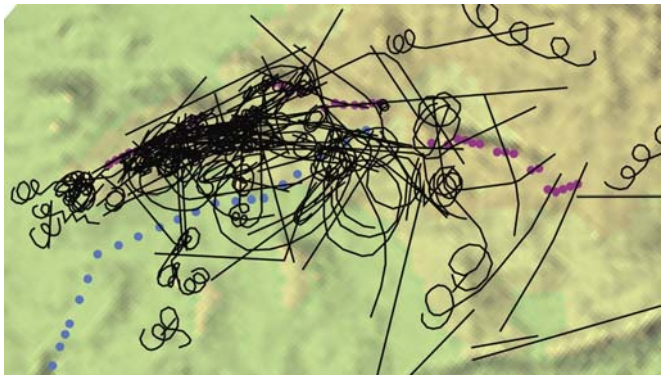
DOPPS
Društvo za opazovanje in proučevanje ptic Slovenije

Report on Golden Eagle for the Environmental impact assessment of Volovja reber wind farm

Tomaž Jančar
Tomaž Mihelič
Borut Rubinić
Primož Kmecl



October 2007
Amended: February 2009

Version 2

Summary

This report has been made for the Environment impact assessment of the Volovja reber wind farm. Our study demonstrates that the impact of the wind farm on the golden eagle would be unacceptably large and that the Environmental Statement submitted by the developer is inadequate and does not show the actual situation.

Description of the situation

In the wider Volovja reber area one pair of golden eagles (Aquila chrysaetos) is breeding, which is the only pair in the region. The closest known eagle territories are 25 km (in Croatia) and 30 km away (in Slovenia).

The pair of eagles from Volovja reber has three known nests, which are used for nesting in turn. All three nests are situated around the chain of turbines of the planned wind farm at a distance from 200 m to less than 4 km.

The data collected show that the territory is above-average importance with good food availability as pair breeds practically every year. In 2007, the eagles nested in the nest in the tree, which is only about 200 m away from nearest proposed wind turbines.

The area of the proposed wind farm and power line is in the centre of activity of this pair of golden eagles. In our surveys we recorded 203 observations of golden eagles in the wider Volovja reber area; most observations were less than 1000 m away from the proposed wind turbines. We recorded 54 instances of eagles landing and perching on 38 different locations – most of them less than 500 m from the proposed wind turbines. We recorded 11 instances of territorial undulating flights, 9 of them were less than 800 m from the proposed wind turbines.

We recorded 202 instances of eagles flying through the individual wind turbine areas. We estimate that eagles fly through individual turbine area several 1000 times every year.

Comparison of data collected for this Report with data from the developer's Environmental Statement

The surveyors which were surveying birds for the developer's Environmental Statement recorded a very limited quantity of data, tenfold less than presented in this Report (Table 13). The difference in the quantity of the data collected is enormous, which is one of the reasons why the assessment of the impact of the wind farm on golden eagle in the investor's Environmental Statement is incorrect.

The expected impact of installing the wind farm on golden eagle

Based on the data we collected we have estimated with the help of the Band's model that 5 instances of collisions of golden eagles with wind turbines can be expected anualy if the wind farm is erected on Volovja reber as proposed. This can be expected if the number of eagle flights through the wind turbine area does not change and under presumptions we describe. Even if the number of collisions was 10 times less than we predict golden eagles would quickly disappear from the Volovja reber.

Explanation:
This document is the updated version of the document, which was prepared in October 2007 and was submitted to ARSO (Agency of Republic of Slovenia for Environment) on 26th of October 2007 together with a proposal for reopening the administrative proceeding of the Environment Impact Assessment of the Volovja reber wind farm. Compared with the first version of our report, in this version the text is slightly expanded and consolidated. In addition, this version includes some new information and new analyses, such as:

- section "A" was added - Description of the area
- new data for October and November 2007 were added and data for the autumn 2007 survey was updated (after the completion of the first version of this Report one field report (for 22.9.2007) and one supplementary field report (9.9.2007) were collected
- possible neighbouring territory of golden eagles in the direction of Croatian border was analyzed
- eagles' flight lines were analyzed
- minimal distances of eagles from observers were analyzed
- the comparison of potential eagles' hunting area (after Trontelj 2006) with recorded eagles' flight lines has been made

Table of contents

Front page photo: Golden Eagles' flight lines recorded at the Volovja reber (Figure 8 of this report).

A – Proposed development and area description

Proposed Volovja reber wind farm is planned in the south-western part of Slovenia (Figure 1), within IBA Snežnik-Pivka, which with an area of 54,906 ha is among the largest IBAs in Slovenia. A major part of the IBA is high karst plateau overgrown with extensive Dinaric fir-beech forests. At the south-western edge of the plateau there are extensive dry karst meadows, one of the largest in Slovenia. The proposed wind farm is located on the ridge where there are the highest altitude meadows of this part of the IBA, between 950 and 1100 m a.s.l.

47 wind turbines were originally proposed. Following the proposal of the consultancy, that compiled the Environmental Statement for the developer, 4 wind turbines were withdrawn from the project. The reason given was that at these locations "more frequent flights of raptors" and "perching of Golden Eagles" was recorded. In June 2006 the Agency of environment of the Republic of Slovenia (ARSO) issued an Environment protection consent for 33 wind turbines. Consent for 10 turbines was rejected because they were planned either within the Natura 2000 site or in the immediate vicinity of its borders. The Environment protection consent is not final as legal action was brought against it. EIA will be repeated as ARSO failed to include DOPPS as party to the proceeding.

The developer intends to erect V52 type wind turbines: power 850 kW, rotor diameter 52 m, height of steel wind tower 53 m. Furthermore, construction of 110 kV high voltage power line is planned. Out of 43 power line poles planned 22 are proposed within the IBA boundaries.

Figure 1: Position of the proposed Volovja reber wind farm within Slovenia. Legend: blue line – IBA Snežnik-Pivka; purple line – string of proposed wind farm, distance between ends of the string is 6 km.

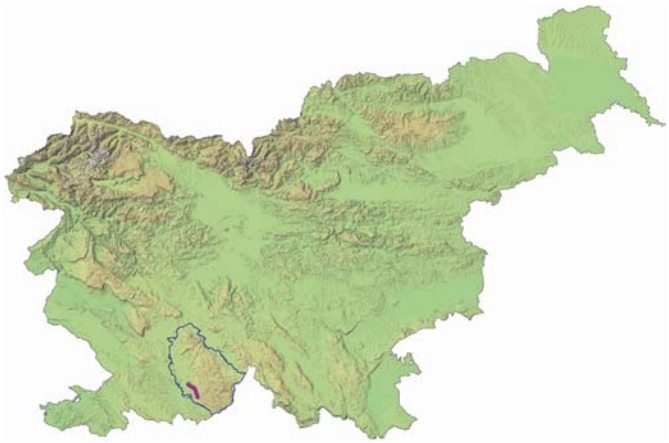


Figure 2: Volovja reber wind farm outline: purple dots – approved turbines; red triangles – turbines withdrawn by developer; red pluses – rejected turbines; blue dots – powerline poles; blue line – border of the Snežnik-Pivka IBA. Distance between farthermost turbines is 6 km.

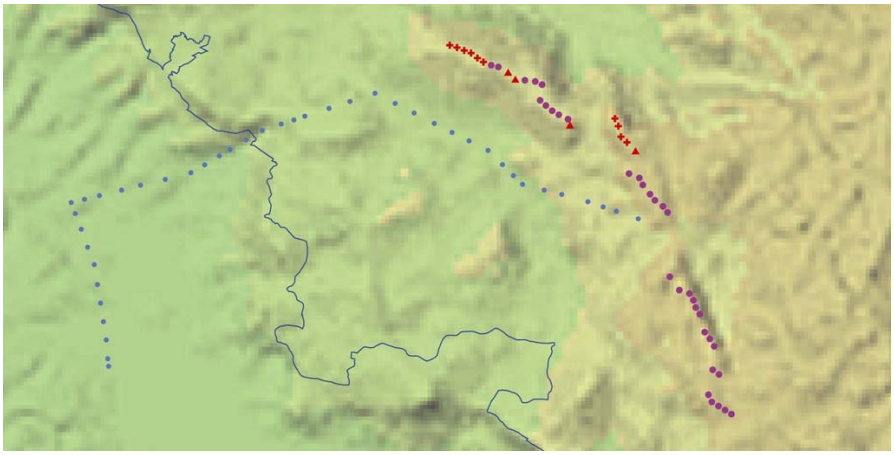


Figure 3: Position of the Volovja reber wind farm within Snežnik-Pivka IBA. Legend: blue line – border of the IBA; red line – border of the SPA Snežnik-Pivka; purple dots – proposed wind turbines. Colours of the relief represent altitudes: green – below 800 m; sandy – 800 to 1000 m; brown – 1000 to 1500 m; pink – above 1500 m.

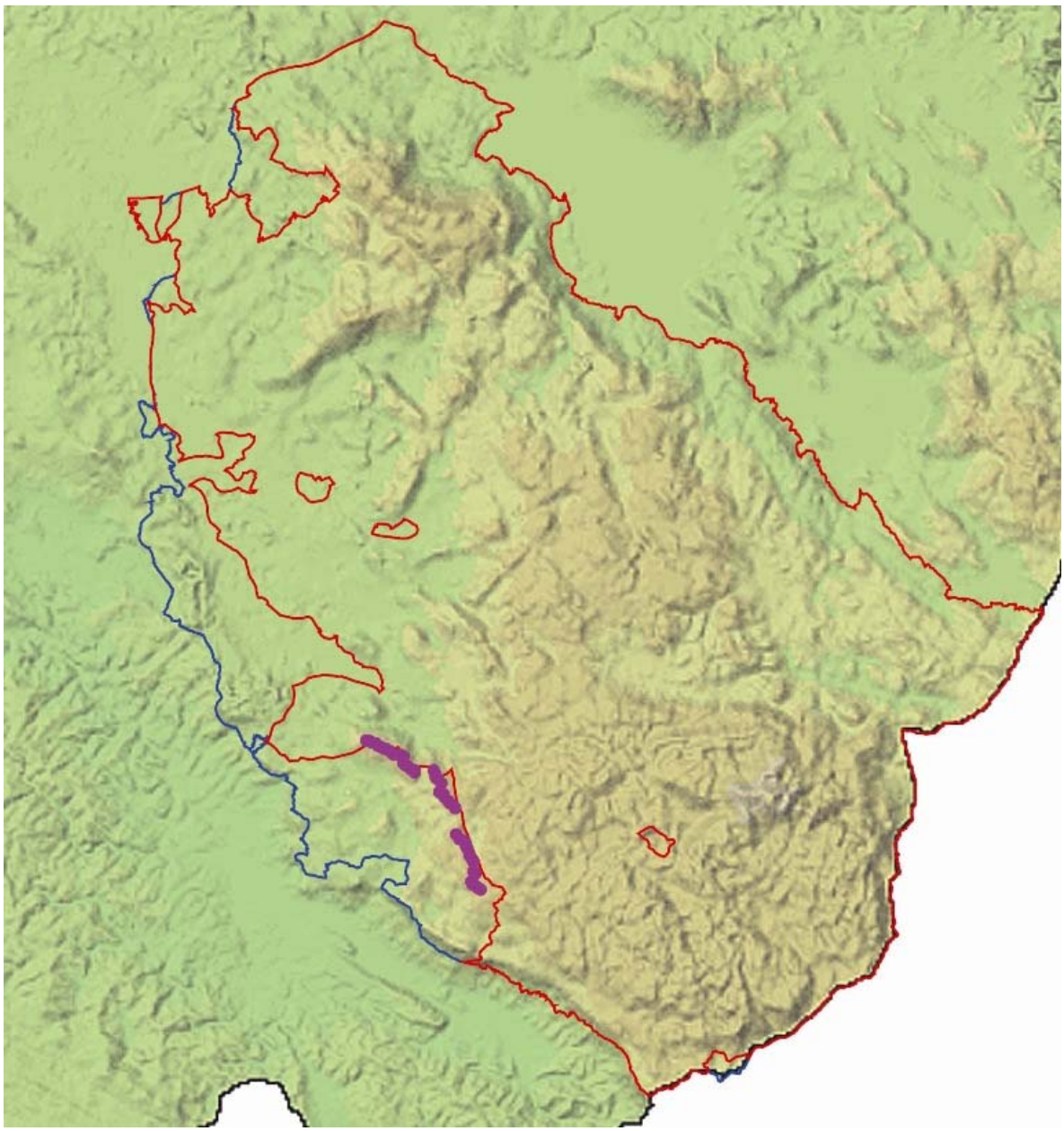
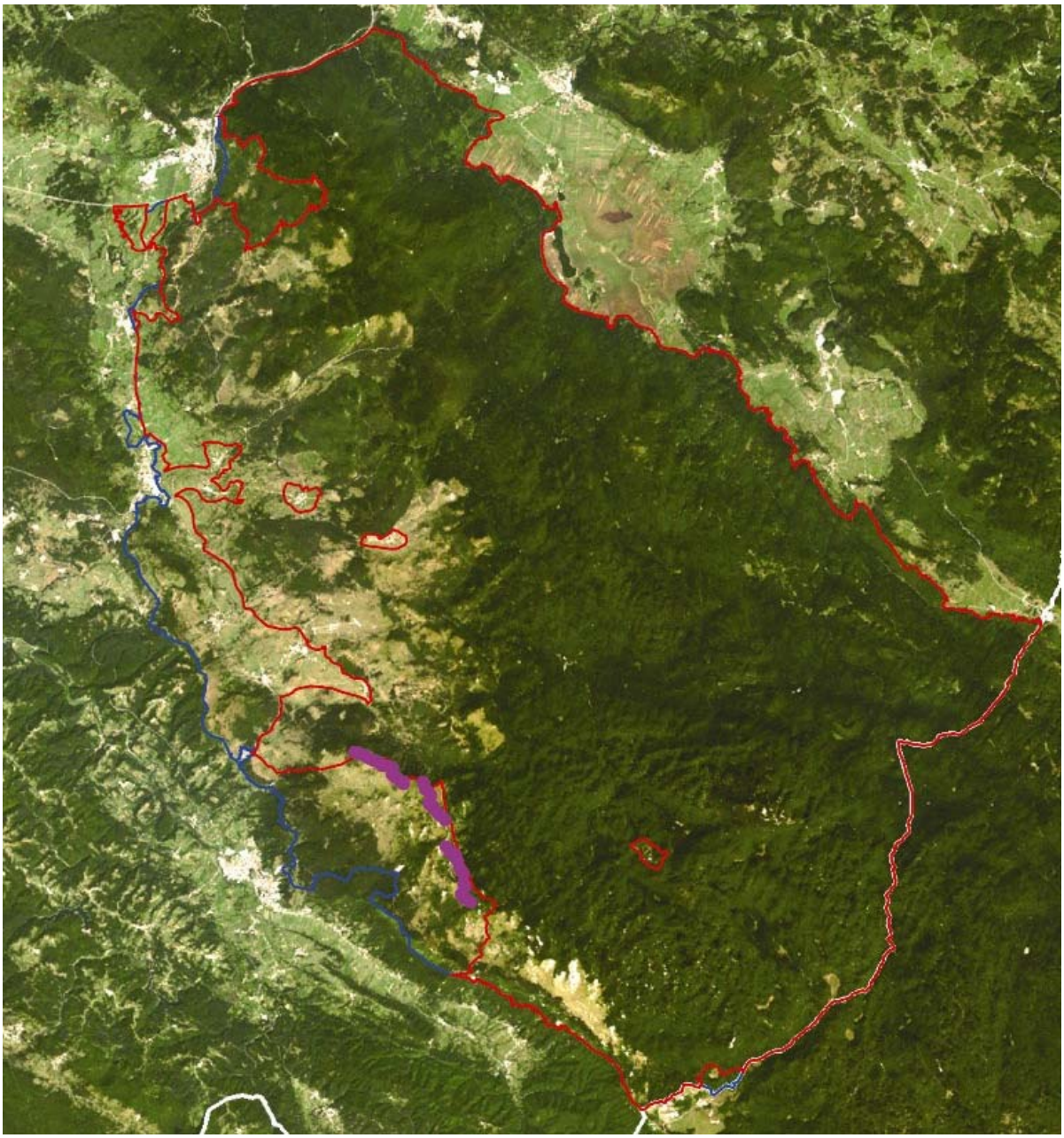


Figure 4: Position of the Volovja reber wind farm within Snežnik-Pivka IBA. Colours represent land use: dark green – forest; light green meadows and fields; light brown – mountain meadows; white – urban and rocks.



B – Present situation

B1 – Methods

B1.1. Systematic monitoring of raptors at Volovja reber

DOPPS has carried out three systematic surveys of raptors at Volovja reber: in spring 2005 and in autumn 2006 and 2007. The survey method of the three surveys was similar, although it has somewhat developed with time. In this report only data on golden eagle is included, although the method was the same for all raptor species.

Movements of raptors were recorded from the vantage point, which was not always the same. In the 2005 and 2006 surveys the vantage point was either on the Mt. Velika Milanja (either on the summit or on the prominent group of rocks called “Zob” (The Tooth), ca 270 m SE from the summit) or on the un named hill where wind turbine no. 25 is planned. In the 2007 survey the location of the vantage point was changed a little more to get some data also for other parts of proposed chain of wind turbines. In two days raptors were recorded simultaneously from two vantage points. See Tables 1 and 2 for data on the quantity of time spent surveying at different locations of vantage points and Table 3 for information on different survey days.

