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Expert Opinion on the Expected Impact on Bats

as Part of the Environmental Impact Assessment for the Proposed "Čibuk 1" Wind Farm Located near the Villages Dolovo and Mramorak in the Municipality of Kovin (Autonomous Province of Vojvodina, Republic of Serbia)

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1 Introduction

1.1 Background of the investigation

With "Cibuk 1" a wind farm of 57 wind turbines is planned for construction near the villages of Dolovo and Mramorak in the Municipality of Kovin (Autonomous Province of Vojvodina, Republic of Serbia).

The construction and operation of wind turbines may have a negative impact on local bats and can also affect migratory bats. The main effects on bats are (EUROPEAN COMMISSION 2010, PAUNOVIĆ *et al.* 2011; see also Chapter 6):

- risk of collision
- disturbance and displacement
- barrier effects
- loss or degradation of habitats

1.1.1 International conventions, laws and standards with regards to bats

In order to assess the impact of constructing and operating the planned wind farm on bats and to conform to European standards this expert opinion is based on European conventions (Bern and Bonn Convention in particular EUROBATS) and directives (Habitats Directive):

Bern Convention: Convention on the Conservation of European Wildlife and Natural Habitats (Serbia acceded 1 May 2008)

The Bern Convention is an internationally binding legal instrument covering most of the natural heritage of the European continent and extending to some African states. Its aims are to conserve wild flora and fauna and their natural habitats and to promote European co-operation within the area.

The Convention particularly emphasizes the need to protect endangered natural habitats and endangered vulnerable species, including migratory species.

The rules relevant for the conservation of special species are listed in article 6:

"Article 6

Each Contracting Party shall take appropriate and necessary legislative and administrative measures to ensure the special protection of the wild fauna species specified in Appendix II. The following will in particular be prohibited for these species:

a all forms of deliberate capture and keeping and deliberate killing;
b the deliberate damage to or destruction of breeding or resting sites;
c the deliberate disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation, insofar as disturbance would be significant in relation to the objectives of this Convention;
d the deliberate destruction or taking of eggs from the wild or keeping these eggs even if empty;
e the possession of and internal trade in these animals, alive or dead, including stuffed animals and any readily recognisable part or derivative thereof, where this would contribute to the effectiveness of the provisions of this article."

Bonn Convention: Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Serbia acceded 1 March 2008)

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. This intergovernmental treaty, negotiated under the aegis of the United Nations Environment Programme, is concerned with the conservation of wildlife and habitats on a global scale.

Regarding bats the Bonn Convention is implemented by the Agreement on the Conservation of Populations of European Bats (which Serbia has not yet ratified).

The relevant rules for protection are presented in article III (Fundamental Obligations), particularly in paragraph 1: "*Each Party shall prohibit the deliberate capture, keeping or killing of bats except under permit from its competent authority.*"

Furthermore, it is based on the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (in the following: Habitats Directive).

Habitats Directive: Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. Overall the directive protects more than 1,000 animals and plant species and more than 200 so called "habitat types" (*e.g.* special types of forests, meadows, wetlands, *etc.*) that are of European importance.

Until now most attention regarding the implementation of the Habitats Directive has focused on the establishment of the Natura 2000 network. This "1st pillar" of the directive refers to the conservation of natural habitats and of the habitats of species. The Habitats Directive comprises a "2nd pillar", however, that is related to the protection of species. In particular, Articles 12 and 16 aim at the establishment and implementation of a strict protection regime for animal species listed in Annex IV(a) of the Habitats Directive within the whole territory of Member States.

"Article 12

1. *Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV (a) in their natural range, prohibiting:*
   (a) all forms of deliberate capture or killing of specimens of these species in the wild;
   (b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;
   (c) deliberate destruction or taking of eggs from the wild;
   (d) deterioration or destruction of breeding sites or resting places.
2. *For these species, Member States shall prohibit the keeping, transport and sale or exchange, and offering for sale or exchange, of specimens taken from the wild, except forthose taken legally before this Directive is implemented.*
3. *The prohibition referred to in paragraph 1 (a) and (b) and paragraph 2 shall apply to all stages of life of the animals to which this Article applies.*
4. *Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States*

shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned.

1.1.2 General note on the implementation of legal requirements into practice

As Microchiroptera (bats) are listed in Annex IV (Animal and plant species of community interest in need of strict protection) of the Habitats Directive as well as in Annex II (except for Common Pipistrelle – *Pipistrellus pipistrellus*) of the Bern Convention, the matters of fact of article 6 of the Bern Convention and article 12 of the Habitat Directive are obligatory for all bat species occurring in Serbia.

In terms of a threshold of significance many authors only consider effects that result in the deterioration of populations, contrary to the Habitats Directive (cf. KIEL 2005, LÜTTMANN 2007). LANA (2009) states that assessing a restriction on deliberate disturbances for certain European bird species is not based on individuals but on local populations. Accordingly, an impact would be rated as significant if effects harmed a number of individuals in a way that the chances of survival, rate and success of reproduction of the population as a whole would deteriorate.

In terms of applicable assessment criteria and significance thresholds, this expert opinion adheres to guidelines used in Germany and internationally as well (*e.g.* EUROPEAN COMMISSION 2007, EUROPEAN COMMISSION 2010, PAUNOVIĆ *et al.* 2011, LANA 2009, MUNLV 2010, RODRIGUEZ *et al.* 2008).

1.2 Aim of the investigation and the expert opinion

The main purpose of the investigation is to collect baseline data on the occurrence of bats within the study area (cf. Chapter 1.3) and to describe the temporal and spatial distribution of each species.

As a result the aim of this expert opinion is to

- identify, predict and assess likely effects of the proposed wind farm on bats;
- assess whether impacts of the proposed wind farm remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts;
- recommend mitigation measures or measures for compensation in order to minimize possible conflicts.

Accordingly, Chapters 2 and 3 of this report describe the project and the methods used in the investigations. Intensive observations of roosting, hunting and migrating bats, carried out from 2009 to 2011, form the basis for presenting the occurrence of species in the study area and for describing the importance of the area for bat species (Chapter 4). Proceeding from potential effects of wind turbines on bats (Chapter 6), the prediction and the assessment of likely effects (Chapter 7) as well as the opportunities for mitigation and compensation measures will be presented (Chapter 8).

1.3 Description of the study area and its wider surroundings

1.3.1 The area of the proposed wind farm

The proposed site for "Čibuk 1" wind farm is located in south Banat (Autonomous Province of Vojvodina) in the agricultural area west of the Deliblato Sands Special Nature Reserve." (Karapandža & Paunović 2011 and cf. Map 2.1). "The area is made up almost exclusively of intensively cultivated monoculture fields, mostly without hedge-rows. The presence of non-cultivated land is negligible and there is no forest-steppe and forest vegetation. The bushy and ligneous vegetation is composed of individual trees, bushes and small intermittent and/or scarce lines of trees along dirt roads and around the depression of the Stankova valley in the vicinity of the village of Mramorak. This depression is in a state of late eutrophication, with water availability only in the wettest periods in the year.

The eastern border of the planned wind-farm "Čibuk 1" site stretches along the unused Vladimirovac-Bavanište railway track for a distance of 1 km. There is an electrical energy installation (*i.e.* an overhead power line) running through both of the sites. The entire study area contains a dense network of dirt roads used to access the fields (Image 5). Primary village dumps are sporadically present along certain parts of the roads, especially in the narrower area around the settlements." (cf. Karapandža & Paunović 2011).

At the eastern border of the planned wind farm a 1 km buffer zone to Deliblato Sands Special Nature Reserve is established. This buffer zone shall minimize potential adverse effects of the proposed wind turbines to animals and habitats of the Deliblato Sands Special Nature Reserve.

Within the buffer zone an abandoned farm with a stock of older trees (near VP 8 in Karapandža & Paunović (2011) / VP 4 in Rašajski (2011)) endows the area with structures that occur rarely within the wind farm area.

1.3.2 Deliblato Sands

Karapandža & Paunović (2011) describe Deliblato Sands as follows: "On the east and north-east sides of the entire study area is the Deliblato Sands Special Nature Reserve, which stretches in a northwest-southeast direction. This reserve was placed [...] under protection as Europe's largest area of eolic sand residue with distinctive forms of dune relief, characteristic sand, steppe and forest ecosystems, a unique mosaic of biocoenosis and typical and specific specimens of flora and fauna (Images 6 and 7). Many of these species are rarities and very significant based upon international criteria" (Official Gazette of the Republic of Serbia, Nos. 43/02, 81/08).

2 Description of the proposed project

2.1 Wind turbines

"Čibuk 1" wind farm is planned to be equipped with 57 wind turbines (such as VESTAS V-112 IEC (class IIA, with a nominal power of 3 MW)). The tower height of each turbine will be 120 m, the length of a turbine blade will be 57 m.

The poles of the turbines, spaced in accordance with the technical and technological concept, will be positioned on individual agricultural plots relatively close to existing local roads in the area covered by the plan. The installations of the wind turbines will comprise the following elements:

- a 25x25 m tower foundation (625 m^2 for each turbine);
- a 26x51 m service plateau in front of the tower on which the main construction crane will be positioned, surrounded by 1 m wide drainage ditches (1,326 m^2 for each turbine);
- auxiliary plateaus (on both sides of the service plateau) 50x12 m and 40x15 m, respectively, on which auxiliary cranes for erecting the main crane will be positioned, as well as installation equipment (tower components, blades, etc.);
- a 6 m wide wind turbine access road that will have a minimum horizontal curve radius of 42 m during the construction phase to enable access for special transport vehicles.

The tower foundation, service plateau and access road are permanent facilities (fixed elements) that will be used during the operation of the tower, whereas the auxiliary plateaus and the curve areas of the access road are temporary elements that will no longer be used once the wind turbine has been constructed (cf. DETAILED REGULATION PLAN of the Infrastructure System for the Čibuk wind farm at Mramorak 2009).

2.2 Access to wind power plants

Access to the wind turbine towers will be secured by constructing 5 m wide access roads leading from the nearest field road to the foundation of the tower. According to the draft development concept, these access roads are not considered construction land but will remain cultivated land serving the constructed wind towers.

The draft development plan does not propose the construction of any new municipal roads. The existing Dolovo-Deliblato Sands municipal road will retain its current category and regulation, notwithstanding possible adaptations in order to ensure optimal traffic conditions.

Existing field roads will retain their purpose as agricultural access roads while some roads that ensure the most convenient access to individual wind turbines in accordance with their adopted layout may be reconstructed within the limits of their current dimensions, covered by modern paving and furnished with appropriate traffic elements (cf. DETAILED REGULATION PLAN of the Infrastructure System for the Čibuk wind farm at Mramorak 2009).

2.3 Permanent habitat loss due to construction of wind turbines and further required facilities

A total of at least 111,207 m^2 (11.12 ha) of largely intensively cultivated land will be permanently lost. To very low extent of ruderal vegetation along dirt roads will be lost as well.

- **Expert Opinion on the bat investigation near the villages Dolovo and Mramorak**

  as part of the EIA for the proposed Wind Farm "Cibuk 1" (Republic of Serbia, Autonomous Province of Vojvodina, Municipality of Kovin)

  reported to: CONTINENTAL WIND SERBIA, d.o.o.

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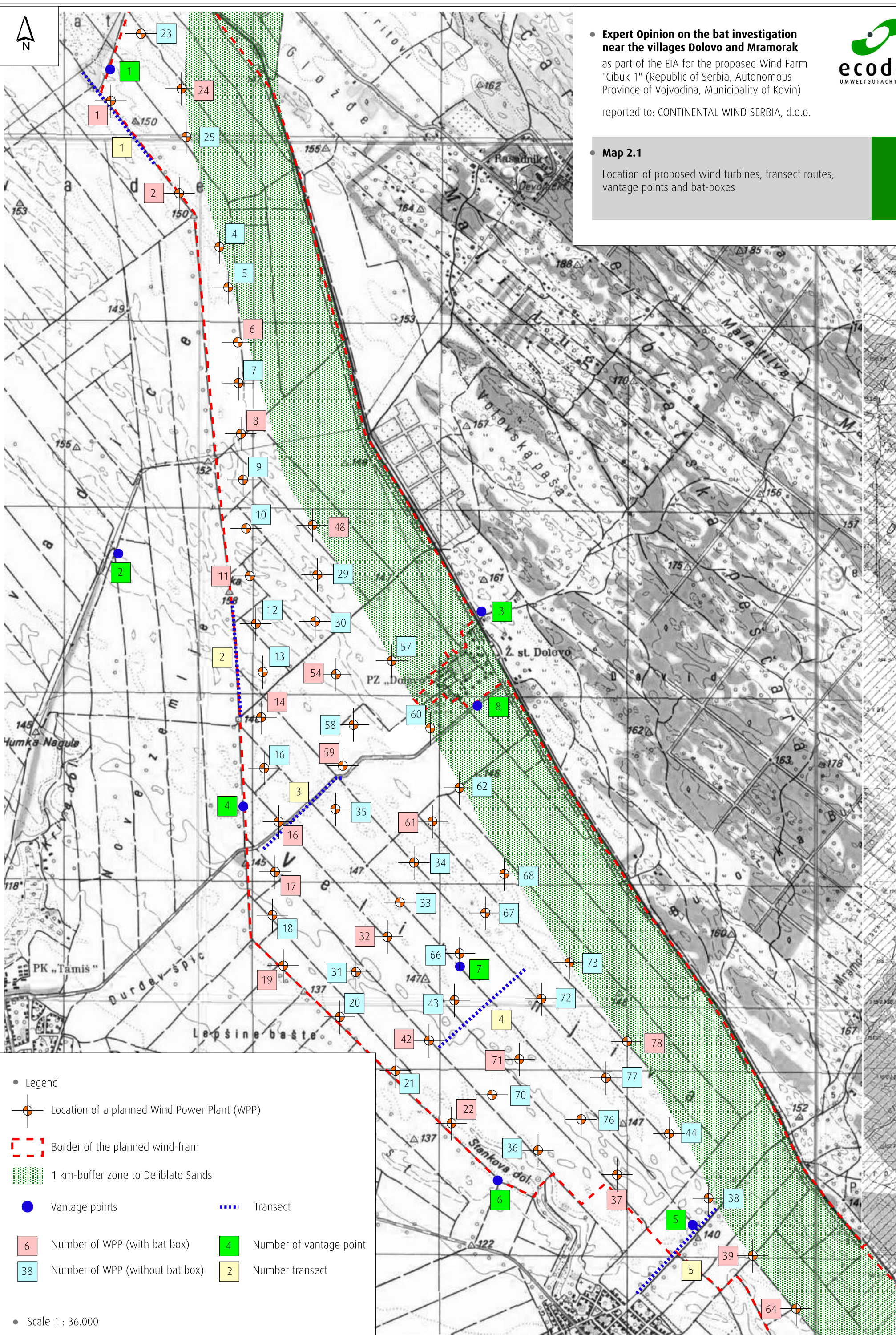
- **Map 2.1**

  Location of proposed wind turbines, transect routes, vantage points and bat-boxes



3 Methods

To establish a database for predicting the impact of the project, roosting, hunting and migrating bats were recorded on the site envisaged for the wind farm as well as its surroundings. The data on bats leading to this expert opinion were collected by two independent teams doing field studies from September 2009 to August 2011 (continuing to November 2011) (cf. Table 3.1 and 3.2: Karapandža & Paunović 2011 and Rašajski 2011).

The study area covers the site selected for the proposed wind farm, predominantly the transect routes and the locations of the bat-boxes as well as the vantage points. Additionally, the settlements in the vicinity of the study area and in Deliblato Sand were surveyed, mainly to get information on roosts (nursery roosts, mating roosts) in the surroundings of the planned wind farm area (cf. map 3.1).

3.1 Team 1 (Javor Rašajski)

Team 1 used two different field methods in the period from September 2009 to September 2010 (no exact data of investigation are given): visual monitoring and mist netting (cf. Rašajski 2011).

Visual monitoring and Mist netting

"In the absence of electronic detectors that enable the monitoring of bats during the night, the methodology was simplified to a great extent. Counts were performed by way of monitoring bats in the evening hours until complete darkness as well as by using night vision binoculars. The individual monitoring times did not exceed three hours in the period from April through July, while the duration of monitoring decreased to only two hours in late August and early September. "

[Mist netting was conducted using] "so-called Japanese nets, which have a mesh size of 2 x 2 cm; the mist nets were set up at a height of up to four metres. This is generally considered the most precise method of establishing bat species. Before being released, the bat individuals were photographed and the photographs were submitted to the consultants. No other data was collected, and the individuals were not ringed.

Moreover, the most significant factor in successful mist netting is the location, *i.e.* a setting that would ensure that the mist nets were masked by shrubs and trees and thus not detected by bats. There were very few suitable locations for mist netting at the surveyed territory.

Mist netting was mostly conducted in the immediate vicinity of the abandoned farm that is along the old Čibuk – Čibuk railway station road which was the only location that provided a suitable setting for the mist netting activity."

3.2 Team 2 (Branko Karapandža & Milan Paunović)

Team 2 applied three different methods to obtain important data on the occurrence of bats within the study area: In 2010 vantage point counts and, additionally, mist netting and roost searches roosts were done. In 2011 transects walks and permanent monitoring of bat activity using bat-boxes were conducted. In addition thermal imaging of bats was conducted during two nights (10 and 11 October 2011).

3.2.1 Methods used in 2010

3.2.1.1 Vantage point counts

This method was conducted from March to November 2010 at eight (March and April 2010 six) vantage points. In total 29 days and 259 hours were spent in the study area.

"The research of bat activity on the wind-farm site and in its immediate vicinity was performed using the vantage point count method. The eight vantage points at which the vantage point count was performed, marked by numbers 1 through 8 [...], were selected with the purpose of obtaining the best possible overview of the diversity of the habitats in the study area from the aspect of the ecology of bats and in order to cover the wind-farm area as completely as possible. This was the reason why vantage points 7 and 8 were added two months after the research of bat activity had already begun. Vantage points 1 to 6 had been selected before the beginning of the research based on the preliminary site survey. The geographic coordinates of the vantage points are presented in Table 1 below. In order to get the most complete picture of the site and the habitat use by bats (*i.e.* the functions of the present bat habitats), the position of the surveyor was occasionally changed during the vantage point count within an area of up to 500 m from the established vantage points.

Bat activity was registered by audio detection of their ultrasound echolocation signals and calls using the Pettersson D 240x ultrasound bat detector (with time expansion and heterodyne systems), which was held in the hand of the surveyor, and by visual detection using a hand-held spotlight [...]. For each established bat contact, identification (preliminary) of the species was recorded as well as the time, duration, estimated minimum and maximum flight altitudes and any other observations concerning hunting behaviour. The entire activity of a bat during which it did not leave the audio-visual field of the surveyor was recorded as a single and unique contact so that the number of contacts reflects the number of present specimens as realistically as possible, at least during a short time interval (Limpens 2010)." (cf. Karapandža & Paunović 2011).

In order to facilitate the comparison of bat activity in terms of intensity in various spatial and temporal frames of reference, a time-standardised measure was introduced – the average number of contacts / hour of vantage point count – representing the total number of registered contacts within a specific space and/or period divided by the total duration of vantage point counts conducted in that space and/or period. As a measure of the relative number of species in a given period, the percentage of bat flights/contacts is used for individuals identified as belonging to a specific species

(or a group of species), *i.e.* their share in the total number of flights/contacts registered in that period. (cf. KARAPANDŽA & PAUNOVIĆ 2011).

3.2.1.2 Mist netting

"Mist netting was used as an auxiliary method both at the wind-farm site and near the potential roosts in the immediate surroundings. This method was applied in order to establish the presence of bats at potential roosts, to determine the reproductive and phenological status of specimens and, potentially, to make a more precise identification of species that cannot be distinguished by ultrasound detection. The use of mist nets is not very suitable for open habitats where bats fly at a relatively high altitude, as is the case with the present site. Mist netting was conducted from dusk until dawn during the following four working nights: 10/11 May, 10/11 June, 19/20 and 29/30 August." (cf. KARAPANDŽA & PAUNOVIĆ 2011).

3.2.1.3 Searching for roost sites

"In addition to the monitoring of bat activity at the wind-farm site, potential roost sites (*i.e.* bat colonies) were also searched for at the site, in the neighbouring settlements (Dolovo, Mramorak, Vladimirovac and a spread out settlement around the Dolovo train station) and in the area of the Deliblato Sands Special Nature Reserve through inspection of potentially suitable structures as well as through ultrasound and visual detection of bat activity and interviews conducted with the local population. These activities were conducted during a total of 38.4 effective hours, occasionally on the same nights when a vantage point count was being carried out (in the intervals between counts at individual vantage points) or during mist netting and additionally on the following days: 3 and 8 March, 12 April, 7/8 June, 30 June/1 July, 5 and 10/11 August." (cf. KARAPANDŽA & PAUNOVIĆ 2011).

3.2.2 Methods used in 2011

Since the methods used in 2011 have not yet been described, they are presented here in detail.

3.2.2.1 Transect walks

In order to detect bats within the study area the transect method was used. This investigation started In June 2011 and will be continued until the end of November 2011. Five transects were established in order to cover all parts of the study area as well as its main habitat structures. Each transect has a given length of 1.25 km and was monitored for about 1.25 hours per night. A special schedule was established in order to change the temporal order of transect walks during each examination (cf. Table 3.1).

Transect 3 located in the middle of the study area (see Map 2.1) is used as a baseline for comparing bat activity. In 2010 a regularly used bat flight path between Dolovo and Deliblato Sands was detected showing a high degree of bat activity.

The other four transects are located as follows:

- Transect 1 in the north at the border of the study area represents an area with structural elements (bushes, hedge-rows) leading to a higher diversity of habitats.
- Transects 2 and 4 in the middle (roughly) of the study area run along dirt roads in an open and intensively used agricultural area with almost no ruderal vegetation.
- Transect 5 in the south of the study area follows a field path with a bordering broad ruderal vegetation rich in flowers.

The position, direction and length are marked on Map 2.1.

Bat activity is recorded by detection of their ultrasound echolocation signals and calls using the Pettersson D 240x ultrasound bat detector (with time expansion and heterodyne systems). In addition, weather conditions and land use are noticed for each transect too.

For each established bat contact at a certain point, identification (preliminary) of the species are recorded as well as time, duration, estimated minimum and maximum flight altitudes and any other observations regarding hunting or social behaviours.

In order to identify present bat species as precisely as possible, in addition to on-site identification the detected bat ultrasound signals are recorded using a Zoom H2 audio recorder and subsequently analysed using BatSound 4.03 (© Pettersson Elektronik AB) software assisted by the relevant literature.

According to Rahmel *et al.* (1996) visual and acoustic recordings using a bat-detector is an appropriate method to reliably determine relevant species in wind energy projects. At least in typical flight situations the majority of indigenous bats can be determined by bat-detectors (Limpens & Roscher 1995). Nonetheless, if an individual is recorded only briefly and cannot be observed visually, a reliable identification of the species is not possible. For this reason some entries in the results are noted indeterminately ("*Chiroptera* spec." or "*Nyctalus* sp.").

