Landscape Metrics Explain the Ecological Susceptibility of Terrestrial Ecosystems

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Supplementary information (S).

1. Determination of Ecological Susceptibility

The object-oriented method of the determination of ecological susceptibility is mainly based on the principle of extreme values (Misra, 1991). According to the principle of extreme values, the closer a measure of a given ecological factor is to its critical values, the higher the ecological susceptibility (Figure S1). Consequently, the following steps are taken to determine the measure of ecological susceptibility:

1.1. Designing Conceptual Diagram

On the basis of the objective method of the determination of ecological susceptibility, ecological factors are firstly enlisted. The conceptual diagram of the ecosystem (Amiri, 2019) is then designed by the ecological factors based on ecological knowledge. Figure S2 shows the conceptual diagram of the ecosystem, which is to be analyzed for further steps in determining the measure of ecological susceptibility.

1.2. Conceptual Diagram Analysis

To analyze the conceptual diagram of the ecosystem, the interaction analysis method, which was introduced by Jorgensen and Bendoricchio (2001), is applied. Accordingly, the existence and the lack of existence of the relationship between the two ecological factors are assigned 1 and 0, respectively. The measures in the rows and those of the columns were summed, and the relative importance measure of a given ecological factor is then calculated by subtracting the sum of a given column from that of the corresponding row (Table S1). The absolute measure K_i is then considered as the measure of the relative significance of a given ecological factor.

1.3. Determining Ecological Susceptibility

The ecological maps (slope, geographical aspect, elevation, soil, vegetation, groundwater table depth, soil pH, and geology) are reclassified according to Tables S2, S3 and S4, aiming at presenting, to present the extent to which each of the ecological factors implies the ecological susceptibility.

Having intersected the reclassified ecological maps by the grid map of the study area, the measure of ecological susceptibility is then integrated by the enlisted ecological factors for each of the cells using Eq. S1 as follows:

$$ESI = \sum_{i=1}^{n-1}(K_i X_i) \tag{S1}$$

where, ESI is the ecological susceptibility index, K_i: is the value of ecological factor *i* th, and X_i stands for the measure of ecological susceptibility of the cell *i* th.

Exemplar 1:

Supposing a study unit has the following ecological feature:

Ecological Factor	Value	Limitation code	Importance
Geology	None- resistance	5	6
Aspect	West	2	2
Elevation	1283.29 m.s.l.	6	5
Slope	42.09 percent	7	4
Rain	500 mm	7	1
Temperature	9	6	4
Soil deep, and	40 cm	4	1
Vegetation landcover	17.16 percent	4	3

$$\boldsymbol{ESI} = (\mathbf{5} * \mathbf{6}) + (\mathbf{2} * \mathbf{2}) + (\mathbf{6} * \mathbf{5}) + (\mathbf{7} * \mathbf{4}) + (\mathbf{7} * \mathbf{1}) + (\mathbf{6} * \mathbf{4}) + (\mathbf{4} * \mathbf{1}) + (\mathbf{4} * \mathbf{3}) = \mathbf{139}$$

2. Results of modeling

2.1. Mean landscape metrics-based models:

$$S_i = 103.473 - 0.303DF1_{para} + 0.211DF2_{para} \tag{S2}$$

$$S_i = -545.958 + 1037.458DF1_{frac} - 767.774CF1_{frac} + 346.877EF1_{frac} \tag{S3}$$

$$S_i = 273.757 + 100.326LogR1_{rcc} + 192.815LogA_{rcc} + 136.893Log\ BU_{rcc} \tag{S4}$$

$$S_i = 83.309 + 104.295DF1_{contig} - 115.890DF2_{contig} - 101.589CF1_{contig} + 68.822R1_{contig} \quad (S5)$$

$$LogS_i = 1.796 + 1.061LogDF1_{shp} - 1.039LogCF1_{shp} + 0.612LogEF1_{shp} + 0.842LogOF1_{shp} \quad (S6)$$

2.2. Weighted average landscape metrics-based models:

$$S_i = -80.909 + 36.703LogA_{para} + 48.103LogBU_{para} \quad (S7)$$

$$S_i = 499.865 - 200.070BU_{frac} - 159.793A_{frac} \quad (S8)$$

$$Log\ S_i = 2.425 + 1.415LogOF1_{rcc} + 0.987LogA_{rcc} \quad (S9)$$

$$S_i = 90.753 + 62.645LogR1 - 93.749LogBU_{contig} \quad (S10)$$

$$S_i = 161.538 - 7.755A_{shp} - 21.226CF1_{shp} \quad (S11)$$

2.3. Median landscape metrics-based models:

$$S_i = 128.584 - 79.400LogDF1_{para} + 188.424LogDF2_{para} - 244.609LogOF1_{para} + 116.635LogCF1_{para} \quad (S12)$$

$$S_i = -1905.395 - 803.618CF1_{frac} + 1456.622S_{frac} + 480.866DF1_{frac} + 527.542R1_{frac} + 322.194EF1_{frac} \quad (S13)$$

$$Log\ S_i = 1.791 + 0.543OF1_{rcc} - 0.196DF2_{rcc} \quad (S14)$$

$$S_i = 72.326 + 64.868DF1_{contig} - 91.686CF1_{contig} - 135.672DF2_{contig} + 215.146OF1_{contig} \quad \text{(S15)}$$

$$S_i = 97.351 + 164.099LogDF1_{shp} - 407.997LogCF1_{shp} + 280.870LogA_{shp} \quad \text{(S16)}$$

where,

$Log\ S_i$: the ecological susceptibility measure for cell *i*

para: the (mean, weighted mean, and median) perimeter-area ratio of LULC *i*,

frac: the (mean, weighted mean, and median) fractal dimension index of LULC*i*,

rcc: the (mean, weighted mean, and median) related circumscribing circle index of LULC*i*,

contig: the (mean weighted mean, and median) of the contiguity index of LULC*i*,

shp: the (average, weighted average, and median) shape index for patches of LULC*i*,

DF1: closed deciduous broad-leaved forest,

DF2: open deciduous broad-leave forest,

CF1: closed mixed forest,

EF1: closed evergreen needle-leaved forest,

R1: high-density rangeland,

A: agriculture,

BU: build-up,

OF1: open mixed forest and

S: shrubland.

S. References

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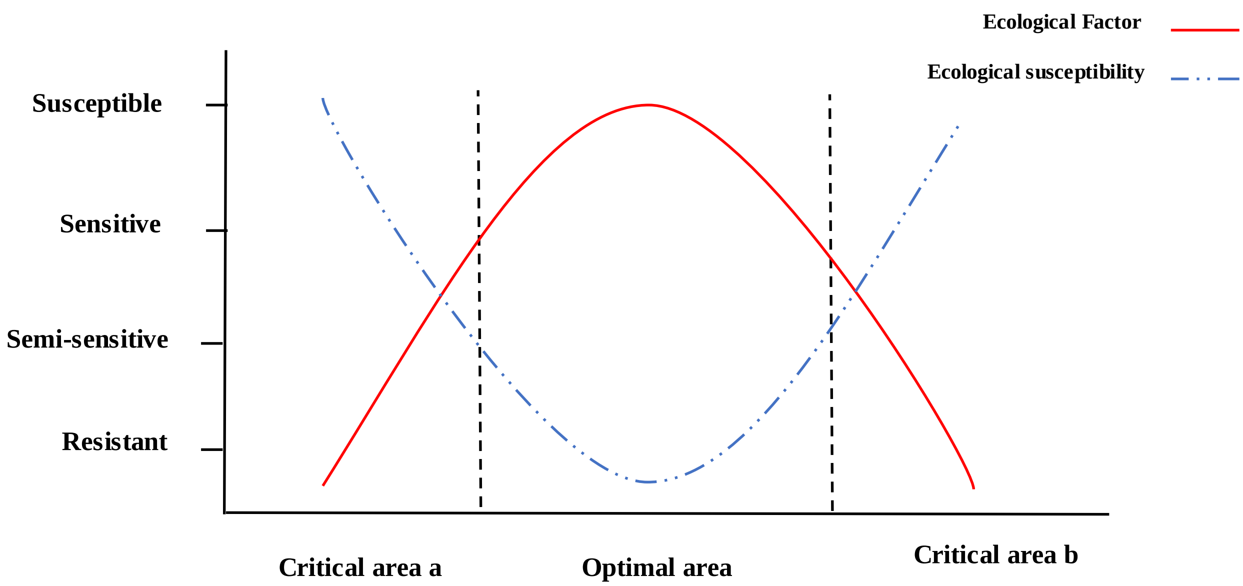


Figure S1: Conceptual relationship between ecological susceptibility and ecological factor measures (Amiri, 2019)

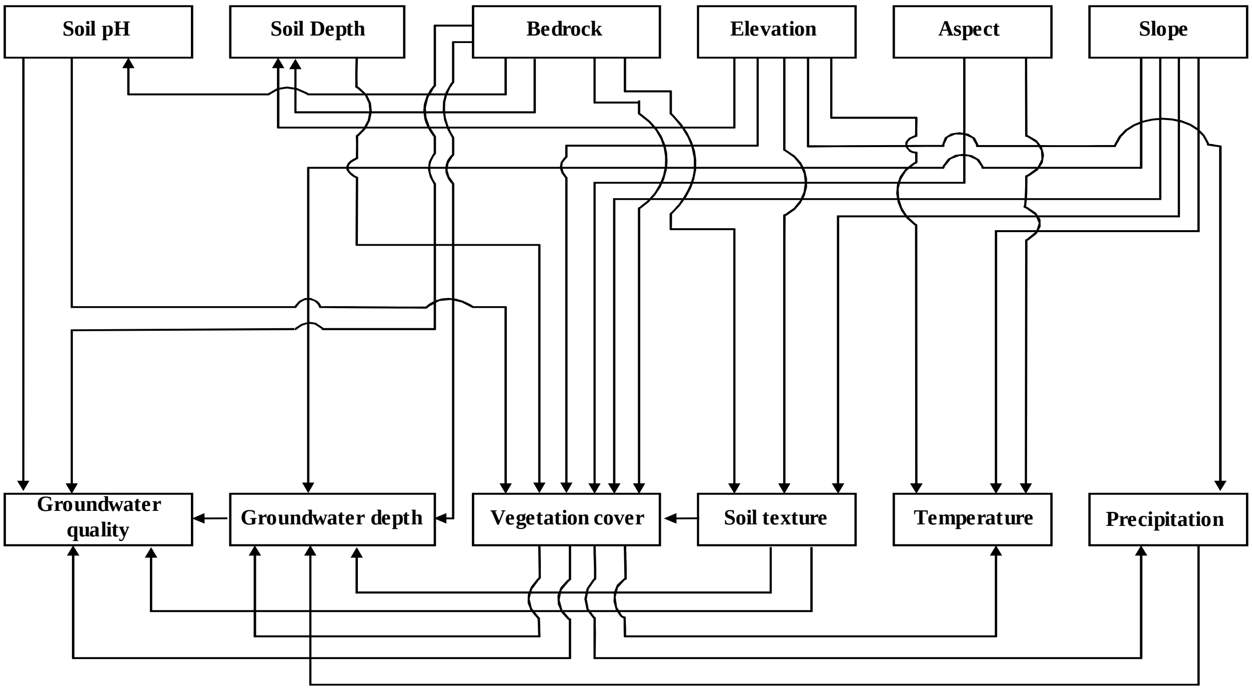


Figure S2: Conceptual diagram of the ecological factors (Amiri, 2019)

