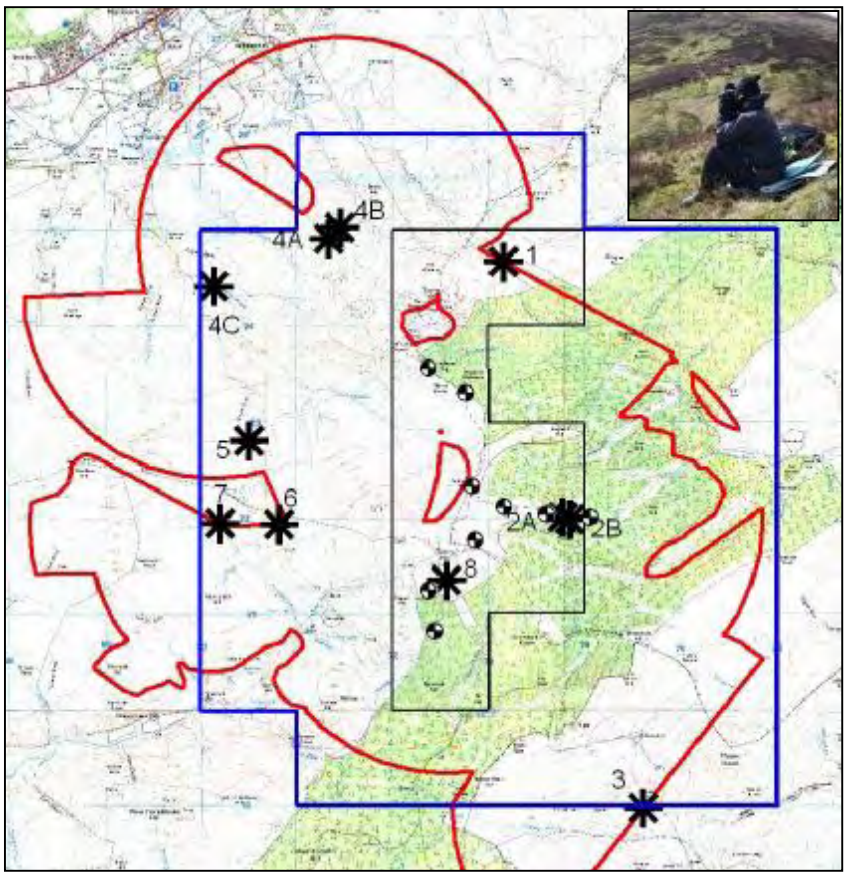
# Bird Impact Assessment for Penbreck Windfarm South Lanarkshire



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*1 Cause* 1

*2 Methods of Data Collection* 1

**2.1 Preliminary remark** 1

**2.2 Open land survey (according to BROWN & SHEPHERD 1993)** 2

**2.3 Vantage Point Watches** 3

**2.4 Forest survey (point-stop-registration)** 20

**2.5 Special registration** 20

**2.6 Request of old data at SNH** 20

**2.7 Mapping of vegetation and habitat** 21

*3 Methods of the interpretation* 21

**3.1 Data preparation** 21

**3.2 Collision risk** 21

**3.3 Open land survey** 24

**3.4 Forest survey (point-stop-registration)** 24

*4 Results* 25

**4.1 Open-land survey** 25

4.1.1 Target Species 25

4.1.2 Secondary species 27

**4.2 Vantage-point watches** 31

4.2.1 Overview 31

4.2.2 Phenology 32

4.2.3. Range use 33

4.2.4 Displays 40

4.2.5 Flying altitude 41

**4.3 Woodland point-counts** 43

*5 Comparison with the previous years and subsuming evaluation* 45

*6 Mitigation measures* 46

**6.1 Principles** 46

**6.2 Further preventive and attenuative measures** 46

**6.3 Creation of appropriate breeding and feeding habitats** 47

*7 Impairments* 51

**7.1 Present state of knowledge** 51

**7.2 Prognosis for the planned Wind Park** 56

Habitat loss 56

Disturbance and Displacement 56

Collision risk (results of the calculation) 57

*8 Impact assessment of the Muirkirk & Lowther Uplands SPA* *60*

**8.1 Legal and ecological basis** **60**

**8.2 Characterisation of the Natura 2000 area concerned and inference of the relevant conservation objectives and evaluation standards** **61**

**8.3 Subsuming stock informations** **65**

**8.4 Impairments to be expected through the planned wind park** **66**

**8.5 Evaluation of the compatibility** **66**

*9 Literature* *69*

*10 Maps* *71*

*11 Appendix* *72*

*Fig. 1: Delimitation of the area of investigation with the location of the area in southern Scotland* 2
*Fig. 2: Location of the Vantage Points* 4
*Fig. 3: Distribution of the observation times on the 11 Vantage Points in the three observation periods* 5
*Fig. 4: Locations of the random points with 200 m radius in relation to the vantage points* 9
*Fig. 5: Flight activities of Hen Harrier, Buzzard and Kestrel in dependence of the distance to the next VP* 10
*Fig. 6: Focal points of the observed disturbances.* 13
*Fig. 7: Comparison of the observations of Hen Harrier males and females in April* 14
*Fig. 8: Times of observation in the course of the year.* 16
*Fig. 9: Distribution of the observers on the VPs* 17
*Fig. 10: Distribution of the target species with consideration of the overlapping areas* 18
*Fig. 11: Distribution of the secondary species with consideration of the overlapping areas* 19
*Fig. 12: Delimitation of the windpark.* 22
*Fig. 13: Spread of the target species 2005 and 2006 in the investigation area.* 25
*Fig. 14: Territories and centres of territories of the secondary species 2005.* 27
*Fig. 15: Territories and centres of territories of the secondary species 2006.* 28
*Fig. 16: Frequency of Sky Lark and Meadow Pipit as breeding birds in 2005* 30
*Fig. 17: Spread of Hen Harrier observations in the period of investigation* 32
*Fig. 18: Spread of Peregrine Falcon observations in the period of investigation.* 33
*Fig. 19: Display flights of Hen Harriers in 2005 and 2006* 40
*Fig. 20: Duration of stay in percentages of the target species in the three levels of altitude* 41
*Fig. 21: Spread of flight movements in rotor height (RH), resp. above and below rotor height* 42
*Fig. 22: The edge of the forest is marked by a missing transition between the forest and the open land* 47
*Fig. 23: Views of the southwestern slopes of the Cairn Table with distinctive heathland areas* 48
*Fig. 24: Grass areas east of the forest area, which were still dominated by heath approximately 10 years ago.* 49
*Fig. 25: Grass areas in the south of the area of investigation with a strong dominance of Molinia.* 49
*Fig. 26: Western slope of Stony Hill with the border of cultivation between heath and grass areas.* 50
*Fig. 27: Map of the Special Protection Area and location of the project.* 62

*Tab. 1: Overview of the blocks of observation time.* 6
*Tab. 2: Activity of target and secondary species in the three periods of investigation.* 15
*Tab. 3: Technical data of the wind energy plant* 23
*Tab. 4: Periods of time of the periods of investigation as well as the hours of activity of the species.* 23
*Tab. 5: Measurements and flight speeds of the investigated bird species used for the collision calculation.* 23
*Tab. 6: Survey results of target species 2005 und 2006* 26
*Tab. 7: Survey results of secondary species 2005 and 2006* 31
*Tab. 8: Frequency of the observed flight movements of the target and secondary species* 31
*Tab. 12: Results of point counts in the forest* 43
*Tab. 13: British studies of the possible disturbance effects of wind farms on bird distribution* 54
*Tab. 9: Risk of collision for all nine turbines* 57
*Tab. 10: Risk of collision for the two turbines in the north* 58
*Tab. 11: Risk of collision for the seven turbines in the south* 58
*Tab. 14: Ecological requirements of qualifying interests of the SPA* 63
*Tab. 15: Overview of the impairments to be expected to the five qualifying species* 66

# 1 Cause

On the border of the Muirkirk & North Lowther Uplands Special Protection Area (SPA) a wind park with 9 plants is being planned in Penbreck & Carmacoup Forest, East Ayrshire/South Lanarkshire. In 2005/2006 a survey according to the guidance of Scottish Natural Heritage (SNH 2005) was done for this project. The aim of the survey was the assessment of the impacts of the planned windfarm on birds and on the species conservation objectives of the SPA.

This investigation was preceded by the planning of 18 wind power plants on the same location. After the submission of the Environmental statement in November 2000, this project was rejected by SNH (Scottish National Heritage). The reasons for the rejection were methodical deficiencies in the assessment of the landscape and of the Avifauna in the environmental statement in the opinion of SNH. The insufficient assessment of possible effects of the plants on the Avifauna also played the main role in the rejection of the request in the inquiry in February 2004.

The task of the present study is to conduct ornithological investigations with methodical standards and to an extent, which allow an assessment of the possible effects of the planned wind plants.

# 2 Methods of Data Collection

## 2.1 Preliminary remark

The basis of this investigation were the “guidelines” (state of April and November 2005) set by SNH, which are not repeated in detail at this point. On deviations from the methodical guidelines (e.g. registration of the secondary species) we shall elaborate on in the following chapters.

The delimitation of the area of investigation is shown in Fig. 1. It is based on a 2 km radius around the planed plants and in addition also includes areas in greater distance west of the planned sites, which can serve as reference areas for future monitoring investigations. In total an area of approximately 40 km² (approx. 28 % forest, 72 % moorland, heath- and grassland) was investigated. Approx. 30 km² (=70 %) lie in the area of the “Muirkirk and North Lowther Uplands SPA”.

The investigation program was communicated to SNH in writing at the beginning of the investigations 2005 (mail to Andrew McGregor, 09.03.2005). The comments received thereon were taken into account in the present investigation (for example in 2006 an observation period was moved to the period of February/March, as the Golden Plover can already be present in their territories at this time).

The results from the breeding period 2005 and the winter 2005/2006 were presented and explained to SNH (Mr. Andrew McGregor, Mrs. Dianne Holman) on the 19th of April 2006. The results and the underlying method were seen as sound, and methodical modifications in 2006 were not seen to be necessary. The investigation of voles, as proposed by Mr. Andrew McGregor on this appointment, was not made, as the mapping of breeding birds was scheduled for two years and a prey assessment, according to the guidelines, is only demanded as a supplementary measure for one year surveys. However the main argument was that our investigations showed

no connection between the recorded density of Meadow Pipits (potential prey of the Hen Harrier) and the centers of activity of the Hen Harrier. Thus such a connection also does not seem to be cogent in the case of the small mammals. Mr. McGregor accepted this argumentation and a prey assessment with regard to voles was no longer seen as necessary.

The results of the breeding season 2006 were presented to Mr. McGregor and Mrs. Holman on the 18th of July 2006. Subject to a detailed examination, Mr. McGregor voiced the opinion that with the presented results the main point of contention of the previous licensing procedure – the insufficient data with regard to the birds – would be resolved.

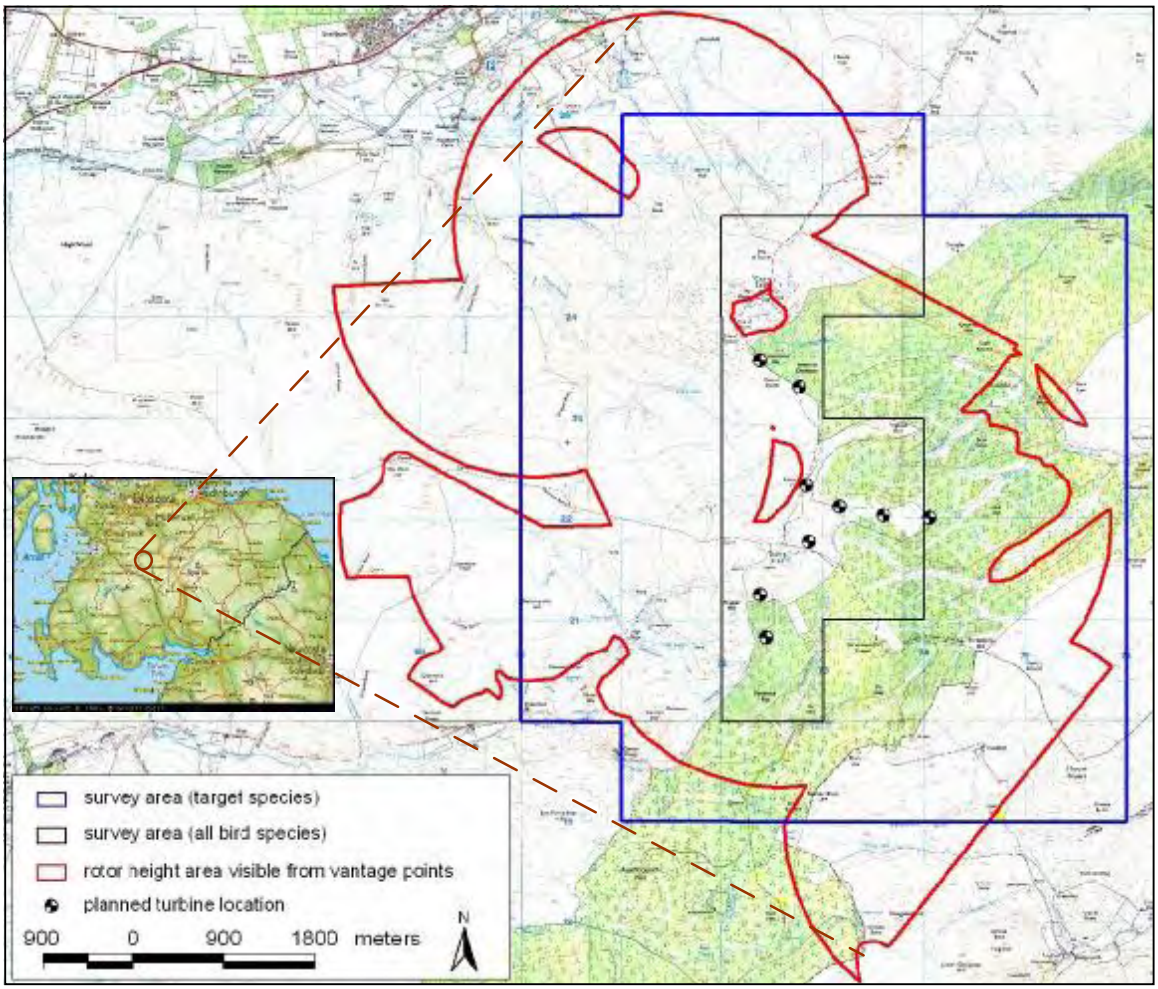



**Fig. 1: Delimitation of the area of investigation with the location of the area in southern Scotland (source of the overview map: www.map-of-uk.co.uk).**

## 2.2 Open land survey (according to BROWN & SHEPHERD 1993)

The registrations for the determination of the size of stock (searching for nests and finding of territories) for the five target species (Hen Harrier, Peregrine Falcon, Merlin, Short-eared Owl and Golden Plover) were made on three dates in 2005 and 2006 respectively (2005: 08.04., 03.-05.05., 26./28./29.05.; 2006: 19./24.04., 15.-18.05., 07./08.06.) by exhaustive control of the entire area (38 1-km² grids) (incl. all stream valleys) (see Fig. 1). In addition to this the eyrie of the Peregrine Falcon was checked again at the end of June and mid July respectively in both

years. Additionally some other species (Oystercatcher, Lapwing, Redshank, Curlew, Snipe, Sandpiper, Dipper, Grey Wagtail, Stonechat and Wheat eater) were recorded by the survey. Moreover in 2005 a mapping of Meadow Pipit and Sky lark was made in eight 1-km² grids around the plants, as these species, especially the Meadow Pipit, are an important prey for the Hen Harrier. The counting took place in ¼-km² grids (N = 32) within the 1-km² grids after the method of BROWN & SHEPHERD (1993) on the following dates: 08.04., 04./05.05., 26./28./29.05.2005.

## 2.3 Vantage Point Watches

For the determination of focal point areas of flight activity in the area of investigation and for the calculation of the collision risk Vantage Point Watches were made. According to specifications of SNH, the Hen Harrier, Merlin, Peregrine Falcon Golden Plover and Short-eared Owl were set as target species. As secondary species we selected the Buzzard, Kestrel, Sparrow hawk, Goshawk, Raven and Curlew, as these species can be impaired in their behaviour by the wind energy plant or endangered through collision. Other large birds, even during the migrating periods, hardly appeared in the area. Merely Gulls flew over the area regularly, yet only in small numbers and mostly in greater height.

On a pre-excursion on the 16th and 17th of March 2005 eight Vantage Points (1, 2a, 2b, 3, 4a, 4b, 5 and 6) were chosen by Dr. K. Handke and Dr. M. Reichenbach in a way which largely covers the area of investigation including the reference areas. In Fig. 2 the locations of these points, as well as those of the additional observation points selected during the period of investigation (see below), are illustrated. The points should give as good an overview of the area as possible, be as accessible as possible, have a minimal disturbance effect on birds and be located outside of the planned plant locations. Naturally, due to the topography of the area, it was not always possible to fulfill all of these criteria. Thus, for example, the points 2a and 2b are located within the area of the planned plants, as from no other point nearly as good a view of the area was possible (the surrounding lies in the forest and in valleys respectively.). In Appendix 5 there are panorama photographs of all vantage points.

In addition in the course of the investigations three further Vantage Points were set up. Point 4c was deemed necessary by us, as in its surrounding, which was not visible from either Point 4a or 5, there was a suspicion of Hen Harriers in both years. Point 7 was only occupied in the breeding season 2005, as also in its surrounding there was the suspicion of Hen Harriers, which however was not confirmed. In the breeding season 2006 the observation point 8 was additionally set up, in order to check if Peregrine Falcons fly regularly into the area of the planned plants from their nest site in the south of the area.

The maximum observation radius was at 2 km according to SNH (2005) (see Fig. 2). Naturally, due to the topography, the entire radius was mostly not equally well visible. Thus from each point and by every observer sketches were made on site, in which the visible areas were illustrated. In this way the site maps of one point made by the various observers could be compared amongst each other and adjusted. Afterwards a review on the basis of the contour lines of the topographical map took place in the GIS (ArcView 3.3). At the digitalization of the map 30 meters were added to the visible areas, as for the calculation of collisions only the flight movements in rotor height are relevant. In the following, when talking about the visible areas and visible planes, one always means the rotor height of 30 meters visible from the points.

This is based on the classification into levels of altitude:

Below rotor height: < 30 m

In rotor height: 30-200 m

Above rotor height: > 200 m

The rotor height was set to 30–200 m, as at the beginning of the investigation the plant type had not been decided. The actual rotor height if the planned Vestas V90 3MW is 35-125 m and thus lies within the rotor height set for the site survey.

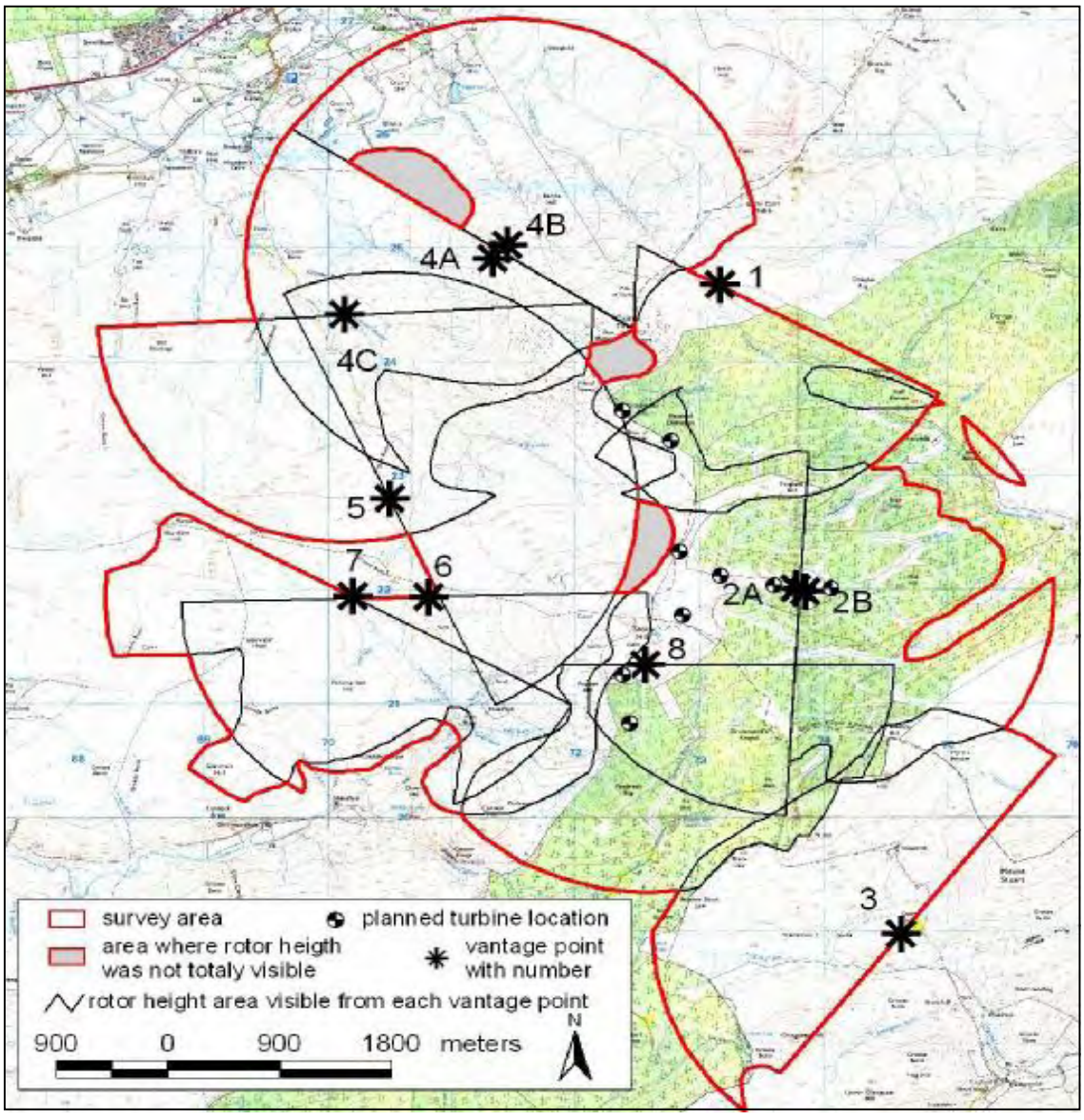



**Fig. 2: Location of the Vantage Points and the areas in rotor height (>30 m) visible from them.**

In Fig. 2 there are three gray-coloured areas within the area of investigation, in which the rotor height was not fully visible. This merely concerns few meters in the lower area of the rotor height, however as the frequency of flight movements of the Hen Harrier, for example, decreases with increasing altitude (MADDERS & WHITFIELD 2006; WHITFIELD & MADDERS 2006), this must be taken into account in the discussion of the results of the collision calculations.

In the photographs in appendix 5, all vantage points including the areas visible from there within 180° are illustrated. In appendix 2 the observation periods and the names of the observers are summaries separately for each point. All observations made by nine qualified ornithologists with a field experience of many years (max. 32 years). Appendix 1 shows an overview of the observers involved, as well as their qualifications.

In total 1667 hours were spent observing at the 11 Vantage Points (breeding season 2005: 664,25 h, Winter 2005/2006: 359 h, breeding period 2006: 643,75 h). The observation times per point for the three observation periods are illustrated in Fig. 3.

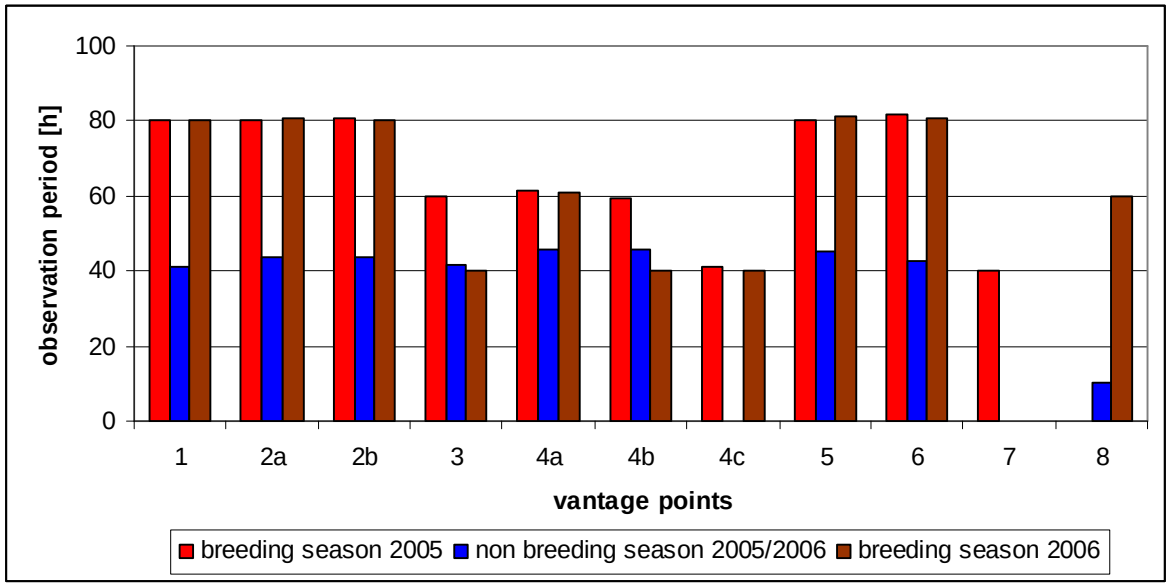



**Fig. 3: Distribution of the observation times on the 11 Vantage Points in the three observation periods (breeding season 2005, non-breeding season 2005/2006, breeding season 2006).**

On all 11 Vantage points the minimum of 36 h set out by the SNH guidelines were reached and clearly exceeded in breeding and the non-breeding season. At points with heightened bird activity (e.g. VP 5) and in areas which would be particularly affected by the planned wind plants, the observation times were substantially increased in the breeding season (e.g. 80 h at 1, 2a, 2b, 5 and 6 and 60 h at 4a).

The observations were made simultaneously in blocks of time from 3 to a maximum of 9 days, by 2 up to a maximum of 8 observers each (comp. Tab. 1).

**Tab. 1: Overview of the blocks of observation time.**

| season | number of dates | date | number of observers | hours of observation |
|---|---|---|---|---|
| breeding season 2005 | 6 dates | 04.–11.04. | 8 | 250,75 |
| | | 02.–05.05. | 6 | 66 |
| | | 26.–29.05. | 4 | 72,5 |
| | | 13.–16.06. | 4 | 106,75 |
| | | 28.06.–01.07. | 4 | 115,75 |
| | | 18.–20.07. | 4 | 52,5 |
| non-breeding season 2005/2006 | 5 dates | 04.-06.08. | 4 | 80,75 |
| | | 06.–09.09. | 4 | 79 |
| | | 03.-05.10. | 4 | 77 |
| | | 07.–09.11. | 4 | 38,75 |
| | | 27.02.–02.03. | 4 | 83,5 |
| breeding season 2006 | 5 dates | 18.–26.04. | 8 until the 22.04., afterwards 2 | 304,25 |
| | | 15.–18.05. | 4 | 78,25 |
| | | 06.–09.10. | 4 | 121,25 |
| | | 26.–29.06. | 4 | 109,75 |
| | | 17.–20.07 | 4 | 30,25 |

There were eight observers active in April 2005 and 2006 respectively, as the activity of the Hen Harrier and other target species was particularly high due to territory occupation and courtship. On the other dates the observations were usually made by four ornithologists (exceptionally by two or six).

Observations were made at various times of day and in varying weather conditions. The observations were only interrupted during heavy rains and fog. Apart from binoculars, every ornithologist was also equipped with a spotting scope. Attention was paid, that as far as possible every observer had worked on every VP in each observation block. Through this rotation the influence of individual observation mistakes on the quality of the data should be minimized (comp. Fig. 9).

The observations were made from green and black chairs respectively. The observers moved as little as possible at the points in order to avoid disturbances.

***Deviations***

The recording of the observations (time of day, species, quantity, gender, flight altitude, flight duration, behaviour (e.g. displays), flight path with mapping) was done according to the guidelines of SNH (2005). Merely the following modifications of the registration method to the guidelines were made:

In the field it was more practicable not to estimate the flight altitude every 15 seconds (as suggested in the instructions), but rather to continually measure the duration of a flight movement and while doing so to register the duration of stay of a bird in a level of altitude. I.e. during the continuing measuring by the stopwatch, merely the moment of the change into another level of altitude was recorded. As the change of level of altitude only occurred rather rarely within the target species, the concentration could be put on to the flight path and the change of level of altitude could be very precisely plotted onto the map.

As the estimation of altitude in the field could be faulty (MADDERS & WHITFIELD 2006), flight movements, which did not clearly lie below 30 m or above 200 m, were always allocated to the rotor height (presumption of the worst case).

Due to the low bird activity (see Tab. 2) the intervals in the observation times were normally reduced to 30 minutes and individually spread throughout the observation day.

Due to the small bird activity, it was possible to increase the precision of registration in comparison to the recommendations of SNH (2005) in the case of the secondary species. Also for these species each flight movement was noted in the map with time of day, duration and altitude of flight. At simultaneous presence of the target and the secondary species, generally we were careful to register all movements of the target species.

Examples of protocol documents and site maps used in the field are given.

***Recording of Disturbances***

Parallel to the ornithological observations at the vantage points, all disturbances for example by hikers, off-road vehicles or low flying aircraft, were noted. The recording of disturbances was done in standardized form on a form (time and kind of disturbance, reaction of the birds, presence of the bird species).

***Discussion of errors***

*Were the results influenced by disturbances of the observers, especially at the points 2a/2b and 8, which lie in proximity to the planned wind energy plant?*

In order to be able to see into as big an area of the area of investigation as possible, it was unavoidable to occupy these heightened points. There were no alternatives. It can not be ruled out that this affected the flight movements of birds (avoidance, circumvention movements). In the cases of the Hen Harrier, the Buzzard and the Kestrel, the three most common species, the disturbance effects of the observers were statistically investigated. For the other species there are no sufficient observations in order to make statistically backed statements.

In order to assess a disturbance effect of an observer, two hypotheses are set out:

1. Without the influence of the observer the flight movements of the birds are evenly spread throughout the area of investigation.
2. If a disturbance effect of the observers exists, there is a positive connection between the flight activity of the birds and the distance to the vantage points (the greater the distance, the greater the flight activity).

In order to obtain independent data for the statistical analysis, 100 points very randomly spread throughout the entire area of investigation (ArcView 3.3, Script: “random points”). The only condition for the distribution of the points was a distance to the edge of the area of investigation of at least 200m and a minimum distance of 400 m between each other. Subsequently the distance of the points to the nearest vantage point was calculated. For the determination of the flight activity a circle with a radius of 200 m was made around each point (see Fig. 4) and the length of all flight movements of Hen Harrier, Buzzard and Kestrel were added up separately for each species. While few flight observations and migrating birds resulted in a low value for the flight activity, circling and/or frequent flight movements achieved a high value. Thus for each of the 100 random points the distance to the nearest vantage point and a value for the flight activity (measured in the length of the flight lines) was available.

In this analysis varying flight activities due to the topographical situations or differences of quality of habitat were not taken into account. The varying observation duration of the individual area sections was also not taken into account, while the number of hours of observation from the central vantage points is approximately the same (see appendix 2). Normally observation points visible to each other were occupied simultaneously, so that the flight activities near observation points almost exclusively took place, when the point was also occupied. An assessment of the data for point 4c, which was merely occupied in the breeding season 2005, showed that the flight movements near 4c were observed from that point and not from 4a.

