BIRDS AND BATS SURVEY FOR THE KOSTOLAC WIND FARM CONSTRUCTION PROJECT

November 2014 – November 2015

STUDY

Survey team

Fauna C&M

Survey data synthesis and analysis

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INTRODUCTION

This study presents the collected and analysed results of a one-year birds and bats fauna survey from November 2014 to November 2015 in the area of potential construction of the Kostolac wind farm infrastructure complex, in the wider area of the Kostolac open cast mines, south and east of the village of Kostolac in the Branicevo District. This study will form part of the Kostolac wind farm infrastructure complex environmental impact assessment. The study was commissioned by the investor Public Enterprise Electric Power Industry of Serbia (EPS), Belgrade, while the survey and study were conducted by the Fauna C & M team, Novi Banovci.

The construction of wind farms in Serbia was foreseen due to significant increase in electricity demand and the ability to cover part of the needs from alternative energy sources, according to the current Energy Development Strategy of Serbia (Official Gazette RS, № 44/2005), and the Draft Strategy under preparation (Ministry of Mining and Energy of the Republic of Serbia 2014).

As electricity generation from wind is one of the strategic and planning objectives of the Public Enterprise Electric Power Industry of Serbia (2014), the Kostolac Coal Basin Spatial Plan of Special Purpose (Official Gazette RS, № 1/2013) favours the construction of electric power facilities and announces the use of wind and solar energy, the wider zone of the Kostolac open cast mines was chosen for wind farm development. In the context of investment-technical documentation for the present project, and in order to review the environmental impact of the project, after the public procurement was conducted (Public Enterprise Electric Power Industry of Serbia 2014), a contract was signed (№ 2189/21-14, dated 30 October 2014) between EPS and the group of tenderers Netinvest d.o.o. and Fauna and C & M as the Service Provider. This marked the beginning of the Birds and Bats Survey Project for the Kostolac Wind Farm Construction Project.

One-year survey stipulated by the contract is an optimal period and method to reliably identify the fauna of birds and bats at a particular location, its basic ecological characteristics and potential project impacts. This served as the basis to establish appropriate measures to prevent, reduce and eliminate any potential adverse impacts of the project, in this case of the Kostolac wind power plant.

Design – planning framework

The Birds and Bats Survey Project for the Kostolac Wind Farm Construction Project began with the delivery of the existing documentation and input data in the possession of EPS to the Service Provider, i.e. the relevant planning and project documentation: Geotechnical Field Investigations Project for Wind Farm Development at Kostolac, Preliminary Feasibility Study with the General Design for the Kostolac Wind Farm Development, the corresponding Opinions of the Nature Conservation Institute of Serbia (№020-2014/2 dated 25 August 2011) and adequate digital plans and maps.

Sometime later, or immediately upon arrival i.e. approval, the following documents were delivered: a document containing KfW's recommendations i.e. *Baseline Survey of Birds and Bats at a Wind Farm.docx*, together with the Conditions and Data for the Kostolac Wind Farm Construction Technical Documentation Development (№ 14207/1 dated 8 December 2014) and the Nature Conservation Conditions for the technical documentation development for the Kostolac Wind Farm construction (№ 020-2775/2 dated 29 December 2014) of the Nature Protection Institute of Serbia.

Under the General Design, the planned Kostolac wind farm will consist of 20 wind turbines with individual capacity ranging from 2.5 to 3 MW. Wind turbine positions are grouped into four spatial units - locations named after the closest villages next to which they are positioned - Klenovnik, Petka, Cirikovac and Drmno (Figure 1).

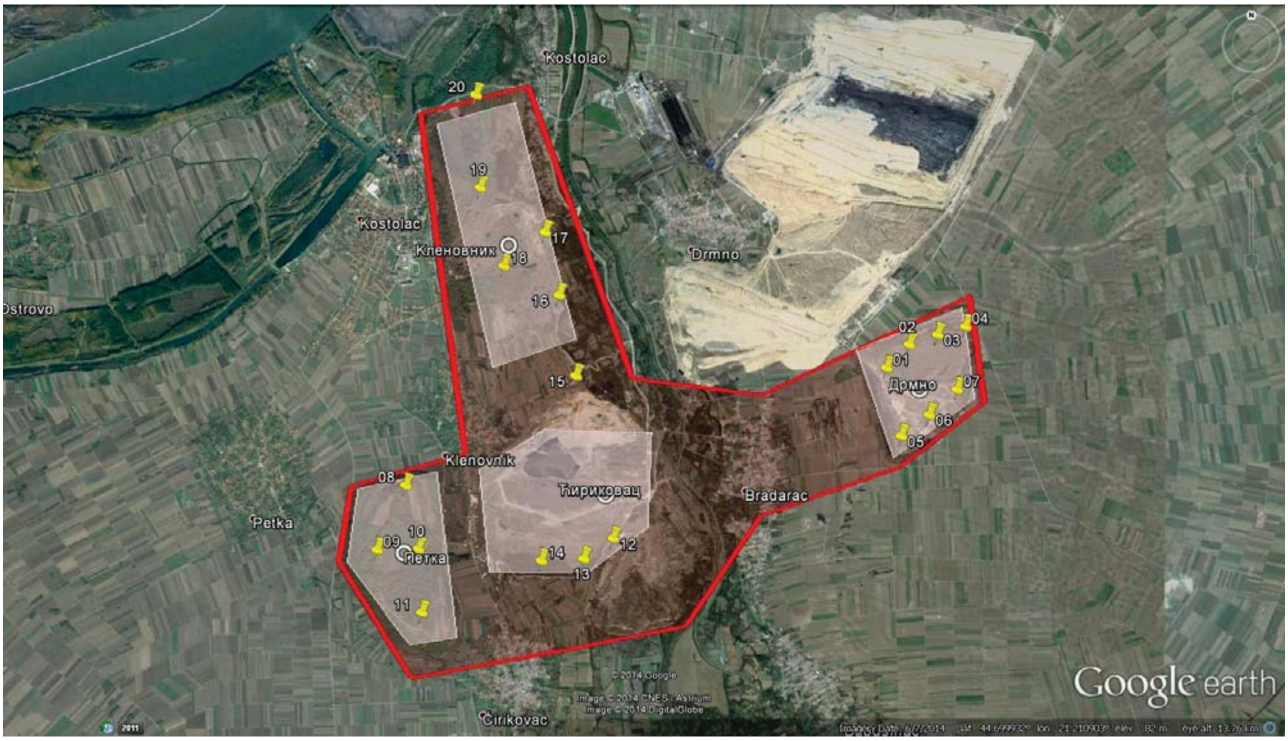

Figure 1. Kostolac wind farm layout containing the wind turbine position under the General Design, prior to the commencement of the survey. Source: JP EPS (General Design)

A specific quality of the planned Kostolac wind farm is that its locations, mostly reclaimed overburden dump sites, are fully covered by the scope of the Kostolac Coal Basin Spatial Plan of Special Purpose (Official Gazette RS, № 1/2013). The main objective of the Spatial Plan is "to ensure spatial conditions for sustainable spatial development of the planning area, rational exploitation of lignite, oil and gas deposits and other resources in the Kostolac Basin, as well as to neutralize or mitigate the negative development, environmental and socio-economic effects of this exploitation and processing of energy and other resources, as well as that "inside the area planned for electricity generation activities, wind energy utilization is (also) foreseen".

Conditions by JP Srbijasume (№ 14207/1 of 8 12 2014) stipulate that the location of the future Kostolac wind farm "is not inside the area managed by JP Srbijasume".

According to the Spatial Plan of the Republic of Serbia by 2020 (Official Gazette RS, № 88/2010), the area covered by the Kostolac Wind Farm General Design neither has protected natural areas nor areas proposed for protection, as well as elements of the ecological network of Serbia defined under the relevant Decree (Official Gazette RS, № 102/2010). Therefore, in this respect there are no legal implications nor restrictions for wind farm construction and operation, which is stated in the Nature Protection Conditions (№020-2775/2 dated 29 December 2014). The existence of protected areas and elements of the Serbian ecological network around the site have potential implications on this survey project and the construction and operation of the planned wind farm which will be examined in the next section of this study. This is also highlighted by the Nature Protection Conditions.

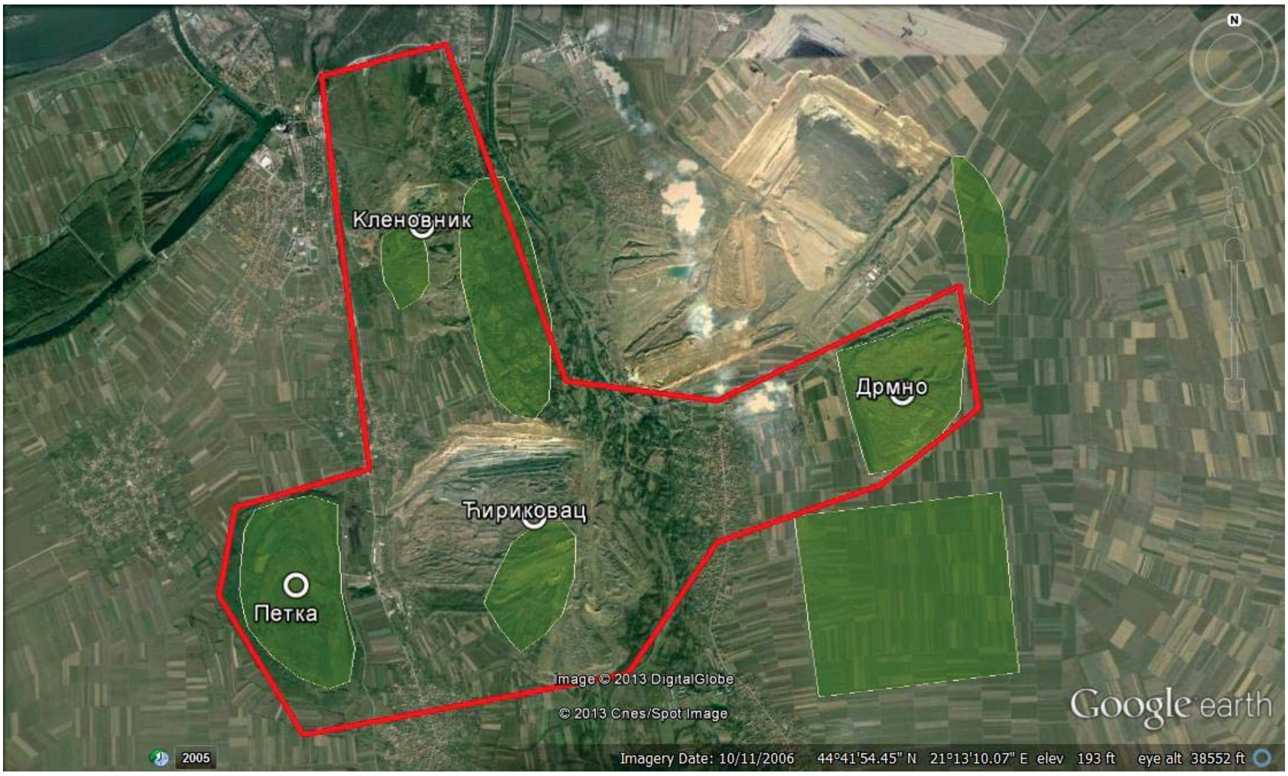

Figure 2. Potential wind farm development locations under the Nature Protection Institute of Serbia opinion (green areas). Source: JP EPS (General Design)

The opinion by the Nature Protection Institute of Serbia (№ 020-2014/2 dated 25 August 2011) specifies the zones which, "assuming that they are on agricultural land and that they do not contain isolated habitats of important protected species, are potential sites where wind farm development is possible" (green area in Figure 2); these zones largely overlap with wind farm locations according to the General Design (bright areas in Figure 1).

At the beginning of this survey, the Service Providers made a recommendation, accepted by EPS, to apply the ***preventive planning*** principle throughout the Kostolac Wind Farm Project, aimed at bats and birds protection. This principle involves early identification of potential conflicts between the construction and operation of the planned wind farm and conservation and survival of birds and bats and timely response to resolve these conflicts by optimizing the wind farm project. This approach makes it possible, with the least possible costs, to prevent or reduce to a minimum even during the design/planning phase significant negative impacts of wind farm construction and operation (Rodrigues et al. 2015). By applying the principles of preventive planning at the outset of this survey based on the findings and recommendations of the preliminary analysis carried out in the context of conflicts prepared as part of the Preliminary Report describing the conducted analysis of the existing documentation (Karapandza et al. 2014), wind farm plan has changed (Figure 3), i.e. positions of individual wind turbines were significantly altered (compare Figures 1 and 3, Figure 42), which will be further elaborated in subsequent sections of this study. For this reason, all survey aspects after the initial reconnaissance and preliminary analyses were planned and implemented based on the revised wind farm plan.

Figure 3. Kostolac wind farm plan containing wind turbine positions after the changes suggested at the beginning of this survey. Source: JP EPS.

Legal framework

Impact assessment of projects likely to have significant effects on the environment in Serbia is regulated by the Environmental Impact Assessment Law (Official Gazette of RS, № 135/2004) and its amendments (Official Gazette RS, № 36/2009b) detailed in a series of by-laws to the Law (Official Gazette of RS, № 69 2005a, b, c, g; 114/2008). Examination of bat impacts throughout the environmental impact assessment and strategic environmental impact assessment was elaborated in detail in the form of a separate document containing the methodological guidelines (Paunovic et al. 2011).

According to the Decree stipulating the List of Projects for which impact assessment is mandatory and the List of Projects for which an environmental impact assessment may be required (Official Gazette RS, № 114/2008), wind farm projects ("installations intended for harnessing of wind power to generate energy - wind farms) with a total output of over 10 MW" are on the List II - Projects for which an environmental impact assessment may be required. This was also indicated by the Nature Protection Institute of Serbia in its Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014) stipulating that EPS needs to apply to the competent ministry with the request to decide on the need to assess the environmental impact. Based on this and the technical characteristics of the planned wind farm (20 turbines with individual capacity 2.5-3 MW), as well as practices in similar projects, it is certain that for the Kostolac wind farm development, an environmental impact assessment will be required.

The Nature Protection Law (Official Gazette RS, № 36/2009 and 88/2010b) i.e. the resulting Regulation proclaiming and protecting strictly protected and protected wild species of plants, animals and fungi with Annexes containing the lists of species forming an integral part thereof (Official Gazette RS, № 5/2010), stipulates 308 species of birds in Serbia as protected or strictly protected species, while all species of bats have a strictly protected status (except species *Myotis alcathoe* and *Plecotus macrobullaris* whose presence in Serbia was identified after the Regulation was adopted). "The protection and preservation of wildlife means preventing any actions affecting the distortion of the favourable state of populations of wild species, destruction or damaging of their habitats, litters, nests or disruption of their life cycle, i.e. favourable state" (Article 71, paragraph 1 of the Nature Protection Law, Official Gazette RS, №36/2009).

Furthermore, under the Game and Hunting Law (Official Gazette RS, № 18/2010), i.e. the resulting Regulation proclaiming a closed hunting season for the protected species of wild animals (Official Gazette RS, № 9/2012), 23 species of birds are classified into the game species whose hunting is permitted within in a given period, while 10 species are classified as the permanently protected game.

Serbia has ratified and for the most part implemented all the conventions internationally regulating the protection of birds and bats, of which the most important are the Convention on the Conservation of European Wildlife and Natural Habitats, the so-called Berne Convention (Official Gazette RS, № 102/2007) and the Convention on the Conservation of Migratory Species of Wild Animals, the so-called Bonn Convention (Official Gazette RS, №102/2007b).

All European bat species are listed in Appendix II of the Bern Convention (strictly protected species), excluding species *Pipistrellus pipistrellus* which is in Appendix III (protected species), while the vast majority of bird species is covered by one of these two Appendices. Implementation mechanism of the Berne Convention in Serbia is the Nature Protection Law, or the above Regulation (Official Gazette RS, № 5/2010), so that all species of birds and bats covered by this Convention have an adequate legal protection status in Serbia. Within the framework of the Bonn Convention, 176 protected bird species are recorded in Serbia, of which 16 are on the Appendix I list (endangered species), while others are on the Appendix II list (species with an unfavourable conservation status) as well as all European bat populations. The Bonn Convention has special implementation instruments in the form of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) i.e. the Agreement on the Conservation of Populations of European Bats (EUROBATS), undergoing ratification in Serbia during the period of this Study (EUROBATS 2015a).

Protection of birds in the European Union is regulated by a separate directive for the European Union birds (Official Journal of the European Union [09/147/EC]). Implementation mechanism of the Berne Convention for other species in the European Union is the Directive on the conservation of natural habitats and wild fauna and flora, the so-called European Directive on Habitats and Species (Official Journal of the European Union [92/43/EEC]) while all species of bats are listed in Appendix IV (species requiring strict protection) of this directive. Moreover, 13 species, all of which are recorded and in Serbia, are listed in Appendix II (species whose conservation requires the designation of special areas of conservation and preservation).

The impact of wind farm projects on birds and bats has been recognized by a number of relevant international organizations and agreements, which have in recent years produced several documents providing instructions and guidance related to this issue. The most important and most relevant of these documents for Serbia and Europe are the guidelines of the European Commission (European Commission 2010) covering birds and bats, the report by the European Council and the Berne Convention (Langston and Pullan 2003, Gove et al. 2013) for birds, and EUROBATS guidelines for bats (Rodrigues et al. 2008), whose revised version was adopted during the course of this survey (Rodrigues et al. 2015). Guidelines and standards relating to the impact assessment of wind farms on bats, are provided in a separate section of the national guidelines (Paunovic et al. 2011).

Following the generally recognized adverse impacts of wind farms on birds and bats, national and international legal obligations governing the protection of species, technical and spatial characteristics of the planned wind farm, as well as the current procedural practices in similar projects, it is certain that the birds and bats survey will be required as an integral part of the environmental impact assessment for the Kostolac Wind Farm Construction Project.

Monitoring of fauna in a certain area is the basic approach employed for inventorying, determining the structure of biological communities, habitat preferences of individual species and their groups, as well as for identification of their population and conservation status. For an environmental impact assessment study examining the impact of construction and operation of various projects, monitoring of at least one calendar year ensures the consideration of seasonal dynamics and spatial and migratory characteristics of the fauna elements. This is of particular importance when potential impact of wind farms on flying vertebrates - birds and bats needs to be explored. Such monitoring allows us to identify the extent of the wind farm construction and operation impact on the type and populations of birds and bats present at the site, as well as to precisely and comprehensively formulate measures to be implemented in order to prevent, reduce or eliminate adverse impacts. This is explicitly noted by the Nature Protection Institute of Serbia in its Nature Protection Conditions (020-2775/2 dated 29 December 2014), stipulating at the same time methodological requirements for conducting a one-year survey of birds and bats inside the area covered by the wind turbines impacts, fully implemented by this survey, and in some respects exceeded (this will be elaborated in detail in sections of the study relating to the methodology).

For all these reasons, EPS decision to conduct a one-year survey of birds and bats for the Kostolac Wind Farm Construction Project is a legal and professional/scientifically feasible and informed decision.

Figure 4. Common kestrel *Falco tinnunculus* on a meteorological tower at the Petka location. Photo: Milan Paunovic, original.

Relevant prior knowledge of the birds and bats fauna

Concrete information about birds were not found in the relevant scientific and professional publications relating to the narrow zone of the studied area, i.e. the planned wind farm location, while for the wider area of Kostolac, section of the Danube from the confluence of the Velika Morava until Ram, as well as the complementary parts of southern Banat, there are only a few literature units and data.

Literature data of the regional and wider coverage are useful for understanding the ornithological importance of the studied area in comparison with the data in the wider surroundings, as well as to pay special attention to phenomena recorded on other comparable sites outside the area of research. In this respect, Puzovic's papers are useful (2007, 2008), brining examples of bird nesting on high voltage transmission lines in Serbia, since the studied area contains a number of different types of transmission lines, which are potential nest carriers. One of the few papers that may be useful for the study area due to its ecological specificity, provides information about birds on similar ash landfills of the Nikola Tesla thermal power plants near Obrenovac (Puzovic et al. 2008). The Birds of Prey Atlas (Puzovic *ur*. 2000) informs us about the wealth and biology species of this group in the broader study area. The monograph by Puzovic et al. (2009) allows the positioning and understanding of the study area compared to the internationally important and protected areas for birds in Serbia (IBA - Important Bird Areas). A paper by Vasic (1995) allows consideration of the former state of the fauna of Serbia (and Montenegro). Papers such as Puzovic et al. (1999, 2006b), Tucakov et al. (2005, 2009), and Tucakov Vucanovic (2008), Vucanovic et al. (2010), Sciban et al. (2012) facilitated recognition of the status of some important species in the wider and immediate surroundings of the location.

The relevant scientific and professional publications do not include any specific data about the bats relating to the location of the planned wind farm. Such data were also not found for the wider environment. The exception is the *Deliblatska Pescara* for which bat data exist in the two published papers (Ham et al. 1980, 1983), listing 5 species (*Rhinolophus Ferrumequinum*, *Myotis emarginatus*, *Myotis nattereri*, *Plecotus austriacus* and *Plecotus auritus*). However, such data may not be considered relevant for this survey project because of the environmental and geographical specificities and the distance of this site.

Serbia has so far established the presence of 30 bat species, with 3 more species considered to be potentially present (Paunovic et al., 2011, Budinski et al., *accepted*). Of this number, inside the Stig and Branicevo regions, where the location is situated, only 8 species were identified (*Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Rhinolophus euryale*, *Myotis emarginatus*, *Myotis myotis*, *Myotis blythii* (=*oxygnathus*), *Pipistrellus Pipistrellus* and *Miniopterus schreibersii*), making this region among the poorest in Serbia (Paunovic et al. 2004). However, this number is actually a reflection of the lack of research in this region, not a real indicator of the state of the bat fauna diversity (Paunovic et al. 2004). Therefore, the presence of representatives of almost all bat fauna species of Serbia may be expected at the location.

DESCRIPTION OF THE INVESTIGATED LOCATION AND ITS SURROUNDINGS

Locations of the planned Kostolac wind farm are on the territory of Pozarevac in the Branicevo district, between the urban settlements of Kostolac and Pozarevac and east of them (Figure 5).

Figure 5. Position of the planned Kostolac wind farm inside a wider area.
Source: Google Earth 2012 with modification, Branko Karapandza, original.

All four wind farm locations (Figures 1 and 3) are largely reclaimed overburden dumps of the Kostolac Coal Basin surrounded by mainly agricultural land, mining operations and thermal power plants, as well as by the number of settlements (Official Gazette RS, № 1/2013).

Figure 6. View from the Sopotska Greda at the Kostolac location to the rolling anthropogenic relief of the closed open cast mine Klenovnik and Pomoravlje lowlands. Photo: Marko Rakovic, original.

Locations of the future wind farm, with a range of altitudes generally from about 100 to 135 m (in some places even more, with the highest elevation at 174 m) dominate the surrounding lowlands of Pomoravlje and Stig (Figure 6) - alluvial plains of Velika Morava and Mlava, whose elevation generally ranges from 75 to 80 m (Kuzman et al. 2009). The natural boundary between these two plains, and their watersheds, is the Sopotska (Pozarevacka) Greda (Kuzman et al., 2009, Figure 20), where Cirikovac and Klenovnik locations are situated (Figures 5 and 20). Drmno location is situated east in the Stiska Plain, while the Petka is in the west, inside the Pomoravlje region; however, both locations are in the immediate vicinity of the Sopotska Greda (some 3 and 1.5 km, respectively - Figure 5). In relation to the surrounding plains, wind turbine locations, in addition to higher elevations, are characterized by a distinct rolling relief, mainly resulting from anthropogenic activities (ore mining and overburden dumping, Figure 6).

In biogeographical terms, the location is in the province of Moesia, and it is characterized by original forest vegetation and biomes of mainly southern European and sub-Mediterranean deciduous forests (Matveyev and Puncer 1989). However, due to the presence of numerous watercourses and standing waters, it also contains the vegetation of aquatic and wetland habitats (Figure 7). Nevertheless, in the major part of the province of Moesia, especially in its Peripannonian part, where the location is situated, the original vegetation and indigenous ecosystems were highly reduced, fragmented and transformed due to the centuries-long anthropogenic activities, mainly into agrobiocenoses, while these processes are still ongoing (Matveyev and Puncer 1989; Stevanovic and Stevanovic 1995; Stevanovic and Vasic 1995). This typical situation dominated by agrobiocenoses is characteristic for the most part of the immediate wind farm location surroundings (Figure 6).

Figure 7. Elements of preserved indigenous forests, wetlands and aquatic habitats in the vicinity of the location prevalent only in the zone of the Mlava and Mogila rivers. Photo: Marko Rakovic, original.

Figure 8. Locations characterized by ruderal vegetation in various stages of succession, while woody and shrub vegetation is present mainly in the form of small shrubs, bushes and single trees - view towards the vantage point VP5 - Drmno location. Photo: Milan Paunovic, original.

Locations themselves have very poor indigenous forest vegetation and aquatic and wetland habitats, although their fragments and elements still exist here, but they are dominated by a very specific set of ruderal plant communities in different stages of succession (from rare herbaceous vegetation to shrubs and bushes, Figure 8) and to a lesser extent, relatively young anthropogenic forest plantations (mainly resulting from re-cultivation activities), while agrocoenoses are only present in fragments (Figure 9).

Figure 9. Young anthropogenic forest plantings and agrocoenoses are most common at the Petka site. Photo: Milan Paunovic, original.

Figure 10. Mines and thermal power plants dominate the landscape – Kostolac thermal power plant and Drmno open cast mine. Photo: Milan Paunovic, original.

The climate is moderate continental, with the notable central European and Mediterranean influences (Matveyev and Puncer 1989; Stevanovic, and Stevanovic 1995).

Anthropogenic activities are frequent in the vicinity of locations, while the locations themselves are largely the product of anthropogenic activities. Immediately next to the locations' borders there are numerous settlements - the town of Kostolac and villages (Stari) Kostolac, Drmno, Bradarac, Maljurevac, Cirikovac, Petka and Klenovnik (Figures 5 and 24), as well as complexes of administrative and/or industrial facilities of the Kostolac mines and thermal power plants. Dominant activities are agriculture (Figure 6) and, specifically, mining and energy (Figure 10), resulting is highly developed infrastructure. Location and its surroundings are traversed by a dense network of high-voltage transmission lines (Figure 11). Between Petka and Cirikovac locations, next to the Klenovnik location, passes the state road of the IIA order Pozarevac-Kostolac (159), while next to the Drmno location, the state road of the IIB order Ram-Klicevac-Bratinac (372) (Official Gazette RS, №105/2013 , 119/2013).

Figure 11. Several high-voltage transmission line intersect the location and its surroundings - one south of the Petka location. Photo: Ines Svenda, original.

Figure 12. At each location, there is one well-maintained gravel road - Cirikovac location. Photo: Milan Paunovic, original.

On the actual locations, there are only dirt roads, where as a rule at least one is well maintained crushed stone road (Figure 12) which passes across the location and comes out to some of the asphalt roads, while side roads are mostly earth and inadequately maintained roads. In some parts of the country roads there are illegal dumpsites, especially in the area around the settlements. Buildings on the locations are rare, while the closest ones are the administrative and industrial facilities of the Kostolac Mines and Thermal Power Plants (Figure 13). Settlements are located in the immediate vicinity (Figures 5 and 6).

Figure 13. Part of the Cirikovac open cast mine management complex buildings. Photo: Milan Paunovic, original.

Drmno location (Figures 8 and 14) is located south of the Drmno open cast mine, and east of the village of Bradarac. It covers an area of about 2.4 km^2. It is located on an outside dump, established in the form of benches, slopes and conical accumulations of different width and height. The thickness of the backfilled layer is about 50 m, while the highest terrain elevation is about 141 m above sea level (Figure 8). After overburden dumping was completed, the location was recultivated. There are no settlements in its immediate vicinity.

The nearest settlement is Bradarac, located about 1.2 km from the location boundary, which is about 1.4 km from the nearest wind turbine positions. The largest part is covered with ruderal grass vegetation, while the woody and shrub vegetation is present only in the form of small groves and shrubs, as well as individual trees and small groups (Figure 14), with only one more fragment in the central part. Dense woody-shrub vegetation (mostly shrubs and bushes), is prevalent only on the slopes and at the foot of the location. At the location and its immediate vicinity there no aquatic and wetland habitats or farmland. There are not many buildings at the location, but there are several hunting feeders and shooting stands in a rather dilapidated condition. North of the location, at a distance of 400-500 m from the border and about 700 m from the nearest wind turbine position, there is a complex of buildings of the Drmno mine management, which have a certain, but not high, cryptic potential for bats.

Of all of the locations, this one is characterized by the lowest, trophic and cryptic potential both for the birds and the bats.

Figure 14. Central plateau of the Drmno location - view from the vantage point VP5.
Photo: Milan Paunovic, original.

Cirikovac location (Figures 12 and 15) is located on the alluvial plain of the Mogila River and partly on the Sopotska Greda, west of the Mlava River, south of the Cirikovac mine, southeast of the Klenovnik village and northeast of the Cirikovac village. The location is part of the outside and inside overburden dump of the Cirikovac mine. It covers an area of about 1.7 km^2. The thickness of the backfilled layer is 10-40 m, while the terrain elevation ranges from 75 to 130 m above sea level.

In the immediate vicinity of the location border is the Klenovnik village; however, the positions of the closest wind turbines are some 1.4 km away, so that the wind turbine positions are closer to the Cirikovac village - the closest one at only 800 m. Major part of the location is overgrown with low shrubs and woody plants, mainly shrubs, bushes (Figure 12) and forests dominated by acacia and poplar, which is why the terrain is relatively vast and rugged, while along its peripheral parts there is rare agricultural land and grass vegetation (Figure 15). Large part of the location is occupied by the ash dump with a water surface whose edges and surroundings are waterlogged at the lowest elevations (Figure 15) - there are several bands of floating vegetation and marsh vegetation of cane type, with thick bushy vegetation in the outer zone, offering plenty cryptic conditions for numerous birds and other animals. On the southwest border of the location, at a distance 500-650 m from the nearest wind turbine position, there is a complex of buildings of the Cirikovac mine management (Figure 13) having a certain cryptic potential for bats and small singing birds, as well as individual trees inside the complex.

On the whole, this location has a moderate cryptic and trophic potential for birds, while bats have moderate trophic, and low cryptic potential, but the potential shelters are located in the immediate vicinity.

Figure 15. Ash landfill in central part of the Cirikovac location with wetland peripheral parts and surroundings - view from the vantage point VP1. Photo: Milan Paunovic, original.

Petka location (Figures 9 and 16) is located southeast of the village of the same name, southwest of the Klenovnik village and the Cirikovac mine and northwest of the Cirikovac village. It covers an area of about 2.64 km^2. The site is an overburden dump of the Cirikovac mine. The thickness of the backfilled layer is about 60 m, while the highest terrain elevation is about 136 m above sea level.

The nearest village is Klenovnik located along the location boundary; however, the nearest wind turbine position is located some 750 m. The village of Cirikovac is some 350 meters from the boundary and about 1.2 km from the nearest wind turbine, while Petka village is some 750 m from the location boundary, and about 1 km from the nearest wind turbine position. The location is a successful example of land reclamation and is characterized by relatively developed forest vegetation, and agricultural areas (Figure 9) - fields, meadows and alfalfa areas. At the foot of the location, in the direction of Cirikovac, there are artificial stands of black pine, while much of its foothill and slopes are covered with dense acacia and poplar forest. Major part of the location plateau is covered with woody vegetation dominated by acacia and poplar, but mostly of dense shrub or thicket type (Figure 16), or young plantations (Figure 9). On the location and in its immediate vicinity there are no aquatic and wetland habitats. In the eastern part of the location there is a landfill. The location has no buildings, just several game feeders and hunting stands. In its immediate vicinity there are few individual structures (e.g. as part of the nursery along the eastern location border), while at a distance of 500 m are the nearest buildings of the Klenovnik and Cirikovac villages, as well as the complex of buildings of the Cirikovac mine management (Figure 13).

This location has a relatively high trophic and cryptic potential for birds, while it has high trophic or low cryptic potential for bats.

Figure 15. Ash landfill in the central part of the Cirikovac location with wetland boundary parts and surroundings - view from the vantage point VP1. Photo: Milan Paunovic, original.

Klenovnik location (Figures 6, 17, 20 and 24) is the only one whose major part is actually the natural terrain, or the Sopotska Greda (Figure 20) in the western part bordering with the closed open cast mine Klenovnik (Figures 6 and 17), and in the far south with the closed open cast mine Cirikovac (Figure 15). It covers an area of about 3.3 km^2. The terrain is extremely undulated with its peak around 174 m above sea level.

At the location boundary is the Stari Kostolac village, from which the closest wind turbine positions are some 500 m away, as well as from the Kostolac village (Figure 24), which is only 200 m away from the boundary. The Klenovnik village is situated some 400 m from the location boundary, or about 1.1 km from the nearest wind turbine position. The location is covered with grass, shrub and woody vegetation (Figures 6, 17 and 20), while in some parts, especially in the west in the dumped overburden pockets, a system of a large number of small and a few larger standing waters with an entire complex of aquatic, pond, riparian and wetland habitats was formed in the area of almost 1 km^2 (Figure 17). In the immediate vicinity of the location at a distance of 0.5 to 2 km there are complexes of aquatic and wetland habitats of the Mlava, Danube and Dunavac rivers. Although the area of the eastern Sopotska Greda slopes in this zone has under the Spatial Plan (Official Gazette RS, № 1/2013) been categorized as a forest, here, except in a narrow strip along the Mlava river, there is no forest, but fragments of shrubs and bushes with very rare individual trees. There are also several loess cuts having the cryptic potential for some bird species, mostly at the edge of the said depression with wetlands (Figure 17), as well as landslides preventing them from nesting in these places in the south of the location. Along the north-western and north-eastern location boundary there are waste landfills. At the location there are 3 types of farm buildings and a cottage with low cryptic potential for bats. The northern part of the location is traversed by the coal conveyor with functional lighting.

Some parts of this location have a very high cryptic and trophic potential for birds, with a high trophic and low cryptic potential for bats.

Figure 17. Aquatic and wetland habitats are highly frequent on the Klenovnik location as well as loess cuts. Photo: Milan Paunovic, original.

As already pointed out, the wind farm location does not contain any protected natural areas nor areas proposed for protection (Official Gazette RS, № 88/2010), as well as the ecological network of Serbia elements (Official Gazette RS, № 102/2010).

Figure 18. View to the Labudovo Okno from the Ram Fortress. Photo: Ines Svenda, original

However, in the immediate vicinity of the location, at a distance of only 1.5 km north-east from the location, there is Labudovo Okno (Figures 5 and 18) - a complex of riparian and aquatic habitats of the Danube in the Deliblatska Pescara area. The largest part of this complex, i.e. the riparian area of Banat and the Danube between Dubovac and Stara Palanka, Dubovac Marsh, Ada Zilovo and Cibuklija and the mouth of the Karas River, is covered by the Deliblatska Pescara Special Nature Reserve (SNR) (Official Gazette RS, Nos. 3/02, 81/08). The broader area including the entire course of the Danube from the mouth of the Nera and the Romanian border to the mouth of the Mlava, including the area around the mouth of the Nera, Zavojska Ada, as well as a narrow riparian strip on the right side of the Danube (Puzovic et al. 2006a), also has the status of an area protected by the Convention on Wetlands of International Importance especially as the waterfowl habitat (Official Gazette SFRY, № 9/1977), the so-called Ramsar site (national code 3RS005, № 1655). This area is the most important nesting, wintering and migratory stop of birds living in aquatic and wetland habitats of Serbia (Puzovic et al., 2006a, 2009) and as such it has the status of an internationally and nationally important bird area (*IBA - Important Bird Area*) with IBA code RS016IBA and it is part of the ecological network of Serbia (Official Gazette RS, № 102/2010). With even a longer section of the Danube and a wider riparian area on both sides of this area, the so-called Lower Danube area is envisaged for protection under the current Regional Plan of the Republic of Serbia by 2020 (Official Gazette RS, № 88/2010). Furthermore, this area in the neighbouring Romania is connected to the *Porțile de Fier* National Park.

Southwestern boundaries of the Deliblatska Pescara SNR is about 4 km from the location, while the Deliblatska Pescara itself is on the other side of the Danube at some 7 km (Figure 5). This space has been placed "under protection ... as the largest European area built from the layers of Aeolian sand with distinct forms of relief and characteristic sand, steppe and forest ecosystems, with unique mosaic of communities and specific and typical representatives of flora and fauna. Many of them are natural rarities ... (strictly protected and protected species) ... significant according to international criteria ..." (Official Gazette RS, Nos. 3/02, 81/08). Deliblatska Pescara also has an IBA status, with RS015IBA code (Official Gazette RS, № 102/2010). With 180 recorded bird species (Puzovic et al. 2009), and 21 species of bats (authors' data), it is one of the most important centres of bird and bat fauna diversity in Serbia (Paunovic et al. 2004). However, given that the location is separated by a wide zone of the Danube valley and habitats highly altered by intensive anthropogenic activities, the potential impact of the proximity of the Deliblatska Pescara on the state of bat fauna at the location is negligible.

Also in the immediate vicinity of the location, at a distance of about 1.5 km north of the location is the Danube River, and some 7 km west the Velika Morava River (Figure 5). Velika Morava river valley and, in particular, the Danube valley are very important European migration corridors of birds and bats during the spring and autumn. For this reason, its watercourse and riparian area are protected by law as ecological corridors of international importance, forming a part of the ecological network of Serbia (Official Gazette RS № 102/2010).

Directly along the boundary and partly inside the location stretch the river valleys of Mlava and Mogila (Figure 5), characterized by the few remaining relatively preserved aquatic, humid and indigenous forest habitats (Figures 7 and 19) along the boundary area.

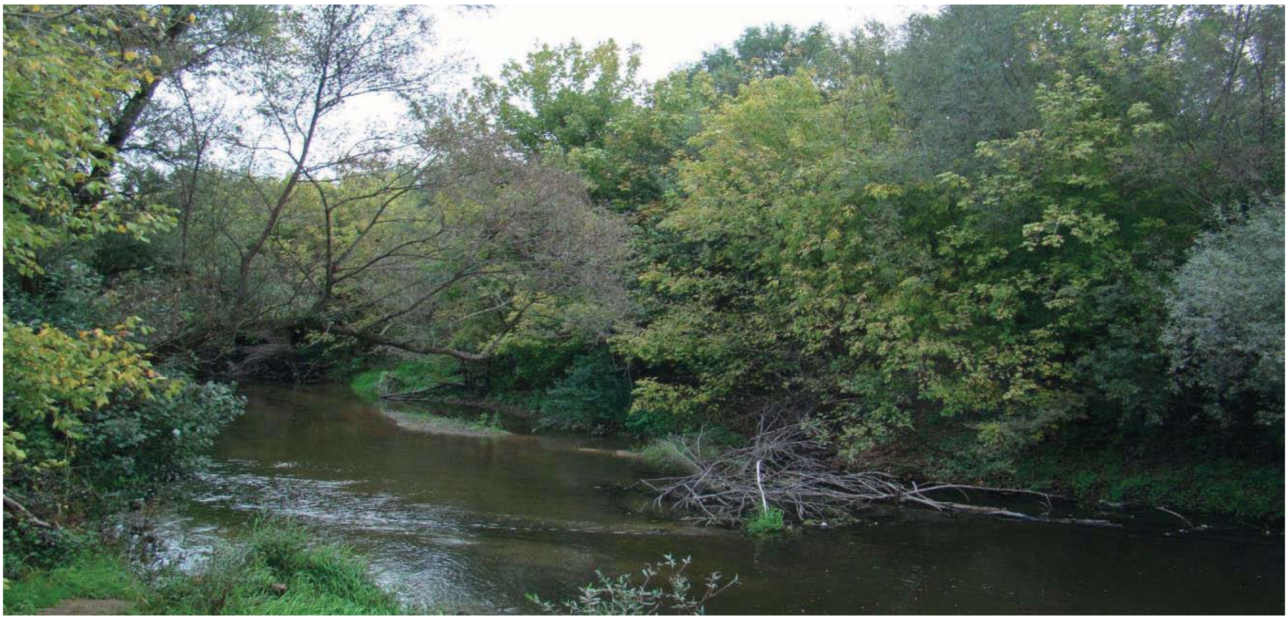

Figure 19. Mlava River in the immediate vicinity of the location. Photo: Branko Karapandza, original.

MATERIAL AND METHODS

Methodological assumptions of the birds and bats survey were conceived on the basis of the Terms of Reference forming an integral part of the Tender Documentation for the public procurement (Public Enterprise Electric Power Industry of Serbia 2014) , becoming an integral part of the Contract (№ 2189/21-14, dated 30 October 2014) signed between the survey service providers and JP EPS.

Survey of bird fauna and analysis of the potential wind turbine impact largely follow the relevant guidelines (European Commission, 2010, Langston and Pullan 2003; Gove et al. 2013; Scottish Natural heritage 2014), taking into account the specificities of the regional bird fauna (Paunovic et al., 1995, Vasic 1995 Puzovic et al., 1999; Puzovic ed., 2000; Puzovic et al., 2006b, 2009; Tucakov et al. 2005, 2009, and Tucakov Vucanovic 2008, Vucanovic et al. 2010, Sciban et al. 2012) and the specific characteristics of the location (Puzovic et al., 2008, Puzovic 2007, 2008). The concept of bats survey and the methods applied, analysis of results and proposals of measures to prevent and reduce the harmful effects, largely follow the appropriate standard instructions and recommendations (Mitchell-Jones 2004, Mitchell-Jones and Carlin 2009, Limpens 2010, Hundt 2012, Rodrigues et al. 2008, 2015) and national methodological guidelines (Paunovic et al. 2011), taking into account the specificities of the wind farm project, the regional specificity of the bat fauna (Paunovic et al. 2004, 2011; Karapandza and Paunovic 2010) and the specifics of the investigated location.

Thus conceived, birds and bats surveys fully comply with (and in some respects exceed, which will be further elaborated later) the methodological requirements set by the Nature Conservation Institute of Serbia under its Nature Protection Conditions for the development of the technical documentation for the Kostolac wind farm construction (№ 020-2775/2 dated 29 December 2014).

Methodology of this study largely satisfies, in some respects even exceeds, KfW recommendations for the birds and bats survey of the Kostolac Wind Farm Construction Project (*Baseline Survey of Birds and Bats at a Farm.docx Wind*). Any discrepancies are explained in detail and clarified in memos and Reports approved by EPS "without any objections" (№ 2189/27-14 of 19 11. 2014, № 1331/1-15 23.2. 2015 and № 1331/3-15 of 18. 5. 2015), and will be further elaborated here.

This survey was conducted by the Fauna C & M team from Novi Banovci. Data collection was done by a team consisting of Milan Paunovic, M.Sc., ecologist/chiropterologist/ ornithologist - a professional project manager, Branko Karapandza, chiropterologist-technical project manager, Marko Rakovic, M.Sc., ornithologist - associate, Vukasin Josipovic, chiropterologist- associate, and Ines Svenda mapping/documentation officer - specialist. Data processing, analysis and synthesis presented in this study and in phase reports, as well as the methodological setting of the survey was carried out by Branko Karapandza and Milan Paunovic, M.Sc., based on the data collected by field and literature research, but also on the basis of experience in birds and bats fauna research for the needs of wind farm projects and knowledge of the situation in the studied area and its surroundings.

All investigations were carried out by using equipment, materials and software owned by the Fauna C & M or the team members.

This survey consisted of two main groups of activities: **fieldwork** and **cabinet work**. **Fieldwork** involved terrain reconnaissance, identification of itineraries, transects and census points, biotope state identification, field studies of birds and bats, as well as photographic documentation of habitats and species representatives. **Cabinet work** consisted of research and study of the relevant literature, documents and legal regulations, survey methodology identification, database creation and updates, computer analysis of recorded ultrasonic bat signals, photographic documentation organization, analysis of data and reporting.

The survey results are, primarily, scientific and technical data about the ecology, bionomics and birds and bats fauna phenology inside the research area (the wind farm location and the control area). By applying appropriate methodologies, these surveys cover all relevant growth stages and the entire life cycle of all the present birds and bats fauna elements. These data provide a detailed insight into the daily and seasonal dynamics of birds and bats and their use of habitats, particularly important migratory corridors, flight corridors, (hunting) territory and nesting sites/shelters. Based on this - comprehensive - set of findings, it is possible to reliably determine the ecological functions and the importance of research areas for present birds and bats. Thus, these findings provide the reliable estimation (type and level of all potential) risks for each taxon and a reliable assessment of the wind farm project impact on the present species of birds and bats which then allows the formulation of precise and detailed measures preventing and reducing any significant adverse impacts.

Under the Contract, survey results were submitted to the Investor in the form of quarterly summary reports. A comprehensive overview of the results is provided in the appendices of this Study, while their synthetic overview and analysis is presented in the Study.

Figure 20. Sopotska Greda ridge in the Klenovnik location zone. Photo: Marko Rajkovic, original.

Terrain reconnaissance and preliminary conflict analysis

The aim of terrain reconnaissance is to supplement the information about the investigated area available from the planning and design documentation, literature, topographic maps and satellite images (GoogleEarth). It is largely focused on the identification and assessment of habitats and structures for which there is a high probability that they are used by birds and/or bats. All this (analysis of satellite images and topographic maps supplemented by reconnaissance) provides a preliminary assessment of ecological functions of the investigated area for birds and bats, and identification of the present habitat elements potentially significant for birds and bats, which is referred to as the **preliminary environmental assessment**.

Based on the preliminary environmental assessment of the investigated areas, a detailed methodological research approach is developed, including the precise definition of positions: census points for birds survey, transects and census points for bat surveys, as well as the control (reference) area.

Preliminary environmental impact assessment, together with the technical design characteristics, facilitates a **preliminary conflict analysis** - on the basis of the identified and assessed potential project impacts on birds and bats, their activity and habitats, in particular identifying potentially high-risk zones at the location. Early identification of these conflicts ensures a timely response by applying the **preventive planning principle** in order to protect bats and birds. This is considered the most effective way to reduce negative impacts of construction and operation of wind turbines even during the design/planning phase (Rodrigues et al. 2015). EPS accepted and conducted the preventive planning principle from the start of this survey upon the recommendation of the Service Provider.

Reconnaissance started on 14 November 2014, by a preliminary visit of the wind farm location and its immediate surroundings. This visit covered all four locations of the planned Kostolac wind farm and all planned wind turbines positions, as well as all the landscape and habitats elements on the locations and in their vicinity potentially relevant for this survey. In particular, structures/elements in the field were recorded not present in the planning and design documentation and maps, or not presented accurately and/or adequately, potentially significant for the birds and/or bats fauna. Consequently, smaller and larger ponds, were recorded, together with the unclassified roads, farms and cottages, feeders and hunting stands, local municipal and other waste landfills - permanent and temporary. A preliminary review of the vegetation was also performed, as well the identification of potential habitats of birds and bats and their elements. In order to identify potential trophic resources of birds, traces of the birds of prey presence were recorded in particular small mammals, harvested fields, as well as alfalfa areas and meadows of a different type. Power lines were also recorded as potential nesting sites of some bird species.

Potential hunting territories of bats were also identified - zone where more pronounced concentration of insects – bat prey, as well as potential flight corridors - roads and other natural and anthropogenic linear landscape elements, and shelters - buildings and old trees. In addition, a preliminary identification of the present bird fauna was carried out, particularly stork nests on poles and houses. In addition to bird species during the surveys other types of animals were recorded whose presence could have an effect on birds, their retention, nutrition and safety, or at least one phase of their life cycle. Findings of this research, i.e. preliminary environmental assessment and preliminary conflict analysis, as well as their conclusions, were presented to the Investor in detail in the form of a preliminary report (Karapandza et al. 2014). The summary of these conclusions is presented under the section of this study entitled *Description of the Investigated Location and its Surroundings*.

In agreement with the Investor, reconnaissance was continued on 22 November 2014 with a detailed tour of the location and mapping of habitats at the Petka location to find a solution for the conflicts identified during the preliminary conflict analysis. On the same day, wider area of the wind farm was also visited to discover an adequate control area, in accordance with the KfW recommendations. The Investor was notified in detail about the findings and conclusions of these investigations under separate documents attached to the First Quarterly Report, and will be elaborated in this Study.

Figure 21. 14 November 2014 reconnaissance at the Drmno location. Photo: Milan Paunovic, original.

Defining of the control (reference) area

According to the KfW recommendations for birds and bats survey for the wind farm development projects (*Baseline Survey of Birds and Bats at a Wind Farm.docx*):

"Data should be collected for the wider planned wind farm impact zone (about 6 km^2) and a comparable control area. In this way, the comparison of the survey data with the post-construction survey data may be calibrated in relation to the appropriate comparison for the control area, while the impact of the regional environmental conditions variations may be separated from the quantification of the established wind farm impacts.

Appropriate control area should:

- coincide with the planned wind farm location in terms of habitats and topography,
- have a similar set of species as the planned wind farm location,
- cover at least half of the area of the wind farm location,
- be located in an area with a similar set of habitats and a similar topography and exposure,
- be positioned as close to the wind farm location as possible, but far enough to ensure that the species from the control area are not exposed to the direct wind farm operation after commissioning, and it should have little or no localized movement of key species between these two areas."

During the site visit on 22 November 2014, the team visited and evaluated potential control areas previously identified based on the analysis of topographic maps and satellite images. Based on the above criteria and the identified characteristics of potential control areas, it was concluded that the only possible solution is the control area defined in Figure 21.

The control location is defined in accordance with the recommendations to the maximum possible extent allowed by the field situation – it ideally meets the first four criteria, while the correspondence is not ideal with respect to the fifth (last) point. The last criterion would ideally be satisfied if at least three of the previous ones were not satisfied.

Area of the control location is approximately 3 km^2, characterized by similar topography, exposure, and a set of habitats, and the expected birds and bats fauna, as the wind farm location. Topographical and environmental specificities of the wind farm location in relation to the entire surrounding area of Pomoravlje and Stig, resulting from the choice of the future wind farm location on the former overburden dumps of the Kostolac Basin and (and Sopotska Greda), drastically limited and conditioned the choice of the control location.

Wind farm location is characterised by higher elevations and a much more undulated relief compared to the surrounding alluvial plains. Similarly, the wind farm location has a very specific set of ruderal plant communities in different stages of succession and to a lesser extent, anthropogenic forest plantations, and only extremely fragmentary agrocoenoses, compared to agrocoenoses dominating the nearby area, with significant share of aquatic and wetland habitats, and, in a very small extent, climatogenic forest vegetation biome of sub-Mediterranean and southern European mostly deciduous forests. The only location largely coinciding with the wind turbine location according to its topographic and environmental characteristics (Figure 34) not intended for wind farm development has been chosen as the control location.

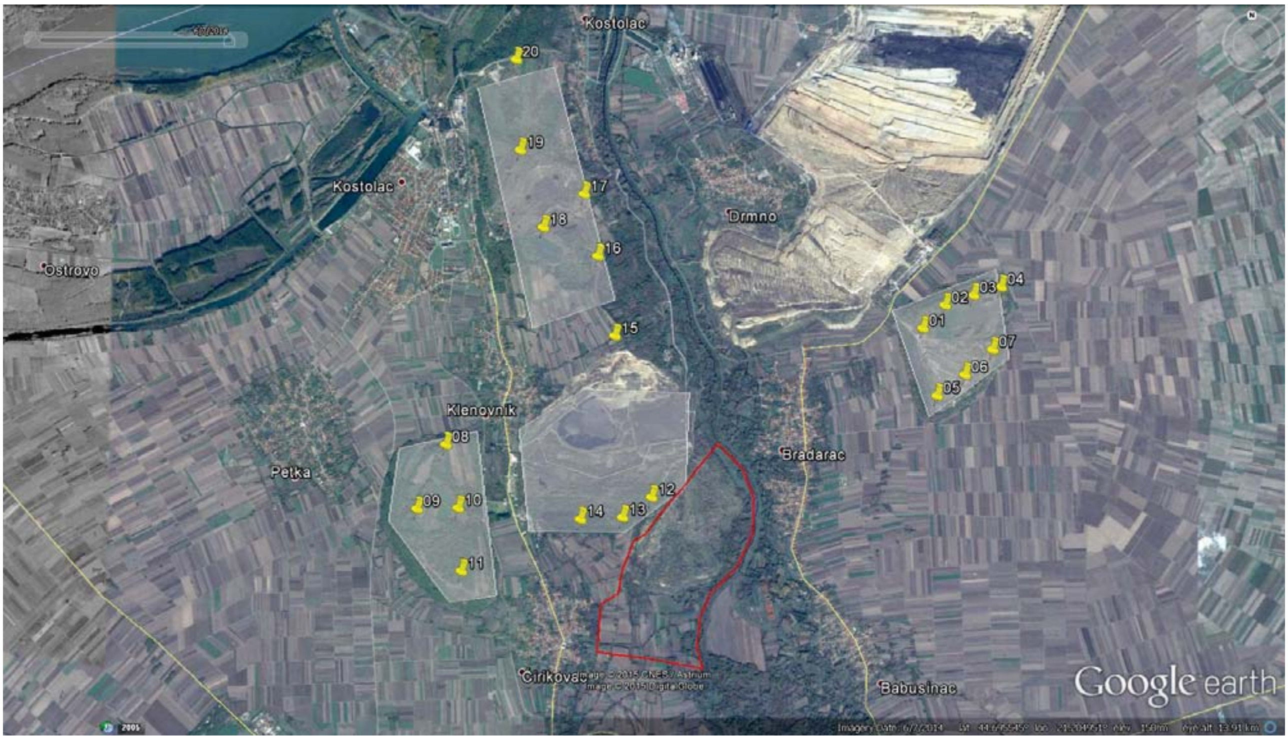

Figure 21. The control area (red) selected for birds and bats survey for the Kostolac Wind Farm Development Project (white, with wind turbines positions at the time of control area definition). Source: Google Earth 2014 with the modification, Branko Karapandza, original.

Although the selected control area is situated near the wind farm location, i.e. 2 out of 20 planned wind turbines, due to the specific terrain configuration (it is separated from the location by a high overburden ridge formed in between) it may be expected, though not entirely, that it will largely be isolated from the wind farm operation impact and that the movement of the target species between the wind farm location and the control area will be relatively small.

In view of the above, it may be safely concluded that except the selected control area none of the neighbouring areas coincide with the wind turbine location in terms of their topography, habitats and the expected fauna composition, i.e. these areas do not even come close when it comes to satisfying at least 3 of the 5 criteria set out in the recommendations, which makes them unacceptable for the control area. Accordingly, even if the selected control area does not fully satisfy the fifth point of the recommendations, it would still be the only option.

Birds' survey

Birds' survey commenced by analysing the satellite imagery (GoogleEarth), topographic maps and plans and through preliminary terrain reconnaissance, thus identifying potential ecological functions of the location's habitat and landscape elements essential for birds. This survey, i.e. field data collection, was conducted by employing two basic methods: **census in points** and **nesting investigation**. Standard ornithological equipment and material - high-quality binoculars and telescopes (Figure 23) were used for visual detection and identification of species and bird behaviour observation. Auto-recorders were used to record the collected field data.

Investigation area covered by this birds' survey was defined as **wind farm locations**, with an additional 500 m beyond their boundary and the **control area** (Figure 22).

The census was carried out on vantage points (VP) numbered from 1 to 7 (Figure 22, Table 1). VPs were defined to visually cover the entire future wind farm location and its immediate surroundings, as well as the control area outside the wind farm location, which is used to compare the data collected in the potential wind farm area, in accordance with the KfW recommendations. Care was taken to detect the influence of natural areas outside the future wind farm area from the selected VPs, estimated to be of potential importance to the structure and dynamics of the bird fauna in the area concerned. VP positions have been carefully selected to deliver maximum visual coverage with a minimum number of points. VPs 1 to 5 cover the potential wind farm location, while VPs 6 and 7 were used for surveys of the control area.

Figure 22. Layout of the birds' survey VPs in the studied area - inside the wind farm location (white translucent surfaces) and the control area (area limited by a red line). Source: Google Earth 2013 with the modification, Branko Karapandza, original.

To ensure approach efficiency, VPs were placed on easily accessible points, on or near the local or earth/dirt roads. Geographical coordinates of the individual vantage points are given in Table 1.

Table 1. Geographical coordinates of vantage points (geographic date WGS 84).

Vantage points (VP)	Name	North latitude	East longitude
1	Cirikovac	44.68381769	21.20850932
2	Petka	44.68030768	21.17156876
3	Klenovnik	44.70713622	21.19660023
4	Kostolac	44.71930096	21.18450883
5	Drmno	44.69913620	21.25408575
6	Kontrolna 1	44.68052578	21.20918599
7	Kontrolna 2	44.67276631	21.20359945

Census in points was conducted from dawn to dusk in conditions of good visibility. Every observation, i.e. investigation unit, lasted 1-2 hours on each VP during each investigation day. Two types of data were collected - the number of all species per investigation unit on each VP, and the number, duration, flight altitude and other relevant flight characteristics of the target (priority) species. The area was constantly visually scanned from VPs (Figure 23) to detect bird specimens, especially those belonging to the target species category. From the moment of detection, individual target species were visually monitored until the end of their flight or until they disappeared from the view.

Figure 23. Census in points – VP6 inside the control area. Photo: Branko Karapandza, original.

Recorded data on target species overflights include the date and time of observation, duration, type and direction of flight, distance from the vantage point and observation of behaviour. Overflight height of individual specimens, aggregation, or flocks of birds were especially evaluated, recorded and classified into 5 altitude zones (Table 2); minimum, maximum and average overflight height were assessed. Altitude zones were classified at the start of the survey, when the exact type of wind turbines was unknown. Later, for the purposes of this study, a critical zone was defined – altitude range inside which the movement of the wind turbine blades was foreseen, i.e. from 50 to 180 m from the base. In accordance with this, overflight at critical altitudes - critical overflights include overflights in high altitude zones 2, 3 and 4 (Table 2).

Table 2. Classification of bird overflight altitude zones.

Zone	1	2	3	4	5
Altitude range (m)	<50	50-100	100-150	150-200	>200
Critical zone (K)	X		K		X

Target (priority) **species** are defined as species with high conservation status, or as species that may be substantially affected by wind farm operation. Target species, according to these criteria were diurnal birds of prey *Falconiformes* which are normally considered to be vulnerable, as well as other larger birds and longer living birds such as storks and herons *Ciconiiformes*, cranes *Grus grus* and some waterfowl *Anseriformes*. Also, the target species may be the ones common and frequent in the studied area and its surroundings, under significant adverse impact of the planned wind farm.

Along with the survey of overflights and the presence of bird species and specimens, standard ornithological research on potential wind farm locations implies **nesting investigations**, certain or potential, i.e. detection of nests and nesting activity/behaviour. While researching bird nesting requires special attention to this aspect of their lives, based on their behaviour one may conclude if they are nesting, and in rare cases find a nest. Therefore, the most common nesting investigations are based on identifying the territory of couples or females by following the behaviour, primarily male singing and their territorial behaviour. Nesting investigations also involve searches of the thickets, bushes and small groups of trees and forest plantations, as well as meadows and rural fences.

Table 3 contains the fieldwork schedule by months, i.e. investigation days and number of field days.

Birds' survey was carried out during the total of 36 investigation days, with a total of 322 hours effectively spent on the census in points. Number of census hours by month was different depending on the length of daylight in certain periods of the year - whereby during December census was carried out for about 6 hours a day, throughout January, February, October and November for about 7, in March 8, in April 9, and in May, June, July, August and September for about 11 hours. During each working day census was carried out on all seven VPs.

Table 3. Schedule of field days per month and day, including the number of engagement days and hours (census in points and additional nesting investigations).

Month	Days	№ of days	№ of hours	
			census	nesting*
December	13, 14, 28.	3	19	
January	8, 16, 31.	3	21	
February	8, 15, 28.	3	21	
March	8, 15, 22.	3	25	8
April	5, 19, 27.	3	27	24
May	3, 20, 23.	3	33	24
June	6, 20, 21.	3	34	24
July	8, 18, 25.	3	34	24
August	9, 12, 26.	3	32	
September	6, 20, 27.	3	33	
October	4, 10, 31.	3	21	
November	1, 11, 21.	3	22	
Total engagement		36	322	104

* Nesting is investigated by hiring an additional researcher during the same days when the census in points is carried out, but also during the census when such working hours were not specially counted.

Nesting investigations were conducted during the nesting season, from late March to July, during the census in points and movement from one point to another, and additionally, in parallel during the same days when the census was conducted by hiring additional researchers. During March, April, May, June and July additional nesting investigations were conducted for about 8 hours per day, i.e. about 24 working hours per month, and 104 in total, and included the whole area of research.

Table 4. Number of observation/field days between December 2014 - October 2015 per vantage point and month.

Month	Bird investigation days							Total observations
	VP 1	VP 2	VP 3	VP 4	VP 5	VP 6	VP 7	
December	13, 14, 28.	13, 14, 28.	13, 14, 28.	13, 14, 28.	13, 14, 28.	13, 14, 28.	13, 14, 28.	21
January	8, 16, 31.	8, 16, 31.	8, 16, 31.	8, 16, 31.	8, 16, 31.	8, 16, 31.	8, 16, 31.	21
February	8, 15, 28.	8, 15, 28.	8, 15, 28.	8, 15, 28.	8, 15, 28.	8, 15, 28.	8, 15, 28.	21
March	8, 15, 22.	8, 15, 22.	8, 15, 22.	8, 15, 22.	8, 15, 22.	8, 15, 22.	8, 15, 22.	21
April	5, 19, 27.	5, 19, 27.	5, 19, 27.	5, 19, 27.	5, 19, 27.	5, 19, 27.	5, 19, 27.	21
May	3, 20, 23.	3, 20, 23.	3, 20, 23.	3, 20, 23.	3, 20, 23.	3, 20, 23.	3, 20, 23.	21
June	6, 20, 21.	6, 20, 21.	6, 20, 21.	6, 20, 21.	6, 20, 21.	6, 20, 21.	6, 20, 21.	21
July	8, 18, 25.	8, 18, 25.	8, 18, 25.	8, 18, 25.	8, 18, 25.	8, 18, 25.	8, 18, 25.	21
August	9, 12, 26.	9, 12, 26.	9, 12, 26.	9, 12, 26.	9, 12, 26.	9, 12, 26.	9, 12, 26.	21
September	6, 20, 27.	6, 20, 27.	6, 20, 27.	6, 20, 27.	6, 20, 27.	6, 20, 27.	6, 20, 27.	21
October	4, 10, 31.	4, 10, 31.	4, 10, 31.	4, 10, 31.	4, 10, 31.	4, 10, 31.	4, 10, 31.	21
November	1, 11, 21.	1, 11, 21.	1, 11, 21.	1, 11, 21.	1, 11, 21.	1, 11, 21.	1, 11, 21.	21
Total obser.	36	36	36	36	36	36	36	252

Table 4 shows the unit birds' observations by month and VP, as well as the total number of observations per month and vantage point. A total of 252 observations/field days are evenly distributed, both per VP and per month, only the duration of the individual observations was different depending on the time of year.

All collected data on target species overflights were detailed and mapped in the appendices to this study (Appendices 1 and 2), while the study section entitled *Results* provides an overview by type and VP, along with any other recorded species and nesting investigations results, particularly per overflight altitude.

Settings and implementation of this bird fauna survey, in terms of the field research methods applied are fully in line with and satisfy all relevant guidelines (European Commission 2010, Langston and Pullan 2003, Gove et al., 2013, Scottish Natural Heritage 2014) while in terms of time and detail of the data collected even exceed the requirements set by the Nature Protection Institute of Serbia under the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014).

Field methodology of this bird fauna survey largely meets the KfW recommendations ("*Baseline Survey of Birds and Bats at a Wind Farm.docx*"), while the only exception was **radar** use. In accordance with standard guidelines followed by the KfW recommendations (Langston and Pullan 2003, European Commission 2010, Gove at al. 2013, Scottish Natural Heritage 2014) the use of radar is only recommended as a complementary visual method and only in terms of long-term poor visibility and expected high nocturnal activity of important species. Given that no such weather conditions were expected, as well as such composition characteristics and activities of the bird fauna at the location, the use of a radar was not planned under the methodological assumptions of this survey, as it cannot be considered necessary. Furthermore, this method is extremely uneconomic – it is extremely costly compared to the very limited potential effects.

In terms of the bird fauna survey data processing and analysis, applied methodology fully complies with the most relevant guidelines (European Commission, 2010, Langston and Pullan 2003) and fully meets the requirements set by the Nature Protection Institute of Serbia under the Nature Protection Conditions (№020-2775/2 dated 29 December 2014). For the most part, KfW recommendations were also met, together with the guidelines of the Scottish Natural Heritage (2014), the exception being the use of a **model to calculate the collision risk** of the Scottish Natural Heritage (2000). The use of this or any other similar model was not foreseen, because this and similar models include numerous approximations and simplifications, as indicated by their authors (Scottish Natural Heritage 2000, 2014), and do not provide nearly as satisfying reliable prediction of the collision risk on the basis of survey data (e.g. Gove et al. 2013, American Wind Wildlife Institute 2015).

Bats' survey

Field surveys during this bats' survey employ three basic methods and techniques:

- Investigation of potential bat shelters
- Manual bat activity detection along transects
- Automatic bat activity detection

Throughout this survey, **bats were not be captured by using special nets** (*mist-nets*), as this method is not suitable for open habitats in which bats are flying relatively high (Paunovic et al. 2011) dominating the surveyed location. This method is usually applied in the surveys of this type, in accordance with the relevant recommendations (Rodrigues et al. 2008; Paunovic et al. 2011), only as a back-up method, in order to determine the reproductive and phenological status of individuals and to precisely identify the species that cannot be reliably distinguished by ultrasonic audio detection, and the presence of bats in potential, hard to reach or inaccessible, shelters, which was not necessary throughout the present survey activities.

Investigation area for the bats' survey was defined as **wind farm locations**, with an additional 200 m beyond their boundary and the **control area** (Figures 22 and 25).

