

Spawning site selection and segregation at the landscape, habitat and microhabitat scales for five syntopic Asian amphibians

Johanna Ambu¹, Desiree Andersen², Amaël Borzée^{1,*}

1 - Laboratory of Animal Behaviour and Conservation, College of Biology and the Environment,
Nanjing Forestry University, Nanjing 210037, China

2 - Division of EcoScience, Ewha Womans University, Seoul 03760, Republic of Korea

*Corresponding author; e-mail: amaelborzee@gmail.com

ORCID iDs: Ambu: 0000-0002-8072-7677; Borzée: 0000-0003-1093-677X

Supplementary material

Table S1. Coordinates of the occurrence data used in the study and associate raw data of habitat (Republic of Korea, February to March 2020). Species absence and presence are binary encoded by 0 and 1 respectively. Species names are abbreviated such as: “Bs” for *Bufo sachalinensis*, “Ru” for *Rana uenoi*, “Rc” for *Rana coreana*, “Rh” for *Rana huanrenensis*, and “Hy” for *Hynobius* sp.

Latitude	Longitude	Bs	Ru	Rc	Rh	Hy	Elevation (m)	pH	Conductivity (μ S/m)	Total dissolved solids (mg/L)	Salinity (mg/L)	Surface (m ²)	Water depth (cm)	Distance to dirt road (m)	Distance to large road (m)	Distance to forest (m)	Vegetation cover (%)
35.181851	126.541723	0	1	0	0	1	138	8.1	151.5	107	14.3	32.13	46	12	46	0.001	10
35.174015	126.53742	0	1	0	0	0	131	8.1	208	148	94.5	1134	25	6	3	30	0.1
35.177379	126.525551	0	1	0	0	0	87	7.32	127	91.6	64.8	5925	10	24	300	0.001	0.1
35.177498	126.523967	0	1	0	0	1	87	7.27	150	74.2	106	424.2	70	4	145	0.001	30
34.615056	126.718434	0	1	0	0	0	88	8.03	70.3	49.5	33.6	67.6	5	0.001	460	10	10
34.440496	126.636956	0	1	1	0	0	72	7.52	90.9	63.7	41.1	126	8	17	370	75	100
34.798258	127.32988	0	1	0	0	0	75	9.65	65.2	46.5	30.9	7.41	3.6	0.001	250	40	0.1
34.991198	127.364433	0	0	0	0	0	147	7.6	19.08	136	95.8	203	18	25	50	55	100
35.098458	128.209184	0	0	0	0	0	54	7.42	123.9	87.7	60.1	11040	>150	10	200	0.001	20
34.813402	128.620469	0	1	0	0	0	24	6.69	136.9	97.4	70.3	0.38	4	22	70	0.001	90
35.317063	128.627252	0	1	1	0	0	52	7.11	104.3	74.8	53.4	2975	15	3	130	9	0.1
35.29137	128.673047	0	0	0	0	0	32	6.65	173.8	124	90.4	5460	>150	6	245	75	10
35.290928	128.673153	0	0	0	0	0	16	6.17	160.7	113	79.7	11.13	4	15	250	135	100
35.100171	128.316759	0	0	0	0	0	107	7.55	102.5	73	52.4	71.4	57	4	170	0.001	30
35.1818	126.540889	1	0	0	0	0	138	6.46	147.4	82.4	51.1	17500	>150	2	2	0.001	0.1
34.767518	126.764794	0	0	0	0	0	174	6.95	63.5	45.5	3.5	500	>150	80	70	15	20
34.44127	126.636165	0	1	0	0	0	105	6.29	89.7	64.5	43.7	9.66	15	17	480	2	80
34.799665	127.328626	0	0	0	0	0	106	6.98	66.4	47.1	31.8	21000	>150	5	285	0.001	0.1
34.799343	127.330545	0	1	1	0	0	75	6.69	82.3	58.2	39.8	450	5	4	340	40	100
34.988748	127.361206	0	1	0	0	0	115	6.79	114.3	66	44.4	4.3	4	7	8	17	100
34.991481	127.364396	1	1	0	0	0	147	7.77	223	158	10	105	70	13	30	50	50
35.146963	127.686222	1	0	1	0	0	6	7.28	126.5	90.6	58.3	3300	45	30	50	0.001	80
35.104341	127.756005	0	1	0	0	0	107	7.49	99.7	73.7	52.1	14.4	2.5	3	55	8	90
35.100495	127.767287	1	0	0	0	0	59	7.97	94.8	68.1	45.9	3500	>150	2	15	10	10
35.099747	128.317398	0	1	1	0	0	83	7.82	67.1	48.1	32.4	800	10	3	95	25	70
36.485866	127.737912	1	0	0	0	1	196	8.12	126	89.2	55.6	3600	>150	15	105	5	0.1
36.613205	127.467446	0	1	1	0	0	71	7.46	112.3	79.9	50.6	21	10	245	25	245	0.1
37.572087	126.869008	1	0	1	0	0	12	8.28	281	200	128	585	15	0.001	35	340	70
36.495415	127.189263	1	0	0	0	0	49	9.3	531	380	249	15300	>150	4	4	65	0.1

