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Report of the IWG on Wind Turbines and Bat populations

Members

Luísa Rodrigues (Convenor; Portugal), Marie-Jo Dubourg-Savage (SFEPM, France), Lothar Bach (Germany), Christine Harbusch (NABU, Germany), Tony Hutson (IUCN, United Kingdom), Laurent Biraschi (Luxembourg), Alison Elliot (United Kingdom), Eeva-Maria Kyheröinen (Finland), Kaja Lotman (Estonia), Lauri Lutsar (Estonian Fund for Nature, Estonia), Per Ole Syvertsen (Norway), Jacques Pir (Luxembourg)

Subgroups

To simplify the work, several sub-groups were created:

Sub-group	Coordinator (c) and members
1) preparation of an Excel file of references	Marie-Jo
2) compilation of data on bat mortality per country	Marie-Jo (c), Lothar
3) preparation/analysis of a questionnaire	Laurent (c), Eeva, Lauri, Jacques
4) updating of tables	Christine (c), Marie-Jo
5) mitigation and compensation measures	Luisa (c), Lothar
6) estimation of mortality rate taking into consideration predation and efficiency	Lothar (c), Luisa
7) impact of mortality rate on populations	Christine (c), Lothar, Luisa
8) deterrents	Lothar (c), Luisa

Results

Results are presented by sub-group.

1) Preparation of an Excel file of references

Annex 1 contains a list of new references on this subject. Apart from those which refer directly to bats and wind turbines, there are also references on new techniques to assess the impacts of Wind Turbines and on migration.

2) Compilation of data on bat mortality per country

Annex 2 contains an updated table with data on bat mortality per country. The table presents the number of fatalities per species. The IWG recalls the countries to send their data, to complete the table.

3) Preparation/analysis of a questionnaire

A questionnaire was sent to all Parties and Non-Parties Range States. 27 replies were received, and 3 countries informed that there are no wind farms in their territories. The replies are being analysed as far as possible before the Meeting, and a report will be prepared during the AC Meeting.

4) Updating of tables

Annex 3 contains new data about studies done in Europe; this table is an update to Table 1 of EUROBATS Publication Series nº 3. The IWG recalls the countries to send their data, to complete the table.

5) Mitigation and compensation measures

There are some measures suggested in the bibliography, but there are no references about their application. They include:

- site selection:
  - avoidance of flyways (Ahlén *et al*. 2007)
  - avoidance of forests (NLT 2005, Regierungspräsidium Freiburg 2006, LANU 2008)
  - avoidance of insect rich habitats as rivers, lakes etc. (Ahlén *et al*. 2007, LANU 2008)
  - avoidance of woodland areas (buffer zone at least 200 m) (NLT 2005, Regierungspräsidium Freiburg 2006, LANU 2008, Rodrigues *et al*. 2008)
  - buffer zone of at least 50 m from any habitat features or structures suitable for roosts (Dürr 2007, Natural England 2009)
  - buffer zone of at least 500 m from maternity roosts (NLT 2005, LANU 2008)
  - buffer zone of at least 500 m from any nature protection areas incl. Natura 2000 areas (NLT 2005)
- operation:
  - stop turbines during periods of high risk, including parts of the night, weeks in the season, and weather situations (e.g. low wind speed) (Ahlén *et al*. 2007, Dürr 2007)
  - lock blades in place while turbine is not operating (Smallwood 2006)
  - synchronize the operations of wind turbines in a row of turbines to be on and off at the same times (Smallwood 2006)
  - reduction of the amount of flying insects around the tower and blades (Ahlén *et al*. 2007)
  - removal or relocating if fatalities are concentrated at specific turbines (Arnett *et al*. 2008)
  - remove broken and non-operating wind turbines (Smallwood 2006)
- other:
  - subsidies for maintenance of trees that are potential roosts (ICNB 2009)
  - installation of bat-boxes and other alternative roosts (ICNB 2009)
  - promote public awareness (ICNB 2009)
  - protect feeding habitats (restoration of riparian vegetation, pesticides decrease) (ICNB 2009)
  - improvement of potential foraging habitats or roosts away from the WT area (Harbusch & Bach 2005)

Ahlén, I., L. Bach, H.J. Baagøe, & J. Pettersson (2007) *Bats and offshore wind turbines studies in southern Scandinavia*. Report to the Swedish Environmental Protection Agency: 37 pp.

