Farr wind farm: A review of displacement disturbance on golden plover arising from operational turbines 2005-2015.

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Summary

1. Previously, operational and construction impacts of the 40 turbine Farr windfarm on breeding golden plover were assessed over the period 2005 (pre-construction) to 2010 (operational).
2. Three hypotheses were tested: 1. No impact; 2. Immediate and permanent displacement of golden plover away from turbines; 3. Gradual but permanent displacement of golden plover away from turbines.
3. This update incorporates additional data up to 2015. As previously, golden plover territories were assigned to a 'wind farm' group if the territory centre was within a 500 m buffer drawn around the turbines. All others were assigned to a 'control' group.
4. As previously, data on territory centres and nest locations (when available) were analysed.
5. All of the previous analyses were repeated using the new data and the original conclusions were supported.
6. There remains no evidence to support Hypothesis 2 or 3. There has been no systematic or significant shift in the mean centres of golden plover territory centres or any changes in the variability of territory coordinates.
7. There is no evidence that territory centres moved away from turbine locations.
8. In 2010 the number of wind farm territories declined from 20 in 2009 to 18 but this followed the most severe winter on record. There was a larger decline (20 to 15) in the control group.
9. In 2011 the wind farm territories increased from 18 to 25 while the control group reduced from 15 to 14.
10. Since 2012 only the wind farm area has been monitored and the number of territories reduced to 17 in 2012 during one of the wettest years on record. However, when previous analyses were repeated using new data the original conclusions were supported despite the decline.
11. In 2013 the number of territories had reduced to 16. When previous analyses were repeated using new data from 2013 the original conclusions were supported despite the small decline which is almost certainly explained by poor weather conditions during the nesting period.
12. In 2014 the number of territories had increased to 22. When previous analyses were repeated using these new data the original conclusions were supported. There was a small increase in the distance from territory centres to turbines but the seven nests that were found had a mean distance to a turbine of only 241 m (range 115 - 427 m, including four with a distance of 200 m or less).
13. In 2015 the number of territories had increased to 24. When previous analyses were repeated using these new data the original conclusions were supported.
14. **In conclusion, there is no evidence of any decline in the number of golden plover breeding attempts at the Farr wind farm or in the spatial pattern of territories either with respect to each other or the turbines. Using current evidence the most parsimonious explanation of the observed results is scenario 1 – no biologically significant impact**.

Contents

1. Background

1.1 Farr Wind Farm was granted consent on the 5th October 2004 and construction began in April 2005. The last of 40 turbines was erected in March 2006, in advance of the 2006 golden plover breeding season. The consent had a number of conditions, including a requirement to undertake a breeding birds monitoring programme from the consent date (annually for three years from commissioning and subsequently at five year intervals, at 5, 10 and 15 years after the construction phase).

1.2 This is an update, using data up to 2015, on the previous reports (Fielding and Haworth 2010, 2011).

1.3 The original analyses (Fielding and Haworth 2010) were predicated on three possible responses by golden plover to the wind farm construction and operation.

1. **No biologically significant impact**: under this scenario some minor annual variation in the number and distribution of golden plover territories is expected but no significant systematic impacts, related to the wind farm, would be apparent.
2. **Immediate and permanent displacement**: under this scenario it is expected that, immediately after construction, there would be a displacement of birds away from turbines, in the wind farm area, leading to a change in the spatial distribution of territories and a permanent reduction in the number of territories. The size of this reduction would be determined by the magnitude of the displacement distance. Following this impact there will still be some minor annual variation in the number and distribution of golden plover territories.
3. **Gradual and permanent displacement**: under this scenario it is expected that there would no immediate or large displacement of birds away from turbines but that displacement effects would accumulate over time if birds are site-faithful or habituated. As Ratcliffe (1976) noted, there are indications that individual pairs returning in successive years tend to nest closer to the site of the previous year than do new birds. Consequently, as the original occupants die, under this scenario, they would not be replaced within the displacement zone and after a few years, the distribution and abundance would resemble scenario two.

1.4 The conclusion of the analyses reported in Fielding and Haworth (2010, 2011) was that there was no evidence for a biologically significant decline in the number of golden plover breeding attempts at the Farr wind farm or in the spatial pattern of territories either with respect to each other or the turbines. Using current evidence the most parsimonious explanation of the observed results is scenario 1 – no biologically significant impact.

1.5 This report uses new data from 2011-2015 to test if the above conclusions are still valid.

2. Data

2.1 Data on locations of the golden plover territory centres and nest sites, during the 2011-2015 breeding seasons, were extracted from the Farr Wind farm Breeding Wader Reports (Rob Frith & Associates 2011, Coyle 2012, 2013, 2014, 2105). The survey methodology is the accepted standard for censusing upland breeding waders and is the methodology currently recommended by both SNH (SNH 2005) and the RSPB (Gilbert *et al* 1998).

2.2 In 2011 territory distribution data were gathered from four survey periods (158 hours) between April 15th and June 26th. An additional 135 hours was allocated to golden plover breeding observations, nest searching and colour ringing chicks.

2.3 In 2012 territory distribution data were gathered from three survey periods (63 hours) between April 29th and June 20th. An additional 161 hours was allocated to golden plover breeding observations, nest searching and colour ringing chicks.

2.4 In 2013 territory distribution data were gathered from four survey periods (128 hours) between May 7th and June 20th. An additional 64 hours was allocated to golden plover breeding observations, nest searching and colour ringing chicks.

2.5 In 2014 territory distribution data were gathered from four survey periods (128 hours) between April 29th and June 23rd. An additional 64 hours was allocated to golden plover breeding observations, nest searching and colour ringing chicks.

2.6 In 2015 territory distribution data were gathered from three survey periods (96 hours) between May18th and June 18th.

2.7 In 2012 - 2015 the reference/control area to the north of the wind farm was not surveyed.

3. Methods

3.1 Golden plover territories are split into control and wind farm groups depending on the distance between the territory centre and the nearest turbine. Any territory centre more than 500 m north of the upper row of turbines was assigned to the control group.

3.2 A variety of statistics are used to describe patterns in golden plover territory centres and nest locations and to provide evidence for the magnitude of any disturbance or displacement effects. Statistics were calculated for all sites and, separately, for the wind farm and control sites.

3.3 Location statistics were: minimum and maximum X and Y coordinates; mean and median centre (arithmetic mean and median of the x and y coordinates).

3.4 The relationships between territories and turbines were described in three ways.

a) Distance to the nearest turbine (minimum and maximum distances, mean distance, standard error of the distance, first quartile, median (second quartile) and third quartile. Distances were also calculated for the second, third fourth and fifth nearest turbines.
b) Area of a territory defined by a Thiessen polygon with a maximum radius of 500 m. (A maximum radius is needed to take account of unsurveyed regions and natural territory boundaries in the absence of neighbours. The area within a Thiessen polygon is closer to the point on which the polygon is centred than it is to any other point in the dataset.
c) Number of turbines within a territory Thiessen polygon (wind farm group only).

4. Results

4.1 Detailed results are presented in Appendix A.

4.2 In 2011 there were 39 territories, 25 in the wind farm group and 14 in the control group.

4.3 In 2012 there were 17 territories in the wind farm group. The 2012 Farr Wind farm Breeding Wader Report (Rob Frith & Associates, 2011) listed 16 territories but a nest (nest 3) with a single cold egg was located more than 800 m from the nearest territory centre and for the purposes of these analyses it was included as the 17th territory.

4.4 In 2013 there were 16 territories in the wind farm group, ten of which were within 200 m of a turbine.

4.5 In 2014 there were 22 territories in the wind farm group, ten of which were within 200 m of a turbine.

4.6 In 2015 there were 24 territories in the wind farm group, ten of which were within 200 m of a turbine.

4.7 Despite changes in the number of territories the number with territory centres within 200 m of a turbine has remained remarkably stable. If the wind farm had caused any displacement it would be expected that those closest to the turbines would be the most affected.

4.8 Six nest sites were identified in 2011. Five were identified during April when clutch sizes were determined. The sixth was found in May and contained egg fragments with an agitated female in close proximity.

4.9 Five nests were identified in 2012. Three were located in late May and a further two in the last two weeks of June.

4.10 Nine nests were located in 2013. Six were located in early May and three more in early June.

4.11 Seven nests were 2014, six were located between April 29th and May 19th, the seventh was found on June 20th.

4.12 The number of territories in the wind farm has been quite variable since 2008 and 2013 was the lowest recorded, although 2011 was one of the largest. 2014 saw a 37% increase over the 2013 figure with a further two territories in 2015.

4.13 As previously, there is no evidence from any of the location statistics to support Scenario 2 or 3. For example, there have been no systematic or significant shifts in the mean centres of golden plover territory centres (Fig. 1).

4.14 There is a slight suggestion that territory centres have moved away from turbine locations but this is largely due to additional territories around the periphery of the wind farm. (Table 2 and Figs 2a and 2b). However, the seven nests that were found in 2014 had a mean distance to a turbine of only 241 m.

4.15 Over the first nine years of recording the proportion of wind farm territory centres that were less than 200 m from the nearest turbine increased at approximately 3% per year (Table 1, percentage within 200m = 2.89.year -5761.5, R^2 = 84.7%). This trend is partly explained by the relative stability of the number of centres within 200 m of a turbine even when the total number of territories declined. The subsequent reductions in 2014 and 2015 are explained by the expansion of territories >200m from a turbine (Table 1).

