Bat survey on the subalpine grasslands of Mt Varnous (Florina, Greece): preliminary results

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Summary

The area of Prespa in Greece includes two Natura 2000 sites, which constitute the National Park of Prespa since 2009. The Park is well known for its high diversity of wild flora and fauna. The number of mammal species increased by 43% in 14 years (1995-2009), mainly because of the increase in bat species recorded since 2000. Temperate bats are insectivores and therefore may be an important part of grassland wildlife, since grasslands support a significant insect fauna. We present the results of a preliminary bat survey on the subalpine grasslands of Mt Varnous at the ridges separating the Prespa basin from the basins of Florina and Pisoderi at an altitude of 2000 m, by means of echolocation call recordings. We found that these subalpine grasslands are used by at least five species: a) *Tadarida teniotis*, b) *Miniopterus schreibersii*, c) *Pipistrellus pipistrellus*, d) *Hypsugo savi*, and e) *P. nathusii* which are all protected by international and national legislation. Further research on bats in the wider study area is considered of fundamental importance. The results of this preliminary survey impose careful planning of any kind of investment projects in the area (e.g. wind-farms, ski centers), aiming at the reduction of impacts on bats, and therefore on the total biodiversity of Prespa.

Key words: echolocation, Prespa National Park, environmental impact assessments, monitoring

Introduction

The area of Prespa in Greece includes the Natura 2000 sites "Prespa National Forest" (code GR 1340001) and "Mt Varnous" (GR 1340003), which constitute the "Prespa National Park" since July 2009. The park covers the entire Greek part of the Prespa basin and together with the respective parts of the basin in Albania and FYROM form the Transboundary Prespa Park, which in 2000 was declared the first transboundary protected area in the Balkans. The area is well-known for its high biodiversity, including more than 1326 plant species and 260 bird species (Catsadorakis and Malakou 1997). The number of mammal species increased from 42 to more than 60 between 1995 and 2009, mainly because more bat species were recorded since 2000. In 1995, eight bat species were known in the area (Helversen and Weid 1990, Catsadorakis 1995), but their number increased to 25 after joint summer field surveys conducted by the Groupe Mammalogique Breton (GMB, France), the Society for the Protection of Prespa (SPP, Greece) and individual researchers (Annex 1), making the bat fauna of the area one of the richest in Greece with at least 15 species reproducing (Grémillet and Dubos 2008, Grémillet et al. 2010).

European bats feed on insects, thus playing a key role within ecosystems by regulating their populations. They use a great variety of habitats and are characterized by unique biological features and ecological requirements (Dietz et al. 2009). To orientate in their environment, bats use ultrasound (echolocation). Echolocation calls vary between species and therefore can be used to identify species through acoustic surveys, either by direct listening (Barataud 2004a, 2004b) or through recording and analysis of temporal and frequency parameters (Papadatou et al. 2008).

We present results of a preliminary acoustic field survey conducted in 2009 over two mountain ridges (1900-2000 m a.s.l.) in the NE border of Prespa National Park, Greece. Our aims were (a) to collect data on species presence and activity at these altitudes for the first time in the park, and (b) to identify species that could be affected by a wind-farm with 34 turbines planned to be established in the study area, because bats had been neglected during the compilation of the necessary pre-establishment environmental impact assessment study (ADK 2009-10). Important impacts on bats throughout Europe have been confirmed following assessments and monitoring at wind-farms, e.g. Germany (Bach 2001, Trapp et al. 2002, Brinkmann et al. 2006), France (Cosson 2004), Switzerland (Leuzinger et al. 2008) and Spain (Benzal and Moreno 2001, Lekuona 2001), as well as in the U.S. (e.g. Kunz et al. 2007). Dead bats at wind turbines have been reported for species that are also found in the National Park of Prespa, such as *Nyctalus leisleri*, *Eptesicus serotinus*, *Vespertilio murinus*, *Pipistrellus nathusii*, *P. pipistrellus*, *P. pygmaeus* and *Myotis myotis*. Therefore, setting up a wind-farm in the study area without care for bats might increase their mortality risk and threaten viable populations.

