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Supplementary Material

Population demography of the Tasmanian short-beaked echidna (*Tachyglossus aculeatus*)

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Supplementary Material

Supplementary Material SM1. – Raw and categorised climate data

Table 1. – Summarised weather records across the study period from the nearest weather station at Melton Mowbray, Tasmania (<4 km from the study site, station number 94201). "Frequency days >32°C" shows the number of days exceeding 32°C (the upper temperature limit for echidna activity) in the calendar year. This was used to group years with the highest temperatures, relative to the rest of the study period ("bad" under the temperature category). "Total spring/summer rainfall" is the total rainfall over the preceding spring (echidna emergence from hibernation) and summer. For example, in 2012, rainfall was totalled across September to November 2011 (preceding spring) and December to February 2011/2012. This was used to group years with the lowest rainfall during critical echidna feeding times, relative to the rest of the study period ("bad" under the rainfall category).

	Temperature category		**Rainfall category**	
Year	**Frequency days >32°C**	**Category**	**Total spring/summer rainfall**	**Category**
1997	7	Good	178.8	Good
1998	10	Bad	118.2	Bad
1999	3	Good	216.2	Good
2000	8	Bad	111.6	Bad
2001	7	Good	156.6	Good
2002	2	Good	265.6	Good
2003	9	Bad	165.4	Good
2004	1	Good	150.6	Good
2005	2	Good	124.4	Bad
2006	5	Good	288.8	Good
2007	8	Bad	104.6	Bad
2008	8	Bad	168.4	Good
2009	5	Good	144.0	Good
2010	5	Good	237.2	Good
2011	1	Good	227.4	Good
2012	5	Good	176.4	Good

Model	Rank	$QAIC_c$	$\Delta QAIC_c$	w_i
Ĉ = 1.0				
Φ (rain.sex)	1	83.0	0.00	0.44
Φ (rain)	2	84.3	1.28	0.23
Φ (temp.sex)	3	85.3	2.23	0.15
Φ (temp)	4	86.0	3.01	0.10
Φ (sex)	5	87.5	4.47	0.05
Φ (.)	6	88.4	5.36	0.03
Ĉ = 1.25				
Φ (rain.sex)	1	68.1	0.00	0.31
Φ (rain)	2	68.3	0.18	0.28
Φ (temp)	4	69.6	1.57	0.14
Φ (temp.sex)	3	69.9	1.78	0.13
Φ (sex)	5	70.8	2.73	0.08
Φ (.)	6	71.1	3.03	0.07
Ĉ = 1.5				
Φ (rain)	2	57.6	0.00	0.30
Φ (rain.sex)	1	58.1	0.55	0.22
Φ (temp)	4	58.7	1.15	0.17
Φ (.)	6	59.6	2.03	0.11
Φ (temp.sex)	3	59.6	2.04	0.11
Φ (sex)	5	59.7	2.13	0.10
Ĉ = 1.75				
Φ (rain)	2	49.9	0.00	0.30
Φ (temp)	4	50.9	0.99	0.18
Φ (rain.sex)	1	51.0	1.07	0.17
Φ (.)	6	51.4	1.45	0.14
Φ (sex)	5	51.8	1.83	0.12
Φ (temp.sex)	3	52.3	2.35	0.09
Ĉ = 1.8				
Φ (rain)	2	48.7	0.00	0.29
Φ (temp)	4	49.6	0.96	0.18
Φ (rain.sex)	1	49.8	1.16	0.16
Φ (.)	6	50.0	1.35	0.15
Φ (sex)	5	50.4	1.78	0.12
Φ (temp.sex)	3	51.1	2.40	0.09
Ĉ = 2.0				
Φ (rain)	2	44.2	0.00	0.29
Φ (temp)	4	45.1	0.87	0.19
Φ (.)	6	45.2	1.01	0.17
Φ (rain.sex)	1	45.7	1.47	0.14
Φ (sex)	5	45.8	1.60	0.13
Φ (temp.sex)	3	46.8	2.58	0.08

Supplementary Material SM2. – Sensitivity analysis of known-fates model, showing $QAIC_c$ and rank-order change with incremental increases in $\hat{C}$ adjustment (over-dispersion factor).