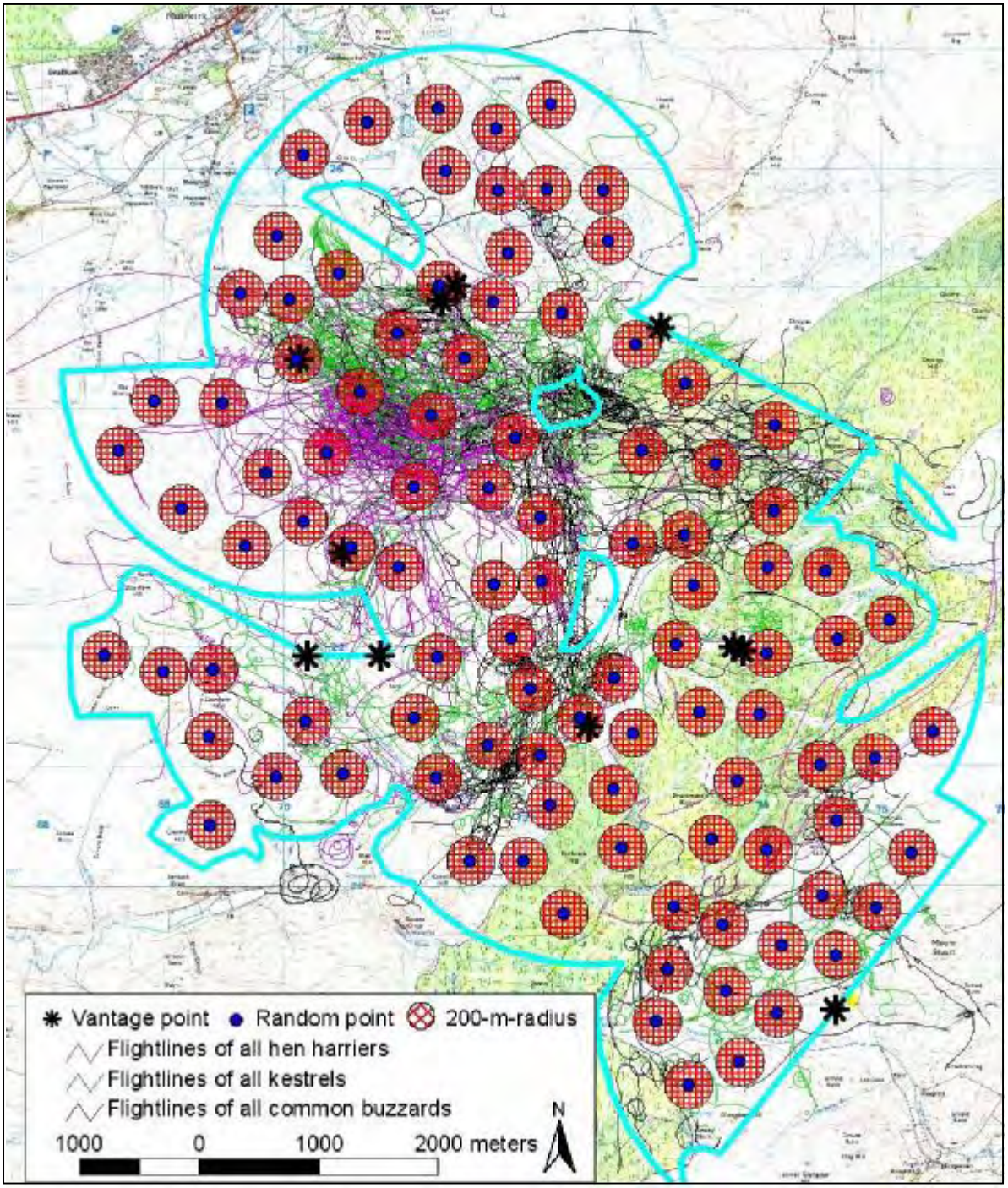
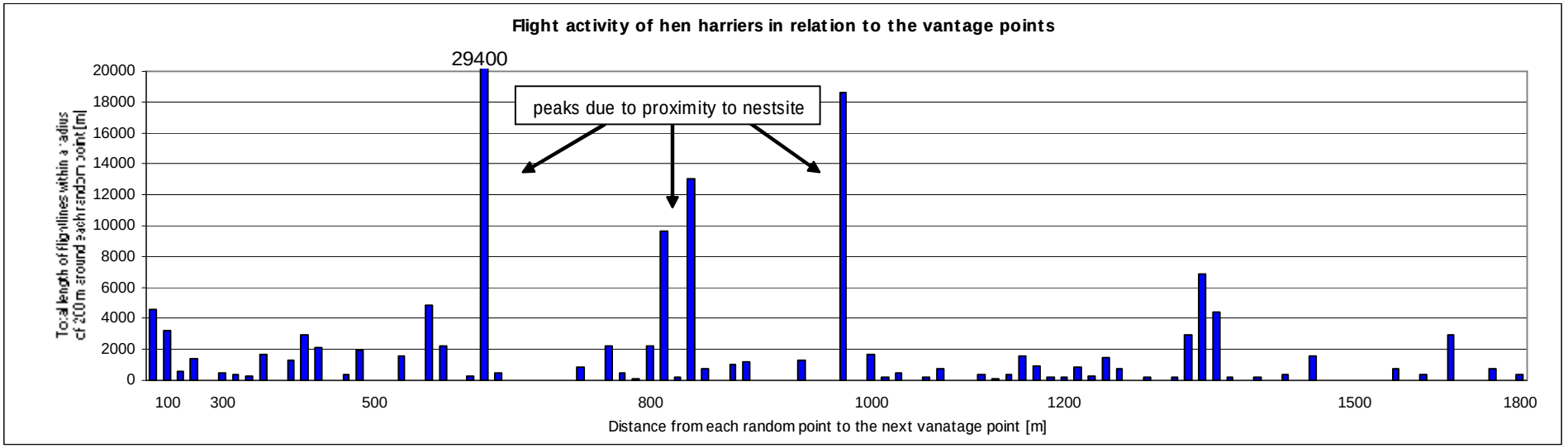



**Fig. 4: Locations of the random points with 200 m radius in relation to the vantage points and the flight lines of Hen Harrier, Kestrel and Buzzard.**

The following three figures show the flight activity per 200 m radius around the random points in dependence of the distance to the next vantage points for each of the three species. Each column shows the value for a random point. In the case of the Hen Harrier, the four areas near the nesting area are clearly recognizable as extreme values. These values were excluded from the statistical analysis. The other values fluctuate between 0 and 5000 m flight line per random point.



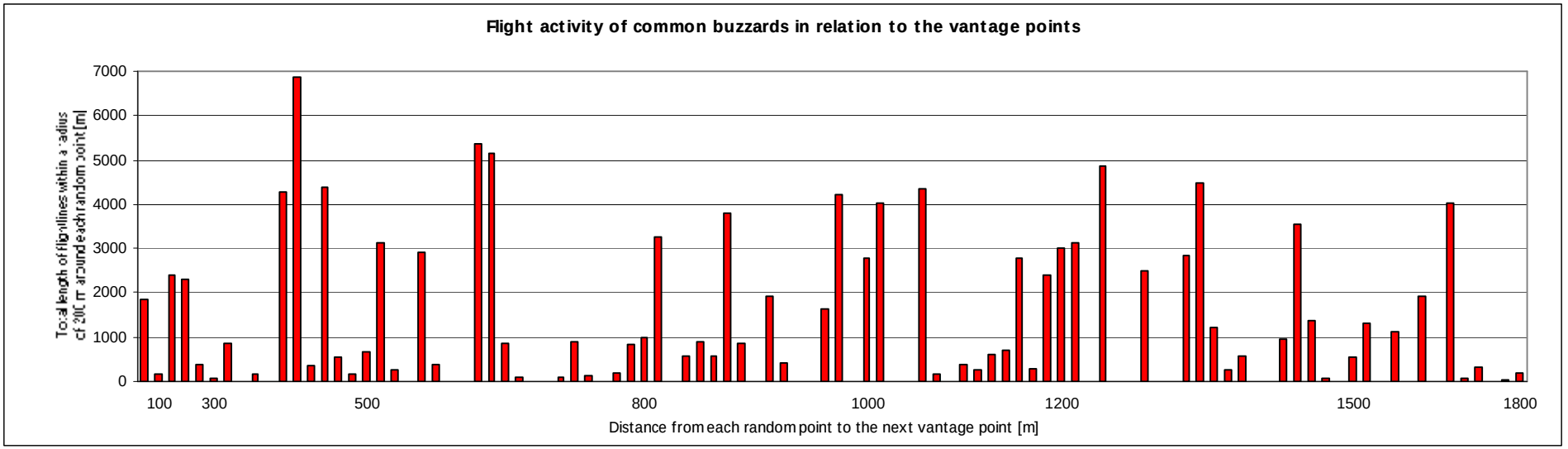




**Fig. 5: Flight activities of Hen Harrier, Buzzard and Kestrel (see continuation on the next page) in the circular areas around the random points in dependence of the distance to the next vantage point (data from 2005 and 2006).**

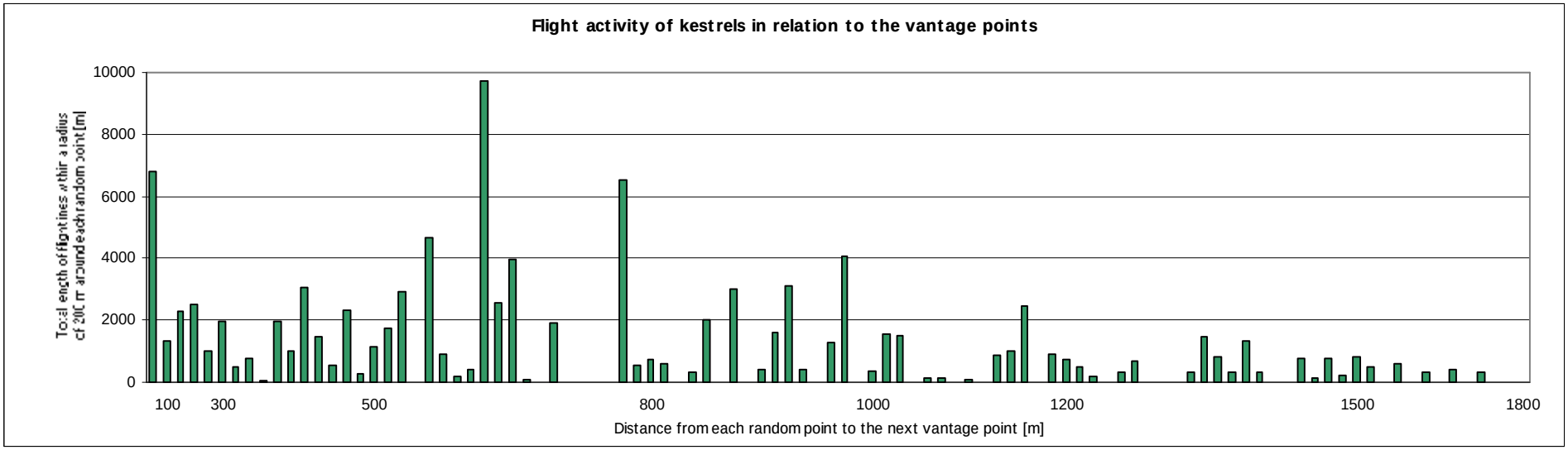



**Fig. 5: Continuation.**

The flight activity of the Buzzard fluctuated strongly. The added up lengths of the flight movements lie between 0 and almost 7000 m. In the nearer surroundings of the observation points the average values lie at approximately 2000 m flight line.

In the vicinity of the observation points the observed flight activity of the Kestrel is higher than further away from them. The second highest value is reached at a point in immediate proximity of an observation point. Thus, on the strength of this fact a negative impact can be ruled out. The decreasing flight activity in greater distances is connected to the fact that the relatively small bird can easily be overlooked from a distance above 1000 m.

From the diagrams a negative influence of the observers on the species Hen Harrier, Buzzard and Kestrel can not be deduced. In order to obtain sufficiently strong and objective results, the data was tested on a correlation between the distance and the flight activity with the statistic program SPSS 13.0.

In the cases of the Hen Harrier and the Buzzard there was no significant correlation between the distance and the flight activity (rank correlation according to Spearman-Rho, significance $p>0,05$). For the data of the Kestrel a highly significant negative correlation (rank correlation according to Spearman-Rho, correlation coefficient: -0,434, significance $p<0,001$) emerges. This confirms that on the one hand there was no negative influence through the observers, but also that the Kestrel was very significantly less observed at increasing distance.

*Were the results influenced through other disturbances e.g. hikers?*

In total 367 disturbances were noted during the observation period. In 224 cases these consisted of hikers and in 89 cases of low flying aircraft. Additionally 37 vehicles (cars, lorries and quads), 6 bicyclists and 11 other disturbances (e.g. chainsaw noises) were noted.

Due to the low bird activity (see Tab. 2) direct disturbances were only noted very rarely. In both years, for example, hikers who used a path on the western flank of the Cairn Table regularly disturbed the Hen Harrier as soon as they came into the vicinity of the nest area. This might have le to a slightly heightened flight activity, which however should not matter within the sum of the observations. The focal points of disturbance through hikers were predominantly in a longer distance to the planned sites (see Fig. 6). In the area of the wind park no direct disturbance influences could be registered, so that an influence of the collision calculations can be ruled out. Also in the case of the low flying aircraft no direct disturbance could be registered, as usually there were no birds present at the same time.

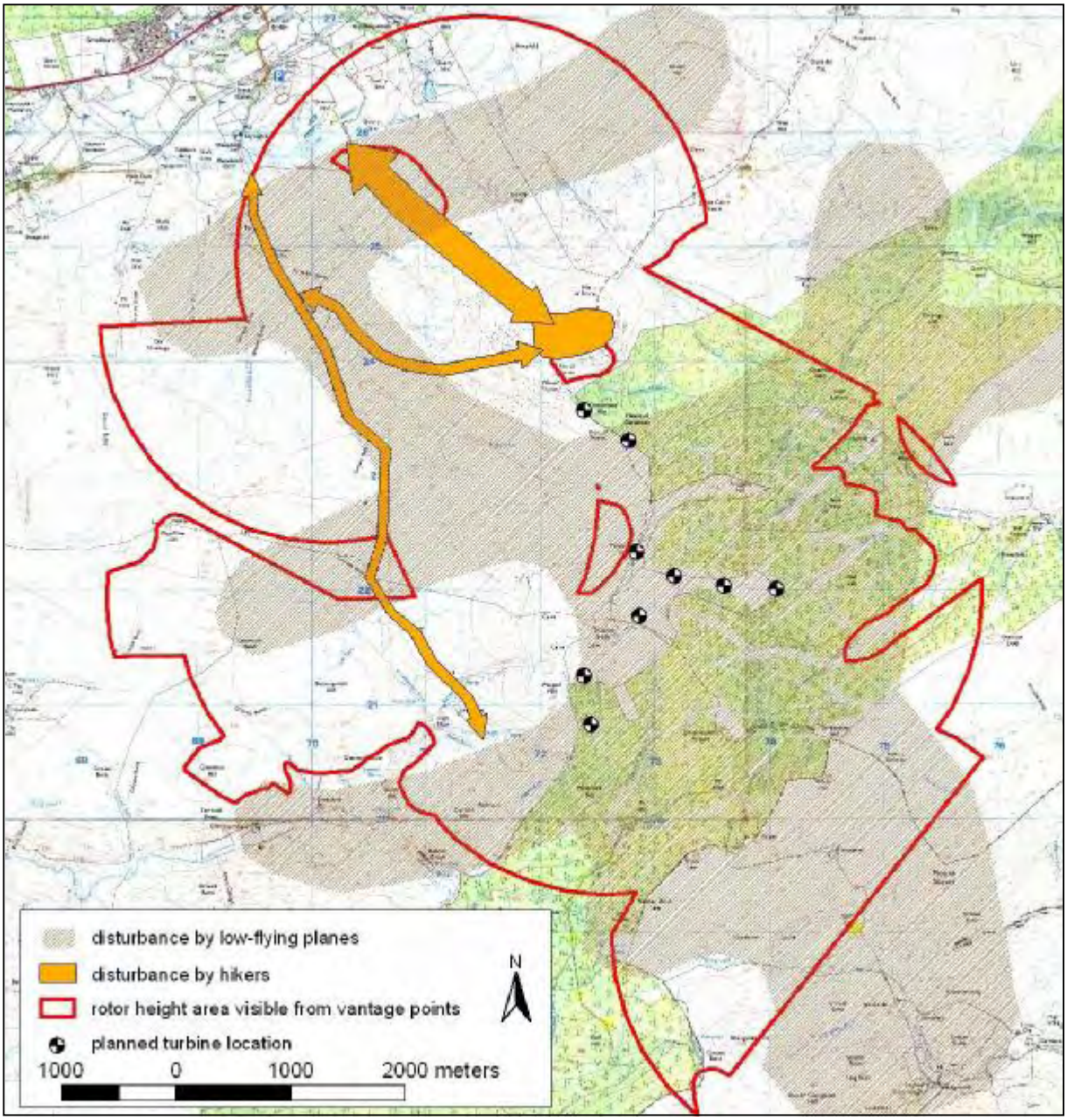



**Fig. 6: Focal points of the observed disturbances.**

*Visibility of the birds*

The likelihood of registration is not the same for all considered bird species. It depends on the size, the colouring and the behaviour of the animals as well as the on the weather conditions and the visibility. A conspicuously coloured male Hen Harrier which flies within a small distance to the observer, is significantly easier to spot than a female Hen Harrier which is hunting close to the ground 2 km away from the observer. Especially the female Hen Harrier, but also the Merlin, which flies very close to the ground, over greater distances hardly stand out against the dark background of the heath landscape. In order to check an influence on the observation results, the number of Hen Harrier observations before the beginning of the nest occupation and without courtship activity was evaluated separately according to gender (see Fig. 7). This is based on the assumption that the numbers of male and female Hen Harriers in the area are equal, and also their activities are similar.

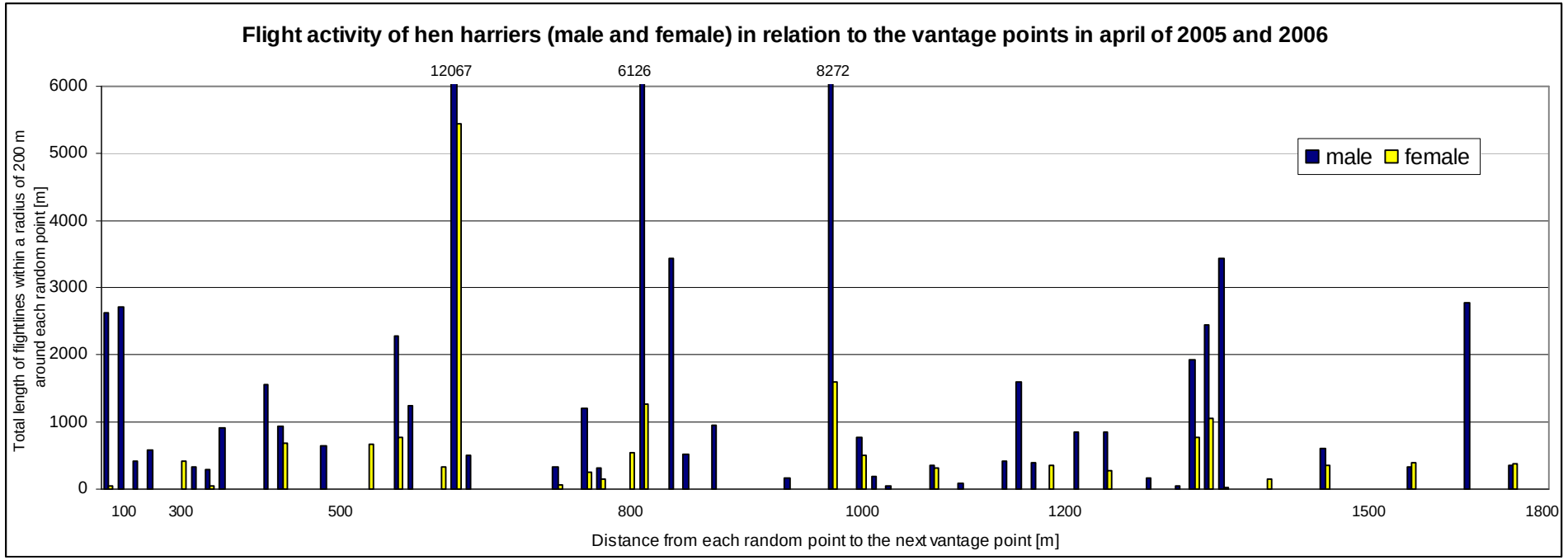



**Fig. 7: Comparison of the observations of Hen Harrier males and females in April before the beginning of the nest occupation and without courtship activities.**

Throughout the entire distance area considerably more males than females were observed. This difference is significant (Mann-Whitney U-test, $p<0,05$). The significant difference exists in the distance area up to 1000 m, as well as in the distance area above 1000 m. As there also is no negative correlation between the distance and the flight activity (neither with males nor with females) (rank correlation according to Spearman-Rho, significance $p>0,05$), the small amount of observed flight activity of the females is not distance-dependant. Thus one can assume, that the lesser conspicuity of the female is not solely responsible for the differences in the frequency of observations, but that the assumption that both genders are present with equal activity in the area is false. The male, even before the egg deposition, is totally liable for the food supply of the female and thus has to make a substantially bigger effort than the female as far as foraging is concerned (GLUTZ VON BLOTZHEIM *et al.* 1989).

However, at this point one should refer back to the previous section, where for the Kestrel a highly significant, negative correlation between the distance and the observed flight activity was registered. The connection makes apparent that with increasing distance it became more difficult to spot small birds with inconspicuous plumage in the field. As a further example the Merlin can be mentioned at this point, whose nest in 2005 was situated directly in the field of vision of the VP 5 within a distance of approximately 800 m. Here, in contrast to the numerous observations of the Hen Harrier in the nest area, there were only few observations of the Merlin.

The results of the Kestrel and the Merlin show that for these two species the observations of the flight movements can not make up the sole basis for an evaluation of the influence of the wind energy plant, but if necessary additional general assumptions on the radius of action must be made.

*Was it possible for the observers to register all bird activities at the same time?*

In the case of simultaneous activity of several birds there is at least the risk that a person can not record all necessary parameters (length of observation, flight altitude, behaviour) (see MADDERS & WHITFIELD 2006). Due to the unexpectedly low activities, we can largely rule this out in our investigations. On average 0,4 target species and 1,0 secondary species were registered per hour. Split up into the three periods of observation, the following picture emerges (Tab. 2).

**Tab. 2: Activity (number of observations / hour) of target and secondary species in the three periods of investigation.**

| | breeding season 05 | non-breeding season 05/06 | breeding season 06 |
|---|---|---|---|
| target species | 0,5 | 0,1 | 0,4 |
| secondary species (without Curlew) | 1,1 | 0,9 | 0,8 |

Thus it only occurred in individual cases that the observations of secondary species accumulated (for example during particular upwind situations in the field of vision of VP 4a). In these rare cases one always concentrated on the target species so that it is possible that single Buzzard- and Kestrel observations were not registered. In view of the total of 641 Buzzard and 662 Kestrel observations during the entire period of observation, these should not be significant.

Merely in the case of the Curlew in the area of the VP 3, the mapping of all flight movements was terminated in the duration of the investigations, as the species had occupied three territories in the vicinity of the VP and thus more flight movements occurred. A concentration on all movements of the Curlew would have led to neglect of the target species in this case. As in this case the mapping of the flight movements was not continued thoroughly, the Curlew was not taken into account in the calculation of bird activity (Tab. 2).

*Accuracy of the localization and altitude estimation*

As in many areas prominent topographical features (e.g. rocks, trees, buildings, brook valleys) were missing, partly no possibility of comparison for the altitude estimation was available (e.g. masts, trees) and visibility was partly adverse as well (rain, fog in the higher altitude), certainly in

individual cases false altitude estimations and localizations were made in the field. However, at the digitalization of the field data a plausibility control was made, so that obviously faulty information could be corrected. From the VPs 1-3 and 8 there were good orientation aids in the form of the forest roads and the trees. At the localization at the VPs 4a/b and 5 we orientated ourselves primarily on brook valleys and the managed heathlands.

To balance insecurities in the altitude estimation, in case of doubt the worst case (=rotor height) was assumed.

*Covering of all relevant times of day and year*

As to the seasons, all relevant times were covered (see Fig. 8)

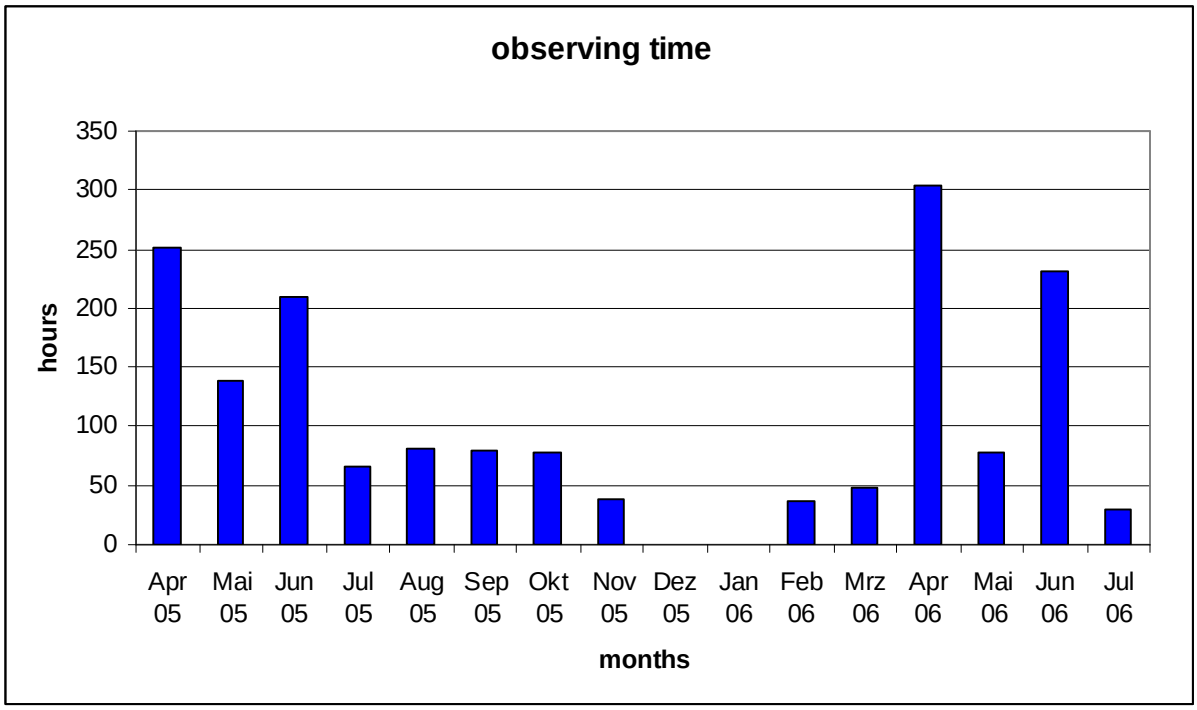



**Fig. 8: Times of observation in the course of the year.**

However due to bad visibility in the morning through fog and low hanging clouds respectively, often one could only start with the observations in the late forenoon. Thus the early morning hours are underrepresented. (see appendix 2). However, as in the remaining morning observations no fundamentally different picture of the flight activity emerged, this point can most likely be neglected. To balance this, the observations were extended as far as possible into the evening hours on a series of days.

*Differences between the observers*

The differences which certainly always exist between the individual observers were balanced by a frequent swap of the observers at the VPs, in order to ensure as even a distribution of the observers as possible (see appendix 2). From Fig. 9 it becomes clear that all observers were active at almost every point.

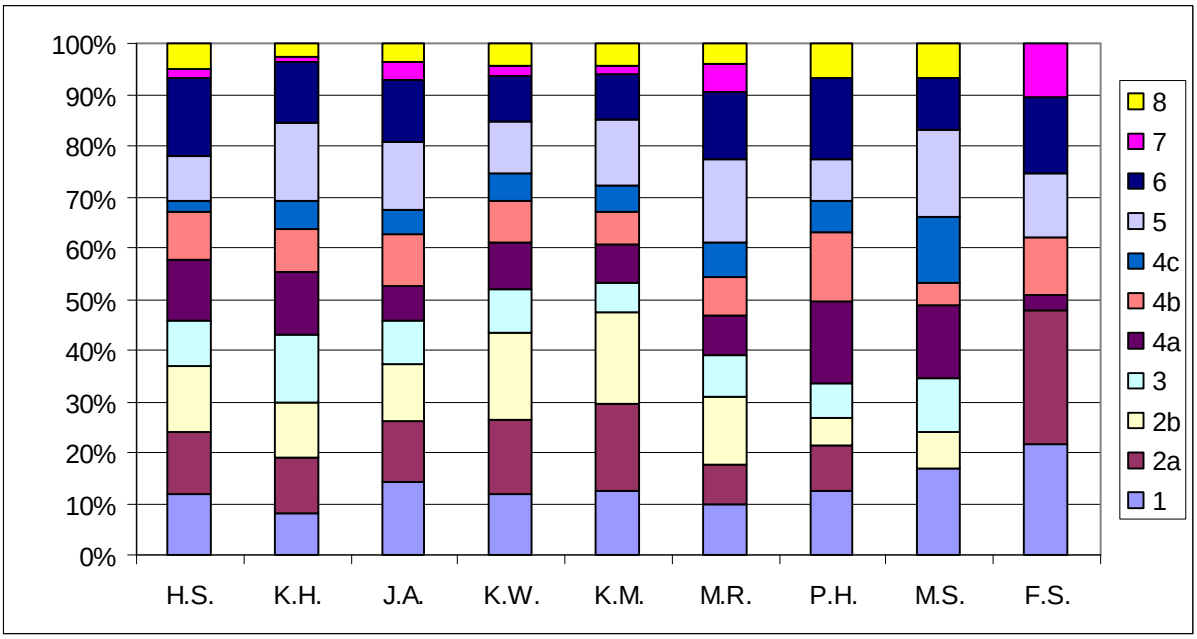



**Fig. 9: Distribution of the observers on the VPs (proportion of the observation time in percentages, abbreviations see appendix 1)**

*Does the overlapping of the observation areas influence the results?*

Owing to the topography in some cases overlaps of areas of observation could not be avoided (e.g. between VP4c and 5 or VP 6 and VP 7), as otherwise there would have been large areas between the vantage points, which could not be seen. It is thinkable that the thus heightened observation activities in the overlapping areas also led to an apparently heightened bird activity. In order to prevent a double counting, usually a communication per radio or mobile phone took place, so that the animals were only noted once for the overlapping area. However, these consultations were only very rarely necessary, which is due to the low flight activity in the area of investigation on the whole (comp. Tab. 2). Thus, the more intensive observation of the overlapping areas and the consequent higher probability of spotting a bird can be neglected.

In Fig. 10 and Fig. 11 the overlapping areas as well as the distribution of the observations of target and secondary species are shown. Accumulations of observations of target species were in the nest area of the Hen Harrier. A connection with the overlapping areas (blue crosshatched) can not be detected. In the observations of the secondary species accumulations can also be found. These are situated in the vicinity of Stony Hill and Cairn Table, as well as on the western flank of Cairn Table. An accumulation in the overlapping areas can not be detected here either.