Materials and methods

Study area

Field work was conducted on 22 July 2009 at the location "Toumba-Anthovouni", in the area of "Bella Voda", Mt Varnous (Fig. 1).

Fig. 1. Location of Mt Varnous and the study area (source: Google Earth, 2010)

Research was focused on the north and east of the area, where wind turbines 1-18 are planned to be established (ADK 2009-10). Particular attention was paid to the northernmost

part of the area (wind turbines 1-8, Fig. 2), as this may be the most threatening for bats. Specifically, the following mountain ridges were surveyed:

a) The ridge on the northern part of the study area between the Prespa basin on the west and the Akritas-Florina basin on the east (*ca* 1900 m a.s.l.): *a priori*, this location is an interesting connection route for flying fauna (bats and birds). The western side of the mountain is dominated by *Nardus* grasslands with blueberries (*Vaccinium myrtilus*) at the highest parts of the valley of the Gaidouritsa tributary of Agios Germanos River, which outflows to Lake Megali Prespa. The eastern mountainside consists of a grassland patch on top of the ridge followed by a continuous patch of blueberry bushes and a young beech (*Fagus sylvatica*) wood; the valley leads to the village of Akritas and ends up to the plain of Florina.
b) The ridge between Prespa and Pisoderi-Florina (*ca.* 2000 m a.s.l.) basins, which has a northwest-southeast orientation and is dominated by *Nardus* grasslands, blueberries, rocky habitats and patches of beech and other trees (Fig. 2).

