The Impacts of Vegetation Cutting on Peatlands and Heathlands

A Review of Evidence

November 2023

Natural England Evidence Review NEER028

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Foreword

Semi-natural habitats in England are subject to a range of interventions that may influence the composition of vegetation communities, the condition of the habitat, its ecosystem function and the fauna that it supports. One such intervention is cutting of vegetation, which unlike grazing for example, has received little research attention.

As a management practice, cutting of vegetation is on the increase and this review has been commissioned as a first step in identifying what is known about the practice and how it may affect both habitats and ecosystem services. Natural England will use this work to help with operational decision-making and to identify evidence gaps.

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Executive summary

- A rapid evidence review was conducted focussing on rain-fed peatlands and heathland systems to understand the nature of the literature on the impacts of vegetation cutting.

- The priority questions interrogated by the evidence review were informed by a stakeholder survey.

- Following standard Natural England evidence review protocols, and a professional, independently performed, literature search, 37 relevant evidence sources were identified.

- Very few studies included a true ‘unmanaged’ control, with the majority of studies comparing cutting to another management strategy (usually burning or grazing). Where ‘uncut’ or ‘unburnt’ areas were included, they were often not classed as true ‘unmanaged’ controls, and so drawing comparisons to ‘non-intervention strategies’ was generally not possible.

- Several studies did not report on whether the cuttings were left or removed, making it difficult to draw any general conclusions about residue management.

- For **vegetation composition** there are studies that cover peatlands, heathlands, some undetermined moorland types, and open areas within upland woodland. Cutting was associated with increased cover of *Calluna* for peatlands on Ilkley Moor in West Yorkshire, and also with less bare ground than after burning at the separate Peatland-ES-UK study sites in northern England. Studies at the Peatland-ES-UK sites indicated that *Eriophorum* species cover increased more after mowing than burning. Bryophyte composition between cut and burnt treatments were different and *Sphagnum* mosses increased on mown areas later in the experiment, but were relatively constant on the burned areas indicating a different longer-term trajectory for mown sites compared with burned areas.

- At other sites with mixed heath and peatland, studies have suggested that vegetation species richness, diversity and percentage cover were lowest in the most recently cut areas, and highest in the intermediately-aged cut patches. The oldest cut patches had low diversity and species richness.

- A comparison of burning and cutting on regeneration of different aged stands of *Calluna* on an upland heathland in Scotland suggested there was greatest standing crop, highest density of sprouting centres, and the highest amount of growth from sprouting centres from intermediately-aged heather (e.g. 6-8 years) after either cutting or burning.

- For lowland heathland, a systematic review published in 2009 showed that management interventions (grazing, cutting or burning) resulted in higher graminoid to ericoid ratios than no management.

- There have been studies on heathland restoration from bracken dominance suggesting bracken eradication is extremely challenging. Twice yearly cutting has been shown to support heathland recovery (and better than herbicidal treatment) but removing the bracken litter layer and supplying additional seed was necessary to increase speed of colonisation and vegetation development.

- Management strategies to keep areas of open habitat within woodlands have included cutting. One study found some vegetation cover differences between mowing and burning treatments within open woodland areas, for example with increased cowberry/lingonberry cover associated with mowing and a reduction associated with burning compared to controls.

- For **water quality**, there were two sets of relevant studies, but on peatlands only. The studies related to the Peatland-ES-UK experiment suggest no significant impacts of cutting on aquatic water quality variables measured at the plot-scale while higher stream phosphorus concentrations and lower lead concentrations were found from cut sub-catchments compared to burnt ones. The separate Goyt Valley studies also confirmed no significant differences in aquatic carbon concentrations in surface runoff between burnt and cut peatland plots, except in the first year after burning, when aquatic carbon in runoff was higher from burnt than cut plots. At Goyt, disturbance by both burning and cutting changed the composition of the pore water dissolved organic carbon compared to undisturbed controls, and newer cut and burned areas were also associated with higher pore water dissolved organic carbon concentrations compared to controls.

- On **hydrological functioning**, the same two sets of studies as for water quality (peatland sites only) indicated water table changes, at least in the initial few years after disturbance. For the Peatland-ES-UK experiment water tables were shallower after cutting compared to under burning. The Goyt Valley studies suggested both cutting and burning led to shallower water tables compared to control sites. Shallower water tables were associated with enhanced relative contributions of overland flow for cut and burn treatments compared to controls in the Goyt Valley study, but there was no significant difference in water tables under ‘cut and remove brash’ compared to ‘cut and leave brash’ strategies. An overland flow velocity experiment in Cumbria showed that upland grassland type and management (e.g. cutting) strongly influenced surface water velocity. Similar overland flow velocity comparisons relating to cutting management for a broader range of heath and peatland systems are not available. No information is available on how vegetation cutting practice influences heath soil or peat permeability or macropore hydrological functioning.

- For **carbon budgets** only the Peatland-ES-UK studies and the Goyt Valley studies have reported impacts of vegetation cutting and these are only for peatlands. In the Peatland-ES-UK studies no significant differences in methane or net ecosystem exchange were found between mown and burnt plots while laboratory experiments indicated lower soil respiration rates from decomposition processes on burnt compared with mown (+brash) plots. After four years, the mown plots were considered to act as a small carbon sink, whereas the burned plots were considered to be a small carbon source. The Goyt Valley studies showed that management (burning, cutting, 'no management for 5 years', restored) had little impact on ecosystem respiration, net ecosystem exchange, or dissolved organic carbon concentration.

- Only the Peatland-ES-UK study reports on **physical changes to the soil/peat** associated with cutting and there is no information from other sites, other types of cutting practice or from heathlands. That study showed there were significant initial differences in microtopography between burnt, cut and uncut plots with some surface compression or, perhaps, moss hummock loss apparent for all mown sites, and a change in peat movement (expansion and contraction on wetting and drying) associated with burning.

- On **vegetation structure,** three peatland studies suggested limited influence of vegetation cutting on overall structure except for the intended reduction in *Calluna* height in the immediate aftermath of cutting. One study reported significant changes in the 'leafy to woody' ratio of *Calluna* after cutting and burning, but no differences in the leaf area index between cutting and burning treatments. One peatland study found significantly lower moss depth, moss microtopography, vegetation height and percentage cover of mosses on cut plots compared with uncut plots, although these measurements were taken only a few months after cutting.

- On **associated fauna**, there were no studies reporting on vegetation cutting impacts on grazing mammals. Six studies reported on vegetation cutting impacts on birds on sites that were a mixture of heathland and peatland. A ten year peatland study suggested that burning, cutting and grazing management strategies had no positive impact on breeding birds, with some species showing a negative trend associated with such management. For a mixed peatland and heathland site one study showed that where a greater percentage of moorland was cut (flail) there were increases in curlew and skylark populations. In areas where a greater percentage of moorland was burned there were increases in golden plover and red grouse. Other studies suggested that the intensity of cutting management is often too small to lead to bird population impacts but increases in wading birds on a mixed bog and heath site were associated with areas of increased cut and burn management. One black grouse study across 14 sites in the North Pennines showed no significant difference in breeding success between cut sites and controls. Invertebrate studies suggest a successional process with lower diversity but higher presence of pioneer species in the short-term after a disturbance such as cutting or burning, and more diversity and richness in the intermediate term (e.g. 8 years) after cutting disturbance.

- No relevant studies were available on the impacts of cutting on **wildfire risk**.

- Given multiple drivers that are encouraging more vegetation cutting in UK blanket and raised bogs and in heathlands and the limited evidence for impacts (whether significant or not significant) across most questions examined by this evidence review, there is a clear need for new research to inform policy and practice.

Contents

Introduction

This report provides the findings of a rapid review of evidence on the impacts of cutting vegetation on peatlands and heathlands in the UK. Stakeholders were consulted on the priorities for the scope of the review. The review focusses on completed studies in the published peer-reviewed literature. However, as we found an overall lack of such studies that were within the overall scope of the study, we included PhD theses and relevant technical reports within the review.

a. Project context

Cutting of vegetation in patches in moorland environments has been increasingly used as a management strategy over recent years. The technique is most commonly used where land is managed to support game birds for grouse shooting, but may also be implemented with the aim of managing fire risk, to prevent succession and enhance local habitat diversity (Anderson, 2014), or to support the provision of bales and brash for peatland restoration projects. With these different practices the cut material may be left on site or may be removed and, as such, the impacts on moorland functioning may vary. In undertaking cutting practice, vehicles are often used, given that hand clearance is time consuming. There is concern that vehicular action associated with cutting may impact peatland functioning (Williams-Mounsey et al., 2021). Given the range of drivers and range of practices of moorland cutting, it is important for policy and practice implementation to understand how such cutting impacts moorland systems. Here we carry out a rapid evidence review of literature to assess the level of available information on the topic of cutting vegetation on peatland and heathland. The review has been conducted in accordance with the guidelines in NEER001 (Stone, 2013).

