Amphibian and Reptile Conservation

RESEARCH REPORT 18/01

Jersey multi-species distribution, habitat suitability & connectivity modelling

Appendix D

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amphibian and reptile conservation

Appendix D – MaxEnt model performance and results

Table D1 Performance assessment of final models for each focal species, showing: the regularisation value used in the final model (β), the AUC value of the test data (AUC_{test}) and its standard deviation (SD), the AUC value of the training data (AUC_{train}) and the difference between the AUC test and training data (AUC_{diff}). The number of training and test occurrences used in each cross-validation replicate are also shown.

Species	β	AUC_{test}	SD	AUC_{train}	AUC_{diff}	Training	Test
Western toad	2.0	0.8689	0.042	0.882	0.0131	170/171	8/9
Grass snake	3.5	0.975	0.017	0.9775	0.0025	65/66	3/4
Bank vole	0.5	0.8624	0.088	0.9076	0.0452	76/77	4/5
Common pipistrelle bat	1.0	0.9358	0.054	0.9476	0.0118	78/79	4/5
Long-eared bats	2.5	0.9336	0.085	0.9483	0.0147	32/33	1/2
Red squirrel	1.5	0.8078	0.086	0.8555	0.0477	80/81	4/5
Field cricket	1.0	0.9561	0.067	0.9778	0.0217	25/26	1/2
Waxcap fungi	0.5	0.8524	0.127	0.9169	0.0645	38	2
Scaly stalkball	1.0	0.9958	0.004	0.9971	0.0013	8	1
Green-winged orchid	1.0	0.9787	0.019	0.9879	0.0092	21/22	1/2
Pyramidal orchid	1.0	0.9322	0.142	0.9667	0.0345	19	1
Southern marsh-orchid	1.0	0.9114	0.215	0.9155	0.0041	10	1
Lizard orchid	1.0	0.9423	0.083	0.9729	0.0306	8	1
Early-purple orchid	1.0	0.8776	0.136	0.919	0.0414	9	1
Jersey buttercup	0.5	0.9873	0.015	0.9902	0.0029	4	1
Ragged robin	0.5	0.904	0.194	0.9853	0.0813	16	1
Autumn lady's-tresses	1.0	0.8449	0.235	0.9831	0.1382	18	1

Table D2 Variables tested in MaxEnt models, with variables retained in final models shown in bold and their respective permutation importance and percent contribution averaged over replicate runs.

Species	Variable	Permutation importance	Contribution (%)
Western toad	aspect	–	–
	building density	9.3	8.5
	landcover type	33.5	33.5
	distance to (all) boundary features	–	–
	distance to built-up areas	–	–
	distance to coastal heathland	5.1	2.1
	distance to dune heathland	–	–
	distance to gardens	44.4	44.4
	distance to ponds and reservoirs	7.8	7.8
	distance to roads	–	–
	distance to streams	–	–
Grass snake	aspect	–	–
	building density	–	–
	landcover type	1.0	4.2
	distance to (all) boundary features	–	–
	distance to bracken	–	–
	distance to coastal grassland	1.8	0.6
	distance to coastal heathland	0.6	1.8
	distance to dune grassland	85.0	79.0
	distance to dry stone walls	–	–
	distance to gardens	–	–
	distance to (all) grassland	–	–
	distance to improved grassland	–	–
	distance to ponds and reservoirs	0.6	0.6
	distance to ruderal	–	–
	distance to (all) scrub	6.3	10.1
	distance to semi-improved grassland	–	–
	distance to streams	–	–
	distance to toads	4.8	4.0
	distance to unimproved grassland	–	–
	distance to (all) woodland	–	–
Bank vole	aspect	–	–
	building density	6.9	10.5
	landcover type	68.1	32.1
	distance to (all) boundary features	8.5	11.5
	distance to (all) grassland	4.2	4.2
	distance to (all) scrub	6.4	39.0
	distance to verges	3.6	1.5
	distance to (all) woodland	2.3	1.2
Common pipistrelle bat	building density	–	–
	landcover type	10.2	11.3
	distance to (all) grassland	–	–