Table 5 provides an overview of the field activities schedule carried out during bats' survey period.

Table 5. Overview of field activities and methods per month.
Numbers designate the number of field days

Activities/methods	Nov	Dec	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Working	
												days	hrs
Terrain reconnaissance	2											2	17
Shelter investigation*		1				1	1		1			4	87
Manual activity detection*			3**	4	4	4	4	4	4	4	4	32	251
Automatic activity detection			4**	4	4	4	4	4	4	4	4	32	341
Total working days	2	1	0	8	8	9	9	8	9	8	8	70	696

* Potential shelters were investigated during the special working days, as well as through manual detection of bat activity along transects when these working days were not included.

** Working days planned for manual and automatic activity detection in March (when they could not be implemented given that bat activity has not started at that time) were reassigned (with the Employer's approval under the *Second Quarterly Report describing Implemented Services* (1331/3-15)) to the coming months to include more extensive detection activities inside the control region within the remaining investigations period.

Detection of bat activity - manual and automatic, commenced in April, as previously there was no bat activity, and it was conducted until November. This survey element, therefore, covered the entire bat activity period at the location in 2015, and all phenological phases of their activities inside the studied area during one year. Under the previously planned schedule, plans were made to start this survey element in March when bat activity normally starts in Serbia after hibernation (Paunovic et al. 2004, 2011). However, in March long-lasting adverse weather conditions were recorded (low temperatures, especially intense rainfall during the night), which completely prevented bat activity in this period. For this reason, the start of detection activities had to be aligned with the field situation, i.e. it had to be postponed until appropriate weather conditions, i.e. until the commencement of bat activity in mid-April. The first field day of survey activities, 16 April, was the first day of the forecasted (and achieved) evening temperatures above 7°C, according to standard recommendations (Rodrigues et al. 2015).

Methodological settings of this bats' survey, both in terms of field investigation methods, and data processing and analysis, completely follow the relevant national (Paunovic et al. 2011) and international (Rodrigues et al. 2008, 2015) guidelines and fully comply with the Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014) and KfW recommendations. In terms of the schedule, i.e. intensity of investigations, the survey meets, and also exceeds the nature protection conditions and the KfW recommendations, which is necessary to meet more adequate, and higher international standards (Rodrigues et al. 2008, 2015) referred to by the KfW recommendations.

This bats' survey was fully realized by observing the best practice principles (Battersby *comp*. 2010).

Figure 24. Potential bat shelters, both in buildings and in trees, are much more numerous than in the vicinity of wind farm locations where cryptic conditions are poor - view from the Klenovnik location. Photo: Milan Paunovic, original.

Investigation of potential bat shelters

Identification and inspection of bat shelters according to the national (Paunovic et al., 2011) and international (Rodrigues et al. 2008) guidelines, as well as the KfW recommendations is a necessary survey method on locations designated for wind farm development.

In the complete absence of concrete data about bat shelters, this survey involved the necessary identification and evaluation of potential bat shelters inside the investigations area. During the preliminary environmental assessment, review of the submitted planning and design documentation, satellite images (GoogleEarth) and topographic maps with the terrain reconnaissance, at the actual wind farm location and its immediate vicinity, anthropogenic and natural structures were identified potentially suitable for bat shelters. Buildings potentially suitable for bat shelters have been identified at the wind farm location in very small numbers and almost exclusively at the Klenovnik location. They are more numerous in the immediate vicinity of the Cirikovac location - inside the zone of the Cirikovac mine management complex (Figure 13), while they are more frequent, and at other locations exclusively present only in areas around neighbouring villages. Furthermore, to an extremely small extent at the location and in a much higher number in the immediate area, zones showing potential for dendrophilous bat species shelters were identified, i.e. old deciduous trees with hollows and crevices used by these species as shelters.

The basic investigation method of potential bat shelters is a detailed visual inspection during the day (when bats reside in shelters), with the aim of finding evidence of their presence and evaluating potential shelters (Mitchell-Jones 2004; Paunovic et al. 2011; Hundt 2012) and should to be carried out for each of the potential shelters at least once in each season (Rodrigues et al. 2015).

If direct inspection of potential shelters is not possible (due to the inaccessibility of potentially suitable areas, for example, cracks, gaps, holes), or if a direct inspection may not definitely determine whether bats are present in a potential shelter or not, additional research needs to be conducted by applying appropriate methodologies. Appropriate methodologies for the study of potential bat shelters (Mitchell-Jones, 2004; Paunovic et al., 2011; Hundt 2012), especially in inaccessible or difficult to access structures, comprises visual detection of possible bat flights from/to potential shelters, by using hand-held lamps, in combination with audio-detection of ultrasonic signals by manual bat detectors. Investigation of bats flying out of potential shelters usually starts about 30 minutes before sunset and lasts up to 2 hours after sunset. Investigation of bats flying in/returning to their potential shelter is usually realized in the period between 2 hours before sunrise to 15 minutes after sunrise. It may be possibly extended after this to 10 minutes after the last recorded specimen.

Furthermore, shelters of some species may be identified based on the sounds coming from shelters, while some species exhibit a characteristic behaviour around shelters referred to as swarming. This an easily observable behaviour frequent during the breeding season (late summer, early autumn). For this reason, it should be given special attention throughout these periods.

Population polling may also be helpful in identifying potential shelters, especially major potential colonies.

Potential bat shelters identification and inspection activities were implemented during a total of 87 hours effectively, periodically during the same nights when transects were realised, but also additionally on: 2 November and 22 December 2014, when potential bat shelters were visually identified and directly inspected where possible, on 13 June, 16 July and 9 September 2015, when it was conducted by detecting flights to/from shelters, swarming and sounding. Consequently, this investigation included all growth stages of bat life cycle and the entire calendar year.

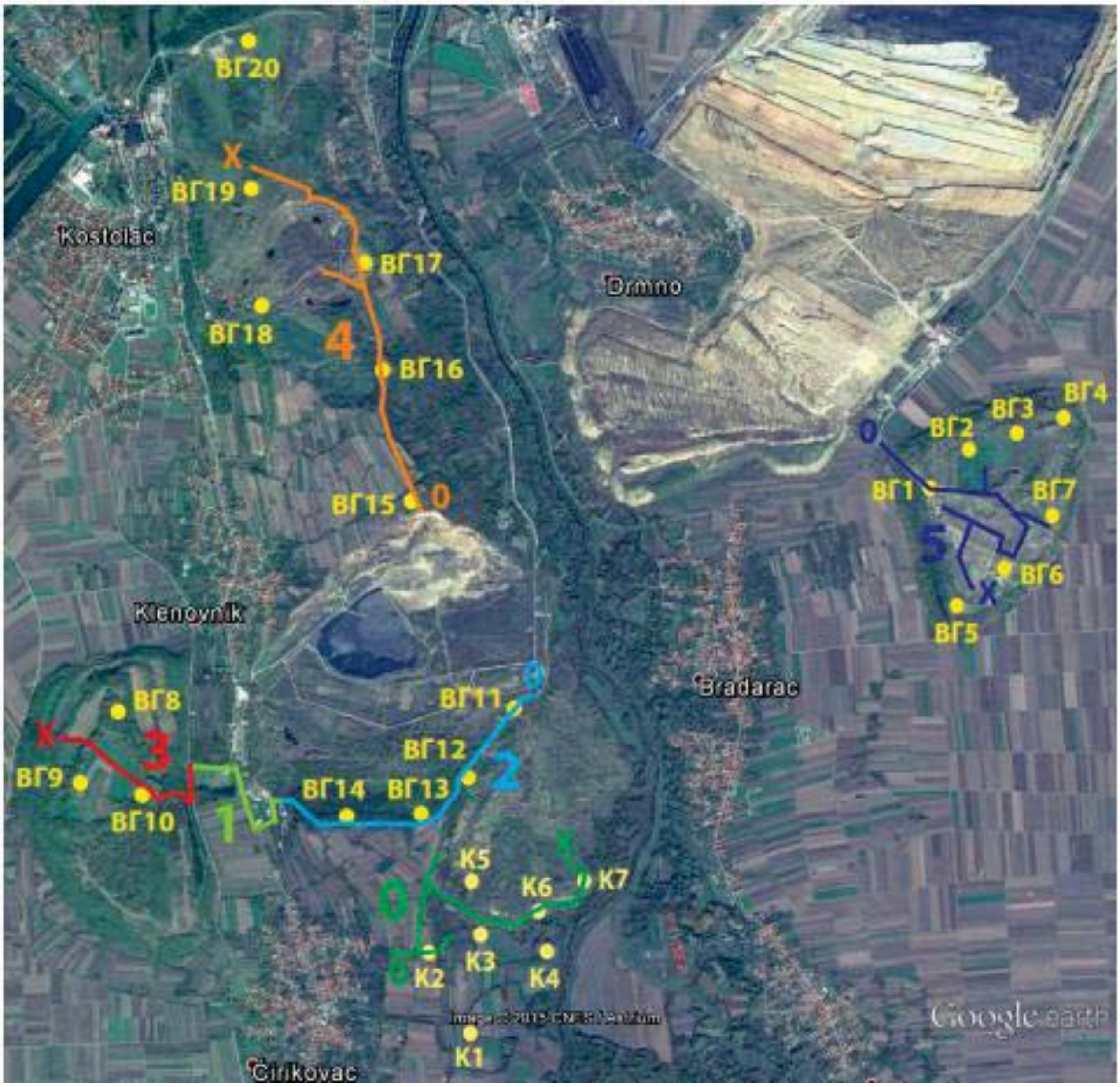

Figure 25. Transect positions (wind farm locations - 2, 3, 4 and 5, immediate surroundings - 1, control area - 0) and census points (on wind turbine positions VG01-VG20, control area - K1-K7) for bats' survey Source: Google Earth 2014 with the modification, Branko Karapandza, original.

Manual detection of bat activity on transects

Manual bat activity detection on transects is stipulated by national (Paunovic et al. 2011) and international (Rodrigues et al. 2008, 2015) guidelines and KfW recommendations, as a necessary survey method at the locations envisaged for wind farm development.

By studying the delivered planning and design documentation, satellite images (Google Earth 2013) and topographical maps and through preliminary field surveys, potential ecological functions of habitat elements and landscape for bats were identified at the future wind farm location, together with provisional transects. Forest and pond habitats were identified as potentially important hunting areas, especially on Petka and Klenovnik sites, and in the Mogila River zone inside the control area. At the actual wind farm location there are no significant natural linear landscape elements commonly used by bats as flight corridors. In the absence of these typical flight corridors, bats use roads and visible relief elements in areas and under environmental conditions such as the ones existing at the studied location (Paunovic et al. 2011).

Transects (lines marked with different colours and numbers from 0 to 5 on Figure 8), mostly along country roads are defined to cover and represent the location area both in spatial and environmental terms, especially their ecological elements potentially important for bats. One transect was defined on each of the four wind turbine locations (2, 3, 4 and 5), one in the vicinity of the location (1), and one in the control area (0).

The transects method is implemented in combination with the census method (census points) - transects are realised along the defined routes by walking at a steady pace of 2-2.5 km/h, with five-minute stops at the defined points uniformly distributed over the entire length of the transects.

Bat activity along transects is registered by auto-detection of their ultrasonic echolocation signals and by an ultrasonic bat detector *Pettersson D240x* (possessing *time expansion* and *heterodyne* systems) hand-held by the researcher, together with visual detection by means of hand-held reflector lamps. For each identified bat flight (contact), type, number of individuals, time, duration, location, habitat, and possibly flight direction and height is recorded, together with a note on bat behaviour. As one single overflight/contact, the entire bat activity was registered during which the bat definitely did not go outside the audio-visual zone of the researcher. This was done to allow the number of overflights/contacts to more realistically reflect the number of individuals present, at least in a short time interval (Limpens 2010). During each field investigation, the basic meteorological and environmental parameters were recorded.

Figure 26. Bat activity survey on transects through auto-detection by using ultrasound detectors held by the researcher, with visual detection by means of a hand-held reflector lamp – Drmno location. Photo: Ines Svenda, original.

Flight altitude of bats was not systematically recorded, as it was a reflection of the limited audio-visual field of the researcher holding an ultrasound detector, i.e. the specific quality of ultrasonic signals of certain species, not actual altitudes at which members of these species are flying (Rodrigues et al. 2008, 2015). For this reason, the recorded altitudes would not have been representative, and are therefore irrelevant for this study. It is thus considered that the altitude data collected during this survey, by visual observation along the transects, when possible wind farm impacts were analysed, may be used more correctly in combination with, for this purpose, relevant, information about the flight characteristics and altitude of concrete bat species collected through systematic investigations (Rodrigues et al. 2008, 2015).

In addition to on-site identification, in order to precisely identify the species, when necessary, registered ultrasonic signals of bats were recorded by a digital audio-recorder Zoom H2 and subsequently analysed on a computer by using a specialized software *BatSound* 4.03 (©*Pettersson Elektronik* AB), adequate literature (Russo and Jones, 2002; Pfalzer and Kusch, 2003; Obrist et al., 2004; Boonman et al., 2009; Limpens 2010) and a comparative collection of recordings owned by the authors.

Once a month, along each of the transects one working night was realized with three unit transects during the same night - one at twilight, one in the central part of the night and one at sunrise. The direction of transects changed between different periods and months. Unit transects at twilight lasted from sunset until the transect in one direction was completed. Unit transects in the central part of the night were realised more or less immediately after the transect at sunset was lasting until the transect in the opposite direction was completed.

Unit transects at sunrise started before the sunrise lasting for as much as it was needed to complete the transect before sunrise. Unit transects on shorter transects 1, 2 and 3 were realised consecutively during the same night, as it were the case of one longer transect comprising three segments.

Overview of the field investigations covering bat activities on transects is given in Table 6, presenting working nights, unit transects and the effective duration of transects per transect and month, while full details of the schedule are given under the review of the investigation results in the special appendix at the end this study (Appendix 3).

Table 6. Bat activity detection on transects by a hand-held detector.

Month	Transects (length in km)						№ of unit trans.	№ of working nights	Duration (hrs)
	0 (3.3)	1 (1.2)	2 (2.3)	3 (1.4)	4 (3.7)	5 (3.9)			
April	25/26.	16/17.	16/17.	16/17.	23/24.	30/1.	18	4	33.7
May	20/21.	9/10.	9/10.	9/10.	13/14.	23/24.	18	4	30.8
June	18/19.	17/18.	17/18.	17/18.	21/22.	22/23.	18	4	29.7
July	22/23.	8/9.	8/9.	8/9.	9/10.	23/24.	18	4	30.7
August	28/29	14/15.	14/15.	14/15.	5/6.	15/16.	18	4	30.5
September	19/20.	8/9.	8/9.	8/9.	3/4.	11/12.	18	4	32.0
October	21/22.	6/7.	6/7.	6/7.	3/4.	9/10.	18	4	31.4
November	12/13.	19/20.	19/20.	19/20.	11/12.	20/21.	18	4	32.3
№ of unit transects	24	24	24	24	24	24	144	32	251.1
Working nights	8	8	8	8	8	8			
Duration (hrs)	56.3	10.7	37.4	23.4	62.0	61.3			

Manual detection of bat activity on transects was conducted during a total of 32 working nights in the overall effective duration of 251 hours.

The same number of working nights was realised on all transects - one a month, or 8 in total, and an equal number of unit transects - 3 per month, or 24 in total. Effective time spent on transects was generally proportional to their length, and, if the shorter transects 1, 2 and 3 were observed together as they were realised, equally on all transects.

Transect duration was also equal per month, a small variation occured as a direct result of the difference in the duration of the night and the level of bat activity recorded by month.

Automatic detection of bat activity

Automatic bat activity detection is mentioned in the national guidelines (Paunovic et al. 2011) and KfW recommendations as the preferred survey method at the locations foreseen for wind farm development, while under the most relevant and latest international standards (Rodrigues et al. 2008, 2015) it is considered as the necessary method which aims to investigate the bat activity on the planned wind turbine sites.

Automatic detection of activities during this survey were stationary, i.e. it was carried out by applying the census in points method, by employing detector systems positioned at ground level. In accordance with standard recommendations (Rodrigues et al. 2008, 2015), census points for automatic detection of bat activity were wind turbine positions (VG01-VG20, Figure 22 and Table 7), and additionally, position 7 inside the control region (K1 -K7, Figure 22 and Table 7). Planned wind turbine positions were the positions defined after the wind farm layout was changed initiated through preliminary conflicts analysis of this survey (Figures 3 and 42).

Automatic detection systems used throughout the survey consisted of ultrasonic bat detector *CDP 302 R3* manufactured by *Ciel-electronique* (with 1/10 *frequency division* and an internal clock) with an external microphone *CEM0001-0020* of the same brand, connected with the digital audio recorder Olympus VN713PC equipped with specialized software manufactured by *Ciel-electronique* (Figure 27).

Figure 27. Automatic stationary bat activity detection system used in this survey. Photo: Ines Svenda, original.

Table 7. Geographic coordinates of the census points (geographic date WGS 84).

	Census point	North latitude	East longitude
Location – planned wind turbine positions	VG01	44.69913	21.24826
	VG02	44.701702	21.251783
	VG03	44.702793	21.256191
	VG04	44.703701	21.26053
	VG05	44.69161	21.25046
	VG06	44.69393	21.25480
	VG07	44.69674	21.259195
	VG08	44.68459	21.173170
	VG09	44.679745	21.169697
	VG10	44.67910	21.175337
	VG11	44.68430	21.20969
	VG12	44.68047	21.205532
	VG13	44.677750	21.201349
	VG14	44.677574	21.194595
	VG15	44.69812	21.20005
	VG16	44.707157	21.197208
	VG17	44.714104	21.195047
	VG18	44.711308	21.18626
	VG19	44.71899	21.18506
	VG20	44.729137	21.184378
Control area	K1	44.66403	21.205475
	K2	44.66875	21.201891
	K3	44.66985	21.206337
	K4	44.66886	21.21205
	K5	44.67304	21.205555
	K6	44.671501	21.211082
	K7	44.672611	21.214777

Automatic ultrasonic detection systems were placed/activated at least 15 minutes before sunset and removed/shut down minimum 15 minutes after sunrise, to cover the entire period of potential nocturnal bat activity inside the investigated area. In order to ensure a more precise insight into the dynamics of nocturnal bat activity, an internal clock of the detector was adjusted to emit audio signals every hour, to allow the positioning of the registered bat signals inside hourly intervals.

In order to identify the ultrasonic signals of bats and species/groups of species to which these signals belong, recordings were analysed by using the free software (freeware) *Audacity* and a specialized software *BatSound 4.03* (©*Pettersson Elektronik AB*), corresponding literature (Russo and Jones, 2002; Pfalzer and Kusch 2003; Obrist et al., 2004; Boonman et al., 2009; Limpens 2010) and comparative collection of recordings owned by the authors. Analysis, i.e. identification of bat signals, covered the interval of each recording between the first full hour before dusk and the first full hour after dawn.

Results were recorded and analysed in terms of the number of registered overflights by taxonomic/ecological groups of bat species, at hourly intervals, dates, months and census points (Appendix 4). Species groups were defined to reflect taxonomic and, in particular, environmental familiarity of species, and similar wind farm effects. Processing of results according to these groups of species is sufficient and appropriate given the automatic detection activities objective. This kind of processing is more appropriate for detectors commonly used for automatic detection, as this method has a less accurate ability of reliable and precise identification of species than the detection using time expansion held by the researcher with visual detection (Paunovic et al., 2011, Rodrigues et al. 2015). However, this method may also help to identify certain species that are usually less likely registered by manual detection (Paunovic et al. 2011).

Overview of the realised field investigations of bat activity on census points through automatic detection is shown in Table 8, presenting working nights and effective duration of census.

Table 8. Realized automatic bat activity detection schedule.

Month	Census points				№ of working nights	Duration (hrs)
	K1-K7	VG 01-07	VG 08-14	VG 15-20		
April	25/26.	24/25.	23/24.	26/27.	4	40.2
May	14/15.	13/14.	19/20.	23/24.	4	36.4
June	8/9.	11/12.	13/14.	24/25.	4	33.9
July	15/16.	22/23.	21/22.	16/17.	4	35.5
August	11/12.	29/30.	30/31.	14/15.	4	40.9
September	7/8.	23/24.	22/23.	21/22.	4	46.5
October	18/19.	23/24.	24/25.	21/22.	4	52.2
November	1/2.	3/4.	4/5.	2/3	4	55.5
№ of work nights	8	8	8	8	32	341.0
Duration (hrs)	84.3	86.5	85.4	84.9		

Automatic detection of bat activity in the census points was conducted during a total of 32 working nights in the overall effective duration of 341 hours.

Seven complete system for automatic detection (with an additional 2 stand-by ones) have allowed simultaneous performance of this survey element on census point 7. For this reason, the automatic activity detection could be carried out in four rounds, i.e. during 4 working nights a month. The same number of working days was realised on all census points - one a month, i.e. 8 in total, with equal census duration (census duration is the period from sunset to sunrise), while small variations occur as a direct result of differences in the duration of each night, which most directly reflects the differences in the duration of the census by month.

RESULTS

The investigated area of the future wind farm location is situated in an area of forest and riparian landscapes that have long been largely altered into agricultural land or agrobiocenoses. The actual wind farm locations, as well as the largest part of the control area, are a result of much more drastic and more recent anthropogenic activities - surface coal mining and overburden dumping, which did not only completely eliminate vegetation at a given moment, but also transformed the landscape. Today's vegetation present at the studied locations is the result of the interaction between the natural process of spontaneous colonization and succession and planning activities involving re-cultivation lasting from the moment of dumpsite/mine closure, therefore, at most a few decades; the most common are ruderal plant communities in different stages of succession. Agrobiocenoses, which dominate the surrounding area, cover5-10% of the surface at the Petka and Klenovnik locations, while at the Cirikovac and Drmno locations they are present only along the boundaries, whereas inside the control area they account for about 30% of the area.

At the locations of Cirikovac, Klenovnik and Drmno, as well as in the control area, woody and shrub vegetation covers about 10-15% of the total area, while it occupies up to 80% at the Petka location. However, relatively young dense stands are mostly present (bushes, shrubs, small forests, young forest), which sometimes also form linear formations along the roads, with some also relatively young, individual trees and shrubs or small groups, mostly acacia, poplar and Siberian elm (as well as false indigo bush). Somewhat older but also very dense stands of acacia, poplar and black pine, whose actual situation indicates that they are actively managed, are only present on the slopes and at the foot of the Petka location. Natural stands of indigenous floodplain forests are present only at the border of the control area inside the Mogila, Mlava and Danube zones, while they are much more prevalent outside the investigated areas, i.e. outside the locations, in the valleys of Mogila, Mlava and the Danube. There are almost no old trees on the locations, because the re-cultivation process development of woody vegetation began not so long ago, while on the control area they are represented only marginally.

Aquatic and wetland habitats do not exist on Petka and Drmno locations, and are present on the 10-20% of the area at the Klenovnik location – inside the mined-out mine zone, at the Cirikovac location – inside the ash landfill area, and the control area – in the Mogila and Mlava valleys, mainly peripherally. Much larger and more important aquatic and wetland habitats with relatively preserved natural vegetation may be found in the immediate vicinity of the location – inside the Mogila and Mlava valleys, especially the Danube.

At the locations, especially at Klenovnik, there are also loess cuts, but they are mostly affected by landslides.

Inside the locations, as well as at the control area, there are almost no buildings; however, there are settlements close to all the locations, and the Cirikovac mine management complex next to the mine boundary. Different mining and energy infrastructure (numerous power lines, industrial facilities, transportation systems, lighting, well-maintained crushed stone roads), as well as many elements of the abandoned mining equipment are present at all locations and in their surroundings. Hunting infrastructure (hunting stands, feeders, salt-licks) is present on all locations and the control area. However, on the locations it is generally neglected and in various stages of deterioration.

Due to the above, on the basis of a preliminary environmental assessment at the beginning of this survey, it was estimated that the wind farm locations have different trophic and cryptic potential for birds and bats, which is shown in Table 9, along with the appropriate evaluation of the control area and the surroundings.

Table 9. Preliminary assessment of the cryptic and trophic potential of the Kostolac wind farm location control area and the surroundings for birds and bats.

Location	Birds		Bats	
	cryptic	trophic	cryptic	trophic
Ćirikovac	moderate	moderate	low - moderate[1]	moderate
Petka	high	high	low	high
Klenovnik	high	low – high[2]	low	low - high[2]
Drmno	low	low	low	low
Control area	moderate[3]	moderate - high[3]	moderate - high[3]	moderate - high[3]
Surroundings	high[4]	low[5] - high[4]	high[4]	low[5] - high[4]

1 along the boundary (Cirikovac mine management complex area)
2 in the area of aquatic and wetland habitats of the closed Klenovnik mine and along the northern boundary
3 along the boundary (forest, aquatic and wetland habitats in the Mogila and Mlava valleys)
4 preserved aquatic, wetland and forest habitats (mainly in river valleys), settlements
5 zones of intense ongoing mining and thermal power activities

For this reason, prior to the start of the field investigations, presence of birds and bats fauna was expected on the locations, but, due to the anticipated relative scarcity of trophic and, particularly for bats, cryptic resources on the actual location compared to the immediate and wider surroundings, no great diversity and numbers. Although the surroundings include previously known important birds (and bats) habitats, especially the protected area Labudovo Okno and valleys of Mogila and Mlava rivers, together with the ecological corridors of international importance (Danube and Velika Morava), it was considered that this cannot have any significant impact, as these habitats, as opposed to the wind farm location, contain ecological resources required to meet the basic needs of all birds and bats.

However, this survey conducted from November 2014 to November 2015 established that the wind farm location and its immediate vicinity contain representatives of 120 bird species (Tables 10 and 11) and at least 19 species of bats (Table 12). Since many of them were recorded in extremely small numbers and only marginally on the locations, this result may be characterized as expected, however, due to the relatively large number of registered species, it is essential for the fauna of this area. The narrower wind farm area is dominated by species preferring open ruderal habitats and very dense shrubs and bushes. However, in some areas there are also species preferring aquatic and wetland habitats. This section provides specific information on the birds and bats fauna elements findings from November 2014 to November 2015 inside the study area, i.e. on the potential wind farm locations and in their immediate surroundings, as well as inside the control area.

Birds' survey

Inside the entire investigated area from December 2014 to November 2015, the presence of a total of 120 species of birds was recorded (Tables 10 and 11). Representatives of many of the recorded species were present in extremely small numbers. Of this number 17 species were classified into target species with respect to their national and international importance and status of conservation and protection, as well as on the basis of the wind turbines collision risk susceptibility due to their specific bionomy, behaviour, flying manner and height and possible disruption of habitats caused by the wind farm infrastructure development.

Table 10. List of all bird species whose members were recorded (marked +) at the potential Kostolac wind farm locations and vantage points.
Target species were specially highlighted (shaded and bolded). Nesting data are given under a separate column containing the species name (c – certain nesting, п – potential nesting)

№	Species	Nesting	VP1	VP2	VP3	VP4	VP5	VP6	VP7
1	***Cygnus olor***				+				
2	*Anas platyrhynchos*	c	+						
3	*Coturnix coturnix*	c	+	+	+	+	+		+
4	*Phasianus colchicus*	c	+	+	+	+	+		+
5	*Perdix perdix*	c		+		+	+		+
6	*Tachybaptus ruficollis*	c				+			
7	*Phalacrocorax carbo*		+	+	+	+			
8	***Casmerodius albus***		+						
9	*Ardea cinerea*		+	+	+	+			+
10	***Ciconia nigra***						+		
11	***Ciconia ciconia***		+	+	+				+
12	***Pernis apivorus***			+					
13	***Circus cyaneus***		+		+	+	+		
14	***Circus pygargus***			+					
15	***Circus aeruginosus***		+	+	+	+	+	+	
16	***Accipiter gentilis***	п		+					+
17	***Accipiter nisus***	п	+		+	+	+	+	+
18	***Haliaeetus albicilla***								+
19	***Buteo buteo***	c	+	+	+	+	+	+	+
20	***Falco columbarius***				+				
21	***Falco vespertinus***						+		
22	***Falco subbuteo***	п	+	+	+	+		+	
23	***Falco tinnunculus***	c	+	+	+	+	+		+
24	***Grus grus***		+						

№	Species	Nesting	VP1	VP2	VP3	VP4	VP5	VP6	VP7
25	*Crex crex*	с				+			
26	*Gallinula chloropus*	с				+			
27	*Larus ridibundus*		+	+	+	+		+	
28	*Larus canus*					+			
29	*Larus michahellis*		+	+	+	+	+	+	
30	*Columba livia f. domestica*	с	+	+	+	+		+	
31	*Columba palumbus*	с	+	+	+		+		+
32	*Streptopelia decaocto*	с	+	+	+	+	+		
33	*Streptopelia turtur*	с	+	+	+	+	+	+	+
34	*Cuculus canorus*	с	+	+		+			+
35	*Athene noctua*	с				+			
36	*Otus scops*	п		+					
37	*Asio otus*	с		+*	+*		+*		+*
38	*Strix aluco*	п		+*		+*			+*
39	*Caprimulgus europaeus*				+*				
40	*Apus apus*		+	+	+	+	+		
41	*Merops apiaster*	с	+	+	+	+	+	+	+
42	*Upupa epops*	с	+		+	+		+	
43	*Jynx torquilla*	с	+						+
44	*Picus viridis*	п	+	+				+	+
45	*Dendrocopos major*	с	+	+	+	+	+	+	+
46	*Dendrocopos medius*	с	+						+
47	*Dryobates minor*	с	+			+	+	+	+
48	*Oriolus oriolus*	с	+	+		+		+	+
49	*Lanius minor*	п				+	+		+
50	*Lanius collurio*	с	+	+	+	+	+	+	+
51	*Lanius excubitor*		+	+	+	+	+	+	+
52	*Pica pica*	с	+	+	+	+	+	+	+
53	*Garrulus glandarius*	п	+	+	+	+		+	+
54	*Coloeus monedula*		+		+	+			
55	*Corvus frugilegus*		+			+	+		+
56	*Corvus corone/cornix*	с	+	+	+	+	+	+	+
57	*Corvus corax*	с	+	+	+	+		+	
58	*Parus caeruleus*	с	+	+	+	+	+	+	+
59	*Parus major*	с	+	+	+	+	+	+	+
60	*Parus palustris*	с	+	+				+	+
61	*Lullula arborea*	с	+	+	+	+	+	+	+

№	Species	Nesting	VP1	VP2	VP3	VP4	VP5	VP6	VP7
62	*Alauda arvensis*	с		+	+	+	+		+
63	*Riparia riparia*	с	+	+	+	+		+	+
64	*Hirundo rustica*	п	+	+	+	+	+	+	+
65	*Delichon urbicum*	п	+	+	+	+		+	+
66	*Aegithalos caudatus*	с	+	+	+		+	+	+
67	*Phylloscopus sibilatrix*		+						
68	*Phylloscopus trochilus*		+	+	+	+	+	+	+
69	*Phylloscopus collybita*		+	+	+	+	+	+	+
70	*Acrocephalus arundinaceus*	с	+			+			+
71	*Hippolais icterina*			+					
72	*Sylvia atricapilla*	с	+	+	+	+	+	+	+
73	*Sylvia borin*				+			+	+
74	*Sylvia nisoria*	с	+	+	+	+		+	+
75	*Sylvia curruca*	п	+	+	+	+	+	+	+
76	*Sylvia communis*	с	+	+	+	+	+	+	+
77	*Regulus regulus*		+					+	
78	*Sitta europaea*	с	+	+					
79	*Certhia brachydactyla*	п		+				+	
80	*Troglodytes troglodytes*	с	+	+					+
81	*Sturnus vulgaris*	с	+	+	+	+	+	+	+
82	*Turdus viscivorus*		+	+	+	+	+		+
83	*Turdus merula*	с	+	+	+	+		+	+
84	*Turdus pilaris*		+	+	+	+	+		+
85	*Turdus philomelos*	с	+	+	+	+	+	+	+
86	*Muscicapa striata*	п	+	+				+	+
87	*Ficedula hypoleuca*		+						+
88	*Ficedula albicollis*		+	+					+
89	*Saxicola rubetra*		+	+	+		+		+
90	*Saxicola rubicola*	с	+	+	+	+	+		+
91	*Erithacus rubecula*	с	+	+	+	+		+	+
92	*Luscinia luscinia*			+					
93	*Luscinia megarhynchos*	с	+	+	+	+	+	+	+
94	*Phoenicurus ochruros*	с	+	+				+	+
95	*Oenanthe oenanthe*	п	+		+				
96	*Prunella modularis*			+					
97	*Passer domesticus*	с		+	+	+	+		+
98	*Passer montanus*	с	+	+	+	+	+		+

№	Species	Nesting	VP1	VP2	VP3	VP4	VP5	VP6	VP7
99	*Anthus campestris*	п	+	+		+	+	+	
100	*Anthus trivialis*	с	+	+	+	+	+	+	+
101	*Anthus pratensis*		+	+	+	+	+	+	+
102	*Anthus spinoletta*		+	+	+			+	
103	*Motacilla flava*					+			
104	*Motacilla feldegg*	п		+	+	+		+	+
105	*Motacilla alba*	с	+	+	+				+
106	*Fringilla coelebs*	с	+	+	+	+	+	+	+
107	*Fringilla montifringilla*			+			+	+	+
108	*Coccothraustes*	с	+	+	+	+	+	+	+
109	*Pyrrhula pyrrhula*			+					
110	*Serinus serinus*	п	+	+	+	+		+	+
111	*Loxia curvirostra*					+			
112	*Carduelis chloris*	с	+	+	+	+	+	+	+
113	*Carduelis carduelis*	с	+	+	+	+	+	+	+
114	*Carduelis spinus*		+	+		+		+	+
115	*Carduelis cannabina*	п	+	+	+	+	+	+	+
116	*Emberiza calandra*	с	+	+	+	+	+		+
117	*Emberiza citrinella*	с	+	+	+	+	+	+	+
118	*Emberiza cia*						+		
119	*Emberiza hortulana*	с	+	+		+		+	+
120	*Emberiza schoeniclus*		+			+	+	+	
Total number of species		58+19=77	88	87	72	79	58	60	77
			119					89	
Total number of target species		2+3=5	9	8	9	6	7	4	6
		16						8	

* Members of this species were recorded at the given VP only during the bat investigations

Bottom of Table 10 shows the total number of all species and target species recorded on vantage points (VPs) and total for the wind farm locations and the control area. Here it is evident that the species are relatively evenly present on VPs, with a minimum of 58 recorded on VP5 and a maximum of 88 species recorded on VP1. The number of target species exhibits similar trends, i.e. it is relatively uniform. Viewed collectively, both the number of species and the number of target species are smaller in the control area than in the studied area. A total of 119 species was recorded only inside the studied area, of which 16 were classified in the target category, while the control area contained a total of 89 bird species of which 8 target ones. The only species recorded inside the control, but not in the studied area falling into the target category is the white-tailed eagle *Haliaeetus Albicia*.

Throughout the 104 hours spent investigating bird nesting inside the studied area, two categories were recorded – certain and potential nesting birds (Table 10). A total of 58 bird species was recorded whose representatives nest inside the investigated area, while 19 species of birds were classified into the category of potential nesting. Of the target species, only two most frequently observed fall into the category of certain nesting birds - buzzard and kestrel, while three were identified as potential – Northern goshawk, Eurasian sparrowhawk and Eurasian hobby. Positions of the discovered nests of the target and other species are shown in Figure 28.

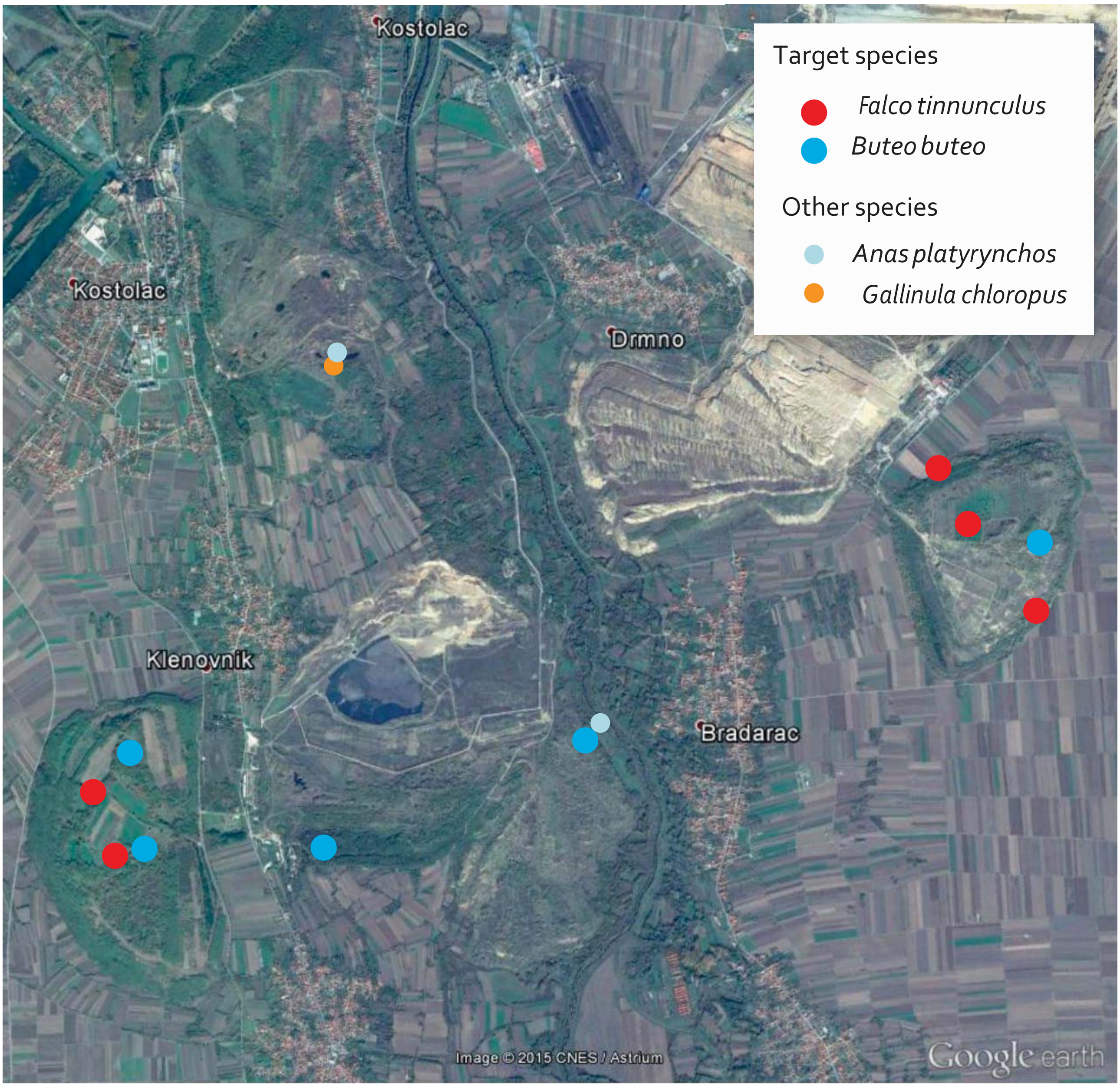

Figure 28. Nest positions discovered inside the investigated area, between April and July 2015.
Source: Google Earth 2014 with modification, Ines Svenda, original.

Such bird diversity in the area designated for the Kostolac wind farm, registered on certain vantage points allowing separate locations to be observed representing groups of wind turbines, may be explained by the diversity and the presence of certain habitat types, their quality, as well as the actual position of the location and its remoteness from the Danube.

Based on the Table 11 data, of the total of 120 recorded bird species, 110 are listed in the appendices of the Berne Convention (Official Gazette RS, № 102/2007a) - 82 in Appendix II - strictly protected species, and 28 in Appendix III - protected species. When it comes to the Bonn Convention (Official Gazette RS, № 102/2007b) 44 of the present species are on the Appendix II list, and 3 on the Appendix I list. In the context of the Birds Directive of the European Union (Official Journal of the European Union [09/147 / EC]) 21 species have been classified under Appendix I, 22 under Appendix II, 4 species under Appendix III. Under the domestic nature protection legislation, out of the total of 120 registered species, 94 were declared strictly protected, while 23 species were listed as protected (Official Gazette RS, № 36/2009, 5/2010). A total of 15 species are classified as hunting game species in a certain period of the year, while one is permanently protected (Official Gazette RS, № 18/2010), 9/2012). Only one of the recorded species has no protection status - domestic pigeons *Columba livia f. domestica*. They live in all of the surrounding settlements and occasionally in small and large flocks inside the investigated area feeding in anthropogenically altered habitats under crops. However, their nesting was discovered only at one location.

Table 11. List of bird species whose members are recorded in the area of the potential Kostolac wind farm and the control area from December 2014 to November 2015 with the protection categories under the Berne (Appendices II and III) and the Bonn Convention (Appendices I and II), Directive on the Conservation of Birds of the European Union (Appendices I, II or III), national nature protection law (З - protected, СЗ – strictly protected) and game and hunting law (Л-closed season, T-permanently).

№	Species	Berne	Bonn	Bird directive	Protection in Serbia	Closed season in Serbia
1	***Cygnus olor***	**III**	**II**	**II**	**З**	
2	*Anas platyrhynchos*	III	II	II, III	З	Л
3	*Coturnix coturnix*	III		II	З	Л
4	*Phasianus colchicus*	(III)		II, III	З	Л
5	*Perdix perdix*	III		II, III	З	Л
6	*Tachybaptus ruficollis*	II			СЗ	
7	*Phalacrocorax carbo*	III			З	Л
8	***Casmerodius albus***	**II**	**II**	**I**	**СЗ**	
9	*Ardea cinerea*	III			З	Л
10	***Ciconia nigra***	**II**	**II**	**I**	**СЗ**	
11	***Ciconia ciconia***	**II**	**II**	**I**	**СЗ**	
12	***Pernis apivorus***	**II**	**II**	**I**	**СЗ**	
13	***Circus cyaneus***	**II**	**II**	**I**	**СЗ**	
14	***Circus pygargus***	**II**	**II**	**I**	**СЗ**	
15	***Circus aeruginosus***	**II**	**II**	**I**	**СЗ**	
16	***Accipiter gentilis***	**II**	**II**		**З**	**Л**
17	***Accipiter nisus***	**II**	**II**		**СЗ**	

№	Species	Berne	Bonn	Bird directive	Protection in Serbia	Closed season in Serbia
18	***Haliaeetus albicilla***	**II**	**I, II**	**I**	**СЗ**	
19	***Buteo buteo***	**II**	**II**		**СЗ**	
20	***Falco columbarius***	**II**	**II**	**I**	**СЗ**	
21	***Falco vespertinus***	**II**	**I, II**	**I**	**СЗ**	
22	***Falco subbuteo***	**II**	**II**		**СЗ**	
23	***Falco tinnunculus***	**II**	**II**		**СЗ**	
24	***Grus grus***	**II**	**II**	**I**	**СЗ**	
25	*Crex crex*	II	I	I	СЗ	
26	*Gallinula chloropus*	III		II	З	Л
27	*Larus ridibundus*	III		II	З	
28	*Larus canus*	III		II	З	
29	*Larus michahellis*	III				
30	*Columba livia f. domestica*					
31	*Columba palumbus*			II, III	З	Л
32	*Streptopelia decaocto*	III		II	З	Л
33	*Streptopelia turtur*	III		II	З	Л
34	*Cuculus canorus*	III			СЗ	
35	*Athene noctua*	II			СЗ	
36	*Otus scops*	II			СЗ	
37	*Asio otus*	II			СЗ	
38	*Strix aluco*	II			СЗ	
39	*Caprimulgus europaeus*	II		I	СЗ	
40	*Apus apus*	III			СЗ	
41	*Merops apiaster*	II	II		СЗ	
42	*Upupa epops*	II			СЗ	
43	*Jynx torquilla*	II			СЗ	
44	*Picus viridis*	II			СЗ	
45	*Dendrocopos major*	II			СЗ	
46	*Dendrocopos medius*	II		I	СЗ	
47	*Dryobates minor*	II			СЗ	
48	*Oriolus oriolus*	II			СЗ	
49	*Lanius minor*	II		I	СЗ	
50	*Lanius collurio*	II		I	СЗ	
51	*Lanius excubitor*	II			СЗ	
52	*Pica pica*			II	З	Л

№	Species	Berne	Bonn	Bird directive	Protection in Serbia	Closed season in Serbia
53	*Garrulus glandarius*			II	З	Л
54	*Coloeus monedula*			II	З	
55	*Corvus frugilegus*			II	З	Л
56	*Corvus corone/cornix*				З	Л
57	*Corvus corax*	III			З	
58	*Parus caeruleus*	II		II	СЗ	
59	*Parus major*	II			СЗ	
60	*Parus palustris*	II			СЗ	
61	*Lullula arborea*	III		I	СЗ	
62	*Alauda arvensis*	III		II	СЗ	
63	*Riparia riparia*	II			СЗ	
64	*Hirundo rustica*	II			СЗ	
65	*Delichon urbicum*	II			СЗ	
66	*Aegithalos caudatus*	II			СЗ	
67	*Phylloscopus sibilatrix*	II	II		СЗ	
68	*Phylloscopus trochilus*	II	II		СЗ	
69	*Phylloscopus collybita*	II	II		СЗ	
70	*Acrocephalus arundinaceus*	II	II		СЗ	
71	*Hippolais icterina*	II	II		СЗ	
72	*Sylvia atricapilla*	II	II		СЗ	
73	*Sylvia borin*	II	II		СЗ	
74	*Sylvia nisoria*	II	II	I	СЗ	
75	*Sylvia curruca*	II	II		СЗ	
76	*Sylvia communis*	II	II		СЗ	
77	*Regulus regulus*	II	II		СЗ	
78	*Sitta europaea*	II			СЗ	
79	*Certhia brachydactyla*	II			СЗ	
80	*Troglodytes troglodytes*	II			СЗ	
81	*Sturnus vulgaris*			II	З	
82	*Turdus viscivorus*	III	II	II	СЗ	
83	*Turdus merula*	III	II	II	СЗ	
84	*Turdus pilaris*	III	II	II	СЗ	
85	*Turdus philomelos*	III	II	II	СЗ	
86	*Muscicapa striata*	II	II		СЗ	
87	*Ficedula hypoleuca*	II	II		СЗ	

№	Species	Berne	Bonn	Bird directive	Protection in Serbia	Closed season in Serbia
88	*Ficedula albicollis*	II	II	I	C3	
89	*Saxicola rubetra*	II	II		C3	
90	*Saxicola rubicola*	III	II			
91	*Erithacus rubecula*	II	II		C3	
92	*Luscinia luscinia*	II	II		C3	
93	*Luscinia megarhynchos*	II	II		C3	
94	*Phoenicurus ochruros*	II	II		C3	
95	*Oenanthe oenanthe*	II	II		C3	
96	*Prunella modularis*	II			C3	
97	*Passer domesticus*				3	
98	*Passer montanus*	III			3	
99	*Anthus campestris*	II		I	C3	
100	*Anthus trivialis*	II			C3	
101	*Anthus pratensis*	II			C3	
102	*Anthus spinoletta*	II			C3	
103	*Motacilla flava*	II			C3	
104	*Motacilla feldegg*	II			C3	
105	*Motacilla alba*	II			C3	
106	*Fringilla coelebs*	III			C3	
107	*Fringilla montifringilla*	III			C3	
108	*Coccothraustes*	II			C3	
109	*Pyrrhula pyrrhula*	III			C3	
110	*Serinus serinus*	II			C3	
111	*Loxia curvirostra*	II			C3	
112	*Carduelis chloris*	II			C3	
113	*Carduelis carduelis*	II			C3	
114	*Carduelis spinus*	II			C3	
115	*Carduelis cannabina*	II			C3	
116	*Emberiza calandra*	III			C3	
117	*Emberiza citrinella*	II			C3	
118	*Emberiza cia*	II			C3	
119	*Emberiza hortulana*	III		I	C3	
120	*Emberiza schoeniclus*	II			C3	
	Total number of species	111	45	43	117	15
	Total number of target species	17	17	12	17	1

Although the total number of 119 species of birds present inside the investigated area may be characterized as significant from the faunal aspect, in quantitative terms the number of recorded individuals is relatively small.

Out of the ecological groups of birds vulnerable to wind turbines, for which reason they received special attention, particularly classified as the so-called target species, diurnal birds of prey (*Falconiformes*) may be highlighted. It is surprising that the studied area did not contain any significant species of waterfowl (*Anseriformes*), primarily geese (*Anser sp.*). Apart from the few specimens and wild ducks pairs (*Anas platyrhynchos*) and one overflight of two mute swans (*Cygnus olor*) during the autumn and winter months no common waterfowl flocks have been registered. Herons and storks (*Ciconiiformes*) were recorded only sporadically, mostly individual specimens or several birds together. Although the subject area is not far from three rivers, primarily the Danube, the lack of major optimal aquatic and wetland habitat at this location does not favour the presence and retention of these two ecological groups of birds, making difficult their nutrition, hiding and nesting. Therefore, members of a small number of species of herons, storks and waterfowl were encountered in very small numbers and with very low recording frequency.

Diurnal birds of prey are constantly present at the location. This may be explained by the fact that inside the investigated location there is a considerable trophic base for birds of this ecological group, primarily rodents (*Rodentia*), which represent a significant fauna element in agricultural habitats. For this reason, at the location the most numerous are buzzards (*Buteo buteo*), common kestrel (*Falco tinunnculus*), as well as seasonal and other birds of prey such as the harrier (*Circus sp*.) and falcons (*Falco sp*.). Hawk (*Accipiter gentilis*) and sparrowhawk (*Accipiter nisus*) have a wider range of prey to feed on, however, members of these two species were recorded in very low numbers. White-tailed eagle (*Haliaeetus albicilla*), only once observed inside the control area, represents the only finding of the eagles in more than 12 months of investigations.

Out of the overflights of other target species none may be pinpointed as significant. Nocturnal predators - owls (*Strigiformes*) were very scarce in the investigated area and represented by 4 species. Although their conservation status is relatively high, they are not listed as the target species for their specific lifestyle and hunting. They are oriented to hunting rodents living on or in the ground, so the collision risk during the wind power infrastructure operation is relatively small.

Songbirds are represented with a number of species, but mostly small number of representatives that would be notably affected by the potential wind farm. However, numerous specimens and flocks of skylarks (*Alauda arvensis*), starlings (*Sturnus vulgaris*), may be singled out as significant findings, as well as several species of thrushes and three species of swallows. Each of these species may in their own special way be affected by the wind farm, yet their classification into lower risk categories, positive population trend and significant number do not give grounds for concern. Other songbirds due to their ecological status and habitat use are even less affected and vulnerable to the Kostolac wind farm project construction and operation.

Bats' survey

This survey from April to November 2015 established that at the entire investigated area, and inside wind farm locations, there were at least 19 species of bats (Table 12). Even this number of species, which is certainly not definitive, is more than twice the number of species registered so far in the wider nearby area of the Stig and Branicevo regions (Paunovic et al. 2004) and makes more than 63% of the total bat fauna of Serbia (Paunovic et al., 2011, Budinski et al., *accepted*), so that, seen only on the basis of the number of registered species, species diversity of the Kostolac wind farm bat fauna may be characterized as high. However, since the vast majority of species has been recorded in an extremely small number of specimens/overflights, this result may be, in terms of fauna, although important, characterized as expected.

Summary of the bat fauna survey results for the Kostolac Wind Farm Construction Project realized from November 2014 to November 2015 (Table 5), in the wind farm location area, its immediate surroundings and the control area, is shown in tables presented in this study: overview of the manual detection on transects along with previous knowledge of the bat fauna in a wider area of Stig and Branicevo (Paunovic et al. 2004) in Table 12, overview of the automatic detection activities results in Tables 13 and 29, overview of the established ecological functions of habitats in Table 14. Detailed overviews of results by month are given in appendices at the end of the study: manual detection of activity on transects in Appendix 3, and automatic detection of activity on census points in Appendix 4.

At the wind farm location and in its immediate vicinity, ultrasonic auto-detection was used to register 14 species whose members may surely be distinguished on the basis of echo-location signals: *Rhinolophus ferrumequinum*, *Miniopterus schereibersii*, *Myotis bechsteinii*, *Myotis emarginatus*, *Myotis nattereri*, *Barbastella barbastellus*, *Pipistrellus pygmaeus*, *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Pipistrellus nathusii*, *Hypsugo savii*, *Nyctalus leisleri*, *Nyctalus noctula*, *Vespertilio murinus* and *Eptesicus serotinus*.

Apart from these, activity of representatives of four groups of species was registered whose members could not be distinguished with certainty on the basis echo-location signals - *Myotis myotis / oxygnathus*, *Myotis brandtii / mystacinus / alcathoe*, *Myotis daubentonii / capaccinii* and *Plecotus sp*. – therefore, it is probable that at least one species from each of the groups is present at the location, making a total of at least 19. However, it is very likely that this number is actually higher, i.e. 23, because at least occasionally, and/or sporadic presence of 8 species of these groups (*Myotis brandtii*, *M. mystacinus*, *M. alcathoe*, *M. myotis*, *M. oxygnathus*, *M. daubentonii Plecotus austriacus* and *P. auritus*) is almost certain, based on their widespread distribution and existence of suitable environmental conditions at the location and its immediate vicinity (Dietz et al. 2009; Paunovic et al. 2011). This is supported by the data on the presence of at least some of these species in the vicinity of the location (Paunovic et al. 2004 - see Table 12).

Table 12. List of bat species (i.e. groups of species that cannot be readily distinguished on the basis of echo-location signals) whose members were recorded by manual ultrasonic detection from April to November 2015, or potentially present at the Kostolac wind turbine location, its immediate vicinity and the control area, with relative species numbers registered along transects (as the total number and percentage of registered overflights). Alongside is an overview of species recorded earlier in the wider surroundings, inside the Stig and Branicevo regions (Paunovic et al. 2004).

Area / Species/Group	Region	Control (0)		Surr. (1)		Locations: Cirikovac		Petka		Klenovnik		Drmno		TOTAL	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
Rhinolophus ferrumequinum	+	12	0.9			4	0.6	1	0.3	2	0.3	15	3.4	34	0.9
Rhinolophus hipposideros	+														
Rhinolophus euryale	+														
Miniopterus schreibersii	+	3	0.2	8	2.8	2	0.3	11	2.8	9	1.5	4	0.9	37	1.0
M.brandtii/mystacinus/alcathoe		36	2.8	3	1.1	33	4.5	10	2.6	9	1.5	3	0.7	94	2.5
Myotis oxygnathus	+														
Myotis myotis	+														
M.myotis/oxygnathus		2	0.2			2	0.3	1	0.3					5	0.1
Myotis bechsteinii		8	0.6			3	0.4							11	0.3
Myotis emarginatus	+	1	0.1			3	0.4							4	0.1
Myotis nattereri								1	0.3					1	0.0
M.daubentonii/capaccinii		1	0.1					1	0.3	1	0.2	0	0.0	3	0.1
Myotis sp.		24	1.9			16	2.2	7	1.8	2	0.3	0	0.0	49	1.3
Plecotus sp.		1	0.1			1	0.1			1	0.2	0	0.0	3	0.1
Barbastella barbastellus						1	0.1	1	0.3			1	0.2	3	0.1
Pipistrellus pygmaeus		+*								+*		1	0.2	1	0.0
Pipistrellus pipistrellus	+	6	0.5			2	0.3			2	0.3	2	0.5	12	0.3
P.kuhlii/pipistrellus		2	0.2			1	0.1			1	0.2	0	0.0	4	0.1
Pipistrellus kuhlii		482	37.3	142	49.8	442	60.9	205	52.6	222	37.4	132	30.3	1625	43.6
P.kuhlii/nathusii		273	21.1	64	22.5	125	17.2	99	25.4	158	26.6	154	35.3	873	23.4
Pipistrellus nathusii		111	8.6	28	9.8	32	4.4	19	4.9	42	7.1	45	10.3	277	7.4
P.nathusii/H.savii		11	0.9	3	1.1	9	1.2	3	0.8	3	0.5	7	1.6	36	1.0
Hypsugo savii		4	0.3			2	0.3	1	0.3	2	0.3	13	3.0	22	0.6
Pipistrellus/Hypsugo sp.		30	2.3	15	5.3	21	2.9	8	2.1	16	2.7	11	2.5	101	2.7
Nyctalus leisleri		17	1.3	6	2.1	2	0.3	7	1.8	23	3.9	16	3.7	71	1.9
N.noctula/leisleri		14	1.1	1	0.4			1	0.3	14	2.4	0	0.0	30	0.8
Nyctalus noctula		220	17.0	9	3.2	4	0.6	5	1.3	69	11.6	17	3.9	324	8.7
N.noctula/lasiopterus												1	0.2	1	0.0
Vespertilio murinus								1	0.3					1	0.0
Eptesicus serotinus		4	0.3	3	1.1	4	0.6	1	0.3	6	1.0	4	0.9	22	0.6
E.serotinus/V.murinus/Nyctalus		4	0.3	1	0.4	1	0.1	2	0.5	6	1.0	5	1.1	19	0.5
Chiroptera *indet.*		27	2.1	2	0.7	16	2.2	5	1.3	6	1.0	5	1.1	61	1.6
Total	8	1293	100.	285	100.	726	100.	390	100.	594	100.	436	100.	3724	100.
Activity index		23.0		26.6		19.4		16.7		9.6		7.1		14.8	
Minimum №of species		16		7		15		14		13		12		19	

* Individual members of this species were reliably identified only by way of automatic detection.

On the other hand, the two species recorded in the Stig and Branicevo regions (Paunovic et al. 2004), have not been registered during this survey - *Rhinolophus hipposideros* and *Rhinolophus euryale*.

The presence of the species *Rhinolophus hipposideros* may be expected inside the investigated area, however only in small numbers (similar to the related and ecologically similar species *Rhinolophus ferrumequinum*) as here there are at least somewhat adequate habitats and shelters (Dietz et al., 2009, Paunovic et al. 2011). It may be possible that present representatives of these species have not been registered during the survey due to the expected small numbers and very silent ultrasonic signals difficult to register by ultrasonic audio-detection (Dietz et al., 2009, Paunovic et al., 2011, Rodrigues et al. 2015). At the wind farm location, the presence of species *Myotis dasycneme* may also be expected, at least occasionally, and in small numbers, because in the immediate vicinity of the location there are optimal habitats and shelters (Dietz et al., 2009, Paunovic et al. 2011), and because this species was previously recorded in nearby parts of the neighbouring regions of South Banat and Carpathian Serbia (Paunovic et al. 2004). Moreover, it is highly likely that a small number (6-8) of overflights along the transects registered during the survey belong to the representatives of this species, which could not be identified with certainty due untypical characteristics of echo-location signals (for this reason they were recorded as *Myotis sp*.).

The presence of the species *Rhinolophus euryale*, although previously observed in the surroundings, cannot be expected because inside the investigated area (and its immediate surroundings) there are no suitable underground shelters, while the representatives of this species are usually active during the day in the immediate vicinity of shelters (Dietz et al . 2009, Paunovic et al. 2011). For the same reason, the investigated area also does not contain ecologically similar (Dietz et al., 2009, Paunovic et al. 2011) species *Rhinolophus blasii*, *Rhinolophus mehelyi* and *Myotis capaccinii*, although they were recorded in nearby parts of the neighbouring regions of the Carpathian Serbia (Paunovic et al. 2004). Although recently registered in Serbia (Budinski et al., *accepted*), inside the investigated area the presence of markedly alpine species *Plecotus macrobullaris* cannot be expected due to the specificity of its ecology and distribution (Dietz et al. 2009, Alberdi et al. 2013).

It should be noted as a curiosity that this survey registered the presence of species *Myotis bechsteinii*, *Myotis nattereri*, *Barbastella barbastellus*, *Pipistrellus pygmaeus*, *Pipistrellus kuhlii*, *Pipistrellus nathusii*, *Hypsugo savii*, *Nyctalus leisleri*, *Nyctalus noctula*, *Vespertilio murinus* and *Eptesicus serotinus*, as well as groups of species *Myotis brandtii / mystacinus / alcathoe*, *Myotis daubentonii / capaccinii* and *Plecotus sp*. whose representatives have not previously been recorded in the surroundings, i.e. in the Stig and Branicevo regions (Paunovic et al. 2004). This increases the number of the bat fauna species in the region to 22, thus confirming the initial hypothesis of this survey and Paunovic et al. (2004) that a small number of previously recorded species was the result of a lack of research, rather than the actual state of fauna.

All bat species recorded throughout this survey are protected in Serbia under the Nature Protection Law (Official Gazette RS, № 36/2009, 5/2010), ratified international conventions (Official Gazette RS, № 102/2007a, 102/2007b) and the EUROBATS agreement whose ratification is in progress (EUROBATS, 2015). Similarly, in the European Union they are protected under the so-called European Directive on Habitats and Species (Official Journal of the European Union [92/43/EEC]), discussed in more detail in the initial section of this study. In addition, 9 species registered during this survey, or considered potentially as present inside the investigated area (*Rhinolophus ferrumequinum*, *Rh. Hipposideros*, *Miniopterus schreibersii*, *Barbastella barbastellus*, *Myotis emarginatus*, *M. bechsteinii*, *M. dasycneme*, *M. myotis* and *M . oxygnathus*) are listed in Appendix II of the European Habitats Directive. For this reason, strict specific additional protection and population survey measures are applied in their case in the EU.

Despite the significant number of the identified species, it should be noted that the overwhelming majority of them during the manual detection was recorded in a very small relative number, i.e. only a few times compared to the 3724 overflights/contacts recorded on transects (Table 12). By far the largest part, as much as 3099, i.e. more than 83% of all registered overflights/contacts fall to only 3 species: *Pipistrellus kuhlii*, *Nyctalus nathusii* and *Pipistrellus noctula*, whereas their real relative number is even greater, as the representatives of these species certainly account for a significant part of the additional 252, i.e. 6.8%, which is the share of overflights/contacts not possible to identify precisely at the level of genus, species groups or families (due to long distances and short duration). Furthermore, among these species, with relative number of up to 43.6% (with the largest part of the additional 27.9% incompletely identified overflights) *Pipistrellus kuhlii* clearly stands out, so that this species may be considered as extremely dominant across the entire investigated area, while species *Nyctalus noctula* with 8.7% and *Pipistrellus nathusii* with 7.4% are sub-dominant. All other species were far less frequent, 2.5% of overflight belonged to the representatives of the group *Myotis brandtii / mystacinus / alcathoe*, 1.9% to the representatives of the species *Nyctalus leisleri*, while all other species/groups, namely as many as 14 were recorded with almost negligible relative number - under 1% (8 of them only sporadically - 5 or fewer times throughout the survey duration).

Very similar relative number of species was observed on transects surveyed individually (Table 12), i.e. on all wind farm locations, their surroundings and the control area. The situation with the planned wind turbine positions, i.e. corresponding census points (Table 13) is entirely complementary, as here there is a clear dominance of the group *Pipistrellus / Hypsugo / Miniopterus spp.* (which is the dominant species on transects *Pipistrellus kuhlii*), while the group *Nyctalus / Vespertilio spp*. is sub-dominant (also including the sub-dominant species *Nyctalus noctula*), although this is not so distinct. Significant differences were observed only at the census points inside the control area (Table 13), where the definite domination of the group *Nyctalus / Vespertilio spp.* was recorded, followed by the sub-dominant group *Pipistrellus / Hypsugo / Miniopterus spp*. All of these variations are essential in understanding the spatial dynamics of bat fauna of the studied area and will be analysed in detail under a separate section of this study.

Table 13. Number of overflights registered on census points during this survey by groups of species and points. Activity index (overflights/h) was also specified, according to the census points and total relative number of species inside the control area and the location.

Location	Month	Rh	My	Pi	Ny	Es	?	Total	Activity index
Control area	K1		6	86	132	1	6	231	2.7
	K2		25	167	214	2	64	472	5.6
	K3		5	48	1157	1	10	1221	14.5
	K4			145	857	9	59	1070	12.7
	K5	3	3	91	391	1	5	494	5.9
	K6		4	132	879	2	7	1024	12.1
	K7		7	165	113		14	299	3.5
Total		3	50	834	3743	16	165	4811	8.1
Relative number		0.1%	1.0%	17.3%	77.8%	0.3%	3.4%		
Drmno	VG01	2	7	85	107		27	228	2.6
	VG02	1	10	73	47		26	157	1.8
	VG03		33	436	67	1	45	582	6.7
	VG04	1	2	111	103		11	228	2.6
	VG05	3	7	76	94	2	26	208	2.4
	VG06		11	167	138	3	42	361	4.2
	VG07	1	2	114	99	2	13	231	2.7
Petka	VG08	5	76	332	31	1	88	533	6.2
	VG09		6	60	32		17	115	1.3
	VG10		6	146	104		21	277	3.2
Ćirikovac	VG11		7	69	57		26	159	1.9
	VG12		2	145	46		42	235	2.8
	VG13	4	12	223	66	1	56	362	4.2
	VG14		2	35	21		26	84	1.0
Klenovnik	VG15		7	76	85	1	10	179	2.1
	VG16		15	72	104	2	17	210	2.5
	VG17		8	37	111		5	161	1.9
	VG18			90	153	1	24	268	3.2
	VG19		10	50	148		13	221	2.6
	VG20		6	79	180	2	18	285	3.3
Total		17	229	2476	1793	16	553	5084	3.0
Relative number		0.3%	4.5%	48.7%	35.3%	0.3%	10.9%		

Legend: Rh - *Rhinolophus ferrumequinum* Pi – *Pipistrellus/Hypsugo/Miniopterus* Es - *Eptesicus serotinus*
Ny - *Nyctalus/Vespertilio* spp. My - *Myotis/Plecotus/Barbastella* spp. ? - *Chiroptera indet.*

Due to the extreme dominance of one, and almost negligible numbers of most of the other species, despite significant total number of registered species, it may be argued that the bat fauna inside the investigated area, as well as on individual wind farm locations, their surroundings and the control area, is **qualitatively poor** and that according to these quantitative composition characteristics it is similar to the peripheral parts of the highly urbanized areas or typical agricultural ecosystems under monocultures (Simon et al.2004, author's data). This is confirmed by the fact that these characteristics (most pronounced dominance of a single species, the smallest number of registered species) are most prominent on the transect in the vicinity of the location (transect 1, Figure 25), but also on the transects in Cirikovac and Petka (i.e. their section in continuation of transect 1), i.e. inside the zone of the studied area characterized by the highest level of urbanization, as well as that the dominant species *Pipistrellus kuhlii* is also the most synanthropic bat species in this part of Europe (Dietz et al., 2009, Karapandza and Paunovic 2010, Paunovic et al. 2011).

