

## Supporting information

**Table S1.** The native and invasive ranges of 10 study aquatic plant invaders

Name	Family	Native ranges	Invasive ranges
<i>Alternanthera philoxeroides</i>	Amaranthaceae	Argentina, Bolivia, Brazil, Paraguay, Peru, Venezuela	Australia, China, France, Indonesia, Italy, New Zealand, United States
<i>Ceratophyllum demersum</i>	Ceratophyllaceae	United Kingdom, United States	Burkina Faso, China, Finland, New Zealand, Norway, Sweden
<i>Crassula helmsii</i>	Crassulaceae	Australia	Belgium, Denmark, France, Germany, Ireland, Netherlands, United Kingdom
<i>Elodea canadensis</i>	Hydrocharitaceae	United States	Australia, Austria, Denmark, Finland, France, Germany, Mexico, New Zealand, Norway, Poland, Portugal, Russia, South Africa, Spain, Sweden, Switzerland
<i>Hydrilla verticillata</i>	Hydrocharitaceae	India, South Korea	New Zealand, United States
<i>Ludwigia peruviana</i>	Onagraceae	Argentina, Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Venezuela	Australia, Dominican Republic, Indonesia, Puerto Rico, United States
<i>Najas minor</i>	Hydrocharitaceae	Austria, Belgium, France, Germany, India, Italy, Japan, Poland, Portugal, Russia, Ukraine	Canada, United States
<i>Pistia stratiotes</i>	Araceae	Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, Suriname, Venezuela,	Australia, Burkina Faso, Papua New Guinea, Puerto Rico, United States
<i>Potamogeton crispus</i>	Potamogetonaceae	Australia, Colombia	Canada, New Zealand, United States
<i>Sagittaria platyphylla</i>	Alismataceae	Mexico, Panama, United States	Australia, Georgia, New Zealand

**Table S2.** Summary of bioclimatic variables that were used as bioclimatic layers of Maxent modeling

Code	Environmental variables	Unit
Bio1	Annual mean temperature	°C
Bio2	Mean diurnal range	°C
Bio4	Temperature seasonality	SD*100
Bio8	Mean temperature of the wettest quarter	°C
Bio12	Annual precipitation	mm
Bio14	Precipitation of the driest month	mm
Bio15	Precipitation seasonality	CV*
Bio18	Precipitation of the warmest quarter	mm

\*CV represents coefficient of variation; SD represents standard deviation.

**Table S3.** The training omission rate for all 10 aquatic plant invaders.

Species		1	2	3	4	5	6	7	8
<i>Alternanthera philoxeroides</i>	Native	0.052	0.052	0.052	0.086	0.052	0.052	0.052	0.052
	Invasive	0.040	0.040	0.060	0.096	0.050	0.050	0.040	0.050
<i>Ceratophyllum demersum</i>	Native	0.019	0.025	0.077	0.100	0.070	0.019	0.019	0.019
	Invasive	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.115
<i>Crassula helmsii</i>	Native	0.048	0.048	0.063	0.099	0.051	0.051	0.048	0.048
	Invasive	0.020	0.044	0.092	0.100	0.076	0.021	0.020	0.020
<i>Eloдея canadensis</i>	Native	0.000	0.028	0.049	0.098	0.045	0.028	0.000	0.028
	Invasive	0.000	0.034	0.074	0.100	0.083	0.037	0.000	0.025
<i>Hydrilla verticillata</i>	Native	0.000	0.016	0.047	0.094	0.016	0.016	0.000	0.016
	Invasive	0.010	0.010	0.039	0.098	0.020	0.010	0.000	0.010
<i>Ludwigia peruviana</i>	Native	0.003	0.020	0.048	0.098	0.048	0.003	0.000	0.020
	Invasive	0.031	0.031	0.063	0.094	0.031	0.031	0.031	0.047
<i>Najas minor</i>	Native	0.004	0.030	0.068	0.098	0.030	0.008	0.004	0.008
	Invasive	0.000	0.019	0.066	0.094	0.019	0.000	0.000	0.019
<i>Pistia stratiotes</i>	Native	0.000	0.028	0.047	0.094	0.028	0.009	0.000	0.028
	Invasive	0.037	0.043	0.056	0.099	0.049	0.043	0.037	0.043
<i>Potamogeton crispus</i>	Native	0.000	0.027	0.079	0.098	0.041	0.022	0.000	0.019
	Invasive	0.000	0.029	0.060	0.098	0.044	0.029	0.000	0.025
<i>Sagittaria platyphylla</i>	Native	0.012	0.025	0.037	0.099	0.025	0.012	0.012	0.025
	Invasive	0.000	0.019	0.047	0.094	0.019	0.019	0.000	0.019
Mean		0.014	0.028	0.056	0.092	0.040	0.023	0.013	0.032
SD		0.018	0.013	0.019	0.021	0.021	0.016	0.018	0.023