While fen peatlands, particularly in lowland environments, have a long history of vegetation cutting for a range of purposes, including agricultural production (Carvalho et al., 2020), our scope is restricted to ombrotrophic peatland (raised bog and blanket bog) and heathland, where there is felt to be a considerable contemporary drive for increasing and/or enhanced cutting, yet limited understanding of impacts. Ombrotrophic systems are dominated by peatlands which are largely isolated from groundwater inputs (they are mainly rain-fed), but can often form part of an environmental mosaic wherein there are smaller patches of groundwater dominated peat (Charman, 2002). UK bogs tend to be dominated by bryophyte, sedge and dwarf shrub mixes. Heathlands form on more mineral-rich soils with a shallow or no upper organic layer and they tend to be more freely-draining than peatlands. In the UK, heathlands tend to be dominated by *Nardus* and *Molinia* grasslands, or ericaceous dwarf shrub systems with some ferns and occasional small trees (Holden et al., 2007).

b. Scope

Within the context of UK ombrotrophic peatlands and heathlands, to determine the scope of the review, in conjunction with Natural England, we devised a set of six questions which were sent, as a questionnaire in a word document and an online survey, to stakeholders. Stakeholders who contributed included representatives from the Moorland Association, national parks, peatland practitioners, water companies, charities and the Environment Agency. We received twelve responses (results in Appendix 1: Final Scoping Document). As such, the scope was refined and prioritised as indicated in section 1.3.

c. Review aim and research questions

The scoping survey results showed the highest interest in vegetation composition, water quality, hydrological function, carbon budget and physical changes. There was also some interest in vegetation structure, associated fauna, wildfire risk and non-intervention strategies. Therefore, our review will focus on seeking evidence to address the following high priority questions:

For ombrotrophic peatland and heathland:

a. What is the effect of vegetation cutting on **vegetation composition**?

b. What is the effect of vegetation cutting on **water quality**?

c. What is the effect of vegetation cutting on **hydrological functioning**?

d. What is the effect of vegetation cutting on **carbon budgets**?

e. What are the **physical changes** (e.g. erosion) that result from vegetation cutting?

We will also review the following, lower priority, questions for ombrotrophic peatland and heathland:

f. What is the effect of vegetation cutting on **vegetation structure**?

g. What is the effect of vegetation cutting on **associated fauna** (grouse and sheep)?

h. What is the effect of vegetation cutting on **wildfire risk**?

i. What is the effect of **non-intervention strategies** compared to vegetation cutting and how does cutting style and residue management influence outcomes?

To address the latter (i), since these issues are cross-cutting and may have impacts on all of the other outcomes being reviewed as listed above, we will cover available evidence around that set of topics while addressing questions (a)-(h) (i.e. if there are comparative studies available). It is beyond the scope of the review to cover all non-intervention outcomes on their own as that would require a huge review of all literature on natural/undisturbed heathland and peatland systems.

It should be noted that there may be cases from the question list above where there is no evidence available, or, at best, the evidence is extremely limited.

d. Nature of the evidence

The evidence included in the report was not limited to peer-reviewed scientific journal articles. We also included theses, reports and grey-literature. Academic literature was accessed via the extensive library and online journals available at the University of Leeds, and by contacting authors of potential evidence. We worked with library staff to conduct a thorough formal literature search. All evidence references were stored in reference management software (Endnote). Grey literature sources, including expert opinion and stakeholder sources, were included, and subject to the same selection criteria and rigorous assessment as published, peer-reviewed literature.

1. Methods

1.1. Devising search terms and strategy

Using the results of the scoping surveys, we devised a list of research questions as outlined in section 1.3. Using the Population-Intervention-Comparison-Outcome (PICO) framework outlined in Stone (2013) we converted those research questions into a list of search terms to use in our search strategy.

The PICO framework contains four elements. These are:

- Population - the population/species/habitat/issue of interest.
- Intervention - the intervention, activity or approach to be used.
- Comparison - the main alternative to the intervention.
- Outcome - what outcomes should be considered?

Using this framework, we defined the population, intervention, comparison and outcome search terms, and synonyms for each (Table 1). Both peatland and heathland are routinely referred to as ‘moorland’ in some of the evidence so synonym checks have to be carefully performed.

Vegetation cutting can be carried out in various ways, and so these terms were also included as ‘cutting’ synonyms: flail, mow and strim. Flailing uses a threshing tool to reduce vegetation height, usually used for harvesting crops. Mowing and strimming both involve using mechanical tools to cut vegetation, either in linear or circular motions.

Table 1. PICO framework for the literature search

PICO	Search terms	Synonyms
Population	Peatland, heathland	moorland, ombrotrophic bog, blanket bog, raised, mire, wetland, peat, upland, shrubland, acid soil
Intervention	Cutting vegetation	flailing, mowing, strimming
Comparison	No intervention, burning, grazing	
Outcome	Vegetation composition, water quality, hydrological function, carbon budgets, physical changes, fauna, wildfire	species, biodiversity, water chemistry, water table, stream flow, carbon store, carbon stock, carbon flux, erosion, grazing, grouse, sheep, deer

1.2. Evidence search

The searches identified studies of the impact of cutting vegetation on peatlands and heathlands. The searches comprised of three concepts; management; heathlands or peatlands and cutting. Subject headings and text words, truncation, and phrase searching occurred where appropriate in bibliographic databases. In order to find additional grey literature (including conference papers, dissertations and reports) we searched Google Scholar and Conservation Evidence. In total, there were 548 results before deduplication and 317 results after deduplication. Search results were downloaded into EndNote Reference Management software for screening. The full search strategy can be found in Appendix 4: Search Strategy.

In February/March 2023, we searched the following sources:

- Web of Science. Social Sciences Citation Index (SSCI) 1900-present (Clarivate)
- Web of Science. Arts & Humanities Citation Index (AHCI) 1975-present (Clarivate)
- Web of Science. Conference Proceedings Citation Index–Science (CPCI-S) 1990-present (Clarivate)
- Web of Science Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH)-1990-present (Clarivate)
- Web of Science. Emerging Sources Citation Index (ESCI)--2015-present (Clarivate)

- Scopus (Elsevier B.V.) from 1823
- CAB Abstracts (Ovid) from 1910
- Ethos (British Library) from inception
- Google Scholar search engine
- Conservation Evidence - Site

1.3. Selecting relevant evidence

Following the schematic and plan laid out in section 7 of Stone (2013), all potential evidence was first assessed based on its title, then on the abstract. Title screening removed 36 pieces of evidence, and abstract screening removed 117 pieces of evidence. Full paper screening removed an addition 31 pieces of evidence. An additional 31 pieces of evidence were removed as there was no full text available online, or they were not in English. There were 102 pieces of evidence remaining, of which 60 were studies based in the UK, and 37 of those were relevant to answering the research questions (Table 2, Table 3).

There were 15 studies based in Europe that considered one or more aspects of cutting on peatland or heathland vegetation. These are summarised in section 3.10.

Table 2. Evidence screening process

Screening	NE code	Number of papers
All potential evidence	A	317
Title screening	B	36
First pool of evidence	A-B=C	281
Abstract screening	D	117
Second pool of evidence	C-D=E	164
Full paper screening	F	31
No full text available		10
Full text not in English		15
Not available online (books)		6
Best available evidence for review	E-F=G	102
Based in the UK		60
Relevant to answering the specific research question		37

Some words in the search strategy resulted in irrelevant papers including when the word ‘cut’ referred to, for example, cut-over bogs, where peat has been cut, clear-cut, methods used in restoration (moss cutting), cutting drainage ditches, and species name (giant cutgrass). These account for the majority of evidence removed during screening.

Coding used in Table 3:

Type of Evidence:

AE-B: Academic evidence - Boolean searches, includes all the academic literature obtained from Boolean searches

AE-SS: Academic evidence - snowball searches, includes all academic literature obtained from snowball sampling of other, non-empirical evidence reviews

Type of Study:

1 Meta-analyses, systematic review of Randomised Control Trials (RCTS), or RCTs including cluster RCTS

2 Systematic reviews of, or individual, non-randomised controlled trials, case-control trials, cohort studies, controlled before-and-after (CBA) studies, interrupted time series (ITS) studies, correlation studies

3 Non-analytical studies, for example: case reports, case series studies

4 Expert opinion, formal consensus

5 Modelling, where data was used to develop projections of change over time and space rather than evidence changes that have occurred

Internal validity scores:

++ All or most of the methodological criteria have been fulfilled. Where they have not been fulfilled the conclusions are thought very unlikely to alter (low risk of bias).

+ Some of the methodological criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions (risk of bias).

- Few or no methodological criteria have been fulfilled. The conclusions of the study are thought likely or very likely to alter (high risk of bias).

Table 3. List of relevant UK evidence. Some cells are intentionally left blank

First Author	Year	Source	Source of Evidence	Type of Evidence	Type of study	Internal validity	Habitat	Manage-ment	Question answered (1)	Question answered (2)	Question answered (3)	Question answered (4)
Anderson	2003	Forest Research	Report	AE-B	2	++	open areas within trees	cutting, grazing, burning	vegetation composition			
Bond	2020	Hydrological Processes	Journal Article	AE-B	2	++	grassland	grazing, cutting	hydrological function			
Bond	2022	Hydrological Processes	Journal Article	AE-B	2	++	grassland	grazing, cutting	hydrological function			
Burn	2021	University of York, UK	Thesis	AE-B	2	+	moorland	cutting, burning	water quality	carbon balance		
Calladine	2014	Bird Study	Journal Article	AE-B	2	+	moorland	grazing, burning, cutting	vegetation composition	vegetation structure	associated fauna	
Cotton	1994	Journal of Environment al Management	Journal Article	AE-B	2	+	moorland	burning, cutting	vegetation composition			
Dixon	2011	Durham University, UK	Thesis	AE-AS	2	++	moorland	cutting, burning	water quality	carbon balance		
Douglas	2017	Bird Study	Journal Article	AE-B	2	++	moorland	grazing, burning, cutting	vegetation structure	associated fauna		
Eyre	2003	Journal of Insect Conservation	Journal Article	AE-B	2	+	moorland	burning, cutting, herbicides	associated fauna			