The detectability of each species using a detector clearly varies. “Loud-calling” species with low frequency-calls (*e.g.* Common Noctule, *Nyctalus noctula*) can be detected at greater distances, while so-called whisperer species (*e.g.* Bechstein's bat, *Myotis bechsteinii*), Brown or Gray long-eared bat (*Plecotus auritus* or *P. austriacus*) may not be recorded even at distances of 10 m. Thus the relative activities of different species are not directly comparable. There is a high likelihood that loud-calling species are over-represented within the results in relation to whisperers.

For each transect walk the obtained contacts (one or more individuals of a species in one location), the duration of the contact, the determination and number of individuals as well as their behaviour were recorded. Thus the number of contacts of each transect walk can be calculated. Every contact was counted as new if the contact was not unambiguously assigned to a bat that had already been

recorded. The probability of double counting is relatively high. Consequently, the number of contacts does not represent the total number of individuals but relative activity.
As the required time to walk along a transect and the length of all transects were nearly the same, bat activity of each transect can be compared spatially and temporally.
The aim of transect walks is to obtain information about species-composition and the distribution of different bat species in the study area as well as the significance of different habitat structures within the study area.

In this survey the results of the first five transect walks are presented, analysed and assessed. Nine more transect walks at each transect are scheduled until the end of November 2011.
Weather conditions during transect walks were good with little or no wind and no rainfall (cf. Table 3.1).

Table 3.1: Overview of site visits from June to September 2011, corresponding weather conditions and temporal schedule of examined transects

no.	date	wind (Bft)	cloudiness	moon	precipitation	schedule of investigated transects
1	13.06.2011	0 - 1	at first few clouds, later clear	full moon	0%	1, 2, 3, 4, 5
2	01.07.2011	0	at first few clouds, later clear	new moon	0%	5, 1, 2, 3, 4
3	12.07.2011	0 - 1	no clouds	3/4-moon	0%	4, 5, 1, 2, 3,
4	17.07.2011	0 - 2	mostly clear, few slight clouds	2/3-moon	0%	3, 4, 5, 1, 2
5	01.08.2011	0 - 1	no clouds	new moon	0%	2, 3, 4, 5, 1
6	10.08.2011	0 - 1	mostly clear, few slight clouds	3/4-moon	0%	1, 2, 3, 4, 5
7	21.08.2011	0 - 1	no clouds	1/2-moon	0%	5, 1, 2, 3, 4
8	30.08.2011	1	no clouds	new moon	0%	4, 5, 1, 2, 3,
9	03.09.2011	0 - 1	no clouds	1/3-moon	0%	3, 4, 5, 1, 2
10	14.09.2011	0 - 2	no clouds	full moon	0%	2, 3, 4, 5, 1
11	30.09.2011	0 - 1	no clouds	1/2-moon	0%	1, 2, 3, 4, 5

3.2.2.2 Automatic ultrasound detection (bat-boxes)

A means to continuously and automatically record bat activity at certain sites is the use of bat-boxes. These are equipped with a bat-detector made of an external microphone (here: produced by *Ciel-electronique*, non-serial production detectors with frequency division functionality and a built-in clock that was adjusted to a 15-minute intervals to relate bat activity to certain periods per night) connected to an Olympus VN-5500PC digital audio recorder (cf. Figure 3.1). The detectors transfer the entire ultrasound range into audible range, so that all bat activities at distances up to max. 100 m (frequency-depended) are recorded. The automatic ultrasound detection systems were used in fixed positions at the eight vantage points of the 2010 investigation as well as 22 sites of the planned wind turbines (in total 30 sites that cover the study area spatially and ecologically, cf. Map 3.1). Ten bat-boxes could be deposited simultaneously per single night. All 30 sites could thus be covered in three nights. Bat-boxes operated from dusk till dawn. Additional data, *e.g.* starting and ending time, weather conditions (temperature, wind speed, wind direction, sky cover and rainfall) and land use for every bat-box was noted. After picking up the bat-boxes, wav-files on the voice recorders were saved on personal computers. Recorded files were analysed using audacity, a program that counts the number of contacts (sounds of echolocation by bats) per time interval.

The investigation commenced in April 2011 and continues until the end of November 2011.

Figure 3.1: Bat-box. Left: detector with cable to microphone. Right: energy supply and digital audio recorder.

As the measured activity depends on a number of factors (season, weather, number of nights, *etc.*) and as quantitatively high activities can have rather different causes (*e.g.* permanent hunting individuals *vs.* single flights by many individuals), it does not seem appropriate to establish a general assessment based on fixed thresholds for low, average or high activity (as proposed by Dürr 2007). In addition, different types of bat-boxes differ in sensitivity, thwarting comparisons of studies in which different types of bat-boxes were used. Nevertheless, investigations using bat-boxes lead to valuable qualitative and semi-quantitative results on the activity of bats at particular sites.

For these reasons, the results were evaluated based on the following aspects:

- In order to assess the activity at the sites and compare them with data obtained in previous studies, the activity of each night was standardized for maximum flight time (contacts / hour). Maximum flight time equals the length of the dark phase (official sunset to sunrise times for Dolovo). At the end of the study the annual average activity for each site can be determined based on the average activity of all nights.
- The data of bat-boxes may - along with the detector inspections - reveal seasonal bat activity in the study area. Thus, certain phenomena (*e.g.* activity of migrating bats) can be indicated.

Wherever possible, species or at least species groups are determined. In many cases it is not possible to distinguish between certain species, *e.g.* if the sound characteristics are not typical, but most cases at least groups of species can be distinguished.

In this survey the results of the first nine passes are presented, analysed and assessed. The weather conditions were mostly good with low or no wind, moderate to high temperature and almost no rainfall (cf. Table 3.2).

Table 3.2:: Overview of the usage of bat-boxes from April 2011 to July 2011, corresponding weather conditions and investigated site (VP: vantage point, WT: wind turbine)

week	date	wind	cloudiness	temperature	precipitation	investigated sites
17	27.04.2011	light - strong	clear - partly cloudy	10 - 14°C	light rain in the morning	VP 1, WT 24, WT 3, WT 6, WT 8, WT 48, VP 2, WT 11, WT 54, WT 14
	29.04.2011	calm - light	clear	9 - 15°C	no rain	WT 64, WT 39, VP 5, WT 78, WT 37, WT 36, WT 42, WT 22, WT 20, VP 6
	30.04.2011	light - moderate	clear - scattered clouds	11 - 15°C	light rain in the morning	WT 19, VP 4, WT 16, WT 32, VP 7, WT 71, WT 59, WT 61, VP 8, VP 3
20	18.05.2011	calm - light	clear - scattered clouds	13 - 17°C	no rain	WT 14, WT 61, WT 32, WT 17, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	19.05.2011	light	clear - scattered clouds	17 - 25°C	no rain	VP 2, WT 24, VP 1, WT 3, WT 1, WT 54, WT 11, WT 48, WT 8, WT 6
	21.05.2011	calm - light	clear - partly cloudy	17 - 24°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
22	04.06.2011	calm - light	clear - partly cloudy	20 - 24°C	no rain	VP 2, WT 24, VP 1, WT 3, WT 1, WT 54, WT 11, WT 48, WT 8, WT 6
	05.06.2011	light - moderate	clear - partly cloudy	19 - 25°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	06.06.2011	strong	partly cloudy	19 - 24°C	no rain	WT 14, WT 61, WT 32, WT 17, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
24	15.06.2011	calm	clear	17 - 23°C	no rain	VP 2, WT 24, VP 1, WT 3, WT 1, WT 54, WT 11, WT 48, WT 8, WT 6
	16.06.2011	calm	clear	20 - 25°C	no rain	WT 14, WT 61, WT 32, WT 17, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	17.06.2011	calm - light	clear - scattered clouds	16 - 23°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64

continuation of Table 3.2

week	date	wind	cloudiness	temperature	precipitation	investigated sites
26	27.06.2011	light - moderate	cloudy	19 - 15°C	no rain	VP 2, WT 24, VP 1, WT 3, WT 1, WT 54, WT 11, WT 48, WT 8, WT 6
	29.06.2011	calm - light	cloudy	16 - 18°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	01.07.2011	light	partly cloudy	13 - 19°C	no rain	WT 14, WT 61, WT 32, WT 17, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
27	06.07.2011	calm	clear	14 - 17°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	07.07.2011	calm - light	clear	18 - 25°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	08.07.2011	calm	clear	19 - 26°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
28	10.07.2011	calm - light	clear	22 - 28°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	12.07.2011	light	clear	17 - 28°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	08.07.2011	calm	scattered clouds	19 - 23°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
29	18.07.2011	calm - light	partly cloudy	20 - 21°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	21.07.2011	calm	partly cloudy - very cloudy	15 - 16°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	23.07.2011	calm - light	clear - partly clouds	17 - 19°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
30	26.07.2011	calm - light	clear - partly cloudy	14 - 20°C	light rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	30.07.2011	calm - light	clear	14 - 20°C	light rain in the beginning	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	31.07.2011	calm - light	clear - scattered clouds	15 - 19°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
31	05.08.2011	light	clear - partly cloudy	16.5 - 23°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	06.08.2011	light	clear	18.5 - 22.5°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	07.08.2011	moderate	clear	20.5 - 27.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
32	08.08.2011	moderate	clear - cloudy	16.5 - 24.5°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	13.08.2011	calm	clear - partly cloudy	14.5 - 22.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	14.08.2011	calm	clear	16 - 24.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
33	15.08.2011	light	clear	17.5 - 24°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	16.08.2011	light	clear - scattered clouds	15.5 - 24.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	17.08.2011	calm	clear	16 - 24.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64

continuation of Table 3.2

week	date	wind	cloudiness	temperature	precipitation	investigated sites
34	24.08.2011	light	clear	14.5 - 25°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	26.08.2011	moderate to strong	clear	21.5 - 26.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	28.08.2011	calm - light	clear	13.5 - 21.5°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
35	30.08.2011	calm - light	scattered clouds	14 - 24.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	31.08.2011	calm - light	clear - scattered clouds	13 - 22.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	01.09.2011	calm - light	clear -cloudy	18.5 - 22°C	periods of rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
36	06.09.2011	calm	clear - scattered clouds	11.5 - 19.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	07.09.2011	light	scattered clouds	12.5 - 22.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	08.09.2011	light - moderate	cloudy	16.5 - 20.5°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
37	12.09.2011	light	clear	15.5 - 25.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	13.09.2011	light	clear	16 - 26°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	14.09.2011	calm - strong	clear - cloudy	17 - 23.5°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
38	21.09.2011	light	clear - cloudy	14.5 - 18.5°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16
	22.09.2011	light	clear	13.5 - 18°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	23.09.2011	light	clear	10 - 15°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
39	27.09.2011	light	clear - scattered clouds	9.5 - 17.5°C	no rain	WT 78, WT 71, VP 7, WT 42, WT 22, VP 6, VP 5, WT 39, WT 37, WT 64
	30.09.2011	light	clear	12.5 - 13°C	no rain	VP 2, WT 8, WT 6, WT 24, VP 1, WT 54, WT 11, WT 48, WT 3, WT1
	02.10.2011	light	clear	15.5 - 22°C	no rain	WT 61, WT 32, WT 17, WT 14, WT 19, VP 4, VP 3, VP 8, WT 59, WT 16

3.2.2.3 Thermal imaging

During two nights (10 and 11 October 2011) investigations with two thermal cameras were undertaken at four vantage points (VP 4, 5 and 8 of the investigation by KARAPANDŽA & PAUNOVIĆ 2011 and WT 59) in order to obtain information about flight-heights and flight-directions of bats. In each night the investigation started around sunset. At most two hours were spent at a vantage point (cf. Table 3.3). When bat activity was very low due to low temperature the field survey was stopped.

As it is not possible to distinguish species with thermal cameras, it was necessary to have an additional surveyor using a bat-detector for species identification. Two surveyors scanned the sky around each vantage point, while one surveyor used the bat-detector to record and identify species. When bats were seen on the screen of the thermal cameras their flight height and direction were estimated by the surveyor.

A detailed description of the used method, its restrictions and data analysis is given by MCLAUGHLIN (2011).

Table 3.3: Overview of temporal schedule and weather conditions of the thermal imaging investigation

VP	start time	end time	temp. start	temp. end	clouds	wind (bft)	precipitation
10.10.2011							
VP 5	18.00	20.00	10°C	5°C	1/8	2 - 3	no rain
WT 59	20.30	21.30	5°C	5°C	0/8	0 - 1	no rain
VP 8	21.40	22.00	5°C	5°C	0/8	0 - 1	no rain
11.10.2011							
VP 4	18.00	20.00	11.5°C	11°C	8/8	0 - 1	no rain
VP 5	20.30	21.40	11°C	11°C	8/8	0 - 1	no rain

4 Results

4.1 Team 1 (Javor Rašajski)

Mist netting and visual observations

Six species were recorded by mist netting. The most abundant species was the Common Noctule which occurred at the northern border and near the abandoned farm (totally 172 observed visual contacts; note that double counts are very likely for all species). Common Noctule was rare in the central parts of the study area.

The second-most species were Kuhl's Pipistrelle (*Pipistrellus kuhlii*) and Whiskered Bat (*Myotis mystacinus*) with a total of 47 observed contacts. Both species were recorded mostly at the border or outside the area of the planned wind farm.

The Serotine Bat (*Eptesicius serotinus*) was recorded 27 times. It occurs most numerously at VP 4 near the abandoned farm and at the asphalt road leading from Dolovo to Deliblato Sands. Some contacts of this species were recorded in the southern part of the study area at VP 5.

Grey Long-eared Bat was detected 17 times, mostly outside the study area near the abandoned farm.

At two times a Greater Horseshoe Bat appeared near vantage point 4 (cf. Rašajski 2011, p. 131 - 138).

The results showed, that most activity was observed at VP 4 near the abandoned farm. This corresponds to the results of Karapandža & Paunović (2011) who identified a hunting area near the abandoned farm (there the site is named VP 8).

Furthermore, Rašajski identified activity in the southern part of the study area where Karapandža & Paunović (2011) also registered a hunting area, and at the asphalt road leading from Dolovo to Deliblato Sands where Karapandža & Paunović (2010) assumed a flight path of bats from potential roosts within the settlement to hunting areas in Deliblato Sands.

4.2 Team 2 (Branko Karapandža & Milan Paunović)

4.2.1 Results of the investigation in 2010

4.2.1.1 Searching for roosts and mist netting

No roosts were found within the site of the planned wind farm. Furthermore, potential suitable roosts sites like buildings or older tree with holes are mostly absent within the location.

However, large numbers of potential roosting sites were found in the settlements close to the study area as well as in Deliblato Sands.

In detail the following roosts were detected (Karapandža & Paunivic 2011):

- A nursery roost of the Greater Horseshoe Bat (*Rhinolophus ferrumequinum*) and Geoffroy's Bat (*Myotis emarginatus*) existed in the attic of the Rošijana forestry service house at the Deliblato Sands Special Nature Reserve. This roost is kwon at least since 1980, but it is located more than 1.000 m away from the planned wind farm site. The forestry service house may be used as a roosting site for Long-eared Bats, too.

- Large numbers of colonies of Kuhl's Pipistrelle were recorded in all settlements close to the study area. They comprise small colonies of a few to several dozens to large colonies of about 300 to 400 individuals.
- In all settlements, especially at the outskirts, as well as in the area of the Deliblato Sands Special Nature Reserve, large numbers of mating roosts of the Common Noctule were found. This was indicated by the calls of individuals of this species, regularly registered in the period from late August to November in hollow tree trunks and man-made structures.
- Mating roosts of Nathusius' Pipistrelle (*Pipistrellus nathusi*) likely existed in the area of Delblato Sands and the settlement around the Dolovo train station more than 1,000 m away from the planned wind farm site. Mating calls of Nathusius' Pipistrelle near VP 8 may indicate roosts in tree trunks, too.
- A small colony of about 10 to 12 individuals of Wiskered Bat might have existed at a house near VP 3.

4.2.1.2 Vantage point counts

Karapandža & Paunović (2011) recorded at least 15 species during vantage point censuses within the study area. There are reliable indications that about 18 species could be found in the study area. Overall 1,586 contacts were counted.

73 % of all contacts were made up of four species: Kuhl's Pipistrelle (23.3 %), Nathusius' Pipistrelle (13.7 %), Serotine Bat (13.2 %) and Common Noctule (9.9 %). Furthermore, 14.6 % of all contacts derived from one of these species as well but could not be distinguished beyond doubt. Individuals of the family Vespertilionidae were recorded in 6.1 % of cases. All other species or groups of species made up fractions of less than 5 %, in most cases less than 1 %.

Most contacts were established at vantage point 8 with an average number of 26 contacts / h. The recorded activity was actually two times higher than at VP 5, the VP displaying the second highest number of contacts / h (13.65); followed by VP 3 and VP 4 with 9.85 and 7.10 contacts / h, respectively. At the other VPs between 3.5 and 5.3 contacts / h were counted.

Most contacts were recorded in June and August with an overall number of 12.6 and 10.0 contacts / h, respectively. In September, May and June 9.59, 8.08 and 6.48 calls / h were detected, respectively. November, March, April and October had the lowest numbers of contacts / h.

Detailed results are presented by Karapandža & Paunović (2011).

4.2.2 Results of the investigation in 2011

4.2.2.1 Transect walks

During the investigation, 737 spatially separated contacts were recorded (cf. Figure 4.1 and Table 1 in Annex I) yielding an average of about 67 contacts per night and 10.7 contacts / hour. Most of the contacts derived from the night 12 July, where a total of 183 contacts (29.2 contacts / h) were registered. The lowest number of contacts was detected on 30 September 30, when a total of 18 different contacts were registered (about 3 contacts / h; cf. Table 1 and 2 in Annex I).
Overall bat activity was highest at transects 1, 3 and 5, while it was comparatively low at transect 4 and 2 (cf. Figure 4.1).

The most common species was the Serotine Bat with a total of approximately 32 % of all contacts. Especially at transects 1 and 2 (cf. Figure 4.1, 4.2 and 4.3) its activity was very high with about 61 % and 57 % of all recorded contacts. Kuhl's Pipistrelle and Common Noctule had a total share of about 19 % and 17% of all registered contacts. Kuhl's Pipistrelle was most common at transect 3 (cf. Figure 4.5), Common Noctule at transect 4 and 5 (cf. Figure 4.6 and 4.7). Nathusius' Pipistrelle and undetermined Pipistrelles were represented with 6.5 % and 10%, respectively. In total, 621 contacts (about 84% of all contacts) derived from the mentioned (group of) species (cf. Table 1 in Annex I).

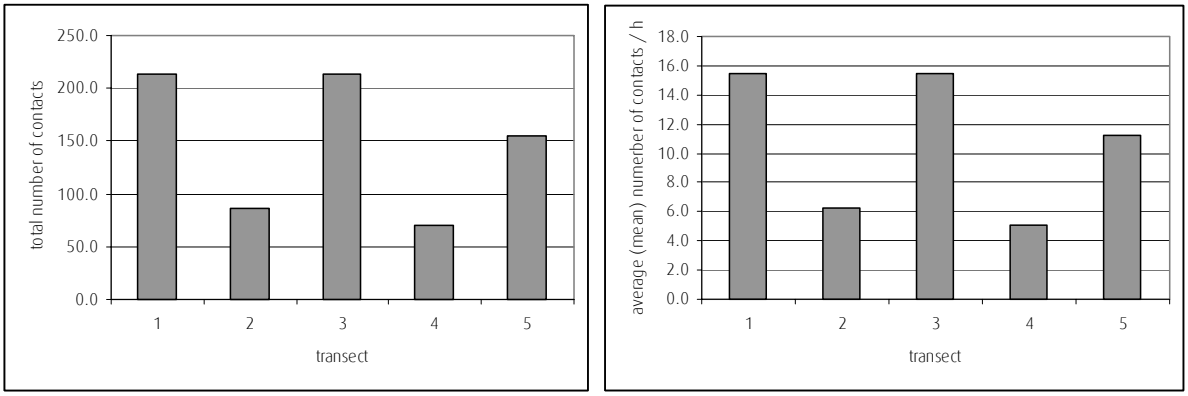


Figure 4.1: Bat activity at each of the five transects (left: total number of contacts recorded during five transect walks; right: average number of contacts / hour)

To compare and assess the activity of bats species during transects walks the median number of calls / h of all species in total is calculated (5.6 calls / h). In a second step the activity of a particular bat species is assessed as

- low: the number of calls / h is lower than the 25 %-quartile: (< 3.2 calls / h)
- medium: the number of calls / h is between the 25 %-quartile and the median: (3.2 to 5.6 calls / h)
- high: the number of calls / h is more than the median: (> 5.6 calls / h)

Activity within the study site as a whole

As given in Figure 4.2 Serotine Bats showed a high activity in July which derived from a single night, however. The activity decreased drastically in August and September when the overall activity was low.

Overall activity of Common Noctule, Kuhl's and Nathusius' Pipistrelle was low in general.

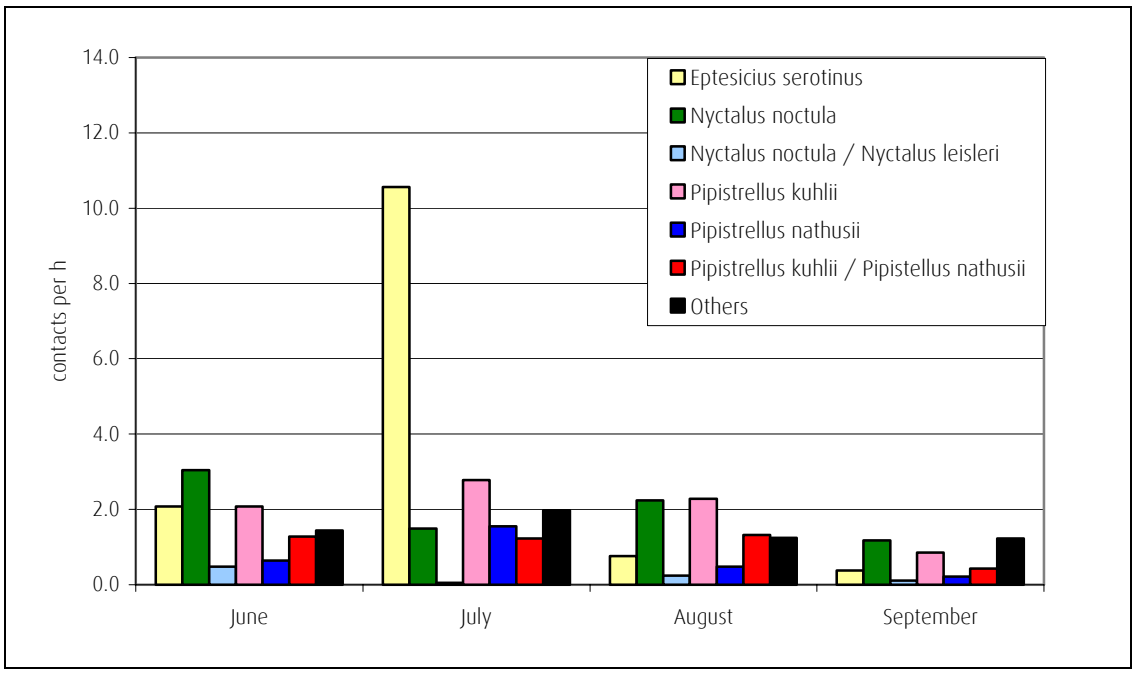


Figure 4.2: Average of bat activity (contacts / h) at all transects for the months June to September

Transect 1

At transect 1 at least seven species were detected. On average Serotine Bat showed a high activity (cf. Figure 4.3). However, this is mainly due to a very high activity during a single night (12 July). During several nights (in June, mid-July, August and September) activity of Serotine Bat was lower, between 1 and 5 contacts / h, and was thus comparable to the recorded activity of all other species. Activity of Common Noctule was high in June and decreased - as of *Pipistrellus* species - to low in July, August and September.

