



CENTRE FOR EVIDENCE-BASED CONSERVATION

SYSTEMATIC REVIEW No. 27

**WHAT ARE THE IMPACTS OF HUMAN RECREATIONAL
ACTIVITY ON THE DISTRIBUTION, NEST-OCCUPANCY RATES
AND REPRODUCTIVE SUCCESS OF BREEDING RAPTORS?**

REVIEW REPORT

Reviewers: Alejandro Martínez-Abraín, Daniel Oro, Juan Jiménez, Gavin Stewart & Andrew Pullin

Postal Address: IMEDEA (CSIC-UIB), C/Miquel Marquès 21, 07190 Esporles, Mallorca, Spain

E-mail Address: a.abrain@uib.es
Telephone: +34971611929
Fax: +34971611761

Martínez-Abraín, A., Oro, D., Jiménez, J., Stewart, G. & Pullin, A. 2008. What are the impacts of human recreational activity on the distribution, nest-occupancy rates and reproductive success of breeding raptors? Systematic Review No. 27. Collaboration for Environmental Evidence.

COVER SHEET

Title	WHAT ARE THE IMPACTS OF HUMAN RECREATIONAL ACTIVITY ON THE DISTRIBUTION, NEST-OCCUPANCY RATES AND REPRODUCTIVE SUCCESS OF BREEDING RAPTORS?
Systematic review	Nº27
Reviewer(s)	Martínez-Abraín, A., Oro, D., Jiménez, J., Stewart, G. & Pullin, A.
Date draft protocol published on website	<i>21st March 2007</i>
Date final protocol published on website	<i>11th July 2007</i>
Date draft review published on website	<i>6th March 2008</i>
Date final review published on website	<i>12th June 2008</i>
Date of most recent amendment	
Date of most recent SUBSTANTIVE amendment	
Details of most recent changes	
Contact address	IMEDEA (CSIC-UIB),C/Miquel Marquès 21, 07190 Esporles, Mallorca, Spain
Sources of support	Conselleria de Medio Ambiente (Generalitat Valenciana)
Conflicts of interest	<i>None</i>

SYSTEMATIC REVIEW SUMMARY

Background

One of the most common topics in environmental impact assessment is the effects of human disturbance on bird species, and particularly on birds of prey. However, scientific information available on this topic has never been properly synthesized so that decisions taken by managers can be based on evidence rather than on personal experience or on individual pieces of information which may be inconsistent with the whole.

Objectives

To systematically collect and synthesize the available published and unpublished evidence in order to answer the question ‘what are the impacts of human recreational activities on nest-occupancy rates and reproductive success of breeding raptors?’

Search strategy

Seven electronic databases were searched using 19 sets of specific keywords. Unpublished information was sought by means of web-based search engines and by writing to individual experts and institutions involved in raptor study and protection.

Selection criteria

We included studies that fulfilled the following criteria:

1. Subject: breeding raptors (both diurnal and nocturnal)
2. Intervention: human recreational activities performed close to nesting sites during the breeding period.
3. Outcomes: changes in nesting-site location, nest-occupancy rate and breeding success parameters.
4. Types of study: any field *in situ* study carried out in any part of the world involving wild-breeding raptors, comparing occupied nests (treatment) with random points in unoccupied areas suitable for reproduction or comparing nest location and performance before and after human disturbance took place (BACI experiments).

Data collection and analysis

Agreement between two independent researchers was assessed and a high degree of accordance was found for study inclusion, suggesting a repeatable procedure. Data (all original statistics from which an effect size could be calculated) were extracted following an a priori data extraction protocol regarding subject, intervention and outcome. Random-effects meta-analysis was performed by means of the software Metawin 2.1 on twenty-four independent data points, consisting of means, standard deviations and sample sizes of both control and treatment. The overall data set was divided into subgroups and meta-analysis was performed for each subgroup individually to account for heterogeneity. We modelled causes of heterogeneity by means of the software and environment R, taking individual effect sizes as the response variable, species and nesting site (tree vs. cliff-nesting) as factors and body size as a covariate (both as a continuous variable and as a dichotomous one). Models were built both for Hedge’s *d* and the log response ratio (lnR), as effect size metrics. Model selection was carried out taking into account the loss of Kullback-Leibler information by means of information theoretic criteria linking classical likelihood

theory with theoretical information criteria (Akaike Information Criterion and Akaike weights).

Main results

A total of 3887 articles were detected by our specific searches. The final number of articles considered for data extraction was 52. The only outcome that we could meta-analyze was the displacement distance of nests from roads, compared to random points in suitable areas for breeding. Although the literature also provided comparable information on other anthropic variables, such as distance to unpaved tracks, we decided to consider only one of these variables (roads) as surrogate of human access to the countryside. A total of 24 studies were found to provide comparable information on this outcome.

A modest statistically significant effect of the presence of paved roads (as a proxy of human accessibility to the countryside) on raptor nest location was found after performing a random-effects meta-analysis on 24 independent data points (Pooled effect size (lnR)=0.22 (Bootstrap 95%CI 0.036 to 0.423; back-transformed ln Response Ratio 1.28; 1.07-1.57 bootstrap 95% CI). The mean absolute magnitude of nest displacement from roads, compared to random control points, was 663.46 ± 389.23 m.

Species negatively affected by roads included Cooper's hawk, Spanish Imperial Eagle, Cinereous Vulture, Booted eagle, Eagle owl, Common buzzard, Bald eagle, and Peregrine falcon, some of them endangered species. Species which showed a tendency to be positively affected by roads included: Peregrine falcon, Booted eagle and Common Buzzard. The fact that some species such as Booted eagles and Common buzzards are present in both categories suggests that distance to roads is, to some extent, a population-specific trait, rather than a species-specific trait.

When exploring heterogeneity by means of Generalized Linear Mixed Models two explicative variables were considered: size of the raptor (body length), and nature of nesting substrate (tree-nesting vs. cliff-nesting) in addition to species which was incorporated as a random variable to prevent pseudoreplication. The longest displacement distances to roads were shown by big raptors breeding on trees, a group including many threatened species such as Cinereous vulture and Spanish Imperial eagle. Mean distance for this group of species was 1375 ± 922.4 m. In fact, model selection by means of information theoretic criteria indicated the influence of body size and nesting substrate on effect size was similar, especially when using Hedges' d as an effect size metric.

Conclusions

Implications for management / policy / conservation: In countries where forested areas are very fragmented the fact that big and tree-nesting raptors tend to nest far from roads can be a serious handicap for reproduction. Big raptors commonly nesting on trees (e.g. Booted eagle) which are found nesting on cliffs eventually, might reflect local human disturbance if trees are not scarce. Similarly, typically cliff-nesting raptors found breeding on trees (e.g. Golden eagle) might indicate low local human disturbance, if cliff availability is not a limiting factor locally.

Implications for research: Further empirical work (BACI experiments) to quantify the effect of human recreational activities on breeding raptors needs to be carried out if conservation decisions are to be based on evidence. No substantive progress on knowledge accumulation regarding this topic has been detected in the last 30 years.