Total number of overflights registered on transects during this survey - 3724, is not small. However, this number does not reflect the actual situation in most of the investigated areas - the highest total activity was registered on the transect in the vicinity of the location (Table 12), which is also the most urbanized location, but the overwhelming majority of the total number of overflights on Cirikovac, Petka and Klenovnik locations and inside the control area is, as a rule, registered along their proportionally short segments characterized by a higher degree of urbanization and proximity to urban areas. This highly uneven spatial distribution of bat activity was not only recorded on the transect at the Drmno location where the lowest activity was registered compared to all the transects, and where the urbanization processes are the lowest. All of these specifics of the spatial bat fauna dynamics inside the studied area will be analysed in detail under a separate section of this study. Therefore, all this clearly points to the conclusion that the bat fauna on the wind farm locations, with the exception of certain zones affected by urbanization or in their vicinity, may be assessed in **quantitative** terms as **poor,** and significantly poorer than the surrounding and the control areas (Table 12).

Bat shelters at the wind farm locations are negligible, which confirms the initial assessment of the **scarcity of cryptic conditions at the location**, made on the basis of the preliminary environmental assessment at the beginning of this survey. Exhaustive search for potential shelters, i.e. structures and objects potentially suitable for bat shelters discovered only 4 buildings at the Klenovnik location (one cottage and three small abandoned farms) and an extremely limited number of potentially suitable mainly older trees on the outskirts of the location. Detection of flights to/from shelters established that bats during the entire period of this survey did not use the shelters located inside the structures at the Klenovnik location. A detailed inspection of potential shelters in trees and bat activity in their vicinity showed that such shelters on locations were used only by one species *Pipistrellus nathusii* in the period from mid-September to mid-October at the Klenovnik location, while at the Drmno location by 1 species *Nyctalus noctula* in October and 2 in November. In these periods, this is clearly indicated by relatively regular copulation calls coming from shelters in holes and crevices of certain trees (red dots in Figure 38).

Both detailed visual inspection, and bat activity detection in their vicinity gave no indication that during the survey period bats use the scarce potential shelters in trees at the Cirikovac and Petka locations. Any potential shelters within the thickets and older forests on the slopes and at the foot of the Petka location could not be checked in full due to extremely difficult accessibility or complete inaccessibility. However, their number is certainly not significant as the research has not determined the presence of shelters along the edges of these stands, while also the age of the trees is not such to expect massive formation of cavities and cracks.

Table 14. List of bat species (i.e. groups of species that cannot be readily distinguished on the basis of echo-location signals) whose ecological functions of habitats were identified during the survey or potentially present in the Kostolac wind turbine locations, their immediate vicinity and the control area. (+ found, (+) very likely,? there are indications, but not confirmed)

Species/group of species	Control area				Surroundings				Locations			
	shelters	hunting	flying	migration	shelters	hunting	flying	migration	shelters	hunting	flying	migration
Rhinolophus ferrumequinum		?	?							(+)	(+)	
Miniopterus schreibersii						+	(+)			?	?	
M.brandtii/mystacinus/alcathoe		(+)	+							(+)	+	
M.myotis/oxygnathus												
Myotis bechsteinii		?	?									
Myotis emarginatus												
Myotis nattereri												
M.daubentonii/capaccinii												
Plecotus sp.												
Barbastella barbastellus												
Pipistrellus pygmaeus												
Pipistrellus pipistrellus			?								?	
Pipistrellus kuhlii		+	+		+	+	+			+	+	
Pipistrellus nathusii	+	+	+	+	+	+	+	+	+	+	+	
Hypsugo savii			?							?	?	
Nyctalus leisleri		?	?			?	(+)			(+)	(+)	
Nyctalus noctula	+	+	+		+	+	+	(+)	+	+	+	(+)
Vespertilio murinus												
Eptesicus serotinus					+	+	(+)					
№of species with functions min. (max)/min. № of present species	**4 (9) / 15**				**5 (6) / 7**				**4 (9) 19**			

The situation is very similar in most of the control area – here it was also established beyond doubt that bats during the entire survey period did not use shelters in the few facilities - farms, while 1 individual species *Pipistrellus nathusii* used a shelter in one old tree in September and October, whereas another individual species *Nyctalus noctula* used a shelter in the hunting stand only in September (Figure 36), from where copulation calls were relatively regular (red dots in Figure 38). However, in the peripheral part of the control area, slightly entering the floodplain forests zone along the Mlava and Mogila rivers, mostly located along the control area boundary or outside (red framed area in Figure 38, Figure 36), during the entire survey period, numerous shelters in trees were used by at least 60 individuals of the species *Nyctalus noctula*. This was determined by the observed swarming in April, and later confirmed by inspection of the flights to/from shelters in June and August and copulatory sounds in September and November. Also based on sounds during the copulatory period, 30-40 shelters of the species *Pipistrellus nathusii* were observed in this zone.

The preliminary environmental assessment has already clearly suggested that in the immediate vicinity of the location, the situation is completely different than at the actual location - structures and facilities potentially suitable for bat shelters here are numerous. In the nearby forest areas, many old trees were observed, while in the villages, old trees and man-made structures, especially numerous older and dilapidated ones, providing an abundance of different types of potential shelters suitable for different types of bats. Therefore, discovered bat shelters in the vicinity of the location may be characterized as expected. Detection of flights to/from shelters has safely established that the shelters in inaccessible areas of the Cirikovac mine management building area were used by a small number of individuals of the species *Pipistrellus kuhlii* - 6 to 7 animals in June, 9 to 11 in July and 8 to 10 in September, while between July and September shelters in buildings or old trees inside this area by individual specimens (1-2 individuals) of the species *Pipistrellus nathusii*, *Nyctalus noctula* and *Eptesicus serotinus*. In old trees inside this area, between September and November, a number copulation shelters was recorded of the species *Nyctalus noctula* (4-6) and *Pipistrellus nathusii* (4-5). A much larger number of potential shelters and shelters of these and other species was recorded throughout the entire survey period in the vicinity of the wind farm location, which was not included in systematic research, particularly in areas surrounding settlements, and in the zone around the floodplain forests of the Mlava and Mogila rivers outside the investigated area.

Both the initial assessment pointing to the scarcity of cryptic resources on wind turbine locations and an opposite assessment about the relative abundance of trophic resources discovered during the survey proved to be accurate. This is clearly supported by the existence of, and at least in some parts of the location, and in some periods, a high intensity of bat hunting activities (Appendix 3). Moreover, during this survey, inside the entire wind turbine location, permanently and during the entire night between April and September, relatively large number and diversity of potential bat prey was obvious - flying and non-flying insects active at night (butterflies, mosquitoes, flies, beetles, crickets). This was especially noticeable, but not limited to, the above mentioned zones characterized by a higher degree of urbanization (which sometimes includes lighting), while inside the control area and in the lower parts (near the wetland and forest habitats of Mlava and Mogila rivers), periodically significant number of bats was recorded, followed by a high share of hunting activities. Therefore, **trophic resources** for bats were rich on all and the entire wind farm locations, as well as inside the control area, especially in the surroundings during the period of this survey, which may be characterized as expected.

DISCUSSION AND ECOLOGIC ANALYSIS

Birds

Birds' survey for the Kostolac Wind Farm Construction Project lasted from December 2014 to November 2015 and covered all growth stages. The investigation was conducted based on the census method on vantage points. In total there were 7 - 5 at the wind farm location, and 2 in the control area. All bird species living and or staying at the location were recorded, in relation to the said vantage points. Targeted species were particularly recorded and discussed, or the ones, according to the international experience, thought to be particularly vulnerable and endangered by wind farm construction and operation. In addition to their number, length of retention, altitude range, flight direction, behaviour and other characteristics were also recorded.

Analysis of survey results by month

Survey of ornithofauna and its elements was carried out on 5 vantage points (VP 1 - VP5). Two more vantage points were used for surveying at the so-called control area (VP6 and VP7). The data for both areas – studied and control ones as well as summary data are presented in Table 15. When considering the total number of species on all VPs at the location by month, spring migratory activity and growth in the number of species in April with a peak in January (n = 71) were clearly noticed, while on the other hand, roaming, autumnal migrations and wintering from August to December were less expressed with a peak in August (n = 62) (Table 15). Number of target species by months completely follows the trend of the total number of species, however most of them were registered in April (n = 7) and August (n = 7) (Table 15). Since most of the target species belong to the diurnal birds of prey, termination of territoriality and beginning of the roaming during flying and migration in the second half of August explains the growth in the number of target species recorded in the second half of the year.

Inside the control area, the trend is similar to the studied area, however, with a smaller number of species. Thus, the spring migration with the highest number of recorded species was also low, with the highest values in April, while the autumn migration had the highest values in September. When the situation in both areas is considered, both on the studied and control one, almost identical trend is obtained, but with a slightly higher values of recorded species by month.

Table 15. Number of recorded species by month and vantage point inside the studied area.

Month	Control area				Wind farm location							TOTAL	
	VP6	VP7	Total All	Total Target	VP1	VP2	VP3	VP4	VP5	Total All	Total Target	All	Target
December	8	11	17	1	13	17	8	8	6	28	4	30	4
January	12	19	25	2	21	18	12	19	12	38	4	42	5
February	5	14	15	1	25	17	8	8	10	33	4	34	5
March	10	22	24	2	30	27	19	19	11	45	5	48	5
April	20	35	39	2	48	39	25	32	24	71	7	74	7
May	19	34	37	2	40	32	18	32	14	65	2	68	3
June	15	32	36	2	43	31	24	23	11	59	4	64	4
July	18	28	31	3	45	27	24	27	21	58	4	59	4
August	25	31	39	2	43	26	24	25	18	61	7	66	7
September	22	34	42	2	34	32	26	20	16	53	5	60	5
October	24	21	32	2	37	31	28	22	19	54	6	57	6
November	18	20	27	2	23	17	14	20	22	37	3	41	4
Total All	60	77	89		88	87	72	79	58	119		120	
Total Target	4	6		8	9	8	9	6	7		16		17

Figure 29. Common buzzard *Buteo buteo* – the most frequent species. Photo: Milan Paunovic, original

December 2014

During 21 observations in December, representatives of 30 species of birds were recorded in both areas, studied and control one, of which 4 were target species (Table 15). Inside the studied area 28 species were recorded, while in the control area 17. Altitude ranges of target species are given in Table 16. The order of species in the table corresponds to the descending number of findings in December.

Table 16. Overview of the number of overflights of the target species by vantage point and altitude range in December 2014. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	2	1		5	1	1	1	2	1	3	1		2	1		2						15	6	2	23
Falco tinnunculus	1			3									4									8			8
Casmerodius albus	3																					3			3
Accipiter nisus	1																					1			1
Total flights per range	7	1		8	1	1	1	2	1	3	1		6	1		2						27	6	2	35
Total flights	8			10			4			4			7			2			0			35			
% critical flights	13%			10%			50%			25%			14%			0%			/			17			
№ of target species	4			2			1			1			2			1			0			4	1	1	

Recorded members of the target species were scarce in December. While this is expected, there were no aquatic habitats birds, i.e. large flocks of geese whose flocks were at least in the northern parts of the studied area closest to the Danube. Of the four recorded species, overflights of only one - buzzard *Buteo buteo* were registered in the critical altitude range. Buzzard overflights were dominant in this month and were the most numerous (n = 23, Table 16), with a total of 6 overflights inside the critical range. Common buzzard is followed by kestrel *Falco tinnunculus* with 8 total registered overflights, and the great egret *Casmerodius albus* with 3 and sparrowhawk *Accipiter nisus* with 1 overflight. Overflights of the last three species were in the zone below the critical range.

Other species present were recorded without extreme overflight and specimen numbers. Thereby, more prominent ones were mixed flocks of yellowhammer and meadow pipit, but they were tied to the ground and shrubs, especially on VP2. Roaming flocks of finches *Fringilidae* were occasionally recorded.

January 2015

In January, for a total of 21 observations in both studied areas, members of 42 species were recorded. Of these, 5 species were the target ones (see Table 15). The number of species present in the studied and control area was 38 and 25, respectively. Altitude ranges of target species and number of findings are shown in Table 17. The order of species in the table corresponds to the descending number of findings in January.

Table 17. Overview of the number of overflights of the target species by vantage point and altitude range in January 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo		1	1	3		1	1	2	1	1	1	1	2		2		1					7	5	6	18
Falco tinnunculus	1			2			1			1			4	1								9	1		10
Accipiter nisus	1									1												2			2
Falco columbarius							1															1			1
Accipiter gentilis																				1			1		1
Total flights per range	2	1	1	5		1	3	2	1	3	1	1	6	1	2		1			1		19	7	6	32
Total flights	4			6			6			5			9			1			1			32			
% critical flights	25%			0%			33%			20%			11%			100%			100%			22%			
№ of target species	3			2			3			3			2			1			1			4	3	1	

Of these target species, common buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* were again the only more frequent species. At critical altitudes, overflights of these two most numerous species were recorded, however, their number compared to the non-critical overflights is small, only 22% of the total number of target species overflights (Table 17). In addition, 2 overflights of the Eurasian sparrowhawk *Accipiter nisus* were recorded and one merlin *Falco columbarius* and northern goshawk *Accipiter gentilis*. Waterfowl flocks were also not recorded in this month.

In addition to these target species, finches *Fringilidae* stand out by the number of recorded specimens and to a lesser extent, representatives of the crow family *Corvidae*. Members of all the listed species are due to their relatively low flying altitude at no collision risk with the wind turbine rotor blades.

February 2015

In February, for a total of 21 observations in both studied areas, members of 34 species were recorded. Of these, 5 species were target ones (Table 15). The number of species present in the studied and control area was 33 and 15, respectively. Altitude ranges of target species and number of findings are shown in Table 18. The order of species in the table corresponds to the descending number of findings in February.

Table 18. Overview of the number of overflights of the target species by vantage point and altitude range in February 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo		1	2	2	1						2	1	4									6	4	3	13
Falco tinnunculus				2									2									4			4
Casmerodius albus	1																					1			1
Circus cyaneus													1									1			1
Accipiter nisus																			1			1			1
Total flights per range	1	1	2	4	1						2	1	7						1			13	4	3	20
Total flights	4			5			0			3			7			0			1			20			
% critical flights	25%			20%			/			67%			0%			/			0%			20%			
№ of target species	2			2			0			1			3			0			1			5	1	1	

Of these target species, common buzzard *Buteo buteo* was the only more frequent species, while common kestrel *Falco tinnunculus* was rarely observed in this month - only 4 overflights. At the critical altitudes, only 4 out of 13 buzzard overflights were recorded, which is only 20% of the total number of overflights of the target species (Table 18). Overflights of the other three species - great egret *Casmerodius albus*, hen harrier *Circus cyaneus* and Eurasian sparrowhawk *Accipiter nisus* were recorded once each.

In addition to these target species, smaller flocks of common starling *Sturnus vulgaris* stand out by the number of recorded specimens, followed by finches *Fringillidae*. Members of all the listed species are due to their relatively low flying altitude at no collision risk with the wind turbine rotor blades.

March 2015

In March, for a total of 21 observations in both studied areas, members of 48 species were recorded. Of these, 5 species were target ones (Table 15). The number of species present in the studied and control areas was 45 and 24, respectively. Altitude ranges of target species and number of findings are shown in Table 19. The order of species in the table corresponds to the descending number of findings in March.

Table 19. Overview of the number of overflights of the target species by vantage point and altitude range in March 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	2	3	2	3	2	1		2	1	2	4		1	3	1		1		1	1		9	16	5	30
Falco tinnunculus				3				1		1			5	1								9	2		11
Circus aeruginosus	2			1									1			1						5			5
Accipiter nisus							1															1			1
Grus grus			1																					1	1
Total flights per range	4	3	3	7	2	1	1	3	1	3	4		7	4	1	1	1		1	1		24	18	6	48
Total flights	10			10			5			7			12			2			2			48			
% critical flights	30%			20%			60%			57%			33%			50%			50%			38%			
№ of target species	3			3			3			2			3			2			1			4	2	2	

Overflights of target species are once again by far the most numerous – common buzzard *Buteo buteo* (30), followed by common kestrel *Falco tinnunculus* with 2 times less overflights (11). Buzzards in this month had a higher number of overflights inside the critical zone. Among other target species, the first specimens of marsh harrier *Circus aeruginosus* migrating were recorded at the end of the second decade. On March 15, a smaller migrating flock of cranes *Grus grus* was recorded during higher overflight over VP1. Overflights of the last two species, as well as one overflight of the Eurasian sparrowhawk were recorded outside the critical range, thus beyond the reach of the imaginary future wind turbine rotor blades.

Of the other species, starlings still stand out by the number of specimens recorded similar to February. Bird migration during this month was not frequent, while larger migratory flocks were scarce.

April 2015

In April, for a total of 21 observations in both studied areas, members of 74 species were recorded. Of these, 7 species were target ones (Table 15). The number of species present in the studied and control areas was 71 and 39, respectively. Altitude ranges of target species and number of findings are shown in Table 20. The order of species in the table corresponds to the descending number of findings in April.

Table 20. Overview of the number of overflights of the target species by vantage point and altitude range in April 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	3	1	1	2	2		2	1		2	1	1	1	2			1		1		1	11	8	3	22
Falco tinnunculus				2									3						1			6			6
Circus aeruginosus	1						1			1			1									4			4
Falco subbuteo					1		1							1								1	2		3
Pernis apivorus						1																		1	1
Falco vespertinus													1									1			1
Accipiter gentilis					1																		1		1
Total flights per range	4	1	1	4	4	1	4	1		3	1	1	6	3			1		2		1	23	11	4	38
Total flights	6			9			5			5			9			1			3			38			
% critical flights	17%			44%			20%			20%			33%			100%			0%			29%			
№ of target species	2			5			3			2			5			1			2			5	3	2	

In this month, of the target species, the most numerous were the overflights of common buzzard *Buteo buteo*, followed by overflights of common kestrel *Falco tinnunculus*; however, they were almost three times lower than the buzzard overflights. They are followed by overflights of marsh harrier *Circus aeruginosus* and Eurasian hobby *Falco subbuteo*. Individual overflights of honey buzzard *Pernis apivorus*, blue-footed falcon *Falco vespertinus* and northern goshawk *Accipiter gentilis* were also recorded. In the critical zone, buzzards were the most frequent (8), followed by Eurasian hobby (2) and northern goshawk (1). In this month, migratory species such as honey buzzard, blue-footed falcon and Eurasian hobby appear for the first time.

In terms of flight altitude, skylark *Alauda arvensis* stands out among other species in this month. Males of this species during the mating dance, attraction of females and territorial marking perform vertical flights up to an altitude of 100 m, which may give rise to collision risks with the future wind turbine blades. In addition to field larks, flights of hoopoe *Upupa epops* in pairs and individually were also recorded, whereas grouping of the species members from the crow family *Corvidae* also commenced. In early April, last smaller migratory flocks of fieldfare *Turdus pilaris* were registered, while in mid-April first smaller migratory flocks of European bee-eater *Merops apiaster*. The first migratory flocks of the barn swallow *Hirundo rustica*, common house martin *Delichon urbicum* and common swift *Apus apus* were recorded in the first ten days of April. Other migratory species were recorded individually, not in compact flocks. At the beginning of the third decade, first examples of doves *Streptopelia turtur* were recorded. All of them due to the relatively low flight altitude are not at risk from potential collision with wind turbines in operation.

May 2015

In May, for a total of 21 observations in both studied areas, members of 68 species were recorded. Of these, 3 species were target ones (Table 15). The number of species present in the studied and control areas was 65 and 37, respectively. Altitude ranges of target species and number of findings are shown in Table 21. The order of species in the table corresponds to the descending number of findings in May.

Table 21. Overview of the number of overflights of the target species by vantage point and altitude range in May 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	1	4		1	3		1	1			4		1	2			2		1	1		5	17		22
Falco tinnunculus				5			1						4									10			10
Haliaeetus albicilla																				1			1		1
Total flights per range	1	4		6	3		2	1			4		5	2			2		1	2		15	18		33
Total flights	5			9			3			4			7			2			3						
% critical flights	80%			33%			33%			100%			29%			100%			67%			55%			
№ of target species	1			2			2			1			2			1			2			2	2	0	

Common buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* stand out according to the number of findings, however, their number is relatively small and it comes down to individual specimens, pairs and reproductive groups. Table 21 shows that buzzard mostly flew on critical altitudes (10), while all kestrel overflights were below the critical altitude zone. One specimen of white-tailed eagle *Haliaeetus albicilla* started flying from the control area to soon reach the critical altitude of some 100 m above ground.

Members of other bird species, primarily European bee-eater *Merops apiaster*, common starling Sturnus vulgaris, European greenfinch *Carduelis chloris*, barn swallow *Hirundo rustica* and common house martin *Delichon urbica* were also recorded individually or in small flocks or aggregations across the entire investigated location and the control area. Findings of the passing red-backed *shrike Lanius collurio* were also frequent, while the number of rooks *Corvus frugilegus* has also increased, who together with the their fledglings started to wander in search of food in small flocks. During this month, appearance of quail *Coturnix coturnix* was first recorded. For many birds species migration was in progress. Singing males of field lark *Alauda arvensis* were recorded on each of the observation zones in higher numbers than in the previous month.

June 2015

In June, for a total of 21 observations in both studied areas, members of 64 species were recorded. Of these, 4 species were target ones (Table 15). The number of species present in the studied and control areas was 59 and 36, respectively. Altitude ranges of target species and number of findings are shown in Table 22. The order of species in the table corresponds to the descending number of findings in June.

Table 22. Overview of the number of overflights of the target species by vantage point and altitude range in June 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	3	2	1	1	2		1	3		1			2	2			2		1	1		9	12	1	22
Falco tinnunculus	1			3	2		3						4									11	2		13
Ciconia ciconia					1															1			2		2
Falco subbuteo							1															1			1
Total flights per range	4	2	1	4	5		5	3		1			6	2			2		1	2		21	16	1	38
Total flights	7			9			8			1			8			2			3			38			
% critical flights	29%			56%			38%			0%			25%			100%			67%			42%			
Nº of target species	2			3			3			1			2			1			2			3	3	1	

During this month, reproduction period for most birds began. For this reason, almost all species were represented by nesting specimens. Members of the target species were usually recorded individually during overflights, search for food or prey. Table 22 shows that overflights of the buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* were again most abundant. However, their overflights in critical altitudes differ significantly, whereby overflights inside the critical zone were 5 times higher in favour of the buzzard. A total of 42% of overflights were in the critical zone. Overflights of white stork *Ciconia ciconia* were recorded for the first time.

For members of some species migration was still in progress, while smaller and medium-sized flocks were formed by juvenile specimens of the first annual hatch. This primarily includes barn swallow *Hirundo rustica* and common house martin *Delichon urbica*, as well as sparrows *Passer sp*. Singing territorial males of field lark *Alauda arvensis* were recorded on each vantage point similar to May.

July 2015

In July, for a total of 21 observations in both studied areas, members of 59 species were recorded. Of these, 4 species were target ones (Table 15). The number of species present in the studied and control areas was 58 and 31, respectively. Altitude ranges of target species and number of findings are shown in Table 23. The order of species in the table corresponds to the descending number of findings in July.

Table 23. Overview of the number of overflights of the target species by vantage point and altitude range in July 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	1	2	2	1	3			2		1	3		2	2			3		1	3		6	18	2	26
Falco tinnunculus	1			3	1		4			3	2		5	1					1			17	4		21
Falco subbuteo		1														1						1	1		2
Ciconia ciconia								1															1		1
Total flights per range	2	3	2	4	4		4	3		4	5		7	3		1	3		2	3		24	24	2	50
Total flights	7			8			7			9			10			4			5			50			
% critical flights	43%			50%			43%			56%			30%			75%			60%			48%			
№ of target species	3			2			3			2			2			2			2			3	4	1	

The reproduction period for most of the species ends late this month, while their roaming period starts before the autumn migration. Members of the target species were usually individually recorded during overflights or when they were searching for food or prey. Table 23 shows that overflights of the buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* were again the most numerous, however, their overflights on critical altitudes differ significantly, while there were 4 times more overflights inside the critical zone in favour of the buzzard. A total of 48% of overflights was inside the critical zone. Recorded members of the target species were registered individually during overflights, when they were searching for food or hunting for prey.

Members of other species were recorded mainly individually or in small flocks or aggregations. Among other interesting birds are turtledove *Streptopelia turtur* forming small flocks in the last decade of July, coinciding with the time of the last cereal crops harvest activities whose seeds are used as food by this species, and preparation for the start of the migration. Slightly larger flocks were again formed by barn swallows *Hirundo rustica* comprised mainly of young specimens.

August 2015

In August, for a total of 21 observations in both studied areas, members of 66 species were recorded. Of these, 7 species were target ones (Table 15). The number of species present in the studied and control areas was 61 and 39, respectively. Altitude ranges of target species and number of findings are shown in Table 24. The order of species in the table corresponds to the descending number of findings in August.

Table 24. Overview of the number of overflights of the target species by vantage point and altitude range in August 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	1	4	2	2	1	1	1	3		3	2		4	3		1	4			1		12	18	3	33
Falco tinnunculus				5			2			5	1		2	3					2			16	4		20
Circus aeruginosus	1							1		1												2	1		3
Falco subbuteo								1			1												2		2
Ciconia ciconia		1																					1		1
Circus pygargus				1																		1			1
Accipiter gentilis				1																		1			1
Total flights per range	2	5	2	9	1	1	3	5		9	4		6	6		1	4		2	1		32	26	3	61
Total flights	9			11			8			13			12			5			3			61			
% critical flights	56%			9%			63%			31%			50%			80%			33%			43%			
№ of target species	3			4			4			4			2			1			2			5	5	1	

Members of the target species were recorded mainly individually during overflights, when they were searching for food or prey. A total 61 overflights of the target species was recorded. Buzzards *Buteo buteo* and common kestrel *Falco tinnunculus* had constant and numerous overflights, however, in smaller numbers. Data show that the western marsh harrier *Circus aeruginosus* has begun to wander who completed its reproduction period, while the hen harrier *Circus cyaneus* whose migration begins at the end of the second decade of this month was recorded for the first time. White stork *Ciconia ciconia* in this month gradually ends its wandering and starts to migrate. Buzzards had by far the most overflights inside the critical zone, they are followed by the common kestrel, although on a much smaller scale.

Members of other species were recorded mostly individually, however, some have begun to group together into medium-sized and large flocks. Doves *Streptopelia decaocto* and turtledoves *Streptopelia turtur* formed small but frequent flocks which have roamed the fields dwelling on the ones where wheat was harvested, and used power lines to rest. Large monotype flocks of the European bee-eater *Merops apiaster* were recorded, together with the mixed flocks of barn swallows *Hirundo rustica* and sand martins *Riparia riparia*. Grouping of flocks of house and tree sparrows, *Passer domesticus* and *Passer montanus* was also noticed. Mainly individual specimens of red-backed shrikes *Lanius collurio* were more frequent given that their migrations have started. All of these species were flying at altitudes up to 50 m.

September 2015

In September, for a total of 21 observations in both studied areas, members of 60 species were recorded. Of these, 5 species were target ones (Table 15). The number of species present in the studied and control areas was 53 and 42, respectively. Altitude ranges of target species and number of findings are shown in Table 25. The order of species in the table corresponds to the descending number of findings in September.

Table 25. Overview of the number of overflights of the target species by vantage point and altitude range in September 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo		2	1	1	3		1	3		1	3		1	2		1	2		1	1		6	16	1	23
Falco tinnunculus	2			5			3	1		4			7						1			22	1		23
Circus aeruginosus	1			2			1			1												5			5
Ciconia nigra															1									1	1
Pernis apivorus					1																		1		1
Total flights per range	3	2	1	8	4		5	4		6	3		8	2	1	1	2		2	1		33	18	2	53
Total flights	6			12			9			9			11			3			3			53			
% critical flights	33%			33%			44%			33%			18%			67%			33%			34%			
№ of target species	3			4			3			3			3			1			2			3	3	2	

Recorded members of the target species were mainly recorded individually, during overflights, when they were searching for food or prey. Table 25 shows that in this month, 23 overflights of buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* each were recorded, of which inside the critical zone 16 buzzards and only 1 common kestrel. With the end of the reproduction season inside the studied area, an increased number of buzzard *Buteo buteo*, common kestrel *Falco tinnunculus* and western marsh harrier *Circus aeruginosus* was recorded, while black stork *Ciconia nigra* and honey buzzard *Pernis apivorus* were recorded during migration.

Some significant phenomena were registered for other species. Earlier this month, last migration flocks of quail *Coturnix coturnix*, European bee-eater *Merops apiaster* were recorded, as well as the last mixed flocks of three swallow species. Members of the species *Streptopelia decaocto* have formed small flocks of up to 30 specimens, as well as turtle doves *Streptopelia turtur*. Smaller flocks and single specimens of multiple songbird species were also registered. There were also groups of house sparrows *Passer domesticus* and tree sparrows *Passer montanus*, as well as different species of crows *Corvidae* in mixed flocks. Flocks of all these species have flown on altitudes of up to 50 m.

October 2015

In October, for a total of 21 observations in both studied areas, members of 60 species were recorded. Of these, 6 species were target ones (Table 15). The number of species present in the studied and control areas was 54 and 32, respectively. Altitude ranges of target species and number of findings are shown in Table 26. The order of species in the table corresponds to the descending number of findings in October.

Table 26. Overview of the number of overflights of the target species by vantage point and altitude range in October 2015. The order of species is given according to the decreasing number of overflights.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	2	2	1	2	3	1		3		1	2		2	2		2	2	1		1		9	15	3	27
Falco tinnunculus				4	1		2			4			6									16	1		17
Circus cyaneus	1						1				1		1									3	1		4
Accipiter nisus	1												1			1						3			3
Cygnus olor									1															1	1
Grus grus			1																					1	1
Total flights per range	4	2	2	6	4	1	3	3	1	5	3		10	2		3	2	1		1		31	17	5	53
Total flights	8			11			7			8			12			6			1			53			
% critical flights	25%			36%			43%			38%			17%			33%			100%			32%			
Nº of target species	4			2			4			3			4			2			1			4	3	3	

Recorded members of the target species were mainly recorded individually, during overflights, when they were searching for food or prey. Members of the three target species flew at critical altitudes (32% of the total number of overflights), yet at the same time, the number of findings and number of specimens was again the highest in the case of buzzards *Buteo buteo*. Marsh harrier *Circus aeruginosus* was not registered, however, individual specimens of hen harrier *Circus cyaneus* and Eurasian sparrowhawk *Accipiter nisus* were present. One small flock of 11 specimens of common crane *Grus grus* was registered during overflights over VP1.

Among other species, more frequent smaller and medium-sized flocks of different species of finches from the family *Fringillidae*, and smaller flocks of sparrows *Passer sp*. were identified.

November 2015

In November, for a total of 21 observations in both studied areas, members of 41 species were recorded. Of these, 4 species were target ones (Table 15). The number of species present in the studied and control areas was 37 and 27, respectively. Altitude ranges of target species and number of findings are shown in Table 27. The order of species in the table corresponds to the descending number of findings in November.

Table 27. Overview of target species overflights per vantage point, altitude range in November 2015

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	3	2		1	2		2	2	1	2	1		3	2		2	2		1	1		14	12	1	27
Falco tinnunculus	1			7			2			6			4	1								20	1		21
Circus cyaneus	1									1			1									3			3
Accipiter nisus																			1			1			1
Total flights per range	5	2		8	2		4	2	1	9	1		8	3		2	2		2	1		38	13	1	52
Total flights	7			10			7			10			11			4			3			52			
% critical flights	29%			20%			29%			10%			27%			50%			33%			25%			
Nº of target species	3			2			2			3			3			1			2			4	2	1	

Buzzard *Buteo buteo* and common kestrel *Falco tinnunculus* dominated by the number of overflights in November. In critical areas, buzzard was most frequent. Other examples of target species were flying below the altitude of 50 m.

Among the other species on the studied location, mixed flocks of species belonging to the crow family *Corvidae* were grouped into smaller flocks. Birds of the finch family *Fringilidae* continue to flock together with ordinary finches *Fringilla coelebs* dominating. Flocks of goldfinches *Carduelis carduelis* and European greenfinch *Carduelis chloris* were also large. Yellowhammer *Emberiza citronella* and meadow pipit *Anthis pratensis* have also started to group together.

Figure 30. Mixed flock of members of the crow family *Corvidae*. Photo: Milan Paunovic, original

Bionomy, flight methods and directions of the target species at the studied location

This section examines the biological status, phenology and overflight directions and method of the target species or species considered to be particularly vulnerable to wind farm construction and operation, decidedly significant in terms of national and/or international preservation and protection status. Tables containing target species overflight per vantage point are given in Appendix 1 at the end of the study. Maps of the area, containing all overflights of the target species are given in Appendix 2. Critical overflights were highlighted on the maps estimated to be within the range of the future wind turbine rotor blades.

Mute swan *Cygnus olor*

Two specimens of this species were recorded during a high overflight, above the critical altitude range, on 31 October 2015, not far from VP4. Birds were flying in a straight line due southwest. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Great egret *Casmerodius albus*

Individual specimens of this species were observed in December 2014 and early February 2015, from VP1 towards the ash landfill. Birds were either standing on the ground or flying away towards the Mogila River or flying very low, only a few meters from the ground, moving in different directions from one position in search for food or rest. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Black stork *Ciconia nigra*

Only one overflight of 4 members of this species was recorded on 20 September 2015. Their overflight was above the critical altitude range at the level of VP5. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

White stork *Ciconia ciconia*

A total of 5 specimens during 4 observations were recorded in June, July and August on VP1, VP2 and VP3 and VP7 inside the control area. All the overflights were inside the critical altitude zone, including the control area. Storks inside the area in question were present during the migration period, while they were very rare throughout the nesting period when they search for food on alfalfa fields and other low crops, as well as wetlands. A very small number of findings was caused by the lack of optimal feeding conditions. Due to the small number of findings and low numbers, potential vulnerability by the future wind farm infrastructure was not recognized. Single nests were located in villages located around the perimeter of the studied locations in Cirikovac, Klenovnik and Drmno, in a nearby settlement of Kostolac - a total of 2. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

European honey buzzard *Pernis apivorus*

A total 2 of specimens during 2 observations were recorded during overflight only throughout the migration period, in April and September, both on VP2. The specimen from April flew above the critical wind turbines collision zone, while the specimen from September flew inside the critical altitude zone. During the spring migration, it was recorded in early April, while during the autumn migration, from late August until the end of the second week of September (Puzovic ed. 2000). At the studied area, no nesting members of this species were recorded, due to the lack of adequate forest habitats, although it is probable on the surrounding habitats with large forests. For this reason, it is considered as the nesting bird of the wider area (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Figure 31. European honey buzzard *Pernis apivorus*. Photo: Milan Paunovic, original

Western marsh harrier *Circus aeruginosus*

Members of this species (Figure 20) were flying low individually over the entire studied area in the spring, from mid-March to the end of May and the end of summer and in autumn, from late August to mid-October, where they were regularly looking for prey - rodents. A total of 17 samples was registered on 17 occasions. They were recorded flying almost exclusively at altitudes up to 50 m (94% of overflights). Most findings were on VP1 (n = 4), followed by VP3 (n = 3), and VP4 (n = 3). Inside the studied area, no nesting members of this species were recorded, as there are no suitable wetland habitats, although it is evident in the surrounding waterlogged habitats with larger reed zones, making it a nesting bird of the wider area (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Hen harrier *Circus cyaneus*

Members of this species were recorded flying low in February during spring migration, while during the autumn migration and winter roaming they were observed in October and November. The frequency and number of overflights was small with only individual specimens observed. A total of 8 specimen was recorded on 8 overflights. Of these, 7 overflights were at heights up to 50 m, and only 1 in the lower part of the critical range of 50 to 100 m. It does not nest in Serbia (Puzovic ed. 2000). Throughout the colder period of the year, from autumn to spring, individual specimens in the surroundings were recorded Vasic et al. (2012). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Montagu's harrier *Circus pygargus*

One specimen of this species was recorded in August on VP2. Overflight was at the altitude below 50 m. It is a rare nesting bird of northern Banat and southwestern Serbia where on the Sjenica - Pester Plateau one nesting example was recorded (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Northern goshawk *Accipiter gentilis*

During the 3 recorded overflights, 3 specimens were registered. The findings were recorded in January on VP7 inside the control area, in April on VP2 and in August on VP2. Flight altitude in August was mainly up to 50 m, and in January and April inside the critical zone. It nests regularly in the entire Serbia, while nesting in the study area was not recorded. For this reason, it was classified into the potential nesting category. Inside the wider area around the studied area, it is considered to be a certain nesting bird (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Eurasian sparrowhawk *Accipiter nisus*

It is similar to the Northern goshawk, however, it is more frequent in the medium height vegetation as it hunts from ambush. A total of 9 specimens was recorded on 9 overflights, in the period from December to March and in October and November. All overflights were at the altitude below 50 m, i.e. below the critical zone. Although it is a regular nesting bird of the surrounding area (Puzovic ed. 2000), evidence of nesting both at the studied location and its immediate vicinity was not found, probably for the same reasons as the Northern goshawk. However, owing to nesting probability at the Petka location (VP2), it was classified into the potential nesting birds. Both males and females were recorded. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

White-tailed eagle *Haliaeetus albicilla*

Only one specimen of this species was recorded on 3 May on VP 7 flying from the control area due east. For about 1 observation minute, it reached the altitude of about 100 m, which corresponds to the critical flight zone. It is a regular, but less frequent nesting bird of Serbia, primarily Vojvodina (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Buzzard *Buteo buteo*

Buzzard (Figure 29) is one of the two most common species in the area, whose representatives were recorded during almost every field visit. It was mostly individual specimens, couples, potential partners or family groups flying in circles in search of prey, resting and using individual structures as observation points - trees, shrubs, or even hillocks. During the 252 observations, the presence of 413 specimens during 286 overflights was registered. Most specimens were recorded during the migration period, in March, before the reproduction period, and in July and August, after the reproduction period when birds wander, and the first days of the autumn migration period. It was recorded in a range of altitudes, from the surface to about 250 m above ground. Inside the critical altitude zone, a total of 147 flights was recorded (about 51% of the total number of overflights). Findings presented in Appendix 1 may not be seen on a map in Appendix 2 due to the large number of overflights that could not be clearly presented. Overflights were relatively uniformly recorded on VPs. It is a certain nesting bird of the wider area around the study area, but nests have also been found in neighbouring areas (Puzovic ed. 2000). Five nests were discovered - 2 at the site Petka location and 1 each at the Cirikovac, Drmno and the control area.

Merlin *Falco columbarius*

Only one specimen flying low was recorded in VP3 on 8 January. It nests in the northern regions of Europe, while in Serbia, a regular small number of individual specimens occurs during the winter (Puzovic ed. 2000). Findings presented in Appendix 1 may be seen on a map in Appendix 2. This minor number of species findings whose representatives seek prey near the ground indicates that they cannot be affected by the wind farm construction and operation.

Blue-footed falcon *Falco vespertinus*

Three specimens were observed flying low over the ground and hunting around VP5 on 27 April. Findings presented in Appendix 1 may be seen on a map in Appendix 2. It is a regular, but rare nesting bird of Serbia, primarily Vojvodina (Puzovic ed. 2000).

Eurasian hobby *Falco subbuteo*

Members of this species were recorded inside the studied location from late April until late August, mostly individual specimens on all VPs, mostly on VP3. Nests were not discovered inside the studied location, although it is considered as the probable nesting bird of the surrounding area (Puzovic ed. 2000). For this reason, it was classified as a potential nesting bird inside the studied location. Flight altitude of almost all Eurasian hobbies was almost equally above and below 50 m (3: 5), when birds observed the area or hunted prey. A total of 8 overflight and 8 specimens was recorded. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Common kestrel *Falco tinunnculus*

Alongside buzzards, common kestrel (Figure 4) is the second most frequently recorded species in the area. During a total of 252 observations, 202 specimens were recorded during 164 overflights. It was registered in a wide range from the ground up to 150 m in height. It frequently used larger solitary trees and various infrastructure for rest, observation and hunting, similar to buzzard. Number of flights below the critical zone was over 90%, much more than the number of flights in the critical zone which was below 10% (in the radio of 148: 16), while no overflights were recorded above the critical altitude zone. Nesting was recorded at the studied location during the study period, which is in line with existing data (Puzovic ed. 2000) on certain nesting in the region of the Peripannonian Serbia. Nesting success rate inside and around the studied area was not verified, however, five active nests were observed - 3 at the Drmno location and 2 at the Petka location. Findings from Appendix 1 are not mapped in Appendix 2 due to the large number of overflights that could not be clearly presented.

Common crane *Grus grus*

Overflights of small flocks of these birds (Figure 32) were recorded over the respective locations on 2 occasions, on 15 March and 10 October. Overflight height was high, above 200 m, VP1. Overflight of 34 specimens was recorded in total (23 + 11). Cranes were once nesting birds of Serbia. Findings presented in Appendix 1 may be seen on a map in Appendix 2.

Figure 32. Small flock of common cranes *Grus grus* on VP1. Photo: Milan Paunovic, original

Spatial and environmental analysis

Habitats inside the future wind farm area contain very poor indigenous forest vegetation and aquatic and wetland habitats, although fragments and elements here do exist. However, they are dominated by a very specific set of ruderal plant communities in different stages of succession (from rare herbaceous vegetation to shrubs and bushes) and to a lesser extent, relatively young anthropogenic forest plantations (resulting from overburden dump re-cultivation), while agrocoenoses are present only in fragments. The largest area is occupied by uncultivated land overgrown in weed, representing to a certain level regenerated areas similar to the natural steppe and forest-steppe habitat. Inside the studied (and control) area there is a number of mosaic-like habitats, many of which covering a relatively small area, directly influencing the composition of bird species, as birds prefer to stay and feed close to or above water bodies and forests. Each of the four locations foreseen for wind farm development is specific, wherefore a generalized description of the structure of their habitat may not be provided. However, it is evident that such a mosaic-like arrangement of small areas of different types of habitats is most preferred by small singing birds, while it is mostly unfavourable for herons, storks, and waterfowl. Naturally, there are exceptions, and these are the types with a wider habitat valence. In the case of storks and herons, this is the grey heron *Ardea cinerea*, and in the case of waterfowl, mallard *Anas platyrhynchos*. However, due to its population status, endangerment status and position in national and international legislation in the field of nature protection, these two species are not listed as target species and will therefore not be elaborated.

Throughout the investigation period, a total of 252 observations was carried out, with 322 hours of surveys on VPs and 104 hours of nest search during 36 field days. This was used to create an image about the state of the studied fauna elements and habitats and as the basis to analyse the data collected. Recorded 119 bird species at the studied location, with 120 inside the entire study area, which includes the study and control areas, clearly point towards a qualitatively relatively high diversity of bird fauna (Table 7), however in quantitative terms, the number of specimens was rather small as expected. At the studied location, the number of species was equally recorded, although most on VP1 (n = 88), and least on VP5 (n = 58). Other VPs have similar values of the number of recorded species (VP1 n = 87, n = 3 VP3 = 72, VP 4 n = 79) (Table 9, see Map 2 for VP positions). This leads us to a conclusion that the cause of this uniformity should be sought in the uniformity of neglected habitats and overburden dumps at the studied location, the absence of major and constantly damp, forest and forest-steppe habitats, considerable distance of major water bodies, relatively frequent presence of people and agricultural and mining machinery in habitats. All of the above features make the studied location not optimal for the retention of many bird species, especially its use during breeding. On the other hand, some taxa and ecological groups of birds inside the studied area, permanently or seasonally, find abundant trophic resources, which causes their seasonal retention in relatively large numbers. This is primarily related to diurnal birds of prey feeding on small rodents and species of small songbirds finding inside the habitats of the study area plenty of food, hiding and nesting places.

Table 28 provides an overview of target species and their overflights by vantage point and three altitude ranges. Most overflights of the target species occurred on VP5, slightly less on VP2, followed by VP1 and VP4. The number of recorded overflights inside the critical zone above 50 and below 180 m from the ground is the largest around VP3 and VP4, where it is 42 to 37% of the total number of overflights for each VP, while in the area of VP1 and VP3 this percentage is lower - from 25 to 33%. Estimation was also done for target species in the control area, however, it is not considered here, as it serves only for comparison purposes.

Table 28. Overview of the number of overflights of target species per vantage point and altitude ranges.

Species	VP1			VP2			VP3			VP4			VP5			VP6			VP7			TOTAL			
	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	<	K	>	Σ
Buteo buteo	18	25	13	24	23	5	10	24	4	17	24	3	25	21	3	8	20	1	7	10	1	109	147	30	286
Falco tinnunculus	7			44	4		18	2		24	3		50	7					5			148	16	0	164
Circus aeruginosus	5			3			2	1		3			2			1						16	1	0	17
Accipiter nisus	3						1			1			1			1			2			9	0	0	9
Circus cyaneus	2						1			1	1		3									7	1	0	8
Falco subbuteo		1			1		2	1			1			1		1						3	5	0	8
Casmerodius albus	4																					4	0	0	4
Ciconia ciconia		1			1			1												1		0	4	0	4
Accipiter gentilis				1	1															1		1	2	0	3
Pernis apivorus					1	1																0	1	1	2
Grus grus			2																			0	0	2	2
Ciconia nigra															1							0	0	1	1
Cygnus olor									1													0	0	1	1
Haliaeetus albicilla																				1		0	1	0	1
Circus pygargus				1																		1	0	0	1
Falco vespertinus													1									1	0	0	1
Falco columbarius							1															1	0	0	1
Total flights per range	39	27	15	73	31	6	35	29	5	46	29	3	82	29	4	11	20	1	14	13	1	300	178	35	513
Total flights	81			110			69			78			115			32			28			513			
% critical flights	33%			28%			42%			37%			25%			63%			46%			35%			
№ of target species	9			8			9			6			8			4			6			11	9	5	

Summary of species findings by altitude ranges and their descending order according to the total number of findings is given in Table 28. As evident from the table, by far the largest number of findings belong to buzzards *Buteo buteo* and common kestrel *Falco tinnunculus* - 286 and 164 overflights. Members of four species follow with significantly fewer findings - marsh harrier *Circus aeruginosus* (17), Eurasian sparrowhawk *Accipiter nisus* (9), hen harrier *Circus cyaneus* (8) and Eurasian hobby *Falco Subbuteo* (8). Other findings/overflights of target species were recorded less than 5 times during one year of survey, and their presence at the location may be considered highly insignificant.

Generally speaking, the most common altitude range of most species is up to 50 m - a total of 300 findings, and from 50 to 200 m - 178 findings (Table 28). The maximum daily number of registered target species is really small (see table in Appendix 1). For this reason, it may not be concluded that they are concentrating inside the studied area. Of the total of 513 of the recorded target species overflights, 178 were inside critical altitude zone of 60 to 180 m above the ground, which is only about 35%. The largest number of target species overflights - 65% was recorded in the altitude zone up to 50 m and 200 m above the ground, which is not critical when it comes to possible risks from wind turbine rotor blades. Number and percentage of flights on critical altitudes per vantage point are given in Table 28. The data obtained on the basis of one-year survey allows us to assess that that the studied location largely meets the bird security criterion, especially target species, when it is used for wind farm development and operation, and that the habitat state and quality do not have any greater significance for bird life, as they do not provide optimal conditions for their life and retention, especially not for the majority of target species. From the biological viewpoint, main features are significant presence of trophic resources for birds of prey and granivorous species. Periodically, especially after harvests and planting of weeds and grass on reclaimed overburden, prey of diurnal raptors - small rodents may have optimal living conditions and greater abundance inside the studied area. During the harvest, in agricultural habitats of the studied location, significant amount of grain and other agricultural fruit remains attracting the granivorous species of birds, as well as small rodents eaten by the birds of prey.

The most sensitive survey subjects are birds of prey belonging to endangered species because of which they are mainly under the strict protection regime. Of the 17 target species, 12 belong to the diurnal birds of prey. The larger birds of prey such as imperial eagles *Aquila heliaca*, were not recorded at the studied location during this survey, while the white-tailed eagle *Haliaeetus albicilla* was not observed at the studied location, but only once, on VP7 inside the control area. The same goes for the booted eagle *Aquila pennata* whose findings have become frequent recently in southern Banat (Tucakov et al. 2005, Vucanovic et al. 2010, personal data of the authors). Specimens of the saker falcon *Falco cherrug* were also not found.

The presence, however, of a large number of specimens of small rodents (*Rodentia*) and insectivores (*Lipotyphla*) in agrocoenoses of the studied location attracts a large number of diurnal birds of prey such as buzzards, kestrels and harriers. For this reason, their numbers is prevailing, as evidenced by the increasing number of findings of the members of these bird species relative to other target species (Table 28). From the diurnal birds of prey, the most frequent were the buzzard *Buteo buteo* and common kestrel *Falco tinnunculus*, while individual overflights of the Western marsh harrier *Circus aeruginosus* were relatively frequent. Northern goshawk *Accipiter gentilis* and Eurasian sparrowhawk *Accipiter nisus* were constantly present in small numbers, while the Eurasian hobby *Falco subbuteo* was also constantly present, though only in a small number throughout the warmest time of the year.

Many birds of aquatic habitats, primarily geese (*Anseriformes*) were not recorded, while the overflights of the great cormorant *Phalacrocorax carbo* were very rare, suggesting that the studied location does not contain their optimal habitats, or that it is not in the direction of their important flight corridor. From the *Ciconiidae* family, white stork *Ciconia ciconia* and black stork were recorded only a few times or only once, while only the grey heron, *Ardea cinerea* was recorded more often. However, due to its status, this species was not classified as a target species. From nocturnal predators - owls (*Strigiformes*) inside the studied area, the presence of four species was recorded, whose sounds were registered in the spring during the bat fauna surveys.

Figure 33. Small flock of turtledoves *Streptopelia turtur*. Photo: Milan Paunovic, original

Among other birds occurring more frequently, the European bee-eater *Merops apiaster* and starling *Sturnus vulgaris* should be singled out, as well as small flocks of turtledoves *Streptopelia turtur* in July and later. The height of their flight ranges from the ground up to 50 m above ground, with rare exceedances of this altitude which is why they cannot be characterized as potentially affected by the wind turbine blades. Often, especially in autumn, smaller and medium-sized flocks of different species of finches (*Fringilidae*), sparrows (*Passer sp*.) were registered, as well as the mixed small flocks of several swallows species (*Hirundo rustica*, *Riparia riparia*, *Delichon urbicum*), and several flocks of several crow species (*Corvidae*), wandering the fields outside the reproduction period or during migration. Habitats of the studied location are favoured by the Eurasian skylark *Alauda arvensis* and crested lark *Galerida cristata* during the breeding period when the presence of a large number of males was noticeable guarding their territory, but also outside this period, when birds were grouped in small and medium-sized flocks. The presence, habits, behaviour and flight altitudes by other species and their numbers are not important for this discussion.

Impact of the location landscape and its immediate surroundings on bats

This survey has unequivocally established that bats are constantly present in the future wind farm locations, in their immediate vicinity, as well as inside the control area, although on the actual locations, particularly outside of urban areas and at greater distances from them, in smaller numbers. In this section, survey results will be analysed from the ecological point of view. Based on the data collected, we will attempt to give as exhaustive answer as possible to the question what is the ecological function and significance of the wind farm location and its immediate surroundings, i.e. landscapes and habitats, for the existing bats, i.e. in what way the present bats use areas and habitats of the location to meet their needs. This analysis will focus on the presence of the vital living functions of bats at the location and its immediate surroundings potentially influenced by the wind farm construction and operation.

In addition to the constant presence of bats, transects conducted from April to November 2015 demonstrated that the location and its immediate surroundings were characterised by ongoing bat activity during this period, i.e. throughout the entire period of the year during which bats are active. Moreover, although the bat activity registered on transects during this survey when the entire investigated area is concerned may be characterized as high, this activity in most of the actual wind farm locations is considerably lower. We can say that this result was expected from the aspect of initial estimates of the relative poverty of environmental resources formulated on the basis of preliminary environmental analysis. High overall activity of bats at the periphery and in the vicinity of locations (villages and other high urbanization level areas) results from abundance of trophic - cryptic resources, expected and confirmed during this survey, in this part of the studied area. Occasionally high bat activity at single locations may be explained by abundance of trophic resources established throughout this survey in the largest part of the locations and confirmed existence of cryptic resources, negligibly inside the locations, but to a much higher extent in their immediate vicinity.

Figure 34. Rolling anthropogenic relief and specific set of ruderal and dense bushy – woody vegetation is also present inside the control area. Photo: Marko Rakovic, original.

To allow easy comparison of the **activity intensity** in different spatial and temporal frames, a standardised temporal measure will be used - **activity index** - representing the total number of registered overflights in a certain area and/or period divided by the total effective length of the transect in this space and/or time.

For ease of comparison, bat **activity index categorisation** will be used, either in space or time, adapted to the ecological conditions existing in Serbia:

- Less than 1 overflights per hour - **very low**,
- 1 to 5 overflights per hour - **low**,
- 5 to 10 overflights per hour - **moderate**,
- 10 to 30 overflights per hour - **high**,
- More than 30 overflights per hour - **very high**.

As a measure of the relative **number of species** inside a certain space and/or period, the **percentage share** of overflights will be used identified as belonging to a particular species (i.e. group of species) in the total number of overflight/contacts in this space and/or period.

To facilitate easer analysis of the spatial differences in the registered activity intensity compared to the ecological characteristics of the study area and the potential wind farm project plan, specific spatial-ecological units were singled out, repeatedly mentioned previously - wind farm locations, their immediate surroundings and the control area. **Wind farm locations** will here mean the area covered by transects 2, 3, 4 and 5 (light blue, red, orange and purple lines marked with corresponding numbers in Figure 25), all census points on wind turbine positions (yellow dots marked VG01-VG20 in Figure 25) and locations: Cirikovac location - transect 2 and VG11-VG14, Petka location transect 3 and VG08-VG10, Klenovnik location - transect 4 and VG15-VG20, Drmno location transect 5 and VG01-VG07. Locations are generally less urbanized areas containing overburden dumps of the closed open cast mines with a specific set of open ruderal vegetation and mostly young dense woody-shrub vegetation, also containing urban elements, forests, agrobiocenoses and wetland habitats. The **immediate surroundings** mean an area covered by transect 1 (light green line in Figure 25) - highly urbanised area between Petka and Cirikovac locations including part of the Cirikovac mine management complex and a segment of the state IIA order road between Pozarevac and Kostolac. The **control area** means an area covered by transect 0 (dark green line in Figure 25) and all census points inside this area (light yellow points marked K1-K7 in Figure 25) - an area ecologically similar to the locations, but with a slightly more distinct influence of indigenous aquatic, wetland and forest habitats generally placed in the surrounding area, and only peripherally inside this area, as well as the nearby settlements also only peripherally.

Temporal and spatial dynamics of bat activity

It is obvious that (Appendix 3, Table 29, Diagram 1) both at the location and its immediate vicinity there are quantitative differences in the registered activity in time - between different parts of the same night, between nights during the same month, between months during the entire season, and in space - between the transects and census points, as well as among transects/locations and census points/wind turbine positions, and, in particular, between the spatial ecological units (locations, their immediate surroundings and control area). In this section, these differences in the registered activity recorded inside the investigated area will be analysed in order to draw conclusions about the regularities existing in the temporal and spatial dynamics of bat activity. Regularities in the dynamics of activities specific to individual species, due to their bionomic and ecological characteristics, will be analysed under a separate section below to review the ecological function of the location, its immediate surroundings and control area specific for these species.

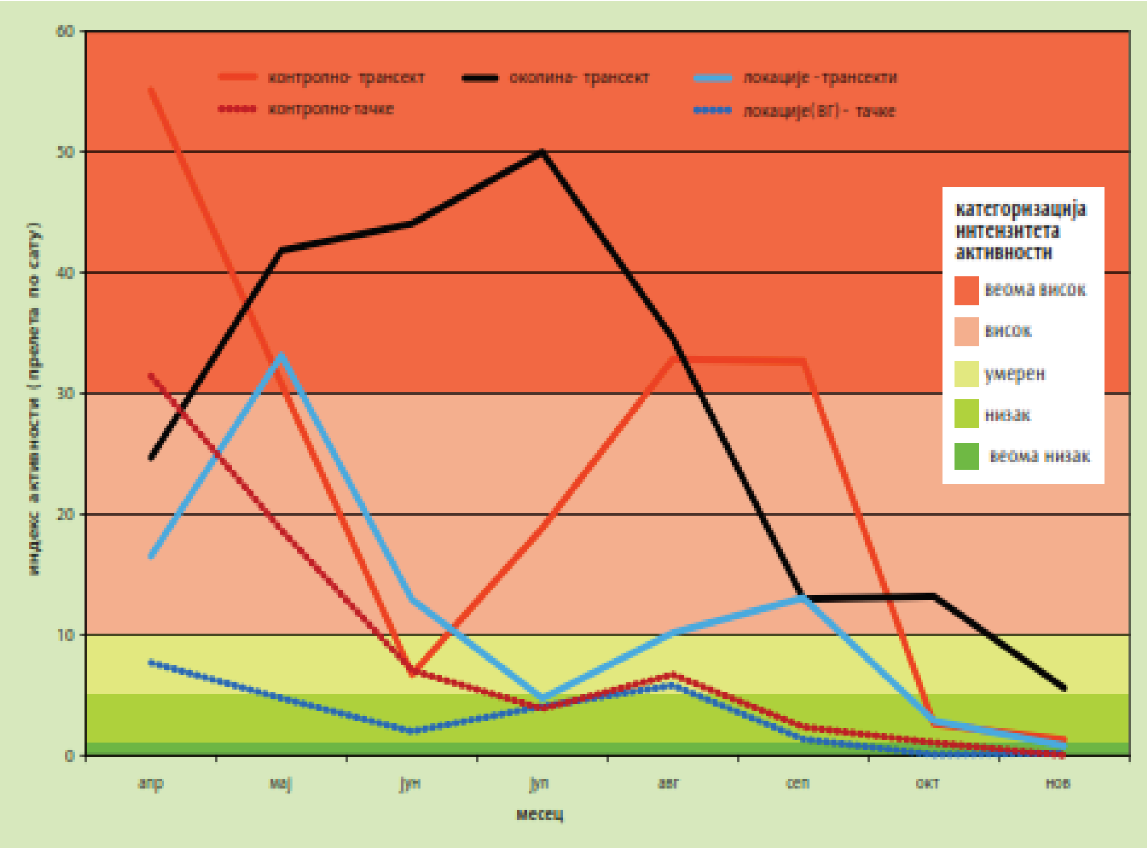

Diagram 1. Bat activity index per month and spatial – ecological units.

It has already been stated that during the period covered by this survey inside the entire study area, i.e. both at the wind farm locations, their immediate surroundings and the control area, there is constant bat activity, registered on transects and census points (Table 29, Figure 1).

Table 29. Bat activity index (average number of overflights per transect/census point) including categorisation (colours identical to the ones on Diagram 1) per months and census points/transects and spatial/ecological units and minimum number of registered species per month. Empty cells represent periods with no activity registered (overflights per hour) for the sake of clarity.

Location		Apr	May	June	July	Aug	Sep	Oct	Nov	Total
Control area	K1	5.88	5.86	6.93	1.94	1.84	1.00	0.99		2.74
	K2	13.55	17.47	9.04	2.62	2.56	3.57	0.61		5.55
	K3	45.05	67.49	9.86	1.48	1.54	1.90	1.06		14.48
	K4	46.05	18.12	4.93	11.41	20.78	6.24	2.05		12.69
	K5	23.22	7.92	9.98	4.90	3.79	0.90	0.99		5.86
	K6	80.03	11.39	4.46	2.51	3.17	1.72	0.46		12.14
	K7	6.28	2.50	4.11	2.28	13.21	1.18	1.22		3.55
	Total	**31.44**	**18.68**	**7.05**	**3.88**	**6.70**	**2.36**	**1.05**	**0.00**	**8.14**
Drmno	VG01	4.17	1.84	4.01	2.01	9.70	1.18			2.63
	VG02	4.87	3.68	0.71	0.33	5.46	0.51		0.07	1.81
	VG03	3.68	5.41	1.89	44.28	6.50	0.76		0.29	6.73
	VG04	2.88	1.62	2.71	1.78	11.68	1.69		0.07	2.63
	VG05	4.77	1.73	1.18	2.90	7.06	2.70		0.07	2.40
	VG06	4.47	3.46	7.54	2.01	17.05	1.60		0.14	4.17
	VG07	1.59	3.14	6.37	1.00	9.04	2.03	0.15	0.07	2.67
Petka	VG08	34.89	4.43	6.26	5.82	1.03	0.85	0.32	0.72	6.24
	VG09	1.78	2.10	0.59	3.58	2.54	0.93	0.08	0.14	1.35
	VG10	2.47	12.07	3.43	1.90	7.23	1.02		0.57	3.24
Cirikovac	VG11	1.48	1.66	4.02	4.59	4.23	0.34		0.36	1.86
	VG12	4.15	17.82	0.24	0.34	2.16	0.34			2.75
	VG13	13.54	16.27	0.59	1.23	3.85	1.27	0.16	0.29	4.24
	VG14	4.45	0.55	0.24	1.90	0.85	0.42		0.07	0.98
Klenovnik	VG15	9.82	1.91		1.59	3.23	1.36	0.08	0.07	2.11
	VG16	14.92	1.80		0.57	2.63	1.02	0.08	0.07	2.47
	VG17	7.81	2.81		0.34	2.42	2.12	0.15	0.29	1.90
	VG18	13.32	6.07		3.53	2.32	1.95	0.08	0.22	3.16
	VG19	13.92	2.81		0.68	2.22	2.04	0.30	0.07	2.60
	VG20	4.63	3.82		0.91	15.16	2.79	0.08	0.14	3.33
Location (VG) total		**7.68**	**4.75**	**1.99**	**4.07**	**5.82**	**1.35**	**0.07**	**0.19**	**2.96**
Locations	2 Cirikovac	35.6	91.4	5.3	3.6	11.9	6.8	2.0	0.4	19.4
	3 Petka	12.8	46.2	35.3	4.2	16.0	14.9	4.1	2.6	16.7
	4 Klenovnik	18.1	12.8	5.9	2.2	4.6	26.4	5.0	0.9	9.6
	5 Drmno	3.8	13.3	16.5	8.0	12.7	2.1	0.8	0.3	7.1
	Locations total	**16.5**	**33.2**	**12.9**	**4.7**	**10.2**	**13.1**	**2.9**	**0.8**	**11.7**
1 surroundings		24.7	41.8	44.1	50.0	34.6	13.0	13.2	5.6	26.6
0 control area		55.1	30.8	6.7	18.8	32.8	32.7	2.6	1.3	23.0
Transects total		**25.4**	**32.9**	**12.6**	**9.7**	**16.2**	**17.2**	**3.3**	**1.1**	**14.8**
Min. № of species		16	13	11	9	12	10	9	6	**19**

Overview of the activity index per month (Table 29, Figure 1) clearly shows that the activity (as well as fauna diversity, i.e. the number of identified species on transects) on all transects/points, viewed individually and as a whole, and inside all spatial-ecological units during the survey period began in mid-April, and grew rapidly, whereas inside the control area at the beginning of the activity period it achieved an absolute maximum (both on transects and census points). On locations and the surrounding area, the activity was the highest during the summer, with a characteristic minimum in mid-summer on locations (June/July) and a maximum in the second half of the year (August/September), while a similar dynamics was also observed in the control area, (in both cases and transects and census counts). However, this summer minimum was not observed in the surrounding area. With the start of autumn, activity gradually decreased to finally stop completely. This activity generally follows the annual cycle of bat activity usual for Serbia (Paunovic et al. 2011), caused by regular seasonal changes in weather conditions favourable and unfavourable for the activity of bats and their prey, whose seasonal activity dynamics is followed by bats.

Furthermore, some deviations from the usual seasonal dynamics of bat activity registered during this survey was conditioned by unusual weather conditions.

As mentioned before, in March and in early April, when bat activity usually begins in Serbia after hibernation (Paunovic et al. 2011), in 2015 long-lasting adverse weather conditions were registered - very low temperature, especially during the night, together with highly intense rainfall. Such long-term adverse weather conditions - meteorological extremes, lead to a very low concentration or complete absence of insects, bat prey over long periods, preventing normal bat activity. That is why the beginning of this survey phase was postponed until the appropriate weather conditions were established, i.e. until the commencement of bat activity at the beginning of April. This disorder of the annual bat cycle was also registered throughout the year in other areas of Serbia and the Balkans (authors' data), resulting from the indicated weather conditions. This year's absence of bat activity at the location during the period from early March to mid-April may not, therefore, be considered as typical seasonal dynamics of bat activity at the location, as it is caused by weather conditions extremely deviating from the normal variation usual for this period and area. Moreover, the winter, i.e. the period during which the bats were active in Serbia, was unusually long this year because it started in December 2014. This caused the bats to completely exhaust their internal energy reserves and immediately after the favourable conditions have been established (prey appeared) they started a very intense hunting activity. This is at least partially the reason for a very intense, and even maximum bat activity, registered at the very beginning of the survey, which is uncommon for Serbia, although also registered this year in other regions of Serbia and the Balkans (authors' data). This level of activity was also enabled by unusually high abundance, activity and diversity of prey at the beginning of the season (Appendix 3).