1: Fixed cumulative value 1 training omission; 2: Fixed cumulative value 5 training omission; 3: Fixed cumulative value 10 training omission; 4: 10 percentile training presence training omission; 5: Equal training sensitivity and specificity training omission; 6: Maximum training sensitivity plus specificity training omission; 7: Balance training omission, predicted area and threshold value training omission; 8: Equate entropy of thresholded and original distributions training omission; SD represents standard deviation.

**Table S4.** Climatic niche overlap of all 10 aquatic plant invaders between native and invasive models across 12 freshwater biomes on the global scale.

Species		1	2	3	4	5	6	7	8	9	10	11	12
<i>Alternanthera philoxeroides</i>	D	0.554	0.621	0.294	0.780	0.947	0.596	0.534	0.464	0.606	0.604	0.700	0.561
	I	0.861	0.886	0.647	0.950	0.989	0.853	0.829	0.790	0.841	0.873	0.933	0.837
<i>Ceratophyllum demersum</i>	D	0.579	1.000	0.307	0.731	0.603	0.443	0.441	0.568	0.399	0.693	0.847	0.321
	I	0.851	1.000	0.622	0.933	0.853	0.767	0.753	0.836	0.750	0.901	0.969	0.660
<i>Crassula helmsii</i>	D	1.000	1.000	1.000	1.000	0.790	0.463	0.353	1.000	0.445	1.000	1.000	0.397
	I	1.000	1.000	1.000	1.000	0.929	0.764	0.655	1.000	0.787	1.000	1.000	0.763
<i>Elodea canadensis</i>	D	0.593	1.000	0.708	0.498	0.318	0.565	0.434	0.631	0.715	1.000	0.937	0.502
	I	0.815	1.000	0.927	0.825	0.625	0.840	0.745	0.858	0.932	1.000	0.995	0.824
<i>Hydrilla verticillata</i>	D	0.639	1.000	0.188	0.301	0.663	0.312	0.356	0.485	0.659	0.467	0.548	0.428
	I	0.893	1.000	0.528	0.558	0.892	0.621	0.710	0.811	0.872	0.757	0.844	0.727
<i>Ludwigia peruviana</i>	D	0.543	0.488	0.483	0.486	0.603	0.500	0.537	0.779	0.427	0.575	0.405	0.262
	I	0.819	0.772	0.774	0.774	0.850	0.790	0.796	0.950	0.724	0.840	0.700	0.567
<i>Najas minor</i>	D	0.595	1.000	0.530	0.527	0.445	0.178	0.144	0.385	0.351	0.454	0.546	0.502
	I	0.844	1.000	0.827	0.832	0.743	0.473	0.416	0.658	0.664	0.782	0.846	0.793
<i>Pistia stratiotes</i>	D	0.242	0.708	0.542	0.633	0.776	0.555	0.514	0.663	0.618	0.710	0.667	0.527
	I	0.578	0.925	0.829	0.878	0.876	0.816	0.820	0.913	0.879	0.933	0.919	0.791
<i>Potamogeton crispus</i>	D	0.466	1.000	0.817	0.794	0.568	0.464	0.382	0.691	0.689	0.858	0.746	0.536
	I	0.757	1.000	0.976	0.972	0.852	0.775	0.704	0.901	0.914	0.985	0.957	0.792
<i>Sagittaria platyphylla</i>	D	0.731	1.000	0.866	0.572	0.733	0.310	0.226	0.735	0.430	1.000	0.780	0.241
	I	0.933	1.000	0.971	0.858	0.936	0.633	0.551	0.918	0.736	1.000	0.969	0.544

