Grazing assessor's report on status of cattle grazing and associated habitat monitoring across Epping Forest

Plate 1. English longhorn cattle, fitted with *Boviguard* and GPS collar, ruminating in hornbeam woodland at Warren Wood Slope, Epping Forest (© P. Dennis)

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1. Introduction

This is the fourth report by the Independent Grazing Assessor for the Conservators of Epping Forest. This follows further visits to Epping Forest, 20-22 July and 19-20 October 2015, during which particular attention was paid to the current status of vegetation at several grassland, heath and woodland sites where grazing had commenced or grazing management was imminent. The invisible fencing jigsaw had been constructed and completed over the winter and grazing had been introduced to the Chingford reduced loop, Warren Wood Slope and Deershelter Plain. Emphasis of this report is on five aspects of the grazing management:

- An assessment of the condition of the vegetation at a number of the management compartments that will shortly be managed with cattle grazing.
- How best to synchronise grazing with mechanical operations, initially to deal with shrub colonisation and then to manage troublesome plant species that are thorny, noxious/ unpalatable or of little nutritional value. Such species include tussock grasses, thistle, Bracken, Bramble, Dog rose (Briar), Blackthorn, birch and Holly.
- An appraisal of push and pull stimuli to encourage cattle to forage from the open meadows and rides into the currently, sparsely vegetated wood pasture areas characterised by dappled shade.
- An assessment of the effects of autumn grazing on vegetation in the small, heathland sites and consideration of appropriate stocking densities and timing of future cattle grazing on these small sites.

- To review the ecological monitoring programme as the onset of grazing progresses.

2. Condition of vegetation in management compartments

Several management compartments affected by a lack of grazing management were visited and assessed during two visits over the summer of 2015. Attention was paid to the delay in grazing that was caused by several factors: the late introduction or a lack of grazing to some compartments when movement restrictions were imposed on the cattle due to the detection of bovine tuberculosis adjacent to Epping Forest in 2013-14, late grazing within only selected areas during completion of installation of the invisible fencing loops in 2014. The second visit this year was necessary because of further delays to the introduction of cattle to the invisible fenced compartments due to some technical problems with the collars fitted to the cattle. The current state of the vegetation was scrutinised with attention to the height of growth and state of secondary succession (presence of perennial woody plants, or thorny shrubs). This was essential to consider whether grazing could be directly introduced or whether mechanical clearance or topping might first be required (Section 4). In general, the situation in the compartments that had remained ungrazed, remained similar to observations made in summer 2014, with noticeable increases in species such as *Molinia caerulea* (Purple moor grass), *Deschampsia caespitosa* (Tufted hair grass), *Cirsium pallustris* (Marsh thistle) and *Salix* spp. (Willow) in wetter areas, and of *Rubus fruticosus* (Bramble), *Rosa canina* (Dog rose or Briar), *Crataegus monogyna* and *Prunus spinosa* (thorns), *Pteridium aquilinum* (Bracken) and *Betula* spp. (birch) in the drier habitats.

The schedule of the field visits in July initially focused on the isolated sites such as Fernhills and Big View, then the core grazed areas of Fairmead and Chingford Plain and the adjacent smaller site of Warren Wood Slope, with visits to the small heath sites of Sunshine Plain North, Sunshine Plain South, Deershelter and Long Running later on the first day and for the final morning. The return visit in October allowed an assessment of the effects on vegetation of the grazing, introduced late in the summer, across many of these sites but at some locations, e.g., Big View grazing was followed by mechanical shrub clearance. During both visits, consideration was given to transitions of open habitat (meadow and fen) to woodland at Chingford Plain to Bury Wood, Honey Lane to Big View and Rushey Plain to Sunshine Plain South.