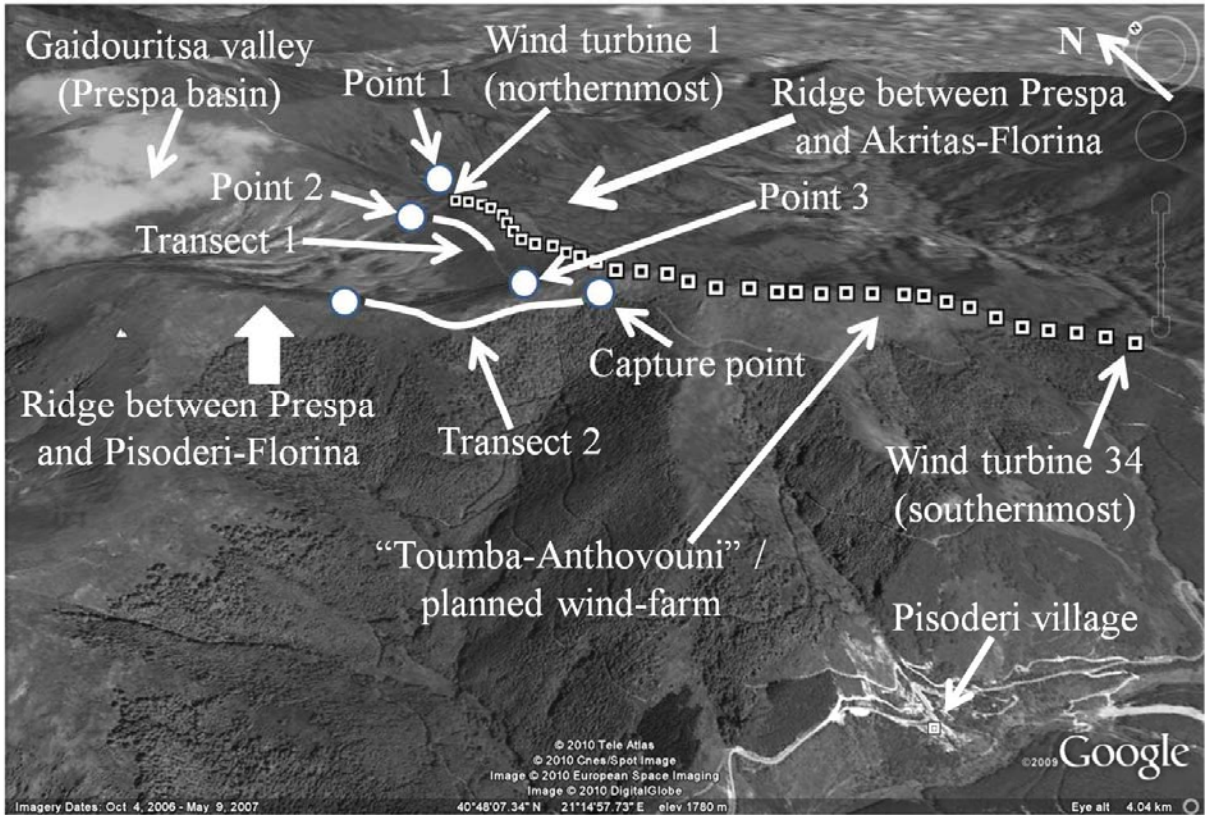

Fig. 2. Locations of sampling points and transects (source: Google Earth, 2010/ drawings – apart from wind turbine locations – are out of scale)

Field techniques and species identification

Two teams were placed each at a single ridge. The first team, at Prespa-Akritas ridge, comprised three observers each of which was equipped with an ultrasonic detector. Two heterodyne detectors (Pettersson D200; Batbox 3) primarily measured bat activity by scanning all frequencies from 10 to 60 kHz per minute and allowed identification of some species or groups of species. A time-expansion detector (Pettersson, D240X) combined with a recording device allowed for more precise species identification through analysis of echolocation calls using ultrasound analysis software (BatSound Pro) later on a computer. The survey was divided in three parts: (a) from sunset (21:19) until 21:55, the members of the team were placed at a line of *ca.* 100 m wide perpendicular to the slope, with equal distances between them, in the beech wood of the eastern mountainside, and performed point sampling

(Fig. 2, Point 1); (b) from 22:05 until 00:05, the observers performed point sampling forming a 50 m line, on the top of the ridge (Point 2); and (c) between 00:05 and 00:43, the observers were placed at a line of *ca*. 70 m wide and walked along a transect from Point 2 to the south (Fig. 2, Transect 1) of *ca.* 200 m through the grassland-blueberry habitat. The second team was placed at the Prespa-Pisoderi ridge into a zone comprising woods and open grasslands (Fig. 2). The ultrasonic detector used (Pettersson D1000X) recorded in real time while the user simulteneously listened to bats in frequency division (left ear), allowing the detection of bats at any frequency, and heterodyne mode (right ear), allowing a higher detectability over a limited window of *ca.* 10 kHz (40-50 kHz). From 21:30 until 00:00, the team walked along a transect of *ca.* 900 m (Fig. 2, Transect 2) from the road leading to the Vigla ski centre on the edge of the mixed beech-pine grove in the southeast (Fig. 2, Capture Point) to the grassland-blueberry habitat in the northwest. From 00:34 until 00:50, the team performed point sampling on the way from Pisoderi to Akritas ridge (Fig. 2, Point 3).

Results and discussion

Bat species identification

Species were identified using published data from central and northern Europe (e.g. Russo & Jones 2002; Barataud 2004a, 2004b), as well as from species recorded in Greece (Papadatou et al. 2008). Thirty-eight echolocation call recordings from both ridges (Akritas-Florina ridge, time-expansion detector, n=10 calls; Pisoderi-Florina ridge, real-time detector, n=28) allowed to obtain a preliminary list of bat species or groups of species present on Bella Voda, Mt Varnous. Calls identified on site using the heterodyne system at Akritas-Florina ridge also assisted on species or groups of species identification.

