



***CEE review 08-001***

***IS PREDATOR CONTROL AN EFFECTIVE STRATEGY FOR  
ENHANCING BIRD POPULATIONS?***

***Systematic Review Protocol***

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## 1. BACKGROUND

The control of predators in order to protect populations of vulnerable species is an important nature conservation issue. The population growth of native predator species in some areas and the introduction of non-native predators beyond their natural range such as to oceanic islands, has led to increased predation pressure upon many vulnerable species. Research has shown that fauna may be negatively affected and at the extreme pushed to extinction by predation (e.g. O'Connor 1991; Groombridge 1992; Côté & Sutherland 1995). Predation pressure is often set against a background of increasingly fragmented habitats, land-use changes and numerous other human interventions which may increase predation intensity and thus its detrimental effects on populations (e.g. Terborgh 1989; Krebs *et al.* 1999).

To assess the efficiency of predator removal as a conservation measure for vulnerable bird species, the results of 20 published studies of predator removal programs were meta-analysed by Côté & Sutherland (1997). Results showed that predator removal had a large, positive effect on hatching success of the prey bird species, with removal areas showing higher hatching success, on average, than 75% of the control areas. Predator removal also increased post-breeding population sizes (i.e. autumn densities). In contrast, the effect of predator removal on breeding population sizes was not significant and studies differed widely in their reported effects. Côté & Sutherland (1997) concluded that predator removal often leads to the goal of game management (to enhance harvestable post-breeding populations) but that it is much less consistent in achieving the usual aim of conservation managers, i.e. to maintain or increase bird breeding populations. In the 10 years since the study took place many new predator control measures have been implemented in an attempt to protect vulnerable nesting birds. The aim of the current systematic review is to determine whether the inclusion of additional information and use of explicit systematic review methodology leads to similar conclusions to those reached by Côté & Sutherland (1997).

The impact of predator control may be dependent on a number of variables. Côté & Sutherland (1997) investigated the effect of the status of the prey species (declining, increasing, or stable), whether the prey species were game or non-game species, whether they were migratory species, whether all or some of the predators were removed and whether the study site was mainland or an island. The authors also examined the effect of experimental design (before-and-after studies or simultaneous experimental and control areas) on the heterogeneity of outcomes. We will investigate the same factors, as well as additional variables including the type of predator control (elimination, reduction in numbers or decreased access to prey), whether the prey species are ground-nesting or not and duration of control.

This systematic review will use explicit methodology to capture evidence on the effectiveness of removing predators to increase bird populations. Data will be captured by using comprehensive literature searches, specific inclusion criteria and formal assessment of the quality and reliability of the studies retrieved. Meta-analysis and sub-group analysis will be used where appropriate to establish the overall effectiveness of predator removal on enhancing bird populations. Finally, recommendations for the policy implications of predator removal will be developed, showing the factors which had the greatest effects on population numbers and highlighting knowledge gaps which require further research. The review will have wide international relevance and be of use to practitioners particularly in relation to the management of bird species of conservation concern.

## 2. OBJECTIVE OF THE REVIEW

### 2.1 Primary question

Is predator removal an effective strategy for enhancing bird populations?

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

Subject	Intervention	Outcomes	Comparators	Designs
Bird populations	Predator control by: shooting trapping poison-baiting exclusion fences nest cages	Long-term changes in population size (over one year); within season effects on population size (post-breeding), hatching success and fledging success	No predator control	Any studies providing measures before and after implementation of predator control or comparing predator control areas to adjacent or similar areas without predator control

### 2.2 Secondary questions

Do factors such as prey species, predator species, environmental or geographical factors (e.g. habitat type, island/mainland, latitude) or operational level variables (e.g. predator control method, size of control area, duration/timing of control, fencing of control area, duration of monitoring) alter the efficacy of predator control programmes in enhancing bird populations?

## 3. METHODS

### 3.1 Search strategy

We will take as a starting point the review by Côté & Sutherland (1997) and will then obtain published and unpublished information using the following sources.

#### 3.1.1 General sources

The following computerised databases will be searched:

1. ISI Web of Knowledge (ISI Web of Science and ISI Proceedings)
2. Science Direct
3. Directory of Open Access Journals (DOAJ)
4. Copac
5. Scopus
6. Index to Theses Online (1970-present)
7. Digital Dissertations Online
8. Agricola
9. Wildlife & Ecology Studies Worldwide
10. ConservationEvidence

Following consultation CAB Abstracts were omitted from the search.

Searches will use the following English language search terms (\* denotes a wildcard):

1. predator\* AND manag\* AND nest\*
2. predator\* AND manag\* AND bird\*
3. predator\* AND control\* AND nest\*
4. predator\* AND control\* AND bird\*
5. predator\* AND remov\* AND nest\*
6. predator\* AND remov\* AND bird\*
7. predator\* AND reduction AND nest\*
8. predator\* AND reduction AND bird\*
9. predator\* AND exclusion AND nest\*
10. predator\* AND exclusion AND bird\*
11. predator\* AND trap\* AND nest\*
12. predator\* AND trap\* AND bird\*
13. predator\* AND bait\* AND nest\*
14. predator\* AND bait\* AND bird\*
15. predator\* AND cage\* AND nest\*
16. predator\* AND cage\* AND bird\*
17. predator\* AND exclosure\*
18. predat\* AND fence\*
19. predator\* AND eradicat\*
20. predator\* AND cull\*

Additional terms may be added as the search progresses involving combinations of existing terms or new terms, as deemed necessary by the lead reviewer and relevant experts.