Table 1. – Models are ranked by ascending $QAIC_c$ scores. $QAIC_c$= Akaike's information criterion adjusted for overdispersion and corrected for small sample sizes, w_i= Akaike's weight.

Supplementary Material SM3. – Breakdown of vagrant and non-vagrant individuals in the main dataset (October-February, 1996-2012), and capture effort, per year

Table 1. – Breakdown of vagrant and non-vagrant individuals by year, age and sex

	Vagrant				Non-vagrant			
Year	**Juvenile**	**Adult Female**	**Adult Male**	**Total**	**Juvenile**	**Adult Female**	**Adult Male**	**Total**
1996	0	6	2	8	0	21	10	31
1997	1	6	2	9	2	29	12	43
1998	0	0	5	5	6	21	12	39
1999	0	2	5	7	6	26	8	40
2000	0	2	1	3	8	22	9	39
2001	1	0	0	1	5	13	6	24
2002	0	2	1	3	3	8	5	16
2003	0	4	0	4	3	14	4	21
2004	0	2	0	2	3	14	6	23
2005	0	2	2	4	2	11	3	16
2006	0	0	1	1	1	6	4	11
2007	0	1	1	2	4	13	5	22
2008	3	2	1	6	7	19	7	33
2009	1	0	0	1	6	11	8	25
2010	0	2	1	3	7	9	10	26
2011	0	2	0	2	6	10	9	25
2012	0	2	1	3	6	12	7	25
Total captures	**6**	**35**	**23**	**64**	**75**	**259**	**125**	**459**
Total individuals	**6**	**35**	**23**	**64**	**20**	**59**	**32**	**111**

Table 2. – Breakdown of animals caught per year relative to the number of days spent in the field

Year	Oct-Feb field days	Number of non-vagrants caught Oct-Feb	Total number caught Oct-Feb	Total number radio-tracked Oct-Feb
1996	21	31	39	11
1997	31	43	52	18
1998	21	39	44	11
1999	34	40	47	18
2000	21	39	42	16
2001	19	24	25	16
2002	25	16	19	15
2003	33	21	25	11
2004	25	23	25	10
2005	30	16	20	11
2006	25	11	12	10
2007	21	22	24	21
2008	23	33	39	26
2009	27	25	26	22
2010	38	26	29	24
2011	45	25	27	27
2012	43	25	28	27
Total	**482**	**459**	**523**	**294**
Total individuals	**-**	**111**	**175**	**58**

Supplementary Material SM4. – Model-selection results for October-February data, with vagrants (individuals captured once only) included

Table 1. – Summary of CJS model-selection results. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. n = 175.

Model	**Parameters**	**AIC_c**	**ΔAIC_c**	**w_i**	**Deviance**	**%DE**
Φ (.) p(t)	17	1391.4	0.00	0.40	820.9	22.2
Φ (temp) p(t)	18	1392.7	1.35	0.20	820.1	22.3
Φ (rain) p(t)	18	1392.9	1.54	0.18	820.3	22.2
Φ (sex) p(t)	18	1393.3	1.93	0.15	820.7	22.2
Φ (rain.sex) p(t)	20	1396.2	4.81	0.04	819.3	22.3
Φ (temp.sex) p(t)	20	1396.7	5.34	0.03	819.8	22.3
Φ (t) p(t)	32	1407.6	16.16	0.00	804.0	23.8
Φ (sex.t) p(t)	48	1430.5	39.14	0.00	789.5	25.2

Table 2. – Summary of Pradel model selection results. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. Sample size = 175.