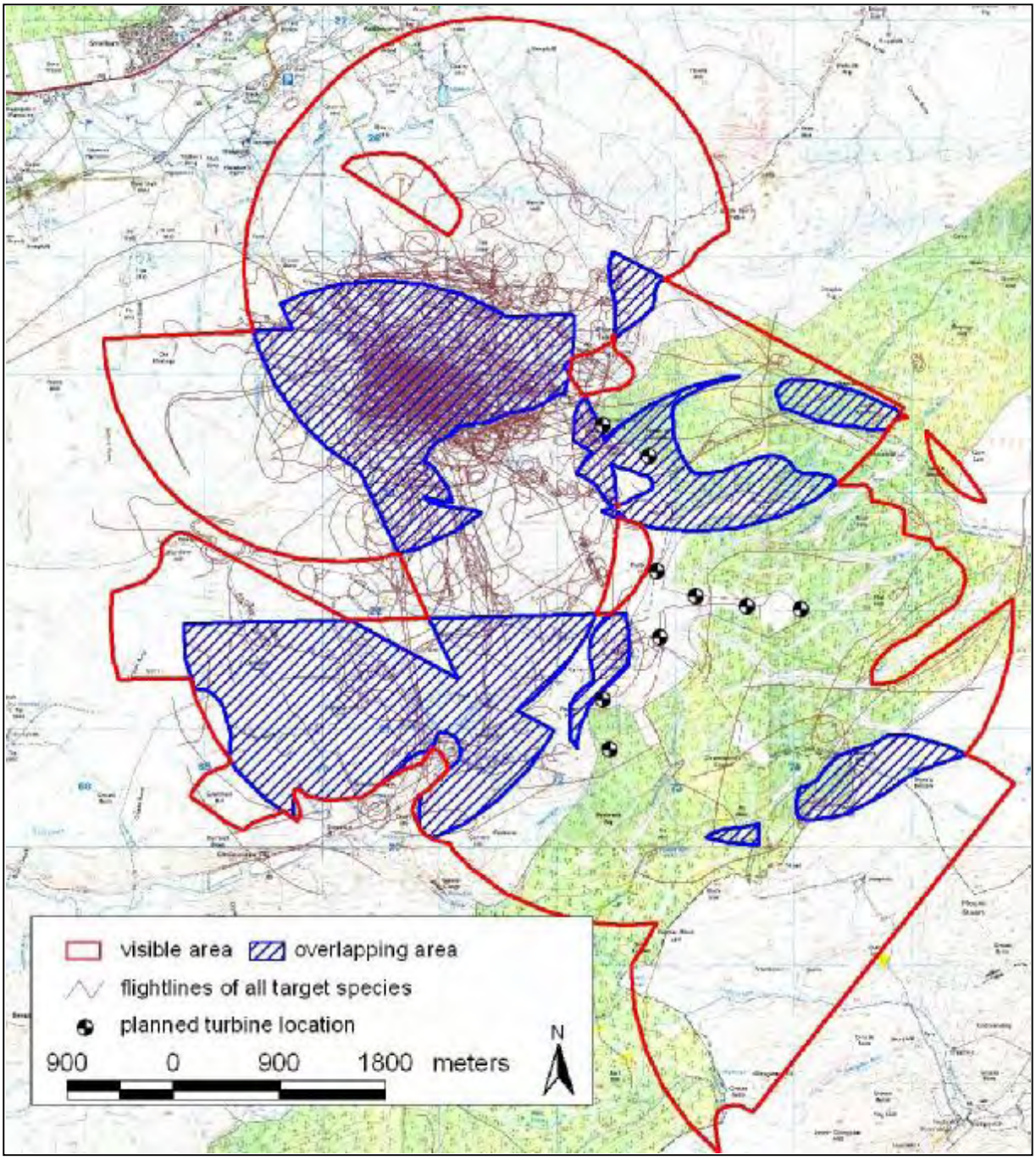



**Fig. 10: Distribution of the target species with consideration of the overlapping areas (blue crosshatched).**

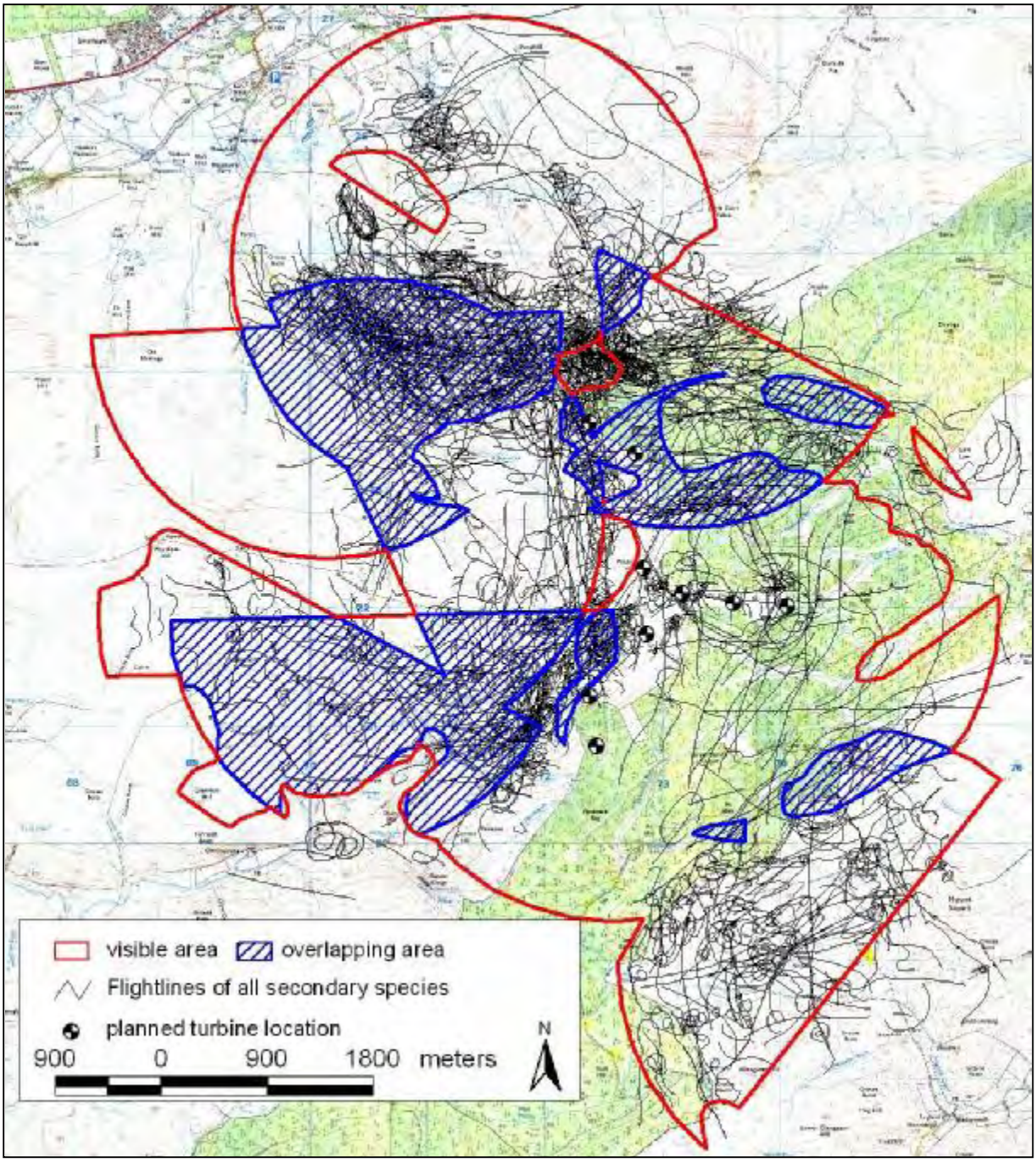



**Fig. 11: Distribution of the secondary species with consideration of the overlapping areas (blue crosshatched).**

*Visibility of the airspace*

With increasing height birds are increasingly difficult to see. This especially applies to relatively small species such as for example the Golden Plover and the Merlin and with a dark cloud cover. Thus flight movements above rotor height are probably underrepresented in the results. However, these observations are not relevant for the estimation of the collision risk of the plants.

*Adverse visibility during fog, snowfall and heavy rains*

We have reduced the error sources by interrupting the observations during fog, snowfall or heavy rains, and through the fact that observations were only started when the visibility had cleared or

the heavy rain had seized. Principally the weather conditions were better in 2006 than in 2005 (see appendix 2). However, as the observed activity of the target and secondary species were not significantly different in the two years (see Tab. 2), it can be assumed that the weather had no crucial influence on the visibility and/or the activity of the birds.

*Mis-identifications owing to great distances*

This source of errors should hardly be relevant in this project, as all observers were very well acquainted to the relatively few bird species in the area and were always equipped with spotting scopes with at least 30-fold magnification factor.

## 2.4 Forest survey (point-stop-registration)

In 2005 17 point-counts were done in 1 km² grids within the forest. An exhaustive mapping was not possible, as the afforestation areas are very inaccessible. In each grid all birds were registered in the morning for 25 minutes from one point (sight observations calling and singing birds,) on three dates (08.04., 05.05., and 28.05.) and registered in a form including their numbers. The entire observation time was 21¼ hours.

## 2.5 Special registration

*Owls, Woodcock*

For the registration of Owls and Woodcocks night excursions within the forest areas were made 3 times (April/May/June) in 2005 and once (April) in 2006.

*Black Grouse*

According to statements of the local hunter, Black Grouse were more common in the past when the afforestation areas were younger. Courtship sites are no longer known. In both 2005 and 2006 we once walked all larger valleys and forest areas in an excursion in the early morning hours in April and May respectively.

*Nest search and breeding success control in the cases of the Hen Harrier and the Merlin*

In the case of the two raptor species, hints towards nests resulted above all from the vantage point investigations. Therefore with these species the nests were usually once checked in good weather conditions (warm, rainless days). In 2005 the Merlin nest could be found (4 eggs), however the Hen Harrier nest had already been vacated at the time of the control. In 2006 the Merlin nest could not be localized, with the Hen Harrier the first control found 5 eggs, at the second control the nest had been vacated.

## 2.6 Request of old data at SNH

For the compilation of this study SNH provided data about the breeding occurrence of the Hen Harrier, the Merlin, the Short-eared Owl and the Peregrine Falcon from the years 2000-2005. In addition data about the Golden Plover from the years 1989 and 1999 were available from the previous application procedure.

### 2.7 Mapping of vegetation and habitat

Vegetation mapping from the SPA for the year 1997/1998 was made available to us by SNH and in July 2006 was checked by us in the field as the basis of a management plan. Additionally, on the basis of aerial pictures old heathlands, grasslands and areas with present heathland maintenance schemes were delimited by the heath distribution, as the usage has changed in the last years especially through the abandonment of the usage.

## 3 Methods of the interpretation

### 3.1 Data preparation

The registered breeding bird data as well as the observation at the vantage point digitalized in GIS (ArcView 3.3) into a geo-referenced map basis. Also the analysis of visibility of the rotor height made at the vantage points was transferred into the GIS and checked on the basis of the contour lines. On this basis the size of the visible area could be calculated for each point.

### 3.2 Collision risk

Principally the calculation of the collision risk adheres to the guidelines of SNH (2005) and to BAND *et al.* (in press). The calculation was made for the four target species Hen Harrier, Peregrine Falcon, Merlin and Golden Plover. In both years the Short-eared Owl was not present in the area of the planned sites, so that there is no collision risk for this species.

Three steps are necessary for the calculation of the collision risk:

Step 1: Projection of the number of flights through the rotors per year (without avoidance movement)

Step 2: Calculation of the probability of the bird hit for the flights through the rotors

Step 3: Correction through the avoidance behaviour of the birds

For the projection of the number of flights through the rotors per year all observed flights in rotor height in the area of the planned windpark were used. A reduction of the flight duration due to the greater rotor heights seen in the field was not made, as a variation of the rotor height set out in the field from the actual rotor height was by an large restricted on the upper area between 125 and 200 m. However, as most observations were made in the lower area of the rotor height, a proportional reduction of the observed flight durations would distort the results unnecessarily.

The windpark area was not defined by connecting the outer most plants, as the planned plant sites are up to over 500 m apart from each other and are arranged finger-like. Thus the windpark area was seen as the single locations with a radius of 45 m (rotor radius) to begin with. In order to balance out inaccuracies in the plotting of flight movements in the field, this area was enlarged by a distance of 200 m in accordance with the guidelines of SNH (2005) (SNH guideline 200-500 m) (see Fig. 12). Neighbouring locations were connected in this process. An enlargement by a greater distance than 200 m around the plants does not make sense, as the planed plant sites firstly are located on the boundary between two extremely different habitats (monotonous spruce

forest and open grass-/heathland) and secondly the topographical conditions delimit the windpark from the wider surrounding (location on ridges). Amongst other things this also emerges from the clearly differing frequentation of the entire area of investigation by target and secondary species (see Fig. 10, Fig. 11 and map No.1 to map No.8). An inclusion of further data through a larger area of investigation would not consider the topographical and vegetation-specific peculiarities of the windpark and falsify the results. Furthermore, after the experiences in the field and in the evaluation, the assumption of an inaccuracy of 500 m at the localization of the flight movements seems disproportionately high to us.

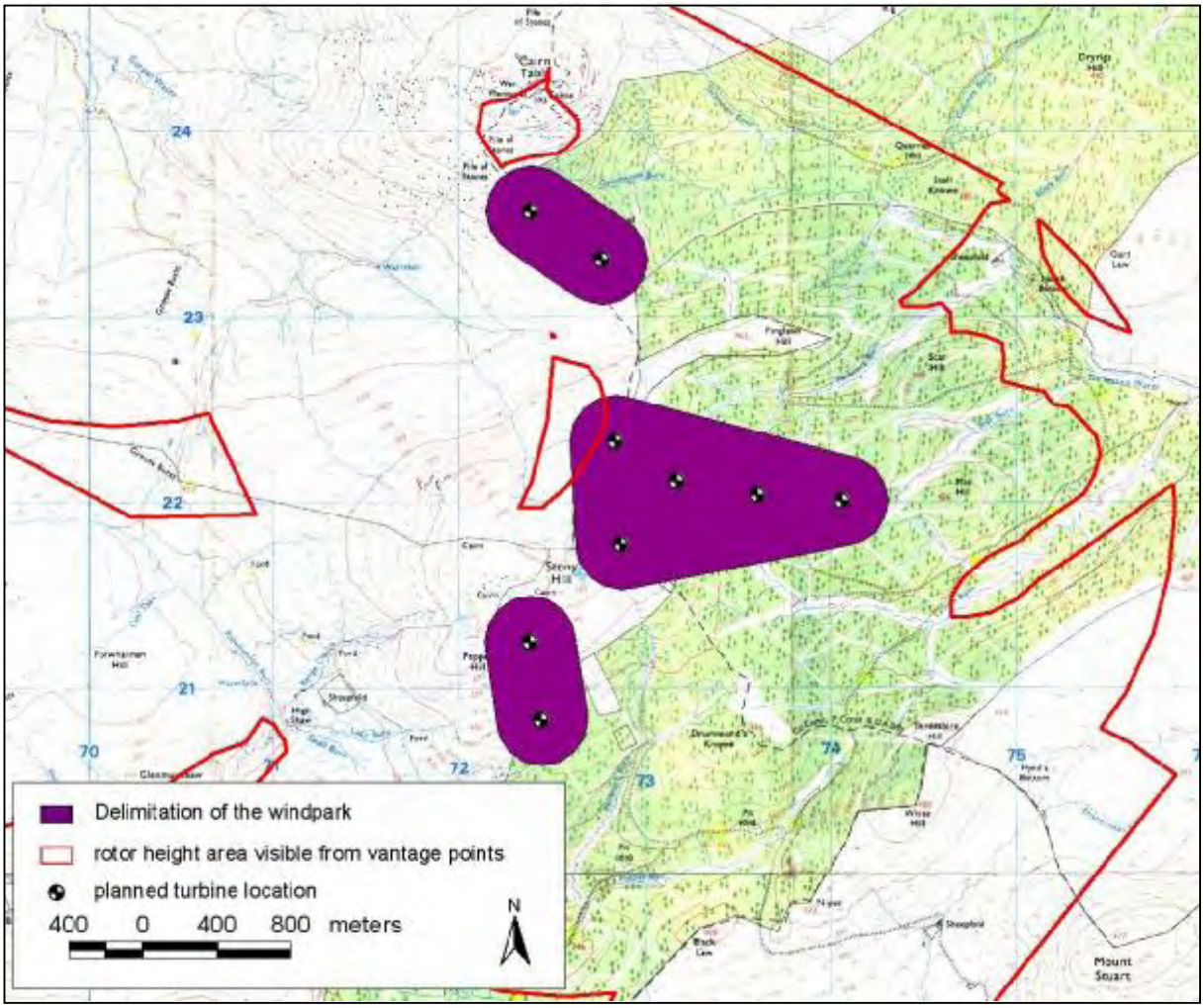



**Fig. 12: Delimitation of the windpark.**

For the determination of the „flight risk volume" as well as the "combined volume swept out by the windfarm rotors", the following data of the wind energy plant were used (Tab. 3):

**Tab. 3: Technical data of the wind energy plant**

| technical data | |
|---|---|
| blade diameter | 90 m |
| chord width of blade | 3,512 m |
| pitch angle of blade | 17,5° |
| angular velocity of rotor | 16,1 rpm |
| min height of rotor blades | 35 m |
| max height of rotor blades | 125 m |

The periods of time for which the flight observations were projected are illustrated in Tab. 4. The daylight hours per day and thus the phases of activity of the investigated species were calculated on the basis of the times of sunrise and sunset (http://www.wettermail.de/wetter/sunset.html).

**Tab. 4: Periods of time of the periods of investigation as well as the hours of the phases of activity of the investigated species.**

| investigation episode | period of time | duration |
|---|---|---|
| breeding season 2005 | April until Juli 2005 | 122 days, 1967 hours |
| non-breeding season 2005/2006 | August 2005 until März 2006 | 243 days, 2602 hours |
| breeding season 2006 | April until Juli 2006 | 122 days, 1967 hours |

For the calculation of the probability that a bird is actually hurt in the rotor area (step 2), further data about the investigated bird species are necessary. The measurement of the birds and their average flight speed (Tab. 5) stem from several authors (JOHNSTON & MCFARLANE 1967; GLUTZ VON BLOTZHEIM *et al.* 1975; COCHRAN & APPLEGATE 1986; DEL HOYO *et al.* 1994, 1996; SVENSSON *et al.* 1999; BAND *et al.* in press).

**Tab. 5: Measurements and flight speeds of the investigated bird species used for the collision calculation.**

| bird species | wingspan [m] | length [m] | average speed [m/sec] |
|---|---|---|---|
| Hen Harrier | 1,1 | 0,5 | 8 |
| Peregrine Falcon | 1 | 0,45 | 12,1 |
| Merlin | 0,6 | 0,3 | 10,9 |
| Golden Plover | 0,55 | 0,26 | 23,6 |

So far there are only few studies about the flight speeds of birds, so that here there is a certain insecurity in the collision model (MADDERS & WHITFIELD 2006). We were careful to use the lowest speeds given in the various specifications in each case (i.e. the worst case).

The probabilities to be hit during a flight through the rotors were calculated with the prepared Excel table sheet by BAND (bill.band@snh.gov.uk).

As the collision model presupposes that the bird does not evade, the result must be corrected by a corresponding factor. So far there is still only little knowledge about the avoidance behaviour of various bird species at the approach to a wind energy plant. In investigations of raptors in several windparks in the USA there were established avoidance rates between 87,27% and 100%, while in most studies the rates were above 98% (WHITFIELD & BAND in press). In the present study, for the species Peregrine Falcon, Merlin and Golden Plover the authors' recommendation of 95% was used. For the Hen Harrier an avoidance rate of 99% might be realistic (WHITFIELD & MADDERS 2005). However, for precautionary reasons a rate of 97,5% should be used, as the data situation remains scarce.

## 3.3 Open land survey

Principally the territories were made up on the basis of breeding evidence (nest localization, mature birds with young) or breeding hints (usually at least two sightings in the breeding season with territorial behaviour (singing, courtship)). In the case of the Meadow Pipit and the Sky Lark the maximum numbers from the three registration dates of ¼ km² grids each were used.

## 3.4 Forest survey (point-stop-registration)

Usually the species that were encountered twice in the point-counts with territorial behaviour in the grid were classified as breeding birds. However, with some common species, such as the Wood Pigeon, Blackbird, Robin or Willow Warbler observations at only one plotting (in dependence of the registration date) with territorial behaviour led to their classification as a breeding bird. In the other cases species that were observed once in suitable habitat were classified as suspected of breeding (e.g. Goldfinch) or, dependent on the date of registration, identified as a migrant (e.g. Meadow Pipit) respectively.

Chance observations of further species outside of the point-counts were also included in the evaluation. Depending on the time of observation, behaviour of the animals and suitability of the site of the finding as a breeding habitat, the species were classified as breeding birds (breeding and breeding suspicion) and migrants and foraging guests respectively.

# 4 Results

## 4.1 Open-land survey

### 4.1.1 Target Species

The following Figure (Fig. 13) shows the spread of the target species in both investigation years.

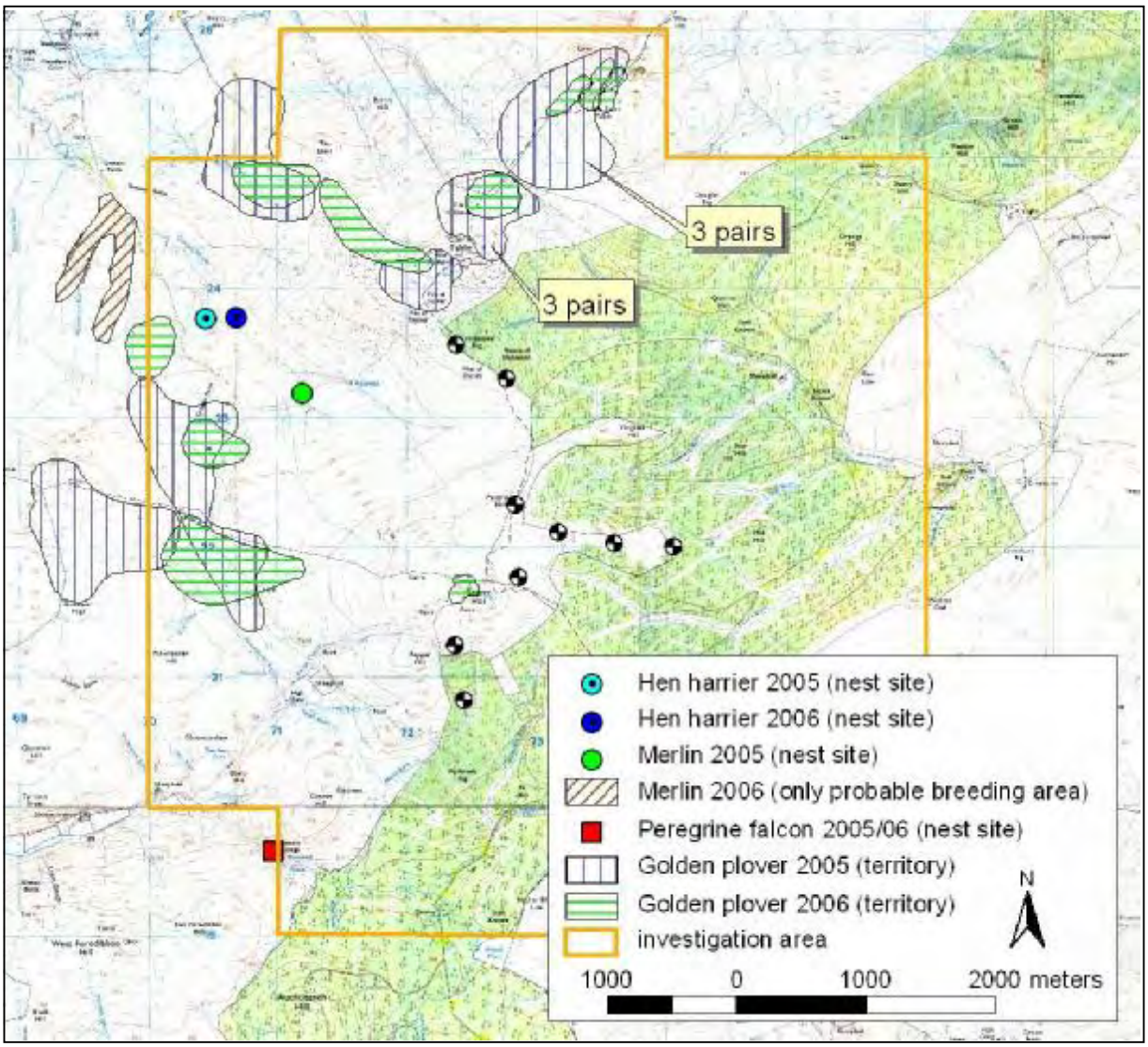



**Fig. 13: Spread of the target species 2005 and 2006 in the investigation area.**

In both 2005 and 2006, 1 pair of hen harriers incubated in the area of investigation. In both years the locations of the nests were on the slopes of the Garpel Water in the north west of the area (see Fig. 13). The species had no breeding successes in 2005 or 2006. In both investigation years activities at the nest site (such as delivery of prey) could be observed up until mid June. As in 2005 the nest site was not frequented before, the reason for the abandonment of the incubation (BRUTAUFGABE) in 2005 are unclear. In 2006 the empty nest (on the 15.05. it held 5

eggs) could be found on the 28.06. Slightly below some feathers of an adult female hen harrier were found. A further pair of hen harriers presumably incubated to the southwest just outside of the investigation area. In the southeast, sporadic observations of hen harriers could also be made in 2006. These, according to the local SNH-ornithologist, possibly belonged to a third pair, which incubates east of the investigation area.

The Merlin and the Peregrine Falcon were represented by a pair each in the area in both 2005 and 2006. The Peregrine Falcon lies in a rock face in the Connor Craigs in the south of the investigation area (see Fig. 1). The observation of warning adult birds suggests a brood in both years, however infant birds could not be registered in either year (at the control in 2006 the animals had left the valley already). However, SNH reported that the pair had raised four infant birds in 2005 (MCGREGOR, pers. communication). The Merlin incubated in a lateral branch of the Garpel Water in the west of the investigation area. Here a nest with four eggs could be detected on the 15.06.2005 in a heathland. Infant birds of this species could not be observed either. In 2006 there was a suspicion of incubation; however the location of the nest could not be determined.

Of the Short-eared Owl, which did not incubate in the investigation area, there exists only one observation form April 2005 and one from June 2006.

The most frequent target species of the area is the Golden Plover, which incubated with 10 pairs in each year. Especially in 2005 the species had good breeding success. Focal point areas were the Cairn Table (2005: 4 pairs, 2006: 2 pairs), the Little Cairn Table (2005 and 2006: 3 pairs each) as well as the plain between VP 5 and 6 (2005: 2 pairs, 2006: 3 pairs).

In 2005 a pair of Golden Plovers incubated in the area of Cairn Table. This territory partly was within a radius of 500 metres around the planned wind power station. In 2006 a pair of Golden Plovers was registered on Stony Hill inside of the 500 metres radius.

**Tab. 6: Survey results of target species 2005 und 2006 in the whole investigation area (40 km$^2$) and within 500 m-radius to proposed wind turbines. bp = breeding pairs, - = no breeding pairs, bp ? = breeding probable**

| No. | species | total number of breeding pairs 2005 | within 500m-radius to proposed wind turbines | total number of breeding pairs 2006 | within 500m-radius to proposed wind turbines |
|---|---|---|---|---|---|
| 1 | Hen Harrier (Circus cyaneus) | 1 bp | - | 1 bp | - |
| 2 | Merlin (Falco columbarius) | 1 bp | - | 1 bp ? | - |
| 3 | Peregrine Falcon (Falco peregrinus) | 1 bp | - | 1 bp | - |
| 4 | Golden Plover (Pluvialis pluvialis) | 10 bp | partly 1 bp | 10 bp | 1 bp |

### 4.1.2 Secondary species

The two following figures show the spread of centres of territories and territories (REVIERZENTREN UND REVIERE) of selected secondary species in the years 2005 (Fig. 14) and 2006 (Fig. 15).