4.16 There is no evidence for a significant change in either the number or density (number per km^2) of turbines in the territory Thiessen polygons (Tables 1 & 2). Although the number of territories has declined in 2012 and 2013 the number within 200 m of a turbine remained remarkably constant at approximately 10.

4.17 Similarly, nests are quite close to turbines. For example, in 2012 Nest 1 (predated) was approximately 300 m from the nearest turbine and adjacent to a track; nest 2 (4 chicks ringed) was 130 m from a turbine; nest 3 (single cold egg) was 124 m from a turbine; nest 4 (used nest found) was 350 m from a turbine and nest 5 (2chicks ringed nearby) was only 67 m from a turbine. Similarly, in 2013, four nests were located less than 200 m from a turbine including three at 66, 124 and 130 m from the nearest turbine. The seven nests that were found in 2014 had a mean distance to a turbine of only 241 m (range 115 - 427 m, including four with a distance of 200 m or less).

4.18 Figures 3 – 12 show the positions of territory centres and their Thiessen polygons in relation to the turbine locations and turbine 500 m buffer.

Table 1. Number of wind farm golden plover territories and the number of centres less than 200 m from the nearest turbine.

Year	Territories	Less than 200 m	
		n	%
2005	24	9	37.5
2006	27	11	40.7
2007	27	10	37.0
2008	27	13	48.1
2009	20	9	45.0
2010	18	10	55.0
2011	25	13	52.0
2012	17	9	52.9
2013	16	10	62.5
2014	22	10	45.5
2015	24	10	41.7

Table 2 Number of turbines, and turbine density, per territory Thiessen polygon.

	Turbines in Thiessen polygon								Turbines per km^2			
Year	**0**	**1**	**2**	**3**	**4**	**5**	**1+**	**(% 1+)**	**n**	**Mean**	**SE**	**Median**	**Max**
2005	3	10	6	5	0	0	21	87.5	24	4.1	0.57	3.7	8.4
2006	9	6	9	0	2	1	18	66.7	27	3.8	0.64	4.4	9.0
2007	8	7	8	3	1	0	19	70.4	27	3.6	0.60	3.4	10.3
2008	8	6	6	7	0	0	19	70.4	27	4.1	0.72	3.2	12.9
2009	3	6	6	4	0	1	17	85.0	20	3.8	0.52	4.0	8.6
2010	3	5	4	4	2	0	15	83.3	18	3.8	0.58	4.0	8.9
2011	4	10	5	1	4	0	20	80.0	25	4.4	0.67	3.7	7.6
2012	4	3	4	2	3	1	13	76.5	17	3.5	0.67	3.2	8.0
2013	3	2	5	3	3	0	13	81.3	16	4.0	0.65	4.3	8.0
2014	8	8	3	1	3	0	15	68.2	22	2.7	0.52	2.7	7.0
2015	8	8	2	3	3	0	16	66.7	24	3.5	0.82	2.3	17.2
All	61	71	58	33	21	3	186	75.3	247	3.8			17.2

Figure 1. Mean x and y coordinates (+) for wind farm golden plover territories 2005-2015. The 2005 centre is a filled circle; the 2015 centre is a filled circle (green). The turbine 500 m buffer is shaded grey. Contains Ordnance Survey data © Crown copyright and database right 2010

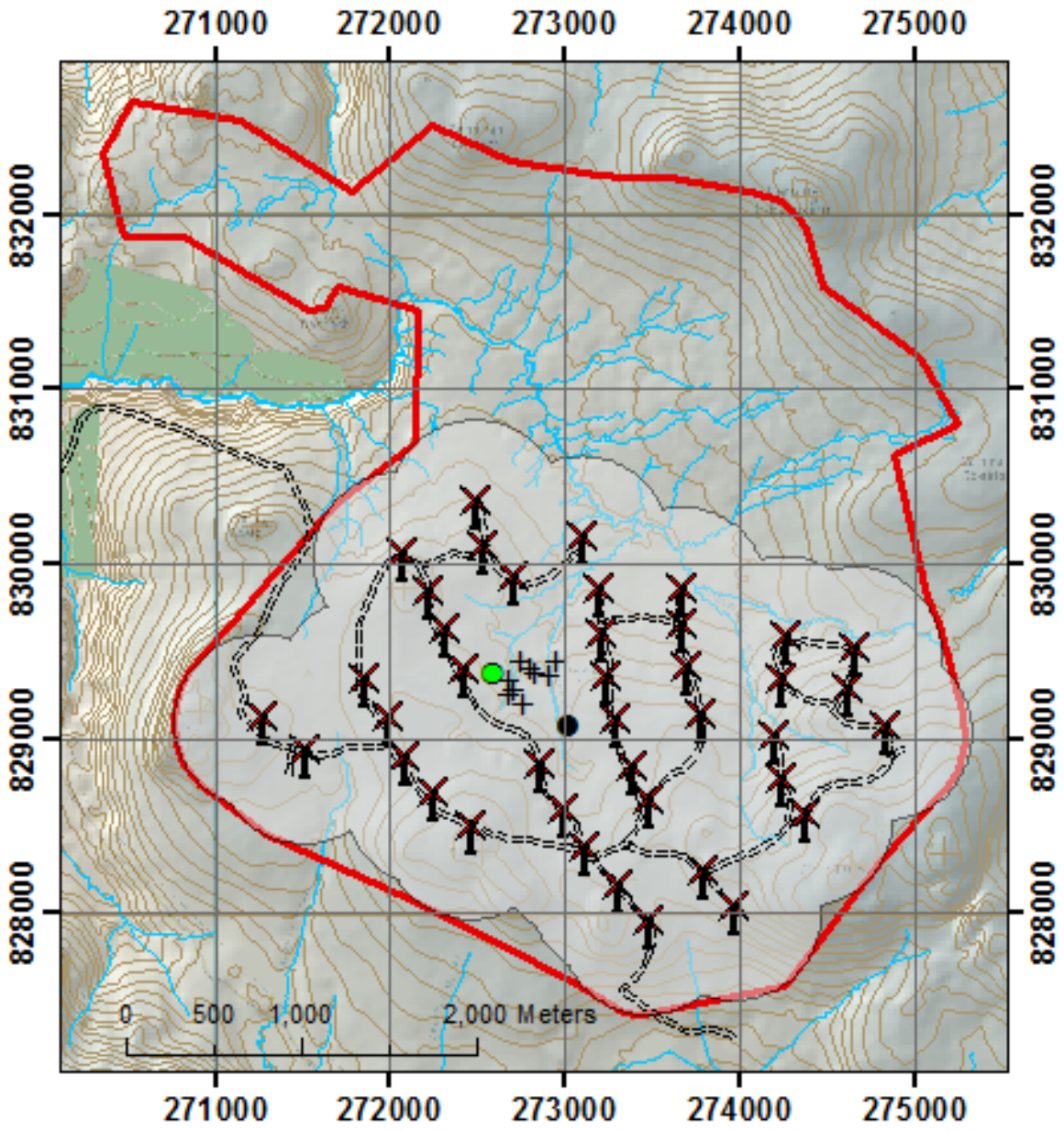
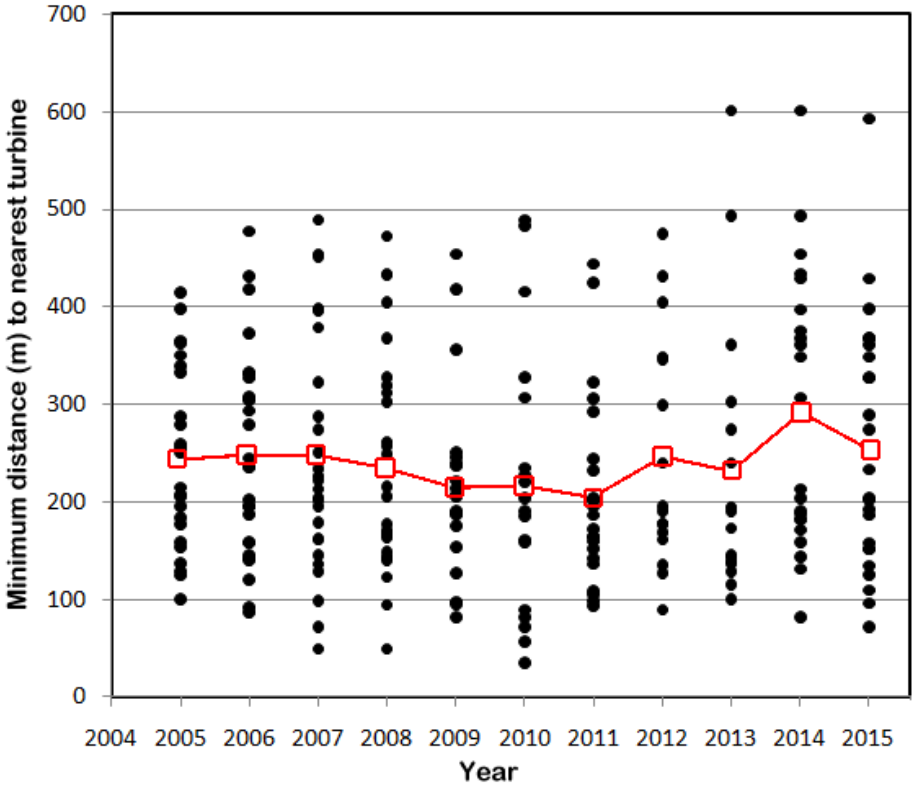


Figure 2a Minimum distances from wind farm golden plover territory centres to the nearest turbine 2b Mean distances from wind farm golden plover territory centres to the nearest five turbines. Means are shown for each year as red squares.