First Author	Year	Source	Source of Evidence	Type of Evidence	Type of study	Internal validity	Habitat	Manage-ment	Question answered (1)	Question answered (2)	Question answered (3)	Question answered (4)
Ghorbani	2007	Land Degradation & Development	Journal Article	AE-B	2	+	moorland	cutting, herbicides	vegetation composition			
Hancock	2011	Forest Ecology and Management	Journal Article	AE-B	2	++	open areas within trees	burning, cutting	vegetation composition	vegetation structure	associated fauna	
Heinemeyer	2019	PeerJ	Journal Article	AE-B	2	-	moorland	burning, cutting	physical changes			
Heinemeyer	2019	Defra	Report	AE-B	2	-	moorland	burning, cutting	vegetation composition	water quality	carbon balance	physical changes
Heinemeyer	2023	University of York, UK	Report	AE-B	2	-	moorland	burning, cutting	vegetation composition	water quality	hydro-logical function	carbon balance
Holmes	2022	Mires and Peat	Journal Article	AE-B	2	++	moorland	cutting	vegetation structure			
Liepert	1993	Journal of Environmental Planning and Management	Journal Article	AE-B	2	+	moorland	cutting, burning	vegetation composition			
Lowday	1992	Journal of Applied Ecology	Journal Article	AE-B	2	++	heathland	cutting	vegetation composition			
Ludwig	2019	Journal of Ornithology	Journal Article	AE-B	2	++	moorland	cutting, burning, grazing	associated fauna			
Ludwig	2018	Avian Conservation and Ecology	Journal Article	AE-B	2	++	moorland	cutting, burning, grazing	associated fauna			

First Author	Year	Source	Source of Evidence	Type of Evidence	Type of study	Internal validity	Habitat	Manage-ment	Question answered (1)	Question answered (2)	Question answered (3)	Question answered (4)
Marrs	1992	Journal of Applied Ecology	Journal Article	AE-B	2	+	heathland	cutting, herbicide	vegetation composition			
Marrs	2007	Journal of Environmental Management	Journal Article	AE-B	2	+	moorland	cutting, herbicide	vegetation composition			
Miles	1987	NERC	Book Section	AE-B	3	-	uplands	cutting, burning, grazing	vegetation composition			
Miller	1970	Journal of Applied Ecology	Journal Article	AE-B	2	+	uplands	burning, cutting	vegetation composition			
Milligan	2004	Biological Conservation	Journal Article	AE-B	2	++	moorland	grazing, cutting, herbicide	vegetation composition			
Mohamed	1967	University of Aberdeen, UK	Thesis	AE-B	2	+	heathland	burning, cutting	vegetation composition			
Morton	2019	Wetlands Ecology and Management	Journal Article	AE-B	2	+	peatlands	burning, cutting	physical changes			
Morton	2016	University of York, UK	Thesis	AE-B	2	+	peatlands	burning, cutting	vegetation composition	water quality	carbon balance	vegetation structure
Newton	2009	Systematic Review – Collab. for Environmental Evidence	Report	AE-B	2	+	heathland	grazing	vegetation composition			

First Author	Year	Source	Source of Evidence	Type of Evidence	Type of study	Internal validity	Habitat	Manage-ment	Question answered (1)	Question answered (2)	Question answered (3)	Question answered (4)
Pakeman	2002	Applied Vegetation Science	Journal Article	AE-B	2	++	heathland	cutting	vegetation composition			
Qassim	2015	Durham University, UK	Thesis	AE-B	2	++	peatlands	burning, cutting	water quality	carbon balance		
Sanderson	2020	Insect Conservation and Diversity	Journal Article	AE-B	2	++	moorland	cutting	vegetation composition	associated fauna		
Titterton	2022	Moors for the Future Partnership	Report	PE	2	++	peatlands	cutting	vegetation composition	vegetation structure		
Usher	1993	Biological Conservation	Journal Article	AE-B	2	+	heathland	burning, cutting	associated fauna			
Usher	1992	Biodiversity and Conservation	Journal Article	AE-B	2	+	heathland	burning, cutting	vegetation composition	associated fauna		
Warren	2003	Proc. European Conference: Black Grouse	Conference Proceeding s	AE-B	2	-	moorland	cutting	vegetation composition	associated fauna		
Worrall	2011	Joint Nature Conservation Committee	Report	AE-B	2	++	peatlands	grazing, burning	carbon balance			
Worrall	2013	Hydrological Processes	Journal Article	AE-B	2	++	peatlands	cutting, burning	water quality	Hydro-logical function		

2. Impacts of cutting on peatlands and heathlands: review

It should be noted that many studies involved comparisons of cutting with other techniques such as burning. While there has been debate about the impacts of moorland burning (e.g. Brown and Holden (2020) and literature within), this rapid evidence review is not seeking to address those associated issues. We included studies that compare the impact of cutting to burning because that was often how the studies were designed but this review is not concerned with directly evaluating burning impacts. Where possible, we assessed the impact of cutting compared to unmanaged 'control' plots/areas: however, there is a dearth of such evidence.

We also observed that some studies could be considered 'duplicate' evidence. For example, there have been a series of reports, research papers and theses that have stemmed from the Peatland-ES-UK project led by the University of York. In such an instance one report may build on another and reinforce the same point, or the results in a published paper or PhD thesis may have also been included in a separate report. Therefore, care is needed when interpreting the 'weight' of evidence when two or three evidence sources may, in fact, provide the same evidence but presented in different forms. A further point to note is that, unusually within the context of the rest of the moorland cutting literature we reviewed, the Peatland-ES-UK project has been subject to several published critiques on aspects of the study design (e.g. no true 'unmanaged' control plots), methods and conclusions (Evans et al., 2019; Heinemeyer et al., 2019b; Heinemeyer et al., 2019c; Young et al., 2019; Young et al., 2021).

2.1. What is the effect of vegetation cutting on vegetation composition?

After the formal search and screening process there were two PhD theses, three reports, one conference paper and 17 relevant journal papers on peatland or heathland vegetation cutting and vegetation composition. There was enough evidence that results were reported by habitat type. Of these, the majority refer to research carried out on 'moorland', 'peatland' or 'upland' (n=15) and 'heathland' (n=6). The remaining studies refer to their study habitats as open areas within woodlands (n=2). Several studies have compared the impact of cutting vegetation (by mowing, flailing etc.) to other methods of removing vegetation (e.g. burning); however some studies have no undisturbed true control areas. This can make comparisons between studies difficult.

2.1.1. Peatland studies

Trends in *Calluna*, *Empetrum* and bare ground cover under ‘undisturbed’, burning, flailing and rolling management strategies, were studied on Ilkley Moor (Cotton and Hale, 1994). While Ilkley Moor has both peatland and heathland areas, the study site description in the source document states the soil in the study area was peat. In the undisturbed plots, there were no significant changes in *Calluna* or *Empetrum* over time, whereas there were in the treated plots. *Calluna* cover increased in all three treatments; bare ground decreased; and *Empetrum* did not change over the experiment. The authors concluded that the rolling strategy (where vegetation was cut with spades) was least satisfactory, creating larger areas of bare peat prone to erosion, and delaying revegetation by 3-4 years compared with flailing/burning. Flailing leaves litter on the soil surface, which may have other consequences, but gave similar revegetation results to burning, with no discernible differences after 10 years.

Heinemeyer et al. (2019d), in their report to Defra (BD5104) on the Peatland-ES-UK study, found a higher proportion of bare ground after burning compared with mowing and untreated plots. Heather re-growth was also slower on burnt than mown plots; both these effects only lasted four years. Cotton grass species cover increased after mowing (significantly more than burning). Bryophyte composition also differed: non-*Sphagnum* mosses were greater on burned than mown areas, and *Sphagnum* mosses increased on mown areas in the final year of the experiment and were relatively constant on the burned areas. In a follow-up report, after more years of gathering data and further analysis for the same experiment, Heinemeyer et al. (2023) report similar findings, expanding on other grass species present, and reporting on a *Sphagnum*-pellet addition experiment. Adding *Sphagnum* pellets after mowing resulted in a small increase in cover. The increase in *Sphagnum* and cotton grass after mowing indicate a different longer-term trajectory for mown sites compared with burned areas.

Investigating the same Peatland-ES-UK sites, a thesis reported that the total number of vegetation species present in plots after burning and mowing treatments was not significantly different, whereas there were significant differences in the Shannon H index (a diversity metric) between plots (Morton, 2016). Redundancy analysis of their vegetation composition data showed three main traits, broadly correlating with management, splitting their sites into ‘unmanaged’, ‘mown’ or ‘burnt’ polygons. Their results also showed that ‘BR’ and ‘LB’ plots (mown with brash removed or brash left) had significantly lower *Calluna* and higher *Eriophorum* cover after treatment than burned or unmanaged plots.

Calladine et al. (2014) included vegetation surveys in their study of moorland bird populations in southwest Scotland, and found that management had little impact on vegetation composition. Their study looked at the impact of cutting and burning vegetation, and grazing, creating pools, blocking drains, and predator control. There were differences between different land areas (‘compartments’ classed as degraded or intact blanket bog) and over time, but not between management strategies.

Sanderson et al. (2020) studied vegetation and invertebrates in areas of Geltsdale Nature Reserve, Cumbria, cut at different times by a doubled-wheeled tractor with a flail mower. Cuttings were removed. The sites were dominated by *Calluna vulgaris*, *Eriophorum vaginatum* and bryophytes. Using a chronosequence of cut patches, the authors reported that vegetation species richness, diversity and percentage cover were lowest in the most recently cut areas, and highest in the intermediate aged patches. The oldest cut patches had low diversity and species richness.

A trial conducted for Moors for the Future by Titterton et al. (2022) found that cutting cotton grass (*Eriophorum*) resulted in an increase in planted *Sphagnum* moss growth in experimental plots. There were four treatments: a control (no cutting or planting), planted but not cut, cut and planted, cut and not planted. On Hare's tail cotton grass plots, cutting the grass before planting resulted in an increase of 11% *Sphagnum* cover (compared to uncut plots). The differences between cut and uncut plots increased each year up to the end of the study (5 years). On cotton grass plots, the difference in *Sphagnum* cover between cut and uncut plots was 10.3%, but this was not statistically significant (Titterton et al., 2022).

