Are brown bears recovering in the Cantabrian Mountains? Reply to Fernández-Gil et al.

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Abstract: We reply to the critique from Fernández-Gil et al. (2010) regarding our study on trends in female brown bears with cubs (F_{CUB}) in the Cantabrian Mountains, Spain (Palomero et al. 2007). We discuss the relationship between sampling effort and the number of F_{CUB}, the methods used to collect the data, and the relationship between the F_{CUB} and the whole bear population.

Key words: brown bear, Cantabrian Mountains, Chao estimator, females with cubs, sampling effort, Spain, *Ursus arctos*

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Our study of the trends in female brown bears (*Ursus arctos*) with cubs (F_{CUB}) in the Cantabrian Mountains of Spain (Palomero et al. 2007) has been criticized by Fernández-Gil et al. (2010), who question whether there really has been an increase. Their criticism focuses on 3 main aspects: (1) the increase in sampling effort during the study period; (2) unsystematic data collection and (3) the assumption that the F_{CUB} trend reflected the general population trend.

Increase in sampling effort

Fernández-Gil et al. (2010) base their first criticism of our article (Palomero et al. 2007) on data published in a previous book (Palomero et al. 2006:Fig. 1.3) that described the substantial increases in observation effort (number of people involved by the end of the year) during the study period in both Cantabrian populations.

In that book, we considered the possible effect of such an increase on the number of F_{CUB} located. Observation effort was significantly correlated with the number of F_{CUB} in the western population (WP; $r = 0.734$, 16 df, $P = 0.002$), but not in the eastern population (EP; $r = 0.195$, 16 df, $P > 0.1$) (Palomero et al. 2006:39). We also found that observation effort was significantly correlated with the total observations of F_{CUB} in the WP ($r = 0.808$, 16 df, $P < 0.001$), but not the EP ($r = 0.0096$, 12 df, $P > 0.1$). Hence, we concluded that ''the greater effort applied in monitoring the WP involved an increase in the number of observations for each F_{CUB} and better monitoring and verification of F_{CUB} detected'' (Palomero et al. 2006:39).

However, we dispute the conclusion that the trend in F_{CUB} was produced by increasing number of observers for 2 reasons: (1) since monitoring started, a double observation network has existed consisting of a 'Coverage Net' and a 'Survey Net' (the former increases the probability of detection of F_{CUB} throughout the Cantabrian Mountains bear range); and (2) in the WP, increases in other indices related to population size but unrelated to observation effort for the F_{CUB} were noted (see below).

To rule out the possibility that the increase in F_{CUB} was caused by an increase in sampling effort, we suggested examining the dynamics of the F_{CUB} index after sampling efforts stabilised. We are also in the process of examining whether other indices that did not depend on sampling intensity (such as damage to livestock and agriculture) also increased in parallel with the number of F_{CUB} (unpublished data).

Unsystematic data collection

Fernández-Gil et al. (2010) consider our data collection to be unsystematic and point out that our data did not fit the analytical requirements.

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Although more rigorous protocols have been in place since 1994, it is true that the WP data was initially not gathered systematically. Hence, we omitted data from 1989–1993 when assessing the F_{CUB} trend for the WP (Palomero et al. 2007). Briefly explained in Palomero et al. (2007), the method used thereafter was described in detail in Palomero et al. (2006:23). It consisted of a double information network consisting of a general 'Coverage Net' (CN) and a specific network for F_{CUB} called 'Survey Net' (SN). The CN covered the entire brown bear distribution range and provided data on any bear presence, including F_{CUB}. It involved the public authorities' ranger services, which were not specialised in F_{CUB} monitoring (around 80 rangers in WP bear territory), as well as hunting association gamekeepers (approximately 40 in the WP), with the number of observers not changing substantially over the study. Palomero et al. (2006) only quantified as observation effort the Survey Net, which came into operation in 1989 in the EP and 1994 in the WP (currently 9 and 13 people, respectively). Members of the SN were specialists in monitoring F_{CUB} who confirmed data on family groups provided by the Coverage Net and conducted their own surveys. Although the CN was not set up to conduct random sampling (members did not attempt to locate bears according to any pre-established plan), one of their tasks was to inform the regional authorities of any evidence of bear presence in their area of operations, such as bear damage, F_{CUB}, or other bears (for safety reasons, this included information about a bear in an area where hunting was scheduled). Thus, the CN provided homogenous data coverage throughout the Cantabrian brown bear range for decades.

One indication that the CN provided balanced information from the entire bear range even when the SN had few staff is that using both nets, we detected the most dispersing family groups in 1989–92 and 1993–96, when the SN was smaller. Subsequently, despite there being more observers in the SN, we noticed a loss of geographic distribution of peripheral F_{CUB} and concentration of F_{CUB} in the most important breeding areas (Palomero et al. 2007:Fig. 4). If the detected number of F_{CUB} depended on the number of observers in the SN, fewer observers would have resulted in observations being concentrated in the best known areas, and the increase in SN would have made it easier to detect bears located in peripheral areas.

