Cantabrian Capercaillie signs disappeared after a wind farm construction

Manuel A. González & Vicente Ena

González, M. A. & Ena, V. 2011. Cantabrian Capercaillie signs disappeared after a wind farm construction. *Chioglossa*, 3: 65-74.

Capercaillie (*Tetrao urogallus*) is a grouse highly sensitive to human activities and declining throughout most of its European range. The Cantabrian subespecies *Tetrao urogallus cantabricus* is the most endangered and the only inhabiting caducifolious forests. Although many causes have been suggested as possible reasons for its alarming decline, no definite evidence supports any of them. Hence, the only effective measure so far is habitat conservation. In this sense, wind farms development is an emergent threat to this population. In a recently described Mediterranean habitat, we assessed Capercaillie occurrence before and after a wind farm construction in a wintering site. After construction Capercaillie presence signs decreased to zero and space use changed, likely due to human disturbances derived from the wind farm construction and maintenance. These changes in habitat use at a local scale and related negative effects on Capercaillie are discussed. As part of the precautionary principle conservation measures for this subespecies should avoid any wind farm within the current Cantabrian Capercaillie range while further research on Capercaillie and wind farms interactions should be urgently carried out.

Key words: *Tetrao urogallus*, Cantabrian Capercaillie, disturbances, Mediterranean, presence, wind farm.

Introduction

Capercaillie *Tetrao urogallus* is declining throughout most of its European range (Storch, 2007). The Cantabrian subspecies *T. urogallus cantabricus* suffered a 60% population decline in the last three decades and it is currently restricted to an area of less than 2,000 Km^2 (Bañuelos & Quevedo, 2008; Obeso & Bañuelos, 2003) in the provinces of Asturias and León, northern and southern slopes of the Cantabrian Mountains respectively (NW Spain; Figure 1). Its global population is estimated at 400 adult birds (Bañuelos & Quevedo, 2008), which is lower than the minimum viable population for this species (Grimm & Storch, 2000). In the face of this worrying situation, Cantabrian Capercaillie is considered as the most endangered subspecies according to the IUCN criteria (Storch *et al*., 2006) and was proposed by the U.S. Wildlife Service to be listed as endangered as well (Krofta, 2010).

Many causes have been proposed as responsible for Cantabrian Capercaillie decline. The most relevant, from a local to a global scale, are the following i) low genetic variability (Alda *et al.,* 2011; Rodriguez-Muñoz *et al*., 2007), ii) low reproductive success (Bañuelos *et al*., 2008), iii) resource competition with ungulates (Blanco-Fontao *et al*., submitted), iv) forest fragmentation (Quevedo *et al*., 2006b), v) anthropogenic disturbances such as people trekking in the habitat (Suarez-Seoane & Garcia-Rovés, 2004) and vi) climate change (Obeso & Bañuelos, 2003). Unfortunately, little is known about the effects of these causes on Cantabrian Capercaillie performance and no evidence definitively supports any of them so far. However, it is likely that there is not a single decline cause but rather an additive or synergistic effect of most of them. In this context, a strong need for research is recommended while no effective conservation measures further than habitat conservation are sensible and sound (Quevedo *et al*., 2005). For instance, some anthropogenic disturbances on habitat are likely to be easily avoided for the aim of Capercaillie habitat conservation. One of such disturbances that may constitute a threat for Cantabrian Capercaillie is the recent wind power development within its current range (de la Calzada, 2011; Purroy *et al*., 2010).

Wind farms are known to negatively affect the performance of bird populations both directly by means of collisions with turbine rotating blades (Carrete *et al*., 2009; Kunz *et al*., 2007) and indirectly mediated by habitat destruction, fragmentation and disturbances caused as a consequence of the access infrastructures necessary for construction and maintenance of the wind farms (Lucas *et al*., 2007). Although neither direct nor indirect impacts of wind farms on Capercaillie have been reported so far, proximity of remaining Scottish Capercaillie and wind farm construction is not recommended (Bright *et al*., 2008). Furthermore, other grouse have shown dramatic population declines (*Tetrao tetrix*; Zeiler & Grünschachner-Berger, 2009) or avoidance behaviour after wind farms installation (*Tympanuchus* sp; Pruett *et al*., 2009).