All raptors which were in visible distance, i.e. ca. 2 kilometres from the vantage point were recorded.

Surveys took place from about 7 a.m. to late afternoon, on average about 9 hours per survey day.

Observations were recorded on special forms. Surveyors were equipped with maps where they drew the lines of raptors flights. In 2005 and 2006 surveys maps were at the scale of 1:30:000, in 2007 the survey scale was 1:17.000. In the 2007 survey, locations of proposed wind turbines were shown on the map. In 2005 and 2006 surveys only some surveyors recorded raptor flight lines on maps, and even those drew lines only for the most interesting species. In the 2007 survey all surveyors drew flight lines for the majority of recorded raptors.

For every raptor observed the following data was recorded on the forms provided:

- species and (if detectable) age and sex of the individual
- number of individuals
- time of observation – in minute accuracy
    - in the 2005 and 2006 survey the time when the raptor was closest to surveyor
    - in the 2007 survey the time of the beginning and of the end of the observation
- height of flight; for more accurate height determination we compared it with the height of local anemometrical towers (40 and 100 m), which are present at several locations of the ridge.
    - In 2005 and 2007 height of flight was recorded relative to the position of the surveyor at the moment when the bird was closest to the surveyor
    - In 2007 survey we recorded the height of flight relative to the ground when the bird flew over the ridge where wind turbines are planned; in cases of prolonged observation of an individual bird surveyors recorded several heights at different parts of the proposed wind farm chain; surveyors paid special attention to whether the bird was flying in the reach of proposed wind turbines (below 80 m) or above them
- direction of flight
- in some special occasions short comment about a birds activity (e.g. when eagles undulating display flight was observed)

Surveyors were also recording principal parameters of weather conditions (wind, precipitations, temperature, cloudiness, visibility). Weather was recorded every hour or when changing.

Each surveyor was equipped with binoculars and telescope.

Given that it was not possible to distinguish the individual birs of same species we counted as a unit one observation of one bird. I.e., if the same eagle was observed for three times during the survey day, we recorded 3 observations in the results table.

In 2005 survey there was only one surveyor at the vantage point at a time. This proved not enough, because several times there were more than one raptor in the field of vision. Therefore for the 2006 survey we tried to increase the number of surveyors. In the 2007 survey we had at least 2 surveyors at

a time at the vantage point. Even two surveyors proved not enough in some occasions when there were several raptors in the sky.

In results of the 2007 survey there are also included data of non-systematic recordings of Mr. Aleš Jagodnik, a nature photographer who wisited Volovja reber five times in the duration of the survey. This data is important because he collected a large proportion of golden eagle and griffon vulture observations, most of them photo documented. Mr. Jagodnik visited the site for the purpose of bird photography. Therefore he was dressed in-consciously trying to be as much as possible invisible for birds. We believe that this is the reason why he collected most of the close observations of large raptors.

In total 31 systematic survey days - 276 survey hours - were carried out, while in 5 non-systematic survey days an additional 20 hours were carried out (*Tables 1* and *2*). 24 surveyors participated in the surveys.

Table 1: Time spent surveying in days and in hours, by years. In case there were more than one surveyor at the vantage point, we counted as if there was only one

		2005	2006	2007	Sum
Systematic survey	Survey days	10	7	14	31
	Survey hours	98:30	58:45	118:25	275:40
Occasional survey	Survey days	/	/	5	5
	Survey hours	/	/	20:05	20:05

Table 2: Distribution of surveying effort by different vantage points [hours]

	Volovja reber	V. Milanja	vrh z VE 25	J. Devin	Štanga
	Vr	**I**	**II**	**III**	**IV**
2005		98,5			
2006		32,8	25,9		
2007	18,2	8,9	74,6	26,4	10,3
Sum	18,2	140,3	100,5	26,4	10,3
Sum %	6%	47%	34%	9%	3%

Surveyors

In systematic surveys participated 23 surveyors, while additional 8 observers contributed occasional data.

Initials in the Tables means: **AF** – Andrej Figelj, **AJg** – Aleš Jagodnik, **Ajn** – Ana Jančar, **AR** – Aljaž Rijavec, **BK** – Brane Koren, **BR** – Borut Rubinič, **BS** – Boštjan Surina, **BV** – Barbara Vidmar, **BŽ** – Barbara Žnidaršič, **EV** – Eva Vukelič, **IB** – Igor Brajnik, **IE** – Ivan Esenko, **IK** – Ivan Kogovšek, **JF** – Jernej Figelj, **MG** – Miran Gjerkeš, **MK** – Miha Krofel, **MS** – Mateo Skodler, **NP** – Nevenka Pfajfar, **PB** – Primož Bizjan, **PT** – Paul Tout, **PTr** – Peter Trontelj, **PV** – Polonca Voglar, **RD** – Rok Dolinar, **SP** – Slavko Polak, **TB** – Tomaž Berce, **TJ** – Tomaž Jančar, **TM** – Tomaž Mihelič, **TR** – Tomaž Remžgar, **VH** – Vojko Havliček, **VŠ** – Vilijana Šiškovič, **ŽM** – Željka Modrić.

*Table 3: Information on different survey days. **P** – occasional visits (included are data of persons, who were observing birds at the site non-systematically); **Surveyor:** for explanation of initials see above; **Vantage point**: II – hill with proposed wind turbine no. 25, I – Mt. Velika Milanja (peak or Zob), III – Devin, IV – NW sub-summit of Mt. Štanga, Vr – Volovja reber (central part) (see locations on Figure 6).*

Date	P	Surveyor	Time of survey	duration of survey	Vantage point
3.5.2005		JF	8:30-17:20	9:50	I
8.5.2005		BK	7:10-18:15	11:05	I
13.5.2005		JF	7:45-17:30	9:45	I
16.5.2005		BK	7:35-16:55	9:20	I
22.5.2005		BK	7:10-17:45	10:35	I
23.5.2005		JF	7:35-17:30	9:55	I
29.5.2005		BK	8:00-17:30	9:30	I
2.6.2005		JF	9:30-18:30	9:00	I
7.6.2005		BK	7:45-17:00	9:15	I
13.6.2005		BK	7:15-17:30	10:15	I
29.8.2006		TM,IB	7:30-15:30	8:00	I,II
2.9.2006		IB	7:25-19:05	11:40	II
5.9.2006		IB,VŠ	7:15-17:30	10:15	II
12.9.2006		IB,BV	7:15-15h	7:45	I
19.9.2006		IB,MG	7:50-16:30	8:40	I
22.9.2006		IB	10:15-14h	3:45	I
27.9.2006		ŽŠ	8:20-17h	8:40	I
10.8.2007		TJ,Ajn	7:45-16:10	8:25	I,II,III
15.8.2007		TR,PB,RD	7:40-18:45	11:05	III
15.8.2007	p	Ajg	10:55-14:30	3:35	Vr
20.8.2007		JF,AF	9:18-17:10	5:50	III,IV
25.8.2007		IB,MG	8:03-18:33	10:30	II
30.8.2007		TJ,AF	7:45-19:20	8:50	II
4.9.2007		AF,BR,PV	14:50-17:55	3:05	III
4.9.2007		JF,IB	14:25-18:00	3:35	II
8.9.2007	p	Ajg	10:40-16:00	5:20	Vr
9.9.2007		PTo,MS	7:30-16:45	9:15	II
9.9.2007	p	Ajg	16:11-18:00	1:50	I
14.9.2007		TJ,BR	8:00-18:00	10:00	II
19.9.2007		EV,TB,NP	8:40-16:00	7:20	I,II
20.9.2007		PTo,IB	7:30-17:10	9:20	II
20.9.2007		JF,PV	8:15-17:50	9:35	IV
22.9.2007		AR,BŽ	8:30-19:00	10:30	II
23.9.2007	p	AJg	12:00-15:50	3:50	Vr
25.9.2007		AF	7:40-16:45	9:05	II
30.9.2007	p	AJg	10:30-16:00	5:30	Vr

Figure 5: Distribution of survey effort [hours] by vantage points.

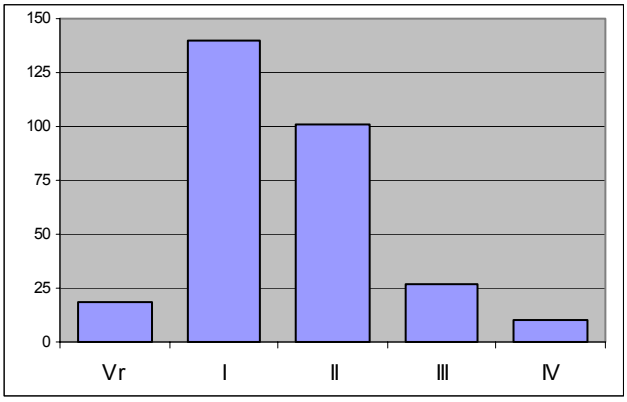
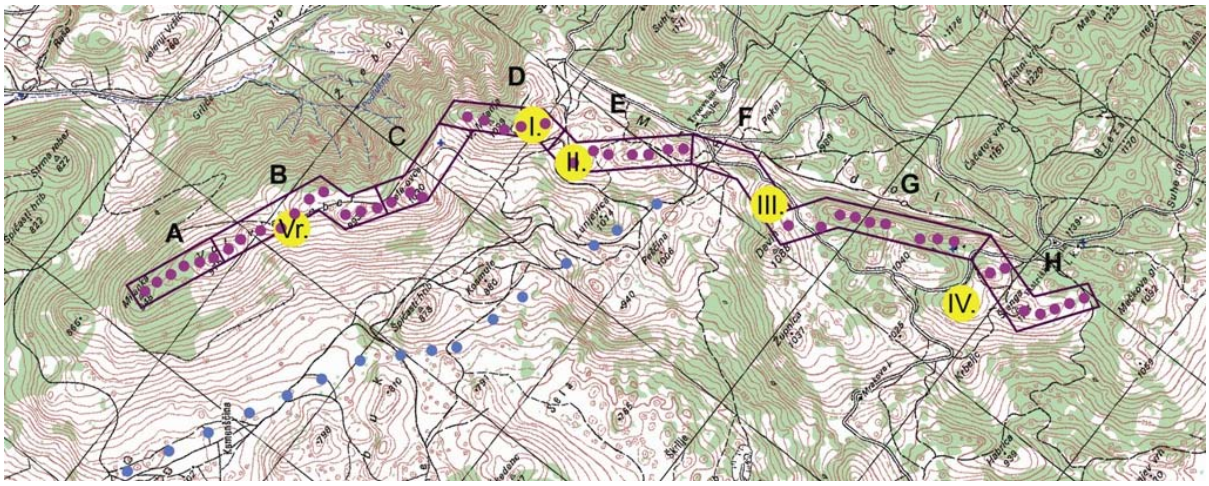


Figure 6: Location of vantage points (yellow dots) and wind farm sections as used for presenting information on number of birds flying through individual wind turbine areas.



B1.2. Data collected incidentally

In this report are also included all observations of golden eagles within the wider surrounding of the proposed wind farm which were collected by DOPPS members and other reliable observers during occasional visits and excursions.

Incidentally collected data are concentrated on the area around hills Velika Milanja, Bele ovce and Volovja reber (narrower meaning). The reason for this is the exceptional landscape beauty, which attracts more people to this part of the area.

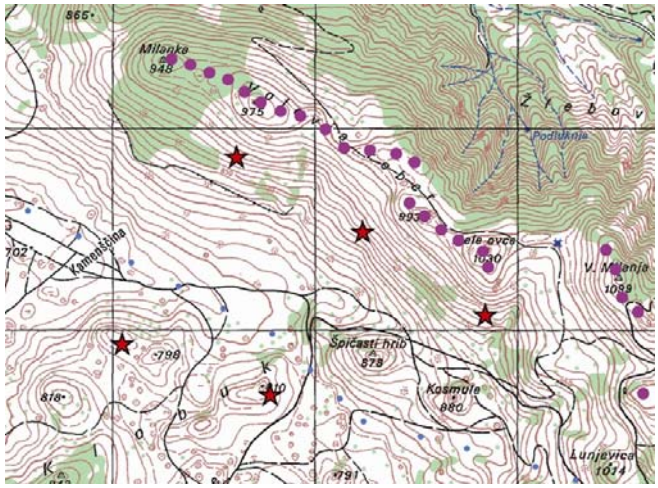
Observers were encouraged to record data to forms, which were used for the 2007 raptor survey, and to plot flight lines on a map.

B1.3. Rock partridge survey on 8th November 2007

A special survey performed in the morning of 8th November 2007 contributes important information to understanding the golden eagles activity at Volovja reber. Therefore we emphasize it specially. The survey was intended and designed to gather information on the presence of Rock Partridge *Alectoris graeca* at the Volovja reber area. Unexpectedly we gathered a large amount of information about golden eagles' activity.

The survey took place in early morning, between dawn and a little after sunrise, i.e. from 5:30 to 8:00 a.m. The first eagle was observed at 6:48. Intensive eagles' flights were recorded until 7:47, while at 8 a.m. surveyors left the area. 5 surveyors participated in the survey. They were recording eagles' flights to 1:17.000 field maps. The survey took place on the slopes of the north-western part of the proposed wind farm, roughly between peaks of Milanja, Klobuk and Bele ovce. The approximate locations of the five surveyors are shown on *Figure 7*.

Figure 7: Approximate locations of five surveyors in the 8th November 2007 survey (red stars). Purple dots indicate locations of proposed wind turbines.



B1.4. Processing of lines of flight data

For all eagle observations for which detailed information on observation location was available lines of eagle's flights were recorded to Geographic Information System (GIS). ArcView 3.3 software was used.

Observation records from 2007 were recorded in sufficient detail that it was possible to copy drawings from the field maps directly to GIS.

For older records detailed locations were often not recorded, so it was not possible to plot lines of flight. Several observations were recorded only provisionally, which means that lines of flight for previous years are less accurate. For some older observations the location was recorded only as a point, without direction and distance of flight. In such cases we plotted in GIS a 300 m line oriented west-east with its centre in the recorded observation point. On the printed maps this can be seen as a dash.

In some cases we plotted more than one flight line for one observation. This was the case when the observed bird was lost for a short period of time and then observed again not far away.

B1.5. Flights through individual wind turbine area

The data recording method in 2007 makes it possible to calculate the number of flights through the individual wind turbine areas of the proposed wind farm. Because this was not a focus of the 2005 and 2006 surveys, data for theses two surveys does not enable calculation of the number of flights through the different wind turbine areas.

For the purpose of this data processing we divided the proposed string of wind turbines into 8 sections (Figure 2).

In data processing we used the following criteria:

- flight through wind turbine area
    - counted were flights between the ground and the height of 80 m from the ground

- one flight of one bird across the ridge (perpendicular to the wind turbine string) is counted as a processing unit
- if a bird was flying along the ridge, one flight of one bird through an individual wind turbine area was counted as a unit (e.g. in the case of a bird flying along the ridge and was passing string section with 5 wind turbines, the recorded result was 5 flights through wind turbine areas)

- flight over the wind turbine area:
  - counted were flights higher than 80 m from the ground
  - one flight of one bird over a wind turbine section was taken, as a processing unit regardless of whether a bird was flying along the section or perpendicular to it; when a bird flew along the ridge and passed several sectors we counted it as one processing unit for each sector
- observations outside of the wind turbine area
  - in cases where a bird didn't fly through the wind turbines area or over it, as a processing unit was taken the observation of one bird regardless of the duration of observation

B2 – Results

B2.1. Breeding data and location of nests

The Golden Eagles territory in the Volovja reber surrounding is one of those with the longest history of documentation for Slovenia. First known records are provided by Schollmayer (1891), who reports on breeding of eagles near Koritnice village and at Suhi vrh near Šembije village, both in the near surrounding of the proposed Volovja reber wind farm.

The pair of Golden eagles from the Volovja reber area has several nests, which are used alternately in different years. Known are 3 nests, but we can not exclud the possibility, that there are other undiscovered nests, as nests in trees are difficult to find. Two nests are not far apart, the distance is about 3 km. The distance from these two nests to the third one, which is now destroyed, was larger, about 9 km.

In *Table 4* basic information on nests is presented. The accurate location of nests is sensitive information because of possible nest robbery. Therefore DOPPS will provide the Environmental Agency with accurate nest locations in a separate document which has to be kept and treated as secret.

Table 4: Basic information on known Golden Eagles' nests at wider Volovja reber area

Kr	The nest is located within large cavity in the rocky cliff in near Koritnice village. Distance from nearest proposed wind turbines is about 2 km.
Zb	The nest was located on small ledge on steep slope overgrown with Dawny Oak *Quercus pubescens* and European Hop-Hornbeam *Ostrya carpynifolia* in near Zabiče village. Distance from nearest proposed wind turbines is about 4 km. The nest was in year 1997 2 metres high, which proves it was used for many years. In Febrary 2001 nest was destroyed (Boštjan Surina, personal communication). Nest location was checked in July 2006, but no nest or remnants of the nest were seen (Tomaž Mihelič & Tomaž Jančar)
Vr	The nest is located on the large Austrian pine tree (*Pinus nigra*) in the area of proposed Volovja reber wind farm; between 200 and 300 m from nearest proposed wind turbine. Distance from nearest proposed wind turbines is between 200 and 300 m. The nest was discovered accidentally in Jun 2007 (Aleš Jagodnik).