Table S1: The interaction matrix analysis of the conceptual diagram (Amiri, 2019)

Factors	Slope	Aspect	Elevation	Geology	Soil texture	Soil pH	Soil depth	Vegetation cover	Precipitation	Temperature	Groundwater depth	Groundwater quality	Sum	Absolute Importance value $K = \left(\sum_{i=13}^{1} X_i - \sum_{j=13}^{1} X_j \right)$
Slope	0				1			1	1		1	1	5	0-5
Aspect		0						1		1			2	0-2
High from sea level			0		1		1	1	1	1			5	0-5
Geology				0	1	1	1	1			1	1	6	0-6
Soil texture					0			1			1	1	3	0
Soil pH						0		1				1	2	-1
Soil depth							0	1					1	1
Vegetation cover								0	1	1	1	1	4	3
Precipitation									0		1		1	1
Temperature										0			0	4
Groundwater depth											0		0	4
Groundwater quality												0	0	5
Sum	0	0	0	0	3	1	2	7	2	4	5	5		

Table S2: Classification and ecological susceptibility coding of the ecological factors

Elevation (m.s.l.)	Slope (%)	Ecological Susceptibility code	Geographical aspect	Ecological Susceptibility code	Geology	Soil depth (cm)	Ecological Susceptibility code
0-100	0-2	1	Flat	1	very resistance	> 120	1
100-200	2-5	2	North	3	resistance	80-120	2
200-400	5-8	3	East	3	un-resistance	50-80	3
400-600	8-12	4	South	2	susceptible	25-50	4
600-1200	12-15	5	West	2	very susceptible	10-25	5
1200-1800	15-30	6					
1800-2200	30-65	7					
>2200	> 65	8					

Table S3: Classification and ecological susceptibility coding of the climatic factors and vegetation

Precipitation (mm/yr)	Temperature (Cº)	Ecological susceptibility code	Vegetation cover (%)	Ecological susceptibility code
200-400	4-6.25	8	75-100	1
400-600	6.25-8.5	7	50-75	2
600-800	8.5-10.75	6	25-50	3
800-1000	10.75-13	5	0-25	4
1000-1200	13-15.25	4		
1200-1400	15.25-17.5	3		
1400-1600	17.5-19.75	2		
1600-1800	19.75-22	1		

Table S4: The importance value of the ecological factors for ecological susceptibility

Ecological Factor	Importance value
Bedrock	6
Elevation	5
Temperature	4
Slope	4
Vegetation cover	3
Aspect	2
Precipitation	1
Soil	1

Table S5: The equation, range, and physical meaning of the structure-related landscape metrics (Amiri et al., 2019)

Landscape Metric	Formula	Range	Remarks
Contiguity index	$contig = \frac{\left(\frac{\sum_r^z c_{ijr}}{a_{ij}}\right)}{v-1}$ where C_{ijr} is the contiguity value for pixel r in patch ij, v is the sum of values in a 3-by-3 cell template, and a_{ij} is the area of patch ij in terms of the number of cells	$0 \leq contig \leq 1$	The value of metric varies between 0 for a one-pixel patch and 1 for a connected patch (McGarigal and Marks, 1995)
Fractal dimension index	$frac = log\left(\frac{p}{0.5A}\right)$ where P is perimeter and A stands for area	$1 \leq frac \leq 2$	The index ranges between 1 for a regular (square) patch and 2 for an irregular (convoluted) patch (Rutledge, 2003)
Perimeter-area ratio	$para = \frac{P_{ij}}{A_{ij}}$ where P is perimeter and A stands for area	$para \geq 0$	The farther the ratio is from 1, the more the patch deviates from the isodiametric shape (Farina, 2006)
Related circumscribing circle	$rcc = 1 - \left(\frac{a_{ij}}{a_{ij}^s}\right)$ where a_{ij} is the area (m^2) of patch ij, and a_{ij}^s is the area in m^2 of the smallest circumscribing circle around patch ij	$0 \leq rcc \leq 1$	It varies from 0 for a convoluted patch to 1 for an elongated patch (Rutledge, 2003)
Shape index	$shp = \frac{1}{N_i} \sum \frac{L_i}{4\sqrt{A_i}}$ where N_i stands for the number of patches of category i, L_i is the perimeter, and A_i is the area of each patch in a given category.	$1 \leq shp \leq \infty$	For a square-shaped patch, the value of the index is equal to 0, but for an irregular shape-patch, it is ∞ (Rutledge, 2003)

Table S6: Statistics of the regression models for predicting the measures of ecological susceptibility using landscape structural metrics

Type of model	Model No.	Model Variable	Coefficients						Collinearity Statistics	
			B	Std. Error	Beta	r^2	t	*p-value*	Tolerance	VIF
Mean landscape metric-based model	2	Cons.	103.473	29.071		0.436	3.559	0.001		
		$DF1_{para}$	-0.303	0.069	-0.555		-4.371	0.000	0.999	1.001
		$DF2_{para}$	0.211	0.071	0.378		2.973	0.005	0.999	1.001
	3	Cons	-545.958	348.004		0.515	-1.569	0.126		
		$DF1_{frac}$	1037.45	205.649	0.614		5.045	0.000	0.963	1.039
		$CF1_{frac}$	-767.774	214.588	-0.431		-3.578	0.001	0.983	1.017
		$EF1_{frac}$	346.877	168.554	0.251		2.058	0.047	0.958	1.044
	4	Cons	273.757	46.200		0.539	5.925	0.000		
		$R1_{rcc}$	100.326	28.982	0.576		3.462	0.003	0.979	1.021
		A_{rcc}	192.815	62.619	0.550		3.079	0.007	0.850	1.176
		BU_{rcc}	136.893	61.981	0.392		2.209	0.041	0.860	1.163
	5	Cons	83.309	14.036		0.577	5.936	0.000		
		$DF1_{contig}$	104.295	26.276	0.464		3.969	0.000	0.938	1.066
		$DF2_{contig}$	-115.890	33.170	-0.404		-3.494	0.001	0.959	1.043
		$CF1_{contig}$	-101.589	40.296	-0.294		-2.521	0.017	0.943	1.060
		$R1_{contig}$	68.822	33.821	0.235		2.035	0.050	0.957	1.045
	6	Cons	1.796	0.055		0.546	32.688	0.000		
		$DF1_{shp}$	1.061	0.233	0.543		4.557	0.000	0.968	1.033
		$CF1_{shp}$	-1.039	0.378	-0.329		-2.750	0.010	0.962	1.040
		$EF1_{shp}$	0.612	0.286	0.256		2.141	0.040	0.963	1.038
		$OF1_{shp}$	0.842	0.413	0.243		2.036	0.050	0.965	1.036
Weighted average landscape metric-based model	7	Cons.	-80.909	46.965		0.396	-1.723	0.094		
		A_{para}	36.703	12.689	0.425		2.893	0.007	0.802	1.248
		BU_{para}	48.103	22.610	0.312		2.128	0.040	0.802	1.248
	8	Cons.	499.865	67.993		0.502	7.352	0.000		
		BU_{frac}	-200.070	87.561	-0.388		-2.285	0.028	0.495	2.022
		A_{frac}	-159.793	71.694	-0.378		-2.229	0.032	0.495	2.022
	9	Cons.	2.425	0.136		0.433	17.847	0.000		
		$OF1_{rcc}$	1.415	0.517	0.489		2.736	0.014	0.985	1.015
		A_{rcc}	0.987	0.459	0.385		2.151	0.045	0.985	1.015
	10	Cons.	90.753	13.301		0.590	6.823	0.000		
		$R1_{contig}$	62.645	14.600	0.648		4.291	0.000	1.000	1.000
		BU_{contig}	-93.749	35.084	-0.403		-2.672	0.016	1.000	1.000
	11	Cons.	161.538	13.108		0.565	12.324	0.000		
		A_{shp}	-7.755	1.225	-0.706		-6.333	0.000	0.999	1.001
		$CF1_{shp}$	-21.226	8.656	-0.274		-2.452	0.019	0.999	1.001
Median landscape metric-based model	12	Cons.	128.584	252.594		0.547	0.509	0.614		
		$DF1_{para}$	-79.400	23.465	-0.401		-3.384	0.002	0.979	1.022
		$DF2_{para}$	188.424	45.388	0.502		4.151	0.000	0.940	1.064
		$OF1_{para}$	-244.609	80.272	-0.366		-3.047	0.005	0.951	1.052
		$CF1_{para}$	116.635	49.817	0.279		2.341	0.025	0.966	1.036
	13	Cons.	-1905.395	546.501		0.641	-3.487	0.001		
		$CF1_{frac}$	-803.618	188.691	-0.457		-4.259	0.000	0.974	1.026
		S_{frac}	1456.622	374.745	0.420		3.887	0.000	0.961	1.041
		$DF1_{frac}$	480.866	147.785	0.359		3.254	0.003	0.920	1.087
		$R1_{frac}$	527.542	195.825	0.295		2.694	0.011	0.934	1.071
		$EF1_{frac}$	322.194	153.208	0.234		2.103	0.043	0.909	1.101
	14	Cons.	1.791	0.080		0.264	22.433	0.000		
		$OF1_{rcc}$	0.543	0.171	0.480		3.176	0.003	0.922	1.085
		$DF2_{rcc}$	-0.196	0.082	-0.362		-2.394	0.022	0.922	1.085
	15	Cons.	72.326	13.648		0.581	5.299	0.000		
		$DF1_{contig}$	64.868	18.017	0.411		3.600	0.001	0.974	1.027
		$CF1_{contig}$	-91.686	33.782	-0.316		-2.714	0.010	0.936	1.069
		$DF2_{contig}$	-135.672	32.623	-0.492		-4.159	0.000	0.908	1.101
		$OF1_{contig}$	215.146	64.145	0.391		3.354	0.002	0.933	1.072
	16	Cons.	97.351	4.247		0.475	22.920	0.000		
		$DF2_{shp}$	164.099	56.284	0.375		2.916	0.006	0.933	1.071
		$CF1_{shp}$	-407.997	113.219	-0.449		-3.604	0.001	0.995	1.005
		A_{shp}	280.870	134.625	0.268		2.086	0.045	0.935	1.070