Capercaillie deaths by collision with rotating blades may occur, since collisions with power lines, ski lift lines, and fences have been reported (Baines & Summers 1997; Menoni *et al*., 1997; Moss *et al*., 2000). However, the mostly terrestrial behaviour of this species may prevent a big incidence of direct collisions. Conversely, the fragmentation and anthropogenic disturbances derived from the construction of access infrastructures and the increased traffic of heavy machinery are likely to negatively affect Capercaillie space use (Summers *et al*., 2007). As revealed that winter ski tourism affected habitat use at a small spatial scale and capercaillie preferred disturbance-free forest patches while that areas with tourism infrastructure were only used when tourists were absent (Thiel *et al*., 2008). Personally, at the southern Mediterranean oak *Quercus pyrenaica* forests of the Cantabrian range we observed in 2008 early June one tagged hen which left the site where it had stayed without moving (*i. e.* nesting period) in the last two weeks. This fact coincided with a bulldozer working <500 m far from the site during the construction of a wind farm and it is probable that the hen to left the nest due to bulldozer disturbances (own unpublished data). Overall, works related to wind farms construction and maintenance are expected to negatively affect Capercaillie. The aim of this study is to asses if human disturbances during and after the construction of a wind farm can affect the Capercaillie space use in winter.

Methods

The study area is located in the Mediterranean biogeographic region at the southern slope of the Cantabrian range (NW Spain; see González *et al*., 2010 for detailed description of the habitat and Capercaillie population). Natural Mediterranean oak *Quercus pyrenaica* forest intermingled with young Scots pine plantations (<30 years old) cover most of the study area (95%; Figure 1). The remaining surface of the study area is occupied by post-burnt heathlands (*Erica* sp.; Figure 1, 2). The site is <2 km southern far from 3 occupied leks (see Figure 1) and also <5 km south of the wind farm at least two more occupied leks are known to exist (González *et al*., 2010). Both in the traffic and foot-paths were easy to find Capercaillie presence signs and direct sightings in winter since at least 2005 thus we considered it as a wintering site (M. A. González, pers. obs.). The area is neither considered in the Cantabrian Capercaillie

