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**NOVAR WINDFARM LTD
ORNITHOLOGICAL MONITORING
STUDIES**

**BREEDING BIRD AND
BIRDSTRIKE MONITORING
2001 RESULTS & 5-YEAR REVIEW**

November 2001

Bioscan Report No.
E1003BM1

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1 SUMMARY

This report presents the findings of the fifth year, (2001) of the Novar Windfarm Ornithological Monitoring Studies. The first report (Bioscan E0607R1 1997), principally monitored the breeding birds at Novar from May to July 1997 during the peak of the windfarm construction phase and subsequent reports have compared the operating windfarm with matched "control" 1km survey squares.

The survey methodology has remained essentially the same throughout, but additional features have become monitored as their potential importance became apparent. For the second year blue hare numbers, as a potentially important eagle prey item, have been followed. There is now a formal assessment of the association between "muirburn" and breeding birds.

The report continues to incorporate the findings of weekly searches for birdstrike casualties, which began in late 1997 once the turbines became fully operational. In 2000 and 2001, the success of birdstrike monitoring was also tested by placing carcasses at randomly chosen turbine positions.

Birdstrike monitoring

During the monitoring period since first operation, five bird strike casualties have been recorded. Three have been grouse and two kestrels. The circumstances of all but one the strikes suggest collision with stationary turbines, i.e. when birds are perhaps less able to detect the machines by sound.

There are now two years when an estimate of bird strike rates have been available in parallel with testing of retrieval rates, taking into account both birds removed by scavengers before they could be recorded and the monitor's success rate at finding carcasses that remain. These data suggest that there are approximately 1.4 casualties for every recorded corpse. In turn this suggests about five birdstrikes from the whole windfarm in the last two years, giving a risk rate per turbine of approximately 0.08 casualties per year. This compares with the lower range of risk estimates from elsewhere, rather than greatly higher rates from windfarms in the Netherlands that are near to concentrations of wildfowl and / or waders.

Breeding Bird Monitoring

In 2001 as in 2000 observation conditions were less hampered by weather than in some previous breeding seasons. As in previous years, a summary of the weather conditions encountered during observations has been included.

Among raptors, golden eagles appear to have fledged young again, although this happened at a new eyrie that was not discovered until August. This means that this eagle range has been highly productive during the monitoring period, missing only one year (2000).

Peregrine again attempted to breed at only one eyrie, but this appears to have failed in conjunction with a cold and wet northerly weather period. Productivity of the species during the monitoring period has been average, with one out of two eyries rearing young in most years. After years of absence, merlins have reappeared during 2000 to 2001, but breeding is uncertain as yet. There continue to be observations of hen harrier but as yet no breeding reestablished. Red kites occasionally use the windfarm altitudes but activity at lower levels appears to have increased.

Among ground nesting species, red grouse appeared to be in a declining part of their cycle, observations having peaked in 1999. This species and meadow pipit appear to do better in windfarm squares than in controls, but only in good years for the species overall, i.e. it is possible that the "up" part of fluctuations are enhanced in windfarm squares. This could be due to shelter from predation.

Skylark have done well in alternate years in the study period, with 2001 again being a good year. The full monitoring period has now produced enough data to map all registrations of this and even the more sparse species of importance. As a result, habitat associations (especially strong for skylark) can be seen. Several species are localised within the overall study area, favouring low altitudes and / or edges with forestry habitats that tended to be within control rather than windfarm squares.

Effects from the windfarm itself on bird distribution or numbers have proved to be very small, with the only population effects appearing to be the favouring of red grouse and meadow pipit in good years. If this is truly due to a predator shelter effect, this means that there is some behavioural avoidance of the turbines by the main raptor predators. However this latter effect, if present, is too small to detect from the direct structured observations of the predators and has had no effect on the productivity of species such as golden eagle and peregrine that breed in the general area.

Moorland management and density of prey species

Overall, moorland management directed at Red Grouse requirements has increased the numbers of this species and possibly also increased the number of Blue Hares present. Blue hares are however more influenced by the habitat restoration on road verges and around turbine bases: they concentrate on the locally greener vegetation there. Other species such as meadow pipit and golden plover appear to be unaffected judging from the last three years' results.

Overflying species

Grey geese again dominated observations of overflying species, but foot-and mouth restrictions meant that observations started too late for greylags. Flocks of up to 164 and 350 pinkfeet were encountered and as in previous years they avoided turbine areas. Flight corridors observed were in Strathrusdale, Glenglass and over Strath Mor and over Loch Glass and Meall Mor.

2 INTRODUCTION AND METHODS

2.1 Introduction

- 2.1.1 This report presents the results of monitoring of moorland breeding birds at National Wind Power's Novar windfarm for the 2001 breeding season. The specification for the studies remains as in 1998. (Bioscan Report No E0771R2), with the agreed additional works of mapping the distribution of Blue Hares carried on in 2001 as in 1999 - 2000. An assessment of the impact of muirburn on breeding birds has also been made in 2000 and 2001.
- 2.1.2 Weather conditions in 2001 followed last year in being less restrictive on observations than in 1999 with only a few days when conditions prevented or delayed observations.
- 2.1.3 In addition to the breeding bird monitoring, tests were made of the efficacy of birdstrike monitoring by using decoy corpses placed at random locations. The results of the testing and the effect on judgement on the amount of mortality are discussed in this report.

2.2 Specification

- 2.2.1 To undertake systematic monitoring of moorland breeding birds over a given area containing the windfarm site. Also, to survey simultaneously over a comparable area of adjacent moorland to provide a "control site", against which any recorded differential in breeding bird behaviour or productivity, (breeding success), can be evaluated. The emphasis of the breeding bird studies is to be placed upon Golden Plover, Red Grouse, Red throated Diver and all "raptor" species. All other breeding birds are to be recorded simultaneously.
- 2.2.2 To check within 50 metres of each operational turbine on a weekly basis to search for any "birdstrike" casualties, (i.e. birds killed or injured), as a consequence of colliding with the operational wind turbines.
- 2.2.3 The studies are to commence in the first year of construction and, subject to annual review, are to continue for a period of 5 years. (see appendix 2 for detail of specification).
- 2.2.4 The strategic purpose of the above studies are to enable all parties involved, (see below), to determine whether the construction and operation of the Novar Windfarm incurs any measurable, or detectable effects upon the local bird community that may be directly attributed to the construction and/or operation of the windfarm at Novar.
- 2.2.5 The results of the monitoring studies are to be collated and provided, in confidence, to all parties at the end of each season, prior to a meeting at which the findings will be discussed and the requirements for future studies agreed. Copies of this report will be provided to:

Mr. R.J. Graham	Ornithological surveyor.
Mr. Allan Todd	The Highland Council
Mr. Peter Wortham	Scottish Natural Heritage
Mr. George Campbell	RSPB
Ms Kenna Chisholm	RSPB
Mr. C White / Peter McLellan	National Wind Power Ltd.
Mr R.Munro Ferguson	Novar Estate
Dr Charles Gibson	Bioscan (UK) Ltd

Note: As the report contains detailed information on bird species protected by law, additional copies of this report will not be issued by Bioscan without the prior written approval of Scottish Natural Heritage and RSPB.

2.3 Methodology

- 2.3.1 A “constant search” method was employed to establish the number of territory holding birds in both the windfarm site and control site totalling 20 square kilometres. Each 1 x 1 kilometre square was subdivided into four, 500 x 500 metre squares and each of these quadrants was searched for a constant duration of 20 - 25 minutes during which all sightings of species were recorded according to activity and behavioural criteria. Sightings of species made outside this framework were also noted, but separately as *Supplementary Records*.
- 2.3.2 The survey specification called for three visits to each quadrant during the breeding season, avoiding wet or very windy weather. Full coverage was achieved.
- 2.3.3 The first survey period was completed between 1st and 11th May (inclusive). The subsequent two visits were completed subject to occasional difficult weather conditions. Stalking limitations did not affect this survey (Appendix I), although access in April for checking overflying species was delayed by foot and mouth disease restrictions.
- 2.3.4 In the case of “off site” raptors the nest sites have been monitored according to standard Raptor Study Group techniques. Information on known raptor nest sites and previous breeding success has been provided by the Highland Raptor Study Group, (HRSG) and combined with any additional nest sites identified during the pre-application studies to enable the most comprehensive coverage possible.
- 2.3.5 On completion of the field observation work, individual maps were produced to record each registration (recorded bird activity), using the letters A, B and C to identify for each of the monthly field visits.

2.3.6 Lines were drawn round those registrations estimated to denote a breeding pair. For a "cluster" to be accepted as attempted breeding or breeding one of the following has to be recorded.

1. 1 nest.
2. A pair with young.
3. A pair acting as if with young.
4. A bird, or birds present in the same area on two or more occasions, showing signs of attachment to the area.

3 BIRDSTRIKE MONITORING RESULTS

- 3.1 Before 2001, the only casualties reported had been an immature kestrel on 4th February 1998 and a red grouse on 14th May 2000. Both these casualties proved on examination of the bird and turbine performance records to have injuries consistent with collision with the tower or with blades that had been stationary at the time.
- 3.2 Two more grouse casualties and a second kestrel were reported during 2001. In addition, test carcasses continued to be placed for the monitor in the course of 2001 to check on efficiency and estimate rates of removal by scavengers. Both monitoring and testing were however suspended from 25th February to 28th April 2001 because of foot-and-mouth disease precautions. This means that fifteen months in all of tested monitoring are now available. The results are summarised in Table 1.

Table 1. Retrieval rates of test carcasses

	Retrieved	Scavenged	Missed	Total	Efficiency	Correction
2000 post-training	22	2	5	29	75.9	1.32
17-18/2/1	3	0	1	4	75.0	1.33
2-3/6/1	3	0	3	6	50.0	2.00
23-4/6/1	3	0	3	6	50.0	2.00
28-9/7/1	5	0	2	7	71.4	1.40
25-6-8/1 small	1	0	0	1	100.0	1.00
25-6-8/1	4	0	2	6	66.7	1.50
22-3/9/1	6	0	0	6	100.0	1.00
Nov 01	15	0	9	24	62.5	1.60
Total 2001	40	0	20	60	66.7	1.50
Overall	62	2	25	89	69.7	1.44
Observed mortality	3			4.306		
N turbines				34		
Over years				1.25		
Rate/turbine/year				0.101		

- 3.3 Table 1 shows the number of test birds (usually pigeon to buzzard size) that were **retrieved** successfully by the monitor, assumed to have been **scavenged** because neither monitor nor placer found them and **missed** by the monitor and later picked up by the tester. This allows a percent **efficiency** to be calculated and thence a **correction** factor that finds the number of birds estimated to have been killed for every casualty found.
- 3.4 Rows show these measures carried forward as a total for the 2000 study, for each test occasion in 2001, then the 2001 total and overall total for both years. This last is probably the best estimate of efficiency, giving an overall estimate of 1.44 casualties for every bird picked up.

- 3.5 Ignoring data prior to 2000 and up to early July in that year because the monitor was untested, three real casualties have been observed (one kestrel and two grouse), suggesting an estimated total of 4.3 over the 15 months' observations. Taking into account the number of turbines and the time, this gives an estimated casualty rate of just over 0.1 per turbine per year, i.e. an average turbine at Novar would give rise to a casualty in a period of something like ten years.
- 3.6 This is a small data set and, when even larger data sets give rise to wide statistical uncertainties in casualty rates, must be regarded as a "ball-park" figure. However it is comparable with the low (0.02 to 0.07) total rates observed in Californian studies rather than those observed in Dutch wind farms with large concentrations of waders and waterfowl. The latter have been estimated at more than two orders of magnitude higher than this.

4 BREEDING BIRD MONITORING RESULTS FOR 2001

4.1 Water birds

Red-throated Diver: Red Data bird, Amber List, Schedule 1, Annex 1, Appendix II.

As it would be easy to pinpoint this Schedule 1 bird, Lochs known to hold (or have held) divers are recorded as Lochs A- K on Wyvis, Novar and Kildermorie Estates. No young were observed this year on any lochs. The diver island was not put out due to foot and mouth precautions.