2.1.2. Heathland studies

A systematic review of grazing, burning, cutting and no management on lowland heathland, conducted by Newton et al. (2009a), found 144 pieces of evidence that were relevant, but only 13 meta-analyses that compared all land-management strategies. Their review showed that management interventions (grazing, cutting or burning) resulted in higher graminoid to ericoid ratios than no management. Results from burning and cutting treatments had significant heterogeneity. There were not enough data on timing of burning or cutting, or on age of *Calluna* to analyse further, and they concluded that more studies are needed, alongside a standardised monitoring protocol. Their report also includes the results of a questionnaire sent to heathland managers to investigate the impact of grazing but also includes some feedback on other management types. The work showed the extent of grazing, burning and cutting on heath in the UK: all heaths had some current or historic record of grazing, 38% of heaths were managed with fire, 66% with cutting (but only small areas, <5% of the area of these sites were cut annually), and 30% were managed with herbicides. A minority of sites (only 4) reported cutting more than 10% of their area annually.

Miller and Miles (1970) investigated the impact of burning and cutting on regeneration of different aged stands *of Calluna* on upland heathland in Scotland (Kerloch Moor). In the cut plots, the loose litter after cutting was raked to remove it from the plots. There were significant differences between age classes and percentage cover after burning. In the cut plots, after one growing season, there was greatest standing crop from heather aged 6-8 years. Older heather had less standing crop. The 6- to 8-year-old heather also had the highest density of sprouting centres, and the highest amount of growth from sprouting centres. There was more regeneration after cutting in spring, compared to cutting in autumn. Despite cutting and burning giving similar *Calluna* regeneration results, the authors concluded that cutting has too many disadvantages, as the accumulation of cut heather could make the soil unsuitable for germination and seedling establishment.

Kerloch Moor also featured in a thesis by Mohamed (1967), alongside three sites classed as ‘heathlands’ and they reported similar findings to those of Miller and Miles (1970). Mohamed (1967) conducted field and greenhouse experiments and found that the most *Calluna* regeneration occurred after burning or cutting plants aged 11-14 years. They employed three different cutting methods: at soil level, at 5 cm from soil level, and clipping 50-60% of the current years’ growth. Cutting at ground level killed the youngest plants (under 3 years) and the oldest plants, whereas plants aged 7-14 years regenerated. Cutting at 5 cm above the ground produced a smaller growth form in plants about 10 years old, and older plants failed to regenerate. Clipping the tips of *Calluna* caused all ages to regenerate.

A study of invertebrates on heathlands included an assessment of ‘Callunetum’ vegetation (Usher, 1992), showing that just four months after burning or cutting, there was more heather regrowth at cut sites than burned areas (see Usher 1992, Table 1, p. 64).

2.1.3. Cutting as a method of heathland ‘restoration’

Removing bracken species (*Pteridium aquilinum*) from experimental plots at Hordron Edge in the Peak District showed mixed success (Ghorbani et al., 2007). There were six experimental treatments, including a ‘no-cut’ control, cut plots (once or twice yearly), and herbicide applications. The plots were split into sub-plots (grazers excluded from half) and sub-sub-plots (three *Calluna vulgaris* seeding treatments), making for a complex experimental design. They analysed the seed bank in the litter layer and soil, and found treatment altered seed density and composition. They concluded that twice-yearly cutting was the best management strategy to restore moorland from bracken-rich to *Calluna* and heath species, but removing the bracken litter layer and supplying additional seed was necessary to increase speed of colonisation and vegetation development. Using the same experimental set-up, Marrs et al. (2007) found that the elemental content of the vegetation and litter layer was significantly impacted by bracken-control measures. Removing bracken (through cutting and/or herbicide treatment) increased nutrient content of developing vegetation (*Calluna* and heathland species), and increased plant species diversity.

Lowday and Marrs (1992) and Marrs and Lowday (1992) investigated bracken cutting as a method of restoring heathland. Six bracken control treatments were applied, similar to Ghorbani et al. (2007), including a ‘no-cut’ control, cut plots (once or twice yearly), and herbicide applications. The plots were split into sub-plots with half receiving seeds of the ‘objective’ species (*Calluna* at one site, and heath grasses at the other). The bracken in the uncut plots showed variation over time, and so results are presented relative to the untreated values. There were significant differences between all treatments at both sites.

Cutting (either once or twice a year) reduced bracken biomass, herbicide alone caused a small decrease, and cutting plus herbicide also caused a small decrease. There was a difference in *Calluna* biomass after cutting and sowing *Calluna* seeds after 3-4 years. The authors conclude that bracken is not easy to eradicate.

Bracken encroachment was also a problem at Ramsley Moor (Derbyshire) and Levisham Moor (North York Moors) investigated by Pakeman et al. (2002). Experimental plots were treated with herbicide, cut, seeded with *Calluna* and/or brash. Cutting significantly slowed the rate of encroachment compared with uncut areas, but there were no increases in non-bracken species cover as a result of cutting alone.

A study of cutting *Molinia* to encourage development of moorland species showed that frequent cutting reduced *Molinia* cover (Milligan et al., 2004). A tractor-mounted drum flail-mower was used either once, twice or thrice, to cut *Molinia* in experimental plots at Ramsgill Bents (North Yorkshire). The litter was left on the ground. This experiment also looked at the impact of grazing, herbicides and heather brash in combination with cutting, leading to a complex experimental design. Species cover and vegetation height were recorded in quadrats seven times over four years. Cutting *Molinia* increased the amount of bare ground in the first six months. After three cuts, there was a significant increase in the amount of bare ground. Cutting also significantly reduced vegetation height. The number of species and Shannon-Weiner diversity index increased with increased cutting intensity. Cutting three times decreased *Molinia* cover the most. Due to the complex experimental design, there were five-way interactions between time, grazing, cutting, herbicide and brash, leading to several significantly different interactions.

2.1.4. Upland studies where peatland or heathland habitat type is not explicitly specified or could not be determined from information provided

Mowing and cutting are mentioned as a method of maintaining grasslands in the uplands by Miles (1987). It was reported that cutting ‘rejuvenates’ woody vegetation, although leaving heather brash on the ground can impede regeneration.

There was no significant difference in percentage heather cover between burnt and cut plots on Danby High Moor on the North York Moors (Liepert et al., 1993). The percentage cover increased in both ‘young’ and ‘old’ burns and cuts. There were higher weights of seedling in ‘young’ plots for cut areas than burnt, and in ‘old’ plots, the seedling growth was significantly greater on burnt areas than cut ones. The study showed that the impact of burning and cutting is dependent on the ‘age’ of the heather stand at time of management intervention.

Vegetation surveys carried out as part of a black grouse breeding experiment on heather moorland showed little change in the species composition in control and treatment plots after cutting (Warren et al., 2003). There was a reduction in vegetation height during June/July after being cut in early April, which favoured black grouse.

2.1.5. Open areas within trees

Management strategies to keep areas of open habitat within woodlands are discussed in a 'Practice Guide' for the Forestry Commission and include felling, mulching, brush-cutting, grazing or burning (Anderson, 2014). The aim of these techniques is to increase vegetation disturbance, thereby increasing vegetation diversity within woodlands. However, the empirical evidence for impacts was not presented within the report. Hancock et al. (2011) found both mowing and burning within open areas of woodland (Abernethy Forest in the Cairngorms) changed the vegetation cover, reducing both heather and bilberry cover. However, in subsequent years, the percentage cover of bilberry was higher in treated (burned or mown) plots than the control plots. The greatest changes were observed in cowberry cover (*Vaccinium vitis-idaea*, also known as mountain cranberry or lingonberry), where mowing increased cowberry compared to controls, and burning decreased cowberry cover. The authors conclude that there were minimal differences in vegetation cover between burning and mowing, and so would recommend mowing vegetation for capercaillie management.

2.2. What is the effect of vegetation cutting on water quality?

After the formal search and screening process there were only three relevant papers/reports and four relevant PhD theses on vegetation cutting and water quality. These studies were all on peatlands. The studies were from two experiments: the Peatland-ES-UK study (Burn, 2021; Heinemeyer et al., 2019d; Heinemeyer et al., 2023; Morton, 2016), and the Peak District Goyt experiment (Dixon, 2012; Qassim, 2015; Worrall et al., 2013).

Burn (2021) investigated soil water quality (from 15 cm depth) at the Peatland-ES-UK sites and found no significant differences in dissolved organic carbon (DOC) concentration, specific absorbance ($SUVA_{254}$, absorbance at 254nm divided by DOC concentration) ratios or Hazen values (water colour) between burnt, mown or uncut plots. Morton (2016) also investigated the DOC and POC concentrations in streams draining from treated sub-catchments (cut or burn) and found no significant differences in DOC concentration after treatment. They found POC concentrations were significantly lower after treatment. Cutting and leaving the brash on the soil surface led to an increase in stream phosphorous concentrations, compared with no increase in burnt areas (Heinemeyer et al., 2019d). There were no significant differences in other water quality metrics (DOC, $SUVA_{254}$). In their 'Phase 2' report, Heinemeyer et al. (2023) reported that there were significantly lower lead concentrations in stream water from mown areas compared with burned areas.