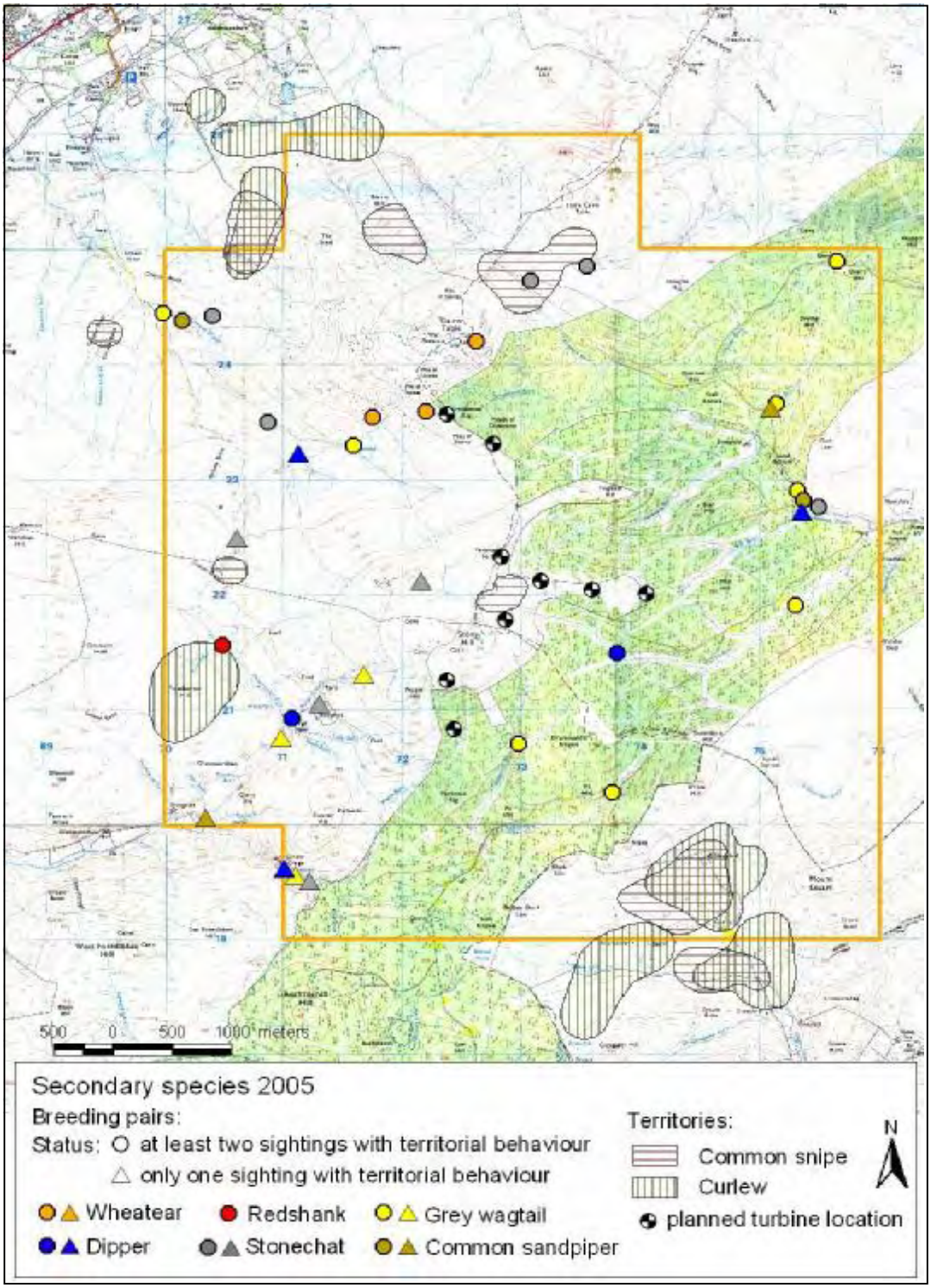



**Fig. 14: Territories and centres of territories of the secondary species 2005.**

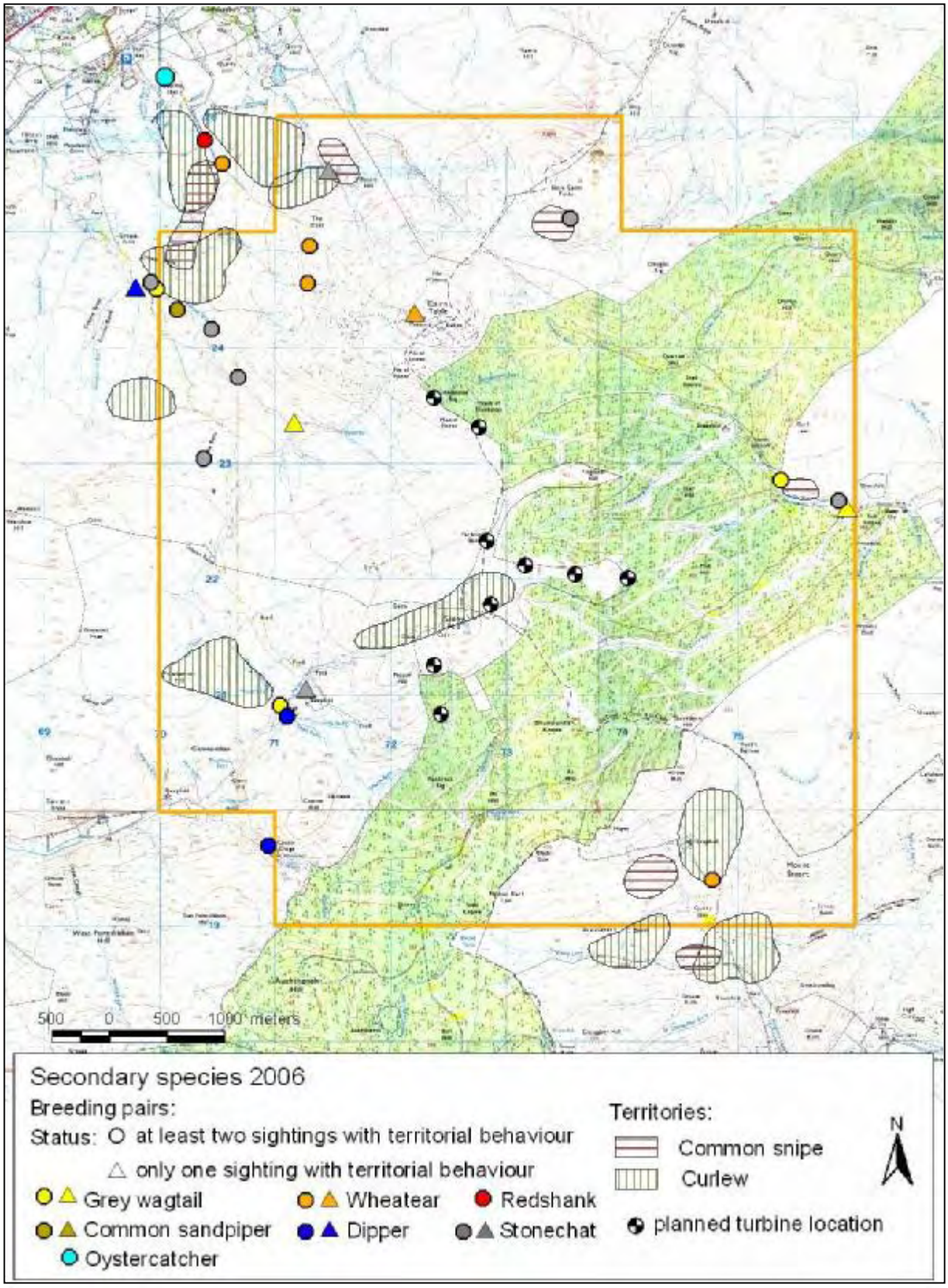



**Fig. 15: Territories and centres of territories of the secondary species 2006.**

*Limicoles*

Waders were surprisingly rare in the area of investigation (see Fig. 14, Fig. 15). The Lapwing was absent and there was only a suspicion of incubation in the case of the Redshank in both years. The Oystercatcher only incubated on the edge of the area in 2006. The most common were Snipe (2005: 6-8 pairs, 2006: 5-6 pairs) and the Western Curlew (2005: 7 pairs, 2006; 10 pairs) In both years the incubation incidents of the last-mentioned species concentrated on the grassland areas on the outskirts of Muirkirk (2005: 3 pairs, 2006: 4 pairs), as well as west of Mount Stuart (2005 and 2006 3 pairs each). Also the evidences of Snipe were mostly found in grassland areas in both years. Within a 500 metres radius around the planned plants a Snipe pair could be registered in 2005 and a Western Curlew pair could be registered in 2006 (both territories on Stony Hill).

*Species of Aquatic Birds*

Typical species of breeding birds of the streams in the area are the species Sandpiper, Grey Wagtail, and Dipper (see Fig. 14, Fig. 15). The most common species in both years was the Grey Wagtail with 8 –11 pairs (2005) and 3-5 pairs (2006). All three species incubate on streams in the woods as well as in the open land.

*Small birds of the open land*

Stonechat (*Saxicola torquata*) and Northern Wheatear (*Oenanthe oenanthe*)

The two species Stonechat (2005: 5-9 pairs, 2006: 6-8 pairs) and Northern Wheatear (2005: 3 pairs, 2006: 4-5 pairs) were the representatives of breeding birds of the open land. The evidences of the Stonechat were concentrated in heathland areas and stream valleys (BACHTÄLER) in the west of the investigation area (Fig. 14, Fig. 15). In 2005 Northen Wheatears incubated exclusively in the area of the Cairn Table, in 2006 also south of VP 4a and on the way to 4a/b. A further pair could be registered in the southeast of the area, north of VP3, in 2006.

Meadow Pipit (*Anthus pratensis*)

The Meadow Pipit is to be found throughout the area of investigation. In the woodland areas he is only absent in those areas which are fully forested. The species reaches its highest density in the areas which are totally treeless, especially around Stony Hill (14 pairs/10 ha). In the eight investigated square kilometres grids, the Meadow Pipit reaches a population density of 8,45 pairs/10 ha in the open areas (470 ha). The valleys in the woodland areas, the edges of the woodlands, and the larger forest lanes and clear-cuttings within the forest are less densely populated (Fig. 16).

Sky Lark (*Alauda arvensis*)

Second to the Meadow Pipit, the Sky Lark is the most common songbird species in the open areas of the investigation area. However it avoids the valleys and clear-cuttings of the woodland area and many areas bordering to the forest. Also, partly it is absent in the large valley southwest of Cairn Table. All in all, the Sky Lark is distinctly less common than the Meadow Pipit and reaches an average density of 1,26 pairs/10 ha in the quantitatively investigated grids. The highest densities were reached between Stony and Pepper Hill with a density of 2,8 pairs/10 ha. Quite frequently they were also detected around Cairn Table (Fig. 16).

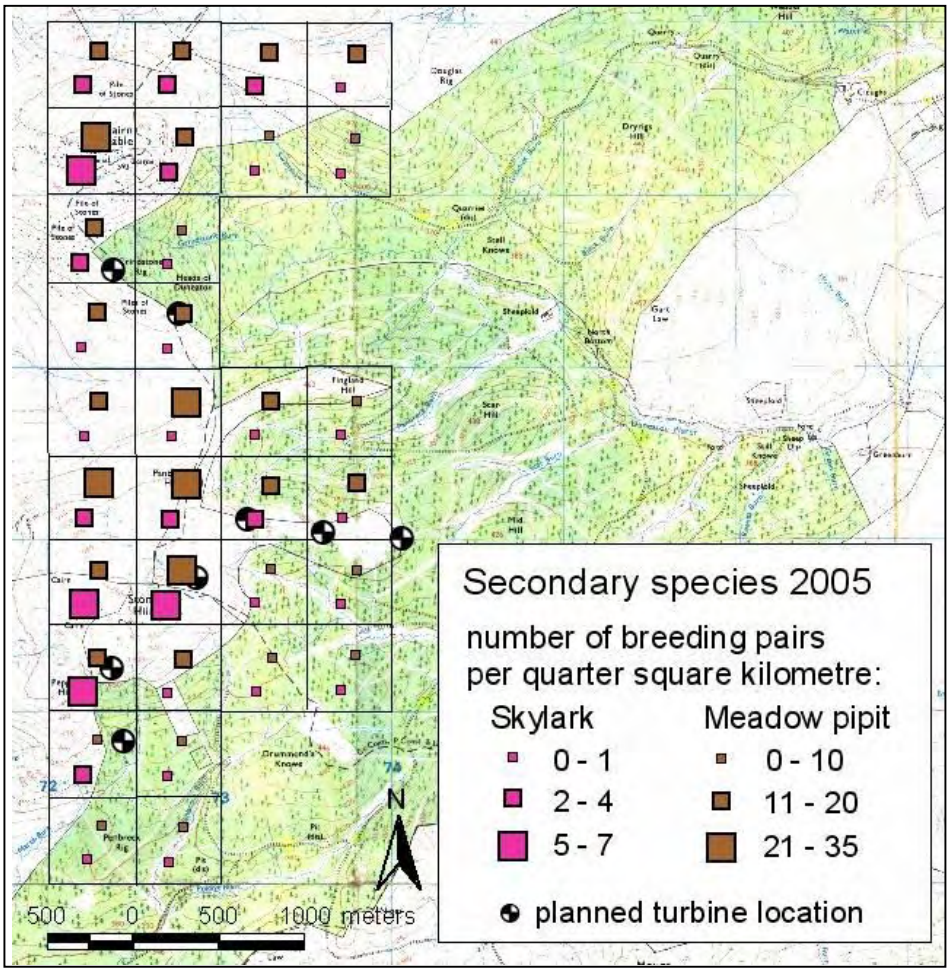



**Fig. 16: Frequency of Sky Lark (*Alauda arvensis*) and Meadow Pipit (*Anthus pratensis*) as breeding birds in 2005 per ¼ square kilometre grid.**

**Tab. 7: Survey results of secondary species 2005 and 2006 in the whole investigation area (40 km2) and within 500 m-radius to proposed wind turbines. bp = breeding pairs, - = no breeding pairs, bp ? = breeding probable**

| No. | species | total number of breeding pairs 2005 | within 500m-radius to proposed wind turbines | total number of breeding pairs 2006 | within 500m-radius to proposed wind turbines |
|---|---|---|---|---|---|
| 1 | Oystercatcher (*Haematopus ostralegus*) | - | - | 1 bp | - |
| 2 | Common snipe (*Gallinago gallinago*) | 6-8 bp | 1 bp | 5-6 bp | - |
| 3 | Curlew (*Numenius arquata*) | 7 bp | - | 10 bp | 1 bp |
| 4 | Redshank (*Tringa totanus*) | 1 bp ? | - | 1 bp ? | - |
| 5 | Common Sandpiper (*Actitis hypoleucos*) | 2-4 bp | - | 1 bp | - |
| 6 | Grey Wagtail (*Motacilla cinerea*) | 8-11 bp | - | 3-5 bp | - |
| 7 | Dipper (*Cinclus cinclus*) | 2-5 bp | - | 2-3 bp | - |
| 8 | Stonechat (*Saxicola torquata*) | 5-9 bp | - | 6-8 bp | - |
| 9 | Wheatear (*Oenanthe oenanthe*) | 3 bp | 1 bp | 4-5 bp | - |

## 4.2 Vantage-point watches

### 4.2.1 Overview

The following table (Tab. 8) gives an overview of the frequency of the observed flight movements of the target and secondary species in the individual periods. With 376 sightings, the most flight movement among the target species could be registered from the hen harrier. The second largest number of flight movements was reached by the Golden Plover with 155 registered flights. The Peregrine Falcon and the Merlin could be observed distinctly less frequently from the vantage points. The Short-eared Owl was merely registered twice. In total the Common Kestrel and the Eurasian Buzzard were spotted the most often. Flight movement of the Common Raven, Sparrow hawk and Goshawk were noted less frequently.

**Tab. 8: Frequency of the observed flight movements of the target and secondary species from the vantage points.**

| Species | Number of observations | | | |
|---|---|---|---|---|
| | Breeding season 05 | Non-breeding season 05/06 | breeding season 06 | Total |
| Hen Harrier | 156 | 4 | 216 | 376 |
| Peregrine Falcon | 24 | 6 | 6 | 36 |
| Merlin | 27 | 4 | 16 | 47 |
| Short-eared Owl | 1 | | 1 | 2 |
| Golden Plover | 106 | 16 | 33 | 155 |
| Eurasian Buzzard | 285 | 94 | 262 | 641 |
| Common Kestrel | 354 | 145 | 163 | 662 |
| Goshawk | 5 | 1 | | 6 |
| Sparrow Hawk | 12 | 9 | 13 | 34 |
| Common Raven | 65 | 50 | 57 | 172 |

### 4.2.2 Phenology

*Hen Harrier*

The most observations amongst the target species are of the Hen Harrier (Tab. 8). Hen Harriers were most frequently observed between April and June in both years (see Fig. 17). Outside of this period there are only few observations from September, November and March. These are of infant birds and females. Courtship flights were observed in April and May.

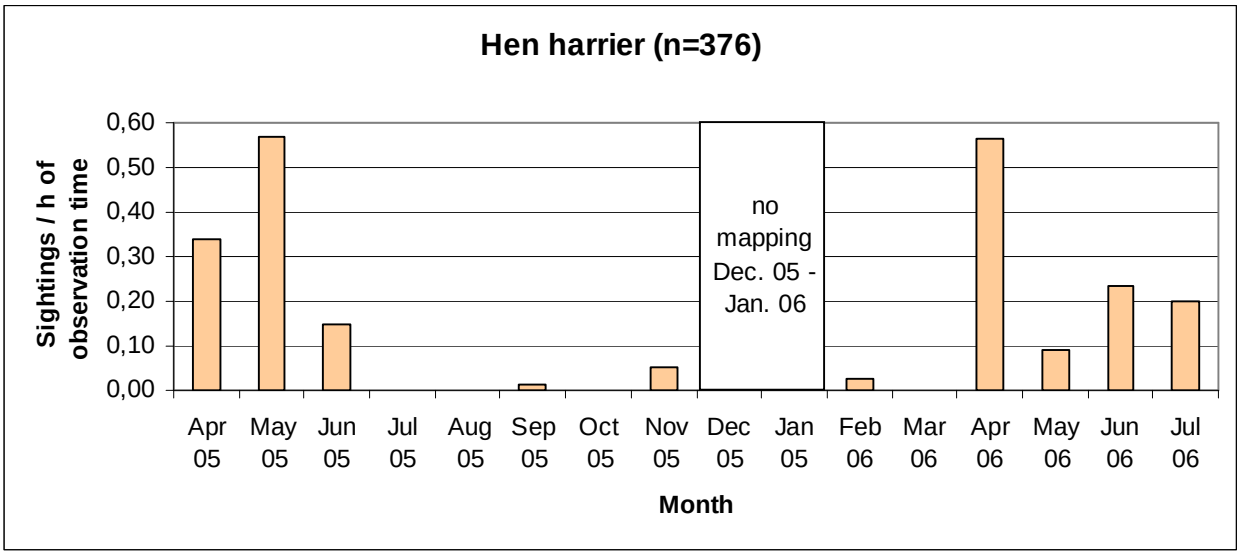



**Fig. 17: Spread of Hen Harrier observations in the period of investigation**

*Merlin*

Merlin only appeared in the period between April and August with a heightened activity in July/August. There were only four sightings in the non-breeding season. In 2006 Merlins were most frequently seen in April.

*Peregrine Falcon*

Fig. 18 shows the spread of the observations of the Peregrine Falcon in the entire observation period. The most observations were made in the period between March and August 2005, with maximum at the end of the breeding season 2005 in July/August. Surprisingly there are no observations from September until November.

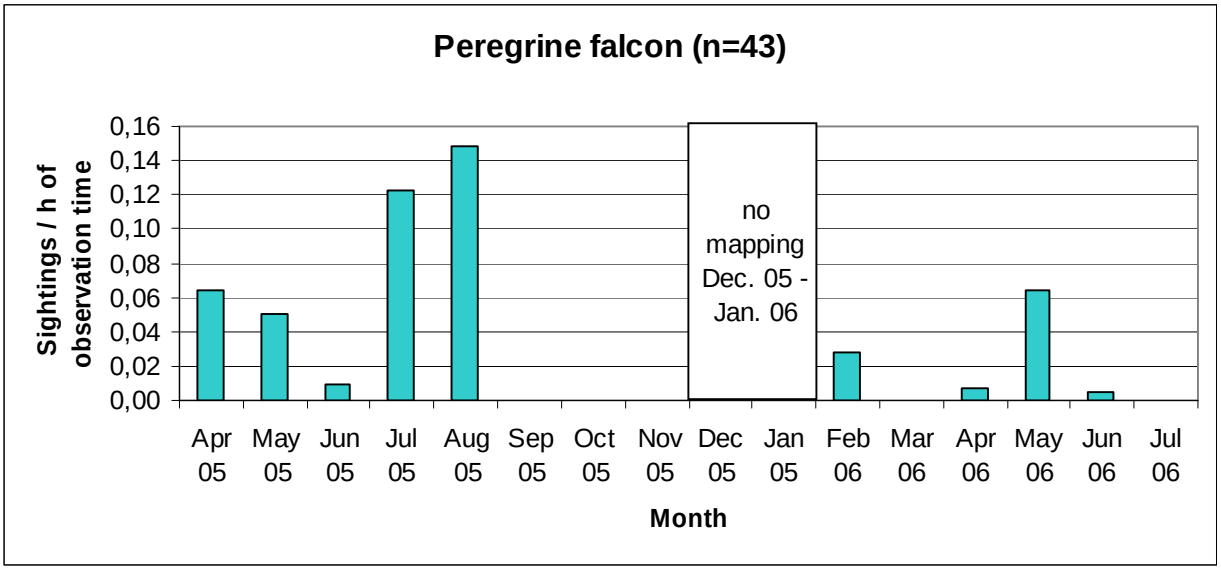



**Fig. 18: Spread of Peregrine Falcon observations in the period of investigation.**

Im Jahr 2006 wurden deutlich weniger Wanderfalken im Untersuchungsgebiet beobachtet als 2005. Die meisten Beobachtungen fanden im Mai statt.

*Golden Plover*

Golden Plovers are predominantly found in the breeding season. First observations were made at the breeding sites in March 2005 and February 2006- Most observations were made in the period from May until August in both years. Afterwards this species was absent.

### 4.2.3. Range use

**Range use of Hen Harrier (Circus cyaneus)**

*Breeding season 2005*

In 2005 the numerous observed flight movements of the Hen Harrier showed a clear concentration on the western and southwestern slopes of the Cairn Table (see map No.1). However this area of concentration with a diameter of approximately 1 km does not stretch circularly around the location of the nest, but was above the nest in the slope area. To the west and south of the nest, on the other hand, hardly any flight movement was registered.

Outside of this area of concentration only relatively few Hen Harrier flights were observed. These primarily occurred in the valley between Cairn Table and Stony Hill, on the north-western slope of the Cairn Table as well as in the south of the area of investigation. Here it can not be ruled out that those in the south were individuals of second pair, which was breeding outside of the area of investigation. There are only sporadic observations of Hen Harriers in the forest areas.

The ridge between the forest and the bordering open land to the west, on which the planned wind energy site is located, was only used to a very minor degree by the Hen Harrier. The

distance between the area of concentration around the nest and the nearest planned wind energy plant is approximately 1 km.

*Non-breeding season 2005/2006*

In this period only four sightings of Hen Harriers were achieved: Two on Stony Hill and two on the north-western slope of Cairn Table (see map No.1). Thus, the area of investigation is hardly used by this species outside of the breeding season.

*Breeding season 2006*

Also in 2006 numerous flight movements were observed, which again almost exclusively stemmed from one breeding pair. However, it is possible that several observations in the south again stemmed from a second pair with a nest location outside of the area of investigation. The overall picture resembles the spread of 2005 very strongly (see map No.1) with the main area of activity on the southwestern slopes of the Cairn Table. The distance between the area of concentration around the nest and the nearest planned wind energy plant is again approximately 1 km. Sporadic foraging flights stretch to Stony Hill and above the forest areas. As in the previous year, flight movements across the planned wind farm only occurred to a very minor extent.

Evidently the species does not, or only to a very minor degree, use the ridge along the outskirts of the forests as a hunting ground. The observations on the south-eastern outskirts of the forest – according to the information of a local SNH ornithologist- possibly belong to a further pair, which breeds to the east of the area of investigation and evidently only frequents the latter very rarely.

**Range use of Peregrine Falcon (Falco peregrinus)**

*Breeding season 2005*

The 24 flight observations are spread across the area of investigation without a distinct area of concentration (see map No.2). A certain accumulation is to be noticed in the south of the area of investigation (in the vicinity of the breeding site in the Connor Craigs), as well as west of the Cairn Table. Hunting flights over the forest were hardly observed at all. From the area of the planned plant sites there are four observations, of which two were over Stony Hill.

*Non-breeding season 2005/2006*

There are six flight observations form this period (see map No.2): two on the south-western slope of Cairn Table, one over Stony Hill, and three south and west of Stony Hill.

Thus, outside of the breeding season the species only seems to use the area of investigation to a very minor extent.

*Breeding season 2006*

In the breeding season 2006 the Peregrine Falcon was only observed six times, although the eyrie in the Connor Craigs was occupied again. Four flight movements can be allocated to the surrounding area of the eyrie (see map No.2), one led over the area of the planned wind energy sites.

Evidently the Peregrine Falcon used the area of investigation only to a very minor extent for foraging. Therefore the preferred hunting grounds are assumed to be west of the breeding site.

**Range use of Merlin (Falco columbarius)**

*Breeding season 2005*

In the breeding season 2005 the Merlin was observed 27 times (see map No.3). The location of the nest was located southwest of Cairn Table. The flight movement were concentrated predominantly to the west of Cairn Table, however the species was also observed north-east of Cairn Table and in the south of the area of investigation. A crossing of the planned wind park was not observed. However, due to the difficult observability of the species over long distances, it is not impossible that the species occasionally flies through the wind park.

*Non-breeding season 2005/2006*

For this period of time there are four flight observations (see map No.3), all of which were located in the area of the Cairn Table. A crossing of the planned wind park did not occur.

*Breeding season 2006*

From this period of time there are 16 flight observations of the Merlin, all of which were located in the western part of the area of investigation (see map No.3) Despite considerable effort, the location of the nest could not be found, however it is assumed to be near the Garpel Waters. A crossing of the planned wind park could not be observed, yet with this species there is the limitation, that flight movements in a great distance to the observer possibly could not all be registered (see chapter 2.3), as the species mostly flies very low and hardly stands out against the dark background of the heathland.

**Range use of Golden Plover (Pluvialis apricaria)**

*Breeding season 2005*

The observations show two areas of increased activity, which correlate wit the locations of the breeding sites: the slopes of the Cairn Table, especially the western area and the peak, as well as a larger area in the west of the area of investigation (see map No.4). Crossings over the planned wind park were registered in two cases.

*Non-breeding season 2005/2006*

From this period there are five flight observations, as well as a series of ground locations (see map No.4). The focal point of the observations was on the northwestern slope of the Cairn Table. There are no observations in the area of the planned wind park.

*Breeding season 2006*

The 33 observed flight movements show a clear concentration on the western slopes of the Cairn Table (see map No.4). There were further observations in the west of the area of investigation. Thus the picture resembles the situation in 2005. The planned wind park was probably crossed

by an animal once in the period of observation, which was however only registered away from the site. Apart from that, the detected focal points of activity are located well away from the planned wind park.

**Range use of Short-eared Owl (Asio flammeus)**

*Breeding season 2005*

From the breeding season 2005 there is only one observation west of Stony Hill (see map No.3). There are no hints for any breeding activity.

*Non-breeding season 2005/2006*

There are no observations.

*Breeding season 2006*

In this period there was only one sighting of a Short-eared Owl south-west of Cairn Table (see map No.3). Evidently, in the second year of investigation the species did not breed in the area of investigation either.

**Range use of Buzzard (Buteo buteo)**

*Breeding season 2005*

The numerous observations of this species (N = 285) are very unevenly spread throughout the area of investigation (see map No.5). Some clear areas of concentration can be detected: the western and southern slopes of Cairn Table and the western and southern slopes of Stony Hill. Furthermore there are cumulative sightings between Cairn Table and Stony Hill, as well as along the ridge on the eastern edge of the forest. For large parts of the area of investigation, on the other hand, there were no or only very few observations. Buzzards fly over parts of the area of the planned plant site.

*Non-breeding season 2005/2006*

The spatial spread of the sightings from the non-breeding season correlates with the that of the preceding breeding season (see map No.5). Merely the southern and northern edges of the planned wind park lie within the area of heightened flight activity.

*Breeding season 2006*

In the breeding season 2006 in several areas a different picture emerges as compared to the two previous periods of time. The approximately equally frequent observations (N = 262) are spread through a markedly larger part of the area of investigation (see map No.5). The concentrations on Cairn Table as well as between Cairn Table and Stony Hill are to be found again in 2006, yet there is also a strong accumulation of flight movement over the forest in the north-east of the area of investigation, as well as over the open plains in the south-west of the area of investigation. Also the area of the planned wind park was frequently flown over. Possibly this is to do with the changed location of the eyries, or with the, in comparison to the previous year,

favourable weather conditions (more widespread occurrence of thermals due to more intense solar radiation).

**Range use of the Kestrel (Falco tinnunculus)**

*Breeding season 2005*

The flight movements of the Kestrel in 2005 showed a similar spread to those of the Buzzard, with areas of concentration on the south-western slopes of Cairn Table and Stony Hill (see map No.6). However, in contrast to the Buzzard there is a higher utilization of the open lands, especially west of Stony Hill and in the south-east of the area of investigation. The area of the planned wind park is partly also more frequently used than by the Buzzard.

*Non-breeding season 2005/2006*

In the non-breeding season – as with the Buzzard –the spread of the flight movements resembles the picture of the preceding breeding season to a high degree (see map No.6).

*Breeding season 2006*

As with the Buzzard the picture from the breeding season 2006 was changed in comparison to both preceding periods of time (see map No.6). The clear concentration on Cairn Table has largely dissolved and instead there is a striking accumulation west of Stony Hill. From the area of the planned wind park there are fewer observations than in 2005. Here the changed flight pattern is presumably also due to the changed location of the eyries or the more favourable weather conditions (comp. Buzzard).

**Range use of Sparrow hawk (Accipiter nisus) and Goshawk (Accipiter gentilis)**

*Breeding season 2005*

There were five flight observations of the Goshawk over the forest, of which two were in the height of the rotors near the planned wind park. Of the Sparrow hawk there were 12 observations, of which six were inside of or near the planned wind park. For both species one can assume a breeding occurrence in the forest (see map No.7).

*Non-breeding season 2005/2006*

For the Goshawk there is only one flight observation in the east of the area of investigation over the forest. Nine sightings could be made of the Sparrow hawk, all of which apart from one are located over the forest (see map No.7).

*Breeding season 2006*

From this period of time there are 13 observations of the Sparrow hawk over the forest. Partly the birds also flew in the area of the planned wind power stations. No observations could be made of the Goshawk. Thus the Sparrow hawk was confirmed as a breeding bird, while it is uncertain whether the Goshawk was breeding in the forest in 2006. Also in the survey the species was only found in 2005, not however in 2006.

**Range use of Curlew (Numenius aquatus)**

*Breeding season 2005 and 2006*

From both years there are only few flight movements west of the forest (see map No.8). Four flight lines over the forest also cross the area of the wind park. The highest flight activity was detected in the southeast of the area of investigation, where within three Curlew territories numerous flight movements took place (not plotted in detail). The spread of the flight lines essentially corresponds the spread of the breeding grounds (comp. map No.8).

*Non-breeding season 2005/2006*

There are no sightings from this period of time.

*Breeding season 2006*

Auch in der Brutzeit 2006 wurden die meisten Flugbewegungen des Brachvogels im Südosten des Untersuchungsgebietes registriert, wo wiederum drei Brutpaare festgestellt wurden (comp. Map No. 8). Drei Flugbewegungen wurden im Bereich des Windparks beobachtet.

**Range use of Raven (Corvus corax)**

*Breeding season 2005*

The 65 flight observations of the Raven in the breeding season 2005 were predominantly in the area of Cairn Table and Stony Hill (see map No.8). The flight movements of the species thus show a similar spread pattern as the Buzzard and the Kestrel – however with far fewer observations. The remainder of the area of investigation is hardly used, merely on the southwestern edge of the forest some further observations could be made. Nine observations were within the area of the planned wind park.

*Non-breeding season 2005/2006*

In the non-breeding season the concentration of flight movements was stronger in the area of Cairn Table than in the breeding season 2005. In addition to some flights over Stony Hill, ten flight observations could be made in the area of the planned wind park (comp map No.8).

*Breeding season 2006*

The spread of the flight observations in the breeding season 2006 resembles the spread in the breeding season 2005. Additionally the species was repeatedly spotted over the forest in the west of the area of investigation. In the area of the planned wind park seven flights of the Raven were registered.

**Subsuming overview and causes of differing range use**

Topography, habitat distribution, location of the nesting sites and weather conditions are the essential factors for the use of space by the birds in the area. Man-made disturbances, such as flight movements, vehicles and ramblers, on the other hand, are of subordinated significance. Thus some Golden Plovers nest directly on the Cairn Table, where we could observe the most

ramblers and also in both years the Hen Harrier bred near a small path which leads from Cairn Table down to the valley (comp. Fig. 6)

Especially for the Buzzard and the Kestrel, during bad weather conditions (wind, rain) the topography makes up an essential factor, as both species shift to the western and southern slopes of the Cairn Table and Stony Hill due to the favourable upwind situations there. During calm, fair weather conditions (especially in the breeding season 2006) the observations are spread over a larger area, as due to rising hot air (Thermal) the flight conditions are then largely homogenous.

Hen Harrier and Merlin were primarily found in the heathlands. These species avoid the monotonous grass areas. The managed heathlands to the west of and below Cairn Table were preferred (comp. map 1 and map 3). The high concentration of hen harrier observations can be explained through the location of the nest, which in both years was in managed heathlands. Evidently there is no connection between the density of Meadow Pipits and Sky Larks as important prey and the range use of the Hen Harrier. In areas of high density of these two species, e.g. around Stony Hill and in the planned wind park, only very few Hen Harriers were observed (comp. Fig. 16 and map No.1).

The observations of the Golden Plover mainly indicate a connection to favourable breeding sites, which in this area are primarily cliffs and low heath between Cairn Table and Little Cairn Table.

Possibly the location of the eyries (which, especially in the forest, are not known) also influences the range use of the Kestrel and the Buzzard in the area of investigation, which was different in the breeding seasons 2005 and 2006 (more observations of the Buzzard in the north-east).

A connection between the eyrie and the flight movements also emerges with the Peregrine Falcon.

The observations of the Curlew and other meadow limicoles such as the Oystercatcher and the Redshank were concentrated on heavily pastured, short-grassed areas in the north-west, as well as the south-east of the area (Mount Stuart) where the species also breed. Outside of the breeding area these species were only spotted very irregularly.

### 4.2.4 Displays

In the year 2005 five display flights of the Hen Harrier could be observed, which can be ascribed to three pairs. Three of the observations took place in the surroundings of the Cairn Table and thus stem from the breeding pair whose nest was located at the bottom of Cairn Table (Fig. 19). The eastern display flight stems from a male, whose territory was in the SPA bordering to the east. In the southwest of the area of investigation, display flights of a further male could be registered in both 2005 and 2006. The further 30 display flights in 2006 were again mapped in the area of Cairn Table, in a distance of up to over 2 km to the nest location.

