Manage the level of grazing by either lowering stock density or reducing the duration of grazing.

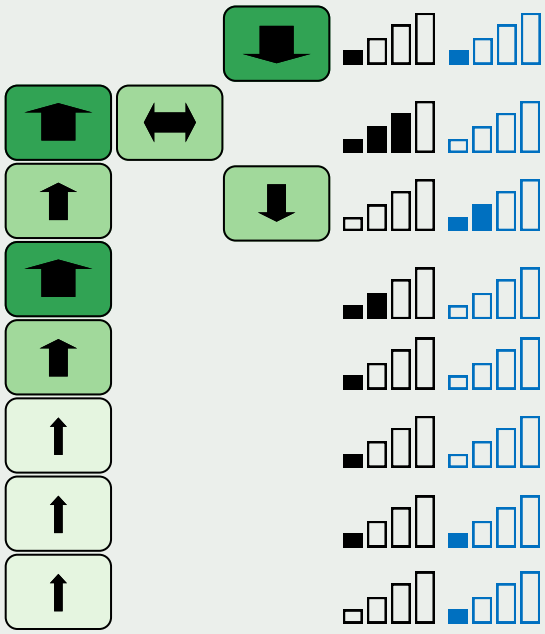
MANAGING ECOSYSTEM SERVICES

UPLANDS

REDUCE GRAZING INTENSITY

GOODS & SERVICES

- Food
- Biodiversity
- Recreation & Tourism
- Climate Regulation
- Erosion Control
- Flood Control
- Disease and Pest Control
- Water Quality



These pages represent a review of the available evidence linking management of habitats with the ecosystem services they provide. It is a review of the published peer-reviewed literature and does not include grey literature or expert opinion. There may be significant gaps in the data if no published work within the selection criteria or geographical range exists. These pages do not provide advice, only review the outcome of what has been studied.

Full data are available in electronic form from the Evidence Spreadsheet.

Data are correct to March 2015.

KEY

Quality of Evidence

Good

Medium

Poor

Quantity of Evidence

Number of sources showing direct evidence

Number of sources showing indirect evidence

Magnitude and Direction of Effect

Direction

Magnitude

Strong

Medium

Low

MANAGING ECOSYSTEM SERVICES

UPLANDS

REDUCE GRAZING INTENSITY

Provisioning Services—providing goods that people can use.

Cultural Services—contributing to health, wellbeing and happiness.

Regulating Services—maintaining a healthy, diverse and functioning environment.

PROVISIONING

Food: ***Moderate Evidence***:- Livestock grazing in upland England is mainly for the production of meat, breeding stock and wool. Grazing is the main land use due to poor climate and soils, and upland livestock grazing is an important element of the rural economy[1]. Reduction of grazing will therefore have an impact on food production and associated industries. An analysis of lamb eating quality has demonstrated that moorland lamb has better flavour qualities than lowland lamb[2]. ***Weak Evidence:-*** Moderate grazing helps to prevent grasses such as *Molinia* from out-competing heather where there are associated heather-honey industries[3]. The effect of grazing regime on food supply for salmonid fish on adjoining streams has also been investigated. A study from North America found that rotational grazing generated more riparian vegetation and terrestrial invertebrates in the upland stream food chain than intensive grazing[4]. A similar result was found in another study, also from North America, where upland streamside variables most favourable to salmonid fisheries were obtained from lower grazing intensities[5].

CULTURAL

Biodiversity: *Strong Evidence:-* The relationship between grazing regime on overall biodiversity and specific species are complex. A number of studies show that low level grazing is generally beneficial but that over-grazing leads to a decrease in diversity[6]. Grazing animals selectively take the more palatable species which can lead to an increase in the less preferred species affecting the diversity of the site in upland UK[7,8]. Species such as *Nardus stricta* may spread due to its unpalatability as shown by a study from Scotland[9]. Reduced grazing favours heather over grass communities in dry UK moorland[10]. Control of *Molinia* to allow heather regeneration following burning can be achieved by low intensity grazing by sheep[11]. Higher grazing intensities however had a negative effect on heather regeneration. Grazing at low densities had a positive effect on moorland plant communities, while lack of grazing tended towards species poor grassland[12]. In Scotland, heavy cattle grazing caused a general decline in heather through eating it, trampling and dung deposition[13]. Data from a nine year long study of grazing in riparian grasslands associated with upland conifer forests found that species richness declined in -grazed plots and remained static in grazed plots[14]. The stocking density was low however at 2.5 cows ha^{-1}. This is supported by findings that show cattle grazing can create structural diversity in upland woodlands and increased biodiversity on heaths and grasslands[15]. While there are suggestions of a link between increased grazing and bird populations declines[16], the link depends on the bird species under study and is often not straighforward[1,17].