- 25.04.01 Loch E. A pair of divers called once. One bird showing a lot of belly white and making ripples on calm water. Birds present for almost three hours.
- 26.04.01 Loch J. A pair present at head of loch feeding (one caught a large trout).
- 09.05.01 Loch C. One bird present at south end. No sign of diver island at usual mooring.
- 10.05.01 Lochs A,B,F & K. Checks showed no birds present.
Loch C. A single bird near head of loch.
Loch D. A pair of birds present.
- 03.06.01 A single bird flying over Wyvis lodge.
- 22.06.01 Loch C. No birds obvious.
- 23.06.01 Loch D. Three birds present together.
Lochs A,B,F & K. No birds present.
- 25.06.01 Loch C. A single bird present at east end of loch.
- 27.06.01 Loch E. A pair of birds present.
- 30.07.01 Loch E. A pair of birds present for more than one hour.
- 12.08.01 Loch A. Three birds present – one departed.
Loch B. A single bird flying high over loch and calling.

Supplementary records from keepers

- 23.06.01 Loch A. Birds seen recently on this water.
Loch C. A pair and a single bird noted.
- 24.06.01 Two birds calling high over Tigh na Craig.

Black-throated Diver: Red Data bird, Amber List, Schedule 1

- 06.08.01 Loch J. A pair observed fishing (keeper also reported this pair).

4.2 Raptors and owls

Red Kite: Red Data bird, Red List, Schedule 1, Annex I, Appendix II.

- 08.05.01 A single bird on Meall an Leathaid C6. Three birds circling in W13.
- 09.05.01 A single bird flew along face of WTGs 32,29 and 26 (W12).
- 11.05.01 A single bird circling in W9.
- 04.06.01 Two birds flew south over Strath nan Gleann W9.

Supplementary records

- 24.04.01 Two birds circling in Strath Mor below Cnoc Gille Mo Bhrannaig.
25.04.01 A single bird seen at Tor Dearg with three birds later in day all circling and moving gradually through Strath Mor. Colour tags on one bird dated it as a 1st year bird (hatched 2000). It is likely that all kites seen at this time of the year are immature or non territorial birds that wander and may be looking for potential future territory.
- 09.05.01 A single bird thermalling with two buzzards near sub-station.
06.06.01 A single bird being mobbed by a Raven at Tor Dearg.
22.06.01 A blue tagged (left wing Scottish bred) flew east from the shoulder of Cnoc Gille Mo Bhrannaig to Cnoc a Loin.
10.07.01 A single bird circled over rocks on Meall an Leathaid before gliding eastwards towards Ballone.

Hen Harrier: Red Data bird, Red List, Schedule 1, Annex 1, Appendix II.

- 10.07.01 Female hunting in W13 below WTGs 31 and 36.

Supplementary records

- 03.05.01 A female flew high over Strath Mor from Scorr Liath to Ceislein hills.
09.05.01 C.Ross and K.Chisholm (RSPB) watched a female quartering ground near Square W14 Bendealt (Torran na Ceardaich).
10.07.01 Female hunting in W13 below WTGs 31 and 36.
10.07.01 Male flew over rocky outcrop on Meall an Leathaid following the ridge to drop out of site to the north near summit.

Buzzard: Candidate Red Data Bird.

Supplementary records

- 24.04.01 A single bird with broken primary feather on right wing flew over sub-station towards south end of Acharn wood.
09.05.01 Two birds thermalling with a kite near sub-station.

Golden Eagle: Red Data bird, Red List, Schedule 1, Annex 1, Appendix II.

- 05.05.01 Droppings and feathers in C19.
09.05.01 Found a single breast feather near WTG 25. No sign of other feathers.
08.06.01 Eagle feathers, pellets and hare kill in C19 at two locations.

Supplementary records

- 25.04.01 Two birds soaring over Ceislein hills, talon wrestling occasionally. Birds separated and the larger glided towards Fyrish at height and was lost to sight near Cnoc Duchaire.

- 26.04.01 Checked out all known eyries and found recent dropping (sing) on one eyrie with a cast feather. There were no plucks or signs of occupancy in any eyries.
- 27.04.01 A single bird, probably male, in vicinity of eyries being mobbed by merlin.
- 03.06.01 Watched for eagle activity beyond Wyvis Lodge without success.
- 23.06.01 Bird hunting on Kildermorie Estate over Abhainn na Glas, (eyrie nearest this sighting has not been made up for four years).
- 24.06.01 Engineer reported bird near sub-station recently.
- 24.07.01 Keeper saw bird with prey in core nesting area.
- 06.08.01 Keeper told me about bird with prey on 24th July. Found new eyrie having checked out rocks on Ben Wyvis.
- 07.08.01 Accessed eyrie, much down and wash suggesting successful fledging. Prey remains of fox cub, hare and ptarmigan. No sighting of birds.

Merlin: Red Data bird, Red List, Schedule 1, Annex 1, Appendix II.

- 01.05.01 No sign of birds near nest site. Climbed tree and patched up old nest.

Supplementary record

- 25.05.01 A pair of birds present in C20 near 2000 probable nest site. Birds displaying and were joined by a third bird. All three flew off to the NE shoulder of Cnoc Ceislein. Checked all stones on the Ceislein hills for signs of droppings or plucks and found none.

Peregrine: Red Data bird, Red List, Schedule 1, Annex 1, Appendix II.

Neither of the two known sites was successful. At Eyrie A no breeding attempt was made. Eyrie B failed at young stage possibly as a result of an extended spell of wet weather borne on a northerly airstream.

- 31.05.01 Bird very vocal at Eyrie B.

Supplementary records

- 24.04.01 No sign of birds at Eyrie A.
- 25.04.01 No sign of birds at Eyrie A.
- 29.04.01 Evening to dusk watch revealed no birds at or near Eyrie A.
- 30.04.01 No sign of birds at Eyrie B.
- 03.05.01 No sign of birds at Eyrie A. Wyvis keeper has not seen birds in the area this year. Several sightings however reported by D.Sutherland.
- 06.06.01 No sign of birds at Eyrie A.
- 20.06.01 Visit to Eyrie B with abseil rope. Adult female present and calling weakly. No sign of male. Droppings on edge of nest ledge. Abseil into nest revealed no sign of young. Presumed failed at young stage; cause weather?

Kestrel: Amber List.

- 04.06.01 Found kestrel's nest in C20. Both adults present, female brooding three small young and two eggs. Male agitated.
- 10.07.01 Observed four fledged young kestrels in vicinity of nest. Female hunting in Strath Mor near Cnoc Gille Mo Bhrannaig.

Supplementary records

- 20.06.01 A single bird hunting on Torr Dearg. Adult and two fledged young on rocks overlooking Eileanach Lodge.
- 22.06.01 Ringed five grey downy chicks at nest sight in C20. EG58671,72,78,79 & 80. Hatching success five out of five.
- 21.07.01 D.Sutherland found a dead female kestrel during birdstrike monitoring two metres east of WTG 35 on Cnoc Gille mo Bhrannaig.
- 24.07.01 Predated young found near natal site (EG58680).

4.3 Other moorland bird species

Red Grouse: Red Data bird, Appendix III (Berne)

As in 2000 Red Grouse were registered in seventeen squares and absent in three, two windfarm (W10 & W14) and one control square (C2).

Only one nest was found on the second visit and is recorded as predated.

Successful breeding to chick stage resulted in three broods being observed during normal visits. Wind farm staff reported several broods throughout the area near roads.

Table 2: Size classes of Red Grouse covies

No of young birds per covey	9	8	7	6	5	4	3	2	1	Probable Young
No of covies in:										
2001										
Windfarm	0	1	0	0	0	0	1	0	0	
Control	0	0	0	0	0	0	0	1	0	
2000										
Windfarm	0	0	1	0	0	0	1	0	0	2
Control	0	0	0	0	0	0	0	1	0	
1999										
Windfarm	1	0	0	0	0	1	0	2	1	
Control	0	0	0	0	1	0	0	0	0	
1998										
Windfarm	0	0	1	1	0	3	0	0	0	
Control	2	2	1	0	1	0	1	0	0	
1997										
Windfarm	0	0	0	0	0	0	0	0	0	
Control	0	0	0	1	0	2	0	0	0	

Estimated breeding attempt during 2001:- Windfarm – 5 Control – 5
 Actual success (chicks):- Windfarm – 2 Control – 1

Breeding attempts are down by almost half on 2000 but actual success in covey numbers observed is the same. The small total numbers limits the interpretation of this. However there does appear to have been a rise and then fall in overall number of registrations during the study period (Figure 1), perhaps part of a typical grouse population cycle.

Figure 1: Total registrations of adult grouse in formal survey

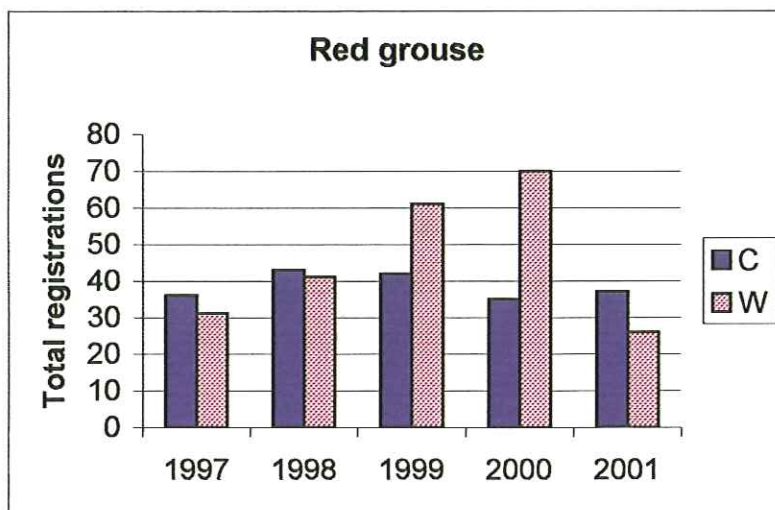


Figure 1 suggests that the rise only took place in windfarm squares: in control squares registrations have stayed at the lower level without rising or falling.

Supplementary records

- 22.06.01 Four chicks on road in W10. (Note no grouse registered over three visits in W10). Male and female with four chicks on road 50 metres from WTG 4.
- Season Site staff observed chicks on the road or verges throughout the breeding season.

Ptarmigan:

This species was not recorded this year.

Golden Plover: Red Data bird, Amber List, Annex 1, Appendix III.

- 05.05.01 No birds seen or heard during survey of C17 & C19.
- 04.06.01 A single bird alarm calling in C20 on shoulder of Cnoc Ceislein.
- 27.06.01 A single bird alarm calling in C17 in misty conditions.
- 13.07.01 Two birds present followed observer from Cnoc Ceislein to beyond Tor a Mhadaidh Ruaidh and back.

Supplementary records

- 25.04.01 A single bird called in alarm (eagle or me) on Tor a Mhadaidh trilling later at Ceislein trig point. High pitched alarm call on east shoulder of Cnoc Ceislein. Assumed that only one bird was involved.
- 24.07.01 Checked full length of Ceislein ridge and located no plovers.

Skylark: Red Data bird.

Skylark registrations are very similar to the “peak” in 1999 and are considerably up on 2000 with birds recorded in eleven squares. Square C16 continued to show prime territory as in previous years. A nest with two eggs, suggesting an uncompleted clutch was found on the first visit in C16. The nest was not relocated on the next visit. In all fourteen breeding territories were observed suggesting a successful breeding season with good numbers of registrations being recorded over three visits in prime squares C15, C16, and C18.