We do not understand Fernández-Gil et al. (2010) when they suggest that estimates for F_{CUB} vary if teams provide different results. Since 1989, results have been validated at a national coordination meeting of all the teams working in the Cantabrian Mountains (Palomero et al. 2006:24). Their concerns about variability would be more applicable to results from data collected prior to the inception of standardised monitoring, such as those of Wiegand et al. (1998) and Naves et al. (1999). These used unconfirmed information from surveys, thereby raising the possibility that data were incomplete, heterogeneous, and not comparable among time periods or locations (Palomero et al. 2006:25).

It is true that because the area was not sampled randomly, and because observers were instructed to obtain multiple observations on each F_{CUB} once identified, data did not conform to the probabilistic model underlying the Chao estimator (M. Haroldson, US Geological Survey, Bozeman, Montana, USA, personal communication, 2006). However, the trend for F_{CUB} in Palomero et al. (2007) was obtained not from the Chao estimator, but rather from the observed F_{CUB}. Therefore, we believe the trend we report is a valid one even if assumptions were violated in calculating the Chao estimator.

Did the trend in F_{CUB} reflect a true population trend?

Fernández-Gil et al. (2010) attributed to us the contention that the F_{CUB} trend reflected the true population trend in Cantabrian brown bears. No such statement appeared in Palomero et al. (2007). We estimated that although the annual 3% rate of increase in F_{CUB} in the EP was not statistically significant, the statistically significant 7.5% rate of increase in the WP allowed us to assume that the population was increasing overall. However, we do not necessarily assert that the increase was 7.5%, merely that the finding of a significant regression of F_{CUB} on time allowed us to conclude that the population was increasing ($\lambda > 1$). We assert that the assumption that the F_{CUB} trend generally reflected the overall population trend was reasonable because, for the overall population to have not increased while the F_{CUB} did, other age and sex classes would have had to decrease. Fernández-Gil et al. (2010) do not present information indicating that this was so. In fact, evidence exists to the contrary. Some of the abundance indices verified by Fernández-Gil and Naves (2007) suggest that bears in at least a part of the WP increased during 1994–2006. While acknowled-

ging the difficulties involved in detecting temporary changes using abundance indices because of small sample sizes and large variances, they posited that "scats appear suitable for considering trends because they are the indices that are least dependent on changes in detectability" (Fernández-Gil and Naves 2007:23), and they found a significant trend of summer scat in Somiedo Natural Park, one of the most important breeding areas in the WP, during 1994–2006 ($r^2 = 0.34$; $P = 0.04$; Fernández-Gil and Naves 2007:11).

Fernández-Gil et al. (2010) suggest that an increase in cases of infanticide might have induced some females to breed annually instead of biannually, which would have led to an overestimate in the number of F_{CUB}. We have no evidence that infanticide has truly increased in recent years, but if we analyse the data again excluding F_{CUB} whose cubs had died (1996, 2000, 2001, and 2004), we find a very similar trend ($\lambda = 1.072$; 95% CI = 0.997–1.153; $P = 0.061$) to that obtained when those animals are included (without the possible effect of infanticide, $\lambda = 1.075$; 95% CI = 1.002–1.154; $P = 0.043$). The confidence intervals of these 2 estimates of λ overlap.

Fernández-Gil et al. (2010) also point out that the adoption of digiscoping may have increased the ability to differentiate family groups, thereby increasing the F_{CUB}, index. However, digiscoping began in 2004, and so could not have affected the 1994–2004 time series. Furthermore, Fernández-Gil et al. (2010) suggest that the increase of F_{CUB} may be due more to good weather conditions than to a decrease in mortality, but they fail to provide any evidence. It would be interesting to make a formal comparison of recent mortality with that prior to the increase in population to shed light on this controversial point. Even if the increase in F_{CUB} were due to reasons other than a reduction in mortality, the increase would still be a valid one.

Fernández-Gil et al. (2010) cautioned that no other temporal window in the period under consideration revealed a positive trend. However, given that the significance of a correlation depends in part on the degrees of freedom of a time series, shortening a series length makes it increasingly unlikely that significant trends will be obtained. To ascertain whether the population is recovering, an analysis of longer, not shorter, time series is required. To do so, it would be advisable to reanalyse the trend for F_{CUB}, adding information from after 2004.

In our opinion, the most important methodological concerns shown by Fernández-Gil et al. (2010) either have already been dealt with (Palomero et al. 2006), are based on incorrect interpretations of Palomero et al. (2007), or are based on unsound methods. From a conservation perspective, their concern would be justified if our data on the partial recovery of the population contradicted those of other studies or if the results of our paper justified a reduction in conservation measures. Neither is the case: bears continue to enjoy the highest level of protection afforded by the autonomous regions, the Spanish State, and the EU, and efforts have been increased on the key issue of improving linkage between the two populations.

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