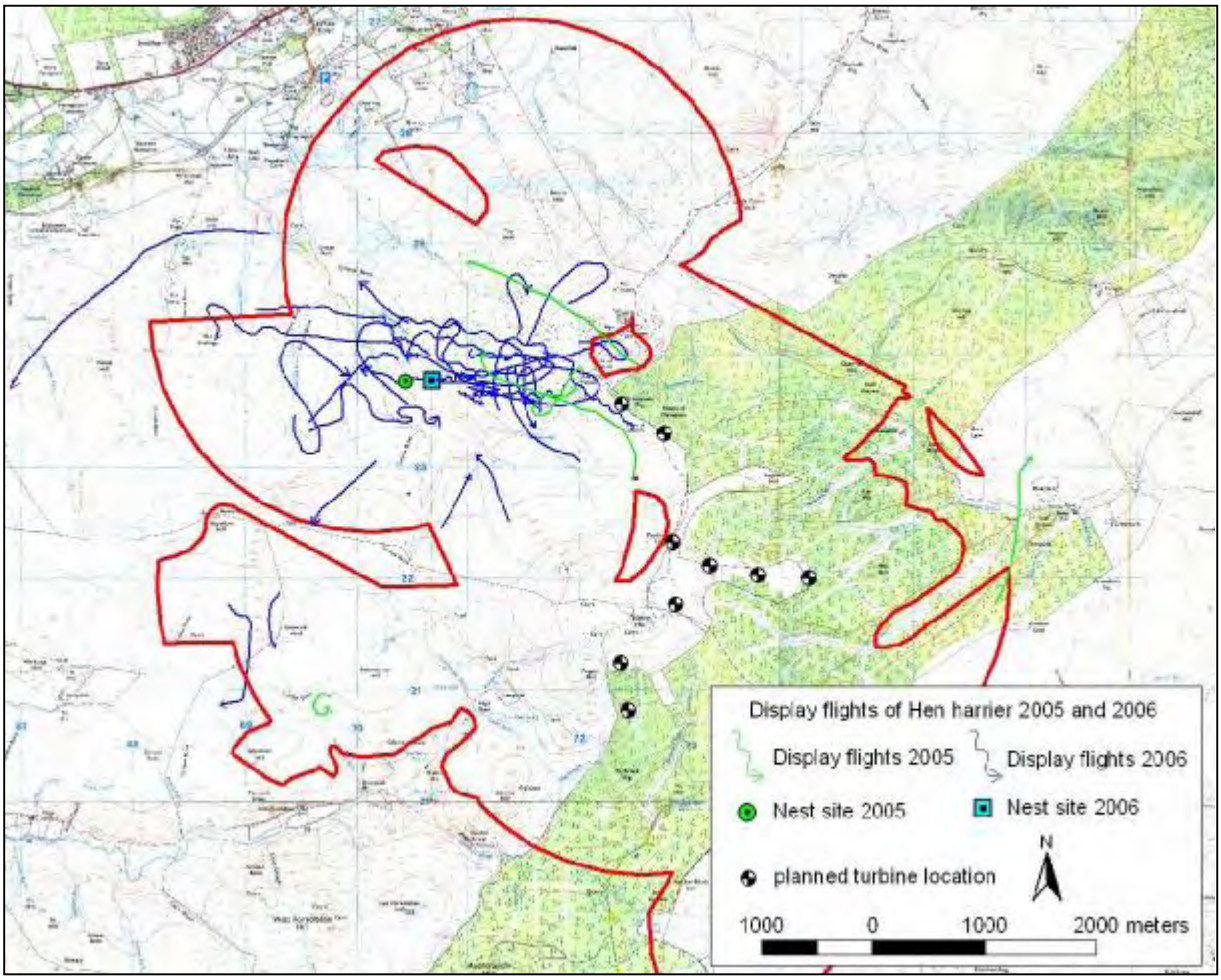



**Fig. 19: Display flights of Hen Harriers in 2005 and 2006**

### 4.2.5 Flying altitude

For an overview of the distribution of the flying altitude of the target species, the flight times of all flight observations were added together and the proportion of the stay in each level of altitude was calculated. For this the period of investigation was subdivided in the breeding season 2005, the non-breeding season 2005/2006 and the breeding season 2006 (Fig. 20).

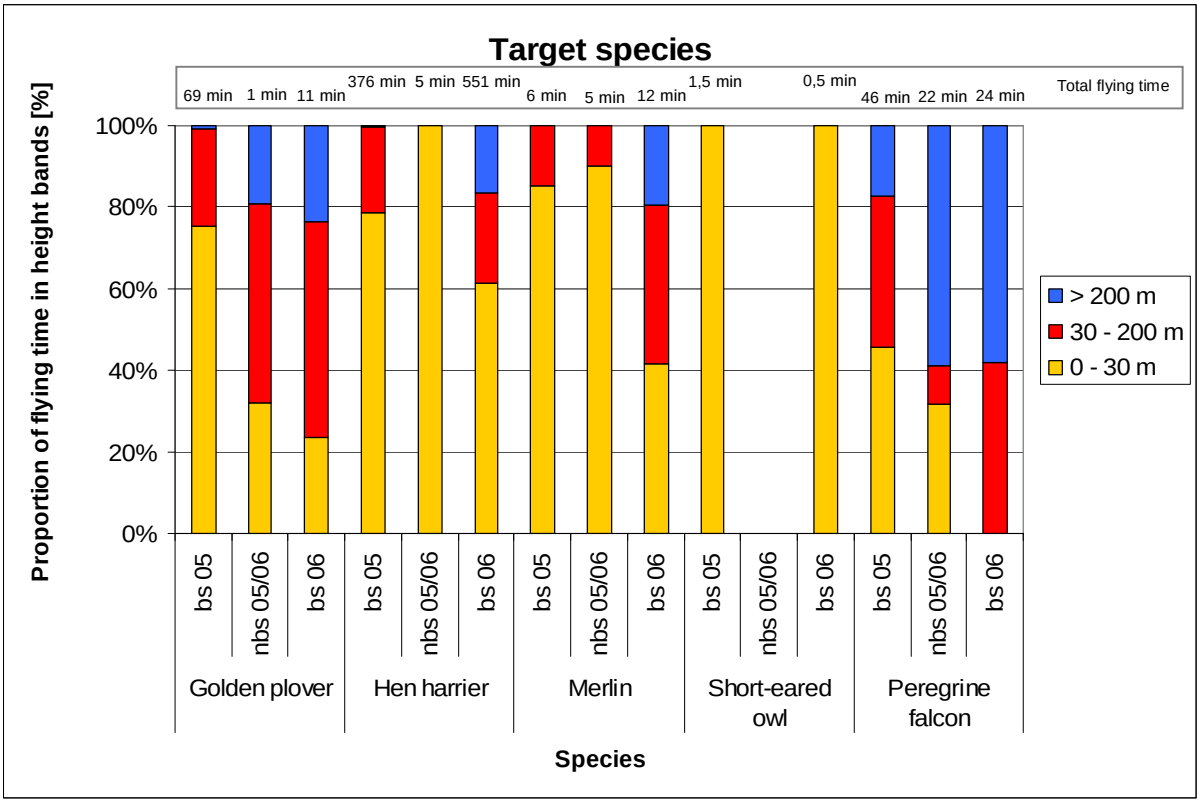



**Fig. 20: Duration of stay in percentages of the target species in the three levels of altitude divided into the three periods of investigation (breeding season 2005 (bs 2005), non-breeding season 2005/2006 (nbs 05/06), breeding season 2006 (bs 06)).**

First of all the varying duration of stay of the separate species in the levels of altitude is striking. While the Golden Plover and the Peregrine Falcon were spending time above 30 m more often and for longer periods of time, the Hen Harrier and the Short-eared Owl preferred the level of altitude near the ground. In the case of the Short-eared Owl, the two observations in the area however do not suffice to give a universally valid statement.

In the breeding season 2005 and in the non-breeding season 2005/2006 Merlins were predominantly found near the ground, while in the breeding season 2006 the species was mainly registered above 30 m. This, in case of the Merlin particularly marked, effect can be found with all species. Here the influence of the weather on the preferred flying altitude becomes clear. Under the bad weather conditions in the year 2005 (see appendix 2) the birds stayed in the layers near the ground. The observation days in 2006 on the other hand were often warmer and calmer than in 2005, so that the better thermals and the better visibility led to an increased proportion of time spent in higher flying altitudes.

As, exceeding the requirements of SNH, the flight movements of the secondary species were monitored with similar accuracy to that of the target species, one can also make a statement about the preferred flying altitudes in their case. In this case the diagram (Fig. 21) refers to the number of flight movements within and outside of the rotor height. Due to the merging of the two levels of altitude outside of the rotor height, a change of the preferred flying altitude owing to the weather conditions can not be analysed for the secondary species.

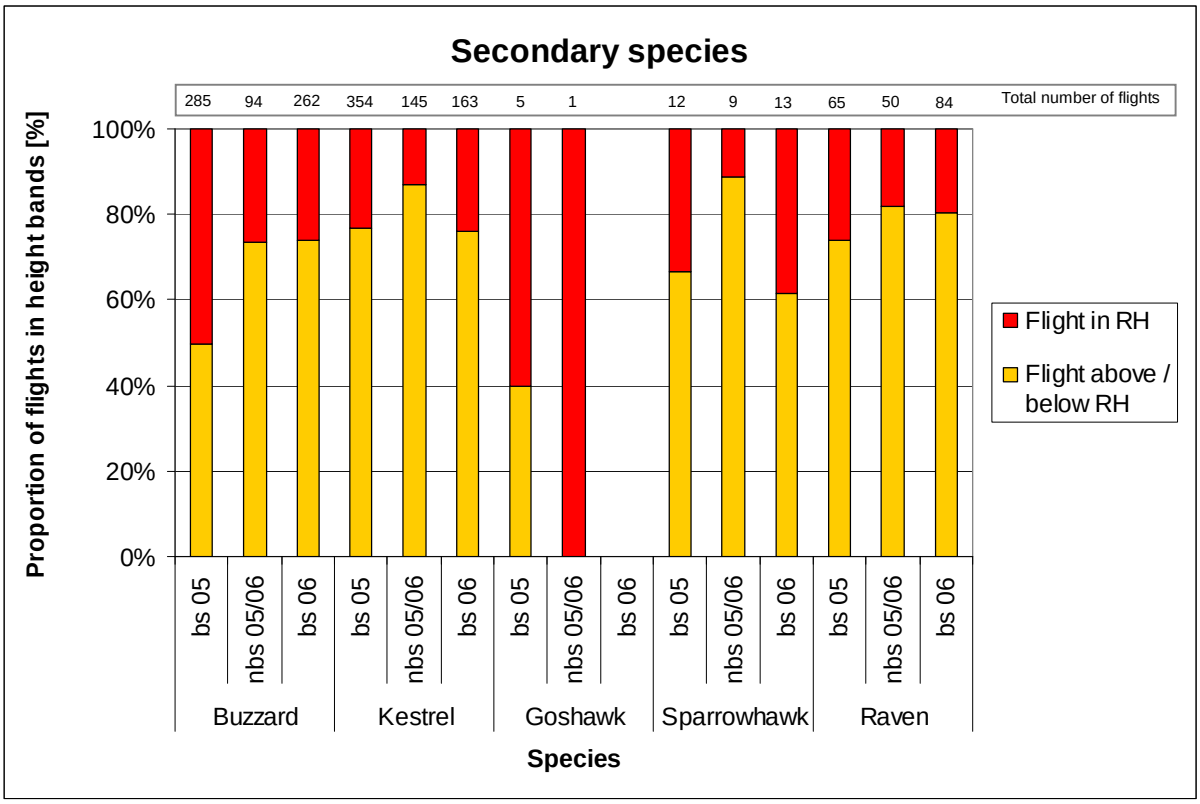



**Fig. 21: Spread of flight movements in rotor height (RH), resp. above and below rotor height, in percentages; subdivided into the three periods of investigation (breeding season 2005 (bs05), non-breeding season 2005/2006 (nbs 05/06), breeding season 2006 (bs 06)).**

In the breeding season 2005 approximately 50% of the flight movements of the Buzzard were registered in rotor height. In the non-breeding season and the breeding season 2006 it was approximately 25%. In contrast, the Kestrel and the Raven remained relatively constant at about 20% (+/- 6%) of the flight movements in rotor height. In winter the Sparrow hawk flew markedly less in rotor height than in summer. However, in this case the small total number of observations must be considered, as with little numbers percentage values fluctuate more strongly for mathematical reasons. For this reason one can not make any universally valid statements from the data of the six observations of the goshawk.

## 4.3 Woodland point-counts

Of the 34 bird species found within the context of the point-counts (see Tab. 9), 28 of them are breeding birds in the woodland (breeding or suspicion of breeding). For the Goshawk, which was observed 5 times in the breeding season 2005 outside of the regular woodland registration dates, there is also a suspicion of breeding. Furthermore, in 2006 the Tawny Owl (3 calling sites), the woodcock (one animal performing the courtship display) and the Grasshopper Warbler (2 calling sites) were detected with territorial behaviour in the area. The Kestrel and the Peregrine Falcon brood outside of the forest, yet they were spotted over the forest several times during the registration. The Common Teal, the Herring Gull, the Feral Pigeon and the Barn Swallow were migrating or foraging. Despite an intensive search only two observations of the Black Grouse could be made (06.09.2005 and 21.04.2006). Moreover in April 2006 Red-legged Partridges were detected in the forest on two occasions. Both species presumably are not breeding in the woodland area at the moment.

23 of the bird species brood directly in the forest. The remaining species have their territory on the edges of the forest, the clear-cut areas and the stream valleys (e.g.: the Stonechat, the Meadow Pipit) and streams (the Sandpiper, the Grey Wagtail and the Dipper) respectively. The Goldfinch was detected near an old building.

In 2005 the most frequent species in the forest were the Common Redpoll, the Chaffinch, the European Robin, the Wren, the Eurasian Siskin, the Willow Warbler, the Goldcrest, the Red Crossbill, the Coal Tit and the Hedge Accentor. These 10 species make up 85,4% of all registered birds in the forest. Furthermore, these species were detected in more than 70% of all grids. However, in 2006 the Red Crossbill was completely absent in the area. The Meadow Pipit, the Song Thrush, the Wood Pigeon and the Blackbird are common as well. The remaining species were only observed in small numbers of individuals and on few locations. On the waters, the Grey Wagtail appears most frequently (Verification in 6 places).

Apart form the Meadow Pipit, which was observed in small bands on several occasions at the beginning of April, migrators were hardly ever observed (e.g.: two Common Teals in April).

There were no Woodpeckers and other cavity breeders, with the exception of the Coal Tit are rare (e.g.: the Crested Tit) or also missing (e.g.: other Tit species). Also the Carrion Crow and the Buzzard were only rarely observed in the dense forest areas.

**Tab. 9: Results of point counts in the forest B = species breeding in the forest, (B) = species breeding outside the forest, M/F = species on migration or only foraging**

| No. | Species | %-level | total | status | number of grids with detection | total 08.04. | total 05.05. | total 28.05. |
|---|---|---|---|---|---|---|---|---|
| 1 | Redpoll (*Carduelis flammea*) | 13,0% | 233 | B | 17 | 94 | 44 | 95 |
| 2 | Chaffinch (*Fringilla coelebs*) | 11,6% | 207 | B | 17 | 61 | 66 | 80 |
| 3 | Robin (*Erithacus rubecula*) | 10,0% | 178 | B | 17 | 42 | 69 | 67 |
| 4 | Wren (*Troglodytes troglodytes*) | 9,5% | 170 | B | 17 | 34 | 75 | 61 |
| 5 | Siskin (*Carduelis spinus*) | 9,0% | 160 | B | 17 | 46 | 41 | 73 |

| No. | Species | %-level | total | status | number of grids with detection | total 08.04. | total 05.05. | total 28.05. |
|---|---|---|---|---|---|---|---|---|
| 6 | Willow Warbler (*Phylloscopus trochilus*) | 8,8% | 158 | B | 17 | - | 75 | 83 |
| 7 | Goldcrest (*Regulus regulus*) | 8,3% | 149 | B | 17 | 48 | 62 | 39 |
| 8 | Crossbill (*Loxia curvirostra*) | 5,2% | 92 | B | 12 | 12 | 14 | 66 |
| 9 | Coal Tit (*Parus ater*) | 5,0% | 90 | B | 17 | 34 | 27 | 29 |
| 10 | Dunnock (*Prunella modularis*) | 4,9% | 88 | B | 16 | 24 | 34 | 30 |
| 11 | Meadow Pipit (*Anthus pratensis*) | 4,3% | 77 | B | 15 | 41 | 5 | 31 |
| 12 | Song Thrush (*Turdus philomelos*) | 2,5% | 45 | B | 14 | 12 | 17 | 16 |
| 13 | Woodpigeon (*Columba palumbus*) | 2,1% | 37 | B | 11 | 15 | 13 | 9 |
| 14 | Blackbird (*Turdus merula*) | 1,1% | 20 | B | 11 | - | 13 | 7 |
| 15 | Tree Pipit (*Anthus trivialis*) | 0,8% | 14 | B | 3 | - | 4 | 10 |
| 16 | Grey Wagtail (*Montacilla cinerea*) | 0,7% | 13 | B | 6 | 4 | 3 | 6 |
| 17 | Swallow (*Hirundo rustica*) | 0,4% | 8 | M/F | 2 | - | - | 8 |
| 18 | Mistle Thrush (*Turdus viscivorus*) | 0,3% | 6 | B | 5 | 4 | 2 | - |
| 19 | Mallard (*Anas platyrhynchos*) | 0,3% | 5 | B | 2 | - | - | 5 |
| 20 | Cuckoo (*Cuculus canorus*) | 0,3% | 5 | B | 5 | - | 5 | - |
| 21 | Dipper (*Cinclus cinclus*) | 0,3% | 5 | B | 2 | 2 | 3 | - |
| 22 | Sparrowhawk (*Accipiter nisus*) | 0,2% | 4 | B | 4 | 1 | - | 3 |
| 23 | Crested Tit (*Parus cristatus*) | 0,2% | 4 | B | 4 | 4 | - | - |
| 24 | Common Sandpiper (*Actitis hypoleucos*) | 0,2% | 3 | B | 2 | - | - | 3 |
| 25 | *Teal (*Anas crecca*)* | 0,1% | 2 | M/F | 1 | 2 | - | - |
| 26 | Kestrel (*Falco tinnunculus*) | 0,1% | 2 | (B) | 2 | - | - | 2 |
| 27 | Peregrine Falcon (*Falco peregrinus*) | 0,1% | 2 | (B) | 2 | - | - | 2 |
| 28 | Goldfinch (*Carduelis carduelis*) | 0,1% | 2 | B | 2 | 1 | - | 1 |
| 29 | Carrion Crow (*Corvus corone*) | 0,1% | 2 | B | 2 | - | 1 | 1 |
| 30 | Buzzard (*Buteo buteo*) | 0,1% | 1 | B | 1 | 1 | - | - |
| 31 | Pheasant (*Phasianus colchicus*) | 0,1% | 1 | B | 1 | - | 1 | - |
| 32 | Herring Gull (*Larus argentatus*) | 0,1% | 1 | M/F | 1 | - | - | 1 |
| 33 | Feral Pigeon (*Columba livia*) | 0,1% | 1 | M/F | 1 | - | - | 1 |
| 34 | Stonechat (*Saxicola torquata*) | 0,1% | 1 | B | 1 | - | 1 | - |
| | Total | | 1786 | | | 482 | 575 | 729 |

Outside the three surveys the following species were registered in the woodland:

- Black Grouse (Tetrao tetrix) (1 specimen on the 6th of September 2005 and 1 specimen of the 21st of April 2006)

- Goshawk (Accipiter gentilis) (between April and August 2005 six sightings; probably breeding in the woodland)
- Tawny Owl: 3 territories 2006, Woodcock: one specimen performing the courtship display, Grasshopper Warbler: 2 territories 2006, Red-legged Partridge: 2 observations in April 2006

# 5 Comparison with the previous years and subsuming evaluation

The results of the mapping of breeding birds to a large degree confirm the data of SNH of the previous years regarding their distribution (see map 9). However in some species there are decreasing numbers to be recorded.

This becomes most obvious in the case of the Golden Plover. In 1989 the species could still be registered with approximately 29 pairs in the area of investigation. 10 years later their numbers had decreased by over 50% (1999: approx. 14 pairs). Particularly the breeding sites on Stony Hill and the plain to the west of VP5 and to the west and southwest of VP6 were abandoned. The distribution of the Golden Plover 05/06 strongly resembles that of 1999. They are predominantly concentrated on the rocky areas between Cairn Table and Little Cairn Table.

A decrease of numbers is also to be recorded in the case of the Hen Harrier. While in the period between 1994 and 2000 almost every year at least 2 pairs and up to a maximum of 6 pairs (1998, 2000) were breeding in the area of investigation, since 2001 only one pair could be registered in bad years (2001, 2005, 2006) and a maximum of three pairs in good years (2004). The verifications are predominantly concentrated on the western areas of the area of investigation. According to a SNH ornithologist, former breeding sites of the species in the bordering areas to the southeast were abandoned.

The Short-eared Owl only breeds irregularly in the area of investigation. The species was last registered as a breeding bird in 2004 (at least 3 pairs). Thus one can not make any statements with regard to a change in numbers.

According to data from SNH the Peregrine Falcon was present with two breeding pairs in several years in the area. However, in both years of investigation, only the southern breeding site in the Connor Craigs could be confirmed, while the second breeding site does not seem to exist any longer.

The Merlin also does not breed in the area on a yearly basis. Since 1989, one up to a maximum of six breeding pairs could be detected in the area on an irregular basis.

With the exception of one Golden Plover pair on Stony Hill in 2005/2006, the area around the planned plants was of no importance to breeding pairs of the target species. The negative tendencies of the development of the numbers of the target species is probably predominantly the result of the worsened condition of the habitat (lacking management), as well as, in the case of the Hen Harrier, the bad breeding success rate. In 2005/2006 the species did not have a breeding success either.

A systematic investigation of the range use of the target and secondary species is so far not available. Our investigation for the target species Hen Harrier, Merlin and Golden Plover showed explicit focal areas. The same applies to the secondary species Curlew, Buzzard and Kestrel. The Peregrine Falcon, which was the fourth target species to breed in the area in 2005/2006, predominantly hunts outside of the area of investigation. The Short-eared Owl was a rare visitor in both years of investigation, which definitely did not breed in the area.

At least as far the songbird species (Meadow Pipit, Sky Lark) are concerned, the food supply is high. This also applies to the sites of the planned wind energy plants. Regardless of this, these areas were only frequented by hunting Hen Harriers to a minor degree.

Decisive for the range use of the birds are topography, quality of habitat, location of the breeding sites and the weather conditions. The heathlands (breeding sites of the Merlin and Hen Harrier), cliffs, (breeding sites of the Golden Plover) and the slope areas of Cairn Table and Stony Hill (hunting area for the Buzzard and Kestrel) are of particular significance. The monotonous grass areas, but also the Penbreck Forest, which is hardly flown over by the Peregrine Falcon, Golden Plover, Merlin and Hen Harrier and is of no significance as a hunting ground to the species, is only of no importance.

# 6 Mitigation measures

## 6.1 Principles

In order to avoid conflicts with the protection of birds as far as possible, or to minimize these, technical literature makes the following general recommendations (according to PERCIVAL 2005; DREWITT & LANGSTON 2006):

1. *Avoid a high density of wintering or migratory waterfowl and waders where important habitats might be affected by disturbance or where there is potential for significant collision mortality.*

This demand is fulfilled, as the data in the non-breeding season 2005/2006 have shown that wintering or migratory waterfowl and waders are of no significance in the area of investigation.

2. *Avoid areas with a high level of raptor activity, especially core areas of individual breeding ranges and in cases where local topography focuses flight activity which would cause a large number of flights through the wind farm.*

This demand is also fulfilled, as the principle activities, especially of the Hen Harrier, occur in a considerable distance from the planned wind park. The vantage point watches in 2005 and 2006 have shown that in the area of the planned wind parks only a small flight activity of the target species took place. The local topography does precisely not lead to a focusing of flight activity in the area of the wind park.

3. *Avoid breeding, wintering or migrating populations of less abundant species, particularly those of conservation concern, which may be sensitive to increased mortality as a result of collision.*

Auch diese Anforderung ist erfüllt, da im Laufe des Planungsprozesses die Anlagenstandorte im Bereich von Stony Hill und Cairn Table in einer Weise verschoben wurden, dass zwischen Anlage und dem nächsten Goldregenpfeiferrevier ein Mindestabstand von 250 m eingehalten wird.

## 6.2 Further preventive and attenuative measures

- Reduction of the plants from 18 to 9
- Construction outside of the breeding period (is advised)

- Development of edges of the forest consisting of deciduous wood (recommended in largest distance possible to the site (2 km), with the aim to compensate the impairment of the landscape and to improve the hunting possibilities of the Merlin, Fig. 22). Als Baumarten kommen hier Erle, Birke und Eberesche in Frage.

**Fig. 22: The edge of the forest is marked by a missing transition between the forest and the open land. Thus the development of a belt of deciduous wood lends itself as a measure.**

## 6.3 Creation of appropriate breeding and feeding habitats

The aim of this measure is the improvement of the breeding habitats of the Hen Harrier, the Merlin and the Golden Plover, as well as the improvement of the range of food for the Peregrine Falcon. Through the rather great distance of the location of the areas where these measures are implemented to the wind park, the named species are supposed to be lured away from the surrounding of the wind park in order to avoid impairments, and especially collisions. That such measures can be successful is shown by WALKER *et al.* (2005) through the example of a pair of the Golden Eagle, which, following the construction of a wind park and the simultaneous improvement of a more distant feeding habitat through tree felling, shifted its activities from the area of the wind park to the area where these measures had been implemented (WALKER *et al.* 2005).

The core of this measure is the heather restoration. The heathland areas make up the most attractive breeding areas for the Hen Harrier, the Merlin and partly also the Golden Plover. If one takes a look at the spatial spread of the centres of activity of these species (see maps 1, 3 and 4) in relation to the spread of the heathland areas (see map 10), it becomes quite clear that they are almost exclusively bound to the areas with distinctive heathland areas. Focal areas are the south-western slopes of the Cairn Table, which are characterised by a mosaic of well managed heathland areas of different ages (Fig. 23).

**Fig. 23: Views of the southwestern slopes of the Cairn Table with distinctive heathland areas**

In contrast to this, the southern and south-western parts of the area of investigation, as well as the areas to the east of the forest area, are marked by distinctive grass areas (Fig. 24, Fig. 25, Fig. 26), in which only a very minor degree of activity was recorded.

The relationships pointed out between the range use of the Hen Harrier and the spread of the heathland, are confirmed by the results of the REDPATH *et al*. (1998) form Argyll:

*"Harriers showed a clear preference for nesting in heather. Within heather moorland, harriers nested in taller heather … than expected by chance. More nests were on northwestfacing slopes than expected by chance. Heather moorland is declining in the uplands due to overgrazing and afforestation. The association of harriers with heather suggests, that their future may become increasingly dependent on moorland, where heather is maintained for grouse."* (REDPATH *et al.* 1998).

**Fig. 24: Grass areas east of the forest area, which, according to information by a local SNH-ornithologist, were still dominated by heath approximately 10 years ago.**

**Fig. 25: Grass areas in the south of the area of investigation with a strong dominance of *Molinia.***

**Fig. 26: Western slope of Stony Hill with the border of cultivation between heath and grass areas.**

In the development of the areas where such measures are implemented one should thus aim for a status as can be seen on the southwestern slope of the Cairn Table, which is of particular significance to the Hen Harrier. These managed areas are marked by a small-scale alteration of young and old heathlands, which are regularly burnt.

The development of heath areas should occur in an area, in which grass (Molinia) dominates at the moment and which is located at a sufficient distance (at least 1 km) to the planned wind park. We recommend areas west and southwest of Stony Hill. As far as management is concerned, one should orientate oneself at the example of Muirkirk and North Lowther Uplands Management Scheme (SNH 2003), i.e. burning, catching of crows and possibly the check-up of Hen Harrier nests.

The size of the areas which are to be developed should be derived from the respective extent of the centres of activity preferred by the Hen Harrier in 2005/2006 around the breeding sites (2005 approximately 100 ha, 2006 approximately 200 ha, see map 1). Thus an area of approximately 100 – 200 ha is recommended.

For more details of the characteristics of the present and historic utilisation of the area and the measures to be taken, one should look at the “Moorland Report – Past Management, Future Enhancement”, which was especially compiled for this purpose and is enclosed in the appendix 6.

# 7 Expected impact of the planned windfarm

## 7.1 Present state of knowledge

Literature on the effects of wind energy plants on birds is very extensive and contains primarily publications from the USA, the UK and Germany (overviews in ERICKSON *et al.* 2001; LANGSTON & PULLAN 2003; HÖTKER *et al.* 2004; REICHENBACH *et al.* 2004; PERCIVAL 2005; DREWITT & LANGSTON 2006). Nevertheless the present state of knowledge is relatively incomplete and urgently requires further research efforts.

One can distinguish between the following types of impairments:

- Direct habitat loss
- Displacement due to disturbance
- Barrier effect
- Collision

It is not possible to give a general prediction as to which effects of a wind park are to be expected, as these always depend on a series of factors, especially on the specific sensitivity of the existing species, their status in the area (breeding, resting, foraging or migrating), the size of the population, the topography and the type of habitat. Thus one always needs a case-to-case assessment specific to the species and the location.

In the following, to begin with the present state of knowledge concerning the effects of wind energy plants on the relevant bird species in the area of investigation will be taken as a basis for a prediction of the effects.

*Hen Harrier*

MADDERS & WHITFIELD (2005) give a compilation of the knowledge for the Hen Harrier and stress that the two essential potential risks for this species lie in displacement/disturbance and collision. In particular they come to the following conclusion:

**Displacement**: In general foraging activity appears to be little affected by displacement (and if it does, usually only in a very limited area). In the context of the extent of foraging ranges of breeding harriers and the even larger ranges of non-breeding harriers any such displacement is unlikely to be problematic unless a large number of closely spaced turbines are located close to harrier nests.

**Collision**: In general, hen harriers appear to be less vulnerable to collision than several other raptors. Harriers tend to fly at low altitudes and so the height of the rotor sweep should strongly influence collision rate. The reduced mortality in more modern wind farms, despite much higher levels of flight activity, suggested that higher rotor blade heights reduces collision risk in harriers due to their typically low flight altitude. Against expectations that mortality should rise with increasing harrier activity, there was no evidence that the level of use by harriers *per se* influenced estimates of collision mortality.

On the subject of displacement, there is a BACI study (before-after-control-impact) from Germany, which shows that in the cases of the Hen-, the Western Marsh-, and the Montagu's Harrier, the utilisation intensity of the investigated wind park area was higher after the

construction of the site than it was before (BERGEN 2001). However, the three species only appeared in small numbers of individuals, which do not allow for a statistical analysis.

REICHENBACH made a compilation for Germany of known case studies of observations of the Western Marsh-, and Montagu's Harrier in relation to wind energy plants (REICHENBACH 2005). On the basis of the 10 case studies of the Western Marsh Harrier and the 5 case studies of the Montagu's Harrier, he makes the following statements:

- Both species utilize areas inside of wind parks for foraging and can get very close to the plants in the process. Pronounced avoidance reactions (avoiding of sites, taking detours) were so far not registered. Furthermore, often used flight routes near breeding sites through wind parks were documented.
- For both Harrier species several broods – also with breeding success – were detected at close distance to wind parks. So far the smallest registered distance was approximately 150 m, for broods in 600-700 m distance there are before and after comparisons, which prove a permanence of the breeding site.
- Acting on the assumption of the observations set forth, according to which Harriers also hunt within wind parks and do not, or only barely, avoid proximity to sites, theoretically a heightened risk of collision is to be expected. On the other hand, - in comparison to the Red Kite, White-tailed Sea Eagle, the Buzzard and the Kestrel (comp. DÜRR 2004, Data for 2006 pers. communication) – the only very minor number of proven collision victims, shows that Harriers, due to their species-specific hunting method with a very low flight altitude, are only at a very minor risk form collisions with rotors of wind energy plants.