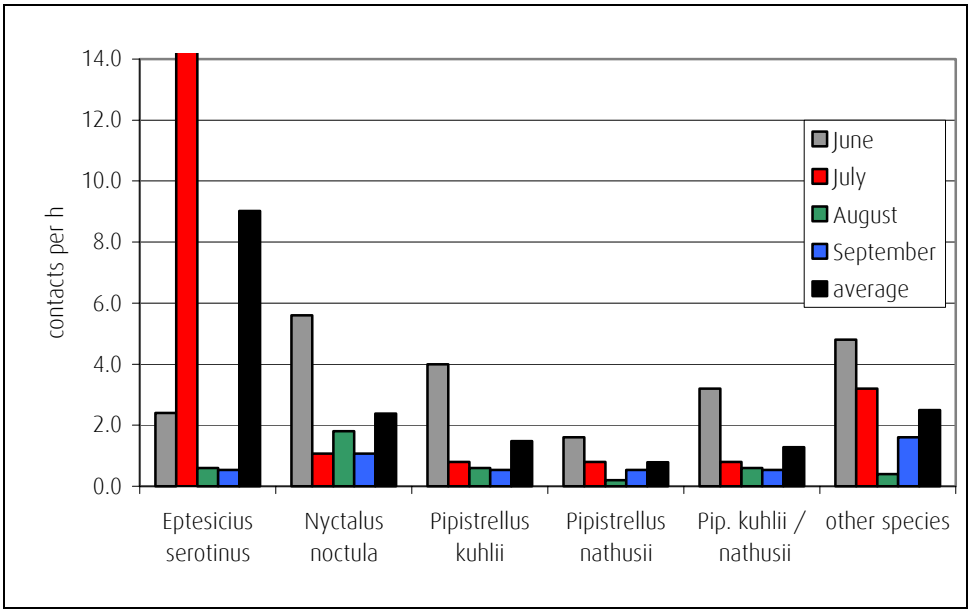


Figure 4.3: Monthly bat activity (contacts / h) during transects walks at transect 1

Transect 2

At least five species were recorded at transect 2. With on average about 3.5 contacts / h Serotine Bat showed a moderate activity at transect 2 (cf. Figure 4.4). Again this was due to a single night (12 July) with a very high activity (as already noted on transect 1). In other nights activity of Serotine Bat was low (mainly less than 2 contacts / h).

Activities of the remaining bat species measured at this transect were low.

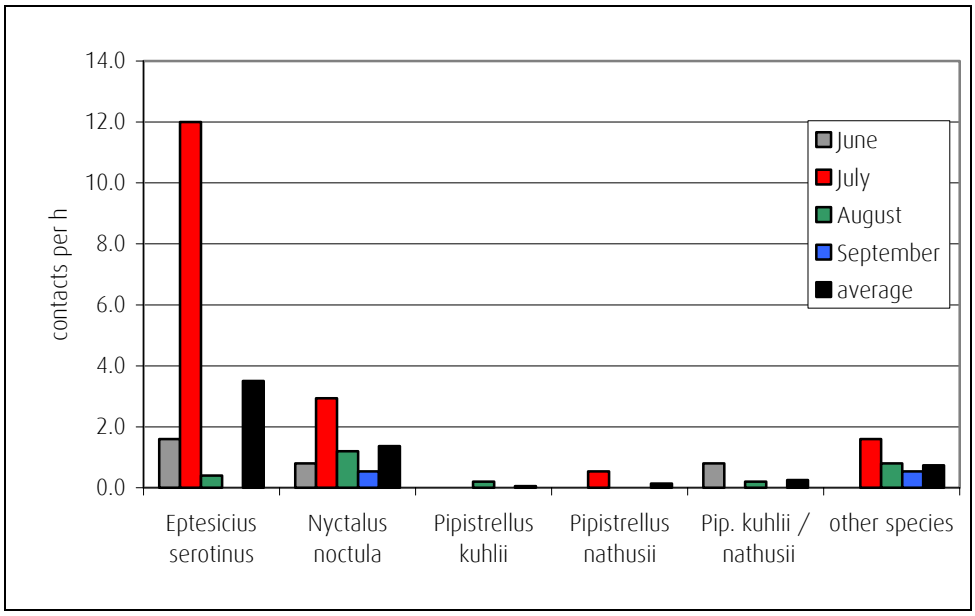


Figure 4.4: Monthly bat activity (contacts / h) during transects walks at transect 2

Transect 3

At least seven species were recorded at transect 3. In contrast to transect 1 and 2, species of the genus *Pipistrellus* (especially Kuhl's Pipistrelle) occurred comparatively often at transect 3 (cf. Figure 4.5). A high activity of Pipistrelles was measured in June and July with highest activity of Kuhl's Pipistrelle on 17 July (24 contacts / h). Activity of species of genus *Pipistrellus* decreased in August and September but remained on a moderate level.

Serotine Bats were often recorded in June as well. In comparison with transect 1 and 2 its activity in June was lower, but still on a high level. In August and September activity decreased to low level.

Recorded activity of Common Noctule was low.

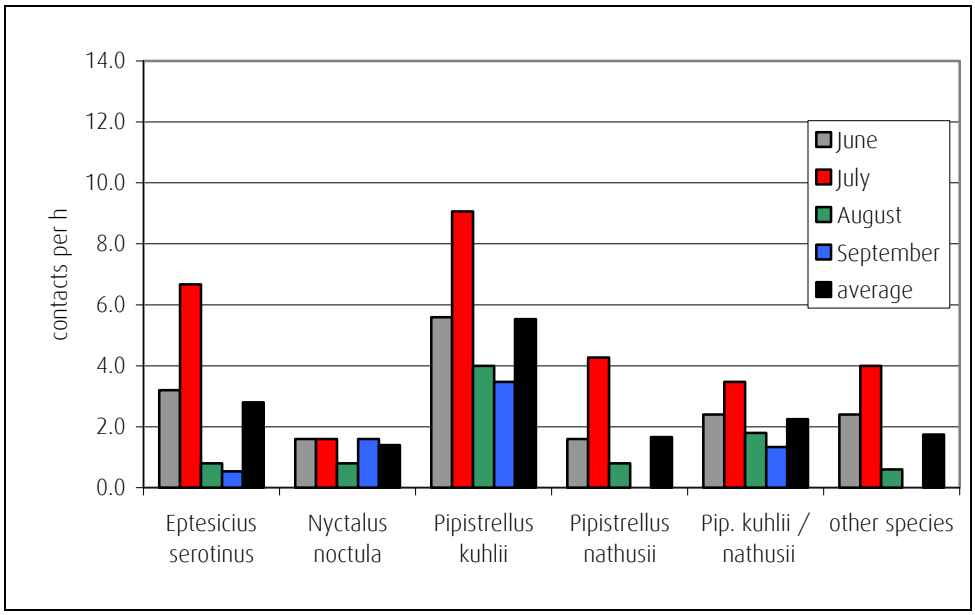


Figure 4.5: Monthly bat activity (contacts / h) during transects walks at transect 3

Transect 4

Except for Common Noctule average activity of each species was low (cf. Figure 4.6). On 31 August a high activity of Common Noctules was recorded (8 contacts / h) which leads to moderate activity of Common Noctules in August. Except of this particular night the activity of Common Noctules was low.

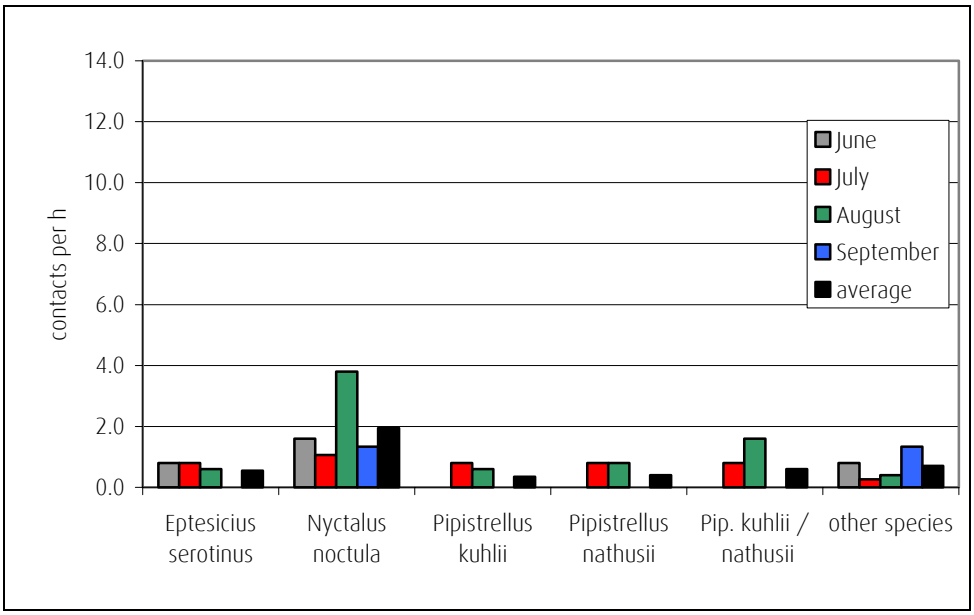


Figure 4.6: Monthly bat activity (contacts / h) during transects walks at transect 4

Transect 5

At least nine bat-species were recorded at transect 5. Common Noctule and Kuhl's' Pipistrelle were the most frequent species.

The activity of Common Noctules was high in June and moderate August. In July and September their activity was low.

Kuhl's' Pipistrelle was predominantly detected in August when they showed a high activity. Activity in June and September was low.

Serotine Bat, Nathusius' Pipistrelle showed an average activity of about 1 to 2 contacts / h and thus a low activity (cf. Table 4.7).

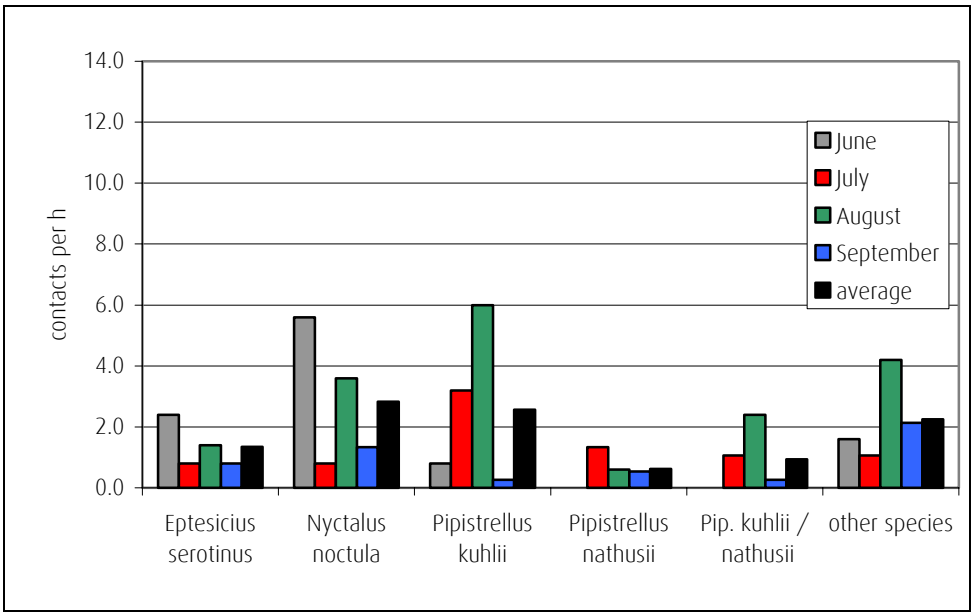


Figure 4.7: Monthly bat activity (contacts / h) during transects walks at transect 5

4.2.2.2 Bat-boxes

During the conducted 18 passes (with three nights each) a total of 454 analyzable files were recorded. At certain locations and during some nights no recording could be obtained due to technical defects, noise overloads from insects or wind or due to damaging and disappearing of bat-boxes (cf. Table 4.1). Files which have been not analysable due to insect noise (predominantly crickets and bush crickets from the order Saltatoria) mostly occured in weeks 27 to 34. In 27 further cases noise arose from wind or insects (light blue in Table 4.2) but files could still be analysed. In these cases bat calls might have been masked by insect noise, so that the number of calls is underestimated. For most locations, between 15 and 17 files were analyzable. At three locations less than ten files could be analysed (cf. Table 4.1).

Locations WT 20 and WT 36 were substituted by two other locations: WT 17 and WT 1. Thus only one file exists for WT 20 and WT 36, so that the results are not considered in the analysis. Due to the comprehensiveness of the data, it is not discussed in detail but presented in Annex I.

Table 4.1: Files (data sets) per site and per study-week and potential flight time (dusk till dawn)

week / Site	17	20	22	24	26	27	28	29	30	31	32	33	34	35	36	37	38	39	no. of files	record potential flight
WT 22																			18	176.25
WT 32																			16	155.25
WT 54																			18	175.75
WT 71																			17	167.50
VP 2																			15	148.75
VP 6																			8	72.50
WT 14																			15	150.00
WT 17																			15	147.00
WT 16																			16	155.25
WT 61																			18	176.25
WT 42																			17	167.50
VP 3																			13	128.00
WT 8																			14	136.25
WT 59																			17	165.75
WT 78																			17	167.50
VP 7																			16	157.50
WT 11																			16	154.50
WT 24																			16	158.25
WT 6																			17	167.25
WT 19																			17	166.50
VP 1																			7	61.25
WT 64																			16	153.50
VP 4																			14	132.00
WT 37																			16	156.50
WT 2																			17	167.75
WT 1																			16	157.50
WT 39																			17	167.25
WT 48																			12	119.00
VP 5																			14	135.50
VP 8																			8	75.50
WT 20																			0	0.00
WT 36																			1	10.00
total	26	30	29	29	30	26	25	21	23	20	22	23	19	24	25	26	26	25	454	4,429.25

Explanations for Table 4.3:

white:	Complete file (data set) obtained and analysed
black:	No bat-box deposited
light blue:	Noise overload at least at half of the night; files could be analysed. Some bat calls may be masked by other noise.
dark blue:	File not analyzable due to insect overload
orange:	No recordings because of technical defect

The 454 files in total contained 14,260 different bat calls. Consequently, considering all nights and all locations the average activity was 3.2 calls / h. At eight locations this average activity was exceeded substantially (cf. Table 4.3). Activity was highest at WT 48 and VP 8 with about 20 and 24 calls / h, respectively.

Except for WT 48, WT 2 and VP 8, no other yielded recordings of more than 1,000 calls in total. At 19 locations less than 400 calls were recorded during all nights combined (cf. Table. 4.1). Locations with a high bat activity (located at the bottom of Table 4.2) are predominantly located at the borders of the study area (north: VP 1, WT 1 and WT 2; east: VP 8 and WT 48; south: VP 5, WT 37 and WT 39; cf. Map 4.1), while activity in the centre was mostly low (locations that are located at the top of Table 4.2). In certain nights a high activity was also recorded in the centre of the study area. This result might refer to single individuals continuously hunting at a site. Accordingly, the high activity in the centre does probably not constitute a regular phenomenon.

In most cases bat calls were recorded during a small and distinctive period of time, indicating that the activity probably refers to one or two individuals hunting close to the bat-box (many sequences with feeding buzzes).

In total the overall bat activity was moderate from mid of May to mid of June and increased to a high level from mid of June to mid of July. Starting in August the activity decreased and was low to moderate in August and low in September (cf. Table 4.2).

As stated in Chapter 6, the collision risk of bat species differs significantly. In fact, species of the genera *Nyctalus* and *Pipistrellus* and, moreover, Parti-coloured Bat (*Vespertilio murinus*) are believed to be particularly prone to collision whereas collision risk seems to be low for many other species (*e.g.* species of genus *Myotis*, cf. Dürr 2011). Thus in Table 4.5 only species are considered that are particularly prone to collision (calls which could not be clearly identified, *e.g. Nyctalus* / *Eptesicus*, are included). Taking all nights and locations into account, the average activity was 2.3 calls / h. At nine locations this average activity was exceeded substantially (more than 3 calls / h; cf. Table 4.2 and Map 4.2). A very high activity was recorded at VP 8 with an average about 21 calls / h. As can be seen in Table 4.3, the nine locations with a substantial activity above average are located at the borders of the study area (North: VP 1, WT 1; East: VP 8 and WT 48; South: VP 5, WT 37, WT 39 and WT 64; West: WT 19).

The overall activity of this particular species was high in May, June and in the first week of July. Afterwards the activity decreased to a moderate level in the remaining weeks of July. In August the activity was low to moderate and decreased to low in September (cf. Table 4.4).

Table 4.2: Recorded activity of all bats / species (given are the number of contacts during each night and the average number of contacts / hour at each location)

	April		May		June						July								August								September										total	
	Week 17		Week 20		Week 22		Week 24		Week 26		Week 27		Week 28		Week 29		Week 30		week 31		week 32		week 33		week 34		week 35		week 36		week 37		week 38		week 39			
site (VP/WT)	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	calls per h
VP 2	0	0.0	17	1.7	4	0.4	11	1.2	0	0.0	1	0.1	0	0.0	6	0.7			8	0.9			4	0.4	14	1.3	1	0.1	1	0.1	0	0.0	1	0.1	0	0.0	68	0.4
WT 14	0	0.0	1	0.1	11	1.2	4	0.4	6	0.6							10	1.1	4	0.4	0	0.0	5	0.5	1	0.1	2	0.2	11	1.0	10	0.9	1	0.1	8	0.7	74	0.5
WT 32	0	0.0	0	0.0	27	2.9	19	2.0	17	1.8	15	1.7	15	1.7	11	1.3	13	1.4	6	0.6	5	0.5	3	0.3	3	0.3	1	0.1			4	0.4	6	0.5	0	0.0	145	0.9
WT 54	3	0.3	14	1.4	7	0.8	10	1.1	10	1.1	24	2.7	1	0.1	8	0.9	18	2.0	24	2.6	13	1.3	24	2.5	1	0.1	3	0.3	0	0.0	1	0.1	0	0.0	0	0.0	161	1.0
WT 71	0	0.0	20	2.0	18	1.9	11	1.2	9	1.0	7	0.8			9	1.0	19	2.1	0	0.0	3	0.3	10	1.0	15	1.4	4	0.4	11	1.0	8	0.7	7	0.6	10	0.8	161	1.0
WT 17			27	2.7	0	0.0	30	3.2	6	0.6	7	0.8	4	0.5			34	3.8	5	0.5	22	2.3	1	0.1			4	0.4	1	0.1	1	0.1	3	0.3	0	0.0	145	1.0
VP 6	0	0.0	20	2.0	14	1.5	2	0.2	0	0.0			14	1.6			8	0.9			22	2.3															80	1.1
WT 22	5	0.5	27	2.7	17	1.8	16	1.7	17	1.8	7	0.8	1	0.1	14	1.6	25	2.8	5	0.5	0	0.0	9	0.9	10	1.0	0	0.0	11	1.0	55	4.9	12	1.0	14	1.1	245	1.3
WT 16	29	2.3	3	0.3	26	2.8	0	0.0	2	0.2	17	1.9	31	3.5	31	3.5	38	4.2	9	1.0	24	2.5	0	0.0					21	1.9	0	0.0	11	0.9	0	0.0	242	1.6
WT 61	2	0.2	10	1.0	27	2.9	73	7.7	31	3.4	0	0.0	33	3.8	0	0.0			21	2.3	17	1.7	5	0.5	6	0.6	19	1.8	40	3.6	0	0.0	1	0.1	2	0.2	287	1.7
WT 42	0	0.0	14	1.4	26	2.8	90	9.5	32	3.5	21	2.4			14	1.6	22	2.4	19	2.1	16	1.6	11	1.1	8	0.8	7	0.7	0	0.0	12	1.1	0	0.0	1	0.1	293	1.8
WT 8	1	0.1	1	0.1	24	2.6	25	2.6	54	5.8	89	10.2	9	1.0			12	1.3					9	0.9	5	0.5	1	0.1	0	0.0	3	0.3	8	0.7			241	1.9
WT 59	0	0.0	9	0.9	48	5.2	24	2.5	11	1.2	11	1.3	9	1.0	27	3.1	107	11.9	13	1.4	0	0.0	10	1.0			12	1.1	13	1.2	0	0.0	2	0.2	2	0.2	298	1.9
WT 78	0	0.0	0	0.0	32	3.5	178	18.7	30	3.2	7	0.8	13	1.5			0	0.0	5	0.5	12	1.2	1	0.1	9	0.9	3	0.3	3	0.3	7	0.6	8	0.7	3	0.2	311	1.9
WT 6	1	0.1	5	0.5	15	1.6	15	1.6	36	3.9	125	14.3	43	4.9	8	0.9			5	0.5	2	0.2	9	0.9	9	0.9	4	0.4	5	0.5	15	1.3	0	0.0	2	0.2	299	1.9
VP 7	0	0.0	39	3.9	0	0.0	203	21.4	3	0.3	25	2.9	12	1.4			7	0.8	7	0.8	33	3.4	32	3.3	2	0.2	0	0.0	7	0.6	0	0.0	3	0.3	16	1.3	389	2.4
VP 3	52	4.7	29	2.9	27	2.9	54	5.7	0	0.0	64	7.3	0	0.0	44	5.0											8	0.8	0	0.0	34	3.0	17	1.4	6	0.5	335	2.6
WT 11	2	0.2	0	0.0	3	0.3	43	4.5	1	0.1	220	25.1	58	6.6	8	0.9	10	1.1	14	1.5	8	0.8			2	0.2	12	1.1	0	0.0	10	0.9			3	0.2	394	2.7
WT 24	5	0.5	0	0.0			5	0.5	17	1.8	302	34.5	41	4.7	29	3.3	1	0.1			0	0.0	15	1.5	2	0.2	2	0.2	0	0.0	0	0.0	0	0.0	3	0.2	422	3.0
WT 64	17	1.5	41	4.1	42	4.5	40	4.2	29	3.1	41	4.7	1	0.1	47	5.4	53	5.9	54	5.8	4	0.4	59	6.1			28	2.7	1	0.1	0	0.0	6	0.5			463	3.1
WT 19	0	0.0	339	33.9	28	3.0	20	2.1	38	4.1	10	1.1	10	1.1	29	3.3	8	0.9	0	0.0			1	0.1	0	0.0	8	0.8	16	1.5	8	0.7	5	0.4	1	0.1	521	3.1
VP 4	6	0.5	1	0.1	5	0.5	104	10.9	53	5.7	0	0.0	0	0.0	74	8.5	66	7.3	45	4.9	19	1.9	33	3.4							2	0.2	21	1.8			429	3.3
WT 39	41	3.7	52	5.2	38	4.1	119	12.5	188	20.3	75	8.6	42	4.8	20	2.3			4	0.4	8	0.8	13	1.3	16	1.5	21	2.0	0	0.0	14	1.2	13	1.1	17	1.4	681	4.2
WT 37	0	0.0	55	5.5	97	10.5	48	5.1	80	8.6	10	1.1	0	0.0	36	4.1	77	8.6			111	11.4	137	14.1			0	0.0	9	0.8	1	0.1	11	0.9	6	0.5	678	4.5
VP 5	34	3.1	6	0.6	134	14.5	94	9.9	111	12.0	117	13.4	53	6.1	54	6.2	55	6.1	0	0.0	9	0.9	0	0.0	0	0.0	18	1.7	19	1.7			0	0.0	47	3.8	751	4.7
VP 1	0	0.0	33	3.3	29	3.1	22	2.3	42	4.5	179	20.5	15	1.7																							320	5.1
WT 1			16	1.6	284	30.7	46	4.8	268	29.0			4	0.5	1	0.1	66	7.3	0	0.0	2	0.2	28	2.9	20	1.9	11	1.0	1	0.1	28	2.5	0	0.0	0	0.0	775	5.2
WT 2	1	0.1	8	0.8	57	6.2			212	22.9	564	64.5	31	3.5	48	5.5	26	2.9	0	0.0	4	0.4	2	0.2	40	3.8	5	0.5	0	0.0	3	0.3	1	0.1	0	0.0	1,002	6.6
WT 48	1	0.1	1	0.1	25	2.7	94	9.9	641	69.3	973	111.2	394	45.0											4	0.4			0	0.0	3	0.3	0	0.0	0	0.0	2,136	19.9
VP 8	192	17.5	443	44.3	500	54.1	301	31.7	138	14.9			223	25.5									62	6.4											55	4.5	1,914	24.8
total	392	1.3	1,231	4.1	1,565	5.8	1,701	6.2	2,082	7.5	2,911	12.8	1,057	4.5	518	2.8	675	3.4	248	1.2	334	1.5	483	2.0	167	0.8	174	0.7	170	0.6	219	0.7	137	0.4	196	0.6	14,260	3.2