36.404383	126.82922	0	0	1	0	1	85	8.41	284	280	185	240	10	1	5	300	20
36.082561	127.49533	1	0	0	0	0	200	7.55	234	165	113	6400	40	8	5	0.001	10
35.764771	127.195161	0	1	1	0	0	133	7.05	236	163	119	2.08	20	35	10	25	40
35.784083	127.141025	1	1	0	0	0	107	8.2	132.4	93.1	59.1	7150	>150	6	200	0.001	0.1
35.703385	126.656826	1	0	0	0	0	44	7.84	123.7	88.3	55	3685	>150	10	315	0.001	30
34.821134	126.409831	1	0	0	0	0	48	8.31	214	141	93.6	27900	>150	13	20	0.001	0.1
34.802407	127.264514	1	0	0	0	0	22	7.92	102.4	72.7	47	34500	>150	8	195	8	30
35.618729	128.396137	0	0	0	0	0	30	7.33	584	416	273	11660	12.5	0.001	5	30	50
35.633432	128.308986	0	1	1	0	0	42	8.98	276	185	126	22	12.5	7	90	67	100
35.826259	128.70482	1	0	0	0	0	118	8.98	151.4	113	69.7	10282	>150	1	15	8	10
35.879846	128.957405	0	1	0	0	1	176	8.03	168.6	120	80.8	108	15.5	0.001	14	45	0.1
36.577502	128.972972	0	0	0	1	0	205	8.72	397	282	186	25	5	4	3	15	0.1
36.506276	128.708258	0	0	0	0	0	148	8.11	227	164	106	18900	>150	5	7	0.001	0.1
36.646091	127.332475	1	0	0	0	0	38	7.9	204	144	89.3	11591	25	10	30	170	90
37.7884	128.566969	0	0	0	0	0	886	8.57	61.2	26.8	24.4	2.34	11	4	4560	0.001	0.1
37.648307	128.329219	0	0	0	0	0	629	7.95	65	46.9	25.5	1.56	8	15	30	25	0.1
37.591558	127.128476	0	0	0	0	0	62	7.88	252	174	108	1680	>150	5	3	50	50
37.867888	126.864684	1	0	0	0	0	83	7.43	331	239	155	504	>150	2	5	75	10
37.828795	128.417427	0	1	0	0	0	539	7.89	355	250	164	60	>150	30	35	0.001	0.1
37.684407	128.079858	0	0	0	0	0	414	8.14	128	90.3	5.71	224.75	>150	5	5	30	0.1
37.640856	128.023314	0	1	0	0	0	272	7.45	134.2	95.2	63.2	684	10	0.001	400	0.001	100
37.58638	127.976104	0	1	0	0	0	220	9.07	614	435	291	792	8	2	25	30	20
37.575707	127.955837	0	1	1	0	0	214	8.01	129.1	91.6	59.1	315	12.3	15	20	100	20
37.575196	127.955005	0	0	0	0	0	214	7.73	142.3	100	65.2	3150	>150	20	30	40	20
37.554065	127.676434	0	0	0	0	0	158	7.82	161	115	72.9	5250	>150	40	10	0.001	0.1
36.61569	127.467562	1	0	0	0	0	88	7.53	167.1	118	74.9	170	12.5	8	35	25	20
36.616569	127.454139	0	0	0	0	0	65	7.97	394	277	182	3850	>150	5	20	90	50
36.613243	127.445346	0	0	0	0	0	53	7.84	230	163	107	1000	22.5	2	10	60	30
36.547351	127.370512	0	0	0	0	0	58	9.16	191.7	135	92.4	6500	>150	5	20	10	0.1
36.565873	127.351653	0	0	0	0	0	46	8.72	727	516	340	11700	>150	2	5	15	20
37.80832	126.954698	0	0	0	0	0	152	8.43	97.5	69.8	42.9	875	>150	5	25	0.001	0.1
37.794865	126.954557	0	0	1	0	0	152	7.94	64.9	46.1	28	595	>150	5	30	80	30

