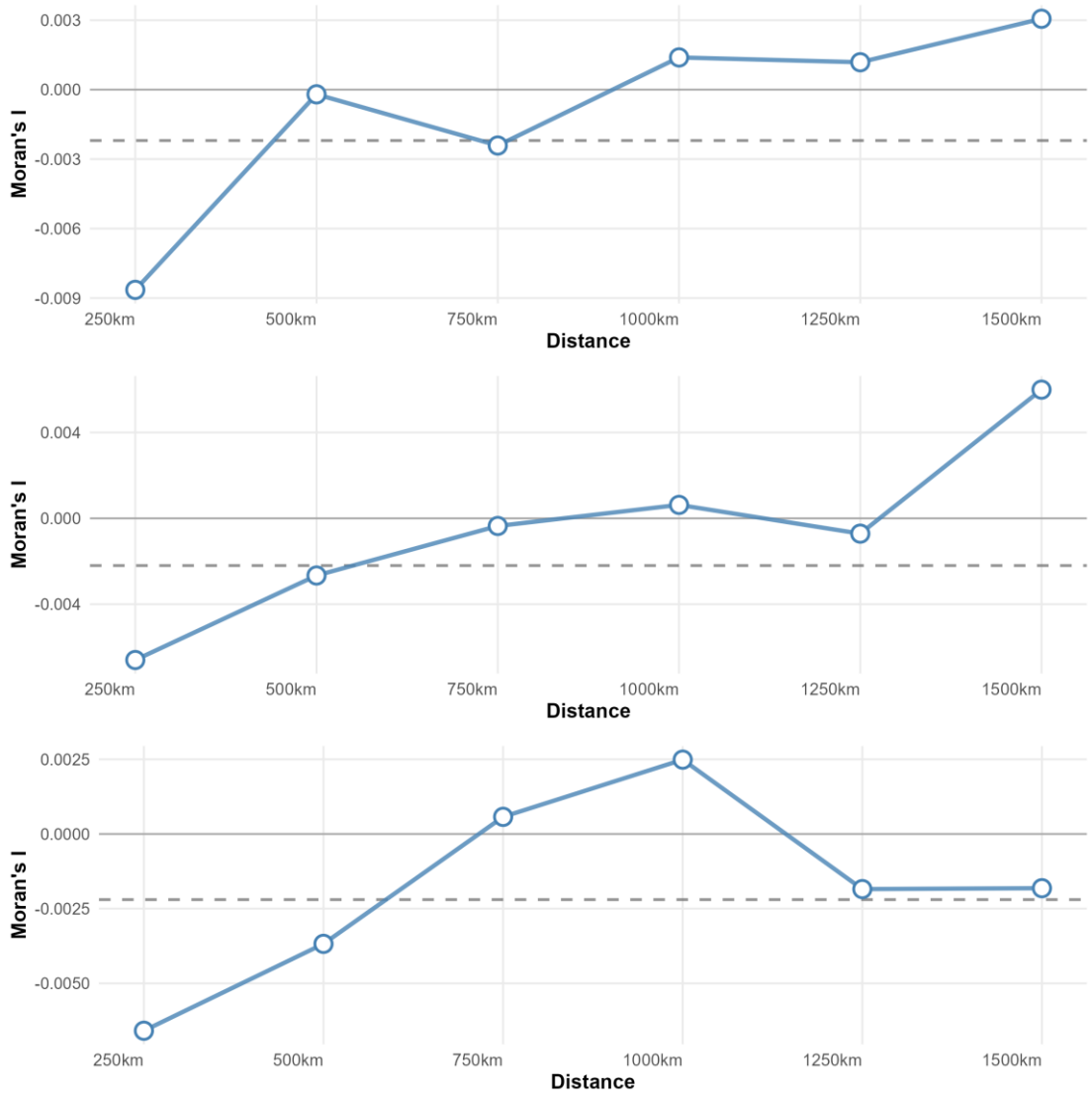

Fig. S6 Moran's I test on the residuals of random forest models (species richness, biomass and productivity) of dioecy.