Arnett; B.E., Brown, W.K., Erickson, W.P., Fiedler, J.K., Hamilton, B.L., Henry, T.H., Jain, A., Johnson, G.D., Kerns, J., Koford, R.R., Nicholson, C.P., O´Connell, T.J., Piorkowski, M.D. & R.D. Tankersley (2008) Patterns of Bat Fatalities at Wind Energy Facilities in North America. *Journal of Wildlife Management* 72(1): 61-78.

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LANU (2008) *Empfehlungen zur Berücksichtigung tierökologischer Belange bei Windenergieplanungen in Schleswig-Holstein*. Schriftenreihe LANU SH- Natur 13: 1-90.

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NLT (2005) *Hinweise zur Berücksichtigung des Naturschutzes und der Landschaftspflege sowie zur Durchführung der Umweltprüfung und Umweltverträglichkeitsprüfung bei Standortplanung und Zulassung von Windenergieanlagen*: 1-31.

Regierungspräsidium Freiburg (2006) *Auswirkungen von Windkraftanlagen auf Fledermäuse. Ergebnisse aus dem Regierungsbezirk mit einer Handlungsempfehlung für die Praxis*: 1-11.

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6) Estimation of mortality rate taking into consideration predation, efficiency and % of area controlled

Due to the increasing perception of the problematic of wind turbines and bats, several post-monitoring studies have been done during the last years throughout Europe. Unfortunately, only few studies take correction factors into account (see table 1), and there is no consensus about the applicability of different formulas. Different groups prefer different formulas (e.g. Winkelmann 1992, Johnson *et al*. 2003, Erickson *et al*. 2004, Arnett 2005, Grünkorn *et al*. 2005, Kerns *et al*. 2005). But to be able to compare estimation of fatalities/WT/year, it is necessary to apply not only investigations for the estimation of search efficiency and predator bias but also the same correcting factors everywhere. Momentary two new approaches in Germany (Brinkmann pers. comm.) and USA (Huso pers. comm.) are under development.

Another problem and even more important s that most of the post-monitoring studies (e.g. in Germany) are not published or otherwise officially available. Wind farm developers must be forced to make all reports available, to allow an overview over a broader geographical scale and to increase the knowledge about mortality rate.

The mortality is highly variable between different sites. But it seems that close or inside forests and in areas with bat migration immediately at the shore line the mortality is highest. Beside that the mortality varies between years (see Brinkmann *et al*. 2006, Dulac 2008).

TABLE 1.—Bat mortality at wind farms in different European landscapes and the different use of correction factors (Y = done, * = lower range with 2 correction factors, higher range with 3 correction factors)