37.857923	126.853023	1	0	0	0	0	86	7.59	219	155	101	1050	70	40	370	10	100
37.858052	126.852496	0	0	1	0	0	78	7.48	254	173	112	200	12.5	2	370	50	0.1
37.859472	126.848385	0	0	1	0	0	48	7.59	179.4	127	85.6	3400	7.5	5	340	10	0.1
37.863102	126.847254	0	0	0	0	0	46	7.11	473	337	224	2800	20	40	30	140	0.1
37.865552	126.863893	0	0	1	0	0	64	7.41	768	574	363	4000	10	2	25	95	0.1
37.760988	126.837712	0	0	0	0	0	60	8.01	366	260	166	1200	>150	5	790	0.001	10
37.758892	126.837104	0	0	1	0	0	52	9.73	183.4	130	81.9	54.6	>150	5	615	50	0.1
37.647617	127.040049	0	0	0	0	0	43	7.42	172	122	79.2	300	80	0.001	45	25	10
37.593637	127.221907	0	0	0	0	0	37	7.74	380	268	173	4400	>150	8	15	45	10
37.600227	127.223843	0	0	0	0	0	75	7.63	367	259	170	500	100	15	50	35	10
37.973957	127.32082	0	0	0	0	0	153	8.16	79	56.2	36.7	500	>150	10	125	0.001	0.1
37.515506	127.641867	0	0	0	0	0	86	8.2	137.5	97.5	60.7	750	>150	10	20	25	0.1
37.507987	127.614292	0	0	0	0	0	78	8.25	210	148	94.6	6050	>150	3	430	10	10
37.011738	127.792718	1	0	0	0	0	129	9.12	192.2	136	87.1	3850	>150	10	405	30	0.1
37.011044	127.792513	0	1	1	0	0	129	7.15	334	241	156	1950	15	30	460	50	0.1
37.002443	127.784515	1	0	0	0	0	120	8.6	182.9	130	85	2400	50	3	190	0.001	20
36.999694	127.778135	1	0	0	0	0	102	9.58	152.5	107	71.1	4200	>150	2	190	0.001	70
37.011146	127.757794	1	0	0	0	0	134	8.35	240	170	110	5250	>150	8	8	0.001	0.1
37.003792	127.750232	0	0	0	0	0	114	8.72	329	233	155	1575	40	4	20	40	60
35.32222	128.196016	0	1	0	0	0	123	8.99	75.9	52.6	37.2	28.8	2.5	7	300	0.001	0.1
35.133467	128.22326	0	1	0	0	1	98	8.82	155.8	110	74.1	2220	5	2	25	5	90
35.132828	128.22299	0	0	1	0	0	66	8.08	706	500	335	15.78	9	45	60	30	10
35.098657	128.208401	0	0	1	0	0	49	7.43	145.9	104	64.9	75.6	9	10	100	10	70
34.813122	128.620256	0	1	0	0	1	24	7.31	128.6	85	56.8	13363	6	6	105	0.001	20
34.812623	128.618349	0	1	0	0	0	36	7.09	88.1	62.4	40.9	41.8	7	115	225	0.001	20
35.345273	129.285072	0	0	1	0	0	39	8.35	285	204	132	700	4	110	230	6	50
35.352559	129.27877	0	1	1	0	1	41	7.17	186.1	132	88.3	266	1.13	15	20	0.001	60
37.597768	126.982558	0	0	0	1	1	175	8.07	331	235	149	8.64	26	10	55	0.001	30
37.655703	127.081601	0	0	0	1	1	44	7.92	58.8	41.6	56.7	14.19	10	35	150	90	20
37.661856	127.08064	0	0	0	1	0	78	7.21	73.8	52.3	33.2	35305	26	70	20	25	80
37.681127	127.060645	0	0	0	1	1	86	7.41	81.7	58.6	36.1	2835	10	90	150	0.001	40
37.685745	127.06832	0	0	0	1	1	134	6.48	45.7	32.4	22.4	12025	9	22	550	0.001	100