A meeting was arranged with Roger Beecroft, the herdsman, and Heather Taylor, the newly appointed grazier at Warren Wood Slope during the July visit. The discussion reflected recent experience of grazing the reduced, invisible fenced compartment at Chingford Plain. The cattle grazing had been suspended a few days earlier since five cattle had walked over the invisible fenceline and had to be retrained at another location whilst the fault was investigated. There was no apparent fault with the collar. The integrity of the invisible fenceline was also checked and appeared fine. The problem was considered most likely caused by the weight of the additional GPS unit mounted on the same collar, so that it hung clear of the neck of cattle and led to poor contact of the conductive strip of the collar, so no warning buzz was experienced by the cattle on approach to the buried wire. The four English longhorn cattle observed at Warren Wood Slope and fitted with the same collars

appeared to be successfully contained within that small compartment although there was a problem with the GPS units since some had 'dropped out' and that prevented real-time tracking of the cattle location by the grazier. These cattle had regularly accessed woodland between the open grassland and the bridleway/ footpath parallel with the road. There was also significant wallowing behaviour in the flushes on the edge of the meadow which had disrupted prolific Marsh thistle growth. The general effect on the structure of the grassland was noticeable and effective although a significant extent was trampled into a tight sward by horse use of the central, broad path up the hill.

By the October 2015 visit, periods of cattle grazing had been successfully introduced and completed at the small loop at Chingford Plain (grazing by four cattle recommenced in early August for four weeks, with eight cattle for the fifth and sixth week), within traditional electric fenced areas at Big View (from the first week of August), Deershelter (from July), Sunshine Plain North (four cattle from 25 August) and Long Running (from end-August). Cattle remained within a small electric fenced area at Fairmead at the time of the visit awaiting completion of loops of invisible fencing to allow grazing over an extensive area of grassland and fen at Fairmead (the Peartree and Fairmead invisible fenced compartment of 150 ha, due to be grazed by 50 cattle, April to November each year).

Detailed observations on the vegetation status of the visited compartments and discussion of future, appropriate grazing or mechanical cutting management are reported under sections 4 and 5. Finally, a recent research update, a Chinese experimental study has demonstrated no effect of cattle grazing on plant diversity in grasslands of initially high botanical diversity whereas the cattle served to increase diversity in grasslands of low diversity, whilst decreasing standing biomass (Liu *et al*., 2015). This corroborates the anticipated, positive, long-term effect of cattle grazing at Epping Forest.

3. Build-up of the cattle herd for the expansion of grazing to all compartments for 2016 onwards

Winter cattle housing had been funded for the programme of herd expansion based on winter calving. English longhorn cattle calved in December and Red poll cattle in early January so that calves were sufficiently old and partially weaned at 5 months for the onset of summer grazing in the compartments. In 2014, the herd comprised 40 breeding cows and 20 < 2 year old Red poll and 20 breeding cows and 20 < 2 year old of English longhorn. It was anticipated that there would be a further 37 Red poll and 17 English longhorn calves and five bought English longhorn heifers by 2015. As at July 2015, the herd was reported as composed of 40 English longhorn cows and a similar number of Red poll cows. The estimated 32 GLU of English longhorn and 28 GLU Red poll in summer 2015 falls below the 56.5 and 40.7 GLUs anticipated last year (Dennis, 2014) so there is not yet the capacity to simultaneously graze 49 - 194 ha and further herd expansion is required and understood to be in hand from conversation with John Phillips, the new Epping Forest Grazing Officer.

4. The complementary role of grazing with mechanical operations to manage troublesome plant species

In July 2015, there were further technical matters to resolve with the *Boviguard* invisible fence system, despite completion of the buried wire perimeter of the jigsaw grazing compartments. The parallel reduction of the English longhorn herd in recent years but relatively slow build-up of the Red poll cattle numbers also limited the extent of land that could be grazed for significant periods. A consequence of delays to the introduction of grazing to several compartments of Epping Forest has been rapid vegetation change due to the fertility and nutrient status of much of the land. Secondary ecological succession was evident in the meadow or heath vegetation and led to varied cover by tussock grasses, thorny vines/ tall herbs, thorny shrub and trees. Typical examples were observed at Big View and Sunshine Plain North. *Carpinus betulus* (Hornbeam) of lower slope and *Fagus sylvaticus* (Beech) of higher wooded slopes of Honey Plain include pollarded and crown reduced areas which lead uphill to the open glade of Big View. The understory and field layer included vigorous Bracken, *Urtica dioica* (Stinging nettle) and Bramble growth, which are accessible and possibly manageable with solely grazing in the lower area but require manual cutting and clearance in order to facilitate more extensive ingress and foraging by the cattle.

Plate 2. Different perspectives from July (top) and October 2015 (bottom) across the compartments of Big View (left) and Sunshine Plain North (right). Mechanical cutting in mid- and late-summer and grazing in the interim was applied to Big View, whilst solely late summer grazing by Red poll cattle harvested the prolific growth of Purple moor grass at Sunshine Plain North.

