

Global Warming Drives Transitions in Suitable Habitats and Ecological Services of Rare *Tinospora* Miers Species in China

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Figure and Table Legends

Table S1 Average AUC values of training and testing sets for each species

Species	Train data AUC	Test data AUC	Standard deviation
<i>T. craveniana</i>	0.989	0.988	0.005
<i>T. yunnanensis</i>	0.989	0.989	0.003
<i>T. sinensis</i>	0.988	0.983	0.003

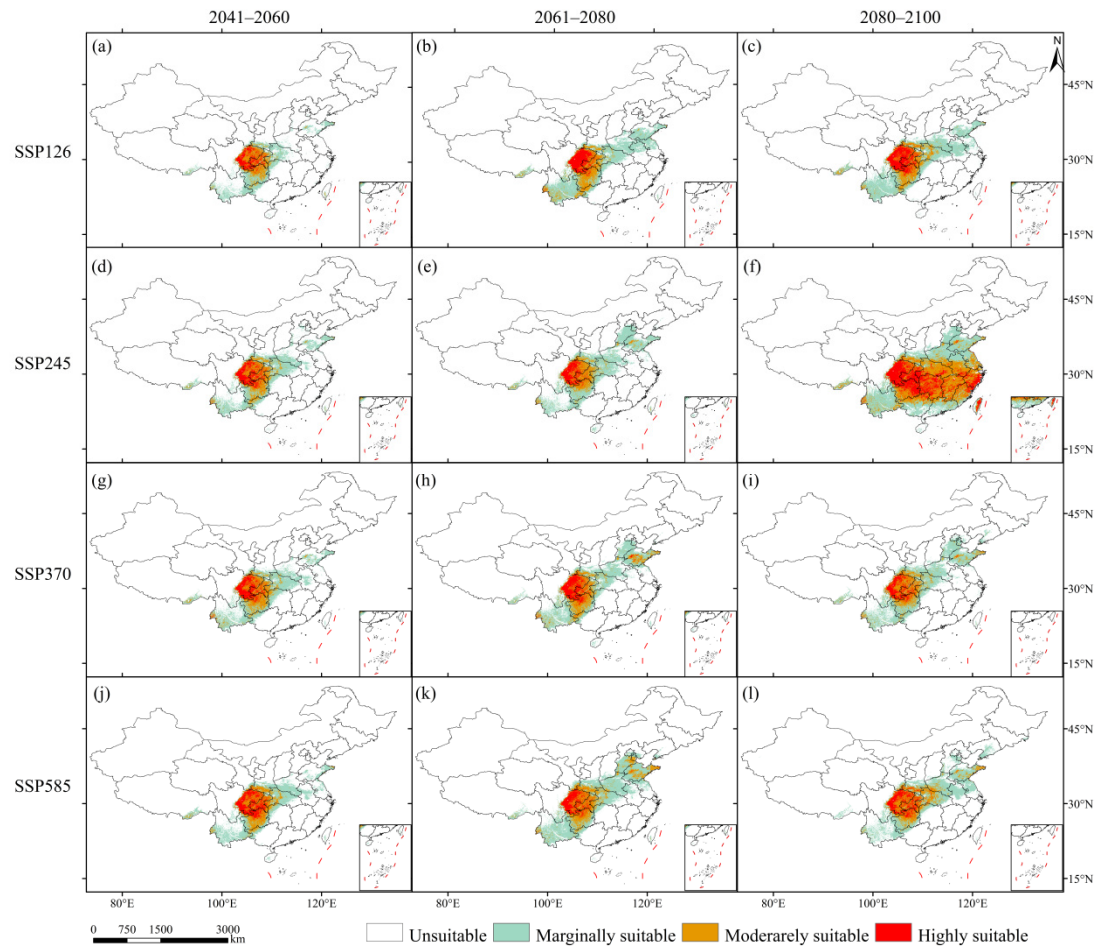


Figure S1, Potential distribution habitats of *T. craveniana* under the future climate scenario