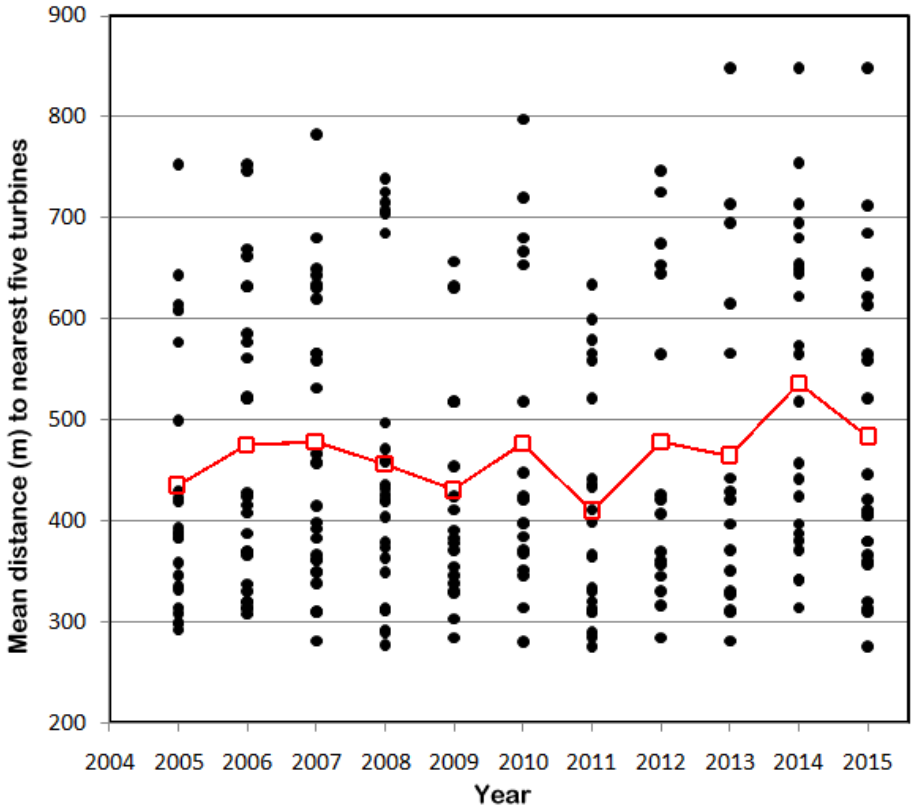


Figure 3. 2015 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

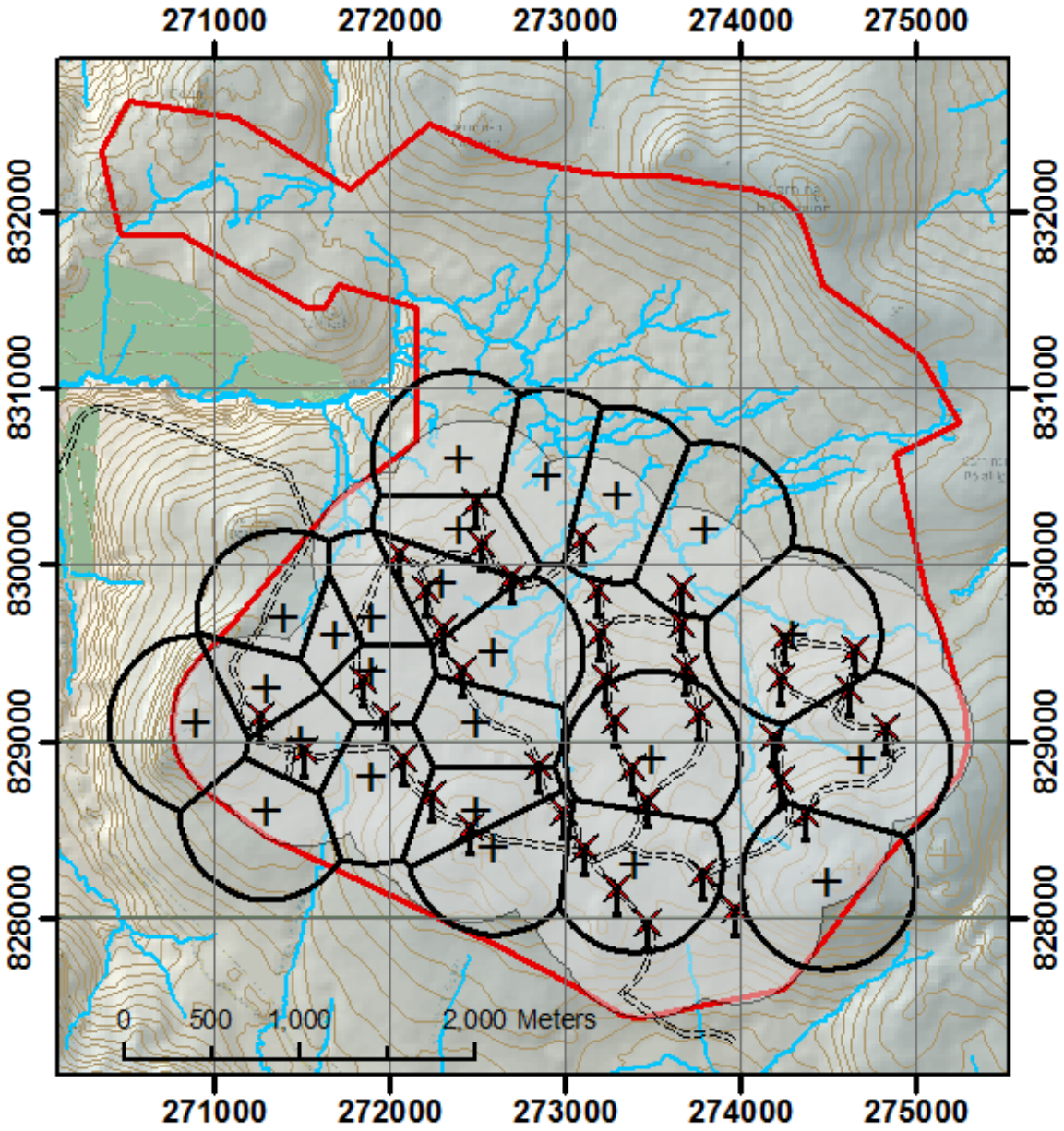


Figure 4. 2014 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Eight nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

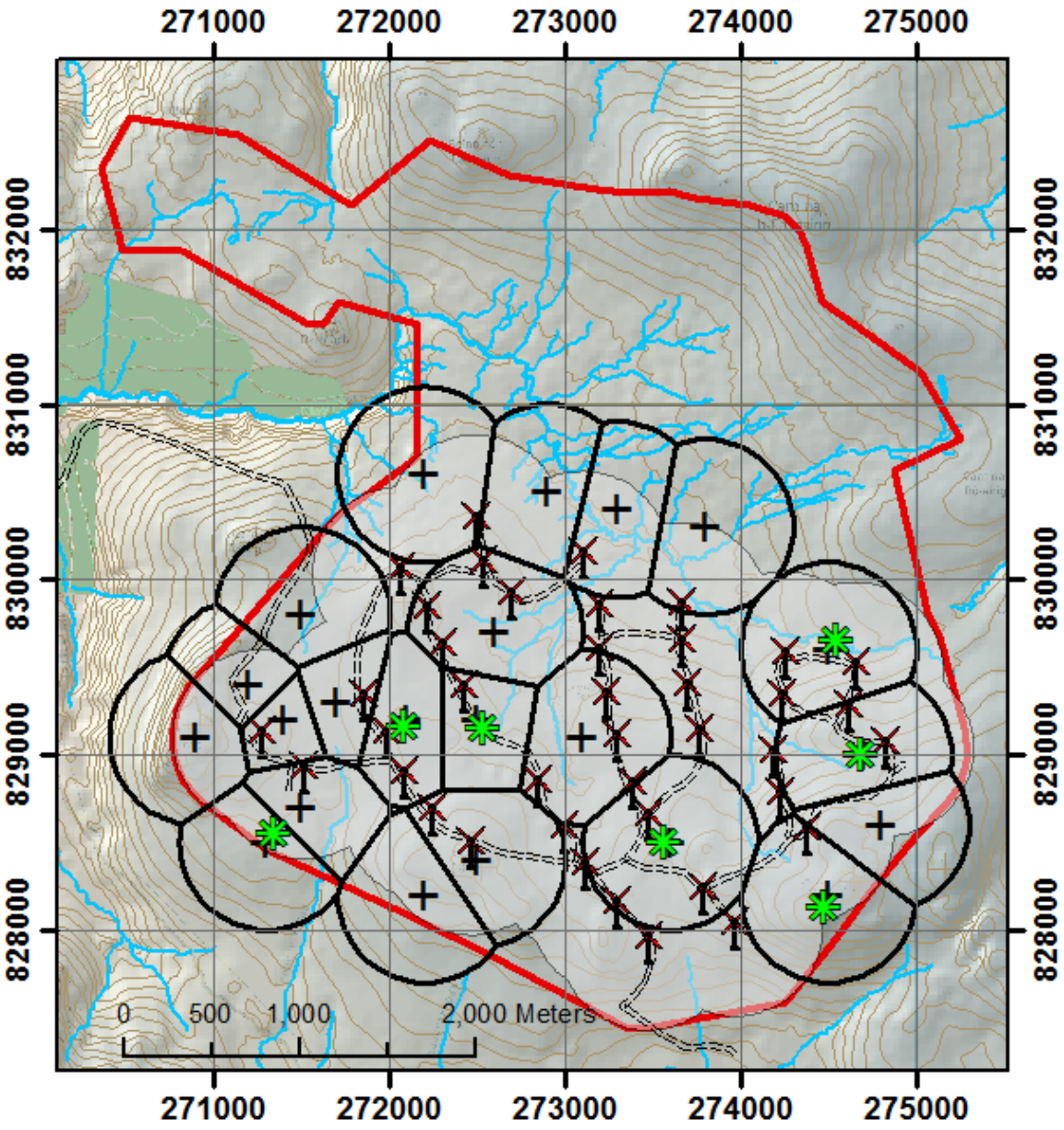


Figure 5. 2013 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Eight nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