Supplementary record

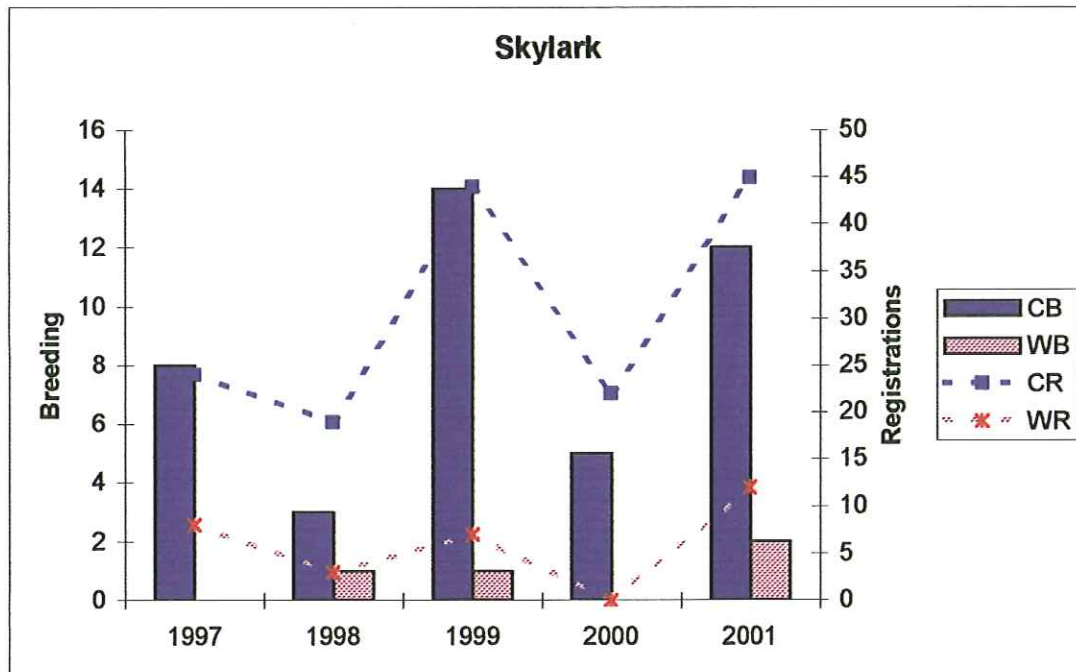
- 24.04.01 Singing birds noted at Tor Dearg (C16), and Tobar Buidhe (C20).

Table 3: Skylark 1997-2001

Control/Windfarm + Number	Year	C1	C3	W4	C6	W8	W9	W1	W1	W1	W1	C15	C16	C17	C18	C19	C20	TOTAL
Breeding Record Registration	2001	0	0	0	0	0	0	2	0	0	0	3	5	0	2	0	2	14
		1	0	1	0	1	2	6	0	1	1	9	19	0	10	0	6	57
Breeding Record Registration	2000	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5
		0	0	0	0	0	0	0	0	0	0	1	15	0	5	0	1	22
Breeding Record Registration	1999	0	0	0	0	0	0	1	0	0	0	2	7	0	3	0	2	15
		0	0	0	0	0	0	6	0	0	1	7	22	0	8	0	7	51
Breeding Record Registration	1998	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	4
		0	1	0	1	0	0	3	0	0	0	4	10	0	0	0	3	22
Breeding Record Registration	1997	0	0	0	0	0	0	0	0	0	0	0	5	1	0	0	2	8
		0	0	0	1	1	0	3	1	1	2	1	14	2	0	1	5	32

There are many more skylark in control squares than in windfarm squares simply because the low altitude ground favoured by this species is concentrated in control areas (see maps in Appendix 6). However the species has fluctuated in parallel in both windfarm and control areas (Figure 2), unlike red grouse (Figure 1).

Figure 2: Breeding records and registrations of skylark: 1997-2001.



Curlew: Red Data bird, Amber List, Appendix III

03.05.01 A bird singing in C18 and another seen suggesting a territorial pair.

Supplementary record

25.04.01 A single bird calling near Loch a Chaplaich (C18) in morning, at noon and again in late afternoon.

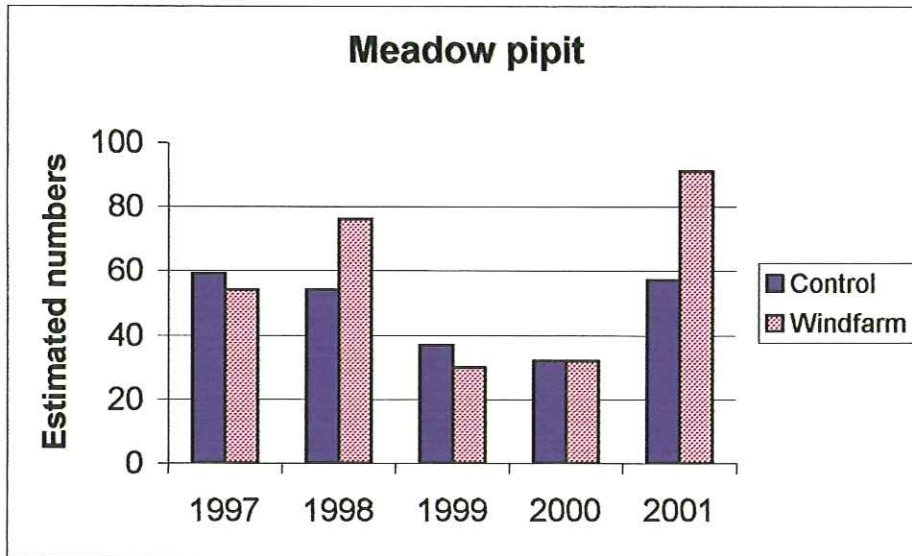
Although birds were seen and heard early in the season, subsequent visits did not record any further observation.

Meadow Pipit:

This species apparently shows a considerable increase throughout the survey area following two successive poor seasons. Registrations are up in both windfarm and control squares resulting in increased breeding estimates, which exceed the 1998 high by 14%. Breeding concentrations appear to favour more sheltered wider valley floors and sides with running water than higher rounded hill tops. Meadow pipits do not appear to be negatively affected by the presence of turbines or road based activity hence some of the higher densities being recorded in windfarm squares. Comparison of

registrations on the third visit with the first two visits show that birds appear to leave higher ground (Meall Mor 738M) and move towards lower ground and thereafter the coast. Small flocks were registered in some such lower squares, which inflated third visit registrations.

Figure 3: Breeding estimates for meadow pipit 1997-2001



It is of interest that of the three birds common enough to have sufficient data, fluctuations are wholly dissimilar between species. Clearly the fluctuations are not linked to simple weather variables that should affect all species in the same manner. Figure 3 however shows that meadow pipit, like red grouse, attains high levels in the windfarm squares in good years but the response is smaller or absent in controls. Table 4 gives the full data for all squares.

Table 4a: Meadow Pipit: apparent breeding comparison 1997 -2001

Control Squares No.	1	2	3	6	15	16	17	18	19	20	Total
2001	6	7	9	6	6	4	3	5	5	6	57
2000	3	3	4	5	4	3	1	4	1	4	32
1999	4	5	3	5	4	1	0	1	1	13	37
1998	5	5	5	8	7	6	3	2	4	9	54
1997	6	5	1	5	8	6	5	9	4	10	59
Windfarm Squares No	4	5	7	8	9	10	11	12	13	14	Total
2001	10	11	4	13	13	12	4	9	11	4	91
2000	5	4	1	4	4	7	1	3	1	2	32
1999	5	7	1	3	7	1	1	3	0	2	30
1998	10	8	5	10	12	8	6	6	6	5	76
1997	3	6	4	3	8	9	4	5	7	5	54

Table 4b: Meadow Pipit: registrations by squares

Squares	1st Visit A	2nd Visit B	3rd Visit C	2001 total	2000 total	1999 total
1	14	13	16	43	48	43
2	28	18	21	67	37	40
3	28	21	18	67	33	42
4	32	24	23	79	34	45
5	23	25	26	74	31	50
6	13	13	15	41	37	52
7	17	14	14	45	41	37
8	21	23	56	100	59	56
9	21	36	31	88	45	65
10	21	41	27	89	41	54
11	7	14	6	27	31	31
12	18	27	21	66	57	41
13	12	27	16	55	29	31
14	16	20	20	56	47	23
15	14	25	25	64	68	54
16	23	18	17	58	57	53
17	6	5	8	19	34	13
18	24	20	27	71	40	40
19	15	12	18	45	38	74
20	16	14	60	90	43	33
Total	369	410	465	1244	850	877

Table 4b shows a breakdown of registrations by visit. Testing the numbers of registrations at each date between windfarm and control shows that in general the birds increase in numbers slightly earlier in control than in windfarm squares (chi-square=10.9, df=2, p=0.004). This is probably due to the generally higher altitudes of windfarm squares (see Appendix 6).

Whinchat: Candidate Red Data bird.

This species was not observed on any visit.

Stonechat: Candidate Red Data bird, Amber list.

Registrations on the second visit in W10 and W14 are the only records of breeding stonechats this year.

04.06.01 Three birds, one female two juveniles at burn in W10.
Three juveniles at Torran na Ceardaich.

Supplementary records

- 06.06.01 Male and female with four fledged young at Torran na Ceardaich (SE corner of W14).
20.06.01 Male and female with two fledged young at Torran na Ceardaich.
22.06.01 Two juveniles at Torran na Ceardaich.

These sightings at Torran na Ceardaich presumably of the one family are a positive breeding record for the second successive year in the same location.

Wheatear: Candidate Red Data bird.

- 08.05.01 Two males recorded in W13, one near turbines and other near road at Tor Dearg.
09.05.01 A single bird noted in C4 and a single female in W7 on track.
31.05.01 A male in W7 was the only record for the second visit.
25.06.01 A female was recorded in W13 plus two other birds. A single bird was recorded in W14.
29.06.01 A single bird was located in C2 in Coir na Baiste near Meal Mor.

Supplementary records

- 24.04.01 Male on fence near sub-station.
03.05.01 Two males skirmishing at Tor Dearg in roadside ditch.
23.06.01 Two juveniles on road at W10.
24.07.01 Two juveniles on ridge near Cnoc Ceislein.
27.07.01 One juvenile near WTG 32.

Hooded Crow:

Supplementary records

- 25.04.01 A single bird mobbing Red Kite on Tor a Mhadaich
10.07.01 Adult and juvenile flew west to east along Strath Mor.

Raven: Candidate Red Data bird.

- 08.05.01 Two birds moving between Sgorr Liath (W14) and Meall an Tuirc (S).
09.05.01 Single birds registered in C1 and W7.
31.05.01 A single bird registered in C2. Four birds comprising most of the local family recorded on the top of Meall an Tuirc (N). A juvenile with brown body feathers and glossy black primaries landed close to me in W7. A metal ring was observed on its left leg denoting successful fledging.
13.07.01 Three birds observed near summit of Cnoc Ceislein.

Supplementary records

- 24.04.01 A single bird crossed Strath Mor from Meall an Tuirc (S) to the west end of the Ceislein hills.

- 25.04.01 Two birds flying west through Strath Mor, one half rolling in flight and calling. Two ravens seen later in day at Loch a Chaplaich.
- 26.04.01 Two young visible in nest.
- 08.05.01 Birds active between Meall an Tuirc (S), Sgorr Liath and Cnoc Gille mo Bhrannaig.
- 03.06.01 Raven mobbing Red Kite near Tor Dearg.
- 22.06.01 Raven on trig point on Cnoc Ceislein.
- 30.06.01 Abseiled into nest to ring four half grown pulli (HT 48311 -14 incl.) Both adults seen returning to nest after we left.
- 10.07.01 Five ravens on slopes below Cnoc Gille mo Bhrannaig.
- 24.07.01 A single bird on trig point on Cnoc Ceislein. Two birds at west end of Ceisleins.
- 30.07.01 Raven flew from Meall an Leathaid to Cnoc a Leacachan. A single bird present at Loch a Chaplaich.

4.4 Other bird species

Non-Moorland Species

Species in this classification that were recorded as breeding mainly in woodland areas:

Robin: W11.
 Song Thrush: W7.
 Willow Warbler: W7.
 Coal tit: W11.
 Chaffinch: W7, W11, W14.

Woodland species present but not recorded as breeding:

Coal Tit: W7.
 Goldcrest: W7, W11.
 Siskin: C2, C3, W5, W10.
 Hooded Crow: W7.
 Robin: W7, W14.
 Crossbill: W11.
 Redpoll: W11.
 Songthrush: W11.
 Willow Warbler: W11, W14.
 Bullfinch: C20.