Species	Variable	Permutation importance	Contribution (%)
	distance to (all) boundary features	17.2	1.3
	distance to historic buildings	44.8	74.7
	distance to major buildings	17.7	6.3
	distance to ponds and reservoirs	4.9	2.8
	distance to roads	–	–
	distance to ruins	–	–
	distance to (all) woodland	5.2	3.6
Long-eared bats	building density	3.3	1.7
	landcover type	0.1	7.6
	distance to (all) bare ground	2.1	1.1
	distance to (all) boundary features	–	–
	distance to (all) grassland	–	–
	distance to historic buildings	90.5	86.5
	distance to improved grassland	0.0	0.0
	distance to major buildings	2.9	1.7
	distance to ponds and reservoirs	–	–
	distance to ruins	–	–
	distance to (all) scrub	–	–
	distance to semi-improved grassland	–	–
	distance to unimproved grassland	–	–
Red squirrel	aspect	–	–
	building density	9.3	4.5
	landcover type	14.7	9.5
	distance to (all) boundary features	2.9	2.5
	distance to gardens	13.8	34.6
	distance to (all) grassland	–	–
	distance to mixed woodland	1.0	0.6
	distance to roads	12.0	14.7
	distance to (all) scrub	–	–
	distance to squirrel feeders	3.1	4.2
	distance to streams	2.8	1.6
	distance to (all) woodland	40.3	27.9
Field cricket	aspect	–	–
	building density	16.3	6.3
	landcover type	35.3	60.1
	distance to (natural) bare ground	4.8	13.0
	distance to coastal grassland	6.0	2.4
	distance to coastal heathland	23.4	6.7
	distance to (all) grassland	9.7	2.7
	distance to roads	–	–
	distance to (all) scrub	4.4	8.7

Species	Variable	Permutation importance	Contribution (%)
Waxcap fungi	aspect	–	–
	landcover type	85.4	69.5
	distance to (natural) bare ground	8.4	6.5
	distance to semi-improved grassland	3.3	21.5
	distance to unimproved grassland	2.9	2.5
	distance to (all) woodland	–	–
Scaly stalkball	aspect	–	–
	building density	–	–
	landcover type	0.0	40.8
	distance to (all) bare ground	0.3	2.3
	distance to (natural) bare ground	–	–
	distance to (all) boundary features	0.2	16.9
	distance to coniferous woodland	–	–
	distance to dune grassland	–	–
	distance to dune marram	98.7	36.7
	distance to (all) grassland	0.7	3.3
	distance to ponds and reservoirs	–	–
	distance to roads	–	–
	distance to (all) scrub	–	–
	distance to unimproved grassland	–	–
	distance to (all) woodland	–	–
Green-winged orchid	aspect	–	–
	building density	–	–
	landcover type	2.7	9.4
	distance to (all) boundary features	4.9	21.0
	distance to dune grassland	92.5	69.6
	distance to dune marram	–	–
	distance to (all) grassland	–	–
	distance to roads	–	–
Pyramidal orchid	aspect	–	–
	building density	–	–
	landcover type	11.9	17.2
	distance to (all) boundary features	–	–
	distance to dune grassland	33.2	53.9
	distance to (all) grassland	52.8	26.3
	distance to semi-improved grassland	2.1	2.5
	distance to roads	–	–
	distance to verges	–	–
Southern marsh-orchid	aspect	–	–
	landcover type	0.0	51.9
	distance to (all) boundary features	–	–
	distance to (all) grassland	–	–

Species	Variable	Permutation importance	Contribution (%)
	distance to ponds and reservoirs	–	–
	distance to roads	–	–
	distance to streams	–	–
	distance to wetlands	95.9	43.1
	distance to (all) woodland	4.1	5.0
Lizard orchid	aspect	–	–
	building density	12.7	4.9
	landcover type	6.3	30.8
	distance to banks	–	–
	distance to (natural) bare ground	12.4	10.4
	distance to bracken	–	–
	distance to coastal grassland	–	–
	distance to coastal heathland	–	–
	distance to dune grassland	67.7	53.3
	distance to (all) grassland	–	–
	distance to scrub	1.0	0.6
	distance to (all) woodland	–	–
Early-purple orchid	aspect	–	–
	landcover type	36.4	83.0
	distance to (all) boundary features	–	–
	distance to dune grassland	–	–
	distance to (all) grassland	63.6	17.0
	distance to roads	–	–
	distance to scrub	–	–
	distance to verges	–	–
	distance to (all) woodland	–	–
Jersey buttercup	aspect	–	–
	building density	–	–
	landcover type	1.4	48.2
	distance to (all) boundary features	–	–
	distance to coastal grassland	34.7	30.3
	distance to coastal heathland	–	–
	distance to (all) grassland	–	–
	distance to major buildings	–	–
	distance to (all) scrub	63.9	21.5
	distance to (all) woodland	–	–
Ragged robin	aspect	–	–
	building density	–	–
	landcover type	18.6	23.1
	distance to banks	–	–
	distance to (all) bare ground	–	–
	distance to (all) grassland	–	–