Investigation	numbers of WT	collision rate bats/WT/year	searcher efficiency bias	carcass removal bias	% of effectively searched area per WT	reference
Freiburg - 2004	16	20,9	Y	Y		Brinkmann *et al*. 2006
Freiburg - 2005	8	11,8	Y	Y	Y	Brinkmann *et al*. 2006
Fröhnd - 2005	2	16,5	Y	Y		Behr *et al*. 2006
Rosskopf -2005	4	31,5	Y	Y		Behr and v. Helversen 2006
Switzerland - 2007	8	8,2				Leuzinger *et al*. 2008
North Sea coast - 2008	5	1,9	Y	Y	Y	Bach and Bach 2008
Schleswig-Holstein - 2004	24	0	Y	Y		Grünkorn *et al*. 2005
Bouin - 2004	8	20,3 - 21,6*	Y	Y	Y	Dulac 2008
Bouin - 2005	8	21,5 - 26,7*	Y	Y	Y	Dulac 2008
Bouin - 2006	8	6,0 - 9,3*	Y	Y	Y	Dulac 2008
North Sea coast - 1990	130	0				Vauk *et al*. 1990
Oberdorf - 2004	5	0				Traxler *et al.* 2004
Prellenkirchen - 2004	8	8				Traxler *et al.* 2004
Steinberg - 2004	9	5,33				Traxler *et al.* 2004
Aragon - 1999	?	10,15				Latorre and Zueco 1998
Navarra II	10	13,3				Lekuona 2001, Petri and Munilla 2002
Navarra I	10	3,09				Lekuona 2001, Petri and Munilla 2003
Saxony (16 WP) - 2004	92	1,5				Endl *et al*. 2005
Saxony I - 2004	10	4,6				Endl *et al*. 2005
Saxony II - 2004	10	1,1				Endl *et al*. 2005
Saxony (11 WP) - 2006	26	0,9				Seiche *et al*. 2007
Portugal (Seixinhos) - 2006	8	1,86	Y	Y	Y	Strix 2007
Portugal (Lameira) – 2006/2007	8	0,63				Ecosistema 2007
Portugal (Outeiro) – 2006	15	5,98	Y	Y	Y	Profico Ambiente 2007
Portugal (Outeiro) – Spring 2008	15	1,86				Cabral *et al*. 2008

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Winkelman, J. E. (1992) De invloed van de Sepproef Windcentrale te Oosterbierum (Fr.) op vogels. 1: aanvaringsslachtoffers, pp. 71. DLO Instituut voor Bos- en Natuuronderzoek (Hrsg.), Arnhem.

7) Impact of mortality rate on populations

To our knowledge, no study regarding the impact of mortality by wind turbines on bat populations was published yet, so this important issue cannot be presently assessed.

8) Deterrents

There are only two groups working with possibilities to deter bats from the surroundings of blades from wind turbines. Two possibilities are discussed:

1. radar
2. emission of ultrasound noise

Radar:

Nicholls & Racey (2007) studied the activity of bats (mainly *Pipistrellus* species) in the surroundings of different radars (3 civil air traffic control radar, 3 weather radar, 4 military ATC radar). The bat activity was significantly reduced (circa 50%) in habitats exposed to a high electromagnetic field strength (EMF) of greater than 2 v/m when compared to matched sites registering EMF levels of zero. The reduction in bat activity was not significantly different at lower levels of EMF strength within 400 m of the radar. But it is difficult to quantify the relation more detailed, since no detailed specification on the radar units is presented. Therefore more studies, especially experiments with different operating frequencies, are needed to measure the deterrent effect on bats. Both authors are still studying that phenomenon and a second paper will come during this spring.

Emission of ultrasound noise

The idea is that a bat will be irritated when an emitted noise (broad banded ultra sound emission) is louder than the incoming echo to the bat (Szewczak & Arnett 2008). Spanjer (2006) tested *Eptesicus fuscus* in the lab and found out that there was a significant reduction of landings in areas with ultra sound emission in none-feeding trials. But there was no significant reduction of landings in areas with ultra sound emission in feeding trials. The number of bats

passing the area when the device emitted sound was significant lower than when the device was silent in both none-feeding and feeding trials. The bats captured significant less mealworms in areas with ultrasound emission than without.

Szewczak & Arnett (2007) have tested the ultrasound device at six different ponds in August and September 2007 and found out that the activity of bats was reduced up to 90% in areas with ultrasound broadcast and they did not observe any habituation. Problematic is the small range (12 m) of ultrasound broadcast. Horn *et al*. (2008) tested the acoustic bat deterrent at Marple Ridge wind farm. The results were different: whereas in one case the bat activity was significant lower at a deterrent-treated wind turbine it was not so in a second approach case. A multivariate regression analysis showed a significant relationship between two wind measurements, barometric pressure, and the presence or absence of the deterrent. Their results show that several factors influence the effectiveness of deterrent systems. However, it was also observed that some bats were attracted to these devices (Horn pers. com.).