D represents Schoener's D for APIs between native and invasive models on both native and invasive ranges; I represents the measure derived from Hellinger distance called *I* based on both the native and invasive ranges.

**Table S5.** Numerical data of climatic suitability for all 10 aquatic plant invaders in the native ranges based on freshwater biomes

Species		1	2	3	4	5	6	7	8	9	10	11	12
<i>Alternanthera philoxeroides</i>	C <sub>Native</sub>	0.227	0.071	0.103	0.000	0.000	0.150	0.408	0.000	0.232	0.176	0.175	0.020
	C <sub>Invasive</sub>	0.050	0.049	0.033	0.000	0.000	0.166	0.318	0.000	0.092	0.079	0.085	0.055
<i>Ceratophyllum demersum</i>	C <sub>Native</sub>	0.494	0.000	0.000	0.466	0.178	0.428	0.503	0.488	0.366	0.000	0.000	0.444
	C <sub>Invasive</sub>	0.123	0.000	0.000	0.432	0.090	0.102	0.071	0.036	0.034	0.000	0.000	0.041
<i>Crassula helmsii</i>	C <sub>Native</sub>	0.000	0.000	0.000	0.000	0.000	0.566	0.276	0.000	0.106	0.000	0.000	0.069
	C <sub>Invasive</sub>	0.000	0.000	0.000	0.000	0.000	0.080	0.010	0.000	0.010	0.000	0.000	0.004
<i>Elodea canadensis</i>	C <sub>Native</sub>	0.396	0.000	0.000	0.062	0.015	0.335	0.436	0.420	0.078	0.000	0.000	0.298
	C <sub>Invasive</sub>	0.143	0.000	0.000	0.531	0.020	0.154	0.087	0.100	0.199	0.000	0.000	0.043
<i>Hydrilla verticillata</i>	C <sub>Native</sub>	0.000	0.000	0.003	0.010	0.000	0.583	0.000	0.000	0.018	0.082	0.157	0.000
	C <sub>Invasive</sub>	0.000	0.000	0.044	0.081	0.000	0.180	0.000	0.000	0.092	0.045	0.071	0.000
<i>Ludwigia peruviana</i>	C <sub>Native</sub>	0.298	0.146	0.282	0.387	0.000	0.067	0.164	0.001	0.350	0.238	0.344	0.087
	C <sub>Invasive</sub>	0.140	0.041	0.083	0.473	0.000	0.119	0.219	0.000	0.124	0.091	0.109	0.004
<i>Najas minor</i>	C <sub>Native</sub>	0.001	0.000	0.029	0.052	0.001	0.089	0.097	0.000	0.017	0.007	0.019	0.000
	C <sub>Invasive</sub>	0.001	0.000	0.022	0.006	0.000	0.030	0.012	0.002	0.005	0.009	0.024	0.001
<i>Pistia stratiotes</i>	C <sub>Native</sub>	0.392	0.219	0.190	0.739	0.000	0.063	0.260	0.000	0.385	0.392	0.344	0.042
	C <sub>Invasive</sub>	0.124	0.066	0.093	0.228	0.000	0.160	0.418	0.000	0.203	0.206	0.177	0.125
<i>Potamogeton crispus</i>	C <sub>Native</sub>	0.205	0.000	0.095	0.000	0.000	0.491	0.521	0.000	0.385	0.085	0.161	0.276
	C <sub>Invasive</sub>	0.088	0.000	0.077	0.000	0.000	0.465	0.284	0.000	0.099	0.069	0.092	0.157
<i>Sagittaria platyphylla</i>	C <sub>Native</sub>	0.028	0.000	0.000	0.096	0.001	0.169	0.141	0.108	0.168	0.000	0.190	0.022
	C <sub>Invasive</sub>	0.007	0.000	0.000	0.299	0.004	0.033	0.020	0.010	0.099	0.000	0.164	0.006

