Cantabrian capercaillie through time: a further comment

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In a recent note published in this journal (Rubiales et al. 2009) we discuss the role the long-term environmental history of the Cantabrian Mountains may have played in the dynamics of the Cantabrian capercaillie *Tetrao urogallus cantabricus*, the only subspecies of capercaillie at risk of extinction worldwide. Three key conclusions, in the light of the available palaeoecological data were that: 1) the vegetation occurring within the range of the Cantabrian capercaillie has heavily changed during the last three millennia, due primarily to anthropogenic activity; 2) the extensive distribution of pinewoods until the historical period is coherent with the pattern of association of capercaillie and conifers occurring in the rest of its range; and 3) in the light of the distinct current patterns of decline and persistence of the capercaillie, it could be expected that the demise of pinewoods (becoming locally extinct at the western part of the Cantabrian mountains) would have had implications in the capercaillie persistence in the long term.

In this respect, although the Rodriguez-Muñoz et al.'s (2010) note in the last issue of Grouse News purports to be a reply to our communication, it does not respond to any of our arguments, but rather reproduces a misleading debate devoid of any scientific basis. Further, they seem to question the validity of our conclusions by arguing that: 1) genetic and fossil evidence supports that Cantabrian capercaillie has remained confined to the Cantabrian area since, at least, the beginning of the last glacial cycle, and 2) the current decline of capercaillie may not be explained by a long-term ecological process spanning centennials.

Here, we show that the arguments provided by Rodríguez-Muñoz et al (2010) have no scientific relevance to refute our hypothesis. Firstly, they present an unfortunate string of wrong assumptions on the geographical and palaeoecological setting of the Cantabrian areas. A relevant point argued is that human activities have not had a major influence in the shaping of the vegetation (and particularly of pinewoods) during the Holocene. However, accumulating evidence from palaeoecology (including pollen and macrofossils) are showing that pinewoods extensively survived up to the historical period and that anthropogenic activity has been the major driver of change during the last two millennia. Moreover, historical data reinforce that the intense deforestation owed to human action spanned centennials (and not only some decades of the 20th century). These arguments are already detailed in Rubiales et al. (2008, 2009) and in some of the works cited in their own note, as in García Antón et al. (1997); but readers can also check, for further discussions (Manuel et al. 2003, Ezquerra & Gil 2004, Gil & Torre 2006, Sevilla 2008, López Merino et al. 2010, Carrión et al. in press, Jalut et al. in press). Furthermore, niche modelling studies (cited wrongly in the note) such as the examples of Benito et al. (2006, 2008) show that the simulated maps of presence include the Cantabrian Mountains, both for the mid-Holocene and the present, as potential distribution areas for *Pinus sylvestris,* reinforcing the weak role of climate in explaining its recent natural distribution.

Regarding the long term, geographical confinement of Cantabrian capercaillie in the Iberian mountains, we consider that this model is fully compatible with a coupled history with pinewoods (i.e. *Pinus sylvestris*) in the mountains of western Iberia, that also show a long history of isolation as shown from their genetic data (e.g. Soranzo et al. 2000, Chedaddi et al. 2006) and from that of other pine dependent species, (e.g. *Thaumetopoea pityocampa*, Rousselet et al. 2010).

It seems evident that Cantabrian capercaillie has been able to persist without conifers in wide areas during a considerable amount of time and that its present demise is very probably due to a mixture of factors and that the absence of pines is probably not among the most important. However, the question that still remains open is whether or not, under critical adverse situations for the capercaillie, the existence of conifers (pinewoods in the case of Iberia) may confer additional advantages for their survival. It is true that the lack of long-term animal data-sets hamper the precise reconstruction of population trends at the centennial to millennial scale, but in the absence of an empirical approach, there is no theoretical reason to doubt on the existence of long time-lags between habitat deterioration and species losses (e.g. Diamond 1972, Tilman et al 1994). Now more than ever, long-term processes such as resilience and thresholds are major topics of research in the field of ecology (e.g. Willis et al. 2010) that will probably deserve more attention that they have so far received from experimental ecologists. Although increasingly threatened, ongoing research on Cantabrian capercaillie could still help us to deepen in these questions and it thus makes sense to investigate these points by tracking the history of their habitat and the current use of non-natural pinewoods.

