

CORRESPONDENCE

Human disturbance and the conservation of the Spanish imperial eagle: a response to Gonzalez et al. (2006)M. Ferrer¹, J. J. Negro¹, E. Casado¹, R. Muriel¹ & A. Madero²¹ Department of Applied Biology, Estación Biológica de Doñana, CSIC, Seville, Spain² Consejería de Medio Ambiente, Junta de Andalucía, C/ Fuente del Serbo, Jaén, Spain**Correspondence**

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González *et al.* (2006) analysed the influence of human intrusions on the behavior of breeding Spanish imperial eagles *Aquila adalberti* and concluded that hatching rate was negatively correlated with the frequency of intrusions. Following this result, they suggested the adoption of a 500-m-radius exclusion zone around every nest with no human activities allowed during the breeding season and an outer 800-m-radius buffer zone where some activities would be allowed by permission. This is an interesting and valuable study. Nevertheless, some considerations should be made before the proposal could be adopted.

First, González *et al.* may have underestimated the fact that eagles can habituate to non-lethal human activities. They did report, however, a negative relationship between the probability of a flight reaction and the frequency of human activities, with reactions being less frequent in areas with more human activities. This critical result points out that eagles are indeed able to habituate to human presence, as other raptors do where they are not persecuted (e.g. ospreys *Pandion haliaetus* in North America, Bird *et al.* (1996). Furthermore, this agrees with previous studies on responses of breeding Spanish imperial eagles to human intruders (Ferrer, 1990; Ferrer, García & Cadenas, 1990). These studies showed reinforcement in nest-defense by eagles in the same territories over the years. The legal protection of all birds of prey from the late 1970s in Spain and, especially the growth of public awareness for endangered species, resulted in the reinforcement of the eagles' aggressive tendencies by non-destructive human intruders, including bird-banders or veterinarians. This change in selective pressure, coupled with the fact that the Spanish imperial eagle is a raptor possessing a long reproductive life, would facilitate a decrease in approaching distance to the intruders.

Second, we have concerns with the statistical analyses. González *et al.* reported a significant negative correlation between hatching rate and per cent of days with intrusions during the incubation period ($r_s = -0.63$, $P < 0.05$). However, using data from their table 5, $r_s = -0.627$, $P = 0.052$, only marginally significant under $\alpha = 0.05$ (using Statistica software as well as SPSS software). The authors also reported a non-significant relationship between hatching

rate and average intrusions per day ($r_s = -0.52$, $P > 0.05$), which was in fact significant using the raw data they provide (i.e. $r_s = -0.677$, $P = 0.031$). Nonetheless, excluding territory M-18, with only six observation days, all significances disappear. Taking into account that the relation between disturbances and hatching rate is the basis for the proposed 800-m-radius buffer area, this proposal does not seem to be well supported. In addition, it seems to be unnecessarily conservative, as González *et al.* state that imperial eagles never respond to human intrusions occurring > 600 m away from their nest site. The extra distance from 600 to 800 m covers 88 Ha, or 43.7% of the total suggested area.

Lastly, in long-lived species such as the Spanish imperial eagle, fecundity is the demographic parameter with the lowest effect in the short term on the annual per cent of population change (Ferrer & Calderón, 1990; Ferrer & Hiraldo, 1991; Ferrer, 2001). A hypothetical increase of 5% in fecundity due to the establishment of the human-free area would increase the population 0.09% year⁻¹. A 5% increase in adult survival, however, would increase the population 1.6% year⁻¹, or 17.7 times faster. Results obtained protecting dangerous power lines have shown that even higher annual increases are possible (Ferrer & Hiraldo, 1991). Considering that the Spanish imperial eagle population has been on the increase during the last 10 years, and that more than 60% of the new pairs established themselves in private properties, it seems counter-productive to impose restrictions to land owners. The proposed management action is not warranted from a scientific point of view, and may even be detrimental if the presence of eagles diminished owners' income. There is the risk that eagles were harassed or their nest destroyed (even if unlawful) if otherwise legal activities such as hunting, cork harvesting or livestock raising were curtailed. In conclusion, although we recognize the interest and utility of this study, and we agree to improve eagle fecundity avoiding human interference; we believe that the usefulness of such a buffer area excluding human presence has not been sufficiently demonstrated by Gonzalez *et al.* It is expected to have a small effect on eagle population growth and probably a negative impact in public opinion about eagles. On the other hand, eagle's habituation

to human presence can lead to a huge increase in potential nesting habitat for this species, and there are already examples of eagles successfully raising young <200 m away from picnic areas and roads (M. Ferrer pers. obs.). The adoption of large exclusion areas in otherwise humanized landscapes must be exerted with caution in a world where conservation should not always equate to exclude us humans.

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