Moorland/Water species recorded as breeding:

Mallard

- 03.05.01 A drake and duck were present on Loch Chaplaich.
- 08.06.01 A single one-third grown duckling appeared to be on its own on Loch Chaplaich. No sign of adults or other ducklings.

Moorland/Water species present but not recorded as breeding:

Twite

09.07.01 A flock of fourteen birds in W5.

4.5 Overflying species

Grey Geese

Foot and mouth restrictions prevented an earlier survey and many Greylags were reported back in Iceland prior to the 24th April when surveying recommenced on Novar.

24.04.01 One hundred and sixty four Pinkfeet flying north in Strathrusdale outwith the windfarm area.
Three hundred and fifty Pinkfeet flew up Glenglass and turned north east over Meall an Tuirc (south) to fly high over Strath Mor well away from turbines.

27.04.01 Fifty five Pinkfeet flew high over Loch Glass and high over the top of Meal Mor.

Common Gull

03.05.01 Three birds circled over Loch a Chaplaich but did not land.

20.06.01 A single bird moved east to west through Strath Mor.

Swift

29.06.01 Ten birds in C3.

10.07.01 A single bird flew through Squares W13 and W14.

Supplementary record

20.06.01 Two birds flew east to west through Strath Mor.

Swallow

03.05.01 Two birds passed through Strath Mor in an easterly direction.

5 MOORLAND MANAGEMENT AND DENSITY OF PREY SPECIES

5.1 General

The Estate continues its upland moorland management policy of predator control (targeting particularly fox and hooded crow) and heather management by annually burning rank heather to allow fresh new growth and berry bearing plants (blaeberry, cloudberry, crowberry).

Muirburn

In 2001 muirburning was carried out by the Estate prior to the start of the survey work in late April. Burning affected very small areas in two windfarm squares (W10 & W13) and two control squares (C6 & C16) and apparently had little effect on Red Grouse (or any other species) with Grouse breeding in proximity to burning in W13 & C16.

Red Legged Partridge

The Estate has in previous years had the modest numbers of Red Legs as a quarry species mainly on lower ground and on the margins of moorland and grazing. In spring 2001 large release pens were constructed at several locations including W10: two pens, and C20: two pens. In both squares roads were extended into the moor and simple post and netting enclosures were constructed. Each pen takes 400 partridges, delivered in late July.

There were no grouse registrations in W10 where pens and road were constructed. Three pairs bred in 2000.

5.2 Assessment of muirburning effect on bird species

Red Grouse

Although Red Grouse numbers appear to be down on previous years muirburn is not anticipated to be the cause. No grouse were registered in W10, which had a small area of muirburn plus the construction of two partridge release pens and an extension of the road network. W13 also had a small amount of burning and this square recorded two breeding attempts. Similarly C16 recorded breeding close to modest burning.

Golden Plover

As no burning was carried out on the top of ridges Golden Plover were not disturbed by this possible cause.

Meadow Pipit

Numbers of this species are up on previous years. The small amount of muirburn has not resulted in any obvious change in population or use of the ground.

Skylark

Skylark registrations and breeding attempts are up in both W10 and C16. Muirburn in small areas has no effect on this species.

Muirburn this year has had little or no apparent impact on any species.

5.3 Discussion of bird species

Schematic maps in Appendix 6 show the distribution of registrations (excluding supplementary records) summarised for all years. Eleven bird species and blue hare are covered, being all the species either regarded as critical for assessment (e.g. the raptors) or common enough to show trends. Few if any of the critical species were common enough to test the effects of windfarm on behaviour: even over five years any judgement has to rely on differences of one or two individual sightings. This is because these critical species are not making common enough use of the study area whether windfarm or control squares to gather large data sets.

The effects of differences in altitude can also be seen clearly in some of the maps in Appendix 6. Some common species, such as skylark, are clearly restricted to lower ground and therefore commoner in control squares. Others, such as meadow pipit and red grouse, are less restricted and the apparent benefit of windfarm squares in good years might be real, perhaps associated with less predator activity. The main aspects of spatial and temporal changes in numbers are summarised briefly below.

Grouse numbers measured by breeding attempts in 2001 is almost 50% of numbers recorded in 2000 with five attempts in windfarm and five attempts in control squares. In 2000 windfarm squares accounted for fifteen attempts to four in control squares. However successful breeding is almost identical to 2000 with two covies in windfarm and one covey in control squares. Observations this year do not suggest that breeding attempts are affected positively or negatively by turbines and maintenance activity although on a count, registrations of grouse in control squares have been more than or equal to windfarm squares in poor years and less than in windfarm squares in good years.

Meadow Pipit numbers are up in both breeding attempts and registrations on all previous years with substantially more territories being located in windfarm squares. As for red grouse, this difference appears to be expressed only in good years for the species.

Skylark numbers were also up substantially with most breeding attempts showing in control squares where it is thought that appropriate habitat on lower ground is the key rather than the effects of windfarm operations.

Golden Plover probably attempted to breed on the Ceislein hills in 2001 but were not recorded elsewhere. Over the study there have been too few records of this species to

tell if the windfarm had any effect, although one pair apparently bred in the windfarm during the construction year.

Merlin were recorded early in the survey but were not observed thereafter.

Hen Harrier sightings were more frequent with birds foraging within the survey area on several occasions. It is thought for a fifth successive year that this species did not breed and that sightings may well have been of a bird (s) from Wyvis Estate.

Red Kites continue to frequent both windfarm and control squares. Colour tagged birds observed were of mobile non breeding first year birds.

Golden Eagles observed are thought to be non territory holding birds frequenting the eastern perimeter of the Wyvis eagles range. Cast up, pellets "wash" and prey remains of hare and moulted body and wing feathers were all observed and noted as birds resident in the area. The only sighting recorded is of this pair.

Raven use the entire survey area. Based on numbers of birds seen together it is thought that most sightings are of the family breeding near to a control square.

Kestrel bred successfully in a control square fledging five young. The species only appears to venture into the altitudes of the windfarm occasionally and most activity has been confined to the periphery of the study area. Nevertheless there have been two casualties in the study period associated with stationary or slowly rotating turbines.

Buzzard observations were confined to two supplementary sightings near the sub-station (outwith the survey area) with no sightings after the 9th May. Like kestrels, the species appears to make little use of the altitudes of the windfarm.

Deer again, three species, were regularly observed at various places throughout the survey area.

5.4 Blue Hares

Blue Hares continue to be widely scattered (see Appendix 6) but were absent from all squares west of Meall an Tuirc (N). Hares still concentrate on the "grassy" road verges where several leverets were seen during the season. In consequence windfarm square 13 has seen more than double the registrations of any other square during the study period. Recorded numbers are slightly down on last year (Table 5a), which may reflect eagle predation and a hard winter.

Table 5a: Blue hare – main sightings

Records are shown on actual dates, annotated A, B and C to show the three rounds of visits to which sightings belong.

Squares	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 May																				1A
5																			2A	
8													1A							
9							1A													
31											2B									
4 June									1B				5B							1B
7						1B														
8																			3B	
25													5C	2C						
27																	1C			
10 July									1C						1C					1C
13																				

Table 5b: Blue hare supplementary records

Squares	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
9 May								1	1	2		1								
31								2				2	4							
24 July																				
27													1							

Three hares were also seen on 31st May on the road up from the sub-station

6 CONCLUSIONS OF FIVE YEARS OBSERVATIONS

6.1 Water birds

Red-throated Divers

Red-throated divers raise small numbers of young mainly on Kildermorie. One young was fledged within two kilometres of nearest turbine. Adults were observed feeding on inland lochs but flight down river courses to the Firths to feed in salt water. Only one record was made of birds overflying the windfarm at altitude.

6.2 Raptors

Red Kite

Red Kites frequent the windfarm and were frequently observed close to turbines or flying between them below blade height. Kites do not breed in the survey area.

Hen Harrier

Harriers did not breed in the survey area but were observed hunting. Although seen in windfarm squares they appeared to keep clear of turbine clusters.

Buzzard

Buzzards were observed close to turbines but appeared to avoid the structures when hunting. The species probably nest in nearby woods but not in the survey area.

Golden Eagle

A pair bred on an adjoining estate and birds have been observed hunting or carrying prey from Novar back to eyrie. Birds have summered and wintered on the edge of the breeding territory in the survey area. No eagles have been observed close to turbines.

Osprey

Birds have been seen in the survey squares but remote from the turbines. They do use hills to gain height.

Kestrel

This species has bred in the survey area and adults and young regularly observed hunting close to turbines. Two kestrels have died as a result of colliding with turbines.

Merlin

This is a scarce raptor, which probably bred in a control square. Only one record of a bird has been noted in a turbine square.

Peregrine

Two pairs bred, one just outside the survey area and one within the survey. They have had varying success. Adults are not uncommon in windfarm squares but none have been observed flying near to turbines. Plucks found no nearer to turbines than two hundred and fifty metres suggest that peregrines hunt successfully in turbine squares.

6.3 Moorland Species

Red Grouse

This species is under management and enjoys the benefits of avian and ground predator control as well as a muirburn regime to encourage heather growth. Grouse nests have been found close to turbine bases and young observed similarly. Registrations in the field show that grouse breed and live equally well in turbine areas or areas free of development. It is likely that generations of grouse have now survived within windfarm areas. This is the only other recorded species to suffer collision with the turbines. There have been three birds sent for post mortem: two appeared to have impacted with stationary or slowly rotating turbines and the third with a fully operational turbine. Grouse may well benefit from protection from predators by the turbines and may also take advantage of road grit on the access tracks.

Golden Plover

Prior to construction it is thought that this species bred on hills now covered by turbines although none were present in the immediate pre-construction survey. Only one pair of birds has been recorded possibly breeding near turbines on Cnoc Gille mo Bhrannaig in the first two years of operation. Since then there have been no records in the windfarm but birds were recorded two kilometres distant on Cnoc Ceislein acting as if holding territory for the subsequent three years suggesting that birds were displaced from the windfarm to similar suitable habitat.

Skylark

This species regularly uses the same squares in fluctuating numbers and seem to favour certain habitats mainly in control squares. As numbers fluctuate due to weather or winter survival it is thought that the windfarm will have little or no bearing on their breeding success.

Meadow Pipit

This is the most abundant species within the survey area. Registrations and breeding attempts fluctuate considerably as a consequence of weather survival. There is a pattern of peaks in breeding in windfarm areas in good years that do not take place in controls, but there appears to be no long-term benefit of this as in "poor" years the

birds are equally abundant in windfarm and control squares. It is certainly a prey species for kestrel and merlin and probably larger predators such as harriers, kites, buzzard and peregrine. Ravens probably take eggs and young.

It is worth noting that all species leave the upland moorland in winter except red grouse, golden eagle and raven. Apart from these three species there is no risk to birds from turbines during winter.

6.4 Overflying Species

Observations of spring migration in the field have shown that geese either fly over the turbines at altitude in a northerly direction or they fly along Strath Mor below turbine level before heading north over the sub-station. As all observations have been made in good visibility it is clear that the geese can see the turbines and, on one occasion, deviated a flight path away from the WTGs 34 and 36. There is no record of autumn migration.

6.6 General

The field surveyor has seen little to suggest that any species is at risk from the turbine blades or structures although that danger will always be present. Three recorded casualties of two species in fifteen months of tested observations suggest that the majority of birds using the area do so with safety.

It is probable that some birds have been displaced as evidenced by the apparent movement of the golden plover. Others such as harrier, eagle and peregrine may have lost hunting territory. Small ground nesting pipits and lark populations fluctuate from year to year making an assessment of negative or positive effect of the development difficult to detect.

Moorland management is more likely to have a positive effect generating habitat and relatively predator free environments for species beyond red grouse. Increasing populations of red grouse will however attract predators. The present policy of not shooting hares will offer a year round food source for eagles which may reduce eagle predation on grouse.

