

CENTRE FOR EVIDENCE-BASED CONSERVATION

Review No. 3

Working Title: Control of Bracken (*Pteridium aquilinum*)

Review Protocol

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1. Background

Bracken (*Pteridium aquilinum*) is a cause of concern to the Royal Society for Protection of Birds (RSPB) and other conservation organisations as it is a potentially invasive species on all ericaceous heath and acidic grassland including nature reserves. Where bracken is dominant it excludes most specialist heathland/moorland bird species of conservation concern, although there are a few species that may benefit from a certain proportion of bracken e.g. nightjar and whinchat. Conservation managers therefore usually wish to reduce the abundance of bracken and restore either dwarf-shrub dominated heath or acid grassland (G. Hirons *pers comm.*).

Various management interventions are employed to control Bracken. For example, Lowland heathland reserves in Dorset are subject to herbicide application and scraping. In E Devon bracken rolling is used. Bracken on the Sandlings heathland is cut and sprayed with herbicide. At upland reserves like Geltsdale, bracken is managed by herbicide application and the manipulation of water tables. Vyrnwy is managed by allowing ponies to graze and trample bracken dominated areas and by cutting (G. Hirons *pers comm.*). The choice of management is dependant upon many factors such as cost, terrain, availability of stock, machinery, manpower and knowledge. Organic status may preclude the use of chemical control.

There has been little direct monitoring of the effectiveness of different treatments for bracken control. The Dorset heathland project maps areas sprayed and revisits to assess success and on some reserves there are NVC surveys repeated at intervals and time series studies of the extent of bracken derived from aerial photographs (G. Hirons *pers comm.*). However, there is a large body of literature concerning the effects of management on bracken. For example the bracken database contains 1800 papers many of which are relevant to the control of bracken. A systematic review on the control of bracken would allow practitioners to base their management on the best available scientific evidence whilst identifying any gaps in knowledge for the scientific community. There are currently no systematic reviews on bracken

control, although numerous conventional reviews exist (Pakeman & Marrs 1994, 2001, Pakeman & Sangster 2000, Pakeman *et al.* 2000a, 2000b, 2001).

The RSPB are interested in a range of subjects, interventions and outcomes (Table one). Initially all of these will be included. However, the question may be refined by reducing the number of subjects, interventions or outcomes depending on the size of the literature and the desired focus of the review. Any such changes will be subject to discussion between CEBC and RSPB personnel.

Subjects (habitats)	Interventions (management)	Outcomes		
		Primary	Secondary	Tertiary
Lowland heath	Herbicides	Any change in the abundance of bracken including litter:	Vegetation type (community composition) after intervention in comparison to vegetation type (community composition) before intervention	Any other outcomes. e.g impact of bracken control on nightjar, whinchat, invertebrates.
Upland heath	Mowing or cutting			
Lowland acidic grassland	Impact of livestock (Cattle, sheep, ponies)	Fronnd density		
Upland acidic grassland	Handpulling	Cover		
	Rolling	Frequency		
	Burning*	Biomass		
	Combination techniques			

Table 1. The subjects, interventions and outcomes of relevance to the control of bracken. * burning is thought to be deleterious.

2. Specific Objective of the Review

To determine the impact of various bracken control interventions on bracken abundance, community composition and other outcomes in acid grassland and heathland.

3. Methods

3.1. Search Strategy

The following computerised English language databases will be searched: English Nature's "Wildlink", JSTOR, ISI Web of Knowledge, Index to Theses Online and the bracken database

(<http://www.appliedvegetationdynamics.co.uk/database.html>). Search terms used will be:

- *Pteridium aquilinum* and Management
- *Pteridium aquilinum* and Control
- Bracken and Management
- Bracken and Control

More specific terms based on the interventions (see Table one) will also be used as necessary. For example the intervention herbicide or chemical name 'asulam' will be entered along with Bracken or *Pteridium aquilinum*. Wildcards will be utilised as appropriate. Additional searches will be performed in Spanish, French and German on the meta search engine Alltheweb. The first 100 hits in each language for the four major search terms will be screened for relevant data.

Selected sections of the RSPB library will be hand searched. The bibliographies of all articles viewed at the full text stage will be searched for uncaptured references. Where appropriate, authors will be contacted for missing data. Recognised experts and current practitioners will be contacted for information.

3.2. Study Inclusion and Exclusion Criteria

- **Relevant Subjects.** The subject will be considered global and the geographical area will be recorded in order to interpret any patterns of variation in the results. The geographical location of papers within the UK will also be recorded as vegetation recovery after control is much faster in the wetter west, where the litter decomposes faster (R. Pakeman *pers comm.*). Other differences in the response of bracken to control may exist and this would be interesting to explore.
- **Types of Interventions.** Initially all the interventions in Table one will be considered valid. However, this amounts to undertaking seven systematic reviews. It may therefore become necessary to reduce the number of interventions prior to viewing the full text of articles. The interventions must be undertaken on bracken dominated communities to be considered valid. Grazing and burning will only be considered valid interventions when undertaken with bracken control as a primary objective. Difficult intermediates may arise when interventions occur on mosaics or do not state their objectives. These will be included initially and subject to consideration by further assessors.
- **Types of Comparator.** The control method must be compared to an unmanaged control. Note that the unmanaged control may be subject to normal marginal land management practices such as burning and grazing provided they are not undertaken with bracken management as a stated objective.

- **Types of Outcome.** All outcomes will be recorded although the timescale must be known or approximated for the outcome to be considered valid.
- **Types of Study.** All studies will be included if they present primary data about a relevant subject, intervention and outcome along with a valid comparator.

The inclusion and exclusion criteria will be applied to all potential studies at the title or title and abstract stage by one reviewer. Articles will be assumed to fulfil the relevance criteria where there is insufficient information to make a decision without reference to the full texts. Articles passing on to the full text stage will be assessed independently by two reviewers. Disagreement will be resolved by consensus following assessment by a third reviewer.

3.3. Study Quality Assessment

Study quality will be scored according to a hierarchy of evidence adapted from models of the systematic review process used in medicine and public health (Stevens & Milne 1997; Pullin & Knight 2003). Three reviewers will assess each accepted article independently, filling in an assessment form. Disagreement regarding study quality and inclusion will be resolved by reaching consensus.

3.4. Data Extraction Strategy

Data will be extracted by one reviewer and a subset of the data will be checked by another to verify accuracy. Data regarding the study characteristics, study quality and results will be extracted using data extraction forms. It is likely that these forms will be subject to amendment following consultation with statisticians and piloting the process of data extraction.

3.5. Data Synthesis

Summary tables of study characteristics, study quality and results will be presented, accompanied by a narrative synthesis. Quantitative analysis will be undertaken on data that is suitable for more formal statistical treatment. It is anticipated that Forrest plots, statistical tests of homogeneity of 2x2 tables, subset analysis and ordination will be used to explore heterogeneity of results. However, this is dependent upon the nature of the extracted data. Subgroup analyses may be performed on habitat type and location, soil moisture or other potentially confounding factors, the intervention, data quality and time. Meta-analysis may be undertaken if appropriate data exists.

4. Potential Conflicts of Interest and Sources of Support

None declared: This work is funded by English Nature and The Royal Society for Protection of birds.

5. References

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