The Goyt Valley burning and cutting experiments were designed to examine carbon fluxes (Dixon, 2012; Qassim, 2015) and some of the findings contrast with those of Burn (2021). There were no clear long-term differences in DOC concentration in overland flow at wet and dry sites, between burned and cut plots (either new or old cuts and burns, compared to controls); seasonal and yearly variation were higher than inter-treatment variation. However, at 'dry heather sites', in the first year after burning treatment, the DOC concentrations in overland flow were up to 50% higher than the control, and 20-30% higher than the cut treatments. There was some variation in the soil water DOC concentrations between plots treated at different stages – 'new' cuts and 'new' burns had higher soil water DOC concentrations than 'old' cuts and burn sites. The 'cut and leave' treatment, where plants were cut and the material was left on the soil surface, had significantly lower soil water DOC concentration than the control plot (Worrall et al., 2013). There were also some significant differences in variables used as proxies for DOC composition: the E4/E6 ratio showed significant differences between the control and old and new burn sites, but not between the control and any cut treatments. The E4/E6 ratio tended to be lowest from burned sites, intermediate from cut sites, and highest from the control site, indicating that the DOC from burned sites was more humified and of higher molecular weight than DOC from control sites. Worrall et al. (2013) also found significant differences in $SUVA_{254}$ between sites: the DOC from new 'cut and leave' treatment had significantly higher specific absorbance than the control. Amalgamating all three cut treatments (new cut and leave, new cut and lift, old cut and leave) showed significantly higher specific absorbance than controls, but no difference to amalgamated burn treatments. Similar to the results of Qassim (2015), there were no significant differences in overland flow DOC concentration between controls and treatments.

2.3. What is the effect of vegetation cutting on hydrological functioning?

Two of the three pieces of evidence on hydrological function were based on the same two peatland study areas as for water quality: Peatland-ES-UK and the Goyt valley. The third evidence source is provided by an upland grassland study on organo-mineral soils.

Heinemeyer et al. (2023) reported on hydrological impacts of burning versus mowing as part of the Peatland-ES-UK project. Mown plots were wetter (shallower water table and higher soil moisture) post-treatment than burned plots. The authors suggested this hydrological difference between burn and cut treatments for 2013-2016 was not found for the later 2019-2021 period. The authors presented some analysis suggesting streamflow reduced after mowing but increased after burning. Stormflow peaks were considered to be slightly (but not significantly) greater in burnt plots compared to mown plots, but in the driest site such differences were found to be significant. However, the authors suggested the downstream flood effects were uncertain.

In the Goyt valley, the depth to water table was considered in a study of cutting and burning (Worrall et al., 2013) which showed that the depth to water table decreased after both treatments (water table was closer to the surface, Figure 2 in Worrall et al. (2013)), due to vegetation loss decreasing evapotranspiration rates. There was no significant difference in water table between ‘cut and lift’ and ‘cut and leave’ strategies, showing that removing or leaving the cut material did not impact the depth to water table. This study also investigated the proportion of surface runoff detected at each treatment site and showed that there was a significant increase in proportion of overland flow where management interventions had been applied.

While the peatland studies above examined water tables or relative overland flow contribution, they did not measure overland velocities for different treatments, a factor that could be crucial in downstream flood risk. One upland UK study has empirically investigated overland flow velocities on non-peat systems. Bond et al. (2020) found that overland flow in upland grassland differed between management strategies, and there were also seasonal differences in surface roughness. They studied overland flow velocities in experimental plots with four habitat types: hay meadow, low-density grazing, rushes and rank grassland. Rank grassland had slowest flows across the year, followed by low-density grazing, then rushes and hay meadows. After the hay meadow was cut, the flow velocity increased significantly, suggesting that cutting vegetation reduced resistance to overland flow. In a follow-up modelling study, Bond et al. (2022) showed how changes in surface roughness caused by upland grassland vegetation changes can impact on downstream responses to storm events.

2.4. What is the effect of vegetation cutting on carbon budgets?

A review of carbon fluxes from UK peatlands considered mowing and cutting as peatland management strategies, but could not report any studies covering the effects of vegetation cutting on carbon or greenhouse gas (GHG) budgets (Worrall et al., 2011). They hypothesised that leaving biomass on site (rather than removing it through burning) would lead to increased respiration, contributing to the litter layer, and potentially forming a ‘mulch’ layer, keeping the underlying peat wet and preventing erosion. They approximated that cutting impacts would be similar to grazing and burning managements. Since then, there have been some studies that have attempted to examine carbon or GHG budgets on peatlands in response to cutting, but not on heathlands. Our search results showed there were six studies investigating the impact of cutting vegetation on carbon budgets. They were only from the Peatland-ES-UK and Goyt Valley study sites.

Burn (2021) investigated the impacts of different management strategies on carbon fluxes in laboratory mesocosms of peat. Gas flux measurements were taken routinely, but sampling was significantly disturbed by the COVID-19 pandemic. Significant differences in net ecosystem exchange (NEE) were found in mesocosms from different management strategies, but post-hoc tests showed these were due to differences between degraded and restored plots (from a wider UK sample collection of peatland restoration treatments), rather than between mown or burnt plots. At the Peatland-ES-UK sites methane fluxes differed by site, but there were no significant differences between management strategies. In the mesocosms, there were significant differences in methane fluxes between degraded and mown sites (Figure 5.18, Burn (2021)).

Soil carbon cycling, ecosystem CO_2, net ecosystem exchange (NEE) and carbon sequestration at Peatland-ES-UK sites were assessed by Heinemeyer et al. (2019d) in their report for Defra (BD5104), and the follow-up report on phase 2 of their experiment (Heinemeyer et al., 2023). Field measurements showed no significant impact of management on soil respiration rates. Lab-based experiments on surface peat showed lower soil respiration rates from decomposition processes on burnt compared with mown (+brash) plots. Both burnt and mown plots were net carbon sources after management treatment, with higher carbon losses from burnt plots. After four years, the NEE from mown plots indicated a small carbon sink, whereas the NEE from burned plots indicated a small carbon source. The net ecosystem C balance showed carbon losses were higher in the first two years following burning treatment compared with mowing, but that total post-management losses were lower in the burned areas than in the mown areas. Carbon sequestration was reported with mixed results, with field sites and peat cores showing conflicting responses to management (see also the second paragraph of section 3 above for references debating the merits of the Peatland-ES-UK peat core carbon sequestration analysis).

Morton (2016) also utilised the Peatland-ES-UK site set-up to investigate the carbon budget of peatlands under burning and cutting management strategies. Cutting was carried out by double-wheeled tractors and *Calluna* was cut to approximately 14 cm above the peat. Brash was removed from half the mown plots. *Sphagnum* pellets were added to half of the plots. NEE calculations showed all sites were carbon sinks before treatment, and the burnt plots were the largest sources after treatment. Both treatments with *Sphagnum* pellets (BR+Sph and LB+SPh), and the mown+brash (LB) treatment were carbon sinks, whereas the treatment where *Calluna* was mown and the brash removed (BR) was a carbon source (see Figure 2.3 in Morton (2016)). Post-treatment, the ecosystem respiration (R_{eco}) was highest from the untreated site, and there were significant differences between treatment types. There was no relationship between management and methane fluxes.

The Goyt Valley study showed that management (burning, cutting, ‘no management for 5 years’, restored) had little impact on ecosystem respiration, NEE, DOC concentration or canopy height (Dixon, 2012). Dixon (2012) recommended cutting (or burning) *Calluna* before the canopy height reaches 30 cm to maximise C storage, rather than relying on a rotational cut/burn cycle of a specific number of years.

2.5. What are the physical changes that result from vegetation cutting?

Physical changes resulting from cutting vegetation were studied at the Peatland-ES-UK sites in three reports and papers (Heinemeyer et al. (2019a); Heinemeyer et al. (2019d); Morton and Heinemeyer (2019)). We found no other relevant studies.

Heinemeyer et al. (2019a) investigated the impact of burning and cutting vegetation on peat depth, bulk density and peat surface micro-topography, hypothesizing that cutting machinery would cause compaction of peat and hummocks. They found significant initial post-treatment differences in micro-topography between burnt, cut and uncut plots – the offset to peat surface was approximately 2 cm lower for all mown sites. There were no significant differences in peat depth or bulk density after treatment, compared with control plots. Further to this study, Heinemeyer et al. (2019d) and Heinemeyer et al. (2023) reported no differences in average peat surface temperatures or frequency of occurrence of peat pipes between treatments. The maximum temperatures were higher from burned plots, and there was a smaller range of surface temperatures from uncut and brash-covered cut sites than for burnt locations.

Morton and Heinemeyer (2019) investigated the impact of management on 'bog-breathing' (the rise and fall of the surface peat level as it wets and dries) and found a significant, negative change in peat height at burnt sites, suggesting that the peat shrunk after burning, or did not expand as much as for other management types. There were also significant differences in the change in peat height over the course of the experiment between different vegetation types – the change in peat height for burnt *Calluna* was significantly lower than the change in peat height in unmanaged *Calluna* (Morton and Heinemeyer (2019), Figures 5 and 6). Peat surface level change under mown *Calluna* was not significantly different to the change under either burned or unmanaged *Calluna*. Management differences accounted for less of the variation than vegetation cover and water-table depth fluctuations. For POC concentration (as a proxy for erosion), greater differences were found between before and after treatment (reduced) than between burnt and mown plots (Heinemeyer et al., 2023).

We also reviewed the following, lower priority questions for ombrotrophic peatland and heathland.

2.6. What is the effect of vegetation cutting on vegetation structure?

Our search found six studies that included assessment of the impact of cutting on vegetation structure on moorland; three of these were studies of moorland bird populations (Calladine et al., 2014; Douglas et al., 2017; Hancock et al., 2011). We found no studies focussed specifically on heathland vegetation cutting and structure.

Calladine et al. (2014) included vegetation structure analysis in their study of moorland bird populations in southwest Scotland, and found little habitat response to changes in management, including the impact of cutting and burning vegetation, and grazing, creating pools, blocking drains, and predator control. Douglas et al. (2017) found changes in graminoid height with changes in sheep density, and changes in dwarf shrub height in relation to percentage area burned, but no clear relationship between percentage area cut and vegetation structure change. Hancock et al. (2011) found both mowing and burning changed the vegetation structure by reducing heather height for at least a year after treatment.