Even if these results concerning the Western Marsh Harrier and the Montagu's Harrier can not be generally transferred to the Hen Harrier, there is a strong congruence with the statements of MADDERS & WHITFIELD (2005) about the Hen Harrier (see above). Thus, at this point they are mentioned as additional validation and confirmation of the knowledge about the Hen Harrier and Harriers in general.

*Peregrine, Merlin, Short-eared Owl*

A number of studies about the sensitivity of raptors to wind energy plants are available (Overview in MADDERS & WHITFIELD 2006). Here in turn it is important to distinguish between displacement/disturbance and collision risk. In general, raptors only seem to have a small sensitivity to possible disturbing influences from wind energy plants (HÖTKER *et al.* 2004; REICHENBACH 2004; MADDERS & WHITFIELD 2006). In respect to the Merlin and the Short-eared Owl there are no investigations available, for the Peregrine Falcon the statement is merely based on small number of investigated breeding pairs.

The generally emerging low sensitivity to displacement through wind energy plants corresponds to the fact, that raptors are the group of birds which is most affected by collision losses. From individual wind parks in the USA one knows that there are a high number of flights of the Golden Eagle, the Red-tailed Hawk and the American Kestrel. In Spain the same applies to the Griffon Vulture and in Germany to the Red Kite, the Buzzard, the White-tailed Sea Eagle and Kestrel. Individual collision losses of the Peregrine Falcon are known from Belgium and the USA. So far there are no findings for the Merlin and the Short-eared Owl (LANGSTON & PULLAN 2003; DÜRR 2004 and pers. communication with data from 2006; PERCIVAL 2005; DREWITT & LANGSTON 2006).

The number of collision losses varies enormously between different wind parks, so that general statements are not possible. However, it emerges that areas with a high density of activity of certain (not all) raptor species bear a heightened conflict potential with regard to collisions.

For the Short-eared Owl, due the similarity of its flight and hunting behaviour to that of the Hen Harrier, one can probably assume an all-in-all lower collision risk. Yet one must keep in mind that, due to hunting flights in the dark and with bad visibility, the vulnerability might be higher.

For the two Falcon species Peregrine and Merlin the collision risk is generally higher, as they more often hunt in greater heights and at greater speed. This especially applies to the Peregrine Falcon, whereas the Merlin searches for prey in rather low and very fast flight over the open land. However, while chasing flying prey or along the edges of the forest, the species can also reach rotor height.

*Golden Plover and Curlew*

Disturbance and Displacement

In many cases, including upland wind farms, no significant disturbance effect on breeding waders has been detected (PERCIVAL 2005). PERCIVAL (2000) reports a wind park in Yorkshire, in which a study according to the BACI design (before-after-control-impact) shows that breeding Golden Plovers were not impaired by the wind park. There was no difference in distribution pattern in relation to the turbine positions and no evidence of any disturbance zone. Golden Plover have even been found nesting within 30 m of a turbine. Whilst pair numbers in a nearby control area remained constant, numbers at the wind farm actually increased (PERCIVAL 2000).

Further studies about the influence of wind energy plants on Golden Plovers are not available. Thus, in the following some results of other wader species will be summarised to begin with.

In investigations of 10 wind parks (each with area of reference in England and Wales) THOMAS (1999) could also not find any far-reaching disturbance effect on breeding birds of the coast and highland areas (including the Western Curlew; Lapwing; Meadow Pipit; Sky Lark). Through statistical analysis the following significant results emerged from this study of a total of 170 wind energy plants (THOMAS 1999):

- The spatial distribution of all birds was no more cramped in the areas of the wind parks than in the areas of reference. However, there were signs that the immediate surrounding of the sites were avoided.
- The comparison to a coincidental distribution showed that the birds were neither in a greater, nor in a smaller distance to the sites than expected.
- In a individual viewing of the Lapwing and the Western Curlew this method led to the same result: a displacement effect could not be recognised.
- The density of all bird species was no lower in the area of the wind parks than in the reference areas.
- The spatial distribution of the birds primarily depended on the quality of the habitat.
- There was no decrease of the density of birds near wind parks with higher sites and greater rotor diameters, as well as greater site numbers.

In a wind park in Scotland, GILL (in LANGSTON & PULLAN 2003) compared the stocks of breeding birds within the wind park area with those of reference area before and several years after the construction of the site. The wader species (Curlew among others) showed comparable yearly variations of stock within the wind park and the reference area. A disturbing influence by the site was not found.

PERCIVAL (2000) provides a summary of the results from British studies (Tab. 10). He concludes that the majority of more recent studies have found no problems with disturbance effects. All the British studies on coastal and moorland birds have shown no significant effect. However, LANGSTON & PULLAN (2003), as well as DREWITT & LANGSTON (2006) emphasise that many of these older studies do not meet modern requirements with regard to method and statistical analysis, so that their relevance is only limited.

**Tab. 10: British studies of the possible disturbance effects of wind farms on bird distribution (after PERCIVAL 2000)**

| Site | Number of turbines | Distance affected | Species significantly affected | Habitat | Species present | Source |
|---|---|---|---|---|---|---|
| Burgar Hill GB, ORKNEY | 3 | -- | Red-throated Diver | Coastal moorland | Upland species inc. divers and raptors | (MEEK *et al.* 1993) |
| Haverigg GB, CUMBRIA | 5 | -- | None | Coastal grassland | Golden Plover, gulls | (SGS ENVIRONMENT 1994) |
| Blyth GB, NORTHUMBERLAND | 9 | -- | None | Coastal shoreline | Cormorant; Eider; Purple Sandpiper, gulls | (STILL *et al.* 1995) |
| Bryn Tytli GB, WALES | 22 | -- | None | Upland moorland | Upland species, inc. Red Kite and Peregrine | (PHILLIPS 1994) |
| Cemmaes GB, WALES | 24 | -- | None | Upland moorland | Upland species | (DULAS ENGINEERING LTD. 1995) |
| Carno GB, WALES | 56 | -- | None | Upland moorland | Upland species | (WILLIAMS & YOUNG 1997) |
| Ovenden Moor GB, NORTH--WEST ENGLAND | 23 | -- | None (Golden Plover numbers increased) | Upland moorland | Upland species, inc. Golden Plover and Curlew | (EAS 1997) |
| Windy Standard GB, SOUTH-WEST SCOTLAND | 36 | -- | None | Upland moorland | Upland species | (HAWKER 1997) |

Despite possibly limitations of its relevance due to method, the basic point made by the studies from the UK corresponds to many studies from Germany, in which, partly even by the BACI – design and the accompanying habitat analysis a displacement effect of more than 150 m on species such as the Lapwing, the Black-tailed Godwit, the Oystercatcher and the Curlew could not be found (overwiews in HÖTKER *et al.* 2004; REICHENBACH *et al.* 2004; up-to date results in REICHENBACH & STEINBORN 2006).

However, as such results can not be transferred from one species to another without limitations, in case of the Golden Plover, due to the still small number of studies it makes sense to apply the provision principle and, in the sense of a worst case scenario, to assume possible displacement effects for the time being.

Collision Risk

So far data about collisions of the Golden Plover with wind energy plants in their breeding areas have not become known, which however can due to a lack of such studies.

However, due to their behaviour one must assume that a certain collision risk can not be ruled out from the start (according to WHITFIELD 2004):

Golden Plovers are vulnerable to collision when making display flights, during chases between birds and when making flights to and from feeding areas off the site. Flights when birds would be vulnerable to collision often occur in the early morning and late evening, when, for example, members of pair exchange duties for incubating and can even occur at night. Vulnerable flight activity thus often occurs in conditions of low flight intensity, heightening the risk of collision.

Collision risk will be greatest for turbines very close to breeding areas and will be much less for turbines in forest or away from breeding areas. The risk posed by turbines will depend on the height, frequency and direction of flights (WHITFIELD 2004).

*Kestrel and Buzzard*

Like most raptor species, the Kestrel and the Buzzard also show no, or only very minor, sensitivity to the displacement effect of wind energy plants (MADDERS & WHITFIELD 2006). A new, three-year study from northern Germany, which apart from the wind energy plants also included habitat parameters, found no influence of the wind park on the location of the nest and the breeding success in the case of the Buzzard (HOLZHÜTER & GRÜNKORN 2006). However, outside of the breeding season the Buzzard seems to keep a distance of approximately 100-150 m to the plants, although the differences are of no statistical significance (results of a five year BACI-study, REICHENBACH & STEINBORN 2006). In the case of the Kestrel, on the other hand, so far all studies show that an avoidance behaviour towards the plants can not be found (overwiews in HÖTKER *et al.* 2004; REICHENBACH *et al.* 2004; REICHENBACH & STEINBORN 2006).

The lacking avoidance behaviour corresponds to the relatively high number of collision losses, which are known from Germany. According to a nation-wide German database, the Buzzard is the second most frequent bird species amongst the known collision victims. The Kestrel comes at the 7$^{th}$ place (DÜRR 2004 and pers. communication, state on the 22.05.2006).

*Sky Lark, Meadow Pipit*

Many studies, from the UK as well as from Germany, have shown that the Sky Lark and the Meadow Pipit show no, or only very little, sensitivity to disturbing influences by wind energy plants. Apart from the studies from the UK, which were mentioned above in context of the Golden Plover, a further British wind park has been investigated before, during, and in the duration of the 7 years after the construction of the plants (DH Ecological Consultancy in LANGSTON & PULLAN 2003). The analysed species included the Meadow Pipit, the Sky Lark and the *Lagopus lagopus scotius*. An influence of the wind energy plants was not found.

Overviews in HÖKTER *et al.* (2004) and REICHENBACH *et al.* (2004) show that this result corresponds to results of many other studies. Also a higher collision risk is so far no topic of discussion in the case of these species.

*Wood species*

LANGSTON & PULLAN (2003) only assume a danger for songbirds in the case of nightly bird movement. In literature there is an agreement, that especially wood breeding songbirds are not influenced by wind energy plants (overviews in HÖTKER *et al.* 2004; REICHENBACH *et al.* 2004).

Pigeons and *corvidae* are so far known in relative small numbers as collision victims (e.g. DÜRR 2004 and pers. communication, state on the 22.05.2006), yet a stock endangering influence is no topic among experts.

## 7.2 Prognosis for the planned Wind Park

Für die nachfolgenden Prognosen werden folgende Grundlagen verwendet:

- Ergebnisse der VP watches und der surveys (chapter 4 and 5),
- Gegenwärtiger Wissensstand zur Empfindlichkeit der Arten gegenüber Windenergieanlagen (chapter 7.1),
- Geplante mitigation measures (chapter 6).

On this basis, the following impact on the observed bird species are to be expected from the construction and operation of the plant.

### Habitat loss

**!!Interne Notiz: Quantifizierung durch Mr. Taylor**

Die für die Erschließung des Windparks und durch die Anlagen selbst versiegelte Fläche nimmt nur einen sehr geringen Anteil an dem Lebensraum der target species ein. Zudem wird der Bereich nach unseren Kartierungen von den target species nicht oder nur in sehr geringem Maße genutzt (Karten 1 bis 5). Damit ist der Habitatverlust für die target species zu vernachlässigen.

Auch bei den secondary species (Sperber, Mäusebussard, Turmfalke, Kolkrabe, Großer Brachvogel) werden die neun Anlagenstandorte nicht als Brutplatz genutzt. Der Bereich der Anlagenstandorte ist aber im Gegensatz zu den target species ein stärker genutzter Teil ihres Aktionsraumes (siehe Karten 5 bis 8). Hier wurden Sperber, Turmfalke, Kolkrabe und vor allem der Mäusebussard beobachtet. Bei diesen vier Arten kann es zu einer geringfügigen Verkleinerung des verfügbaren Lebensraums kommen, der aber in Anbetracht der für diese Arten vorhandenen Fläche nicht relevant ist.

### Disturbance and Displacement

Die meisten target species brüten nicht im Umfeld der Anlagen und haben auch ihre Hauptaktivität weitab der geplanten Anlagen, sodass hier eine Störung / Vertreibung ausgeschlossen werden kann (Wanderfalke, Merlin, Kornweihe und Sumpfohreule). Als einzige der fünf target species brüten Goldregenpfeifer in mehreren Paaren regelmäßig am Cairn Table und unregelmäßig in Einzelpaaren am Stony Hill. Durch die vorgeschlagene Anlagenverschiebung (siehe Kap. 6) wurde sichergestellt, dass sich die neuen Standorte außerhalb der festgestellten

Goldregenpfeiferreviere plus eines Puffers von 250 m, befinden (siehe Karte 4). Größere Flugaktivitäten wurden im Bereich der Anlagen nicht beobachtet.

Auf der Grundlage des bisherigen Kenntnisstandes (Kap. 7.1) wird deshalb davon ausgegangen, dass Störungen oder Vertreibungen für den Goldregenpfeifer ebenfalls nicht zu erwarten sind, zumal die Annahme eines 250 m-Meidungsradius bereits auf dem Vorsorgeprinzip beruht.

Für die Greifvögel unter den Secondary species gilt dies ebenfalls, da es nach dem vorliegenden Kenntnisstand (Kap. 7.1) keine Hinweise auf Meidungsreaktionen gegenüber Windanlagen gibt. Gleiches gilt für den Kolkraben. Für den Großen Brachvogel gibt es Hinweise auf Meidung bis 250 m. Da diese Arten aber nicht im Bereich der geplanten Anlagen brüten, sind lediglich Ausweichbewegungen bei Flügen in Anlagennähe zu erwarten.

### Collision risk (results of the calculation)

The calculation of the risk of collision (according to BAND *et al.* in press) of the target species gave the following results (Tab. 11 to Tab. 13):

**Tab. 11: Risk of collision for all nine turbines (calculated according to Band et al. in press).**

| Season | Hen Harrier | Peregrine Falcon | Golden Plover | Merlin | Short-eared Owl |
|---|---|---|---|---|---|
| dead individuals per 1 year | | | | | |
| bs 05 | 0.003 | 0.006 | 0 | 0.004 | 0 |
| nbs 05/06 | 0 | 0.013 | 0 | 0 | 0 |
| bs 06 | 0.011 | 0.006 | 0 | 0 | 0 |
| dead individuals per 25 years | | | | | |
| bs 05 | 0.075 | 0.159 | 0 | 0.111 | 0 |
| nbs 05/06 | 0 | 0.324 | 0 | 0 | 0 |
| bs 06 | 0.287 | 0.151 | 0 | 0 | 0 |
| 1 dead individual every x years | | | | | |
| bs 05 | 333 | 156 | - | 225 | - |
| nbs 05/06 | - | 77 | - | - | - |
| bs 06 | 87 | 166 | - | - | - |

bs = breeding season, nbs = non-breeding season

**Tab. 12: Risk of collision for the two turbines in the north (calculated according to BAND *et al.* in press)**

| Season | Hen Harrier | Peregrine Falcon | Golden Plover | Merlin | Short-eared Owl |
|---|---|---|---|---|---|
| dead individuals per 1 year | | | | | |
| bs 05 | 0.003 | 0 | 0 | 0.005 | 0 |
| nbs 05/06 | 0 | 0.014 | 0 | 0 | 0 |
| bs 06 | 0.013 | 0.007 | 0 | 0 | 0 |
| dead individuals per 25 years | | | | | |
| bs 05 | 0.084 | 0 | 0 | 0.124 | 0 |
| nbs 05/06 | 0 | 0.362 | 0 | 0 | 0 |
| bs 06 | 0.321 | 0.168 | 0 | 0 | 0 |
| 1 dead individual every x years | | | | | |
| bs 05 | 299 | | - | 202 | - |
| nbs 05/06 | - | 69 | - | - | - |
| bs 06 | 78 | 149 | - | - | - |

bs = breeding season, nbs = non-breeding season

**Tab. 13: Risk of collision for the seven turbines in the south (calculated according to BAND *et al.* in press)**

| Season | Hen Harrier | Peregrine Falcon | Golden Plover | Merlin | Short-eared Owl |
|---|---|---|---|---|---|
| dead individuals per 1 year | | | | | |
| bs 05 | 0 | 0.006 | 0 | 0 | 0 |
| nbs 05/06 | 0 | 0 | 0 | 0 | 0 |
| bs 06 | 0 | 0 | 0 | 0 | 0 |
| dead individuals per 25 years | | | | | |
| bs 05 | 0 | 0.155 | 0 | 0 | 0 |
| nbs 05/06 | 0 | 0 | 0 | 0 | 0 |
| bs 06 | 0 | 0 | 0 | 0 | 0 |
| 1 dead individual every x years | | | | | |
| bs 05 | - | 161 | - | - | - |
| nbs 05/06 | - | - | - | - | - |
| bs 06 | - | - | - | - | - |

bs = breeding season, nbs = non-breeding season

Insgesamt ergeben die Berechnungen sehr niedrige Werte, die zwischen 0 und 0,014 toten Individuen pro Jahr liegen. Bei einer voraussichtlichen Laufzeit des Windparks von 25 Jahren führen die Windenergieanlagen laut Kollisionsberechnung bei keiner der betrachteten Vogelarten zu einem Verlust eines Individuums. Statistisch gesehen werden maximal im Bereich der nördlichen Anlagen 0.36 Wanderfalken in 25 Jahren getroffen.

Aus den Ergebnissen wird ersichtlich, dass im Vergleich das größte Kollisionsrisiko für den Wanderfalken besteht. Die anschaulichste Zahl ist die Anzahl der Jahre, die es nach der Berechnung dauert, bis ein Individuum getroffen wird. Für den Wanderfalken schwanken die Angaben je nach Saison zwischen 77 und 166 Jahren, d. h., dass im schlimmsten Fall alle 77

Jahre ein Individuum von den geplanten Anlagen getroffen wird. Für die Kornweihe muss schlimmstenfalls von einem toten Individuum alle 87 Jahre ausgegangen werden. Für den Merlin ist das Kollisionsrisiko noch einmal extrem geringer. Von dieser Art wird laut Berechnung lediglich alle 225 Jahre ein Individuum getroffen. Für Goldregenpfeifer und Sumpfohreule besteht kein Kollisionsrisiko.

Bei einer differenzierten Betrachtung des Windparks fällt auf, dass die meisten Flugbewegungen in Rotorhöhe im Bereich der beiden nördlichen Anlagen stattgefunden haben. Doch auch wenn man diese beiden Anlagen getrennt betrachtet, bleibt das Kollisionsrisiko auf einem sehr niedrigen Niveau. Für die südlichen sieben Anlagen ist das Kollisionsrisiko für die meisten target species gleich null. Lediglich für den Wanderfalken besteht hier ein wenn auch extrem geringes Risiko.

Wie in chapter 2.3 dargelegt, muss für die kleinen Greifvogelarten Merlin und Turmfalke davon ausgegangen werden, dass Sichtungen in größerer Entfernung unterrepräsentiert sind. Insbesondere für den Merlin nehmen wir, dass die VP watches keine ausreichende Datengrundlage geliefert haben, um eine realistische Kalkulation des Kollisionsrisikos vornehmen zu können. Für diese Art kann daher sinnvollerweise nur eine qualitative Abschätzung des Kollisionsrisikos vorgenommen werden. Die Verteilung der erfolgten Sichtungen des Merlins (see map. No. 3) gibt jedoch Hinweise, dass die Art in erster Linie im Bereich der gut ausgeprägten Heideflächen jagt (wie die Kornweihe), d.h. weniger im Bereich des geplanten Windparks. Dennoch könnte möglicherweise der Waldrand eine attraktive Struktur für die Singvogeljagd sein. Sollten Merline jedoch tatsächlich häufig entlang der Waldränder jagen, wird davon ausgegangen, dass zumindest einzelne Sichtungen an den vantage points No. 1, 2a, 2b and 8 hätten erfolgen müssen. Es wird daher angenommen, dass die Art im Bereich des geplanten Windparks tatsächlich nur selten auftritt. Wahrscheinlich ist das Kollisionsrisiko größer als Null, d.h. höher als in Tab. 11-13 berechnet, jedoch mit ziemlicher Sicherheit nicht höher als beim Wanderfalken.

Due to the planned habitat improvement (see chapter 6.3) one can expect that the range use of the relevant species (especially the Hen Harrier and the Merlin) will increase in the areas where these measures have been implemented, and in turn decrease in the area of the planned wind park. Thus, the collision calculation based on the data before the construction of the plants gives a worst-case scenario, which presumably will never become reality.

Bei allen fünf Secondary species können Kollisionsopfer nicht ausgeschlossen werden, da sie in Rotorhöhe nachgewiesen wurden (siehe Karte 5 bis 8). Dies betrifft insbesondere die Arten Mäusebussard und Turmfalke, die bereits als Kollisionsopfer bei Windanlagen nachgewiesen worden sind. Betrachtet man allerdings die Nutzungsschwerpunkte durch Mäusebussard und Turmfalke und deren Populationsgröße sowie den geringen Flächenanteil des Windparks am Untersuchungsgebiet, so ist auch hier der Einfluss des Kollisionsrisikos zu vernachlässigen.

# 8 Impact assessment of the Muirkirk & Lowther Uplands SPA

## 8.1 Legal and ecological basis

The planned wind park is located on the border of the Natura 2000 area "Muirkirk & Lower Uplands SPA" (special protection area), dedicated according to the directive 79/409/EEC (bird directive).

Article 6 of the directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (habitat directive), requires to examine the compatibility of projects with the conservation objectives of an area of communal significance (according to habitat directive) or of an SPA (according to bird directive), before they are permitted or executed. In combination the two area types make up the coherent European ecological network "Natura 2000".

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."

The integrity of the site involves its ecological functions. The decision whether it is adversely affected should focus on and be limited to the site's conservation objectives (EC Guidance on Managing Natura 2000 sites). The integrity of a site is the coherence of its ecological structure and function, across its whole area, which enables it to sustain the habitat, complex of habitats and/or the levels of the populations of the species for which it was classified (http://www.scotland.gov.uk/library3/nature/habd-14.asp).

In a verdict of September 2004, the European Court of Justice specified the definition of the relevance of impairments in the sense of article 6 paragraph 3 of the FFH directive ("Herzmuschel-ruling" legal case C-127/02). This states, that a project can significantly impair a Natura 2000 area if it threatens to endanger the conservation objectives set out for this area. Before the licence is granted, all aspects which, by themselves or in combination with other plans or projects, could impair the conservation objectives set out for this area must be determined under consideration of the best relevant scientific knowledge. The competent authorities may only licence a project, if they have reached certainty that it will not have negative effects on the area as such. This is the case, when from a scientific point of view there is no doubt that there are no such effects.

From this it follows that a project can significantly impair a Natura-2000 area if it threatens to endanger conservation objectives set out for the area concerned. Here one must particularly take the principle of provision into account, which is one of the foundations of the policy of a high protection level, which the EU pursues in the area of the environment, and in the light of which the FFH-directives are to be interpreted according to the European Court of Justice.

The evaluation of the relevance of possible impairments as a measure for the compatibility of a project can thus only lead to a positive result if there is a high level of certainty that impairments are really only to be expected to a very minor extent or not at all.

## 8.2 Characterisation of the Natura 2000 area concerned and inference of the relevant conservation objectives and evaluation standards

### Brief description

Muirkirk and North Lowther Uplands SPA (~ 26.300 ha) is located in southwest Scotland. It comprises three adjacent upland areas (situated to the north and south of the town Muirkirk, and the northern Lowther Hills), together with Airds Moss, a low-lying blanket bog situated between the two upland areas of north and south Muirkirk. The predominant habitats include semi-natural areas of blanket bog, acid grassland and heath. There are a range of blanket bog and wet heath types found within the site, influenced by a variety of land management practices and other impacts, including drainage, grazing or heather burning (or a combination of these factors). Stock grazing and moorland management for Red Grouse *Lagopus lagopus scoticus* are the two main current land uses. Large areas of the uplands (totalling about 80% of the area) are managed for grouse shooting, but the type and frequency of moorland management is variable in different areas. This, and patterns of agricultural management, create a diverse mix of upland habitats. Muirkirk and North Lowther Uplands is of special nature conservation importance within Britain and Europe for its outstanding breeding assemblage of upland birds. The site regularly supports populations of European importance of five Annex I species: Hen Harrier *Circus cyaneus* (a species also present in winter), Short-eared Owl *Asio flammeus*, Merlin *Falco columbarius*, Peregrine Falcon *Falco peregrinus* and Golden Plover *Pluvialis apricaria*.

Breeding raptors and Golden Plover are potentially vulnerable to disturbance from agricultural practices, game management and recreational activities (including walking and bird watching) on the site. Potential threats to the moorland include degradation, loss of heather and peat erosion through inappropriate muirburn, overgrazing, public/vehicular access and the spread of bracken.

The SPA was wholly notified as SSSI because of its populations of breeding and wintering Hen Harriers, breeding population of Short-eared Owl, wider assemblage of moorland breeding birds and important upland and blanket bog habitats.

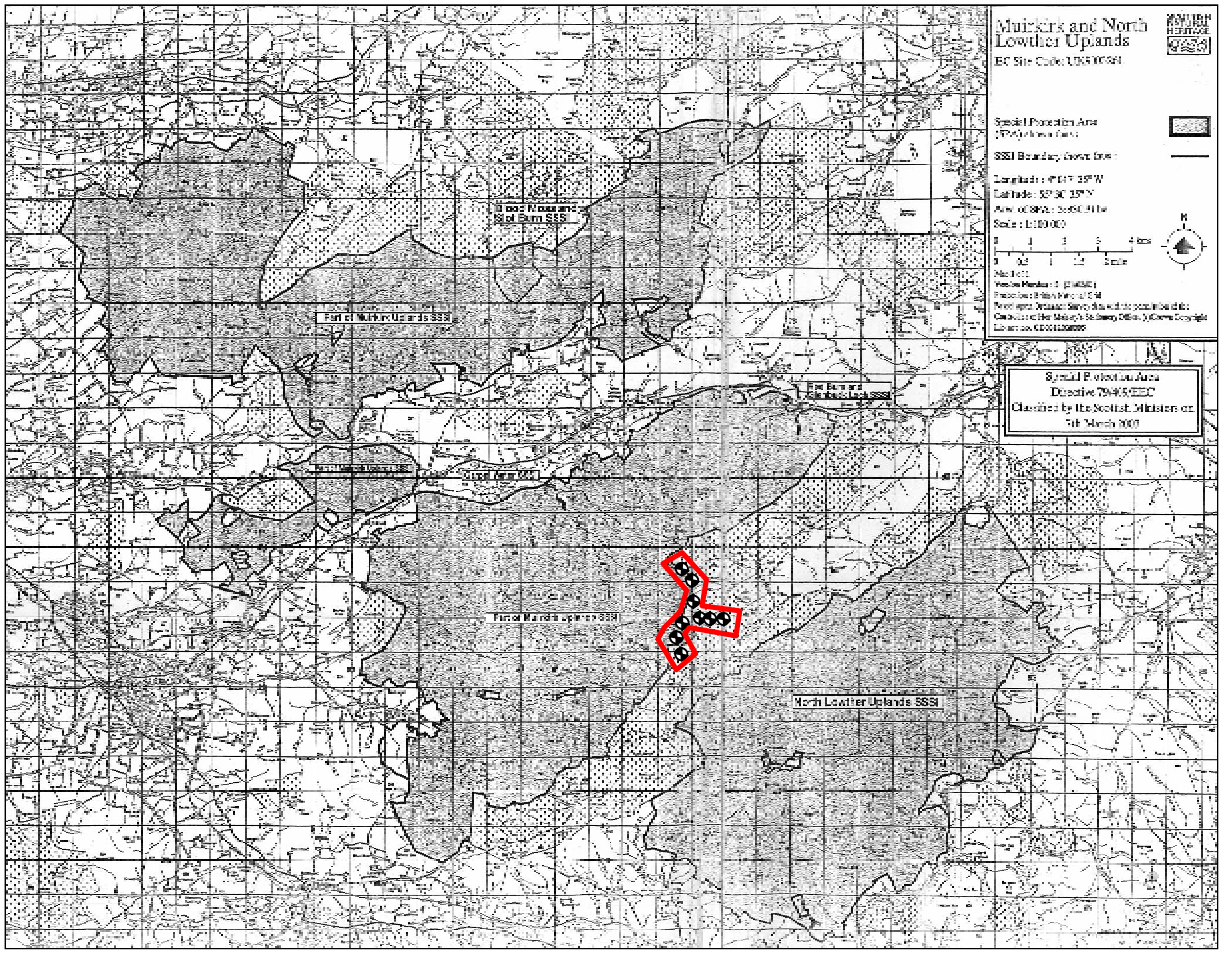



**Fig. 27: Map of the Special Protection Area "Muikirk and North Lowther Uplands" and location of the project.**

## Conservation objectives and standards of testing

In the following the conservation objectives as stated by SNH are given in their precise wording:

Species Conservation Objective: To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained.

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species
- No significant disturbance of the species

## Qualifying species:

**Hen Harrier**

- For which the area qualifies under Article 4.1 by supporting a nationally important breeding population of the Annex 1 species (29 breeding females, 6% of the GB population). The area also qualifies for hen harrier under Article 4.1 by supporting a nationally important wintering population of the Annex 1 species (12 individuals, 2% of the GB population).

**Short-eared Owl**

- For which the area qualifies under Article 4.1 by supporting a nationally important breeding population of the Annex 1 species (26 pairs, 3% of the GB population).

**Merlin**

- For which the area qualifies under Article 4.1 by supporting an important breeding population of the Annex 1 species (9 pairs, 0.7% of the GB population).

**Peregrine**

- For which the area qualifies under Article 4.1 by supporting an important breeding population of the Annex 1 species (6 pairs, 0.5% of the GB population).

**Golden Plover**

- For which the area qualifies under Article 4.1 by supporting an important breeding population of the Annex 1 species (minimum of 145 pairs, 0.7% of the GB population).

**Selection Rationale**

Hen Harriers and Short-eared Owl are Annex 1 species and qualify on Muirkirk and North Lowther Uplands under article 4.1 of the Birds Directive (79/409/EEC) as they breed on the site in nationally important numbers. The populations of these species on Muirkirk and North Lowther Uplands are considered to be of national importance as they hold greater than 1% of the Great Britain population during the breeding season.

Merlin, Peregrine and Golden Plover are Annex 1 species and qualify on Muirkirk and North Lowther Uplands under article 4.1 of the Birds Directive (79/409/EEC). The selection of sites with greater than 1% of the Great Britain population does not identify an adequate suite of most suitable sites for the conservation of these species. Therefore Muirkirk and North Lowther Uplands has been identified as some of the most suitable sites for these species even though their populations fall below 1% of the Great Britain population during the breeding season.

Hen Harrier are Annex 1 species and also qualify on Muirkirk and North Lowther Uplands under article 4.1 of the Birds Directive (79/409/EEC) as they winter on the site in nationally important numbers. The populations of these species on Muirkirk and North Lowther Uplands are considered to be of national importance as they hold greater than 1% of the Great Britain population during winter.