Model	**Parameters**	**AIC_c**	**ΔAIC_c**	**w_i**	**Deviance**	**%DE**
Φ(.) β(.) p(t)	19	2340.3	0.00	0.35	867.0	38.0
Φ(rain) β(.) p(t)	20	2341.6	1.36	0.18	866.2	38.1
Φ(temp) β(.) p(t)	20	2341.7	1.45	0.17	866.3	38.1
Φ(.) β(rain) p(t)	20	2342.0	1.71	0.15	866.6	38.0
Φ(temp) β(rain) p(t)	21	2343.4	3.18	0.07	865.9	38.1
Φ(rain) β(rain) p(t)	21	2343.4	3.19	0.07	865.9	38.1
Φ(.) β(t) p(t)	34	2357.6	17.32	0.00	851.1	39.2
Φ(temp) β(t) p(t)	35	2358.7	18.42	0.00	849.9	39.2
Φ(rain) β(t) p(t)	35	2358.9	18.64	0.00	850.1	39.2

Supplementary Material SM5. – Model selection results for all season data.

Table 1. – Summary of CJS model selection results, vagrants excluded. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. Sample size = 140.

Model	Parameters	AIC$_c$	ΔAIC$_c$	w_i	Deviance	%DE
Φ (t) p(t)	32	1738.1	0.00	0.32	1186.3	33.4
Φ (temp) p(t)	18	1739.6	1.59	0.14	1218.4	31.6
Φ (.) p(t)	17	1739.7	1.63	0.14	1220.5	31.5
Φ (rain) p(t)	18	1739.8	1.70	0.14	1218.5	31.6
Φ (sex) p(t)	18	1740.4	2.31	0.10	1219.1	31.6
Φ (temp.sex) p(t)	20	1740.5	2.47	0.09	1215.0	31.8
Φ (rain.sex) p(t)	20	1741.3	3.20	0.06	1215.7	31.8
Φ (sex.t) p(t)	48	1764.7	26.68	0.00	1176.3	34.0

Table 2 – Summary of CJS model selection results, vagrants included. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. Sample size = 227.

Model	Parameters	AIC$_c$	ΔAIC$_c$	w_i	Deviance	%DE
Φ (t) p(t)	32	1988.6	0.00	0.87	1186.4	29.9
Φ (.) p(t)	17	1995.7	7.07	0.03	1225.7	27.6
Φ (sex) p(t)	18	1995.7	7.12	0.02	1223.7	27.7
Φ (temp) p(t)	18	1995.9	7.30	0.02	1223.8	27.7
Φ (rain) p(t)	18	1996.0	7.37	0.02	1223.9	27.7
Φ (rain.sex) p(t)	20	1996.2	7.61	0.02	1219.9	27.9
Φ (temp.sex) p(t)	20	1996.5	7.93	0.02	1220.2	27.9
Φ (sex.t) p(t)	48	2012.9	24.27	0.00	1174.6	30.6

Table 3 – Summary of Pradel model selection results, vagrants excluded. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. Sample size = 140.

Model	Parameters	AIC$_c$	ΔAIC$_c$	w_i	Deviance	%DE
Φ(rain) β(.) p(t)	20	2441.9	0.00	0.23	1249.1	44.9
Φ(temp) β(.) p(t)	20	2442.0	0.08	0.22	1249.1	44.9
Φ(.) β(.) p(t)	19	2442.6	0.63	0.17	1251.8	44.8
Φ(temp) β(rain) p(t)	21	2443.0	1.03	0.14	1248.0	45.0
Φ(rain) β(rain) p(t)	21	2443.1	1.11	0.13	1248.1	45.0
Φ(.) β(rain) p(t)	20	2443.5	1.55	0.11	1250.6	44.9
Φ(temp) β(t) p(t)	35	2459.3	17.40	0.00	1233.6	45.6
Φ(rain) β(t) p(t)	35	2459.4	17.50	0.00	1233.7	45.6
Φ(.) β(t) p(t)	34	2459.5	17.52	0.00	1236.0	45.5

