Supplementary material

Table S1. Summary of model outputs for the four species held at four zoological collections in the UK (HAI: human animal interactions, OOS: out of sight). Statistically significant differences have been highlighted in bold.

Species	Location	Comparison	Behaviour	Model output	AIC	Confidence intervals	
						2.5%	97.5%
Wallabies	White Post Farm	Open vs closed	Alert	-0.037±0.175, Z=-0.211, p=0.833	1332.9	-0.38	0.31
			Feeding	**0.429±0.105, Z=4.076, p<0.001**	**2057.5**	**0.22**	**0.64**
			Comfort	0.280±0.230, Z=1.216, p=0.224	812.5	-0.17	0.74
			Locomotion	**0.536±0.181, Z=2.956, p=0.003**	**941.6**	**0.18**	**0.89**
			Resting	**-0.646±0.097, Z=-6.654, p<0.001**	**2297.8**	**-0.83**	**0.45**
			Positive HAIs	**-0.219±0.085, Z=-2.544, p=0.01**	**302.0**	**-1.51**	**0.64**
			Positive social interactions	**-0.208±0.079, t=-2.634, p=0.009**	**884.0**	**-0.36**	**-0.05**
			OOS	**0.532±0.238, Z=2.239, p=0.03**	**1316.3**	**0.08**	**1.01**
		Open period comparisons	Alert	0.002±0.054, Z=0.031, p=0.975	920.2	-0.10	0.11
			Feeding	-0.032±0.037, Z=-0.865, p=0.387	1369.7	-0.11	0.04
			Comfort	-0.050±0.032, Z=-1.568, p=0.118	827.8	-0.11	0.01
			Rest	**0.076±0.024, Z=3.206, p=0.001**	**1672.6**	**0.03**	**0.12**
			Locomotion	**-0.219±0.072, Z=-3.051, p=0.002**	**569.0**	**-0.36**	**-0.08**
			OOS	-0.082±0.075, Z=-1.092, p=0.275	827.8	-0.23	0.07
		Weeks since reopening	**Alert**	**0.038±0.017, Z=-2.204, p=0.028**	**915.4**	**-0.07**	**0.004**
			Feeding	-0.012±0.013, Z=-0.911, p=0.362	1369.6	-0.04	0.01
			Comfort	0.023±0.013, t=1.867, p=0.063	828.6	-0.001	0.05
			Resting	-0.001±0.011, Z=-0.131, p=0.896	1682.6	-0.02	0.02
			Locomotion	0.013±0.014, t=0.881, p=0.379	900.8	-0.02	0.04
			OOS	0.028±0.030, Z=0.951, p=0.341	828.1	-0.03	0.09
		Closed period comparisons	Alert	-0.100±0.304, Z=-0.328, p=0.725	401.5	-0.71	0.49
			Feeding	**0.433±0.145, Z=2.998, p=0.003**	**644.2**	**0.15**	**0.72**
			Comfort	-0.787±0.447, Z=-1.760, p=0.079	265.0	-1.70	0.07
			Locomotion	-0.212±0.270, Z=-0.784, p=0.433	350.4	-0.74	0.32
			Resting	-0.116±0.216, Z=-0.538, p=0.591	593.2	-0.55	0.30

			OOS	-0.326±0.374, Z=-0.870, p=0.384	479.9	-1.10	0.38
Rabbits	White Post Farm	Open vs closed	Feeding	-0.077±0.183, Z=-0.423, p=0.672	920.9	-0.44	0.28
			Alert	**-1.003±0.215, Z=-4.675, p<0.001**	**538.7**	**-1.42**	**-0.59**
			Positive social interactions	**-0.513±0.261, Z=-2.041, p=0.041**	**413.2**	**-1.01**	**-0.02**