Grazing alone at Big View would have achieved little clearance of the vegetation due to establishment of bracken, bramble and birch (Plate 2; top left). Mechanical clearance of

the woody vegetation, at the top of the slope, followed discussion during the July visit and this was followed by several weeks of cattle grazing within a perimeter of electric fencing. The site was then topped on the mid and lower slopes after grazing ceased to leave a more typical wood pasture character (Plate 2; bottom left). Early spring and later summer grazing each year, should now extend the intervals before costly, mechanical operations are again required. The early season grazing is essential to consume succulent early growth of species such Bramble and Briar, which remain widely distributed across the site. The stocking density must be significantly reduced or cattle removed once the vernal flowering species emerge and grasshopper activity commences, typically to accumulate an average stocking rate of 0.75 GLU ha^{-1} $year^{-1}$ (Robeson, 2013).

Aster amellus (Michaelmas daisy) is prolific at Fernhills and some remaining dense stands have infrequently been accessed. On inspection, there is little growth below the dense stands and cutting is a further necessary step with perhaps supplementary feeding in the centre of these remaining stands to encourage future trampling which may help to suppress growth. Optimal conservation management for this species corresponds to a low and irregular pasturing regime (Plate 3).

Plate 3. Michaelmas daisy, Fleabane and little associated, nutritious ground cover will be unlikely to attract grazing cattle at Fernhills, looking towards Trueloves South.

The requirements for manual clearance of birch and chemical control of bracken in combination with cattle grazing at the small, heath sites is discussed in section 6.

5. Appraisal of push and pull stimuli to encourage cattle to forage from the open meadows and rides into the currently, sparsely vegetated wood pasture areas characterised by dappled shade

The longer term conservation outcome for the reintroduction of cattle grazing is to encourage a natural foraging pattern within woodland rides and wood pasture in addition to the preferred, open grassland locations within any particular invisible-fenced compartment. Discussion took place during the earlier summer visit with Jeremy Dagley, and on the later visit, with both Jeremy Dagley and the newly appointed Grazing and Landscape Project Manager, John Phillips, about the best way to motivate the cattle to forage in partially shaded woodland, the rides, wood pasture or the tall herb and tussock

grasses of more open sites. This challenge to achieve effective conservation grazing management was discussed in the last annual report (Dennis, 2014). This was applicable to most of the grazing compartments enclosed by the new configuration of invisible fencing and had two important implications. It was desirable for grazing to be exerted across the full extent of each compartment, albeit with variable grazing pressure throughout. There were also implications for the calculation of stocking density and duration of grazing days should cattle remain within a restricted area of a specific vegetation type. The consequence would be over-grazing of the more nutritious or accessible parts of a compartment and under-grazing of the shadier, less nutritious places or other areas obscured by thorn thicket.

A number of push and pull factors were considered that might facilitate widespread foraging across the full extent of each compartment. Daytime heat and nuisance flies were push factors that encouraged the cattle off the open, grassland and fen areas into adjacent shaded woodland, observed for the English longhorn cattle at Warren Wood Slope during the July visit (Plate 1). Such quiet wooded areas served as pull factors for cattle to ruminate after early morning grazing and despite the lack of foraging on plants in such areas, trampling of soil and dung deposits could exert favourable effects in those wooded areas, leading to gap creation and dispersal and germination of grassland plant species into the generally bare woodland field layer. In discussion with John Phillips and Andy Froud, the most viable pull factors were to strategically relocate watering positions (Skovlin, 1965). John Phillips was actively researching current drinking troughs and ponds, routes of water pipelines and natural watercourses in order to reconfigure drinking areas within less nutritious foraging areas of each compartment. This is highly desirable and the effect to increase grazing intensity where water is provided is supported by scientific investigations (Fernandez-Gimenez & Allen-Diaz, 2001). Another viable pull factor is to provide supplementary food or mineral blocks in the areas deemed to be less attractive for cattle foraging (Putman *et al*., 1987). It is considered inappropriate to import such minerals or plant material into areas with a nature conservation objective (e.g., SSSI) but there is merit in the proposal by John Phillips to cut grass in meadow areas within Epping Forest, to make hay bales and to strategically locate these in areas such as restored wood pasture sites of crown reduced and thinned trees, where there remains little growth in the field layer. Again, trampling, and the seeds within dung deposits and unused hay may be incorporated into the soil in these areas and could facilitate the establishment of palatable grasses and an increase in the future forage value. Initial attempts to use tree fodder were reported last year (Dennis, 2014) and this remains a possible viable alternative form of supplementary feeding to achieve the conservation objective and is worthy of further investigation and field trials.