ACKNOWLEDGEMENTS

Access arrangements on the neighbouring estates of Wyvis and Kildermorie enabled a full survey to be completed. The field surveyor is indebted to the Beattie family and Wyvis estate and to Mr Ian Duncan of Kildermorie and his keepers Andy and Dougie Russell.

On Novar access arrangements through the high ground keeper Sam Milne enabled all aspects of the study to be completed.

The Highland Raptor Study Group provided some confidential information, which has been used during the five year survey period.

Lastly engineering staff based in the sub-station provided ad hoc information over the five years of the survey.

APPENDIX 1: BIRDSTRIKE MONITORING AND TEST RESULTS

In order to check the efficiency of monitoring, carcasses were placed near turbines prior to search days according to a random number system. Following a relatively low detection rate up to early summer 2000 a search method was demonstrated to the surveyor, which has resulted in a higher detection rate on subsequent random tests mainly using dead pigeons

Detailed monitoring results have at the time of writing been received up to 30th September 2001. Further test results have been received in letter form and are appended, but not the full monitor data sheets: these will follow as available.

Novar Wind Farm Bird Strike Monitoring Programme

Date	Turbines searched	Evidence of Strike		WTG No.	Bird Species	Weather Conditions	Wind Speed	Signed
		Yes	No					
29.10.00	16-1		✓			S.S.W wind gales wet	15-+ m/sec	D. Sutherland
5.11.00	36-19		✓	35, 23, 31.	pigeon dummies	East Wind almost none sunny still.	0-2 m/sec	D. Sutherland
6.11.00	16-1		✓	11, 9, 8.	pigeon dummies	N.N.E. Good wind. misty wet cold	8-10 m/sec	D. Sutherland
11.11.00	36-19		✓			South Wind dull and cold.	4-5 m/sec	D. Sutherland
12.11.00	16-1		✓			S.S.W. wind misty	0-2 m/sec	D. Sutherland
18.11.00	36-19		✓			West Wind cold snow strong wind	10-14 m/sec	D. Sutherland
19.11.00	16-1		✓			S.W. wind strong heavy rain	12-15 m/sec	D. Sutherland
24.11.00	36-19		✓	33, 31.	pigeons dummies	West wind good. cold	10-14 m/sec	D. Sutherland
25.11.00	16-1		✓	1, 3.	pigeons dummies	South West mod wind misty	6-8 m/sec	D. Sutherland
1.12.00	36-19		✓			West wind mod to good	8-10 m/sec	D. Sutherland
2.12.00	16-1		✓			W.S.W. wind good rain showers	10-11 m/sec	D. Sutherland
9.12.00	36-19		✓			W.S.W. wind good wet	10-13 m/sec	D. Sutherland
10.12.00	16-1		✓			West wind good. wet.	9-12 m/sec	D. Sutherland
16.12.00	36-19		✓			North Wind, dry. little wind	4-6 m/sec	D. Sutherland
17.12.00	16-1		✓			S.S.E. wind low dry, frosty but bright	4-5 m/sec	D. Sutherland
23.12.00	36-19		✓			West wind good snow covered	10-14 m/sec	D. Sutherland
24.12.00	16-1		✓			W.N.W wind heavy snow	8-12 m/sec	D. Sutherland
29.12.00	36-19		✓			North West, low wind crisp snow covering	6-8 m/sec	D. Sutherland
31.12.00	16-1		✓			North wind mod to good frosty cold wind	8-11 m/sec	D. Sutherland
5.1.01	36-19		✓			W.N.W. good wind frosty & snow	10-12 m/sec	D. Sutherland
6.1.01	16-1		✓			N.N.W. mod wind cold & dry	7-8 m/sec	D. Sutherland
13.1.01	36-19		✓			South wind low. frosty sunny	4-5 m/sec	D. Sutherland
14.1.01	16-1		✓			S.S.W. Low wind. crisp sunny day	4-5 m/sec	D. Sutherland
20.1.01	36-19		✓			S.S.E. Low wind sunny	3-5 m/sec	D. Sutherland
21.1.01	16-1		✓			South wind mod good dull	8-10 m/sec	D. Sutherland

Novar Wind Farm Bird Strike Monitoring Programme

Date	Turbines searched	Evidence of Strike		WTG No.	Bird Species	Weather Conditions	Wind Speed	Signed
		Yes	No					
27.1.01	36-19		✓			S.S.W low wind frosty	3-6 m/sec	D. Sutherland
28.1.01	16-1		✓			W.N.W. mod wind sunny	7-10 m/sec	D. Sutherland
2.2.01	36-19		✓			S.W. low wind sunny	3-5 m/sec	D. Sutherland
3.2.01	16-1		✓			West wind moderate snow showers heavy	6-9 m/sec	D. Sutherland
10.2.01	36-19		✓			N.N.W. wind heavy snow showers	7-10 m/sec	D. Sutherland
11.2.01	16-1		✓			W.N.W. deep snow	5-7 m/sec	D. Sutherland
17.2.01	36-19		✓	34 26	Dumries Woodcock & Crow	West mod to good snow covered. dry.	7-10 m/sec	D. Sutherland
18.2.01	16-1		✓	16	Dummy Mallard duck hen.	S.S.W low wind dull. snow covered.	4-6 m/sec	D. Sutherland
24.2.01	36-19		✓			W.S.W. good wind Heavy snow	10-14 m/sec	D. Sutherland
25.2.01	16-1		✓			West wind low snow covered. dull.	5-6 m/sec	D. Sutherland
	No Survey due to Foot and Mouth							
28.4.01	36-19		✓			East Wind predominantly showers	5-7 m/sec	D. Sutherland
29.4.01	16-1		✓			Low Wind. turbines facing all directions sunny	3-4 m/sec	D. Sutherland
5.5.01	36-19		✓			West Wind sunny	4-5 m/sec	D. Sutherland
6.5.01	16-1	✓		16	Male Grouse.	W.S.W. wind sunny	5-7 m/sec	D. Sutherland
12.5.01	36-19		✓			E. & S.E. WIND.	4-6 m/sec	D. Sutherland
13.5.01	16-1		✓			East wind misty	3-7 m/sec	D. Sutherland
19.5.01	36-19		✓			S.W. Wind	4-6 m/sec	D. Sutherland
20.5.01	16-1		✓			West Wind. sunny	3-5 m/sec	D. Sutherland
26.5.01	36-19		✓			South Wind. dry	5-7 m/sec	D. Sutherland
27.5.01	16-1		✓			S.W. Wind. sunny dry	8-9 m/sec	D. Sutherland
2.6.01	36-19		✓	1.34	Pigeon dummy	NORTH Wind Strong	12-15 m/sec	D. Sutherland
3.6.01	16-1		✓	1.16. 1.6.	Pigeon dummy pigeon.	West Wind Strong	10/14 m/sec	D. Sutherland
9.6.01	36-19		✓			N. W wind showers	5-8 m/sec	D. Sutherland
10.6.01	16-1		✓			North wind Low	4-7 m/sec	D. Sutherland

Novar Wind Farm Bird Strike Monitoring Programme

Date	Turbines searched	Evidence of Strike		WTG No.	Bird Species	Weather Conditions	Wind Speed	Signed
		Yes	No					
16.6.01	36-19		✓			East wind cloudy dry	8-9 m/sec	D. Sutherland
17.6.01	16-1		✓			N.W. wind	10-12 m/sec	D. Sutherland
23.6.01	36-19		✓	1.31	pigeon dummgs.	W.S.W wind hot	6-7 m/sec	D. Sutherland
24.6.01	16-1		✓	1.6 1.2	pigeon dummies pigeon	West Wind Warm some rain	4-10 m/sec	D. Sutherland
30.6.01	36-19		✓			S.W. wind Low cloud	8-11 m/sec	D. Sutherland
1.7.01	16-1		✓			W.S.W wind cloudy & Sunny	7-12 m/sec	D. Sutherland
7.7.01	36-19		✓			N.W. wind. low cloud	8-9 m/sec	D. Sutherland
8.7.01	16-1		✓			N.N.W. wind misty	7-8 m/sec	D. Sutherland
15.7.01	36-19		✓			West wind some showers	8-9 m/sec	D. Sutherland
15.7.01	16-1		✓			W.S.W. wind. Low cloud some rain	8-11 m/sec	D. Sutherland
21.7.01	36-19	✓		1.35.	Kestrel	South Wind sunny dry	6-7 m/sec	D. Sutherland
22.7.01	16-1		✓			S.S.W. wind sunny	5-8 m/sec	D. Sutherland
28.7.01	36-19		✓	1.35 31 32	pigeon damage.	West wind	7-8 m/sec	D. Sutherland
29.7.01	16-1		✓	1.9 13	pigeon dummies.	Strong West wind	13-17 m/sec	D. Sutherland
4.8.01	36-19		✓			West wind dry	7-8 m/sec	D. Sutherland
5.8.01	16-1		✓			West wind drizzle and cloudy	4/0 m/sec	D. Sutherland
11.8.01	36-19		✓			South East dull	4-6 m/sec	D. Sutherland
12.8.01	16-1		✓			North Wind	6-8 m/sec	D. Sutherland
18.8.01	36-19		✓			South wind some rain	7-10 m/sec	D. Sutherland
19.8.01	16-1		✓			West wind mist on tops	6-8 m/sec	D. Sutherland
25.8.01	36-19		✓	7.27 x2	pigeon robin (dummy)	South wind low cloud	5-8 m/sec	D. Sutherland
26.8.01	16-1		✓	7.14 9 14	pigeons (dummies)	West wind dry	4-6 m/sec	D. Sutherland
1.9.01	36-19		✓			South wind misty	7-9 m/sec	D. Sutherland
2.9.01	16-1		✓			S.S.W. wind wet	6-10 m/sec	D. Sutherland
8.9.01	36-19		✓			West wind showers clear	12-14 m/sec	D. Sutherland

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6 December 2001

Dear Charlie,

Novar Windfarm Ornithological Study - Bird Strike Monitor Efficiency

I submit below survey results for four visits in November.

2/11/01 Visit no 6.

WTG.	Paces	Bearing	Habitat	Difficulty
9 Pigeon	18	90	Open tussocky ground	Mod
21 Pigeon	25	250	Open tussocky ground	Mod
23 Pigeon	20	10	Broken peaty ground	Diff.
24 Pigeon	30	200	By road in ditch	Easy
24 Pigeon	20	80	Broken ground	Diff
32 Pigeon	25	360	Heather	Diff.

David conducted his search and picked up birds at 9, 21, 23, 24 and 32. The missed bird was in broken ground which I retrieved.

9/11/01 Visit no 7.

WTG.	Paces	Bearing	Habitat	Difficulty
8 Pigeon	20	60	In heather snow	Mod
11a Pigeon	20	40	Open ground road junction	Mod
11b Pigeon	45	180	Bare ground	Easy
15 Pheasant	35	220	Heather grass	Mod
29 Pheasant F	35	140	Foot of bank	Easy
34 Pheasant M	30	300	Hag snow	Diff.

David picked up birds at turbines 8, 11b and 34. I retrieved birds at 11a, 15 and 29.

16/11/01 Visit no 8.

WTG.	Paces	Bearing	Habitat	Difficulty
5a Pheasant F	31	60	Hag heather	Mod
5b Pheasant M	30	270	Hag heather	Diff
14 Pigeon	25	50	Road verge	Easy
29 Pheasant peg	32	220	Ditch	Mod
33 Pheasant M	18	20	Heather	Mod
36 Pheasant peg F	31	330	Ditch heather	Diff.

Due to shortage of birds I used pheasant wings, heads and tails nailed to a wooden peg as a "reconstructed" bird. David collected birds at 5b, 14, 33 and 36. I retrieved the remaining two birds from 5a and 29.

30/11/01

Visit no 9.

WTG.		Paces	Bearing	Habitat	Difficulty
4	Pheasant peg	22	340	Grassy bank	Easy
10	Pheasant F	23	220	peat with tussock grass	Mod
20	Pheasant F	35	270	Road verge	Mod
28	Pigeon	12	150	Ditch	Mod
31	Wood pigeon	34	120	Heather	Mod
32	Rook	27	130	Ditch heather	Mod

David retrieved birds at 4, 31 and 32. He advised that there was complete snow cover which covered the birds. He collected three birds which were showing through the snow. There was no snow when birds were put out. I observed **11 Snow Buntings** feeding near TWG 31.