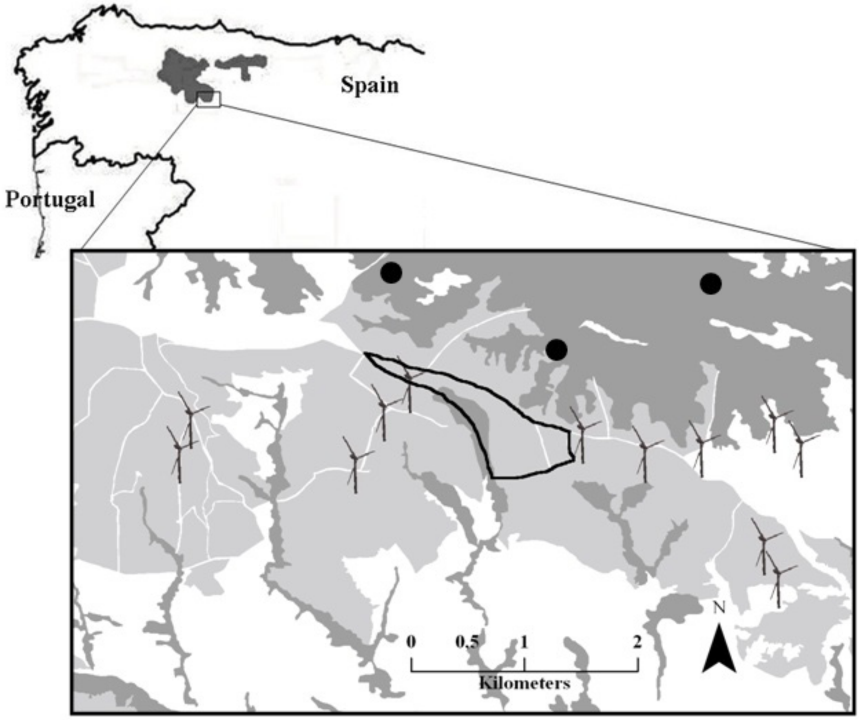

Figure 1: In grey: Cantabrian Capercaillie current distribution (NW Iberian Peninsula), rectangle: site of the studied wind farm; installed wind turbines are drawn, white lines: traffic-paths, grey (light and dark): forests used by the Capercaillie, grey dark: Mediterranean oak forests, grey light: Scots pine plantations, black line: circuit, black dots: occupied leks. *[En gris: distribución actual del urogallo cantábrico (NO Península Ibérica), rectángulo: área del parque eólico estudiado, se representan los molinos eólicos instalados, líneas blancas: pistas, en gris (claro y oscuro): bosques usados por el urogallo, en gris oscuro: melojares mediterráneos, línea negra: circuito, puntos negros: cantaderos ocupados.]*

Recovery Plan (BOCYL, 2009) nor in Natura 2000 network. Consequently, 12 wind turbines were constructed between August 1st and December 15th 2009, the Valdesamario wind farm that extends over ~6 km. Turbines although installed did not work in 2010 thus deaths by collisions were not expected to occur (Figure 1).

Before and after the wind farm construction (January-February 2009 and 2010) we surveyed a circuit considered to be the wintering site in the middle of the Valdesamario wind farm. The circuit consisted of 4 km through the traffic-path and perpendicular foot-paths. Two km of the circuit were by traffic-path, 1.2 km by foot-paths through pine plantations and 0.8 km by foot paths-through natural Mediterranean oak forests as a real reflection of the habitat characteristics of the site (see Figure 1). The circuit was divided in 80 points 50 m long each one according to three point classes: i) 40 points corresponded to traffic-path; ii) 24 points were foot-path in pine plantations and iii) 16 points were foot-path in natural Mediterranean oak forests. We surveyed the circuit weekly from mid January to the end of February both in 2009 and 2010 looking for Capercaillie presence data: i) signs such as droppings, footprints and feathers, and/or ii) direct sightings. Each point was considered with presence when at least containing one presence sign. In each survey signs were collected or deleted not to consider them in the next survey. We studied differences between 2009 and 2010 surveys in the total number of presence signs and points with presence by means of a T test as data reached the parametric assumptions. Before construction people and vehicles were anecdotic in the circuit, however, after construction the traffic-path was frequently used by people and motor vehicles while the foot-paths remained as before.

Habitat selection at a local scale was determined using design I (population level) selection ratios according to each point class (Manly *et al*., 2002). Available habitat for the Capercaillie was each point (n = 80) within the 4 km circuit. Manly´s selectivity index is proportional to the probability of each point in the circuit (*i. e.* traffic-path, pine plantation and oak forest) to be used while assuming unrestricted access to each available point. The index ranges from 0 (maximum avoidance) to infinite (maximum positive selection), where 1 indicates that the point is used according to availability (Manly *et al*., 2002). Habitat use was determined as the number of points with Capercaillie presence found in each point class (*i. e.* traffic-path, foot-path in pine plantation and foot-path in oak forest). Analyses were performed with library adehabitat (Calenge, 2006) in R statistical package (R Development Core Team 2008).

Results

We found significant differences in the number of presence signs before and after the construction of the wind farm (T test $T = 3.15$, $P = 0.01$) but not in the number of points with presence before and after (T test $T = 1.83$, $P = 0.1$). Before the construction of the wind farm, points with presence (n = 64) were detected in each survey, whereas after the construction, points with presence (n = 21) were only found in the first of five surveys and decreased to zero. Globally we detected 178 presence signs (*i. e.* droppings, feathers and footprints) before and only 34 (*i. e.* droppings) after construction. Five direct sightings (twice a hen and a cock the remaining, Figure 3) were registered before with a minimum of five different birds frequently

Figure 2. Wind turbine of the "Valdesamario" wind farm above the Mediterranean *Quercus pyrenaica* oak forest. Winter 2011. Author: Manuel A. González. *[Molino eólico del parquet eólico "Valdesamario" sobre melojar mediterráneo Quercus pyrenaica. Invierno 2011. Autor: Manuel A. González.]*