38.073053	127.411607	0	0	0	1	0	283	7.13	186.4	132	83.2	388	NA	16	25	0.001	20
38.072207	127.409491	0	0	0	1	0	249	6.72	51.4	37.5	26.3	9.75	20	8	110	125	20
38.089575	127.451582	0	0	0	1	0	550	7.11	104.4	74.3	46.5	102	30	10	300	0.001	10
38.053635	127.549209	0	0	0	1	1	253	6.94	37.2	26.5	20	20475	16	70	65	10	50
37.98054	127.61739	0	0	0	1	0	148	7.09	64.8	46.1	29.9	2.09	8	15	105	40	10
37.870262	127.65014	0	0	0	1	0	132	6.94	99	70.2	44.3	7.86	8	30	5	170	10
37.802299	127.622271	0	0	0	1	0	122	7.63	97.7	69.6	42.1	2.55	12	25	3	0.001	0.1
37.738482	127.630956	0	0	0	1	0	105	7.49	64.5	45.8	28.4	1.4	10	5	5	40	10
37.735745	127.691573	0	0	0	0	0	113	8.38	196.6	140	90.1	12.88	10	18	2	70	20
36.924418	127.937416	0	0	0	1	0	127	9.3	271	192	126	7.5	2	12	30	14	100
36.92814	127.929982	0	0	0	1	0	78	8.97	464	342	228	40448	3	180	18	40	10
36.894377	128.077383	0	0	0	1	0	182	8.39	294	209	134	4256	17	60	3	60	80
36.865757	128.088411	0	0	0	1	0	212	8.05	40.4	28.4	18.8	246848	17	210	7	0.001	20
36.857395	128.085496	0	0	0	1	0	235	7.4	150.3	107	67.4	30625	14	4	17	35	10
36.834142	128.097147	0	0	0	1	0	319	7.88	48.7	37.6	22.2	287.82	40	15	65	0.001	0.1
36.812177	128.034802	0	0	0	1	0	404	7.45	359	260	157	0.1914	5	20	60	0.001	10
37.041557	128.267565	0	1	0	0	1	223	7.8	418	299	198	45	15	25	470	30	70
37.042133	128.264905	0	1	0	1	1	237	8.13	446	319	213	8.8	15	0.001	700	5	70
37.04259	128.275065	0	0	0	1	0	192	8.92	532	378	255	114.9	13	20	10	60	10
37.262229	128.476366	0	0	0	1	1	336	8.04	296	211	134	5.94	14	15	550	0.001	20
37.278657	128.421073	0	0	0	1	0	256	9.48	269	193	130	0.954	3	75	10	30	0.1
37.285365	128.420405	0	0	0	1	0	317	8.44	566	403	270	0.235	2	8	55	55	0.1
37.241041	128.428146	0	0	0	1	0	217	8.62	450	319	216	2385	17	27	120	270	0.1
37.240254	128.429311	0	1	0	0	0	217	9.47	363	260	174	6.27	4	2	5	125	10
37.096968	128.404858	0	0	0	1	1	246	8.06	458	324	216	222.3	>150	130	25	0.001	50
36.66645	126.642333	1	0	0	0	0	72	7.88	120.7	52.7	84.2	357050	60	15	430	60	100

Table S2. Pairwise correlations coefficients for the variables measured in this study (Republic of Korea, February to March 2020). In bold are the variables removed from the analyses.

	Elevation	pH	Conductivity	Total dissolved solids	Salinity	Surface	Depth	Distance to dirt road	Distance to large road	Distance to forest	Vegetation cover
Elevation	1	0.143	-0.092	-0.093	-0.163	-0.284	-0.019	0.113	-0.047	-0.149	-0.245
pH		1	0.334	0.34	0.3	0.002	0.06	-0.14	-0.134	0.128	-0.251
Conductivity			1	0.951	0.832	0.029	0.042	-0.087	-0.26	0.204	-0.049
Total dissolved solids				1	0.871	0.031	0.032	-0.073	-0.282	0.253	-0.014
Salinity					1	0.038	-0.069	-0.096	-0.177	0.189	0.002
Surface						1	0.512	0.016	-0.085	-0.106	-0.043
Depth							1	0.033	-0.075	-0.195	-0.182
Distance to dirt road								1	-0.062	-0.134	-0.01
Distance to road									1	-0.221	0.067
Distance to trees										1	0.102
Vegetation cover											1

Table S3. Biotic and abiotic factors tested in Generalized linear models, and their influence in the type of breeding habitat for *Bufo sachalinensis* ($n = 22$), *Hynobius* sp., ($n = 18$) *Rana coreana* ($n = 21$), *Rana huanrenensis* ($n = 29$) and *Rana uenoi* ($n = 33$; Republic of Korea, February to March 2020). SE is the standard error, Z is the Z-value from the Wilcoxon's test, and *P* corresponds to the p-value. Significant variables are denoted in bold.