Table S7: Results of the inter-model comparison for the mean, weighted average, and median landscape metric-based models

Type of model	Model no.	RSS	Log (RSS/n)	2 K	K+1	n-K-1	AIC	Δj	EXP (−0.5 * Δj)	Wi
Mean landscape metric-based model	2	1.4244	-1.4262	6	4	34	-47.4880	20.8974	2.90E-05	2.90E-05
	3	1.3910	-1.4365	8	5	33	-45.3737	23.0117	1.01E-05	1.01E-05
	4	30.3139	-0.0981	8	5	33	5.4827	73.8681	9.11E-17	9.11E-17
	5	95.2459	0.3991	10	6	32	27.0394	95.4248	1.90E-21	1.90E-21
	6*	0.2935	-2.1121	10	6	32	-68.3854	0.0000	1.00E+00	1.00E+00
Weighted average landscape metric-based model	7	0.4258	-1.9505	6	4	34	-67.4143	7.1991	2.73E-02	2.20E-02
	8	0.3313	-2.0596	6	4	34	-71.5583	3.0551	2.17E-01	1.74E-01
	9	1.4031	-1.4327	6	4	34	-47.7361	26.8773	1.46E-06	1.17E-06
	10	34.8924	-0.0371	6	4	34	5.2979	79.9113	4.44E-18	3.57E-18
	11**	0.2753	-2.1400	6	4	34	-74.6134	0.0000	1.00E+00	8.04E-01
Median landscape metric-based model	12	1.3394	-1.4529	10	6	32	-43.3338	26.7425	1.56E-06	1.25E-06
	13	0.2823	-2.1290	12	7	31	-66.1930	3.8833	1.43E-01	1.15E-01
	14	0.4785	-1.8999	6	4	34	-65.4913	4.5850	1.01E-01	8.12E-02
	15***	0.2650	-2.1566	10	6	32	-70.0763	0.0000	1.00E+00	8.04E-01
	16	1.4639	-1.4143	8	5	33	-44.5306	25.5457	2.84E-06	2.28E-06

* The most appropriate model for group 1
** The most appropriate model for group 2
*** The most appropriate model for group 3

Table S8: *A priori* and *posterior* statistics of the independent variables of the candidate models

Analysis stage	Statistics	Mean landscape metric-based model				Weighted average landscape metric-based model		Median landscape metric-based model			
		$DF1_{shp}$	$CF1_{shp}$	$EF1_{shp}$	$OF1_{shp}$	A_{shp}	$CF1_{shp}$	$DF1_{contig}$	$CF1_{contig}$	$DF2_{contig}$	$OF1_{contig}$
A priori statistics[1]	Min.	1.0477	1.0000	1.0000	1.0476	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000
	Max.	2.0779	1.5533	1.5714	1.5587	9.8350	2.3154	0.6961	0.2778	0.2917	0.2847
	Mean	1.3739	1.1352	1.1286	1.2412	4.0367	1.3462	0.3107	0.1225	0.1078	0.1629
	S.D.	0.2259	0.1150	0.1558	0.1118	2.4686	0.3492	0.1718	0.0935	0.0983	0.0493
	Variance	0.0510	0.0132	0.0243	0.0125	6.0939	0.1220	0.0295	0.0087	0.0097	0.0024
Posterior statistics[2]	Min.	0.5857	0.8334	0.9774	0.8604	1.2018	0.7882	-0.1423	-0.0312	-0.0326	-0.0326
	Max.	6.2583	1.6506	3.2429	1.7085	9.7074	7.9927	1.2057	0.2651	0.2835	0.2835
	Mean	1.3735	1.1354	1.1294	1.2379	4.0557	1.3440	0.3108	0.1226	0.1066	0.1066
	S.D.	0.2460	0.1065	0.1760	0.1119	2.5012	0.4173	0.1763	0.0936	0.0980	0.0980
	Variance	0.0605	0.0113	0.0310	0.0125	6.2560	0.1741	0.0311	0.0088	0.0096	0.0096

[1] No. of observation=38.
[2] No. of observation=15,000.

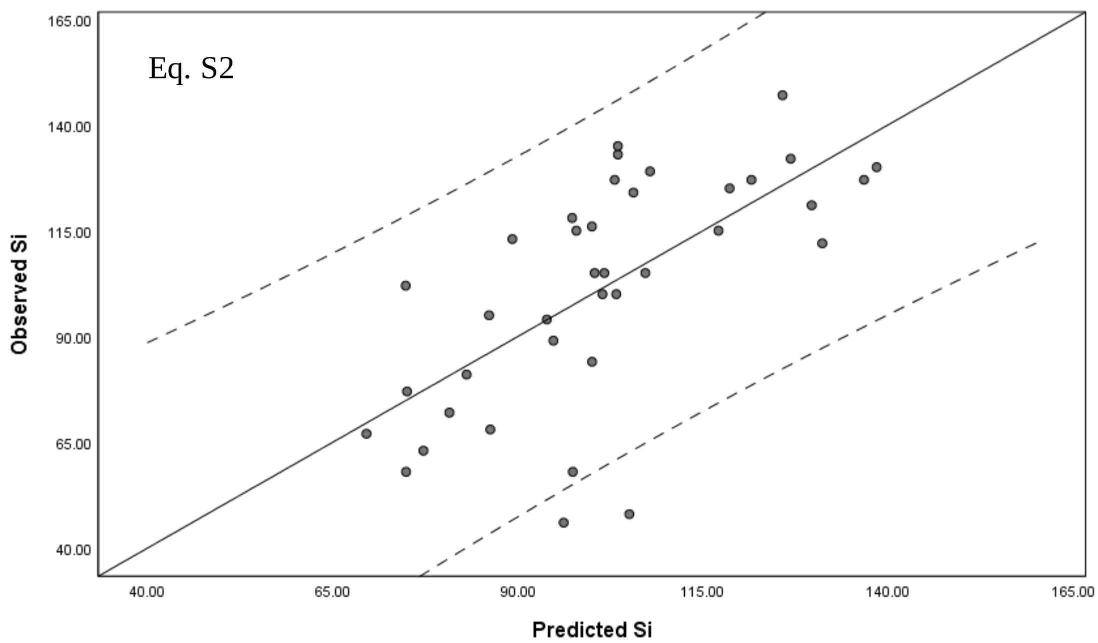
Table S9: *A priori* and *posterior* statistics of the Y variables of the candidate model.

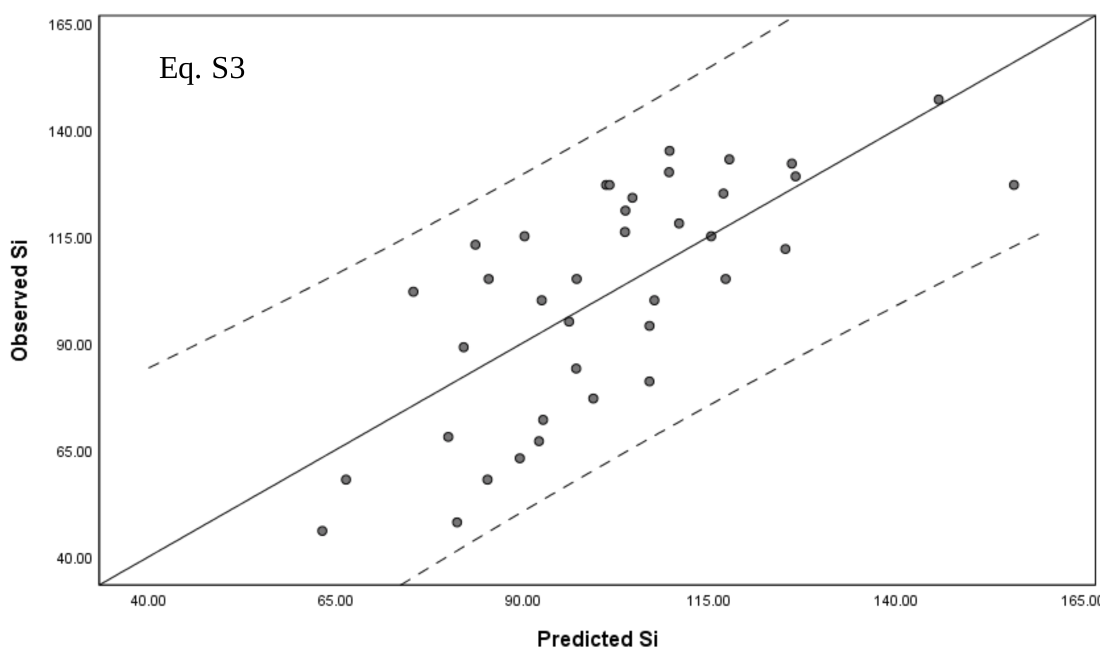
Statistics	*A priori* statistics	*Posterior* Statistics												
		Mean landscape metrics-based model					Weighted mean landscape metrics-based model			Median landscape metrics-based model				
			Y_{sim}|Change in target variable for SA					Ysim|Change in target variable for SA			Ysim|Change in target variable for SA			
	$Y_{obs.}$[1]	Y_{sim}[2]	Y_{sim}|$DF1_{shp}$	Y_{sim}|$CF1_{shp}$	Y_{sim}|$EF1_{shp}$	Y_{sim}|$OF1_{shp}$	Y_{sim}[2]	Y_{sim}|A_{shp}	Y_{sim}|$CF1_{shp}$	Y_{sim}[2]	Y_{sim}|$DF1_{contig}$	Y_{sim}|$CF1_{contig}$	Y_{sim}|$DF2_{contig}$	Y_{sim}|$OF1_{contig}$
Min.	46.0000	27.6574	40.1243	67.2021	90.7948	72.8338	-31.1516	57.6832	-39.4189	35.7142	72.2685	88.5849	77.8220	86.0609
Max.	147.0000	610.0575	495.4196	136.7039	189.1619	129.7619	135.1566	123.6436	113.5032	525.2236	159.7162	115.7552	120.7103	526.8301
Mean	101.6579	99.6678	99.2155	100.0519	98.9469	98.8811	101.5588	101.5119	101.7064	107.3213	101.6649	101.6537	101.8231	107.1539
S.D.	27.1017	24.8117	19.0106	9.6954	8.8584	7.5278	21.2864	19.3967	8.8570	26.0066	11.4392	8.5823	13.2962	17.2131
Variance	734.5014	615.6210	361.4023	94.0017	78.4713	56.6674	453.1099	376.2333	78.4461	676.3435	130.8548	73.6558	176.7882	296.2891