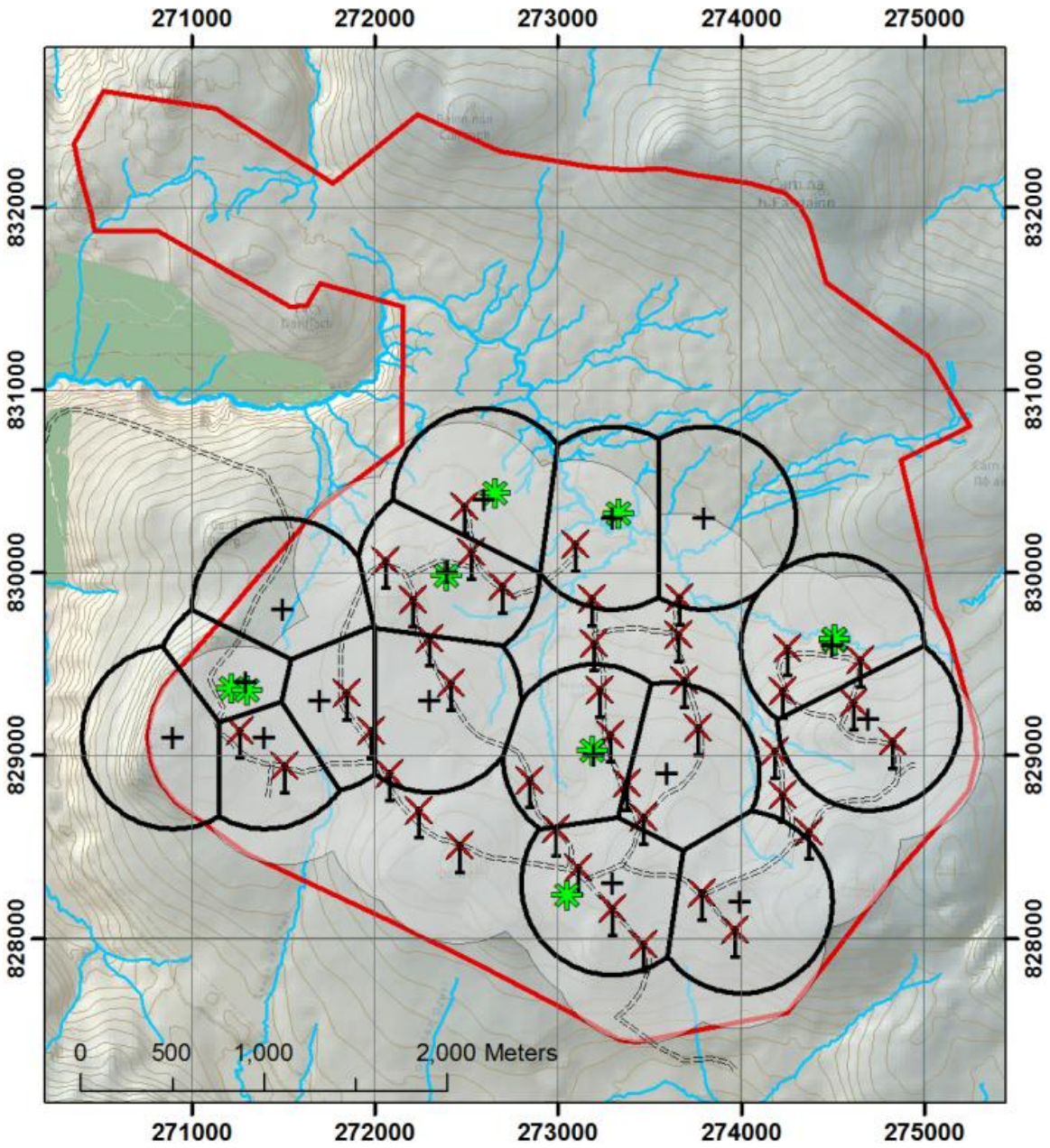


Figure 6. 2012 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Five nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

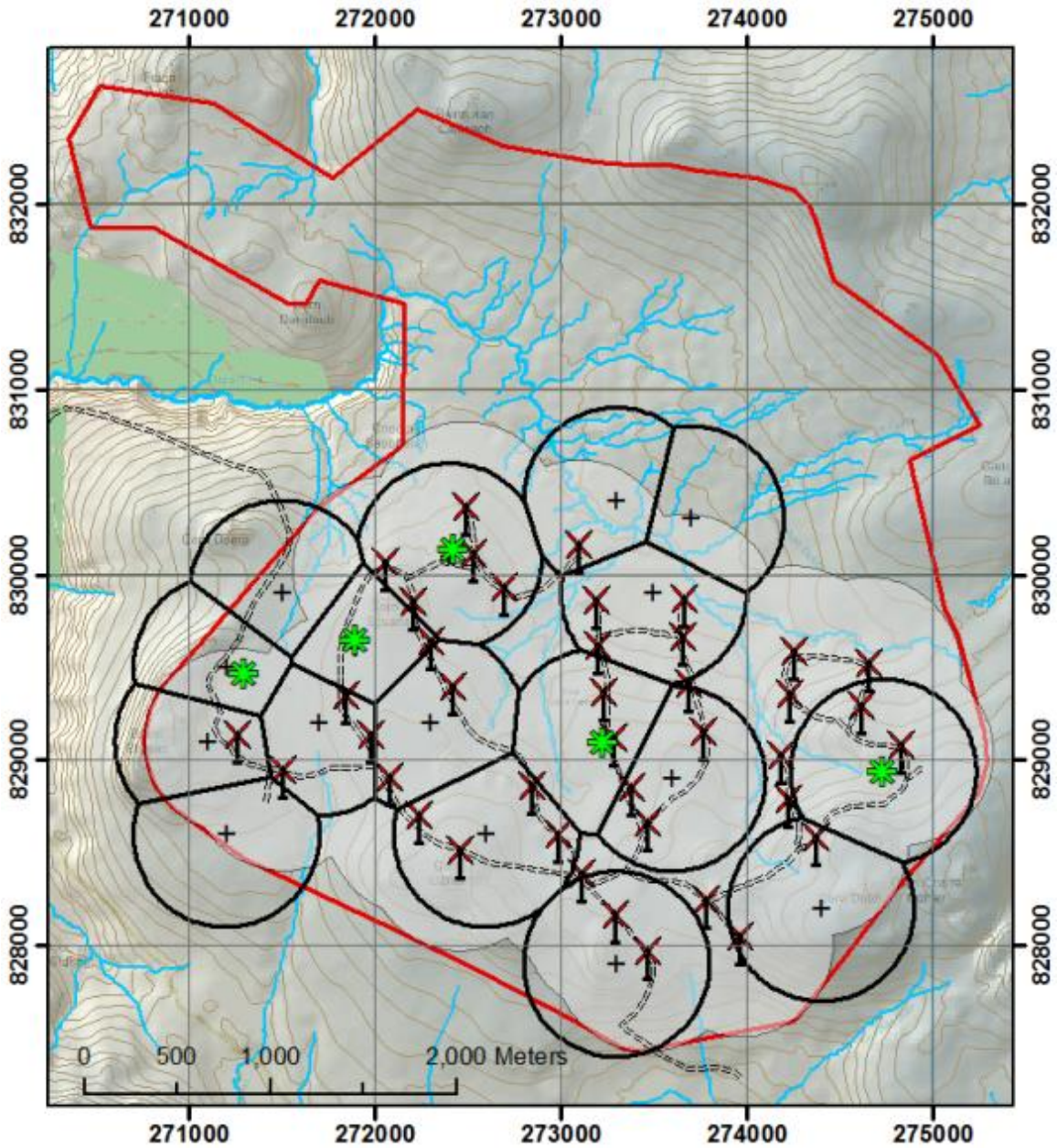


Figure 7. 2011 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Six nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