Holmes and Whitehead (2022) studied the impact of cutting moorland vegetation, comparing vegetation structure at cut and nearby uncut plots. They found significantly lower moss depth, moss microtopography, vegetation height and percentage cover of mosses on cut plots compared with uncut plots. These differences were recorded in spring, after the vegetation was cut in winter, showing a rapid response to management. Moss microtopography changes could be due to compaction during cutting, or due to moss hummock tops being physically cut and removed.

Vegetation structure changes were reported by Morton (2016) in their thesis, based on the Peatland-ES-UK sites. Their study of burning and cutting on moorland species showed significant reductions in the 'leafy to woody' ratio and *Calluna* height after management interventions, between the 'do nothing' treatment, and other management interventions. There were no differences in the leaf area index or the 'leafy to woody' ratio between burning and cutting treatments after intervention.

Titterton et al. (2022) included an assessment of the impact of cutting *Eriophorum* (cotton grass) on the height of grass (alongside *Sphagnum* cover), and found that cutting the grass reduced the height of the grass by 10-25 cm. The grass height increased to a consistent height in the Hare's tail cotton grass plots, except for the 'planted and cut' plot where the cotton grass height was approx. 9 cm lower than before cutting. In the Common cotton grass plots, the height decreased by up to 30 cm and rapidly re-grew to a similar height to before cutting in all cut plots.

2.7. What is the effect of vegetation cutting on associated fauna?

2.7.1. Birds

We found six studies of bird population dynamics that assessed the impact of vegetation cutting. They were all conducted on 'moorland', and most studies described the sites as a mixture of peatland and heathland.

Burning, cutting and grazing management strategies had no positive impact on breeding birds in a ten-year study on a peatland (Calladine et al., 2014). Moorland birds, including red and black grouse, skylark, meadow pipit, golden plover, curlew and snipe, were studied on a Special Protection Area in Muirkirk and North Lowther Uplands, southwest Scotland. Red grouse, skylark and meadow pipet showed a significant population decline over the course of the study, while there was no detectable change in populations of black grouse, plover, curlew and snipe in response to management.

Bird and vegetation surveys were carried out at experimental grazing, burning and cutting plots at Geltsdale nature reserve in Cumbria (Douglas et al., 2017). The area is described as moorland, with rough grassland, blanket bog, and dry and wet heath. Significant changes in bird abundance (including red grouse) were associated with changes in management. In areas where a greater percentage of moorland was cut (flail) there were increases in curlew and skylark populations. In areas where a greater percentage of moorland was burned there were increases in golden plover and grouse.

In open areas of Abernethy Forest, vegetated with bilberry and ericaceous shrubs, a plot-scale experiment investigated the impact of management (mowing or burning) on capercaillie populations (Hancock et al., 2011). The litter severed by mowing was left on the ground. Vegetation, arthropod and capercaillie surveys were carried out. Changes in vegetation cover (specifically increases in bilberry cover after mowing) increased the habitat area available to capercaillie broods, especially alongside the increase in food availability (spiders). There was increased capercaillie usage of burnt and mown areas, but the impact of management on brood success could not be determined.

On Langholm Moor (southwest Scotland), grouse counts and vegetation surveys showed that management 'intensity' (e.g. proportion of sample points at which heather had been recently burned or cut) was too low to have a direct impact on grouse productivity or post-breeding density (Ludwig et al., 2018). At the same site, a study of wading birds found increases in bird populations, associated with moorland grouse management strategies (annual burning and flail cutting (Ludwig et al., 2019). The site was described as heather moorland, with bog and heath habitats.

Comparing 14 sites in the North Pennines, black grouse breeding success was reported to be higher in cut sites compared to control sites, but not significantly higher (Warren et al., 2003). In the year before cutting, there were 1.9 chicks per hen at both control and treatment sites. After cutting, there were 0.4 chicks per hen in the control plots and 1.4 in the cut plots.

2.7.2. Other fauna

Four relevant studies investigated the impact of cutting vegetation on invertebrate populations. One study of bird populations also included the impact of vegetation cutting on invertebrates as a food source for birds (Hancock et al., 2011). Hancock et al. (2011)

found both management treatments (mowing and burning) caused a significant increase in spiders (types of spiders were not differentiated), whereas burning was associated with a significant decrease in beetles and increase in ants.

Eyre et al. (2003) found higher numbers of invertebrate species on dry, open, managed *Calluna* sites, and lowest numbers on *Molinia* sites in a study of beetle, spider and bug assemblages at four sites in Dumfries and Galloway. The sites were classified as 'wet *Calluna*, *Eriophorum* and *Vaccinium* moor, *Molinia* moor, dry *Calluna* moor and grassy streamsides with bracken'. They found significant effects of moorland management (unmanaged, grazed, herbicide and burning, or cutting) on ground beetles, with less effect on rove beetle and spider species. They did not distinguish between burned and cutting management strategies, concluding that open spaces in *Calluna* increased diversity by providing varied habitats for beetles.

Sanderson et al. (2020) studied areas of blanket bog at Geltsdale Nature Reserve cut at different times by a doubled-wheeled tractor with a flail mower. Cuttings were removed. The sites were dominated by *Calluna vulgaris*, *Eriophorum vaginatum* and bryophytes. Using a chronosequence of cut patches, the authors reported that invertebrate species richness, diversity and abundance were lowest in the most recent cut patches (<5 years). Intermediate aged cut patches (approx. 8 years old) had higher species richness, diversity and abundance.

Danby Low and Danby High Moors (heathlands), on the North York Moors, had significant differences in invertebrate populations after burning and cutting (Usher, 1992; Usher and Thompson, 1993). Disturbance caused by fire or cutting provides open habitats within heathlands for arthropods, similar to early succession areas, populated with pioneer species.

Heinemeyer et al. (2023) also studied the impact of mowing and burning on cranefly emergence and abundance and the population of three bird-dependant species at the Peatland-ES-UK sites. Results showed that burning had a negative impact on both emergence and abundance, whereas mowing had a positive impact on emergence and abundance, and on the three bird populations that depend on craneflies (golden plover, dunlin and red grouse).

2.8. What is the effect of vegetation cutting on wildfire risk?

We found no studies that investigated cutting vegetation on peatland or heathland as a method of reducing wildfire risk.

2.9. What is the effect of non-intervention strategies compared to vegetation cutting and how does cutting style and residue management influence outcomes?

Our search resulted in 37 relevant UK studies of cutting vegetation on peatlands and heathlands. Very few studies included a true ‘unmanaged’ control, with the majority of studies comparing cutting to another management strategy (usually burning or grazing). Where ‘uncut’ or ‘unburnt’ areas were included, they were often not classed as true ‘unmanaged’ controls, and so could not give information as ‘non-intervention strategies’.

The Peatland-ES-UK project included sites labelled as ‘uncut’ but these are actually uncut areas within managed (historically mown and/or burnt) catchments – whether these can truly be classed as ‘uncut’ is a topic of discussion in the associated response to peer-review document (Heinemeyer et al., 2019c). In response to comments, the authors agreed there was no true unmanaged site included in the study. This also applies to other reports and publications based at these sites (Burn, 2021; Heinemeyer et al., 2019a; Heinemeyer et al., 2019d; Heinemeyer et al., 2023; Morton, 2016; Morton and Heinemeyer, 2019). Several studies did not report on whether the cuttings were left or removed, making it difficult to draw any general conclusions about residue management. Studies including flail cutting usually leave the residue on the soil surface (Cotton and Hale, 1994; Hancock et al., 2011) but not all studies report whether the residue was left or removed.

2.10. European studies of cutting vegetation on peatland and heathland

2.10.1. Europe-wide

Miller and Gardiner (2018) reviewed how grazing and mowing impacted grasshopper (*Stethophyma grossum*) populations in Western Europe. Habitat types included swamps, wet heath, bogs (blanket and raised) and fens. They concluded that a sensitive mowing regime can be beneficial for grasshoppers, if carried out at the appropriate point in the lifecycle, and made recommendations for management of different habitat types. The impact of grazing vegetation on lowland heath in Europe was reviewed by Newton et al. (2009b). They included studies on cutting vegetation, and responses from stakeholder questionnaires. They concluded that of their 266 pieces of evidence, only 13 were suitable for their systematic review, and therefore highlighted the need for more research into both cutting and grazing. Webb (1998) discussed traditional management of European heathlands, and stated that cutting of vegetation can be useful to maintain succession, while burning depletes nutrients.

2.10.2. Belgium

Damblon (1992) used pollen to reconstruct the recent history of disturbed mires in Belgium and showed how traditional practices such as burning, coppicing, grazing, mowing and cutting had led to the dominance of *Ericaceae* on bogs and fens, while the abandonment of these practices led to a brief cover of *Calluna* followed by a rapid spread of *Molinia* tussocks due to drainage and reintroduction of more frequent burning. On wet heath in Belgium, Jacquemart et al. (2003) investigated the impact of mowing plus removing the top layer of soil on restoration success. Mowing had relatively little impact on vegetation composition, whereas removing the top layer of peat significantly decreased *Molinia* cover and promoted growth of typical wet heath species, improving restoration. Growth and seedling establishment of parasitic plants (*Cuscuta epithymum*) was not significantly impacted by management (including mowing); however, stage of succession of host plant (*Calluna vulgaris*) did have an impact (Meulebrouck et al., 2009).

2.10.3. France

Cazau et al. (2011) investigated burning and cutting of old moorland vegetation on mouflon (*Ovis gmelini musimon* spp) populations. Both cutting and burning caused a shift in plant composition from ligneous to herbaceous species, which was beneficial to mouflon, who were consistently feeding on these treated plots compared with the untreated plots.