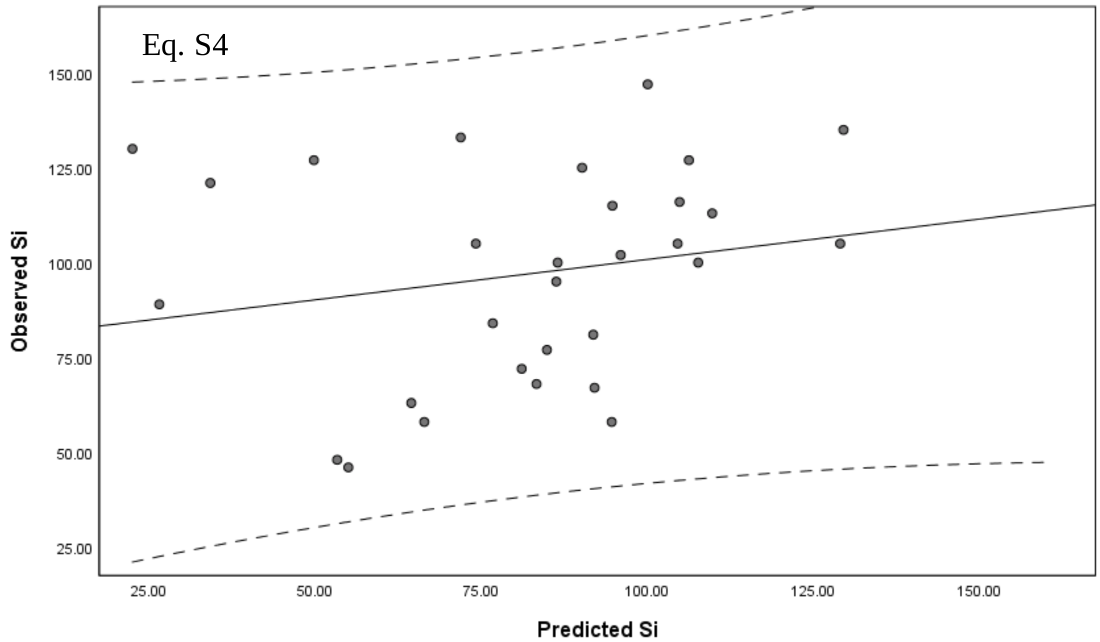
[1] No. of observation=38.
[2] No. of observation=15,000.

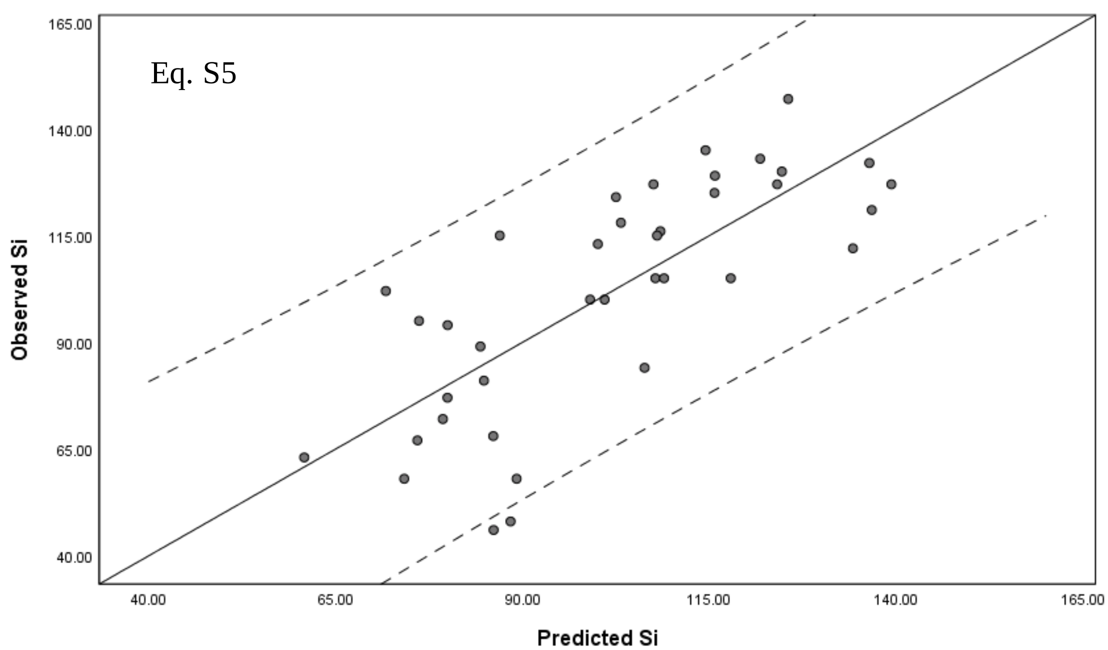
Table S10: Results of statistical distribution fitting to the candidate models.

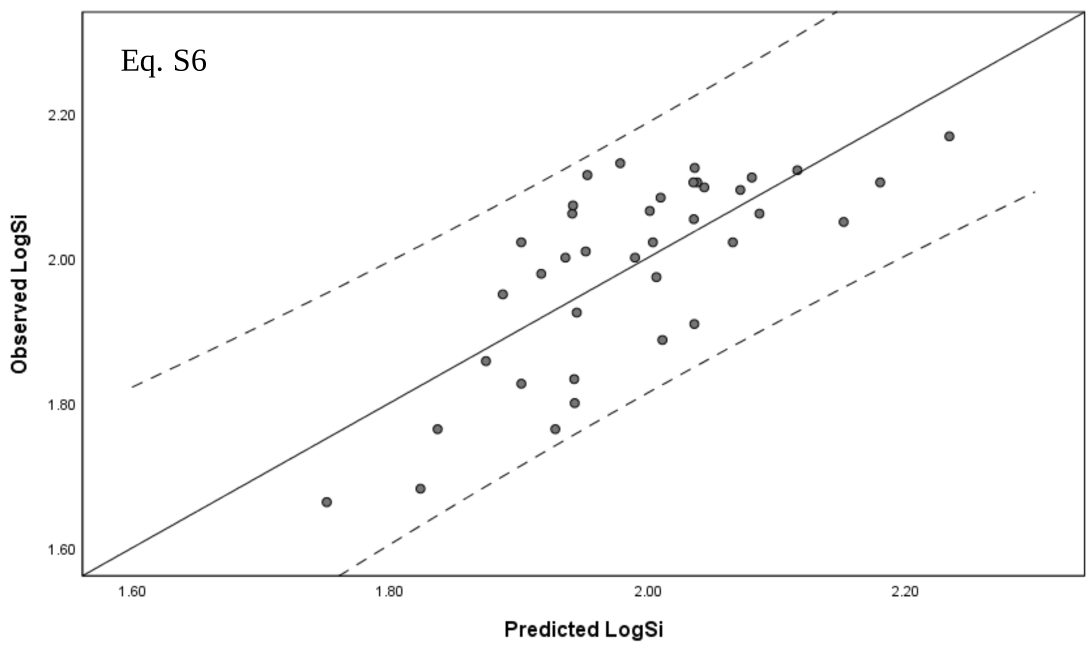
Type	Analysis stage	Model variable	Statistical distribution	Kolmogorov Smirnov Statistics	Kolmogorov Smirnov P-value	Statistical parameters	Sample Size
Mean Landscape Metric-based Model	*A prior* statistics	$DF1_{shp}$	Burr	0.05589	0.99928	k = 0.48705 α = 16.003 β = 1.2385 γ = 0	38
		$CF1_{shp}$	Pearson 5	0.09571	0.84462	α = 112.85 β = 126.95 γ = 0	
		$EF1_{shp}$	Wakeby	0.161	0.25001	α = 0 β = 0 γ = 0.13307 δ = 0.12005 ξ = 0.97739	
		$OF1_{shp}$	Erlang	0.06733	0.99072	m = 123 β = 0.01007 γ = 0	
		$Y_{obs.}$	Johnson SB	0.06191	0.99671	γ = -0.53444 δ = 0.7108 λ = 109.55 ξ = 32.205	
	Posterior statistics	Y_{sim}	Log-Logistic (3P)	0.00852	0.2251	α = 5.6691 β = 69.257 γ = 26.552	15000
Weighted Average Landscape Metric-based Model	*A prior* statistics	A_{shp}	Wakeby	0.08257	0.93892	α = -35.719 β = 1.5001 γ = 36.413 δ = -1.1267 ξ = 1.2018	38
		$CF1_{shp}$	Gen. Logistic	0.09409	0.85846	k = 0.32446 σ = 0.15977 μ = 1.2522	
	Posterior statistics	Y_{sim}	Wakeby	0.02218	7.5830E-7	α = 168.9 β = 6.0194 γ = 60.957 δ = -1.1706 ξ = 49.413	15000
Median Landscape Metric-based Model	*A prior* statistics	$DF1_{contig}$	Gen. Extreme Value	0.1325	0.47691	k = -0.07974 σ = 0.15034 μ = 0.23501	38
		$CF1_{contig}$	Johnson SB	0.13184	0.48323	γ = -0.0622 δ = 0.49423 λ = 0.29647 ξ = -0.03133	
		$DF2_{contig}$	Johnson SB	0.18484	0.131	γ = 0.18583 δ = 0.50329 λ = 0.31643 ξ = -0.03269	
		OF1contig	Frechet	0.43892	4.5019E-7	α = 4.0584 β = 0.15424 γ = 0	
	Posterior statistics	Y_{sim}	Burr	0.01078	0.06087	k = 1.4293 α = 6.8421 β = 113.02 γ = 0	15000