	Estimate	SE	Z	CI _{Lower}	CI _{Upper}	P
<i>Bufo sachalinensis</i>						
Elevation (m)	-0.59	0.37	-1.61	-1.30	0.13	0.108
pH	0.51	0.35	1.47	-0.17	1.20	0.141
Conductivity ($\mu\text{S/m}$)	-0.16	0.39	-0.40	-0.92	0.61	0.689
Distance to road (m)	-0.17	0.34	-0.50	-0.84	0.50	0.617
Distance to dirt road (m)	-0.22	0.33	-0.66	-0.87	0.43	0.509
Distance to forest (m)	-0.28	0.32	-0.87	-0.92	0.35	0.382
Surface (m ²)	0.85	0.51	1.67	-0.15	1.84	0.094
Vegetation cover (%)	0.30	0.35	0.86	-0.38	0.97	0.389
Depth (cm)	1.10	0.41	2.72	0.31	1.90	0.007
<i>Hynobius</i> sp.						
Elevation (m)	0.45	0.31	1.45	-0.16	1.06	0.148
pH	-0.03	0.33	-0.09	-0.68	0.62	0.928
Conductivity ($\mu\text{S/m}$)	0.21	0.33	0.63	-0.44	0.86	0.526
Distance to road (m)	0.25	0.33	0.78	-0.39	0.89	0.438
Distance to dirt road (m)	-0.12	0.29	-0.40	-0.68	0.44	0.687
Distance to forest (m)	-0.62	0.31	-2.02	-1.23	-0.02	0.043
Surface (m ²)	0.26	0.33	0.79	-0.39	0.92	0.427
Vegetation cover (%)	0.81	0.39	2.08	0.05	1.58	0.038
Depth (cm)	-0.54	0.35	-1.57	-1.22	0.14	0.117
<i>Rana coreana</i>						
Elevation (m)	-1.11	0.43	-2.56	-1.96	-0.26	0.010
pH	0.18	0.35	0.51	-0.50	0.85	0.611
Conductivity ($\mu\text{S/m}$)	-0.06	0.37	-0.16	-0.78	0.66	0.873
Distance to road (m)	0.45	0.37	1.20	-0.28	1.17	0.229
Distance to dirt road (m)	0.75	0.40	1.91	-0.02	1.53	0.056
Distance to forest (m)	1.55	0.54	2.88	0.49	2.61	0.004
Surface (m ²)	0.04	0.44	0.08	-0.82	0.90	0.935
Vegetation cover (%)	-0.29	0.34	-0.85	-0.97	0.38	0.394

Depth (cm)	-1.21	0.44	-2.75	-2.07	-0.35	0.006
<i>Rana huanrenensis</i>						
Elevation (m)	2.14	0.73	2.94	0.71	3.57	0.003
pH	-1.21	0.68	-1.77	-2.54	0.13	0.077
Conductivity ($\mu\text{S/m}$)	0.76	0.48	1.59	-0.18	1.70	0.113
Distance to road (m)	-0.66	0.47	-1.43	-1.58	0.25	0.154
Distance to dirt road (m)	0.31	0.46	0.67	-0.59	1.20	0.501
Distance to forest (m)	-0.61	0.57	-1.06	-1.73	0.52	0.289
Surface (m ²)	0.42	0.53	0.79	-0.62	1.46	0.428
Vegetation cover (%)	0.75	0.57	1.31	-0.37	1.87	0.191
Depth (cm)	-2.48	0.82	-3.01	-4.09	-0.86	0.003
<i>Rana uenoi</i>						
Elevation (m)	0.71	0.39	1.81	-0.06	1.47	0.071
pH	-0.32	0.33	-0.97	-0.96	0.32	0.330
Conductivity ($\mu\text{S/m}$)	0.10	0.31	0.32	-0.51	0.70	0.749
Distance to road (m)	0.28	0.32	0.87	-0.35	0.92	0.384
Distance to dirt road (m)	-0.35	0.28	-1.27	-0.90	0.19	0.205
Distance to forest (m)	-0.38	0.34	-1.12	-1.03	0.28	0.263
Surface (m ²)	-0.35	0.39	-0.90	-1.10	0.41	0.371
Vegetation cover (%)	0.11	0.31	0.36	-0.49	0.71	0.722
Depth (cm)	-1.40	0.41	-3.43	-2.20	-0.60	0.001

Table S4. Distance at which *Bufo sachalinensis*, *Hynobius* sp., *Rana uenoi*, *Rana coreana* and *Rana huanrenensis* lay their eggs from the bank and whether they share their breeding habitat (Republic of Korea, February to March 2020). SE is the standard error and *t* is the test statistic of the Student's test with its associated p-value (*P*). Significant variables are denoted in bold.