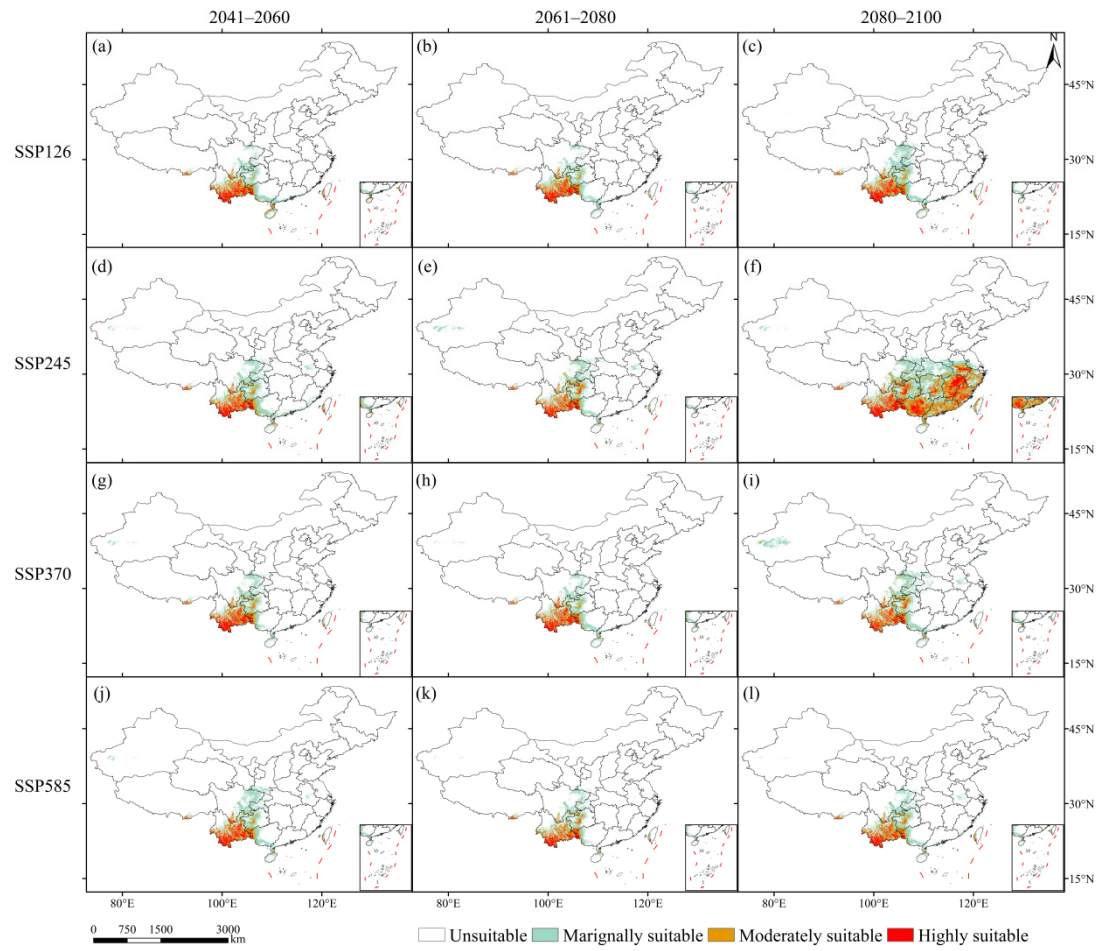


Figure S2, Potential distribution habitats of *T. yunnanensis* under the future climate scenario