**Tab. 14: Ecological requirements of qualifying interests of the SPA**

| Species | Resource | Ecological requirements | Examples of potential risks |
|---|---|---|---|
| **Hen harrier** | Breeding sites | Tall heather (to lesser extent scrub, young forestry and rush) | Increase grazing pressure, inappropriate muirburn and loss of moorland habitat (e.g. through afforestation, development). Cessation of moorland management |
| | | Disturbance free | Recreational activities, commercial development. |
| | Food supply | Prey availability, especially meadow pipits, voles and red grouse and the habitat on which they rely. | Conversion of moorland to improved grassland. Lack of appropriate moorland management, resulting in uniform deep heather habitat. Loss of moorland habitat (e.g. through afforestation, development). |
| | Roost site | Disturbance free | Recreational activities, commercial development. |
| | | Roosting habitat | Habitat change at roost sites. |
| | Additional risks | | Death of birds due to collision with wind turbines. |
| **Merlin** | Breeding site | Tall heather and old nests of other species in trees. | Tree felling. Increase grazing pressure, inappropriate muirburn and loss of moorland habitat (e.g. through afforestation, development).<br>Cessation of moorland management |
| | | Disturbance free | Recreational activities, commercial development. |
| | Food supply | Maintenance of numbers of passerines (especially meadow pipits) and the habitat on which they rely. | Conversion of moorland to improved grassland. Lack of appropriate moorland management, resulting in uniform deep heather habitat. Loss of moorland habitat (e.g. through afforestation, development). |
| **Peregrine** | Breeding site | Quarries, crags or cliffs. | Mineral exploitation. |
| | | Disturbance free | Increased human presence near nest sites, e.g. by rock climbers. |
| | Food Supply | Birds species (such as pigeons, starling, crow, thrushes, waders, auks, gulls, terns, duck and grouse) and the habitat on which they rely. | In a moorland environment issues that may affect prey numbers are: conversion of moorland to improved grassland, lack of appropriate moorland management resulting in uniform deep heather habitat and loss of moorland habitat (e.g. through afforestation, development). |
| **Golden plover** | Breeding sites | Short or tussocky vegetation. | Changes in grazing pressure and loss of moorland habitat (e.g. through afforestation, grassland improvement, development). |
| | | Disturbance free. | Recreational activities, commercial development. |

| Species | Resource | Ecological requirements | Examples of potential risks |
|---|---|---|---|
| | Food supply | Beetles and earthworms and the habitat on which they rely. Marginal or low-intensity agricultural pastures are of importance for supplementary feeding during summer. | Loss and intensification of agricultural pasture in proximity to breeding habitat. |
| **Short-eared owl** | Breeding sites | Vegetation cover (e.g. grass, reeds, heather). | Increase grazing pressure, inappropriate muirburn and loss of moorland habitat (e.g. through afforestation, grassland improvement, developments).<br>Cessation of moorland management |
| | | Disturbance free | Recreational activities, commercial development. |
| | Food supply | Voles abundance & distribution. | Lack of appropriate moorland management, resulting in uniform deep heather habitat. Loss of moorland habitat (e.g. through afforestation, conversion of moorland to improved grassland). |

## 8.3 Subsuming stock informations

Für die fünf Target species liegen folgende Informationen vor:

Die Kornweihe brütet seit 2004 mit nur einem Paar im Tal zwischen Cairn Table und Stony Hill. In früheren Jahren brüteten dort bis zu drei Paare. 2001 brütete auch ein Paar nördlich von Stony Hill.

Aus dem gleichen Bereich ist auch seit mehreren Jahren das Vorkommen von einem Merlinpaar bekannt. Dieses Vorkommen wurde auch 2005 und 2006 von uns bestätigt.

Auf Connor Craig, 2 km südwestlich des geplanten Windparks, brütet seit mind. 2002 regelmäßig 1 Paar des Wanderfalken.

Sumpfohreulen brüten unregelmäßig im Westen des geplanten Windparks. 2004 wurden dort 4 Paare festgestellt. 2005 und 2006 fehlte diese Art als Brutvogel im Gebiet.

Die häufigste target species ist der Goldregenpfeifer. Im Bereich des Untersuchungsraumes um die geplanten Anlagen brüteten 1999 15 Paare, 2005 und 2006 jeweils 10 Paare, die sich vor allem auf Cairn table und Little Cairn Table konzentrierten (1999: 7 Paare, 2005/2006 ca. 6 Paare). Das zweite Bestandszentrum liegt ca. 2-3 km vom Windpark (1999: 6 Paare, 2005/2006: ca. 3 Paare). 1999 und 2006 brütete außerdem ein Paar auf Stony Hill.

Unsere Raumaktivitätsuntersuchungen haben deutlich gezeigt, dass die Hauptaktivitäten der fünf target secies außerhalb des geplanten Windparks liegen.

Für weitere Ergebnisse wird auf Kap. 4 verwiesen.

## 8.4 Impairments to be expected through the planned wind park

Entsprechend der Ausführungen in Kap. 7 ergeben sich zusammenfassend folgende Aussagen (Tab. 15):

**Tab. 15: Overview of the impairments to be expected to the five qualifying species**

| Species | Type of possible impact | | |
|---|---|---|---|
| | Collision mortality | Displacement / disturbance | Direct habitat loss |
| **Hen Harrier** | extremely low | not expected | extremely low |
| **Short-eared Owl** | none | not expected | extremely low |
| **Merlin** | extremely low | not expected | extremely low |
| **Peregrine** | extremely low | not expected | extremely low |
| **Golden Plover** | none | not expected | extremely low |

## 8.5 Evaluation of the compatibility

A project can significantly impair a Natura 2000 area if it threatens to endanger the conservation objectives set out for this area (European Court of Justice, legal case C-127/02). The reaching of the relevance always depends on the kind, duration, range and intensity of an effect, in combination with the specific sensitivities of the set area-specific conservation objectives and the relevant structures and functions of each case.

The crucial question to be answered by the assessment is:

*Can it be ascertained in light of the conservation objectives that the proposal will not adversely affect the integrity of the site?*

Thus it is to be examined, whether the possible impairments stemming from the wind park – collision mortality, indirect habitat loss by displacement and direct habitat loss through construction of the wind farm – have an influence on the five mentioned species, which lead to a significant reduction of the habitat and/or the breeding stock.

In the following, each conservation objective will be discussed separately on the basis of the impairment to be expected, as set out in the previous chapter, to clarify whether a significant impairment in the sense of the habitat directive exists.

*Ensure for the qualifying species that there is no significant disturbance of the species*

Entsprechend den Ausführungen in Kapitel 7.2 kommt es zu keiner significant disturbance of the qualifying species durch den geplanten Windpark.

*Ensure for the qualifying species that the population of the species is maintained as a viable component of the site.*

Weder aus den Prognosen zur Störung, zur Vertreibung oder zum Habitatverlust noch aus der Kollisionsberechnung lässt sich eine Beeinträchtigung der Populationen durch den geplanten Windpark ableiten.

*Ensure for the qualifying species that the structure, function and supporting process of habitats supporting the species are maintained in the long term*

Der von dem Windpark betroffene Bereich weist nur eine geringe Lebensraumfunktion für die qualifying species auf. Im Zuge der mitigation measures wird eine Habitatverbesserung (Kap. 6.3) durchgeführt, die auch für die Laufzeit des Windparks aufrechterhalten wird (habitat management). Damit ist für das Gesamtgebiet eine Aufwertung festzustellen.

*Ensure for the qualifying species that the distribution and extent of habitat supporting the species are maintained in the long term*

Die Habitatverbesserungen werden in Bereichen durchgeführt, in denen sich das Nahrungshabitat für die qualifying species in den letzten Jahren u.a. durch Nutzungsaufgabe verschlechtert hat. Damit wird mit dem Bau des Windparks eine insgesamt größere Fläche geeigneten Habitats zur Verfügung stehen.

*Ensure for the qualifying species that the distribution of the species within the site is maintained in the long term*

Die Verbreitung der qualifying species ist nach den Ergebnissen dieser Studie nicht beeinträchtigt.

Fazit:

Die zweijährigen Untersuchungen haben gezeigt, dass der Bereich des geplanten Windparks von den qualifying species nicht bzw. nur sehr selten genutzt wird. Die Neststandorte von Kornweihe, Wanderfalke und Merlin lagen in beiden Jahren in Abständen zwischen 1300 m (Merlin) und 2000 m (Kornweihe und Wanderfalke). Die Flugbeobachtungen machen deutlich, dass die geplanten Windenergiestandorte nur sehr selten zur Nahrungssuche genutzt wurden. Flugbewegungen in Rotorhöhe fanden nur in wenigen Einzelfällen statt, so dass die Kollisionsberechnung keine Verluste während der anzunehmenden Laufzeit des Windparks von 25 Jahren vorhersagt. Nicht zuletzt durch die Reduzierung der Anzahl der Windenergieanlagen sowie durch die Verschiebung der Standorte der verbleibenden neun Anlagen werden mögliche Beeinträchtigungen weiter reduziert. So liegen nun auch die Reviere des Goldregenpfeifers in einem ausreichenden Abstand zum geplanten Windpark.

Die geplanten Maßnahmen im Rahmen des habitat managements wirken den in Tab. 14 genannten potenziellen Risiken entgegen, denen die qualifying species ausgesetzt sind. Darin ist für alle Arten der loss of moorland habitat und lack of appropriate moorland management besonders betont. Hier setzt das geplante habitat management an. Die vorgesehenen mitigation measures (habitat management) führen somit insgesamt zu einer Verbesserung des Lebensraums für die qualifying species, insbesondere angesichts der nur geringen zu erwartenden Beeinträchtigungen durch den geplanten Windpark.

Zusammenfassend lässt sich damit aussagen, dass die Erhaltungsziele des SPA von dem geplanten Windpark nicht erheblich beeinträchtigt werden.

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# 10 Maps


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|---|---|
| Map 1 | Flight Observations of Hen Harrier |
| Map 2 | Flight Observations of Peregrine Falcon |
| Map 3 | Flight Observations of Merlin and Short-eared Owl |
| Map 4 | Flight Observations of Golden Plover |
| Map 5 | Flight Observations of Common Buzzard |
| Map 6 | Flight Observations of Common Kestrel |
| Map 7 | Flight Observations of Sparrow Hawk and Goshawk |
| Map 8 | Flight Observations of Common Raven and Curlew |
| Map 9 | |
| Map 10 | Concentration of Heather |

# 11 Appendix

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|---|---|
| Appendix 1 | Qualification of the used observers |
| Appendix 2 | Table including times of observation, observer and weather |
| Appendix 3 | Records (Target, Secondary, Disturbance) including examples |
| Appendix 4 | Records (wood species) including example |
| Appendix 5 | Panorama pictures of the points |
| Appendix 6 | Penbreck Windfarm Proposal. Moorland Report: Past Management, Future Enhancement. |

## Appendix 1: Qualification of the used observers

**Dr. Klaus Handke** (born 16.02.1958, abbr. K.H.) university study of biogeography and landscape ecology in Saarbrücken and Münster, graduated landscape ecologist since 1993, habilitated at the University of Natural Resources and Applied Life Sciences in Vienna since 2000, independent consultant and owner of an office since 1985, active as an ornithologist since 1972, over 117 publications, member of the German Ornithological Society, BUND and WWF, spokesman of the Bremen nature conservancy advisory council.

**Dr. Marc Reichenbach** (born 05.06.1964, abbr. M.R.) managing director of ARSU Gmbh, university study of biology and ecology, PhD thesis on the impact of windfarms on birds at the Technical University of Berlin, consultancy work on windfarms since 15 years (more than 100 projects with focus on birds and bats), active as an ornithologist since the age of 12, special focus and observation training on birds of prey (approved falconer and part-time activity as a cameraman for nature documentaries)

**Dipl. Geogr. Pia Handke** (born 02.08.1960, abbr. P.H.), university study of biogeography and landscape ecology in Saarbrücken and Münster, co-worker in the office of Dr. Handke since 1985 and active as an ornithological consultant since 1980, amongst other things in 60 wind park projects.

**Dipl Biol. Julia Adena** (born 17.02.1971, abbr. J.A.) university study of biology in Bremen, since 1999 freelance-, and since 2001 full time employee of the office of Dr. Handke and active as an ornithological consultant since 1999, amongst other things in 25 wind park projects.

**Dipl. Geogr. Karin Menke** (geb. 03.03.1964, abbr. K.M.), Studium der Landschaftsökologie in Münster, von 1994 bis 2000 Mitarbeiterin im Büro von Dr. Handke, seit 2000 als selbstständige Gutachterin tätig, Mitarbeit u.a. in zahlreichen Windparkprojekten

**Dipl. Landschaftsökol. Hanjo Steinborn** (born 31.03.1976, abbr. H.S.) university study of landscape ecology in Oldenburg, since 2003 active as an ornithological consultant for the ARSU GmbH, experience with upland birds from over 20 journeys in the Scandinavian highlands, 4 week internship at BirdWatch Ireland.

**Dipl.-Ing. Landschaftsarchitektur (FH) Kerstin Windelberg** (born 17.10.1978, abbr. K.W.) Studium der Landschaftsarchitektur mit Schwerpunkt Landschaftsplanung in Erfurt, seit 2004 für die ARSU GmbH tätig, u.a. Mitarbeit bei mehr als 25 Windparkprojekten. Seit 1990 zahlreiche vogelkundliche Exkursionen in USA, Saudi-Arabien, Syrien und Skandinavien.

**Frank Sinning** (born 08.01.1965, abbr. F.S.) Studium der Biologie sowie Stadt- und Regionalplanung in Oldenburg. Seit 1989 ornithologisch tätig, seit 1991 freischaffend-selbständig mit eigenem Gutachter- und Planungsbüro. Über 300 Projekte mit Vogelkartierungen für Planung und Naturschutz. Mitglied im Bund deutscher Biologen, NABU und der Ornitholgischen Arbeitsgemeinschaft Oldenburg.

**Martin Sprötge** (born 04.07.1962, abbr. M.S.) Freischaffender Landschaftsarchitekt, Studium der Landschafts- und Freiraumplanung an der TU Berlin, Diplomarbeit am Institut für Ökologie - Ökosystemanalyse und Vegetationskunde (1989), Seit 1985 als selbständiger Gutachter ornithologisch tätig, ab 1990 Firmenzugehörigkeit bei der planungsgruppe grün, ab 2000 als Inhaber und Geschäftsführer, 14 Veröffentlichungen, Mitglied der Niedersächsischen Orn. Vereinigung NOV und des BUND.