In the last paragraphs, Rodríguez-Muñoz and co-workers attempt to discredit our work by attacking questions that we have not addressed (i.e. that "pine afforestation is likely to improve its recovery more than the natural restoration of deciduous forests") or by using demagogic assumptions (i.e. that our argument encourage “forest managers to keep replacing the natural hardwoods with pine plantations”). We believe that a more careful reading of our original note would have obviated this spurious criticism. Contrasting opinions are always welcomed, but instead of using provocative arguments to distort the debate, researchers should rely on objective data to prove their own assumptions. We certainly still believe that those reflections on the role of natural conifers over the long-term history of the Cantabrian capercaillie bring a fresh and open perspective to biogeographers and managers that watch over the conservation of the last capercaillies in the Cantabrian range.

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On the impact of ice crust above snow burrows of grouse

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Menoni et al. (2010) discussed the problems of impact of ice crust formation on grouse and partridges in the winter and its possible relations to climate change. The paper presented two instances of deaths of two Tetraonid birds, ptarmigan *Lagopus muta* and black grouse *Tetrao tetrix*, both with transmitters. The ptarmigan was found in June, whereas the photograph shows the bird in winter plumage without any signs of spring moult. The Black grouse was found in buried in snow. The diagram shows the bird covered with snow on a slope. The bird was located next to a large stone. The paper deals with the issues of ice coating and the combination of conditions which might burry grouse alive in their snow burrow, which the authors tried to demonstrate on the example of two findings mentioned above. Ice coating indeed might appear throughout the grouse range during periods of freezing rain. These conditions of ice coating ("ledyanaya kukhta") are well known in old literature. It is not new that it makes food of grouse inaccessible for several days, and in some cases might cause severe decline of local populations of grouse and even local extinctions (see Formozov 1946, 2010, Novikov 1981, Potapov 1974, 1985, 1992 and references therein). This factor indeed might affect populations of wild grouse, however I found no direct indications that the probability of ice rain significantly increased in the recent global warming episode. The authors did not make any specific indication to that too. In this short communication I address only the issue of 'buried in snow chamber' phenomenon and its impact on the grouse.

The Grouse, or Tetraonidae birds, are the youngest family of the order Galliformes. Its origin and evolution is based on an old and deep adaptation to survival during the winter season while staying in one place, i.e. survival as a non-migrant. Among these adaptations, both morphological and behavioral, are the habits of the birds to roost under snow, and to move on snow cover. The birds developed unique morphological structures on their toes, represented by pectination on both sides of the phalanges. This trait appears in all species of grouse (except all species of the genus *Lagopus* and Chinese grouse *Bonasa severzowi* at the beginning of the winter. These pectination is very important in the process of digging into snow during preparing the snow burrows (Potapov 1969, 1992). The birds loose this pectination during spring. In *Lagopus* species the pectination is replaced by thick feathering. Another important morphological adaptation for roosting in snow burrows is the thick feathering of the nostrils. The purpose of this adaption is not only to protect the respiration system from the snow crystals while the bird is digging through snow, but to condensate moisture from the exhaled air in order to prevent a formation of icing on the walls of under snow burrows and tunnels. I mention these well known characters here only to stress the importance of snow burrows in which the grouse spend not only long winter nights, but also significant parts of the daytime. The ambient temperature in such snow burrows is optimal for birds, and ranges between -1 and - 3 C. The temperature in snow burrows is not correlated with the ambient temperature above snow level, which often reaches extreme levels of -50 C and below. In other words, the regular roosting in snow burrows (i.e. thermal refuges) is one of the main adaptations of grouse for survival during the winter season. Other important adaptations are the ability to live on twigs, buds, catkins, needles etc of trees and shrubs with low nutritional content throughout all of the winter months.

These adaptations are of a prime importance in the areas with severe winter conditions: Scandinavian countries, most parts of Russia, Alaska (USA), Greenland (Denmark) and Canada. In other countries, especially in Western Europe, where the snowy winters are frequent only in high mountains, the situation is very different. Snow cover appears for a comparatively short time and irregularly. Because of frequent thaws and little thickness this snow cover is not suitable for preparing snow burrows. In such conditions there is no strong need for a thermal shelter for the grouse. This need appears only during the strong and prolonged winter frosts accompanied by the sufficient decrease of the day's longevity. In such cases only two reasons may prevent grouse from preparing a thermal refuge (snow burrow): 1. little quantities or