			Resting	**0.357±0.098, Z=3.646, p<0.001**	**1242.6**	**0.16**	**0.55**
			Positive HAIs	-0.130±0.274, Z=-0.473, p=0.636	347.6	-0.67	0.41
			Comfort	-0.122±0.155, Z=-0.791, p=0.429	795.3	-0.44	0.17
			Locomotion	-0.138±0.225, Z=-0.614, p=0.539	467.8	-0.58	0.30
			Environmental interactions	-0.257±0.349, Z=-0.737, p=0.461	293.5	-0.94	0.43
			OOS	-0.422±0.334, Z=-1.264, p=0.206	6995.9	-1.10	0.24
		Closed periods (lockdown 2 vs lockdown 3)	Alert	-0.445±0.278, Z=-1.601, p=0.109	278.2	-0.99	0.10
			Positive HAIs	-0.028±0.436, Z=-0.063, p=0.950	147.4	-0.87	0.85
			Feeding	-0.307±0.252, Z=-1.217, p=0.224	368.1	-0.81	0.18
			Comfort	-0.255±0.246, Z=-1.039, p=0.299	321.4	-0.74	0.22
			Positive social interactions	-0.081±0.346, Z=-0.235, p=0.814	193.7	-0.76	0.60
			Locomotion	-0.498±0.285, Z=-1.75, p=0.080	188.7	-1.06	0.06
			Environmental interactions	0.343±0.246, t=1.396, p=0.167	245.9	-0.14	0.82
			Resting	0.035±0.193, Z=0.182, p=0.856	465.8	-0.35	0.41
			OOS	**1.2469±0.4842, Z=2.575, p=0.01**	**295.7**	**0.26**	**2.18**
		Open period comparisons (post lockdown 1 vs post lockdown 2)	Feeding	-0.789±0.421, Z=-1.874, p=0.061	551.2	-1.59	0.08
			Comfort	0.487±0.293, Z=1.663, p=0.096	477.5	-0.08	1.08
			Positive HAIs	**1.259±0.386, Z=3.265, p=0.001**	**199.1**	**0.19**	**2.01**
			Locomotion	**0.596±0.290, Z=2.057, p=0.042**	**389.4**	**0.03**	**1.16**
			Alert	**0.675±0.092, Z=-6.101, p<0.001**	**370.3**	**0.15**	**1.20**
			Positive social interactions	0.070±0.246, Z=0.283, p=0.778	348.6	-0.41	0.55
			Resting	-0.233±0.170, Z=-1.367, p=0.172	777.6	-0.56	0.11
			OOS	-0.370±0.722, Z=0.513, p=0.608	364.2	-0.88	2.07

		Weeks since reopening	Alert	-0.009±0.019, t=-0.479, p=0.633	381.6	-0.05	0.03
			Comfort	-0.007±0.020, Z=-0.334, p=0.739	480.2	-0.05	0.03
			Feeding	**0.064±0.028, Z=2.272, p=0.023**	**556.9**	**-**	**-**
			Positive HAIs	**0.099±0.030, t=-3.269, p=0.001**	**198.2**	**-**	**-**
			Positive social interactions	0.005±0.017, t=0.322, p=0.748	353.9	-0.03	0.04
			Locomotion	-0.024±0.020, t=-1.179, p=0.240	397.5	-0.06	0.02
			Resting	0.005±0.012, Z=0.454, p=0.650	779.2	-0.02	0.03
			OOS	-0.049±0.059, Z=-0.827, p=0.480	363.7	-0.18	0.06
Macaws	White Post Farm	Open vs closed (lockdown 3)	Alert	-0.343±0.356, Z=-0.964, p=0.335	266.4	-1.05	0.35
			Feeding	**-0.900±0.338, Z=-2.666, p=0.008**	**271.9**	**-1.58**	**-0.25**
			Preening	**0.866±0.349, Z=2.479, p=0.013**	**198.0**	**0.20**	**1.57**
			Positive social interactions	-0.500±0.402, Z=-1.245, p=0.213	220.5	-1.31	0.28