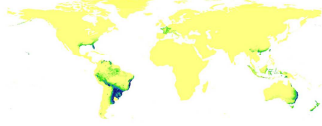
1: large lakes; 2: large river deltas; 3: montane freshwaters; 4: oceanic islands; 5: polar freshwaters; 6: temperate coastal rivers; 7: temperate floodplain rivers and wetlands; 8: temperate upland rivers; 9: tropical and subtropical coastal rivers; 10: tropical and subtropical floodplain rivers and wetland complexes; 11: tropical and subtropical upland rivers; 12: xeric freshwaters and endorheic (closed) basins. C<sub>Native</sub> and C<sub>Invasive</sub> represent the climatic suitability based on native and invasive models. Other codes were the same as Fig. 1.

**Table S6.** Numerical data of climatic suitability for all 10 aquatic plant invaders in the invasive ranges based on freshwater biomes

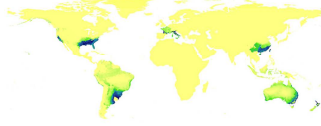
Species		1	2	3	4	5	6	7	8	9	10	11	12
<i>Alternanthera philoxeroides</i>	C <sub>Native</sub>	0.001	0.000	0.002	0.195	0.003	0.075	0.035	0.005	0.147	0.119	0.025	0.007
	C <sub>Invasive</sub>	0.004	0.000	0.021	0.080	0.003	0.213	0.106	0.053	0.181	0.230	0.055	0.051
<i>Ceratophyllum demersum</i>	C <sub>Native</sub>	0.175	0.000	0.112	0.000	0.172	0.427	0.113	0.153	0.108	0.076	0.080	0.000
	C <sub>Invasive</sub>	0.596	0.000	0.049	0.000	0.428	0.387	0.028	0.008	0.132	0.266	0.190	0.000
<i>Crassula helmsii</i>	C <sub>Native</sub>	0.000	0.000	0.000	0.000	0.027	0.256	0.134	0.000	0.000	0.000	0.000	0.000
	C <sub>Invasive</sub>	0.000	0.000	0.000	0.000	0.404	0.321	0.337	0.000	0.000	0.000	0.000	0.000
<i>Elodea canadensis</i>	C <sub>Native</sub>	0.037	0.000	0.210	0.006	0.018	0.168	0.119	0.057	0.055	0.000	0.080	0.044
	C <sub>Invasive</sub>	0.111	0.000	0.169	0.450	0.025	0.256	0.237	0.046	0.131	0.000	0.258	0.048
<i>Hydrilla verticillata</i>	C <sub>Native</sub>	0.026	0.000	0.000	0.002	0.011	0.014	0.034	0.026	0.048	0.000	0.000	0.008
	C <sub>Invasive</sub>	0.050	0.000	0.000	0.424	0.013	0.278	0.161	0.169	0.485	0.000	0.000	0.130
<i>Ludwigia peruviana</i>	C <sub>Native</sub>	0.010	0.000	0.391	0.356	0.003	0.046	0.014	0.009	0.187	0.219	0.390	0.008
	C <sub>Invasive</sub>	0.012	0.000	0.032	0.126	0.011	0.082	0.052	0.023	0.124	0.061	0.009	0.002
<i>Najas minor</i>	C <sub>Native</sub>	0.004	0.000	0.000	0.099	0.001	0.006	0.006	0.005	0.020	0.000	0.000	0.006
	C <sub>Invasive</sub>	0.067	0.000	0.000	0.016	0.000	0.063	0.134	0.142	0.134	0.000	0.000	0.011
<i>Pistia stratiotes</i>	C <sub>Native</sub>	0.005	0.000	0.147	0.278	0.003	0.043	0.021	0.008	0.229	0.113	0.233	0.010
	C <sub>Invasive</sub>	0.123	0.000	0.162	0.217	0.015	0.239	0.169	0.160	0.390	0.334	0.418	0.113
<i>Potamogeton crispus</i>	C <sub>Native</sub>	0.004	0.000	0.000	0.236	0.001	0.030	0.017	0.009	0.414	0.000	0.000	0.020
	C <sub>Invasive</sub>	0.194	0.000	0.000	0.196	0.006	0.142	0.232	0.268	0.144	0.000	0.000	0.283
<i>Sagittaria platyphylla</i>	C <sub>Native</sub>	0.000	0.000	0.017	0.000	0.000	0.082	0.022	0.000	0.069	0.000	0.000	0.010
	C <sub>Invasive</sub>	0.000	0.000	0.023	0.000	0.000	0.316	0.156	0.000	0.113	0.000	0.000	0.026