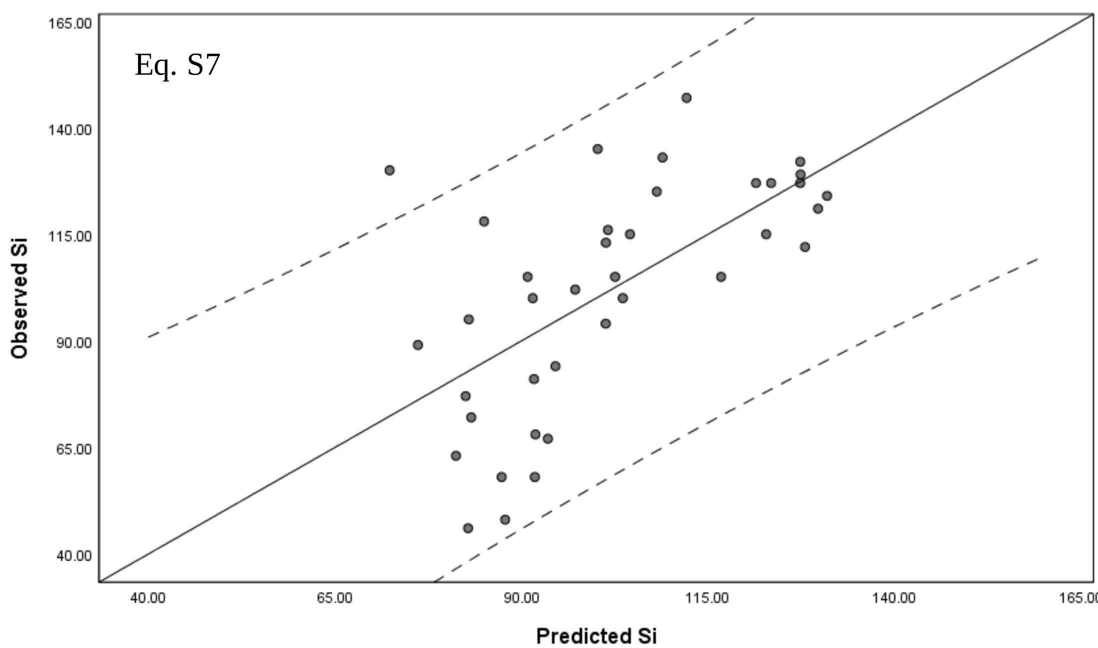

Eq. S2
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si

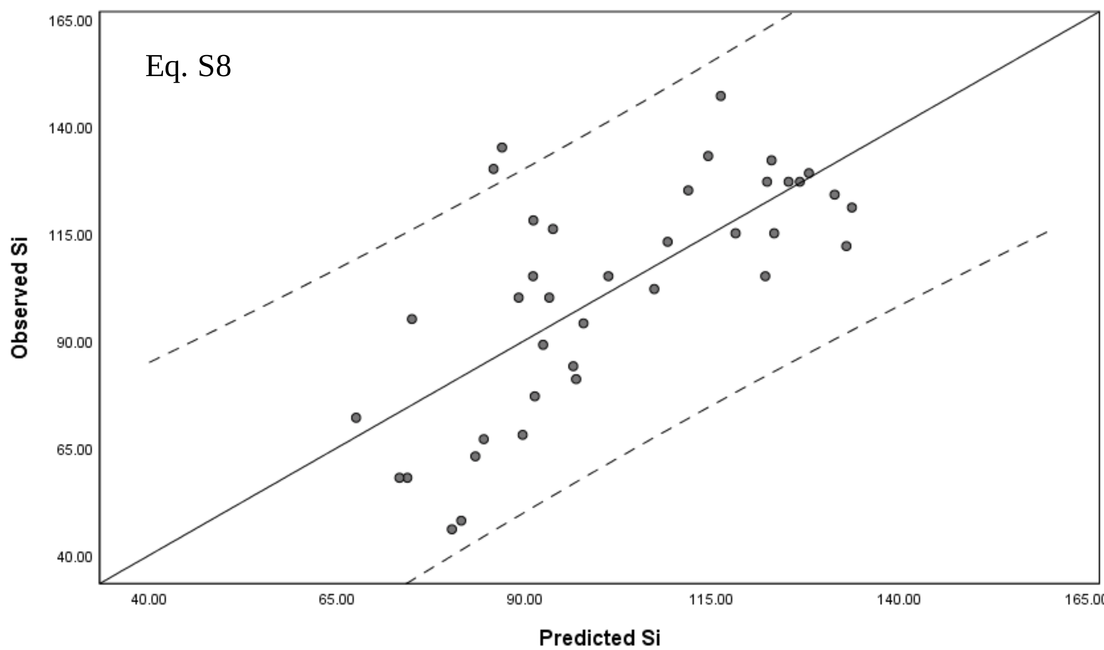

Eq. S3
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si


Eq. S4
150.00
125.00
100.00
75.00
50.00
25.00
Observed Si
25.00
50.00
75.00
100.00
125.00
150.00
Predicted Si