In Table 5 are presented data on the breeding history of the Volovja reber pair of Golden Eagles. Data was collected from a thorough search of literature, personal communication with local biologists and from our own observations.

Collected data proves that in the last 19 years – from 1990 to 2008 – eagles were breeding in at least 11 years. As confirmed breeding we counted also observation of juvenile eagles before the end of

September. Watson (1997, p. 167) says, that for the first two months after leaving the nest eagles stay in the near vicinity of the nest. Eagles in Slovenia leave the nest about the end of July (Tomaž Mihelič, personal communication).

For 6 years there is no data available, it is not known whether nests were checked at all, although MKGP (1996) Decision says, that before 1996 eagles were regularly breeding in the nest near Zabiče village. For the remaining two years it is known, that eagles were not breeding in one of the nests, but there is no information whether the rest of the nests were checked.

On the basis of available data it is not possible to confirm, that in some years eagles were not breeding at all.

Table 5: Breeding information for the pair of Golden eagles at the Volovja reber in different years. Breeding: B – confirmed breeding; PB – possible breeding; ? – no data. Comments: p.c. – personal communication

Year	Breeding	Nest location	Comments
1984	?	Kr	The nest near Koritnice village is empty (6 April 1984) (Slavko Polak, p.c.)
1985	?	Kr	The nest near Koritnice village is empty (23 March 1985) (Slavko Polak, p.c.)
1990	**B**	**Kr**	Eagles were breeding in the nest near Koritnice village (Slavko Polak, p.c.)
1991	?		No information available
1992	?		No information available
1993	?		No information available
1994	PB	?	No information available On 29 January 1994 eagle was observed when performing territorial undulating flight over the north slope of the Volovja reber (Slavko Polak, p.c.)
1995	?	Kr	The nest near Koritnice village is empty (Slavko Polak, p.c.), no data available for other nests
1996	**B**	**Zb**	The eagles have nested in the nest near Zabiče village. “This nest is known for decades, the eagles have raised young nearly every year” (MKGP 1996)
	?	Kr	The eagle was observed sitting near the Koritnice nest (31 March 1996) (Slavko Polak, p.c.)
1997	**B**	**Zb**	The eagles have nested in the nest near Zabiče village (Surina 1999).
1998	**B**	**Zb**	The eagles have nested in the nest near Zabiče village (Surina 1999).
1999	**B**	**Kr**	The eagles have nested in the nest near Koritnice village (Surina 1999) The eagles have successfully raised two youngs in the nest near Koritnice village (Slavko Polak, p.c.)
	?	Zb	Eagles were observed repairing nest near Zabiče on 10th March and 14th May 1999 (Boštjan Surina, p.c.)
2000	?		No information available
2001	?	Zb	Location of the Zabiče nest was visited on 11th February 2001. The nest was destroyed (Boštjan Surina, p.c.), no data available for other nests

2002	PB	?	No information available. On 14 June 2003 second calendar year eagle was observed near Mt. Bele ovce (Jernej Figelj, p.c.)
2003	**B**	**?**	In 2003 eagle was observed twice when performing territorial undulating flight, first time on 24 May near Mt. Bele ovce (Slavko Polak, p.c.) and second time 9 June over western slope of the Mt. Milanka (Jernej Figelj, p.c.) **Juvenile** eagle was observed on 30 August 2003 over Mt. Goli vrh (Jernej Figelj, p.c.)
	?	Kr	The nest near Koritnice village is empty (4 June 2003) (Slavko Polak, p.c.), no data available for other nests
2004	**B**	**Kr**	The eagles have nested in the nest near Koritnice village; non-fledged young has disappeared from the nest in unclear circumstances (Luskovec 2005). On 3 December 2003 eagle was observed when performing territorial undulating flight near Mt. Devin at Trnovska bajta (Tome et al. 2004a).
2005	**B**	**Kr**	The eagles have nested in the nest near Koritnice village; non-fledged young has disappeared from the nest in unclear circumstances (Luskovec 2005). Pair of adult eagles was observed on 23 May 2005 sitting on the rocks of Mt. Bele ovce, which might indicate, that eagles were not taking carre for the young any more (Jernej Figelj)
2006	**B**	**?**	The nest near Koritnice is empty, no signs of nest at the location near Zabiče (18 July 2006) (Tomaž Mihelič & Tomaž Jančar) no data available for other nests **Juvenile** eagle was observed on 27 September 2006 over Mt. Velika Milanja (Željko Šalamun, p.c.)
2007	**B**	**Vr**	The eagles have successfully nested in the nest in the area of proposed Volovja reber wind farm, one young was raised (Aleš Jagodnik, p.c.)
	/	Kr	The nest near Koritnice village has been repaired (beginning of April 2007) (Slavko Polak, p.c.)
	/	Zb	On 10 June 2007 was observed adult eagle close to former nest near Zabiče village. Eagle was lacking one tail feather (Miha Krofel, p.c.). Obviously, the eagle was not one of those from Volovja reber, as they had complete tail feathers; this indicates possibility that there is another eagle's territory in the direction towards Gomance (Croatian border).
2008	**B**	**Kr**	The eagles have successfully bred in the nest near Koritnice village, one young was raised (Jernej Figelj, Tomaž Jančar, Tomaž Mihelič & Aleš Jagodnik)

B2.2. Observations of Golden eagles

Pair of Golden Eagle, together with current years young, are present at the proposed wind farm area and near surrounding all the time. In three systematic raptor surveys we recorded 99 observations of eagles (*Table 7*). Additionally we collected 104 incidental records of eagles (*Table 8*), which makes a total of 203 eagle observations in the period 2003 to 2007.

Most observations of golden eagles were recorded at the proposed wind farm area and its near proximity (*Figure 8*). According to available information eagles prefer south-western slopes of the ridge where the string of wind turbines is proposed, and on the ridge itself.

A young eagle which was raised in 2007 was observed exclusively at the proposed wind farm area. The majority of observations were within 1 km from the proposed wind turbines locations. The most

distant observation is from 22nd September 2007, when the young eagle was tracked to Mt. Ahac, about 4 km from the proposed string of wind turbines. Figure 13 shows 24 flight lines of young eagle recorded between August and November 2007. Additionally we have heard young eagle several times calling from various locations on the slope between Mt. Milanka and Mt. Župnica, beneath the proposed wind turbines string. Usually it was not possible to locate exactly the position of calling young eagle.

We continued frequent visits of the area also in 2008. Data is not processed yet, but it is already known, that the pattern of eagles' movements is very similar to that from the previous year. Even young eagle can be found in same area as in 2007. This was somewhat unexpected as in 2007 eagles nested in the nest at the proposed wind farm area while in 2008 they nested in the nest which is about 3 km away from the proposed wind farm.

We have collected interesting data on golden eagles activity from a special survey in the early morning of 8th November 2007 when 5 surveyors were recording eagles' flights between dawn and sunrise. Very intensive morning eagles' activity was recorded: in a single hour 13 observations of eagles were recorded and 15 flight lines plotted. It is worth mentioning that eagles were recorded several times flying further to the south-east, out of the surveyors' vision. This was the first visit performed that early in the morning. This survey indicates increased eagles' activity early in the morning. We have repeated the early morning visit on 10th November 2007 when 2 observers recorded 8 eagles' observations. This data indicates that we have missed a large proportion of the eagles' activity in other visits as we were too late, usually arriving well after sunrise.

Table 6: Data on number of Golden Eagle observations at the wider Volovja reber area. Legend: No of lines – number of observations for which more accurate information on location or on direction of flight was recorded.

	No of observations	No of lines
2003	21	16
2004	8	1
2005	29	7
2006	11	10
Total 2003-2006	69	34
2007 Jan – Jul*	38	30
2007 survey Aug-Sep	62	58
2007 Oct-Nov**	19	18
8 Nov 2007	13	15
2007 Total	132	121
Grand total	201	155

* incidental observation from 5.8.2007 is included

** observations from 8.11.2007 are not included

Table 7: Data on number of Golden Eagle observations at the Volovja reber area collected within three DOPPS's systematic raptor surveys.

DOPPS **May – Jun 2005**		**DOPPS** **Aug – Sep 2006**		**DOPPS** **Aug – Sep 2007**	
Date	No. of observations	Date	No. of observations	Date	No. of observations
3.5.2005	3	29.8.2006	3	10.8.2007	2
8.5.2005	0	2.9.2006	1	15.8.2007	4
13.5.2005	3	5.9.2006	1	20.8.2007	0
16.5.2005	3	12.9.2006	0	25.8.2007	3
22.5.2005	1	19.9.2006	2	30.8.2007	6
23.5.2005	4	22.9.2006	1	4.9.2007	0
29.5.2005	4	27.9.2006	1	8.9.2007	5
2.6.2005	3			9.9.2007	10
7.6.2005	3			14.9.2007	11
13.6.2005	4			19.9.2007	0
				20.9.2007	5
				22.9.2007	5
				23.9.2007	8
				25.9.2007	2
				30.9.2007	1
TOTAL	28	**TOTAL**	9	**TOTAL**	62

Table 8: Data on number of observations of Golden Eagles at the Volovja reber area collected both, within systematic surveys and incidentally

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**total**
2003					5	6		2	3	1	1	3	**21**
2004			2	1	5								**8**
2005					18	11							**29**
2006								3	8				**11**
2007			1	5	6	13	11	17	47	5	29		**134**
total	**0**	**0**	**3**	**6**	**34**	**30**	**11**	**22**	**58**	**6**	**30**	**3**	**203**

Figure 8: Lines of golden eagles flight recorded at wider Volovja reber area in years 2003 to 2007. Legend: purple dots – locations of proposed wind turbines; blue dots – locations of proposed power line pylons. [155 lines]

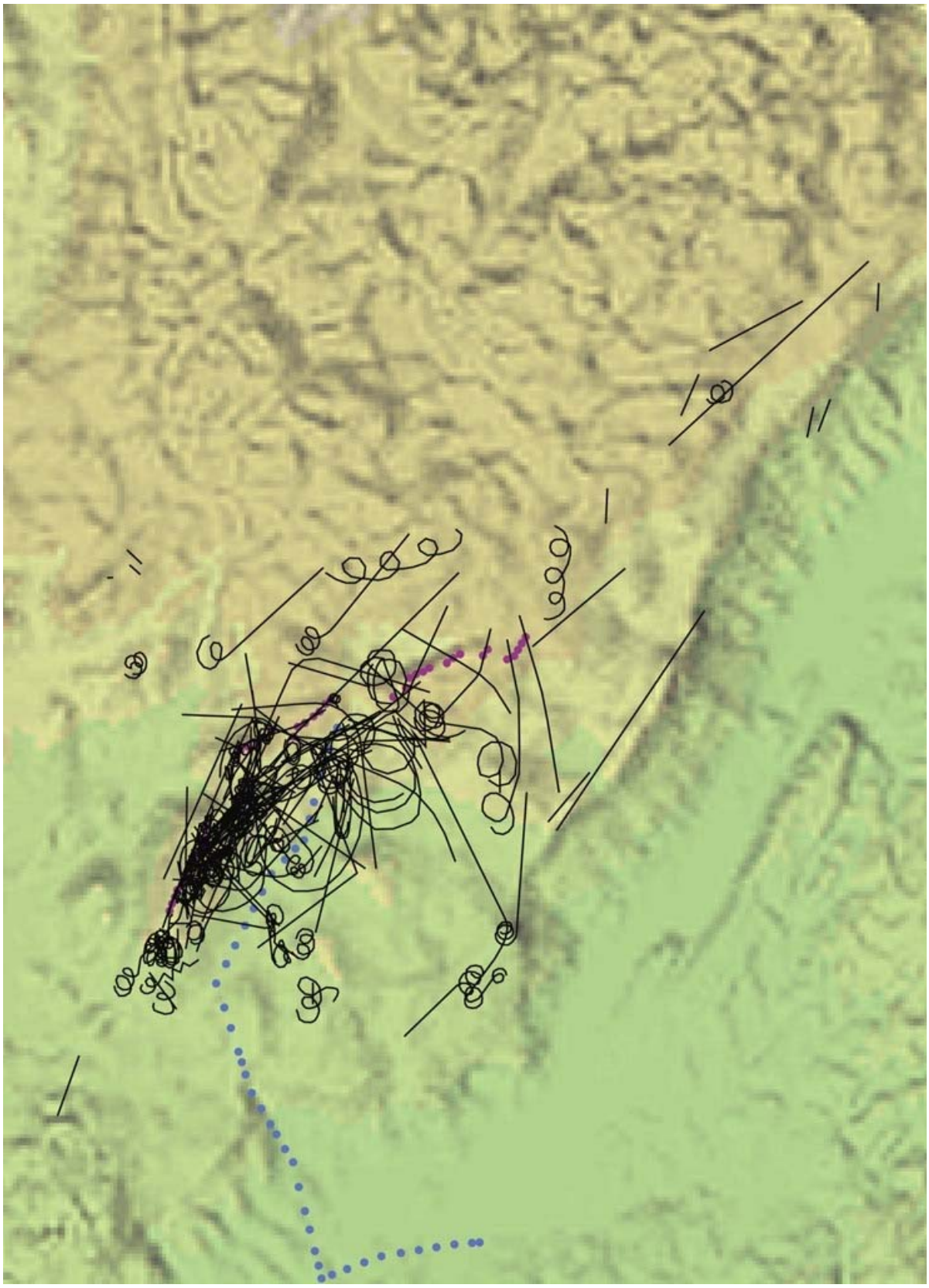


Figure 9: Lines of golden eagles flight recorded at wider Volovja reber area in years 2003 to 2006. Legend: purple dots – locations of proposed wind turbines; blue dots – locations of proposed power line pylons. [34 lines]

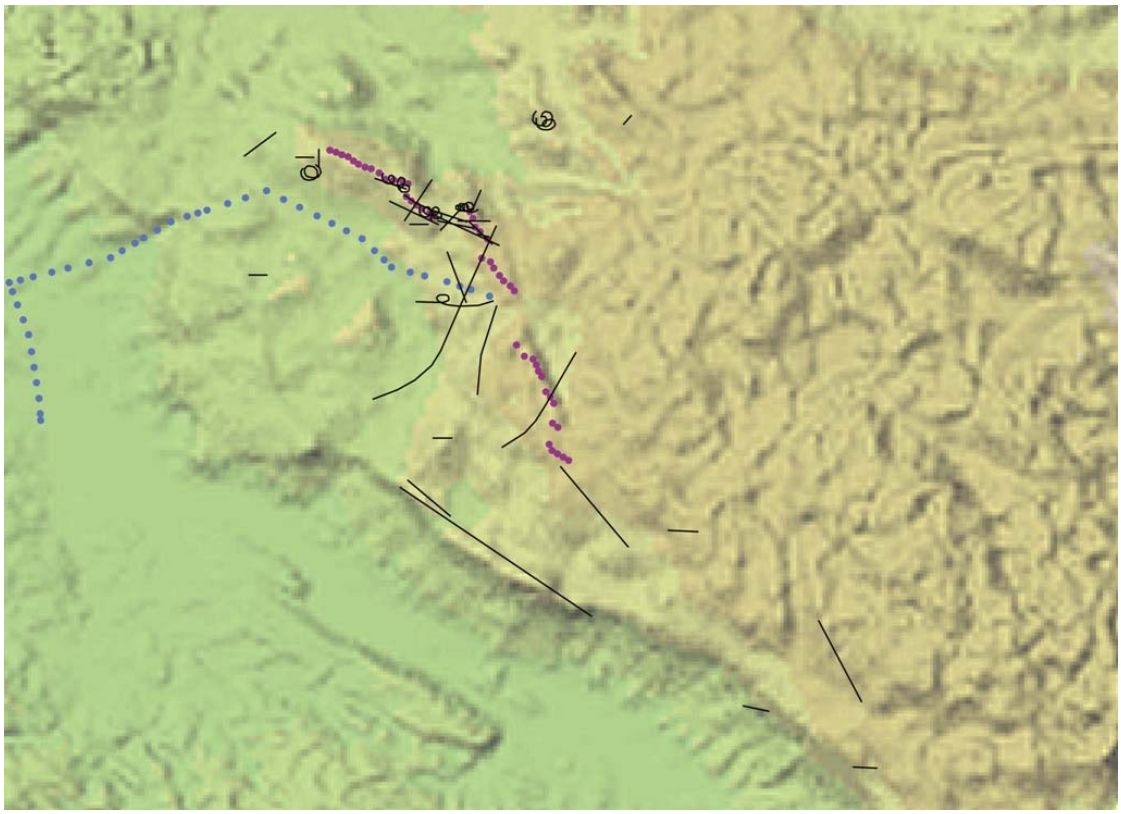


Figure 10: Lines of golden eagles flight recorded at wider Volovja reber area in year 2007 (without data recorded in systematic raptor survey in August and September 2007 and on 8th November 2007). [48 lines]