The usual seasonal dynamics of bat activity at the location, under conditions without long-term adverse weather conditions present in the initial period of this survey, with greater or smaller deviations, certainly follows the annual activity cycle common for Serbia (Paunovic et al. 2011) - starting and growing relatively fast in early spring (usually in March), and then, as registered during the survey, running continuously with the characteristic oscillations throughout the spring, summer and early autumn (April-September), and gradually falling through autumn (October, first half of November) stopping at the end of autumn (second half of November).

Bat activity intensity throughout the period of optimal conditions (April – September) registered by this survey, at the wind farm locations, may be assessed as generally low to moderate on transects, and generally low at wind turbine positions, while it is consistently notably higher in the immediate surroundings and the control area, i.e. high to very high. **Activity minimum** during the periods of optimal conditions was recorded on transects on all locations, on most wind turbine positions at the Petka and Drmno locations, and on the census points inside the control area **in the first half of July**. On wind turbine positions in general, and individually at the Cirikovac and Klenovnik locations, as well as on the control area transect, the minimum was recorded in the second half of June, especially evident at the Klenovnik location where the census was realized at the end of the month. This characteristic activity intensity decrease at the beginning of the summer results from a reduced movement of the females during and after birth (Dietz et al. 2009), coinciding with this period. During this period the females do not leave shelters for several days to hunt and remain close to the shelter for several days afterwards. Maximum activity throughout this period registered along the transect around the location is entirely concordant, as this is the zone closest to the shelters (confirmed and potential ones). **Maximum activity** during optimal conditions (except for the unusual peak at the beginning of the activity), was recorded on locations, both on wind turbine positions and on transects, **in the second half of August** (with the exception of the transect at the Klenovnik location where it was recorded at the beginning of September rather than at the beginning of August). Results from the control area were similar, however, this maximum is equally pronounced in September along the transect. These maximums result from the start of activity (first flight) of the young born about a month and a half ago to two, which is the period during which the young bats are ready for their first flight (Dietz et al. 2009). This seasonal dynamics clearly indicates that, perhaps only to the minimum extent at the location and certainly to a much greater extent, in the immediate vicinity where cryptic conditions are much richer, significant reproductive activity happens of at least some of the present species.

The secondary **activity maximum** during the period of optimal conditions recorded in the **third decade of September** on the control area transect (not on the location transects, as well as in the census points inside the control area, where the investigations were conducted in the first decade of the month) coincides with the period of the most important migratory influx of members of the migratory species in this part of Europe (Hutterer et al. (eds.), 2005; Dietz et al., 2009, Paunovic et al. 2011). This maximum was not observed on any wind turbine positions, although investigations were carried out during the adequate period.

Given that they resulted from the normal life cycle dynamics of bats, activity minimums and maximums registered during this survey in June/July and in July, at the location may be considered as a rule, i.e. they may be expected in these periods in the future, when this is usual for Serbia (Paunovic et al. 2011). Some differences in the time when minimum and maximum activity occurs in different species, largely result from bionomic and environmental specificities of the species (which are the cause of the difference in their spatial activity dynamics, i.e. different numbers at different transects), which is also manifested through the differences in the seasonal activities dynamics between individual transects and will be further elaborated under a separate section of this study.

As they are conditioned by the normal life cycle dynamics of bats, activity minimums and maximums registered during this survey in June/July and in August and September at the location may be considered as a rule, i.e. they may be expected in these periods in the future. However, minimums and maximums conditioned by reproduction activities may be expected earlier i.e. in periods when this is usual for Serbia (Paunovic et al. 2011) - minimum at the end of May/early June, maximum in late July/early August. This departure from the usual dynamics of the annual cycle of bats was also registered this year in other areas of Serbia and the Balkans (authors' data) and it probably results from the delayed start of activities. Some differences in time when these minimums and maximums of activity occur in different species, largely result from bionomic and environmental specificities of the species (which are the cause of the difference in their spatial activity dynamics, i.e. different representation in different spatial - ecological units) which is manifested through the differences in the seasonal dynamics of activities between spatial - ecological units and will be further elaborated under a separate section of this study.

As far as the **daily dynamics of activities** (Appendix 3) is concerned, it is observed that during the period of optimum weather conditions (April-September) activity in all parts covered by investigations begins in the interval of a few minutes (control area and immediate surroundings), but usually about half an hour to about 3/4 hour after sunset and lasts with periodically changing or unabated intensity specific for the transect or part thereof, throughout the night, stopping in about one hour to half an hour before sunrise, at the control area and the immediate surroundings, to just a few minutes before sunrise. During the night of 8/9 September when the temperature dropped below the level allowing prey activity, as well as during all working nights in October and November, the activity was concentrated to the beginning of the night, but later dropped significantly or completely stopped.

Spatial dynamics of activity also shows clear regularities, observed when the registered activity intensity is reviewed (Table 29, Figure 1) and collected data examined (Appendix 3).

The highest overall bat activity intensity was registered on transect 1, i.e. ***around the location***, and may be described as **high**, but almost on the **verge of very high**. Moreover, the monthly intensity of activities on this transect was during almost all months of this survey very high or high, moderate only in November, and the highest in comparison to other transects during almost every month. Very pronounced spatial concentration of activities in its two proportionally very small (but very specific) parts in spatial-ecological terms is highly noticeable, i.e. inside the areas of electric lighting. By far the largest part of the overall activities on this transect - about 2/3 of the total, or 31 to 92% in individual unit transects were registered along the section of this transect running through the central part and next to the gate of the Cirikovac mine management complex, which accounts for about 1/4 of this transect. Along this section, the constant, as a rule, very high activity was often registered, which was particularly evident in July because at that time the maximum was recorded, while on the other hand, minimum activity was registered on locations. The concentration of activity was also observed, on an even smaller segment of the transect, passing by the nursery, which accounts for only about 5% of this transect where about 1/4 of the total activity was registered (8-42% during individual unit transects) with a very high to high activity. In other parts of the transect, activity was significantly lower, inside the moderate range. Contrary to the activity, the diversity along this transect/unit was by far the lowest – out of 19 species (minimum) recorded during the survey, only 7 was registered.

High to very high activity was recorded constantly, randomly, throughout shelter identification and inspection during the entire nights, and in the **vicinity of the location** outside the part covered by activity detection - inside the zone of forest, aquatic and wetland complexes and, especially, settlements, even outside periods of optimal weather conditions, especially around the street lights.

Figure 35. Floodplain forests in the valleys of Mogila and Mlava rivers where numerous shelters of the species *Nyctalus noctula* and potentially other species were registered. Photo: Branko Karapandza, original.

High total activity was also registered inside the ***control area***, i.e. on transect 0, during most months very high, while it was moderate during the period of optimum conditions only in June. At the census points, the overall activity was moderate ranging from very high to low, depending on the position of the moon. The absolute activity maximum inside the control area, both on the transect and the census points, was recorded at the very beginning of the survey in April. Significant spatial concentration of activities was also registered on this transect, along its two proportionally very small, but highly specific parts in spatial-ecological terms. Nearly 1/2 of the total activity (12-100% during the individual unit transects) was registered at its southernmost section, i.e. along the country road running from the edge of the Cirikovac settlement towards this area, making only about 16% of this transect. Very high to high activity was almost always registered here, which is particularly evident at the beginning of daily activities (i.e. during the unit transects at dusk starting from the end of this transect). This segment is also a kind of a bat activity "diversity centre" of the entire investigated area, because here inside the small area as many as 15 species (minimum) was registered of the 16 recorded in the control area, which makes this transect different from all the others - 19 in total registered by this survey. Overwhelming concentration of activities may be seen on the central segment of the transect, at the intersection of the eastern Sopotska Greda slope and southern slope of the overburden dump, almost at their foothills. In this segment, nearest to the aquatic and wetlands habitats of the Mogila valley, making only about 11% of this transect, about 1/4 of the total activity was registered (0-39% during individual unit transects), but with large variations over the period of optimal conditions, from low to very high, typically, the highest during the unit transects at sunrise. In other parts of the control transect, i.e. in a predominantly agricultural area of the Sopotska Greda and typical ruderal areas of the overburden dump, the activity was significantly lower, ranging generally from very low to low. This fully corresponds to the activity registered in census points - the highest (total high from low to very high by month) in the area of wetland habitats in the Mlava valley (K3, K4, K6), high to moderate at the point closest to the settlement (K2) and the lowest (total low, mostly low to moderate by month) inside the zone of typical agrocoenoses of the Sopotska Greda (K1) and overburden dump (K7).

Figure 36. Hunting stand on the Sopotska Greda slope from where copulation sounds of one male was registered belonging to the species *Nyctalus noctula* in September 2015. Photo: Milan Paunovic, original.

All locations are characterized by significantly **lower** activity both compared to the surrounding area and the control area, both on transects and census points - total activity on transects surveyed is **high**, though slightly above the range of moderate, while it ranges from moderate to high on the individual transects, whereas it is **low** on wind turbine positions, both in total and on almost on all individually.

The highest total activity on all locations was also registered on the transect 2 at the ***Cirikovac*** location - high, though with the highest variations during the periods of optimal conditions of all transects - from very high in April and May, low to moderate during other months. This dynamics was fully observed on wind turbine positions inside the central part of the location (VG12 and VG13), where only from May to April the highest activity was recorded, while during other months, and on the remaining wind turbines throughout the entire survey period, it ranged from low to very low. Along this transect, i.e. along the crushed stone road, activity was relatively uniform over the entire length where woody/shrubby vegetation was very dense (shrubbery and bushes), i.e. slightly to the east of the planned VG13 wind turbine position, while it is significantly lower and often (almost) completely absent in the east segment of the road, i.e. in open ruderal habitats. The only additional activity concentration was inside the cleared zones prepared for geological probing of the terrain on planned VG13 and VG14wind turbine positions, where the manual detection as a rule, recorded high activity. Given that it is extremely spatially focused next to the vegetation tops at the cleared area edges, this activity is not always reflected in the stationary detection results (during which the detectors were positioned in the middle of the cleared area on the ground). This is a transect where the highest number of species was recorded at the location - 15 (minimum), while it is also a "diversity centre" of the investigated area and the location, given that on the short far eastern segment outside the dense vegetation, inside a very small area, as many as 13 species were registered (characterised by the indicated low activity).

High or lower, total activity, with much smaller variations throughout the period of optimal conditions (mainly high or low to very high), was recorded on the transect at the ***Petka*** location. Higher total activity, **moderate**, was recorded at the **VG08** wind turbine position, where it is such (or close to the limit), during most months, ranging up to very high in April. Owing to this, the position stands out in comparison to almost any other inside the entire planned wind farm. At the VG09 position, activity is consistently low to very low. VG10 position is characterized by occasionally moderate to high activity, which coincides with the concentration of activity observed on a nearby part of the transect - more than 2/3 of the total activity (0-100% during individual unit transects) is registered on the eastern branch, which extends in the foothills and lower slopes, making up about 1/3 of its total length. During the period of optimal conditions, activity on this segment was as a rule high to very high. Occasionally high activity on this transect was recorded only on its far western point, also in the lower part of the slope, while in other parts, i.e. in the higher parts of the slopes and the central plateau of the location, it was significantly lower in the period of optimal conditions ranging from moderate to very low and often absent. Common to all higher activity zones at the Petka location (end sections of the transect, VG8, to some extent, VG10), in addition to positions outside the central highest part of the location, is that they are located in the surroundings or in the immediate vicinity of the forest and/or thickets/shrubs.

Klenovnik location is characterized by a **moderate** overall activity intensity on the transect, though borderline high, whereby throughout the period of optimal conditions it ranges from low to high with a relatively narrow range of variation. On this transect, a very distinct spatial concentration of activities may also be noticed - about 2/5 of the total, or 0-81% during individual unit transects were registered at the far northern part of the transect running directly next to or near the coal conveyors, i.e. inside the electric lighting area, which accounts for about 1/5 of the transect. This concentration is even more pronounced if we take into account that the activity here was completely absent during unit transects at dusk starting from this end, i.e. the ones at dawn ending here, because activity detection along this segment was conducted before or after the end of the daily activities of bats in this area. In other parts of the transect, activity varies by month ranging over the period of optimal conditions, from very low to high. The total intensity of activities on all wind turbine positions at this location is low with only occasionally moderate to high activity on almost all positions recorded in April; only on position VG20, high activity was not registered at the start of activity, but at the end of August. What is interesting is that activity was not registered in June on any of the wind turbine positions inside this location, i.e. in the third decade of this month, when census was conducted here.

The lowest overall intensity of activity of all the transects on locations (also throughout this survey), **moderate**, was recorded at the ***Drmno*** location. This was not observed at the wind turbines positions where the total intensity of the activity was essentially similar as in other locations, on certain positions even slightly higher - low or close to the limit at VG06, while it is **moderate** (and the highest from all wind turbine positions) at **VG03**; activity on VG03 is the same, or borderline, during most of the months, ranging to very high in July (i.e. in the third decade when census was realised on this location), while the high or moderate activity was registered on all positions inside the wind turbine location in August (end of month), and moderate on VG06 and Vg07 in June (first half). Certain concentration of activity on the transect at this location may be seen only along its segment near the highest point (where the bird census vantage point - VP5 is located), i.e. inside the zone of the only significant fragment where the vegetation is woody and shrubby inside the central part of the location, where only at the entire location, occasionally high or even very high activity was recorded.

When, therefore, we take into account all previous analyses of spatial dynamics of the activity intensity at the wind farm location, it may be concluded that the **major part of the location**, i.e. typical areas of reclaimed overburden dumps containing open ruderal vegetation, are mainly characterized by a **low to moderate activity**, low on almost all the planned wind turbines positions. Higher activity intensity (moderate to high, and in some places and/or occasionally very high) was regularly recorded mainly along forest edges, bushes and shrubs, including individual segments of country roads and, in particular, inside the zone or near urban/industrial elements, usually in peripheral parts of the location. Location surroundings and the control area are characterised by significantly higher activity.

Daily **dynamics of activity** also exhibits a distinct spatial regularity - during all months activity in the **vicinity of settlements** (southern segment of the control transect, K2), inside the zone or close to the urban complex of the Cirikovac mine management (transect in the vicinity of the location, western section of the transect at the Cirikovac location, VG14), but also in the vicinity of the floodplain forests complex in the Mogila and Mlava valleys (central segment of the control transect, K4, K6, K7) usually begins only a few minutes after sunset, as a rule achieving the maximum intensity quickly and lasting longer than elsewhere (sometimes up to a few minutes before sunrise, Figure 37). Activity in other parts starts slightly later (especially at the Drmno location, on the transect and census points, but also on the southern end of the transect at the Klenovnik location and VG15, as well as on the eastern end of the transect at the Cirikovac location and VG 11, while during the initial transect intervals at the beginning of the evening (half hour to one hour after sunset) activity deep inside the location is almost fully or nearly absent, whereas the full intensity is gradually achieved only later in the night.

Transects and spatial - ecological units differ according to the **qualitative** characteristics of the recorded **activities**, apart from their quantity (intensity), i.e. according to the share of overflights during which **hunting behaviour** was recorded in the total number of overflights (Appendix 3), as well as according to the **orientation and spatial concentration of flights**.

A **high** proportion of the total hunting behaviour, even higher than in other transects, was regularly recorded on the **control transect**, especially in its segments where activity is concentrated. Consequently, at the edge of the settlements, during the period of optimal conditions, at the start of the daily bat activity (i.e. at the beginning of transect at dusk starting from this end), a considerably **lower** share of hunting behaviour was recorded, together with the more frequent flight direction from the settlements (west – east). Pronounced flight direction, though this time in the opposite direction (east – west) and relatively high share of hunting behaviour, were recorded in this zone at the end of the daily bat activity. On this segment, bats were particularly focused on flying inside the road zone.

Also **high** proportion of hunting behaviour, significantly higher than on other transects and in other parts of this transect, i.e. almost 100%, was regularly recorded in parts of the transect in the **surrounding area** where the activity is concentrated - in the central part, next to the gate of the Cirikovac mine management complex and next to the nursery building. The high share of hunting behaviour (with very high activity) was also recorded here in June and July (when on other transects, activity and share of hunting behaviour were minimal), as well as in October and November, usually inside the lighting zones.

Constantly high share of the hunting behaviour was not registered systematically during shelter identification and inspection around the location, throughout all periods of the night and during the entire activity season in the zone of all settlements, especially around the street lights, and occasionally inside certain zones of forest, wetland and aquatic habitats.

Lower average share of hunting behaviour was mainly recorded on **locations**, while it is regularly high only in areas where the activity is concentrated. Along the belt conveyor for coal at the Klenovnik location, along the road next to the east foothills and slopes of the Petka location, as well as along the part of the road at the Cirikovac location running through the shrubbery, activity was highly focused inside the zone of these linear elements/roads; along the road at the Cirikovac location pronounced flight direction from the Cirikovac mine management complex was recorded (east-west) during the unit transects at dusk, or in the opposite direction before dawn. In other parts of the location covered by transects, flights were significantly focused along the roads or other landscape elements, while the hunting behaviour and activity was occasional. The high share of hunting behaviour, as a rule accompanied by a higher activity intensity, was sometimes unsystematically recorded during the identification and inspection of shelters, and in some parts of the location not covered by transects, mostly inside or near forests, thickets/shrubs and/or wetland habitats.

This survey did not reveal any seasonal transition activity, i.e. occurrence of **migratory flocks**, which would directly point towards the migratory processes inside the location. Observation of migratory flocks inside the location was not quite abandoned, but due to the relative distance of the famous migration corridor - the Danube, it was not expected. The existence of certain migratory processes, which may be observed indirectly through seasonal changes in the dynamics of individual species activities will be discussed for each species separately in the next section of this study.

Figure 37. Dozens of *Nyctalus noctula* individuals hunted regularly over the control area, and in April almost until dawn. Photo: Branko Karapandza, original.

Analysis of general ecological functions of the location landscape and its surroundings for bats

When all the previous analyses of seasonal, daily and spatial dynamics of bat activity are taken into account, and when qualitative observations about their behaviour, flight pattern and flight routes are added to this collected through visual and ultrasonic audio-detection, together with the registered and potential shelters data, conclusions may be drawn about how bats as a whole are using the space and habitats at the wind farm locations, their immediate surroundings and inside the control area (Figure 38).

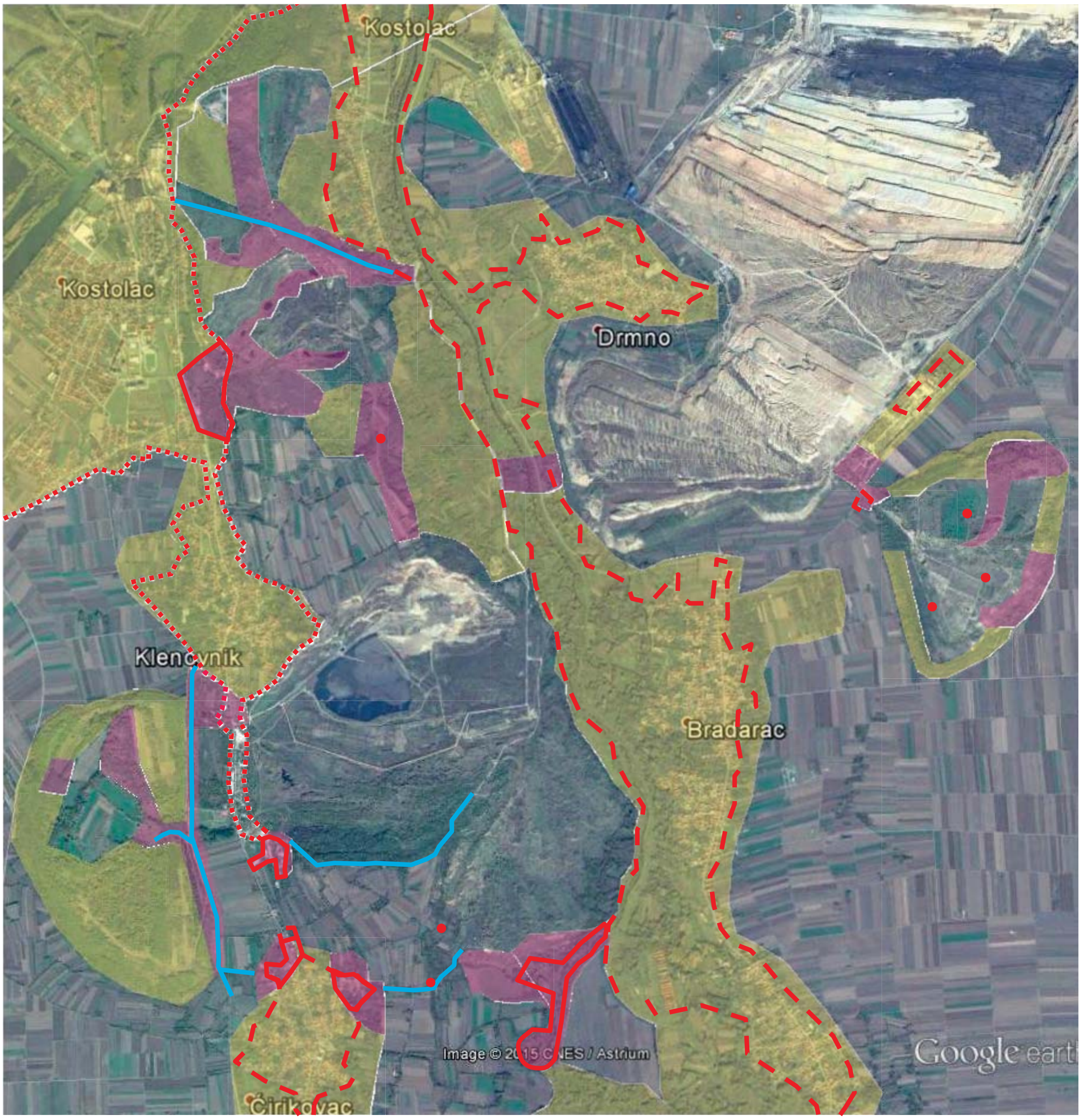

Figure 38. Ecological functions of the Kostolac wind farm location landscape, its immediate surroundings and the control area for bats (explained below). Source: Google Earth 2014 with the modification, Branko Karapandza, original.

As already stated, this survey clearly established that the actual wind farm ***locations*** have a very low ecological potential for **shelters**. For this reason, they are not of interest for the local bat fauna. On locations, only 4 copulation shelters were registered in older trees (red dots in Figure 38) - 3 at the Drmno location, 1 at the Klenovnik location. In addition, zones of potential shelters (area framed by the dotted red line in Figure 38) at the wind farm locations are only a small group of older trees at the foothills of the Drmno location, and part of the zone around the Kostolac village, entering peripherally into the Klenovnik location. All other woody vegetation zones and few structures at the locations, based on the findings of this survey, *may not be regarded as a potential bat shelters*.

This also goes for the **control area**, except the peripheral zone in the Mogila and Mlava valley where inside the floodplain forest zone a number of **shelters** in old trees was registered (area framed by the full red line in Figure 38), characterized by low cryptic potential, while outside of this zone only 2 copulation shelters were registered (red dots in Figure 38) - one in an old tree near the edge of the village, and one in the hunting stand on the Sopotska Greda slopes.

A much larger number of registered (area framed by the full red line in Figure 38) and potential (area framed by the dotted red line in Figure 38) **shelters** is located **around** the actual locations – inside the Cirikovac open cast mine management complex zone, all surrounding settlements and other urbanized areas, as well as inside forests along the Mlava and Mogila rivers.

On the other hand, rich trophic base established on all and entire locations (not just along the transects), together with the registered presence and hunting activity of bats also on all locations, clearly indicate that bats use this entire area as a hunting territory. However, some zones may be clearly singled out as important **hunting territories** on ***locations*** (translucent mauve area in Figure 38) and individual segments of certain roads (full light blue line in Figure 38) where typically higher intensity, higher activity concentration and a higher hunting behaviour share were recorded. This zone is characterized by the presence of thickets/shrubs, forest or wetland habitats elements. Significant hunting territories also include other elements, fragments and complexes of woody and shrub vegetation on locations (translucent yellow area in Figure 38), which could not be systematically covered by this survey. Outside these zones, in typical open ruderal habitats, occupying most of the locations, throughout the season, mainly low, even very low activity intensity was registered, with a very small share of hunting behaviour, which clearly indicates that in most of the locations there is no significant hunting activity of bats, i.e. that the area outside the marked area is not a hunting territory of greater importance.

In the ***control area***, significant hunting territories include aquatic, wetland and forest habitats in the Mogila river valley (light purple transparent area in Figure 38), country road running from this zone to the village (full light blue line in Figure 38), as well as the nearby settlement zone.

Significant **hunting territories** of bats are almost certainly all other urban areas and zones of aquatic, wetland and forest habitats in the vicinity of the location (yellow translucent area on Map 2), which are much more prevalent here than at the location. However, they could only be covered by this study to a minimal extent (translucent mauve surface in Figure 38).

Daily transitional bat activity, from shelters to the hunting territories in the twilight before sunrise, and vice versa is, in general, highly spatially focused along the **flight corridors** accompanying the most obvious linear landscape elements of a certain area serving as landmarks (Dietz et al. 2009; Limpens 2010; Paunovic et al. 2011). Such landscape elements in the major part of the location, in the absence of linear woody and shrub vegetation (rows of trees, hedges) and watercourses, would be roads running from villages and other areas with significant potential shelters towards the centre of locations, especially the ones containing shrubs and thickets along some of their sections (Paunovic et al. 2011). Special attention during this survey was dedicated to these landscapes elements, whereas transects usually follow roads for this reason. Special attention was also paid to the approaches to urban areas - settlements and industrial complexes, as these areas contain by far the largest share of the registered and potential shelters, and where, as a result, possible transitional daily activity was most visible at dusk and before dawn.

The intensity, early start, orientation and spatial focus of activities registered at dusk on the transect at the ***Cirikovac location***, especially on the segment closest to the Cirikovac open cast mine management complex, clearly indicate that this road is a **flight corridor** for bats having shelters in the management complex buildings, using as a daily transition route towards hunting territories at the location (full light blue lines in Figure 38), and in the opposite direction at dawn when returning from hunting territories to shelters. This flight corridor along the road section containing shrubbery and underbrush, over the central part of the night, between the departure from the shelter at dusk and return before dawn, is used by bats as an important hunting territory, as well as the clearings beside the road, i.e. their edges. The intensity, slightly earlier start and spatial focus of activities registered along the belt conveyor for coal at the ***Klenovnik location*** and on the road running along the east foothills and hillside of the ***Petka location*** clearly indicates that these roads are **flight corridors** for bats (full light blue line in Figure 38). Since in these corridors no evident unidirectional flight is observed either in the twilight or at dawn, while both roads are linking two settlements (town and village of Kostolac, i.e. Cirikovac and Klenovnik villages) it may be reasonably assumed that these flight corridors are used by individuals having shelters in both neighbouring villages for daily transition towards the hunting territories at the locations and their surroundings. These flight corridors are also used by bats as significant hunting territories, especially in areas with woody and/or bushy vegetation and/or lighting, throughout the central part of the night, between their departure from the shelter at dusk and return before dawn.

Very high intensity, early start and late end of activity, highly focused flights at dusk and at dawn, as well as the spatial focus registered in the ***control area*** along the country road running from the Cirikovac village zone to the Mogila and Mlava valley clearly indicate that this a highly significant flight corridor (full light blue line in Figure 38) used for daily transition by many individuals having shelters in the village zone towards the hunting territories in the valley.

During this survey, the existence of **migratory corridors** inside the zone of locations was not directly observed, while the well-known migratory corridor in the surrounding area is the Danube valley.

Analysis of ecological specificities of certain bat species at the locations, their immediate surroundings and the control area

Although all bat species essentially have the same basic needs achieved in the given ecological conditions of the landscape they live in, each of them has their own ecological and bionomical specificities, i.e. a specific way to meet these needs in the given circumstances. It is therefore necessary to analyse the specific features of each species regarding the landscape and habitat use in this area to satisfy their basic needs, in addition to general ecological functions of the wind farm location and its immediate surroundings, i.e. present landscapes and habitats, as elaborated above. Without this it would not be possible to draw conclusions about the full ecological functions and importance of the location for the present bats, as well as about the potential conflicts occurring throughout the wind farm project.

It has already been pointed out that during this survey on a larger part of the wind farm location very low to moderate activity has been registered, with the exception of only a few very specific ecological zones where the activity is high or very high, and the specific ecological units in the immediate vicinity of the location and the control area. Furthermore, it was also noted that only to 3 species account for more than 83% of all overflights/contacts registered on the transects: *Pipistrellus kuhlii*, *Pipistrellus nathusii* and *Nyctalus noctula*, where their relative number, in fact, is even higher, because they certainly account for a significant part of the additional 6.8%, which is the share of overflights impossible to identify precisely at the level of genus, species groups or families (due to long distances and short duration). Similarly, on the census points, due to the specific methodology (as previously discussed) overflights have not been identified at the species level, only two groups of species account for 84% of all registered overflights on wind turbine positions (inside the control area as much as 95%): *Pipistrellus/Hypsugo/Miniopterus spp*. and *Nyctalus/Vespertilio spp*., along with at least part of the additional 11% (i.e. 3.4%) of incompletely identified overflights. Therefore, it may reasonably be assumed, and this is confirmed by the detailed analysis of a small sample of the automatic detector recordings, that almost all overflights within the respective group belong precisely to these three species. On some transects and/or their parts and/or in certain periods, high and very high activity of members of these 3 species was registered. However, for all of them some important ecological functions (Table 14) were registered at the location and/or in its immediate surroundings. Hence, these 3 species may at least to some extent be relevant for this study, wherefore special attention in this section will be paid to the spatial and temporal dynamics of their activities (allowing us to draw reliable conclusions due to their numbers) and analysis of their ecological specificities at the location and its immediate surroundings.

All other species were recorded, both on transects and census points, in a far lower number, the majority only sporadically. Only the representatives of the species/group of *Myotis brandtii/mystacinus/alcathoe* and *Nyctalus leisleri* were recorded on transects during this survey in numbers that cannot be described as negligible (2.5% and 1.9%). Furthermore, the presence of individual ecological functions at the locations (Table 12) was only directly registered (or it is highly probable) for them. However, their small number does not indicate the great importance of the location for their populations, wherefore, it may be expected that the wind farm project will not have a significant impact on them. Also, due to the small number (small sample), it is not possible to draw reliable conclusions about the temporal and spatial dynamics of their activities at the location, and therefore, generally, about their ecological specificities in this area. For this reason, these species will here not be separately analysed.

Pipistrellus kuhlii

On the whole, the members of this species were during this survey recorded on transects by far most frequently of all species. They account for 43.4% of all the registered overflights, wherefore their total relative number is 5 or almost 6 times higher than the members of the species *Nyctalus noctula* and *Pipistrellus nathusii* coming second, i.e. third according to their relative number (Table 12). Since the greater share of the 26.3% of the registered overflights that could be identified only at the level of genus or species groups surely belongs to the members of this species, its actual relative number inside the investigated area is actually higher. A group of species *Pipistrellus/Hypsugo/Miniopterus spp*. which includes this species is also relatively the most numerous on wind turbine positions with 48.7% (i.e. with relative presence slightly lower than the sum of this species and *Pipistrellus nathusii* than on transects), while in the census points inside the control area with 17.3% they were more than 4 times scarcer than members of the group *Nyctalus/Vespertilio spp*. (Table 13). Inside both of these spatial-ecological units, on a smaller sample of automatic detector recordings analysed in detail, members of this species account for about 2/3 of the overflights of this group that could be identified at the species level.

Furthermore, in man-made structures inside the Cirikovac mine management complex, shelters of a small number (6-11) of individuals of this species were registered (Table 14). In all the surrounding settlements, a large number of shelters and potential shelters of this species was registered in man-made structures, together with their intensive transitional and hunting activity, especially around light sources. It may be noted that in all towns and other urban areas, they are absolutely dominant in terms of presence and number. These findings are fully consistent with the earlier findings of the complete dominance of this species in urban habitats of Serbia, which has occurred over the last twenty years at the expense of the related species *Pipistrellus pipistrellus*, previously dominant in these areas (Paunovic and Marinkovic 1998, Karapandza and Paunovic 2010). At the actual wind farm locations during this survey no potential shelters of this species were recorded.

Table 30. Activity index (overflight/h) and the relative number of the species *Pipistrellus kuhlii* per month and transect. The range of variation in the share of overflights in which the hunting activity was recorded and the average duration of overflights during the unit transects throughout the period of optimal conditions were shown separately.

Transect	Apr	May	June	July	Aug	Sep	Oct	Nov	Total	N (%)	% Hunt	Duration (s)
2	10.15	73.28	3.77	1.59	6.84	1.99	0.65	0.39	11.83	60.9%	0.0-100.0	2.9-9.2
3	3.28	27.69	21.49	1.75	7.46	8.25	1.03	0.96	8.75	52.6%	0.0-100.0	3.2-21.1
4	5.44	5.53	3.36	0.79	1.93	9.79	1.16	0.50	3.58	37.4%	0.0-100.0	2.5-76.7
5	0.24	1.81	4.38	4.01	6.16	0.80			2.15	30.3%	0.0-100.0	2.2-14.5
Location	4.47	20.80	5.86	2.17	4.99	5.09	0.65	0.38	5.44	46.6%		
0	18.73	13.53	2.43	5.51	12.59	13.45	0.29	0.88	8.56	37.3%	4.0-100.0	4.2-11.5
1	5.05	21.32	30.94	25.83	14.24	9.55	4.62	4.88	13.25	49.8%	0.0-100.0	4.5-37.9
Total	7.62	19.06	5.95	3.84	7.05	7.07	0.76	0.68	6.47	43.6%		
N (%)	30.0%	57.8%	47.3%	39.7%	43.5%	41.1%	23.1%	61.1%				

However, although on the whole members of this species are relatively by far the most numerous species with the highest intensity on the transects in total, as well as in all spatial-ecological units, on each of the transects and during all months when the transects were conducted, activity of the members of this species in the study area is not evenly distributed in space or in time.

The highest, high, total activity was recorded on the transect in the ***vicinity of the location***, while it is pronounced and concentrated in the section passing through the central part and next to the Cirikovac mine management complex gate, where virtually always (including October and November) intense, and often continuous, hunting activity of at least 3-6 members was recorded, mainly around lights. In other parts of this transect, activity is many times lower, except on the other end of the transect, i.e. on the Petka location boundary. On the ***control area*** transect, total activity is relatively lower, moderate, though here it is particularly concentrated and generally high in its southernmost section, i.e. along the country road section running from the edge of the Cirikovac village to the Mogila river valley and the overburden dump, where also regularly high, although lower activity was recorded. In all other parts of this transect, and on the census points inside the control area, activity is several times lower, low or very low, and often entirely absent (which is why their share on census points is several times lower than the representative of the group *Nyctalus/Vespertilio spp*.).

The transect at the ***Cirikovac location*** is also characterised by the high overall activity, with by far the highest relative number, without very marked concentration, but clearly declining with distance from the mine management complex towards the centre of the location. Although during the transects regular and very frequent hunting activity was recorded at the positions of wind turbines VG13 and VG14, i.e. on clearings made for geological probes (as discussed above), low and even very low activity of the corresponding group of species was typically recorded here and on other wind turbine positions. It was also observed that the higher activity on the transect in the surrounding area usually involves lower activity on the transect at the Cirikovac location, and vice versa. At the ***Petka location***, total activity on the transect is slightly lower, moderate, and particularly concentrated in the zone of the road (and pipeline) extending along the foot and lower eastern slopes where it is usually high; on VG08 and VG10 wind turbines positions, as well as on the western end of the transect, high activity was also recorded, though only sporadically, while in other parts of the transect, as well as on the VG09 position, it is typically low or even very low. ***Klenovnik location*** is characterized by the low overall activity in the transect or a very strong concentration of activities along the belt conveyor for coal where regularly high or even very high, often constant, usually in the lighting zones; in all the other parts of the transects, as well as on the wind turbines positions, they are registered mainly with very low activity, even though at least in some places, and moderate and high activity is sometimes recorded (e.g., in April, on all wind turbines positions and in the central part of the transect, on the edge of the Cirikovac mine on the transect in September). At the ***Drmno location*** transect, total activity is also low, the lowest compared to all the same transects similar to the relative number (although here definitely dominant), while a certain activity concentration was observed only occasionally inside the zone at the foot of the location, where the access country road from the location reaches the asphalt road (state road - Ram-Klicevac-Bratinac), across from the Drmno mine management complex, and where on several occasions moderate to high activity was recorded around a group of trees; on wind turbines positions as well as in all other parts of the transect, activity not categorized as very low or low was registered only incidentally (most drastically in July at the VG03 position).

Hunting behaviour was recorded on all transects, while the highest and most constant share is in the area of the Cirikovac mine management complex, i.e. around electric lighting, ***around the locations***, where the daily activity starts earlier than in most other parts of the study area.

The specific dynamics of daily activity is observed in the segment of the control transect along the road running from the edge of the village to the Mogila valley - daily activity starts earlier than in other parts of the transect and other transects, hunting behaviour is almost completely absent at the beginning of daily activities, with the maximum activity intensity and very strong flight orientation from the settlement (west-east); unidirectional flight disappears later, with only a slight decrease in the activity intensity. The share of hunting behaviour increases significantly and it is constantly high until the end of daily activities, when again unidirectional flight is observed, but in the opposite direction from the valley to the village (east-west); from the beginning to the end of the activity, a very distinct spatial focus of the flight may be identified by the members of this species inside the road zone. The share of hunting behaviour is also constantly high in the Mogila valley/overburden dump slopes where the activity starts slightly later.

Average share of hunting behaviour at the ***locations*** is generally lower, while it is regularly high only in the mentioned zones where the activity is concentrated – along the belt conveyor for coal at the Klenovnik location, along the road running alongside the east foothills and hillside of the Petka location, as well as along the major part of the road at the Cirikovac location where the pronounced flight direction was recorded from the mine management complex towards the location (east-west) at sunset, or in the opposite direction before dawn. In all these zones, one may observe a very distinct spatial focus of the flight by the members of this species inside the roads/linear elements zone. In other parts of the location covered by transects, significant spatial focus of the flight was not identified along roads or other landscape elements, while the hunting behaviour and activity, is only occasional.

An obvious minimum activity not conditioned by the adverse weather conditions was recorded during the third decade of June until the first week of July on all transects and census points where the survey was carried out at that time, except on the transect in the surrounding area where absolute maximum activity was registered. Summer activity maximum was registered on all transects and census points from mid-August to the first week of September.

The absolute maximum activity which, on some of the transects and in most census points, was observed at the beginning of the season, is most probably the result of an unusually long winter (explained in greater detail earlier) and cannot be considered as typical. Similarly, in all locations, as well as inside the control area, very low activity in October and November may be observed, although the weather conditions and the presence of potential prey during the survey were at a satisfactory level. Even though this dynamics may be regarded as a rule, during seasons with different long-lasting weather conditions significant deviations are possible.

All this clearly indicates that members of this species having numerous shelters in the area of the Cirikovac village use the control area, in particular the overburden dump slopes towards the Mogila river valley, as hunting territory, where their hunting activity is much more focused in the area of field roads than in the case of other species, especially the flight corridor along the road running from the village to the valley.

Smaller numbers of these species having shelters in the buildings of the Cirikovac mine management complex use the management complex zone as the most significant hunting territory. Their significant hunting territory is also the Cirikovac location, entirely along the flight corridor limited by the road. A number of individuals having shelters in the Cirikovac and Klenovnik villages also use the road/pipeline connecting these settlements directly along the east foothills of the Petka location as an important flight corridor/hunting territory, while a certain number of individuals whose shelters are located in the Kostolac village use the belt conveyer for coal as a significant flight corridor/hunting territory at the Klenovnik location. Important hunting territories belonging to this species in all these villages are located outside the location zones. It was not clearly established where the shelters of a small number of individuals of this species are at the Drmno location, though it is likely that they are in the zone of the Drmno mine management complex. Furthermore, it was also not clearly established where the shelters of a small number of individuals of this species are, occasionally hunting in the western and northern slopes of the Petka location, but it is certain that they are located in the Klenovnik and/or Petka villages area, while sporadic hunting activity in the central part of the Klenovnik location surely comes from individuals from the eponymous village. All hunting territories/flight corridors on locations (as well as inside the control area, but not within the Cirikovac mine management complex) are significant only during spring and summer. Numerous registered and potential shelters in buildings in settlements and other urban complexes, are definitely used by the members of this sedentary species (Dietz et al. 2009) during all their life cycle phases forming larger or smaller colonies (both maternity and hibernation colonies). Distinct minimum activity in June/July, and maximum in August/September, indicate significant maternity activity, or flying of the young population in these periods out of the shelters (see explanation in the previous section), which was later than usual, but within the optimal life cycle limits for this species in Serbia (authors' data).

Figure 39. *Pipistrellus kuhlii*. Photo: Branko Karapandza, original.

Summary: During spring and summer, not autumn, the actual locations and some of their parts are moderately important transitional areas and hunting territories, almost exclusively along the flight corridors limited by roads and other linear infrastructure, for a smaller number of members of this highly numerous sedentary species that during all life cycle stages (including reproduction and hibernation) uses shelters in buildings inside urban areas and their surroundings.

Table 31. Activity index (overflight/h) and the relative number of a group of species *Pipistrellus / Hypsugo / Miniopterus spp*. per month and census point.

Location		Apr	May	June	July	Aug	Sep	Oct	Nov	Total	N (%)
Control area	K1	2.29	3.47	0.23	0.91	0.72	0.45	0.68		1.02	37.2%
	K2	6.78	6.08	1.53	0.91	0.41	1.44	0.08		1.96	35.4%
	K3	1.30	1.08	0.12	0.23	0.72	1.09	0.23		0.57	3.9%
	K4	2.29	1.52	2.00	3.19	2.97	2.71	0.30		1.72	13.6%
	K5	2.39	1.19	0.94	2.05	1.74	0.63	0.46		1.08	18.4%
	K6	3.19	7.16	1.06	0.57	0.82	0.72	0.30		1.57	12.9%
	K7	3.19	0.76	1.88	1.37	7.99	0.90	0.76		1.96	55.2%
	Total	3.06	3.04	1.11	1.32	2.19	1.14	0.40	0.00	1.41	17.3%
Drmno	VG01	2.58	1.30	1.06	1.56	1.70	0.51			0.98	37.3%
	VG02	2.78	3.03	0.24	0.22	0.94	0.17		0.07	0.84	46.5%
	VG03	2.78	1.51	1.41	40.15	1.51	0.17		0.29	5.04	74.9%
	VG04	2.19	1.30	2.12	1.34	3.67	0.59		0.07	1.28	48.7%
	VG05	2.58	0.86	0.71	1.23	1.88	0.34		0.07	0.88	36.5%
	VG06	1.99	2.27	6.25	0.33	5.93	0.51		0.07	1.93	46.3%
	VG07	1.29	2.27	2.71	0.78	3.58	0.93		0.07	1.32	49.4%
Petka	VG08	20.07	3.43	4.61	4.81	0.38	0.25	0.08	0.57	3.89	62.3%
	VG09	1.09	1.44	0.24	2.24	0.94	0.17		0.14	0.70	52.2%
	VG10	1.78	9.19	2.36	0.78	0.94	0.08		0.50	1.71	52.7%
Cirikovac	VG11	0.30	1.11	1.65	3.58	0.47			0.36	0.81	43.4%
	VG12	1.88	13.62	0.24		0.09				1.70	61.7%
	VG13	9.59	11.07	0.35	0.67	1.22	0.17		0.14	2.61	61.6%
	VG14	2.27	0.33		0.90		0.08			0.41	41.7%
Klenovnik	VG15	4.51	0.90		1.14	0.81	0.42			0.89	42.5%
	VG16	4.61	1.24		0.34	0.51	0.59			0.85	34.3%
	VG17	1.40	0.90		0.23	0.20	0.68		0.22	0.44	23.0%
	VG18	5.91	0.45		1.59	0.30	0.68		0.14	1.06	33.6%
	VG19	2.90	0.90		0.34	0.20	0.68			0.59	22.6%
	VG20	2.82	0.67		0.57	2.73	0.68	0.08	0.14	0.92	27.7%
Total		3.77	2.89	1.20	3.14	1.40	0.39	0.01	0.14	1.44	48.7%

Pipistrellus nathusii

Members of this species during the transects of this survey, considered as a whole, come third with 7.4% of their relative number. However, they were recorded nearly 6 times less than the most numerous members of the related species *Pipistrellus kuhlii* and only slightly less often than the members of the species *Nyctalus noctula* (Table 12). Similar to the previous species, substantial, although smaller share of the 27.1% of the registered overflights applies to this species, which could be identified only at the level of genus or species groups, wherefore their actual relative number at the location and in its surroundings is, in fact, higher. The corresponding group of species (whereas the members of this species in the smaller sample of automatic detector images analysed in detail accounts for about 1/3 of the overflights inside the group) is relatively the largest with 48.7% on wind turbine positions, though not on the control area census points with 17.3%, where members of the group *Nyctalus/Vespertilio spp*. were more than 4 times more numerous (Table 13).

During this survey at the locations, just one copulation shelter of this species was directly registered inside a tree (Klenovnik). Another such shelter was registered in agricultural areas of the control area, and many more (30-40) in the floodplain forests zone along the Mlava and Mogila rivers in the peripheral section and, mainly, along the border of the control area or beyond it. A small number (4-5) of copulation shelters was registered in old trees within the Cirikovac mine management complex, together with at least 2 shelters of individual members during the summer period also in trees. Discovery of shelters in trees (and hard to reach cracks) of this and other dendrophilous species (except during the breeding season in the case of the species whose males make distinct copulation sounds) is extremely difficult, except when the time-consuming and costly methods of radio-telemetric monitoring are used, not necessary for this survey type (Paunovic et al, 2011, Rodrigues et al. 2008, 2015). However, in the vicinity of the wind farm location, not covered by the systematic investigations, especially around the area of floodplain forests of the Mogila and Mlava rivers outside the investigated area, as well as in the areas surrounding the settlements, 12 shelters in old trees and buildings were identified, used by this species during other life cycle phases (Dietz et al. 2009, Paunovic et al. 2011) as well as numerous potentially suitable shelters. Activity of the members of this species in the settlements was recorded regularly, though with lower intensity, and mainly in the peripheral and park areas. In addition, regular hunting activity around lighting was also recorded.

Active members of this species were recorded on all transects throughout the entire survey (Table 32), with the most balanced spatial and temporal activity intensity compared to other species, which is especially noticeable on the wind farm locations. However, the activity has always and everywhere been low or even very low, several times lower than the activity of the species *Pipistrellus kuhlii*. However, the relative number was significantly higher compared the members of the species *Nyctalus noctula* on all locations and their surroundings, with the exception of the control area. All this is in line with the findings of the census points, the only difference is that, on a smaller sample of the analysed detailed images, the relative number of the members of the species *Pipistrellus kuhlii* was twice as high.

Table 32. Activity index (overflight/h) and the relative number of the species *Pipistrellus nathusii* per month and transect. The range of variation in the share of overflights in which the hunting activity was recorded and the average duration of overflights during the unit transects throughout the period of optimal conditions were shown separately.

Transect	Apr	May	June	July	Aug	Sep	Oct	Nov	Total	N (%)	% Hunt	Duration (s)
2	3.69	0.46	0.25	0.45		1.00	0.43		0.86	4.4%	0.0-100.0	2.0-6.1
3		3.30	0.81	0.35	0.36	1.27		0.32	0.81	4.9%	0.0-50.0	3.0-12.3
4	0.51	1.35	0.54	0.13	0.39	1.86	0.65		0.68	7.1%	0.0-100.0	3.0-10.0
5	0.12	3.06	1.42	0.26	0.67	0.27	0.26		0.73	10.3%	0.0-75.0	2.0-11.0
Location	1.02	2.00	0.83	0.27	0.40	1.09	0.39	0.04	0.75	6.4%		
0	3.12	2.54	0.57	1.59	1.84	4.88	1.16		1.97	8.6%	0.0-46.2	1.5-39.5
1	1.12	4.74	3.75	5.83		1.36	4.62		2.61	9.8%	0.0-50.0	2.0-5.5
Total	1.48	2.24	0.87	0.78	0.72	1.91	0.76	0.03	1.10	7.4%		
N (%)	5.8%	6.8%	7.0%	8.1%	4.5%	11.1%	23.1%	2.8%				

On all the ***locations*** and wind turbine positions, activity of this species was equally very low both in space and time. Slightly higher, although moderate or low activity was recorded only occasionally, without any spatial concentration. Uniform spatial arrangement of activities, unlike the members of the species *Pipistrellus kuhlii*, outside the *Pipistrellus kuhlii* species concentration zones, makes the relative number of these species (though with low and even very low activity) much closer than when the entire transect area is observed. In the ***surroundings*** and the ***control area*** activity is many times higher, but typically, low and also without the pronounced activity concentration; exceptions are only partially and periodically (most notably in May along the transect and in August on K7) lower parts of the control area (Sopotska Greda and overburden dump slopes, Mogila River valley), as well as the area closest to the settlement only in September, while the most distinct exception (in the first decade of July) is the Cirikovac mine management complex zone. In both cases, the share of hunting behaviour is higher.

Hunting behaviour was recorded regularly on all and entire locations, while the only concentration, observed to some extent, is present in the vicinity of the elements and fragments of woody and shrub vegetation.

In the lower parts of the control area and inside the Cirikovac mine management complex, daily activity starts significantly earlier than in other parts of the transects and, in particular, on locations.

Certain spatial focus of activities, including hunting activities is observed among the members of this species, along field roads and especially along the flight corridor (light blue line in Figure 38), but is much less pronounced than that of the members of the species *Pipistrellus kuhlii*.

Minimum activity of this species, not conditioned by the adverse weather conditions, was recorded from mid-June until the first week of July, except on the transect in the surrounding area where in July absolute activity maximum was recorded. Maximum summer activity was registered on all transects and census points from the end of August to the first week of September. The most prominent maximum activity on the control transect, which is particularly contributed by the increased activity around settlements, was observed at the end of September, which corresponds to the secondary maximum occurring at the beginning of October on the transect in the surrounding area; the corresponding maximum was not observed on locations. Activity in all spatial - ecological units was almost entirely absent in November.

Above survey results indicate that the entire area of the investigated locations may be taken as a hunting territory of this species, though of low importance. Its more significant hunting territories are in the control area and its surroundings covered by this investigation – inside the Cirikovac mine management complex and the Mlava and Mogila river valleys. More important hunting territories may be found in urban areas and forest/wetland habitats not covered by the systematic investigations under this survey, which fully corresponds to the ecology and bionomics of this species (Karapandza and Paunovic 2010, Dietz et al. 2009, Paunovic et al. 2011). Although the daily transition (due to the small number of individuals/overflights) is not clearly visible, it is certain that the hunting activity at the locations comes from individuals whose negligible number of shelters is at the locations, low number inside the Cirikovac mine management complex, high along the Mogila and Mlava rivers floodplain zone in the peripheral part and at the control area boundary, and even higher in urban and forest zones outside the area systematically covered by this survey. This is indicated by the number and position of the registered copulation, but also other types of shelters, as well as by the availability of potential shelters, and coincides with the characteristics and seasonal activity dynamics.

On the basis of the constant presence of members of this species, it is certain that the locations and their surrounds are characterised by the constant presence of the local populations of this species (a seasonal long-distance migrant), which coincides with the existing information about Serbia and the region (Dietz et al., 2009, Karapandza and Paunovic 2010). Minimum activity in June/July, maximum in August/September, point to the significant maternity activity, or flying of the young population out of the shelters in these periods (see explanation in the previous section). This is characteristic for the life cycle of this species in Serbia (authors' data) and it is not uncommon for the region (Dietz et al. 2009), although it is a little later than usual, but within the limits of the normal life cycle of this species in Serbia (authors' data). The absolute activity maximum, but even then with the intensity only slightly higher than moderate, which was recorded inside the Cirikovac mine management complex zone during maternity activity indicates that a certain, though a small part of this activity takes place here, i.e. that this zone also contains maternity shelters belonging to a small number of individuals (not less than 2 as noted during the survey of shelters in this period, but probably not more than 3 registered on transects); simultaneous activity minimum on locations indicates that these are common hunting territories of these individuals. Copulation activity takes place frequently in urban and forest zones outside the investigated areas, more frequently inside the control area, less frequently inside the Cirikovac mine management complex zone, and negligibly on locations. This activity is most definitely accompanied by hibernation.

Although at the very beginning of the activity season, high, maximum activity was observed on census points, potentially pointing towards the presence of migratory population in this period, such a conclusion may not be reliably drawn, given that the activity of all species in this period was unusually high, most probably due to a very long winter (which is explained in more detail above). However, the most distinct maximum activity, though only with moderate intensity, observed in late September/early October inside or near urban areas, i.e. close to settlements on the control transect and the transect located in the surrounding area, with an almost complete later absence of activity, points to the temporary presence of a scarce, yet significant migratory population in these zones and throughout this period. During the period in which they were residing around the location, members of the migratory population most probably used shelters in these and other urban zones, while there are no indications about where their hibernation takes place later. On the basis of the negligible activities of the members of this species on locations throughout this period, it may be clearly concluded that the actual locations are insignificant for this population. Such dynamics of migratory activity is typical of the region (Dietz et al. 2009). Migratory activity, i.e. migratory corridors, were not directly observed, however, their presence in the broader area is highly probable along the Danube valley, a well-known migration corridor of this species, mostly following the valleys of major rivers during migrations (Dietz et al. 2009).

Figure 40. *Pipistrellus nathusii*. Photo: Branko Karapandza, original.

Summary: For the members of the constantly present and relatively numerous local population, who during all of their life cycle phases, including maternity activity and copulation (probably hibernation) have shelters in forests and surrounding urban zones, and only negligibly at the actual locations, the entire locations are less important hunting territories throughout the activity period, while slightly more important hunting territories at the locations are inside the zone containing elements and fragments of woody and shrub vegetation, whereas individual roads and other infrastructure elements serve as linear flight corridors, although to a smaller extent. Transitional migratory activity takes place in the surrounding urban zones. These zones are neither used for copulation nor hibernation by the members of the migratory population. Actual locations have no importance for this population, although the Danube valley is a significant migratory corridor.

Table 33. Activity index (overflight/h) and the relative number of a group of species *Nyctalus/Vespertilio* spp. per month and census point.

	Location \ Month	Apr	May	June	July	Aug	Sep	Oct	Nov	Total	N (%)
Control area	K1	3.39	2.17	6.58	0.80	0.82	0.45	0.15		1.57	57.1%
	K2	3.59	10.09	5.99	0.34	0.41	1.70	0.53		2.52	45.3%
	K3	43.75	66.18	9.63	0.80	0.31	0.45	0.84		13.72	94.8%
	K4	43.55	14.97	2.35	5.59	15.67	3.35	1.75		10.16	80.1%
	K5	20.83	6.62	8.92	2.28	1.74	0.27	0.38		4.64	79.1%
	K6	76.54	3.80	3.41	1.37	2.25	1.00	0.15		10.42	85.8%
	K7	2.49	1.30	2.00	0.46	4.81	0.18	0.46		1.34	37.8%
	Total	27.74	15.02	5.55	1.66	3.72	1.06	0.61	0.00	6.34	77.8%
Drmno	VG01	0.70	0.32	2.36	0.11	6.88	0.25			1.24	46.9%
	VG02	0.79		0.12		3.20	0.34			0.54	29.9%
	VG03	0.50	0.54	0.47	0.11	4.43	0.42			0.77	11.5%
	VG04	0.30	0.11	0.59	0.22	7.91	0.68			1.19	45.2%
	VG05	0.60	0.65	0.47	0.33	4.71	2.11			1.09	45.2%
	VG06	0.89	0.43	0.24		10.55	0.84		0.07	1.59	38.2%
	VG07	0.10	0.76	2.24	0.22	5.27	1.10	0.07		1.14	42.9%
Petka	VG08	0.10	0.22	1.18	0.45	0.66	0.42	0.08	0.07	0.36	5.8%
	VG09	0.40	0.55	0.24		1.31	0.51	0.08		0.37	27.8%
	VG10	0.10	2.21	0.71	0.34	5.82	0.93		0.07	1.22	37.5%
Cirikovac	VG11	0.59	0.22	0.83	0.34	3.38	0.25			0.67	35.8%
	VG12	2.08	0.33		0.11	1.69	0.25			0.54	19.6%
	VG13	2.17	0.89	0.12	0.11	1.88	1.02	0.16		0.77	18.2%
	VG14	1.09	0.11	0.12		0.47	0.25			0.25	25.0%
Klenovnik	VG15	4.01	0.90		0.23	2.22	0.93	0.08	0.07	1.00	47.5%
	VG16	8.11	0.45			1.41	0.25	0.08	0.07	1.22	49.5%
	VG17	6.01	1.91			1.92	1.02	0.15	0.07	1.31	68.9%
	VG18	6.31	5.28		1.02	1.82	1.19	0.08	0.07	1.80	57.1%
	VG19	9.62	1.80		0.23	1.41	1.36	0.30		1.74	67.0%
	VG20	1.21	2.25		0.11	11.77	1.86			2.10	63.2%
Total		2.28	1.00	0.48	0.20	3.94	0.80	0.05	0.03	1.05	35.3%

Nyctalus noctula

On the whole, members of this species on transects conducted during this survey come second by their relative number (Table 12), whereas they were recorded 5 times less than the members of the most numerous species *Pipistrellus kuhlii*, though not considerably more often than the third most numerous species *Pipistrellus nathusii*. Similar to the previous species, a significant share, yet a much smaller number (1.3%) of the registered overflights that could be identified only at the level of genus or species groups, belong to the members of this species. However, their actual relative number at the location is higher than the reported one but not by much. Group of species *Nyctalus/Vespertilio* spp. containing this species comes second by its relative number, even at the wind turbine positions, with as much as 35.3% (i.e. with the relative number 3 times higher than the sum of this species and the species *Nyctalus leisleri* than on transects), while on the census points inside the control area with 77.8% they are relatively by far the most numerous and several times more abundant than the members of the group *Pipistrellus/Hypsugo/Miniopterus* spp. (Table 13); within both of these spatial - ecological units, based on the smaller sample of automatic detector images analysed in detail, the members of this species account for more than 4/5 of the overflights of this group that could be identified at the species level (which is almost an identical number as in the case of transects).

In the course of this survey on locations (Drmno), only an extremely small number (3) of copulation shelters of this species in trees was directly registered; a slightly higher number (4-6) of copulation shelters was registered in old trees, where also in the trees, at least two shelters of individual members were registered during the summer period; inside the control area, a short-term copulation shelter on a hunting stand was registered, with a lot more shelters in the area of the floodplain forest along the Mlava and Mogila rivers and inside the peripheral part and, for the most part, along the control area boundary or beyond it, used by many members of this species (at least 60) throughout the entire activity season, including the breeding season when from a number of trees (50-70) inside this zone, copulation vocalisation was registered. Discovery of shelters in trees (and hard to reach cracks) of this and other dendrophilous species (except during the breeding season in the case of the species whose males make distinct copulation sounds) is extremely difficult, except when the time-consuming and costly methods of radio-telemetric monitoring are used, which is not necessary for this survey type (Paunovic et al, 2011, Rodrigues et al. 2008, 2015). However, in the vicinity of the wind farm location, which was not covered by systematic investigations, especially around the area of floodplain forests of the Mogila and Mlava rivers outside the investigated area, but also in the areas surrounding the settlements, 40 shelters in old trees and buildings were identified, used by this species during other life cycle phases (Dietz et al. 2009, Paunovic et al. 2011) as well as numerous potentially suitable shelters. Excluding copulation calls, activity of the members of this species in the settlements was recorded only sporadically (although hunting was repeatedly recorded around light sources), while the regular overflights were registered high in the air above the settlements. In the surrounding forest/wetland complexes along the Mlava and Mogila rivers they were recorded regularly and with a much higher relative density and activity intensity compared to the locations, often with a high share of hunting behaviour.

Table 34. Activity index (overflight/h) and the relative number of the species *Nyctalus noctula* per month and transect. The range of variation in the share of overflights in which the hunting activity was recorded and the average duration of overflights during the unit transects throughout the period of optimal conditions were shown separately.

Transect	Apr	May	June	July	Aug	Sep	Oct	Nov	Total	N (%)	% Hunt	Duration (s)
2	0.37				0.23	0.20			0.11	0.6%	0.0	1.0-4.4
3	0.66	0.66				0.32			0.21	1.3%	0.0	2.0-6.0
4	0.38	0.27			1.03	5.58	1.29	0.13	1.11	11.6%	0.0-100.0	4.0-8.0
5		0.28	0.52		0.67	0.40	0.13	0.26	0.28	3.9%	0.0-100.0	1.0-9.0
Location	0.28	0.27	0.18		0.62	2.11	0.48	0.13	0.52	4.4%		
0	17.24	3.08	0.57	0.72	4.81	3.84	0.14		3.91	17.0%	0.0-100.0	3.0-142.2
1	1.12				6.10		0.66		0.84	3.2%	0.0-33.3	4.0-9.0
Total	4.03	0.94	0.27	0.16	1.77	2.38	0.41	0.09	1.29	8.7%		
N (%)	15.9%	2.9%	2.1%	1.7%	10.9%	13.8%	12.5%	8.3%				

Members of this species were also registered during the survey on all transects and census points and throughout all survey months, though with a spatially and temporally extremely uneven activity intensity. They are relatively most numerous on census points in the control area, where they are by far most dominant (especially on K3, K4, K5 and K6 with the share of the relevant species group of 80 even up to 95%), while along the control area transect, their number is only half the number of members of the dominant species *Pipistrellus kuhlii*.

By far the highest level of overall activity, moderate, was recorded in the control area, both on the transect and census points. High concentration of activities may be seen along the Sopotska Greda and overburden dump slopes, in particular, on aquatic, wetland and forest habitats in Mogila and Mlava river valleys - often with high or even very high intensity. Almost the entire activity of this species on the transect was recorded in this area, as well as a high overall, and occasionally very high activity on the census points K3, K4 and K6, usually, with a very high share of hunting behaviour. In the ***vicinity*** of the location throughout most of the months they were not recorded, while moderate activity was recorded in mid-August, resulting from intense hunting activities of 2-3 individuals around the lighting inside the parking and gate areas of the Cirikovac mine management complex.

At the Cirikovac and Petka ***locations***, they were recorded irregularly and sporadically, mainly with negligible activity and number, as well as on transects and wind turbine positions (in April and August on wind turbine positions, recorded activity may be described as very low or non-existent), without any hunting activity. The situation is specific at the Drmno location where the recorded activity, both on the transect and the wind turbine positions, was largely negligible, nonetheless higher levels of activity were recorded periodically on the transect (June, August) with the concentration and hunting activity in the area around the highest elevation, and even more, though only in August, on all wind turbine positions.

They were recorded more regularly only at the Klenovnik location, whereas the activity was highly concentrated in the north of the location (in the wider zone of the belt conveyors for coal and nearby ponds), where, especially after the vegetation was cleared and extensive pipeline works conducted, moderate and even high activity was recorded occasionally, both on the transect and on VG19 and VG20 positions, typically with a high proportion of hunting behaviour; moderate activity was recorded from time to time on the VG18 position; in other parts of the transect, as well as in other wind turbine positions, except in April, low or very low level of activity was recorded, similar to other locations.

In the case of this species no spatial focus of activities in the areas along roads and other linear elements was recorded, whereas overflights were typically recorded high in the air, which is fully conformant with the ecology and bionomics of this species (Dietz et al. 2009, Paunovic et al. 2011). When conditions during the transects allowed good visual detection (at the beginning or at the end of daily activities, during the nights with bright moonlight) flying altitude of the members of this species was recorded. It ranged from 2 to 150 m, though the altitude of the majority of overflights ranged from 30 to 80, which also coincides with the ecology and bionomics of this species (Dietz et al. 2009, Rodrigues et al. 2008, 2015).

Absolute activity maximum of the members of this species, present only inside the control area, was recorded in April. Activity minimum not caused by adverse weather conditions recorded from the third decade of June until the second week of July in all spatial - ecological units, was less pronounced on only a part of the control transect in the valley, while it was not manifested as such only on census point K4. Summer activity maximum, which is also the absolute maximum at the location, was registered on most transects and census points from the end of August to mid-September. Since then, the activity gradually declined in all spatial – ecological units (both on transects and census points), while the characteristic autumn maximum was not observed.

The above overview of the survey results indicates that members of this species having numerous shelters in trees of the forests along the Mogila and Mlava rivers, have most important hunting territories in the zones of aquatic, wetland and forest habitats in valleys of these rivers. On locations, there are only few and only intermittently significant hunting territories belonging to this species - in the north of the Klenovnik location and to some extent in the central and peripheral parts of the Drmno location, whereas in all other parts of these and other locations there is only regular transitional activity mainly of negligible intensity. Although it is likely that hunting and transitional activity of the members of this species, which was registered in the area above the location, comes from individuals who have scarce shelters inside the Cirikovac mine management complex, and at least occasionally in a particularly small number at the Drmno location, and much more numerous inside settlement and forest zones in the area, this cannot be reliably argued due to the specific bionomy of this species. Members of this species, unlike previous ones, although showing some tendency to follow the linear landscape elements during their flights, do not have clearly defined flight corridors and fly at much higher altitudes (Dietz et al. 2009, Karapandza and Paunovic 2010). For this reason, the methodology applied during the survey may not be used to clearly identify and spatially define their movement between the shelters and hunting areas. This could be reliably determined only by applying time-consuming and costly methods of radio-telemetric monitoring, which is not necessary for this type of survey (Paunovic et al, 2011, Rodrigues et al. 2008, 2015).