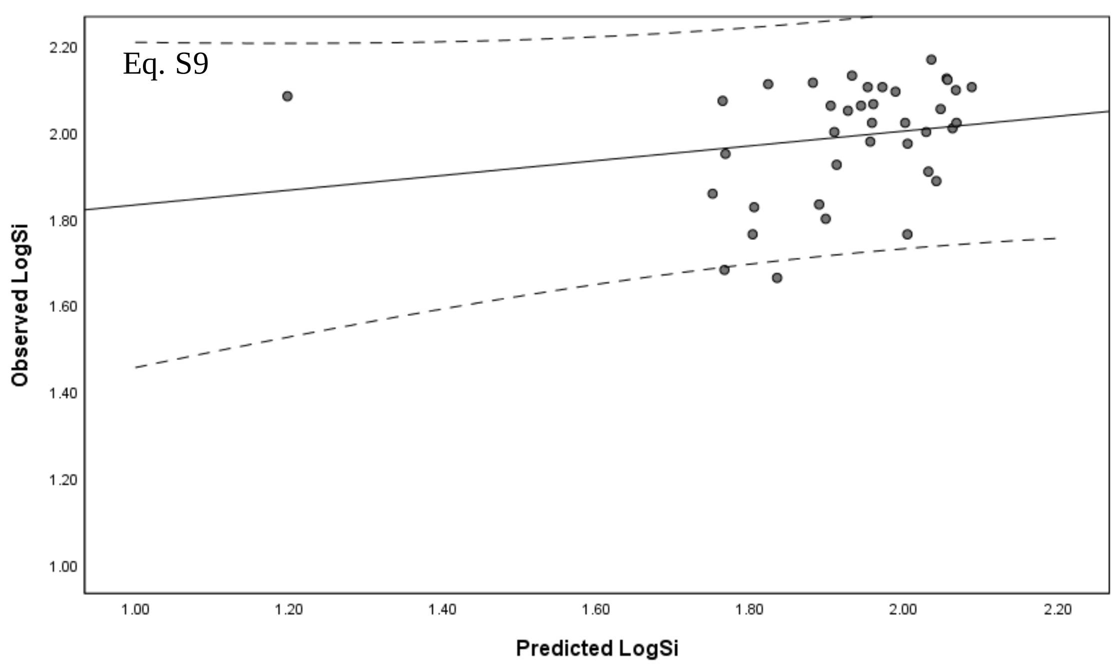

Eq. S5
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si


Eq. S6
Observed LogSi
Predicted LogSi
1.60
1.80
2.00
2.20

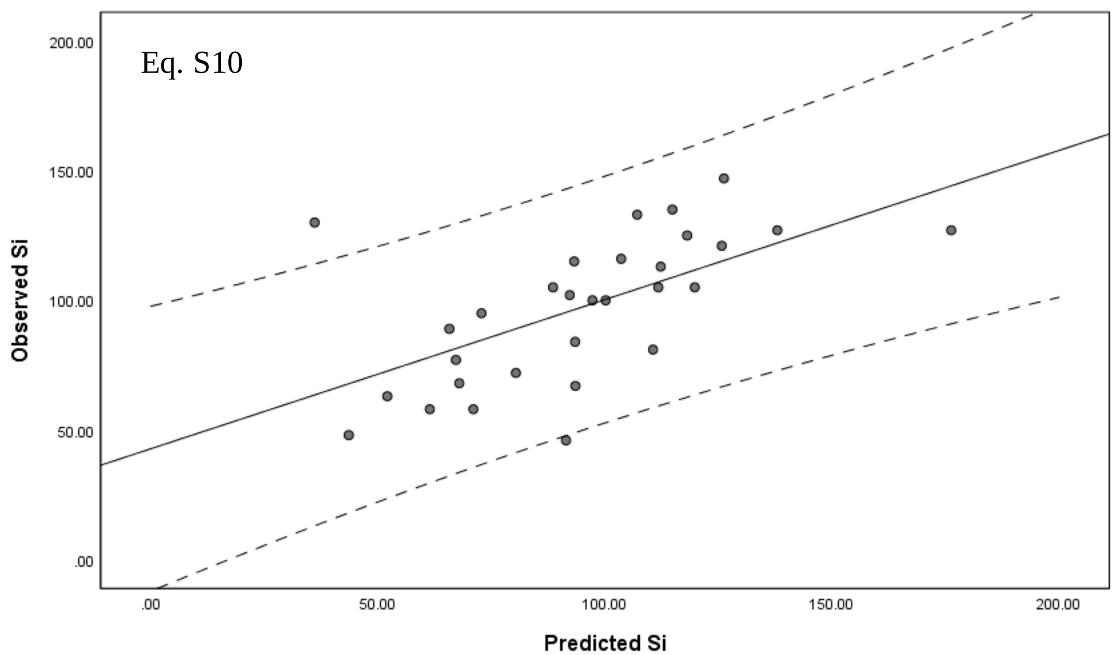

Eq. S7
Observed Si
Predicted Si
40.00
65.00
90.00
115.00
140.00
165.00



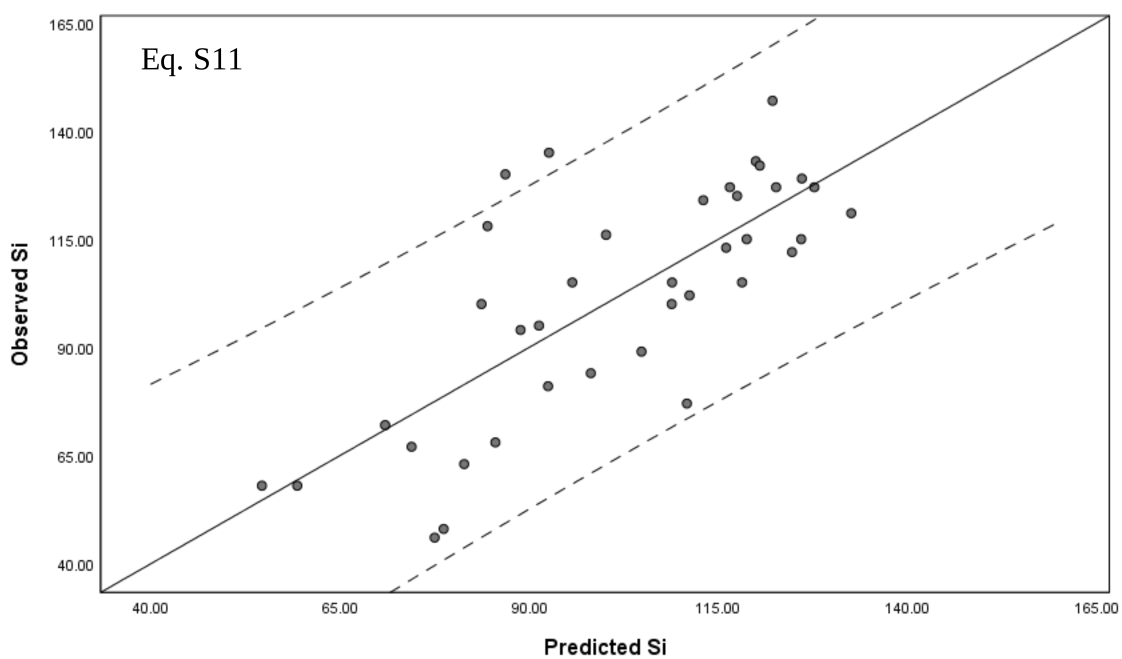
Eq. S8
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si



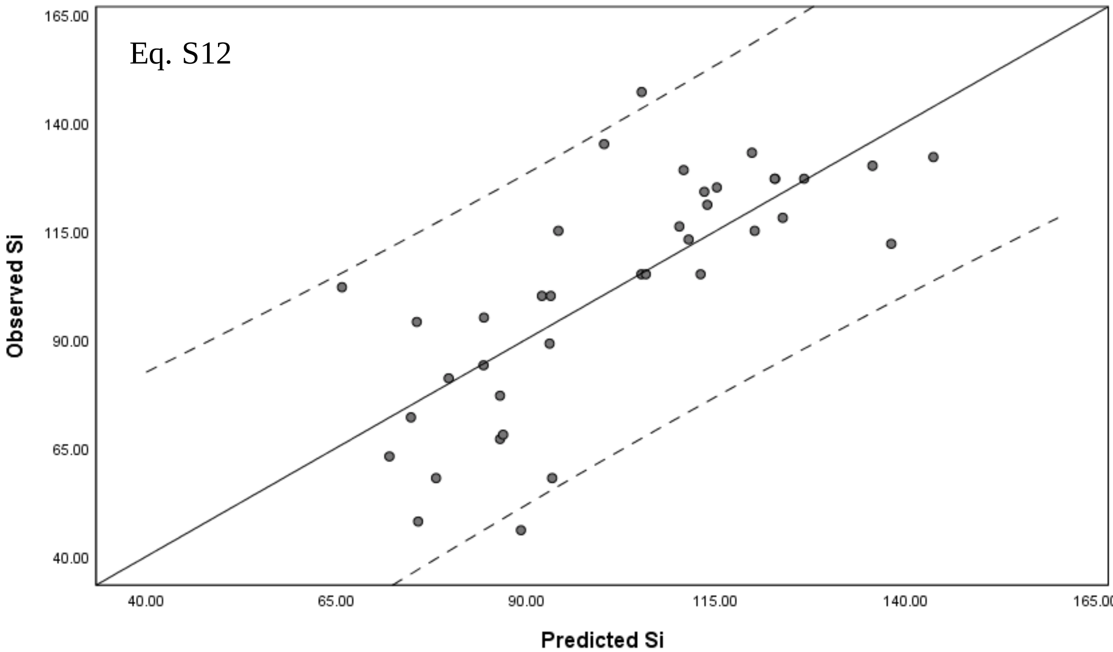
Eq. S9
2.20
2.00
1.80
1.60
1.40
1.20
1.00
Observed LogSi
1.00
1.20
1.40
1.60
1.80
2.00
2.20
Predicted LogSi

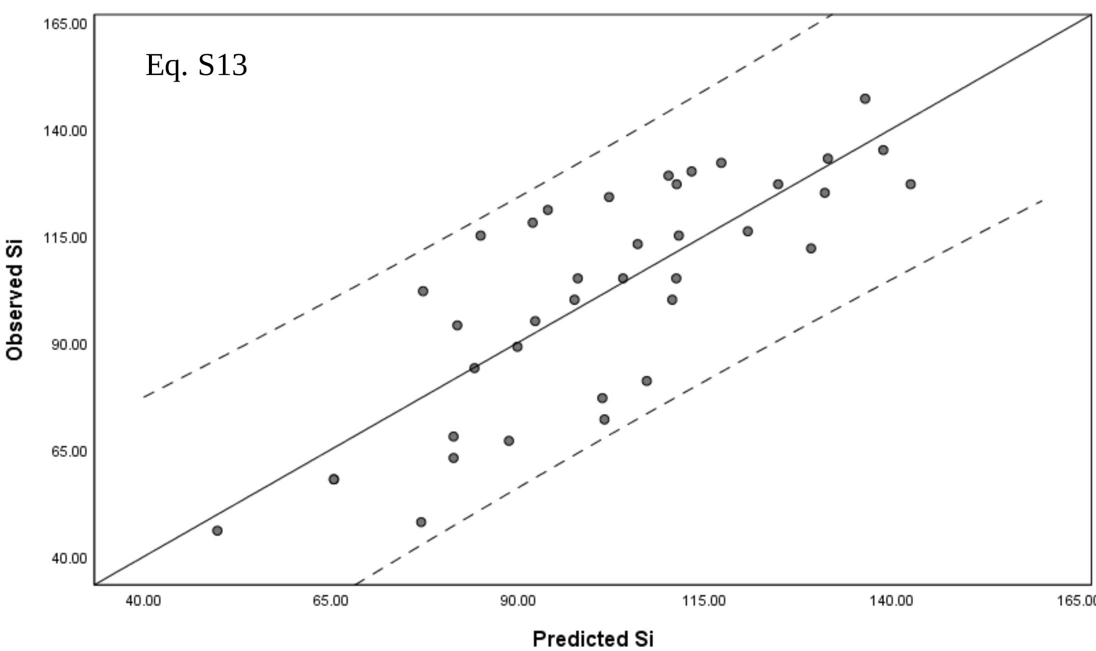


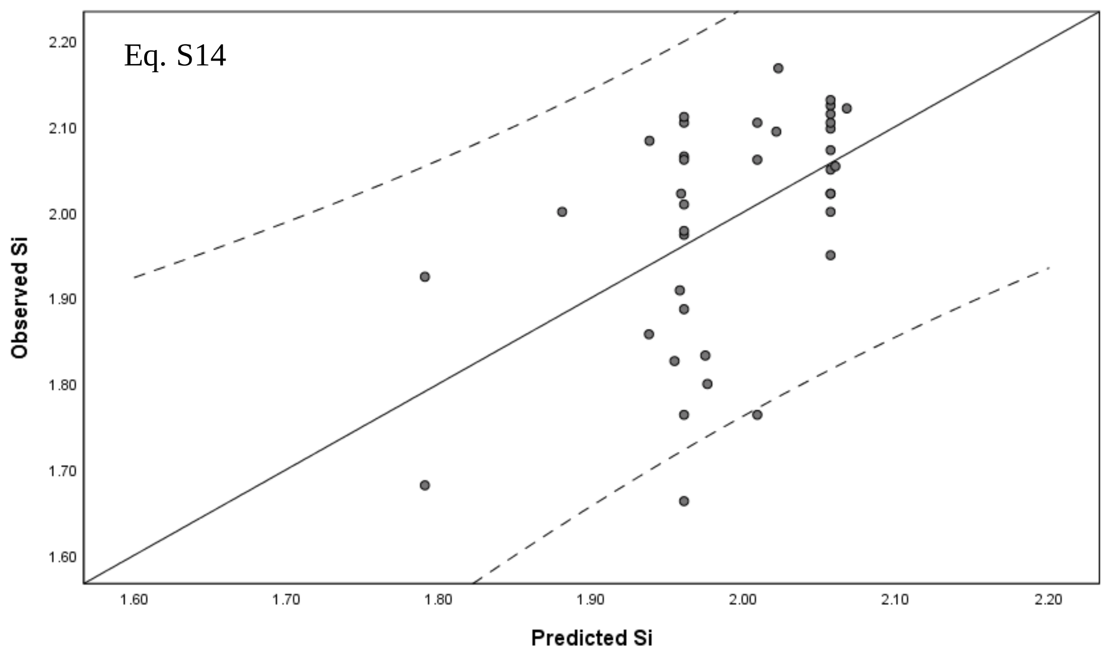
Eq. S10
200.00
150.00
100.00
50.00
.00
Observed Si
.00
50.00
100.00
150.00
200.00
Predicted Si