# Appendix 2: Table including times of observation, observer and weather

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| VP 1 (breeding season 05: 80 hours, non-breeding season: 41,25 hours, breeding season 06: 80,75 hours) | | | | | | | | | | |
| 05/04/2005 | Hanjo Steinborn | 9:50 | 17:15 | 6:55 | 0:30 | 4 | SW | 3-5 | heavily cloudy | rain shower |
| 06/04/2005 | Frank Sinning | 10:40 | 17:50 | 6:00 | 1:10 | 3-5 | SW | 4-8 | dull | snow- and hail shower |
| 07/04/2005 | Julia Adena | 10:55 | 18:20 | 5:40 | 1:45 | 2-3 | W | 4-6 | heavily cloudy | hail- and snowrain shower |
| 10/04/2005 | Martin Sprötge | 10:35 | 18:15 | 7:20 | 0:20 | 10-12 | SW | 5-6 | cloudy | |
| 11/04/2005 | Frank Sinning | 8:50 | 17:30 | 7:45 | 0:55 | 7-8 | SW | 5-7 | cloudy | |
| 03/05/2005 | Klaus Handke | 11:45 | 18:00 | 6:15 | | 12 | S-SW | 2 | cloudy | rain shower |
| 29/05/2005 | Pia Handke | 13:00 | 18:45 | 5:45 | | 8 | W | 3-4 | cloudy | |
| 14/06/2005 | Karin Menke | 9:45 | 18:30 | 7:45 | 1:00 | 13-15 | W | 3-6 | dull | rain |
| 15/06/2005 | Kerstin Windelberg | 14:00 | 18:35 | 4:35 | | 13-16 | SE | 6-8 | sunny | |
| 16/06/2005 | Klaus Handke | 9:15 | 18:30 | 7:30 | 1:45 | 15-17 | S | 2-4 | dull | rain, fog |
| 29/06/2005 | Julia Adena | 8:40 | 19:55 | 9:45 | 1:30 | 17 | SE | 3-6 | dull | short rain shower |
| 19/07/2005 | Julia Adena | 10:45 | 16:00 | 4:45 | 0:30 | 12 | SW | 5-7 | partly cloudy | scattered rain shower |
| 05/08/2005 | Marc Reichenbach | 10:00 | 18:30 | 8:00 | 0:30 | 12 | NW | 2-3, 3-5(-6) | heavily cloudy | rain shower |
| 07/09/2005 | Karin Menke | 10:00 | 18:00 | 6:45 | 1:15 | 15 | W | 3-5 | dull | rain shower |
| 08/09/2005 | Hanjo Steinborn | 10:00 | 19:15 | 7:45 | 1:30 | 14 | SW | 1-2(-3) | heavily cloudy | |
| 04/10/2005 | Julia Adena | 8:20 | 18:05 | 7:45 | 2:00 | 9 | SW | 3-6 | dull | |
| 09/11/2005 | Kerstin Windelberg | 9:55 | 15:00 | 5:05 | | 2-5 | SW | 3-4 | partly cloudy | |
| 28/02/2006 | Karin Menke | 10:00 | 16:30 | 6:00 | 0:30 | -2 | NW | 5-8 | partly cloudy | |
| 18/04/2006 | Martin Sprötge | 13:30 | 18:45 | 4:15 | 1:00 | 6 | SW | 3-5 | partly cloudy | |
| 19/04/2006 | Karin Menke | 10:15 | 17:30 | 4:45 | 2:30 | 10 | W | 2-4 | cloudy | |
| 20/04/2006 | Marc Reichenbach | 10:30 | 19:00 | 7:30 | 1:00 | 9 | SE | 1-3 | dull | |
| 21/04/2006 | Hanjo Steinborn | 9:20 | 18:50 | 7:30 | 2:00 | 14 | NE | 0-2 | partly cloudy | |
| 22/04/2006 | Kerstin Windelberg | 9:30 | 18:30 | 7:00 | 2:00 | 10 | SW | 7-8 | cloudy | from 17:30 on rain |
| 16/05/2006 | Julia Adena | 10:15 | 17:45 | 5:30 | 2:00 | 17 | S | 1-3 | cloudy | from 14:00 on rain showers |
| 07/06/2006 | Klaus Handke | 9:15 | 19:30 | 8:30 | 1:45 | 12-18 | NW | 1-2, 2-4 | dull, later partly cloudy | |
| 08/06/2006 | Hanjo Steinborn | 9:15 | 19:30 | 8:15 | 2:00 | 21 | W | 1-3 | partly cloudy | |
| 09/06/2006 | Pia Handke | 9:50 | 19:10 | 8:20 | 1:00 | 20 | S | 1-4 | sunny | |
| 27/06/2006 | Kerstin Windelberg | 8:15 | 19:30 | 9:15 | 2:00 | 18 | W | 3 | cloudy | |
| 28/06/2006 | Hanjo Steinborn | 9:35 | 12:35 | 3:00 | | 14 | S | 3-5 | dull | |
| 29/06/2006 | Hanjo Steinborn | 9:00 | 17:00 | 7:00 | 1:00 | 15 | S | 4-6 | dull | rain |
| VP 2A (breeding season 05: 80,5 hours, non-breeding season: 43,5 hours, breeding season 06: 83,25 hours) | | | | | | | | | | |
| 05/04/2005 | Frank Sinning | 10:00 | 17:15 | 7:00 | 0:15 | 4 | SW | 3-4, 5-6 | heavily cloudy | |
| 06/04/2005 | Kerstin Windelberg | 11:00 | 17:30 | 6:30 | | 3-5 | SW | 4-5 | dull | snow-/rain-/hail shower, partly sunny |
| 07/04/2005 | Karin Menke | 12:45 | 18:30 | 5:15 | 0:30 | 2-3 | W | 6-7 | heavily cloudy | partly rain shower |
| 10/04/2005 | Klaus Handke | 10:20 | 18:50 | 8:00 | 0:30 | 10-12 | NW | 4-5 | cloudy | |
| 11/04/2005 | Hanjo Steinborn | 8:10 | 17:10 | 8:00 | 1:00 | 9 | SW | 3-6 | cloudy | |
| 03/05/2005 | Karin Menke | 12:30 | 17:45 | 3:00 | 2:15 | 15 | S-SW | 2-3 | cloudy | |
| 28/05/2005 | Pia Handke | 14:00 | 16:30 | 2:30 | | 8 | W | 7-9 | cloudy | rain, storm |
| 29/05/2005 | Klaus Handke | 12:15 | 17:30 | 5:00 | 0:15 | 8 | W | 3-5 | heavily cloudy | rain shower |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 14/06/2005 | Klaus Handke, Kerstin Windelberg | 10:00 | 19:15 | 8:45 | 0:30 | 13-15 | W | 1-2, 3-4 | dull | |
| 15/06/2005 | Karin Menke | 13:45 | 19:00 | 2:45 | 2:30 | 13-16 | S | 4-5 | cloudy | |
| 16/06/2005 | Hanjo Steinborn | 9:30 | 11:30 | 2:00 | | 15-17 | S | 0-2 | dull | rain |
| 29/06/2005 | Frank Sinning | 8:30 | 19:45 | 8:30 | 2:45 | 17 | W | 3 | cloudy | rain, from 16:45 on partly drizzle |
| 18/07/2005 | Julia Adena and Karin Menke | 15:30 | 19:45 | 4:00 | 0:15 | 16 | SW | 3-5 | partly cloudy | partly rain shower |
| 19/07/2005 | Karin Menke | 17:30 | 20:00 | 2:30 | | 14 | W | 6-7 | heavily cloudy | |
| 20/07/2005 | Julia Adena and Karin Menke | 9:00 | 17:15 | 6:45 | 1:30 | 10 | W | 5-6 | cloudy | |
| 05/08/2005 | Hanjo Steinborn | 9:30 | 19:45 | 8:30 | 1:45 | 12 | NW | 2-3, 3-5(-6) | heavily cloudy | rain shower |
| 07/09/2005 | Kerstin Windelberg, Hanjo Steinborn | 10:00 | 18:00 | 7:15 | 0:45 | 15 | SW | 1-3(-5) | dull | |
| 08/09/2005 | Klaus Handke | 9:30 | 19:00 | 8:30 | 1:00 | 20 | SW | 2-6 | heavily cloudy | |
| 04/10/2005 | Karin Menke,Kerstin Windelberg | 8:15 | 18:30 | 8:15 | 2:00 | 11 | SW | 3-4 | cloudy | |
| 09/11/2005 | Marc Reichenbach | 9:45 | 15:00 | 5:15 | | 2-5 | SW | 2-4 | partly cloudy | |
| 28/02/2006 | Julia Adena | 13:50 | 16:50 | 3:00 | | -2 | NW | 3-7 | partly cloudy | |
| 02/03/2006 | Karin Menke | 10:00 | 12:45 | 2:45 | | -3 | N | 0-2 | sunny | |
| 18/04/2006 | Karin Menke | 13:15 | 19:00 | 4:45 | 1:00 | 8 | WSW | 4-6 | partly cloudy | |
| 19/04/2006 | Kerstin Windelberg | 14:30 | 18:00 | 3:30 | | 10 | NW | 3-4 | cloudy | |
| 20/04/2006 | Hanjo Steinborn | 14:00 | 17:45 | 3:45 | | 8 | SE | 0-2 | dull | rain |
| 21/04/2006 | Pia Handke | 9:45 | 18:30 | 7:30 | 1:15 | 12 | NE | 0-2 | cloudy | high fog until 11:00 |
| 22/04/2006 | Julia Adena | 11:30 | 18:30 | 6:00 | 1:00 | 9 | SW | 5-7 | dull | rain |
| 25/04/2006 | Julia Adena | 16:00 | 20:30 | 4:30 | | 8 | SW | 4-6 | heavily cloudy | |
| 16/05/2006 | Klaus Handke | 9:45 | 18:45 | 8:00 | 1:00 | 17 | S | 2-5 | dull | 1 rain shower |
| 18/05/2006 | Marc Reichenbach | 10:00 | 17:30 | 7:00 | 0:30 | 9 | | 5-7 | cloudy | partly rain shower |
| 07/06/2006 | Hanjo Steinborn | 9:00 | 20:00 | 9:00 | 2:00 | 17 | NW | 0-2 | dull, later partly cloudy | |
| 09/06/2006 | Kerstin Windelberg | 9:45 | 19:15 | 8:30 | 1:00 | 20-25 | SE | 3-4 | sunny | |
| 27/06/2006 | Hanjo Steinborn | 13:45 | 19:45 | 5:30 | 0:30 | 18 | W | 0-2 | cloudy, later partly cloudy | |
| 28/06/2006 | Kerstin Windelberg | 9:15 | 11:00 | 1:45 | | 14 | S | 2-4 | dull | |
| 28/06/2006 | Hanjo Steinborn | 13:00 | 18:00 | 4:00 | 1:00 | 14-16 | S | 2-4 | dull | |
| 29/06/2006 | Julia Adena | 8:10 | 16:10 | 7:00 | 1:00 | 15 | S | 4-5 | dull | rain |
| 19/07/2006 | Julia Adena | 10:25 | 12:55 | 2:30 | | 30 | SW | 2-5 | sunny | |
| VP 2B (breeding season 05: 80,75 hours, non-breeding season: 43,5 hours, breeding season 06: 80,25 hours) | | | | | | | | | | |
| 05/04/2005 | Marc Reichenbach | 10:00 | 17:15 | 7:00 | 0:15 | 4 | SW | 3-4 | heavily cloudy | |
| 06/04/2005 | Hanjo Steinborn | 11:00 | 16:45 | 5:00 | 0:45 | 3-5 | SW | 4-6(-8) | dull | snow-/rain-/hail shower |
| 07/04/2005 | Martin Sprötge | 12:35 | 18:30 | 5:00 | 0:55 | 2-3 | W | 6-7 | heavily cloudy | hail- and snowrain shower |
| 10/04/2005 | Julia Adena | 10:30 | 18:45 | 7:30 | 0:45 | 10-12 | W-NW | 4-5 | cloudy | |
| 11/04/2005 | Kerstin Windelberg | 9:15 | 17:15 | 8:00 | | 9 | SW | 3-6 | cloudy | |
| 03/05/2005 | Karin Menke | 11:30 | 18:15 | 3:30 | 3:15 | 15 | S | 2-3 | cloudy | 15 min rain |
| 28/05/2005 | Pia Handke | 16:30 | 18:00 | 1:30 | | 9 | W | 7-10 | cloudy | rain, storm |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 29/05/2005 | Klaus Handke | 9:00 | 19:30 | 4:00 | 6:30 | 8 | W | 3-5 | heavily cloudy | |
| 14/06/2005 | Klaus Handke, Kerstin Windelberg | 10:00 | 19:15 | 8:45 | 0:30 | 13-15 | W | 1-2, 3-4 | dull | drizzle |
| 15/06/2005 | Karin Menke | 15:45 | 19:15 | 2:45 | 0:45 | 13-16 | S | 4 | cloudy | |
| 16/06/2005 | Hanjo Steinborn | 11:35 | 18:00 | 5:00 | 1:25 | 15-17 | S | 0-2 | dull | rain |
| 29/06/2005 | Hanjo Steinborn | 8:30 | 19:45 | 9:30 | 1:45 | 17 | SE | 0-3 | dull | rain shower |
| 18/07/2005 | Julia Adena and Karin Menke | 15:30 | 19:45 | 4:00 | 0:15 | 15 | SW | 3-5 | partly cloudy | partly rain shower |
| 19/07/2005 | Julia Adena | 17:30 | 20:00 | 2:30 | | 14 | W | 6-8 | heavily cloudy | |
| 20/07/2005 | Julia Adena and Karin Menke | 9:00 | 17:15 | 6:45 | 1:30 | 10 | W | 5-6 | cloudy | |
| 06/08/2005 | Marc Reichenbach | 9:45 | 18:45 | 8:30 | 0:30 | 10-15 | NW | 1-4 | cloudy | |
| 07/09/2005 | Kerstin Windelberg, Hanjo Steinborn | 10:00 | 18:00 | 7:15 | 0:45 | 15 | SW | 2-5 | dull | |
| 08/09/2005 | Karin Menke, Klaus Handke | 9:30 | 19:00 | 8:30 | 1:00 | 16 | SW | 2-6 | heavily cloudy | |
| 04/10/2005 | Karin Menke,Kerstin Windelberg | 8:15 | 18:30 | 8:15 | 2:00 | 9 | SW | 3-4 | cloudy | |
| 09/11/2005 | Hanjo Steinborn | 9:45 | 15:00 | 5:15 | | 2-5 | SW | 2-4 | partly cloudy | |
| 28/02/2006 | Julia Adena | 9:50 | 12:50 | 3:00 | | -2 | NW | 3-7 | partly cloudy | |
| 02/03/2006 | Karin Menke | 13:15 | 16:00 | 2:45 | | -3 | N | 0-2 | sunny | |
| 18/04/2006 | Pia Handke | 13:15 | 19:00 | 4:45 | 1:00 | 8 | W | 4-5 | partly cloudy | |
| 19/04/2006 | Kerstin Windelberg | 10:00 | 12:00 | 2:00 | | 10 | NW | 1-2 | cloudy | |
| 20/04/2006 | Hanjo Steinborn | 10:00 | 13:45 | 3:45 | | 8 | SE | 0-2 | dull | rain |
| 21/04/2006 | Klaus Handke | 9:45 | 18:30 | 7:30 | 1:15 | 12 | NE | 1-3 | heavily cloudy | |
| 22/04/2006 | Karin Menke | 10:15 | 19:00 | 6:45 | 2:00 | 9 | S | 5-7 | cloudy | from 18:00 on rain |
| 25/04/2006 | Julia Adena | 11:00 | 16:00 | 4:00 | 1:00 | 8 | SW | 4-6 | heavily cloudy | |
| 16/05/2006 | Hanjo Steinborn | 9:45 | 18:45 | 8:00 | 1:00 | 19-15 | S | 1-2, 3-4 | heavily cloudy | 1 rain shower |
| 18/05/2006 | Julia Adena | 14:15 | 17:15 | 3:00 | | 9 | S | 5-6 | cloudy | rain |
| 07/06/2006 | Kerstin Windelberg | 9:00 | 20:00 | 9:00 | 2:00 | 17 | NW | 0-2 | dull, later partly cloudy | |
| 09/06/2006 | Klaus Handke | 9:45 | 19:15 | 8:30 | 1:00 | 27 | | 2-3 | sunny | |
| 27/06/2006 | Hanjo Steinborn | 9:00 | 13:00 | 4:00 | | 14-18 | S, W | 0-2 | cloudy | |
| 28/06/2006 | Kerstin Windelberg | 11:00 | 18:00 | 6:00 | 1:00 | 14 | S | 2-4 | dull | |
| 29/06/2006 | Karin Menke | 8:00 | 16:15 | 7:15 | 1:00 | 15 | S | 4-5 | dull | rain |
| 19/07/2006 | Marc Reichenbach | 10:15 | 16:30 | 5:45 | 0:30 | 26 | SE | 0-4 | sunny | |
| VP 3 (breeding season 05: 60 hours, non-breeding season: 41,5 hours, breeding season 06: 40 hours) | | | | | | | | | | |
| 05/04/2005 | Kerstin Windelberg | 10:00 | 17:00 | 7:00 | | 4 | SW | 3-4 | heavily cloudy | |
| 06/04/2005 | Marc Reichenbach | 11:15 | 17:30 | 5:00 | 1:15 | 3-5 | SW | 4-7(-8) | dull | snow-/rain-/hail shower |
| 07/04/2005 | Klaus Handke | 10:30 | 18:30 | 7:00 | 1:00 | 2-3 | W | 4-8 | heavily cloudy | hail- and snowrain shower |
| 10/04/2005 | Karin Menke | 9:50 | 17:20 | 7:30 | | 12 | NW | 3-4 | cloudy | |
| 11/04/2005 | Marc Reichenbach | 9:15 | 17:15 | 7:45 | 0:15 | 9 | W | 4-5 | cloudy | |
| 03/05/2005 | Julia Adena | 12:00 | 18:00 | 5:30 | 0:30 | 14 | SW | 3-4 | cloudy | heavily rain shower |
| 14/06/2005 | Hanjo | 10:45 | 18:45 | 6:30 | 1:30 | 13-15 | W | 1-4 | dull | rain |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| | Steinborn | | | | | | | | | |
| 29/06/2005 | Klaus Handke | 9:00 | 19:15 | 9:15 | 1:00 | 17 | SE | 4-5 | dull | drizzle |
| 19/07/2005 | Karin Menke | 11:30 | 16:30 | 4:30 | 0:30 | 16 | NW | 5-6 | heavily cloudy | rain shower |
| 06/08/2005 | Hanjo Steinborn | 9:00 | 19:00 | 8:15 | 1:45 | 10-15 | NW | 1-4 | cloudy | |
| 07/09/2005 | Klaus Handke | 10:30 | 18:00 | 6:45 | 0:45 | 15 | SW | 2-4 | dull | |
| 08/09/2005 | Kerstin Windelberg | 9:30 | 19:15 | 8:00 | 1:45 | 16 | SW | 2-4 | heavily cloudy | |
| 04/10/2005 | Hanjo Steinborn | 8:15 | 18:15 | 8:00 | 2:00 | 9 | SW | 2-3 | dull | |
| 09/11/2005 | Julia Adena | 10:05 | 14:35 | 4:30 | | 2-5 | SW | 3-4 | partly cloudy | |
| 28/02/2006 | Klaus Handke | 10:00 | 16:30 | 6:00 | 0:30 | 0 | NW | 5-8 | cloudy | |
| 20/04/2006 | Pia Handke | 10:00 | 19:30 | 7:30 | 2:00 | 9 | SE | 0-2 | dull | rain until 16:00 |
| 22/04/2006 | Martin Sprötge | 9:45 | 18:15 | 7:30 | 1:00 | 9 | SW | 5-7 | cloudy | fog |
| 23/04/2006 | Hanjo Steinborn | 12:30 | 20:00 | 6:45 | 0:45 | 10-12 | W | 0-2 | cloudy, later sunny | |
| 18/05/2006 | Klaus Handke | 10:15 | 17:45 | 6:30 | 1:00 | 9 | | 6-7 | dull | drizzle |
| 27/06/2006 | Julia Adena | 8:15 | 19:15 | 9:00 | 2:00 | 15-20 | SW, W | 1-3, 4-5 | cloudy, later partly cloudy | |
| 29/06/2006 | Kerstin Windelberg | 13:00 | 15:45 | 2:45 | | 15 | SE | 4 | dull | rain |
| VP 4A (breeding season 05: 61,25 hours, non-breeding season: 45,75 hours, breeding season 06: 61 hours) | | | | | | | | | | |
| 04/04/2005 | Frank Sinning | 15:45 | 17:45 | 2:00 | | 5 | SW | 6-7 | heavily cloudy | snowrain shower |
| 06/04/2005 | Karin Menke | 14:30 | 19:00 | 3:30 | 1:00 | 3-5 | W | 5-6(-8) | dull | hail shower |
| 07/04/2005 | Marc Reichenbach | 10:30 | 18:45 | 7:15 | 1:00 | 2 | W-N | 3-6 | heavily cloudy | hail shower |
| 09/04/2005 | Klaus Handke | 11:15 | 14:00 | 1:00 | 1:45 | - | | 6-7 | heavily cloudy | |
| 02/05/2005 | Julia Adena | 14:10 | 19:10 | 4:30 | 0:30 | 14 | S | 3-4 | cloudy | |
| 03/05/2005 | Hanjo Steinborn | 11:10 | 15:50 | 3:00 | 1:40 | 14 | SSW-NW | 1-2 | heavily cloudy | |
| 26/05/2005 | Pia Handke | 7:45 | 19:45 | 8:15 | 3:45 | 8 | SW | 7-8 | sunny | |
| 29/05/2005 | Hanjo Steinborn | 8:00 | 20:30 | 10:00 | 2:30 | 8 | W | 7-9, 3-5 | heavily cloudy | rain shower |
| 13/06/2005 | Kerstin Windelberg | 14:45 | 19:30 | 4:45 | | 6-9 | NW | 4-5 | cloudy | |
| 28/06/2005 | Hanjo Steinborn | 13:00 | 21:00 | 7:00 | 1:00 | >20 | S | 0-2 | partly cloudy | |
| 30/06/2005 | Klaus Handke | 8:30 | 20:00 | 10:00 | 1:30 | 17 | SE | 2-5 | dull | rain shower |
| 05/08/2005 | Pia Handke | 9:30 | 19:45 | 9:00 | 1:15 | 12 | NW | 6-7 | heavily cloudy | rain shower |
| 06/09/2005 | Hanjo Steinborn | 15:00 | 20:00 | 4:45 | 0:15 | 17 | SW | 4-6 | partly cloudy | |
| 03/10/2005 | Kerstin Windelberg | 14:00 | 18:15 | 4:00 | 0:15 | 14 | SW | 3-4 | dull | |
| 05/10/2005 | Hanjo Steinborn | 8:15 | 16:45 | 7:30 | 1:00 | 10 | S | 2-3 | dull | |
| 07/11/2005 | Julia Adena | 14:30 | 16:30 | 2:00 | | 5 | SE | 5-7 | dull | |
| 08/11/2005 | Kerstin Windelberg | 13:30 | 16:00 | 2:30 | | 5 | S | 5 | dull | |
| 27/02/2006 | Klaus Handke | 14:00 | 17:15 | 3:15 | | 4 | NW | 6-7 | dull | rain |
| 01/03/2006 | Karin Menke and Julia Adena | 9:15 | 16:30 | 6:15 | 1:00 | -1 | NW | 2-4 | partly cloudy | |
| 02/03/2006 | Hanjo Steinborn | 9:45 | 13:00 | 3:15 | | -2 | N | 0-2 | sunny | |
| 02/03/2006 | Klaus Handke | 13:15 | 16:30 | 3:15 | | -2 | N | 0-2 | sunny | |
| 18/04/2006 | Marc Reichenbach | 13:45 | 19:15 | 5:00 | 0:30 | 5 | W | 4-6 | partly cloudy | |
| 19/04/2006 | Pia Handke | 9:15 | 19:45 | 9:30 | 1:00 | 9 | NW | 1-2, 4-5 | cloudy | rain |
| 20/04/2006 | Martin Sprötge | 10:00 | 13:00 | 3:00 | | 9 | SE | 2 | dull | rain |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 20/04/2006 | Martin Sprötge | 16:10 | 19:10 | 3:00 | | 9 | SE | 2 | dull | |
| 21/04/2006 | Kerstin Windelberg | 10:15 | 13:15 | 3:00 | | 12 | NE | 3-4 | cloudy | |
| 21/04/2006 | Kerstin Windelberg | 16:00 | 18:00 | 2:00 | | 12 | NE | 3-4 | cloudy | |
| 22/04/2006 | Hanjo Steinborn | 14:00 | 17:30 | 3:30 | | 9 | SW | 6-8 | cloudy | rain |
| 17/05/2006 | Hanjo Steinborn | 9:40 | 12:10 | 2:30 | | 14 | S | 3-7 | dull | |
| 17/05/2006 | Julia Adena | 12:10 | 19:10 | 6:00 | 1:00 | 14 | S | 3-7 | heavily cloudy | rain |
| 06/06/2006 | Klaus Handke | 13:00 | 20:30 | 6:45 | 0:45 | 20 | W | 4 | partly cloudy | |
| 26/06/2006 | Kerstin Windelberg | 16:15 | 20:15 | 4:00 | | 15 | NW | 2-4 | cloudy | |
| 28/06/2006 | Karin Menke | 8:00 | 19:15 | 8:45 | 2:30 | 14 | S | 2-4 | dull | |
| 19/07/2006 | Martin Sprötge | 9:50 | 14:20 | 4:00 | 0:30 | 28 | SE | 2 | sunny | |
| VP 4B (breeding season 05: 59,5 hours, non-breeding season: 45,75 hours, breeding season 06: 40 hours) | | | | | | | | | | |
| 04/04/2005 | Hanjo Steinborn | 15:45 | 17:45 | 2:00 | | 5 | SW | 5-6, 6-7 | heavily cloudy | snowrain shower |
| 06/04/2005 | Julia Adena | 17:30 | 19:00 | 1:30 | | 3-5 | W | 4-8 | dull | hail- and snowrain shower |
| 07/04/2005 | Kerstin Windelberg | 10:30 | 18:30 | 7:00 | 1:00 | 3 | NW | 3-7 | heavily cloudy | hail shower |
| 02/05/2005 | Klaus Handke | 13:50 | 19:20 | 5:30 | | 14 | S | 4 | dull | |
| 03/05/2005 | Hanjo Steinborn | 12:45 | 18:30 | 2:45 | 3:00 | 14 | SSW-NW | 1 | heavily cloudy | |
| 26/05/2005 | Klaus Handke | 7:45 | 19:30 | 8:30 | 3:15 | 8 | SW | 5-7 | sunny | |
| 29/05/2005 | Marc Reichenbach | 8:30 | 19:30 | 10:00 | 1:00 | 8 | SW | 4-5 | heavily cloudy | |
| 13/06/2005 | Karin Menke | 14:45 | 19:30 | 4:45 | | 6-9 | NW | 4-5 | cloudy | |
| 28/06/2005 | Frank Sinning | 13:00 | 21:00 | 7:00 | 1:00 | 20 | W | 0-3 | partly cloudy | |
| 30/06/2005 | Julia Adena | 8:25 | 20:25 | 10:30 | 1:30 | 17-20 | SE | 2-4 | dull | rain shower |
| 05/08/2005 | Klaus Handke | 9:30 | 19:45 | 9:00 | 1:15 | 12 | NW | 3-5 | heavily cloudy | rain shower |
| 06/09/2005 | Karin Menke | 15:00 | 20:00 | 4:45 | 0:15 | 17 | W | 4-5 | partly cloudy | sunny |
| 03/10/2005 | Julia Adena | 13:45 | 18:15 | 4:30 | | 14 | SW | 2-4 | dull | |
| 05/10/2005 | Kerstin Windelberg | 8:15 | 16:45 | 7:30 | 1:00 | 9 | S | 2-3 | dull | |
| 07/11/2005 | Marc Reichenbach | 14:30 | 16:30 | 2:00 | | 5 | S | 5-7 | dull | |
| 08/11/2005 | Hanjo Steinborn | 13:15 | 16:00 | 2:45 | | 6 | SW | 1-3 | dull | |
| 27/02/2006 | Hanjo Steinborn | 14:00 | 17:15 | 3:15 | | 4 | NW | 3-5 | dull | rain |
| 01/03/2006 | Karin Menke and Julia Adena | 9:30 | 16:30 | 6:00 | 1:00 | -1 | NW | 2-4 | partly cloudy | |
| 02/03/2006 | Klaus Handke | 9:45 | 13:00 | 2:45 | 0:30 | -3 | N | 0-2 | sunny | |
| 02/03/2006 | Hanjo Steinborn | 13:15 | 16:30 | 3:15 | | -3 | N | 0-2 | sunny | |
| 18/04/2006 | Klaus Handke | 13:30 | 19:30 | 5:30 | 0:30 | 5 | W | 6-7 | heavily cloudy | |
| 19/04/2006 | Hanjo Steinborn | 9:20 | 18:50 | 7:45 | 1:45 | 7-9 | W | 2-5 | partly cloudy | |
| 20/04/2006 | Martin Sprötge | 13:00 | 16:00 | 3:00 | | 9 | SE | 2 | dull | rain |
| 21/04/2006 | Kerstin Windelberg | 13:15 | 16:15 | 3:00 | | 10 | NE | 3-4 | cloudy | |
| 22/04/2006 | Hanjo Steinborn | 10:00 | 14:00 | 4:00 | | 9 | SW | 6-8 | dull | |
| 17/05/2006 | Hanjo Steinborn | 12:15 | 19:15 | 6:00 | 1:00 | 11 | S | 3-5 | dull | |
| 06/06/2006 | Pia Handke | 13:00 | 20:15 | 6:15 | 1:00 | 20 | W | 1-3 | sunny | |
| 26/06/2006 | Julia Adena | 16:15 | 20:15 | 4:00 | | 15 | NW | 2-4 | cloudy | |
| 28/06/2006 | Karin Menke | 11:00 | 11:30 | 0:30 | | 14 | S | 2-4 | dull | |
| VP 4C (breeding season 05: 41 hours, breeding season 06: 40 hours) | | | | | | | | | | |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 10/04/2005 | Kerstin Windelberg | 9:45 | 19:45 | 10:00 | | 10-12 | NW | 5-6 | cloudy | |
| 11/04/2005 | Martin Sprötge | 10:15 | 19:45 | 9:00 | 0:30 | 9 | SW | 3 | cloudy | |
| 02/05/2005 | Marc Reichenbach | 13:45 | 19:30 | 5:30 | 0:15 | 14 | S | 2-4 | dull | |
| 04/05/2005 | Kerstin Windelberg | 15:45 | 17:30 | 1:45 | | 14 | SE | 3-4 | heavily cloudy | |
| 28/06/2005 | Klaus Handke | 13:00 | 21:30 | 7:45 | 0:45 | 23 | S | 0-3 | partly cloudy | |
| 01/07/2005 | Hanjo Steinborn | 7:05 | 10:05 | 3:00 | | 15 | SW | 0-2 | heavily cloudy | |
| 20/07/2005 | Pia Handke | 10:00 | 14:30 | 4:00 | 0:30 | 10 | W | 3-4 | cloudy | |
| 19/04/2006 | Marc Reichenbach | 13:45 | 19:15 | 5:00 | 0:30 | 8-10 | NW | 2-4 | cloudy | |
| 20/04/2006 | Karin Menke | 8:30 | 20:30 | 10:00 | 2:00 | 9 | S | 2-4 | dull | rain |
| 21/04/2006 | Julia Adena | 8:40 | 19:25 | 8:45 | 2:00 | 12 | NE | 1-3 | partly cloudy | |
| 22/04/2006 | Pia Handke | 9:00 | 12:00 | 3:00 | | 9 | SW | 6-7 | dull | fog |
| 22/04/2006 | Klaus Handke | 13:00 | 18:00 | 4:30 | 0:30 | 9 | SW | 6-7 | dull | from 17:30 on rain |
| 24/04/2006 | Hanjo Steinborn | 16:30 | 18:30 | 2:00 | | 8 | S | 5-7 | dull | |
| 26/04/2006 | Julia Adena | 11:15 | 13:15 | 2:00 | | 13 | SW | 2-3 | cloudy | |
| 08/06/2006 | Klaus Handke | 10:00 | 12:45 | 2:45 | | 18-24 | W | 2-3 | partly cloudy | |
| 09/06/2006 | Hanjo Steinborn | 9:00 | 11:00 | 2:00 | | 26 | SW | 1-2 | sunny | |
| VP 5 (breeding season 05: 80,5 hours, non-breeding season: 45 hours, breeding season 06: 81 hours) | | | | | | | | | | |
| 04/04/2005 | Kerstin Windelberg | 15:30 | 17:30 | 2:00 | | 5 | SW | 6-7 | heavily cloudy | at the biginning hail (drizzle), later snow |
| 06/04/2005 | Martin Sprötge | 14:30 | 19:00 | 3:30 | 1:00 | 3-5 | W | 4-8 | dull | hail- and snowrain shower |
| 07/04/2005 | Frank Sinning | 10:15 | 18:15 | 8:00 | | 2 | W-N | 2-5 | heavily cloudy | hail, rain, snow |
| 09/04/2005 | Karin Menke | 11:45 | 13:45 | 2:00 | | - | | 6-7 | heavily cloudy | rain |
| 10/04/2005 | Marc Reichenbach | 10:30 | 19:30 | 8:45 | 0:15 | 10-12 | SW | 3-5 | cloudy | |
| 11/04/2005 | Klaus Handke | 9:30 | 19:15 | 8:30 | 1:15 | 12 | SW | 2-3 | cloudy | |
| 02/05/2005 | Hanjo Steinborn | 13:00 | 19:15 | 5:15 | 1:00 | 13 | S | 1-3 | heavily cloudy | 1 drizzle shower |
| 03/05/2005 | Kerstin Windelberg | 10:30 | 18:30 | 7:00 | 1:00 | 14 | SW | 2-4 | heavily cloudy | |
| 13/06/2005 | Hanjo Steinborn | 13:30 | 19:45 | 5:00 | 1:15 | 6-9 | NW | 1-4 | dull | |
| 15/06/2005 | Klaus Handke | 10:00 | 20:00 | 8:15 | 1:45 | 13-16 | E | 5-6 | cloudy | rain, fog |
| 16/06/2005 | Karin Menke | 7:45 | 18:15 | 8:30 | 2:00 | 15-17 | S, W | 0-3 | dull | rain, fog |
| 01/07/2005 | Julia Adena | 6:00 | 10:00 | 4:00 | | 15 | SW | 0-3 | heavily cloudy | light rain |
| 19/07/2005 | Pia Handke | 16:00 | 20:15 | 3:45 | 0:30 | 14 | W | 5 | heavily cloudy | rain shower |
| 20/07/2005 | Klaus Handke | 10:30 | 17:00 | 6:00 | 0:30 | 10 | W | 5-6 | heavily cloudy | |
| 04/08/2005 | Marc Reichenbach | 13:30 | 19:30 | 6:00 | | 15 | SW | 3-5,1-3 | dull | drizzle |
| 06/08/2005 | Klaus Handke | 9:15 | 19:40 | 9:00 | 1:25 | 15-17 | NW | 3-4 | cloudy | partly rain, sonnig |
| 06/09/2005 | Kerstin Windelberg | 15:00 | 19:30 | 4:30 | | 20 | SW | 3 | partly cloudy | sunny |
| 03/10/2005 | Karin Menke | 13:45 | 18:15 | 4:30 | | 14 | SW | 2-3 | dull | |
| 05/10/2005 | Julia Adena | 8:20 | 16:30 | 6:30 | 1:40 | 8-10 | SW | 1-3 | dull | |
| 07/11/2005 | Hanjo Steinborn | 14:30 | 16:30 | 2:00 | | 5 | S | 3-5 | dull | |
| 08/11/2005 | Marc Reichenbach | 13:00 | 16:00 | 3:00 | | 5 | SW | 1-2 | dull | |
| 27/02/2006 | Karin Menke | 14:00 | 17:00 | 3:00 | | 4 | NW | 4-5 | dull | |
| 01/03/2006 | Hanjo Steinborn | 9:15 | 17:00 | 6:30 | 1:15 | -1 | NW | 3-5 | partly cloudy | |
| 18/04/2006 | Hanjo Steinborn | 13:40 | 19:40 | 5:00 | 1:00 | 10-7 | W | 3-4, 1-2 | partly cloudy | |
| 19/04/2006 | Julia Adena | 8:15 | 20:00 | 9:45 | 2:00 | 9 | NW | 1-2 | cloudy | |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 20/04/2006 | Kerstin Windelberg | 9:15 | 20:00 | 8:45 | 2:00 | 10 | SE | 1-3 | dull | rain until 17:00 |
| 21/04/2006 | Martin Sprötge and Karin Menke | 9:30 | 18:30 | 8:30 | 0:30 | 12 | NW | 2 | partly cloudy | |
| 22/04/2006 | Klaus Handke | 9:45 | 12:45 | 3:00 | | 9 | SW | 6 | dull | |
| 22/04/2006 | Pia Handke | 12:45 | 18:00 | 5:15 | | 9 | SW | 4-5 | dull | from 18:00 on rain |
| 24/04/2006 | Julia Adena | 11:45 | 14:45 | 3:00 | | 8 | SW | 3-5 | heavily cloudy | |
| 26/04/2006 | Hanjo Steinborn | 11:30 | 14:30 | 3:00 | | 13 | W | 3-5 | heavily cloudy | |
| 17/05/2006 | Marc Reichenbach | 9:00 | 18:30 | 8:30 | 1:00 | 11 | S | 3-5 | dull | |
| 06/06/2006 | Hanjo Steinborn | 13:35 | 17:35 | 4:00 | | 22 | W | 2-3 | partly cloudy | |
| 08/06/2006 | Klaus Handke | 13:15 | 19:45 | 6:00 | 0:30 | 24 | W | 2-4 | partly cloudy | |
| 26/06/2006 | Karin Menke | 16:00 | 20:00 | 4:00 | | 15 | E | 2-3 | cloudy | |
| 28/06/2006 | Julia Adena | 8:40 | 11:40 | 3:00 | | 14 | SE | 2-3 | dull | |
| 17/07/2006 | Julia Adena | 15:15 | 20:00 | 4:45 | | 20-26 | NW | 2-3 | sunny | |
| 18/07/2006 | Martin Sprötge | 9:00 | 15:00 | 4:30 | 1:30 | | NE | 1-2 | sunny | |
| VP 6 (breeding season 05: 81,5 hours, non-breeding season: 42,5 hours, breeding season 06: 80,5 hours) | | | | | | | | | | |
| 04/04/2005 | Marc Reichenbach | 15:30 | 17:30 | 2:00 | | 5 | SW | 6-8 | heavily cloudy | snow-/rain-/hail shower, partly sunny |
| 06/04/2005 | Klaus Handke | 14:30 | 18:30 | 3:00 | 1:00 | 3-5 | W | 4-8 | dull | |
| 07/04/2005 | Hanjo Steinborn | 10:30 | 18:15 | 7:30 | 0:15 | 3 | W-N | 2-6 | heavily cloudy | hail, rain, snow |
| 10/04/2005 | Frank Sinning | 12:45 | 19:05 | 6:00 | 0:20 | 10-12 | WSW | 2-3, 3-5 | cloudy | |
| 11/04/2005 | Karin Menke | 9:30 | 18:00 | 8:30 | | 9 | W | 3-4 | cloudy | rain shower |
| 02/05/2005 | Kerstin Windelberg | 14:45 | 18:45 | 4:00 | | 14 | S | 3-4 | heavily cloudy | |
| 03/05/2005 | Marc Reichenbach | 13:00 | 18:15 | 4:45 | 0:30 | 14 | SW | 2-3 | heavily cloudy | rain shower |
| 26/05/2005 | Hanjo Steinborn | 8:40 | 19:10 | 8:30 | 2:00 | 11 | SW | 3-6 | cloudy | |
| 13/06/2005 | Klaus Handke | 14:30 | 19:45 | 5:15 | | 6-9 | NW | 2-4 | dull | |
| 15/06/2005 | Hanjo Steinborn | 10:25 | 20:45 | 7:30 | 2:50 | 15-18, später 12 | S | 6-7, 2-4 | heavily cloudy | rain |
| 16/06/2005 | Kerstin Windelberg | 13:30 | 17:45 | 2:30 | 1:45 | 15-17 | S | 0-3 | dull | rain |
| 28/06/2005 | Julia Adena | 13:10 | 20:10 | 6:00 | 1:00 | >20 | SE | 0-3 | sunny | |
| 30/06/2005 | Hanjo Steinborn | 8:00 | 20:00 | 9:45 | 2:15 | 17-20 | S | 0-3 | dull | rain shower |
| 01/07/2005 | Frank Sinning | 6:15 | 9:30 | 3:15 | | 15 | SW | 3 | heavily cloudy | drizzle |
| 19/07/2005 | Klaus Handke | 17:00 | 20:00 | 3:00 | | 12 | W | 6 | dull | |
| 04/08/2005 | Hanjo Steinborn | 13:00 | 19:30 | 5:30 | 1:00 | 15 | SW | 3-5,1-3 | dull | drizzle |
| 06/08/2005 | Pia Handke | 10:00 | 20:00 | 9:00 | 1:00 | 10-15 | NW | 2-3 | cloudy | partly sunny |
| 06/09/2005 | Klaus Handke | 14:45 | 19:30 | 4:15 | 0:30 | 20 | | 3-4 | partly cloudy | |
| 03/10/2005 | Hanjo Steinborn | 14:00 | 18:00 | 4:00 | | 14 | SW | 1-2 | dull | |
| 05/10/2005 | Karin Menke | 8:30 | 16:15 | 6:45 | 1:00 | 8 | SW | 2-3 | dull | |
| 07/11/2005 | Kerstin Windelberg | 14:30 | 16:30 | 2:00 | | 5 | S | 6 | dull | |
| 08/11/2005 | Julia Adena | 13:30 | 16:00 | 2:30 | | 5 | SW | 1-3 | dull | |
| 27/02/2006 | Julia Adena | 14:30 | 17:00 | 2:30 | | 4 | NW | 4-5 | dull | partly heavy rain |
| 01/03/2006 | Klaus Handke | 9:45 | 16:15 | 6:00 | 0:30 | -3 | NW | 3-5 | partly cloudy | |
| 18/04/2006 | Kerstin Windelberg | 14:00 | 20:00 | 5:00 | 1:00 | 10-13 | SW | 4 | cloudy | |
| 19/04/2006 | Klaus Handke | 14:00 | 19:00 | 4:30 | 0:30 | 9 | NW | 2 | cloudy | |

| date | observer | observing time | | | | weather conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | from | until | duration hrs: min | break hrs: min | temp. in °C | wind direction | wind force (Beaufort) | sky cover | precipitation, notes |
| 20/04/2006 | Julia Adena | 9:40 | 19:40 | 8:00 | 2:00 | 9 | SE | 1-3 | dull | light rain until 16:00 |
| 21/04/2006 | Martin Sprötge and Karin Menke | 10:15 | 17:45 | 5:30 | 2:00 | 12 | NE | 1-.3 | partly cloudy | |
| 22/04/2006 | Marc Reichenbach | 10:00 | 17:30 | 7:00 | 0:30 | 5 | SW | 4-6 | cloudy | |
| 16/05/2006 | Marc Reichenbach | 10:40 | 18:40 | 7:00 | 1:00 | 13-10 | S | 1-3, 4-5 | cloudy | 1 rain shower |
| 17/05/2006 | Klaus Handke | 9:15 | 18:15 | 6:30 | 2:30 | 11-14 | S | 3-5 | dull | from 14:30 on rain |
| 06/06/2006 | Kerstin Windelberg | 14:00 | 20:00 | 5:30 | 0:30 | 20-25 | SW | 3-4 | sunny | |
| 08/06/2006 | Pia Handke | 9:00 | 20:00 | 9:00 | 2:00 | 22 | W | 3-4, 2 | partly cloudy | |
| 09/06/2006 | Hanjo Steinborn | 12:00 | 19:15 | 6:15 | 1:00 | 27 | S | 1-2, 2-5 | sunny | |
| 26/06/2006 | Hanjo Steinborn | 16:30 | 19:45 | 3:15 | | 18-14 | NE | 1-2 | heavily cloudy | |
| 28/06/2006 | Julia Adena | 12:15 | 17:30 | 4:15 | 1:00 | 14 | SSE | 2-3 | dull | partly rain |
| 17/07/2006 | Martin Sprötge | 15:30 | 19:30 | 4:00 | | 26 | W-SW | 2-3 | sunny | |
| 18/07/2006 | Julia Adena | 9:15 | 15:00 | 4:45 | 1:00 | | NE | 1-3 | sunny | |
| VP 7 (breeding season 05: 40,25 hours) | | | | | | | | | | |
| 10/04/2005 | Hanjo Steinborn | 12:45 | 18:45 | 6:00 | | 10 | W | 2-3(-4) | dull | |
| 11/04/2005 | Julia Adena | 10:10 | 18:30 | 8:00 | 0:20 | 9 | W | 3-4 | dull | in the afternoon partly rain |
| 02/05/2005 | Karin Menke | 14:45 | 18:45 | 4:00 | | 16 | S | 3-4 | cloudy | |
| 26/05/2005 | Marc Reichenbach | 8:30 | 19:00 | 8:30 | 2:00 | 8 | W | 2-4 | cloudy | |
| 16/06/2005 | Kerstin Windelberg | 9:15 | 13:15 | 4:00 | | 15-17 | S | 0-3 | dull | rain |
| 30/06/2005 | Frank Sinning | 9:30 | 19:15 | 6:45 | 3:00 | 17-20 | W | 1-3 | cloudy | from 11:35 on rain, dry in the afternoon |
| 01/07/2005 | Klaus Handke | 6:20 | 9:20 | 3:00 | | 15 | SW | 3 | heavily cloudy | drizzle |
| VP 8 (non-breeding season: 10,25 hours, breeding season 06: 60 hours) | | | | | | | | | | |
| 28/02/2006 | Hanjo Steinborn | 10:15 | 16:15 | 6:00 | | -2 | NW | 2-4 | partly cloudy | |
| 02/03/2006 | Julia Adena | 10:30 | 15:45 | 4:15 | 1:00 | -3 | N | 0-2 | sunny | |
| 18/04/2006 | Julia Adena | 13:45 | 18:45 | 4:00 | 1:00 | 8 | NW | 2-5 | cloudy | |
| 19/04/2006 | Martin Sprötge | 10:30 | 17:30 | 4:45 | 2:15 | 9 | SW | 2 | partly cloudy | |
| 20/04/2006 | Klaus Handke | 10:30 | 18:30 | 7:00 | 1:00 | 9 | | 1-2 | dull | rain |
| 21/04/2006 | Marc Reichenbach | 10:30 | 17:30 | 6:30 | 0:30 | 9-14 | NE | 1-3 | partly cloudy | |
| 25/04/2006 | Hanjo Steinborn | 11:20 | 19:35 | 7:15 | 1:00 | 8 | SW | 5-7 | heavily cloudy | |
| 18/05/2006 | Hanjo Steinborn | 11:45 | 17:00 | 4:15 | 1:00 | 9 | S | 6-7 | dull | rain shower |
| 07/06/2006 | Pia Handke | 10:00 | 18:45 | 7:45 | 1:00 | 15 | NW | 1-2 | dull | |
| 08/06/2006 | Kerstin Windelberg | 10:15 | 18:15 | 7:00 | 1:00 | 22 | W | 3-4 | partly cloudy | |
| 27/06/2006 | Karin Menke | 8:30 | 19:15 | 8:45 | 2:00 | 14-18 | | 0-2 | cloudy, later partly cloudy | |
| 29/06/2006 | Kerstin Windelberg | 9:45 | 12:30 | 2:45 | | 15 | SE | 4-5 | dull | |

# Appendix 3: Records (Target, Secondary, Disturbance) including examples

## Form 1: target species

observer: vantage point:

date and time:

weather conditions:

| **number** | **species** (sex, if possible) | **classified flying heights with duration** display flights: min. and max. height | **time** (end of flight) | **Number of *dives*** *(display)* | **landing?** | **starting?** |
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classified flying height: **0**: 0m, **1**: 0-30m, **2**: 30-200m, **3**: >200m

## Form 2: secondary species

observer: vantage point:

date and time:

weather conditions:

| **number** | **time** | **Duration of flight** | **species** | **number of birds** | **flying or static?** | **flying height** | **wind** (direction & speed) |
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## Disturbance

observer: vantage point:

date and time:

weather conditions:

| time | type of disturbance | reaction of birds | no reaction because of no birds? |
|---|---|---|---|
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## Appendix 4: Records (wood species) including example

# Formular für Waldvogelerfassung Penbreck

(je Beobachtungstag 30 Minuten/Raster)

**grid: 1** **Bearbeiter: K. Handke**

**date: 28.05.2005** **time: 10:00 – 10:30 Uhr**

***weather: dull, shower***

| species | number of birds | notes |
|---|---|---|
| Buzzard | | |
| Sparrowhawk | | |
| Goshawk | | |
| Hen Harrier | | |
| Kestrel | | |
| | | |
| Woodpigeon | 1 | |
| | | |
| Great Spotted Woodpecker | | |
| | | |
| Dunnock | 2 | |
| Wren | 4 | |
| | | |
| Robin | 5 | |
| Song Thrush | | |
| Blackbird | | |
| Goldcrest | 2 | |
| Chiffchaff | | |
| Willow Warbler | 2 | |
| Blackcap | | |
| Short-toed Treecreeper | | |
| Great Tit | | |
| Blue Tit | | |
| Coal Tit tannen | 2 | |
| Crested Tit | | |
| Chaffinch | 5 | |
| Siskin | 5 | |
| Redpoll | 5 | |
| Crossbill | 47 | |
| | | |
| Hooded Crow | | |
| | | |
| Total number of birds | 11 | |
| | | |

## Appendix 5: Panorama pictures of the points