Explanations for Table 4.3:
yellow marked cells: more than 3.3 calls / h
orange marked cell: more than 6.6 calls / h
red marked cells: more than 10 calls / h
black marked cells: no complete data set available

Table 4.3: Recorded activity of bats belonging to the genera *Nyctalus*, *Pipistrellus* and *Vespertillo* to the family *Vespertilioidae* as well as non-identified species that could not be separated from the above-mentioned groups (given are the number of contacts during each night and the average number of contacts / hour at each location)

	April		May		June						July								August								September										
	Week 17		Week 20		Week 22		Week 24		Week 26		Week 27		Week 28		Week 29		Week 30		week 31		week 32		week 33		week 34		week 35		week 36		week 37		week 38		week 39		total	
site (VP/WT)	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	cont. per h	total cont.	calls per h
VP 2	0	0.0	9	1.0	2	0.2	9	1.1	0	0.0	1	0.1	0	0.0	5	0.6			8	0.9			4	0.4	14	1.3	1	0.1	1	0.1	0	0.0	1	0.1			55	0.4
WT 14	0	0.0	1	0.1	9	1.0	4	0.5	6	0.7							10	1.1	4	0.4	0	0.0	5	0.5	1	0.1	2	0.2	11	1.0	10	0.9	1	0.1	6	0.5	70	0.5
WT 54	2	0.2	14	1.6	6	0.7	8	0.9	10	1.2	23	2.6	1	0.1	8	0.9	17	1.9	24	2.6	10	1.0	13	1.3	1	0.1	3	0.3	0	0.0	1	0.1	0	0.0	0	0.0	141	0.9
WT 32	0	0.0	0	0.0	25	2.9	17	2.0	13	1.5	13	1.5	15	1.7	11	1.3	13	1.4	6	0.6	5	0.5	2	0.2	2	0.2	1	0.1			4	0.4	6	0.5	0	0.0	133	0.9
WT 17	0	0.0	24	2.7	0	0.0	26	3.1	6	0.7	5	0.6	4	0.5			34	3.8	5	0.5	20	2.1	1	0.1			3	0.3	1	0.1	1	0.1	3	0.3	0	0.0	133	0.9
WT 71	0	0.0	19	2.1	18	2.1	11	1.3	8	0.9	7	0.8			4	0.5	16	1.8	0	0.0	3	0.3	10	1.0	15	1.4	4	0.4	11	1.0	8	0.7	7	0.6	10	0.8	151	0.9
WT 6	1	0.1	5	0.6	14	1.6	11	1.3	16	1.9	42	4.8	7	0.8	3	0.3			5	0.5	2	0.2	9	0.9	9	0.9	4	0.4	5	0.5	15	1.3	0	0.0	2	0.2	150	1.0
WT 8	0	0.0	1	0.1	22	2.5	17	2.0	25	2.9	29	3.3	6	0.7			7	0.8					8	0.8	5	0.5	1	0.1	0	0.0	3	0.3	8	0.7	0	0.0	132	1.0
VP 6	0	0.0	20	2.2	14	1.6	1	0.1	0	0.0			13	1.5			7	0.8			29	3.0															84	1.1
WT 22	4	0.4	37	4.1	17	1.9	16	1.9	16	1.9	7	0.8	1	0.1	13	1.5	22	2.4	5	0.5	0	0.0	8	0.8	10	1.0	0	0.0	11	1.0	55	4.9	12	1.0	14	1.1	248	1.4
WT 16	22	2.2	3	0.3	26	3.0	0	0.0	1	0.1	15	1.7	25	2.9	27	3.1	36	4.0	9	1.0	23	2.4	0	0.0					21	1.9	0	0.0	11	0.9	0	0.0	219	1.5
WT 61	2	0.2	9	1.0	25	2.9	57	6.7	21	2.5	0	0.0	26	3.0	0	0.0	0	0.0	21	2.3	17	1.7	4	0.4	6	0.6	19	1.8	40	3.6	0	0.0	1	0.1	0	0.0	248	1.5
WT 24	3	0.3	0	0.0			5	0.6	8	0.9	140	16.0	30	3.4	19	2.2	1	0.1	0	0.0	0	0.0	15	1.5	2	0.2	2	0.2	0	0.0	0	0.0	0	0.0	3	0.2	228	1.5
WT 11	1	0.1	0	0.0	2	0.2	27	3.2	1	0.1	117	13.4	35	4.0	8	0.9	8	0.9	14	1.5	7	0.7			2	0.2	10	1.0	0	0.0	10	0.9			3	0.2	245	1.7
WT 59	0	0.0	6	0.7	41	4.7	20	2.4	6	0.7	11	1.3	8	0.9	22	2.5	104	11.6	13	1.4	0	0.0	6	0.6			10	1.0	13	1.2	0	0.0	2	0.2	2	0.2	264	1.7
WT 42	0	0.0	13	1.4	25	2.9	84	9.9	29	3.4	20	2.3			12	1.4	21	2.3	19	2.1	16	1.6	11	1.1	8	0.8	6	0.6	0	0.0	11	1.0	0	0.0	1	0.1	276	1.8
WT 78	0	0.0	0	0.0	31	3.5	165	19.4	24	2.8	7	0.8	8	0.9			0	0.0	5	0.5	11	1.1	1	0.1	8	0.8	3	0.3	3	0.3	7	0.6	8	0.7	3	0.2	284	1.9
VP 3	31	3.1	17	1.9	19	2.2	45	5.3	0	0.0	51	5.8	0	0.0	19	2.2											8	0.8	0	0.0	30	2.7	17	1.4	6	0.5	243	2.0
VP 7	0	0.0	31	3.4	0	0.0	190	22.4	2	0.2	25	2.9	12	1.4			7	0.8	7	0.8	21	2.2	30	3.1	2	0.2	0	0.0	4	0.4	0	0.0	3	0.3	16	1.3	350	2.3
WT 2	0	0.0	7	0.8	49	5.6			56	6.6	168	19.2	4	0.5	26	3.0	11	1.2	0	0.0	3	0.3	2	0.2	40	3.8	5	0.5	0	0.0	3	0.3	1	0.1	1	0.1	376	2.5
VP 4	3	0.3	1	0.1	5	0.6	104	12.2	16	1.9	0	0.0	0	0.0	66	7.5	55	6.1	45	4.9	19	1.9	30	3.1							2	0.2	21	1.8	0	0.0	367	2.7
WT 64	17	1.7	38	4.2	42	4.8	39	4.6	27	3.2	32	3.7	1	0.1	41	4.7	50	5.6	54	5.8	4	0.4	54	5.5			27	2.6	1	0.1	0	0.0	6	0.5			433	3.0
WT 19	0	0.0	330	36.7	27	3.1	18	2.1	36	4.2	10	1.1	9	1.0	19	2.2	7	0.8	0	0.0			1	0.1	0	0.0	8	0.8	16	1.5	8	0.7	5	0.4	1	0.1	495	3.2
WT 1	0	0.0	12	1.3	273	31.2	46	5.4	77	9.1			4	0.5	1	0.1	49	5.4	0	0.0	2	0.2	28	2.9	20	1.9	11	1.0	1	0.1	28	2.5	0	0.0	0	0.0	552	3.6
WT 39	28	2.8	41	4.6	38	4.3	111	13.1	179	21.1	66	7.5	32	3.7	16	1.8			4	0.4	8	0.8	12	1.2	16	1.5	21	2.0	0	0.0	14	1.2	13	1.1	17	1.4	616	4.0
VP 1	0	0.0	31	3.4	24	2.7	15	1.8	36	4.2	132	15.1	12	1.4																							250	4.1
WT 37	0	0.0	53	5.9	97	11.1	41	4.8	77	9.1	10	1.1	0	0.0	36	4.1	75	8.3			110	11.3	128	13.1			0	0.0	8	0.7	1	0.1	10	0.8	5	0.4	651	4.4
VP 5	28	2.8	5	0.6	128	14.6	65	7.6	85	10.0	83	9.5	46	5.3	43	4.9	53	5.9			8	0.8					16	1.5	18	1.6			0	0.0	47	3.8	625	4.9
WT 48	1	0.1	1	0.1	22	2.5	26	3.1	179	21.1	241	27.5	122	13.9											3	0.3			0	0.0	3	0.3	0	0.0	0	0.0	598	5.7
VP 8	133	13.3	405	45.0	473	54.1	222	26.1	58	6.8			83	9.5									53	5.4											50	4.1	1,477	20.5
total	276	0.9	1,133	4.2	1,474	5.8	1,400	5.7	1,018	4.0	1,255	5.5	504	2.1	399	2.2	603	2.9	248	1.2	318	1.4	435	1.9	164	0.8	165	0.7	165	0.6	214	0.7	136	0.4	187	0.6	10,094	2.3

Explanations for Table 4.4 see Table 4.3

- **Expert Opinion on the bat investigation near the villages Dolovo and Mramorak**

as part of the EIA for the proposed Wind Farm "Cibuk 1" (Republic of Serbia, Autonomous Province of Vojvodina, Municipality of Kovin)

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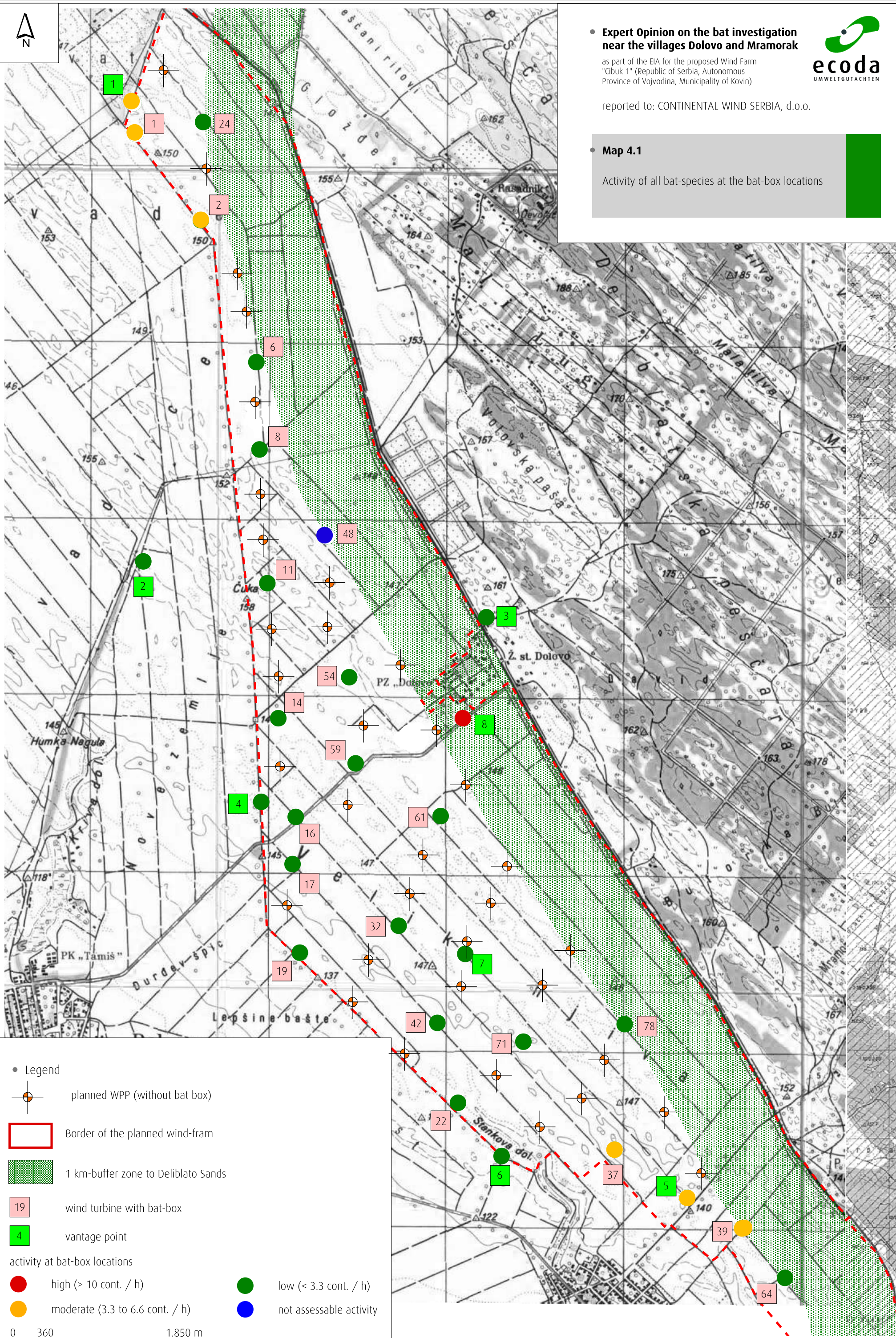
reported to: CONTINENTAL WIND SERBIA, d.o.o.

- **Map 4.1**

Activity of all bat-species at the bat-box locations



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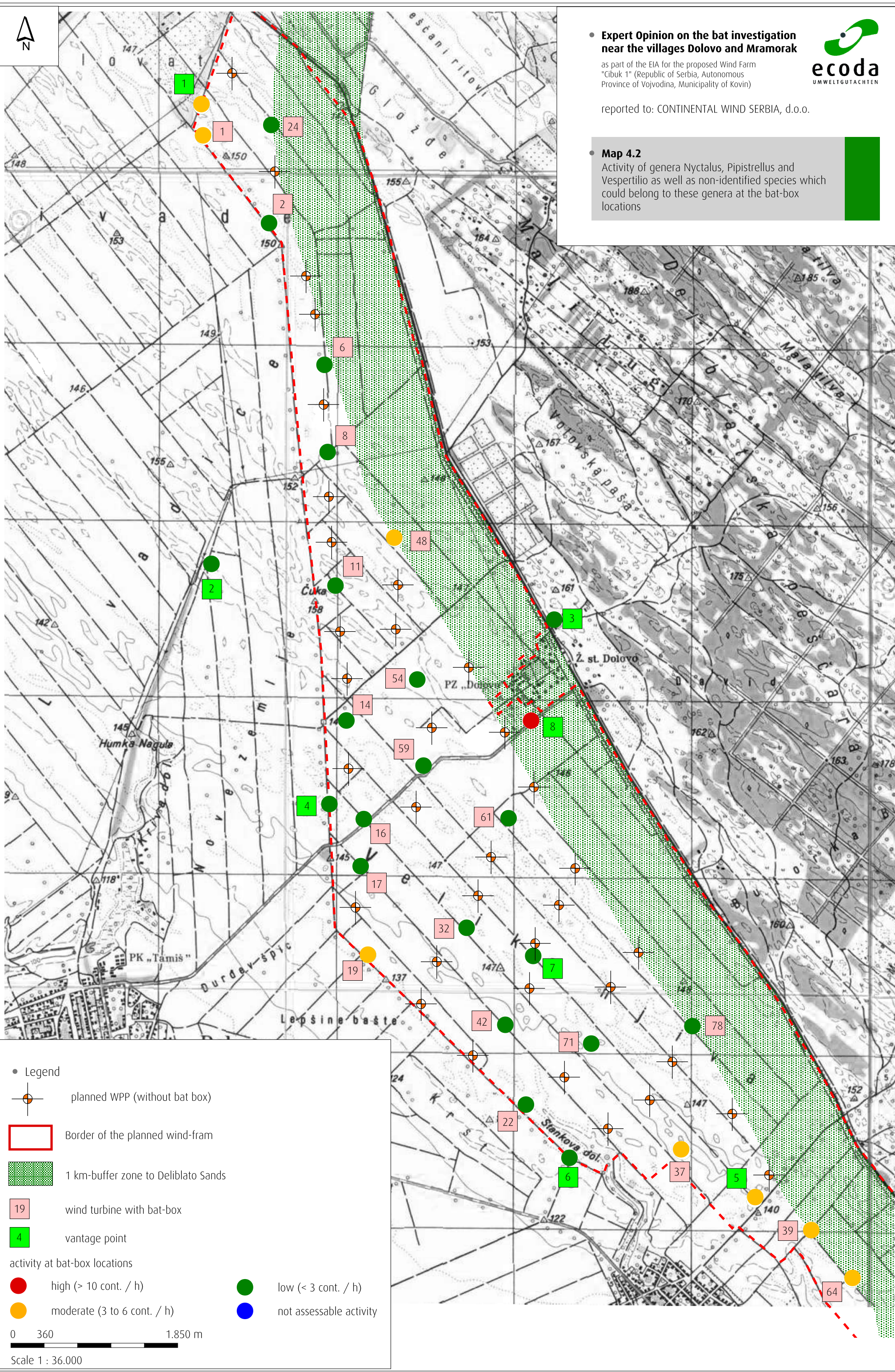
- **Map 4.2**
Activity of genera Nyctalus, Pipistrellus and Vespertilio as well as non-identified species which could belong to these genera at the bat-box locations



4.2.2.3 Thermal Imaging

In total 30 individuals (double-countings are possible) of at least three species were recorded in the two nights of thermal imaging. Most recorded species were of the genus *Pipistrellus* (*P. kuhlii* or *nathusii*). Furthermore, one Common Noctule and five not identified bats were observed (cf. Table 4.4 and 4.5).

All bats which were seen on the screens of the thermal cameras were flying lower than 30 m and, thus, below the rotor swept area of the planned wind turbines.

Table 4.4: Results of the thermal imaging survey on 10 October 2011

Time	Species	Indivi-duals	Behavior and direction of flight	Estimated flight hight (m)
VP 5				
18.36	Pipistrellus kuhlii	1	Commuting east along road	5
18.43	Pipistrellus nathusii	1	Feeding around VP	10
18.45	Pipistrellus nathusii?	1	Heard briefly	-
18.46	Pipistellus kuhlii/nathusii	1	Feeding over VP	10
18.47	not identified bat	1	Feeding west of VP	10
18.53	Pipistrellus nathusii	1	Feeding for west of VP	10
18.58	Pipistrellus nathusii	1	Commuting east along road	10
19.03	Pipistrellus kuhlii	1	Commuting easy along road	10
19.03	Pipistellus kuhlii/nathusii	1	Commuting east along road	10
19.08	Pipistrellus nathusii	2	Commuting east along road	10
19.11	Pipistellus kuhlii/nathusii	1	Seen over VP	15
19.12	Pipistrellus nathusii	1	Commuting west along road	10
19.13	not identified bat	2	Commuting west along road	10
19.18	not identified bat	1	Commuting west along road	10
19.20	not identified bat	1	Commuting SW over VP	30
19.22	Pipistrellus kuhlii	1	Commuting east along road	10
19.29	Pipistrellus kuhlii	1	Commuting west along road	10
19.30	not identified bat	1	Seen to south of road	10
19.37	Pipistrellus nathusii	1	Commuting east along road	10 - 15
WT 59				
	no results			
VP 8				
	no results			

Table 4.5: Results of the thermal imaging survey on 11 October 2011

Time	Species	Indivi-duals	Behavior and direction of flight	Estimated flight hight (m)
VP 5				
18.58	Pipistrellus kuhlii	1	Commuting east along road	10
18.58	Nyctalus noctula	1	Feeding over VP	30
19.17	Pipistrellus kuhlii/nathusii	1	Commuting west along road	10
19.19	Pipistrellus kuhlii/nathusii	1	Commuting west along road	5
19.29	Pipistrellus kuhlii	1	Foraging around bushes	10
19.43	Pipistrellus kuhlii	1	Commuting east.	5
19.50	Pipistrellus kuhlii	1	Commuting south over trees	5
VP 5				
20.30	Pipistrellus kuhlii	1	Foraging along road	5 - 15
20.54	Pipistrellus kuhlii	1	commuting along road	20

4.3 Synopsis

Overall, at least 16 species were recorded in the study area but it is very likely that up to 19 species used the study area at least temporarily (15 species were detected in 2010, during transect walks one additional species was recorded was recorded in 2011: *Hypsugo savii*). All results show that Kuhl's Pipistrelle, Nathusius' Pipistrelle, Common Noctule and Serotine Bat were the most common species. All other species occurred in low numbers within the study area.

Kuhl's Pipistrelle

According to the results of Karapandža & Paunović (2011) Kuhl's Pipistrelle is the most common species. There were numerous colonies and roosts found in the settlement in the vicinity of the study area. Highest activity of this species was measured at VP 4, 5 and 8. The area near these vantage points acted as hunting areas for this species (at least occasionally). Observations along the asphalt road from Dolovo to Deliblato Sands lead to the assumption that this road is used as a flight path from potential colonies / roosts in Dolovo to hunting areas at VP 8 or in Deliblato Sands.

The results of the transect walks show that Kuhl's Pipistrelle was most frequent at transect 3 (the assumed flight path) and 5 in the south, while activity at the remaining transects was low (judged on existing data not including upcoming observations extending until November 2011).

Bat-box data analysed until now lead to almost same results. The intensively used agricultural areas without structures like hedge-rows, flower-rich ruderal vegetation or tree-lines were used only occasionally, while the areas at VP 8 and VP 5 were used frequently.