Species	Variable	Permutation importance	Contribution (%)
	distance to roads	–	–
	distance to (all) scrub	1.4	4.6
	distance to streams	14.9	10.4
	distance to verges	–	–
	distance to wetlands	48.0	53.2
	distance to (all) woodland	17.1	8.7
Autumn lady's-tresses	aspect	–	–
	landcover type	10.4	28.6
	distance to (all) bare ground	6.5	3.6
	distance to cemeteries	28.1	41.6
	distance to coastal grassland	18.4	8.2
	distance to coastal heathland	–	–
	distance to coniferous woodland	10.6	1.7
	distance to dune heathland	2.0	10.0
	distance to gardens	–	–
	distance to (all) grassland	–	–
	distance to (all) scrub	–	–
	distance to streams	0.9	1.7
	distance to unimproved grassland	–	–
	distance to verges	–	–
	distance to (all) woodland	23.1	4.7

Figure D1 MaxEnt responses for final variables retained in model for the Western toad (*Bufo spinosus*). Variables are (a) landcover, (b) building density, (c) distance to coastal heathland, (d) distance to gardens and (e) distance to ponds and reservoirs. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
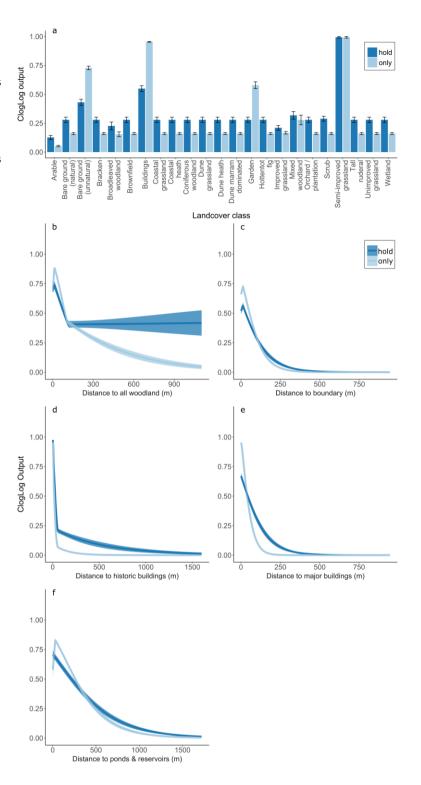
Figure D2 MaxEnt responses for final variables retained in model for the grass snake (*Natrix helvetica*). Variables are (a) landcover, (b) distance to all scrub, (c) distance to coastal grassland, (d) distance to coastal heathland, (e) distance to dune grassland, (f) distance to ponds and reservoirs and (g) distance to toads. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
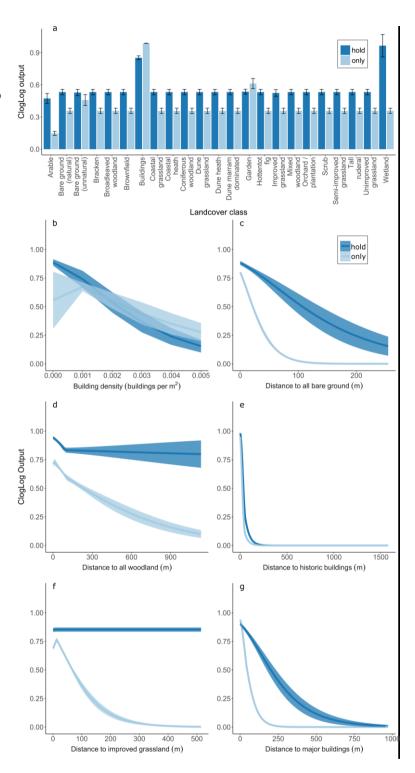
Figure D3 MaxEnt responses for final variables retained in model for the bank vole (*Myodes glareolus*). Variables are (a) landcover, (b) building density, (c) distance to all grassland, (d) distance to all scrub, (e) distance to all woodland, (f) distance to boundary and (g) distance to verges. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.