Target taxon	Syntopic taxon	Estimate	SE	<i>t</i> value	<i>P</i>	Mean distance to bank (m)	Max distance to bank (m)	Min distance to bank (m)	<i>n</i> (egg cluster)	<i>n</i> (site)
<i>Rana coreana</i>	<i>Bufo sachalinensis</i>	-2.15	0.14	-14.98	< 0.001	0.97	2.80	0.00	106	2
<i>Bufo sachalinensis</i>	<i>Rana coreana</i>	-1.14	2.86	-0.40	0.693	0.37	1.10	0.00	3	2
<i>Rana uenoi</i>	<i>Bufo sachalinensis</i>	-0.77	0.39	-1.97	0.050	0.59	2.00	0.00	39	2
<i>Bufo sachalinensis</i>	<i>Rana uenoi</i>	0.08	2.11	0.04	0.972	0.32	1.10	0.00	6	2
<i>Hynobius</i> sp.	<i>Bufo sachalinensis</i>	5.65	2.51	2.25	0.029	2.00	2.00	2.00	2	1
<i>Bufo sachalinensis</i>	<i>Hynobius</i> sp.	3.36	4.80	0.70	0.489	0.20	0.20	0.20	1	1
<i>Rana coreana</i>	<i>Hynobius</i> sp.	-2.45	0.19	-12.71	< 0.001	0.83	3.80	0.02	25	2
<i>Hynobius</i> sp.	<i>Rana coreana</i>	2.57	2.19	1.18	0.246	0.36	0.41	0.30	2	2
<i>Rana uenoi</i>	<i>Hynobius</i> sp.	-0.77	0.36	-2.12	0.035	0.95	3.30	0.00	44	8
<i>Hynobius</i> sp.	<i>Rana uenoi</i>	2.69	1.42	1.89	0.066	0.32	1.78	0.00	34	8
<i>Rana coreana</i>	<i>Rana uenoi</i>	-1.09	0.16	-6.69	< 0.001	2.44	9.20	0.00	74	10
<i>Rana uenoi</i>	<i>Rana coreana</i>	0.93	0.27	3.40	< 0.001	2.23	8.00	0.00	135	10
<i>Rana uenoi</i>	<i>Rana huanrenensis</i>	-0.84	2.06	-0.41	0.685	0.10	0.10	0.10	1	1
<i>Rana huanrenensis</i>	<i>Rana uenoi</i>	3.06	3.87	0.79	0.430	0.44	0.44	0.44	1	1
<i>Hynobius</i> sp.	<i>Rana huanrenensis</i>	0.67	1.32	0.51	0.612	0.21	0.61	0.00	16	9
<i>Rana huanrenensis</i>	<i>Hynobius</i> sp.	0.87	0.88	0.99	0.325	0.16	0.44	0.00	26	9
<i>Bufo sachalinensis</i>	none	-	-	-	-	0.74	7.1	0	30	17
<i>Rana coreana</i>	none	-	-	-	-	9.31	19.6	0	169	8
<i>Rana huanrenensis</i>	none	-	-	-	-	0.17	1.3	0	73	20
<i>Rana uenoi</i>	none	-	-	-	-	0.89	4	0	89	14

Table S5. Relative distance (distance corrected by the waterbody surface) at which *Bufo sachalinensis*, *Hynobius* sp., *Rana uenoi*, *Rana coreana* and *Rana huanrenensis* lay their eggs from the bank and whether they share their breeding habitat (Republic of Korea, February to March 2020). SE is the standard error and *t* is the test statistic of the Student's test with its associated p-value (*P*). Significant variables are denoted in bold.