Nathusius' Pipistrelle

According to the results of Karapandža & Paunović (2011) Nathusius' Pipistrelle was the second-most common species. Activity was concentrated at VP 8. The results clearly indicate that there were mating roosts in the vicinity of VP 8. Hunting behaviour was recorded at all VPs - at least occasionally. Connecting flights from Dolovo to VP 8 and / or Deliblato Sands along the asphalt road were recorded, too, as for Kuhl's Pipistrelle.

The results of the transect walks done so far show the highest activity of Nathusius' Pipistrelle at transect 3 (the assumed flight path), while activity at all other transects is rather low.

Bat-box data are not completely interpretable because calls of Nathusius' and other Pipistrelle Bats could not be distinguished reliably. The results show, however, that intensively used agricultural areas without structures like hedge-rows, flower-rich ruderal vegetation or tree-lines are used only occasionally, while the areas at VP 8 and VP 5 are generally and frequently used by Pipistrelle Bats.

Serotine Bats

According to KARAPANDŽA & PAUNOVIĆ (2011) Serotine Bat was the third common species. Roosts existed in the settlements and in Deliblato Sand surrounding of the study area, while no roost was found within the study area. Serotine Bat occurred most numerously and frequently at VP 8 and to a lower extent at VP 5 and 4, but were recorded at every VP.

Due to the transect walks Serotine Bat was most numerous at transect 1 and 2, though the high number derived predominantly from one night in July. This is in accordance with the bat-box results. Serotine Bat was most numerous at VP 1, WT 1, WT 2, WT 24 (all in the north near transect 1) and at VP 8 and WT 48 (in the east).

Common Noctule

According to the results of KARAPANDŽA & PAUNOVIĆ (2011) Common Noctule was the fourth common species. Mating roosts existed in the settlement and tree trunks in the vicinity of the study area, no roost sites existed within the study area. Individuals of this species were recorded at every VP, most numerously at VP 5 where even hunting behaviour was recorded. In contrast, hunting behaviour occurred rarely at all other VPs.

The results of the transect walks are very well in accordance with those of the bat-box: Common Noctules were most active at transect 5 though detectable in lower numbers at each transect.

According to bat-box results, the main activity of Noctules started in week 20. This species was most frequent at VP 5 as well as at WT 48, 37, 39 and to a lower extent at WT 64 near VP 8. At VP 1, WT 1 and WT 2 in the northern part of the study area, a number of calls could not reliably be separated from calls of the Serotine Bat that was the most frequent species at transect 1 near to the locations of the mentioned bat-boxes.

All other species were low in number and have been already discussed by KARAPANDŽA & PAUNOVIĆ (2011). Thus these species are not presented in detail here.

According to the results of the thermal imaging survey bats did not fly at heights of the rotor swept area of the planned wind turbines. However, this might change after construction of turbines.

5 Significance of the study area for bats

At least 16 species were recorded within the study area. According to Karapandža & Paunović (2011) this finding can be judged as species rich. Most species were recorded at VP 8 where most of the structures suitable for hunting are found. Furthermore, a mating roost of Nathusius' Pipistrelle was found in the same area. The site at VP 8 is the most important location in the study area for bats but it is situated outside the planned wind farm.

Bat-box, transect and vantage point investigations showed that most of the recorded species occurred rarely or occasionally at the most. Only four species were detected regularly indicating that the study area has a certain significance for them. The highest activity of Kuhl's Pipistrelle and Nathusius' Pipistrelle was measured at VP 8 and along the asphalt road leading from Dolovo to Deliblato Sands. High activity of Common Noctule was measured in the south, particularly at VP 5. Furthermore, transect walks showed a high activity of Serotine bats during certain nights in the north. As for Kuhl's and Nathusius' Pipistrelle, the activity at the asphalt road and at VP 8 can be assessed as high. In contrast, most of the unstructured intensively cultivated area has no or a low significance for bats in general. At some locations high activity may occasionally occur, but in comparison to the locations mentioned above these higher activities are rare and do not depend on the location.

The results of the bat-box-investigation show a high activity at some locations (cf. Map 4.1 and 4.2): areas with high significance are located at VP 8 in the east and at VP 5 and WT 37 and 39 in the south. A high activity during many nights was also measured at WT 1 and WT 2 in the north, mostly referring to Serotine Bat, which was also regularly recorded during transect walks. During week 26 to 28 high activities were also detected at WT 48. From mid of August to end of September activity at this WT was very low. Most locations in the centre of the planned wind farm showed low or low to medium activity. This assessment might change as the study is still going on.

An activity of on average 16 contacts / h (for all species of a study area), as obtained by walks at transect 1 and 3, is assessed to be moderate for Germany (cf. Grunwald 2009). The average activity at the remaining transect was much lower (5 to 11 contacts / h). Considering that bat species and individuals are more abundant in southern parts of Europe, a higher average of activity within the study area would be expected. Summarizing, the obtained overall activity within the study area is assessed to be low to medium, indicating that most parts of the study area have no particular habitat functions for bats. This assessment might change, as this study is still going on.

5.1 Significance of the study area for resident bats (availability of suitable habitat)

5.1.1 Roosts

No roosts were found in the study area and, furthermore, potential roosting sites are almost absent. No anthropogenic structures or old trees containing holes are present in the study area. Thus, the significance of the study area as a roosting habitat is very low. A small mating roost of Nathusius' Pipistrelle was found near VP 8. This site is more than 200 m away from the location of the next planned wind turbine.

5.1.2 Hunting habitats and flight paths

Based on the obtained occurrence and activity of the four most common species within the study area it is possible to identify areas of significance. Maps 5.1 to 5.4 illustrate important hunting habitats and flights paths of the four species defined on the results of all applied methods / approaches. As the different approaches all arrive at almost the same result, the assessment of the significance of the study area can be assumed as reliable.

Kuhl's Pipistrelle

In 2010, the main activity of this species started in May and ended in September (Karapandža & Paunović 2011). However, due to results obtained in 2011 it was low in September. Individuals were observed in many parts of the study area. At most locations Kuhl's Pipistrelle occurred only occasionally in relatively low numbers. Thus the general significance of the study area is assessed to be low. At some locations a concentration of contacts was recorded. The asphalt road leading from Dolovo to Deliblato Sand was frequently used as a flight path and a moderately hunting ground. The significance of this flight path is assessed to be high. The most important hunting ground in the study area was the area around VP 8. The vantage point census and the bat-box results so far show a highly frequent use of the area by this species. Thus the significance of this area is assessed to be high. Furthermore, the surroundings of VP 5 were used as a hunting ground but at a lower intensity. The significance of this area is thus assessed to be moderate (cf. Map 5.1 and Table 5.1).

Nathusius' Pipistrelle

In 2010, the main activity of this species started in May and ended in September (Karapandža & Paunović 2011), but was comparable low in September 2011. A small mating roost of Nathusius' Pipistrelle was detected near VP 8.

Individuals of Nathusius' Pipistrelle were recorded hunting at certain locations within the study area, the highest activity being at VP 8. Other locations with a comparatively high activity were VP 4 and VP 7, however, the activity was much lower at VP 8. Furthermore, Nathusius' Pipistrelle seems to regularly use the asphalt road from Dolovo to Deliblato Sands (transect 3).

The results clearly show that the bushy and ligneous vegetation around VP 8 was intensively used as a hunting area and roosting site. As a consequence, the significance of this area for Nathusius' Pipistrelle has to be assessed as high. The asphalt road from Dolovo to Deliblato seems to be intensively used as a flight path by this species. Most parts of the study area - predominantly the open and poorly structured cultivated area in the centre of the study area - were at most only occasionally used for hunting by Nathusius' Pipistrelle. Thus the significance of the open and intensively cultivated land is assessed to be low (cf. Map 5.2 and Table 5.1).

Serotine Bat

Serotine Bats were common in the study area and the third most frequent species in the vantage point study of Karapandža & Paunović (2011). In 2010, the main activity of this species started in May and ended in September. Due to the results of transect walks and the bat-boxes survey in 2011 the activity was highest in July and rapidly decreased to a low level in August and September. Serotine Bats used the study area for commuting between roosts in the settlements and hunting habitats. Parts of the study area were also used for hunting. The activity was highest at VP 8 where the species was observed frequently. Moderate activity was also recorded at VP 5 and VP 4. Serotine Bats were also detected at all other VPs but with a comparatively low level of activity. Data of transect walks showed a high activity at certain nights.

- transect 1 and to a lower extent at transect 2 in the north of the study area,
- transect 3 at the asphalt road from Dolovo to Deliblato Sands.

These results lead to the following conclusions: the ligneous and bushy vegetation at VP 8 is an intensively used hunting habitat and thus has a high significance for this species. Two flight paths can be identified in the study area: one travelling along the asphalt road from potential roosting sites at Dolovo to Deliblato Sands and back (high significance); the other, used at least occasionally, leading along transect 1 and 2 at the western border of the study area (moderate significance). The area around VP 5 was used at a lower intensity as a hunting habitat and is assessed to be an area of moderate significance. Other areas of the study area - especially the open and intensively cultivated land - were at most used only occasionally. The species-specific significance of these areas is thus assessed to be low (cf. Map 5.3 and Table 5.1).

Common Noctule

The main activity of the species starts in April / May and ends in September. Common Noctules used the study area for commuting between roosts in the settlements and hunting sites in Deliblato Sands. Moreover, parts of the study area were also used for hunting. Taking the vantage point census into account, they were most active at VP 8 and to a lower extent at VP 4 and 5 (cf. Karapandža & Paunović 2011). Compared to other species, however, activity of Common Noctules was more equally distributed within the study area. This might refer to the wider range of hunting habitats of Common

Noctules in comparison to those of other species that tend to hunt along structures like hedge-rows or tree lines. Transect walks as well as the bat-box results demonstrate a comparatively high activity in the southern part of the study area at VP 5 and its surrounding. The species-specific significance of this area is assessed to be moderate to high. The level of activity obtained by vantage point counts, transects walks and bat-boxes was relatively low in open cultivated land in the centre of the study area. Thus, the general significance of the entire study area is assessed to be low to moderate (cf. Map 5.4 and Table 5.1). However, activity recorded by bat-boxes at WT 48 was high from mid of June to mid of July, indicating that this area was used as a hunting habitat by Common Noctules. Activity from mid of June to mid of August could have been high as well, but datasets could not be analysed due to noise overloads by insects. From end of August to end of September activity of Common Noctules (and bats in general) at this particular WT was very low.

Other bat species

All other species were rarely or at most recorded occasionally within the study area. The significance of the study area for these species is low or at most low to moderate (cf. Karapandža & Paunović 2011).

Table 5.1: Assessment of the significance of the study area for Kuhl's Pipistrelle, Nathusius' Pipistrelle, Serotine Bat and Common Noctule

species	Assassment of the significance of the study site
Kuhl's Pipistrelle	- general low significance of the study site - hunting area with high significance at VP 8 - asphalt road from Dolovo to Deliblato Sands as a fly path of high frequence and thus high significance - hunting area at VP 5 with moderate activity with moderate significance
Nathusius' Pipistrelle	- general low significance of the study site - hunting area with high significance at VP 8 - asphalt road from Dolovo to Deliblato Sands as a fly path of high frequence and thus high significance
Serotine Bat	- general low significance of the study site - hunting area with high significance at VP 8 - asphalt road from Dolovo to Deliblato Sands as a fly path of high frequence and thus high significance - at least occasional used flight path at transect 1 and 2 with moderate significance - hunting area with high significance at VP 5
Common Noctule	- general low to moderate significance of the study site - hunting area with high significance at VP 8 - hunting area in the vicinity of VP 5 in the southern part of the study site with a moderate to high significance

5.2 Significance of the study area for bat migration

Until now there is no indication that bat migration, mainly of species migrating long-distances (*e.g.* Common Noctule or Nathusius' Pipistrelle), is pronounced within the study area (cf. Karapandža & Paunović 2011). The mentioned species were present in the area as residents but did not migrate through it. The investigation in progress is to lead to additional data so that a reliable assessment on the significance of the area for bat migration will be possible.

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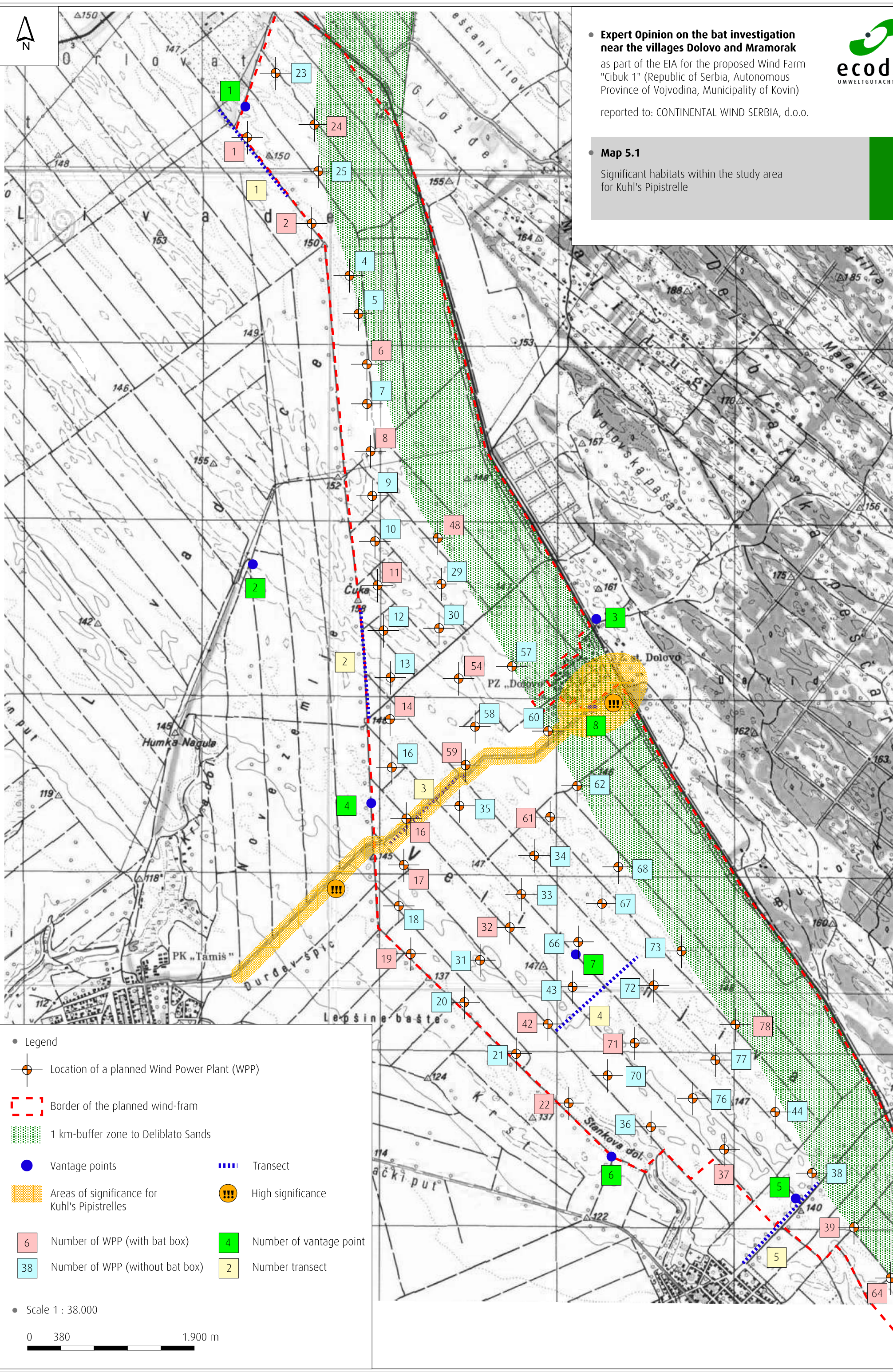
- **Map 5.1**

  Significant habitats within the study area for Kuhl's Pipistrelle



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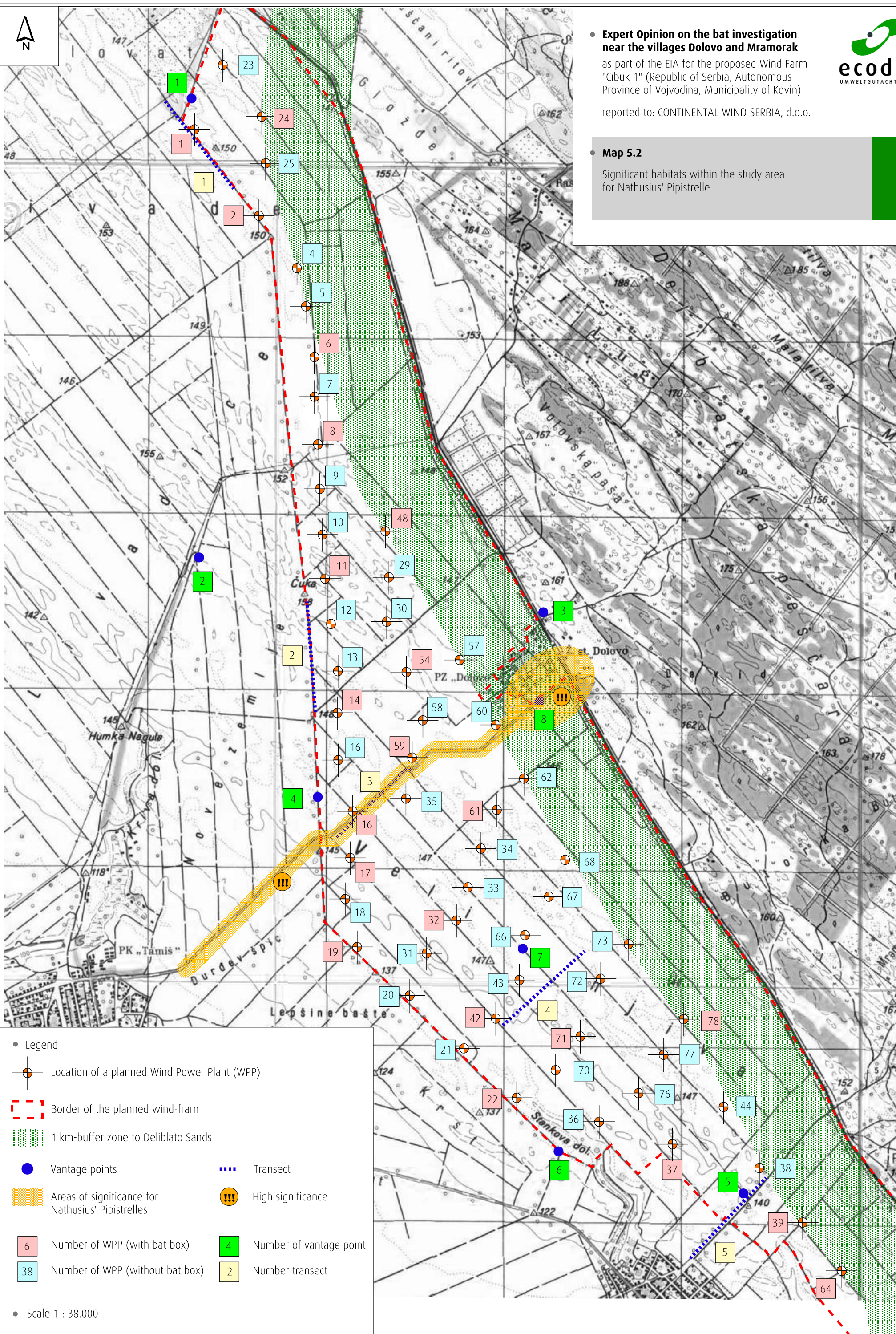
- **Map 5.2**

  Significant habitats within the study area for Nathusius' Pipistrelle



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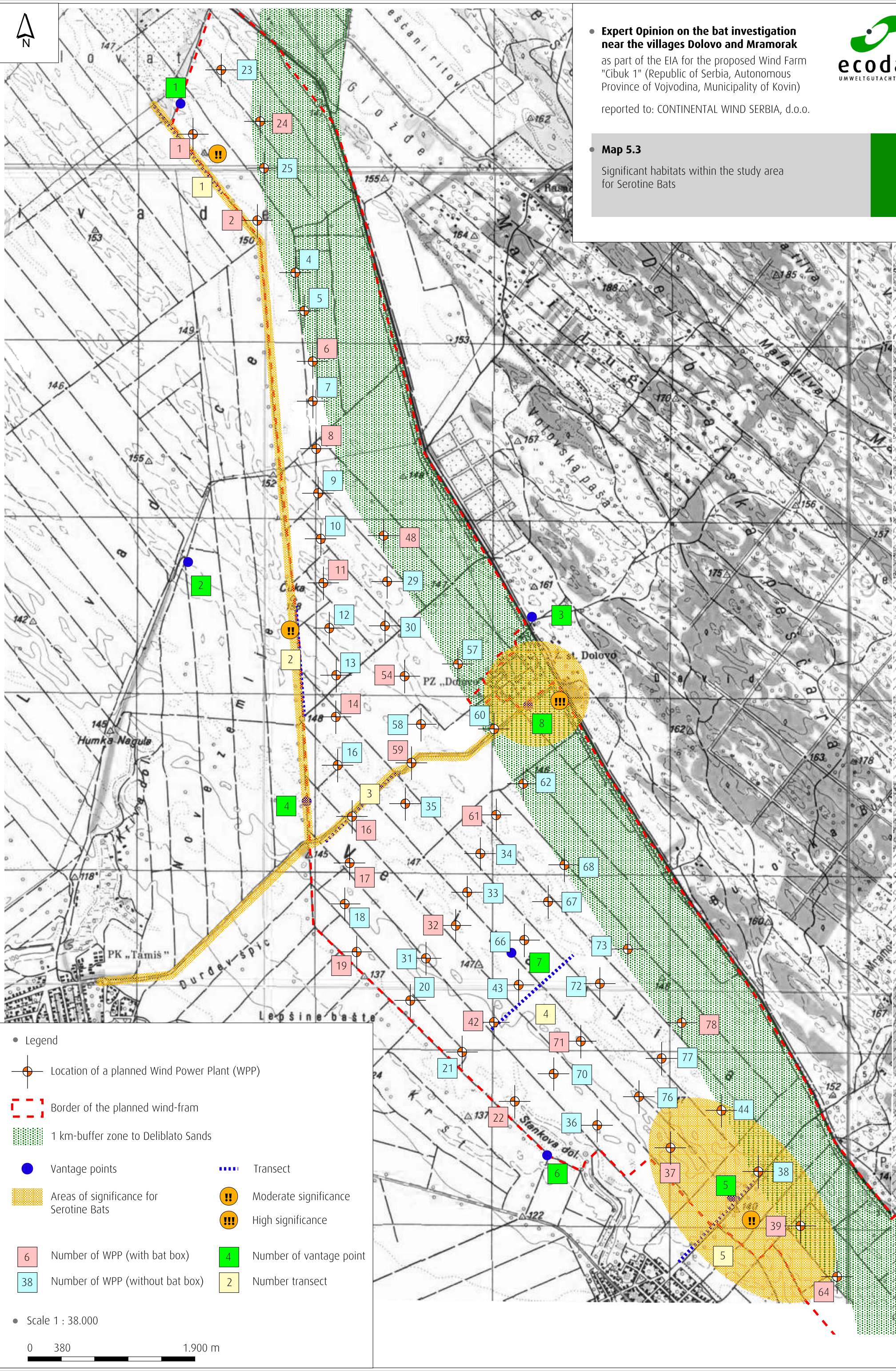
- **Map 5.3**