Five bat species from three different families were identified:

- *Tadarida teniotis* (Molossidae). The species uses "Quasi Constant Frequency-QCF" (QFC, Fig. 3) low frequency narrowband calls with peak frequency around 10-12 kHz, with generally < 20 ms duration (Haquart and Disca 2007). It can be discriminated from *Nyctalus lasiopterus* by its audible feeding-buzz calls emitted while hunting.

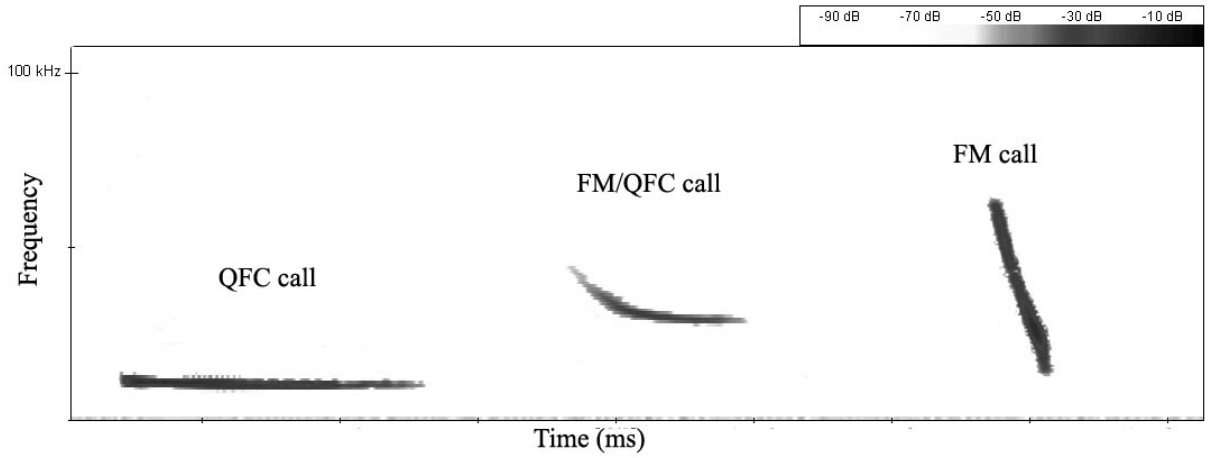

Fig. 3. Different types of ultrasonic calls used by European bats; QCF: quasi constant frequency; FM/QCF: frequency modulated followed by QCF; FM: frequency modulated)

- *Miniopterus schreibersii* (Miniopteridae). The species uses "Frequency Modulated-FM/QCF" calls (FM/QFC, Fig. 3) with end frequency 50-55 kHz. Although its call parameters may partially overlap with those of *Pipistrellus pipistrellus* and *P. pygmaeus*, it may be separated when flying in the open space by its peak frequency (~ 51 kHz).

- *Pipistrellus pipistrellus* (Vespertilionidae). Its calls most often have end frequencies around 45 kHz that are typical of this species.
- *Hypsugo savii* (Vespertilionidae). The species uses FM/QCF calls (FM/QFC, Fig. 3) with end frequencies between 30-36 kHz and peak frequency around 34 kHz, allowing its discrimination from *Pipistrellus kuhli* and *P. nathusii*.
- *Pipistrellus nathusii* (Vespertilionidae). The species uses FM/QCF (FM/QFC, Fig. 3) calls whose frequency bandwidth overlap with that of *Pipistrellus kuhli*. It may be distinguished from the latter by its social calls (Pfalzer and Kusch 2003) and peak frequency (~ 39-40 kHz).