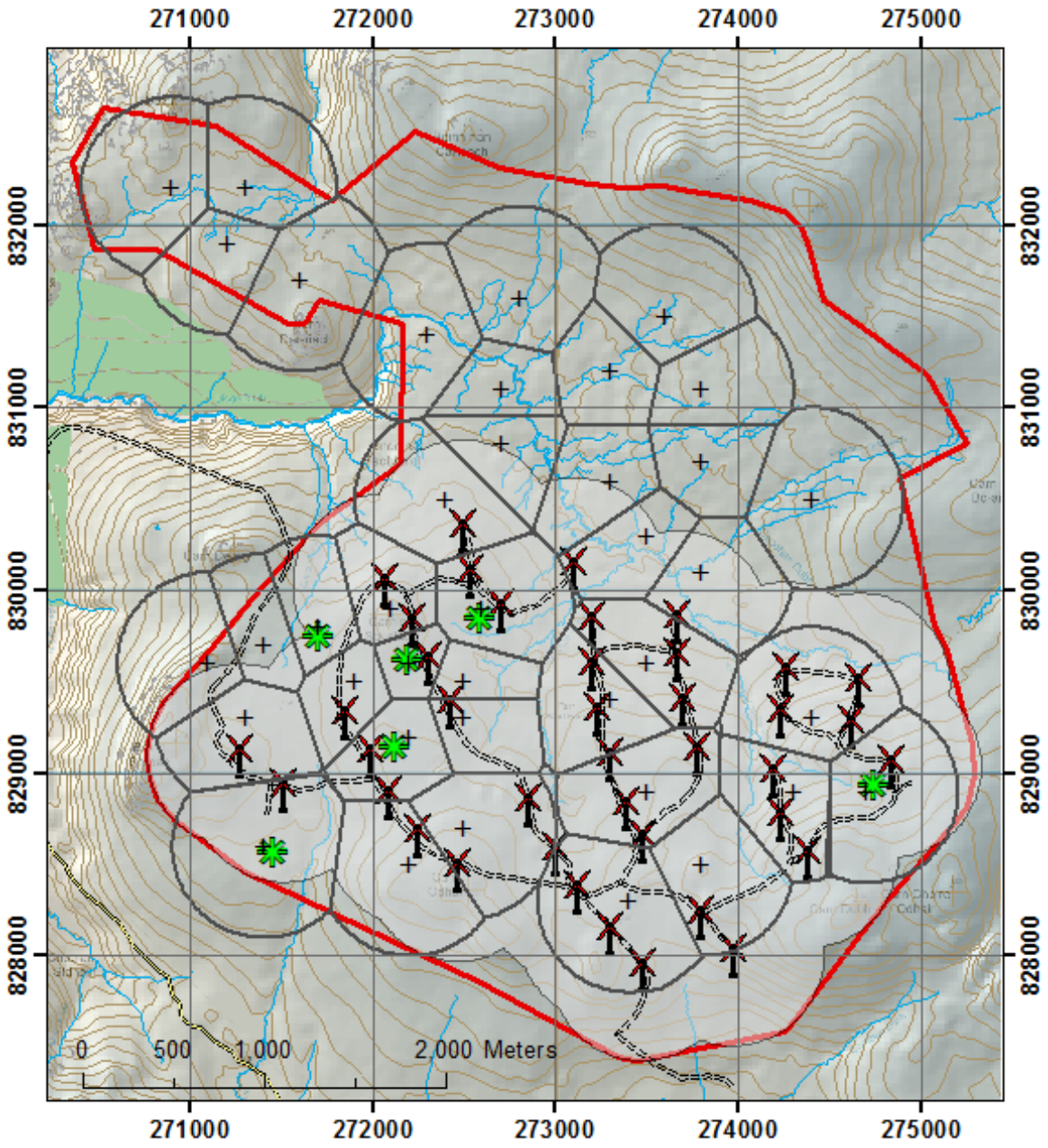


Figure 8. 2010 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

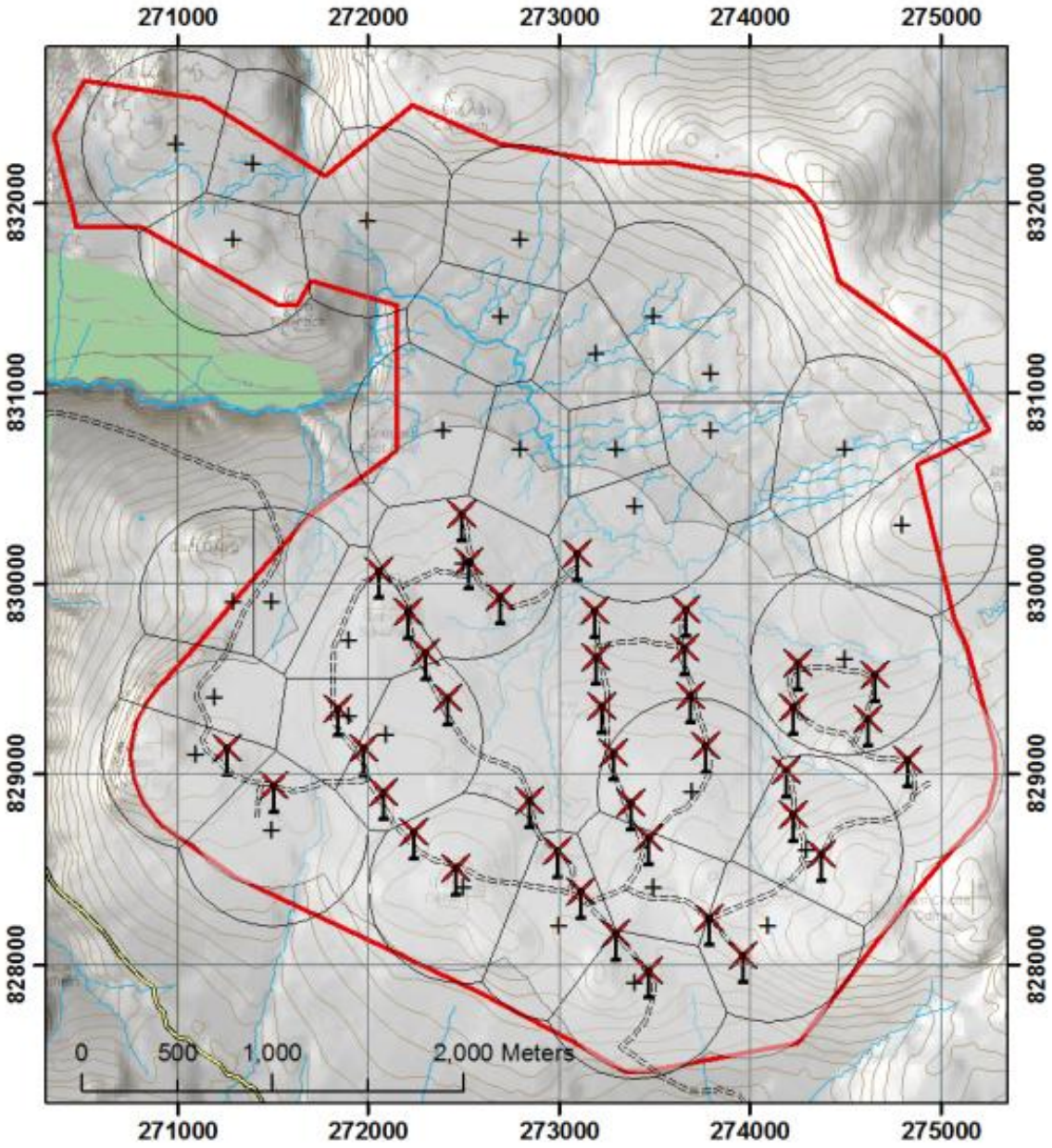


Figure 9. 2009 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

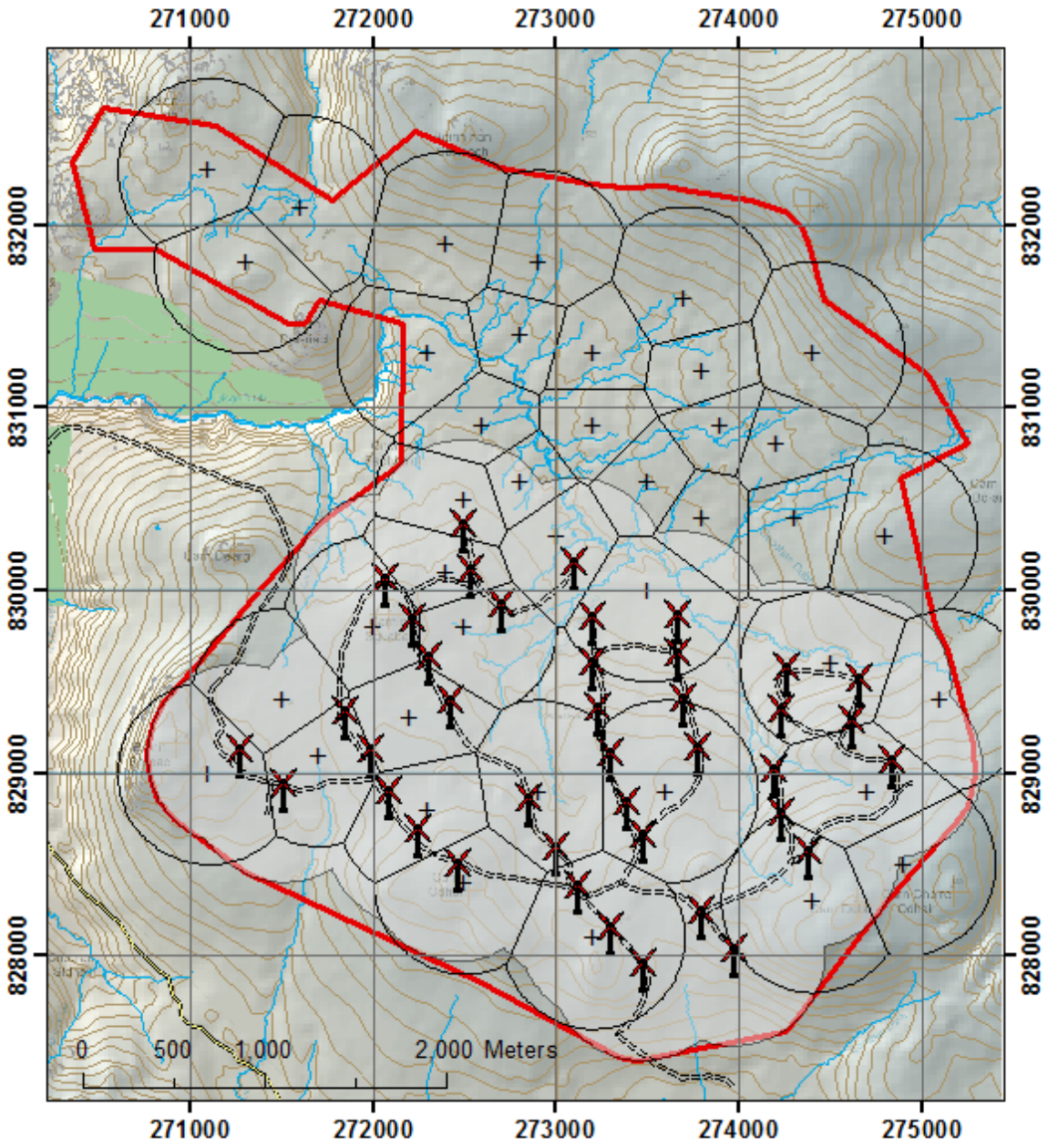


Figure 10. 2008 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. A single nest sites is shown as a green star. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