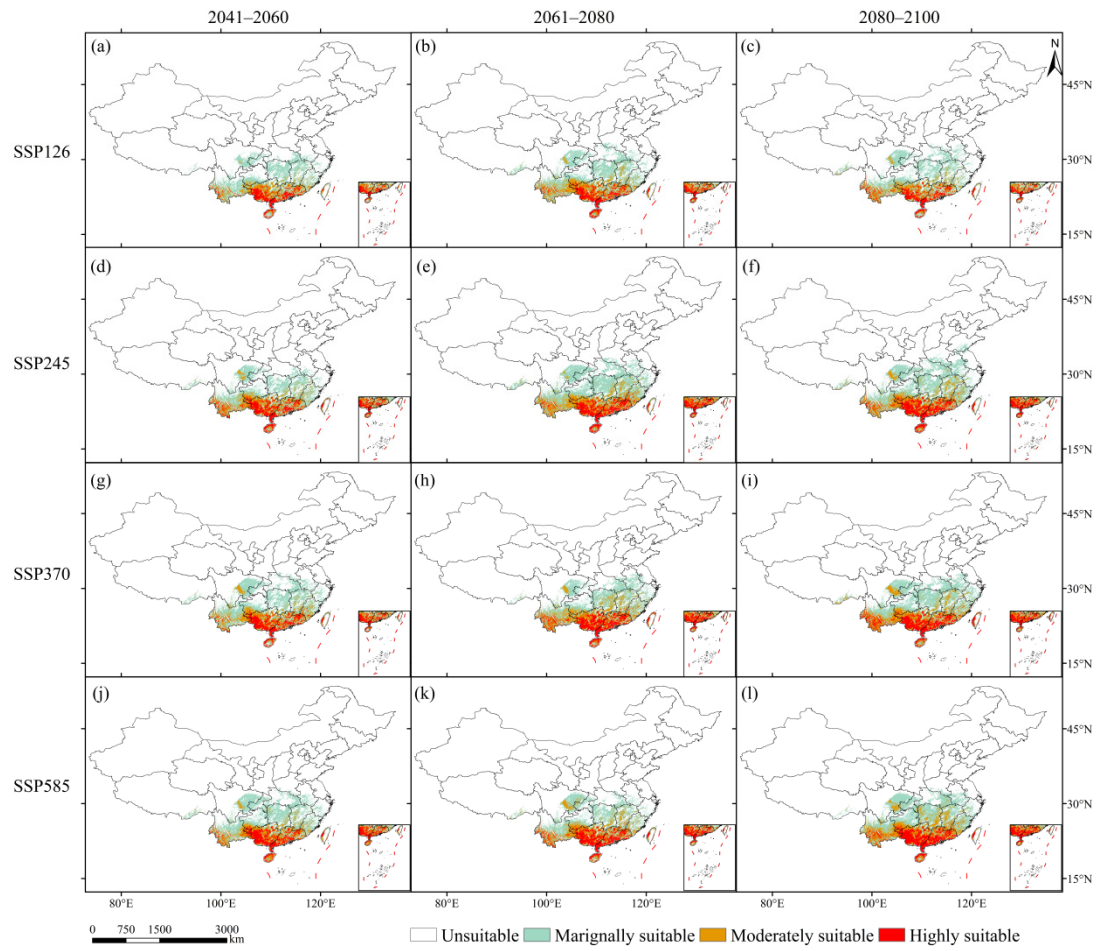


Figure S3, Potential distribution habitats of *T. sinensis* under the future climate scenario

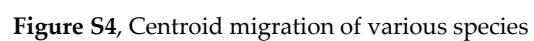


Figure S4, Centroid migration of various species

Table S2 Change of Suitable habitat area ($\times 10^4$ km²) and its ratio (%) for each species