Similar to the previous species, based on the permanent presence, at the location and its immediate surroundings, there is surely a sedentary population of this species (also a seasonal long-distance migrant) which coincides with the existing information about Serbia and the region (Dietz et al. 2009, Karapandza and Paunovic 2010). Based on such information, this population would probably be composed mostly of males. However, the significant maternity activities of this sedentary population, which would not be atypical for Serbia (Karapandza and Paunovic 2010) and the region (Dietz et al. 2009), is clearly supported by the minimum activity in June/July, and maximum activity in late August/early September, which coincides with the maternity activity (or flying of the young out of the shelters) of the local population in these periods (see explanation in the previous section) and it would be on the border of the normal life cycle of this species in Serbia, i.e. a few weeks later than usual (authors' data). Absence of the activity minimum within the maternity period on census point K4 (the closest forest zone of the registered shelters), alongside the moderate intensity then recorded here, as well as along the part of the control transect in the valley, indicates that part of the maternity activity could take place in the vicinity, i.e. that the shelters of this species registered in the forest most likely also function as maternity shelters.

In the vicinity of the location - in forest and urban areas, and to an extremely small extent at the location, significant copulation activity takes place, which, based on the ecology and bionomy of this species (Dietz et al. 2009), reliably points to the hibernation within the same area.

A complete lack of activity maximum, i.e. clear and constant decline in activity during the autumn, indicates that throughout the autumn there was no significant or even temporary migratory inflow, which was this year, inside a somewhat wider area of Serbia, recorded at the beginning of October (authors' data). Since the existence of migratory inflow would be very typical of the region (Dietz et al. 2009), it could not be entirely ruled out inside the investigated area, at least to a lesser extent. However, as these seasonal dynamics was clearly manifested in all spatial - ecological units (both on transects and census points), while the recorded activity of members of this species during the autumn was low and significantly lower than during the summer, it may be concluded that the importance of the entire investigated area for possibly present scarce migratory populations of this species is negligible. Similar to the previous species, the maximum recorded at the beginning of the activity season cannot be interpreted by the presence of the migratory population in this period, as the activity of all species at that time was unusually high, probably due to the very long winter (which is explained in more detail above), whereas similar levels were also recorded in the coming months.

Migratory activity or migration corridors, were not directly observed, although their presence in the broader area of the location is certain in the Danube valley, a well-known migration corridor of this species which during migrations mostly follows the valleys of major rivers (Dietz et al. 2009).

Figure 41. *Nyctalus noctula*. Photo: Branko Karapandza, original.

Summary: Members of the present and relatively numerous local population of this species, which during all life cycle phases, including maternity activity and copulation (probably hibernation) have shelters in forests and urban areas in the vicinity, and to a very small extent at the actual locations, during the entire activity period, use the major part of the locations only as negligible transitory areas, though not as the hunting territory. However, their much more significant occasional hunting territories may be found in the north of the Klenovnik location and in the central and peripheral parts of the Drmno location. Their much more significant hunting territories are around the location – inside the zone of aquatic, wetland and forest habitats of the Mogila and Mlava river valleys. In the local population in the immediate vicinity of the location, there is a significant volume of maternity activity, and it is certain copulation (and even hibernation) occurs here. Migration processes, i.e. occasional presence of a significant migratory population was neither observed at the location nor its surroundings, although the Danube valley is known as an important migration corridor.

Other species

All species except the ones previously analysed were separately recorded at the wind farm locations in a far smaller number. As already pointed out, only representatives of the species/group of *Myotis brandtii/mystacinus/alcathoe* and *Nyctalus leisleri* were recorded during this survey, in numbers that cannot be described as negligible (Table 12). However, due to their small number (small sample) it is not possible to draw reliable conclusions about the temporal and spatial dynamics of their activities at the location, and thus, about their ecological specificities in this area. Although in the vicinity of the location, i.e. in the Cirikovac mine management complex facilities, shelters of a small number (1-2) of members of the species ***Eptesicus serotinus*** were registered, very low activity of the members of the species/group of ***Myotis brandtii/M. mystacinus/M. alcathoe*** and ***Nyctalus leisleri***, indicates that actual location does not include any significant flight corridors, and hunting territories or shelters of their members. Therefore, we cannot expect that they will be significantly affected by the wind farm project.

However, for the species ***Hypsugo savii*** one must still leave a reserve for the future. This species started expanding its range/coverage only recently, by quickly increasing its number in urban zones of the wider area (Paunovic et al. 2015). For this reason, we can expect that it will increase its numbers in urban areas inside the location zone, and subsequently, at the actual locations.

Members of all other species whose presence and activity was recorded at the location and in its immediate surroundings were registered in extremely small numbers (Table 8), usually exclusively or almost exclusively in the immediate surroundings and along the periphery of the location. Nothing indicates that at the location or its immediate surroundings there are significant flight corridors, hunting territories or shelters of the members of these species/groups, in the scope covered by this survey.

Members of all other species whose presence and activity were recorded at the location and its immediate surroundings were registered in extremely small numbers (Table 12). Nothing indicates that at the location or its immediate vicinity there are significant flight corridors, hunting territories or shelters of the members of these species/groups, in the scope covered by this survey: *Rhinolophus ferrumequinum, Miniopterus schreibersii, Myotis myotis/oxygnathus, Myotis daubentonii/capaccinii Myotis bechsteinii, Myotis emarginatus, Myotis nattereri, Plecotus sp., Barbastella barbastellus, Pipistrellus pygmaeus, Pipistrellus pipistrellus, Hypsugo savii u Vespertilio murinus.*

CONCLUSIONS: IMPACT ANALYSIS AND RISK ASSESSMENT

Birds

During the twelve-month survey conducted from early December 2014 until late November 2015 at the study location, presence of 119 species of birds was determined (120 in the entire investigated area including the study and control areas), most of which were in low numbers. As already mentioned, the biggest reason for the low number of specimens of recorded species inside the investigated area was the ultimate uniformity and presence of suboptimal habitats. Trees are almost entirely absent, as well as the middle vegetation level (bushes). The investigated area is characterised by the species living on the surface. Of the species potentially affected by wind turbines, 17 target species were selected, specially monitored and recorded. The volume, altitude and direction of overflight point towards the potentially low effects and intensity of potential adverse impacts. Certain wind turbine operation impacts may be assumed for some species of diurnal birds of prey, most frequent target species, recorded at critical altitudes such as buzzard *Buteo buteo* and common kestrel *Falco tinnunculus*. Other species, such as the western marsh harrier *Circus aeruginosus*, northern goshawk *Accipiter gentilis*, Eurasian sparrowhawk *Accipiter nisus*, white stork *Ciconia ciconia*, including Eurasian hobby *Falco subbuteo*, were much less numerous and were flying at different altitudes from the ground, or mostly up to 50 m, i.e. until the altitude beyond the influence of the future wind turbine rotor blades.

During the investigated period, a total of 252 observations/site visits was realised, with 426 hours (322 + 104) during 36 field days. The largest number of species was recorded at VP 1 - n = 88 Inside the entire area of the studied location, spring migratory activities were distinct to some extent, while, on the other hand, roaming, autumnal migrations and wintering have less recognizable values.

From a total of 513 findings (overflights) of the target species at the location (see Appendix 1), the highest share was on vantage points VP5-115 and VP2 - 110, although on the remaining three VPs the number of target species has a similar, although slightly lower values which indicates significant uniformity and monolithic habitats. Most of the overflights inside the critical zone was on VP3 - 42% of the total number of overflights on this VP, and VP4-37%. This situation identified during a one-year survey, bearing in mind the number and behaviour of the target species, speaks of the small likelihood of conflicts in the case of the wind turbine construction and operation inside the subject area.

The most sensitive subjects of this survey were the birds of prey (*Falconiformes*) belonging to endangered species. For this reason, they are mainly under the strict protection regime. Of the 17 target species, 12 of them belong to the diurnal birds of prey. Nesting of almost all birds of prey species has not been established, except for the most numerous ones - buzzard *Buteo buteo* and common kestrel *Falco tinnunculus*. By far the largest number of overflights was recorded for the two species, while the number of recorded overflights of other species was considerably or extremely limited.

Generally speaking, the most common altitude range of most species was from 0 to 50 m. Of the total of 513 recorded overflights of target species, only 178 had been in the critical altitude zone (altitude ranges 2, 3 and 4) from 60 to 180 m above the ground, which is about 35% of the total number of recorded overflights of the target species. However, most of such overflights belonged to the most frequent and most numerous birds of prey at the location - buzzard *Buteo buteo* and common kestrel *Falco tinnunculus*, which because of their abundance and constant presence, but also due to the characteristics of their overflight, may not be qualified as endangered.

The investigated area does not provide optimal nesting conditions for target species, whereby, throughout the survey, 5 active nests of each of the common kestrel *Falco tinnunculus* and buzzard *Buteo buteo* were discovered inside the investigated location.

Small flocks of doves *Streptopelia turtur*, small monotype and mixed flocks of crows (*Corvidae*), and smaller flocks of starlings *Sturnus vulgaris* and other songbirds were recorded mainly outside the critical altitude zones, and despite the significant presence of the representatives of these species, considerable negative impact of the future wind farm may not be expected.

On the basis of the planned wind turbine layout inside the future Kostolac wind farm and the vantage points data, it may also be assumed that the significant adverse impacts of wind farm construction and operation on bird fauna would not materialise. Twenty wind turbines of the future Kostolac wind farm were allocated on four sub-locations (in line with the plans delivered by the Investor at the start of the survey) inside the investigated location (Map 1). Following the analysed data about the presence and overflight directions of the members of different bird species, as well as the wind turbine layout, it may be assumed that members of the most numerous and most frequent species will mostly be influenced throughout the Kostolac wind farm construction and operation. However, due to the registered characteristics of their overflights, other most frequent target species flying at critical altitudes were scarce. *Consequently, it may be safely estimated that these species will not be largely affected by wind farm construction and operation*. On the other hand, the original wind turbine layout was relatively acceptable from the position of the potential bird fauna impacts, except for the wind turbines foreseen in the westernmost part of the investigated area, around VP2. In synergy with the preliminary findings and recommendations of the bats survey, wind turbines at the Petka location (VP2) were thus relocated.

Suggestions to the Investor in the initial investigation stages led to the current wind turbine layout (Map 4), representing a compromise and a satisfactory solution. *The new situation inside the potential wind farm area meets both the bird fauna protection requirements and the bat fauna protection requirements*. Unlike the bats, birds in the area do not have strict flight corridors. However, by relocating the wind turbines, the Investor attempted to mitigate bird impacts even more, in areas where higher presence of the target bird species was recorded. This can only increase the chances of safe passage for migratory and diurnal birds (and bats alike).

Assessment of negative and positive wind farm impact on birds

Data collected and performed analysis allow us to assess the wind farm construction and operation impacts on birds. Guided by the recommendations based on international experiences (Langston and Pullan 2003, European Commission 2010, Gove et al. 2013) target and selected other species were analysed according to the possible impact. Overall impacts are grouped into 4 large groups - **disturbance** during wind farm construction and operation, **barrier effect**, **direct collision** with wind turbine rotor blades and **loss of habitat** caused by wind farm construction. Each of the impacts may be estimated based on bionomy, autecology, number and behaviour of birds. Estimates for the target species are given in Table 35 and Table 36, respectively.

Table 35. Impact assessment (XXX - large negative impact, XX - moderate, X - small, o - no impact) of the wind farm construction and operation on the *target bird species*. Number of members of the species at the location is only descriptive.

Species	Impact				
	Disturbance	Barrier effect	Direct collision	Loss of habitat	Number
Cygnus olor	o	X	X	o	extremely small
Casmerodius albus	X	X	o	o	extremely small
Ciconia nigra	o	X	X	o	extremely small
Ciconia ciconia	X	X	XX	o	extremely small
Pernis apivorus	o	X	o	o	small
Circus cyaneus	o	o	X	o	small
Circus pygargus	o	X	X	o	small
Circus aeruginosus	o	o	o	o	small
Accipiter gentilis	o	o	X	o	small
Accipiter nisus	o	o	X	o	small
Haliaeetus albicilla	X	o	o	o	extremely small
Buteo buteo	o	o	XX	o	higher
Falco columbarius	o	o	o	o	extremely small
Falco vespertinus	o	o	o	o	extremely small
Falco subbuteo	X	o	X	o	small
Falco tinnunculus	X	o	X	o	small
Grus grus	o	X	X	o	small

As shown in Table 35 and 36, none of the impacts have a strong negative intensity at the investigated location. Target species with the largest cumulative effect are the storks and herons, buzzards, kestrels, including swans, and other selected species such as European bee-eater, field larks and starlings. Although the tables clearly indicate the impact intensities for each species, *it should be noted that the number of members of the majority of the species is relatively small, and therefore without any major effects*.

Table 36. Impact assessment (XXX - large negative impact, XX - moderate, X - small, o - no impact) of the wind farm construction and operation on the *selected other bird species*. Number of members of the species at the location is only descriptive.

Species	Impact				
	Disturbance	Barrier effect	Direct collision	Loss of habitat	Number
Coturnix coturnix	o	o	o	o	medium
Columba palumbus	o	o	o	o	small
Streptopelia decaocto	o	o	o	o	small
Streptopelia turtur	o	o	o	o	small
Merops apiaster	X	X	XX	o	medium
Alauda arvensis	o	o	X	X	high
Hirundinidae	o	X	X	o	high
Corvidae	o	o	o	o	high
Turdus pilaris	o	o	X	o	small
Sturnus vulgaris	o	X	X	o	medium
Fringillidae	o	o	o	o	medium
Emberizidae	o	o	o	o	medium

It should be pointed out, in particular, that throughout the project period, i.e. in its winter portion, there were no extreme winter conditions, leaving the water surfaces of the Danube, and Mlava and Mogila rivers unfrozen. For this reason, the migratory and wintering flocks of waterfowl and other birds of aquatic habitats did not move, which resulted in the absence of overflights of these bird species. Nonetheless, if in the future it comes to extreme winter conditions, overflights of these bird species may be expected, wherefore this observation should be taken into account when planning and preparing mitigation and prevention measures.

On the other hand, assessment of the possible positive impact of the construction and operation of wind turbines and associated infrastructure on certain bird species should be pointed out. Thus, the construction of transmission lines in terms of required supporting infrastructure may have a significant effect on the nesting populations of those bird species given that they are convenient for storing nests (Puzovic 2007, 2008). As already established, many species usually nest on transmission lines, such as sparrows *Passer spp*., starlings *Sturnus vulgaris*, raven *Corvus corax*, crow *Corvus cornix*, magpie *Pica pica*. Raven nests are readily used by birds of prey such as the kestrel *Falco tinnunculus*, buzzard *Buteo buteo*, Eurasian hobby *Falco subbuteo*, even saker falcons *Falco cherrug*, and rarely and the eastern imperial eagle *Aquila heliaca*.

Maintaining the area around the base of the wind turbine towers by grass mowing may increase the number of breeding pairs of species disturbed by tall grass, such as pipit *Anthus spp*., wagtail *Motacilla sp*. and lark *Alaudidae*.

Bats

Based on data collected throughout this survey and prior knowledge of the immediate and wider environment, previous section of this study analysed the ecological functions of the wind farm location landscape and its surroundings for bats. This analysis established the ways bats use this area, as well as the present habitats and their importance for the present bats, which was summarized in Table 37.

Table 37. Assessment of importance (high, moderate, low, negligible) of ecological functions, activity intensity and relative number of the members of different species of bats on wind farm locations.

Species	Shelters	Flight corridors	Hunting territories	Migration inflow	Migration corridors	Activity intensity	Relative number
Pipistrellus kuhlii	*not present*	seasonally moderate	seasonally moderate	*not migrating*		seasonally and locally very high	very high
Pipistrellus nathusii	negligible	low	low	negligible	probably negligible	occasionally moderate	moderate
Nyctalus noctula	negligible	low to negligible	locally moderate	negligible	probably negligible	occasionally and locally high	low to moderate
Hypsugo savii	*not present*	potentially moderate	potentially moderate	*not migrating*		potentially high	potentially high to moderate
Other species	*not present*	negligible	negligible	negligible	negligible	negligible	negligible

Knowledge of the on-site situation (Table 37) and the characteristics of the planned project are needed to identify possible conflicts that may occur during the various stages of the project. However, the extent to which conflicts can be identified during the project to reflect the on-site situation, i.e. the nature and level of the potential project impacts on bats at the location, depends not only on the existing ecological and faunal status. Potential risks for certain species depend to a large degree, from their ecological and bionomic characteristics. For this reason, information about such species are necessary for a complete impact analysis and, in particular, for appropriate risk assessment (impact significance). Overview of ecological and bionomic characteristic of species (potentially) present at the location relevant for this analysis is given in Table 38.

Table 38. Relevant ecologic and bionomic characteristics of bat species present and potentially present at the wind farm location and its immediate surroundings and the potential wind farm project impacts (according to Rodrigues et al. 2008, 2015, EUROBATS2015b)

Species	Low altitude flight	High altitude flight	Hunting close to habitat structures (vegetation, buildings, etc.)	Hunting around lighting	Shelters inside the wind turbine nacelle	Long or mid-distance migration	Risk from direct collision	Share in the identified direct wind turbine collision victims in Europe
Rhinolophus ferrumequinum	X		X				low	0.02%
Rhinolophus euryale	X		X				low	
Rhinolophus hipposideros	X		X				low	
Miniopterus schreibersii	X		?	X		X	**high**	**0.20%**
Myotis mystacinus	X		X				low	0.07%
Myotis brandtii	X	X	X				low	0.02%
Myotis alcathoe	X		X				low	
Myotis oxygnathus	X	X	X			X	low	0.09%
Myotis myotis	X	X	X			X	low	0.13%
Myotis bechsteinii	X		X				low	0.02%
Myotis emarginatus	X	X	X			?	low	0.04%
Myotis nattereri	X		X				low	
Myotis daubentonii	X	X	X			X	low	0.20%
Myotis dasycneme	X	X				X	low	0.07%
Plecotus auritus	X	X	X				low	0.13%
Plecotus austriacus	X	X	X				low	0.16%
Barbastella barbastellus	X		X				moderate	0.11%
Pipistrellus kuhlii	X	X	X	X	X		**high**	**5.38%**
Pipistrellus nathusii	X	X	X	X	X	X	**high**	**20.19%**
Pipistrellus pipistrellus	X	X	X	X	X		**high**	**27.01%**
Pipistrellus pygmaeus	X	X	X	X	X	X	**high**	**4.89%**
Hypsugo savii	X	X	X	X	X		**high**	**5.03%**
Nyctalus leisleri		X	X	X	?	X	**high**	**10.72%**
Nyctalus noctula		X		X	?	X	**high**	**20.84%**
Vespertilio murinus		X		X		X	**high**	**2.98%**
Eptesicus serotinus	X	X	X	X	X		moderate	1.66%

When on-site information are available (Table 37) and when bionomical and ecological characteristics of the species are known (Table 38), and when, on the other hand, we take into account the known and potential bat impacts of the wind turbine project (Table 38; Paunovic et al., 2011, Rodrigues et al. 2008, 2015, EUROBATS 2015b), it is possible to make a reliable assessment of the impact of a particular wind turbine project on bats and gauge the risk and potential significance of each of these impacts (Table 39). Here we have not considered the impact of ultrasound emitted by wind turbines as well as the loss of hunting areas due to the wind farm avoidance, given that nowadays it is well-known that these impacts are not significant (Rodrigues et al. 2015).

Table 39. Possible impacts of the Kostolac wind farm project on local and migratory bat populations (potentially) present at the location and assessment of their importance (high, moderate, low, negligible, none). The numbers refer to additional explanations in the text.

Species	During project execution		During project operation		Population
	Loss of shelters due to construction	Loss of hunting territories due to construction	Loss/disturbance of flight corridors	Direct fatalities (collision, barotrauma)	
Pipistrellus kuhlii	none	low (1)	low (1)	moderate (6)	Local
Pipistrellus nathusii	negligible (2)	negligible (3)	low (4)	moderate (7)	Local
Nyctalus noctula	negligible (2)	negligible (5)	negligible (5)	moderate to high (7)	Local
Hypsugo savii (8)	none	none	none	potentially moderate to high	Local
Other species (9)	negligible or none	negligible	negligible	negligible	Local
Pipistrellus nathusii (9)	negligible	negligible	negligible	negligible	Migration
Nyctalus noctula (9)	negligible	negligible	negligible	negligible	Migration

(1) Comprehensive removal of woody and shrub vegetation during the project execution phase and maintenance of such a state during project operation, as well as the positioning and operation of wind turbines and other infrastructure on important flight corridors (full light blue lines in Figure 38) representing most important hunting territories for the members of the species *Pipistrellus kuhlii* on locations due to the specific bionomics and ecology of this species may only lead to partial loss of these functions inside these zones, which would have low importance for the local population of this species based on the importance of these functions, and the fact that a substantial share of their flight corridors and hunting areas is not on the wind farm location, but in their surroundings, for which reason it cannot be covered by this influence.

(2) Complete removal of trees containing a negligible number of the registered (red dots in Figure 38) and potential (area framed by the red line in Figure 38) shelters of the individual members of these species, based on their number and character, would be negligible.

(3) Only a comprehensive removal of woody and shrub vegetation on the entire location during the project execution phase and maintenance of such a situation during the project operation, which was not provided by the General Design, could affect already small significant hunting territories of this species at the location.

(4) Comprehensive removal of woody and shrub vegetation on the entire location during the project execution phase and maintenance of such a situation during the project operation, as well as positioning and operation of wind turbines and other infrastructure in the areas of important flight corridors (full light blue line in Figure 38) would have high significance for the local population of this species, based on the importance of these flight corridors.

(5) Due to the specific bionomy and ecology of this species, project works as well as wind farm operation cannot considerably disrupt daily transitional and hunting activity of the members of this species normally conducted at altitudes above 40 m (Table 38) inside corridors physically not strictly defined, as confirmed by the observations made during this survey.

(6) Members of this species were registered in Europe as victims of wind turbines, with a significant share of the identified victims, but lower than other species of this genus (Table 38); the extent to which this share is lower because most of this information applies to parts of Europe where this species is not present or it is scarce, or because of the possibly low-risk due to the specific ecology and bionomy, may not be reliably estimated at this moment, however, it is considered that there is a high risk of direct fatalities (Table 38; Rodrigues et al. 2015). Since the members of this species at the locations throughout this survey were by far the most numerous and, at least in some places during the summer and spring they have a high and very high activity intensity, along with the high fatality risks, it may be expected that the rate of direct fatalities will be high at least in this period. However, given that the members of the local population of this species are mostly active outside the locations, while they are highly numerous and dominant not only in the settlements in the immediate vicinity, but also in all urban habitats of Serbia (Karapandza and Paunovic 2010), even a very high rate of fatalities caused by the wind farm operation would not have a high impact on the population of this species.

(7) Members of the species *Pipistrellus nathusii* and *Nyctalus noctula*, due to the specificity of their bionomy, are among the most common victims of wind turbines in Europe (Table 38). Since their high fatality rate may therefore be expected, moderate to high impact on the fatality of their populations is also probable, given that the members of the local populations of both species are present throughout the location and, at least during spring and summer and/or sometimes, relatively numerous, with a moderate to high activity intensity, based on the characteristic spatial and temporal dynamics of activities of the members of each species.

(8) Considerable number of the members of the species *Hypsugo savii* was not registered during the survey, nor have their important ecological functions at the wind farm locations and in their surroundings been identified. For this reason, they cannot be exposed to the wind farm construction and operation impacts. However, this species has recently started to increase its area in Serbia while also relatively rapidly increasing its numbers, especially in urban areas (Paunovic et al. 2015). Consequently, it may be expected that their numbers will increase inside the investigated locations in the coming years, along with the occurrence of flight corridors and hunting territories (but not shelters, which are potentially found only in areas of the surrounding settlements), and thus their activity. Since they were registered in Europe as victims of wind turbines, with a significant share of the identified victims (Table 38b), but less than other species because most of this information applies to parts of Europe where this species is not present or is scarce, therefore, it is considered that there is a high risk of direct fatalities (Table 38; Rodrigues et al. 2015), if in the coming years their numbers and activities in the wind farm area increase considerably, higher fatality rates may be expected.

(9) Members of all other species or populations were registered only sporadically at the locations and in an extremely small number. The actual locations are not essential for these local/migratory populations. Therefore, the wind farm project cannot have any significant impact on their ecological functions. Although there is a certain fatality risk for all the species recorded as victims of wind turbines, given the negligible activity intensity of these species/populations at the locations, this risk may be described as negligible, together with the impact on their local/migratory populations.

HARMFUL IMPACTS PREVENTION AND MITIGATION MEASURES

The most effective way to prevent harmful project impacts (Paunovic et al. 2011), including wind farm projects (Rodrigues et al. 2015), on birds and bats is to apply the principles of **preventive planning** to ensure bats and birds protection. This means that the adverse impacts of the project construction and operation should be prevented or reduced to a minimum even during the design/planning phase.

Upon the recommendation of the Service Provider, EPS accepted and implemented the preventive planning principle from the very start of the survey – based on findings and recommendations of the preliminary conflicts analysis carried out throughout the preparation of the Preliminary Report presenting the conducted analysis of the existing documentation (Karapandza et al. 2014), the wind farm layout was changed at the very start of this survey, i.e. changes were made to the positions of individual wind turbines (Figure 42), aimed at directly preventing the harmful effects of the project on birds and bats.

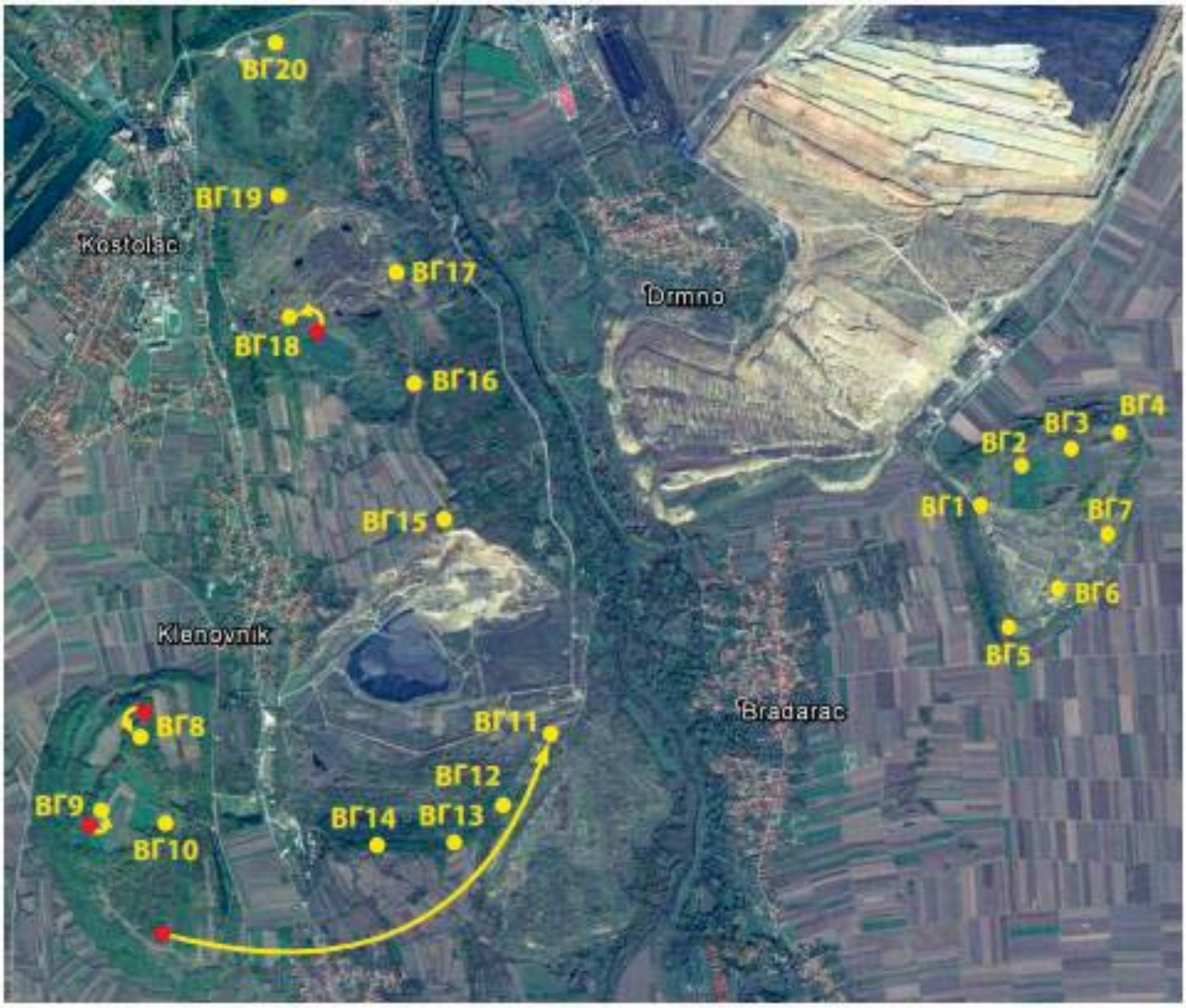

Figure 42. Changes to the wind farm plan as a result of the preliminary conflicts analysis at the start of this survey (red - wind turbines from the General Design, i.e. prior to the survey, yellow - wind turbine positions after the initial survey recommendations). Source: JP EPS and Google Earth 2014 Branko Karapandza, original.

Preliminary conflict analysis found that the ***Petka location*** is largely overgrown with woody shrub vegetation, where the largest part of its central area is characterized by a very dense stands - thickets, shrubs and young forests, while along its peripheral part there are also elderly and thick, coniferous and deciduous stands. It is estimated that especially these older stands may have significance for the retention of certain strictly protected bird species such as diurnal raptors and owls, and that this entire location has a high trophic potential for bats, which was later confirmed by the findings of this survey. Pointing to the explicit position by EUROBATS that wind turbines should not be installed in forests or on a distance of less than 200 m from the forest because of the extremely high risks this poses for all bats (Rodrigues et al. 2008, 2015), it was concluded that the current positions of all wind turbines at the Petka location according to the General Design, pose high fatality risks for the protected and endangered species of birds and bats. It is therefore proposed to prevent this potentially very harmful wind turbine impact, to consider repositioning these wind turbines into the zone where risks will be smaller and/or where extensive cutting of woody and shrub vegetation at this location would be carried out. This cutting is considered acceptable because the vegetation does not have great importance for the conservation of birds and bats fauna of the surrounding area, as the immediate vicinity holds a large number of natural optimal habitats of this type, and it drastically increases their fatality risks. After highly extensive additional analyses were conducted also involving detailed mapping and assessment of habitats at the Petka location, the most optimal solution was reached (Figure 42) – wind turbine VG11 position previously planned in the zone of larger continuous thickets in southern parts of the Petka location was transferred to the Cirikovac location (into the safe environment of open ruderal habitats, as confirmed by this survey), VG08 and VG09 positions were moved to a safe distance from the older stands on the slopes, while on all positions complete removal of shrubs and woody vegetation was planned inside the entire zone to allow smooth wind turbine operation and safety zones of 200 meters around them, which is considered to be general risk reduction measure implemented on all wind turbines positions.

At the ***Klenovnik location***, preliminary conflict analysis demonstrated the existence of pockets of the backfilled overburden material inside the closed mine zone where ponds are formed associated with large complex of aquatic, riparian and wetland habitats. As expected, and confirmed later by this survey, these habitats attract aquatic habitats birds, insects and bats, and represent significant watering areas of the location, essential for birds and bats lifecycle. Therefore, it was concluded that the position of the VG18 wind turbine, which according to the General Design of the time, was in this zone there was a high fatality risk for the protected and endangered species of birds and bats. To prevent these potentially very harmful effects, repositioning of the VG18 turbine was suggested and accepted outside the risk zone (Figure 42). Possible drying of ponds and reconfiguration, i.e. backfilling of overburden material in order to prevent future accumulation of water and formation of these habitats; this would reduce the fatality risks, while the loss of this habitat would not have a significant negative impact since in the immediate vicinity there is a large number of optimal natural habitats of this type.

Birds

The data and analyses indicate a low level of expected adverse bird fauna impacts, both on the local population and nesting birds, and migratory species, while the layout and the distance between the wind turbine towers seem favourable to the survival of birds. Therefore, based on the results and analysis of this survey, no specific measures to prevent and reduce the harmful effects are considered necessary.

To register, prevent and reduce potential damages in the first place, it is necessary to undertake **survey during construction** of the wind farm, as well as the **post-construction survey**, to prevent any possible unforeseen adverse effects by rapid application of additional appropriate measures.

In addition, during cold winters, a very large unforeseen increase in the number and activity of birds in the wind farm area may be expected (elaborated above in detail), which can lead to high direct fatality risks. Because of this, the wind farm plan, depending on the technical capabilities, should provide for possible installation of an automatic detection-based system (radar or adequate video equipment) detecting individuals or flocks of birds inside the risk zone to automatically and temporarily shut down wind turbines or effectively force the birds outside the risk zone. Based on this survey, this type of system is not considered necessary throughout the construction of the wind farm, but as a precautionary measure, this possibility should be left if needed based on the findings of the post-construction survey.

General measures to prevent and reduce possible adverse impact of wind farms on birds are similar to the ones foreseen for bats. Therefore, they will be presented and further elaborated below.

Bats

On the whole, the actual wind farm locations have a certain, though not high, importance for the preservation of the local bat fauna. This relates exclusively to the local populations of the species *Pipistrellus kuhlii*, *Pipistrellus nathusii*, *Nyctalus noctula* (not migratory populations *Nyctalus noctula* and *Pipistrellus nathusii*) for whose members at least moderate important ecological functions exist at the locations which is why here their high or moderate activity and relative number is recorded at least temporarily and/or locally. This may be possibly expected in the near future for *Hypsugo savii*.

Since data and analysis from this study show that the wind farm project may have some impact on bats, qualified in some cases as moderate or highly hazardous (Table 39), throughout the wind farm planning and commissioning stages, some measures need to be foreseen to prevent, reduce and/or remove the foreseen harmful bat impacts (Paunovic et al, 2011, Rodrigues et al. 2008, 2015). The most important of these measures are, thanks to the policy adopted by the Investor to implement preventive planning aimed at protecting birds and bats, have already been applied during the project planning phase, as elaborated above (Figure 42).

In addition to measures reducing the concrete harmful impacts, which will be described in detail, according to the standard guidelines (Paunovic et al, 2011, Rodrigues et al. 2008, 2015), and Nature Protection Conditions stipulated for the Kostolac wind farm technical documentation development (№ 020-2775/2 dated 29 December 2014) of the Nature Protection Institute of Serbia, once the wind farm has been commissioned, **post-construction survey** should be carried out. This survey would monitor changes in the local bat fauna and their ecological functions at the location, especially their fatality rate, if any. Only on the basis of this survey lasting for at least two years (Rodrigues et al. 2008, 2015), may the resulting adverse impacts of the project on bats be reliably examined, together with the efficiency of the proposed and implemented measures for their prevention, reduction and elimination, and subsequently if the need arises, possible changes suggested.

Below is a proposal for measures to prevent and reduce the expected adverse impacts of the Kostolac wind farm project on bats (and birds) present at the location. These proposals fully comply with the standard guidelines (Paunovic et al, 2011, Rodrigues et al. 2008, 2015), and Nature Protection Conditions (№ 020-2775/2 dated 29 December 2014).

Loss of shelters and hunting territories during the project execution

Based on the results and analyses of this survey, it was concluded that during the Kostolac wind farms project execution there will be no significant loss of shelters and hunting territories. Hence, no measures preventing potentially harmful or in the case of the present wind farm unexpected impacts are necessary.

Loss of hunting territories due to wind farm avoidance

Recent studies have shown, and nowadays it is widely accepted, that the wind farm operation has not led to significant loss of hunting territories due to wind turbine avoidance (Rodrigues et al. 2015). Therefore, this impact has not even been considered and no prevention measures are necessary.

Loss/disturbance of flight corridors

Based on the results and analysis of this survey, it was concluded that throughout the Kostolac wind farm project execution there will be no significant loss/disturbance of flight corridors. Hence, no measures preventing the potentially harmful or in the case of the present wind farm unexpected impacts are necessary.

Direct fatalities

The most adverse impact of wind farm operation on bats are direct fatalities (Arnett et al. 2013a, Rodrigues et al. 2015), while the most effective measure preventing/reducing fatalities of at least some of the species is **preventive planning of wind turbine layout** (Rodrigues et al. 2015). Fatalities may be reduced if wind turbines are not positioned in the vicinity of zones with high bat activity concentration, these being the flight corridors identified at the locations (light blue lines in Figure 38), as well as parts of locations with dense woody, bushy and marsh vegetation occasionally functioning as hunting territories. Safe effective distance of the wind turbines is at least 200 metres (Rodrigues et al. 2008, 2015).

As explained in detail above, based on the preliminary conflict analysis, the Investor accepted the suggested solution (Figure 42) involving the repositioning of the individual wind turbines outside the increased fatality risk zones. Therefore, under the current plan/layout, all the wind turbine positions are at a safe distance from the identified most important flight corridors (light blue lines in Figure 38). Hence, it is considered that the maximum was achieved by repositioning the wind turbines from the aspect of bat fatalities prevention.

Fatalities may also be reduced by measures aimed at **reducing the concentration of bat prey** - insects, in the immediate vicinity of individual wind turbines (Rodrigues et al. 2008, 2015). These measures can by no means be allowed to reduce the concentration of prey on the rest of the location, as this would increase the risk of loss of hunting territories. Some of the measures by which this can be achieved and which should be **implemented on all wind turbine positions without exception** include:

- Use of lighting not attracting insects,
- All lighting, not prescribed for safety reasons, should be turned on only when necessary, not continuously throughout the night,
- Immediate surroundings of wind turbines disturbed by their construction, i.e. wind turbine positions, should be maintained (any woody or shrub vegetation should be removed and its further development prevented, including weed; pond creation should also be prevented) so as not to attract insects to allow smooth functioning (safety zones 200 m around the wind turbine should be designated). This particularly applies to the drainage channels around the tower, which need to be designed, constructed and maintained to prevent any longer water retention, development of weed, especially woody and shrub vegetation should be prevented along roads leading from the towers to the district roads.

Although all of these measures should be implemented fully and consistently without exception on all wind turbine positions and safety zones of effective radius of 200 meters around them, **removal and prevention of future woody and shrub vegetation development** inside this zone is particularly important, as these zones inside the locations were the very areas where higher bat activity was recorded throughout this survey, occasionally even very high. Removal and suppression of woody and shrub vegetation is recommended as a precaution across wider areas, between wind turbine positions, whenever and wherever possible.

At the ***Cirikovac location***, along the main gravel road, used as the flight corridor and a hunting territory (light blue lines in Figure 38), due to the high bat activity, but with a distinct spatial focus along the vegetation edges (both at the roadside and on the cleared section along the road), a low and narrow linear vegetation structure combined from low trees and shrubs (low avenue or high hedges) should be formed to prevent bats flying in the direction of wind turbines in this zone and fatality risks. For this purpose, existing vegetation elements may be used. This vegetation should not by any means be preserved or formed, what's more it should be actively removed and suppressed along the individual wind turbines access roads.

The largest share of bat fatalities occurs at low wind speeds, up to 5-6 m/s, given that when wind speed increases above this limit, bat activity decreases dramatically (Arnett et al 2013a, Rodrigues et al. 2015), which was observed during this survey. Very extensive recent research on North American wind power plants (Baerwald et al 2009; Arnett et al, 2010; 2011, 2013b), as well as the European ones (Bach and Niermann 2013) show that wind turbine **curtailment** or **feathering** by changing the angle of the blades until the moment when the wind reaches critical speed, with negligible annual electricity generation losses, lead to a drastic decline in bat fatality (60-90%), which is why this is considered as the only proven method to reduce fatalities (Arnett et al 2013a, Rodrigues et al. 2015). These measures are now automated through computer control systems of wind turbines, stopping wind turbines depending on meteorological parameters and periods during which high activity is expected and, consequently, a high risk of direct bat fatalities (Rodrigues et al. 2015).

At the ***Klenovnik and Drmno locations***, especially on wind turbine positions, occasionally high bat activity is recorded throughout the entire activity season, and therefore a high fatality risk. Since this activity is neither spatially focused nor temporally predictable, reducing high fatality risks is not possible by other measures. Therefore, depending on the technical characteristics of a specific type of wind turbines, wind turbine **curtailment/feathering** should be planned. Implementation of these measures is proposed only on wind turbine positions at the Klenovnik and Drmno locations, in the period from sunrise to sunset every night from 1 March to 30 September in temperatures higher than 7°C and wind speed of less than 7 m/s (Rodrigues et al. 2015). Depending on the technical capabilities of wind turbines and control systems, these curtailment/feathering conditions may be fine-tuned later, i.e. developed into a sophisticated multifactorial algorithm, thus further reducing the total duration of curtailment/feathering - decreasing generation losses without increasing the bat fatality risks.

Summary: Based on the results of this survey and the entire preceding analysis, previously elaborated in detail, it is estimated that:

- The largest part of the measures necessary to prevent adverse wind farm impact has already been implemented by **preventive planning** of wind turbine positions aimed at birds and bats protection.

- All wind turbine positions defined by the current plan (Figure 3) are completely **suitable for the construction and operation,** however by implementing certain general measures, described in detailed above, in order to reduce the concentration of insects in their surroundings, i.e. safety zones of effective 200 meter radius around them, and whenever possible inside the wider area between wind turbine positions: use of lighting not attracting the insects, turning off the lighting not prescribed for safety reasons, and, in particular, **removal and prevention of development of woody, bushy** and weed **vegetation**, as well as not allowing water retention in the immediate vicinity of wind turbines.

- At the ***Cirikovac*** location along the main gravel road, but by no means near the access roads leading to individual wind turbines, **low and narrow linear vegetation structure** (low avenue/high hedges) should be formed at the end of wind farm construction and maintained throughout its operation.

- At the ***Klenovnik*** and ***Drmno*** locations, during the night in the period from 1 March to 30 September, in temperatures higher than 7°C and wind speed of less than 7 m/s, wind turbine **curtailment/feathering** measures should be carried out, with possible fine-tuning of these measures depending on the technical characteristics of the control system.

- Once the project has been commissioned, **post-construction survey** lasting for two years should be carried out, to monitor the changes in the birds and bats fauna and their ecological functions on locations, and in particular fatality rates.

- As a precaution, possible installation of an **automatic bird detection system** should be foreseen, together with the wind turbine shut down/dispersal system. However, this system should not be installed if post-construction survey results do not demonstrate that this is necessary.

Literature

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Appendix 1. Tables listing target bird species per vantage point (VP)

VP1 - Cirikovac

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
1.1	13/12/2014	8:20	M.Raković, M.Paunović	*Buteo buteo*	2	5	2	3	2	direct flight	sw	200	ne
1.2	14/12/2014	8:40	M.Raković, M.Paunović	*Falco tinnunculus*	1	3	1	1	1	direct flight	n	50	sw
1.3	14/12/2014	8:43	M.Raković, M.Paunović	*Casmerodius albus*	1	4	1	1	1	direct flight	ssw	120	e
1.4	14/12/2014	9:00	M.Raković, M.Paunović	*Casmerodius albus*	1	5	1	1	1	standing on base	n	500	
1.5	14/12/2014	9:02	M.Raković, M.Paunović	*Buteo buteo*	1	2	1	1	1	standing on tree	nne	700	
1.6	28/12/2014	8:25	M.Paunović	*Casmerodius albus*	1	2	1	1	1	standing on base	e	500	
1.7	28/12/2014	8:36	M.Paunović	*Accipiter nisus*	1	3	1	1	1	circling	nne	150	ne
1.8	28/12/2014	9:04	M.Paunović	*Buteo buteo*	1	4	1	1	1	standing on tree		150	
1.9	16/01/2015	7:41	M.Raković	*Accipiter nisus*	1	3	1	1	1	hunting	e	50	n
1.10	16/01/2015	8:12	M.Raković	*Buteo buteo*	1	4	2	3	2	direct flight	nnw	300	ese
1.11	31/01/2015	8:03	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	ne	300	s
1.12	31/01/2015	8:16	M.Raković	*Buteo buteo*	4	4	4	5	5	circling, direct flight	w	800	se
1.13	08/02/2015	9:17	M.Raković	*Casmerodius albus*	1	2	1	1	1	standing on base	n	500	
1.14	08/02/2015	9:51	M.Raković	*Buteo buteo*	2	4	5	5	5	direct flight	w	800	e
1.15	15/02/2015	7:34	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	w	400	sw
1.16	15/02/2015	8:02	M.Raković	*Buteo buteo*	1	7	4	5	5	circling	sw	300	w
1.17	01/03/2015	9:03	M.Raković	*Buteo buteo*	3	7	4	5	5	circling	w	350	w
1.18	08/03/2015	9:00	M.Raković	*Buteo buteo*	3	6	2	3	3	circling	n	300	e
1.19	08/03/2015	9:50	M.Raković	*Buteo buteo*	1	5	2	2	2	direct flight	n	700	se
1.20	08/03/2015	10:12	M.Raković	*Buteo buteo*	1	3	1	1	1	standing on tree	w	400	
1.21	15/03/2015	8:52	M.Raković	*Grus grus*	23	3	5	5	5	direct flight	se	600	n
1.22	15/03/2015	9:21	M.Raković	*Buteo buteo*	3	10	4	5	5	circling	se	600	n
1.23	22/03/2015	9:31	M.Raković	*Circus aeruginosus*	1	4	1	1	1	hunting	nw	200	ne
1.24	22/03/2015	9:43	M.Raković	*Buteo buteo*	1	6	1	1	1	standing on tree	n	300	
1.25	22/03/2015	9:56	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	se	250	n
1.26	22/03/2015	10:17	M.Raković	*Buteo buteo*	1	8	2	3	3	direct flight	sw	150	ne

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
1.27	05/04/2015	8:34	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	n	200	
1.28	05/04/2015	8:49	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	nw	350	e
1.29	19/04/2015	10:22	M.Raković	*Buteo buteo*	3	5	2	5	4	conflict in flight	w	300	
1.30	19/04/2015	10:56	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	n	300	ne
1.31	27/04/2015	9:40	M.Raković	*Buteo buteo*	1	5	3	4	5	circling	s	400	e
1.32	27/04/2015	9:58	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	nw	300	
1.33	03/05/2015	8:52	M.Raković	*Buteo buteo*	1	4	1	4	2	circling	n	250	w
1.34	03/05/2015	9:11	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	w	350	ne
1.35	20/05/2015	8:01	M.Raković	*Buteo buteo*	1	2	1	3	2	circling	s	200	n
1.36	20/05/2015	8:08	M.Raković	*Buteo buteo*	1	4	1	2	1	direct flight	ne	350	w
1.37	23/05/2015	11:30	M.Raković	*Buteo buteo*	2	7	3	5	4	circling	w	300	ene
1.38	06/06/2015	8:51	M.Raković	*Buteo buteo*	1	3	1	1	1	standing on tree	nw	150	
1.39	06/06/2015	9:17	M.Raković	*Falco tinnunculus*	2	4	1	1	1	hunting	n	200	ne
1.40	06/06/2015	9:38	M.Raković	*Buteo buteo*	1	4	4	5	5	circling	w	250	n
1.41	20/06/2015	8:11	M.Raković	*Buteo buteo*	2	5	3	5	4	circling	n	300	sw
1.42	21/06/2015	9:07	M.Raković	*Buteo buteo*	1	2	1	2	1	direct flight	se	150	nw
1.43	21/06/2015	9:23	M.Raković	*Buteo buteo*	1	1	1	1	1	standing on tree	nw	200	
1.44	21/06/2015	9:40	M.Raković	*Buteo buteo*	3	5	2	4	3	circling	wnw	400	n
1.45	08/07/2015	10:34	M.Raković	*Buteo buteo*	3	5	3	5	5	circling	wnw	450	s
1.46	08/07/2015	11:10	M.Raković	*Falco tinnunculus*	1	2	1	2	1	hunting	n	200	e
1.47	18/07/2015	9:00	M.Raković	*Falco subbuteo*	1	1	1	2	2	direct flight	ne	50	w
1.48	18/07/2015	9:37	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	w	300	ne
1.49	25/07/2015	9:43	M.Raković	*Buteo buteo*	2	3	2	2	2	direct flight	n	300	sw
1.50	26/07/2015	10:00	M.Raković	*Buteo buteo*	3	4	4	5	5	circling	w	350	e
1.51	27/07/2015	10:28	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	wnw	150	
1.52	09/08/2015	10:17	M.Raković	*Buteo buteo*	2	5	4	5	5	circling	e	300	nw
1.53	09/08/2015	10:42	M.Raković	*Buteo buteo*	1	5	1	2	2	direct flight	e	250	nw

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
1.54	09/08/2015	11:22	M.Raković	*Buteo buteo*	1	5	2	2	2	direct flight	w	300	se
1.55	12/08/2015	8:59	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	n	500	sw
1.56	12/08/2015	9:12	M.Raković	*Circus aeruginosus*	1	4	1	1	1	hunting	nw	200	e
1.57	12/08/2015	9:51	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	e	300	nw
1.58	26/08/2015	9:18	M.Raković	*Buteo buteo*	6	4	5	5	5	circling	n	700	s
1.59	26/08/2015	9:46	M.Raković	*Ciconia ciconia*	1	1	3	4	4	direct flight	nw	400	ese
1.60	26/08/2015	10:02	M.Raković	*Buteo buteo*	1	6	1	2	1	hunting	n	200	e
1.61	06/09/2015	8:47	M.Raković	*Falco tinnunculus*	1	2	1	2	1	direct flight	w	100	ne
1.62	06/09/2015	8:55	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	nne	250	w
1.63	06/09/2015	9:12	M.Raković	*Buteo buteo*	3	5	4	5	5	circling	ene	400	sw
1.64	06/09/2015	10:22	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	n	300	e
1.65	20/09/2015	11:12	M.Raković	*Buteo buteo*	2	5	2	3	2	circling	w	400	ne
1.66	27/09/2015	9:43	M.Raković	*Buteo buteo*	2	2	1	2	2	direct flight	ese	450	n
1.67	04/10/2015	9:28	M.Raković	*Buteo buteo*	5	3	4	5	5	direct flight	ne	600	s
1.68	10/10/2015	8:59	M.Raković	*Grus grus*	11	2	5	5	5	direct flight	nnw	800	se
1.69	10/10/2015	9:06	M.Raković	*Accipiter nisus*	1	1	1	1	1	hunting	s	50	e
1.70	10/10/2015	9:34	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	n	150	e
1.71	10/10/2015	9:41	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	e	100	wnw
1.72	31/10/2015	7:11	M.Raković	*Circus cyaneus*	1	3	1	2	1	hunting	n	200	ese
1.73	31/10/2015	7:38	M.Raković	*Buteo buteo*	3	3	3	5	4	circling	n	800	ese
1.74	31/10/2015	7:38	M.Raković	*Buteo buteo*	3	3	3	5	4	circling	n	800	ese
1.75	01/11/2015	8:27	M.Raković	*Buteo buteo*	1	5	1	2	2	hunting	nw	350	ese
1.76	01/11/2015	8:36	M.Raković	*Falco tinnunculus*	1	1	1	2	1	direct flight	ne	450	w
1.77	01/11/2015	9:08	M.Raković	*Buteo buteo*	1	4	2	3	3	circling	w	500	n
1.78	11/11/2015	8:15	M.Raković	*Circus cyaneus*	1	4	1	1	1	hunting	nw	450	e
1.79	11/11/2015	8:58	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	wnw	350	
1.80	21/11/2015	7:00	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	nw	250	
1.81	21/11/2015	7:19	M.Raković	*Buteo buteo*	1	6	1	2	1	direct flight	n	400	se

VP2 - Petka

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges) min.	max	average	Behaviour	Direction from VP	stance from VP (m)	Flight direction
2.1	13/12/2014	10:11	M.Raković, M.Paunović	*Buteo buteo*	1	1	1	2	1	taking off tree	s	200	n
2.2	13/12/2014	10:42	M.Raković, M.Paunović	*Buteo buteo*	1	3	1	1	1	standing on tree	w	100	
2.3	13/12/2014	10:44	M.Raković, M.Paunović	*Falco tinnunculus*	1	2	1	1	1	standing on hunting	nne	350	
2.4	13/12/2014	10:46	M.Raković, M.Paunović	*Buteo buteo*	1	3	5	5	5	circling	nw	100	nw
2.5	13/12/2014	10:55	M.Raković, M.Paunović	*Buteo buteo*	1	3	1	1	1	standing on tree	ne	600	
2.6	14/12/2014	10:40	M.Raković, M.Paunović	*Buteo buteo*	1	2	1	1	1	standing on tree	w	100	
2.7	14/12/2014	11:00	M.Raković, M.Paunović	*Buteo buteo*	1	2	2	2	2	direct flight	s	200	nw
2.8	14/12/2014	11:25	M.Raković, M.Paunović	*Falco tinnunculus*	1	4	1	2	1	hunting	nw	100	
2.9	28/12/2014	10:35	M.Paunović	*Buteo buteo*	2	5	1	1	1	standing on tree		70	
2.10	28/12/2014	10:54	M.Paunović	*Falco tinnunculus*	1	4	1	1	1	hunting	sw	150	se
2.11	08/01/2015	11:42	M.Raković	*Buteo buteo*	1	3	1	1	1	standing on base	n	100	
2.12	08/01/2015	11:51	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	ne	200	w
2.13	16/01/2015	11:18	M.Raković	*Falco tinnunculus*	1	3	1	2	1	standing on tree	n	200	
2.14	16/01/2015	11:22	M.Raković	*Buteo buteo*	1	2	1	1	1	hunting	s	150	ne
2.15	31/01/2015	10:49	M.Raković	*Buteo buteo*	2	2	4	5	5	direct flight	sw	400	n
2.16	31/01/2015	11:29	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	e	150	
2.17	08/02/2015	7:14	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	e	70	w
2.18	08/02/2015	7:26	M.Raković	*Buteo buteo*	1	2	1	2	1	hunting	sw	130	ne
2.19	08/02/2015	7:31	M.Raković	*Buteo buteo*	2	3	3	5	4	circling	s	200	se
2.20	15/02/2015	11:30	M.Raković	*Falco tinnunculus*	2	20	1	1	1	hunting	ene	400	se
2.21	15/02/2015	12:03	M.Raković	*Buteo buteo*	1	8	1	1	1	standing on tree	w	200	
2.22	01/03/2015	10:47	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	n	200	
2.23	01/03/2015	10:55	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	se	250	n
2.24	01/03/2015	11:21	M.Raković	*Buteo buteo*	1	5	2	4	3	circling	n	500	w
2.25	08/03/2015	10:50	M.Raković	*Falco tinnunculus*	1	5	1	2	1	direct flight	se	500	n
2.26	08/03/2015	11:09	M.Raković	*Buteo buteo*	1	7	4	5	5	circling	n	600	s
2.27	08/03/2015	11:28	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	s	300	nw

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
2.28	15/03/2015	14:42	M.Raković	*Buteo buteo*	2	8	2	4	3	circling	sw	400	ene
2.29	22/03/2015	11:18	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	s	250	nw
2.30	22/03/2015	11:22	M.Raković	*Buteo buteo*	1	6	1	2	1	direct flight	ne	450	sw
2.31	22/03/2015	11:53	M.Raković	*Falco tinnunculus*	1	7	1	2	1	direct flight	sw	250	nne
2.32	05/04/2015	12:39	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	se	300	n
2.33	05/04/2015	12:57	M.Raković	*Accipiter gentilis*	1	2	2	2	2	direct flight	w	200	e
2.34	19/04/2015	11:54	M.Raković	*Buteo buteo*	1	4	2	4	3	circling	w	450	ne
2.35	19/04/2015	12:06	M.Raković	*Falco tinnunculus*	2	5	1	2	1	direct flight	se	150	n
2.36	19/04/2015	12:29	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	sw	200	
2.37	27/04/2015	11:19	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	e	350	w
2.38	27/04/2015	11:27	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	e	600	s
2.39	27/04/2015	11:28	M.Raković	*Falco subbuteo*	1	1	1	2	2	direct flight	wsw	200	n
2.40	27/04/2015	12:09	M.Raković	*Pernis apivorus*	1	2	5	5	5	direct flight	se	400	nw
2.41	03/05/2015	11:19	M.Raković	*Buteo buteo*	2	3	2	4	3	circling	s	300	nw
2.42	03/05/2015	11:42	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	e	150	sw
2.43	03/05/2015	12:13	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	s	200	ne
2.44	20/05/2015	12:11	M.Raković	*Falco tinnunculus*	2	3	1	2	1	direct flight	se	350	nw
2.45	20/05/2015	12:17	M.Raković	*Buteo buteo*	2	4	2	3	3	circling	e	200	n
2.46	20/05/2015	13:22	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	se	150	n
2.47	23/05/2015	9:06	M.Raković	*Buteo buteo*	2	3	2	3	3	circling	n	200	se
2.48	23/05/2015	9:35	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	w	100	
2.49	23/05/2015	10:00	M.Raković	*Falco tinnunculus*	2	3	1	2	1	direct flight	ne	150	sse
2.50	06/06/2015	7:00	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	e	200	wnw
2.51	06/06/2015	7:56	M.Raković	*Falco tinnunculus*	1	3	2	2	2	direct flight	ne	150	s
2.52	06/06/2015	8:23	M.Raković	*Buteo buteo*	2	3	2	3	3	circling	n	250	e
2.53	20/06/2015	13:19	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	sw	250	nne
2.54	20/06/2015	13:28	M.Raković	*Falco tinnunculus*	2	3	1	2	1	direct flight	nnw	250	se
2.55	20/06/2015	14:02	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	e	50	n

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
2.56	20/06/2015	14:21	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on base	s	200	
2.57	21/06/2015	10:40	M.Raković	*Ciconia ciconia*	1	2	2	2	2	direct flight	sw	500	n
2.58	22/06/2015	11:10	M.Raković	*Falco tinnunculus*	2	5	1	2	2	direct flight	ne	300	ssw
2.59	08/07/2015	8:49	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	se	100	nw
2.60	08/07/2015	9:12	M.Raković	*Buteo buteo*	2	3	2	4	3	circling	n	450	e
2.61	08/07/2015	9:34	M.Raković	*Falco tinnunculus*	3	3	1	2	2	hunting	ese	150	wsw
2.62	18/07/2015	7:31	M.Raković	*Buteo buteo*	2	7	2	5	3	circling	wsw	400	e
2.63	18/07/2015	7:37	M.Raković	*Falco tinnunculus*	3	3	1	1	1	hunting	nw	100	sse
2.64	18/07/2015	8:12	M.Raković	*Buteo buteo*	1	2	1	1	1	standing on tree	ssw	200	
2.65	25/07/2015	7:15	M.Raković	*Falco tinnunculus*	2	5	1	2	1	hunting	e	150	nw
2.66	25/07/2015	7:48	M.Raković	*Buteo buteo*	2	3	2	3	2	circling	sw	200	nne
2.67	09/08/2015	9:00	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	ene	200	sw
2.68	09/08/2015	9:12	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	w	150	
2.69	09/08/2015	9:31	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	ese	300	w
2.70	12/08/2015	7:11	M.Raković	*Falco tinnunculus*	1	3	1	2	1	hunting	e	200	s
2.71	12/08/2015	8:02	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	sw	250	ne
2.72	12/08/2015	8:55	M.Raković	*Buteo buteo*	3	5	3	5	4	circling	n	500	ese
2.73	26/08/2015	10:30	M.Raković	*Accipiter gentilis*	1	1	1	2	1	direct flight	e	100	nw
2.74	26/08/2015	10:41	M.Raković	*Buteo buteo*	3	4	4	5	5	circling	sw	400	w
2.75	26/08/2015	10:49	M.Raković	*Falco tinnunculus*	1	2	1	1	1	hunting	s	100	e
2.76	26/08/2015	11:11	M.Raković	*Circus pygargus*	1	4	1	1	1	hunting	s	200	n
2.77	26/08/2015	11:30	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	se	250	ene
2.78	06/09/2015	11:09	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	n	150	
2.79	06/09/2015	11:28	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	ese	200	nw
2.80	06/09/2015	11:46	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	s	150	ne
2.81	06/09/2015	12:03	M.Raković	*Buteo buteo*	2	5	1	2	2	hunting	e	300	s
2.82	06/09/2015	12:12	M.Raković	*Circus aeruginosus*	1	3	1	2	1	hunting	wsw	250	se
2.83	20/09/2015	8:55	M.Raković	*Falco tinnunculus*	2	2	1	2	1	direct flight	wnw	300	se

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
2.84	20/09/2015	9:11	M.Raković	*Buteo buteo*	2	5	2	3	2	flying	e	250	s
2.85	20/09/2015	9:26	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	s	200	ne
2.86	27/09/2015	11:00	M.Raković	*Falco tinnunculus*	1	2	1	1	1	direct flight	e	200	n
2.87	27/09/2015	11:18	M.Raković	*Buteo buteo*	2	7	2	2	2	flying	ne	350	s
2.88	27/09/2015	11:21	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	sw	150	ne
2.89	27/09/2015	12:19	M.Raković	*Pernis apivorus*	1	2	3	3	3	direct flight	n	300	s
2.90	04/10/2015	10:42	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	s	300	
2.91	04/10/2015	10:47	M.Raković	*Buteo buteo*	1	6	1	1	1	taking off tree	w	200	n
2.92	04/10/2015	10:57	M.Raković	*Falco tinnunculus*	2	8	1	2	1	hunting	ese	150	ne
2.93	04/10/2015	11:31	M.Raković	*Buteo buteo*	1	5	2	3	2	flying	e	200	s
2.94	10/10/2015	7:13	M.Raković	*Falco tinnunculus*	1	1	1	2	1	direct flight	e	250	s
2.95	10/10/2015	7:28	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	se	150	n
2.96	10/10/2015	7:30	M.Raković	*Buteo buteo*	3	5	5	5	5	circling	sw	350	wnw
2.97	31/10/2015	11:41	M.Raković	*Buteo buteo*	2	5	2	5	4	circling	n	400	ese
2.98	31/10/2015	11:49	M.Raković	*Buteo buteo*	1	5	2	2	2	flying	se	200	wnw
2.99	31/10/2015	12:05	M.Raković	*Falco tinnunculus*	1	1	2	2	2	direct flight	sse	200	nnw
2.100	31/10/2015	12:32	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	e	100	s
2.101	01/11/2015	9:47	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	ene	300	s
2.102	01/11/2015	9:55	M.Raković	*Buteo buteo*	2	5	1	2	2	hunting	s	250	nne
2.103	01/11/2015	10:11	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	ssw	300	nne
2.104	01/11/2015	10:42	M.Raković	*Falco tinnunculus*	1	6	1	2	1	hunting	wnw	150	ese
2.105	11/11/2015	7:00	M.Raković	*Buteo buteo*	1	7	1	1	1	standing on tree	wnw	250	
2.106	11/11/2015	7:41	M.Raković	*Falco tinnunculus*	1	3	1	2	1	hunting	ne	350	s
2.107	11/11/2015	7:48	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	sse	250	nnw
2.108	21/11/2015	11:11	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	nne	350	s
2.109	21/11/2015	11:27	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	s	400	n
2.110	21/11/2015	11:48	M.Raković	*Buteo buteo*	1	6	2	5	4	circling	n	600	sse

VP3- Klenovnik

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges) min.	max	average	Behaviour	Direction from VP	Distance from VP (m)	Flight direction
3.1	13/12/2014	12:35	M.Raković, M.Paunović	*Buteo buteo*	4	2	1	2	3	standing on base	e	50	
3.2	14/12/2014	14:15	M.Raković, M.Paunović	*Buteo buteo*	1	2	2	3	2	direct flight	n	200	se
3.3	14/12/2014	14:30	M.Raković, M.Paunović	*Buteo buteo*	1	3	4	5	5	circling	w	600	s
3.4	28/12/2014	13:26	M.Paunović	*Buteo buteo*	1	4	1	1	1	direct flight	e	100	ne
3.5	08/01/2015	13:40	M.Raković	*Buteo buteo*	1	3	5	5	5	circling	nw	400	ne
3.6	08/01/2015	14:12	M.Raković	*Falco columbarius*	1	4	1	1	1	hunting	s	100	e
3.7	16/01/2015	12:52	M.Raković	*Buteo buteo*	2	5	3	5	4	circling	wsw	500	nw
3.8	16/01/2015	13:03	M.Raković	*Buteo buteo*	1	3	1	2	2	hunting	e	300	n
3.9	16/01/2015	13:12	M.Raković	*Falco tinnunculus*	2	2	1	1	1	direct flight	sw	200	n
3.10	31/01/2015	12:35	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	ese	300	
3.11	08/03/2015	15:25	M.Raković	*Buteo buteo*	7	6	4	5	5	circling	sw	500	n
3.12	08/03/2015	15:38	M.Raković	*Accipiter nisus*	1	2	1	1	1	hunting	se	150	w
3.13	15/03/2015	17:00	M.Raković	*Buteo buteo*	1	5	2	2	2	direct flight	sw	450	e
3.14	15/03/2015	17:12	M.Raković	*Buteo buteo*	1	5	3	5	4	circling	n	350	sw
3.15	15/03/2015	17:34	M.Raković	*Falco tinnunculus*	1	5	1	2	2	direct flight	w	300	s
3.16	05/04/2015	16:28	M.Raković	*Circus aeruginosus*	1	5	1	2	1	hunting	sw	450	e
3.17	05/04/2015	16:45	M.Raković	*Buteo buteo*	1	6	2	4	3	circling	nw	500	se
3.18	05/04/2015	17:02	M.Raković	*Buteo buteo*	1	8	1	2	1	hunting	s	250	e
3.19	19/04/2015	17:20	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	w	400	e
3.20	27/04/2015	16:53	M.Raković	*Falco subbuteo*	1	2	1	1	1	direct flight	sw	250	n
3.21	20/05/2015	16:12	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	e	300	wnw
3.22	23/05/2015	17:17	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	n	200	w
3.23	23/05/2015	17:46	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	wnw	250	s