1: large lakes; 2: large river deltas; 3: montane freshwaters; 4: oceanic islands; 5: polar freshwaters; 6: temperate coastal rivers; 7: temperate floodplain rivers and wetlands; 8: temperate upland rivers; 9: tropical and subtropical coastal rivers; 10: tropical and subtropical floodplain rivers and wetland complexes; 11: tropical and subtropical upland rivers; 12: xeric freshwaters and endorheic (closed) basins. C<sub>Native</sub> and C<sub>Invasive</sub> represent the climatic suitability based on native and invasive models. Other codes were the same as Fig. 1.

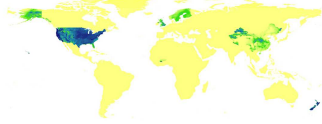
(a) **Native model**



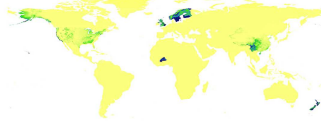
(b) **Invasive model**



(c)



(d)



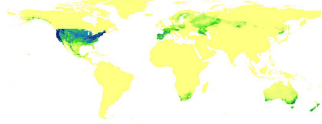
(e)



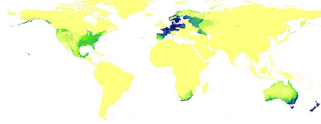
(f)



(g)



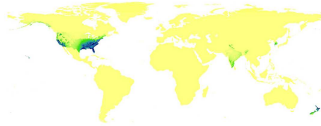
(h)



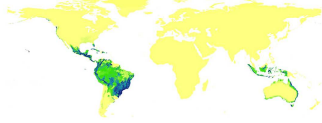
(i)



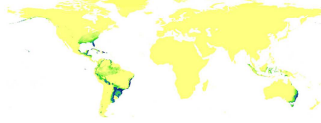
(j)



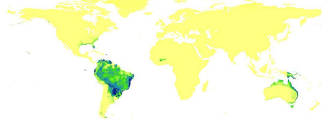
(k)



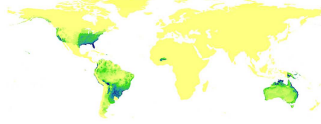
(l)



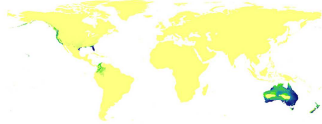
(m)



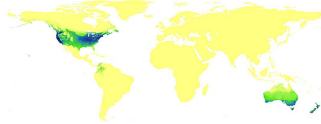
(n)



(o)



(p)



(q)



(r)



**Fig. S1.** The climatic suitability maps based on native and invasive models for *Alternanthera philoxeroides* (a, b); *Ceratophyllum demersum* (c, d); *Crassula helmsii* (e, f); *Elodea Canadensis* (g, h); *Hydrilla verticillata* (i, j); *Ludwigia peruviana* (k, l); *Pistia stratiotes* (m, n); *Potamogeton crispus* (o, p); *Sagittaria platyphylla* (q, r).