Finally, several of the interfaces between meadow, fen and woodland sites present a closed visual obstacle which may discourage general cattle movement (e.g., Big View to Honey Lane; Plate 2, left, Chingford Plain to Bury Wood; Plate 4 and also observed within the Whitehouse Plain-Fairmead, Peartree Plain-Fairmead and Rushey Plain-Sunshine Plain South compartments). The barrier effect of such edges could be reduced by widening and illuminating the existing rides (Plate 4) which have closed in with tall woody vegetation growth. Future thinning of Honey Lane is already proposed. A soft edge with a shrub and

grass-herb fringe from the access track is desirable. The woodland edge facing the meadow could also be varied with some clearance of the edge shrub and clearing of selected trees and shrub to produce a more convoluted boundary. There is a greater possibility that the illuminated woodland of the interior thinned areas will become more visible after such management and will develop a pull factor, serving as stepping stones into the woodland for the naturally inquisitive cattle. The growth and expansion of thorn and bramble thicket in areas such as Chingford Plain, Big View and the upper slopes of Fernhills also tends to obstruct cattle movement and mechanical or manual clearance will be necessary to maintain a representation of these habitats without them encroaching onto grazing areas with later merger that isolates some glades from the cattle (refer to Section 4). Mechanical cut and carry interspersed with longer periods of grazing have been revealed as beneficial for soil chemistry and the balance of botanical species composition over longer periods where fertilisers are not applied (Mládková et al., 2015). Phosphorus available to plants tends to decline under continuous grazing whereas potassium availability falls after years of cut and carry. Grazing tends to favour an increase in grasses whereas cut and carry will encourage, dicotyledonous, flowering plants (Mládková et al., 2015) which implies that a mixture of management methods is desirable to maintain the target species composition of plants.

Plate 4. Chingford Plain to Bury Wood transition. The major woodland ride may encourage cattle ingress into nearby woodland with recent crown reduction and halo thinning but the ride is currently too narrow and hard edged to provide illumination with sufficient sunlight.

6. Effects of autumn grazing on vegetation in the small, heathland sites and consideration of appropriate stocking densities and timing of future cattle grazing on these small sites

Tussock growth of Purple moor grass and birch colonisation had taken place since the last grazing episode two years earlier and was casting shade over remnant heather growth at the heath site of Sunshine Plain North (Plate 2; top right). Solely grazing by Red poll cattle in a 2-3 ha electric-fenced compartment in late summer had successfully cropped the relatively unpalatable Purple moor grass with some trampling out of Bracken growth. The heath plants were observed to be illuminated by clearance of the tussock growth but were unbrowsed and not trampled (Plate 2; bottom right). Despite some evidence of browse, birch was not diminished and physical removal by hand will be desirable. There were

numerous, dispersed *Erica* plants with evidence of vegetative growth from mature root stock although many former *Calluna* sp. stumps have collapsed and have been replaced by birch or bracken. There was occasionally *Calluna* sp. regeneration from root stock but this may possibly relate to a few places where localised bracken spraying had been applied and the heather released from shade.

Some temporary mob-stocking may be necessary to reverse the unchecked growth of competitive species, in particular at the set of heath sites and the experience at Sunshine Plain North this year appears to support such an approach. It is of course essential not to repeat grazing at this stocking density and time of year for more than one year in every 4-5 years otherwise there will be inevitable root trampling and mortality of *Calluna vulgaris* and *Erica* spp. The response to a single episode of higher stocking density by the lighter Red poll cattle breed appeared to achieve the desired reduction in Purple moor grass height and ground cover (Plate 5). There was concern about cattle consumption of *Carex* spp. seed heads, especially of scarcer *Carex binervis* (Green-ribbed Sedge), *Carex echinata* (Star sedge) and *Carex viridula* (Common yellow sedge) recorded at Sunshine Plain North and South. This may have a detrimental effect on seed production to sustain the seed bank, and the viability of the small populations. Research is required to assess the likelihood of endozoochory (increased germination rates after passage through the gut of ruminants) and wider seed dispersal. Electric fencing is proposed at Sunshine Plain South to exclude cattle from the heath so that grassland and bracken areas of the Rushey Plain compartment can be targeted without overstocking the heath or jeopardising the sedge populations over the summer.