  Significant habitats within the study area for Serotine Bats



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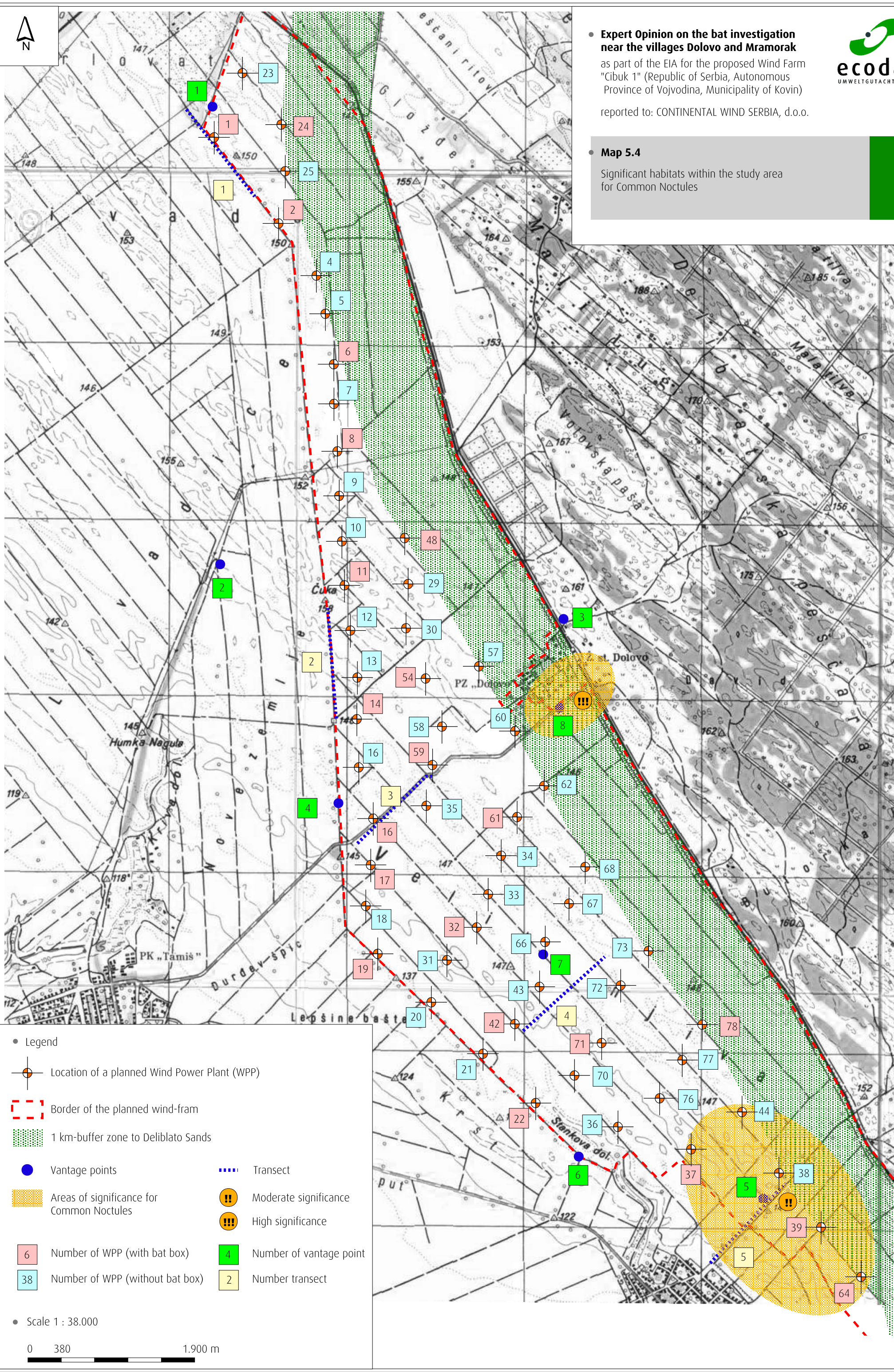
- **Map 5.4**

  Significant habitats within the study area for Common Noctules



6 Potential effects by Wind Power Plants

Potential effects of wind power plants (WPPs) on bats have been intensively studied in the United States, Canada and Germany. Results from investigations obtained in Germany can be – in principle – transferred to the situation in Serbia (species composition is to some degree comparable).

The potential effects of WPPs on bats can be classified as follows:

- collision risk (see Chapter 6.1)
- habitat loss during construction (see Chapter 6.2)
- habitat loss during operation (impairments, displacement; see Chapter 6.3)
- barrier effects and dissection of habitats (see Chapter 6.4)

6.1 Collision risk

The first systematic studies on the collision risk of bats at wind power plants were done in the US and Sweden (*e.g.* Ahlén 2003, Erickson *et al.* 2003). For diverse reasons, however, the results cannot be transferred to areas in Europe (differences in wind farm structure, range of species, landscape structure). Several systematic studies from Germany are available (Endl 2004, Förster 2004, Brinkmann 2006, Seiche *et al.* 2007a, Brinkmann *et al.* 2009, von Niermann *et al.* 2009a, 2009b & 2009c, Brinkmann *et al.* 2011).

The ornithological station at the environmental agency of the state of Brandenburg has been gathering evidence of casualties from collisions nationwide since 2001. As of 01 July 2011, 2,437 cases of bats have been registered that had had accidents at WPPs in Europe (most of them in Germany: 1,487; cf. Dürr 2011), though it can be suspected that the number of animals that were killed but have not been detected is quite high. About 65 % of all found dead animals are of the species Common Noctule and Nathusius' Pipistrelle (both about 23 %), and Common Pipistrelle (about 19 %). Thus the risk of collision is specific and highly variant for each species. While the collision risk is presumably high for these three species, the risk seems to be low for species of the genus *Myotis*. One reason, among others, for this is that the animals are highly dependent on structure, closely flying along hedges or through forests for their hunting flights and possibly also for the transfer flights between summer and winter residencies (Brinkmann 2004). The study by Behr *et al.* (2007) also found no evidence that the genera *Plecotus* and *Myotis* might be endangered by collision with rotors from wind turbines. Seiche *et al.* (2007a) found no dead specimen of singular species of *Myotis*, Grey long-eared bat or Barbastelle, even though these species were hunting in the vicinity of WPPs.

Studies by Niermann *et al.* (2009a) and Brinkmann *et al.* (2011) substantiate the comparatively high risk of collision for the Common Noctule, Nathusius' and Common Pipistrelle, and also confirm the low risk of collision for species of the genus *Myotis*.

The results of the study by Seiche *et al.* (2007a) suggest that the high collision risk of the Common Noctule is restricted to juvenile animals. Of the 57 individuals found whose age could be determined

unambiguously, 54 were juvenile and just three were adult. The authors discuss a possible habituation effect or avoidance behaviour towards wind turbines for adult animals, which is suggested by studies in the US (Erickson *et al.* 2003). In contrast to the findings on the Common Noctule, with the Nathusius' Pipistrelle it is the fraction of adult animals that predominates (Seiche *et al.* 2007a). Niermann *et al.* (2009a) too arrived at the same result: Common Noctule individuals hit were predominantly subadults, Nathusius' Pipistrelle individuals predominantly adults.

According to Endl (2004) findings of dead bats at WPPs occur ubiquitously and are not restricted to individual sites. Obviously, though, at a single location collision rates strongly fluctuate annually. Thus, within the course of systematic studies within the jurisdiction of the State Environmental Agency Bautzen at five locations with a total of 34 WPPs, 37 dead animals were found in 2002 (Förster 2004). Of these, 34 were registered in a single wind park, Puschwitz with 10 turbines (*ibid.*, cf. also Trapp *et al.* 2002), while no casualties of collisions were found at other sites. Within the same area, 22 and 20 dead bats were found in 2003 and 2004, respectively, at 12 sites with a total of 68 wind turbines. At 10 turbines in Puschwitz wind farm, six and seven casualties of collisions were found in 2003 and 2004, respectively. (All numbers stated are contained within the aforementioned compilation of collision casualties.) Bach & Rahmel (2006) also point out that the probability of strike at a single site does not constitute a yearly constant, as studies in Southern Germany (Brinkmann 2006) found varying numbers of animals in different years while using the same methodology. These studies further showed that, in addition to migrating species, resident bats can be affected as well.

Even though collisions could basically happen at every WPP, the collision rate seems to strongly depend on the detailed conditions at a particular site. Thus, not every wind turbine carries a high risk of collision. It could be supposed that some sites bear a higher potential of conflict, for instance those located near a river or a lake which therefore are preferentially used for hunting by some species. In the same way, there seems to be a relevant collision risk, for example, at forest locations for the Common Pipstrelle. Thus, at different WPPs in forests 78 % of all finds were of this species, as a result constituting the most commonly hit species in forests, while there were no casualties of collision at WPPs in open country (Brinkmann 2006). Behr & von Helversen (2005) also predominantly found Common Pipstrelle at four WPPs in a forest ground, making up 89 % and 74 % of all dead animals in 2004 and 2005, respectively. In contrast to open country, Common Pipistrelle in forests probably flies at higher altitudes or over the treetops. With 11 % of all finds, this species was the third-most often registered one at different sites in Saxony (Endl 2004). According to Endl (2004), losses of Common Pipistrelle are connected to sites close to forest areas. This study found a clear link between collision rate at a WPP and vicinity to the edge of a forest. Thus, afflicted Common Pipistrelles were found at six of 88 studied WPPs only. At these six sites, the average distance between WPP and the edge of the forest was 29 m, whereas the average distance was 333 m for all studied WPPs. Of the six WPPs where a Common Pipistrelle was found, not a single one was more than 100 m away from the forest.

Similarly, Seiche *et al.* (2007a) also established that dead Common Noctule, Nathusius' Pipistrelle and Common Pipistrelle were found disproportionately more often at WPPs located at a distance of up to 100 m to various kinds of woods (mainly trees or bushes in fields, forest edges). Regarding proximity to tree lines, a correlation between distance to WPP and number of affected animals could not be established.
In contrast to these findings, the so far most extensive survey in Germany (Brinkmann *et al.* 2011, see also Niermann *et al.* 2009b) did not find that proximity to woods or forests had an apparent influence on the rate of animals found dead.

Until now the influence of type and extent of a WPP has not been thoroughly studied. Barclay *et al.* (2007) could not detect an association between collision rate and size of a WPP. Seiche *et al.* (2007a) found a tendency that larger rotor diameter led to a higher rate of collision. On the other hand, the construction of higher wind turbines did not automatically mean a higher potential of conflict.

In terms of collision rate, there are not only the site-specific differences described above (dependence on habitat structure), but wide-ranging disparities also seem to exist (cf. Seiche *et al.* 2007a). It is notable, according to Bach (2006, p. 3), that "the Common Noctule was hit mainly in Northern Germany while it was not prominent in studies from Southern Germany, even though it occurs in these regions".
This trend is also shown in studies by Niermann *et al.* (2009a): while in the Southwestern interior of Germany the species mostly affected by WPPs is Common Pipistrelle, in Northern Germany it is Common Noctule and Nathusius' Pipistrelle.
In a low-intensity study (mostly only one control, maximum three controls), Kusenbach (2004) examined 94 WPPs at 18 different sites in Thuringia between the end of August and the end of September 2004 for afflicted bats. On the whole, at 18 sites seven individuals of at least three species were found: Nathusius' Pipistrelle (3x), Parti-coloured Bat (2x), Common Noctule (1x), and one indeterminable bat. This strongly indicates that mainly migratory species have accidents at WPPs in Thuringia. This study does not provide any evidence as to what determines how high the collision risk might be. However, the results give evidence that the collision risk seems to be quite distinct among different locations.
Several hypotheses exist as to the cause and effect of bat accidents, under which circumstances bats collide with wind turbines.
Most of the listed dead animals were found in a period between end of July and mid of September, which is the time of nursery roost-fission and breeding season of some species, and also the beginning of autumn migrations (cf. Dürr 2003, 2007). This is taken as evidence that collisions principally occur during migrations (*e.g.* Dubourg-Savage *et al.* 2009, Niermann *et al.* 2009c), possibly because bats use echolocation only sporadically at that time. In Saxony the highest rates of animals

found dead were established, however, between mid-July and August 20, not so much the time of autumn migration but the fission of nursery roosts. The results of NIERMANN *et al.* (2009a) are also more consistent with bats (including migrating bats) primarily having accidents in their reproductive regions rather than during migration). SEICHE *et al.* (2007b) also see a correlation between collision risk and location of, or proximity to, nursery roosts for the three most often affected bat species.

A further hypothesis supposes that the heat dissipated by the generator and / or the gearing mechanism of a wind turbine attracts insects. As a consequence, bats would find the area around the gearbox to be a suitable habitat for hunting. Nights in August, when wind speeds are just about high enough for the rotors to spin but weak enough not to impair the flight of insects would accordingly lead to an increase in collision risk.

Finally it is being discussed that the animals do not collide with wind turbines at all but that the turbulences on the lee side of the rotor impair the animals' flight qualities in a way that they simply crash. For a fraction of the animals found in Southern Germany in 2004, a possible cause of death is being debated called 'baric trauma' by some and surmised to be caused by high and low pressure. The results of the follow-up study from 2005, though, do not support this conjecture (cf. BRINKMANN 2006). However, evidence from studies in Canada now shows that the bats not only collide with turbines, but that the intense low pressure on the lee-side of the rotor does cause internal injuries (bursting of the alveoli), leading to the death of the animals (BAERWALD *et al.* 2008). Proof of dead animals being found without any external injuries is available from several sites in Germany (own observations), making it probable that these effects might cause the death of some of the animals.

As the hypotheses stated above do not exclude each other, it is quite likely that bats are killed by various causes or, rather, under diverse circumstances at different wind turbines.

One way to reduce or prevent accidents at those WPPs that are prone to collisions would be to shut down critical turbines during relevant times. A shut down-algorhythm that significantly reduced collision risk has been firstly developed by BEHR & VON HELVERSEN (2005, cf. BEHR *et al.* 2009a, BRINKMANN *et al.* 2011).

6.2 Habitat loss during construction

Roosting sites, hunting grounds asf. can be destroyed during construction of WPPs. If wind turbines are erected in locations intensively used for agriculture these effects can be regarded as negligible and simple to compensate. Generally, the landscape conservation support plan takes them into account and balances them along with interventions into the function of biotopes. The removal of wood during the construction of a WPP can result in stronger potential conflict. Precautionary planning can, however, mitigate or avoid this outcome. In this view, care should already be taken during the planning phase that trees serving as potential quarters for bats, or structurally rich wooden or forest areas are not destroyed or affected only to a degree absolutely necessary.

6.3 Habitat loss during operation

Up to now it is largely unknown whether bats display avoidance behaviour towards WPPs to a degree that could result in a loss of habitat.

BACH (2001, 2003) examined the effects of the construction and operation of a plant of 70 wind turbines with a hub height of 30 m each and rotor diameter of 30 m each. Compared to the base year 1998 (46 recordings before the construction of the wind park), a partial increase of hunting activity by the Common Pipistrelle after the construction of the WPP is clearly detectable (especially in 2002 with 75 recordings). Furthermore, there is additional proof from Northrhine-Westphalia of Common Noctules hunting within wind parks, some of them even at distances of only 10 m to the shaft of wind turbines (own observations).

Regarding Serotine Bats, though, BACH (2003) concludes that individuals of this species seem to avoid wind parks as they largely kept a distance of more than 100 m to wind turbines. Accordingly, in the first year after construction of the initial turbines (1999) all bats occurred at distances of more than 100 m to the WPPs, whereas in the following years — chiefly 2002 — hunting bats were recorded at distances of less than 100 m. In 2002, there was a frequently used flight path passing wind turbines at a distance of about 100 m. These results leave open whether Serotine Bats indeed avoid WPPs. However, by now BACH (2006) reports of evidence (from three wind parks) showing that the activity of Serotine Bats is significantly lower in the vicinity of WPPs than in adjoining areas.

As indicated by TRAXLER *et al.* (2004), Common Noctules do not seem to avoid the proximity of WPPs, a finding corroborated by own observations. Surveillance during a study in Stade county, however, showed that Common Noctules flew around existing wind turbines and kept a distance of 100 m (cf. BACH 2006).

In systematic recordings, GRUNWALD *et al.* (2007) also detected a number of species that occurred in direct vicinity of wind turbines. The authors therefore presume that these species (Common Noctule, Lesser Noctule, Common Pipistrelle and several species of the genus *Myotis*, among others) do not display avoidance behaviour towards WPPs.

In a study on a wind park in Brandenburg extending over three years, PODNAY (cited in DÜRR 2007) observed distinctive increase of specific hunting flights around wind turbine shafts by Fringed Bats.

Thus, up to now there are a number of studies that could not detect a distinct avoidance behaviour. Ultrasound, potentially emitted by some types of wind turbines, also seems to have little effect on bats (cf. RODRIGUES *et al.* 2008). In summary, there are no reasons up to now to suspect that the operation of wind power plants could lead to significant habitat impairments (possible disturbances for quarters notwithstanding) for bats.

6.4 Barrier effects and dissection of habitats

It is still open to what extent WPPs can have a barrier effect leading to a dissection of functionally and spatially linked habitats or their parts. Information is still missing, though, on avoidance behaviour by most species (cf. Chapter 4.3 indicates that WPPs do not pose a barrier effect over short distances).

BACH & RAHMEL (2006) report of Common Noctules flying around a WPP within their flight corridor while keeping a distance of more than 100 m. The authors assume that evasive manoeuvers of this kind are not to be judged as impairments.

In summary, there are no reasons so far to suppose that bats could be impaired by the operation of WPPs due the creation of a relevant barrier effect or even a dissection of habitats.

7 Prediction and assessment of expected impacts

As outlined in chapter 5, parts of the study area have at least a moderate significance for four species. The following assessment of expected impacts of "Čibuk 1" wind farm thus predominantly refers to these species.

7.1 Deliberate killing during construction or operation (collision risk)

The planned wind farm predominantly comprises intensively cultivated land. Conditions for roosts for bats are mostly absent. The next known mating roost is located in a distance of several hundred meters from the nearest planned wind turbine. Consequently, it can be excluded that individuals will be killed deliberately while they are staying in their roosts.

Individuals might collide with the rotor blades of wind turbines, however. As the causes for these fatalities are not yet fully resolved, assessments as to the collision risk at a given site have to be tentative (cf. Chapter 6). In particular, it is not possible to define thresholds regarding the level of activity leading to a significant risk of collision.

Kuhl's Pipistrelle

There is a huge lack of knowledge concerning the species-specific impact of wind turbines to Kuhl's Pipistrelle because this species is rare in Middle Europe where most of the studies on bats and wind turbines were done. As Common Pipistrelle has similar requirements regarding its preferred habitat characteristics and similar behaviours, analogous conclusions might be drawn by considering species-specific susceptibilities of the Common Pipistrelle to wind turbines. As outlined in chapter 6.1, collision risk for Common Pipistrelle might be significant at forest edges. Obviously, bats hunt above trees lines and get into the rotor swept area. This could be valid for Kuhl's Pipistrelle, too. Only few fatalities have been reported, however, in open landscapes like unstructured open cultivated land. Up to now there have not been certain distances to forest edges defined at which the collision risk may be reduced to a moderate level. Seiche *et al.* (2007a) recommends keeping a distance of 100 m to structures like hedge-rows or edges of forests, while Niermann *et al.* (2011) found no significant relationship between collision risk and like structures. It rather seems to be the fact that collision rates depend on the particular site and the activity level of bats (Niermann *et al.* 2011).

In the study at hand, the highest activity of Kuhl's Pipistrelle was predominantly recorded at VP 8, one of the most structured locations in the area. This location is at least 200 m away from the next planned WT 60. The other next planned WT 57 is more than 400 m away from this area. In this distance a significant collision risk is not expected.

WT 16 and WT 59 are located next to the asphalt road, which is frequently used as a flight path by Kuhl's Pipistrelle. In fact the distance between one of the two turbines and the asphalt road is about 60 m. A significant collision risk cannot be excluded, although the activity at the bat-boxes at WT 16

and WT 59 was rather low and measured flight heights on 10. and 11.10.2011 were low as well. Consequently, appropriate mitigation measures have to be established (cf. Chapter 8).
The location of WT 60 has a distance of about 100 m to the flight path. The recommendation of SEICHE (2007a) is therefore fulfilled. Consequently, it is not expected that there will be a significant collision risk at WT 60. Moreover, structures at the proposed site are not an attractive habitat for Kuhl's Pipistrelle.
All other turbines will keep distances of at least 200 m to significant habitats for Kuhl's Pipistrelle. Thus, a relevant collision risk at these turbines can be excluded.

Nathusius' Pipistrelle

Nathusius' Pipistrelle is one of the species which seems to have a higher risk for colliding with rotor blades or to get into areas with significant air pressure differences (leading to a so-called barotraumata). Within the study area two structures / sites with a high significance for Nathusius' Pipistrelle were identified.
The distance between the proposed location for WT 60 and the ligneous and bushy structures in the vicinity of VP 8 is more than 200 m. The other next planned WT 57 is more than 400 m away from this significant site. Because of the distances mentioned, a relevant collision risk at turbines next to the hunting area around VP 8 is not expected.
WT 16 and WT 59 are located next to the asphalt road that is frequently used as a flight path by Nathusius' Pipistrelle as well as by Kuhl's Pipistrelle and Serotine Bats. In fact the distance of plants WT 15 and WT 59 to the road is about 60 m. A significant collision risk cannot be excluded, although the activity recorded by the bat-boxes at WT 16 and WT 59 was rather low and observed flight heights during thermal imaging survey were low as well (however, this might change after construction of turbines). Consequently, appropriate mitigation measures have to be established (cf. Chapter 8).
The location of WT 60 has a distance of about 100 m to the flight path. The recommendation of SEICHE *et al.* (2007a) is therefore fulfilled. Consequently, it is not expected that there will be a significant collision risk at WT 60. Moreover, structures at the proposed site are not an attractive habitat for Nathusius' Pipistrelle.
All other turbines will be at distances of at least 200 m to significant habitats for Nathusius' Pipistrelle. Thus, a relevant collision risk at these turbines can be excluded.

Common Noctule

Common Noctules have comparably wider hunting ranges and hunt at higher altitudes than other species (*e.g.* species of the genus *Myotis*). Thus, collision risk is believed to be higher for Common Noctules than for many other species (cf. Chapter 6.1).
Most collision victims were found in a period between mid-July and mid-September, which is the time of nursery roost-fission at the end of the reproductive period, and also the beginning of autumn

migrations (cf. Dürr 2003, 2007). This is taken as evidence that collisions principally occur during migrations (e.g. Dubourg-Savage et al. 2009), possibly because bats use echolocation only sporadically at that time. However, recent investigations show that collision risk of Common Noctule is not linked with migration. Niermann et al. (2011) conducted an intensive two-year field study at several wind farms in Germany. In eastern Germany, where females are present during summer and give birth to young in nursery colonies, 27 dead Common Noctules were found, i.e. 40 % of all recorded collision victims. In contrast, at wind farms in south-western and southern Germany not a single dead Common Noctule was recorded. In these areas no nursery sites exist, but males are present during summer. Moreover, adults and juveniles migrate through these parts of Germany during late summer and autumn (in north-western Germany Common Noctules are quite rare). These results clearly indicate that Common Noctules do not regularly collide at wind turbines during migration.