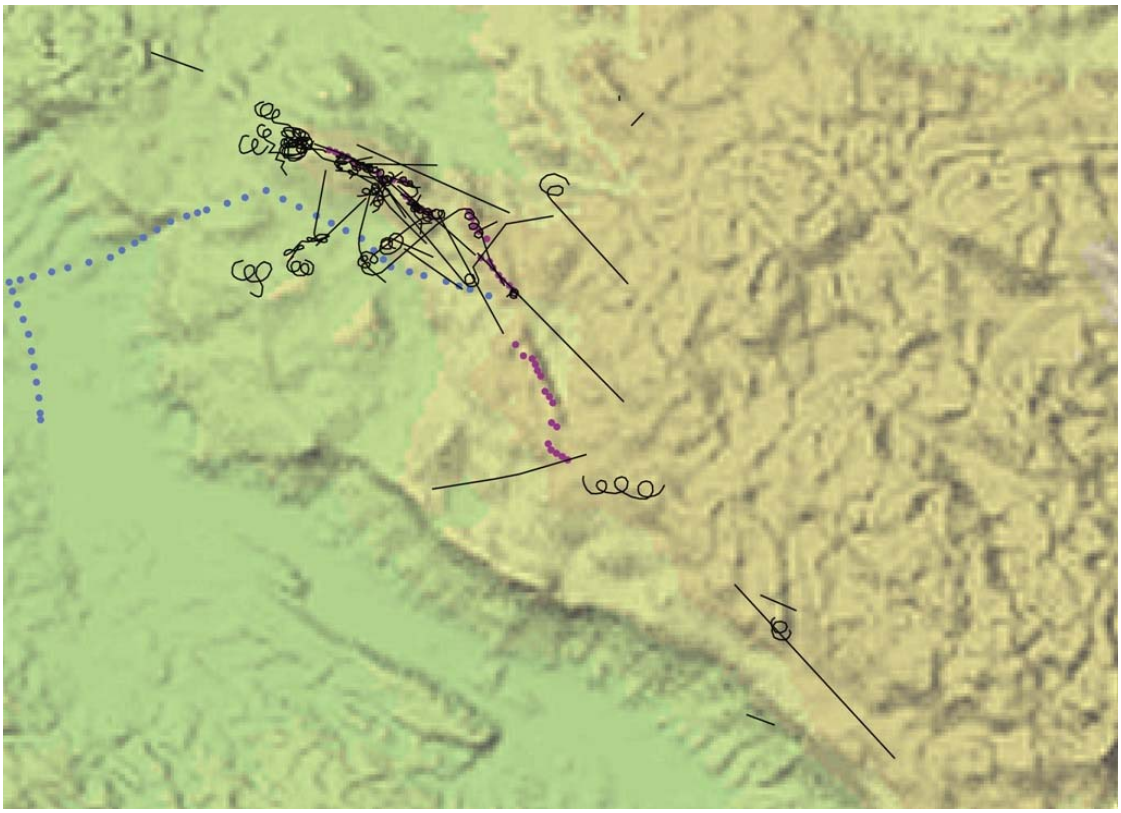


Figure 11: Lines of golden eagles flight recorded at Volovja reber in 2007 systematic raptor survey (August and September). Legend: purple dots – locations of proposed wind turbines; blue dots – locations of proposed power line pylons. [58 lines]

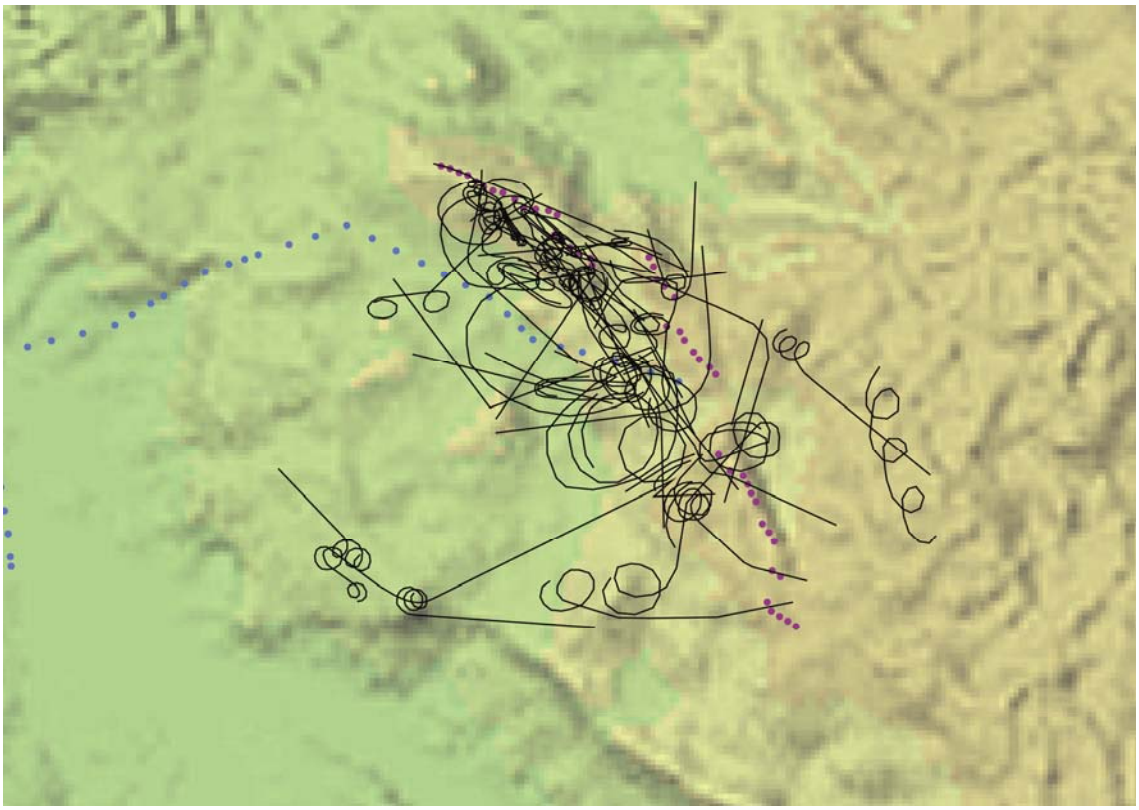


Figure 12: Lines of golden eagles flight recorded between 6:48 and 7:47 a.m. on 8th November 2007 at north-eastern part of proposed Volovja reber wind farm. [15 lines]

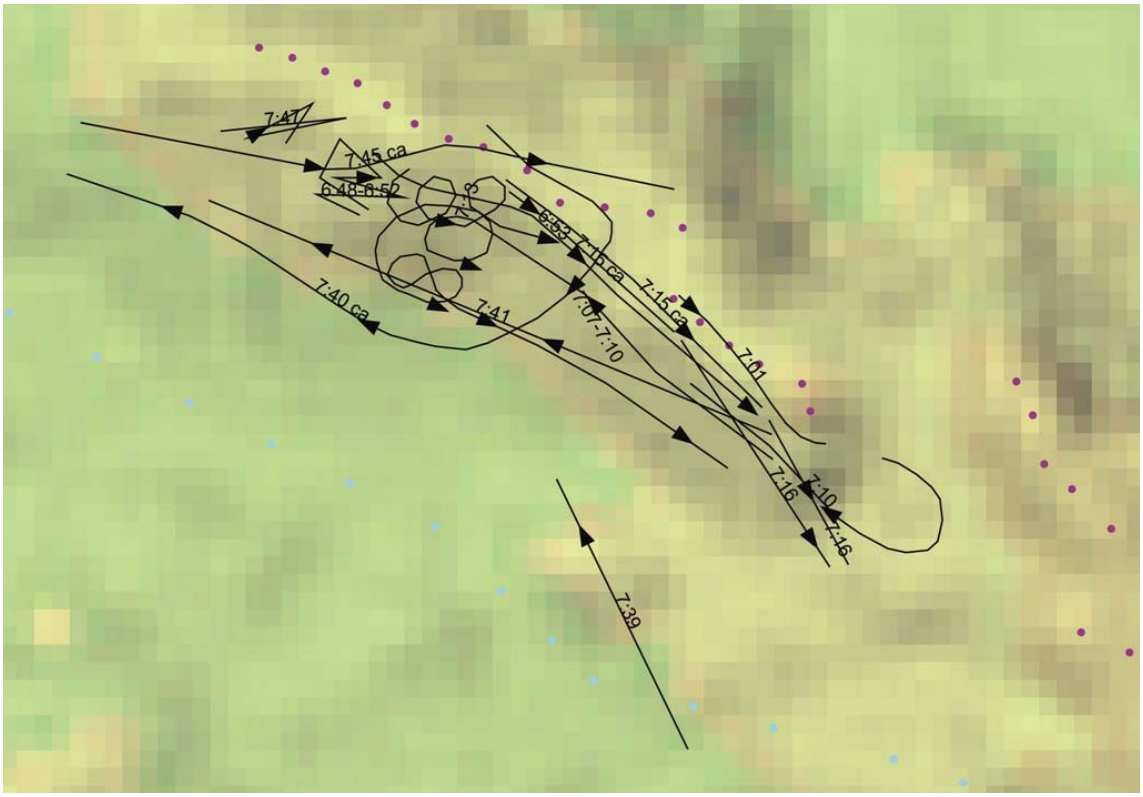
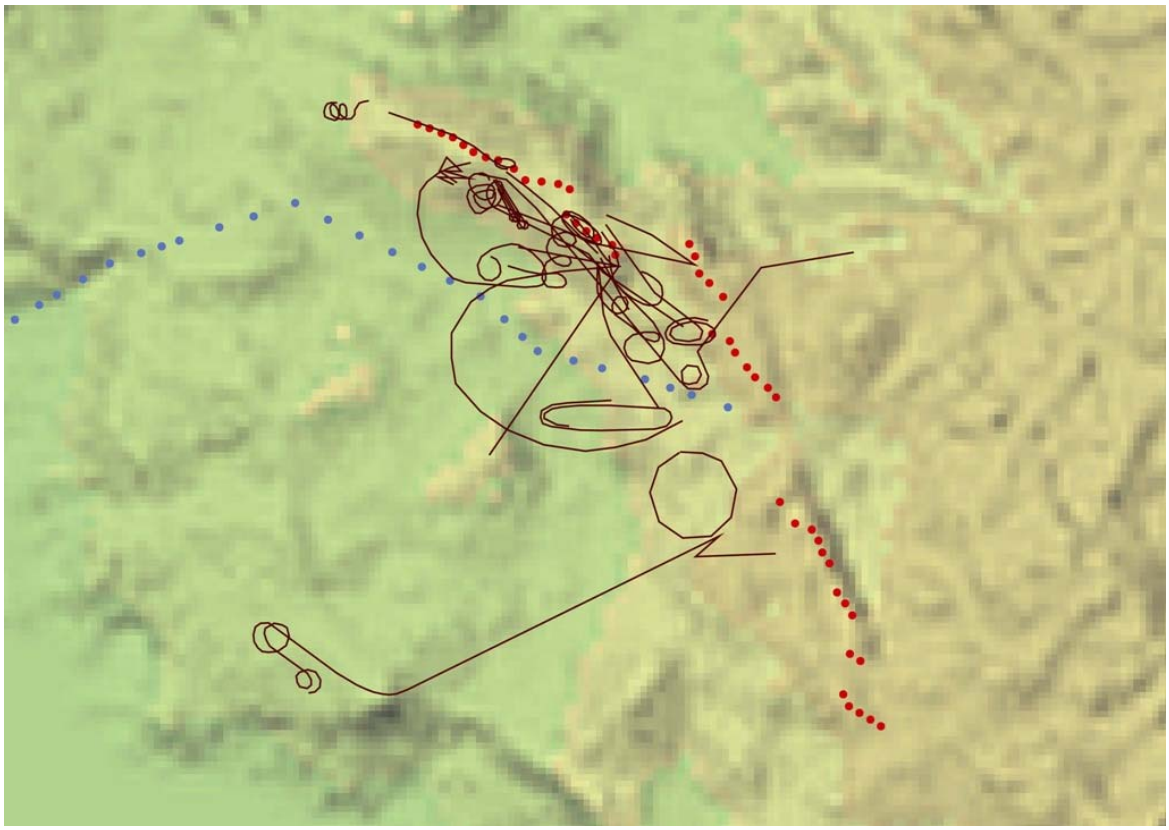
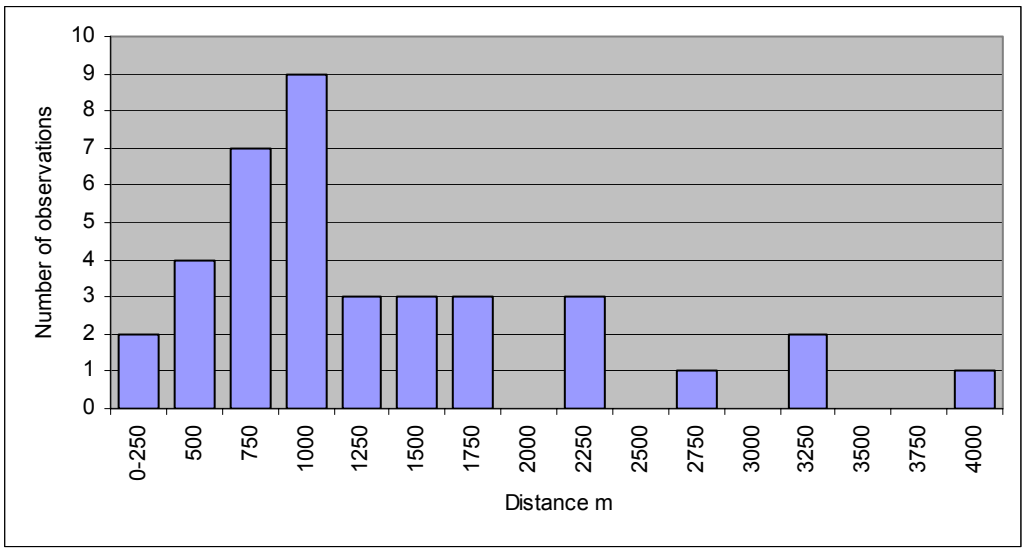


Figure 13: Lines of juvenile eagle's flight recorded at Volovja reber between August and November 2007. Legend: red dots – locations of proposed wind turbines; blue dots – locations of proposed power line pylons. [24 lines]



Data gathered from vantage points in the 2007 survey was analysed to get information on how close eagles approach to observers (*Figure 14*). Eagles approach to observers closer than 500 m in only about 15% of all observations.

Figure 14: Shortest distance of observed eagles from observers at vantage point; recorded in systematic survey in autumn 2007 [n = 38]



We paid special attention to distinct eagle activity. We recorded the locations where we observed eagles perching or landing and places where eagle was observed performing territorial undulating flight.

We recorded 38 locations where eagle was observed landing or perching (one from literature) with a total 54 incidents of perching/landing (three from literature) (*Table 10, Figure 15*)

Furthermore, we recorded 9 incidents of eagle performing territorial undulating flight (one from literature). All except one were on the ridge where the string of wind turbines are planned or in its immediate surrounding (*Table 9, Figures 15* and*16*)

Table 9: List of locations where territorial undulating fligjhts of eagles were observed

Pt. no.	Location	Date	Time of the day	Observers
16	Žlebovi	29.1.1994	?	SP
17	Mt. Bele ovce	24.5.2003	18:30	SP
18	Mt. Milanka - NW slope	9.6.2003	?	JF
19	Mt. J.Devin (location provisional)	3.12.2003	?	(Tome et al. 2004)
20	Volovja reber - ridge	7.4.2007	10:00	TJ
21	Volovja reber – S slope	25.6.2007	12:50	AJ
36	Mt. V.Milanja	20.9.2007	17:10	IB
38	Mt. Peščine	20.9.2007	12:20	PT, IB
44	Mt. Milanka – NW slope	10.11.2007	6:52	TJ,AJg
53	Mt. Veliki Razbor – W slope	29.9.2008	13:12	TJ,AJg
54	Mt. Veliki Razbor – E slope	29.9.2008	13:22	TJ,AJg

Table 10: List of locations where eagles were observed landing or perching. Location: WT – proposed wind turbine location