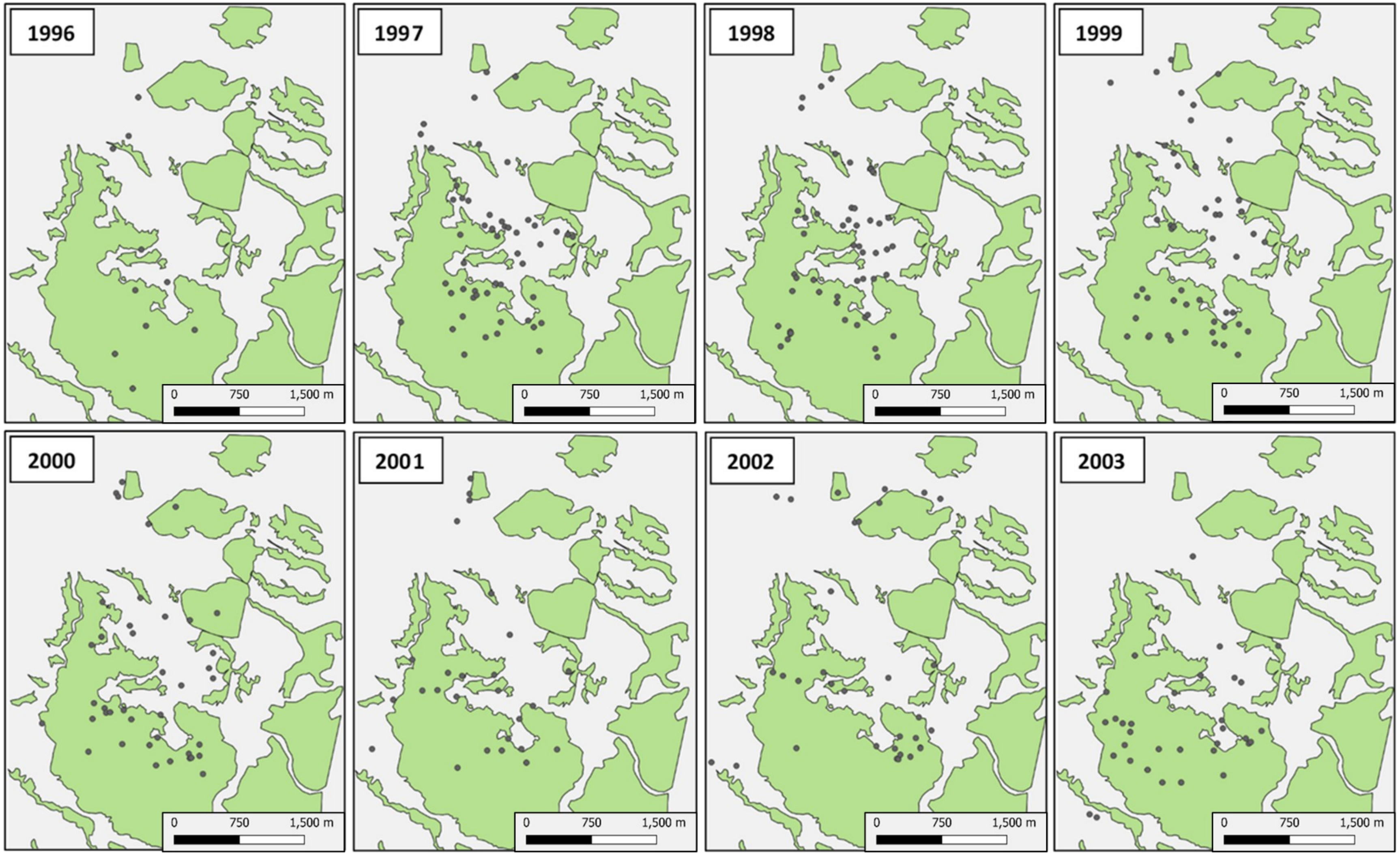
Table 4 – Summary of Pradel model selection results, vagrants included. Models are ranked by ascending AIC_c scores. AIC_c= Akaike's information criterion corrected for small sample sizes, w_i= Akaike weight. Sample size = 227.