Yours sincerely



Ron Graham

c.c. Chris White

APPENDIX 2: SPECIFICATION FOR MONITORING STUDIES

Novar Wind Farm Ltd: Bird Monitoring Specification

NWP Reference: L/NV/HC/Conditions
Highland Council Reference: RC/1995/421

(as extended)

Area to be surveyed

To be clearly outlined in Black on site map.

Methodology

The defined area to be divided into ½ km squares (500 x 500 i.e. four within each 1km square) based on the National Grid. The exact boundary should be finalised in the field and indicated clearly on the final maps produced.

All ½ km squares are to be surveyed thrice, by a single observer, once in early May, June and July.

Between 20 and 25 minutes should be spent in each ½ km square. The whole area should be surveyed by thoroughly walking the area, pausing, scanning and listening.

Squares should be surveyed between 0830 and 1800 hours, subject to the following not being present:

- Strong wind above Beaufort Scale 6
- Precipitation; anything more than light rain.
- Low cloud, fog or bad visibility.

The locations and activities of all target species, Red Grouse, Golden Plover, Red-throated Diver, all raptors and all other species encountered are to be recorded on field maps using specific BTO species and activity codes.

Locations of all sightings are to be mapped to a suitable scale as accurately as possible with the registration centred over a point. As much contextual information as possible should be recorded. This is very important, as we need to distinguish where possible between breeding and non-breeding birds. Birds should be aged and sexed where possible and all their activities recorded, particularly those most indicative of breeding which are the following:

- song/display
- bird carrying nest material
- location of nest or young
- repetitive alarm calling or distraction display, indicating nearby presence of nest or young

- bird carrying food

The location of raptors, in particular Hen Harriers, seen close to but outwith the survey area should also be mapped on all three visits. These species should be included in the species map.

Analysis of data

From the site visits, 3 visit maps will be produced on which all species recorded will be plotted, with the boundary of the area surveyed clearly marked, with the date, start and finish times and weather conditions marked on the edge of each map. From this species maps are to be produced using the following criteria to determine distribution and population of each species.

Birds are to be considered breeding if any of the following activities are observed:

- song/display
- bird carrying nest material
- location of nest or young
- repetitive alarm calling or distraction display, indicating nearby presence of nest or young
- bird carrying food

Where several golden plover individuals are present in an area and it is impossible to determine the number of pairs they represent in the field, individuals are to be judged as representative of different pairs only if the distance between them is greater than 500m For other bird species, 200m should be used for dunlin and passerines and 1000m for all other species. In such cases, where two individuals are considered to be a pair of birds, the pair's location will be placed centrally between the individuals.

In assessing these records for population estimates and in producing the distribution maps, all visit maps are to be considered together.

APPENDIX 3: SURVEY WEATHER NOTES 2001

Weather in mid April, the optimum migration period for grey geese was dominated by a cold northerly air stream, which delayed the departure of some geese and the arrival of summer migrants.

24.04.01	Sunny bright day with 50% cloud cover in light SW breeze veering SE later in day.
25.04.01	Bright in Dingwall but on Novar strong SE breeze with hill mist clearing to 100% cloud with hill mist later in day. Visibility hazy.
26.04.01	Fine bright day with cold northerly breeze.
27.04.01	A clear bright and warm day (2 Small Tortoiseshell butterflies).
29.04.01	A clear bright calm evening.
30.04.01	A dry clear evening with good visibility – warm.
01.05.01	High cloud level 50%, sunny most of the time with light westerly breeze.
03.05.01	50% cloud cover, bright and sunny but cool, light showers on NW to N light breeze.
05.05.01	100% cloud cover but good visibility with 10% cloud cover and SE breeze.
09.05.01	Sunny and bright but with cold east wind, clear sky, no cloud.
10.05.01	Clear fine day, bright and sunny, light winds.
30.05.01	Heavy rain, low cloud and poor forecast. Cancelled visit.
31.05.01	100% cloudy and overcast with strong NW breeze. Occasional light showers.
01.06.01	Windy, low cloud. Drizzle. Unsuitable for survey.
03.06.01	Weather closed in to drizzle, rain and low cloud obscuring cliffs.
04.06.01	25-75% cloud with variable strength westerly winds. Dry, warm and occasionally sunny.
07.06.01	75% cloud cover with gusting wind bearing occasional light showers.
08.06.01	50-100% cloud, winds light to strong NW, cold. Fresh snow on Wyvis (3000m).
20.06.01	Dry clear warm westerly air stream.
23.06.01	Good visibility, 50% cloud, warm.
25.06.01	Light westerly warm wind, good visibility. Wind backed easterly later in day with 95% cloud.
27.06.01	Started bright with clear visibility to 1000m. Abandoned day in strong E wind with haar reducing visibility to 100m
09.07.01	50% cloud cover, misty in valley clearing in light breeze.
10.07.01	Overcast SW wind, light and variable in direction. 100% cloud, occasional light drizzle.
11.07.01	Abandoned day due to strong windy and wet conditions on hill.
13.07.01	Overcast with light westerly breeze.
06.08.01	A calm day with very light winds, clear visibility, warm.
12.08.01	clear day but with rain threatening from west. Dry all day 100% cloud.

APPENDIX 4: RECORDING DATES 2001

KM SQUARE	MAP REF	TYPE	1st VISIT A	2nd VISIT B	3rd VISIT C
1	50.74	C	09.05	31.05	29.06
2	51.74	C	09.05	31.05	29.06
3	52.74	C	09.05	31.05	29.06
4	53.73	W	08/09.05	31.05/07.06	09.07
5	54.73	W	08.05	07.06	09.07
6	55.73	C	08.05	07.06	09.07
7	53.72	W	09.05	31.05	25.06
8	54.72	W	11.05	04.06	10.07
9	55.72	W	11.05	04.06	10.07
10	56.72	W	11.05	04.06	10.07
11	54.71	W	09.05	31.05	26.06
12	55.71	W	09.05	31.05	25.06
13	56.71	W	08.05	04/06/07.06	26.06/10.07
14	55.70	W	08.05	31.05/04.06	05.06/10.07
15	58.71	C	01.05	04.06	10.07
16	57.70	C	03.05	08.06	27.06
17	58.70	C	05.05	08.06	27.06/13.07
18	57.69	C	03.05	08.06	27.06
19	58.69	C	05.05	08.06	13.07
20	59.71	C	01.05	04.06	10.07

Access was subject to agreement with high ground keeper.

APPENDIX 5: BIRD DATA 2001

A: Observed species list Novar windfarm & control areas 2001

Red-Throated Diver

Mallard

Red Kite

Hen Harrier

Golden Eagle

Kestrel

Merlin

Peregrine

Red Grouse

Golden Plover

Curlew

Common Gull

Swift

Skylark

Swallow

Meadow Pipit

Robin

Stonechat

Wheatear

Song Thrush

Willow Warbler

Goldcrest

Coal Tit

Hooded Crow

Raven

Chaffinch

Siskin

Twite

Redpoll

Crossbill

Bullfinch

(includes supplementary sightings)

B: breeding status of bird species during survey

SPECIES	1997		1998		1999		2000		2001	
	W	C	W	C	W	C	W	C	W	C
RED THROATED DIVER								B		+
Mallard								+		B
Red Kite			+		+	+	+	+	+	+
HEN HARRIER						+		+	+	+
Sparrowhawk						+				
Buzzard				+	+	+	+	+		
GOLDEN EAGLE			+		+	+		+		
Osprey								+		
Kestrel				+			+	+	+	B
MERLIN		B	+	+				+		+
PEREGRINE		B		B		B	+	B	+	B
RED GROUSE	B	B	B	B	B	B	B	B	B	B
Ptarmigan		+		+				+		
Black grouse		+								
GOLDEN PLOVER	PB		+	+		PB		PB		+
Snipe			+		+	+	+			
Curlew		+						+		+
Lesser Black-backed Gull						+				
Common Gull										+
Swift			+	+		+	+	+	+	+
Great-spotted Woodpecker				+						
SKYLARK	B	B	B	B	B	B	+	B	B	B
Swallow			+	+	+	+		+		
House Martin				+				+		
Tree Pipit					+					
Meadow Pipit	B	B	B	B	B	B	B	B	B	B
Grey Wagtail								+		
Wren			B	B	B	+	+	+		
Robin	B		B			B	B	B	B	
Whinchat				+		B				
Stonechat	B	B	+	B	B	+	B	+	B	
Wheatear		B	+	B	+	+	+	+	+	+
Ring Ouzel		B						+		
Blackbird							+			
Songthrush	B		+		B	+	B		B	
Willow Warbler	B	B	B		B	B	B	B	B	
Goldcrest			B		+		B		+	
Coal Tit			B		+		+		B	
Great Tit						+				
Hooded Crow			+	+	+		+		+	
Raven *		+	+	+	+	+	+	+	+	+
Chaffinch	B		B	+	B	+	B	+	B	
Siskin			+	B					+	+
Twite		B						+		+
Redpoll			+						+	
Crossbill			+				+		+	
Bullfinch						+				+

* Breeding just outside a control square.

Breeding target species are shown in bold.

Species status is shown as present but not breeding (+), probably breeding (PB) or confirmed breeding (B)
Supplementary Records are not included because they do not form part of the formal sample.

Appendix 6 : Maps showing distribution of all registrations of key species in the study area from 1997 to 2001.

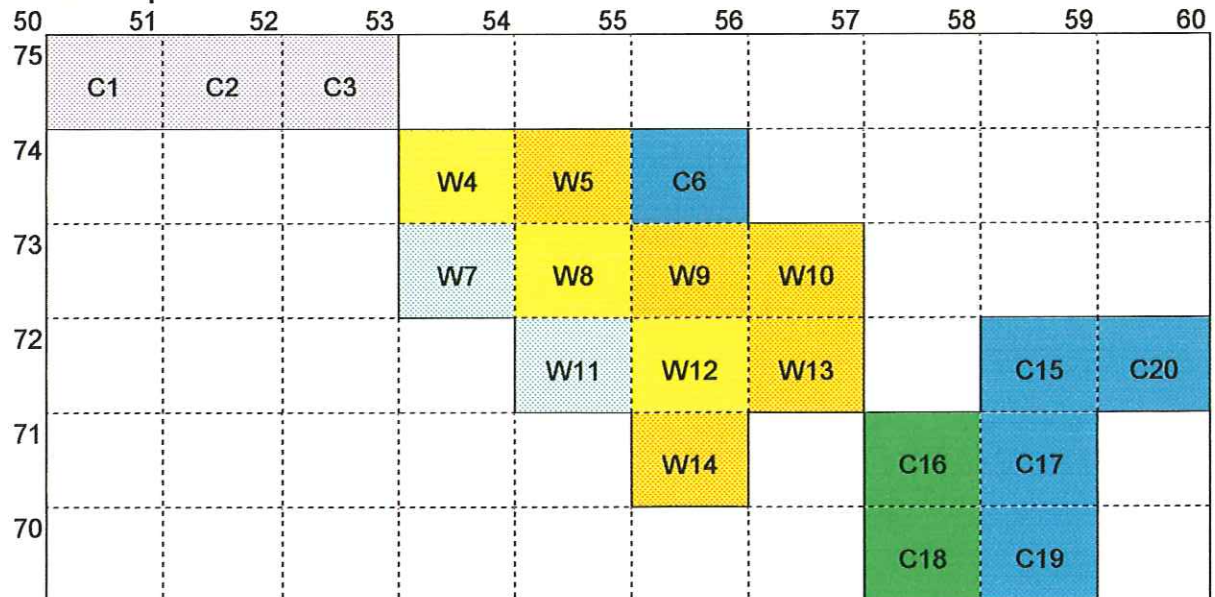
Except where stated otherwise, maps give summed registrations for each square, for formal observations only, i.e. excluding “supplementary” records..

Squares are as on a map, with easting (top border) and northing (left border) shown.

