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CEE review 07-003

WHAT ARE THE EFFECTS OF RECREATIONAL ACTIVITIES ON BREEDING SUCCESS OR BREEDING-SITE FIDELITY OF DIURNAL RAPTORS?

Systematic Review Protocol

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1. BACKGROUND

The risk of impact of recreational human activities to breeding birds of prey is a common topic highlighted by many environmental impact assessments (EIA) worldwide. However, typically environmental impact studies fail to provide proper evidence on the impact of these activities on breeding success and breeding-site fidelity (dispersal) of individual pairs, and especially on the population and meta-population consequences of human activities (Martínez et al. 2003; Suárez et al. 2003). Often managers use the precautionary principle to limit or ban these activities over sighting the previous step of systematically reviewing the information available to make a decision based on evidence.

When dealing with long-lived species such as raptors the survival of adult age classes is the parameter with a higher influence on the population growth rate. Hence, it is of little relevance to put a lot of resources into improving fecundity if causes of adult mortality owing to human activity (e.g. electrocution, drowning, food scarcity owing to human-facilitated diseases, etc) are operating. On the other hand, permanent breeding dispersal out of occupied territories, owing to human impact, can act as an equivalent of local mortality for the local dynamics of the population. However, in practice, many EIAs do not address the health of local raptor populations, but are only concerned with the fate of particular breeding pairs for which extant laws require protection.

Importantly we know from behavioural science that impact of humans on birds is, to a large extent, a matter of cultural habituation to human presence. Large penguins, living in isolated areas with few or no predators become naïve and lose costly anti-predator behaviours, although not all such behaviour is affected (Blumstein & Daniel 2005). For example Humboldt penguins (*Spheniscus humboldti*), which are seldom exposed to human presence apparently do not fear the presence of humans in their breeding colonies, but are actually physiologically stressed (a person passing an incubating penguin at 150 m distance provokes a significant heart rate response), which translates into reduced breeding success (Ellemberg et al. 2006). Likewise Magellanic penguins (*Spheniscus magellanicus*) show typical adrenocortical responses to stressors when humans are present in their breeding grounds, but only if the colony has not been exposed to very high levels of ordinate human presence. Colonies exposed to moderate levels of disturbance do not show evidence of habituation over a period of a few years (Fowler 1999). Hence a usual management suggestion made by scientists is concentrating tourist visits in a small part of breeding colonies allowing birds in the visitation area to habituate (Martínez-Abraín et al. 2007).

Nevertheless, the degree and speed of habituation seems to be a species-specific trait as well as a site-specific trait (Blumstein et al. 2003). It also seems to be quite dependent on size and diet, with large predator species having less tolerance to human presence (Blumstein 2006). For example, although some habituation to pedestrians by Spanish Imperial Eagles was shown by González et al (2006) the same species, together with vultures, showed decreased local abundances during weekends associated to increased road traffic in these areas compared to week days (for a similar case with wintering Bald eagles consult Stalmaster & Kaiser 1998). However, the occurrence of other species did not change between working days and weekend days (Bautista et al. 2004). Habituation seems also to vary depending on age. Adult Bonelli's eagles (*Hieraaetus fasciatus*) may seek the proximity of human settlements during breeding, since they take advantage of human-associated fauna such as pigeons to forage (Sanz et al. 2005), but dispersing juveniles choose areas located farther from villages and roads than expected by chance alone (Balbotin 2005).

