

Climate change and topographic variations affect infestation by *Xyleutes ceramica* (Walker, 1865) (Lepidoptera: *Cossidae*) in teak plantations in Thailand

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Electronic Supplementary Material (ESM)

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Table S1. The characteristics of 10 strata based on the scoring from the standardised value of bioclimatic variables (the largest positive value is a maximum value and the largest negative value is a minimum value of each variable) and the number of localities in each stratum

Strata	BIO1	BIO2	BIO3	BIO4	BIO5	BIO6	BIO7	BIO8	BIO9	BIO10
1	−0.161	1.187	−0.621	0.059	0.591	−0.353	1.154	−0.507	0.300	−0.066
2	−0.956	0.635	−0.334	0.386	−0.815	−0.987	0.606	−0.902	−0.867	−0.934
3	−0.067	−1.790	1.619	−2.400	−0.677	0.819	−1.940	−0.551	0.520	−0.366
4	−0.628	0.762	−0.227	1.455	−0.601	−0.872	0.662	−0.065	−1.107	−0.515
5	0.169	0.707	−0.924	0.449	0.656	−0.150	0.921	0.166	0.205	0.264
6	0.213	0.611	0.045	0.384	0.196	−0.140	0.417	0.468	−0.084	0.209
7	−0.733	−1.254	1.134	−1.732	−1.144	0.113	−1.382	−1.203	−0.224	−0.925
8	−2.182	0.598	−0.178	0.587	−2.150	−1.870	0.506	−2.079	−2.050	−2.164
9	1.168	−1.162	0.950	−0.786	0.760	1.380	−1.249	1.007	1.198	1.091
10	0.984	−0.656	−1.284	0.084	1.163	0.821	0.009	0.839	0.866	1.077

Strata	BIO11	BIO12	BIO13	BIO14	BIO15	BIO16	BIO17	BIO18	BIO19	Localities (n)
1	−0.065	−0.294	−0.746	2.834	−1.938	−0.614	3.100	−0.690	2.869	0
2	−0.962	−0.587	−0.754	0.052	−0.692	−0.606	−0.008	0.192	−0.464	0
3	0.630	3.774	3.231	−0.817	2.181	3.691	−0.846	0.178	0.786	1
4	−0.990	0.730	1.386	0.772	1.221	0.971	0.761	1.540	−0.206	1
5	0.055	−0.673	−0.725	0.453	−0.182	−0.652	−0.061	−0.370	−0.354	0
6	0.066	−0.181	−0.226	−0.480	0.012	−0.141	−0.444	0.988	−0.748	2
7	−0.172	1.059	0.511	−0.545	0.149	0.842	−0.404	−0.615	0.781	3
8	−2.112	−0.187	−0.365	0.522	−0.635	−0.224	0.582	0.518	−0.119	1
9	1.225	−0.180	−0.022	−0.592	−0.169	−0.185	−0.338	−0.956	0.039	1
10	0.895	−0.402	−0.106	−0.586	0.766	−0.330	−0.764	−0.808	0.136	1
Total										10

BIO1 – annual mean temperature (°C); BIO2 – mean diurnal range; BIO3 – isothermality (°C); BIO4 – temperature seasonality (°C); BIO5 – maximum temperature in warmest month (°C); BIO6 – minimum temperature in coldest month (°C); BIO7 – annual temperature range (°C); BIO8 – mean temperature during wettest quarter (°C); BIO9 – mean temperature during driest quarter (°C); BIO10 – mean temperature during warmest quarter (°C); BIO11 – mean temperature during coldest quarter (°C); BIO12 – annual precipitation (mm); BIO13 – precipitation in wettest month (mm); BIO14 – precipitation in driest month (mm); BIO15 – precipitation seasonality (%); BIO16 – precipitation during wettest quarter (mm); BIO17 – precipitation during driest quarter (mm); BIO18 – precipitation during warmest quarter (mm); BIO19 – precipitation during coldest quarter (mm)

<https://doi.org/10.17221/15/2025-JFS>Table S2. The pairwise correlation of considered environmental variables used in modelling (Pearson's correlation coefficient threshold; $r = \pm 0.8$)