As one of the first Seiche et al. (2007a), who searched for collision victims at several wind farms in Saxony (eastern Germany), suggested that the high collision risk of Common Noctule is restricted to juveniles / subadults. Of the 57 individuals whose age could be determined unambiguously, 54 were juvenile and just three were adult. The authors discussed a possible habituation effect or avoidance behaviour towards wind turbines for adult Common Noctules, which is suggested by studies in the US (Erickson et al. 2003), too. As a consequence, Seiche et al. (2007b) also see a correlation between collision risk and location of, or proximity to, nursery roosts for Common Noctule and presumably other affected bat species.

The results obtained within the intensive investigation by Niermann et al. (2011) substantiate the comparatively high risk of collision for juvenile Common Noctules. About 84% of all Common Noctules found dead under a wind turbine were juveniles.

This result, which might be different for other species like Nathusius' Pipistrelle (*Pipistrellus nathusii*), is very much in accordance with the fact that Common Noctules were only recorded as collision victims in areas where nursery sites exist (eastern Germany).

Moreover the result is accordant to the fact that most dead Common Noctules were found in a period between end of July and mid-September (see for instance Figure 3). Juveniles of Common Noctule are able to fly from about mid-July, whereas migration begins mainly in September (end of August at earliest). Hence, between mid-July, after fission of nursery roosts, and end of August (mid-September) juveniles are most active and presumably most prone to collision at wind turbines (Niermann et al. 2011).

In the study at hand a comparatively high activity was measured in the south of the study area and at VP 8. As outlined above, the nearest location of a turbine (WT 60) is about 200 m away from VP 8 and therefore no significant collision risk is expected.

The results of bat-boxes and transect walks show that the hunting area in the south of the study area comprises the locations of five proposed turbines (WT 64, 39, 38, 44 and 37; cf. Map 5.4). Accordingly,

a significant collision risk at these turbines cannot be excluded. Consequently, appropriate mitigation measures have to be established (cf. Chapter 8).

The importance of the other areas, especially the open and intensively cultivated land in the centre of the study area, is low to moderate at most. A significant collision risk at turbines placed in this area can be excluded. However, from end of June to mid of July high activity was recorded by bat-boxes at WT 48. As datasets from mid of July to mid of August of this particular bat-box location could not be analysed, it remains unclear how long the period of high activity lasted. This aspect should be considered in a post-construction monitoring.

All other turbines will be at distances of more than 200 m to areas of at least moderate significance for Common Noctules. Thus, a significant collision risk at these turbines can be excluded.

The results obtained so far give no indication for a particular importance of the study area for migrating Common Noctules.

Serotine Bats

The collision risk of Serotine Bats seems to be comparatively low. Since 2001, a total of 33 bats of this species have been found dead due to collisions with wind turbines in Germany, covering 2.2 % of all recorded collision casualties (Dürr 2011). Collision risk at WT 16 and 59, located close to the flight path along the asphalt road, will be reduced by the proposed mitigation measures required for Kuhl's Pipistrelle and Nathusius' Pipistrelle. The distance between the locations of WT 4 to WT 16 accompanying the regularly used habitat of Serotine Bats that extends from the asphalt road to the north (cf. Map 5.3), is large enough (>200 m) to exclude a relevant collision risk at these turbines. Post-construction monitoring should examine collision risk for Serotine Bats at WT 1 and WT 2, both located near a flight path, and WT 48 where activity recorded by bat-boxes from end of June to mid of July was high (cf. Chapter 8).

Other species

The significance of the study area for all other species is assessed as low to moderate at most. Furthermore, most of these species are not believed to be particularly prone to collision. Thus, a significant collision risk can be excluded for all other species registered within the study area.

Conclusion

Taking the recommended mitigation measures including post-construction monitoring into account (cf. Chapter 8), construction and / or operation of "Čibuk 1" wind farm is not expected to cause the deliberate killing of individuals of bats or to cause an unacceptable collision risk for bats.

7.2 Habitat loss during construction or operation (due to avoidance behaviour)

The mating roost of Nathusius' Pipistrelle was more than 200 m away from the next planned wind turbine. As bats are generally not believed to be affected by operating turbines, it can be excluded that the "Čibuk 1" wind farm will have significant adverse effects on the roosting site at such a distance. The distances between the known roosts in the settlements or in the anthropogenic structures surrounding the study area and the proposed turbines will be about 1,000 m or more. Thus, significant adverse effects on these roosts are not expected. Besides, no roosts were found within the study area.

An adverse effect of the wind farm on roosts of bats can be excluded.

Avoidance behaviour due to operating turbines might lead to a loss or an impairment of hunting areas or flight paths. Recent studies give no clear evidence whether Serotine bats may avoid operating turbines or not (cf. Chapter 6.3). However, studies indicate that a possible effect is of small scale. Assuming that an area of about 100 m to a turbine is affected, and taking into account that WT 1, 2, 16 and 59 are located near significant flight paths of Serotine Bat, these four turbines might cause a disturbance of individuals and an impairment of flight paths. In this case it is expected that flight paths will change slightly. Due to the small scale of the assumed effect, the wind farm will not be a barrier enabling Serotine Bats to continue flying through the location of the planned wind farm and to commute between roosts and hunting areas. Thus, the local population will not deteriorate by a possible impairment of flight paths.

For all other species an avoidance behaviour is not certified (cf. Chapter 6.3). Thus a significant adverse effect of operating turbines is not expected.

Ultrasound that may be emitted by wind turbines does not seem to have adverse effects on bats in general (cf. Rodrigues *et al.* 2008).

<u>Conclusion</u>

Overall, it is not expected that construction and / or operation of "Čibuk 1" wind farm will lead to a relevant loss or impairment of significant habitats for bats.

7.3 Barrier effects and dissection of habitats

"Čibuk 1" wind farm will not present a barrier for bats and, thus, not cause a dissection of habitats. As given in Chapter 6.3 and 6.4 most species are not believed to avoid the vicinity of turbines. Even a possible effect on Serotine Bats is of small scale, so that bats will still be able to fly through the wind farm and to commute between roosts and hunting areas.

8 Recommendations

To reduce collision risk to an acceptable level at WT 16 and WT 59 for Kuhl's and Nathusius' Pipistrelle (and in doing so for Serotine Bat, too), both turbines have to be shut down from May to September in nights having the following conditions:

1. wind speed lower than 6 m/s
2. temperature higher than 10°C
3. no rainfall

Shutting down should start an hour before sunset and end an hour after sunrise.

If this mitigation measure is not a favourable option, removing the asphalt road and adjacent structures to a distance of at least 100 m to the next turbine location might be another option. It is expected that the flight path of bats will relocate in correspondence with the asphalt road enabling the bats to commute at safe distances.

Recent investigations show that collision risk of Common Noctule is mainly restricted to juveniles in the period from mid-July to mid-September (cf. Chapter 7.1). To reduce the collision risk at WTs 37, 38, 39, 44 and 64 for Common Noctules to an acceptable level, turbines have to be shut down from June (due to precautionary principles) to September exhibiting the above mentioned conditions. Shutting down should start an hour before sunset and end an hour after sunrise.

Finally, a post-construction monitoring programme should be implemented for a period of at least two years (recording bat activity automatically by appropriate devices, *e.g.* batcorder or Anabat, and if searches for possible collision casualties; cf. Brinkmann *et al.* 2011). The general purpose of this monitoring is to

- verify the assumptions made within the impact assessment and to determine significant deviations from predicted impacts;
- test the effectiveness of mitigation measures (*e.g.* shutdown programme);
- identify possible critical wind turbines and, if necessary, define further operational mitigation measures;
- determine the weight and significance of proposed impacts (*e.g.* collision rates).

The following aspects should particularly be considered during post-construction monitoring:

- collision risk for Serotine Bat at WT 1 and WT 2, both located near a flight path, and WT 48 where bat-box recordings indicate high levels of activity during single nights;
- identifying the annual period of activity of bats in the rotor swept area of that wind turbines where a shut-down program is recommended (WTs 16, 37, 38, 39, 44, 59 and 64) and probably adjusting the shut-down program due to new findings;

- collision risk for Common Noctule at WT 48 where bat-boxes also indicated high activity in single nights.

Thus the following post-construction monitoring is recommended:
A batcorder shall be installed in each nacelle of the following wind turbines from mid of March to mid of November for at least two years WT 1, WT 2, WT 38, WT 48, WT 59 and WT 64. By this selection of turbines a thorough and representative picture of bat activity in the relevant parts of the project site can be drawn, because all significant areas for bats are covered. Based on the results obtained so far, there is no need for selecting other turbines (*e.g.* WT 16 or 37, 39 or 44): Likewise WT 59, WT 16 is located near the identified flight path of bats between Dolovo and Deliblato Sands. Likewise WT 38 and WT 64, WT 37, WT 39 and WT 44 are located in a foraging habitat of Common Noctule in the south of the project site. Thus, the results obtained by batcorders in the three turbines WT 38, WT 59 and WT 64 can be transferred to the other mentioned turbines.
The main objective of the monitoring is to verify the assumptions made in the impact assessment and - if necessary - to define further operational mitigation measures. Moreover, periods of high bat activity can be identified by the monitoring (*e.g.* depending on time of the year, time of the night and wind conditions) and, thus, periods of high risk of collisions can be predicted. As a consequence, the shut-down programme for the seven wind turbines can be presumably adjusted and improved in a way that collision risk will be reduce to an acceptable level whereas the loss of energy output caused by stopping turbines will be minimized at the same time.
If the results of the two year monitoring show no clear result the monitoring should be extended for another year.

As results of October and November 2011 are not included in this expert opinion conclusions and recommendations may need to be adjusted.

9 Summary

With "Čibuk 1" a wind farm of 57 wind turbines is planned for construction near the villages of Dolovo and Mramorak in the Municipality of Kovin (Autonomous Province of Vojvodina, Republic of Serbia).

The construction and operation of wind turbines may have negative effects on local bats and can also affect migratory bats.
The main purpose of the investigation is to collect baseline data on the occurrence of bats within the study area and to describe the temporal and spatial distribution of each species.
As a result the aim of this expert opinion is to

- identify, predict and assess likely effects of the proposed wind farm on bats;
- assess whether impacts of the proposed wind farm remain at an acceptable level, or whether additional measures are necessary to minimize or eliminate unacceptable impacts;
- recommend mitigation measures or measures for compensation in order to minimize possible conflicts.

In terms of applicable assessment criteria and significance thresholds, this expert opinion adheres to guidelines followed in Germany and by the international community (*e.g.* European Commission 2007, European Commission 2010, Paunović *et al.* 2011, LANA 2009, MUNLV 2010, Rodriguez *et al.* 2008).

To build a database for the prediction of expected impacts by the project, bats were recorded that use the site envisaged for the wind farm and its surroundings for roosting or hunting or that migrate through it. The data on bats leading to this expert opinion were collected by two independent teams doing field studies from September 2009 to September 2011 (still continuing to November 2011) (Karapandža & Paunović 2011 and Rašajski 2011).

Overall, at least 16 species were recorded within the study area but it is highly likely that up to 19 species use the area at least temporarily. The results of the different approaches showed that Kuhl's Pipistrelle, Nathusius' Pipistrelle, Common Noctule and Serotine Bat were the most common species. All other species occurred within the study area in lower numbers.
An activity of on average 16 contacts / h, as obtained by walks at transects 1 and 3 (cf. Table 4.1), is assessed to be moderate for Germany (cf. Grunwald 2009). The average activity at the other three transects was much lower (5 to 11 contacts / h). Considering that bat species and individuals are more numerous in southern parts of Europe, a higher average activity within the study area would have been expected. Summarizing, the obtained overall activity within the study area is assessed to be low to medium, indicating that most parts of the study area have no particular habitat functions for bats.

A small mating roost of Nathusius' Pipistrelle was found near VP 8 at the eastern edge of the wind farm. The roost is located more than 200 m away from the location of the next planned wind turbine. Within the wind farm site no roosts were found and, furthermore, potential roosting sites are almost completely absent.
A few areas occasionally or regularly used as habitats (hunting areas, flight paths) by Kuhl's Pipistrelle, Nathusius' Pipistrelle, Common Noctule and Serotine were identified. These areas are of moderate / high significance for bats.
Until now there is no indication that bat migration, mainly of long-distance migrating species, is pronounced within the study area.

Based on the results obtained so far the expected effects of "Čibuk 1" wind farm are assessed. The main conclusions are:

- A significant collision risk for Kuhl's Pipistrelle, and Nathusius' Pipistrelle at WT 16 and WT 59 cannot be excluded. To reduce the collision risk to an acceptable level, a shut-down programme has to be established for both turbines. This shut-down programme would also minimize the collision risk for Serotine Bat (which is - based on current knowledge - not assessed to be significant).
- A significant collision risk for Common Noctules at WT 37, 38, 39, 44 and 64 cannot be excluded. To reduce the collision risk to an acceptable level, a shut-down programme has to be established for these turbines.
- Post-construction monitoring should be implemented for a period of at least two years to verify the assumptions made within the impact assessment and to determine significant deviations from predicted impacts. A special focus of the monitoring should be on examining the collision risk for Serotine Bats at WT 1, 2 and 48 and for Common Noctules at WT 48.

As results of October and November 2011 are not included in this expert opinion conclusions and recommendations may need to be adjusted.

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Annex I:

Table 1: Species-specific bat activity recorded during transect walks

Table 2: Standardized species-specific bat activity recorded during transect walks

Table 1: Species-specific bat activity (total number of contacts for each night and each transect) from June to September (during transects walks in 2011)

	transect	Barbastrellus barbastrellus	Eptesicius serotinus	Eptesicius serotinus / Eptesicius nilsonii	Eptesicius serotinus / Vespertillus murinus	Myotis sp.	Nyctalus noctula	Nyctalus leislei	Nyctalus noctula / Nyctalus leisleri	v. murinus / Nyctalus noctula / Nyctauls leisleri	Pipistrellus kuhlii	Pipistellus nathusii	Pipistrellus kuhlii / Pipistellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	PipistrEllus spec.	Hypsugo savii	Rh. ferrumequinum	Vespertilionidae	total contacts
13. Jun	1		3			2	7		2		5	2	4					1	1	27
	2		2				1						1							4
	3		4			1	2				7	2	3					1	1	21
	4		1		1		2													4
	5		3				7	1	1		1									13
01. Jul	1		21	2	1	1	3	1			2	3	2						1	37
	2		3				1					1								5
	3		8			1	4				4	3	3							23
	4		1				2				2	3	2			1				11
	5		2			1	3				4		1					1		12
12. Jul	1		96		1	1	1				1		1						1	102
	2		40		3		5	1				1							1	51
	3		2									8	1	3				1	2	17
	4										1									1
	5					1					4	5	2							12
17. Jul	1		5		1	2														8
	2		2				5		1											8
	3		15		1	3	2				30	5	9	2					2	69
	4		2				2						1							5
	5		1			1					4		1							7
02. Aug	1		1				2						1							4
	2		1				2		1		1		1							6
	3		3				1				9	2	2	1				1	1	20
	4		3				3	1			2	1	3							13
	5		6			2	15	1	3	1	2		2					1	1	34
10. Aug	1		1				1													2
	2		1				2		1											4
	3		1		1						6		3					1	1	13
	4						2					1	1							4
	5						1				3		1							5
21. Aug	1					1	5			1	2	1	1							11
	2						1												1	2
	3						1				2	1	2			1			1	13
	4						4					1	1							6
	5		1			4	2				23	3	8	1	2	1		1	2	48

continuation of Table 1

	transect	Barbastrellus barbastrellus	Eptesicius serotinus	Eptesicius serotinus / Eptesicius nilsonii	Eptesicius serotinus / Vespertillus murinus	Myotis sp.	Nyctalus noctula	Nyctalus leislei	Nyctalus noctula / Nyctalus leisleri	v. murinus / Nyctalus noctula / Nyctauls leisleri	Pipistrellus kuhlii	Pipistellus nathusii	Pipistrellus kuhlii / Pipistellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	PipistrEllus spec.	Hypsugo savii	Rh. ferrumequinum	Vespertilionidae	total contacts
31. Aug	1		1				1				1		1							4
	2						1												1	2
	3						2				3	1	2							8
	4						10		1		1	1	3							16
	5										2		1			1				4
03. Sep	1					1	1		1		1									4
	2						1													1
	3		2				4		1		10		4							21
	4						3													3
	5					1	4											1	1	7
14. Sep	1		1			1	3			1										6
	2						1			1										2
	3						1				2		1						1	5
	4					1	2							1		1				5
	5	1	2			1	1				1	1	1		1				1	9
30. Sep	1		1			1				1	1	2	2							8
	2																1			1
	3						1				1								1	3
	4	1				1														2
	5		1			1						1				1				4
total contacts	1		130	2	3	10	24	1	3	3	13	8	12					1	3	213
	2		49		3		20	1	3	1	1	2	2				1		3	86
	3		35		2	5	18		1		74	22	30	6		1		4	10	213
	4	1	7		1	2	30	1	1		6	7	11	1		2				70
	5	1	16			12	33	2	4	1	44	10	17	1	3	3		4	5	155
	total	2	237	2	9	29	125	5	12	5	138	49	72	8	3	6	1	9	21	737
percen-tage of contacts	1		61.0	0.9	1.4	4.7	11.3	0.5	1.4	1.4	6.1	3.8	5.6					0.5	1.4	100
	2		57.0		3.5		23.3	1.2	3.5	1.2	1.2	2.3	2.3				1.2	0.0	3.5	100
	3		16.4		0.9	2.3	8.5		0.5		34.7	10.3	14.1	2.8		0.5		1.9	4.7	100
	4	0.5	10.0		1.4	2.9	42.9	1.4	1.4		8.6	10.0	15.7	1.4		2.9			0.0	100
	5	0.5	10.3			7.7	21.3	1.3	2.6	0.6	28.4	6.5	11.0	0.6	1.9	1.9		2.6	3.2	100
	total	0.3	32.2	0.3	1.2	3.9	17.0	0.7	1.6	0.7	18.7	6.6	9.8	1.1	0.4	0.8	0.1	1.2	2.8	100

Table 2: Standardized species-specific bat activity (contacts / hour for each night and each transect) from June to September (during transects walks in 2011)

	transect	Barbastrellus barbastrellus	Eptesicius serotinus	Eptesicius serotinus / Eptesicius nilsonii	Eptesicius serotinus / Vespertillus murinus	Myotis sp.	Nyctalus noctula	Nyctalus leislei	Nyctalus noctula / Nyctalus leisleri	v. murinus / Nyctalus noctula / Nyctauls leisleri	Pipistrellus kuhlii	Pipistellus nathusii	Pipistrellus kuhlii / Pipistellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	PipistrEllus spec.	Hypsugo savii	Rh. ferrumequinum	Vespertilionidae	total contacts / h
13. Jun	1		2.4			1.6	5.6	0.0	1.6		4.0	1.6	3.2					0.8	0.8	21.6
	2		1.6				0.8						0.8							3.2
	3		3.2			0.8	1.6				5.6	1.6	2.4					0.8	0.8	16.8
	4		0.8		0.8		1.6													3.2
	5		2.4				5.6	0.8	0.8		0.8									10.4
01. Jul	1		16.8	1.6	0.8	0.8	2.4	0.8			1.6	2.4	1.6						0.8	29.6
	2		2.4				0.8					0.8								4.0
	3		6.4			0.8	3.2				3.2	2.4	2.4							18.4
	4		0.8				1.6				1.6	2.4	1.6			0.8				8.8
	5		1.6			0.8	2.4				3.2		0.8					0.8		9.6
12. Jul	1		76.8		0.8	0.8	0.8				0.8		0.8						0.8	81.6
	2		32.0		2.4		4.0	0.8				0.8							0.8	40.8
	3		1.6									6.4	0.8	2.4				0.8	1.6	13.6
	4										0.8									0.8
	5					0.8					3.2	4.0	1.6							9.6
17. Jul	1		4.0		0.8	1.6														6.4
	2		1.6				4.0		0.8											6.4
	3		12.0		0.8	2.4	1.6				24.0	4.0	7.2	1.6					1.6	55.2
	4		1.6				1.6						0.8							4.0
	5		0.8			0.8					3.2		0.8							5.6
02. Aug	1		0.8				1.6						0.8							3.2
	2		0.8				1.6		0.8		0.8		0.8							4.8
	3		2.4				0.8				7.2	1.6	1.6	0.8				0.8	0.8	16.0
	4		2.4				2.4	0.8			1.6	0.8	2.4							10.4
	5		4.8			1.6	12.0	0.8	2.4	0.8	1.6		1.6					0.8	0.8	27.2
10. Aug	1		0.8				0.8													1.6
	2		0.8				1.6		0.8											3.2
	3		0.8		0.8						4.8		2.4					0.8	0.8	10.4
	4						1.6					0.8	0.8							3.2
	5						0.8				2.4		0.8							4.0
21. Aug	1					0.8	4.0			0.8	1.6	0.8	0.8							8.8
	2						0.8												0.8	1.6
	3						0.8				1.6	0.8	1.6			0.8			0.8	10.4
	4						3.2					0.8	0.8							4.8
	5		0.8			3.2	1.6				18.4	2.4	6.4	0.8	1.6	0.8		0.8	1.6	38.4

continuation of Table 2

	transect	Barbastrellus barbastrellus	Eptesicius serotinus	Eptesicius serotinus / Eptesicius nilsonii	Eptesicius serotinus / Vespertillus murinus	Myotis sp.	Nyctalus noctula	Nyctalus leislei	Nyctalus noctula / Nyctalus leisleri	v. murinus / Nyctalus noctula / Nyctauls leisleri	Pipistrellus kuhlii	Pipistellus nathusii	Pipistrellus kuhlii / Pipistellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	PipistrEllus spec.	Hypsugo savii	Rh. ferrumequinum	Vespertilionidae	total contacts / h
31. Aug	1		0.8				0.8				0.8		0.8							3.2
	2						0.8												0.8	1.6
	3						1.6				2.4	0.8	1.6							6.4
	4						8.0		0.8		0.8	0.8	2.4							12.8
	5										1.6		0.8			0.8				3.2
03. Sep	1					0.8	0.8		0.8		0.8									3.2
	2						0.8													0.8
	3		1.6				3.2		0.8		8.0		3.2							16.8
	4						2.4													2.4
	5					0.8	3.2											0.8	0.8	5.6
14. Sep	1		0.8			0.8	2.4			0.8										4.8
	2						0.8			0.8										1.6
	3						0.8				1.6		0.8						0.8	4.0
	4					0.8	1.6							0.8		0.8				4.0
	5	0.8	1.6			0.8	0.8				0.8	0.8	0.8		0.8				0.8	7.2
30. Sep	1		0.8			0.8				0.8	0.8	1.6	1.6							6.4
	2									0.0							0.8			0.8
	3						0.8				0.8								0.8	2.4
	4	0.8				0.8														1.6
	5		0.8			0.8						0.8				0.8				3.2
total contacts / h	1		9.5	0.1	0.2	0.7	1.7	0.1	0.2	0.2	0.9	0.6	0.9					0.1	0.2	15.5
	2		3.6		0.2		1.5	0.1	0.2	0.1	0.1	0.1	0.1				0.1		0.2	6.3
	3		2.5		0.1	0.4	1.3		0.1		5.4	1.6	2.2	0.4		0.1		0.3	0.7	15.5
	4	0.1	0.5		0.1	0.1	2.2	0.1	0.1		0.4	0.5	0.8	0.1		0.1				5.1
	5	0.1	1.2			0.9	2.4	0.1	0.3	0.1	3.2	0.7	1.2	0.1	0.2	0.2		0.3	0.4	11.3
	total	0.0	3.4	0.0	0.1	0.4	1.8	0.1	0.2	0.1	2.0	0.7	1.0	0.1	0.0	0.1	0.0	0.1	0.3	10.72