The results of these studies show that bat can and will avoid ultrasound emissions. However, although bats are known to avoid ultrasound clutter, little is known about the behavioural responses of bats to artificial broadband ultrasound emissions. It must be demonstrated on a full-size scale that bats both can and will avoid large ultrasound fields before acoustic deterrent systems can be expected to function effectively at wind farms.

Conclusions:

It is not proved yet that these systems are suitable to deter bats from wind turbines. Besides that there still exist some other questions/problems that have to be solved. For both systems nothing is known about possible impacts on other species groups as insects or birds. The ultrasound device only works on a small range (12-20 m), being too weak to encompass an entire turbine structure. Furthermore, that device has a limited frequency range, which might result in a species-specific deterrent effect.

So far none of these two systems can be used as a functional system to deter bats from wind turbines and therefore cannot be used as a mitigation measure for bats.

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Annex 1

Arnett E.B., Brown, W.K., Erickson, W.P., Fiedler, J.K., Hamilton, B.L., Henry, T.H., Jain, A., Johnson, G.D., Kerns, J., Koford, R.R., Nicholson, C.P., O´Connell, T.J., Piorkowski, M.D. & R.D. Tankersley	2008	Patterns of Bat Fatalities at Wind Energy Facilities in North America.	Journal of Wildlife Management 72(1): 61-78.
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Moreira, J.	2006	Programa de Monitorização da avifauna com pesquisa direccionada aos quirópteros do Projecto Eólico de Cinfães (Parques Eólicos de Fonte da Quelha e do Alto do Talefe).	Estudo da Ecosfera para a EDP. Relatório Final (Final Report)
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Aegerter J., Simms I., Dale S., Plonczkier P., Ormston C., Carlin C. & Mitchell-Jones T.	2009	Monitoring bats with radar: a joint feasibility study by CSL and Natural England	
Fonio, J	2008	Projet Chirotech (Biotope, Nordex)	Conférence du Bureau de coordination énergie éolienne, « Impacts des éoliennes sur les oiseaux et chiroptères », Berlin 18.04.2008
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Flaquer, C., Puig-Montserrat X., Viadal C., Curćo T. & Russo D.	2009	Habitat selection by the migrant bat Nathusius' pipitsrelle (*Pipistrellus nathusii*) in Iberia.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 75
Gazaryan S.	2009	A role of the Caucasus for migratory bat species: current state of knowledge.	First Internat' Symposium on Bat Migration, Berlin. Abstracts: 21
Giumarro G., Boyden S., Johnson J., Peterson T. & Watrous K.	2009	Summaru of seasonal distribution of migratory tree bats in the Northeastern United States using passive acoustic monitoring.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 76
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Keiss O. & Petersons G.,	2009	Capture and banding of bats during autumn migration at the Pape at the bird ringing station, Latvia 1966-2007.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 56
Kokurewicz T.,	2009	Bat migrations from Germany to Poland: presence of good hibernation site can modify the direction of bat migrations.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 59
Kucharska M. & Furmankiewicz J.,	2009	Are the river valleys migration corridors for bats?	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 50
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Kyheröinen E.-M., Vasko V., Hagner-Wahlstein N., Inberg E., Kosonen E., Lappalainen M., Lilley T., Lindstedt R. & Liukko U.-M. & Norrdahl K.,	2009	Bat migration studies in Finland 2008.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 61
Lindemann C., Kugelschafter K., Woehl S., Seitz A., Kiefer A.,	2009	When do bat spesies leave their hibernaculum? – An insight into spring swarming and departure behaviour.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 57
Masing, M.,	2009	A review of bat migration studies carried out in Estonia.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 63
McCracken G.	2009	Migratory behaviour in bats is linked to their ability to track and eploit migratory insects populations.	First Internat' Symposium on Bat Migration, Berlin. Abstracts: 11
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Salovaara K.,	2009	Preliminary results of bat migration study in Hanko, most southern Finland 2006-2007.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 82
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Vlashenko A. & Gukasova A.	2009	Phenology of bat migration in Kharkov City (North-Eastern Ukraine).	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 77
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Zöphel U. & Brockmann D.	2009	Is the migrating pattern of Noctule (*Nyctalus noctula*) in change?	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 69
Zöphel U. & Hutterer R.	2009	Bat banding in Germany – results concerning bat migration.	First Internat' Symposium on Bat Migration, Berlin. Poster. Abstracts: 68