Regarding raptors, some wild-ranging species, which in the past were not associated with urban areas at all, are known to be colonising towns and cities as direct persecution by humans has decreased. This is the case of the common kestrels (*Falco tinnunculus*) breeding in Berlin (Kubler et al. 2005) and in many other large European cities. This is also the case as well of peregrine falcons (*Falco peregrinus*), re-introduced to many urban areas around the world, such as North America (Cade & Bird 1990; Holroyd & Banasch 1990, Italy (Serra et al. 2001), Perú (Beingolea et al. 2003), Spain (Durany 2006) or Poland (Rejt 2003; 2004), to name just a few. Red-tailed hawks (*Buteo jamaicensis*) are also expanding into urban locations and seem to adjust well to urbanization (Stout et al. 1998; 2006). Raptors breeding in urban areas have high degrees of popular acceptance (Martell et al. 2000), show high plasticity in their diets to adapt to urban prey availability (eating mostly birds since urbanization increases bird biomass), and higher breeding success than their rural counterparts (Kauffman et al. 2003; 2004) or at least similar (Coleman et al. 2002), because they are often free from human persecution and have lower levels of nest predation and parasitism (Chace & Walsh 2006). In some instances, raptors can find safe places in urban areas to breed whilst moving to the rural outskirts to forage (op. cit.) or, on the contrary, breed in wild areas and move to urban or suburban areas to forage (Brambilla et al. 2006). However, sometimes urban environments act as ecological traps providing misleading cues of habitat quality to raptors such as Cooper's Hawks (Boal 1997).

Hence, not only colonial breeding birds can get used to human presence but also solitary breeders such as some falcons and hawks, since urban breeding entails habituation to humans. Some level of habituation to humans by raptors also occurs when humans frequent the breeding grounds of raptors breeding in wild areas (González et al. 2006). However habituation only can occur when two main requirements are met: a) lack of direct effect on birds by means of the proper ordination of human visits (McClung et al. 2004; Finney et al. 2005; Arroyo & Razin 2006) and b) high intrusion frequencies over a long time period (González et al. 2006; see Urios & Martínez-Abraín 2006 for a case of low habituation of a social raptor in an island colony with a low load of terrestrial visitation, but moderate levels of boat affluence during the breeding period). Raptors breeding in isolated sites are not used to human presence, and are most likely especially vulnerable to disturbance.

The question arises whether individual pairs (using either cliff, ground or forest breeding habits) can have their breeding success and fidelity to nesting sites affected by human recreational use of their breeding grounds. Breeding success can be influenced by a number of factors such as reduced nest attendance and consequent cooling or overheating of eggs, permanent clutch abandonment, absence of replacement clutches, lower success of replacement clutches, reduced chick brooding owing to temporal abandonment, permanent chick abandonment or reduced foraging success and hence reduced feeding rates to chicks. In turn, nest-site fidelity can be affected within a breeding season (nest abandonment with subsequent re-occupation) or between seasons (no nest re-occupation between seasons or permanent dispersal).

On the other hand it will also be important to keep in mind during the process of review of this question that human recreational uses could affect raptors more by reducing the quality of potentially good sites for breeding, which are presently unoccupied, than by affecting the normal development of breeding in presently occupied sites. Human occupation of potentially good sites may be the cause for density-dependent inter-specific competition among raptor species with increasing growth rates, owing to site limitation, with negative effects for the less aggressive species (see Ontiveros et al. 2004). This general scarcity of high-quality breeding sites could explain the earlier breeding calendar of some raptor species syntopic to other such raptor species, with more aggressive behaviours, when the more aggressive one or both are showing increasing trends.

Here we shall explore the literature on breeding-site fidelity and breeding success of diurnal raptors to find out whether there is scientific evidence of any effect of recreational activities on the components of fecundity and breeding dispersal as well as on the determinants of these effects, if they occur. To the best of our knowledge only Sidaway (1990) and Woodfield & Langston (2004) have made traditional reviews on the disturbance of human access on foot to birds. Likewise, an ongoing systematic review is now dealing with the impact of public access on ground-nesting birds (Dave Showler, pers. com.). A traditional review oriented to protecting raptors from human disturbance can also contain relevant information on the topic to review (Richardson & Miller 1997).

2. OBJECTIVE OF THE REVIEW

1.1 Primary question

Do human recreational activities affect breeding success and breeding-site fidelity in diurnal raptors?

Table 1. Definition of components of the primary systematic review question.