Annex II:

Recorded species (groups of species) and contacts at all bat-box sites

Annex II: Recorded species(groups) and individuals at the bat-box sites

Week 17	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts		1	1	1	2	0	29		0	5	5		0	41	0	1	3	0	2	17	0	0		0	52	6	34	0		192
	Pipistrellus spp.		0	1	0	1	0	21		0	1	3		0	17	0	0	2	0	0	8	0	0		0	21	1	19	0		117
	Nyctalus spp.		0	0	0	0	0	1		0	3	0		0	11	0	1	0	0	2	9	0	0		0	10	2	9	0		16
	Eptesicus spp.		1	0	1	0	0	3		0	0	2		0	0	0	0	1	0	0	0	0	0		0	15	3	5	0		29
	Myotis sp.		0	0	0	1	0	0		0	0	0		0	13	0	0	0	0	0	0	0	0		0	1	0	0	0		12
	Chiroptera spp.		0	0	0	0	0	0		0	1	0		0	0	0	0	0	0	0	0	0	0		0	5	0	1	0		18
Week 20	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	16	8	5	1	0	1	3	27	339	27	0	0	55	52	14	1	14	9	10	41	20	0	33	17	29	1	6	20	39	443
	Pipistrellus spp.	6	4	1	0	0	0	0	15	323	9	0	0	29	32	8		0	0	4	11	5	0	4	3	7	1		5	20	369
	Nyctalus/Vespertilio spp./	5	3	4	1	0	1	1	7	3	26	0	0	22	7	4		13	6	3	24	12	0	27	5	5	0	2	15	8	20
	Eptesicus spp.	1	1	0	0	0	0	0	3	9	0	0	0	1	10	1		0	3	1	2	0	0	0	0	12	0		0	6	33
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	0	0	0	0	0	2	3	2	0	0	0	0	0		1	0	2	1	2	0	0	0	4	0	2	0	3	6
	Myotis sp.	3	0	0	0	0	0	0	0	0	0	0	0	1	1	0		0	0	0	1	1	0	2	8	0	0	1	0	2	5
	Vespertilionidae spp.	1	0	0	0	0	0	2	0	1	0	0	0	2	2	1	1	0	0	0	2	0	0	0	1	1	0	1	0	0	10
Week 22	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	284	57	15	24	3	11	26	0	28	17		27	97	38	26	25	7	48	27	42	18	32	29	4	27	5	134	14	0	500
	Pipistrellus spp.	261	39	7	12	0	7	8	0	23	6		8	41	11	5	13	3	32	8	11	12	26	19	0	8	1	69	3	0	419
	Nyctalus/Vespertilio spp./	5	3	4	5	0	2	6	0	1	11		15	49	9	19	7	3	4	16	31	5	5	5	2	4	3	34	11	0	16
	Eptesicus spp.	3	7	0	2	1	2		0	0	0		2	0		1	2	0	5	2	0	0	1	3	2	8	0	2	0	0	25
	Nyctalus/Eptesicus/Vespertilio spp.	2	2	2	2	0	0	6	0	0	0		2	3	4	0	2	0	5	1	0	1	0	0	0	4	0	10	0	0	10
	Myotis sp.	8	1	1	0	0	0		0	1	0		0	0		0	1	1	2	0	0	0	0	2	0	0	0	4	0	0	2
	Vespertilionidae spp.	5	5	1	3	2	0	6	0	3	0		0	4	14	1	0	0	0	0	0	0	0	0	0	3	1	15	0	0	28
Week 24	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	46		15	25	43	4	0	30	20	16	5	19	48	119	90	94	10	24	73	40	11	178	22	11	54	104	94	2	203	301
	Pipistrellus spp.	7		2	2	3	0		12	9	4		1	30	91	40	0	1	4	32	4	5	73	4	2	37	50	24	0	159	83
	Nyctalus/Vespertilio spp./	7		7	4	6	4	0	7	1	11	3	11	9	12	33	14	4	15	4	32	4	4	10	7	6	3	20	1	19	52
	Eptesicus spp.	0		4	4	15	0	0	0	0	0		1	3	3	2	68	0	3	11	1	0	0	7	2	2	0	17	1	5	51
	Nyctalus/Eptesicus/Vespertilio spp.	26		2	7	18	0	0	5	3	0	2	3	2	3	7	12	2	1	12	3	2	13	1	0	0	49	15	0	4	30
	Myotis sp.	0		0	4	1	0	0	4	2	0		1	4	5	4	0	2	1	5	0	0	13	0	0	7	0	12	0	8	28
	Vespertilionidae spp.	6		0	4	0	0	0	2	5	1		2	0	5	4	0	1	0	9	0	0	75	0	0	2	2	6	0	8	57
Week 26	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	268	212	36	54	1	6	2	6	38	17	17	17	80	188	32	641	10	11	31	29	9	30	42	0	0	53	111	0	3	138
	Pipistrellus spp.	34	9	0	0	0	0	0	1	25	14	1	8	55	125	24	0	7	4	1	7	4	7	1	0	0	0	28	0	2	26
	Nyctalus/Vespertilio spp./	14	11	2	8	0	4	0	2	1	1	3	2	7	45	2	13	3	1	19	18	3	15	30	0	0	5	41	0	0	1
	Eptesicus spp.	190	156	20	26	0	0	1	0	1	1	9	4	1	9	1	461	0	5	10	1	1	6	6	0	0	32	22	0	1	77
	Nyctalus/Eptesicus/Vespertilio spp.	21	24	14	13	0	2	0	3	1	0	2	1	0	5	2	149	0	1	1	2	1	2	4	0	0	3	14	0	0	19
	Myotis sp.	1	0	0	3	0	0	0	0	1	0	0	0	2	0	2	1	0	0	0	1	0	0	0	0	0	5	4	0	0	3
	Vespertilionidae spp.	8	12	0	4	1	0	1	0	9	1	2	2	15	4	1	17	0	0	0	0	0	0	1	0	0	8	2	0	0	12
Week 27	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts		564	125	89	220		17	7	10	7	302	15	10	75	21	973	24	11	0	41	7	7	179	1	64	0	117		25	
	Pipistrellus/Hypsugo spp.		9	2	3	5		6	4	8	6	7	9	2	31	10	7	10	6	0	3	0	1	1	0	40	0	15		8	
	Nyctalus/Vespertilio spp.		35	11	13	38		6	0	0	0	16	2	3	24	6	64	10	5	0	12	3	3	94	0	2	0	42		13	
	Eptesicus spp.		396	83	60	102		2	1	0	0	159	2	0	4	1	726	1	0	0	4	0	0	44	0	8	0	33		0	
	Nyctalus/Eptesicus/Vespertilio spp.		123	29	12	71		3	1	2	1	114	2	5	11	2	155	2	0	0	8	2	2	33	1	5	0	26		3	
	Myotis sp.		0	0	0	1		0	1	0	0	3	0	0	4	0	3	0	0	0	2	0	0	2	0	4	0	0		0	
	Vespertilionidae spp.		1	0	1	3		0	0	0	0	3	0	0	0	2	15	1	0	0	9	2	1	4	0	4	0	0		1	
	Rhinolophus spp.		0	0	0	0		0	0	0	0	0	0	0	1	0	3	0	0	0	3	0	0	1	0	1	0	1		0	
Week 28	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	4	31	43	9	58		31	4	10	1	41	15	0	42		394	1	9	33	1		13	15		0	0	53	14	12	223
	Pipistrellus/Hypsugo spp.	3	1	1	0	0		22	1	7	0	10	7	0	7		4	0	8	21	1		0	0		0	0	3	13	5	44
	Nyctalus/Vespertilio spp.	0	1	2	4	12		0	1	0	0	12	5	0	21		25	1	0	2	0		4	10		0	0	33	0	6	2
	Eptesicus spp.	0	27	36	3	23		4	0	1	0	11	0	0	7		272	0	1	7	0		5	3		0	0	6	0	0	140
	Nyctalus/Eptesicus/Vespertilio spp.	1	2	4	2	23		0	2	1	1	6	3	0	4		93	0	0	3	0		4	1		0	0	10	0	0	37
	Myotis sp.	0	0	0	0	0		0	0	0	0	0	0	0	2		0	0	0	0	0		0	0		0	0	1	0	0	0
	Vespertilionidae spp.	0	0	0	0	0		3	0	1	0	2	0	0	0		0	0	0	0	0		0	1		0	0	0	0	1	0
	Rhinolophus spp.	0	0	0	0	0		2	0	0	0	0	0	0	1		0	0	0	0	0		0	0		0	0	0	1	0	0

Explanations:
light blue: Noise overload at least at half of the night; files could be analysed. Some bat calls may be masked by other noise.
black marked cells: no complete data set available

Annex II: Recorded species(groups) and individuals at the bat-box sites

Week 29	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	1	48	8		8		31		29	14	29	11	36	20	14		8	27	0	47	9			6	44	74	54			
	Pipistrellus/Hypsugo spp.	0	21	1		1		20		16	3	11	4	10	4	0		0	16	0	18	0			2	5	50	25			
	Nyctalus/Vespertilio spp.	1	2	1		5		3		1	8	2	4	20	9	10		4	4	0	21	4			1	7	7	14			
	Eptesicus spp.	0	22	5		0		3		1	1	6	0	0	4	2		0	2	0	3	1			1	16	1	5			
	Nyctalus/Eptesicus/Vespertilio spp.	0	3	1		2		4		0	2	2	3	2	0	2		4	0	0	0	0			2	6	7	3			
	Myotis sp.	0	0	0		0		1		3	0	4	0	0	0	0		0	3	0	1	4			0	8	7	4			
	Vespertilionidae spp.	0	0	0		0		0		2	0	4	0	4	3	0		0	2	0	2	0			0	1	2	1			
	Rhinolophus spp.	0	0	0		0		0		6	0	0	0	0	0	0		0	0	0	2	0			0	1	0	2			
Week 30	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	66	26		12	10	10	38	34	8	25	1	13	77		22		18	107		53	19	0				66	55	8	7	
	Pipistrellus spp.	35	7		4	2	3	27	25	2	7	0	3	45		10		2	77		17	5	0				42	25	2	0	
	Nyctalus/Vespertilio spp./	8	1		3	4	7	7	7	5	10	1	7	19		10		13	7		26	7	0				9	15	5	2	
	Eptesicus spp.	17	15		3	2	0	2	0	1	3	0	0	1		1		1	3		1	3	0				9	0	1	0	
	Nyctalus/Eptesicus/Vespertilio spp.	3	3		0	2	0	2	2	0	5	0	3	5		1		2	8		7	3	0				1	4	0	3	
	Myotis sp.	0	0		0	0	0	0	0	0	0	0	0	0		0		0	0		1	0	0				2	1	0	0	
	Vespertilionidae spp.	3	0		0	0	0	0	0	0	0	0	0	6		0		0	12		0	1	0				3	9	0	2	
	Rhinolophus spp.	0	0		2	0	0	0	0	0	0	0	0	1		0		0	0		1	0	0				0	1	0	0	
week 31	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	0	0	5		14	4	9	5	0	5		6		4	19		24	13	21	54	0	5		8		45			7	
	Pipistrellus/Hypsugo spp.	0	0	1		6	0	6	0	0	3		4		0	13		3	9	4	29	0	0		5		40			0	
	Nyctalus/Vespertilio spp.	0	0	2		1	4	0	3	0	2		1		2	3		11	1	11	18	0	3		2		0			4	
	Eptesicus spp.	0	0	0		0	0	1	2	0	0		1		0	1		0	0	5	1	0	0		0		2			0	
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	2		4	0	2	0	0	0		0		1	1		10	2	1	3	0	2		0		2			0	
	Myotis sp.	0	0	0		3	0	0	0	0	0		0		1	0		0	0	0	2	0	0		1		0			0	
	Vespertilionidae spp.	0	0	0		0	0	0	0	0	0		0		0	1		0	1	0	1	0	0		0		0			3	
	Rhinolophus spp.	0	0	0		0	0	0	0	0	0		0		0	0		0	0	0	0	0	0		0		1			0	
week 32	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 7	VP 6	VP 8
	total contacts	2	4	2		8	0	24	22		0	0	5	111	8	16		13	0	17	4	3	12				19	9	22	33	
	Pipistrellus/Hypsugo spp.	0	0	1		5	0	17	7		0	0	1	87	0	0		4	0	6	0	2	3				14	3	13	16	
	Nyctalus/Vespertilio spp.	2	1	0		1	0	4	11		0	0	4	10	8	14		5	0	9	2	0	5				5	0	8	10	
	Eptesicus spp.	0	1	0		0	0	0	1		0	0	0	1	0	0		3	0	0	0	0	1				0	0	1	1	
	Nyctalus/Eptesicus/Vespertilio spp.	0	2	1		1	0	0	2		0	0	0	4	0	0		1	0	1	2	1	3				0	0	0	3	
	Myotis sp.	0	0	0		1	0	0	1		0	0	0	0	0	0		0	0	0	0	0	0				0	1	0	3	
	Vespertilionidae spp.	0	0	0		0	0	2	0		0	0	0	9	0	2		0	0	1	0	0	0				0	5	0	0	
	Rhinolophus spp.	0	0	0		0	0	1	0		0	0	0	0	0	0		0	0	0	0	0	0				0	0	0	0	
week 33	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	28	2	9	9		5	0	1	1	9	15	3	137	13	11		24	10	5	59	10	1		4		33			32	62
	Pipistrellus/Hypsugo spp.	16	0	0	4		0	0	0	0	0	5	0	104	5	0		6	1	1	11	0	0		4		11			14	44
	Nyctalus/Vespertilio spp.	10	2	6	2		5	0	1	1	8	7	2	6	7	9		5	3	3	37	9	1		0		16			15	3
	Eptesicus spp.	0	0	0	0		0	0	0	0	1	0	1	0	0	0		11	4	1	5	0	0		0		3			2	6
	Nyctalus/Eptesicus/Vespertilio spp.	2	0	0	1		0	0	0	0	0	3	0	4	0	2		1	2	0	4	1	0		0		3			0	6
	Myotis sp.	0	0	0	1		0	0	0	0	0	0	0	7	1	0		0	0	0	0	0	0		0		0			0	3
	Vespertilionidae spp.	0	0	3	1		0	0	0	0	0	0	0	14	0	0		1	0	0	2	0	0		0		0			1	0
	Rhinolophus spp.	0	0	0	0		0	0	0	0	0	0	0	2	0	0		0	0	0	0	0	0		0		0			0	0
week 34	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	20	40	9	5	2	1				10	2	3		16	8	4	1		6		15	9	0	14					2	
	Pipistrellus/Hypsugo spp.	5	21	5	0	0	0				5	0	0		12	0	3	0		1		6	0		4					1	
	Nyctalus/Vespertilio spp.	14	18	2	3	2	0				5	2	1		3	8	0	1		3		9	8		10					1	
	Eptesicus spp.	0	0	0	0	0	0				0	0	1		0	0	1	0		0		0	1		0					0	
	Nyctalus/Eptesicus/Vespertilio spp.	1	1	2	1	0	1				0	0	1		1	0	0	0		2		0	0		0					0	
	Myotis sp.	0	0	0	0	0	0				0	0	0		0	0	0	0		0		0	0		0					0	
	Vespertilionidae spp.	0	0	0	1	0	0				0	0	0		0	0	0	0		0		0	0		0					0	
	Rhinolophus spp.	0	0	0	0	0	0				0	0	0		0	0	0	0		0		0	0		0					0	

Explanations:
light blue: Noise overload at least at half of the night; files could be analysed. Some bat calls may be masked by other noise.
black marked cells: no complete data set available

Annex II: Recorded species(groups) and individuals at the bat-box sites

week 35	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	11	5	4	1	12	2		4	8	0	2	1	0	21	7		3	12	19	28	4	3		1	8		18		0	
	Pipistrellus/Hypsugo spp.	4	0	1	1	7	0		1	5	0	0	0	0	6	4		1	8	5	16	0	1		0	0		14		0	
	Nyctalus/Vespertilio spp.	7	5	3	0	0	2		1	3	0	2	1	0	14	2		2	1	14	9	4	0		0	7		1		0	
	Eptesicus spp.	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	1	0	1	0	0		0	0		0		0	
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	0	0	0	0		0	0	0	0	0	0	1	0		0	0	0	2	0	0		0	1		0		0	
	Myotis sp.	0	0	0	0	2	0		1	0	0	0	0	0	0	1		0	1	0	0	0	0		0	0		2		0	
	Vespertilionidae spp.	0	0	0	0	3	0		1	0	0	0	0	0	0	0		0	1	0	0	0	2		1	0		1		0	
	Rhinolophus spp.	0	0	0	0	0	0		0	0	0	0	0	0	0	0		0	0	0	0	0	0		0	0		0		0	
week 36	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	1	0	5	0		11	21	1	16	11	0		9	0	0	0	0	13	40	1	11	3		1	0		19		7	
	Pipistrellus/Hypsugo spp.	0	0	2	0		0	7	0	2	4	0		6	0	0	0	0	0	1	0	8	2		0	0		8		3	
	Nyctalus/Vespertilio spp.	1	0	3	0		11	14	1	13	6	0		1	0	0	0	0	13	38	1	3	1		1	0		8		0	
	Eptesicus spp.	0	0	0	0		0	0	0	0	0	0		1	0	0	0	0	0	0	0	0	0		0	0		0		0	
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	0	0		0	0	0	0	1	0		1	0	0	0	0	0	0	0	0	0		0	0		0		1	
	Myotis sp.	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0		1		3	
	Vespertilionidae spp.	0	0	0	0		0	0	0	1	0	0		0	0	0	0	0	0	1	0	0	0		0	0		2		0	
	Rhinolophus spp.	0	0	0	0		0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0		0	0		0		0	
week 37	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	28	3	15	3	10	10	0	1	8	55	0	4	1	14	12	3	1	0		0	8	7		0	34	2			0	
	Pipistrellus/Hypsugo spp.	5	0	4	0	2	3	0	0	0	45	0	1	1	0	4	0	0	0		0	3	0		0	5	0			0	
	Nyctalus/Vespertilio spp.	20	2	10	3	8	7	0	0	8	10	0	2	0	13	5	3	1	0		0	5	6		0	23	2			0	
	Eptesicus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	2	0			0	
	Nyctalus/Eptesicus/Vespertilio spp.	3	1	1	0	0	0	0	1	0	0	0	1	0	1	2	0	0	0		0	0	1		0	1	0			0	
	Myotis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0		0	2	0			0	
	Vespertilionidae spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	1	0			0	
	Rhinolophus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0	0			0	
week 38	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	0	1	0	8		1	11	3	5	12	0	6	11	13	0	0	0	2	1	6	7	8		1	17	21			3	
	Pipistrellus/Hypsugo spp.	0	0	0	0		0	0	0	0	4	0	1	1	0	0	0	0	2	0	0	1	0		0	3	7			0	
	Nyctalus/Vespertilio spp.	0	1	0	8		1	11	3	5	8	0	5	9	13	0	0	0	0	1	6	6	8		1	11	14			3	
	Eptesicus spp.	0	0	0	0		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		0	0	0			0	
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0			0	
	Myotis sp.	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0			0	
	Vespertilionidae spp.	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	3	0			0	
	Rhinolophus spp.	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0				
week 39	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	0	0	2		3	8	0	0	1	14	3	0	6	17	1	0	0	2		0	10	3		0	6		47		16	55
	Pipistrellus/Hypsugo spp.	0	0	1		0	1	0	0	0	0	1	0	0	1	0	0	0	0		0	0	1		0	0		1		1	5
	Nyctalus/Vespertilio spp.	0	1	1		3	5	0	0	1	14	2	0	5	11	1	0	0	2		0	10	1		0	6		44		15	44
	Eptesicus spp.	0	0	0		0	0	0	0	0	0	0	0	1	0	0	0	0	0		0	0	0		0	0		0		0	1
	Nyctalus/Eptesicus/Vespertilio spp.	0	0	0		0	0	0	0	0	0	0	0	0	3	0	0	0	0		0	0	1		0	0		1		0	1
	Myotis sp.	0	0	0		0	2	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0		0		0	4
	Vespertilionidae spp.	0	0	0		0	0	0	0	0	0	0	0	0	2	0	0	0	0		0	0	0		0	0		1		0	0
	Rhinolophus spp.	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0		0	0		0		0	0
total	site (VP/WT)	WT 1	WT 2	WT 6	WT 8	WT 11	WT 14	WT 16	WT 17	WT 19	WT 22	WT 24	WT 32	WT 37	WT 39	WT 42	WT 48	WT 54	WT 59	WT 61	WT 64	WT 71	WT 78	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	VP 8
	total contacts	775	1,002	299	241	394	74	242	145	521	245	422	145	678	681	293	2,136	161	298	285	463	161	311	320	68	335	429	751	80	389	1,914
	Pipistrellus/Hypsugo spp.	376	111	30	26	32	14	134	66	420	111	38	47	411	342	118	27	39	167	84	136	51	114	29	20	126	217	234	36	229	1,107
	Nyctalus/Vespertilio spp.	94	86	58	54	80	53	53	44	43	123	50	62	160	209	126	127	76	62	125	246	84	64	176	29	81	66	263	40	96	154
	Eptesicus spp.	211	626	148	99	143	2	16	7	13	6	187	12	10	37	10	1,530	17	27	37	19	5	14	63	5	63	50	90	3	15	362
	Nyctalus/Eptesicus/Vespertilio spp.	59	161	58	38	122	3	17	18	10	12	129	19	26	47	19	411	23	19	23	32	13	28	39	3	22	65	85	0	17	121
	Myotis sp.	12	1	1	8	8	2	1	7	7	1	7	1	14	14	8	5	3	7	5	8	5	13	6	9	26	14	32	0	16	63
	Vespertilionidae spp.	23	18	4	14	9	0	14	3	22	2	11	4	54	30	12	33	3	16	11	16	3	78	6	2	15	16	43	0	16	107
	Rhinolophus spp.	16	8	5	3	0	1	6	27	345	27	0	0	58	54	14	4	14	9	10	47	20	0	34	17	31	2	10	21	39	443

Explanations:
light blue: Noise overload at least at half of the night; files could be analysed. Some bat calls may be masked by other noise.
black marked cells: no complete data set available