Annex 2
BAT MORTALITY IN EUROPE
State on 30.04.2009

Species	A	CH	CRO	D	F	NL	POR	SE	SLO	SP	TCHE	UK	Total
Nyctalus noctula	3			350	7		1	1		1	3		**366**
Nyctalus lasiopterus										1			**1**
Nyctalus leisleri		1		50	7		18			1	1		**78**
Eptesicus serotinus				25	6		1			1	7		**40**
Eptesicus nilssonii				2				8					**10**
Vespertilio discolor				44				1			2		**47**
Myotis myotis				2						1			**3**
Myotis dasycneme				1									**1**
Myotis daubentonii				3			2						**5**
Myotis brandtii				1									**1**
Myotis mystacinus				1									**1**
Pipistrellus pipistrellus				222	124	1	10	1		1	3		**362**
Pipistrellus nathusii	1			272	53	1		5			2		**334**
Pipistrellus pygmaeus				20	11		2	1				1	**35**
Pipistrellus kuhlii			4		18					1			**23**
Pipistrellus spec.		1		17	42		16				2	3	**81**
Hypsugo savii			3	1	1		6		2	3			**16**
Plecotus austriacus	1			6									**7**
Plecotus auritus				3									**3**
Miniopterus schreibersii					1		1			1			**3**
Tadarida teniotis							1			1			**2**
Chiroptera spec.				16	9		8	30		14		6	**83**
	5	**2**	**7**	**1036**	**279**	**2**	**66**	**47**	**2**	**26**	**20**	**10**	**1502**

Source: T. Dürr, MJ. Dubourg-Savage

Annex 3

Studies done in Europe (update to Table 1 of EUROBATS Publication Series nº 3)

State 05/05/2009					
Study (author, year, area)	**Time**	**Type of turbines**	**Methods**	**Results**	**Habitat types**
Trille *et al* (2008), France	June - October 2008	13 WTs x 2,5 MW	First fatalities recorded at the beginning of June, monitoring 09 July-17 October 2008. Search area 100m x 100m. Control every 3 days for 9 WTs.Tests for search efficiency & predation.	No estimation of mortality as controlled surface was not calculated and monitoring was only performed during 3 months. 73 dead bats (49 Ppip, 6 Pkuh, 13 Pip sp., 2 Eser, 1 Nlei, 2 Chirop. spec.], mainly females. Effective mortality rate 8 bats/controlled WT for 4,5 months. 2 peaks of mortality: 2nd half of July and 2nd half of August. Fatalities occured mainly at the interface grassland / woodland. Only 8% of fatalities with external injury	Ridge NE-SW, mean alt. 1047m. Spruce and some beech trees with adjacent pastures, hay meadows, fields or some fallow land (broom and ferns)
Beucher & Puech (2008), France	15 Juny - 15 October 2008	6 WTs VESTAS V90	Systematic search around WTs (100m x 100m), twice a week with tests for efficiency and predation/scavenging	10 dead bats (Ppip 7, Pkuh 1, Ppip-Ppyg 1, Chirop. Spec.1): 1 in June, 3 end of July, 5 in August, 1 mid-October	Plateau with crops, intensive grasslands and some hedgerows
Strix (2007), Seixinhos Portugal	2006	8 WTs	Efficiency, predation and controlled surface	Mortality rate 1,86 bat/WT/year	
Ecosistema [2007], Lameira Portugal.	2006-2007	8 WTs	Efficiency, predation and controlled surface	Mortality rate 0,63 bat/WT/year	
Profico Ambiente [2007], Outeiro, Portugal	2006	15 WTs	Efficiency, predation and controlled surface	Mortality rate 5,98 bats/WT/year	
Cabral et al (2008), Outeiro, Portugal	Spring 2008	15 WTs	Efficiency, predation and controlled surface	Mortality rate 1,86 bats/WT/year	