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
3.24	06/06/2015	14:19	M.Raković	*Buteo buteo*	2	3	2	3	3	circling	w	300	ne
3.25	06/06/2015	15:09	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	n	100	ssw
3.26	20/06/2015	17:00	M.Raković	*Buteo buteo*	2	5	1	2	1	hunting	wnw	150	s
3.27	20/06/2015	17:58	M.Raković	*Buteo buteo*	1	4	3	5	4	circling	se	300	nw
3.28	21/06/2015	16:12	M.Raković	*Falco subbuteo*	1	1	1	1	1	direct flight	s	150	n
3.29	21/06/2015	16:24	M.Raković	*Buteo buteo*	2	6	3	3	3	circling	wnw	400	sw
3.30	21/06/2015	16:51	M.Raković	*Falco tinnunculus*	2	4	1	1	1	hunting	wsw	250	n
3.31	21/06/2015	17:11	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	n	100	w
3.32	08/07/2015	16:31	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	nw	300	s
3.33	08/07/2015	17:00	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	n	150	wsw
3.34	18/07/2015	14:28	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	nw	150	s
3.35	18/07/2015	14:32	M.Raković	*Buteo buteo*	1	8	2	4	3	circling	s	300	ne
3.36	25/07/2015	15:20	M.Raković	*Falco tinnunculus*	1	2	1	1	1	direct flight	ssw	200	ne
3.37	25/07/2015	15:38	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	se	150	w
3.38	25/07/2015	16:17	M.Raković	*Ciconia ciconia*	2	1	2	3	2	direct flight	ne	600	w
3.39	09/08/2015	16:13	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	ne	400	sw
3.40	12/08/2015	14:42	M.Raković	*Buteo buteo*	1	5	3	5	4	circling	w	250	n
3.41	12/08/2015	15:18	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	e	400	w
3.42	26/08/2015	15:11	M.Raković	*Falco subbuteo*	1	1	2	2	2	direct flight	wnw	350	ne
3.43	26/08/2015	15:19	M.Raković	*Buteo buteo*	2	6	2	5	4	circling	e	500	sw
3.44	26/08/2015	15:48	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	w	100	ne
3.45	26/08/2015	16:00	M.Raković	*Circus aeruginosus*	1	5	1	2	2	direct flight	e	450	sw
3.46	26/08/2015	16:11	M.Raković	*Falco tinnunculus*	1	3	1	2	1	hunting	s	200	ne

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
3.47	06/09/2015	17:00	M.Raković	*Buteo buteo*	1	5	1	2	2	hunting	se	350	w
3.48	06/09/2015	17:22	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	nw	100	
3.49	06/09/2015	17:30	M.Raković	*Buteo buteo*	1	2	3	4	4	direct flight	wsw	400	se
3.50	06/09/2015	17:47	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	se	200	wnw
3.51	20/09/2015	17:07	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	s	300	e
3.52	20/09/2015	17:29	M.Raković	*Circus aeruginosus*	1	5	1	1	1	hunting	sw	150	ene
3.53	27/09/2015	17:00	M.Raković	*Buteo buteo*	2	7	4	5	4	circling	sse	700	n
3.54	27/09/2015	17:21	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	sw	400	ese
3.55	27/09/2015	17:29	M.Raković	*Falco tinnunculus*	1	4	2	2	2	direct flight	e	150	w
3.56	10/10/2015	13:22	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	e	400	ssw
3.57	10/10/2015	13:38	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	wsw	200	n
3.58	10/10/2015	13:46	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	ese	150	wsw
3.59	10/10/2015	13:51	M.Raković	*Circus cyaneus*	1	6	1	2	1	hunting	ssw	300	ene
3.60	10/10/2015	14:05	M.Raković	*Buteo buteo*	1	4	1	3	2	flying	se	450	n
3.61	31/10/2015	14:42	M.Raković	*Cygnus olor*	2	1	5	5	5	direct flight	nw	1300	ssw
3.62	31/10/2015	15:13	M.Raković	*Buteo buteo*	1	5	3	3	3	hunting	s	300	e
3.63	01/11/2015	9:52	M.Raković	*Buteo buteo*	1	5	2	4	3	circling	se	500	w
3.64	01/11/2015	10:09	M.Raković	*Buteo buteo*	1	1	2	2	2	direct flight	sw	450	ene
3.65	01/11/2015	10:43	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	ese	250	wsw
3.66	11/11/2015	12:10	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	se	700	wnw
3.67	11/11/2015	12:34	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	ssw	450	ene
3.68	21/11/2015	13:35	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	s	500	n
3.69	21/11/2015	13:51	M.Raković	*Buteo buteo*	1	5	5	5	5	direct flight	ene	450	s

VP4 - Kostolac

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
4.1	13/12/2014	13:33	M.Raković, M.Paunović	*Buteo buteo*	1	5	1	1	1	standing on tree	sw	200	
4.2	13/12/2014	13:55	M.Raković, M.Paunović	*Buteo buteo*	1	2	2	2	2	direct flight	s	300	w
4.3	14/12/2014	14:58	M.Raković, M.Paunović	*Buteo buteo*	1	5	1	1	1	standing on tree	wnw	150	
4.4	28/12/2014	13:45	M.Paunović	*Buteo buteo*	2	6	1	1	1	standing on tree		100	
4.5	08/01/2015	12:43	M.Raković	*Accipiter nisus*	1	3	1	1	1	direct flight	se	50	n
4.6	08/01/2015	12:59	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	wnw	150	
4.7	16/01/2015	12:43	M.Raković	*Buteo buteo*	2	5	2	4	5	circling	n	400	wnw
4.8	16/01/2015	13:11	M.Raković	*Falco tinnunculus*	1	2	1	2	1	direct flight	se	250	nnw
4.9	31/01/2015	14:05	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	n	250	se
4.10	08/02/2015	15:00	M.Raković	*Buteo buteo*	1	3	2	4	5	circling	sw	350	nw
4.11	15/02/2015	13:22	M.Raković	*Buteo buteo*	1	4	2	3	3	circling	s	200	e
4.12	15/02/2015	13:47	M.Raković	*Buteo buteo*	1	5	1	2	2	direct flight	sw	400	ene
4.13	01/03/2015	16:00	M.Raković	*Buteo buteo*	1	3	2	3	3	circling	ne	350	s
4.14	01/03/2015	16:53	M.Raković	*Buteo buteo*	1	6	1	1	1	hunting	sw	400	e
4.15	08/03/2015	16:31	M.Raković	*Buteo buteo*	2	2	3	5	4	conflict in flight	s	500	sw
4.16	15/03/2015	15:20	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	sw	250	
4.17	22/03/2015	18:19	M.Raković	*Buteo buteo*	1	3	2	2	2	direct flight	ne	350	ese
4.18	22/03/2015	18:32	M.Raković	*Falco tinnunculus*	1	7	1	2	1	hunting	s	200	se
4.19	22/03/2015	18:45	M.Raković	*Buteo buteo*	1	5	2	5	4	circling	w	300	n
4.20	05/04/2015	14:28	M.Raković	*Buteo buteo*	1	4	2	2	2	direct flight	se	250	n
4.21	05/04/2015	14:31	M.Raković	*Buteo buteo*	1	7	1	2	1	hunting	s	300	se
4.22	05/04/2015	14:56	M.Raković	*Circus aeruginosus*	1	2	1	1	1	hunting	sw	250	nw
4.23	19/04/2015	18:40	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	sw	300	
4.24	27/04/2015	18:29	M.Raković	*Buteo buteo*	1	3	5	5	5	circling	se	400	s

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
4.25	03/05/2015	18:43	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	w	500	se
4.26	20/05/2015	14:29	M.Raković	*Buteo buteo*	2	4	3	3	3	circling	s	300	nw
4.27	20/05/2015	15:07	M.Raković	*Buteo buteo*	1	3	1	2	2	hunting	w	400	se
4.28	23/05/2015	18:31	M.Raković	*Buteo buteo*	2	5	3	5	4	circling	nw	600	e
4.29	06/06/2015	12:48	M.Raković	*Buteo buteo*	1	4	1	1	1	hunting	nw	200	s
4.30	08/07/2015	18:00	M.Raković	*Buteo buteo*	2	3	1	1	1	hunting	n	350	sw
4.31	08/07/2015	18:59	M.Raković	*Falco tinnunculus*	1	4	2	2	2	direct flight	n	150	sw
4.32	08/07/2015	19:21	M.Raković	*Falco tinnunculus*	1	1	1	1	1	direct flight	se	200	nnw
4.33	18/07/2015	12:11	M.Raković	*Buteo buteo*	1	3	2	4	3	circling	nw	400	sse
4.34	18/07/2015	12:43	M.Raković	*Falco tinnunculus*	1	4	1	2	2	direct flight	w	250	s
4.35	18/07/2015	12:58	M.Raković	*Falco tinnunculus*	1	3	1	2	1	hunting	se	350	nnw
4.36	18/07/2015	13:02	M.Raković	*Buteo buteo*	1	3	2	2	2	direct flight	e	200	w
4.37	25/07/2015	13:44	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	se	300	n
4.38	25/07/2015	14:39	M.Raković	*Buteo buteo*	1	2	1	2	2	direct flight	ne	300	sse
4.39	09/08/2015	18:00	M.Raković	*Falco tinnunculus*	1	1	2	2	2	direct flight	ese	200	w
4.40	09/08/2015	18:31	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	wsw	250	s
4.41	09/08/2015	19:28	M.Raković	*Buteo buteo*	1	2	3	5	4	circling	sw	400	nne
4.42	12/08/2015	12:02	M.Raković	*Buteo buteo*	1	7	1	1	1	standing on tree	n	150	
4.43	12/08/2015	12:52	M.Raković	*Falco tinnunculus*	2	5	1	2	1	hunting	w	200	s
4.44	12/08/2015	13:00	M.Raković	*Falco tinnunculus*	1	4	1	2	1	hunting	sw	150	ne
4.45	12/08/2015	13:36	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	e	200	w
4.46	26/08/2015	16:50	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on base	wsw	150	
4.47	26/08/2015	16:57	M.Raković	*Falco subbuteo*	2	2	2	2	2	direct flight	sw	200	e
4.48	26/08/2015	17:10	M.Raković	*Falco tinnunculus*	2	5	1	2	1	hunting	ese	150	s
4.49	26/08/2015	17:47	M.Raković	*Falco tinnunculus*	1	1	1	1	1	direct flight	n	200	s
4.50	26/08/2015	17:58	M.Raković	*Circus aeruginosus*	1	1	1	2	1	hunting	ese	300	w
4.51	26/08/2015	18:04	M.Raković	*Buteo buteo*	1	1	2	4	3	circling	ne	200	s

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
4.52	06/09/2015	18:29	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	s	400	ne
4.53	06/09/2015	18:31	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	w	300	se
4.54	06/09/2015	19:12	M.Raković	*Buteo buteo*	1	6	1	2	2	hunting	ese	400	n
4.55	20/09/2015	18:15	M.Raković	*Buteo buteo*	1	5	1	5	4	circling	n	100	se
4.56	20/09/2015	18:28	M.Raković	*Circus aeruginosus*	1	6	1	2	1	hunting	sw	250	e
4.57	20/09/2015	18:55	M.Raković	*Buteo buteo*	2	5	1	2	1	hunting	wsw	500	s
4.58	20/09/2015	19:08	M.Raković	*Falco tinnunculus*	1	6	1	1	1	direct flight	se	300	wnw
4.59	27/09/2015	18:52	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	s	450	wnw
4.60	27/09/2015	19:11	M.Raković	*Buteo buteo*	2	5	3	3	3	direct flight	sse	600	w
4.61	04/10/2015	16:22	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	sse	400	
4.62	04/10/2015	16:28	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	wsw	200	s
4.63	04/10/2015	16:45	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	sw	500	nne
4.64	10/10/2015	14:34	M.Raković	*Buteo buteo*	1	5	1	2	2	hunting	sse	300	ne
4.65	10/10/2015	15:01	M.Raković	*Falco tinnunculus*	1	6	1	1	1	hunting	sw	400	e
4.66	31/10/2015	13:18	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	sw	350	ne
4.67	31/10/2015	13:55	M.Raković	*Circus cyaneus*	1	2	2	2	2	direct flight	w	400	e
4.68	31/10/2015	13:59	M.Raković	*Buteo buteo*	1	5	3	4	4	circling	sse	200	nw
4.69	01/11/2015	16:00	M.Raković	*Buteo buteo*	2	3	1	1	1	standing on base	ne	200	
4.70	01/11/2015	16:18	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	e	400	wsw
4.71	01/11/2015	16:45	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	sse	400	ne
4.72	11/11/2015	11:08	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	s	250	ne
4.73	11/11/2015	11:17	M.Raković	*Circus cyaneus*	1	4	1	1	1	hunting	se	400	w
4.74	11/11/2015	11:29	M.Raković	*Buteo buteo*	3	5	3	4	4	circling	ssw	600	n
4.75	11/11/2015	11:48	M.Raković	*Falco tinnunculus*	1	6	1	1	1	hunting	sw	250	e
4.76	21/11/2015	12:36	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	s	450	wnw
4.77	21/11/2015	12:50	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	w	300	e
4.78	21/11/2015	13:00	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	wsw	250	se

VP5 - Drmno

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
5.1	13/12/2014	14:45	M.Raković,.M.Paunović	*Falco tinnunculus*	1	1	1	1	1	taking off tree	nw	650	n
5.2	13/12/2014	14:53	M.Raković,.M.Paunović	*Buteo buteo*	2	3	2	2	2	direct flight	n	300	se
5.3	13/12/2014	15:07	M.Raković,.M.Paunović	*Falco tinnunculus*	1	2	1	1	1	hunting	sse	450	e
5.4	14/12/2014	15:50	M.Raković,.M.Paunović	*Buteo buteo*	1	5	1	1	1	standing on tree	n	300	
5.5	14/12/2014	16:15	M.Raković,.M.Paunović	*Falco tinnunculus*	1	5	1	1	1	hunting	wnw	200	se
5.6	28/12/2014	7:30	M.Paunović	*Buteo buteo*	2	5	1	1	1	standing on tree	nw	150	
5.7	28/12/2014	8:05	M.Paunović	*Falco tinnunculus*	1	2	1	1	1	taking off tree	n	150	ne
5.8	08/01/2015	15:18	M.Raković	*Buteo buteo*	1	5	4	5	5	circling	sw	500	ese
5.9	08/01/2015	15:34	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	wsw	150	s
5.10	08/01/2015	15:55	M.Raković	*Falco tinnunculus*	1	4	1	1	1	direct flight	n	100	w
5.11	16/01/2015	15:22	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	e	250	sw
5.12	16/01/2015	15:41	M.Raković	*Buteo buteo*	2	3	4	5	5	circling	ese	400	n
5.13	16/01/2015	16:00	M.Raković	*Falco tinnunculus*	1	4	1	2	2	direct flight	s	200	n
5.14	31/01/2015	15:42	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	w	150	sw
5.15	31/01/2015	15:58	M.Raković	*Buteo buteo*	1	2	1	1	1	standing on tree	ne	250	
5.16	31/01/2015	16:12	M.Raković	*Falco tinnunculus*	2	5	1	2	1	direct flight	se	300	n
5.17	08/02/2015	15:40	M.Raković	*Circus cyaneus*	1	5	1	1	1	hunting	w	150	s
5.18	08/02/2015	15:45	M.Raković	*Buteo buteo*	1	7	1	1	1	standing on tree	n	200	
5.19	08/02/2015	15:59	M.Raković	*Falco tinnunculus*	2	3	1	1	1	hunting	ne	70	s
5.20	08/02/2015	16:20	M.Raković	*Buteo buteo*	1	2	1	1	1	standing on tree	n	150	
5.21	15/02/2015	15:43	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	ne	300	
5.22	15/02/2015	15:58	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	n	350	sw
5.23	15/02/2015	16:10	M.Raković	*Falco tinnunculus*	2	2	1	1	1	direct flight	e	400	nw

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
5.24	01/03/2015	13:48	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on	w	150	
5.25	01/03/2015	14:00	M.Raković	*Buteo buteo*	1	5	4	5	5	circling	se	400	n
5.26	01/03/2015	14:04	M.Raković	*Falco tinnunculus*	1	2	2	2	2	direct flight	sw	200	nw
5.27	01/03/2015	14:37	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	ne	350	w
5.28	08/03/2015	13:38	M.Raković	*Buteo buteo*	1	3	4	4	4	direct flight	se	500	n
5.29	08/03/2015	13:51	M.Raković	*Falco tinnunculus*	2	5	1	1	1	hunting	nw	250	e
5.30	15/03/2015	18:18	M.Raković	*Buteo buteo*	2	2	2	2	2	direct flight	ssw	350	wsw
5.31	15/03/2015	18:43	M.Raković	*Falco tinnunculus*	2	2	1	1	1	direct flight	sse	200	ese
5.32	22/03/2015	14:30	M.Raković	*Circus aeruginosus*	1	5	1	1	1	hunting	wnw	250	nne
5.33	22/03/2015	14:44	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	nne	500	se
5.34	22/03/2015	14:52	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	n	300	e
5.35	22/03/2015	15:23	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	sw	450	e
5.36	05/04/2015	18:15	M.Raković	*Circus aeruginosus*	1	3	1	2	1	direct flight	sse	400	w
5.37	05/04/2015	18:32	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on	ne	300	
5.38	05/04/2015	18:36	M.Raković	*Falco tinnunculus*	2	2	1	2	1	direct flight	ese	200	nw
5.39	19/04/2015	15:33	M.Raković	*Falco tinnunculus*	2	4	1	2	1	hunting	n	400	sw
5.40	19/04/2015	15:56	M.Raković	*Buteo buteo*	2	5	3	4	4	circling	se	500	wsw
5.41	27/04/2015	14:20	M.Raković	*Falco vespertinus*	3	8	1	1	1	hunting	n	200	sw
5.42	27/04/2015	14:58	M.Raković	*Falco subbuteo*	1	2	1	2	2	direct flight	ssw	100	ene
5.43	27/04/2015	15:10	M.Raković	*Falco tinnunculus*	2	4	1	2	1	direct flight	se	150	n
5.44	27/04/2015	15:31	M.Raković	*Buteo buteo*	1	2	2	5	3	circling	ene	450	e
5.45	03/05/2015	15:24	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	nw	300	ese
5.46	03/05/2015	15:37	M.Raković	*Falco tinnunculus*	1	5	1	1	1	standing on	nw	200	
5.47	20/05/2015	18:00	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	n	200	sse
5.48	20/05/2015	18:13	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	w	350	ese
5.49	20/05/2015	19:09	M.Raković	*Falco tinnunculus*	1	2	1	2	1	direct flight	se	250	w
5.50	23/05/2015	7:23	M.Raković	*Falco tinnunculus*	1	1	1	1	1	direct flight	e	150	nne
5.51	23/05/2015	8:13	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	sw	300	n

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
5.52	06/06/2015	10:17	M.Raković	*Falco tinnunculus*	1	5	1	1	1	standing on tree	se	150	
5.53	06/06/2015	10:26	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	w	200	w
5.54	06/06/2015	11:12	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	sw	350	nne
5.55	20/06/2015	18:19	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	e	300	sw
5.56	20/06/2015	18:38	M.Raković	*Falco tinnunculus*	1	5	1	2	1	hunting	nw	250	sse
5.57	21/06/2015	14:56	M.Raković	*Buteo buteo*	2	4	1	2	1	direct flight	sw	450	e
5.58	21/06/2015	15:11	M.Raković	*Falco tinnunculus*	2	3	1	1	1	hunting	sw	300	s
5.59	21/06/2015	15:23	M.Raković	*Buteo buteo*	1	4	2	3	2	direct flight	w	500	nnw
5.60	08/07/2015	7:17	M.Raković	*Buteo buteo*	4	5	3	4	4	circling	se	400	w
5.61	08/07/2015	8:03	M.Raković	*Falco tinnunculus*	1	3	1	2	1	direct flight	nne	200	n
5.62	08/07/2015	8:13	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	s	350	nnw
5.63	18/07/2015	10:28	M.Raković	*Falco tinnunculus*	3	5	1	1	1	standing on tree	wnw	250	
5.64	18/07/2015	10:34	M.Raković	*Buteo buteo*	2	2	3	3	3	direct flight	s	300	sw
5.65	18/07/2015	11:06	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	w	150	ese
5.66	25/07/2015	11:00	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	se	250	
5.67	25/07/2015	11:19	M.Raković	*Falco tinnunculus*	2	3	1	2	2	hunting	nw	300	se
5.68	25/07/2015	11:42	M.Raković	*Falco tinnunculus*	2	2	1	2	1	direct flight	wnw	300	w
5.69	25/07/2015	12:14	M.Raković	*Buteo buteo*	1	3	1	2	1	hunting	ne	400	s
5.70	09/08/2015	7:00	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	ne	200	
5.71	09/08/2015	7:26	M.Raković	*Falco tinnunculus*	3	1	1	2	2	direct flight	wnw	300	e
5.72	09/08/2015	7:54	M.Raković	*Falco tinnunculus*	2	6	1	2	1	hunting	ne	200	ese
5.73	09/08/2015	8:12	M.Raković	*Buteo buteo*	1	5	1	3	2	flying	n	300	sw
5.74	12/08/2015	10:18	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	s	150	
5.75	12/08/2015	10:42	M.Raković	*Falco tinnunculus*	2	3	1	2	1	hunting	n	200	s
5.76	12/08/2015	11:00	M.Raković	*Buteo buteo*	2	4	1	2	2	hunting	ne	300	wsw

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
5.77	12/08/2015	11:10	M.Raković	*Falco tinnunculus*	1	1	2	2	2	direct flight	ne	300	w
5.78	26/08/2015	13:42	M.Raković	*Buteo buteo*	1	5	2	2	2	jedri	e	450	nw
5.79	26/08/2015	13:59	M.Raković	*Buteo buteo*	1	7	1	1	1	standing on tree	wsw	200	
5.80	26/08/2015	14:19	M.Raković	*Falco tinnunculus*	2	4	1	2	2	hunting	n	150	e
5.81	26/08/2015	14:28	M.Raković	*Buteo buteo*	1	6	1	2	1	hunting	wnw	250	ese
5.82	06/09/2015	15:08	M.Raković	*Falco tinnunculus*	1	5	1	1	1	standing on tree	nne	150	
5.83	06/09/2015	15:21	M.Raković	*Buteo buteo*	2	4	2	4	3	circling	e	500	wsw
5.84	06/09/2015	15:55	M.Raković	*Falco tinnunculus*	1	6	1	1	1	hunting	n	250	se
5.85	06/09/2015	16:38	M.Raković	*Falco tinnunculus*	1	4	1	1	1	direct flight	wnw	300	ese
5.86	20/09/2015	7:18	M.Raković	*Buteo buteo*	2	5	1	1	1	standing on tree	sw	150	
5.87	20/09/2015	7:56	M.Raković	*Falco tinnunculus*	2	4	1	1	1	hunting	n	200	w
5.88	20/09/2015	8:11	M.Raković	*Falco tinnunculus*	1	1	1	2	1	hunting	nnw	150	se
5.89	20/09/2015	8:23	M.Raković	*Ciconia nigra*	4	1	5	5	5	direct flight	nne	800	ssw
5.90	27/09/2015	15:22	M.Raković	*Falco tinnunculus*	1	3	1	1	1	standing on tree	nne	100	
5.91	27/09/2015	15:49	M.Raković	*Buteo buteo*	1	5	2	4	3	circling	w	300	n
5.92	27/09/2015	16:08	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	nw	150	ese
5.93	04/10/2015	13:30	M.Raković	*Falco tinnunculus*	1	6	1	1	1	standing on tree	nnw	100	
5.94	04/10/2015	13:37	M.Raković	*Falco tinnunculus*	2	3	1	2	1	hunting	nw	150	ese
5.95	04/10/2015	13:51	M.Raković	*Buteo buteo*	2	4	2	3	3	flying	w	300	ne
5.96	04/10/2015	14:18	M.Raković	*Falco tinnunculus*	1	1	1	1	1	hunting	wnw	150	ene
5.97	04/10/2015	14:29	M.Raković	*Accipiter nisus*	1	1	1	1	1	direct flight	w	150	e
5.98	10/10/2015	15:48	M.Raković	*Buteo buteo*	1	3	1	1	1	standing on tree	se	200	
5.99	10/10/2015	15:55	M.Raković	*Circus cyaneus*	1	4	1	2	1	hunting	n	250	sse
5.100	10/10/2015	16:03	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	nw	150	e
5.101	10/10/2015	16:25	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	w	200	ene

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
5.102	31/10/2015	15:48	M.Raković	*Buteo buteo*	1	6	1	1	1	standing on tree	ssw	300	
5.103	31/10/2015	16:12	M.Raković	*Falco tinnunculus*	2	3	1	1	1	hunting	nne	150	ssw
5.104	31/10/2015	16:18	M.Raković	*Buteo buteo*	1	5	2	3	3	direct flight	w	400	ene
5.105	01/11/2015	13:00	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	s	350	
5.106	01/11/2015	13:14	M.Raković	*Falco tinnunculus*	2	5	1	1	1	hunting	ne	350	w
5.107	01/11/2015	13:46	M.Raković	*Buteo buteo*	1	4	1	2	1	hunting	wnw	400	ene
5.108	01/11/2015	13:59	M.Raković	*Falco tinnunculus*	2	3	1	2	1	hunting	nw	350	ese
5.109	11/11/2015	9:45	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	ne	250	
5.110	11/11/2015	10:05	M.Raković	*Circus cyaneus*	1	5	1	1	1	hunting	n	350	s
5.111	11/11/2015	10:16	M.Raković	*Buteo buteo*	1	4	2	3	3	circling	nw	500	s
5.112	11/11/2015	10:32	M.Raković	*Falco tinnunculus*	2	5	1	1	1	hunting	nne	450	s
5.113	21/11/2015	14:47	M.Raković	*Falco tinnunculus*	1	1	1	2	2	direct flight	w	450	ne
5.114	21/11/2015	15:07	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	ne	300	wsw
5.115	21/11/2015	15:22	M.Raković	*Buteo buteo*	2	4	2	3	3	direct flight	ene	500	w

VP6 – Kontrola 1

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
6.1	13/12/14	14:35	M.Raković, M.Paunović	*Buteo buteo*	1	3	1	1	1	standing on shrub	500	ne	w
6.2	28/12/14	9:39	M.Paunović	*Buteo buteo*	1	10	1	1	1	circling	300	ne	se
6.3	31/01/15	9:52	M.Raković	*Buteo buteo*	1	3	3	3	3	direct flight	200	n	sse
6.4	15/03/15	11:14	M.Raković	*Buteo buteo*	8	4	3	5	4	circling	500	nw	se
6.5	22/03/15	8:40	M.Raković	*Circus aeruginosus*	1	5	1	2	1	direct flight	300	ne	s
6.6	19/04/15	9:00	M.Raković	*Buteo buteo*	3	7	2	4	3	conflict in flight	350	n	se
6.7	03/05/15	7:52	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	150	s	ne
6.8	23/05/15	15:28	M.Raković	*Buteo buteo*	4	8	3	4	4	circling	500	wnw	sse
6.9	20/06/15	8:48	M.Raković	*Buteo buteo*	1	3	2	3	3	direct flight	200	s	ene
6.10	20/06/15	9:16	M.Raković	*Buteo buteo*	1	4	1	2	2	hunting	250	se	wnw
6.11	08/07/15	15:05	M.Raković	*Buteo buteo*	2	5	2	3	3	circling	400	nw	e
6.12	25/07/15	17:07	M.Raković	*Buteo buteo*	1	4	3	4	4	circling	300	w	se
6.13	25/07/15	17:26	M.Raković	*Buteo buteo*	1	1	2	2	2	direct flight	400	wnw	ese
6.14	25/07/15	17:51	M.Raković	*Falco subbuteo*	1	1	1	1	1	direct flight	100	e	w
6.15	09/08/15	14:15	M.Raković	*Buteo buteo*	1	5	3	4	4	circling	se	300	wnw
6.16	09/08/15	14:39	M.Raković	*Buteo buteo*	1	6	2	5	3	circling	w	250	nnw
6.17	09/08/15	15:22	M.Raković	*Buteo buteo*	1	2	2	2	2	direct flight	w	500	ene
6.18	12/08/15	16:37	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	s	400	e
6.19	12/08/15	17:00	M.Raković	*Buteo buteo*	1	5	3	3	3	flying	nw	200	s
6.20	06/09/15	6:55	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on shrub	w	300	
6.21	06/09/15	8:12	M.Raković	*Buteo buteo*	2	5	2	5	4	circling	ene	400	s
6.22	20/09/15	15:41	M.Raković	*Buteo buteo*	1	4	2	3	2	flying	s	250	ene

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
6.23	04/10/15	8:18	M.Raković	*Buteo buteo*	1	5	1	2	1	hun	wsw	400	ne
6.24	04/10/15	8:27	M.Raković	*Accipiter nisus*	1	1	1	1	1	direct flight	ne	100	wsw
6.25	04/10/15	8:51	M.Raković	*Buteo buteo*	1	4	4	5	5	circlin	n	600	sw
6.26	10/10/15	10:15	M.Raković	*Buteo buteo*	1	5	1	4	3	circlin	sw	400	ese
6.27	10/10/15	10:59	M.Raković	*Buteo buteo*	1	1	2	2	2	direct flight	nw	200	sse
6.28	31/10/15	8:50	M.Raković	*Buteo buteo*	1	7	1	1	1	standing on tree	w	250	
6.29	01/11/15	7:00	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	w	300	
6.30	01/11/15	7:28	M.Raković	*Buteo buteo*	1	1	2	3	3	direct flight	wsw	350	ene
6.31	11/11/15	13:41	M.Raković	*Buteo buteo*	1	5	1	2	1	hun	se	450	w
6.32	21/11/15	9:00	M.Raković	*Buteo buteo*	1	4	3	4	4	circlin	s	500	ne

VP7- Kontrola 2

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges) min.	max	average	Behaviour	Direction from VP	Distance from VP (m)	Flight direction
7.1	16/01/15	9:55	M.Raković	*Accipiter gentilis*	1	1	1	2	2	direct flight	s	100	ne
7.2	08/02/15	11:59	M.Raković	*Accipiter nisus*	1	1	1	1	1	hunting in trees	w	50	e
7.3	22/03/15	12:25	M.Raković	*Buteo buteo*	1	3	1	1	1	standing on tree	nw	200	
7.4	22/03/15	13:17	M.Raković	*Buteo buteo*	1	5	3	4	4	circling	s	350	ene
7.5	05/04/15	11:33	M.Raković	*Falco tinnunculus*	1	4	1	1	1	direct flight	ne	100	sw
7.6	19/04/15	13:49	M.Raković	*Buteo buteo*	1	3	1	2	1	direct flight	sw	200	n
7.7	19/04/15	14:04	M.Raković	*Buteo buteo*	1	4	5	5	5	circling	s	400	nw
7.8	03/05/15	13:22	M.Raković	*Haliaeetus albicilla*	1	1	1	2	2	takes off from ground	se	300	e
7.9	20/05/15	11:00	M.Raković	*Buteo buteo*	1	5	2	3	3	circling	nne	350	wsw
7.10	20/05/15	11:22	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	ne	250	
7.11	06/06/15	18:15	M.Raković	*Buteo buteo*	1	5	1	1	1	standing on tree	e	300	
7.12	20/06/15	11:34	M.Raković	*Buteo buteo*	2	5	2	5	4	circling	ne	300	s
7.13	21/06/15	12:18	M.Raković	*Ciconia ciconia*	1	1	3	4	3	direct flight	sw	500	n
7.14	08/07/15	12:51	M.Raković	*Buteo buteo*	2	5	2	4	3	circling	se	300	s
7.15	08/07/15	13:02	M.Raković	*Buteo buteo*	2	2	2	2	2	direct flight	wsw	400	n
7.16	18/07/15	18:00	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	wnw	250	
7.17	18/07/15	18:06	M.Raković	*Buteo buteo*	2	3	2	3	3	circling	s	300	e
7.18	18/07/15	18:52	M.Raković	*Falco tinnunculus*	1	5	1	1	1	hunting	sw	100	nne
7.19	12/08/15	18:47	M.Raković	*Buteo buteo*	1	6	2	3	2	direct flight	s	300	ene
7.20	26/08/15	12:08	M.Raković	*Falco tinnunculus*	1	4	1	1	1	hunting	w	250	n
7.21	26/08/15	12:52	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	wsw	300	ne

No.	Date	Time (hh:mm)	Name of investigator	Species	Bird No.	Duration (min)	Flight altitude (altitude ranges)			Behaviour	Direction from VP	Distance from VP (m)	Flight direction
							min.	max	average				
7.22	06/09/15	13:42	M.Raković	*Buteo buteo*	1	4	2	4	3	circling	nw	300	s
7.23	20/09/15	13:49	M.Raković	*Buteo buteo*	1	4	1	1	1	standing on tree	n	150	
7.24	20/09/15	14:00	M.Raković	*Falco tinnunculus*	1	3	1	1	1	hunting	w	200	se
7.25	10/10/15	12:00	M.Raković	*Buteo buteo*	1	5	2	5	4	circling	wsw	400	n
7.26	01/11/15	11:46	M.Raković	*Buteo buteo*	1	5	1	2	1	hunting	nw	400	e
7.27	11/11/15	15:14	M.Raković	*Accipiter nisus*	1	1	1	1	1	direct flight	ne	150	w
7.28	21/11/15	10:03	M.Raković	*Buteo buteo*	1	5	3	5	4	circling	ene	500	wsw

Appendix 2. Target bird species overflight maps

Legend

direct flight

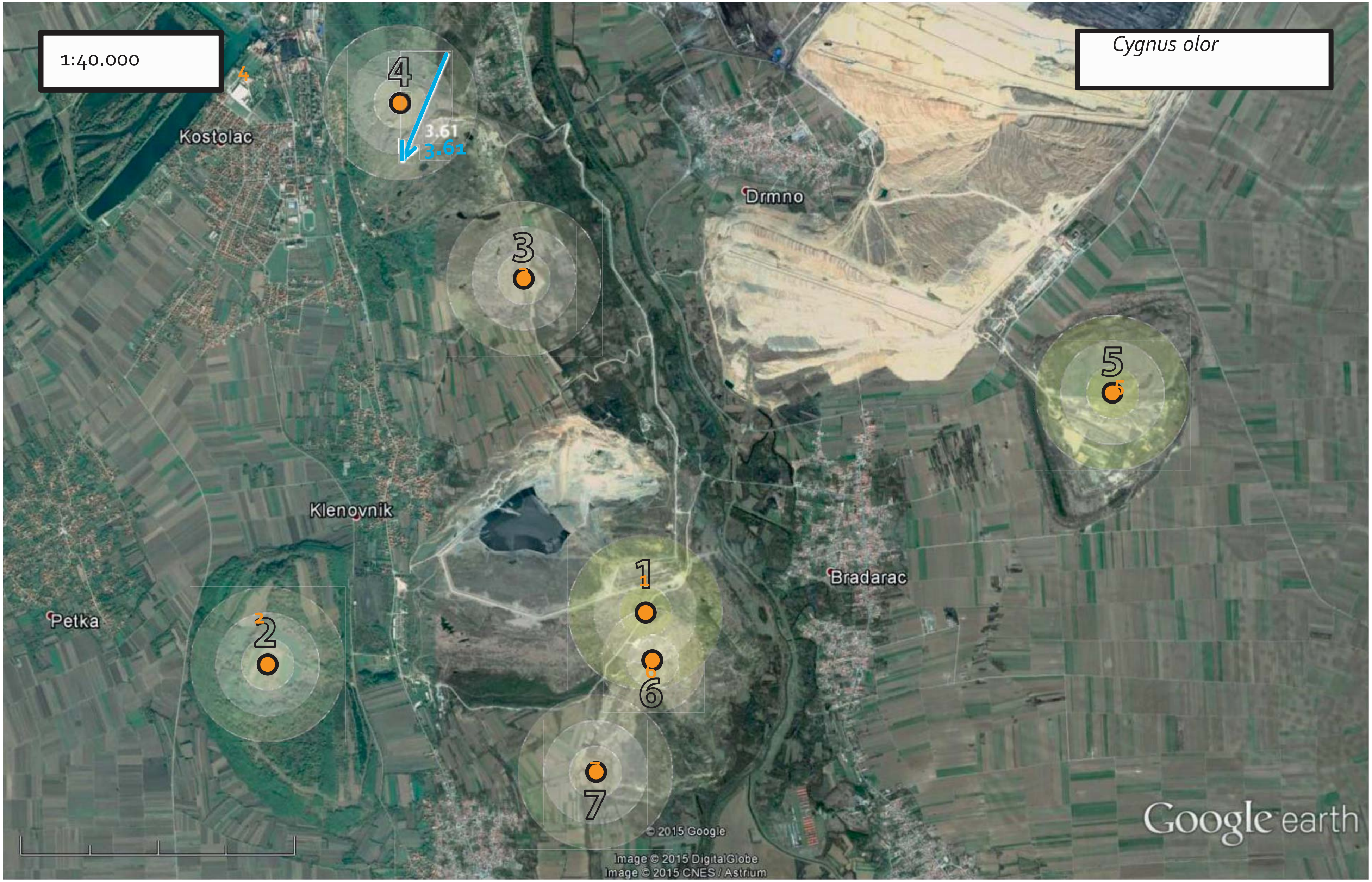
hunting

circling

standing/landing

1.14 fligth below 50 or above 200 m

1.14 critical flight from 50 to 200 m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Cygnus olor
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
3
4
5
6
7
3.61
3.61
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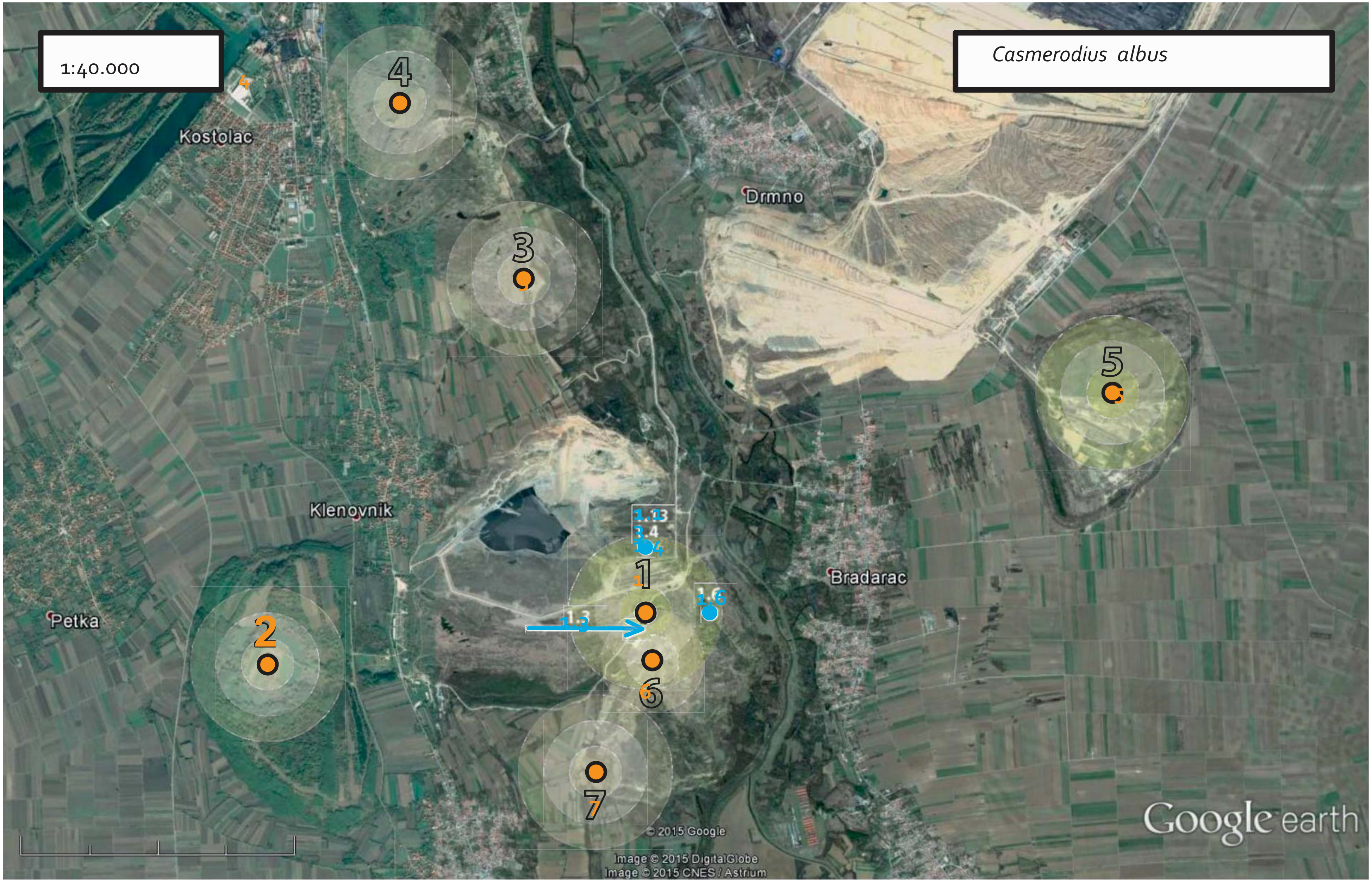
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Casmerodius albus
Kostolac
Drmno
Klenovnik
Bradarac
Petka
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3
5
2
1
6
7
1.6
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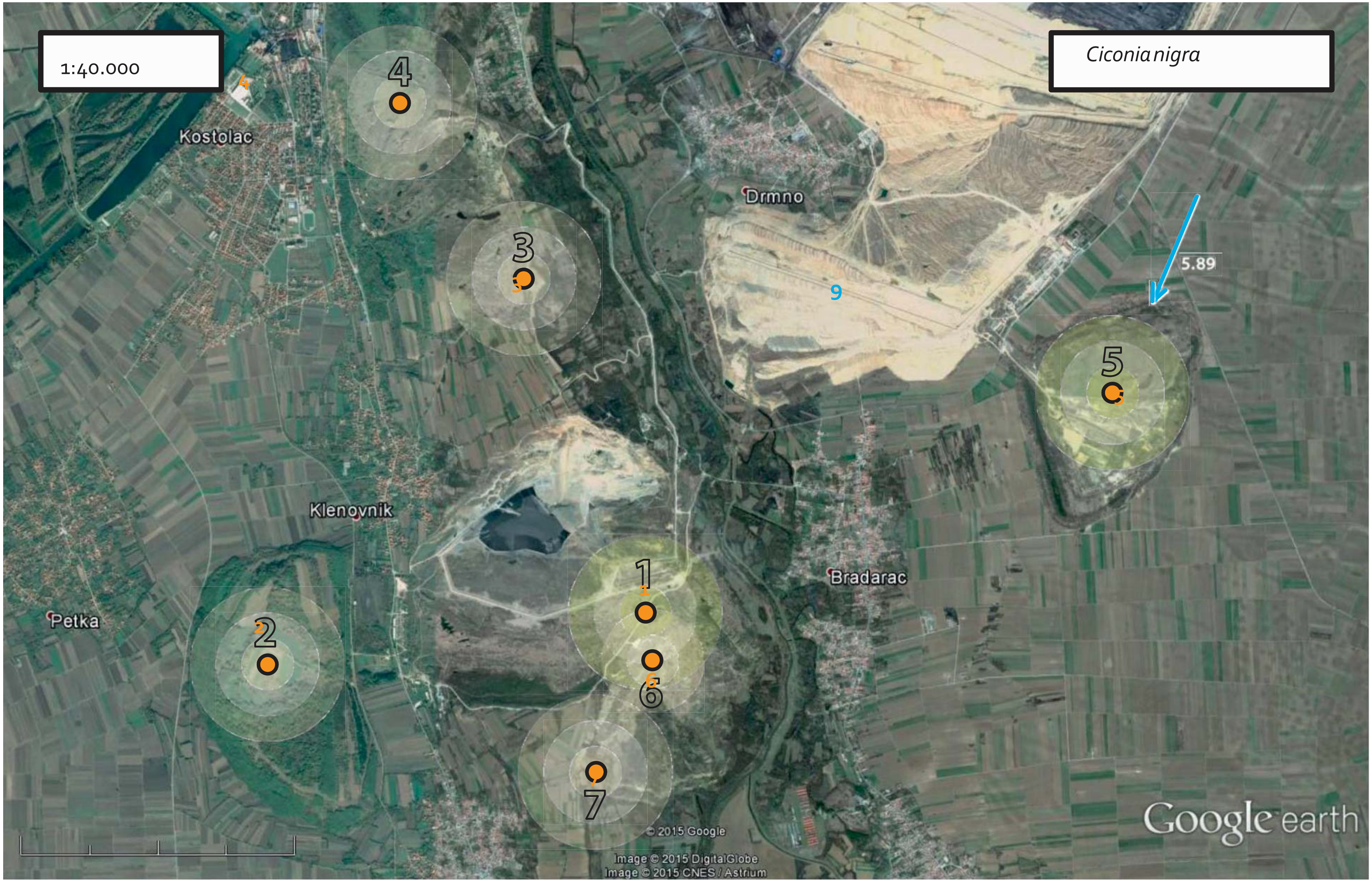
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Ciconia nigra
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
3
4
5
6
7
9
5.89
© 2015 Google
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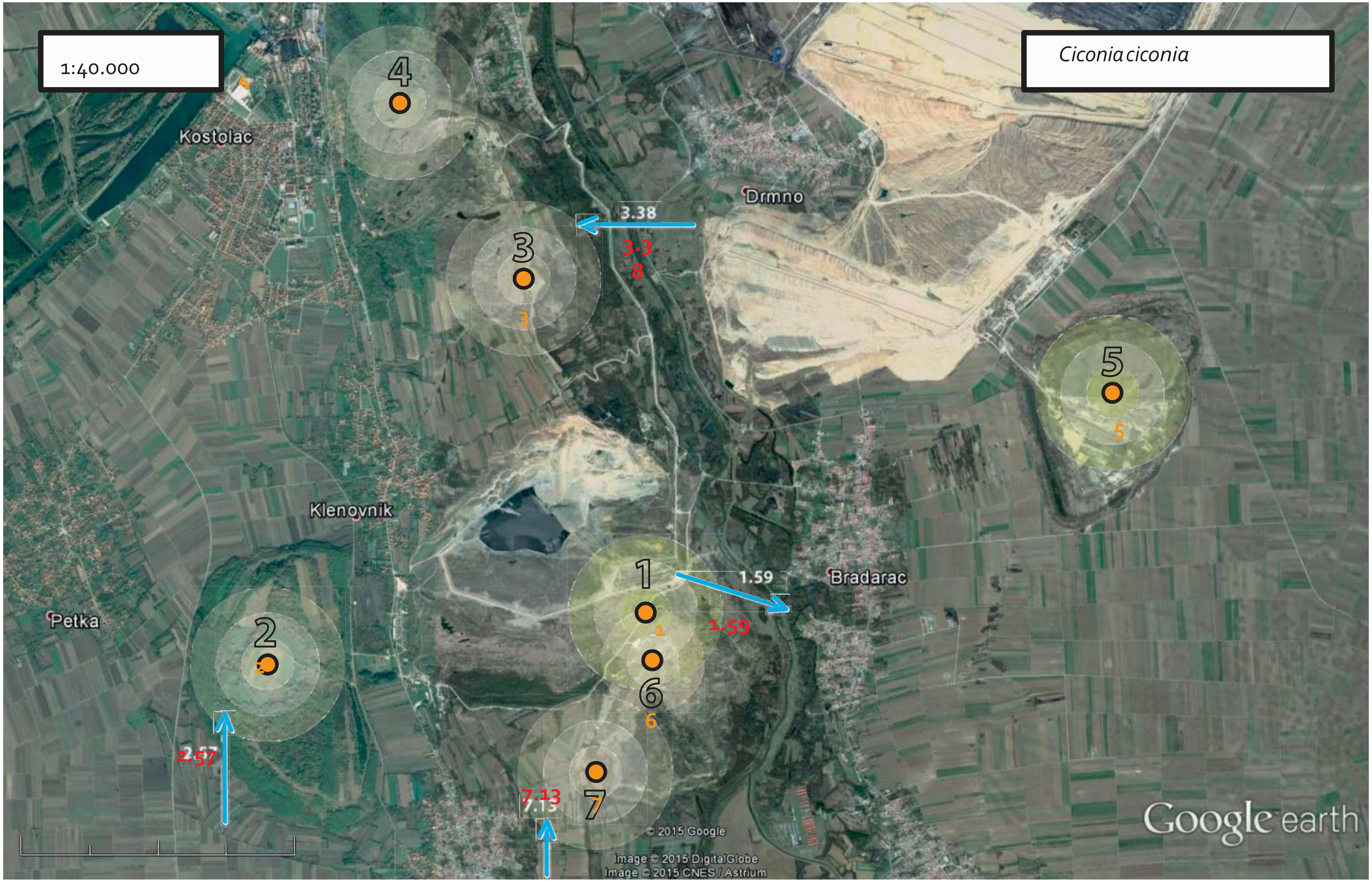
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Ciconia ciconia
Kostolac
Drmno
Klenovnik
Petka
Bradarac
1
2
3
4
5
6
7
3.38
3.38
1.59
1.59
2.57
7.13
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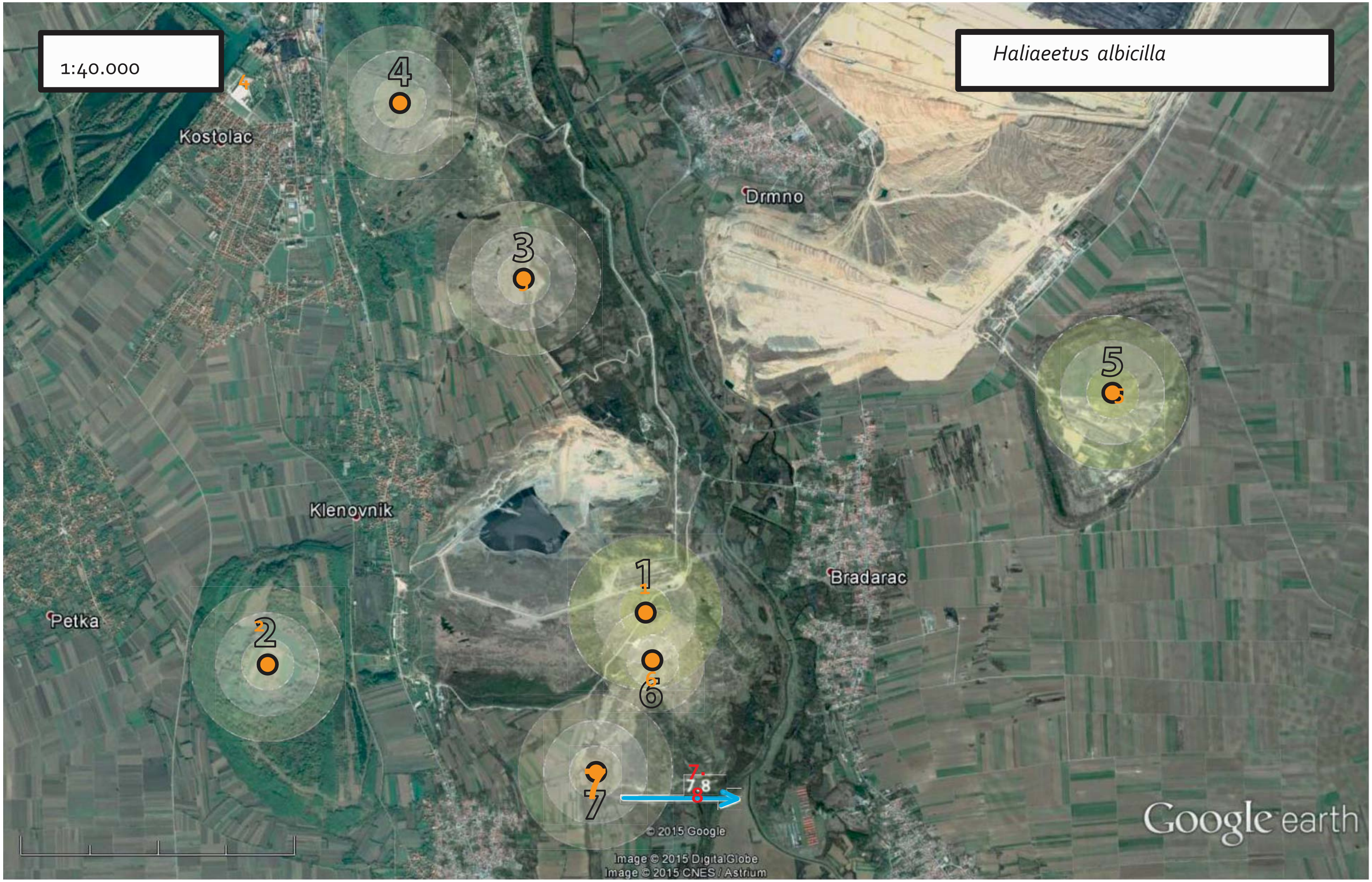
Google earth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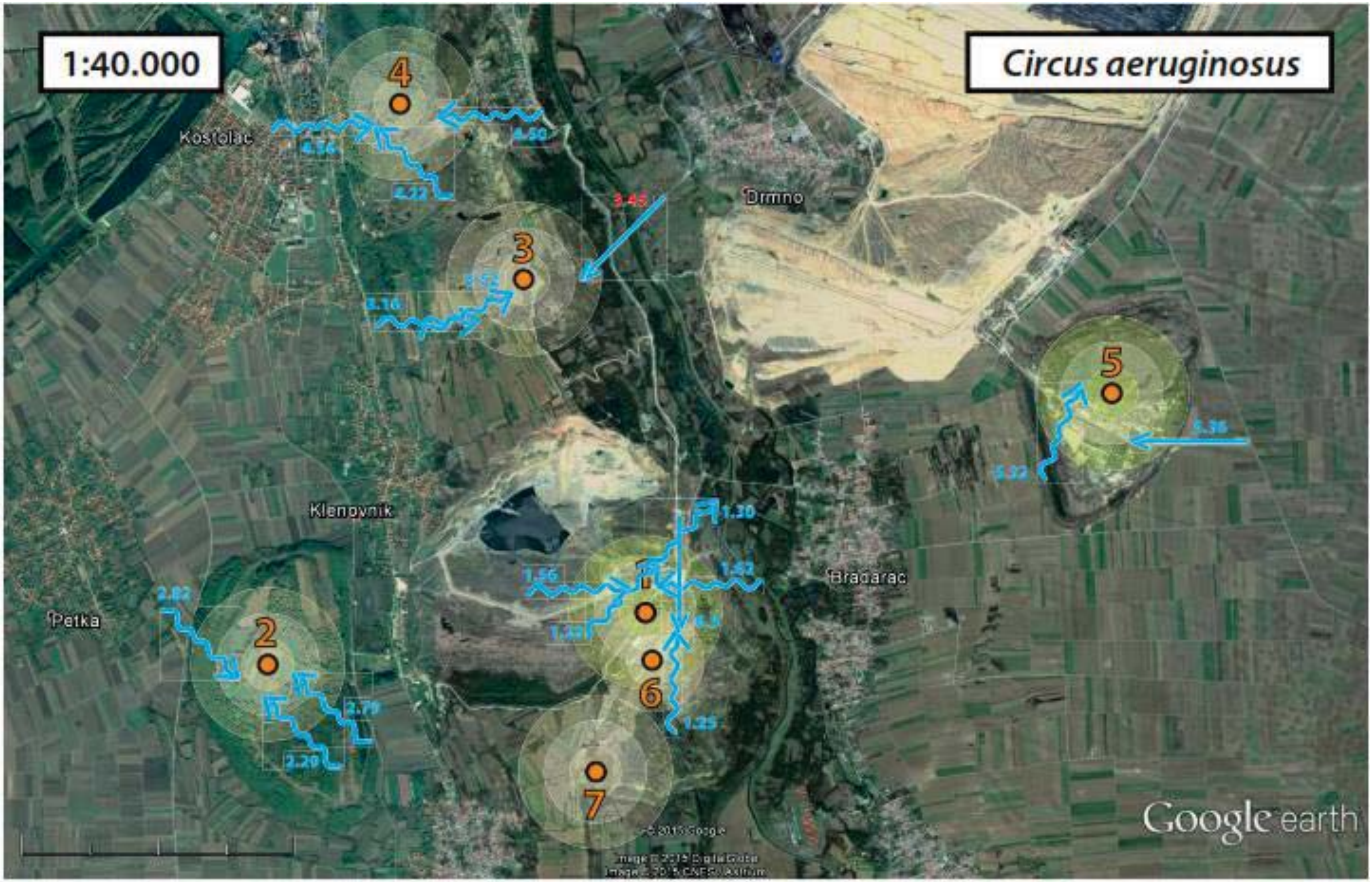
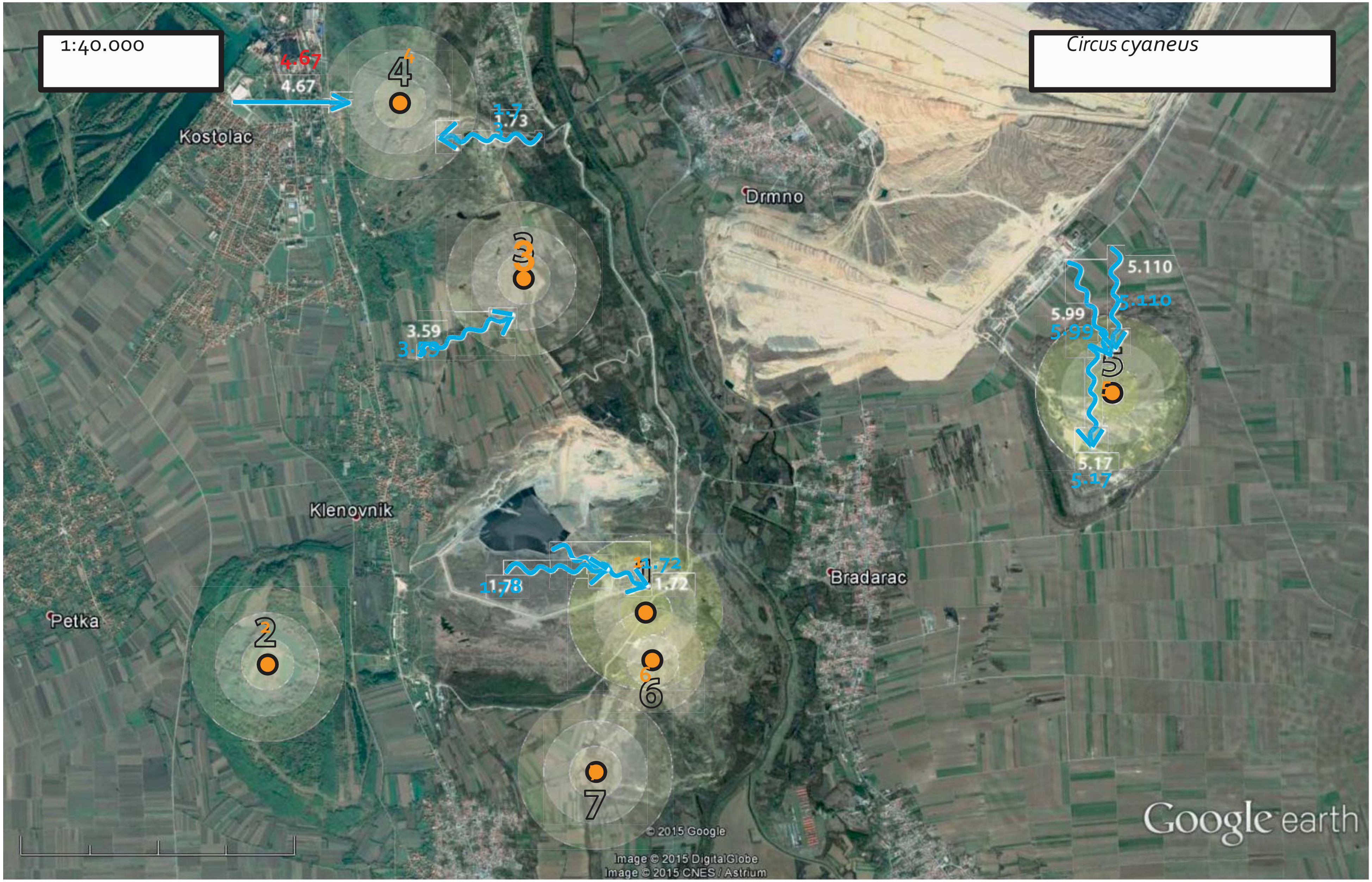
Haliaeetus albicilla
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
3
4
5
6
7
© 2015 Google
Image © 2015 DigitalGlobe
Image © 2015 CNES / Astrium
Google earth