Figure 3. Cock in the border of the traffic-path of the "Valdesamario" wind farm. Winter 2009. Author: Manuel A. González. *[Urogallo en el borde de la pista del parque eólico "Valdesamario". Invierno 2009. Autor: Manuel A. González]*

using the circuit and none bird was seen in surveys after construction. Every point with sightings showed also presence signs (droppings, feathers and/or footprints). Along the circuit 4 km long points with Capercaillie signs summed up to 3250 m (median 550 m; range 400-950 m) before and 1050 m (median 0 m; range 0-1050 m) after. 91% of the presence signs detected before were droppings and 9% trails on the snow, otherwise, after construction every sign corresponded to droppings. Feathers were anecdotic (see Table 1).

In 2009 before the wind farm construction Manly´s selectivity index showed that the traffic-path was used according to availability (w_i = 0.914; P = 0.341), pine plantation avoided (w_i = 0.273; $P < 0.001$) and oak forest strongly selected (w_i = 2.358; $P < 0.001$). After construction in 2010 traffic-path was strongly avoided (w_i = 0.182; $P < 0.001$), while pine plantation and oak forest were selected (w_i = 1.538; P = 0.005; w_i = 2.749; $P < 0.001$ respectively).

Discussion

The factors affecting the decline of the Cantabrian Capercaillie are out of our control, however we may reverse the situation by understanding the local problems and developing precise conservation measures for assessing specific risk activities (Moss *et al*., 2001). Human disturbances may lead to the avoidance of the disturbed area and to a change into a habitat of lower quality which may have negative affects on the Capercaillie, particularly during winter. If prolonged or repeated, human disturbances cause repeated physiological stress reactions, these may in long-term reduce reproduction or immuncompetence (Thiel *et al*., 2008, 2011). Here the question is whether the decrease in the frequency of signs and changes in habitat use indicate adverse effects of wind farm construction and maintenance. If such, negative effects area discussed bellow, but even if not, an increase on stress levels due to constant human presence should be considered and assessed (Thiel *et al*., 2008, 2011).

Although we got no disturbance data our results indicate a decrease in the frequency and change of territory use in a wintering site otherwise quite before the wind farm construction. These results suggest that disturbances due to human activities may be directly related to these changes since disturbances were the most substantial modification to the previous environmental conditions. Apparently Capercaillie frequently used the circuit for walking before the wind farm construction, mainly the foot-path in oak forest but also the traffic-path. After construction, Capercaillie presence was only detected during the first field survey and none Capercaillie was directly seen and the use of the traffic-path decreased to avoidance favouring the use of the foot-path in the young pine plantation. These suggest a benefit to use the plantation in detriment of traffic-path after construction. This fact may be explained by two different hypothesis: i) a decrease in use of the traffic-path derived to an increase in the foot-paths use, and/or ii) the Capercaillie that used the oak forest and pine plantation kept off the human disturbances in the traffic-path and resulted less affected than those using the traffic-path. However, the most likely is to be each bird that used the traffic-path also used the foot-paths and after disturbances the traffic-path use decreased due to a decrease in Capercaillie number using the site. This is also supported by the fact that before we got five direct sightings but none after construction suggesting a decrease in Capercaillie number. A decrease in Capercaillie number could also be related to variations in weather and/or predators pressure, however, in previous random visits to the circuit from 2005 to 2008 winter we always flushed up any bird (pers. obs.). Arguably, this study does not allow differentiation into what could have been merely a short-term disruption to regular winter range or a reduction in Capercaillie number due to construction but a decrease in the frequency and change in the use of the circuit coinciding with relevant human disturbances.