Five groups of species were further identified according to similarities in their ultrasonic call patterns: (a) the "FM" group (Fig. 3), which includes *Myotis* and *Plecotus* species and *Barbastella barbastellus*; (b) the "FM/QCF 37" group, which includes calls with peak frequency 34-40 kHz from potentially three species: *H. savii*¸ *P. kuhli* and *P. nathusii*; (c) the "FM/QCF 52" group including calls with peak frequency 50-55 kHz from potentially two species: *P. pygmaeus* and *M. schreibersii*, the latter probably being the most abundant in this group, but the presence of *P. pygmaeus* cannot be excluded; (d) the "FM/QCF" group including calls covering frequencies between 34-55 kHz without measurable peak frequency but which most probably belong to the species previously mentioned and *P. pipistrellus*; (e) the "QCF" group (QFC, Fig. 3) which includes *Nyctalus noctula*, *N. leisleri*, *Eptesicus serotinus* and *Vespertilio murinus*; these species emit narrowband calls when they fly in open space and use end frequencies between 20-30 kHz. Their acoustic behaviour and distribution in the region of Prespa are not sufficiently known to allow reliable species identification.

Bat activity at Prespa-Akritas-Florina ridge

Bat activity at Prespa-Akritas-Florina ridge was estimated using n=40 contacts with bats with the heterodyne detectors. Activity started at 22:30 with peaks at 23:00 and near midnight (Fig. 4). Almost a third of the activity (30%) corresponded to *T. teniotis*, and over 20% to *M. schreibersii*, *H. savii* and *P. pipistrellus* (Fig. 5).

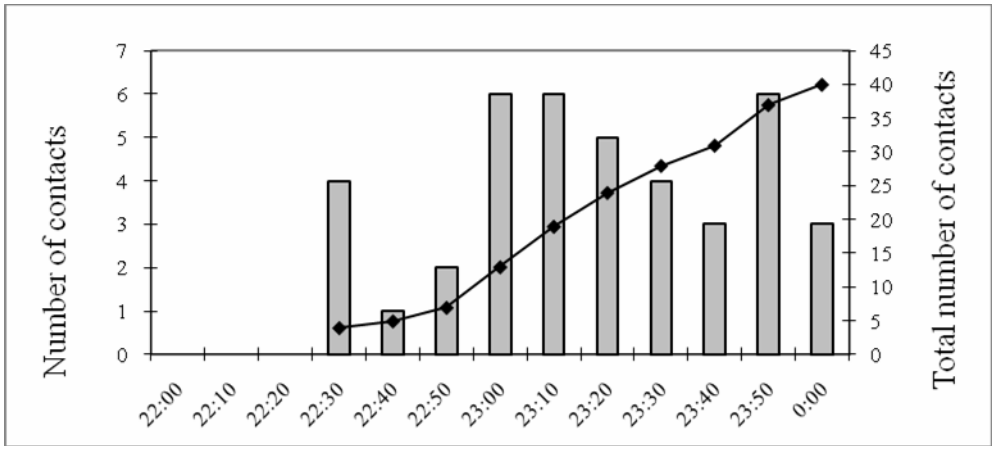

Fig. 4. Bat activity at the Prespa-Akritas ridge (22 July 2009)

With 40 contacts within almost two hours of survey, activity was similar to that found by Barataud (2004b) in the south of the Alps in France at similar altitudes (14 contacts/hour for 29 hours and 45 minutes between 1993 and 2000). Barataud (2004b) found that the maximum number of hunting calls for *T. teniotis* were recorded at this elevation (*ca*. 1900-2000 m a.s.l.) and it has generally been shown that the species hunts in open spaces at high elevations (e.g. Arthur and Lemaire 2009). Recordings from Transect 1 are in agreement with these findings, confirming the hunting activity of *T. teniotis* along this mountain ridge.