Subject	Intervention	Outcome	Comparators	Designs
World breeding diurnal birds of prey	Recreational activities carried out close to nest sites	1. Reduced breeding success or reduced rate of nest-site re-occupation between years affected or not-affected by human recreational uses 2. Reduced breeding success or reduced rate of nest-site re-	1. Breeding success and rates of nest re-occupation in random nests not affected by recreational activities or 2. breeding success and rates of nest re-occupation after human disturbance if long-term	Annual monitoring of raptor nests and territories in areas subjected to recreational activities and areas without these activities or long-term annual monitoring of a sample of raptor nests and

	occupation between areas affected or not-affected by human recreational uses (*)	monitoring data are available	territories including information before and after human disturbance. Experiments measuring flight initiation distance.

(*) If this information is not available we shall summarize flight initiation distances reported for different species during the breeding period.

2.2 Secondary questions

What components of breeding success and breeding-site fidelity are specifically affected by recreational activities?

Although the main question to answer is whether recreational activities affect breeding success and nest-site fidelity in diurnal raptors it may proof useful to identify the specific components of breeding success and nest-site fidelity affected, for management and conservation purposes.

Final breeding success is influenced both by the egg and chick stages. Hence it would be useful to know whether nest vulnerability is higher during the egg or during the chick phases of reproduction. Survival of eggs and chicks may also differ according to local weather conditions and hence it is worth exploring whether raptors breeding in high latitudes or altitudes are more vulnerable than those breeding at low latitudes and altitudes.

Breeding-site fidelity can be divided into fidelity to particular nests or to particular breeding areas, since large raptors are known to have a number of nests whose use they alternate between years. So it is important to know whether nest abandonment is just a local change of nest within the same territory (owing to changes in food availability or changes in pair composition) or a whole local abandonment, with breeding dispersal associated (see Martínez-Abraín et al. 2002). Change of nest can also affect breeding success owing to the heterogeneous nature of nest quality.

What characteristics make raptors more vulnerable to breeding failure or nest abandonment owing to human disturbance?

In addition to external characteristics associated to human disturbance (intensity of frequentation, type of disturbance) it is also important to take into account the intrinsic factors that may make raptors more vulnerable to human presence. Main intrinsic factors influencing breeding response of raptors to human disturbance would include at least social vs. solitary nesting, the size of the species (large species seem to be more vulnerable), reproductive effort (species with high reproductive effort seem to be exhibit more aggressive nest defence), nest accessibility (species with more accessible nests have more aggressive defences;

e.g. ground nesting vs. cliff nesting or tree-nesting species), cover type of nests (species nesting in open-cover nests being more aggressive) (Morrison et al. 2006). Additionally it would be interesting to explore the influence of human presence on prey behaviour since disturbance to predators could me mediated by human disturbance to their prey.

Hence a list of topics to study the determinants of the vulnerability of breeding raptors to human recreational presence would include at least the following:

External factors

- Intensity of human frequentation (factor)
- Type of human disturbance (factor)
- Distance from disturbance to nest (covariate)
- Altitude
- Weather conditions
- Latitude
- Food availability
- Duration of the disturbance
- Topography
- Location of the disturbance (above or below the nest)

Internal factors

- Taxonomic Family (factor)
- Social vs. solitary nesting (factor)
- Mean size of the species (covariate)
- Reproductive effort of the species (covariate)
- Nest accessibility (factor)
- Cover type of nests (factor)
- Disturbance to prey (factor)

From the joint analysis of these factors and covariates applied conclusions could be derived as to propose managing strategies that prevent human disturbance or remediate possible ongoing negative effects.

3. METHODS

3.1 Search strategy

3.1.1. General sources

The following computerised databases will be searched:

1) ISI Web of knowledge (inc. ISI Web of Science and ISI Proceedings)
2) Science Direct
3) Scopus
4) Index to Theses Online
5) Digital Dissertations Online
6) CAB Abstracts

Searches will be done around the following English language search terms:

- “Flight initiation distance” AND (raptor* OR “bird of prey”)
- “Human disturbance” AND (raptor* OR “bird of prey”)
- “Breeding success” AND (raptor* OR “bird of prey”)
- “Nest site fidelity” AND (raptor* OR “bird of prey”)
- Human activit* AND (raptor*or “bird of prey”)
- Human approach* AND bird*
- Escape* AND (raptor OR “bird of prey”)
- Recreation* AND (raptor* OR “bird of prey”)
- Disturb* AND (raptor* OR “bird of prey”)
- Touris* AND (raptor* or “bird of prey”)
- Urban* AND (raptor* OR “bird of prey”)
- Impact* AND (raptor* OR “bird of prey”)
- Road* AND (raptor* OR “bird of prey”)
- Car AND human AND (raptor* OR “bird of prey”)
- Hiking AND (raptor* OR “bird of prey”)
- Research effect* AND (raptor* OR “bird of prey”)
- “Flushing distance” AND (raptor* OR “bird of prey”)
- “Nest success” AND (raptor* OR “bird of prey”)
- Leisure* AND disturbance*

No geographical restriction will be applied to the literature search since all information on any diurnal raptor species is valuable for the purposes of this review, despite the conclusions of the review are finally applied to a particular geographical region.

An Internet search will also be performed using meta-search engines and recommended sites:

http://www.alltheweb.com
http://www.dogpile.com
http://www.google.com
http://www.scholar.google.com
http://www.scirus.com
http://www.ecoinformatics.org/
http://www.data.esa.org
http://www.conservationevidence.com
http://ris.wr.usgs.gov

The first 50 hits (word and/or PDF documents where this can be separated) from each internet search will be examined for appropriate data which will be retrieved. All references retrieved from the computerised databases will be exported into a bibliographic software package prior to assessment of relevance using inclusion criteria.

Bibliographies of included material will be searched for relevance references. Authors of relevant articles will be also contacted for further recommendations, and for provision of any published material or missing data.

3.1.2. Specialist sources

Specialist websites will also be searched for relevant information, including those of NGOs dealing with bird conservation such as RSPB, BTO or BirdLife International, as well as the Raptor Information System.

3.2 Study inclusion criteria

- **Relevant subjects:** Any raptor species
- **Types of intervention:** Any kind of human recreational activity (e.g. road traffic, hiking, human approach, tourism or research activities) performed closed to the nest site of diurnal birds pf prey.
- **Types of comparator:** Breeding success/rates of nest re-occupation in random nests not affected by recreational activities, if control/treatment data are available. 2. Breeding success/rates of nest re-occupation after human disturbance, if long-term monitoring data are available.
- **Types of outcome:** Changes in breeding success or reduced rate of nest-site re-occupation between years affected or non-affected by human recreational uses 2. Changes in breeding success or reduced rate of nest-site re-occupation between areas affected or non-affected by human recreational uses.
- **Types of study:** We shall consider any primary study providing annual monitoring of raptor nests and territories in areas subjected to recreational activities and areas without these activities or long-term annual monitoring of a sample of raptor nests and territories including information before and after human disturbance. We shall also consider primary research dealing with FIDs.
- **Potential reasons for heterogeneity:** Diurnal raptors comprise a large variety of species with distinguishing features (taxonomic bias). All this heterogeneity can in turn translate into ecological bias influencing the final outcome, and hence must be taken into account during the review. Main factors influencing response of raptors to human presence include at least the size of the species (large species seem to be more vulnerable), reproductive effort (species with high reproductive effort seem to be exhibit more aggressive nest defence), nest accessibility (species with more accessible nests have more aggressive defences; e.g. ground nesting vs. cliff nesting or tree-nesting species), cover type nests (species nesting in open-cover nests being more aggressive) (Morrison et al. 2006).

Methodological reasons for heterogeneity would include the fact that outcomes are derived from randomized control/treatment studies or from before/after experiments.

Also, a source of heterogeneity could come from the fact that the review is done by more than one researcher with different inclusion criteria of papers. To prevent that initial assessments of study relevance will be undertaken by one reviewer assessing titles (and abstracts). The repeatability of study inclusion will be verified by assessing a random subset of the references for relevance using a second independent reviewer.

Agreement between the two reviewers must be substantial (kappa=0.6) before assessment of study quality and data extraction from full text articles can be initiated.