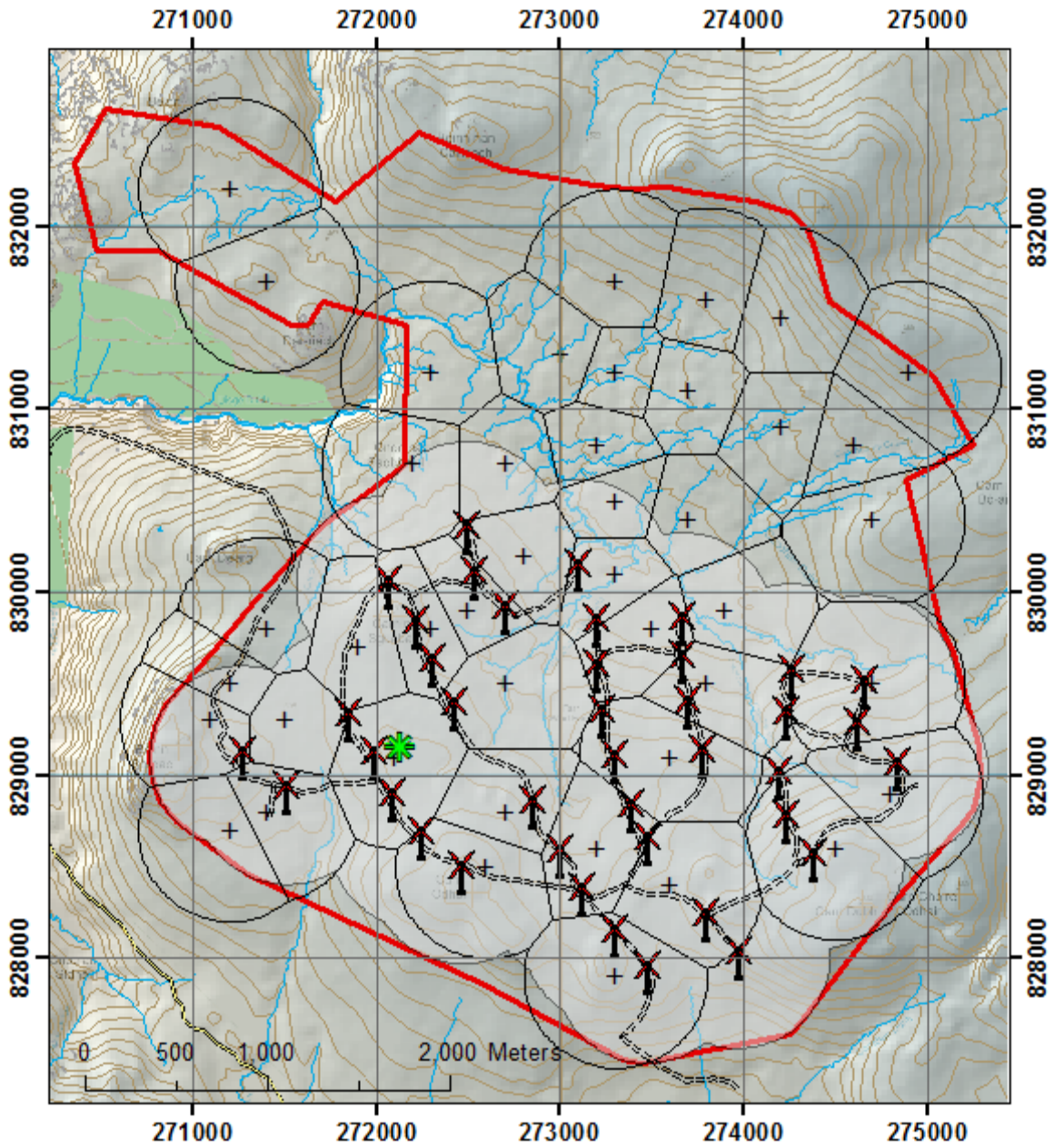


Figure 11. 2007 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

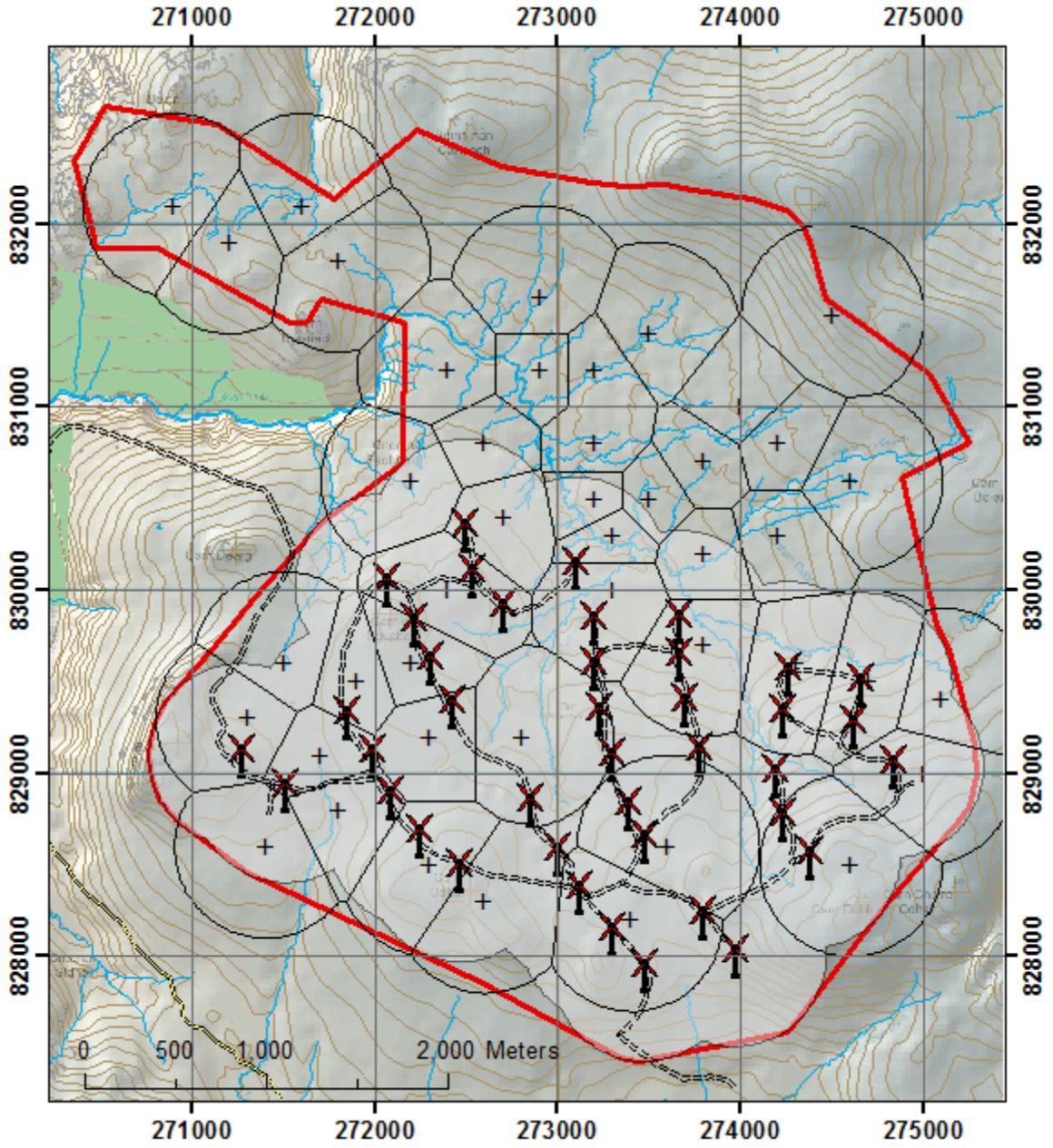


Figure 12. 2006 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.