2.10.4. Germany

Increased nutrient loads from atmospheric deposition (particularly N) has caused vegetation change on heathland in Germany, and Haerdtle et al. (2006) conducted a study to determine if management strategies could compensate for the increased nutrient load. Mowing, prescribed burning and 'sod-cutting' were carried out on plots in an area of heath dominated by *Calluna vulgaris*. Mowing and burning removed the equivalent of 5 years of atmospheric N inputs, but the study concluded that low-intensity management would not be enough to maintain diverse vegetation. Grazing by red deer on areas subjected to management measures including mowing were investigated by two studies in Germany (Riesch et al., 2019; Riesch et al., 2020). Red deer preferentially grazed open heath areas within woodlands that had previously been managed by mowing over areas that were burnt or untreated. This helped maintain vegetation in these semi-natural open areas, and reduced damage to trees in nearby woodland.

2.10.5. Italy

The vegetation cover in plots managed by grazing goats, mowing and prescribed burning on lowland heath in Italy was more diverse after 'repeated disturbance' (Lonati et al., 2009). Lonati et al (2009) recommended management by mowing to regenerate *Calluna* and prevent the spread of invasive grass *Panicum acuminatum*.

2.10.6. Norway

Bracken control on lowland heathland showed using pesticides and vegetation cutting were equally effective in the long-term, but pesticides resulted in faster bracken reduction (Måren et al., 2008).

2.10.7. Poland

Peat systems on the Narew River were subject to modelled conservation measures, including mowing, to determine the changes in evapotranspiration occurring with climate and land-use change. However, there was no direct discussion of the specific impact of cutting (Banaszuk and Kamocki, 2008). In a review that includes studies from Narew River, Kotowski and Piórkowski (2005) discussed the implications of mowing on vegetation success. After three years of mowing, no clear changes in vegetation composition were found.

2.10.8. Not specific to any country

Taylor et al. (2019) conducted a synthesis of evidence on management interventions, designed to conserve peatland vegetation. Their study included studies on four habitat types (bog, tropical peat swamps, fens, fen meadows) with highly organic soils, and considered 125 interventions. The majority of publications related to ‘bog’ habitats. The majority of intervention strategies had no ‘effectiveness’ evidence, and very few interventions had effective, beneficial impacts. The interventions including cutting or mowing were assessed as being either ‘likely to be beneficial’ or ‘unknown effectiveness (limited evidence)’, again showing the need for more evidence into the impact of cutting and mowing vegetation on peatlands.

Appendices

Appendix 1: Final Scoping Document

Background:

The response to 'request for quotation' document was provisionally approved on 09/11/22. The scoping questionnaire was devised and sent to key stakeholders on 13/12/22. Responses were received over a five-week period, until 16/01/23.

The request for quotation document outlined four questions that Natural England saw as their priority (these are the questions referred to in question 5 of our questionnaire, below).

- What is the effect of cutting upon composition and structure of vegetation on heathland and ombrotrophic peatland?
- What is the effect upon the hydrological function and water quality of ombrotrophic peatland and heathland, of cutting vegetation?
- What is the effect of cutting of vegetation on ombrotrophic peatland and heathland upon carbon budgets of these habitats?
- What is the effect of cutting of vegetation on ombrotrophic peatland and heathland upon the associated fauna of these habitats?

The main questions from the scoping questionnaire:

3. How interested in the impact of cutting on ecosystem services and functions are you?

(1 = no interest, 5 = most interested): 1 2 3 4 5

4. How important are these ecosystem service or function issues to you?

Table 4. Please rank the issues you find most important from 1-3 (1 is most important):

Ecosystem service or function	Rank
Vegetation composition	
Vegetation structure	
Water quality	
Hydrological functioning (e.g. water tables, river flow)	
Carbon budget	
Physical changes to the surface, erosion	
Associated fauna	
Other:	

5. Do you feel that the four questions outlined by Natural England (a-d, above) will answer your main queries/questions relating to the impact of cutting on peat/heathland?

Yes

No – I want to know more about:

6. Do you know of any evidence-based reports into the impact of cutting that might not be found in a scientific literature search?

Summary of Stakeholder feedback:

In response to **question 3** (How interested in the impact of cutting on ecosystem services and functions are you?), the majority of respondents ranked their interest in cutting as a 5 (most interested).

The responses to question 4 (How important are these ecosystem service or function issues to you?) were divided into two categories (those who had ranked their top three services from 1-3 (group 1); and those who assigned all services with either rank 1, 2 or 3 (group 2))

Table 5. The responses to question 4.

Group	Veg. comp.	Veg. structure	Water quality	Hydrological functioning	C budget	Physical changes	Associated fauna
1	2	4	4	1	3	4	4
1	1	2	4	3	4	4	4
1	3	4	2	1	4	4	4
1	4	4	4	1	3	2	4
Score	**10**	**14**	**14**	**6**	**14**	**14**	**16**
Rank	**2**	**3**	**3**	**1**	**3**	**3**	**7**
2	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1
2	1	2	2	1	1	1	3
2	1	1	1	1	1	1	1
2	1	1	2	1	2	1	2
2	1	1	1	1	1	1	1
2	1	3	1	1	2	3	2
2	1	1	1	1	1	1	1
Score	**8**	**11**	**10**	**8**	**10**	**10**	**12**
Rank	**1**	**6**	**3**	**1**	**3**	**3**	**7**
combined ranks (equal weighted)	1.5	4.5	3	1	3	3	7

Group	Veg. comp.	Veg. structure	Water quality	Hydrological functioning	C budget	Physical changes	Associated fauna
combined ranks (size weighted)	1.3	5	3	1	3	3	7

These results show the highest interest in vegetation composition, water quality, hydrological function, carbon budget and physical changes, with a lower interest in vegetation structure and associated fauna.

Respondents had the option of adding any other ecosystem services or functions they thought were important. These were added:

- Wildfire resilience/risk prevention/management x 2
- Human wellbeing and enjoyment of "natural" spaces
- It would be useful to know that cutting is not (somehow) damaging to other interests e.g. occasional summer grazing; maintenance of low (natural) density stocks of red grouse.
- Where data exists, it would also be good to know under what circumstances non-intervention (leaving it alone) might yield a better result than cutting (or burning).
- Archaeology
- Amenity (access, recreation, education)

In response to **question 5** (Do you feel that the four questions outlined by Natural England (a-d, above) will answer your main queries/questions relating to the impact of cutting on peat/heathland?), several people answered “No” and wanted to know more about:

- (about NE question ”d”) – This is very broad – with a focus on particular assemblages perhaps (including priority species)?
- Effect of cutting on wildfire risk management – eg is managing heather (by cutting OR burning) simply maintaining a high risk fuel load?
- What other factors affect vegetation recovery (eg, wetness/dryness, aspect, slope, prevailing weather)
- Is it better not to manage heather and simply let it degenerate in order to move away from a heather dominated habitat?
- The effects of different post cutting treatment of the arisings (windrowed, removed, or left in place) – do they result in different outcomes? Particularly with respect to species diversification and wildfire resilience/prevention.
- Should cuttings be left or removed, impacts of follow up grazing or exclusion of grazing, dominance of Molinia in particular
- Interaction of cutting with other land management approaches – ie efficacy of cutting in combination with other interventions

- Grazing (although it may be covered in the questions about vegetation structure and composition. The graziers would like to know about grazing quality. Demonstrating an improvement in grazing quality and reduction in Molinia dominance is key to winning support for work)

These (and the responses to **question 4** “Other” section) show that there is considerable interest in wildfire risk (resilience, risk management, fuel load), and with the practical cutting method (what happens to the cut material, is it removed or left behind), and more broadly, whether cutting should be used as a management strategy at all.

In response to **question 6** (Do you know of any evidence-based reports into the impact of cutting that might not be found in a scientific literature search?), we received the following comments:

- The Greenhouse Gas Demonstrator experiment on Ashop Moor (Featherbed Moss in Snake Valley) is a current NERC funded project by Manchester University and has used cutting, biochar and sphagnum inoculation to look at carbon capture and methane, contact Prof. Martin Evans at UoM. They are monitoring hydrology response as part of this, not specific research to impact of cutting but there could be some useful data.
- Impacts of Cutting Cotton Grass on Sphagnum Moss Growth Trial Report
- We cut some small areas on Holne and Buckfastleigh Moors (Dartmoor) as part of peatland restoration in 2020-21. Unfortunately we couldn’t afford any formal monitoring of the impact. However it may be worth contacting the commoners for anecdotal feedback on how cutting affected grazing.

Scoping Conclusion:

The scoping survey results show the highest interest in vegetation composition, water quality, hydrological function, carbon budget and physical changes. There is also some interest in vegetation structure, associated fauna, wildfire risk and non-intervention strategies.

Therefore our review will focus on the seeking evidence to address the following high priority questions (adapted from NE questions):

For ombrotrophic peatland and heathland:

a. What is the effect of vegetation cutting on **vegetation composition**?

b. What is the effect of vegetation cutting on **water quality**?

c. What is the effect of vegetation cutting on **hydrological functioning**?

d. What is the effect of vegetation cutting on **carbon budgets**?

e. What are the **physical changes** (e.g. erosion) that result from vegetation cutting?

We will also review the following, lower priority, questions for ombrotrophic peatland and heathland:

f. What is the effect of vegetation cutting on **vegetation structure**?

g. What is the effect of vegetation cutting on **associated fauna** (grouse and sheep)?

h. What is the effect of vegetation cutting on **wildfire risk**?

i. What is the effect of **non-intervention strategies** compared to vegetation cutting and how does cutting style and residue management influence outcomes?