Pt. no.	Location	Type of perch	Date	Time of day	Duration of perch. [min]	comments	Observers
4	Mt. Bele ovce – rocks on SW slope	rock	24.5.2003	18:30	125	adult eagle; several callings recorded	SP
			3.12.2003	?	?	eagle landed several times	Tome et al. (2004)
			3.5.2005	8:45	?	adult eagle	JF
			13.5.2005	8:15	?	adult eagle	JF
			23.5.2005	11:26	?	adult eagle	JF
			23.5.2005	16:00	?	pair of adult eagles (photo)	JF
			6.6.2005	?	?	one eagle sitting; "I saw it here several times this days"	BS
			9.5.2007	8:40	12	adult eagle (photo)	TJ
			9.9.2007	10:50	?	adult eagle and juvenile	PT,MS
			9.9.2007	13:35	?	adult eagle is feeding juvenile	PT,MS
			14.9.2007	8:06	?	adult eagle	TJ,BR
			20.9.2007	10:50	?	adult eagle and juvenile	PT,IB
			25.9.2007	10:08	19	juvenile eagle is exposing to sun and preening feathers	AF
			8.11.2007	7:01	5	juvenile eagle	TM
5	Mt. Bele ovce - peak	rock	14.4.2007	17:25	35	adult eagle (photo)	TJ
6	Mt. V.Milanja - Zob	rock	3.12.2003	?	?	eagle landed several times	Tome et al. (2004)
7	Volovja reber – near WT no 14	pine	23.6.2007	13:45	?	adult eagle (photo)	AJg
8	Volovja reber – slope	pine	27.6.2007	19:20	3	adult male	TM,TJ

	beneath WT no 6						
9	Mt. Milanka - slope beneath WT no 3	pine wood	27.6.2007	19:25	5	pair of adult eagles	TM,TJ
10	Volovja reber – foothills beneath WT no 10	pine	5.7.2007	19:38	10	adult female	TJ
12	hill beneath Mt. Škedenc	pine	27.6.2007	9:10	15	adult female (photo)	TM,TJ
13	above Mrzli dol valley (location provisional)	spruce?	3.12.2003	?	?	eagle	Tome et al. (2004)
14	Mt. Planina – near hunters watchtower	ground	2.9.2006	7:50	?	eagle	IB
15	Mt. Milanka – SW slope	pine	24.12.2003	?	?	adult eagle	JF
22	Volovja reber – slope beneath WT no 10	pine	31.3.2007	ca. 16h	1	adult eagle (photo)	AJg
23	Mt. Bele ovce – middle of SW slope	ground	28.7.2007	10:40	?	adult eagle (photo)	AJg
			8.9.2007	13:10	15	juvenile eagle	AJg
24	Mt. V.Milanja - bunker at E slope	bunker	10.8.2007	15:45	5	adult eagle, strong wind	TJ,AJn
25	Volovja reber – slope beneath WT no 12	dead pine	15.8.2007	10:55	1	adult female (photo)	AJg
26	Volovja reber – slope beneath WT no 15	pine	15.8.2007	10:55	5	female observed landed near to male eagle, which was pearchin there before (photo)	AJg
27	Mt. V.Milanja – road on SW slope	road puddle	14.4.2007	/	/	eagles footprints in road puddle, where it presumably drunk (photo)	TJ
28	Mt. J.Devin – N of the peak	pine	30.8.2007	10:03	16	male eagle	TJ,AF
29	Mt. J.Devin – NW of the peak	pine	30.8.2007	11:33	12	male eagle	TJ,AF
30	Mt. Župnica – NW slope	pine	30.8.2007	12:40	30	male eagle	TJ,AF
31	hill 940 - 400 m W of Mt. Peščine	pine	30.8.2007	13:15	3	male eagle	TJ,AF
32	hill 400 m SW from Mt. Lunjevica	pine	30.8.2007	18:26	1	female	TJ,AF
33	Mt. Bele Ovce - SW slope, upper part	pine	14.9.2007	16:28	10	adult eagle	TJ,BR
			8.11.2007	7:16	max 5	juvenile eagle	TM
34	Mt. Suhi vrh – NW slope	spruce	14.9.2007	11:18	?	adult eagle	TJ,BR
35	Mt. Čačetov vrh, peak	spruce	14.9.2007	15:16	?	adult eagle	TJ,BR
37	Volovja reber – slope beneath WT no 6	ground	23.9.2007	13:10	1	adult eagle landed mobbed by 3 ravens	AJg
			23.9.2007	15:25	3	adult eagle and juvenile	AJg
39	Mt S.Devin	rock	5.9.2006	7:56	?	eagle circling low and landing briefly from time to time	IB
40	Sleme	pine	3.11.2007	9:58	?	adult eagle	TJ,,AJn
41	Mt. Milanka – SW slope	pine	10.11.2007	9:47	7	adult eagle	TJ, AJg
42	Mt. Milanka – W slope	pine	10.11.2007	9:44	10	adult eagle	TJ, AJg
43	Mt. Milanka – W slope	pine	10.11.2007	9:44	3	adult eagle	TJ, AJg
45	Mt. Župnica - SZ pobočje	spruce	22.9.2007	16:14	5	juvenile eagle	AR,BŽ
46	Mt. Župnica - S pobočje	ground	22.9.2007	16:20	?	juvenile eagle	AR,BŽ
47	Mt. Velika Milanja	rock	9.9.2007	9:30	35	juvenile eagle, mobbed by kestrels, buzzards and ravens	PT,MS
48	Volovja reber – foothills beneath WT no 12	?	9.9.2007	13:35+	?	juvenile eagle	PT,MS
49	Mt. Milanka - beneath WT no 4	pine	11.11.2007	13:00	5	juvenile eagle	AJg
50	Mt. Milanka – peack	pine	11.11.2007	13:19	?	adult eagle	AJg
51	hill 866, W from Mt. Milanka	pine	11.11.2007	13:30	?	juvenile eagle	AJg

Figure 15: Map of locations where Golden Eagles were observed perching or landing (hexagrams) and performing territorial undulating flights (lightenings); purple dots – proposed wind turbines; light blue dots – pylons of proposed power line.

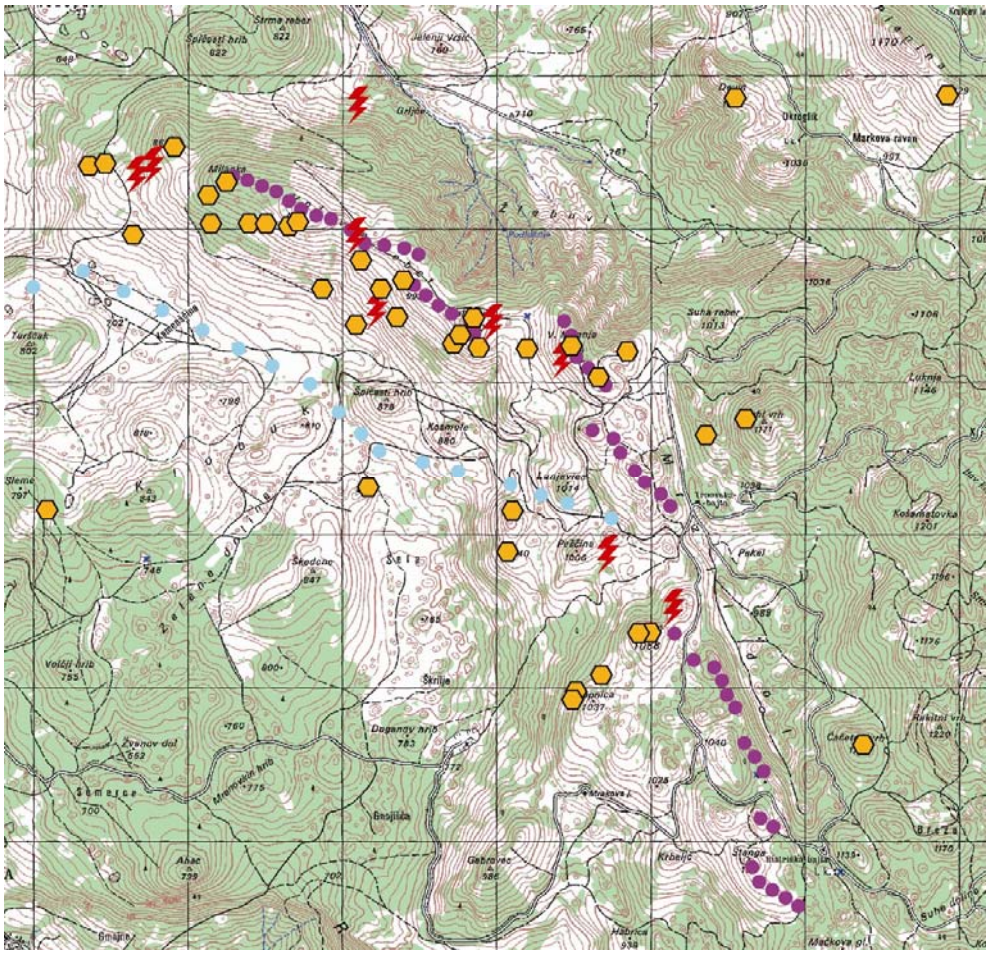
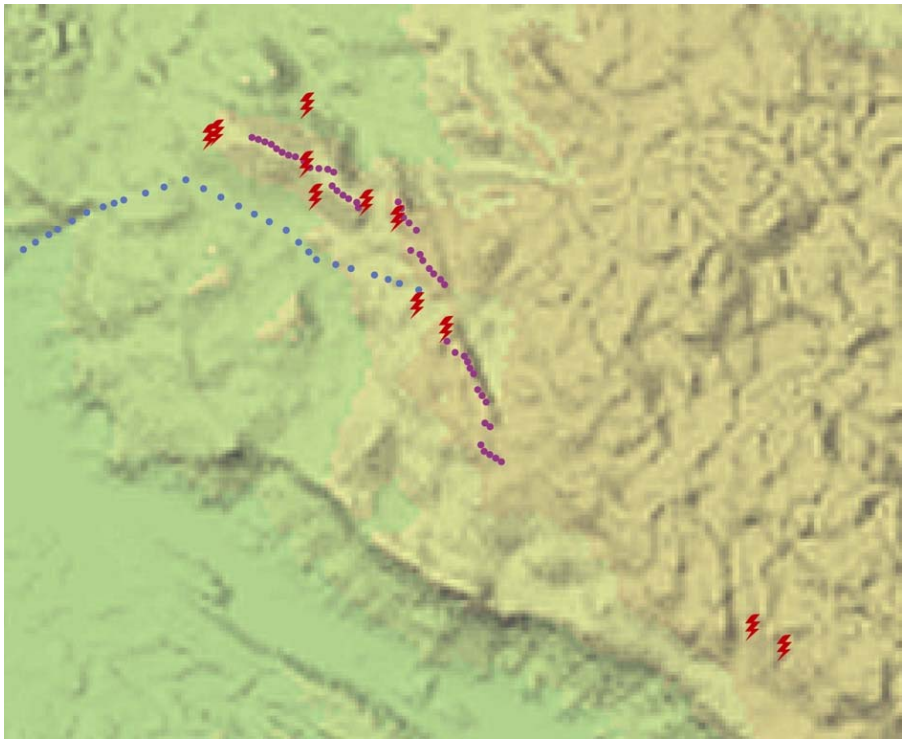


Figure 16: Locations where territorial undulating flights were recorded.



B2.3. Flights through individual wind turbine areas

Until end of 2007 we recorded in total 202 flights of individual eagles through the areas of individual wind turbines. Out of this 74 flights were recorded in the 2007 survey, when we paid special attention to this element of the survey. In the 2005 and 2006 surveys we recorded only 12 such flights, as this was not part of the focus of the survey. Additionally 116 such flights were recorded in various occasional visits, out of this 87 are from 2007 (*Table 11, Figure 17*). It is worth stressing that 11 of these flights were recorded in the morning of 8th November 2007. All these flights were recorded within single hour between 6:48 and 7:47 a.m., in the time about sunrise.

To understand the pattern of occurance of the eagles at Volovja reber area the following information, which is so far available only for the 2007 survey is interesting: out of 62 observations of golden eagles there were 33 observed at least once flying through the wind turbine area, 9 observations were above the wind turbine area, and for only 26 observations eagle did not approach wind turbine areas at all. The total doesn't match as in some cases eagle crossed some sectors within the wind turbines area and other sectors above it, so the observation was recorded in both categories.

Table 11: Number of eagle flights through area of individual wind turbines recorded at different windfarm sectors. Capitals A to H indicates sectors of wind turbines string, see Figure 6.

	A	B	C	D	E	F	G	H	total
2005 & 2006 survey	0	1	5	3	1	0	2	0	12
2007 survey	11	29	20	10	2	0	1	1	74
incidental 2007	9	47	19	6	5	0	0	1	87
incidental 2003-2006	0	0	17	12	0	0	0	0	29
total	20	77	61	31	8	0	3	2	202
total %	10%	38%	30%	15%	4%	0%	1%	1%	

Figure 17: Number of eagle flights through area of individual wind turbines recorded at different windfarm sectors (capitals A to H indicates sectors of wind turbines string): dark blue – 2007 survey, purple – 2005 & 2006 survey; yellow – incidental observations 2007; light blue - other incidental observations.

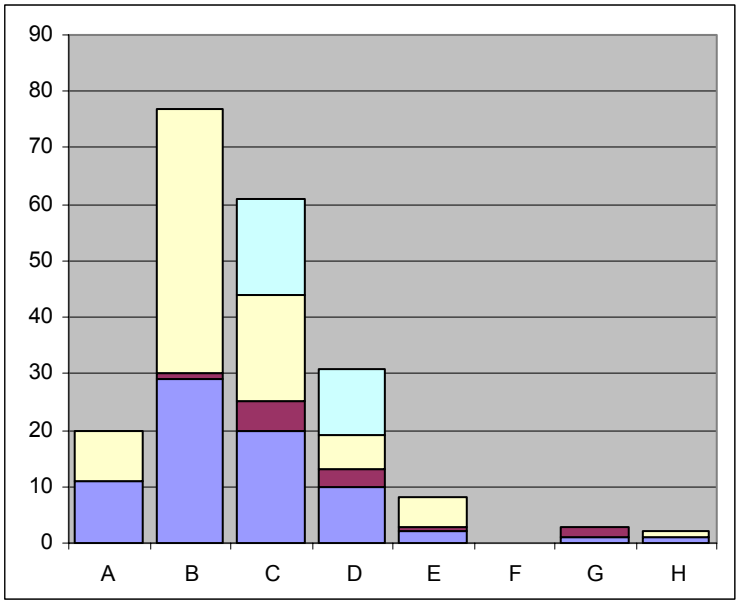
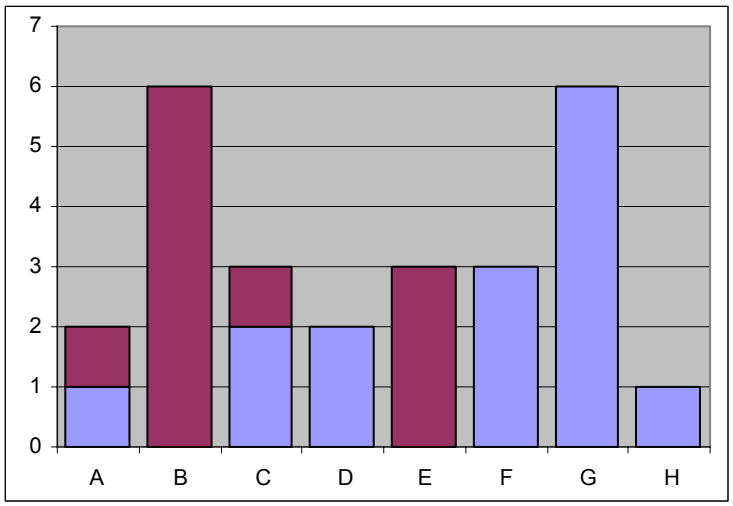


Figure 18: Number of eagle flights above the reach of wind turbines (>80 m) recorded at individual wind farm sectors: capitals indicate individual wind farm sectors).



B3 – Discussion

B3.1. Data on breeding and on location of nests

Number of nests and territories

Golden eagles maintain several nests within their territory which are used for nesting alternately between years. For Scotland Watson (1997, p. 84) reports 4.5 nests per pair on average. For the wider Volovja reber area so far 3 nests are known, but it is not possible to exclude, that there are additional nests which are not yet discovered.

Among ornithologists in Slovenia it is believed that all known nests from the wider Volovja reber area belong to a single pair of eagles, although it seems that nobody has ever studied this. Nevertheless, our recent investigations confirm this. Available data indicates alternating nesting in three known nests (see *Table 5*). An important argument for this is observation of a pair of eagles on 29th September 2008 at Mt. Veliki Razbor area (not far from former nest near Zabiče village). One of the eagles was observed performing territorial undulating flight twice. From the photographs taken it was possible to identify that the birds are the same as nested this year in the nest near Koritnice village.

The only information indicating possible existence of a neighbouring territory further south-east in the direction of the Croatian border is observation of third adult eagle on 10th June 2007 near Zabiče village. The eagle was lacking one tail feather, while both adult eagles from Volovja reber had complete tail feathers. Due to limited space this possible neighbouring territory would have to spread largely beyond the Croatian border.

Watson (1997, p. 338) summarizes information on average distance between neighbouring eagles' territories from various parts of Europe. In the Pyrenees the distance is between 10 and 14 km, in the Apennines from 18 to 21 km, in the French Alps from 9 to 10 km, in Sweden from 10 to 17 km and in Scotland mainly from 3 to 5 km (given information indicates average values from a number of surveys cited by Watson). In the Slovenian Alps this distance is about 8 km (Tomaž Mihelič, personal data). As the distance between the known nests in the wider Volovja reber area is up to 9 km, this might indicate that the nests belong to two neighbouring territories. But spatial conditions do not support this. There is only a narrow belt of meadows between Snežnik forests in the north-east and the populated valley in the south-west available to eagles for hunting. This rather points to a single narrow and prolonged territory.

The existence of only one golden eagle territory within IBA Snežnik-Pivka is also indicated by a study made by the Biotechnical Faculty of Ljubljana University (Trontelj 2006). Here the author carried out spatial analysis of suitable hunting grounds available for Golden eagles within this IBA. The findings indicate that the wider Volovja reber area provides suitable hunting habitat sufficiently large for only

one pair of Golden eagles (*Figure 19*). Habitat conditions in neighbouring Croatian areas were not analysed in this study.