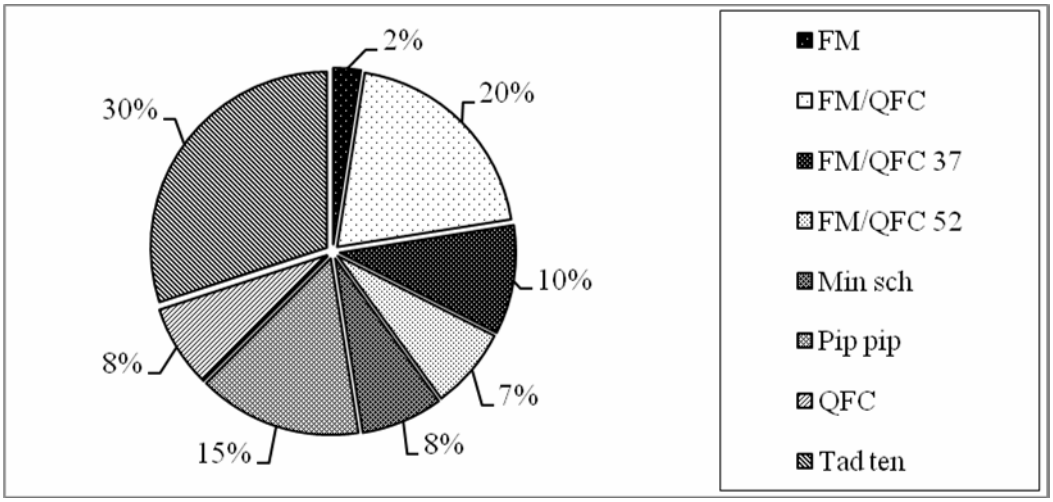

Fig. 5. Relative proportion of acoustic patterns at the Prespa-Akritas ridge (22 July 2009)

Bat activity at Prespa-Pisoderi-Florina ridge

An individual of *P. nathusii* was contacted along Transect 2 (Fig. 2) at 23:00. Twenty contacts with other species were further obtained at Point 3 (Fig. 2). The duration of contacts gives a relative measure of bat activity: echolocation calls were recorded for 12 out of 16 minutes (00:34 to 00:50) of recording time (75%). Many feeding-buzzes of *T. teniotis*, found on all 20 recordings, reveal that these grasslands are important foraging habitats for the species and therefore a habitat of great interest for its conservation in the wider region of Prespa National Park. *Miniopterus schreibersii* was also identified in 8 of the recordings (40%). Point 3 (Fig. 2) showed the highest bat activity (nearly continuous) largely dominated by these two species.

It is important to note that echolocation calls were detected as soon as the team arrived at Point 3, which is located in the continuity of the valley of the Gaidouritsa Stream, whereas almost no activity was detected at Transect 2 on the southern mountainside. This observation may be connected to warm air coming from the valley potentially leading to spatial changes in insect distributions, and thus to variations in the use of this site as a foraging habitat by bats. These complex phenomena, and the even more complex consequences they might have on bat habitat use, highlight the need for a more detailed survey aiming at a better understanding of the use of this mountain site by bats.

Other observations and potential impacts of wind farms

The following bird species were observed flying over the Prespa-Akritas ridge before sunset: *Buteo buteo* (2 individuals), *Falco tinnunculus* (1 individual), *Corvus corax* (4 individuals), *Hirundo rustica* (12 individuals) and *Asio otus* (1 individual). Combining bat and bird observations during this short survey, potential impacts of the planned wind-farm are further questioned in particular for: (a) bat species commuting and foraging high above ground (see for example Alcade and Saenz 2004) or species that migrate (e.g. *Tadarida, Nyctalus*, *Vespertilio*; Georgiakakis et al. unpublished data), but also for species that may look for roosts in wind turbines or hunt insects attracted by the heat produced by the turbines, such as *Pipistrellus* and *Hypsugo* species (Dubourg-Savage 2004); (b) migrating birds, especially birds of prey, a group known to be particularly sensitive to wind turbines (collision risk and "barrier" effect by turbines set up in a line).