			Resting	**0.545±0.197, Z=2.768, p=0.006**	**405.5**	**0.16**	**0.93**
			Locomotion	-0.340±0.229, t=-1.748, p=0.08	226.1	-0.85	0.05
			Environmental interactions	-0.204±0.403, Z=-0.506, p=0.613	192.6	-1.01	0.60
			Positive HAIs	-0.455±0.476, Z=-0.957, p=0.339	108.6	-1.41	0.48
		Open period comparisons	Positive HAIs	-0.112±0.131, t=-0.855, p=0.393	449.8	-0.12	0.12
			Alert	**-0.351±0.041, Z=-8.588, p<0.001**	**595.1**	**-0.43**	**0.27**
			Feeding	**-0.163±0.075, Z=-2.175, p=0.03**	**484.9**	**-0.31**	**0.02**
			Comfort	**0.216±0.074, Z=2.929, p=0.003**	**308.2**	**0.07**	**0.36**
			Resting	**-0.364±0.054, Z=6.722, p<0.001**	**571.8**	**0.26**	**0.47**
			Locomotion	0.139±0.075, Z=-1.842, p=0.070	264.1	-0.01	0.29
			Environmental interactions	0.122±0.098, Z=1.248, p=0.212	285.0	-0.07	0.32
			Positive social interactions	-0.075±0.079, Z=-0.941, p=0.347	398.7	-0.23	0.08
		Weeks since reopening	Alert	0.031±0.021, Z=1.481, p=0.139	655.6	-0.10	0.07
			Locomotion	0.019±0.033, Z=0.565, p=0.572	267.1	-0.05	0.08
			Environmental	-0.042±0.043, Z=-0.978, p=0.328	285.6	-0.13	0.04

			interactions				
			Positive HAIs	-0.033±0.027, t=-1.241 p=0.217	449.9	-0.09	0.02
			Positive social interactions	-0.0003±0.032, Z=-0.011, p=0.992	399.6	-0.06	0.06
			Comfort	-0.063±0.039, Z=-1.641, p=0.101	308.2	0.07	0.36
			Feeding	0.044±0.029, Z=1.495, p=0.135	487.2	-0.01	0.10
			Resting	-0.049±0.031, Z=-1.579, p=0.114	604.9	-0.11	0.01
	Plantasia	Open vs closed periods (lockdown 1)	**Vigilant**	**-0.435±0.100, Z=-4.332, p<0.001**	**395.8**	**-0.63**	**-0.23**
			Positive HAIs	-0.276±0.514, Z=-0.538, p=0.591	134.9	-1.29	0.73
			Feeding	0.331±0.387, Z=0.856, p=0.392	234.9	-0.44	1.09
			Preening	0.494±0.474, Z=1.043, p=0.297	215.1	-0.45	1.41
			Locomotion	0.072±0.321, Z=0.224, p=0.822	178.9	-0.55	0.71
			Resting	0.715±0.418, Z=1.712, p=0.087	223.0	-0.11	1.53
			ARBs	0.325±0.300, Z=1.081, p=0.280	257.0	-0.27	0.92
			Environmental interactions	**1.062±0.445, Z=2.386, p=0.017**	**185.0**	**0.20**	**1.96**
		Open period comparisons	Perched alert	0.186±0.109, Z=1.708, p=0.088	591.4	-0.01	0.20
			Environmental interactions	-0.356±0.314, Z=-1.136, p=0.256	286.0	-0.49	0.13
			Feeding	-0.166±0.360, Z=0.465, p0.642	330.6	-0.44	0.27
			Preening	0.039±0.330, Z=0.120, p=0.905	345.3	-0.31	0.34
			Locomotion	-0.500±0.360, Z=-1.388, p=0.165	222.7	-0.61	0.10
			Positive HAIs	**-2.046±0.666, Z=-3.073, p=0.002**	**108.2**	**-1.78**	**-0.42**