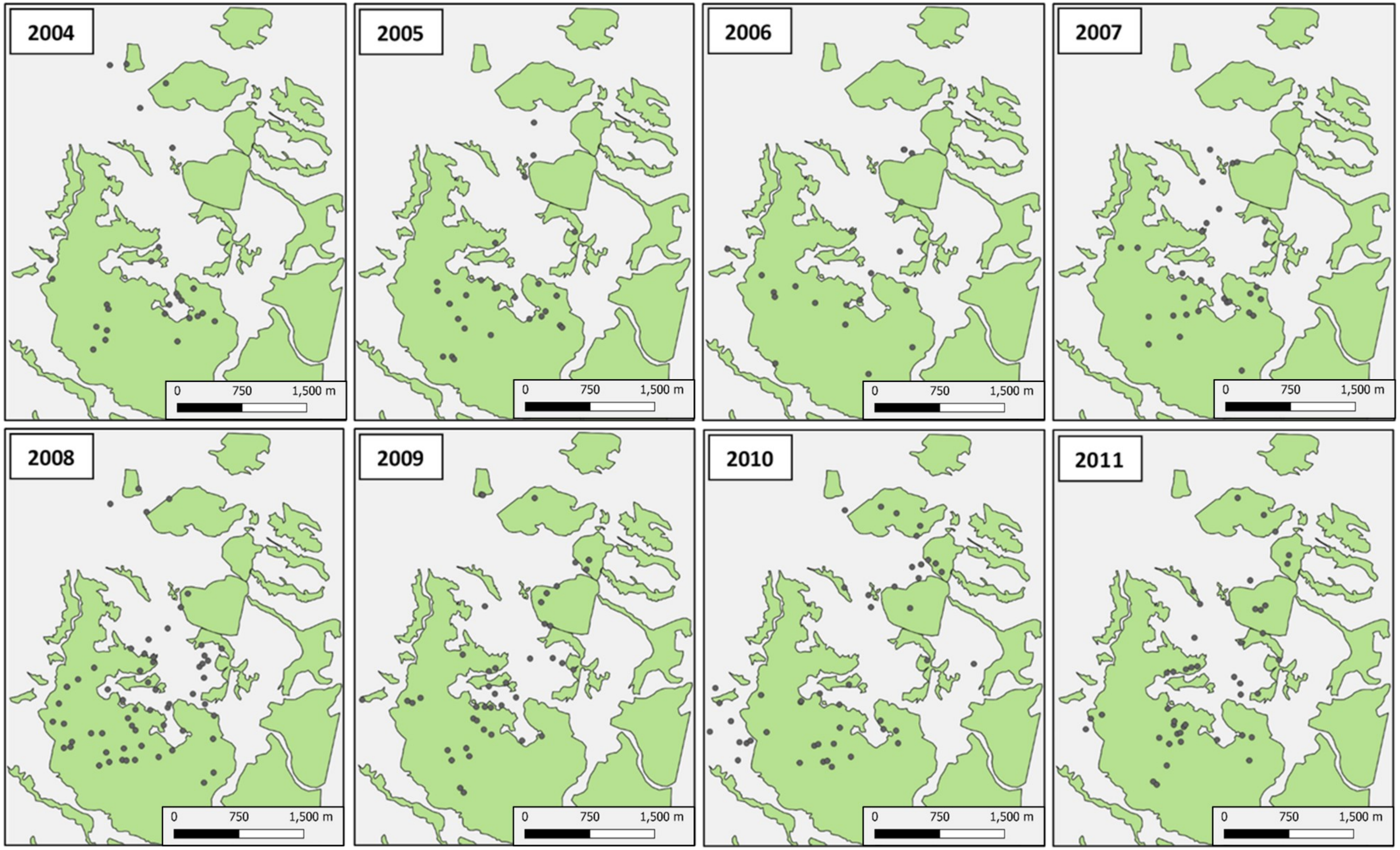
Model	Parameters	AIC_c	ΔAIC_c	w_i	Deviance	%DE
Φ(.) β(.) p(t)	19	3208.6	0.00	0.26	1257.7	40.0
Φ(temp) β(.) p(t)	20	3208.6	0.04	0.26	1255.6	40.1
Φ(rain) β(.) p(t)	20	3208.9	0.31	0.22	1255.9	40.1
Φ(.) β(rain) p(t)	20	3210.7	2.09	0.09	1257.7	40.0
Φ(temp) β(rain) p(t)	21	3210.8	2.14	0.09	1255.6	40.1
Φ(rain) β(rain) p(t)	21	3211.0	2.36	0.08	1255.8	40.1
Φ(temp) β(t) p(t)	35	3229.6	21.01	0.00	1244.1	40.7
Φ(rain) β(t) p(t)	35	3229.7	21.07	0.00	1244.2	40.7
Φ(.) β(t) p(t)	34	3229.7	21.1	0.00	1246.4	40.6