3.3 Study quality assessment

3.3.1 Internal validity

To determine the level of confidence that may be placed in selected data sets, each one must be critically appraised before data extraction to assess the extent to which its research methodology is likely to prevent systematic error or bias. Sensitivity analyses will be used to assess the bias associated with particular methodologies outlined in the matrix below:

Table 2: Types of bias that may be encountered

Type of bias	Low data quality	Intermediate data quality	High data quality
Selection bias (differential assembly of comparison groups)	No comparator No replication No definition of sampling universe	Pseudo-replication Partial definition of sampling universe Improper randomization	Randomized Well replicated Sampling universe defined
Performance bias (differential ecology acting on comparison groups)	Differential number or magnitude of factors influencing heterogeneity for comparison (different types of impact, sites or taxonomy)	Some degree of unbalance in the number or magnitude of factors influencing heterogeneity for comparison	Balance in the number or magnitude of factors influencing heterogeneity for comparison (e.g. type of impact, type of site, taxonomic group)
Detection bias (bias associated with the estimate of breeding parameters)	Availability of lambdas derived just from the initial and last values of time series Differential length of time series from which nest fidelity is estimated Inconsistent measures of breeding success and breeding-site fidelity	Time series with some missing points Some difference in the length of time series used to derive nest site fidelity Some inconsistency on measures of breeding success and breeding-site fidelity	Whole time series from where mean population growth rates and standard deviations are derived Same length of time series for the study of nest-site fidelity Consistent measures of breeding success and breeding-site fidelity
Attrition bias (differential loss of samples related to the intervention)	Only a few types of disturbances to study birds are actually recorded	Some types of disturbance are recorded	All types of disturbances to raptors are recorded

3.3.2 External validity

Results obtained on this review of human disturbance on breeding success and breeding-site fidelity of diurnal raptors are likely to have a large degree of external validity since our literature search is not restricted geographically but includes case studies from all over the world. Nevertheless results can be compared with similar studies performed with other bird groups or other vertebrate (non-bird) groups.

3.4 Data extraction strategy

Data extraction will be undertaken using a review-specific data extraction form. This will be piloted prior to use, to assess repeatability using independent reviewers and a selection of literature spanning a range of outcomes and data quality. Data extraction forms will be amended as necessary to ensure repeatability.

Where necessary, missing data will be imputed from summary statistics or inferred. Sensitivity analysis will be used to explore the impact of any assumptions regarding imputed data.

3.5 Data synthesis

Data extracted both from the grey literature and published material will be meta-analyzed to look for differences in effect size of human impact on breeding success by comparing the mean breeding success before and after disturbance or between pairs affected or non-affected by human disturbance, weighted by the inverse variance (risk ratio assessment). To analyze the impact on rates of nest re-occupation we shall transform, when possible, the qualitative category occupied/unoccupied by distance to the new nest location when there is dispersal. Pairs occupying their nest from one year to the next will be scored 0 m. Pairs which are not marked cannot be assigned to particular nests but we shall assume that new pairs breeding within the former territory of a pair correspond to the same pair. A difference in effect size larger than 0.5 standard deviations will be considered biologically relevant. The relevance of nest-translocation distance is difficult to establish a priori because it changes greatly with species (e.g. large raptors can change nests at distances larger than 5 km within the same territory). If finally this fine quantitative information is not available we shall work with data extracted from behavioural studies dealing with flight initiation distances and shall simply summarize the distances reported for different raptor species, because FIDs are not typically taken during periods of breeding and non-breeding for comparison.

The analysis of external and internal determinants of vulnerability to human impact would be approached through meta-regression by taking mean flight initiation distances as a dependent variable explained by all factors and covariates susceptible of introducing heterogeneity. To prevent pseudo-replication, owing to taxonomic proximity, analyses should be performed by means of phylogenetically independent contrasts.

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5 POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT

There are no potential conflicts of interest to be declared.

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6 REFERENCES

Arroyo, B. & Razin, M. 2006. Effect of human activities on bearded-vulture behaviour and breeding success in the French Pyrenees. Biological Conservation: 276-284.

Balbotin, J. 2005. Identifying suitable habitat for dispersal in Bonelli's eagle: An important issue in halting its decline in Europe. Biological Conservation 126: 74-83.