			Vocalising	**1.216±0.553, Z=2.201, p=0.028**	**119.3**	**0.07**	**1.26**
			Resting	0.291±0.327, Z=0.891, p=0.373	381.8	-0.18	0.47
			ARBs	-0.304±0.666, Z=-1.060, p=0.289	356.8	-0.44	0.13
		Weeks since reopening	Perched alert	-0.005±0.019, Z=-1.708, p=0.779	594.2	-0.04	0.03
			Environmental interactions	-0.044±0.056, Z=-0.788, p=0.431	286.9	-0.17	0.08
			Feeding	-0.005±0.062, Z=-0.078, p=0.938	330.8	-0.14	0.14
			Preening	0.006±0.057, Z=0.100, p=0.920	345.3	-0.12	0.14
			Locomotion	0.006±0.064, Z=0.099, p=0.921	224.6	-0.13	0.15

			Resting	0.057±0.055, Z=1.036, p=0.300	381.2	-0.04	0.03
			ARBs	-0.062±0.051, Z=-1.214, p=0.225	356.3	-0.16	0.03
			Positive HAIs	0.064±0.098, Z=0.655, p=0.512	118.8	-0.16	0.29
			Vocalisations	-0.034±0.770, t=-0.438, p=0.662	124.6	-0.21	0.13
Meerkats	White Post Farm	Open vs closed periods	Positive HAIs	-0.668±0.605, Z=-1.104, p=0.269	199.7	-1.88	0.51
			Feeding	0.046±0.262, Z=0.174, p=0.862	469.7	-0.47	0.56
			Locomotion	0.214±0.306, Z=0.699, p=0.485	351.4	-0.39	0.81
			Environmental interactions	-0.560±0.544, Z=-1.028, p=0.304	180.6	-1.65	0.49
			Resting	0.767±0.426, Z=1.800, p=0.072	284.2	-0.08	1.60
			Alert	**0.366±0.141, Z=2.601, p=0.009**	**466.1**	**0.09**	**0.64**
			Comfort	**0.804±0.380, Z=2.119, p=0.034**	**189.6**	**0.07**	**1.55**
			OOS	**-0.638±0.240, Z=-2.662, p=0.008**	**491.8**	**-1.12**	**-0.17**
		Closure period comparisons	Positive HAIs	-1.939±1.248, Z=-1.553, p=0.120	80.9	-5.13	0.57
			Feeding	0.295±0.518, Z=0.569, p=0.569	210.5	-0.66	1.39
			Environmental interactions	0.059±0.788, Z=0.075, p=0.940	100.7	-1.38	1.72
			Locomotion	**-3.225±1.121, Z=-2.876, p=0.004**	**133.1**	**-6.19**	**1.38**
			Alert	**-1.105±0.309, Z=-3.581, p<0.001**	**200.5**	**-1.70**	**-0.50**
			Resting	-21.902±8722.960, Z=-0.003, p=-0.998	95.8	-	-
			Comfort	-0.524±0.417, t=-1.256, p=0.220	86.4	-1.38	0.33
			OOS	0.575±0.313, Z=1.837, p=0.066	237.1	-0.02	1.22
		Open period comparisons	Alert	0.058±0.157, Z=0.369, p=0.712	240.8	-0.25	0.36
			Positive HAIs	-0.065±0.886, Z=-0.073, p=0.942	71.8	-1.97	1.61
			Feeding	0.188±0.290, Z=0.648, p=0.517	249.5	-0.40	0.74
			Comfort	0.188±0.544, Z=0.346, p=0.730	120.4	-0.92	1.23
			Locomotion	0.107±0.412, Z=0.259, p=0.795	195.1	-0.74	0.89
			Environmental interactions	-0.579±0.990, Z=-0.585, p=0.559	76.0	-2.83	1.25
			ARBs	0.420±0.405, t=1.038, p=0.307	108.7	-0.40	1.24
			Resting	**1.358±0.485, Z=2.798, p=0.005**	**173.0**	**0.37**	**2.30**

			OOS	**-0.792±0.383, Z=-2.067, p=0.038**	**228.6**	**-1.59**	**-0.07**