Target taxon	Syntopic taxon	Estimate	SE	<i>t</i> value	<i>P</i>	Mean distance to bank (m)	Max distance to bank (m)	Min distance to bank (m)	<i>n</i> (egg cluster)	<i>n</i> (site)
<i>Rana coreana</i>	<i>Bufo sachalinensis</i>	-0.09	0.01	-14.06	< 0.001	1.85	6.22	0.22	106	2
<i>Bufo sachalinensis</i>	<i>Rana coreana</i>	< 0.001	0.03	0.02	0.982	0.52	1.57	0.00	3	2
<i>Rana uenoi</i>	<i>Bufo sachalinensis</i>	-0.01	0.01	-1.22	0.224	4.39	13.30	0.00	39	2
<i>Bufo sachalinensis</i>	<i>Rana uenoi</i>	0.01	0.02	0.53	0.593	1.72	7.33	0.00	6	2
<i>Hynobius</i> sp.	<i>Bufo sachalinensis</i>	0.01	0.05	0.12	0.908	3.33	3.33	3.33	2	1
<i>Bufo sachalinensis</i>	<i>Hynobius</i> sp.	< 0.001	0.05	-0.02	0.983	0.33	0.33	0.33	1	1
<i>Rana coreana</i>	<i>Hynobius</i> sp.	-0.07	0.01	-8.43	< 0.001	2.50	12.70	0.00	25	2
<i>Hynobius</i> sp.	<i>Rana coreana</i>	-0.02	0.04	-0.45	0.654	1.04	1.08	1.00	2	2
<i>Rana uenoi</i>	<i>Hynobius</i> sp.	-0.03	0.01	-3.34	0.001	2.53	7.86	0.00	44	8
<i>Hynobius</i> sp.	<i>Rana uenoi</i>	< 0.001	0.03	0.08	0.936	3.01	5.00	0.00	34	8
<i>Rana coreana</i>	<i>Rana uenoi</i>	-0.02	0.01	-3.33	0.001	6.48	6.58	0.00	74	10
<i>Rana uenoi</i>	<i>Rana coreana</i>	0.03	0.01	3.66	< 0.001	8.21	9.30	0.00	135	10
<i>Rana uenoi</i>	<i>Rana huanrenensis</i>	-0.01	0.05	-0.22	0.825	1.25	1.25	1.25	1	1
<i>Rana huanrenensis</i>	<i>Rana uenoi</i>	0.02	0.05	0.43	0.667	5.50	5.50	5.50	1	1
<i>Hynobius</i> sp.	<i>Rana huanrenensis</i>	< 0.001	0.02	0.19	0.853	3.31	9.68	0.00	16	9
<i>Rana huanrenensis</i>	<i>Hynobius</i> sp.	0.01	0.01	0.57	0.571	3.24	5.50	0.00	26	9
<i>Bufo sachalinensis</i>	none	-	-	-	-	0.45	2.01	0.00	30	17
<i>Rana coreana</i>	none	-	-	-	-	11.20	23.10	0.00	169	8
<i>Rana huanrenensis</i>	none	-	-	-	-	2.45	8.67	0.00	73	20
<i>Rana uenoi</i>	none	-	-	-	-	5.57	32.50	0.00	89	14