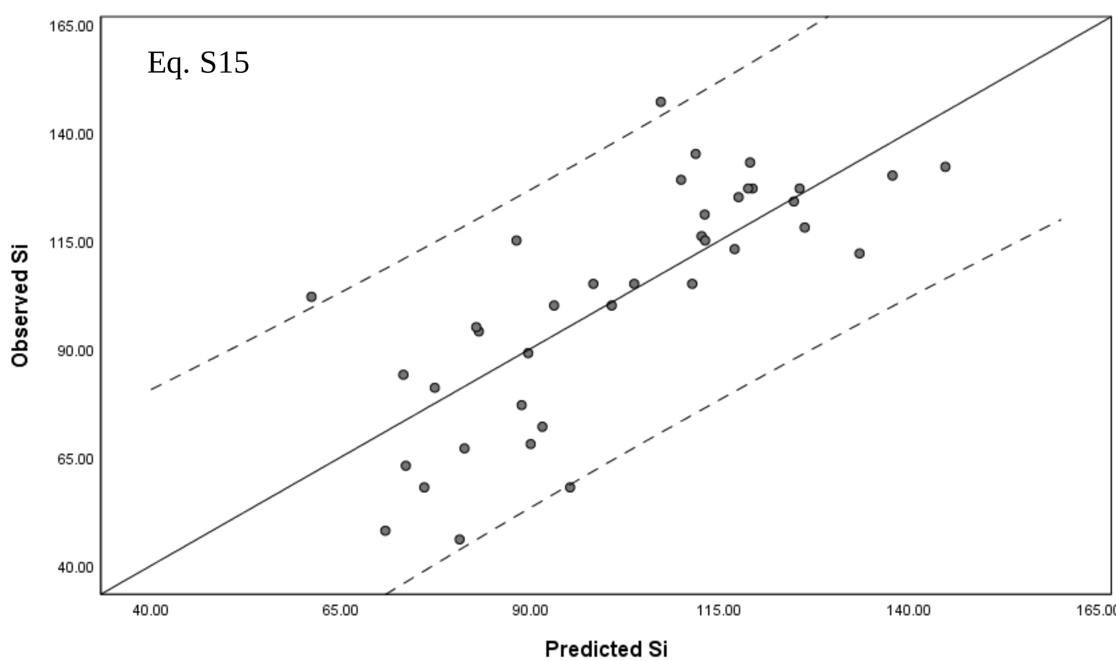


Eq. S11
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si


Eq. S12
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si


Eq. S13
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si


Eq. S14
2.20
2.10
2.00
1.90
1.80
1.70
1.60
Observed Si
1.60
1.70
1.80
1.90
2.00
2.10
2.20
Predicted Si


Eq. S15
165.00
140.00
115.00
90.00
65.00
40.00
Observed Si
40.00
65.00
90.00
115.00
140.00
165.00
Predicted Si

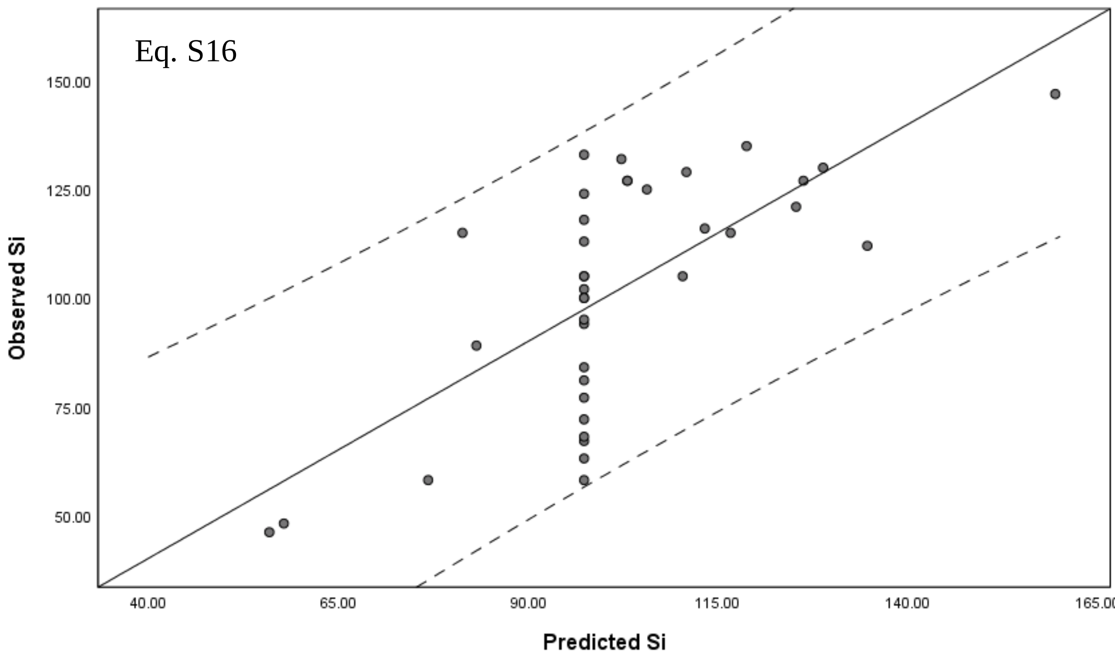
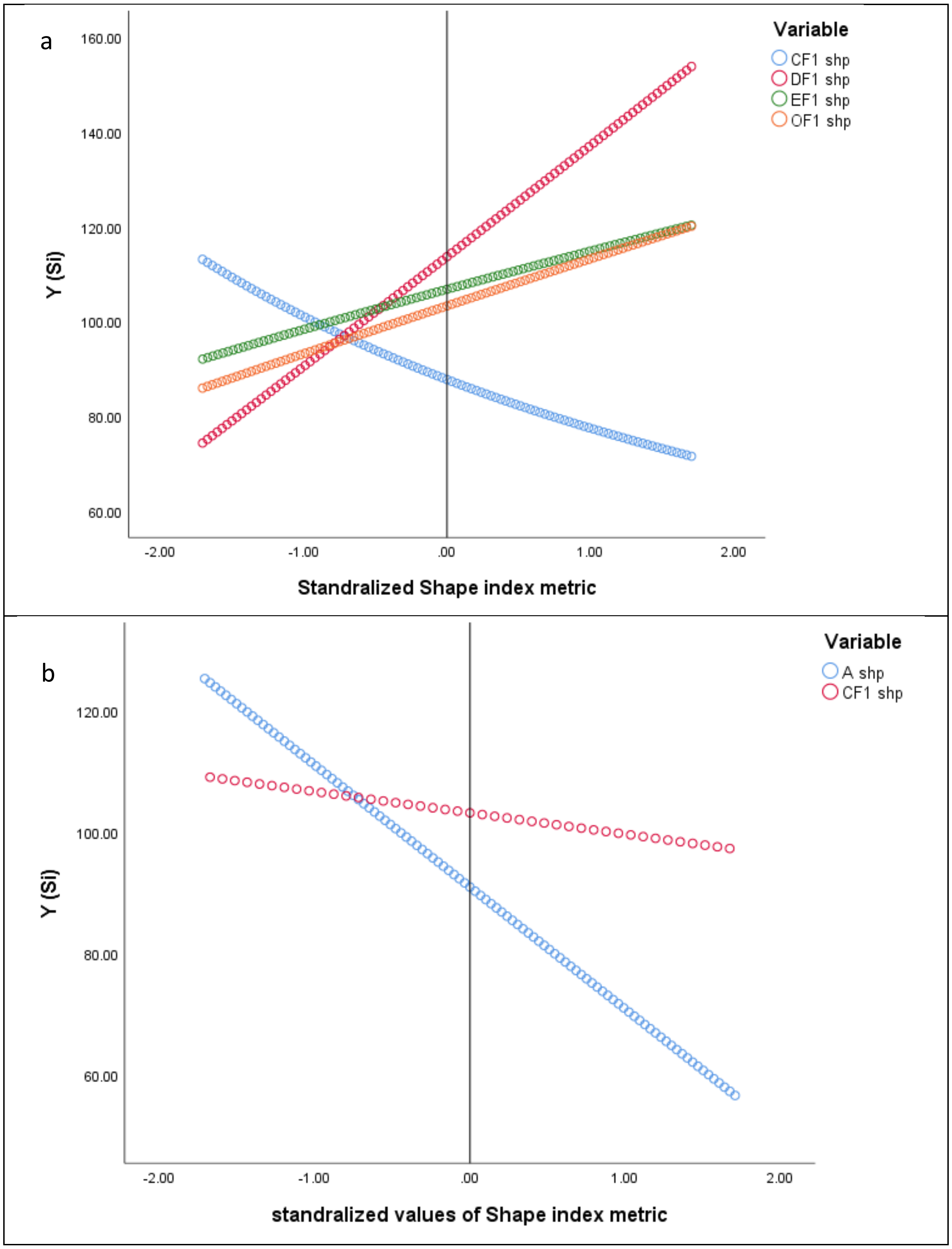


Figure S3: The predicted values to the observed measures of ecological susceptibility prediction models using different landscape metrics.


a
160.00
140.00
120.00
100.00
80.00
60.00
Y (Si)
-2.00
-1.00
.00
1.00
2.00
Standralized Shape index metric
Variable
CF1 shp
DF1 shp
EF1 shp
OF1 shp
b
120.00
100.00
80.00
60.00
Y (Si)
-2.00
-1.00
.00
1.00
2.00
standralized values of Shape index metric
Variable
A shp
CF1 shp