Hereafter we'll presume that there is only one Golden eagle territory in the wider Volovja reber area. We leave open the possibility that a neighbouring territory exists further south-east spreading largely beyond the Croatian border

DOPPS has been intensively gathering data on Golden eagle eyries for more than decade. Currently a paper on the subject is in preparation (Mihelič et al., in preparation). According to available data the Volovja reber territory is the only one in the region. The closest territories within Slovenia are on Mt. Nanos and at Kraški rob, both about 30 km away. The distance to the centres of the closest known Croatian territories in Čičarija and on Mt. Obruč above Rijeka is a bit smaller, about 25 km (Ivan Budinski, personal communication)

Vitality of the territory

Available data indicates that Volovja reber eagles nest virtually every year. For a 19 year time period (1990 to 2008) nesting is confirmed for 11 years, while there is no data indicating, that in some years eagles did not nest at all (*Table 5*). Furthermore there are two sets of confirmed consecutive years with eagles nesting: one for 4 years (1996 to 1999), when local biologist Surina (1999) was studying birds in the region, and second for 6 recent consecutive years (2003 to 2008) when DOPPS has been gathering data within "the case of Volovja reber".

Every year breeding is not common in golden eagles. Watson (1997, p. 145) provides data for western Scotland, where eagles fail to nest on average in 26% of years, while in eastern Scotland, where there are territories richer in prey, eagles fail to nest in 12% of years. The proportion of years, when eagles fail to nest, is larger in territories with poorer food supply. Data on virtually every year nesting in Volovja reber eagles might indicate vital territory, which offers good food supply.

Another information which might indicate higher attractiveness of the territory is that one of the known nests is in a tree, and one was on the small rock ledge exposed to weather. Golden eagles' nests in trees are not very common. Eagles prefer to nest in overhang cliffs, where they are protected from the weather. They nest in trees only when appropriate cliffs are not available in the vicinity (Watson, p. 97). In the whole wider Volovja reber area there is only one larger overhanging cliff with a suitable nest site. And even this is somewhat distant from the most open grassland areas suitable for hunting. The fact that eagles chose a territory with poorer nesting possibilities might indicate good feeding possibilities.

B3.2. Data on observations of eagles

After reaching maturity and occupying a territory golden eagles spend the large majority of their life within it, in the area of its hunting and nesting grounds (Watson 1997, p. 90). A pair does not use the whole territory with equal intensity. Within the territory it has its preferred hunting areas (Watson 1997, p. 91). Below we discuss several indices showing that the area of the proposed wind turbines string is within one of such favoured hunting grounds, and that the wind farm is proposed in the very core of the eagles' territory.

The locations of the three known nests itself indicates that the wind farm is proposed in the very centre of the territory. The eagle observation data confirms this entirely. Eagles spend a large proportion of time on the ridge of the proposed wind turbines string and on the slope beneath it (*Figure 8*). In years 2007 and 2008 (processing of data for 2008 is not completed yet), for which we have most data, eagles probably spent most of the time here (*Figures 10 to 13*).

The collected data does not show a completely reliable picture of the distribution of eagles' movements as we spent disproportionately more survey time at the proposed wind farm area compared to other areas in the vicinity with suitable habitat. As occasional observers didn't record the cumulative time spent observing it was not possible to evaluate this. Nevertheless we can estimate that the frequency of eagles' movements is considerably higher at the area of the proposed wind farm than in other areas in the surroundings.

The distribution of eagles' flights in 2007 and in 2008 seems quite similar. We find this important as eagles nested in different nests in these two years: in 2007 they nested in the nest about 200 to 300 m from the nearest proposed wind turbine, while in 2008 they nested in the nest near Koritnice village, which is about 2 km away. We believe that this is another indication that this part of the territory is disproportionately important to the pair of eagles.

Observations of the undulating territorial flights of eagles additionally confirm that Volovja reber might be in very centre of the territory. Undulating flight represents a message to neighbouring pairs of eagles that a territory is occupied. Usually eagles perform undulating flights in the vicinity of a nest and sometimes close to the borders of the territory (Collopy & Edvards 1989, p. 48; Watson 1997, p. 90 and 130). Out of 11 observed undulating flights 9 were recorded at the area of proposed wind farm (all less than 800 m from the nearest proposed wind turbine).

Another indication which shows that eagles might favour the area of the proposed wind farm is the fact that the pair built a nest in the tree exactly here. Locations of nests in cliffs depend on availability of cliffs, while suitable trees are abundant. The fact that the pair chose the tree in this area might indicate that the area suits eagles disproportionately.

According to Watson (1997, p. 91) a pair of eagles usually use three to four roosts where they spend the night. In our surveys we didn't search for the roosts. But a few evening eagle observations might indicate that one of the roosts could be on the south-western slope of the Mt. Milanka, in the south-western end of the proposed wind farm, which is overgrown with open Austrian pine wood. This is one of the most undisturbed parts of the area as it is away from roads and paths. This might be another indication that eagle favour the area of the proposed wind farm.

For the purpose of Environment Impact Assessment the Biotechnical Faculty of Ljubljana University made a spatial analysis of suitable habitat for Golden eagles within Snežnik-Pivka IBA (Trontelj 2006). In the model the author identified as suitable habitat for eagles open areas which are more than 1 km away from human settlements, which are higher than 700 m a.s.l. Trontelj identified 5 areas where suitable habitat is more abundant. But Trontelj estimates that the available habitat is only sufficient for only one pair of eagles (*Figure 19*). *Figure 20* shows suitable hunting habitat for Golden eagle according to the model from Trontelj (2006) combined with the lines of recorded eagles flights (see *Figure 8*). It can be seen that most eagles flights were recorded in the areas which Trontelj (2006) estimates as suitable for eagles. Furthermore, the concentration of recorded eagles flights correspond to area which Trontelj believes is the centre of the territory.

Figure 19: SPA Snežnik-Pivka (blue line) and potential hunting areas of the golden eagle (green areas). Numbers indicates complexes of more abundant suitable habitat. Reprinted from Trontelj (2006).

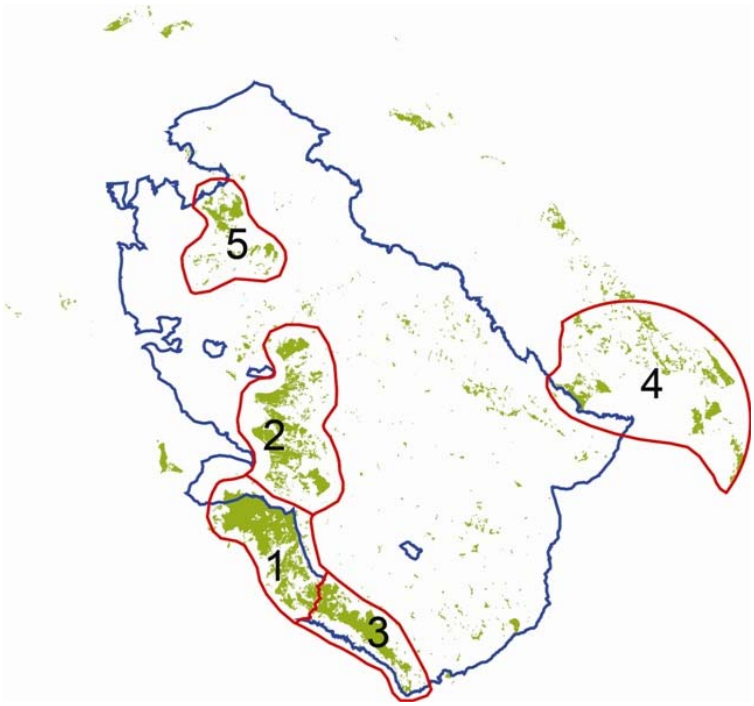
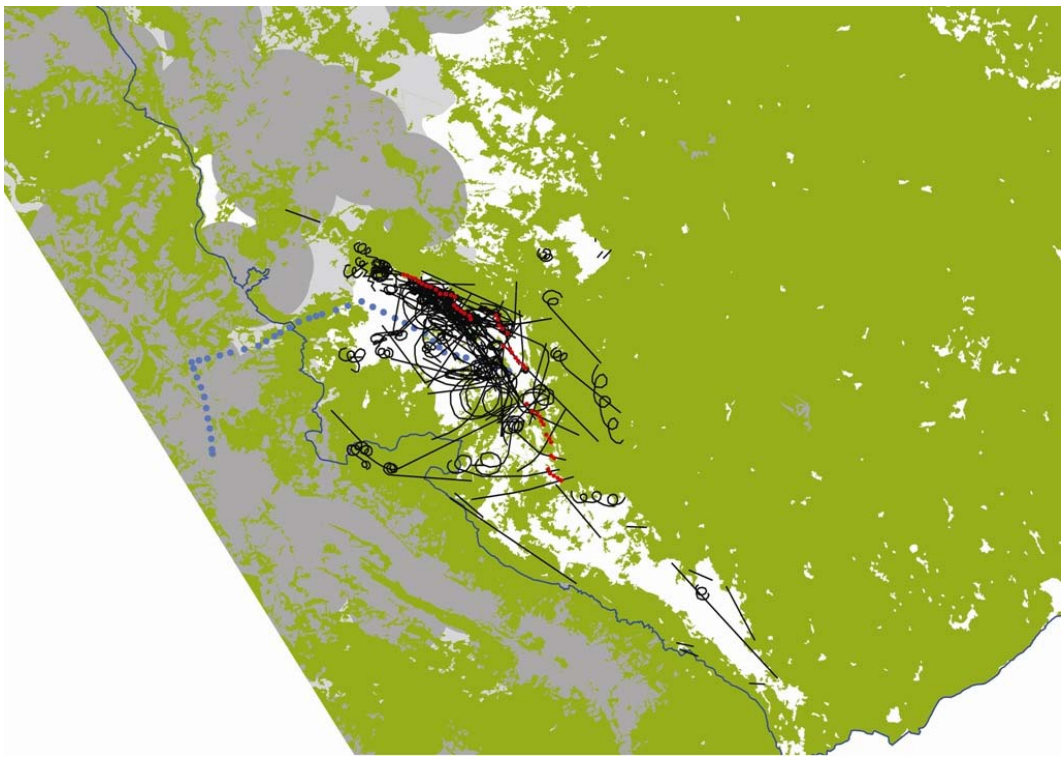


Figure 20: Suitable hunting habitat for golden eagle (white) according to model from Trontelj (2006) compared with lines of eagles' flights. Dark grey – open areas within 1 km from human settlements; light grey – open areas below 700 m a.s.l.; green – forests and urban; blue line – border of the IBA Snežnik-Pivka.



B3.3. Biases in recording bird activity

When assessing the impact of a proposed wind farm to birds it is vital to know the patterns of bird movements within the area. Scottish Natural Heritage (SNH 2005) has proposed a standardised method for recording bird activity at the site of proposed wind farms. The method of recording birds from vantage points is widely used. A similar method was applied for the Volovja reber surveys. Nevertheless, the method has several shortcomings which leads to underestimation of bird activity (Madders & Whitfield 2006). Hereafter we discuss various factors leading to underestimation.

Initially it is important to select vantage points properly. One of the limitations is that detectability decreases with distance from the observer. For the impact assessment of wind farms therefore SNH (2005) proposes that no part of the proposed wind farm should be more than 2 km from a vantage point. This means, that for larger wind farms more than one vantage point should be applied. Another factor is disturbance that observers impose on birds – many raptors avoid approaching observers. SNH (2005) therefore propose that no part of the proposed wind farm should be closer than 500 m to vantage point. Observations closer than that are heavily biased. The same was confirmed by our field work (*Figure 14*); eagles were rarely observed at a distance less than 500 m.

If we were to follow SNH (2005) guidelines we would have to record bird activity simultaneously from 3 vantage points to adequately cover the whole string of proposed wind turbines. We were working most of the time from only one vantage point, which lead to considerable underestimation of bird activity. Furthermore, most of the times (96%) we were working from the vantage points that are located exactly on the proposed string of wind turbines. It was obvious that raptors often changed their direction of flight if they would have to approach too close to observer if continuing flight in original direction.

SNH (2005, p. 44) stresses another factor: after a certain time of intensive bird recording the efficiency of the observer starts to decline. The SNH method therefore limits duration of recording to a maximum of 3 hours per observer. After this time an observer has to be replaced with a fresh one. In the DOPPS surveys observers were recording birds for a full day, which would lead to some missed observations.

An overview of biases in recording raptor activity is given by Madders & Whitfield (2006); all factors given are leading to underestimation of bird activity:

- missed observations: the observer is able to watch through telescope/binoculars only one bird of group of birds, therefore it is realistic that some birds will pass by undetected; the more birds in the air simultaneously the more the observer will miss;
- acuity of the observer: important especially for raptors, which are difficult to identify and are often observed from a larger distance; the experience of the observer and his acuity has a large influence on his results – the same was found in our surveys: there were major differences between observers in detecting raptors;
- visible area: often it is not possible to see the whole proposed wind farm area; the reason can be undulating terrain or sudden weather conditions; furthermore it is more difficult to observe a bird which is above horizon line, than if it is below it;
- angle of visible area: from vantage point an observer can theoretically have good vision to all 360° of surrounding terrain, but in fact an observer can watch much less than 180° simultaneously; birds flying out of the angle of detection will therefore be missed;
- detectability: it is more difficult to detect a bird that is flying rapidly in a straight line than one that is circling slowly above the area; additionally it is easier to observe large birds than small ones;
- avoiding the observer: many birds, especially large ones tend to avoid approaching observers, authors provide information that observations at a distance less than 750 m are underestimated.

Our observations confirm the experience of other authors on the influence of observers on birds activity. Bird photographer Aleš Jagodnik has photographed birds at Volovja reber several times during the 2007 survey. He was inconspicuously dressed and tried to stay imperceptible to birds. Furthermore, he was changing his position on the slope several times during day. As a consequence he witnessed the majority of near observations of eagles and all near observations of Griffon vultures.

Another factor that might lead to underestimation of bird activity is the fact that in DOPPS surveyors usually started work at the vantage points one or two hours after sunrise. Observations between dawn and sunrise on 8th and 10th November 2007 indicate intensive eagles' activity at the ridge where the wind farm is proposed. The situation is similar in eagles' morning activities in the Slovenian Alps (Tomaž Mihelič, personal data).

Taking into account all the above mentioned factors we estimate that the eagles' activity at the Volovja reber is considerably larger than the recorded data shows.

B3.4. Flights through individual wind turbine areas

More than 200 records of flights through individual wind turbine area were recorded in the DOPPS surveys. Records are distributed quite unevenly among the different sections of the proposed wind farm; the majority were recorded at sections B, C and D. It is probably true, that there are some more eagles' flights through sections B, C, D and E than elsewhere as these are the most open areas, most suitable for hunting. But distribution of records is biased with the distribution of the location of the vantage points; time spent surveying in these parts of the proposed wind farm was disproportionaly larger (see *Figure 5*). Sections A and H were most of the time out of reach of observers, observations in sections E, F and G were additionally biased with facing sunlight. Furthermore, sections F and G were in large part below the horizon, which made detection more difficult. Flights through section F were not recorded at all in the 2005 and 2006 surveys as wind turbines are not proposed here.

We estimate that we recorded only a small proportion of all flights of eagles through the different sections of the wind turbines area. Below we list factors that were in our opinion leading to this. To get an impression of how large the real number of flights through wind turbines might be we define below a correction multiplier for each factor:

- we covered adequately only about 1/3 of the wind turbines string from the vantage points (multiplier $f_a = 2$)
- as we were recording from vantage points situated on the proposed wind turbines string and eagles were avoiding observers, we have recorded less eagles flying through the string (multiplier $f_b = 2$);

- we have missed some eagles because observers can watch only one direction at a time; furthermore we were from time to time witnessing several raptors in the air simultaneously so that even two observers were not able to cope with all of them (multiplier f_c = 1.3);
- some parts of the string (even closer ones) were not visible from vantage points due to the configuration of the terrain; furthermore it is difficult to detect birds which cross the ridge at the distance of 2 km (multiplier f_d = 1.3)
- some observers were less experienced; one day only one observer was on the vantage point; we missed some birds due to decreasing concentration resulting from long duration (full day) of observations (multiplier f_e = 1.3)
- we were surveying only a small number of days – in the 2007 survey about 15 days – compared to all the days in one calendar year (multiplier f_f = 20)

We emphasize that these given multipliers represent only a very rough estimation; its purpose is to get a very rough impression of the scale of phenomenon. We did not verify our estimation with a thorough study of literature or with field tests. Nevertheless we believe our estimates are a good basis for consideration of the real number of eagles' flights through the proposed wind turbines areas.

We have calculated the speculative number of eagles' flights through the proposed wind turbines area in one calendar year on the basis of the given multipliers. We have based our calculation on the data from the 2007 survey when we recorded 74 flights through the wind turbines area:

Calculation 1: Estimated number of eagles' flights through proposed wind turbines area for year 2007 (P_L): P_O – number of recorded flights through wind turbines area recorded in survey in autumn 2007; f – correction multipliers (see above).

$$P_L = P_O * f_a * f_b * f_c * f_d * f_e * f_f = 74 * 2 * 2 * 1.3 * 1.3 * 1.3 * 20 = 13{,}000^{1}$$

Correction multipliers in *Calculation 1* are the same as used in the first version of this report (October 2007), we did not take into account new findings. We estimate that the real number of flights through the wind turbines area is even larger as in our observations we have missed a time of intensive hunting in early morning.