Plate 5. Clump of the heath shrub, *Erica tetralix* at Sunshine Plain North, neither browsed nor trampled despite the extent of late summer grazing of adjacent Purple moor grass.

Favourable responses to the reintroduction of cattle grazing of wet heath have recently been reported at Pirbright Ranges (Groome and Shaw, 2015). Purple moor grass reduced in extent under low-intensity grazing and there were favourable responses of waterlogging-tolerant graminoids and *Sphagnum* spp. (bog mosses) although caution was required where grazing encroached upon mire, especially where bog mosses was already established since severe, localised treading damage was possible (Groome and Shaw, 2015). There is an ethical consideration for the welfare of cattle, grazing late on heath with Purple moor grass since the nutritional value and diminishing biomass of vegetation could lead to loss of condition and careful monitoring is advised to determine the appropriate time to remove cattle from such habitats in the autumn.

Deershelter had been grazed since 2003 and currently was grazed with four young English longhorn cattle. There was much evidence of consumption of Purple moor grass during the July visit but little evidence of browse damage to birch since the saplings had grown too large. There appeared to be increased Purple moor grass consumption in the tree fringe and around the pond where cattle had drunk and wallowed. Manual birch pulling by volunteers had been applied at Sunshine Plain South but not Deershelter. There was good recovery of heather in the scrape area where grazing has been excluded. Some grazing should now be considered for this area in future years by reconfiguring the invisible fence loop.

There was abundant growth of grasses and birch at Long Running West in July but there was a very favourable response of the vegetation to three weeks of grazing after electric fencing was constructed by 3 August (Plate 6). The electric fence had also been pushed back beyond the woodland margin with a desirable effect on the structure of the transitional vegetation into the woodland (Plate 6; right). This year, part of the site with the *Dactylorhiza maculata* (Heath spotted orchid) population was left ungrazed. The current annual monitoring programme should allow an assessment of such 'rest' years compared with cattle grazed years. There is certainly a need to clear the secondary regeneration from the site since there will be a detrimental shade effect on the orchids over time without management. The site had been grazed over 20 years with a break in 2014, usually after June each year to avoid the growth and flowering period of the orchids but further information on the sensitivity of creeping willow, a scarce species in Essex, and the reptiles associated with this site is desirable.

Plate 6. Long running West fenceline effect of August 2015 grazing on grassland cover and height (left) and scalloped effect on woodland fringe vegetation such as bracken (right).

Long Running East was very different in character and grazing would be ineffective until the extensive secondary woodland, Bramble, Bracken and birch is cleared. A band of secondary woodland adjacent to the road is due to be cleared under the HLS agreement and grazing may be appropriate in the follow-up management if stocking densities reflect the ground cover available to graze after clearance. Grazing of these small heath sites should be at a stocking rate 0.2-0.5 GLU ha^{-1} $year^{-1}$ in most years, spread over at least 8-10 weeks to reduce damage to wetland and dwarf shrub plants. The strategy of late grazing with higher stocking densities trialled at Sunshine Plain North, appears to have been appropriate for the reduction of Purple moor grass but should not be applied very frequently, perhaps one

in every five years, to avoid compaction of soil and damage to the heather roots, rarer sedges, cotton sedge and *Drosera* spp. (Sundews).

7. Review of ecological monitoring programme

This was a crucial period for the monitoring of vegetation interfaces at the eight selected transect sites with both quadrats along transects and fixed point photographs on Ws within each glade. The introduction of grazing was underway but had not achieved the full annual duration nor full target stocking density of cattle and it is essential to assess the changes at these interfaces annually during the transition. The frequency of re-survey could be relaxed to 3-5 year intervals after a couple annual resurveys. The amended draft of the contract report by Clive Bealey, the plant surveyor, was not yet available to appraise the variability in the ground cover of the major plant species on each transect leading up to the full annual stocking with cattle.