Figure D4 MaxEnt responses for final variables retained in model for the common pipistrelle bat (*Pipistrellus pipistrellus*). Variables are (a) landcover, (b) distance to all woodland, (c) distance to boundary, (d) distance to historic buildings, (e) distance to major buildings and (f) distance to ponds and reservoirs. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
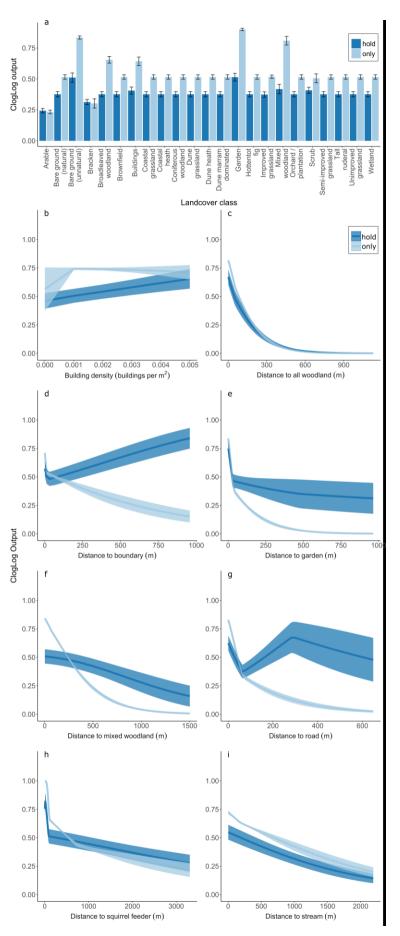
Figure D5 MaxEnt responses for final variables retained in model for long-eared bats (*Plecotus* spp.). Variables are (a) landcover, (b) building density, (c) distance to all bare ground, (d) distance to all woodland, (e) distance to historic buildings, (f) distance to improved grassland and (g) distance to major buildings. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
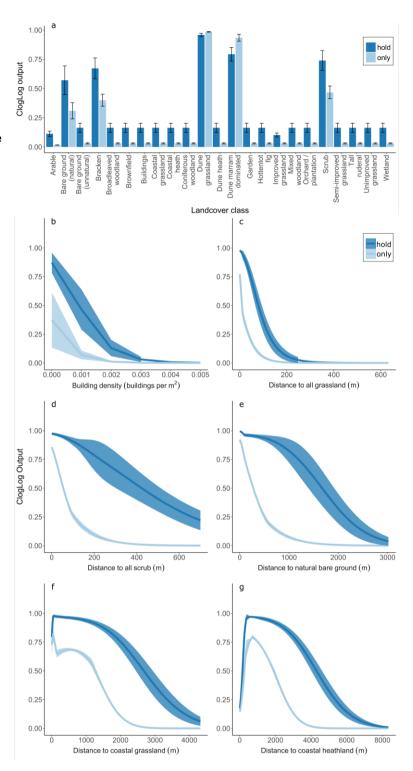
Figure D6 MaxEnt responses for final variables retained in model for the red squirrel (*Sciurus vulgaris*). Variables are (a) landcover, (b) building density, (c) distance to all woodland, (d) distance to boundary, (e) distance to garden, (f) distance to mixed woodland, (g) distance to road, (h) distance to squirrel feeder and (i) distance to stream. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
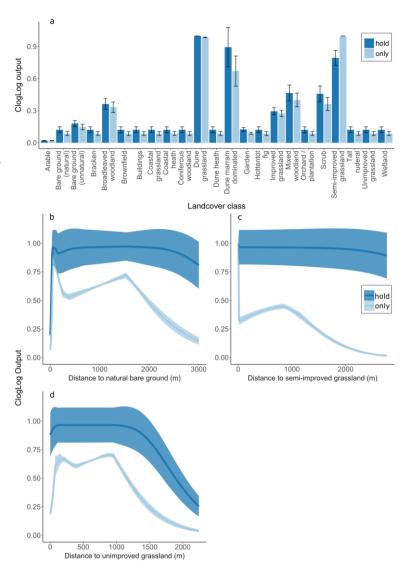