Conservation implications

At least five identified species and certainly more use the surveyed ridges of the Bella Voda at Mt Varnous and bat activity was important at these high altitudes. The establishment of a wind-farm is therefore expected to negatively affect bat populations. The risk may be particularly important for species that intensively use these ridges for commuting and hunting, such as *T. teniotis, M. schreibersii*, *P. pipistrellus* and *Hypsugo savii* (three of them listed in Annex II of the Bern Convention). In addition, although *Nyctalus* and *Eptesicus* species, and *Vespertilio murinus* ("QCF" group) were less abundant during this survey, they may also be at great risk especially on migration (spring and autumn), given that they fly at great heights and have been found dead at considerable rate on already established wind-farms elsewhere in Greece (Georgiakakis et al. unpublished data). Our results strongly suggest the necessity for a more detailed impact assessment study in this area targeting on bats and birds. Further bat surveys throughout the year (from spring to autumn) and throughout the night should be made, aiming at better evaluation of Mt Varnous subalpine grasslands as bat habitats and the prevention of potentially negative impacts of planned wind-farms on these internationally protected species.

Acknowledgments

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Καταγραφή χειροπτέρων στα ψευδαλπικά λιβάδια του Βαρνούντα (Φλώρινα): προκαταρκτικά αποτελέσματα

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Περίληψη

Η περιοχή των Πρεσπών στην Ελλάδα περιλαμβάνει δύο περιοχές του δικτύου Natura 2000, οι οποίες από το 2009 αποτελούν το ενιαίο «Εθνικό Πάρκο Πρεσπών». Το τελευταίο καλύπτει όλη τη λεκάνη των Πρεσπών στο ελληνικό τμήμα αυτής και σε συνδυασμό με τα αντίστοιχα τμήματα στην Αλβανία και την ΠΓΔΜ διαμορφώνουν το διασυνοριακό Πάρκο Πρεσπών, την πρώτη διασυνοριακή προστατευόμενη περιοχή στα Βαλκάνια. Η περιοχή υποστηρίζει σημαντικά υψηλή ποικιλότητα χλωρίδας και άγριας πανίδας, ενώ ο αριθμός των θηλαστικών ειδών αυξήθηκε κατά 43% μέσα σε 14 χρόνια (1995-2009), κυρίως λόγω αύξησης των καταγεγραμμένων ειδών χειροπτέρων από το 2000 και μετά. Τα χειρόπτερα (νυχτερίδες) στις εύκρατες ζώνες πιθανότατα αποτελούν σημαντικά είδη άγριας ζωής των λιβαδιών, καθώς η τροφική τους συμπεριφορά (αποκλειστικά θηρευτές εντόμων) συνδέεται με τη χλωρίδα των λιβαδιών. Στην παρούσα εργασία παρουσιάζονται τα αποτελέσματα της πρώτης καταγραφής χειροπτέρων στα ψευδαλπικά λιβάδια του Βαρνούντα στα όρια της λεκάνης των Πρεσπών με αυτές της Φλώρινας και του Πισοδερίου σε υψόμετρο 2000 m μέσω ηχητικών δεδομένων. Τα ψευδαλπικά λιβάδια του Βαρνούντα χρησιμοποιούνται σημαντικά από τουλάχιστον πέντε είδη νυχτερίδων: α) *Tadarida teniotis*, β) *Miniopterus schreibersii*, γ) *Pipistrellus pipistrellus*, δ) *Hypsugo savi*, και ε) *P. nathusii*, τα οποία υπάγονται σε αυστηρό καθεστώς προστασίας σύμφωνα με τη διεθνή και εθνική νομοθεσία. Απαραίτητη κρίνεται η περαιτέρω έρευνα των χειροπτέρων στην ευρύτερη περιοχή. Τα αποτελέσματα της προκαταρκτικής αυτής καταγραφής επιβάλλουν τον προσεκτικό σχεδιασμό οποιονδήποτε επενδυτικών σχεδίων (π.χ. αιολικά πάρκα, χιονοδρομικά κέντρα) στην περιοχή με στόχο την όσο το δυνατό μεγαλύτερη μείωση των επιπτώσεων στα χειρόπτερα, άρα και στη συνολική βιοποικιλότητα των Πρεσπών.

Λέξεις κλειδιά: ηχοεντοπισμός, Εθνικό Πάρκο Πρεσπών, μελέτη περιβαλλοντικών επιπτώσεων, παρακολούθηση