Species	Years	Climate Scenario	Lost		Remain		Gain		Distribution Change Trend
			Area	Ratio	Area	Ratio	Area	Ratio	
<i>Tinospora sagittata</i> var. <i>craveniana</i>	2041-2060	SSP126	30.17	3.14	82.63	8.61	4.74	0.49	Contraction
		SSP245	18.25	1.90	94.55	9.85	19.01	1.98	Expansion
		SSP370	13.15	1.37	99.65	10.38	17.74	1.85	Expansion
		SSP585	15.42	1.61	97.39	10.14	21.42	2.23	Expansion
	2061-2080	SSP126	9.35	0.97	103.46	10.78	32.76	3.41	Expansion
		SSP245	23.87	2.49	88.94	9.26	36.53	3.81	Expansion
		SSP370	16.18	1.69	96.63	10.07	40.07	4.17	Expansion
		SSP585	13.90	1.45	98.90	10.3	61.49	6.40	Expansion
	2081-2100	SSP126	4.59	0.48	108.21	11.27	34.55	3.56	Expansion
		SSP245	0.55	0.057	112.26	11.69	162.72	16.96	Expansion
		SSP370	19.30	2.01	93.50	9.74	43.71	4.55	Expansion
		SSP585	21.97	2.29	90.83	9.46	53.00	5.52	Expansion
<i>Tinospora sagittata</i> var. <i>yunmanensis</i>	2041-2060	SSP126	28.30	2.95	56.13	5.85	0.26	0.027	Contraction
		SSP245	15.69	1.63	68.74	7.16	1.12	0.11	Contraction
		SSP370	24.85	2.59	59.57	6.21	0.73	0.075	Contraction
		SSP585	18.84	1.96	65.59	6.83	0.74	0.076	Contraction
	2061-2080	SSP126	29.91	3.11	54.52	5.68	0.085	8.82*10 ⁻⁵	Contraction
		SSP245	22.68	2.36	61.74	6.43	2.47	0.26	Contraction
		SSP370	27.67	2.88	56.75	5.91	0.50	0.052	Contraction
		SSP585	32.45	3.38	51.97	5.41	0.11	0.012	Contraction
	2081-	SSP126	17.92	1.87	66.50	6.93	0.010	1.06*10 ⁻⁵	Contraction

<i>Tinospora sinensis</i>	2100	SSP245	7.69	0.80	76.76	8.00	111.46	11.61	Expansion
		SSP370	16.43	1.71	68.00	7.08	8.02	0.84	Contraction
		SSP585	22.81	2.38	61.61	6.42	0.20	0.021	Contraction
		SSP126	1.52	0.18	88.45	9.21	27.22	2.84	Expansion
	2041-2060	SSP245	0.45	0.047	89.51	9.32	38.48	4.01	Expansion
		SSP370	0.30	0.030	89.66	9.34	53.00	5.52	Expansion
		SSP585	0.41	0.043	89.55	9.33	51.77	5.39	Expansion
		SSP126	0.26	0.023	89.74	9.35	49.78	5.19	Expansion
	2061-2080	SSP245	0.013	1.43*10 ⁻⁵	89.95	9.37	73.76	7.68	Expansion
		SSP370	0.29	0.030	89.67	9.34	59.94	6.24	Expansion
		SSP585	0.12	0.013	89.84	9.36	45.09	4.70	Expansion
		SSP126	0.43	0.045	89.53	9.33	35.07	3.65	Expansion
	2081-2100	SSP245	0.15	0.015	89.81	9.36	73.29	7.63	Expansion
		SSP370	0	0	89.96	9.37	72.91	7.59	Expansion
		SSP585	0.72	0.075	89.24	9.30	79.46	8.23	Expansion

Table S3 Assessment of the ecological service value of genus *Tinospora* under present climate scenarios (10⁴ CNY).

Value category	<i>Tinospora sagittata</i> var. <i>craveniana</i>	<i>Tinospora sagittata</i> var. <i>yunnanensis</i>	<i>Tinospora sinensis</i>
Economic	24989.88	27005.86	21377.89
Atmospheric regulation	867.15	937.11	741.82
Cultivation	7095.97	8986.16	6070.33
Soil conservation	1955.46	2113.21	1672.82
Tourist	26.78	28.94	22.91
Biodiversity	74.73	80.76	63.93
Total	35009.97	37834.3	29949.7

Table S4. Future ecological service value of species of the *Tinospora* (10⁴ CNY).