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Figure D7 MaxEnt responses for final variables retained in model for the field cricket (*Gryllus campestris*). Variables are (a) landcover, (b) building density, (c) distance to all grassland, (d) distance to all scrub, (e) distance to natural bare ground, (f) distance to coastal grassland and (g) distance to coastal heathland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
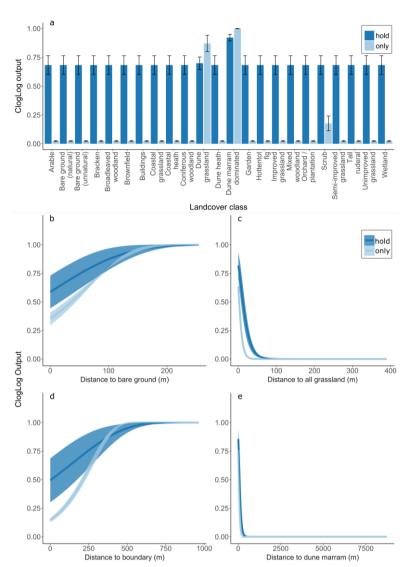

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Figure D8 MaxEnt responses for final variables retained in model for waxcap fungi (*Hygrocybe* spp.). Variables are (a) landcover, (b) distance to natural bare ground, (c) distance to semi-improved grassland and (d) distance to unimproved grassland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
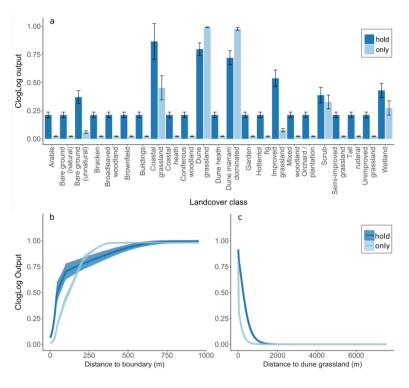
Figure D9 MaxEnt responses for final variables retained in model for the scaly stalkball (*Tulostoma melanocyclum*). Variables are (a) landcover, (b) distance to all bare ground, (c) distance to all grassland, (d) distance to boundary and (e) distance to dune marram. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.