		Weeks since reopening	Alert	-0.025±0.029, Z=-0.865, p=0.387	240.2	-0.08	0.03
			Positive HAIs	-0.104±0.159, Z=-0.656, p=0.512	71.4	-0.46	0.24
			Feeding	0.030±0.053, Z=0.560, p=0.575	249.6	-0.08	0.14
			Resting	0.048±0.094, Z=0.512, p=0.609	179.0	-0.20	0.28
			Comfort	**0.248±0.117, Z=2.124, p=0.034**	**116.5**	**0.01**	**0.51**
			Locomotion	-0.063±0.073, Z=-0.854, p=0.393	194.2	-0.20	0.06
			Environmental interactions	-0.097±0.181, Z=-0.535, p=0.593	75.9	-0.44	0.21
			ARBs	-0.034±0.074, t=-0.465, p=0.645	109.6	-0.18	0.12
			OOS	0.041±0.075, Z=0.547, p=0.585	232.6	-0.11	0.18
	Plantasia	Open vs closed (lockdown 1)	Alert	0.115±0.305, Z=0.377, p=0.706	285.3	-0.49	0.71
			Feeding	-0.623±0.476, Z=-1.309, p=0.191	186.6	-1.58	0.30
			Comfort	0.123±0.336, Z=0.365, p=0.715	239.0	-0.54	0.78
			Locomotion	0.155±0.417, Z=0.371, p=0.711	114.5	-0.64	1.01
			Resting	0.333±0.211, Z=1.577, p=0.115	347.7	-0.08	0.75
			ARBs	-0.442±0.364, Z=-1.216, p=0.224	171.8	-1.16	0.27
			Environmental interactions	**-0.213±0.101, Z=-2.12, p=0.034**	**347.4**	**-0.41**	**-0.02**
		Open period comparisons	Alert	0.110±0.086, Z=1.284, p=0.199	424.8	-0.06	0.28
			Resting	**-0.372±0.195, Z=-1.902, p=0.06**	**493.9**	**-0.38**	**0.005**
			ARBs	-0.074±0.178, Z=-0.416, p=0.677	212.0	-0.42	0.28
			Positive social interactions	0.762±0.242, Z=3.153, p	190.5	0.31	1.27
			Feeding	0.469±0.393, Z=1.196, p=0.232	273.6	-0.15	0.62
			Comfort	-0.346±0.284, Z=-1.218, p=0.223	319.1	-0.45	0.10
			Locomotion	-0.126±0.069, Z=-1.808, p=0.070	181.7	-0.30	0.44
			Environmental interactions	0.091±0.096, Z=0.949, p=0.340	512.7	-0.05	0.14
		Weeks since reopening	Feeding	-0.025±0.067, Z=-0.370, p=0.710	274.9	-0.16	0.11
			Comfort	0.0165±0.049, Z=0.338, p=0.740	320.5	-0.45	0.10
			Alert	**-0.059±0.030, Z=-2.005, p=0.04**	**422.6**	**-0.12**	**-0.0003**

			ARBs	-0.093±0.064, Z=-1.445, p=0.149	210.1	-0.23	0.03
			Positive social interactions	0.111±0.069, Z=1.612, p=0.107	198.8	-0.03	0.26
			Locomotion	-0.126±0.069, Z=-1.808, p=0.070	178.7	-0.28	0.01
			Environmental interactions	0.001±0.016, Z=0.088, p=0.930	513.6	-0.03	0.03
			Resting	0.047±0.033, Z=1.410, p=0.160	495.2	-0.01	0.11
	Knowsley Safari	Open vs closed	Alert	0.095±0.131, Z=0.721, p=0.471	314.5	-0.16	0.36
			Positive HAIs	-0.312±0.426, Z=-0.733, p=0.464	145.2	-1.13	0.53
			Feeding	-0.058±0.151, Z=-0.386, p=0.699	310.1	-0.35	0.24
			Comfort	0.063±0.471, Z=0.135, p=0.893	281.8	-0.96	0.96