Winter is a critical period for Capercaillie when the bird shows a low energetic expenditure due to low food availability and harsh climatic conditions (Gjerde & Wegge, 1987; Spidso & Korsmo, 1994; Storch, 1993). Although in this Mediterranean area the winter is expected to be more favourable than in others since it is warmer (*i. e.* Mediterranean), human disturbances may force Capercaillie to displace to other wintering sites, increasing their energetic expenditure and also, stress levels (Thiel *et al*., 2008; Thiel *et al*., 2011). This, in turn, may have negative consequences in their breeding success and fitness (Moss & Weir 1987; Thiel *et al*., 2011). Otherwise, the fact that human activities and infrastructures explain the occupancy of the leks (Suarez-Seoane & García-Rovés, 2004) suggests that leks closer to 3-4 km to the Valdesamario wind farm would likely become abandoned in the next years. Thus, it is strongly recommended the further census of the three nearest leks to the wind farm (<2 km) to asses its impact on this Capercaillie nucleus.

The potential negative effects here described may be even worse since our study was developed at the time of the stopped rotors. When they would move (*i. e.* currently in 2011) the related disturbances to Capercaillie like to other birds are expected to be higher due to disturbances caused by moving rotors (e.g. risk of collisions, noise and shadow flicker) and humans altogether (Drewitt & Langston, 2006). In the Cantabrian context, with the current knowledge, the only effective conservation measure for the Cantabrian Capercaillie is preserving the natural systems (Quevedo *et al*., 2006a). If the subespecies is critically endangered and wind farms emerging fast, heavy anthropogenic disturbances derived from them within the current distribution range seems incongruous with the subspecies recovery. As part of the precautionary principle, the occurrence of Capercaillie should always be within Natura 2000 network ensuring that key areas of conservation importance and sensitivity are avoided for the wind farm location.

Acknowledgements

We are very grateful to the forest ranger Ramón Balaguer and Luis Robles for their help in the field surveys. Thanks to professor Francisco J. Purroy for their constant support and help. Pedro P. Olea highly improved this manuscript with their comments. Manuel A. González is supported by a predoctoral scholarship from Universidad de León.

Resumen

Desaparición de rastros de urogallo cantábrico tras la construcción de un parque eólico.

El urogallo está considerada un ave sensible a las actividades humanas y en declive en la mayor parte de su distribución europea. La subespecie cantábrica *Tetrao urogallus cantabricus* es la más amenazada y la única que vive en bosques caducifolios. A pesar de que se han sugerido muchas posibles causas del alarmante declive, no existen evidencias para ninguna de ellas. Por tanto, la única medida efectiva y aplicable por el momento es la conservación del hábitat. El desarrollo eólico constituye una nueva amenaza para esta población. En un hábitat mediterráneo recientemente descrito estudiamos la presencia de urogallo antes y después de la construcción de un paruqe eólico en una zona tradicional de invernada de urogallo. Después de la construcción los signos de presencia de urogallo disminuyeron hasta desaparecer por complete junto con un aparente cambio de uso del hábitat, debido probablemente a las molestias derivadas de la construcción y mantenimiento del parque eólico. Se discuten los posibles cambios en el uso de hábitat a escala local y las posibles consecuencias negativas para el urogallo. Por el principio de precaución, debería evitarse la instalación de parques eólicos dentro de la distribución actual del urogallo cantábrico, y es recomendable desarrollar investigaciones más profundas acerca de las interacciones de los parques eólicos y este núcleo de urogallos.

Palabras clave: Mediterráneo, molestias, Molino eólico, presencia, Urogallo Cantábrico

Bibliography

Alda, F. P. Sastre, P. de la Cruz-Ardiel & I. Doadrio. 2011. Population genetics of the endangered Cantabrian Capercaillie in northern Spain. *Animal Conservation*, in press.

Baines, D. & R. W. Summers. 1997. Assessment of bird collisions with deer fences in Scottish forests. *Journal of Applied Ecology*, 34: 941-948.

Bañuelos, M.J. & M. Quevedo. 2008. Update of the situation of the Cantabrian Capercaillie *Tetrao urogallus* cantabricus: an ongoing decline. *Grouse News*, 25: 5-7.

Bañuelos, M.J., M. Quevedo & J. R. Obeso. 2008. Habitat partitioning in endangered Cantabrian Capercaillie *Tetrao urogallus cantabricus*. *Journal of Ornithology*, 149: 245-252.