Our estimations have to be read with precaution, as they are very rough. But without much doubt we can talk about several thousands of flights of eagles through the proposed turbines area each year.

B4 – Comparision of data from this Report with data from developers Environmental Statement

We analyze here all the key studies that are related to the developers' Environmental Statement and are concerning the birds. These can be divided into two main groups. In the first group are original birds studies at the development area made by ornithologists. In second group are various Environmental Statements which summarize and interpret the original ornithological studies.

In the first group are three studies, one that deals with breeding birds (Sovinc et al. 2003) and two that deal with the migrants and wintering birds (Tome et al. 2004a and 2004c). The report on the breeding birds exists in two versions (Sovinc et al. 2003 and Tome et al. 2003). The first version (Sovinc et al. 2003) remained in typescript and is wider. The second version (Tome et al. 2003) which was delivered to the developer by the Aquarius consultancy differs from the first slightly. Excluded were some sections that were unfavourable to the project.

In the second group are three Environmental Statements. The first two of these are dealing with all elements for the environment (E-Net 2004 and 2005). The reason why there are two is that the EIA was carried out twice; it was repeated after the developer's appeal. The third Environmental Statement is focused only on Habitat Directive article 6 assessment (Aquarius 2005).

[1] In the first version of this document made on the basis of incomplete data (63 flights through wind turbines areas) the result of the Calculation 1 was 11.072.

B4.1. Information on breeding and on the location of nests

The breeding birds study (Tome et al. 2003) concludes that the golden eagle breeds in the near surrounding. It states that the eagle's nests are located a good kilometre from the planned windmills. Aquarius (2005, p. 46) in the Environmental Statement even provides data that one of the known eagles' nests is about 1000 m and another more than 4000 m from the nearest proposed wind turbines.

The typescript version of the breeding birds study (Sovinc et al. 2003, p. 15) states that "in a wider area breeds one pair of golden eagles, which means that in case of collision of one individual with wind turbines the species can disappear from the region as a breeding bird." This statement suggests that the pair of golden eagles from Volovja reber is the only one in the region. In the report, which was delivered to the developer (Tome et al. 2003), the entire section with this statement had been removed. This information was later never clearly repeated in any Environmental Statements that were submitted to the EIA procedure.

E-Net (2004, p. 57) states that the eagle's nests were not inspected. None of the investors' studies summarize data on the breeding success of this pair of eagles available in literature, and do not present personal observations of other authors. However, in the Environmental Statement Aquarius (2005, pp. 46) states that the "pair probably do not breed each year." This statement is problematic, since it implies a lower value of this area for reproduction of eagles. The fact is, (1) that Aquarius does not provide any proof for such claim and (2) that it is normal that eagles don't breed every year (see section B3.1. in the Discussion above). As we showed in this study (section B2.1.), the opposite is true: the data shows that the pair nests virtually each year or at least with above-average frequency.

E-Net (2005, p. 118) estimates that the presence of golden eagle, which nests in the vicinity of the proposed wind farm, is of a minor importance. It considers the Primorska region as a suboptimal habitat, since on the little more than 1700 km2 there are less than 5 pairs of golden eagles. By our opinion this statement is problematic, because it implies a lower value of the Volovja reber for breeding of golden eagles. On the southern Primorska, southwest of the line Snežnik-Hrušica-Kanal, the area of which is ca. 2600 km2 there is only approximately 500 km2 of territory, which is appropriate for the golden eagle (authors' estimate). This area is divided into three complexes: a) the area of the »Kraški rob«, b) the area of the southern slopes of the »Trnovski gozd and the Nanos« plateau and c) the area of south-western slopes of the »Snežnik« plateau. Other areas are either at low altitudes, are urbanised or are overgrown with extensive forests. In the area, which is appropriate for the eagle, there are between 5 and 6 territories of golden eagles (Tomaž Mihelič, own data), which means that the eagles here reach decent densities. Volovja reber area is an important part of that small part of the Primorska region that is appropriate for eagles. Therefore we can not talk about a range of a minor importance, as stated in E-Net (2005), but the opposite - the area is of key importance for the conservation of golden eagle in the Primorska region.

B4.2. Data on observations of eagles

Studies that have been carried out for the developer present unclear data on golden eagle observations. Environmental Statement (Aquarius 2005) states in one place that golden eagles were observed 8 times (p. 25), while in another place it talks about observations in 8 days (p. 45). From the developer's original studies (Tome et al. 2003, 2004 and 2004c) it can be concluded that surveyors observed eagles at least 14 times. In the breeding birds survey in spring 2003 (Tome et al. 2003) they recorded eagles eagle in 5 out of 22 censuses. From the report it cannot be understood whether they observed eagle once or more times during each census. During the survey of migratory and wintering birds between October 2003 and May 2004 they observed eagle 9 times (Table 12).

The breeding birds survey (Tome et al. 2004a, p. 2) stresses that the best time for surveying breeding populations of birds of prey is "when the birds of prey have large offspring in their nests or when the youngs are just out of nests, this is mainly in June, July and August." The authors state that due to time constraints they had concluded their study by June 2003. Because of this they believe "that they were able to record only a part of the raptor population in the surrounding area." Despite the fact that the surveys for the developer later continued throughout the year (between October 2003 and May 2004), the ideal time for surveying raptors was omitted completely. In the Environmental Statement (Aquarius 2005), which was submitted to the EIA procedure at the ARSO, a warning that due to non optimal time for fieldwork the results of the surveys are underestimated is entirely omitted.

Sovinc et al. (2003) state that golden eagles were "repeatedly observed while flying over the area [of proposed wind turbines], also low above ground. This is yet another statement that was omitted in the formal version of the report (Tome et al. 2003).

The surveyors which were surveying birds for the developer have collected relatively little data on raptors, less than a tenth of those presented in this study (Table 13). The gap in the quantity of the data collected is enormous, which is also one of the reasons that the assessment of the impact of wind farms on birds is incorrect (ARSO 2006, pp. 38). In our view, a large part of the reason for such a difference lies in the following[2]:

- authors of the developer's bird studies did not carry out any field work between the end of breeding and end of autumn raptor migration (June to September) which is the best time for recording raptors – also in their opinion;
- in their surveys there was only one surveyor at the vantage point at a time, which in our experience, and following the recommendations of SHN (2005) is not sufficient for a comprehensive census;
- efficiency of the raptor surveyor significantly improves with gaining experience (our own experiences, Madders & Whitfield 2006, p. 50);
- they have made little effort to collect data from ornithologists who occasionally visit the Volovja reber area and to review the available literature (eg Surina 1999).

Table 12: Number of observations of eagles at Volovja reber area collected within two surveys ordered by the developer (Tome et al. 2004a in 2004c)

EIMV **oct 2003 – jan 2004**		**EIMV** **jan – may 2004**	
date	no. of observations	date	no. of observations
28.10.2003	1	29.1.2004	
12.11.2003		17.3.2004	
3.12.2003	2	1.4.2004	
17.12.2003		9.4.2004	
8.1.2004		15.4.2004	
14.1.2004		22.4.2004	
		28.4.2004	1
		14.5.2004	2
		25.5.2004	3
		27.5.2004	
Total	3	**Total**	6
minutes	255	**minutes**	50
%	12		

A very important shortcoming of the Environmental Statement (Aquarius 2005) is that the authors concluded the low value of the development area for the golden eagles, based on a very limited number of eagles' observations. The authors did not take into account the fact that a surveyor can not spot every eagle flying in the area of inventory. They did not take into account the factors which make the observation of raptors difficult and lead in unavoidable underestimation (see section B3.3).

[2] In the first version of this Report (October 2007) were stated among the possible reasons also: »in years when surveys for the developer were carried out the eagles have nested in the nest in the Koritnice area, which is slightly away from the current census points«. It seems this is not true. In the course of the censuses of 2008, when the eagle again nested in the Koritnice nest, it appeared that the eagles use the area of the proposed wind farm with a similar intensity, as in 2007, when eagles were nesting in the wind farm area.

B4.3. Flights through individual wind turbine area

Data on the number of flights of eagles through the area of the proposed wind turbines, which were collected within studies made for the developer, have been published in Tome et al. (2004c) and were summarized by the E-Net (2004). From the summary it is not possible to understand how many instances there were of eagles flying through the wind turbine area, since the information is provided only in total for all raptor species. They have recorded only 33 flights of raptors through the turbine area, plus 7 flights of raptors flying along the ridge and not passing the ridge. This is a very modest result. In our experience it is possible to see more than 33 raptors flights through the wind turbines area in a single day of solid fieldwork. In the autumn 2007 survey we had for instance 4 days (10 and 25 August, 14 and 25 September) when we recorded more than 70 raptors flights through the wind turbine area.

Tabel 13: Comparision of the amount of data collected by DOPPS with that of the developer

	DOPPS	**developer**
Number of observations of eagles)	203	14
Number of eagles nests)	3	2
Number of years with confirmed eagles nesting)	11	–
Number of observations of eagles territorial undulating flights	11	1
Number of points where perching of eagles was observed	38	3
Number of flights of eagles through area of individual wind turbines	202	?*

* - available only cumulative data for all species of raptors: 33

C - Expected impact of the windfarm to the Golden eagle

C1 – Foreign experience

The adverse impact of wind farms on birds can be divided into four groups: 1) mortality due to collisions; 2) avoiding the area due to disturbance; 3) obstruction of migration corridors and 4) the loss of habitat (Drewitt & Langston 2006). The Golden eagle has problems primarily with the first two (Madders & Whitfield 2006).

Golden Eagle is resident in Central Europe. Adult territorial eagles spend the vast majority of their life within their permanent territories, while immature eagles and adults which do not have territory, are floating to extensive areas, everywhere suitable feeding habitat is available (Watson 1997). Therefore, the wind farms are especially problematic when they are placed within eagles' breeding territory.

Globally the most studied case of the adverse impact of wind farm to Golden eagles is the Altamont Pass in California, USA. Altamont Pass Wind Resource Area (APWRA) is a 165 km2 large hilly grassland area, where 5,400 wind turbines operate. Turbines here kill on average 67 Golden eagles each year (Smallwood & Thelander 2008). The wider surrounding of the APWRA is well known for the largest breeding density of Golden eagles in the world. In a radius of 30 km around the APWRA there are 61 permanently occupied territories (Hunt & Hunt 2006). Most of the victims are immature eagles and floaters that do not have their own breeding territories. The victims among the territorial eagles are rare, since within the APWRA area there are no breeding territories, and here the adult territorial eagles rarely occur (Hunt 2002). Due to the impact of wind farms on eagle population in the wider surrounding the APWRA is a sink population. Only to replace more than 50 eagles, which are annually killed within the APWRA, 167 permanently occupied nesting territories are needed, which is 2.7 x more than the number of territories within a radius of 30 km from APWRA (Hunt & Hunt 2006). An important finding is that the number of victims among eagles does not decrease over the years. This means that eagles are not able to familiarize to living with wind turbines. In recent years the APWRA implemented several measures to reduce the number of victims. Among others they removed some of the most problematic turbines, some turbines were stopped in the most sensitive seasons, and they painted the blades of some turbines to make them more visible to birds. The result was surprising: the number of casualties among raptors has even increased applying the mitigation measures (Altamont Pass Avian Monitoring Team, 2008)!

In Europe, data on mortality of golden eagles due collisions with wind farms are few. Hötker et al. (2006) reported only one case from Spain. But on the other hand we are not avare of any example, where a wind farm would be bulit in the immediate vicinity of a golden eagles' nest or in the centre of eagles' activity, as is the case at Volovja reber.

Good data on the damage wind farm can cause to the breeding populations of raptors are available for the White-tailed eagle population on the island of Smøla in Norway. In the years 2001 to 2005 68 wind turbines were erected. Out of 12-14 pairs of White-tailed eagles which were breeding here before the installation of the wind farm, 5 pairs have disappeared. In 2005 only 2 pairs successfully bred and raised in total 3 offspring. In 2006, when they begin a systematic examination of the wind farm 9 corpses of White-tailed eagles were found in only 4 months, including 2 of the three eagles, that were raised here in 2005 2005 (BirdLife 2006).

In addition to the risk of collisions with the turbines there is also the possibility that eagles abandon the area due to disturbance. A well known case of such abandonment, which took place in Scotland, is described by Walker et al. (2005).

C2 – Probability of collision with wind turbine

The number of birds of prey that fly through the area of individual wind turbines is a good indicator of the risk to birds to collide with the rotors, once the wind farm is constructed (eg Madders & Whitfield 2006). Several models have been developed on how to calculate the collision risk of birds flying through the turbine area. One of the most known and widely used is the Band model, named after W. Band, developed by the SNH (SNH 2000, Band et al. 2007). The model enables easy calculation of the collision risk for different wind turbine types and bird species. The result assumes that the bird will not take any avoidance action when it reaches the turbine area.

With the help of the Band model, we calculate that the collision risk for the golden eagle that flies through the area of a V52 type turbine, such as those planned for Volovja reber (MOP 2007), is 13.2%

(Calculation 2). The calculation is made with the Excel table, prepared by the SNH (2000) and is available on the website quoted. For clarification of the parameters and the method of calculation, see (SNH 2000, Band et al. 2007)

Calculation 2: Calculation of collision risk for golden eagle passing through rotor area of V52 type wind turbine. For explanations see (SNH 2000, Annex 1 and Band et al. 2007).

CALCULATION OF COLLISION RISK FOR BIRD PASSING THROUGH ROTOR AREA W Band 2.10.2008

Only enter input parameters in blue

K: [1D or [3D] (0 or 1)	1		**Calculation of alpha and p(collision) as a function of radius**										
NoBlades	3						Upwind:			Downwind:			
MaxChord	2,431	m	r/R	c/C	α	collide		contribution	collide		contribution	
Pitch (degrees)	30		radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
BirdLength	0,82	m	0,025	0,575	9,45	24,90	1,00	0,00125	23,50	1,00	0,00125	
Wingspan	2,12	m	0,075	0,575	3,15	8,77	0,68	0,00511	7,37	0,57	0,00429	
F: Flapping (0) or gliding (+1)	1		0,125	0,702	1,89	6,20	0,48	0,00602	4,49	0,35	0,00436	
			0,175	0,860	1,35	5,31	0,41	0,00723	3,22	0,25	0,00438	
Bird speed	13	m/sec	0,225	0,994	1,05	4,83	0,37	0,00844	2,41	0,19	0,00421	
RotorDiam	52	m	0,275	0,947	0,86	4,02	0,31	0,00860	1,72	0,13	0,00368	
RotationPeriod	2,97	sec	0,325	0,899	0,73	3,45	0,27	0,00871	1,27	0,10	0,00319	
			0,375	0,851	0,63	3,01	0,23	0,00878	0,95	0,07	0,00275	
			0,425	0,804	0,56	2,67	0,21	0,00881	0,79	0,06	0,00260	
			0,475	0,756	0,50	2,38	0,19	0,00879	0,80	0,06	0,00295	
Bird aspect ratioo: β	0,39		0,525	0,708	0,45	2,14	0,17	0,00873	0,80	0,06	0,00325	
			0,575	0,660	0,41	1,93	0,15	0,00862	0,79	0,06	0,00351	
			0,625	0,613	0,38	2,05	0,16	0,00997	1,08	0,08	0,00523	
			0,675	0,565	0,35	1,92	0,15	0,01009	1,09	0,08	0,00572	
			0,725	0,517	0,33	1,80	0,14	0,01016	1,09	0,08	0,00616	
			0,775	0,470	0,30	1,69	0,13	0,01019	1,09	0,08	0,00656	
			0,825	0,422	0,29	1,59	0,12	0,01018	1,08	0,08	0,00691	
			0,875	0,374	0,27	1,49	0,12	0,01011	1,06	0,08	0,00722	
			0,925	0,327	0,26	1,39	0,11	0,01001	1,04	0,08	0,00748	
			0,975	0,279	0,24	1,30	0,10	0,00986	1,02	0,08	0,00770	
						Overall p(collision) =		**Upwind**	**17,0%**		**Downwind**	**9,3%**
								Average	**13,2%**			

This is the result, which assumes that the eagle will not take any avoidance action, which in most cases is not realistic. SNH has recently proposed a uniform avoidance rate of 95% for all collision risk assessment for all raptor species in Scotland. SNH have chosen a slightly low value, because they want to take into account the precautionary principle. For the golden eagle the 98% avoidance rate is sufficiently reliable, which was recently proposed by Band (Percival 2007).

In assessing the number of collisions it should be taken into account the fact that the turbine rotate only part time. For our calculation, we used the information provided by the director of the developer in a newspaper article (Valentinčič 2005). According to the wind speed measurements it is expected that the wind power plant will operate around 2300 hours a year, which is approximately 26% of the whole time.

In our raptor surveys we recorded every passing of a bird between the ground and 80 m high as passing through the wind turbine area. As rotors would range from approximately 25 to 80 m above the ground, ie ca. 2/3 of the area we counted as turbine areas, in the Calculation 3 below we therefore introduced factor of 0.6.