Figure D10 MaxEnt responses for final variables retained in model for the green-winged orchid (*Anacamptis morio*). Variables are (a) landcover, (b) distance to boundary and (c) distance to dune grassland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
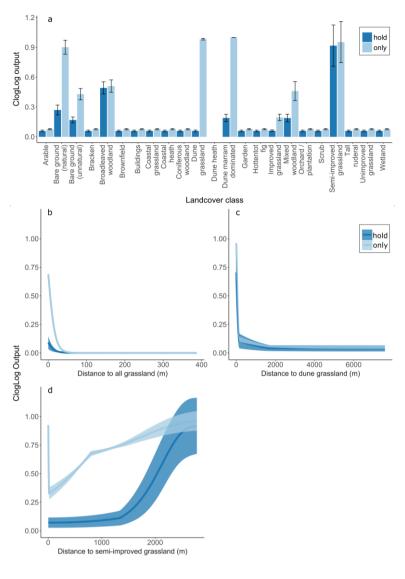
Figure D11 MaxEnt responses for final variables retained in model for the pyramidal orchid (*Anacamptis pyramidalis*). Variables are (a) landcover, (b) distance to all grassland, (c) distance to dune grassland and (d) distance to semi-improved grassland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
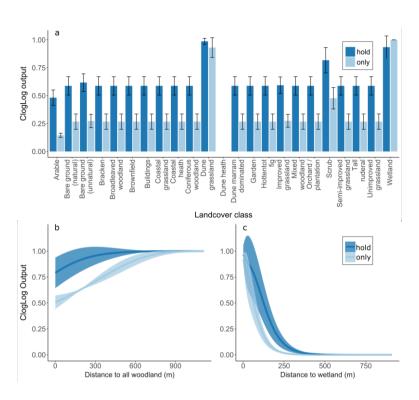
Figure D12 MaxEnt responses for final variables retained in model for the Southern marsh-orchid (*Dactylorhiza praetermissa*). Variables are (a) landcover, (b) distance to woodland and (c) distance to wetland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
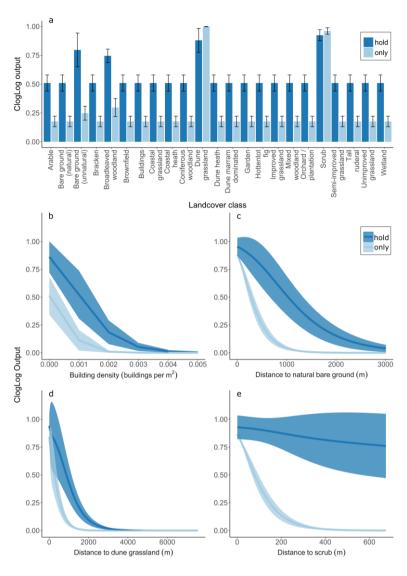
Figure D13 MaxEnt responses for final variables retained in model for the lizard orchid (*Himantoglossum hircinum*). Variables are (a) landcover, (b) building density, (c) distance to natural bare ground, (d) distance to dune grassland and (e) distance to scrub. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
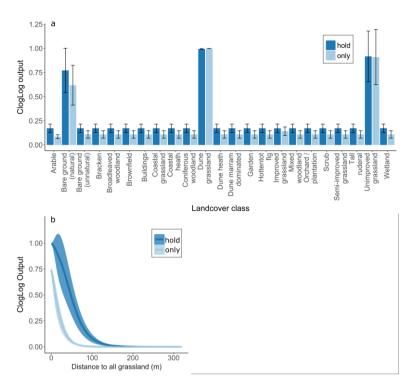
Figure D14 MaxEnt responses for final variables retained in model for the early-purple orchid (*Orchis mascula*). Variables are (a) landcover and (b) distance all grassland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.

Figure D15 MaxEnt responses for final variables retained in model for the Jersey buttercup (*Ranunculus paludosus*). Variables are (a) landcover, (b) distance to all scrub and (c) distance to coastal grassland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
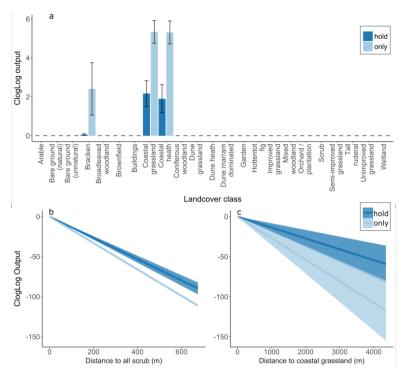
Figure D16 MaxEnt responses for final variables retained in model for ragged robin (*Silene flos-cuculi*). Variables are (a) landcover, (b) distance to all scrub, (c) distance to all woodland, (d) distance to stream and (e) distance to wetland. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.
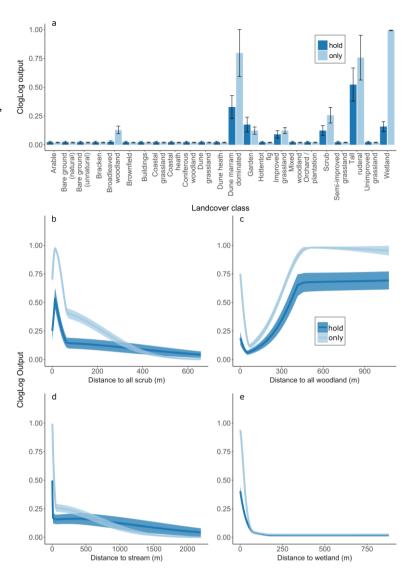
Figure D17 MaxEnt responses for final variables retained in model for Autumn lady's-tresses (*Spiranthes spiralis*). Variables are (a) landcover, (b) distance to all bare ground, (c) distance to all woodland, (d) distance to cemetery, (e) distance to coastal grassland, (f) distance to coniferous woodland, (g) distance to dune heathland and (h) distance to stream. Dark blue indicates responses with all other variables held at their mean value ('hold'), and light blue indicates variable responses for a MaxEnt model created with only a single variable ('only'). Higher Cloglog values indicate greater predicted suitability.

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