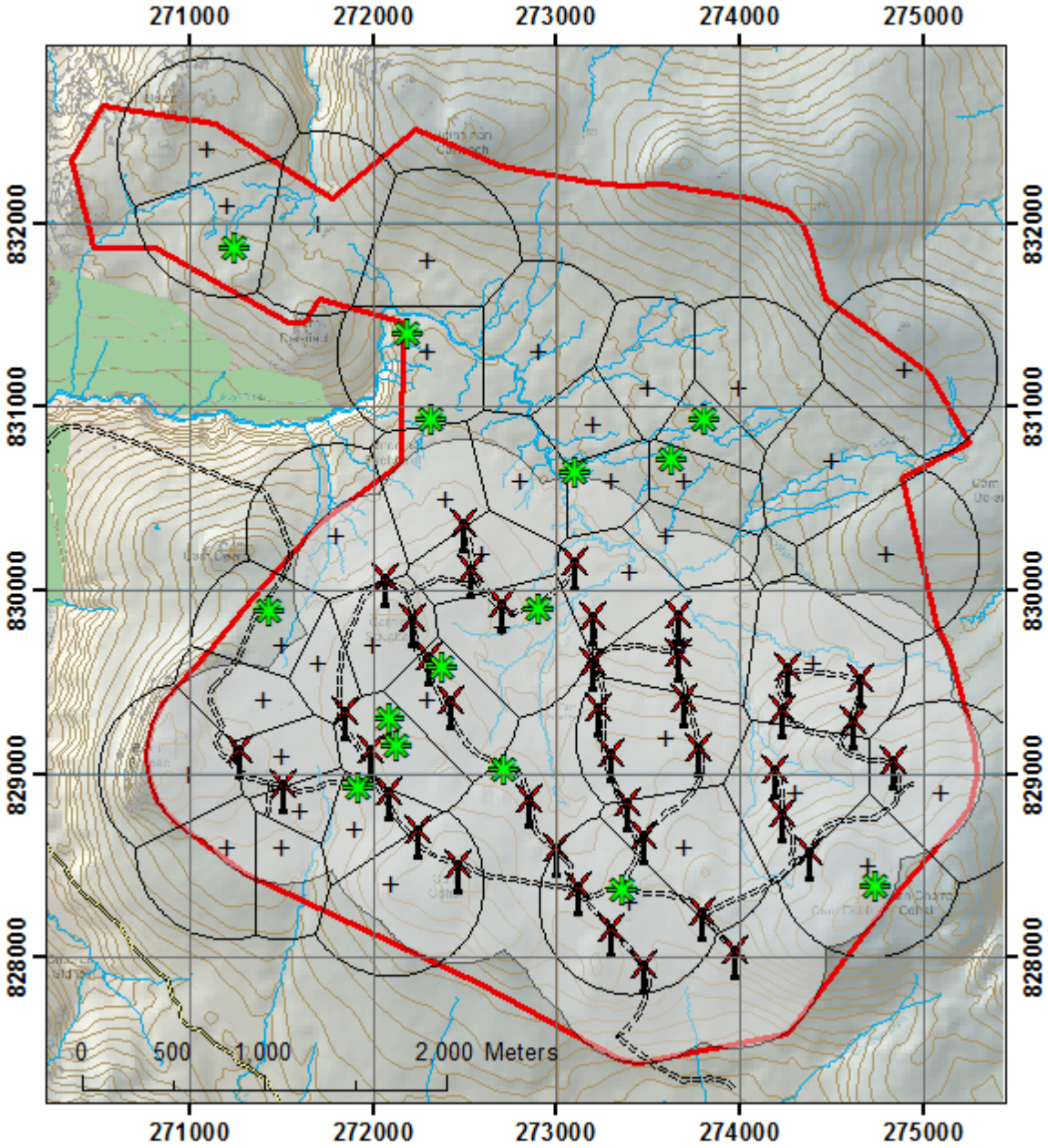
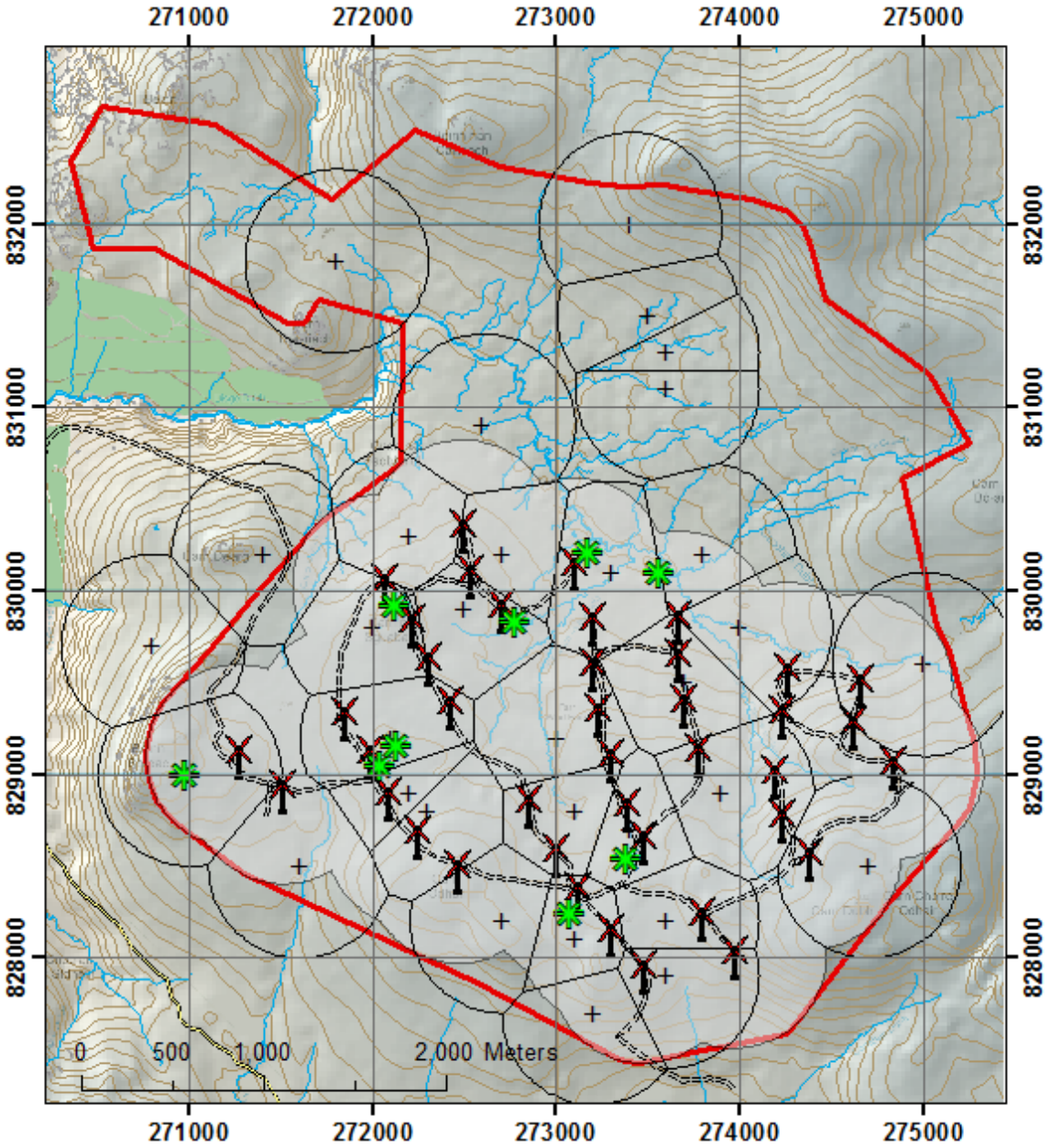


Figure 13. 2005 breeding season: Thiessen polygons, territory centres (+), plus turbines and 500 m buffer and wind farm red line boundary. Nest sites are shown as green stars. The grid is 1 km. Contains Ordnance Survey data © Crown copyright and database.



5. Discussion

5.1 This update uses data from 2011 to 2015 to test if the conclusions listed in Fielding and Haworth (2011) are still valid. In total this represents ten years of wind farm operation (2006-2014). Any impacts of the wind farm's operation should be apparent by now.

5.2 Under scenario 2 there would have been immediate displacement of golden plover away from the turbines. Pearce-Higgins *et al* (2009b) suggested a displacement distance of 200 m for this species. However, a more recent non-correlative study by Douglas *et al* (2011) supports the earlier conclusions of Fielding and Haworth (2010) since they found no significant difference in the changes in abundance of golden plover between a wind farm and a control site, and no evidence that changes in its distribution were related to the wind farm infrastructure.

5.3 The number of turbines in a territory Thiessen polygon (Table 2) has remained relatively constant irrespective if it is measured as a count or a turbine density. In conclusion, there is still no evidence for an immediate, or even delayed, displacement away from turbines.

5.4 There is also no evidence for a systematic change in the pattern of golden plover territories and there is no evidence to support the predicted 200 m displacement distance for golden plover reported in Pearce-Higgins *et al* (2009b). Indeed, the proportion of wind farm territory centres that are within 200 m of turbine bases has shown an increase over the years (Table 1), largely because the number of such territories has been remarkably stable.

5.5 Under scenario 3 there should be an annual decline in the number of golden plovers in the wind farm region at a rate that was a function of the annual adult survival rate. Although there was a decline in the number of territories in 2009, 2010, 2012 and 2013, 2011 saw an almost 40% increase in wind farm territories compared with 2010, while the control group decreased from 15 to 14.

5.6 It is unlikely that the wind farm is the direct cause of the recent declines. In 2010 there were larger declines in the control group. There were no changes in habitat management in the previous 24 months (Rob Frith & Associates, 2010, 2011).