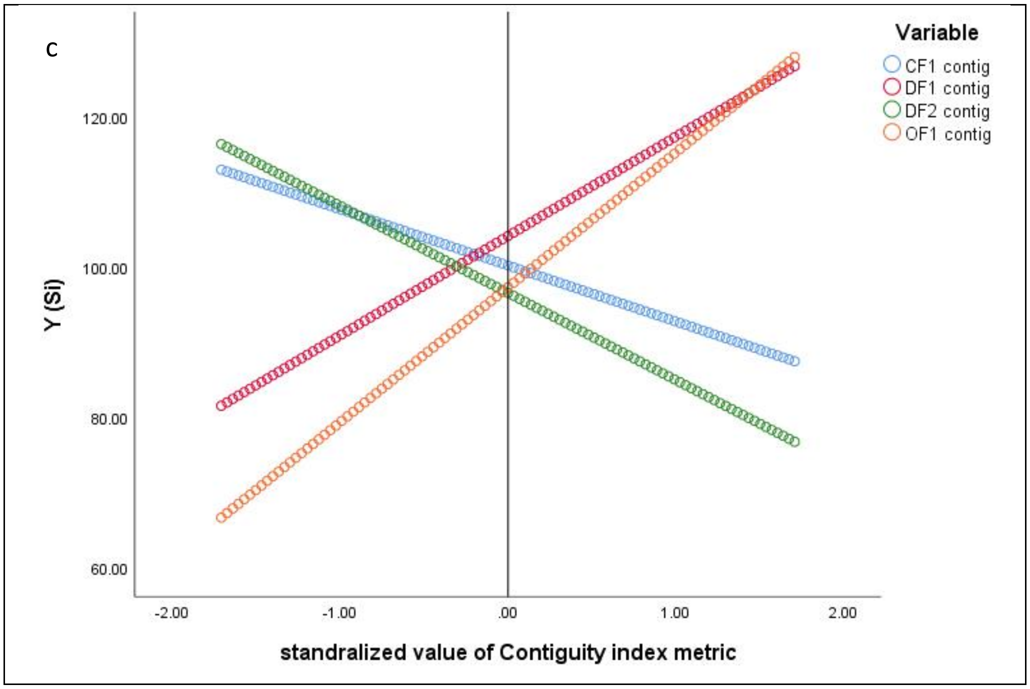
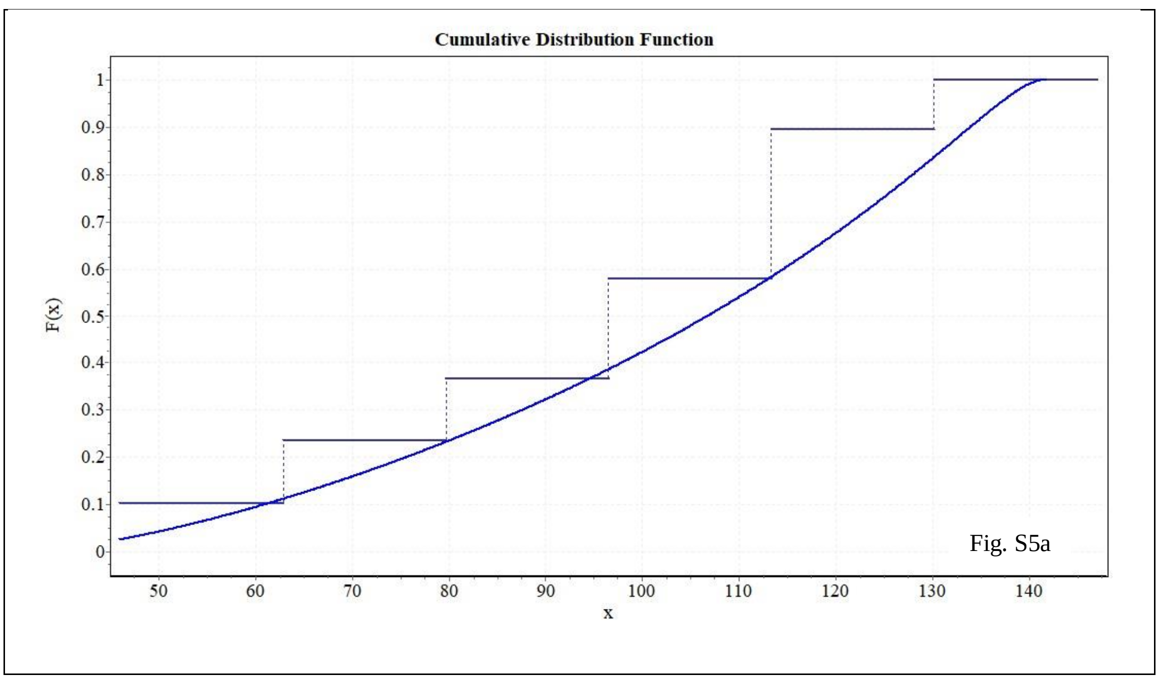
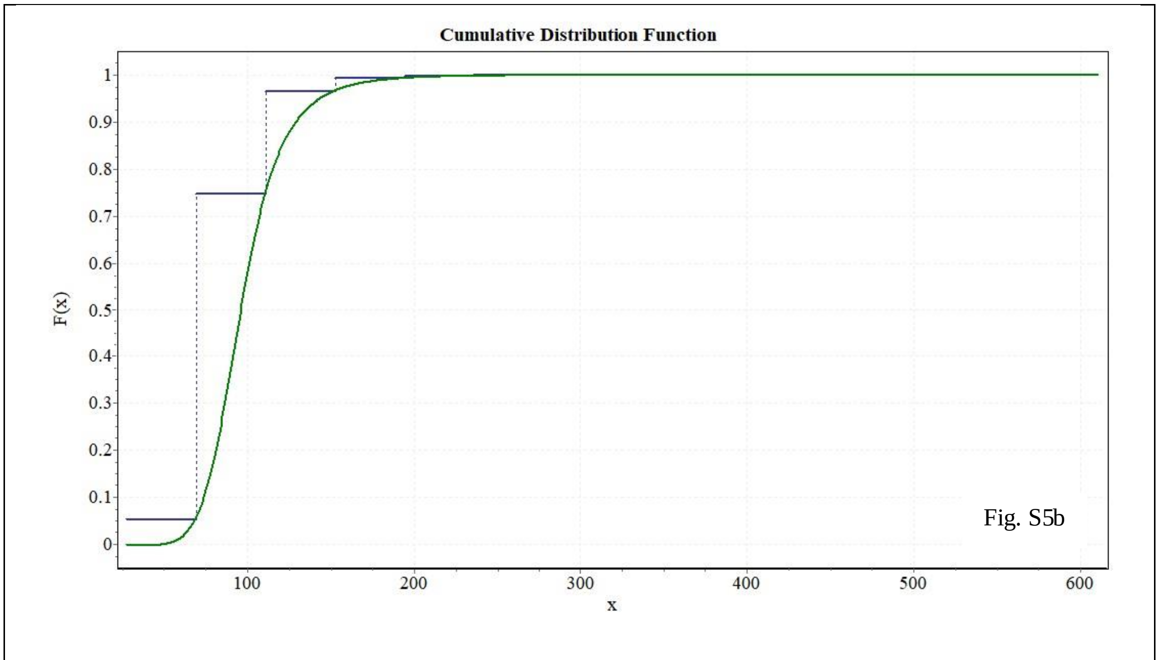
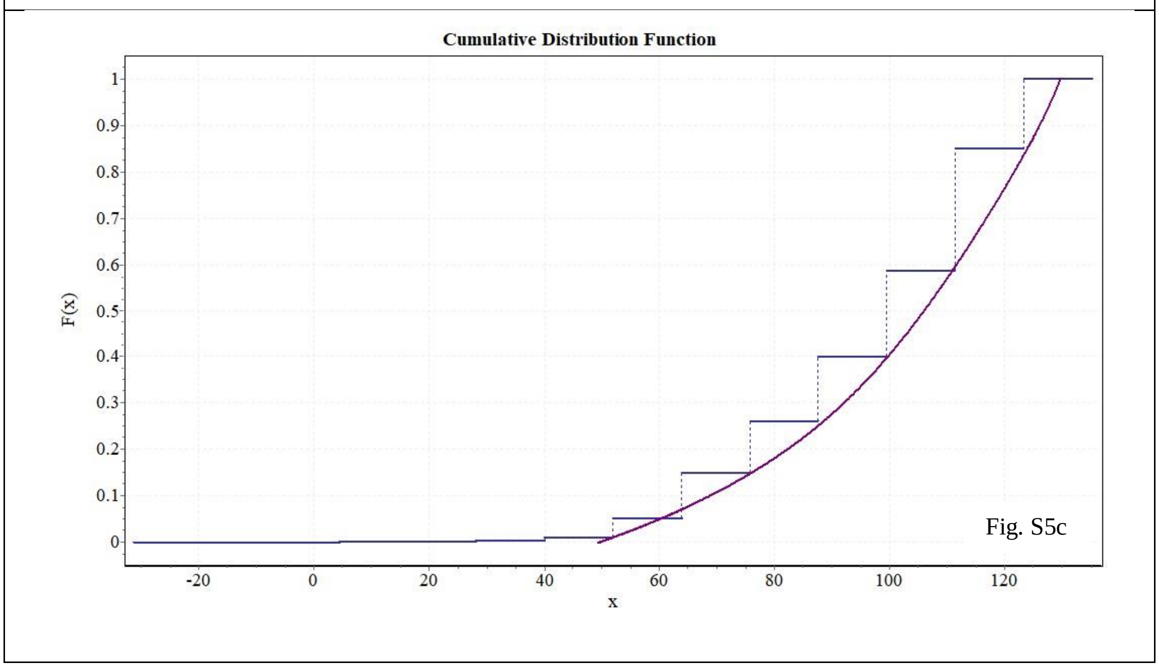


Figure S4: The scatter plots of the measures of independent variables versus the standardized values of the models' responses (a. mean model, b. weighted mean model, and c. median model).




Cumulative Distribution Function
F(x)
x
Fig. S5b


Cumulative Distribution Function
F(x)
x
Fig. S5c

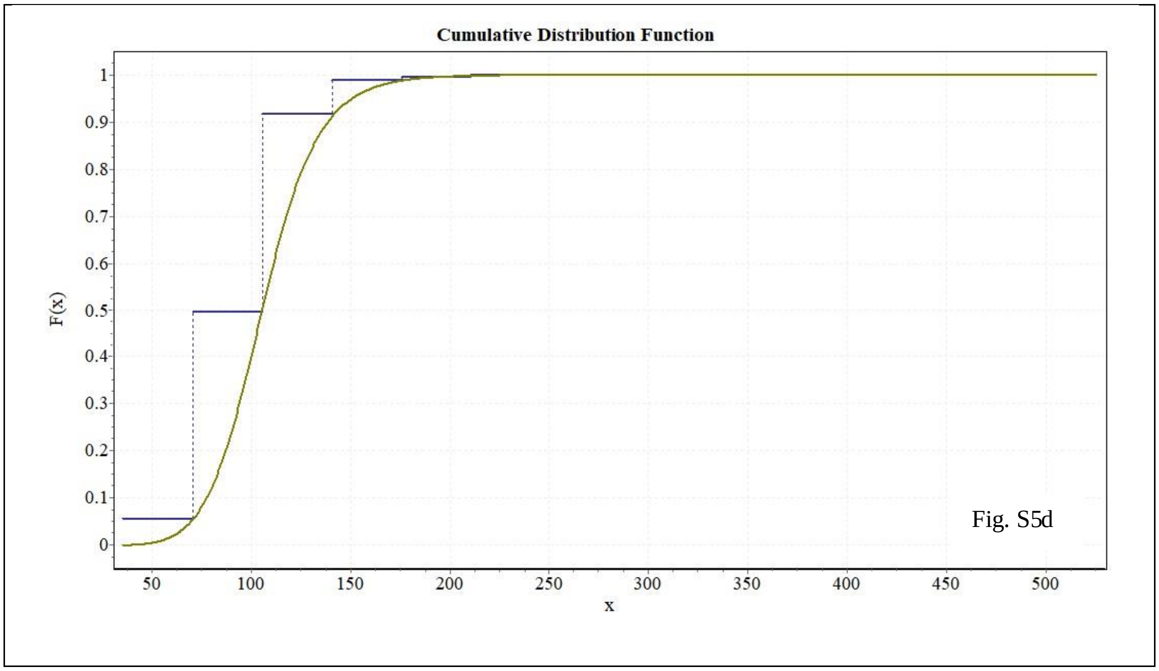


Figure S5: Cumulative distribution function for the observed measures of ecological susceptibility (a), and the simulated measures of the mean (b), weighted average (c), and median (d) landscape metric-based models.