BOCYL. 2009. Decreto 4/2009, de 15 de enero, por el que se aprueba el Plan de Recuperación del urogallo cantábrico (*Tetrao urogallus cantabricus*) y se dictan medidas para su protección en la Comunidad de Castilla y León. *Official Gazette of Castilla y León, Spain*.

Bright, J., R. Langston, R. Bullman, R. Evans, S. Gardner & J. Pearce-Higgins. 2008. Map of bird sensitivities to wind farms in Scotland: A tool to aid planning and conservation. *Biological Conservation*, 141 (9): 2342-2356.

Calenge, C. 2006. The package “adehabitat” for the R software: A tool for the analysis of space and habitat use by animals. *Ecological Modelling*, 197: 516-519.

Carrete, M., J. A. Sánchez-Zapata, J. R. Benítez, M. Lobon & J. A. Donázar. 2009. Large scale risk-assessment of wind-farms on population viability of a globally endangered long-lived raptor. *Biological Conservation*, 142: 2954-2961.

de la Calzada, E. 2011. Urogallos abandonados a su suerte. *Quercus*, 302: 80-83.

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

Gjerde, I. & P. Wegge. 1987. Activity patterns of Capercaillie, *Tetrao urogallus*, during winter. *Holarctic Ecology*, 10: 286-293.

González, M. A., P. P. Olea, L. Robles & V. Ena 2010. The Mediterranean *Quercus pyrenaica* oak forest: a new habitat for the Capercaillie? *Journal of Ornithology*, 151: 901-906.

Grimm, V. & I. Storch. 2000. Minimum viable population size of Capercaillie *Tetrao urogallus*: results from a stochastic model. *Wildlife Biology*, 6: 219-225.

Krofta, D. 2010. Endangered and Threatened Wildlife and Plants; Listing Six Foreign Birds as Endangered Throughout Their Range. Fish and Wildlife Service, Interior. Proposed Rules, 75 (2).

Kunz, T. H., E. B. Arnett, E. W. Erickson, A. R. Hoar, E. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher & M. D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. *Frontiers in Ecology and the Environment*, 5: 315-324.

Lucas, M., G. F. E., Janss & M. Ferre. 2007. *Birds and wind farms: risk assessment and mitigation*. Quercus, Madrid.

Manly, B., L. Mcdonald, D. Thomas, T. Mcdonald & W. Erickson. 2002. Resource Selection by Animals. Pages 1-220 in Statistical Design and Analysis for Field Studies. Chapman & Hall, London.

Menoni, E., P. Landry & C. Berdocou. 1997. Habitat fragmentation and viability of Capercaillie populations in the French Pyrenees. *Wildlife Biology*, 3: 277.

Moss, R., J. Oswald & D. Baines. 2001. Climate change and breeding success: decline of the capercaillie in Scotland. *Journal of Animal Ecology*, 70: 47-61.

Moss, R., N. Picozzi, R. W. Summers & D. Baines. 2000. Capercaillie *Tetrao urogallus* in Scotland - demography of a declining population. *Ibis*, 142: 259-267.

Moss, R. & D. N. Weir. 1987. Demography of Capercaillie *Tetrao urogallus* in north-east Scotland. III. Production and recruitment of young. *Ornis Scandinavica*, 18: 141-145.

Obeso, J.R. & M. J. Bañuelos. 2003. *El urogallo (*Tetrao urogallus cantabricus*) en la Cordillera Cantábrica*. Servicio de Publicaciones de Parques Nacionales. Ministerio de Medio Ambiente, Madrid.

Pruett, C. L., M. A. Patten & D. H. Wolfe. 2009. Avoidance Behavior by Prairie Grouse: Implications for Development of Wind Energy. *Conservation Biology*, 23(5): 1253-1259.

Purroy, F. J., V. Ena, B. Fuertes & M. A. González. 2010. Conservación Nacional. Una población única de urogallo, amenazada por parques eólicos en la provincia de León. Noticias cortas. *Quercus*, 289: 66.

Quevedo, M., M. J. Bañuelos & J. R. Obeso. 2006a. The decline of Cantabrian Capercaillie: How much does habitat configuration matter? *Biological Conservation*, 127: 190-200.