			Positive social interactions	0.141±0.356, Z=1.163, p=0.245	318.4	-0.33	1.11
			Negative social interactions	0.445±-0.556, Z=0.801, p=0.4233	154.2	-0.61	1.54
			Locomotion	-0.115±0.223, Z=-0.516, p=0.606	341.0	-0.56	0.31
			Environmental interactions	0.377±0.316, Z=1.193, p=0.230	320.6	-0.26	0.98
			Resting	0.231±0.413, Z=0.559, p=0.576	316.4	-0.65	1.01
			OOS	-0.688±0.701, Z=-0.981, p=0.326	157.7	-2.31	0.65
		Closure period comparisons	Alert	-0.227±0.389, Z=-0.582, p=0.561	46.6	-0.99	0.52
			Feeding	-0.770±0.329, Z=-2.337, p=0.019	-1.47	-0.17	38.3
			Comfort	1.249±0.674, Z=1.855, p=0.064	38.8	-0.07	2.62
			Positive social interactions	1.121±0.612, Z=1.821, p=0.069	40.0	-0.09	2.36
			Locomotion	-0.223±0.272, Z=-0.82, p=0.412	42.9	-0.78	0.29
			Environmental interactions	0.323±0.539, Z=0.599, p=0.549	41.9	-0.72	1.37
			Resting	0.764±0.638, Z=1.197, p=0.231	40.5	-0.50	2.05
			OOS	1.562±1.250, Z=1.250, p=0.211	30.6	-1.00	4.34
		Weeks since reopening	Alert	0.001±0.009, Z=0.085, p=0.933	272.2	-0.02	0.02
			Positive HAIs	**-0.240±0.061, Z=-3.908, p<0.001**	**104.5**	**-0.38**	**-0.13**

			Feeding	**-0.026±0.012, Z=-2.2, p=0.028**	**266.5**	**-0.05**	**-0.003**
			Comfort	0.016±0.0330, Z=0.472, p=0.637	245.8	-0.05	0.09
			Positive social interactions	0.022±0.023, Z=0.955, p=0.340	281.5	-0.03	0.07
			Negative social interactions	**-0.242±0.060, Z=-4.016, p<0.001**	**118.7**	**-0.37**	**0.13**
			Locomotion	**-0.051±0.016, Z=-3.114, p=0.002**	**291.5**	**-0.08**	**0.02**
			Environmental interactions	**-0.047±0.022, Z=-2.107, p=0.035**	**281.2**	**-0.09**	**-0.001**
			Resting	.0359±0.028, Z=1.980, p=0.195	278.7	-0.02	0.10
			OOS	-0.003±0.052, Z=-0.065, p=0.948	131.5	-0.12	0.11
	Dartmoor Zoo	Open period comparisons	Alert	-0.059±0.227, Z=-0.259, p=0.796	143.7	-0.50	0.34
			Feeding	**-2.603±0.705, Z=-3.694, p<0.001**	**112.5**	**-4.07**	**-1.29**
			Locomotion	-0.016±0.114, Z=-0.141, p=0.888	144.7	-0.24	0.20
			Resting	**1.227±0.412, Z=2.979, p=0.003**	**128.8**	**0.42**	**2.05**
			Environmental interactions	0.281±0.295, Z=0.953, p=0.341	131.2	-0.30	0.86
			OOS	0.671±0.404, t=1.660, p=0.110	79.1	-0.12	1.46
		Weeks since reopening	Alert	0.065±0.042, Z=-1.541, p=0.123	141.6	-0.15	0.02
			Resting	-0.038±0.094, Z=-0.401, p=0.689	136.1	-0.22	0.13
			Environmental interactions	**-0.176±0.053, Z=-3.299, p<0.001**	**123.2**	**-0.29**	**-0.06**
			Locomotion	**-0.074±0.028, Z=2.597, p=0.009**	**130.2**	**-0.02**	**0.13**
			OOS	-0.014±0.084, Z=-0.162, p=0.873	52.1	-0.50	0.31