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

<http://www.alltheweb.com>  
<http://www.scholar.google.com>  
<http://www.Scirus> (All journal sources)  
<http://www.dogpile.com>

The first 50 hits (Word and/or PDF documents where they 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 relevant references. Recognised experts and practitioners and where necessary the first authors of relevant studies will be contacted for provision of any unpublished material or missing data and for further recommendations. Foreign language searches will not be carried out.

### ***3.1.2 Specialist sources***

Specialist websites will also be searched for relevant information, including the websites of the organisations listed in section 6.

### 3.2 Study inclusion criteria

- **Relevant subjects:** Bird populations; all bird species will be included. The scope will be worldwide.
- **Type of Intervention:** Any method of predator control including enclosure fences, nest cages, shooting, trapping and poison-baiting.
- **Types of Outcome:** The primary outcome is long-term (over one year) change in prey species (pre-breeding) population size. Secondary outcomes are within season effects of predator control on prey species (post-breeding) population size, hatching and fledging success.
- **Types of Study:** Any study providing measures before and after the control of potential predators or comparing predator-control areas to adjacent areas without predator control. This criterion therefore includes: Randomised control trials (RCTs), control trials (CTs), site comparison studies (SCSs) and time series that have measures for before and after intervention. Studies comparing one type of predator control with another will not be included unless they also include a control, in which case the different control methodologies will be analysed separately.
- **Potential reasons for heterogeneity:** Prey population status (declining, stable, increasing), game/non-game prey species, migratory/non-migratory prey species, ground-nesting prey species/not, predator species, native/non-native predator species, predator control type (elimination, reduction in numbers, decreased access to prey), predator control method (shooting, trapping, poison-baiting, exclusion fences, nest cages), total/subset predator species control, duration/timing of control, island/mainland populations, size of control area, habitat, latitude, fencing of control area, follow up period (duration of monitoring). Additional subgroup analyses and meta-regressions will be run where possible in order to explore the impact of these factors on the effectiveness of predator control in protecting bird populations.

Initial assessment of study relevance will be undertaken by one reviewer assessing study titles (and abstracts). Where there is insufficient information to make a decision regarding study inclusion when viewing titles or titles and abstracts, then relevance to the next stage of the review process will be assumed. The repeatability of study inclusion will be verified by assessing a random subset (of at least 25%) of references viewed at abstract and full text for relevance using a second independent reviewer. Disagreement will be resolved by consensus, or following assessment by a third reviewer.

### 3.3 Study quality assessment

Study quality assessment is required to add quality covariates to the analyses because well conducted studies have less potential for bias than those that are less robust. Reviewers will consider articles viewed at full text excluding or including them to different categories of study quality using assessment forms designed prior to the review, e.g. hierarchy of methodology to rank randomised controlled trials higher than site comparisons or time series (Stewart *et al.*, 2005). At least two reviewers will independently assess a random subset of 25% of articles viewed at full text. Disagreement will be resolved by consensus, or following assessment by a third reviewer.

### 3.4 Data extraction strategy

Information on the prey species, predator species, study design, intervention, outcomes and quality will be abstracted from the original studies into a specially designed data extraction form for future

synthesis. These forms 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. They may be amended after consultation with statisticians and piloting of the data extraction process. Where necessary, missing data will be imputed from summary statistics or inferred. Sensitivity analysis will be carried out to investigate the impact of any assumptions regarding imputed data.

### **3.5 Data synthesis**

Côté & Sutherland (1997) found sufficient data with comparators to use meta-analysis and to carry out investigations of heterogeneity. Our synthesis will therefore consist of meta-analyses to address the primary and secondary questions. Meta-regression and subgroup analyses will be used to investigate reasons for heterogeneity between studies.

Meta-analysis provides summary effect sizes with each data set weighted according to some measure of its importance, generally in inverse proportion to the variance of its effect. Where data is continuous we will calculate the effect size for each study by using either Hedges' standardised mean difference, which expresses the size of the treatment effect in each study relative to the variability observed in the study (Hedges & Olkin, 1985), or by using log response ratios. Sensitivity analyses will explore the impact of using these different effect size metrics. Where data is binary, risk ratios and risk difference meta-analysis will be undertaken. Combinations of the effect sizes will be undertaken using a random effects model. These models include inter-study variability (assuming a normal distribution) and so are more appropriate than a fixed effect model as the aim is to investigate reasons for heterogeneity between studies. Subgroup analyses and meta-regressions will be run where possible in order to explore ecological and methodological heterogeneity between studies. Publication bias will be investigated by examining funnel plot asymmetry (Egger et al. 1997).

Studies carried out in single year and on a single pair of experiment and control areas or in 2 years as a before-and-after experiment, do not provide sufficient data to allow the calculation of statistics for inclusion in a meta-analysis and so will not be included.

## **4. POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT**

No conflicts of interest declared.  
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## **5. REFERENCES**

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## **APPENDICIES – RELEVANT STAKEHOLDERS FOR CONSULTATION**

### **Statutory/Governmental Advisory Organisations**

Central Science Laboratory (CSL)  
Countryside Council for Wales (CCW)  
Department of Environment, Food and Rural Affairs (DEFRA)  
Department of Environment, Northern Ireland (DOE)  
Department of Agriculture and Rural Development (DARD)  
Feral Organisation Australia  
Invasive Animals Cooperative Research Centre  
IUCN Invasive Species Specialist Group (IUCN)  
Natural England (NE)  
New Zealand Department of Conservation (DOC)  
Scottish Natural Heritage (SNH)  
Joint Nature Conservation Committee (JNCC)

### **Charities/NGO's**

Birdlife International  
British Trust for Ornithology (BTO)  
Island Conservation  
Royal Society for the Protection of Birds (RSPB)  
The Game & Wildlife Conservation Trust (previously The Game Conservancy)  
The National Trust (NT)