1:40.000
Circus aeruginosus
4
3
2
5
6
7
Kostolac
Drmno
Klenovnik
Petka
Bradarac
Google earth
© 2015 Google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Circus cyaneus
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4.67
4
1.73
Kostolac
Drmno
3
3.59
5.110
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5.99
5.99
5
5.17
5.17
Klenovnik
1.78
1.72
1.72
Bradarac
Petka
2
6
7
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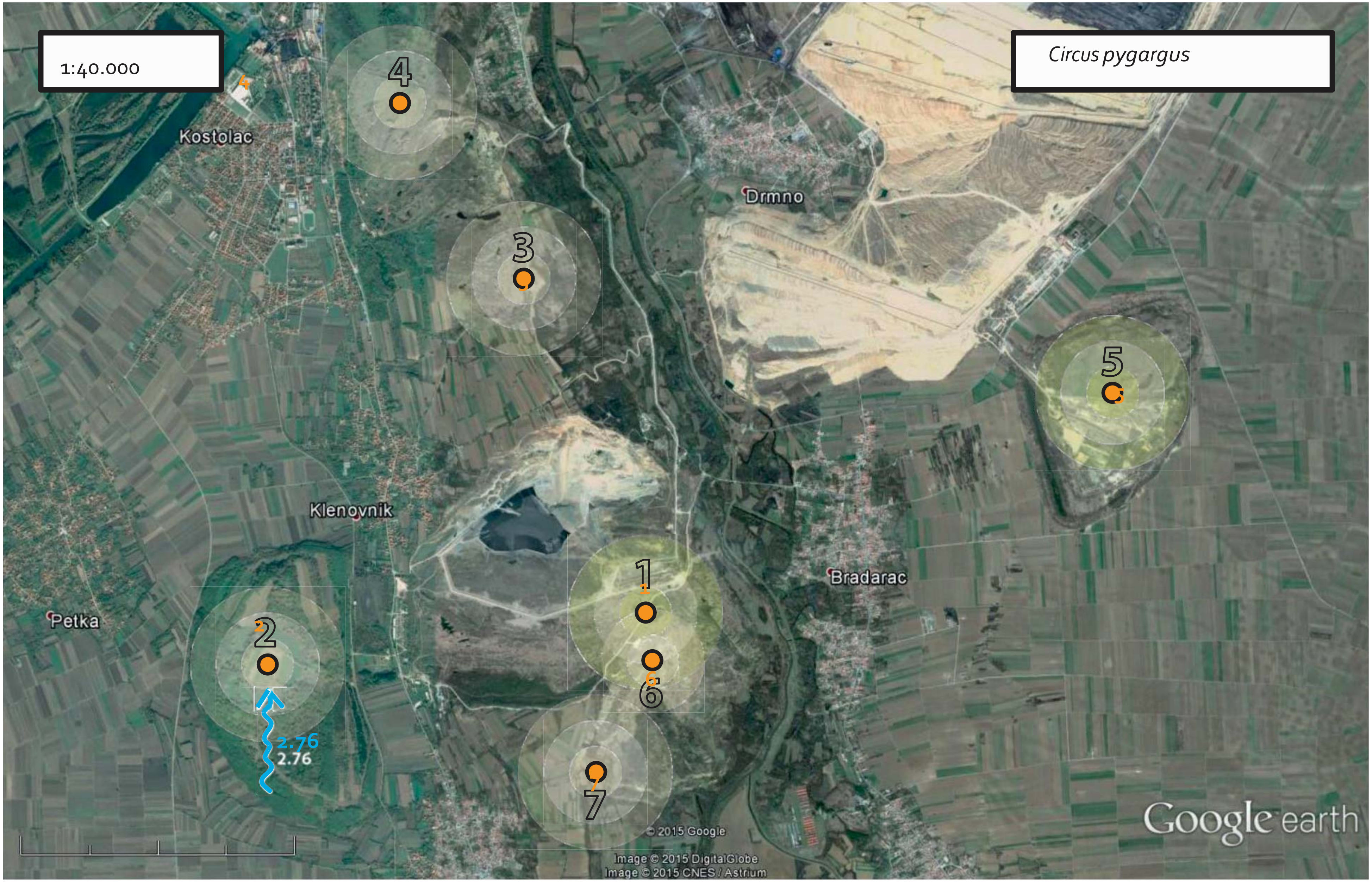
Google earth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Circus pygargus
4
3
5
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
6
7
2.76
2.76
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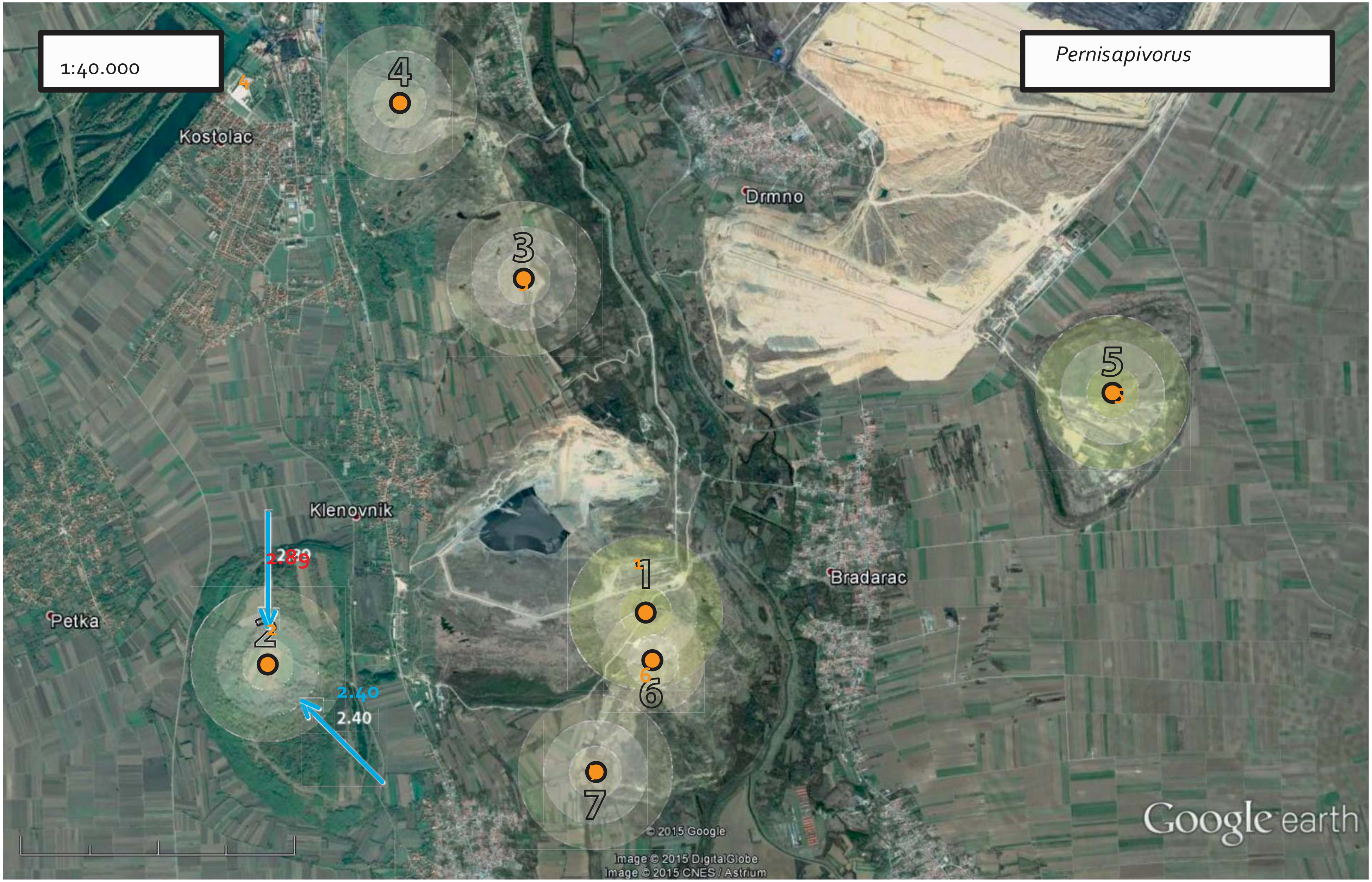
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Pernisapivorus
4
3
5
1
6
7
2
Kostolac
Drmno
Klenovnik
Bradarac
Petka
2.89
2.40
2.40
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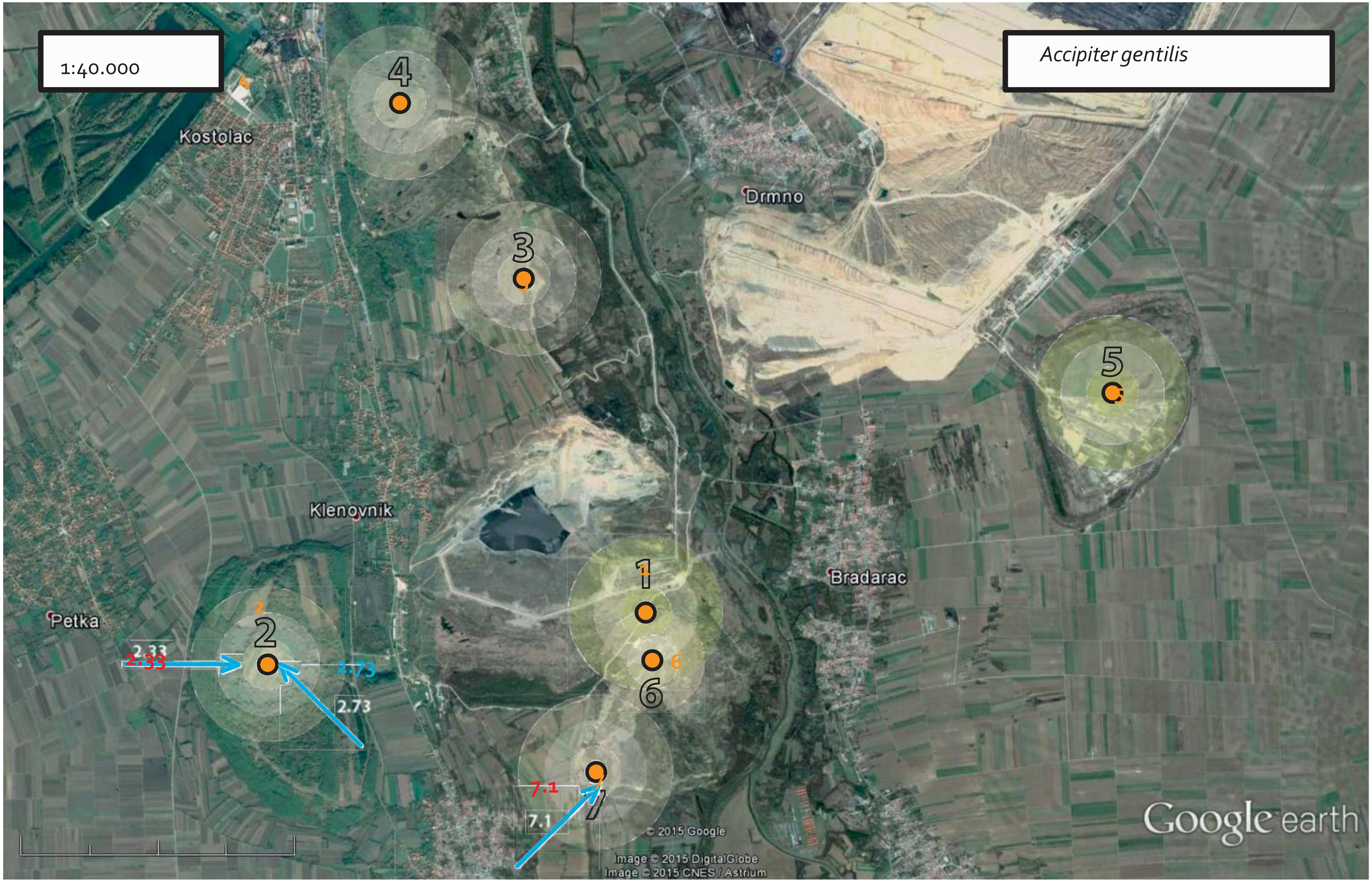
Google earth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Accipiter gentilis
Kostolac
Drmno
Klenovnik
Bradarac
Petka
4
3
5
1
6
2
7
2.33
2.73
7.1
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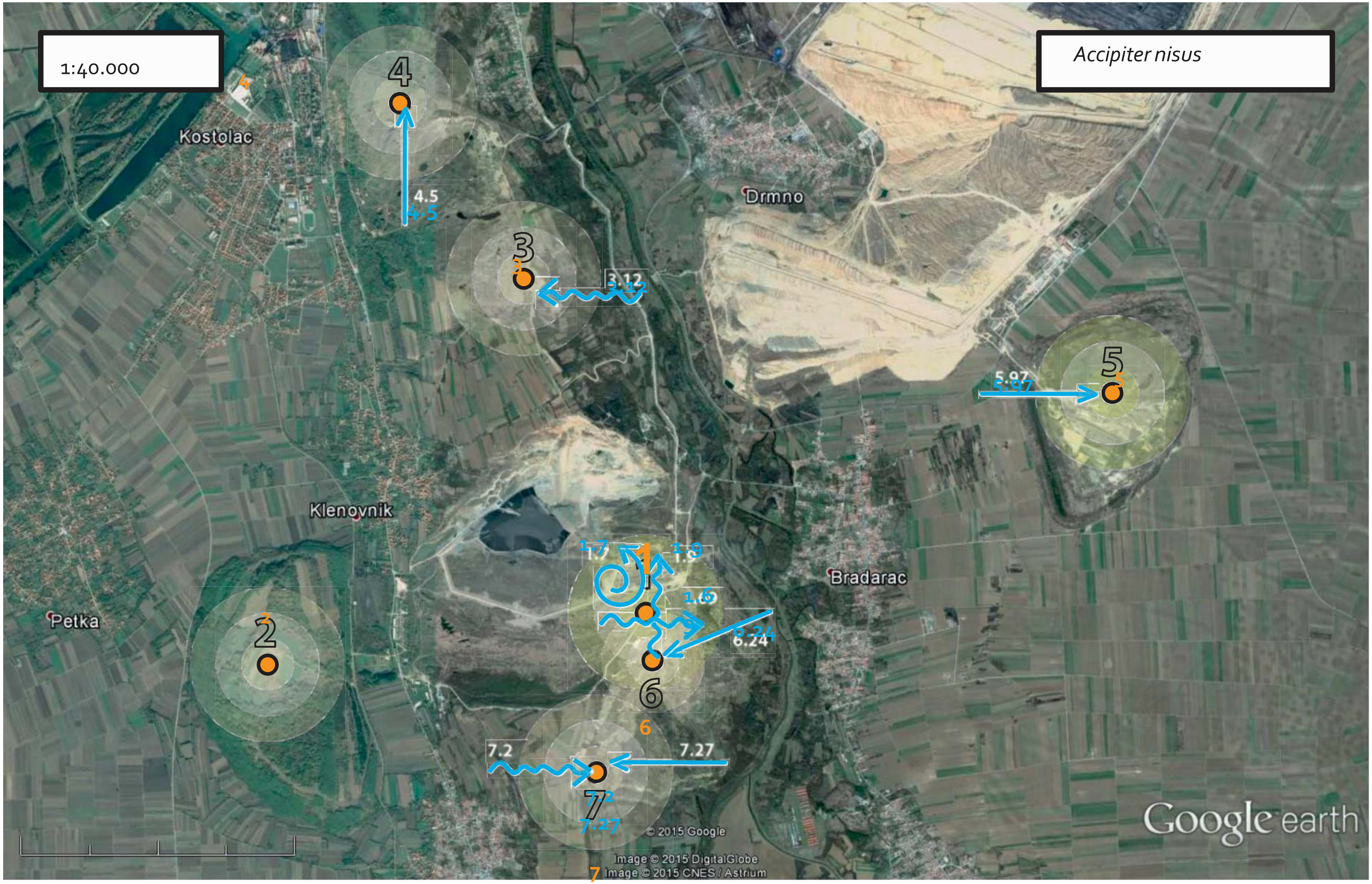
Google earth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Accipiter nisus
Kostolac
Drmno
Klenovnik
Petka
Bradarac
4.5
3.12
5.97
1.7
1.9
1.6
6.24
7.2
7.27
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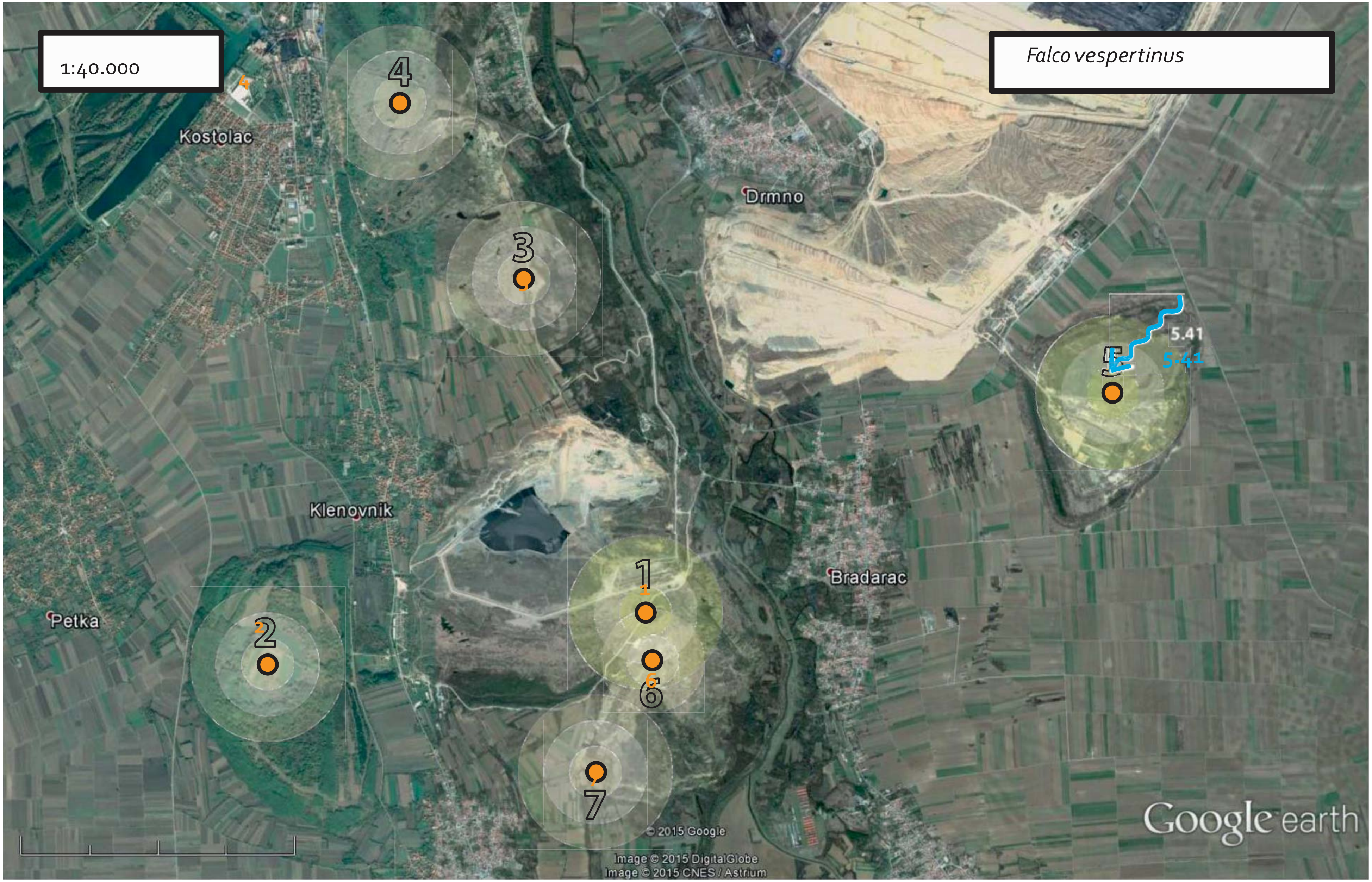
Google earth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Falco vespertinus
4
3
5
5.41
5.41
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
6
7
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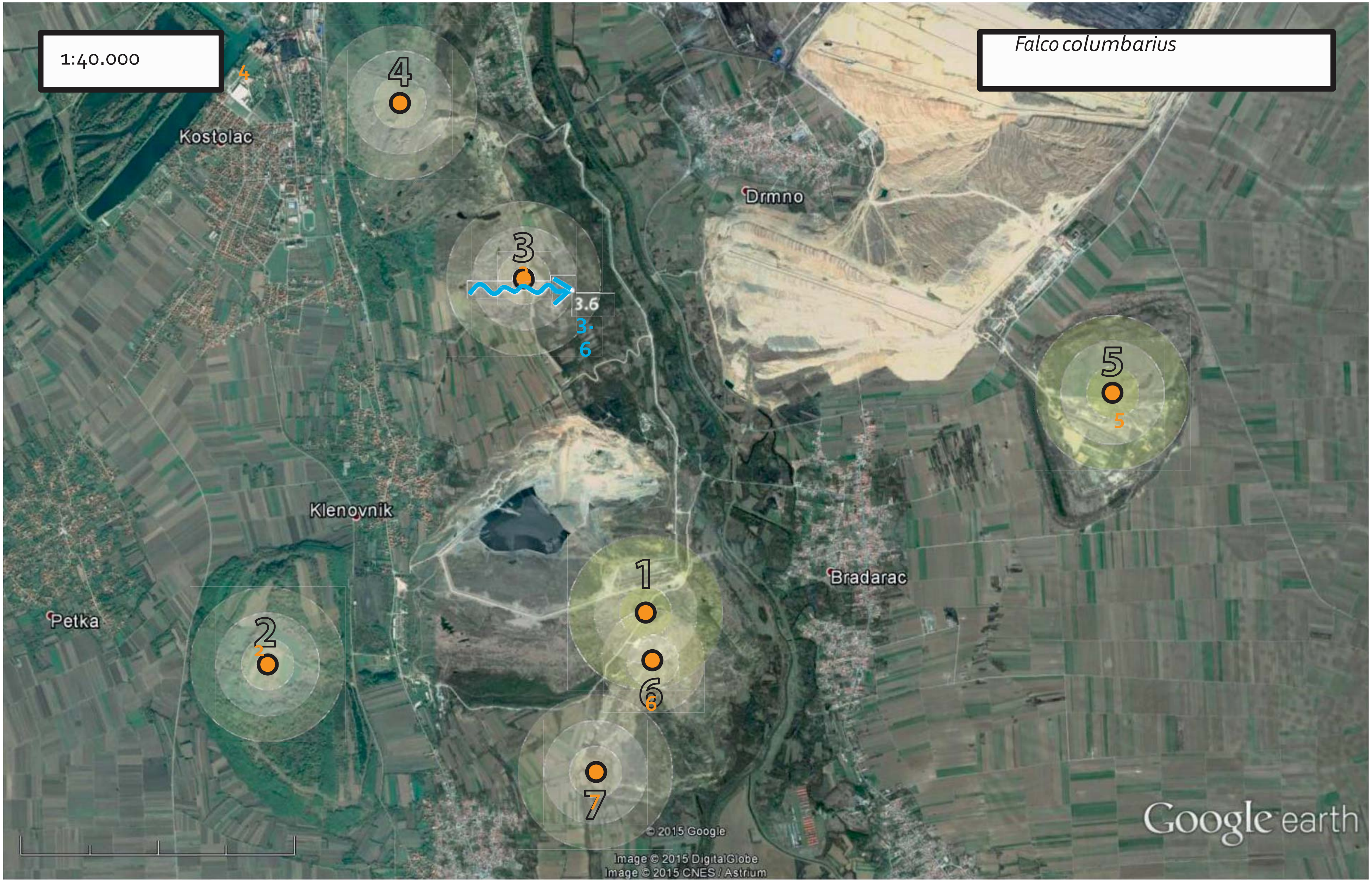
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Falco columbarius
Kostolac
Drmno
Klenovnik
Bradarac
Petka
1
2
3
4
5
6
7
3.6
3-6
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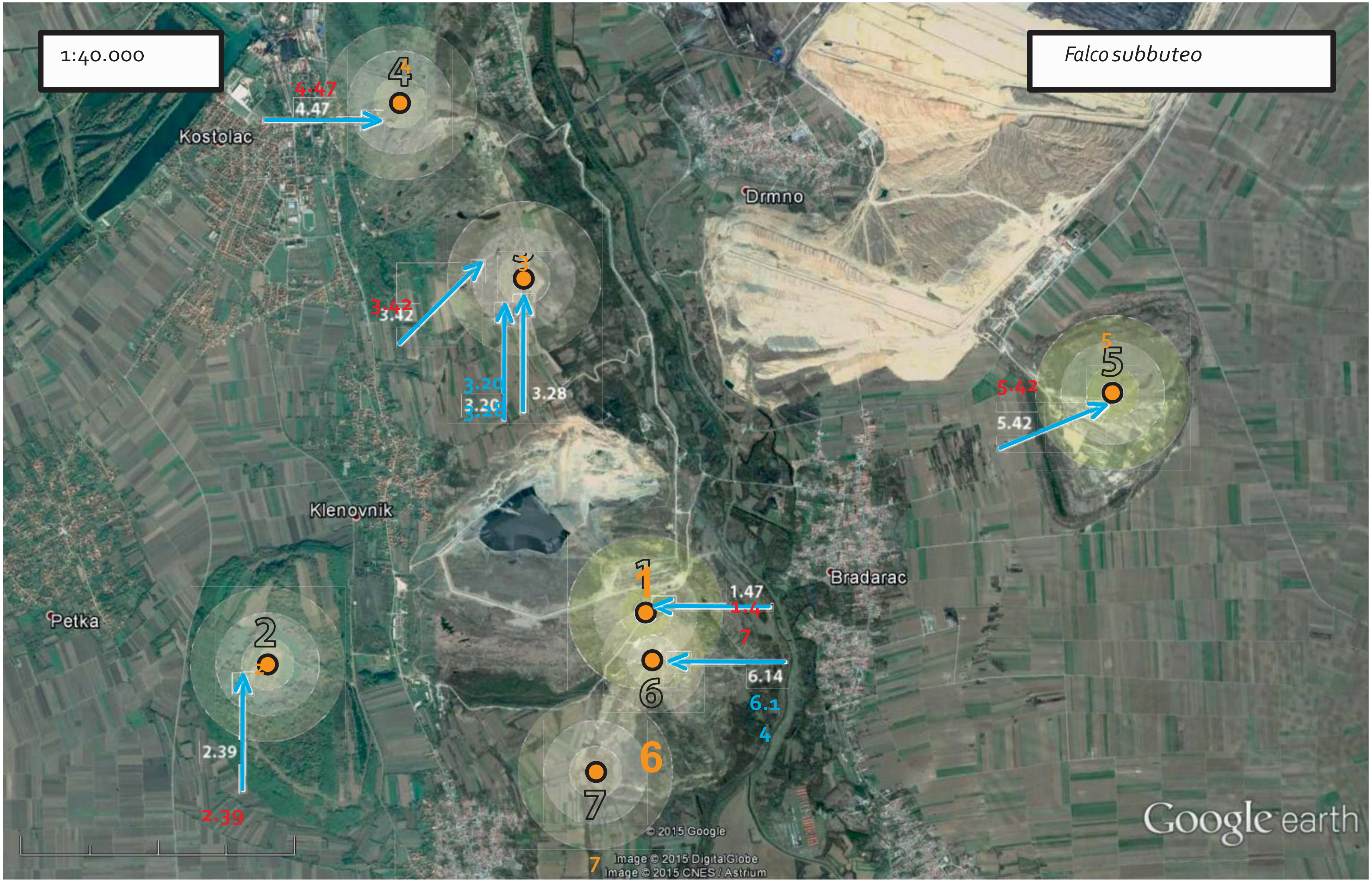
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Falco subbuteo
Kostolac
Drmno
Klenovnik
Petka
Bradarac
4.47
3.42
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5.42
1.47
6.14
2.39
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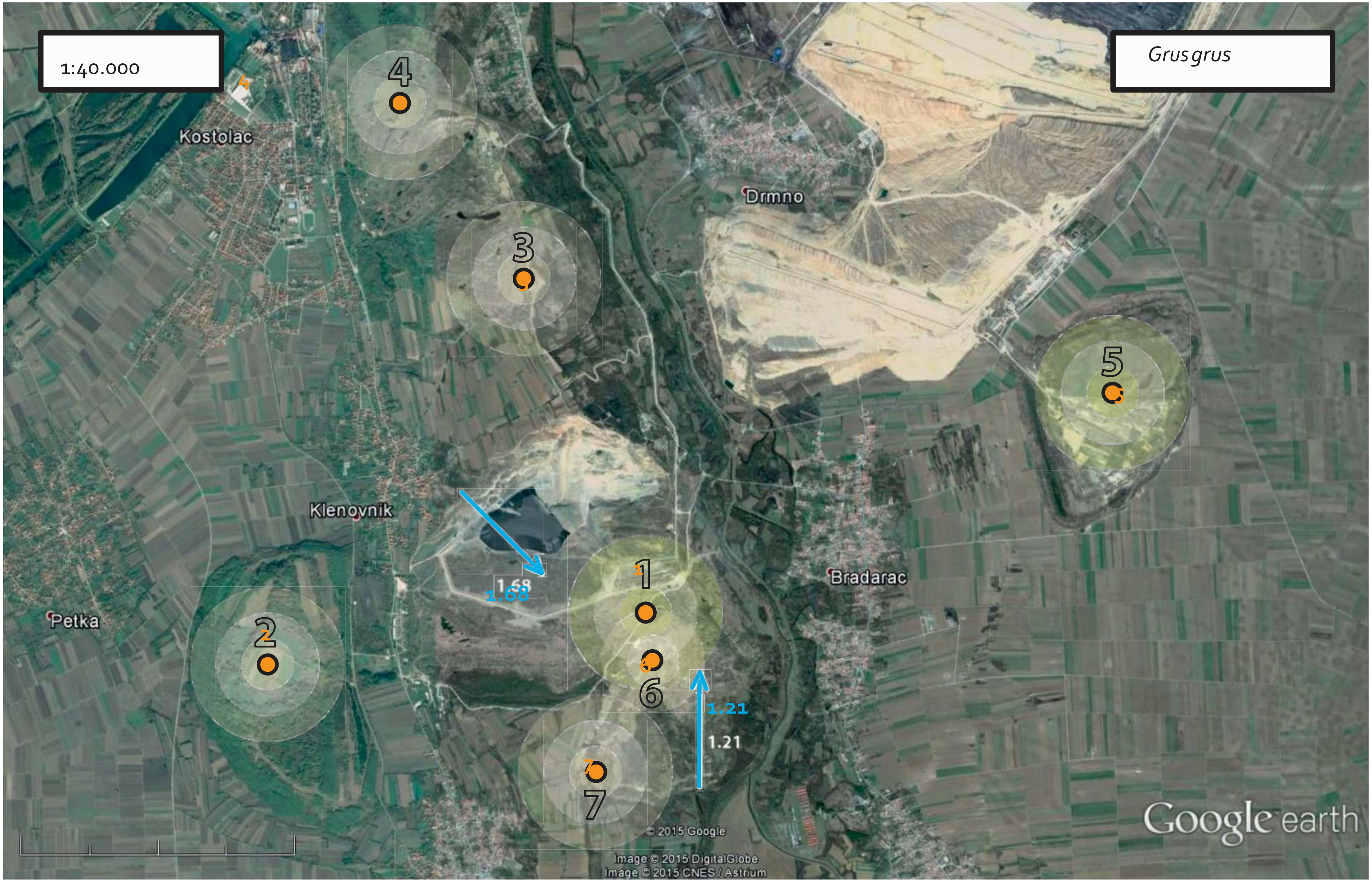
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Grus grus
Kostolac
Drmno
Klenovnik
Petka
Bradarac
4
3
5
1
2
6
7
1.68
1.21
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Appendix 3. Overview of the manual bat activity detection on transects

Legend: N - № of flights/contacts t– average duration of contact (s)

Л - share of overflights during which hunting behaviour was registered

% - relative number (share of overflights belonging to a certain species/group)

Species/groups

Rhfer - Rhinolophus ferrumequinum *Msch - Miniopterus schreibersii*

Mbra/Mmys/Malc - Myotis brandtii / Myotis mystacinus / Myotis alcathoe Mmyo/Moxy - Myotis myotis / Myotis oxygnathus

Mbech - Myotis bechsteinii *Mnat - Myotis nattereri*

Mema - Myotis emarginatus *Bbar - Barbastella barbastellu*

Mdau/Mcap - Myotis daubentonii / Myotis capaccinii

Pkuh - Pipistrellus kuhlii *Pnath - Pipistrellus nathusii*

Ppip - Pipistrellus pipistrellus *Ppyg - Pipistrellus pygmaeus*

Hsav - Hypsugo savii *Pip/Hyp sp. - Pipistrellus/Hypsugo sp.*

Nlei - Nyctalus leisleri *Nnoc - Nyctalus noctula*

Nnoc/Nlas - Nyctalus noctula / Nyctalus lasiopterus

Vmur - Vespertilio murinus *Eser - Eptesicus serotinus*

April

date	16/17. April												16/17. April											
time	21:27-22:13			00:24-00:56			04:17-04:46			Total			19:21-21:26			00:56-2:28			02:29-04:17			Total		
wind	no-weak			weak-no			weak-no						no-weak			no-weak			no-weak					
temperature(ºC)	17-14			15-13			14-12						21-18			17-19			19-15					
clouds/precipitati	clear-low			moderate-			clear						clear			low-			clear					
prey activity	high			high			high						high			high			high					
transect (dir)	1 (o-X)			1 (X-o)			1 (o-X)						2 (o-X)			2 (X-o)			2 (o-X)					
Species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch	4	75.0	23.3	3	100.0	30.0				7	85.7	25.5												
Mbra/Mmys/Malc													3	0.	2.	1	0.	3.	1	0.	3.0	5	0.0	2.5
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.													2	0.	1.							2	0.0	1.8
Plecotus sp.																								
Bbar																1	0.	2.				1	0.0	2.0
Pkuh	4	25.	5.3	3	33.3	12.3	2	0.	5.0	9	22.2	7.6	20	60.	8.	8	12.	5.	27	22.	5.7	55	34.5	6.7
Pnath	1	0.	2.				1	0.	4.	2	0.0	3.0	16	12.	6.	4	0.	4.				20	10.0	5.7
Pkuh/Pnath	9	0.	3.7	2	0.	2.	3	0.	2.7	14	0.0	3.3	54	22.	4.	11	18.	4.	13	7.7	3.3	78	19.2	4.4
Ppip																								
Pkuh/Ppip													1	0.	3.							1	0.0	3.0
Ppyg																								
Pnat/Hsav				1	0.	2.				1	0.0	2.	3	0.	3.3	1	0.	4.	1	0.	4.	5	0.0	3.6
Hsav													1	0.	5.							1	0.0	5.0
Pip/Hyp sp.	2	0.	3.0	3	0.	2.	1	0.	2.	6	0.0	2.3	10	10.	2.	3	0.	2.	1	0.	2.	14	7.1	2.1
Nlei																								
Nnoc				1	0.	5.	1	0.	4.	2	0.0	4.5	2	0.	3.							2	0.0	3.0
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser													2	0.	4.							2	0.0	4.0
Eser/Vmur/Nnoc/Nl	1	0.	6.							1	0.0	6.							1	0.	5.0	1	0.0	5.0
Chiroptera *indet.*	1	0.	1.0	1	0.	1.				2	0.0	1.0	2	0.	1.	1	0.	2.	3	0.	1.5	6	0.0	1.4
Total	22	18.2	7.4	14	28.6	8.	8	0.	3.5	44	18.2	7.1	116	23.3	5.1	30	10.0	4.	47	14.9	4.5	193	19.2	4.8
Transect duration	0:46			0:32			0:29			1:47			2:05			1:32			1:48			5:25		
Activity index	28.7			26.3			16.6			24.7			55.7			19.6			26.1			35.6		
Min. No. of species	3			3			3			4			6			4			3			7		

date	16/17. April												23/24. April											
time	22:13-23:15			23:26-00:24			04:46-05:49			Total			19:30-22:24			22:24-00:41			02:54-05:37			Total		
wind	no-weak			no-			weak-no						no-weak			moderate			weak-no					
temperature(ºC	15-18			18-15			13-15						18-14			14-12			11-8					
ouds/precipitation	clear-low			low-full			clear-low						clear-low			low			clear					
Prey activity	high			high			high						high			high			high					
transect (dir)	3 (o-X)			3 (X-o)			3 (o-X)						4 (o-X)			4 (X-o)			4 (o-X)					
Species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer				1	0.	1.5				1	0.0	1.5	1	0.	1.							1	0.0	1.0
Msch																4	0.	3.				4	0.0	3.4
Mbra/Mmys/Malc	1	0.	2.	2	0.	3.				3	0.0	2.7	6	83.3	4.							6	83.3	4.2
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat				1	0.	4.				1	0.0	4.												
Mdau/Mcap	1	0.	3.0							1	0.0	3.0												
Myotis sp.				1	0.	2.	1	0.	2.	2	0.0	2.				1	0.	2.				1	0.0	2.0
Plecotus sp.																1	0.	2.				1	0.0	2.0
Bbar																								
Pkuh	5	0.	5.4	5	20.	3.				10	10.0	4.3	31	64.	7.	9	22.	5.	3	0.	3.3	43	51.2	7.0
Pnath													1	0.	3.	3	33.3	4.				4	25.0	4.3
Pkuh/Pnath	5	0.	3.4	5	0.	2.	3	0.	4.	13	0.0	3.3	52	28.	3.	6	16.7	7.3	3	0.	3.3	61	26.2	4.1
Ppip													2	50.	5.							2	50.0	5.0
Pkuh/Ppip																1	0.	4.				1	0.0	4.0
Ppyg																								
Pnat/Hsav																								
Hsav	1	0.	4.							1	0.0	4.	1	0.	4.	1	0.	4.				2	0.0	4.0
Pip/Hyp sp.	2	0.	2.3							2	0.0	2.3	2	0.	2.	1	0.	1.5	1	0.	3.0	4	0.0	2.1
Nlei													1	0.	4.				1	0.	3.0	2	0.0	3.5
Nnoc	1	0.	2.				1	0.	5.0	2	0.0	3.5							3	0.	4.7	3	0.0	4.7
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser													2	0.	4.							2	0.0	4.5
Eser/Vmur/Nnoc/Nl				1	0.	1.5				1	0.0	1.5	3	0.	3.5							3	0.0	3.5
Chiroptera *indet.*				2	0.	2.				2	0.0	2.	2	0.	1.3	1	0.	1.				3	0.0	1.2
Total	16	0.0	3.7	18	5.6	2.7	5	0.	3.9	39	2.6	3.3	104	39.4	4.	28	14.3	5.0	11	0.0	3.6	143	31.5	4.8
Transect duration	1:02			0:58			1:03			3:03			2:54			2:17			2:43			7:54		
Activity index	15.5			18.6			4.8			12.8			35.9			12.3			4.0			18.1		
Min. No. of species	5			5			3			8			8			5			3			11		

date	25/26. April												30. April/1. May												April Total	
time	19:32-22:02			22:21-00:49			03:10-05:34			Total			19:38-22:12			22:13-01:05			02:39-05:26			Total				
wind	no-weak			no-weak			weak						no-weak			no-weak			no-weak							
temperature(oC	19-14			14-10			10-8						16-14			14-12			12-13							
clouds/precipitatio	clear			clear			moderate-low						full			full			full							
prey activity	high			high			high						high			high			moderate-high							
transect (dir)	0 (0-X)			0 (X-0)			0 (0-X)						5 (0-X)			5 (X-0)			5 (0-X)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer				1	0.	1.5				1	0.0	1.5							15	73.3	4.	15	73.3	4.2	18	2.1
Msch				1	0.	1.				1	0.0	1.0				1	0.	1.5				1	0.0	1.5	13	1.5
Mbra/Mmys/Malc	7	14.3	3.3	4	25.0	3.1	2	0.	2.5	13	15.4	3.1	1	0.	3.				1	0.	1.5	2	0.0	2.3	29	3.4
Mmyo/Moxy																									0	0.0
Mbech				1	0.	4.				1	0.0	4.													1	0.1
Mema							1	0.	1.5	1	0.0	1.5													1	0.1
Mnat																									1	0.1
Mdau/Mcap																									1	0.1
Myotis sp.	1	0.	1.5	2	0.	1.	1	0.	1.0	4	0.0	1.1													9	1.1
Plecotus sp.																									1	0.1
Bbar																									1	0.1
Pkuh	98	85.7	6.	20	40.0	4.	20	50.0	5.2	138	73.9	5.9	1	0.	6.	1	100.0	11.0				2	50.0	8.5	257	30.0
Pnath	7	0.	4.1	10	20.0	4.	6	33.3	5.8	23	17.4	4.				1	0.	4.				1	0.0	4.0	50	5.8
Pkuh/Pnath	32	40.6	3.9	10	10.0	3.	4	0.	2.8	46	30.4	3.6	2	50.0	3.	5	0.	3.				7	14.3	3.3	219	25.6
Ppip				2	50.0	3.				2	50.0	3.0				1	0.	1.5				1	0.0	1.5	5	0.6
Pkuh/Ppip	2	0.	4.							2	0.0	4.													4	0.5
Ppyg																									0	0.0
Pnat/Hsav	4	25.0	3.0				1	0.	5.0	5	20.0	3.4													11	1.3
Hsav																									4	0.5
Pip/Hyp sp.	9	0.	2.	8	12.5	1.	4	0.	3.0	21	4.8	2.1													47	5.5
Nlei																									2	0.2
Nnoc	6	16.7	4.7							127	93.7	104.7													136	15.9
Nnoc/Nlei																									0	0.0
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser	2	100.0	6.							2	100.0	6.				1	0.	6.				1	0.0	6.0	7	0.8
Eser/Vmur/Nnoc/Nl	2	0.	5.5							2	0.0	5.5													8	0.9
Chiroptera *indet.*	16	31.3	2.5	1	0.	1.				17	29.4	2.	1	0.	1.							1	0.0	1.0	31	3.6
Total	186	57.5	4.9	60	23.3	3.6	160	81.3	46.8	406	61.8	12.9	5	20.0	3.2	10	10.0	4.1	16	68.8	4.	31	41.9	3.9	856	100.
Transect duration	2:30			2:28			2:24			7:22			2:34			2:52			2:47			8:13			33:44	
Activity index	74.4			24.3			66.7			55.1			1.9			3.5			5.7			3.8			25.4	
Min. No. of species	5			7			5			10						5			2			7			16	

May

date	9/10. May												9/10. May											
time	20:55-21:22			01:02-01:27			03:41-04:05			Total			21:23-22:58			23:20-00:59			04:06-05:14			Total		
wind	weak			no-weak			no-weak						weak-no			no-weak			no-weak					
temperature(ºC	17			15-13			10-7						18-20			17-20-15			7-10-6					
clouds/precipitatio	clear			clear			clear						clear			clear			clear					
prey activity	high			high			high						high			high			high					
transect (dir)	1 (X-o)			1 (o-X)			1 (X-o)						2 (X-o)			2 (o-X)			2 (X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer													1	0.	1.5	1	0.	1.				2	0.0	1.3
Msch				1	0.	1.5				1	0.0	1.5												
Mbra/Mmys/Malc	1	0.	2.5							1	0.0	2.5	6	16.7	2.	13	15.	2.				19	15.8	2.7
Mmyo/Moxy																								
Mbech																2	50.	3.				2	50.0	3.0
Mema																3	0.	2.				3	0.0	2.7
Mnat																								
Mdau/Mcap																								
Myotis sp.													8	0.	1.	5	0.	1.5				13	0.0	1.7
Plecotus sp.																								
Bbar																								
Pkuh	17	100.0	37.9	10	70.	8.				27	88.9	25.6	72	72.	8.	199	77.9	8.	49	93.	8.7	320	79.1	8.6
Pnath	4	50.	5.3	1	0.	5.	1	0.	5.0	6	33.3	5.2				1	0.	5.	1	100.0	6.	2	50.0	5.5
Pkuh/Pnath	5	0.	3.4	1	100.0	4.	1	100.0	3.0	7	28.6	3.4	12	33.3	3.	8	25.	3.3	1	0.	3.0	21	28.6	3.3
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav				2	50.	6.				2	50.0	6.				3	0.	3.3				3	0.0	3.3
Hsav																1	0.	4.				1	0.0	4.0
Pip/Hyp sp.				8	0.	2.				8	0.0	2.1	4	0.	1.5	3	0.	1.7				7	0.0	1.6
Nlei																								
Nnoc																								
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser	1	100.0	50.							1	100.	50.0												
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*													4	0.	1.3	2	0.	0.				6	0.0	1.1
Total	28	71.4	23.1	23	39.1	5.1	2	50.0	4.0	53	56.6	13.9	107	53.3	6.	241	66.4	7.4	51	92.2	8.5	399	66.2	7.2
Transect duration	0:27			0:25			0:24			1:16			1:35			1:39			1:08			4:22		
Activity index	62.2			55.2			5.0			41.8			67.6			146.1			45.0			91.4		
Min. No. of species	4			3			1			5			3			7			2			7		

date	9/10. May												13/14. May											
time	19:49-20:51			01:29-02:32			02:44-03:41			Total			19:54-22:15			22:17-00:45			02:33-05:09			Total		
wind	no-weak			no-weak			no-weak						no-weak			weak-moderate			weak-moderate					
temperature(ºC	21-17			13-17			14-10						23-20			21-20			20-17					
clouds/precipitatio	low-clear			clear			clear						low-moderate			moderate-full			low-mostly					
prey activity	high			high			high						high			high			high					
transect (dir)	3 (X-o)			3(o-X)			3(X-o)						4 (X-o)			4 (o-X)			4(X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																1	0.	2.				1	0.0	2.0
Msch													2	0.	2.							2	0.0	2.0
Mbra/Mmys/Malc	1	0.	3.0	1	100.0	6.				2	50.0	4.5				2	0.	1.5				2	0.0	1.5
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar							1	0.	2.	1	0.0	2.												
Pkuh	17	70.	4.	38	39.	7.3	29	44.	9.	84	47.6	7.4	2	0.	4.	28	64.	13.6	11	45.	41.	41	56.1	20.5
Pnath	3	33.3	6.3	7	28.	12.3				10	30.0	10.5				8	37.5	5.	2	50.	5.0	10	40.0	5.3
Pkuh/Pnath	8	50.	3.6	11	27.3	4.	16	12.5	3.8	35	25.7	3.8	8	0.	3.	12	16.7	4.	8	37.5	4.	28	17.9	4.2
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav				1	0.	5.				1	0.0	5.0												
Hsav																								
Pip/Hyp sp.	1	0.	1.5	2	50.	4.				3	33.3	3.2				3	0.	1.	2	0.	1.8	5	0.0	1.3
Nlei																2	0.	5.				2	0.0	5.0
Nnoc				2	0.	4.				2	0.0	4.	2	50.	4.							2	50.0	4.0
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur							1	0.	5.0	1	0.0	5.0												
Eser													1	100.0	6.							1	100.	6.0
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*	1	0.	1.5							1	0.0	1.5	1	0.	0.							1	0.0	#DIV/0!
Total	31	54.8	4.4	62	35.5	7.0	47	31.9	7.0	140	38.6	6.	16	12.5	3.6	56	41.1	8.	23	39.1	19.2	95	35.8	10.3
Transect duration	1:02			1:03			0:57			3:02			2:21			2:28			2:36			7:25		
Activity index	30.0			59.0			49.5			46.2			6.8			22.7			8.8			12.8		
Min. No. of species	3			4			3			6			4			5			2			8		

date	20/21. May												23/24. May												May Total	
time	20:02-22:39			22:40-00:59			02:30-05:02			Total			20:05-22:22			22:25-00:56			02:35-04:59			Total				
wind	weak-no			moderate-			moderate/weak						no			no-			weak-no							
temperature(°C	24-23			23-21			19						23-20			20-15			15-16							
clouds/precipitatio	low-			low-full			low-						low-clear			clear-low			mostly-low							
prey activity	high			high			high						moderatehigh			moderatehigh			moderatehigh							
transect (dir)	0 (X-0)			0 (0-X)			0(X-0)						5(X-0)			5 (0-X)			5 (X-0)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer	3	0.	2.							3	0.0	2.													6	0.6
Msch																1	0.	2.				1	0.0	2.0	4	0.4
Mbra/Mmys/Malc	1	0.	4.				2	50.0	8.5	3	33.3	7.0													27	2.7
Mmyo/Moxy																									0	0.0
Mbech	1	0.	3.0							1	0.0	3.0													3	0.3
Mema																									3	0.3
Mnat																									0	0.0
Mdau/Mcap																									0	0.0
Myotis sp.	1	0.	1.5	1	0.	1.5	1	0.	2.	3	0.0	1.7													16	1.6
Plecotus sp.																									0	0.0
Bbar																									1	0.1
Pkuh	47	76.6	11.5	21	61.9	32.5	33	75.8	26.5	101	73.3	22.	2	50.0	6.	3	66.7	8.	8	75.0	14.5	13	69.2	11.8	586	57.8
Pnath	13	46.2	39.5	2	0.	5.	4	0.	4.5	19	31.6	27.2	4	75.0	10.5	15	60.0	11.0	3	33.3	8.	22	59.1	10.5	69	6.8
Pkuh/Pnath	22	59.1	5.0	21	4.	2.	16	31.3	11.3	59	32.2	5.3	7	28.6	4.	35	62.9	5.1	12	58.3	16.6	54	57.4	7.0	204	20.1
Ppip																									0	0.0
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav	3	0.	4.				1	0.	4.	4	0.0	4.							1	100.0	6.	1	100.0	6.0	11	1.1
Hsav																									1	0.1
Pip/Hyp sp.	2	0.	1.8	1	0.	3.				3	0.0	2.	1	0.	2.							1	0.0	2.0	27	2.7
Nlei	5	40.0	5.8							5	40.0	5.8													7	0.7
Nnoc	17	58.8	11.5	6	50.0	5.				23	56.5	10.2	2	0.	9.							2	0.0	9.0	29	2.9
Nnoc/Nlei	2	100.0	5.0							2	100.0	5.0													2	0.2
Nnoc/Nlas													1	0.	5.							1	0.0	5.0	1	0.1
Vmur																									1	0.1
Eser	1	0.	4.							1	0.0	4.													3	0.3
Eser/Vmur/Nnoc/Nl																									0	0.0
Chiroptera *indet.*	1	0.	1.0	2	0.	1.				3	0.0	1.0	1	0.	0.							1	0.0	0.5	12	1.2
Total	119	58.0	12.0	54	31.5	11.9	57	54.4	18.6	230	50.9	13.5	18	33.3	6.	54	61.1	6.	24	62.5	14.0	96	56.3	8.4	1013	100.
Transect duration	2:37			2:19			2:32			7:28			2:17			2:31			2:24			7:12			30:45	
Activity index	45.5			23.3			22.5			30.8			7.9			21.5			10.0			13.3			32.9	
Min. No. of species	8			4			3			8			3			3			2			4			13	

June

date	17/18. June												17/18. June											
time	21:40-			23:51-			03:46-			Total			20:23-			00:11-			02:20-			Total		
wind	moderate-			moderate-			weak						moderate-			moderate-			moderate-					
temperature(ºC	20-19			17			15						21-20			17-15			15					
clouds/precipitatio	mostly-full			mostly-full			mostly						mostly-full			mostly-full			mostly-full					
prey activity	moderate high			moderate high			moderate high						moderate high			moderate high			moderate high					
transect (dir)	1 (0-X)			1 (X-0)			1 (0-X)						2 (0-X)			2 (X-0)			2 (0-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc	1	0.	2.5							1	0.0	2.5	1	0.	5.							1	0.0	5.0
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	24	54.	10.	6	50.	15.5	3	0.	31.0	33	48.5	13.2	9	22.	5.	3	0.	5.	3	33.3	5.0	15	20.0	5.1
Pnath	2	50.	5.5	2	0.	4.				4	25.0	5.0	1	0.	4.							1	0.0	4.0
Pkuh/Pnath	6	0.	3.2	1	0.	2.				7	0.0	3.0	3	0.	16.0							3	0.0	16.0
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav													1	0.	3.							1	0.0	3.0
Hsav																								
Pip/Hyp sp.	1	0.	3.0							1	0.0	3.0												
Nlei																								
Nnoc																								
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser	1	0.	8.							1	0.0	8.												
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*																								
Total	35	40.0	7.8	9	33.3	10.4	3	0.	31.0	47	36.2	9.	15	13.3	7.1	3	0.0	5.0	3	33.3	5.0	21	14.3	6.5
Transect duration	0:26			0:19			0:19			1:04			1:17			1:17			1:25			3:59		
Activity index	80.8			28.4			9.5			44.1			11.7			2.3			2.1			5.3		
Min. No. of species	4			2			1			4			3			1			1			3		

date	17/18. June												18/19. June											
time	22:07-			22:55-			04:05-			Total			20:23-			22:42-			02:23-			Total		
wind	moderate-			moderate-			weak						no			no			weak-no					
temperature(ºC)	19-18			18-17			15						22-20			20			18-15					
clouds/precipitati	mostly-full			mostly-full			mostly						mostly-moderate			moderate-mostly			mostly-					
prey activity	moderate high			moderate high			moderate high						high			high			high					
transect	3 (0-X)			3 (X-0)			3 (0-X)						0 (0-X)			0 (X-0)			0 (0-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer													3	0.	1.							3	0.0	1.8
Msch																								
Mbra/Mmys/Malc	3	0.	3.7							3	0.0	3.7	2	0.	2.				1	0.	1.5	3	0.0	2.0
Mmyo/Moxy																								
Mbech													1	0.	1.5	3	0.	2.	1	0.	2.5	5	0.0	2.4
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																2	0.	1.	1	0.	3.0	3	0.0	2.2
Plecotus sp.																								
Bbar																								
Pkuh	19	73.7	19.7	24	54.	7.5	10	50.0	8.3	53	60.4	11.3	12	33.3	4.	1	100.0	6.	4	0.	5.0	17	29.4	4.5
Pnath	2	50.	4.5							2	50.0	4.5	2	0.	4.	1	0.	1.5	1	0.	5.0	4	0.0	3.9
Pkuh/Pnath	5	0.	2.	16	0.	2.	3	33.3	3.3	24	4.2	2.	1	0.	3.	2	0.	3.5				3	0.0	3.3
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav				1	0.	2.				1	0.0	2.				1	0.	4.	1	0.	3.0	2	0.0	3.5
Hsav																								
Pip/Hyp sp.																			2	0.	1.8	2	0.0	1.8
Nlei	2	50.	3.0	1	0.	2.				3	33.3	2.												
Nnoc													2	0.	4.				2	100.0	45.	4	50.0	24.5
Nnoc/Nlei																1	0.	5.				1	0.0	5.0
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*				1	0.	1.5				1	0.0	1.5												
Total	31	51.6	11.8	43	30.2	5.1	13	46.	7.2	87	40.2	7.7	23	17.4	3.5	11	9.1	3.2	13	15.4	9.	47	14.9	5.2
Transect duration	0:48			0:56			0:44			2:28			2:19			2:15			2:26			7:00		
Activity index	38.7			46.1			17.7			35.3			9.9			4.9			5.3			6.7		
Min. No. of species	4			3			1			4						4			5			6		

date	21/22. June												22/23.June												June Total	
time	20:24-22:54			22:54-01:21			02:20-04:50			Total			20:24-23:08			23:08-01:40			02:20-04:50			Total				
wind	weak-no			weak-no			weak-no						weak-no			weak-no			weak-no							
temperature(°C	20-17			17-14			14-12						21-17			17-15			14-13							
clouds/precipitatio	moderate-clear			clear-			moderateo-						clear			clear			clear-low							
prey activity	moderatehigh			moderatehigh			moderate						moderatehigh			moderatehigh			moderatehigh							
transect	4 (o-X)			4 (X-o)			4 (o-X)						5 (o-X)			5 (X-o)			5 (o-X)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer																									3	0.8
Msch				1	0.	1.5				1	0.0	1.5													1	0.3
Mbra/Mmys/Malc													1	0.	4.							1	0.0	4.0	9	2.4
Mmyo/Moxy																									0	0.0
Mbech																									5	1.3
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap	1	0.	2.							1	0.0	2.													1	0.3
Myotis sp.	1	0.	0.5							1	0.0	0.5													4	1.1
Plecotus sp.																									0	0.0
Bbar																									0	0.0
Pkuh	21	28.6	5.5	3	33.3	6.	1	0.	5.0	25	28.0	5.6	20	40.0	7.	11	9.1	5.3	3	0.	4.7	34	26.5	6.5	177	47.3
Pnath	2	0.	4.	2	0.	5.				4	0.0	4.	9	11.1	4.	2	0.	5.				11	9.1	4.5	26	7.0
Pkuh/Pnath	7	0.	3.0	4	0.	3.				11	0.0	3.3	23	17.4	3.	10	10.0	3.	2	0.	3.3	35	14.3	3.0	83	22.
Ppip																									0	0.0
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav													3	33.3	4.	2	0.	3.5				5	20.0	4.0	9	2.4
Hsav													13	23.1	4.							13	23.1	4.1	13	3.5
Pip/Hyp sp.	1	0.	1.5							1	0.0	1.5	6	0.	2.7	3	33.3	3.				9	11.1	2.8	13	3.5
Nlei													11	63.6	4.							11	63.6	4.6	14	3.7
Nnoc													4	75.0	8.							4	75.0	8.3	8	2.1
Nnoc/Nlei																									1	0.3
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser													1	0.	4.							1	0.0	4.0	2	0.5
Eser/Vmur/Nnoc/Nl													2	50.0	3.5							2	50.0	3.5	2	0.5
Chiroptera *indet.*													2	0.	1.5							2	0.0	1.5	3	0.8
Total	33	18.2	4.5	10	10.0	4.7	1	0.	5.0	44	15.9	4.	95	29.5	4.	28	10.7	4.	5	0.0	4.1	128	24.2	4.5	374	100.
Transect duration	2:30			2:27			2:30			7:27			2:44			2:32			2:30			7:46			29.73	
Activity index	13.2			4.1			0.4			5.9			34.8			11.1			2.0			16.5			12.6	
Min. No. of species	3			3			1			4			7			2			1			7			11	

July

date	8/9. July												8/9. July											
time	21:19-			00:44-			03:10-			Total			21:48-			23:19-			03:31-			Total		
wind	weak			weak			moderate-						weak-no			weak-no			moderate-					
temperature(oC	29			27			24						29-28			28-27			24					
clouds/precipitatio	clear			low			low-						clear			clear-low			moderateo-					
prey activity	high			high			high						high			high			high					
transect	1 (X-o)			1 (o-X)			1 (X-o)						2 (X-o)			2 (o-X)			2 (X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																1	0.	2.				1	0.0	2.0
Msch																								
Mbra/Mmys/Malc				1	0.	3.				1	0.0	3.0	1	0.	4.							1	0.0	4.0
Mmyo/Moxy																								
Mbech																1	0.	1.5				1	0.0	1.5
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	14	28.	15.	10	80.	12.6	7	100.0	31.8	31	61.3	17.3	4	0.	2.	2	0.	5.	1	100.	5.0	7	14.3	3.8
Pnath	4	25.	5.0				3	0.	4.7	7	14.3	4.	1	0.	4.	1	0.	2.				2	0.0	3.0
Pkuh/Pnath	10	20.	3.2	4	0.	3.	6	16.7	2.	20	15.0	3.0	1	0.	2.				1	0.	4.	2	0.0	3.0
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.																								
Nlei	1	0.	6.							1	0.0	6.							1	0.	2.	1	0.0	2.0
Nnoc																								
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser																			1	0.	5.0	1	0.0	5.0
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*																								
Total	29	24.1	8.7	15	53.3	8.	16	50.0	12.2	60	38.3	9.	7	0.0	3.1	5	0.0	3.1	4	25.0	4.	16	6.3	3.3
Transect duration	0:29			0:22			0:21			1:12			1:31			1:25			1:28			4:24		
Activity index	60.0			40.9			45.7			50.0			4.6			3.5			2.7			3.6		
Min. No. of species	3			2			2			4			3			4			3			7		

date	8/9. July												9/10. July											
time	20:22-21:19			01:06-01:56			02:06-03:10			Total			20:22-22:53			22:53-01:29			02:29-04:59			Total		
wind	weak			weak-			moderate-						no-weak			weak-			weak					
temperature(ºC	30-29			27-25			25-24						21-20			20-18			18-16					
clouds/precipitatio	clear			low-moderate			low-moderate						moderate-low			low-moderate			moderate					
prey activity	high			high			high						moderate			moderate			moderate					
transect	3 (X-o)			3 (o-X)			3 (X-o)						4 (X-o)			4 (o-X)			4 (X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc				1	0.	3.				1	0.0	3.0												
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	2	0.	4.	3	0.	4.				5	0.0	4.	1	0.	4.	4	100.0	76.7	1	0.	2.5	6	66.7	47.3
Pnath				1	0.	4.				1	0.0	4.	1	0.	6.							1	0.0	6.0
Pkuh/Pnath	1	0.	2.5				2	0.	3.5	3	0.0	3.2	1	0.	2.	3	0.	3.	1	0.	3.0	5	0.0	2.9
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav													1	0.	2.				1	0.	17.0	2	0.0	9.5
Hsav																								
Pip/Hyp sp.																								
Nlei							1	0.	4.	1	0.0	4.												
Nnoc																								
Nnoc/Nlei													1	0.	1.5							1	0.0	1.5
Nnoc/Nlas																								
Vmur																								
Eser				1	0.	4.				1	0.0	4.				2	0.	5.				2	0.0	5.0
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*																								
Total	3	0.0	3.5	6	0.0	4.	3	0.	3.7	12	0.0	3.9	5	0.0	3.2	9	44.4	31.1	3	0.0	7.5	17	23.5	18.0
Transect duration	0:57			0:50			1:04			2:51			2:31			2:36			2:30			7:37		
Activity index	3.2			7.2			2.8			4.2			2.0			3.5			1.2			2.2		
Min. No. of species	1			4			2			5			3			2			2			4		

date	22/23. July												23/24. July												July Total	
time	20:13-			22:53-			02:50-			Total			20:12-			22:53-			02:40-			Total				
wind	weak-no			weak-no			weak-no						weak			weak-no			weak-no							
temperature(ºC	31-28			28-25			25						30-28			28-25			24-23							
clouds/precipitatio	low-clear			clear			low-clear						low-clear			clear			low-clear							
prey activity	high			high			high						high			high			high							
transect	0(X-0)			0 (0-X)			0 (X-0)						5(X-0)			5 (0-X)			5(X-0)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer																									1	0.3
Msch																									0	0.0
Mbra/Mmys/Malc	1	0.	3.0							1	0.0	3.0													4	1.3
Mmyo/Moxy							1	0.	1.5	1	0.0	1.5													1	0.3
Mbech	1	0.	2.							1	0.0	2.													2	0.7
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap																									0	0.0
Myotis sp.	12	0.	3.9							12	0.0	3.9													12	4.0
Plecotus sp.																									0	0.0
Bbar																									0	0.0
Pkuh	22	50.0	5.5	10	70.0	8.	6	50.0	5.8	38	55.3	6.3	19	47.4	7.	12	66.7	9.				31	54.8	7.9	118	39.7
Pnath	1	0.	5.0	4	25.0	5.3	6	16.7	6.	11	18.2	6.1				2	0.	3.5				2	0.0	3.5	24	8.1
Pkuh/Pnath	30	3.3	3.4	16	6.3	4.	9	0.	3.3	55	3.6	3.7	10	0.	2.	13	0.	3.3	2	0.	3.0	25	0.0	3.1	110	37.0
Ppip																									0	0.0
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav																1	0.	5.				1	0.0	5.0	3	1.0
Hsav																									0	0.0
Pip/Hyp sp.	1	0.	1.5							1	0.0	1.5	1	0.	1.5							1	0.0	1.5	2	0.7
Nlei																									3	1.0
Nnoc	5	40.0	9.							5	40.0	9.													5	1.7
Nnoc/Nlei	1	100.0	4.				1	0.	3.0	2	50.0	3.5													3	1.0
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser				1	0.	2.				1	0.0	2.				1	0.	4.				1	0.0	4.0	6	2.0
Eser/Vmur/Nnoc/Nl													1	0.	3.							1	0.0	3.0	1	0.3
Chiroptera *indet.*	2	0.	1.3							2	0.0	1.3													2	0.7
Total	76	19.7	4.4	31	29.0	5.7	23	17.4	4.8	130	21.5	4.7	31	29.0	5.4	29	27.6	5.6	2	0.0	3.0	62	27.4	5.5	297	100.
Transect duration	2:28			2:05			2:21			6:54			2:41			2:31			2:32			7:44			30.42	
Activity index	30.8			14.9			9.8			18.8			11.6			11.5			0.8			8.0			9.7	
Min. No. of species	6			3			4			7						3			1			3			9	

August

date	5/6. August												14/15. August											
time	19:56-			22:39-			02:55-			Total			21:11-			23:29-			04:26-			Total		
wind	weak			weak-no			weak-no						no-weak			no-weak			no-weak					
temperature(ºC	30-28			28-25			24-23						29			27-26			23					
clouds/precipitatio	low-clear			clear			clear-low						clear			clear			clear					
prey activity	high			high			high						high			high			high					
transect	4 (o-X)			4 (X-o)			4 (o-X)						1 (o-X)			1 (X-o)			1 (o-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc																								
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	6	33.3	5.0	4	75.0	11.0	5	60.	7.0	15	53.3	7.3	2	50.	12.5	8	50.	5.3	4	0.	4.	14	35.7	6.1
Pnath	1	0.	6.	1	0.	6.	1	100.0	10.0	3	33.3	7.3												
Pkuh/Pnath	1	0.	2.5	3	0.	2.	1	0.	3.0	5	0.0	2.	3	0.	2.	4	0.	1.	2	0.	2.3	9	0.0	2.1
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav							1	0.	3.0	1	0.0	3.0												
Hsav																								
Pip/Hyp sp.	1	0.	1.5							1	0.0	1.5												
Nlei							1	100.0	8.	1	100.	8.				3	33.3	9.				3	33.3	9.0
Nnoc	4	50.	14.	2	50.	12.5	2	50.0	11.0	8	50.0	13.1	4	75.0	7.5	2	50.	5.				6	66.7	6.8
Nnoc/Nlei				1	100.0	4.				1	100.	4.				1	0.	5.				1	0.0	5.0
Nnoc/Nlas																								
Vmur																								
Eser				1	0.	6.				1	0.0	6.				1	100.0	7.				1	100.	7.0
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*																								
Total	13	30.8	7.5	12	41.7	7.8	11	54.5	7.4	36	41.7	7.6	9	44.4	6.	19	36.8	5.2	6	0.0	3.9	34	32.4	5.4
Transect duration	2:43			2:32			2:32			7:47			0:18			0:20			0:21			0:59		
Activity index	4.8			4.7			4.3			4.6			30.0			57.0			17.1			34.6		
Min. No. of species	3			4			4			5			2			4			1			4		

date	14/15. August												14/15. August											
time	19:43-21:11			23:49-01:10			02:52-04:26			Total			21:29-22:26			22:26-23:29			04:48-05:37			Total		
wind	no-weak			no-weak			no-weak						weak-no			weak-no			moderate-					
temperature(ºC	31-29			26-23			23						29-28			28-27			24					
clouds/precipitatio	low			clear			clear						clear			clear-low			moderate-low					
prey activity	high			high			high						high			high			high					
transect	2 (o-X)			2 (X-o)			2 (o-X)						3 (o-X)			3 (X-o)			3 (o-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc	2	0.	3.5							2	0.0	3.5				1	0.	1.5				1	0.0	1.5
Mmyo/Moxy							1	0.	3.0	1	0.0	3.0												
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.							1	0.	2.	1	0.0	2.	2	0.	1.	1	0.	2.				3	0.0	1.3
Plecotus sp.																								
Bbar																								
Pkuh	7	28.	4.7	8	12.	4.	15	13.3	3.5	30	16.7	4.1	15	100.0	21.1	5	20.	6.	1	0.	4.	21	76.2	16.6
Pnath													1	0.	6.							1	0.0	6.0
Pkuh/Pnath	4	25.	3.0	7	0.	2.	3	0.	4.	14	7.1	3.1	5	0.	3.1	8	0.	2.				13	0.0	2.7
Ppip	1	0.	3.0							1	0.0	3.0												
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.													1	0.	1.5	1	0.	3.				2	0.0	2.3
Nlei				1	0.	1.				1	0.0	1.0	1	0.	3.	1	0.	6.				2	0.0	4.5
Nnoc	1	0.	2.							1	0.0	2.												
Nnoc/Nlei													1	0.	1.5							1	0.0	1.5
Nnoc/Nlas																								
Vmur																								
Eser							1	0.	4.	1	0.0	4.												
Eser/Vmur/Nnoc/Nl													1	0.	4.							1	0.0	4.0
Chiroptera *indet.*																								
Total	15	20.0	3.8	16	6.3	3.6	21	9.	3.5	52	11.5	3.6	27	55.6	11.9	17	5.9	3.6	1	0.0	4.	45	35.6	8.5
Transect duration	1:28			1:21			1:34			4:23			0:57			1:03			0:49			2:49		
Activity index	10.2			11.9			13.4			11.9			28.4			16.2			1.2			16.0		
Min. No. of species	4			2			3			7			4			3			1			4		

date	15/16. August												28/29. August												August total	
time	19:42-22:04			22:04-00:37			03:05-05:38			Total			19:20-21:47			21:47-00:00			03:30-05:54			Total				
wind	No-weak			No-moderate			No-weak						No-weak			No-weak			No-weak							
temp (°C) o	33-28			28-25			24						29-24			24-23			19-17							
clouds/precipitation	Little-			Clear-moderate			Little-modera						little			Little-clear			little							
Prey activity	high			high			high						moderate			moderate			moderate							
transect (dir)	5 (o-X)			5 (X-o)			5 (o-X)						o (o-X)			o (X-o)			o (o-X)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer													3	0.0	1.3				1	0.0	2.0	4	0.0	1.5	4	0.8
Msch																									0	0.0
Mbra/Mmys/Malc													7	14.3	2.7	1	0.0	2.0	3	33.3	2.7	11	18.2	2.6	14	2.8
Mmyo/Moxy																									1	0.2
Mbech																									0	0.0
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap																1	0.0	3.0				1	0.0	3.0	1	0.2
Myotis sp.													1	0.0	1.0				1	0.0	1.0	2	0.0	1.0	6	1.2
Plecotus sp.																									0	0.0
Bbar																									0	0.0
Pkuh	10	20.0	5.8	29	51.7	5.3	7	71.4	9.8	46	47.8	6.1	41	31.7	6.3	25	24.0	5.0	23	43.5	5.8	89	32.6	5.8	215	43.5
Pnath	2	50.0	10.0	1	0.0	6.0	2	50.0	5.0	5	40.0	7.2	6	16.7	6.2	2	0.0	5.5	5	40.0	8.0	13	23.1	6.8	22	4.5
Pkuh/Pnath	11	0.0	2.5	9	0.0	2.2	9	11.1	2.3	29	3.4	2.4	30	0.0	3.0	19	5.3	2.6	9	33.3	2.5	58	6.9	2.8	128	25.9
Ppip				1	100.0	5.0				1	100.0	5.0	4	0.0	3.8							4	0.0	3.8	6	1.2
Pkuh/Ppip																									0	0.0
Ppyg				1	0.0	2.0				1	0.0	2.0													1	0.2
Pnat/Hsav																									1	0.2
Hsav													1	0.0	5.0							1	0.0	5.0	1	0.2
Pip/Hyp sp.													2	0.0	2.3				1	0.0	2.0	3	0.0	2.2	6	1.2
Nlei				4	25.0	4.5				4	25.0	4.5	2	50.0	4.5	1	0.0	3.0	3	33.3	5.0	6	33.3	4.5	17	3.4
Nnoc	4	50.0	6.0	1	0.0	5.0				5	40.0	5.8	13	76.9	4.7	9	0.0	4.1	12	58.3	9.4	34	50.0	6.1	54	10.9
Nnoc/Nlei													1	100.0	4.0	1	0.0	1.0	1	100.0	4.0	3	66.7	3.0	6	1.2
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser				1	0.0	7.0				1	0.0	7.0													4	0.8
Eser/Vmur/Nnoc/Nlei	2	0.0	2.0							2	0.0	2.0	1	0.0	1.5				1	0.0	2.0	2	0.0	1.8	5	1.0
Chiroptera *indet.*				1	0.0	0.5				1	0.0	0.5							1	0.0	0.5	1	0.0	0.5	2	0.4
Укупно	29	17.2	4.5	48	35.4	4.5	18	38.9	5.3	95	30.5	4.7	112	24.1	4.5	59	11.9	3.9	61	41.0	5.5	232	25.4	4.6	494	100.0
Трајање трансекта	2:22			2:33			2:33			7:28			2:27			2:13			2:24			7:04			30:30	
Индекс активности	12.3			18.8			7.1			12.7			45.7			26.6			25.4			32.8			16.2	
Минималан бр. врста	3			7			2			7						6			6			9				