Bautista, L.M., García J.T., Calmaestra R.G., Palacín, C., Martín, C.A., Morales, M.B., Bonal, R. & Viñuela, J. 2004. Effect of weekend road traffic on the use of space by raptors. Conservation Biology 18: 726-732.

Beingolea, O., La Venturosa, C. & white, C.M. 2003. First breeding record for Falco peregrinus in urban Lima, Peru, with remarks on the Peruvian breeding population. Journal of Raptor Research 37: 84-85.

Blumstein, D.T. 2006. Developing an evolutionary ecology of fear: how life history and natural history traits affect disturbance tolerance in birds. Animal Behaviour 71: 389-399.

Blumstein, D.T. & Daniel, J.C. 2005. The loss of anti-predator behaviour following isolation on islands. Proceedings of the Royal Society Series B 272: 1663-1668.

Blumstein, D.T., Anthony, L.L., Harcourt, R. & Ross, G. 2003. Testing a key assumption of wildlife buffer zones: is flight initiation distance a species-specific trait? Biological Conservation 110: 97-100.

Boal, C. W. 1997. An urban environment as an ecological trap for Cooper's Hawks Dissertation, University of Arizona, Tucson, Arizona, USA.

Brambilla, M., Rubolini, D. & Guidali, F. 2006. Factors affecting habitat selection in a cliff-nesting peregrine *Falco peregrinus* population. Journal of Ornithology 147: 428-435.

Cade, T.J. & Bird, D.M. 1990. Peregrine falcons, *Falco peregrinus*, nesting in an urban environment: a review. Canadian Field Naturalist 104: 209-218.

Chace, J.F. & Walsh, J.J. 2006. Urban effects on native avifauna: a review. Landscape and urban planning 74: 46-69.

Coleman, J.L., Bird, D.M. & Jacobs, E.A. 2002. Habitat use and productivity of sharp-shinned hawks nesting in an urban area. Wilson Bulletin 114: 467-473.

Durany, E. 2006. http://www.ctv.es/USERS/rbn/Theme/pdf/Premsa/2005

Ellemberg, U., Mattern, T., Seddon, P.J. & Jorquera, G.L. 2006. Physiological and reproductive consequences of human disturbance in Humboldt penguins: The need for species-specific visitor management. Biological Conservation 133: 95-106.

Finney, S.K., Pearce-Higgins, J.W. & Yalden, D.W. 2005. The effect of recreational disturbance on an upland breeding bird, the golden plover Pluvialis apricaria. Biological Conservation 121: 53-63.

Fowler, G.S. 1999. Behavioural and hormonal responses of Magellanic penguins (*Sphenicus magellanicus*) to tourism and nest site visitation. Biological Conservation 90: 143-149.

González, L.M., Arroyo, B.E., Margalida, A., Sánchez, R. & Oria, J. 2006. Effect of human activities on the behaviour of breeding Spanish imperial eagles (*Aquila adalberti*): management implications for the conservation of a threatened species. Animal Conservation 9: 85-93.

Holroyd, G.L. & Banasch, U. 1990. The re-introduction of the peregrine falcon *Falco peregrinus anatum* into southern Canada. Canadian Field Naturalist 104: 203-208.

Kauffman, M.J., Frick, W.F. & Linthicum, J. 2003. Estimation of habitat-specific demography and population growth for peregrine falcons in California. Ecological Applications 13: 1802-1816.

Kauffman, M.J., Pollock, J.F. & Walton, B. 2004. Spatial structure, dispersal, and management of a recovering raptor population. American Naturalist 164: 582-597.

Kubler, S., Kupko, S. & Zeller, U. 2005. The kestrel (*Falco tinnunculus* L.) in Berlin: investigation of breeding biology and feeding ecology. Journal of Ornithology 146: 271-278.

Martell, M.S., McNicoll, J.L. & Redig, P.T. 2000. Probable effect of delisting of the peregrine falcon on availability of urban nest sites. Journal of Raptor Research 34: 126-132.