Table 5 – Summary of known fate model selection results. Models are ranked by ascending $QAIC_c$ scores. $QAIC_c$= Akaike's information criterion adjusted for overdispersion and corrected for small sample sizes, w_i= Akaike weight. Sample size = 76.

Model	Parameters	AIC_c	ΔAIC_c	w_i	Deviance	%DE
Φ (.)	1	76.5	0.00	0.30	19.6	0.00
Φ (sex)	2	76.8	0.22	0.27	17.8	9.2
Φ (temp)	2	78.3	1.7	0.13	19.3	1.5
Φ (rain)	2	78.5	1.94	0.11	19.5	0.5
Φ (temp.sex)	4	79.2	2.6	0.09	16.0	18.4
Φ (rain.sex)	4	80.0	3.45	0.05	16.9	13.8

Supplementary Material SM6. – Maps of the study area showing the central spatial location of each echidna across all years.

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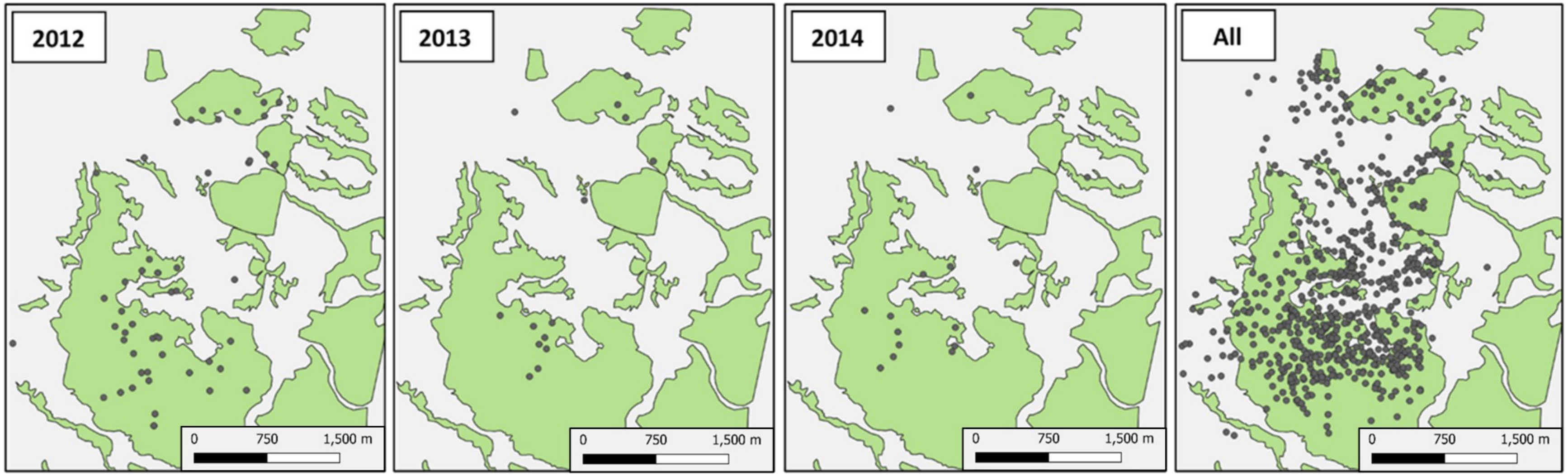

Figure 1 – Maps of the study area showing the central spatial location of each echidna (grey circles, calculated as the central medoid of all capture locations of each individual per year) relative to woodland areas (green polygons). A medoid is a representative point in a cluster whose dissimilarly to the cluster is minimal. Medoids were used, instead of all capture locations, to avoid pseudoreplication of individuals.