To calculate the number of collisions of eagles with turbines per year (TL), which is at the same time the number of killed eagles, we take into account the following information:

P_L = 13.000	estimated number of golden eagles' flights through individual wind turbine areas; see A4.4. above;
S_{tt} = 13,2%	collision risk for golden eagle passing rotor area of the V52 type wind turbine;
F_r = 0,6	correction factor; in field work all eagle flights betveen ground and 80 m hight were recorded as flying through wind turbine area – only about 2/3 of this area is rotor area;
S_u = 98%	avoidance rate for golden eagle
S_v = 26%	share of time when turbines would operate

Calculation 3: Predicted number of golden eagle collisions with rotor blades at Volovja reber wind farm in one year

$$T_L = P_L * S_{tt} * F_r * (1-S_u) * S_v = 13.000 * 0,132 * 0,6 * 0,02 * 0,26 = 5,4$$

According to the calculation and above described presumptions, the Volovja reber wind farm would cause 5 deaths of golden eagle per year if the eagles would not change pattern of using the area. Even if the result are 10 times too high, it is clear that the construction of the wind farm would be detrimental for this pair of golden eagles. Trontelj (2006) has calculated that eagles would disappear from Volovja reber even with a significantly smaller number of collisions with turbines.

Our estimate is significantly different from the estimates in the developer's Environmental Statement Report (Aquarius 2005, pp. 45). They predicted one victim per 60 years for territorial eagles and one victim per 12 years for floaters.

We believe that the assessment of the Environmental Statement is incorrect in particular for the following reasons:

- Authors significantly underestimated the frequency of golden eagles' occurence at the developement area and the number of eagles' passing through the proposed rotor area (for reasons see B4.2);
- The authors did not take into account the specificity of local responses of golden eagles at Volovja reber; the author state this in Aquarius (2005, pp. 45);
- The method authors used is inappropriate, they incorrectly interpreted data of other authors; these two faults are analysed in detail in Trontelj (2006, pp. 1-3).

C3 – Comments on final conclusions of developer's Environmental Statement and on mitigation measures

The original studies made for the developer (Sovinc et al. 2003, Tome et al. 2004a) came to the same conclusion as our assessment: the construction of the wind farm at the Volovja reber is unacceptable due to the expected negative impact on the golden eagle. Let us quote some explicit statements:

- "In a wider area one pair of golden eagles is breeding, which means that the species can disappear as a breeder from the region, as a consequence of collision of one bird with the rotor blade. According to the data collected we assess the probability of the collision as high because we have observed eagles passing the area several times (also low above ground." (Sovinc et al. 2003, p. 15.);
- "On the basis of observations we foresee that after the construction of the wind farm it is likely that fatal collision of golden eagle with rotor blade will happen." (Tome et al. 2004, pp. 14);
- "The impact of operating wind turbines to golden eagle will be according to our assessment unacceptably high, unless collision risk is reduced significantly." (Tome et al. 2004a, p. 7.)

The authors of the original studies were, therefore, aware of the unacceptability of installing a wind farm at the Volovja reber due to the impact on the golden eagle. The authors of the study of migrants and wintering birds (Tome et al. 2004, pp. 14) indicate three possible mitigation measures that could, in their view, reduce the collision risk:

- » physical barriers (wire mesh) infront of the rotor;
- a system for the detection of birds in the air (IR sensors), which would trigger visible (movable objects) and audio (bangs, alarm siren) signals;
- random, but often triggering detterent signals - visible and audible signals (perhaps related to the speed of rotation of rotor - higher frequency of signals at higher rotation speed), "

but in the final plan of the wind farm none of the proposed mitigation measures were incorporated.

Authors of the developer's Environmental Statement (E-Net in 2004 and 2005, Aquarius 2005) ignored warnings of the original studies. Without explanations why they do not follow warnings of the original studies they concluded that the impact of the wind farm to raptors will not be too high and that the wind farm can be constructed.

The only noteworthy mittigation measure proposed by the authors of the developer's Environmental Statement was that 4 out of 47 wind turbines should be omitted: two of them due to the observed landing of eagles near the locations of these two turbines, and another two of them to enable migrating and passing birds (and other animals) an opening of the corridor route in the turbine chain to allow unimpeded passage through the area. In our study we showed that the perching and landing of eagles can be observed virtually anywhere on the ridge (Figure 15). It should also be noted that the authors do not specify any arguments to indicate that such a mitigation measure could have a significant effect on reducing the collision risk for golden eagles. Due to the fact that the application of the precautionary principle is mandatory in EIA, such evidence would have to be shown.

In examining the literature, we encountered two papers indicating that omitting some turbines in the chain does not make much difference for collision risk. Both articles deal with the Griffon vultures. Barrios & Rodrigues (2004) note that the shape of the wind turbines and the spacing between them has no significant impact on the collision risk. Lekuona & Ursua (2007) indicates that there is no difference in frequency of collision between the turbines at the end of the chain and those in the middle of the chain; which means that the creation of corridors with leaving gaps in the chain has no significant meaning. Barrios & Rodrigues (2004) found similar findings for Kestrel Falco tinnunculus.

C4 – Negative impact of windfarm on golden eagle when wind turbine is erected in immediate vicinity of eagles' nest

In short, we want to highlight one more detail in the Environmental Statemen (E-Net 2005, p. 131.). The authors quote the sentence, which implies a small impact of the proposed Volovja reber wind farm to eagles: "According to the Spanish experience, the likelihood of a negative impact of wind farm to Golden eagle is small, as far as its nest is located at least 500 m from the wind farm." The statement is interesting, but the authors do not indicate the source. That statement seems dubious to us, because it is not in accordance with the results of other authors (eg, Hunt & Hunt in 2006, Walker et al. 2005).

The statement, however dubious, is important for the final conclusion of the EIA. Even the authors of the Environmental Statement obviously agree that the negative impact of the windfarm on the Golden eagle is likely, if it is placed closer than 500 meters from the eagle's nest. Given the fact that one of the eagle's nests is only 200 to 300 m away from the nearest proposed turbine, this would mean that at least part of the proposed wind farm is unacceptable.

D – Literature

Altamont Pass Avian Monitoring Team (2008): Bird Fatality Study at Altamont Pass Wind Resource Area, October 2005 to September 2007. Draft report. Poročilo izdelano za Alameda County Scientific Review Committee in za Altamont Pass Wind Resource Area.

Aquarius (2005): Okoljsko poročilo za vetrno elektrarno in povezovalni 110 kV daljnovod na območju Volovja reber nad Ilirsko Bistrico v skladu s Pravilnikom o presoji sprejemljivosti planov in posegov v naravo na varovana območja; Dopolnjeno po reviziji. [Environmental Statement for wind farm and 110 kV power line at the area of Volovja reber near Ilirska Bistrica; Ammended after revision] Aquarius, 13.6.2005. 73 p.

ARSO (2006): Odločba o izdaji okoljevarstvenega soglasja za vetrno elektrarno Volovja reber in za pripadajoči visokonapetostni daljnovod. [Environmental Consent for the Volovja reber wind farm and the integrant powerline] Agency of the RS for Environment, 26.6.2006. 44 p.

Band, W., M. Madders & D.P. Whitfield (2007): Developing field and analytical methods to assess avian collision risk at wind farms. Poglavje 15 v Lucas et al. (2007), pp. 260-275.

Barrios, L. & A. Rodriguez (2006): Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of Applied Ecology 41: 72-81.

BirdLife (2006): Wind farm on the Smøla Archipelago (Norway). Poročilo nevladnih organizacij za Sekretariat Bernske konvencije, 22.8.2006. http://www.coe.int/t/e/cultural_co-operation/environment/nature_and_biological_diversity/nature_protection/BI_Smola_2006.pdf

Collopy, M.W. & T.C.Edwards Jr. (1989): Territory size, activity budget, and role of undulating flight in nesting golden eagles. Journal of Field Ornithology 60(1): 43-51.

Drewitt, A.L. & R.H.W. Langston (2006): Assessing the impacts of wind farms on birds. Ibis 148: 29-42.

E-Net (2004): Poročilo o vplivih na okolje za vetrno elektrarno in povezovalni 110 kV daljnovod na območju Volovja reber nad Ilirsko Bistrico; Številka naloge 228203. [Environmental Statement for wind farm and 110 kV power line at the area of Volovja reber near Ilirska Bistrica; Report No 228203] E-Net okolje d.o.o., August 2004. 141 p.

E-Net (2005): Poročilo o vplivih na okolje za vetrno elektrarno in povezovalni 110 kV daljnovod na območju Volovja reber nad Ilirsko Bistrico; Številka naloge 100105-jh; Dopolnjeno po reviziji. [Environmental Statement for wind farm and 110 kV power line at the area of Volovja reber near Ilirska Bistrica; Report No 100105-jh; Ammended after revision] E-Net okolje d.o.o., 13.6.2005. 159 p.

Hunt, G. (2002): Golden Eagles In A Perilous Landscape: Predicting The Effects Of Mitigation For Wind Turbine Blade-Strike Mortality. California Energy Commission, PIER Environmental area. University of California, Santa Cruz.

Hunt, W.G., R.E. Jackman, T.L. Hunt, D.E. Driscoll & L. Culp (1999). A population study of golden eagles in the Altamont Pass Wind Resource Area: population trend analysis 1997. Renewable Energy laboratory, Subcontract XAT-6-16459-01. Predatory Bird Research Group, University of California, Santa Cruz.

Hunt, G. & T. Hunt (2006): The Trend of Golden Eagle Territory Occupancy in the Vicinity of the Altamont Pass Wind Resource Area: 2005 Survey. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2006-056.

Hötker, H., Thomsen, K.-M. & H. Jeromin (2006): Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation. Michael-Otto-Institut im NABU, Bergenhusen.

Lekuona, J.M. & C. Ursua (2007): Avian mortality in wind power plants of Navarra (Northern Spain), Poglavje 9 v Lucas et al. (2007), pp. 177-192.

Lucas, M., G.F.E. Janss & M.Ferrer ur. (2007): Birds and wind farms – Risk assessment and mitigation. Qurrcus, Madrid. 275 p.

Luskovec, V. (2005): Ali je snežniški orel res komu v napoto? [Does Snežnik eagle realy gets in someone's way?] Delo 15.12.2005.

Madders, M. & D.P. Whitfield (2006): Upland raptors and the assessment of wind farm impacts. Ibis 148: 43-56.

Mihelič, T., J. Hrovat & M.Žnidaršič (in preparation): Planinski orel v Sloveniji. [Golden eagle in Slovenia] Acrocephalus.

MKGP (1996): Odločba o prepovedi uporabe zračnega prostora za jadralno padalstvo in jadralno letenje v območju gnezdišča orla nad Zabičami. Odločba št. 326-08/96 z dne 14.5.1996. [Ministry for agriculture Decision on ban of use of air space around eagles nest above Zabiče village for paragliding; Decission no. 326-08/96 dated 14 May 1996]

MOP (2007): Odločba o izdaji gradbenega dovoljenja za vetrno elektrarno Volovja reber in za pripadajoči visokonapetostni daljnovod. Ministrstvo za okolje in prostor, 19.2.2007. [Decision on issuig the Construction consent for the Volovja reber wind farm and the integrant power line. Ministry for the environment and physical planing]

Percival, S.M. (2007): Predicting the effect of windfarms on birds in the UK: The developement of an objective assessment method. Poglavje 7 v Lucas et al. (2007), p. 137-152.

Schollmayer (1891): Beiträge zur Ornis Krains. Separatdruck aus Ornithologisches Jahrbuch II. Jahrgang, 3. Heft. Wien.

Smallwood, K.S. & C. Thelander (2008): Bird Mortality in the Altamont Pass Wind Resource Area, California. Journal of Wildlife Management 72(1): 215–223.

SNH (2005): Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Gidance. Scottish natural heritage, November 2005. 50 strani.

SNH (2000): Windfarms and birds: Calculating a theoretical collision risk assuming no avoiding action. SNH Guidance. Scottish natural heritage, 9. p + Excell table for collision risk calculation.

Sovinc, A., D. Šere & D. Tome (2003): Ptice gnezdilke območja Volovja reber s poudarkom na oceni vpliva postavitve in obratovanja vetrnih elektrarn. [Breeding birds of the Volovja reber area with a focus on the assessment of the impact of installing and operating the wind farm] Typescript, July 2003. 22 p.

Surina, B. (1999): Ornitofavna zgornjega dela doline Reke in bližnje okolice. [Ornithofauna of the upper part of the Reka river valley and the near surrounding] Annales 9: 303-314

Tome, D., A. Sovinc & D. Šere (2003): Ptice gnezdilke na območju Volovje rebri – rezultati terenskega dela brez vrednotenja. [Breeding birds at the Volovja reber area – results of the field work witout assessment] Aquarius, July 2003. 21 p.

Tome, D., D. Šere, A. Vrezec, I. Čuhalev & M. Paternoster (2004a): Poročilo o vplivih na okolje za izgradnjo vetrne elektrarne na območju Volovje rebri in povezovalnega 110 kV daljnovoda – Študija preletov ptic na območju Volovje rebri in ocena morebitne izgradnje vetrnic ter povezovalnega 110 kV daljnovoda na njihove populacije – vmesno poročilo (ptice pozimi); Referat št.: 1639. [Environmental Statement for wind farm and 110 kV power line at the area of Volovja reber near Ilirska Bistrica – Study of passing birds at the Volovja rebe and assessment of impact of proposed windfarm to their population – interim report (wintering birds)] Elektroinštitut Milan Vidmar – EIMV, February 2004. 15 p.

Tome, D., D. Šere, A. Vrezec, I. Čuhalev & M. Paternoster (2004b): Poročilo o vplivih na okolje za izgradnjo vetrne elektrarne na območju Volovje rebri in povezovalnega 110 kV daljnovoda – Povzetek ocen vplivov na okolje za segment naravno okolje; Referat št.: 1657. [Environmental Statement for wind farm and 110 kV power line at the area of Volovja reber near Ilirska Bistrica – Summary of the environment impact assessments, part natural environment]Elektroinštitut Milan Vidmar – EIMV, April 2004. 6 p.

Tome, D. … (2004c): Študija preletov ptic na območju Volovje rebri in ocena vpliva morebitne izgradnje vetrnic ter povezovalnega 110 kV daljnovoda na njihove populacije – spomladanski prelet ptic; Referat št.: ???. Elektroinštitut Milan Vidmar – EIMV, junij 2004. *[študije nam ni uspelo pridobiti, citirane podatke povzemamo iz Poročil o vplivih na okolje (E-Net 2004 in 2005)].[* [Study of passing birds at the Volovja rebe and assessment of impact of proposed windfarm to their population – spring; we could access this study, so we quote it after *(E-Net 2004 in 2005), where it is summarized]*

Trontelj, P. (2006): Ocena ogroženosti velikih uje po postavitvi vetrne elektrarne na območju Volovje rebri – podrobnejša obrazložitev možnih scenarijev in njihovih verjetnosti. Elaborat Oddelka za biologijo Biotehniške fakultete Univerze v Ljubljani. [Assessment of threat theat installation of wind farm in the area Volovja reber would impose to the large raptors - a detailed explanation of the possible scenarios and their likelihood. Study of the

Department for biology of the Biotechnical Faculty, University of Ljubljana.]March 2006. 12 p.

Valentinčič, D. (2005): Prejeli smo – Nikoli ne bi gradil na Volovji rebri. [Letter of the developer's director to the newspaper Delo]Delo, 16.6.2005, str. 3.

Walker, D., M. McGrady, A. McCluskie, M. Madders & D.R.A McLeod (2005): Resident Golden Eagle ranging behaviour before and after construction of a windfarm in Argyll Scottish Birds 25: 24–40.

Watson, J. (1997): The Golden Eagle. T & AD Poyser, London. 374 p.

E –Photos

Figure I. Young eagle in the nest at the Volovja reber wind farm area. 27.6.2007. Photo: Tomaž Mihelič.

Figure II. Juvenile eagle photographed 2 weeks after leaving the nest. Slope of the Volovja reber, 14.8.2007. Photo: Aleš Jagodnik.

Figure III. Pair of Golden eagles perching on the rocks of SW slope of Mt. Bele ovce. 23.5.2005. Photo Jernej Figelj.

Figure IV. Golden eagle's footprint in the puddle beneath the Mt. Velika Milanja; eagle had probably drunk from the puddle. 14.4.2007. Photo Tomaž Jančar.

Figure V. A feather and a pellet of the Golden eagle on the Bele ovce rocks. 27.6.2007. Photo Tomaž Jančar.

Figure VI. Adult Golden eagle passing the large anemomether tower (100 m) on the Volovja reber. 15.8.2007. Photo: Aleš Jagodnik.

Figure VII. Juvenile Golden eagle passing the anemomether tower at the Volovja reber. August 2007. Photo A.Jagodnik

Figure VIII. Adult Golden eagle at Gure. 23.12009. Photo: Aleš Jagodnik.

Figure IX. Agult Golden eagle and Raven fighting at the Volovja reber on 17.1.2009. Photo Aleš Jagodnik.

Figure X. Adult Golden eagle at Volovja reber on 16.11.2008. Photo Aleš Jagodnik.

Figure XI. Juvenile Golden eagle chasing Griffon vulture. Volovja reber 16.11.2008. Foto Aleš Jagodnik.