Squares have background colours according to windfarm / control designation and to domination by different altitudes / habitat.

Low altitude is taken as lower than the 300m contour, medium as less than 500m and high as more than 500m. Two squares rise to high altitude but drop sharply to medium altitudes dominated by forestry: these are indicated.

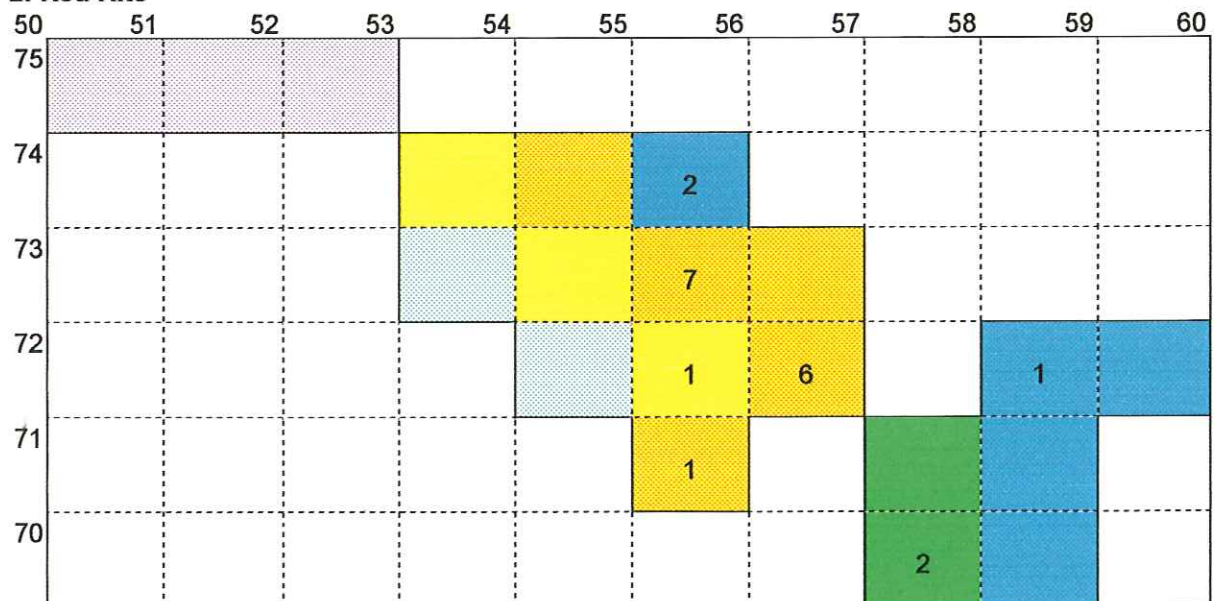
1: Base map



Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

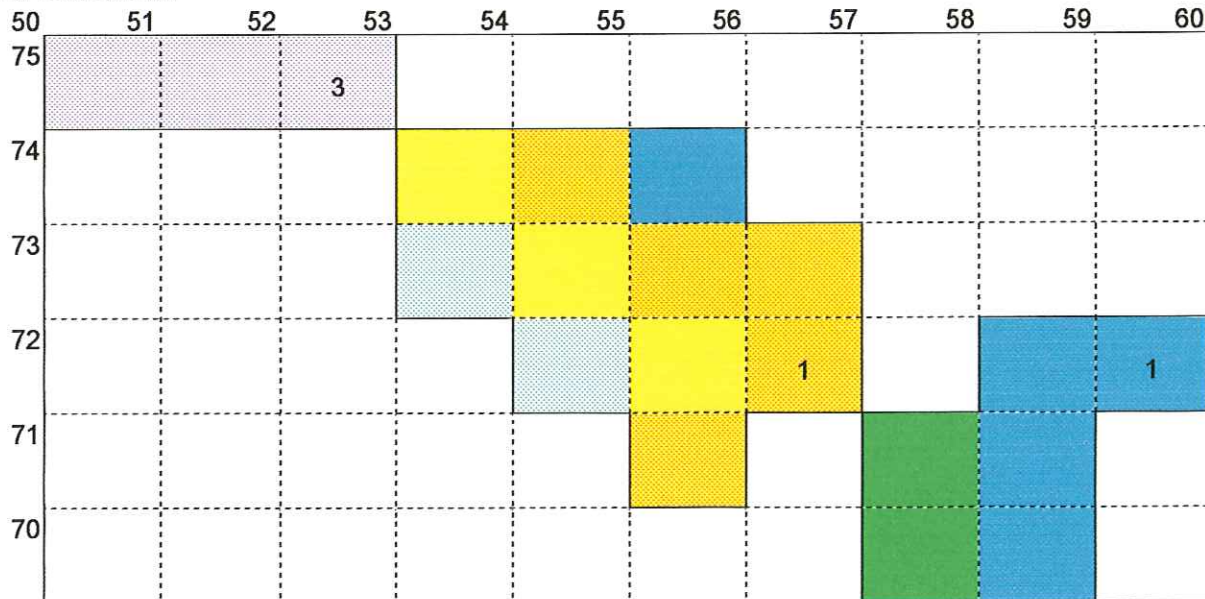
2: Red Kite



Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

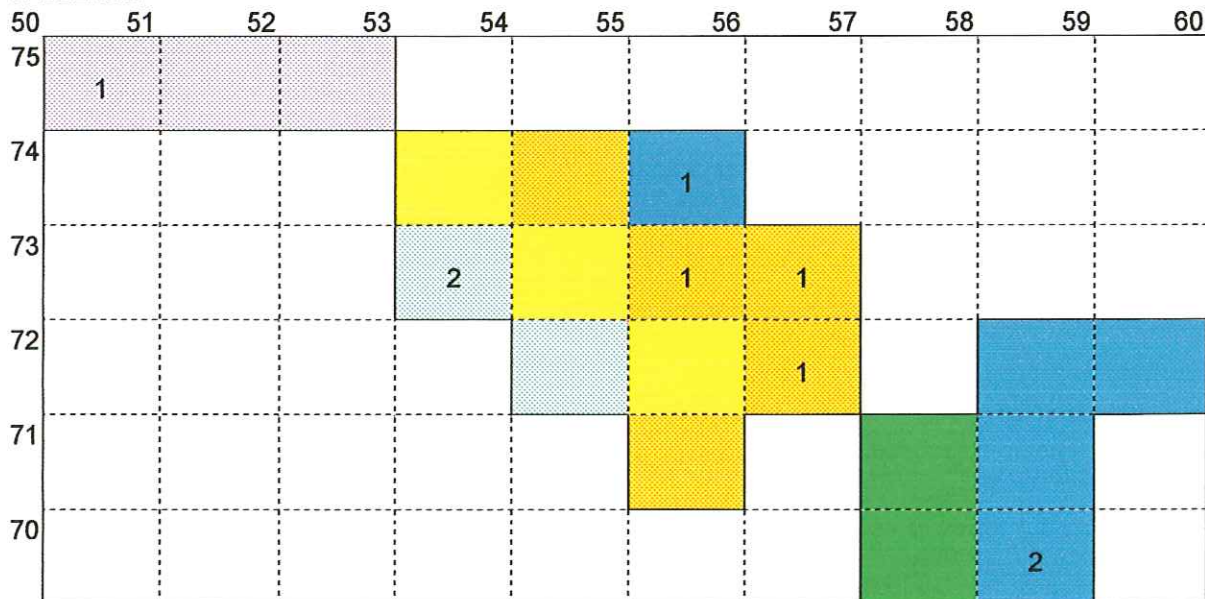
3: Hen Harrier



Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

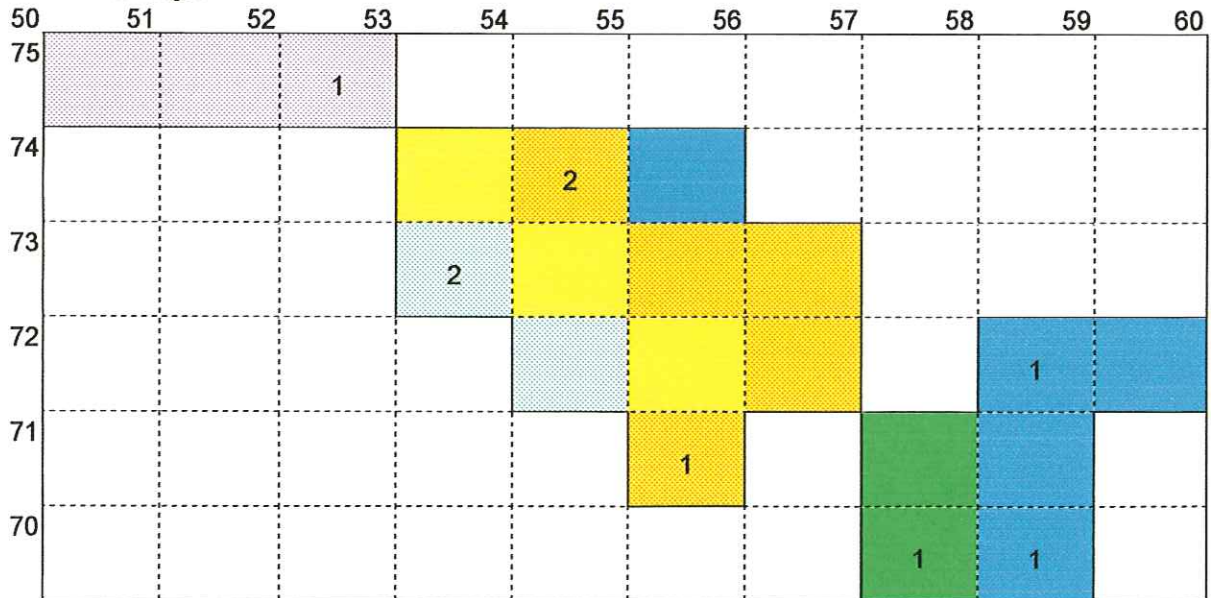
4: Buzzard



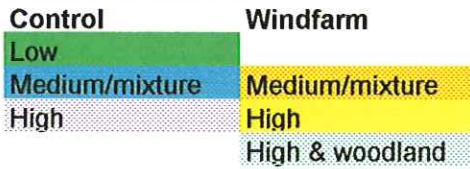
Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