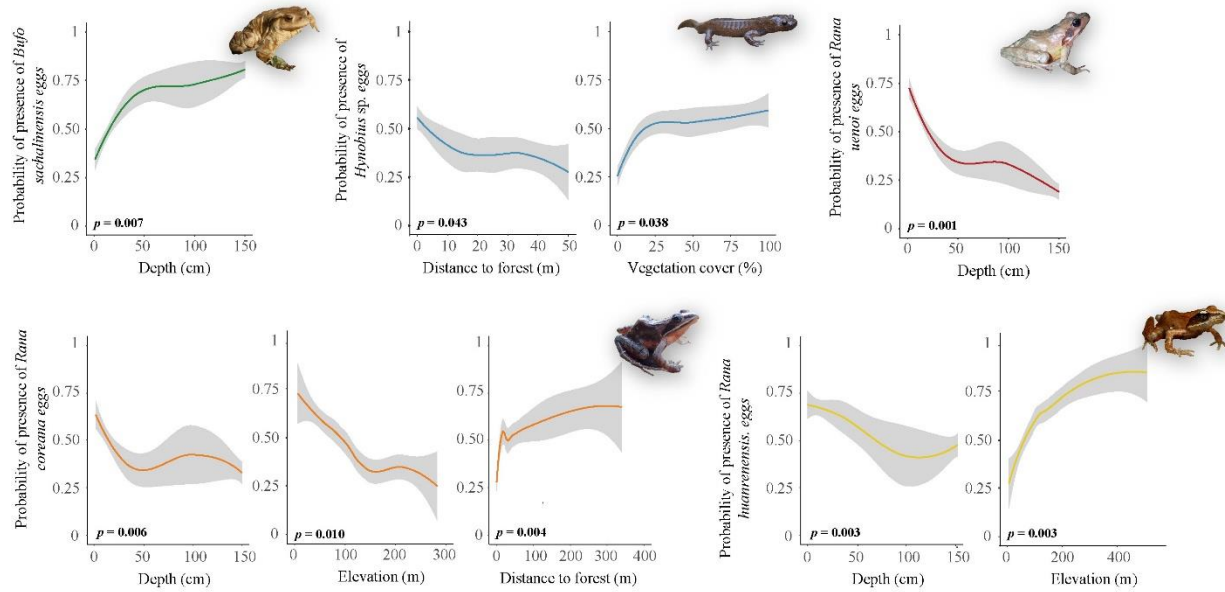


Figure S1. Predictions of the presence of eggs of *Bufo sachalinensis* ($n = 22$), *Rana coreana* ($n = 21$), *Hynobius* sp. ($n = 18$), *Rana uenoi* ($n = 33$) and *Rana huanrenensis* ($n = 29$) for the biotic and abiotic factors that significantly influence their presence at the site (Republic of Korea, February to March 2020). Predictions were made through a Generalized Linear Model. The y-axis shows the probability of presence of the eggs.

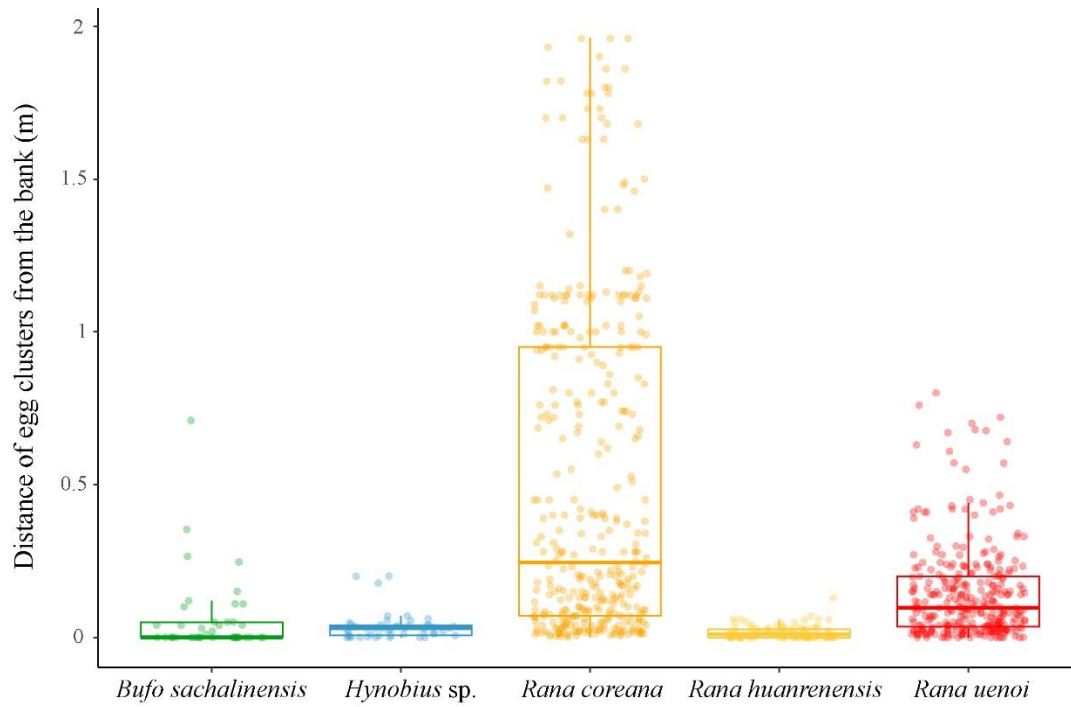


Figure S2. Distances of egg clusters from the bank of the waterbodies for *Bufo sachalinensis* (n = number of eggs; $n = 40$), *Hynobius sp.* ($n = 48$), *Rana coreana* ($n = 374$), *Rana huanrenensis* ($n = 99$) and *Rana uenoi* ($n = 308$; Republic of Korea, February to March 2020).