Species	Years	Climate Scenario	Economic	Atmospheric regulation	Cultivation	Soil conservation	Tourism	Biodiversity	Total
<i>Tinospora sagittata</i> var. <i>craveniana</i>	2041-2060	SSP126	22742.89	789.18	6457.93	1779.64	24.37	68.01	31862.02
		SSP245	29462.85	1022.37	8366.09	2305.47	31.57	88.11	41276.46
		SSP370	29609.85	1027.47	8407.83	2316.98	31.73	88.55	41482.41
		SSP585	36476.82	1265.75	10537.73	2854.32	9.08	109.08	51252.78
	2061-2080	SSP126	32612.84	1131.67	9260.54	2551.96	34.94	97.53	45689.48
		SSP245	25283.87	877.35	7179.45	1978.47	27.09	75.61	35421.84
		SSP370	34838.83	1205.91	9892.62	2726.15	37.33	104.19	48805.03
		SSP585	29441.85	1021.64	8360.13	2303.83	31.55	88.05	41247.05
	2081-2100	SSP126	40676.80	1411.49	11550.33	3182.97	43.58	121.64	56986.81
		SSP245	115184.42	3996.92	32707.05	9013.21	123.41	344.46	161369.47
		SSP370	25808.87	895.58	7328.53	2019.54	27.65	77.18	36157.35
		SSP585	33074.83	1147.70	9391.73	2588.11	35.44	98.91	46336.72
<i>Tinospora sagittata</i> var. <i>yunnanensis</i>	2041-2060	SSP126	17849.91	619.40	5068.55	1396.76	19.13	53.38	25007.13
		SSP245	18962.91	658.02	5384.59	1483.85	20.32	56.71	26566.4
		SSP370	20831.90	722.87	5915.30	1630.10	22.32	62.30	29184.79
		SSP585	19340.90	671.13	5491.92	1513.43	20.72	57.84	27095.94
	2061-2080	SSP126	17954.91	623.04	5098.37	1404.98	19.24	53.69	25154.23
		SSP245	16820.92	583.69	4776.36	1316.24	18.02	50.30	23565.53
		SSP370	18269.91	633.97	5187.81	1429.62	19.58	54.64	25595.53
		SSP585	10961.95	380.38	3112.69	857.77	11.75	32.78	15357.32
	2081-2100	SSP126	19550.90	678.42	5551.55	1529.86	20.95	58.47	27390.15
		SSP245	61445.69	2132.18	17447.74	4808.14	65.84	183.75	86083.34
		SSP370	16631.92	577.13	4722.70	1301.45	17.82	49.74	23300.76
		SSP585	16190.91	561.83	4597.47	1266.94	17.35	48.42	22682.92

<i>Tinospora sinensis</i>		SSP126	27950.86	969.90	7936.75	2187.16	29.95	83.59	39158.21
	2041-	SSP245	40172.80	1394.00	11407.22	3143.53	43.04	120.13	56280.72
	2060	SSP370	37925.81	1316.03	10769.18	2967.70	40.64	113.42	53132.78
		SSP585	41390.79	1436.27	11753.07	3238.83	44.35	123.79	57987.1
		SSP126	34817.83	1208.18	9886.65	2724.50	37.31	104.12	48778.59
	2061-	SSP245	43910.78	1523.71	12468.63	3436.03	47.05	131.31	61517.51
	2080	SSP370	50168.75	1740.86	14245.61	3925.72	53.75	150.03	70284.72
		SSP585	46871.77	1626.46	13309.42	3667.73	50.22	140.17	65665.77
		SSP126	30764.85	1067.55	8735.80	2407.36	32.96	92.00	43100.52
	2081-	SSP245	48950.76	1698.60	13899.75	3830.41	52.45	146.39	68578.36
	2100	SSP370	52793.74	1831.95	14990.98	4131.12	56.57	157.88	73962.24
		SSP585	55145.72	1913.57	15658.84	4315.16	59.09	164.91	77257.29