Variables	<i>SLP</i>	<i>DAH</i>	<i>ELEV</i>	<i>TPI</i>	<i>TWI</i>	<i>BIO1</i>	<i>BIO2</i>	<i>BIO3</i>	<i>BIO4</i>	<i>BIO5</i>	<i>BIO6</i>	<i>BIO7</i>
<i>SLP</i>	1	0.395	0.094	0.054	−0.044	0.083	0.018	0.050	−0.030	−0.041	0.078	−0.043
<i>DAH</i>	0.395	1	0.061	0.060	0.020	−0.078	0.049	−0.016	0.016	−0.064	−0.075	0.044
<i>ELEV</i>	0.094	0.061	1	−0.274	−0.363	−0.968	0.457	−0.218	0.198	−0.722	−0.805	0.434
<i>TPI</i>	0.054	0.060	−0.274	1	0.058	0.288	−0.169	0.069	−0.040	0.230	0.269	−0.156
<i>TWI</i>	−0.044	0.020	−0.363	0.058	1	0.312	−0.205	0.086	−0.073	0.247	0.303	−0.189
<i>BIO1</i>	0.083	−0.078	−0.968	0.288	0.312	1	−0.457	0.120	−0.267	0.621	0.678	−0.391
<i>BIO2</i>	0.018	0.049	0.457	−0.169	−0.205	−0.457	1	−0.479	0.747	−0.164	−0.645	0.936
<i>BIO3</i>	0.050	−0.016	−0.218	0.069	0.086	0.120	−0.479	1	−0.661	−0.191	0.368	−0.752
<i>BIO4</i>	−0.030	0.016	0.198	−0.040	−0.073	−0.267	0.747	−0.661	1	−0.051	−0.586	0.734
<i>BIO5</i>	−0.041	−0.064	−0.722	0.230	0.247	0.621	−0.164	−0.191	−0.051	1	0.642	−0.045
<i>BIO6</i>	0.078	−0.075	−0.805	0.269	0.303	0.678	−0.645	0.368	−0.586	0.642	1	−0.573
<i>BIO7</i>	−0.043	0.044	0.434	−0.156	−0.189	−0.391	0.936	−0.752	0.734	−0.045	−0.673	1
<i>BIO8</i>	−0.034	−0.077	−0.876	0.295	0.312	0.743	−0.271	0.038	0.009	0.687	0.573	−0.222
<i>BIO9</i>	−0.043	−0.068	−0.929	0.235	0.266	0.895	−0.807	0.168	−0.502	0.654	0.937	−0.490
<i>BIO10</i>	−0.039	−0.077	−0.854	0.286	0.307	0.993	−0.384	0.019	−0.163	0.949	0.674	−0.296
<i>BIO11</i>	0.040	−0.073	−0.817	0.263	0.294	0.962	−0.605	0.270	−0.517	0.843	0.776	−0.560
<i>BIO12</i>	0.022	0.006	−0.055	−0.042	0.000	−0.098	−0.360	0.456	−0.430	−0.271	0.107	−0.447
<i>BIO13</i>	0.068	−0.012	−0.209	0.037	0.075	0.025	−0.345	0.390	−0.221	−0.157	0.163	−0.410
<i>BIO14</i>	0.015	0.034	0.411	−0.141	−0.153	−0.337	0.800	−0.297	0.375	−0.091	−0.437	0.555
<i>BIO15</i>	0.036	−0.019	−0.308	0.068	0.097	0.155	−0.290	−0.019	0.718	0.050	0.173	−0.205
<i>BIO16</i>	0.058	0.002	−0.102	−0.022	0.019	−0.075	−0.331	0.413	−0.329	−0.250	0.096	−0.409
<i>BIO17</i>	0.059	0.024	0.370	−0.104	−0.113	−0.296	0.489	−0.102	0.262	−0.112	−0.354	0.409
<i>BIO18</i>	0.031	0.025	0.185	−0.079	−0.090	−0.414	0.525	−0.005	0.539	−0.407	−0.550	0.388
<i>BIO19</i>	0.040	−0.003	0.103	−0.040	−0.017	0.012	−0.165	0.077	−0.316	0.064	0.146	−0.149