CULTURAL

Biodiversity: ***Strong Evidence (continued):-*** Black Grouse were less common on heavily grazed moors due to reduced numbers of invertabrates[18]. Meadow pipit populations are reduced following grazing abandonment, probably due to reduced prey availability[19].Carabid and staphylinid beetles had a mixed response to grazing, with 8 species showing no response, ten species associating with heavy grazing and eight species associating with light or un-grazed treatments[20]. Spiders were most abundant and diverse in un-grazed swards, with fewest species in the sheep and cattle grazed treatments[21]. Light grazing or no grazing was also better for a number of moth species[22]. ***Moderate Evidence:-*** Combinations of grazing with other treatments can have habitat management benefits such as controlling *Molinia* growth following burning[11] or cutting[12]. Light sheep grazing (0.01-0.05 LU ha^{-1} yr^{-1}) on blanket bog can reduce heather cover, and removal of grazing benefits lichen abundance[23,24].

Recreation and Tourism: ***Strong Evidence:-*** A survey of visitors to central southern upland areas found a clear preference for the presence of grazing and a moderate expansion of tree cover a and dislike of monoculture, whether arable or grazing[25].

REGULATING

Climate Regulation: ***Strong Evidence:-*** Ruminant livestock (cows and sheep) can produce 250-500 L of methane (CH_4) per day[26]. A reduction of livestock numbers would result in a reduced contribution to greenhouse gasses. Heavy grazing can return as much as 60% of the net primary production of ingested carbon back to the soil as excreta (25-40%) and the remainder as CO_2 and CH_4[27]. In the Pennines, there was no detectable difference in the amount of carbon accumulated under different grazing regimes, though the overall stocking density was low[28]. Grazing does significantly affect aboveground carbon storage due to the reduction in biomass-rich shrubs compared with grasses[29]. **Moderate Evidence:-** Conversion of arable to pasture results in a net increase of soil carbon[30]. This implies that conversion of existing arable to cattle/sheep pasture may result in increased carbon storage potential.

Erosion Control: ***Strong Evidence:-*** In the forest of Bowland, Lancashire, high grazing intensities have resulted in open bare peat areas that have failed to be recolonized and are subject to erosion[31]. A review or upland farming management supports this finding from a range of UK and USA case studies involving sheep farming[32]. In the Peak District, most erosion occurs from *Agrostis-Festuca* swards which are usually associated with higher densities of sheep[33]. A reduction in grazing to very low levels (below 0.05 LU $ha^{-1}yr^{-1}$) allows vegetation to recolonize bare mineral and peaty soils, though recolonization is very slow[34]. ***Moderate Evidence:-*** In Idaho, USA, unregulated grazing was found to significantly increase the potential for sediment loss, largely from shallow slope banks which cattle preferred[35]. A simulation study, also from Idaho, suggested that moderate grazing could depress the stream-bank surface by 3 cm, while heavy grazing could depress it by 11.5 cm[36].

Flood Control: ***Moderate Evidence:-*** Where there is grazing, the water table is shallower in UK upland sites. This suggests that there may be increased likelihood of increased run-off but this is not demonstrated[37].

Disease and Pest Control: ***Weak Evidence:-*** In caving areas there is a suggestion that overstocking with sheep may expose cavers to bacteria from sheep faeces[32]. It also generally has a higher bacterial load, as show in a study from the Derbyshire peak district[38]. ***Moderate Evidence:-*** A model based on a Scottish dairy farm found that *E. coli* bacterial contamination of rivers could be reduced by both lowering stocking density and not allowing cattle to directly enter the water[39].

Water Quality: ***Strong Evidence:-*** Run-off from grazed plots compared with un-grazed plots shows an increase in chloride ions and sulphate[39]. It also generally has a higher bacterial load, as show in a study from the Derbyshire peak district[38]. ***Moderate Evidence:-*** A model which was validated on a Scottish dairy farm found that *E. coli* bacterial contamination of rivers could be reduced by both lowering stocking density and not allowing cattle to directly enter the water[40].

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