To address the latter (i), since these issues are cross-cutting and may have impacts on all of the other outcomes being reviewed as listed above, we will cover available evidence around that set of topics while addressing questions (a)-(h) (i.e. if there are comparative studies available). It is beyond the scope of the review to cover all non-intervention outcomes on their own as that would require a huge review of all literature on natural/undisturbed heathland and peatland systems.

It should be noted that there may be cases from the question list above where there is no evidence available, or at best the evidence is extremely limited.

Appendix 2: Additional Scoping Comments

In email correspondence with stakeholders, we received the following comments (edited to maintain anonymity):

"I am keen to look at the impacts of cutting because I'm not convinced that solely shifting to cutting (from burning) alone will make a big difference in heather dominance, simply because heather 'likes' to be managed and by continuing regular management are we just re-setting the clock to heather dominance? Hopefully the exception will be in sphagnum inoculated areas but that alone probably isn't enough, we need lots of re-wetting too which isn't always possible on some sites. NT in High Peak have been cutting on blanket bog and heath since 2015 (when we also stopped burning on bog). We are already seeing a very positive growth response from heather in some cuts (not all!), maybe even faster than on burns (anecdotal!), pioneer heather is back within 3 years and growing vigorously on some sites (not all), also introduced sphagnum is not surviving on every planted cut either (dryer/more exposed cuts are failing) – again all anecdotal as we are not monitoring cuts per se – I must stress that none of this is backed up by data and is all my observations at the moment."

“We do vegetation monitoring, but this is designed to pick up changes over time across large areas. Our monitoring ties in with CSM over SSSI units every 3 years (since 2016) and looks at the frequency of indicator species (rather than % cover). We have various hydrological monitoring dotted around, not set up to monitor the effect of cutting, but for other projects. Therefore, we do have some background data that could be of use.”

“It was most difficult to choose three ecosystem services and to rank them, as we see all of the listed items as being important.”

“We have historically cut dry heath at Vyrnwy on rotation for the benefit of priority species. We are also cutting blanket bog under consent as a one-off intervention and as a precursor to rewetting works (dam and gully blocking).

We are all very interested in the outputs of this review, and standby ready to help however we can. The RSPB has been an active advocate of cutting. We have used cutting, to help shift degraded (heather-dominated) blanket bog back to a better state on a number of sites, particularly our nature reserves at Geltsdale and Lake Vyrnwy. Please see attached a couple of refs that will be of interest.

In particular, we have argued in favour of cutting (supported by hydrological works and Sphagnum planting) over burning to manage the recovery of blanket bog – with the intention that the cutting is phased out as the hydrology and ecology of the bog recovers.”

“I’m uncomfortable with the idea that moorland managers simply switch from burning to cutting, simply to maintain a largely heather dominated landscape for grouse. But, I accept, that my concern is not underpinned by any sound evidence.”

“Note that we are currently producing a case study on the outcome of a series replicate cut and burnt plots referred to in the British Wildlife article. I will send this to you when I have it.”

“This is all predicated on the basis that cutting and/or burning is essential, which it may be for fire prevention purposes in certain areas. However, it is not essential on a wide scale approach as used by grouse shooters. There is also the ‘do neither’ approach which is a valid option to consider.”

“My priorities are listed in red on the attached form. I think all are important, but that’s my personal order of priority.”

“I think those are broadly the right questions. However, whilst they might not be able to answer this question, what would be really interesting is what is the long-term impacts of cutting and linking to [Defra report BD5104]? There is a risk that a short-term study doesn’t fully answer the question and opens up NE to more challenge.”

Appendix 3: Evidence Review Group members, and declaration of interests

Dr. Cat Moody, University of Leeds: funding received in the last five years for peatland and moorland related research from NERC, Natural England, Moors for the Future, water companies.

Prof. Joseph Holden, University of Leeds: funding received in last five years for peatland and moorland related research from EU, Yorkshire Water, Forest Research, NERC, Research England, The National Trust, Moors for the Future, Defra.

Deirdre Andre, Library Research Support Advisor, University of Leeds

Alistair Crowle, Natural England

Appendix 4: Search Strategy

Web of Science Databases

Same strategy use for all Web of Science databases

Searched 28/02/23

TS=((vegetation* or plants or flora*) near/3 (cut* or strimm* or mow* or flail*)) AND TS=(heath* or moor* or bog* or peat* or "wetland*" or "wet land*"or "wet meadow*" or "raised mire*" or shrubland* or "shrub land*" or upland* or "acid soil*")

Scopus

Searched 28/02/23

(TITLE-ABS-KEY (vegetation W/1 management OR heather W/1 management OR "calluna vulgaris" W/1 management OR moor* W/1 management) AND TITLE-ABS-KEY (heath* OR moor* OR bog* OR peat* OR "wetland*" OR "wet land*" OR "wet meadow*" OR "raised mire*" OR shrubland* OR "shrub land*" OR upland* OR "acid soil*") AND TITLE-ABS-KEY (cut* OR strimm* OR mow* OR flail*))

CAB Abstracts <1910 to 2023 Week 08>

1 ((vegetation or heather or "calluna vulgaris" or moor*) adj1 management).tw. (2925)
2 vegetation management/ (1522)
3 or/1-2 (2925)
4 heathlands/ (3066)
5 heath*.tw. (10807)

6 moorlands/ (1650)
7 moor*.tw. (13077)
8 bogs/ (5167)
9 bog*.tw. (19537)
10 peat/ (24259)
11 peat soils/ (7604)
12 peat/ (24259)
13 peatlands/ (9203)
14 wetlands/ (63026)
15 "wetland*".tw. (77354)
16 "wet land*".tw. (502)
17 "wet meadow*".tw. (1093)
18 "raised mire*".tw. (38)
19 shrublands/ (5297)
20 shrubland*.tw. (7843)
21 "shrub land*".tw. (565)
22 upland areas/ (6457)
23 upland soils/ (1862)
24 acid soils/ (13304)
25 acid soil*.tw. (17935)
26 or/4-25 (170911)
27 cutting/ (9330)
28 cut*.tw. (326471)
29 strimm*.tw. (13)
30 mowing.sh. (6392)
31 mow*.tw. (14765)
32 flails/ (65)
33 flail*.tw. (834)
34 or/27-33 (338117)
35 3 and 26 and 34 (65)

Ethos British Library

Searched 28/02/23

Not possible to do complex search with multiple terms so conducted multiple simple searches instead – 11 results downloaded into EndNote

- moor* management AND peat* OR heath* OR upland* OR bog* OR wetland*

resulted in 1 record.

- heather management

resulted in 6 records.

- vegetation manegment AND peat* OR heath* OR upland* OR bog* OR wetland*

resulted in 4 records.

Google Scholar

Searched 01/03/23

Adapted the search to find relevant results in Google Scholar as using more complex search did not find relevant results

Search 1: ((vegetation or heather or calluna vulgaris or moor) AND cut - About 3,300 results– downloaded first 100 into EndNote

Search 2 (vegetation or heather or calluna vulgaris or moor) AND mow -3,720 results – downloaded first 100 into EndNote

Search 3 (vegetation or heather or calluna vulgaris or moor) AND flail -64 results – downloaded into EndNote

Search 3 (vegetation or heather or calluna vulgaris or moor) AND strimming -64 results – downloaded into EndNote

Conservation evidence

Searched 01/03/23

Not possible to do complex search with multiple terms so simple search instead

Searched in Studies option

Search 1: Vegetation Management – 380 studies 2 imported into EndNote

Search 2: Moor* management -2 results – 0 imported into EndNote

Search 3 Heather management 12 results – 1 imported into EndNote

Table 6. Search results

Project title: Moody Effect of vegetation cutting on heathland and ombrotrophic peatland

EndNote library: Moody Effect of vegetation cutting on heathland and ombrotrophic peatland

Name of database	Platform	Date searched, ie date final download done	Searched from (yr)	Database last updated: year/month/ week if applicable	Strategy saved as	No of results	Date loaded to EndNote	Data in Name of Database field	Results to reviewer (date & method)	Searcher / Downloader
Web of Science WOS.SCI: 1900 to 2023 -WOS.AHCI: 1975 to 2023 -WOS.ESCI: 2015 to 2023 -WOS.ISTP: 1990 to 2023 -WOS.SSCI: 1900 to 2023 - WOS.ISSHP : 1990 to 2023	Clarivate	28.2.23		28.2.23	Moody Effect of vegetation cutting on heathland and peatland DA 28.2.23	61	28.2.23	Web of Science	2.3.23	DA

Name of database	Platform	Date searched, ie date final download done	Searched from (yr)	Database last updated: year/month/ week if applicable	Strategy saved as	No of results	Date loaded to EndNote	Data in Name of Database field	Results to reviewer (date & method)	Searcher / Downloader
Scopus	Elsevier	28.2.23		28.2.23	Moody Effect of vegetation cutting on heathland and peatland DA 28.2.23	83	28.2.23	Scopus		DA
CAB Astracts	Ovid	28.2.23		28.2.23	Moody Effect of vegetation cutting on heathland and peatland DA 1.3.23	65	1.3.23	CAB Abstracts		DA
Google Scholar	Google	1.3.23		1.3.23	Can't save search strategy in database	327	1.3.23	Google Scholar		DA

Name of database	Platform	Date searched, ie date final download done	Searched from (yr)	Database last updated: year/month/ week if applicable	Strategy saved as	No of results	Date loaded to EndNote	Data in Name of Database field	Results to reviewer (date & method)	Searcher / Downloader
Ethos	British Library	28.2.23		1.3.23	Can't save search - search strategy saved as a word document	11	1.3.23	Ethos		DA

Number of results before de-duplication 547

Number of results after de-duplication 317

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