The mapping of individual plants of *Pedicularis sylvatica* (Lousewort), *Silaum silaus* (Pepper saxifrage) and Heath spotted orchid remained valuable since the detection of changes in the distribution that might follow the reintroduction of grazing could be assessed. This approach could be extended to yellow rattle on Whitehall Plain although there is some doubt about the seed source, given its current inclusion in many meadow restoration seed mixes. The effectiveness of the current blocked sampling areas at detecting change in density could be tested by re-survey of a set of quadrats in the existing survey blocks compared with a set of randomly-dispersed quadrats across the whole site. The use of a remote controlled flying drone, fitted with a digital camera could quickly capture images to assess the annual density and distribution of plants of species such as yellow rattle. Surveyed at the time of peak flowering, the yellow flowers have high contrast amongst the foliage to complete an interpretation by image analysis.

8. Student projects

Two student projects had been established during 2015 that were supervised by research and academic staff at Aberystwyth University. Alexandra Broom, conducting a BSc Honours project on cattle foraging distribution and impact on vegetation and Glenn Mulleady, a Forest Keeper on a distance-learning MSc Livestock Production course, who will investigate the nutritional value of vegetation with varied periods of grazing.

A project meeting of Alexandra Broom, Jeremy Dagley and the author took place at Chingford Plain, initial discussion considered a study of the cattle use of the various grazed compartments of grassland, with adjacent ungrazed areas for comparison but the late onset and temporary suspension of grazing did not promise to provide sufficient data for 2015. Instead, a study of the pattern of grazing of the collection of small, heath sites was chosen. This was confirmed as suitable after an afternoon visit to Sunshine Plain South, Sunshine Plain North and a walk with Andy Froud on day two of the July visit across Deershelter and Long Running. It was confirmed that an alternative project could focus on browse impacts on birch or willow and grazing effects on Purple moor grass at heath restoration sites that had received intensive, moderate or no recent grazing management. The project could be based on the cattle grazing diary, changes in vegetation from the

various surveys and GPS data recorded from the cattle fitted with collars. There was a requirement to co-ordinate periods with an increased frequency of spatial location recording of cattle by Geo-Positioning Satellite trackers with the dates of field observation by Alexandra Broom so that a finer resolution pathway of cattle movements could be assessed in each of the grazed heath sites for the project. Jeremy Dagley had liaised with Matt Upson (AgForward project, Cranfield University) to provide the historic spatial co-ordinates of cattle at the various grazed heath sites. This would be done once filters could be applied to remove aberrant spatial locations, for instance, records displaced beyond the fencelines.

A project meeting was organised with Glenn Mulleady during the July visit, with discussion about the scope of a project to assess the nutritional value of selected grasses in open, haloed/ partially shaded and wooded sites; the MSc project would compare nutritional value of the grasses in cattle grazed or ungrazed examples of each type of site. The study could focus upon Tufted hair grass, Creeping soft grass or Purple moor grass but a longer period of cattle grazing was necessary to provide sites for meaningful comparison and the suggestion was made that the fieldwork of the project should be delayed to 2016, once the reintroduction of cattle grazing was well established.

9. Summing up

Further delays to the expansion of cattle grazing across Epping Forest have occurred due to some further technical difficulties which appear to have been partly resolved by the time of the October 2015 visit. Despite the shorter than expected period of grazing, generally favourable effects were observed at the small heath sites and at Big View. The initial mechanical clearance of shrub growth on the upper slope before the introduction of grazing at Big View is an intervention required at various locations prior to the onset of annual grazing. Secondary succession to shrub and young trees, due to the time elapsed since previous grazing, will not now be consumed by cattle, so mechanical cutting or manual pulling of birch (in heath sites), topping of Tufted hair grass (Chingford), Creeping soft grass, Bracken and *Juncus* spp. rush (Fairmead). Initial manual/ mechanical clearance will also be necessary in woodland and wood pasture sections of compartments where thicket has formed, since this will currently deter ingress by the cattle (e.g., Bury Wood). Regular, annual grazing should then extend the intervals before expensive mechanical interventions are required, especially if grazing in spring is feasible at sites with prolific Bramble and Briar. Some promising methods to encourage movement of cattle into shaded and less vegetated areas in each compartment have been proposed and with further development, should make a positive contribution to the extent of cattle grazing for nature conservation outcomes at Epping Forest.

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