September

date	3/4. September												8/9. September											
time	19:09-21:54			21:54-02:29			03:17-06:01			Total			20:00-20:31			23:57-00:25			03:59-04:28			Total		
wind	no-weak			no-weak			no-weak						no-weak			no			no					
temperature(°C	29-25			26-24			24						17-15			12			8-7					
clouds/precipitatio	low			low-moderate			low						clear			clear			clear					
prey activity	moderate-high			moderate-high			moderate-high						moderate-high			moderate-high			moderate-high					
transect	4 (0-X)			4 (X-0)			4 (0-X)						1 (X-0)			1 (0-X)			1 (X-0)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc	1	0.	1.0							1	0.0	1.0												
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	15	40.	4.	39	30.	5.7	25	32.0	5.8	79	32.9	5.5	12	58.	13.0				2	0.	4.5	14	50.0	11.1
Pnath	6	0.	4.	8	0.	4.	1	0.	4.	15	0.0	4.3	2	0.	4.							2	0.0	4.5
Pkuh/Pnath	16	6.3	2.	11	9.1	3.	12	0.	2.	39	5.1	2.	3	0.	2.							3	0.0	2.5
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.	3	0.	1.0	2	0.	2.				5	0.0	1.6												
Nlei	4	50.	5.3	10	10.	4.				14	21.4	4.												
Nnoc	29	37.9	7.0	16	50.	6.				45	42.2	6.7												
Nnoc/Nlei	2	0.	3.5	9	22.	3.				11	18.2	3.7												
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl				2	0.	1.5				2	0.0	1.5												
Chiroptera *indet.*	2	0.	1.3							2	0.0	1.3												
Total	78	25.6	4.9	97	24.7	4.	38	21.1	4.7	213	24.4	4.	17	41.2	9.	0			2	0.0	4.5	19	36.8	8.3
Transect duration	2:45			2:35			2:44			8:04			0:31			0:28			0:29			1:28		
Activity index	28.4			37.5			13.9			26.4			32.9			0.0			4.1			13.0		
Min. No. of species	5			4			2			5			2			0			1			2		

date	8/9. September												8/9. September											
time	20:32-22:12			22:14-23:57			04:28-06:06			Total			19:00-20:00			00:25-01:30			02:55-03:59			Total		
wind	no			no			no-weak						no-weak			no			no					
temperature(ºC	15-13			13-12			7-6						19-17			12-11			8					
clouds/precipitatio	clear			clear			clear						low			clear			clear					
prey activity	moderate			moderate			moderate						moderate high			moderate			moderate					
transect	2 (X-o)			2 (o-X)			2 (X-o)						3 (X-o)			3 (o-X)			3 (X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch	1	0.	1.0	1	0.	0.				2	0.0	0.				2	0.	1.	1	0.	3.0	3	0.0	1.7
Mbra/Mmys/Malc	2	0.	1.8	2	0.	1.3				4	0.0	1.5												
Mmyo/Moxy				1	0.	5.				1	0.0	5.0				1	0.	6.				1	0.0	6.0
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																			1	0.	3.0	1	0.0	3.0
Plecotus sp.																								
Bbar																								
Pkuh	8	0.	4.1	2	0.	3.3				10	0.0	3.9	22	27.3	5.	1	0.	4.	3	33.3	4.3	26	26.9	4.8
Pnath	2	0.	4.5	3	0.	4.				5	0.0	4.	2	0.	5.	1	0.	3.	1	0.	5.0	4	0.0	4.5
Pkuh/Pnath	5	0.	2.	1	0.	2.				6	0.0	2.	6	0.	2.	3	0.	1.3	1	0.	3.0	10	0.0	1.9
Ppip	1	0.	3.0							1	0.0	3.0												
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.																1	0.	2.				1	0.0	2.0
Nlei																								
Nnoc	1	0.	4.							1	0.0	4.	1	0.	4.							1	0.0	4.0
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*	1	0.	0.5	3	0.	1.3				4	0.0	1.1												
Total	21	0.0	3.1	13	0.0	2.	0			34	0.0	2.	31	19.4	4.	9	0.0	2.3	7	14.3	3.9	47	14.9	3.9
Transect duration	1:40			1:43			1:38			5:01			1:00			1:05			1:04			3:09		
Activity index	12.6			7.6			0.0			6.8			31.0			8.3			6.6			14.9		
Min. No. of species	6			5			0			7			3			4			4			5		

date	11/12. September												19/20. September												September Total	
time	18:54-21:22			21:22-23:56			03:41-06:10			Total			18:39-20:54			20:54-23:10			04:04-06:19			Total				
wind	no-weak			no-weak			no-weak						no			no-weak			no-weak							
temperature(ºC	19-17			17-15			14						29-27			27-23			22-18							
clouds/precipitatio	full-moderate			moderate-clear			moderate-low						clear			clear			moderate-low							
prey activity	moderate-			moderate			moderate-						moderate			moderate			moderate							
transect	5 (X-0)			5 (0-X)			5 (X-0)						0 (X-0)			0 (0-X)			0 (X-0)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer																1	0.	2.				1	0.0	2.0	1	0.2
Msch	1	0.	0.5	1	0.	1.5				2	0.0	1.0	1	0.	2.	1	0.	1.5				2	0.0	1.8	9	1.6
Mbra/Mmys/Malc													2	0.	2.				1	0.	2.	3	0.0	2.5	8	1.5
Mmyo/Moxy																1	0.	1.				1	0.0	1.0	3	0.5
Mbech																									0	0.0
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap																									0	0.0
Myotis sp.																									1	0.2
Plecotus sp.																									0	0.0
Bbar																									0	0.0
Pkuh	3	0.	2.	3	33.3	4.				6	16.7	3.2	65	67.7	9.	13	53.8	6.	13	46.2	5.3	91	62.6	8.0	226	41.1
Pnath				1	0.	3.	1	0.	2.	2	0.0	2.5	9	11.1	4.	17	17.6	4.	7	0.	4.	33	12.1	4.8	61	11.1
Pkuh/Pnath	2	0.	5.0	1	0.	2.				3	0.0	4.	23	4.3	3.	21	9.5	2.	5	0.	2.	49	6.1	2.8	110	20.
Ppip																									1	0.2
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav																									0	0.0
Hsav													1	0.	5.	2	50.0	6.				3	33.3	6.0	3	0.5
Pip/Hyp sp.																									6	1.1
Nlei													1	0.	7.	2	0.	4.	1	0.	5.0	4	0.0	5.0	18	3.3
Nnoc	1	100.0	1.0	2	0.	3.				3	33.3	2.3	10	10.0	5.7	6	16.7	9.	10	10.0	7.4	26	11.5	7.1	76	13.8
Nnoc/Nlei																5	0.	2.				5	0.0	2.9	16	2.9
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser																									0	0.0
Eser/Vmur/Nnoc/Nl																									2	0.4
Chiroptera *indet.*																2	50.0	2.	1	0.	0.5	3	33.3	1.7	9	1.6
Total	7	14.3	2.6	8	12.5	3.1	1	0.	2.0	16	12.5	2.	112	42.0	6.7	71	21.1	4.	38	18.4	5.2	221	31.2	5.6	550	100.
Transect duration	2:28			2:34			2:29			7:31			2:15			2:16			2:15			6:46			31:59	
Activity index	2.8			3.1			0.4			2.1			49.8			31.3			16.9			32.7			17.2	
Min. No. of species	3			4			1			4			7			8			5			9				

October

date	3/4. October												6/7. October											
time	18:13-20:50			20:50-23:22			04:00-06:36			Total			19:40-20:11			22:23-22:53			05:12-05:42			Total		
wind	weak-no			weak-no			weak-no						no			no			no					
temperature(ºC	21-18			18-16			15-14						17			16-15			14					
clouds/precipitatio	clear			clear			low						moderate-low			low			mostly					
prey activity	moderate high			moderate			low						low			low			low					
transect	4 (X-o)			4 (o-X)			4 (X-o)						1 (o-X)			1 (X-o)			1 (o-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch	1	0.	1.0	1	0.	1.				2	0.0	1.0												
Mbra/Mmys/Malc																								
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	7	42.	5.0	2	50.	4.				9	44.4	4.	7	28.	11.8							7	28.6	11.8
Pnath	1	0.	5.0	4	0.	4.				5	0.0	4.	2	0.	5.	5	20.	3.				7	14.3	4.0
Pkuh/Pnath	5	0.	2.	4	0.	3.				9	0.0	2.	2	0.	2.	1	0.	2.				3	0.0	2.3
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.																								
Nlei	1	0.	2.	1	0.	3.				2	0.0	2.5				2	50.	6.				2	50.0	6.5
Nnoc	9	11.1	6.				1	0.	5.0	10	10.0	6.				1	0.	4.				1	0.0	4.0
Nnoc/Nlei	1	0.	5.0							1	0.0	5.0												
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl				1	0.	0.				1	0.0	0.5												
Chiroptera *indet.*																								
Total	25	16.0	4.8	13	7.7	3.3	1	0.	5.0	39	12.8	4.3	11	18.2	8.	9	22.2	4.	0			20	20.0	6.5
Transect duration	2:37			2:32			2:36			7:45			0:31			0:30			0:30			1:31		
Activity index	9.6			5.1			0.4			5.0			21.3			18.0			0.0			13.2		
Min. No. of species	5			4			1			5			2			3			0			4		

date	6/7. October												6/7. October											
time	18:08-			22:53-			03:40-			Total			20:11-			21:25-			05:42-			Total		
wind	no			no			no-weak						no-weak			no-weak			no					
temperature(ºC	20-17			16-13			15-14						17			17-16			14-13					
clouds/precipitatio	moderate			low-			mostly						low			low-			mostly-					
prey activity	low			low			low						low			low			low					
transect	2 (0-X)			2 (X-0)			2 (0-X)						3 (0-X)			3 (X-0)			3 (0-X)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer	1	0.	1.0							1	0.0	1.0												
Msch													3	0.	2.	3	0.	1.				6	0.0	1.8
Mbra/Mmys/Malc				1	0.	3.				1	0.0	3.0												
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																1	0.	1.				1	0.0	1.0
Plecotus sp.				1	0.	2.				1	0.0	2.												
Bbar																								
Pkuh	2	50.	5.5	1	0.	5.				3	33.3	5.3	2	0.	4.	1	0.	5.				3	0.0	4.5
Pnath							2	0.	3.5	2	0.0	3.5												
Pkuh/Pnath				1	0.	1.				1	0.0	1.0				1	0.	5.				1	0.0	5.0
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav													1	0.	0.							1	0.0	0.5
Hsav																								
Pip/Hyp sp.																								
Nlei																								
Nnoc																								
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet*.																								
Total	3	33.3	4.0	4	0.0	2.	2	0.	3.5	9	11.1	3.3	6	0.0	2.7	6	0.0	2.	0			12	0.0	2.5
Transect duration	1:32			1:32			1:32			4:36			0:59			0:58			0:58			2:55		
Activity index	2.0			2.6			1.3			2.0			6.1			6.2			0.0			4.1		
Min. No. of species	2			3			1			5			3			3			0			4		

date	9/10. October												21/22. October												October Total	
time	18:02-20:33			20:33-23:13			04:11-06:44			Total			17:42-20:01			20:01-22:18			04:40-06:59			Total				
wind	no			no-weak			weak						no			no-weak			no-weak							
temperature(ºC	13-11			11-12			14-11						11-9			9-8			8-5							
clouds/precipitatio	mostly			mostly-full			mostly-low						mostly-			moderate-low			low-clear							
prey activity	moderate			moderate			very low						no			no-weak			no-weak							
transect	5 (0-X)			5 (X-0)			5 (0-X)						0 (0-X)			0 (X-0)			0 (0-X)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer																									1	1.0
Msch																									8	7.7
Mbra/Mmys/Malc																									1	1.0
Mmyo/Moxy																									0	0.0
Mbech																									0	0.0
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap																									0	0.0
Myotis sp.																									1	1.0
Plecotus sp.													1	0.	1.5							1	0.0	1.5	2	1.9
Bbar				1	0.	1.				1	0.0	1.0													1	1.0
Pkuh													2	0.	4.							2	0.0	4.0	24	23.1
Pnath	1	100.0	8.	1	0.	7.				2	50.0	7.5	4	0.	2.	3	33.3	5.3	1	0.	5.0	8	12.5	4.1	24	23.1
Pkuh/Pnath				1	0.	1.5				1	0.0	1.5	1	0.	2.	1	0.	2.	1	0.	2.	3	0.0	2.2	18	17.3
Ppip																									0	0.0
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav																									1	1.0
Hsav																									0	0.0
Pip/Hyp sp.																									0	0.0
Nlei				1	0.	3.				1	0.0	3.0				1	0.	5.				1	0.0	5.0	6	5.8
Nnoc							1	0.	0.5	1	0.0	0.5	1	100.0	7.							1	100.0	7.0	13	12.5
Nnoc/Nlei													1	0.	3.							1	0.0	3.0	2	1.9
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser																									0	0.0
Eser/Vmur/Nnoc/Nl																									1	1.0
Chiroptera *indet.*													1	0.	1.							1	0.0	1.0	1	1.0
Total	1	100.0	8.0	4	0.0	3.1	1	0.	0.5	6	16.7	3.5	11	9.1	3.1	5	20.0	4.7	2	0.0	3.5	18	11.1	3.6	104	100.
Transect duration	2:31			2:40			2:33			7:44			2:19			2:17			2:19			6:55			31:26	
Activity index	0.4			1.5			0.4			0.8			4.7			2.2			0.9			2.6			3.3	
Min. No. of species	1			3			1			4			4			2			1			5			9	

November

date	11/12. November												12/13. November											
time	16:12-18:56			18:56-21:29			03:45-06:27			Total			16:11-18:26			18:26-20:43			04:10-06:29			Total		
wind	no-weak			no-weak			no-weak						no-weak			no			no-weak					
temperature(ºC	17-13			13-10			8-7						15-11			11-7			5-6					
clouds/precipitatio	moderate-low			low-clear			clear						clear			clear			clear					
prey activity	moderate high			moderate high			moderate high						moderatea			moderatea			moderatea					
transect	4 (o-X)			4 (X-o)			4 (o-X)						o (X-o)			o (o-X)			o (X-o)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc													1	0.	3.	1	0.	2.				2	0.0	2.8
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	2	50.	6.	2	0.	4.				4	25.0	5.0	5	0.	4.	1	100.0	5.				6	16.7	4.3
Pnath																								
Pkuh/Pnath																								
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.																								
Nlei	1	0.	5.0				1	0.	3.0	2	0.0	4.				1	0.	5.				1	0.0	5.0
Nnoc	1	0.	4.							1	0.0	4.												
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet*.																								
Total	4	25.0	5.3	2	0.0	4.	1	0.	3.0	7	14.3	4.	6	0.0	4.	3	33.3	4.	0			9	11.1	4.1
Transect duration	2:44			2:33			2:42			7:59			2:15			2:17			2:19			6:51		
Activity index	1.5			0.8			0.4			0.9			2.7			1.3			0.0			1.3		
Min. No. of species	3			1			1			3			2			3			0			3		

date	19/20. November												19/20. November											
time	17:05-17:33			21:00-21:29			04:25-04:54			Total			17:33-19:17			19:17-21:00			04:25-04:54			Total		
wind	no-weak			no-weak			no-weak						no-weak			no-weak			no-weak					
temperature(ºC	13-12			6			7						12-8			8-6			7-6					
clouds/precipitatio	low			clear			moderate						low-clear			clear			low-moderate					
prey activity	moderate high			moderate high			moderate high						moderate			moderate			moderate					
transect	1 (X-0)			1 (0-X)			1 (X-0)						2 (X-0)			2 (0-X)			2 (X-0)					
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t
Rhfer																								
Msch																								
Mbra/Mmys/Malc																								
Mmyo/Moxy																								
Mbech																								
Mema																								
Mnat																								
Mdau/Mcap																								
Myotis sp.																								
Plecotus sp.																								
Bbar																								
Pkuh	6	83.3	36.3	1	0.	5.				7	71.4	28.5	2	0.	4.							2	0.0	4.5
Pnath																								
Pkuh/Pnath	1	0.	2.5							1	0.0	2.5												
Ppip																								
Pkuh/Ppip																								
Ppyg																								
Pnat/Hsav																								
Hsav																								
Pip/Hyp sp.																								
Nlei																								
Nnoc																								
Nnoc/Nlei																								
Nnoc/Nlas																								
Vmur																								
Eser																								
Eser/Vmur/Nnoc/Nl																								
Chiroptera *indet.*																								
Total	7	71.4	27.9	1	0.0	5.0	0			8	62.5	23.3	2	0.0	4.5	0			0			2	0.0	4.5
Transect duration	0:28			0:29			0:29			1:26			1:44			1:43			1:44			5:11		
Activity index	15.0			2.1			0.0			5.6			1.2			0.0			0.0			0.4		
Min. No. of species	1			1			0			1			1			0			0			1		

date	19/20. November												20/21. November												November Total	
time	16:04-17:05			21:30-22:33			03:21-04:25			Total			16:03-18:35			18:35-21:09			04:05-06:39			Total				
wind	no-weak			no-weak			no-weak						no-weak			no-weak			weak							
temperature(ºC	16-13			6-5			7-6						15-11			11			12-10							
clouds/precipitatio	low			clear			clear-						moderate-clear			clear-low			clear-mostly							
prey activity	moderate- high			moderatea			moderatea						moderate-low			moderatea			moderate-low							
transect	3 (X-o)			3 (o-X)			3 (X-o)						5 (X-o)			5 (o-X)			5 (X-o)							
species/group	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	Л	t	N	%
Rhfer																									0	0.0
Msch				2	0.0	2.5				2	0.0	2.5													2	5.6
Mbra/Mmys/Malc																									2	5.6
Mmyo/Moxy																									0	0.0
Mbech																									0	0.0
Mema																									0	0.0
Mnat																									0	0.0
Mdau/Mcap																									0	0.0
Myotis sp.																									0	0.0
Plecotus sp.																									0	0.0
Bbar																									0	0.0
Pkuh	3	33.3	4.3							3	33.3	4.3													22	61.1
Pnath				1	0.0	5.0				1	0.0	5.0													1	2.8
Pkuh/Pnath																									1	2.8
Ppip																									0	0.0
Pkuh/Ppip																									0	0.0
Ppyg																									0	0.0
Pnat/Hsav																									0	0.0
Hsav																									0	0.0
Pip/Hyp sp.																									0	0.0
Nlei							1	0.0	5.0	1	0.0	5.0													4	11.1
Nnoc													1	0.0	1.0				1	0.0	10.0	2	0.0	5.5	3	8.3
Nnoc/Nlei																									0	0.0
Nnoc/Nlas																									0	0.0
Vmur																									0	0.0
Eser																									0	0.0
Eser/Vmur/Nnoc/Nl																									0	0.0
Chiroptera *indet.*							1	0.0	0.5	1	0.0	0.5													1	2.8
Total	3	33.3	4.3	3	0.0	3.3	2	0.	2.8	8	12.5	3.6	1	0.0	1.0	0			1	0.0	10.0	2	0.0	5.5	36	100.
Transect duration	1:01			1:03			1:04			3:08			2:32			2:34			2:34			7:40			32:15	
Activity index	3.0			2.9			1.9			2.6			0.4			0.0			0.4			0.3			1.1	
Min. No. of species	1			2			1			4			1			0			1			1			6	

Appendix 4. Overview of automatic bat activity detection

Legend: Rh - *Rhinolophus ferrumequinum*; Es - *Eptesicus serotinus*; My - *Myotis/Plecotus/Barbastella* spp.; Ny - *Nyctalus/Vespertilio* spp.; Pi - *Pipistrellus/Hypsugo* spp.; ? - *Chiroptera indet.*

April

date	23/24. April
time	19:30-05:37
wind	no
temp (°C)	10.3-7.4
clouds/precipitatio	moderate/no

census point	VG08						VG09						VG10					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59											4							
20:00 - 20:59		35	48		1	15			4						7			1
21:00 - 21:59	1	26	62			28		2	1			1			2			
22:00 - 22:59	3	8	32			14									2			
23:00 - 23:59		3	55			11			2					1	3			1
00:00 - 00:59		2	3						1									1
01:00 - 01:59	1	1												1	2		1	1
02:00 - 02:59			3						3						2			
03:00 - 03:59																		
04:00 - 04:59		1																
05:00 - 05:59																		
06:00 - 06:59																		
Total per group	5	76	203	0	1	68	0	2	11	0	4	1	0	2	18	0	1	4
Total contacts	353						18						25					
Duration	10.12						10.12						12.12					
Activity index	34.89						1.78						2.47					

census point	VG11						VG12					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					5						13	
20:00 - 20:59			1			1		2	4		4	
21:00 - 21:59		2				1			9			
22:00 - 22:59									3			
23:00 - 23:59			1									
00:00 - 00:59			1			1					1	
01:00 - 01:59					1				1		1	
02:00 - 02:59									2			
03:00 - 03:59		1									2	
04:00 - 04:59												
05:00 - 05:59												
06:00 - 06:59												
Total per group	0	3	3	0	6	3	0	2	19	0	21	0
Total contacts	15						42					
Duration	10.12						10.12					
Activity index	1.48						4.15					

census point	VG13						VG14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					18				1		3	
20:00 - 20:59		1	43		2	10		1	6		1	1
21:00 - 21:59		1	44			2			4		4	2
22:00 - 22:59		1	1					1	4			1
23:00 - 23:59			2			1			2			
00:00 - 00:59		1	1						4		1	2
01:00 - 01:59			4			1			1			1
02:00 - 02:59			1		1							
03:00 - 03:59			1						1			
04:00 - 04:59					1							
05:00 - 05:59											2	2
06:00 - 06:59												
Total per group	0	4	97	0	22	14	0	2	23	0	11	9
Total contacts	137						45					
Duration	10.12						10.12					
Activity index	13.54						4.45					

date	24/25. April
time	19:31-05:35
wind	weak-moderate
temp (^{O}C)	18.5-8.8
clouds/precipitatio	full-moderate/occasionally weak rain-no

census point	BГ01						BГ02						BГ03					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					3													
20:00 - 20:59			7		1	1		1	11			1			3		1	
21:00 - 21:59			5		3	1		6	9		7	2		1	6		2	
22:00 - 22:59		2	5			3			4			2			6		2	1
23:00 - 23:59			3						1		1	1			3			1
00:00 - 00:59	1	1	3						3						3			
01:00 - 01:59			2												2			
02:00 - 02:59															3			1
03:00 - 03:59			1												1			
04:00 - 04:59															1			
05:00 - 05:59																		
06:00 - 06:59																		
Total per group	1	3	26	0	7	5	0	7	28	0	8	6	0	1	28	0	5	3
Total contacts	42						49						37					
Duration	10.07						10.07						10.07					
Activity index	4.17						4.87						3.68					

census point	BГ04						BГ05					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59											1	
20:00 - 20:59			5					2	8		1	3
21:00 - 21:59			11		3	2		2	8	1	2	
22:00 - 22:59			1			2		1	5		2	3
23:00 - 23:59			3				1	1	2			
00:00 - 00:59			1				1		1			
01:00 - 01:59							1		1			
02:00 - 02:59									1			
03:00 - 03:59												
04:00 - 04:59			1									
05:00 - 05:59												
06:00 - 06:59												
Total per group	0	0	22	0	3	4	3	6	26	1	6	6
Total contacts	29						48					
Duration	10.07						10.07					
Activity index	2.88						4.77					

census point	BГ06						BГ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					2							
20:00 - 20:59		1	3	1	3	5			3		1	
21:00 - 21:59		2	6	1	3	2			2			
22:00 - 22:59			3						2			
23:00 - 23:59		1						1				
00:00 - 00:59			4			1			2			
01:00 - 01:59			1		1				2			
02:00 - 02:59		1	1				1		1			
03:00 - 03:59		1	1						1			
04:00 - 04:59			1									
05:00 - 05:59												
06:00 - 06:59												
Total per group	0	6	20	2	9	8	1	1	13	0	1	0
Total contacts	45						16					
Duration	10.07						10.07					
Activity index	4.47						1.59					

date	25/26. April																							
time	19:32-05:34																							
wind	weak-no																							
temp (^{O}C)	13.4-5.4																							
clouds/precipitatio	clear-low/no																							
census point	K1						K2						K3						K4					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					21			3			21						362						21	
20:00 - 20:59		1	13		5			6	12	1	5	4			8		72				9		4	1
21:00 - 21:59		1	1		2				13			1			5		2				3		1	
22:00 - 22:59			1					1	8								2				1		4	
23:00 - 23:59			3		2			2	6												4		1	
00:00 - 00:59			2		1			2	8			1					1				2		2	1
01:00 - 01:59			3		1			1	7	1											1			
02:00 - 02:59									5			1									1			
03:00 - 03:59								3	4			2									2		1	
04:00 - 04:59					1				5		6	3											69	
05:00 - 05:59					1						4												334	
06:00 - 06:59																								
Total per group	0	2	23	0	34	0	0	18	68	2	36	12	0	0	13	0	439	0	0	0	23	0	437	2
Total contacts	59						136						452						426					
Duration	10.3						10.3						10.03						10.3					
Activity index	5.88						13.55						45.05						46.05					

census point	K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					18						236						3	
20:00 - 20:59			6		51				14		247	1			13		12	2
21:00 - 21:59			7						2		10			1	14		3	
22:00 - 22:59			3						4		4				1		3	
23:00 - 23:59			1					2	3		2				1		1	
00:00 - 00:59			2		2				3					1	1		2	
01:00 - 01:59			3						2		2							
02:00 - 02:59									2					1	1			1
03:00 - 03:59			1						2		1				1			
04:00 - 04:59			1		87						108						1	
05:00 - 05:59					51						158							
06:00 - 06:59																		
Total per group	0	0	24	0	209	0	0	2	32	0	768	1	0	3	32	0	25	3
Total contacts	233						803						63					
Duration	10.3						10.3						10.03					
Activity index	23.22						80.03						6.28					

date	26/27. April																	
time																		
wind																		
temp (°C)																		
clouds/precipitation																		
census point	BΓ15						BΓ16						BΓ17					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
19:00 - 19:59					4						69						13	
20:00 - 20:59		2	15	1	6	5		5	9		3	1			3		18	1
21:00 - 21:59			3		9			1	9		5	1			3		2	
22:00 - 22:59		4	16		9			5	12		2	2			3		5	
23:00 - 23:59			6		5				8		1	1			3		5	
00:00 - 00:59			4		4	1		1	2		1	3					2	
01:00 - 01:59					2				2					2			1	1
02:00 - 02:59			1		1			1	1									
03:00 - 03:59									3						1			
04:00 - 04:59								1							1		11	
05:00 - 05:59																	3	
06:00 - 06:59																		
Total per group	0	6	45	1	40	6	0	14	46	0	81	8	0	2	14	0	60	2
Total contacts	98						149						78					
Duration	9.98						9.98						9.98					
Activity index	9.82						14.92						7.81					

census point	BΓ18						BΓ19						BΓ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
19:00 - 19:59					27						53			1				
20:00 - 20:59			30		16	11		3	11		9	2		1	21		8	2
21:00 - 21:59			3						3		6							
22:00 - 22:59			2					3	5		7	2			2			
23:00 - 23:59			3		3				2		5				1			
00:00 - 00:59			10		2				2		4						1	
01:00 - 01:59			3						2		6						3	2
02:00 - 02:59			3		1				1		1	1			2			
03:00 - 03:59			2					1	2		2	1			1			
04:00 - 04:59			3		11			1	1		1				1			
05:00 - 05:59					3						2							
06:00 - 06:59																		
Total per group	0	0	59	0	63	11	0	8	29	0	96	6	0	2	28	0	12	4
Total contacts	133						139						46					
Duration	9.98						9.98						9.93					
Activity index	13.32						13.92						4.63					

May

date	13/14. May
time	19:54-05:09
wind	weak
temp (°C)	24.7-14.5
clouds/precipitatio	clear-mostly/no

census point	BΓ01						BΓ02						BΓ03						BΓ04					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59																								
20:00 - 20:59									5						1						1			
21:00 - 21:59			1				1		6					3				2			1		1	
22:00 - 22:59									2			2		17	1			2						
23:00 - 23:59		1	3		1				2					3	1		3							
00:00 - 00:59			2					1	4					3	3		1				3			
01:00 - 01:59									1						1						1			
02:00 - 02:59			3			1		1	5						5		1							
03:00 - 03:59			2		2				3			1			2			1			4			1
04:00 - 04:59			1																		2			1
05:00 - 05:59																								
06:00 - 06:59																								
Total per group	0	1	12	0	3	1	1	2	28	0	0	3	0	26	14	0	5	5	0	0	12	0	1	2
Total contacts	17						34						50						15					
Duration	9.25						9.25						9.25						9.25					
Activity index	1.84						3.68						5.41						1.62					

census point	BΓ05						BΓ06						BΓ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59																		
20:00 - 20:59									4						1		2	
21:00 - 21:59			1								2				1			
22:00 - 22:59									1									
23:00 - 23:59									1						3		1	
00:00 - 00:59			2		1	1		2	12			5			4		2	
01:00 - 01:59			1												3			
02:00 - 02:59						1									6		1	1
03:00 - 03:59			4		3				3		2				3			
04:00 - 04:59					2												1	
05:00 - 05:59																		
06:00 - 06:59																		
Total per group	0	0	8	0	6	2	0	2	21	0	4	5	0	0	21	0	7	1
Total contacts	16						32						29					
Duration	9.25						9.25						9.25					
Activity index	1.73						3.46						3.14					

date	14/15. May																																									
time	19:55-05:08																																									
wind	weak																																									
temp (°C)	18.5-11.0																																									
clouds/precipitatio	moderate-low/occasionally rain																																									
census point	K1						K2						K3						K4						K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59																							1						2													
20:00 - 20:59			31		11			1	39		70	8			6		504	2			6	5	117	6	1		8	0	50				52	2	30				2		9	1
21:00 - 21:59		2			9			1	16		6				4		104				8	1	20	3			2		9			1	14		5	1		3	5		3	
22:00 - 22:59			1														2										1															
23:00 - 23:59																																										
00:00 - 00:59																																										
01:00 - 01:59																																										
02:00 - 02:59											1	1																														
03:00 - 03:59									1																																	
04:00 - 04:59											16	1																														
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	0	2	32	0	20	0	0	2	56	0	93	10	0	0	10	0	610	2	0	0	14	6	138	9	1	0	11	0	61	0	0	1	66	2	35	1	0	3	7	0	12	1
Total contacts	54						161						622						167						73						105						23					
Duration	9.22						9.22						9.22						9.22						9.22						9.22						9.22					
Activity index	5.86						17.47						67.49						18.12						7.92						11.39						2.50					

date	19/20. May																																									
time	20:01-05:03																																									
wind	weak																																									
temp (^{O}C)	22.4-16.5																																									
clouds/precipitatio	moderate-mostly/very weak rain																																									
census point	БГ08						БГ09						БГ10						БГ11						БГ12						БГ13						БГ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59			7						2		3				11		12				2			2					3						4	1						
21:00 - 21:59			4		1	2			2						23		2	2			5						30			6		2	8	1		2			1			1
22:00 - 22:59			4								2			1	21			1			1		1	1			47			14		5	77			21						
23:00 - 23:59									4						3		2													1			7			2						
00:00 - 00:59			2			2			1						4		1	1															2		1							
01:00 - 01:59			1												1		1				2						10			2			5		1	1					1	
02:00 - 02:59			6			3		1	3					1	10		2						1				35			12	4				1				2			
03:00 - 03:59			4		1				1						7												1															
04:00 - 04:59			3												3																		1		1							
05:00 - 05:59																																										
Total per group	0	0	31	0	2	7	0	1	13	0	5	0	0	2	83	0	20	4	0	0	10	0	2	3	0	0	123	0	3	35	4	7	100	1	8	27	0	0	3	0	1	1
Total contacts	40						19						109						15						161						147						5					
Duration	9.03						9.03						9.03						9.03						9.03						9.03						9.03					
Activity index	4.43						2.10						12.07						1.66						17.82						16.27						0.55					

date	23/24. May																																			
time	20:05-04:59																																			
wind	weak																																			
temp (°C)	20.7-15.1																																			
clouds/precipitatio	low-moderateo/no																																			
census point	BΓ15						BΓ16						BΓ17						BΓ18						BΓ19						BΓ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
20:00 - 20:59					2				2						1		2				1		39	3					7	1			1		4	
21:00 - 21:59			1		2				1						1		2				3		1				3		2						5	
22:00 - 22:59			1								1				1		1						2										2			1
23:00 - 23:59			1						1		1				1		1												3						1	
00:00 - 00:59															2		1												4				1		1	
01:00 - 01:59									2																		5								1	4
02:00 - 02:59			3		4				1		2																					1	1		5	
03:00 - 03:59		1	2						4			1			2		1																1			2
04:00 - 04:59																	9						5												3	
Total per group	0	1	8	0	8	0	0	0	11	0	4	1	0	0	8	0	17	0	0	0	4	0	47	3	0	0	8	0	16	1	0	1	6	0	20	7
Total contacts	17						16						25						54						25						34					
Duration	8.90						8.90						8.90						8.90						8.90						8.90					
Activity index	1.91						1.80						2.81						6.07						2.81						3.82					

June

date	8/9. June																																									
time	20:19-04:50																																									
wind	weak																																									
temp (^{O}C)	18.6-13.3																																									
clouds/precipitatio	low-moderateo/no																																									
census point	K1						K2						K3						K4						K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59					24						16	1					67					1	7				1		54						18						5	
21:00 - 21:59			2		3				5		1				1		9				16		9	4	1		2		7				3		4				6		1	
22:00 - 22:59						1			3		1	2					3				1		4				1		5				3						3			
23:00 - 23:59									1			3					2	1									1						1						2		3	
00:00 - 00:59					1				2		2	1					1																1					1	1			1
01:00 - 01:59									1		4	2															1						1						2			
02:00 - 02:59												1																											2			
03:00 - 03:59								2	1		2	1															2								1						1	
04:00 - 04:59					28						25																		10						6						7	
	0	0	2	0	56	1	0	2	13	0	51	11	0	0	1	0	82	1	0	0	17	1	20	4	1	0	8	0	76	0	0	0	9	0	29	0	0	1	16	0	17	1
Total contacts	59						77						84						42						85						38						35					
Duration	8.52						8.52						8.52						8.52						8.52						8.52						8.52					
Activity index	6.93						9.04						9.86						4.93						9.98						4.46						4.11					

date	11/12. June
time	20:20-04:49
wind	weak
temp (ºC)	21.3-15.2
clouds/precipitatio	low-clear/no

census point	BГ01						BГ02						BГ03						BГ04						BГ05						BГ06						BГ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59			1		11	1											1						4												1							
21:00 - 21:59			5		8	4						2			4		2				5		1				3		2			1	9	1	1	2			10		9	2
22:00 - 22:59			1								1				3		1				5						2		2				8						7	2	7	8
23:00 - 23:59			1		1				1						3												1						1						2			
00:00 - 00:59			1						1						1						4												2						3		1	
01:00 - 01:59												1			1																		3						1		2	
02:00 - 02:59																					3												16			1						
03:00 - 03:59																					1												14			4						
04:00 - 04:59																																										
Total per group	0	0	9	0	20	5	0	0	2	0	1	3	0	0	12	0	4	0	0	0	18	0	5	0	0	0	6	0	4	0	0	1	53	1	2	7	0	0	23	2	19	10
Total contacts	34						6						16						23						10						64						54					
Duration	8.48						8.48						8.48						8.48						8.48						8.48						8.48					
Activity index	4.01						0.71						1.89						2.71						1.18						7.54						6.37					

date	13/14. June																																									
time	20:21-04:49																																									
wind	weak																																									
temp (^{O}C)	23.4-16.3																																									
clouds/precipitatio	low-clear/no																																									
census point	BГ08						BГ09						BГ10						BГ11						BГ12						BГ13						BГ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59					1												1						4	2																		
21:00 - 21:59			19		2	3					2			1	13		1	2		1	10			6			1						2			1					1	
22:00 - 22:59			4		3										2		1																									
23:00 - 23:59			8					1	1								2							1																		
00:00 - 00:59					2				1												2		2	2			1															
01:00 - 01:59			1												1																											
02:00 - 02:59			2												3																		1		1							1
03:00 - 03:59			5		2	1									1						2		1	1																		
04:00 - 04:59																	1																									
Total per group	0	0	39	0	10	4	0	1	2	0	2	0	0	1	20	0	6	2	0	1	14	0	7	12	0	0	2	0	0	0	0	0	3	0	1	1	0	0	0	0	1	1
Total contacts	53						5						29						34						2						5						2					
Duration	8.47						8.47						8.47						8.47						8.47						8.47						8.47					
Activity index	6.26						0.59						3.43						4.02						0.24						0.59						0.24					

date	24/25. June																																			
time	20:25-04:51																																			
wind	weak																																			
temp (ºC)	12.5-11.4																																			
clouds/precipitatio	full-mostly/weak rain in the evening																																			
census point	ВГ15						ВГ16						ВГ17						ВГ18						ВГ19						ВГ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
20:00 - 20:59																																				
21:00 - 21:59																																				
22:00 - 22:59																																				
23:00 - 23:59																																				
00:00 - 00:59																																				
01:00 - 01:59																																				
02:00 - 02:59																																				
03:00 - 03:59																																				
04:00 - 04:59																																				
Total per group	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	0	0	0	0	0	0	0	0	0	0	0
Total contacts	0						0						0						0						0						0					
Duration	8.43						8.43						8.43						8.43						8.43						8.43					
Activity index	0.00						0.00						0.00						0.00						0.00						0					

July

date	15/16. July																																									
time	20:18-05:04																																									
wind	no-weak																																									
temp (^{O}C)	22.4-14.6																																									
clouds/precipitatio	low-clear/no																																									
census point	K1						K2						K3						K4						K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59																					1														5							
21:00 - 21:59			1									1						1			10	1	7	4		1	8		2			1			2	2			2			1
22:00 - 22:59		1	3						1		1	2			1			2			2	1	2	3		1	7	1		1			1			1			5			
23:00 - 23:59			1						1			3									1			6			1												4			2
00:00 - 00:59			1						2												6		6	4																		
01:00 - 01:59			1						2			1				1					1		11	1			1								1	1			1			
02:00 - 02:59												3									2		2	2			1						1									
03:00 - 03:59			1						2			2			1						5		4	1									1		2							1
04:00 - 04:59					7						2						7						17		1				18				2		2						4	
05:00 - 05:59																																										
Total per group	0	1	8	0	7		0	0	8	0	3	12	0	0	2	1	7	3	0	0	28	2	49	21	1	2	18	1	20	1	0	1	5	0	12	4	0	0	12	0	4	4
Total contacts	17						23						13						100						43						22						20					
Duration	8.77						8.77						8.77						8.77						8.77						8.77						8.77					
Activity index	1.94						2.62						1.48						11.41						4.90						2.51						2.28					

date	16/17. July																																			
time	20:18-05:05																																			
wind	weak-no																																			
temp (ºC)	23.6-19.3																																			
clouds/precipitatio	clear-low/no																																			
census point	BГ15						BГ16						BГ17						BГ18						BГ19						BГ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
20:00 - 20:59																							1													
21:00 - 21:59			3			1			3			1			1						1		1							1						
22:00 - 22:59															1						1			2			2									
23:00 - 23:59			1																		2		1	1									2			1
00:00 - 00:59			1		1																1			1					1				1			
01:00 - 01:59			3																		1	1		1					1				2			
02:00 - 02:59			1																		3						1								1	
03:00 - 03:59			1		1							1						1			4			1										1		
04:00 - 04:59						1															1		6	1												
05:00 - 05:59																																				
Total per group	0	0	10	0	2	2	0	0	3	0	0	2	0	0	2	0	0	1	0	0	14	1	9	7	0	0	3	0	2	1	0	0	5	1	1	1
Total contacts	14						5						3						31						6						8					
Duration	8.78						8.78						8.78						8.78						8.78						8.78					
Activity index	1.59						0.57						0.34						3.53						0.68						0.91					

date	21/22. July
time	20:14-05:10
wind	weak
temp (⁰C)	23.4-16.3
clouds/precipitatio	low-clear/no

census point	BГ08						BГ09						BГ10						BГ11						BГ12						BГ13						BГ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59															1		1												1													
21:00 - 21:59			3		1	1			5			2						2			14		2	1									2			1						
22:00 - 22:59			2		2				5			1					1	1			1									1			1			1						1
23:00 - 23:59			1						2			1								1	1																					
00:00 - 00:59			8	1				1	3			1			1						2												1									1
01:00 - 01:59			2						1			4			1		1	1			6			2									2			1			6			6
02:00 - 02:59			17									1			2			3			7		1	2						1						1			1			
03:00 - 03:59			7			3			4			1			2						1																					1
04:00 - 04:59			3		1																														1				1			
05:00 - 05:59																																										
Total per group	0	0	43	1	4	4	0	1	20	0	0	11	0	0	7	0	3	7	0	1	32	0	3	5	0	0	0	0	1	2	0	0	6	0	1	4	0	0	8	0	0	9
Total contacts	52						32						17						41						3						11						17					
Duration	8.93						8.93						8.93						8.93						8.93						8.93						8.93					
Activity index	5.82						3.58						1.90						4.59						0.34						1.23						1.90					

date	22/23. July
time	20:13-05:11
wind	weak
temp (ºC)	29.4-23.5
clouds/precipitatio	low/no

census point	BГ01						BГ02						BГ03						BГ04						BГ05						BГ06						BГ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
20:00 - 20:59																														1												
21:00 - 21:59			2		1	1								1	1						6		2	1			4		1	9						5			1		2	
22:00 - 22:59			1						1					1	2						3						2									2			1			
23:00 - 23:59			2									1			1		1							1			1									2						
00:00 - 00:59			3			1								2	227			19									2		1	1			2						1			
01:00 - 01:59			1			1			1						129			9			2						2		1				1			1			4			
02:00 - 02:59			5											1		1		1			1									1						5						
03:00 - 03:59														1																												
04:00 - 04:59																																										
05:00 - 05:59																																										
Total per group	0	0	14	0	1	3	0	0	2	0	0	1	0	6	360	1	1	29	0	0	12	0	2	2	0	0	11	0	3	12	0	0	3	0	0	15	0	0	7	0	2	0
Total contacts	18						3						397						16						26						18						9					
Duration	8.97						8.97						8.97						8.97						8.97						8.97						8.97					
Activity index	2.01						0.33						44.28						1.78						2.90						2.01						1.00					

August

date	11/12. August																																									
time	19:48-05:48																																									
wind	weak-no																																									
temp (^{O}C)	23.6-20.6																																									
clouds/precipitatio	low/no																																									
census point	K1						K2						K3						K4						K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59																																										
20:00 - 20:59					2	1					3	4									7		14	3			3		2	1			1		1				4		4	1
21:00 - 21:59												5			2			1			6		14	2			3		5				1		2				13		9	
22:00 - 22:59											1	4					1	1			3		37	7					2						1				21		25	1
23:00 - 23:59		1	1		1							1									3		18	2			2		2	1			2		2	1			6		2	
00:00 - 00:59			1	1	2				1					1	1						2		6				4		1						1				17		3	
01:00 - 01:59			2															2			3		6	1		1	1		2				1		2				7		1	1
02:00 - 02:59			1									3			1						1		8	3			2		2										4			1
03:00 - 03:59			1						1						1						2		4	1			1		1				1						4		1	
04:00 - 04:59			1		2				2						2		2				2		35	2			1						2		5				2		1	
05:00 - 05:59					1																		11												8						1	
Total per group	0	1	7	1	8	1	0	0	4	0	4	17	0	1	7	0	3	4	0	0	29	0	153	21	0	1	17	0	17	2	0	0	8	0	22	1	0	0	78	0	47	4
Total contacts	18						25						15						203						37						31						129					
Duration	9.77						9.77						9.77						9.77						9.77						9.77						9.77					
Activity index	1.84						2.56						1.54												3.79						3.17						13.21					

date	14/15. August																														29/30. August 2015.					
time	19:43-05:37																														19:18-05:55					
wind	weak																														weak					
temp (°C)	29.8-22.5																														24.3-19.1					
clouds/precipitatio	low-clear/no																														low-clear/no					
census point	BΓ15						BΓ16						BΓ17						BΓ18						BΓ19						BΓ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
19:00 - 19:59																																1				1
20:00 - 20:59			2		2	1		1			6	2					5	1					4						4			1	2		7	1
21:00 - 21:59			1		3				1		2				2		6	1					6				1		7				6		16	
22:00 - 22:59					5	1			2	1	1	1					1				1		1	1									3	1	28	
23:00 - 23:59					3						1			1			3				1		2			1			1	1			2		39	
00:00 - 00:59			2		5				1		1						2				1								1	1			6		13	
01:00 - 01:59			2		1				1	1	1												4	1					1	1			2		10	1
02:00 - 02:59			1		2						1	1																		1		1	2		5	
03:00 - 03:59					1						1												1				1			1			3		7	
04:00 - 04:59																	2																2			
05:00 - 05:59																																	1			
Total per group	0	0	8	0	22	2	0	1	5	2	14	4	0	1	2	0	19	2	0	0	3	0	18	2	0	1	2	0	14	5	0	3	29	1	125	3
Total contacts	32						26						24						23						22						161					
Duration	9.90						9.90						9.90						9.90						9.90						10.62					
Activity index	3.23						2.63						2.42						2.32						2.22						10					

date	29/30. August																				
time	19:18-05:55																				
wind	weak																				
temp (°C)	24.3-19.1																				
clouds/precipitatio	low-clear/no																				
census point	BГ01						BГ02						BГ03								
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?			
19:00 - 19:59																					
20:00 - 20:59		1	1		5						1	2			3		1	2			
21:00 - 21:59		1	2		10	2			3		6						8				
22:00 - 22:59			2		5	1					4	3			1		6				
23:00 - 23:59			4		22	2			2		8	1			4		11	1			
00:00 - 00:59					13	1					6	3			1		14				
01:00 - 01:59					10	2		1	1		3	3			5		3	1			
02:00 - 02:59			3		6	2			2		4	1			2		2	1			
03:00 - 03:59			6		1				2		1						1	1			
04:00 - 04:59					1						1						1				
05:00 - 05:59																					
Total per group	0	2	18	0	73	10	0	1	10	0	34	13	0	0	16	0	47	6			
Total contacts	103						58						69								
Duration	10.62						10.62						10.62								
Activity index	9.70						5.64						6.50								

census point	BГ04						BГ05						BГ06						BГ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59									3								1							
20:00 - 20:59	1		1		6				2		2				7		1				9		1	
21:00 - 21:59			4		14				2		1			1	4		7			1	5		7	1
22:00 - 22:59			3		20				4		7	2			5		29	1			6		12	
23:00 - 23:59			6		19				1		17				8		33				6		8	
00:00 - 00:59			10		13				3		9				8		15				5		13	
01:00 - 01:59			4		5				3		5	1			9		6	2			4		7	
02:00 - 02:59			5		3				1	1	5				14		10	1			1		6	
03:00 - 03:59			4		3			1	1		1				6		5	1			2		1	
04:00 - 04:59			2												1		5						1	
05:00 - 05:59					1						3				1									
Total per group	1	0	39	0	84	0	0	1	20	1	50	3	0	1	63	0	112	5	0	1	38	0	56	1
Total contacts	124						75						181						96					
Duration	10.62						10.62						10.62						10.62					
Activity index	11.68						7.06						17.05						9.04					

date	30/31. August 2015
time	19:17-05:56
wind	weak
temp (°C)	22.3-23.4
clouds/precipitatio	clear/no

census point	BГ08						BГ09						BГ10					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59											1						1	
20:00 - 20:59			1		4				2		7	2			5		31	2
21:00 - 21:59									3		1	1					21	1
22:00 - 22:59					1				1		1				1		2	
23:00 - 23:59			2						1								5	
00:00 - 00:59									1		1						1	
01:00 - 01:59					1						2				1		1	
02:00 - 02:59									1						2			1
03:00 - 03:59					1						1			1	1			
04:00 - 04:59			1						1									
05:00 - 05:59																		
Total per group	0	0	4	0	7	0	0	0	10	0	14	3	0	1	10	0	62	4
Total contacts	11						27						77					
Duration	10.65						10.65						10.65					
Activity index	1.03						2.54						7.23					

census point	BГ11						BГ12					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59					1							
20:00 - 20:59			1		13						4	1
21:00 - 21:59		1	2		11						8	1
22:00 - 22:59					6						3	
23:00 - 23:59					1	1					1	1
00:00 - 00:59			2		2	1			1		2	
01:00 - 01:59												
02:00 - 02:59					2							
03:00 - 03:59						1						
04:00 - 04:59												1
05:00 - 05:59												
Total per group	0	1	5	0	36	3	0	0	1	0	18	4
Total contacts	45						23					
Duration	10.65						10.65					
Activity index	4.23						2.16					

census point	BГ13						BГ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59			1									
20:00 - 20:59			6		9	1					1	
21:00 - 21:59					6							1
22:00 - 22:59			1		2	1						1
23:00 - 23:59		1			2	2					1	
00:00 - 00:59						1					3	1
01:00 - 01:59						1						
02:00 - 02:59			1		1							
03:00 - 03:59			1									1
04:00 - 04:59			3			1						
05:00 - 05:59												
Total per group	0	1	13	0	20	7	0	0	0	0	5	4
Total contacts	41						9					
Duration	10.65						10.65					
Activity index	3.85						0.85					

September

date	7/8. September	21/22. September
time	19:02-06:05	18:36-06:22
wind	weak	слаб
temp (^{O}C)	11.2-8.7	17.5-11.1
clouds/precipitatio	low/no	moderate-mostly/no

census point	K1						K3						K4						K5					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59			3						6		1				19		6	1			3		1	
20:00 - 20:59					2			1	5		1				7		5	1			2			
21:00 - 21:59									1		1				3		14				1		2	
22:00 - 22:59								1			2						6				1			
23:00 - 23:59					3			1							1		1							
00:00 - 00:59						1		1									3							
01:00 - 01:59			1														2							
02:00 - 02:59																								
03:00 - 03:59																								
04:00 - 04:59																								
05:00 - 05:59			1																					
06:00 - 06:59																								
Total per group	0	0	5	0	5	1	0	4	12	0	5	0	0	0	30	0	37	2	0	0	7	0	3	0
Total contacts	11						21						69						10					
Duration	11.05						11.05						11.05						11.05					
Activity index	1.00						1.90						6.24						0.90					

census point	K6						K7						K2					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
19:00 - 19:59			3		2				4						5			
20:00 - 20:59			2		2				1		2				5			
21:00 - 21:59			1		2				3									
22:00 - 22:59			2		2				1					3	1			
23:00 - 23:59					3										1		6	1
00:00 - 00:59																	5	
01:00 - 01:59															2		2	1
02:00 - 02:59												1					2	
03:00 - 03:59									1						3			
04:00 - 04:59																		
05:00 - 05:59																	2	
06:00 - 06:59																		
Total per group	0	0	8	0	11	0	0	0	10	0	2	1	0	3	17	0	20	2
Total contacts	19						13						42					
Duration	11.05						11.05						11.77					
Activity index	1.72						1.18						3.57					

date	21/22. September																														22/23. August					
time	18:36-06:22																														18:34-06:23					
wind	weak																														weak-moderate					
temp (^{O}C)	17.5-11.1																														18.6-16.1					
clouds/precipitatio	moderateo-mostly/no																														low/no					
census point	BГ15						BГ16						BГ17						BГ18						BГ19						BГ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
18:00 - 18:59																							1						2						11	
19:00 - 19:59														2	2		1				1								5				2		3	2
20:00 - 20:59									1						3									1			2						1		2	
21:00 - 21:59			1		1				1					1			1				2		1												2	
22:00 - 22:59			1		1				1					2			3				2						2		2							
23:00 - 23:59					3				2		1						1						2				1		2				3		2	
00:00 - 00:59			1		3				1		1						3						4				1		3				1		1	1
01:00 - 01:59											1				1		1				1		3						2							
02:00 - 02:59			2		1				1			1			2		1				2		2				1								1	
03:00 - 03:59												1					1						1													
04:00 - 04:59					2																												1			
05:00 - 05:59																											1									
06:00 - 06:59																																				
Total per group	0	0	5	0	11	0	0	0	7	0	3	2	0	5	8	0	12	0	0	0	8	0	14	1	0	0	8	0	16	0	0	0	8	0	22	3
Total contacts	16						12						25						23						24						33					
Duration	11.77						11.77						11.77						11.77						11.77						11.82					
Activity index	1.36						1.02						2.12						1.95						2.04						2.79					

date	22/23. September																																									
time	18:34-06:23																																									
wind	weak-moderate																																									
temp (°C)	18.6-16.1																																									
clouds/precipitatio	low/no																																									
census point	BГ08						BГ09						BГ10						BГ11						BГ12						BГ13						BГ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
18:00 - 18:59																				1			1												4							
19:00 - 19:59					1						2				1		7						1						2						5						2	
20:00 - 20:59			1		3				1		4						2																									
21:00 - 21:59					1	1											1																								1	
22:00 - 22:59																							1																			1
23:00 - 23:59																																			1							
00:00 - 00:59			1			1																														1						
01:00 - 01:59								1				1																	1						1							
02:00 - 02:59																	1													1			2		1				1			
03:00 - 03:59									1																																	
04:00 - 04:59			1									1																														
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	0	0	3	0	5	2	0	1	2	0	6	2	0	0	1	0	11	0	0	1	0	0	3	0	0	0	0	0	3	1	0	0	2	0	12	1	0	0	1	0	3	1
Total contacts	10						11						12						4						4						15						5					
Duration	11.82						11.82						11.82						11.82						11.82						11.82						11.82					
Activity index	0.85						0.93						1.02						0.34						0.34						1.27						0.42					

date	23/24. September																																									
time	18:32-06:23																																									
wind	weak																																									
temp (^{O}C)	22.8-16.6																																									
clouds/precipitatio	clear-low/no																																									
census point	BГ01						BГ02						BГ03						BГ04						BГ05						BГ06						BГ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
18:00 - 18:59																																										
19:00 - 19:59	1		2														2						3	1					12	2					3				1		4	
20:00 - 20:59																		1		1	1		2	1			2		4				1		3				3		1	
21:00 - 21:59																	2						2	1			2		2			1			1				3		3	
22:00 - 22:59					1										1			1			2		1						3				2		1						3	
23:00 - 23:59			1		1						1									1	1								4				2									
00:00 - 00:59			1		1	2					1				1						1														1				2		1	
01:00 - 01:59			1						1												2												1						2			
02:00 - 02:59		1	1						1																					1						1						
03:00 - 03:59						1					2																								1	1						
04:00 - 04:59																	1																								1	
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	1	1	6	0	3	3	0	0	2	0	4	0	0	0	2	0	5	2	0	2	7	0	8	3	0	0	4	0	25	3	0	1	6	0	10	2	0	0	11	0	13	0
Total contacts	14						6						9						20						32						19						24					
Duration	11.85						11.85						11.85						11.85						11.85						11.85						11.85					
Activity index	1.18						0.51						0.76						1.69						2.70						1.60						2.03					

October

date	18/19. October
time	17:46-06:55
wind	weak
temp (°C)	14.1-10.7
clouds/precipitatio	moderate-mostly/weak rain before dawn

census point	K1						K2						K3						K4					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
17:00 - 17:59																								
18:00 - 18:59			4		2						5				1		6				3		21	
19:00 - 19:59			2			1					1				1								1	
20:00 - 20:59									1		1				1		2				1			
21:00 - 21:59																	1							
22:00 - 22:59			2														2							
23:00 - 23:59						1																		
00:00 - 00:59																								
01:00 - 01:59																							1	
02:00 - 02:59																								
03:00 - 03:59																								
04:00 - 04:59			1																					
05:00 - 05:59																								
06:00 - 06:59																								
Total per group	0	0	9	0	2	2	0	0	1	0	7	0	0	0	3	0	11	0	0	0	4	0	23	0
Total contacts	13						8						14						27					
Duration	13.15						13.15						13.15						13.15					
Activity index	0.99						0.61						1.06						2.05					

census point	K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
17:00 - 17:59																		
18:00 - 18:59			2		3	1			3		1				9		3	
19:00 - 19:59			3						1								2	
20:00 - 20:59											1				1			
21:00 - 21:59			1														1	
22:00 - 22:59					2	1												
23:00 - 23:59																		
00:00 - 00:59																		
01:00 - 01:59																		
02:00 - 02:59																		
03:00 - 03:59																		
04:00 - 04:59																		
05:00 - 05:59																		
06:00 - 06:59																		
Total per group	0	0	6	0	5	2	0	0	4	0	2	0	0	0	10	0	6	0
Total contacts	13						6						16					
Duration	13.15						13.15						13.15					
Activity index	0.99						0.46						1.22					

date	21/22. October																																			
time	17:42-06:59																																			
wind	weak																																			
temp (^{O}C)	10.3-7.4																																			
clouds/precipitatio	overcast/fog																																			
census point	BΓ15						BΓ16						BΓ17						BΓ18						BΓ19						BΓ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
17:00 - 17:59																																				
18:00 - 18:59																																				
19:00 - 19:59																																				
20:00 - 20:59																													1							
21:00 - 21:59																																				
22:00 - 22:59																																				
23:00 - 23:59																							1						2							
00:00 - 00:59																																				
01:00 - 01:59																	2												1							
02:00 - 02:59					1																												1			
03:00 - 03:59											1																									
04:00 - 04:59																																				
05:00 - 05:59																																				
06:00 - 06:59																																				
Total per group	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0	1	0	0	0
Total contacts	1						1						2						1						4						1					
Duration	13.28						13.28						13.28						13.28						13.28						13.28					
Activity index	0.08						0.08						0.15						0.08						0.30						0.08					

date	23/24. October
time	17:38-07:02
wind	weak
temp (⁰C)	10.6-5.4
clouds/precipitatio	low/fog

census point	BГ01					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ02					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ03					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ04					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ05					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ06					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59						
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	0	0
Total contacts	0					
Duration	13.40					
Activity index	0.00					

census point	BГ07					
group/interval	Rh	M	Pi	Es	Ny	?
17:00 - 17:59						
18:00 - 18:59					1	1
19:00 - 19:59						
20:00 - 20:59						
21:00 - 21:59						
22:00 - 22:59						
23:00 - 23:59						
00:00 - 00:59						
01:00 - 01:59						
02:00 - 02:59						
03:00 - 03:59						
04:00 - 04:59						
05:00 - 05:59						
06:00 - 06:59						
07:00 - 07:59						
Total per group	0	0	0	0	1	1
Total contacts	2					
Duration	13.40					
Activity index	0.15					

date	24/25. October																																									
time	17:37:06:03																																									
wind	no-weak																																									
temp (°C)	9.8- -2.5																																									
clouds/precipitatio	clear/no																																									
census point	BΓ08						BΓ09						BΓ10						BΓ11						BΓ12						BΓ13						BΓ14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
17:00 - 17:59																																										
18:00 - 18:59																																										
19:00 - 19:59						1																													2							
20:00 - 20:59			1								1																															
21:00 - 21:59					1	1																																				
22:00 - 22:59																																										
23:00 - 23:59																																										
00:00 - 00:59																																										
01:00 - 01:59																																										
02:00 - 02:59																																										
03:00 - 03:59																																										
04:00 - 04:59																																										
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	0	0	1	0	1	2	0	0	0	0	1	0	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	0	0	0	0	0
Total contacts	4						1						0						0						0						2						0					
Duration	12.43						12.43						12.43						12.43						12.43						12.43						12.43					
Activity index	0.32						0.08						0.00						0.00						0.00						0.16						0.00					

November

date	1/2. November																																									
time	16:25-06:14																																									
wind	weak-no																																									
temp (ºC)	9.3- -1.4																																									
clouds/precipitatio	clear/no																																									
census point	K1						K2						K3						K4						K5						K6						K7					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
16:00 - 16:59																																										
17:00 - 17:59																																										
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03:00 - 03:59																																										
04:00 - 04:59																																										
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total contacts	0						0						0						0						0						0						0					
Duration	13.82						13.82						13.82						13.82						13.82						13.82						13.82					
Activity index	0.00						0.00						0.00						0.00						0.00						0.00						0.00					

date	2/3. November																																			
time	16:23-06:15																																			
wind	no-weak																																			
temp (^{O}C)	10.1-0.6																																			
clouds/precipitatio	low/no																																			
census point	BΓ15						BΓ16						BΓ17						BΓ18						BΓ19						BΓ20					
group/interval	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?	Rh	My	Pi	Es	Ny	?
16:00 - 16:59																																				
17:00 - 17:59																	1				1		1										1			
18:00 - 18:59																																	1			
19:00 - 19:59															2						1					1										
20:00 - 20:59											1				1																					
21:00 - 21:59																																				
22:00 - 22:59																																				
23:00 - 23:59																																				
00:00 - 00:59																																				
01:00 - 01:59					1																															
02:00 - 02:59																																				
03:00 - 03:59																																				
04:00 - 04:59																																				
05:00 - 05:59																																				
06:00 - 06:59																																				
Total per group	0	0	0	0	1	0	0	0	0	0	1	0	0	0	3	0	1	0	0	0	2	0	1	0	0	1	0	0	0	0	0	0	2	0	0	0
Total contacts	1						1						4						3						1						2					
Duration	13.87						13.87						13.87						13.87						13.87						13.87					
Activity index	0.07						0.07						0.29						0.22						0.07						0.14					

date	3/4. November
time	16:22-06:16
wind	no-weak
temp (^{O}C)	9.4- -1.2
clouds/precipitatio	low-clear/no

census point	BΓ01						BΓ02						BΓ03						BΓ04						BΓ05						BΓ06						BΓ07					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
16:00 - 16:59																					1																					
17:00 - 17:59																																							1			
18:00 - 18:59																																										
19:00 - 19:59																																										
20:00 - 20:59																																										
21:00 - 21:59																																										
22:00 - 22:59																																										
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03:00 - 03:59																																										
04:00 - 04:59																																										
05:00 - 05:59																																										
06:00 - 06:59																																										
Total per group	0	0	0	0	0	0	0	0	0	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	0	0	0	0	1	0	0	0
Total contacts	0						0						0						1						0						0						1					
Duration	13.90						13.90						13.90						13.90						13.90						13.90						13.90					
Activity index	0.0						0.0						0.0						0.07						0.0						0.0						0.07					

date	4/5. November																	
time	16:21-06:18																	
wind	weak																	
temp (°C)	9.2- -1.4																	
clouds/precipitatio	clear/low fog in the morning																	
census point	VG08						VG09						VG10					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
16:00 - 16:59						1												
17:00 - 17:59			3		1				2									
18:00 - 18:59			1												3			
19:00 - 19:59			1												4			
20:00 - 20:59			2															
21:00 - 21:59																		
22:00 - 22:59																	1	
23:00 - 23:59																		
00:00 - 00:59																		
01:00 - 01:59																		
02:00 - 02:59																		
03:00 - 03:59			1															
04:00 - 04:59																		
05:00 - 05:59																		
06:00 - 06:59																		
Total per group	0	0	8	0	1	1	0	0	2	0	0	0	0	0	7	0	1	0
Total contacts	10						2						8					
Duration	13.95						13.95						13.95					
Activity index	0.72						0.14						0.57					

census point	VG11						VG12					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
16:00 - 16:59												
17:00 - 17:59												
18:00 - 18:59												
19:00 - 19:59												
20:00 - 20:59												
21:00 - 21:59												
22:00 - 22:59												
23:00 - 23:59												
00:00 - 00:59												
01:00 - 01:59												
02:00 - 02:59												
03:00 - 03:59												
04:00 - 04:59												
05:00 - 05:59												
06:00 - 06:59												
Total per group	0	0	0	0	0	0	0	0	0	0	0	0
Total contacts	0						0					
Duration	13.95						13.95					
Activity index	0.00						0.00					

census point	VG13						VG14					
group/interval	Rh	M	Pi	Es	Ny	?	Rh	M	Pi	Es	Ny	?
16:00 - 16:59												
17:00 - 17:59			2									
18:00 - 18:59												
19:00 - 19:59												1
20:00 - 20:59						2						
21:00 - 21:59												
22:00 - 22:59												
23:00 - 23:59												
00:00 - 00:59												
01:00 - 01:59												
02:00 - 02:59												
03:00 - 03:59												
04:00 - 04:59												
05:00 - 05:59												
06:00 - 06:59												
Total per group	0	0	2	0	0	2	0	0	0	0	0	1
Total contacts	4						1					
Duration	13.95						13.95					
Activity index	0.29						0.07					