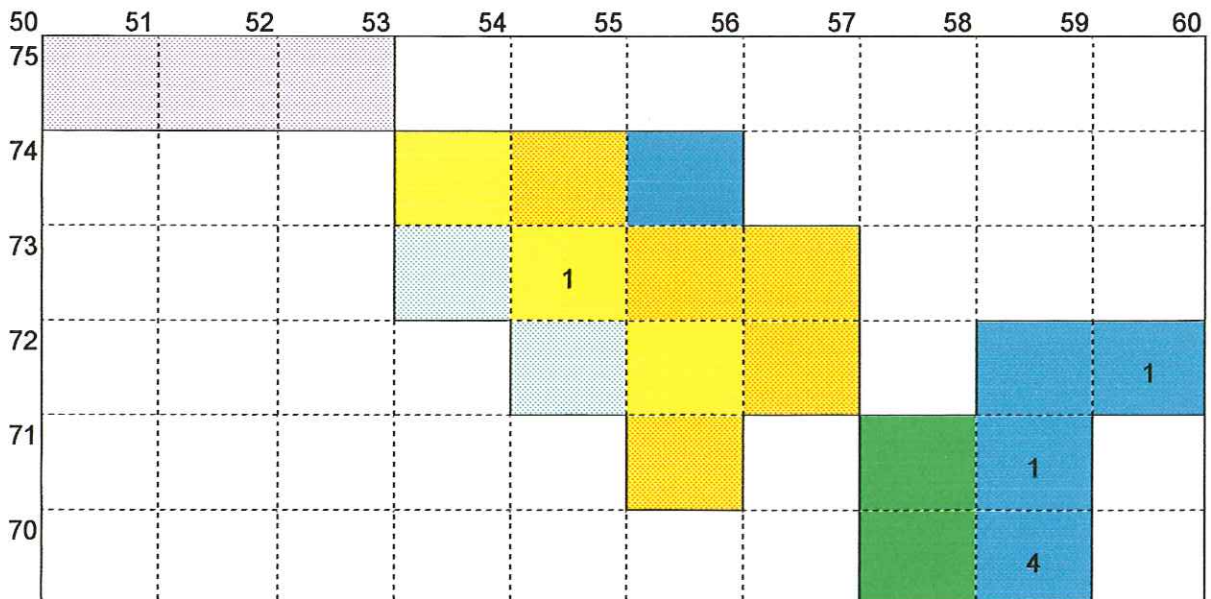
5: Golden Eagle



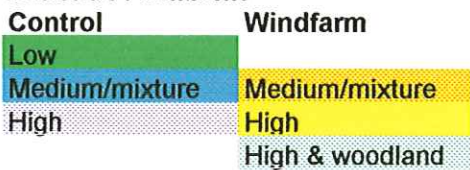
Altitude / Habitat



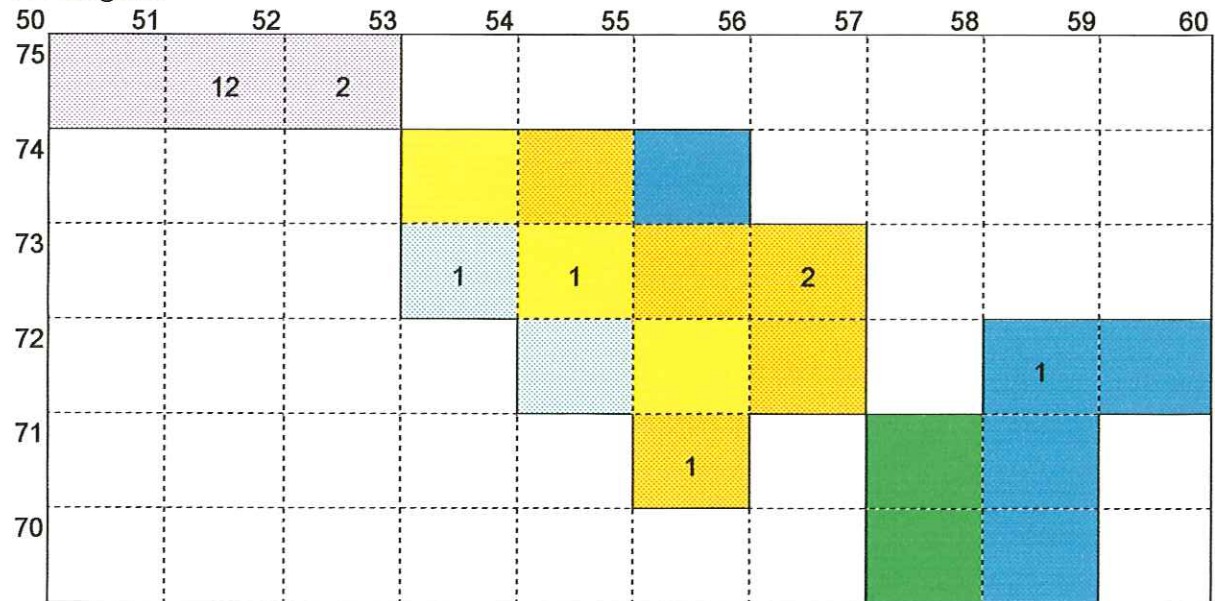
6: Merlin



Altitude / Habitat



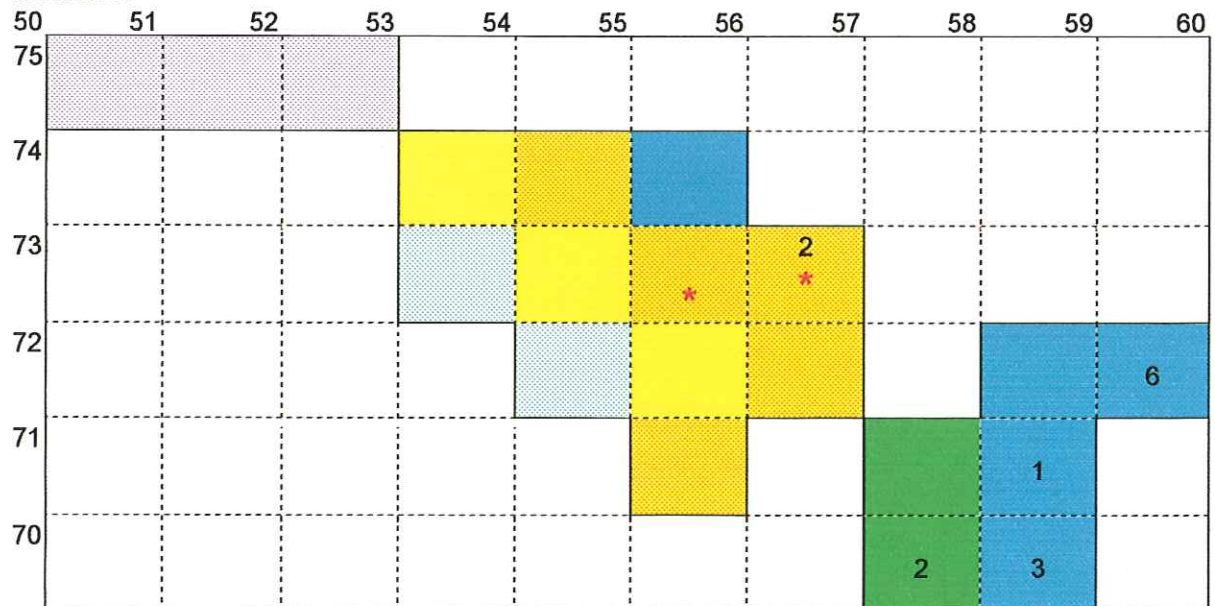
7: Peregrine



Altitude / Habitat

Control	Windfarm
Low	Medium/mixture
Medium/mixture	High
High	High & woodland

8: Kestrel

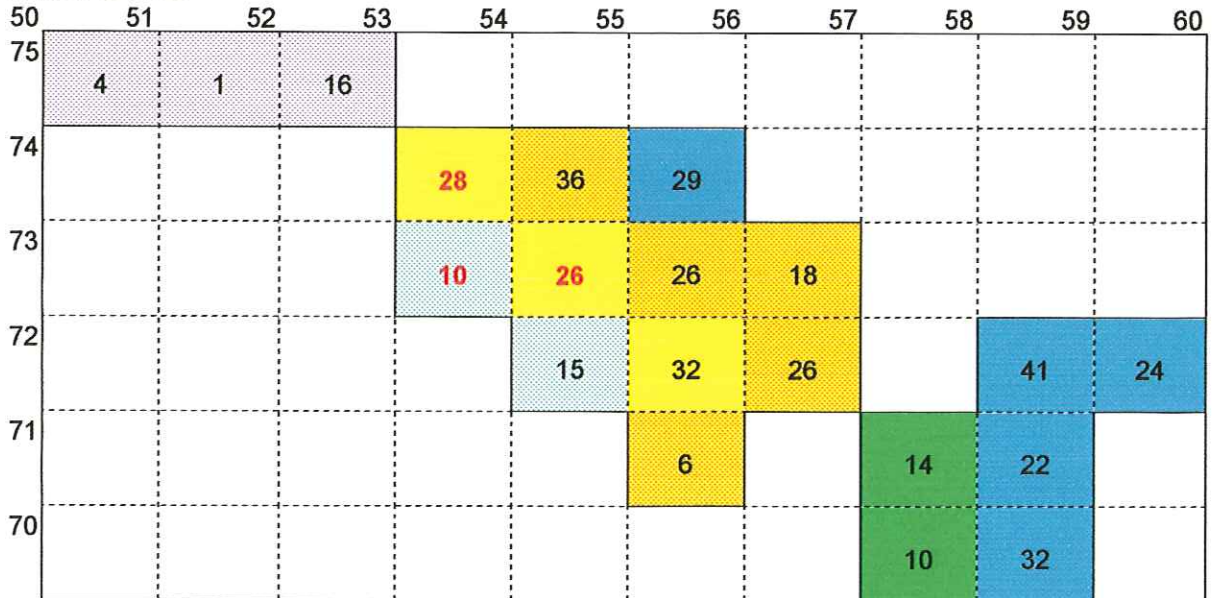


Altitude / Habitat

Control	Windfarm
Low	Medium/mixture
Medium/mixture	High
High	High & woodland

Red asterisks indicate where single casualties have occurred

9: Red Grouse

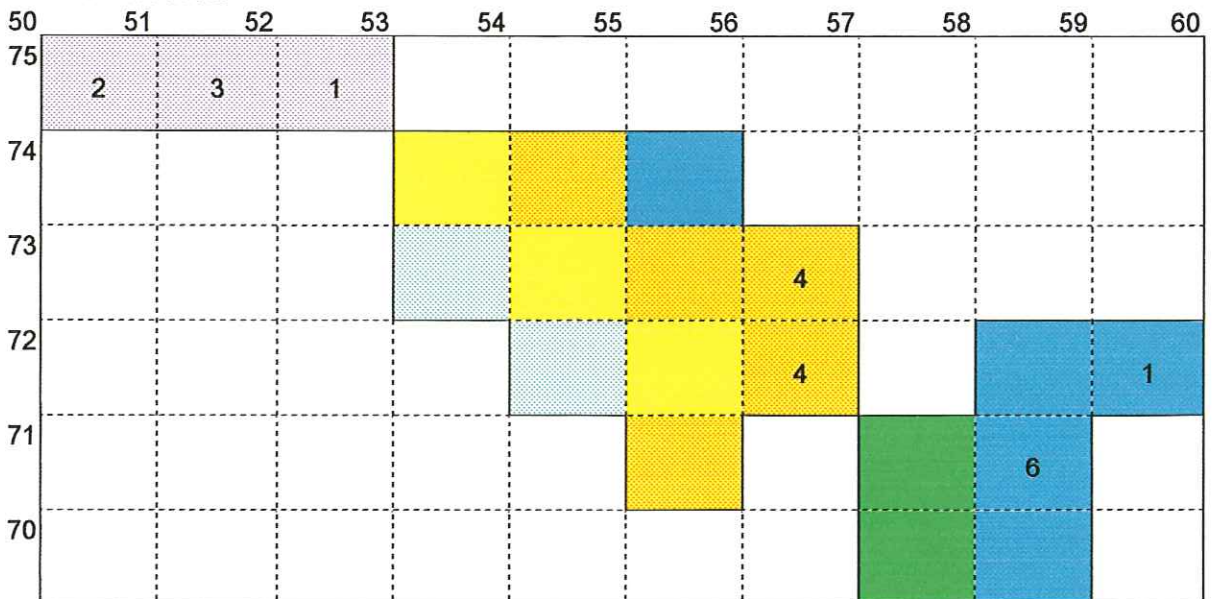


Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

Red text indicates where single casualties have occurred

10: Golden Plover



Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

11: Skylark

50	51	52	53	54	55	56	57	58	59	60
75	0,1		0,1							
74				0,1		0,2				
73					0,2	0,2	4,19			
72				0,1	0,2	0,3			6,23	7,23
71								23,80	1,2	
70								5,27	0,1	

Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

Left hand number in each pair shows breeding records, right hand total registrations. Squares with breeding have text in **bold**

12: Meadow Pipit estimated breeding

50	51	52	53	54	55	56	57	58	59	60
75	24	25	22							
74				33	36	29				
73				15	33	44	37			
72					16	26	25		29	42
71						18		20	12	
70								21	15	

Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

13: Raven (excluding 1998 data not available in correct format)

50	51	52	53	54	55	56	57	58	59	60
75	9	5	2							
74				3	8	6				
73				6		2				
72					1	3				1
71						6		2	3	
70									10	

Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland

14: Blue hare (counted 1999-2001 only)

50	51	52	53	54	55	56	57	58	59	60
75			3							
74				2	3	1				
73				2	2	2	4			
72					1	3	25		9	5
71						2			10	
70								2	12	

Altitude / Habitat

Control	Windfarm
Low	
Medium/mixture	Medium/mixture
High	High
	High & woodland