Quevedo, M., M. J. Bañuelos, O. Saez & J. R. Obeso. 2006b. Habitat selection by Cantabrian Capercaillie *Tetrao urogallus* cantabricus at the edge of the species' distribution. *Wildlife Biology*, 12: 267-276.

Quevedo, M., R. Rodríguez-Muñoz, M. J. Bañuelos & A. Fernández-Gil, A. 2005. A captive breeding programme for Cantabrian Capercaillie: does it make any sense? *Grouse News*, 5: 16-18.

R Development Core Team. 2008. *R: a language and environment for statistical computing*, Vienna.

Rodríguez-Muñoz, R., P. M. Mirol, G. Segelbacher, A. Fernández & T. Tregenza. 2007. Genetic differentiation of an endangered Capercaillie (*Tetrao urogallus*) population at the Southern edge of the species range. *Conservation Genetics*, 8: 659-670.

Spidso, T.K. & H. Korsmo. 1994. Selection of Feeding Trees by Capercaillie *Tetrao urogallus* in Winter. *Scandinavian Journal of Forest Research*, 9: 180-184.

Storch, I. 1993. Patterns and strategies of winter habitat selection in alpine Capercaillie. *Ecography*, 16: 351-359.

Storch, I. 2007. *Grouse status survey and conservation action plan: 2006-2010*.

Storch, I., M. J. Bañuelos, A. Fernández-Gil,

J. R. Obeso, M. Quevedo & R. Rodríguez-Muñoz. 2006. Subspecies Cantabrian Capercaillie *Tetrao urogallus* cantabricus endangered according to IUCN criteria. *Journal of Ornithology*, 147: 653-655.

Suárez-Seoana, S. & P. García-Roves. 2004. Do disturbances in surrounding areas affect a core population of Cantabrian Capercaillie *Tetrao urogallus* cantabricus? The case of the Natural Reserve of Muniellos (Asturias, NW Spain). *Ardeola*, 51: 395-409.

Summers, R. W., J. Mcfarlane & J. W. Pearce-Higgins. 2007. Measuring avoidance by Capercaillies *Tetrao urogallus* of woodland close to tracks. *Wildlife Biology*, 13: 19-27.

Thiel, D., S. Jenni-Eiermann, V. Braunisch, R. Palme & L. Jenni. 2008. Ski tourism affects habitat use and evokes a physiological stress response in Capercaillie *Tetrao urogallus*: a new methodological approach. *Journal of Applied Ecology*, 45: 845-853.

Thiel, D, S. Jenni-Eiermann, R. Palme & L. Jenni. 2011. Winter tourism increases stress hormone levels in the Capercaillie *Tetrao urogallus*. *Ibis*, 153: 122-133.

Zeiler, H.P. & R. Grünschachner-Berger. 2009. Impact of wind power plants on black grouse, *Lyrurus tetrix* in Alpine regions. *Folia Zoologica*, 58(2): 173-182.

Manuel A. González* & Vicente Ena

Dpt. of Biodiversity and Environmental Management
Faculty of Biology and Environmental Sciences
University of León, Spain
* magong@unileon.es

Table 1. Data related to their survey date. *[Datos obtenidos en los muestreos.]*

Year *Año*	Survey *Muestreos*	Points with data *Puntos con signos de presencia*	Length (m) with data *Longitud (m) con signos de presencia*	Nº of droppings *Nº de excrementos*	Nº of feathers *Nº de plumas*	Nº of footprints *Nº de huellas*	Direct sightings *Avistamientos*	Birds seen *Nº aves vistas*
2009	1	9	450	22	-	2	Yes	1 female
2009	2	8	400	31	-	1	Yes	1 male
2009	3	18	900	25	1	-	Yes	1 female
2009	4	19	950	46	-	6	Yes	1 male
2009	5	11	550	37	-	7	Yes	1 male
2010	1	21	1050	34	-	-	No	-
2010	2	-	-	-	-	-	No	-
2010	3	-	-	-	-	-	No	-
2010	4	-	-	-	-	-	No	-
2010	5	-	-	-	-	-	No	-