5.7 2010 had the low number of territories over the monitoring period but this followed one of the most severe winters in recent history. The UK mean temperature between December 2009 and February 2010 were 2.0 °C below the 1971-2000 average, making it the coldest winter since 1978/79 and in northern Scotland it was the coldest winter on record, with the highest number of frosts[1]. It is known that golden plover survival rates are affected by winter severity (e.g. Parr 1992 and Yalden and Pearce-Higgins 1997).

5.8 Given the severity of the preceding winter it would be surprising if there had been no decline in golden plover numbers. Indeed Fielding and Haworth (2010) made such a prediction before the 2010 data were collected (paragraph 5.2.4 “If it is true that golden plover survival rates are affected by winter severity it is possible, given the weather between December 2009 and February 2010, that there may be a significant reduction in occupancy in spring 2010.”).

[1] HTTP://WWW.METOFFICE.GOV.UK/CLIMATE/UK/2010/WINTER.HTML

5.9 2012 and 2013 also experienced declines but these are almost certainly related to spring weather conditions. It is significant that declines are not evident in the immediate vicinity of the turbines with an almost constant 10 territory centres within 200 m of a turbine. This is reinforced by the proximity of nests to turbines and their presence between strings of turbines.

5.10 Spring 2012 was one of the wettest years on record and it is unlikely that golden plover were not affected by these very wet conditions.

5.11 In late May 2013 there was a low front centred over the UK and conditions were unfavourable for nesting plovers with frequent snow and hailstone squalls, strong north-easterly winds and thick fog. Very few plovers were observed on site during this period. June began quite mild with a light westerly wind. However, conditions tended to be overcast with limited sunny periods, which prevented the majority of the pools from drying out and the site remaining rather waterlogged.

5.12 Fielding and Haworth (2010) showed that, in the absence of recruitment, the wind farm population was expected to decline to seven pairs in 2011. The 2011 estimate of 25 pairs is more than treble this, and larger than the number (24) in 2005. The predicted number for 2013 was five pairs; again the actual figure is more than three times larger.

5.13 There is no reason to suppose, particularly given the distribution of territory centres and nest sites, that the declines in 2012 and 2013 were associated with displacement from the wind farm.

5.14 This is supported by the increase from 16 territories in 2013 to 22 in 2014 and 24 in 2015.

6. Conclusions

6.1 Hypothesis 2 was previously rejected since there was no evidence of an immediate change in golden plover distribution or abundance following the construction of the turbines prior to the 2006 breeding season. Eleven years of monitoring data confirms the absence of any wind farm induced change in golden plover distribution or abundance.

6.2 The remaining hypotheses 1 and 3 can be separated if there is robust evidence of a decline in the number of golden plover following construction of the wind farm in advance of the 2006 breeding season. Between 2006 and 2009 there was no evidence for the predicted population decline within the wind farm. Even the declines in 2010, 2012 and 2013 are much smaller than that predicted by a habituation-philopatry hypothesis and the reductions are consistent with observed variation in local populations and the previous severe winter conditions in 2010, the record braking wet conditions throughout 2012 and snow lying in May 2013. This explanation is supported by the recovery to the 2005 population size in 2011.

6.3 Also, the evidence presented against Scenario 2 is relevant. Between 2011 and 2015, the sixth to tenth years of breeding with turbines present, there was no evidence for a change in the overall locations of golden plover territory centres and no evidence for an avoidance of turbines. This was true when nest locations, rather than inferred territory centres, were used.

6.4 **In conclusion, there continues to be no evidence for a decline in the number of golden plover breeding attempts at the Farr wind farm or in the spatial pattern of territories either with respect to each other or the turbines.**

6.5 **Using current evidence the most parsimonious explanation of the observed results is scenario 1 – no biologically significant impact arising from the operation of this wind farm**.

6.6 **In the absence of any habitat management changes, it seems very unlikely that this wind farm will have any impact on the local golden plover population for the remainder of its active life.**

6.7 **Consequently, the conclusions from the Pearce-Higgins *et al.* (2009b) study, at least for golden plover, are not supported by empirical evidence. The results do, however, agree with the later findings by Douglas *et al.* (2011) that included golden plover "There was no significant difference in the change in abundance of either species between the wind farm and control site, and no evidence that changes in the species' distribution were related to wind farm infrastructure."**

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Appendix A. Statistics

A.1. Territory average centres (after 2011 only the wind farm was surveyed)

All territories		Minimum		Maximum		Mean		Median	
Year	n	x	y	x	y	x	y	x	y
2005	32	270800	827700	275000	832000	272919	829578	273100	829550
2006	43	271000	828300	275100	832400	272819	829998	272700	829800
2007	44	270900	828200	275100	832100	273005	830130	273050	830250
2008	43	271100	827900	274900	832200	273007	830026	273200	829900
2009	40	271100	828100	275100	832300	273078	830223	272950	830350
2010	33	271000	827900	274800	832300	272748	830091	272800	830100
2011	39	270900	828300	274700	832200	272715	830059	272600	832200
Min	32	270800	827700	274800	832000	272748	829578	272700	829550
Max	44	271100	828300	275100	832400	273078	830223	273200	832200
Control Territories									
2005	8	270800	829700	273600	832000	272588	831063	273000	831200
2006	16	271100	829700	274900	832400	273043	831119	273250	831100
2007	17	270900	830300	274600	832100	273082	831218	273200	831200
2008	16	271200	829800	274900	832200	273306	831113	273500	831200
2009	20	271100	830300	274800	832300	273147	831221	273200	831300
2010	15	271000	829900	274800	832300	272727	831160	272800	831200
2011	14	270900	830500	274400	832200	272642	831425	272600	831100
Min	8	270800	829900	273600	832000	272588	831063	272600	832200
Max	19	271200	830300	274900	832400	273306	831221	273500	832200
Wind farm territories									
2005	24	271000	827700	275000	830300	273029	829083	273100	828950
2006	27	271000	828300	275100	830600	272685	829333	272400	829200
2007	27	271300	828200	275100	830800	272956	829444	272700	829500
2008	27	271100	827900	274800	830700	272830	829381	272700	829500
2009	20	271100	828100	275100	830600	272920	829360	272650	829350
2010	18	271100	827900	274500	830800	272767	829200	272650	829150
2011	25	271100	828300	274700	830500	272748	829452	272500	830500
2012	17	271100	827900	274736	830400	272684	829261	272600	829200
2013	16	270900	828200	274700	830400	272781	829389	272900	829300
2014	22	270900	828200	274800	830600	272673	829250	272500	829200
2015	24	270900	828200	274700	830600	272563	829354	272450	829650
Min	17	270900	827700	274800	830300	272685	829083	272400	828950
Max	27	271300	828300	275100	830800	273029	829444	273100	830500

A.2. Areas (ha) of Thiessen polygons constructed around golden plover territory centres (mean, standard error, 1st quartile, median, second quartile, minimum, maximum, sample size, upper and lower 95% confidence limits).

Year	Mean	SE	Q1	Median	Q3	Min	Max	n	LCL	UCL
All territories										
2005	46.6	3.1	33.3	44.5	64.6	17.4	78.5	32	40.4	52.8
2006	37.5	2.4	22.4	39.2	51.4	11.1	68.4	43	32.7	42.3
2007	36.7	2.4	20.8	39.1	47.7	11.6	69.7	44	31.9	41.5
2008	38.3	2.1	26.7	33.6	48.1	16.9	64.8	43	34.0	42.6
2009	40.9	2.4	24.6	41.1	52.0	14.9	69.9	40	35.9	45.8
2010	44.4	2.3	33.4	45.0	55.1	20.8	72.9	33	39.8	49.0
2011	37.5	2.1	26.4	37.8	48.4	11.5	67.6	39	33.3	41.7
Control										
2005	55.8	6.8	38.6	64.3	67.4	21.1	78.5	8	40.1	71.6
2006	40.0	4.1	23.0	43.1	52.9	14.6	68.4	16	31.3	48.7
2007	35.5	4.1	19.5	37.1	49.6	12.8	69.7	17	26.9	44.1
2008	40.6	3.9	28.1	37.9	55.9	16.9	64.8	16	32.4	48.9
2009	37.1	3.3	23.2	36.9	50.0	16.5	58.5	20	30.2	44.0
2010	41.6	3.3	31.1	37.7	55.0	20.8	61.6	15	34.4	48.7
2011	39.6	3.4	28.3	37.5	49.9	22.8	64.2	14	32.3	46.9
Wind farm										
2005	43.5	3.2	32.6	41.4	48.3	17.4	78.5	24	36.9	50.2
2006	36.0	2.9	22.4	32.7	48.9	11.1	64.3	27	29.9	42.0
2007	37.4	3.0	22.6	39.1	46.4	11.6	68.9	27	31.3	43.6
2008	36.9	2.6	26.4	33.5	46.7	18.1	63.6	27	31.7	42.2
2009	44.6	3.5	32.7	41.7	59.5	14.9	69.9	20	37.3	51.9
2010	46.8	3.0	34.1	47.8	57.5	22.8	72.9	18	40.4	53.2
2011	36.4	2.7	25.4	37.8	44.0	11.5	67.6	25	30.8	42.0
2102	55.1	3.5	46.8	52.4	65.5	31.4	78.5	17	48.1	62.1
2013	52.6	3.0	50.2	55.2	60.4	25.1	68.5	16	46.3	58.9
2014	48.8	3.3	32.6	50.3	60.4	16.3	73.3	22	41.8	55.7
2015	42.4	3.7	23.3	41.6	52.9	11.4	71.9	24	34.8	50.0