Table S2. To be continued

Variables	BIO8	BIO9	BIO10	BIO11	BIO12	BIO13	BIO14	BIO15	BIO16	BIO17	BIO18	BIO19
<i>SLP</i>	−0.034	−0.043	−0.039	0.040	0.022	0.068	0.015	0.036	0.058	0.059	0.031	0.040
<i>DAH</i>	−0.077	−0.068	−0.077	−0.073	0.006	−0.012	0.034	−0.019	0.002	0.024	0.025	−0.003
<i>ELEV</i>	−0.876	−0.929	−0.854	−0.817	−0.055	−0.209	0.411	−0.308	−0.102	0.370	0.185	0.103
<i>TPI</i>	0.295	0.235	0.286	0.263	−0.042	0.037	−0.141	0.068	−0.022	−0.104	−0.079	−0.040
<i>TWI</i>	0.312	0.266	0.307	0.294	0.000	0.075	−0.153	0.097	0.019	−0.113	−0.090	−0.017
<i>BIO1</i>	0.743	0.895	0.993	0.962	−0.098	0.025	−0.337	0.155	−0.075	−0.296	−0.414	0.012
<i>BIO2</i>	−0.271	−0.807	−0.384	−0.605	−0.360	−0.345	0.800	−0.290	−0.331	0.489	0.525	−0.165
<i>BIO3</i>	0.038	0.168	0.019	0.270	0.456	0.390	−0.297	−0.019	0.413	−0.102	−0.005	0.077
<i>BIO4</i>	0.009	−0.502	−0.163	−0.517	−0.430	−0.221	0.375	0.718	−0.329	0.262	0.539	−0.316
<i>BIO5</i>	0.687	0.654	0.949	0.843	−0.271	−0.157	−0.091	0.050	−0.250	−0.112	−0.407	0.064
<i>BIO6</i>	0.573	0.937	0.674	0.776	0.107	0.163	−0.437	0.173	0.096	−0.354	−0.550	0.146
<i>BIO7</i>	−0.222	−0.490	−0.296	−0.560	−0.447	−0.410	0.555	−0.205	−0.409	0.409	0.388	−0.149
<i>BIO8</i>	1	0.665	0.956	0.729	−0.134	0.060	−0.316	0.243	−0.072	−0.287	−0.159	−0.166
<i>BIO9</i>	0.665	1	0.897	0.965	−0.025	−0.010	−0.305	0.052	−0.051	−0.244	−0.614	0.177
<i>BIO10</i>	0.956	0.897	1	0.928	−0.161	−0.017	−0.283	0.150	−0.130	−0.259	−0.397	0.003
<i>BIO11</i>	0.729	0.965	0.928	1	0.030	0.076	−0.387	0.123	0.019	−0.322	−0.631	0.119
<i>BIO12</i>	−0.134	−0.025	−0.161	0.030	1	0.909	−0.087	0.597	0.914	−0.043	0.258	0.209
<i>BIO13</i>	0.060	−0.010	−0.017	0.076	0.909	1	−0.101	0.763	0.853	−0.063	0.333	0.815
<i>BIO14</i>	−0.316	−0.305	−0.283	−0.387	−0.087	−0.101	1	−0.347	−0.810	0.809	0.096	0.722
<i>BIO15</i>	0.243	0.052	0.150	0.123	0.597	0.763	−0.347	1	0.710	−0.655	0.283	−0.256
<i>BIO16</i>	−0.072	−0.051	−0.130	0.019	0.914	0.853	−0.810	0.710	1	−0.088	0.717	0.122
<i>BIO17</i>	−0.287	−0.244	−0.259	−0.322	−0.043	−0.063	0.809	−0.655	−0.088	1	0.090	0.637
<i>BIO18</i>	−0.159	−0.614	−0.397	−0.531	0.258	0.717	0.096	0.283	0.317	0.090	1	−0.346
<i>BIO19</i>	−0.166	0.177	0.003	0.119	0.209	0.815	0.722	−0.256	0.122	0.637	−0.346	1

Bold – Pearson's correlation coefficient above/below the threshold; *BIO1* – annual mean temperature (°C); *BIO2* – mean diurnal range; *BIO3* – isothermality (°C); *BIO4* – temperature seasonality (°C); *BIO5* – maximum temperature in warmest month (°C); *BIO6* – minimum temperature in coldest month (°C); *BIO7* – annual temperature range (°C); *BIO8* – mean temperature during wettest quarter (°C); *BIO9* – mean temperature during driest quarter (°C); *BIO10* – mean temperature during warmest quarter (°C); *BIO11* – mean temperature during coldest quarter (°C); *BIO12* – annual precipitation (mm); *BIO13* – precipitation in wettest month (mm); *BIO14* – precipitation in driest month (mm); *BIO15* – precipitation seasonality (%); *BIO16* – precipitation during wettest quarter (mm); *BIO17* – precipitation during driest quarter (mm); *BIO18* – precipitation during warmest quarter (mm); *BIO19* – precipitation during coldest quarter (mm); *DAH* – diurnal anisotropic heat; *ELEV* – elevation; *SLP* – slope (%); *TPI* – topographic position index; *TWI* – topographic wetness index

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Table S3. Relative average contribution and relative permutation importance of environmental variables in the preliminary MaxEnt model (the average relative contribution and relative permutation importance were derived from 30 replicates)

Variables	Average contribution (%)	Average permutation importance (%)
<i>BIO4</i>	38.5	26.3
<i>BIO15</i>	17.7	8.2
<i>BIO1</i>	11.0	16.1
<i>BIO7</i>	6.4	10.4
<i>BIO18</i>	4.3	6.0
<i>BIO6</i>	3.9	5.8
<i>BIO5</i>	3.5	3.4
<i>BIO3</i>	3.0	4.5
<i>DAH</i>	2.5	5.2
<i>BIO19</i>	2.3	2.9
<i>SLP</i>	2.1	2.3
<i>TPI</i>	1.5	2.6
<i>BIO12</i>	1.3	1.6
<i>BIO17</i>	1.1	4.0
<i>TWI</i>	0.9	0.7

BIO1 – annual mean temperature (°C); *BIO3* – isothermality (°C); *BIO4* – temperature seasonality (°C); *BIO5* – maximum temperature in warmest month (°C); *BIO6* – minimum temperature in coldest month (°C); *BIO7* – annual temperature range (°C); *BIO12* – annual precipitation (mm); *BIO15* – precipitation seasonality (%); *BIO17* – precipitation during driest quarter (mm); *BIO18* – precipitation during warmest quarter (mm); *BIO19* – precipitation during coldest quarter (mm); *DAH* – diurnal anisotropic heat; *SLP* – slope (%); *TPI* – topographic position index; *TWI* – topographic wetness index