Martínez, J.A., Martínez, J.E., Zuberogoitia, I., García, J.T., Carbonell, R., De Lucas, M. & Díaz, M. 2003. Environmental impact assessment on raptor populations: difficulties in implementation and a search for solutions. Ardeola 50: 85-102.

Martínez-Abraín, A., Oro, D., Ferrís, V. & Belenguer, R. 2002. Is growing tourist activity affecting the distribution or number of breeding pairs in a small colony of the Eleonora's Falcon? Animal Biodiversity and Conservation 25: 47-51.

Martínez-Abraín, A., Oro, D. & Jiménez, J. 2007. Determinants of habituation to humans by yellow-legged gulls *Larus michahellis*. Unpublished report. Conselleria de Territorio y Vivienda. Generalitat Valenciana.

McClung, M., Seddon, P.J., Massaro, M. & Setiawan, A.N. 2004. Nature-based tourism impacts on yellow-eyed penguins Megadyptes antipodes: does unregulated visitor access affect fledging weight and juvenile survival? Biological Conservation 119: 279-285.

Morrison, J.L., Terry, M. & Kennedy, P. 2006. Potential factors influencing nest defense in diurnal North American raptors. Journal of Raptor Research 40: 98-110.

Ontiveros, D., Real, J., Balbontin, J., Carrete, M.R., Ferreiro, E., Ferrer, M., Mañosa, S., Pleguezuelos, J.M. & Sánchez-Zapata, J.A. 2004. Conservation biology of the Bonelli's eagle in Spain: research and management. Ardeola 51: 461-470.

Rejt, L. 2003. Why do urban peregrines lay erlier in Warsaw? Ekologia-Bratislava 22: 423-428.

Rejt, L. 2004. Nocturnal feeding on young by urban peregrine falcons (*Falco peregrinus*) in Warsaw (Poland). Polish Journal of Ecology 52: 63-68.

Richardson, C.T. & Miller, C.K. 1997. Recommendations for protecting raptors from human disturbance: a review. Wildlife Society Bulletin 25: 634-638.

Sanz, A., Mínguez, E., Anadón, J.D. & Hernández, V.J. 2005. Uso heterogéneo del espacio en tres territorios de reproducción del aguila-azor perdicera (Hieraaetus fasciatus). Ardeola 52: 347-350.

Serra, G., Lucentini, M. & Romano, S. 2001. Diet and prey selection on nonbreeding peregrine falcons in an urban habitat of Italy. Journal of Raptor Research 35: 61-64.

Sidaway, R. 1990. Birds and Walkers. A review of existing research on access to the countryside and disturbance to birds. Rambler's Association, London.

Stalmaster, M.V. & Kaiser, J. L. 1998. Effects of recreational activity on wintering bald eagles. Wildlife Monographs 137: 1-46.

Stout, W.E., Anderson, R.K. & Papp J.M. 1998. Urban suburban and rural Red-tailed Hawk nesting habitat and populations in southern Wisconsin. Journal of Raptor Research 32: 221-228.

Stout, w.E., Temple, S.A. & Cary, J.R. 2006. Landscape features of red-tailed hawk nesting habitat in an urban/suburban environment. Journal of Raptor Research 40: 181-192.

Suárez, F., Traba, J., Morales, M.B., Arrieta, S., Herranz, J. & Onate J.J. 2003. Birds and environmental impact assessment: are we correctly addressing the problem? Ardeola 50: 295-300.

Urios, G. & Martínez-Abraín, A. 2006. The study of nest-site preferences in Eleonora's falcon *Falco eleonorae* through digital terrain models on a western Mediterranean island. Journal of Ornithology 147:13-23.

Woodfield, E. and Langston, R. 2004. Literature review on the impact on bird populations of disturbance due to human access on foot. RSPB research report No. 9, Project Ref. FST20-11-011.

APPENDIX 1: AUTHORS AND MAJOR STAKEHOLDERS FOR CONSULTATION

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Statutory/Governmental Advisory organisations

- British Trust for Ornithology
- Royal Society for the Preservation of Birds
- BirdLife International

Charities/NGO's
None