New Forest SAC Management Plan Version II

Part 3: Generic prescriptions for habitat management

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Introduction

These are the management prescriptions which should be applied to New Forest habitats as appropriate and where conditions dictate. To avoid repetition here, Part 3 should be read in conjunction with Natural England Supplementary Advice for the New Forest SAC and New Forest SPA.

There are a range of issues affecting, or which have the potential to affect the condition of the designated habitats in the New Forest. The generic prescriptions are designed either to maintain habitats in favourable condition or to restore them to favourable condition over time. In the latter case there will often need to be considerable initial restoration works applied to a site before the more usual long-term management can begin.

The management requirements of the vast range of species interests for which the New Forest is designated (under SSSI, Ramsar, SPA or SAC), or indeed for which it is of importance in relation to UK Biodiversity, are covered by these generic management prescriptions. Specific guidance to cover legal requirements for certain groups which are given special protection are included in this chapter.

Other constraints or activities which preclude the implementation of these generic prescriptions will prevent the restoration of unfavourable sites and will eventually cause favourable sites to fall into unfavourable condition. In the light of this any plan, proposal or significant regular activity which has the potential to disrupt restoration or maintenance management operations is likely to have an impact on the qualifying features and consequently will require Habitats Regulation Assessment.

To make it simpler for managers to refer to the generic prescriptions they are summarised in a stand-alone document at the end of this chapter. However, to understand the rationale for their formulation and to read the detailed prescriptions one should refer to the issues and full generic prescriptions described and discussed in this chapter.

Three further Forest-wide issues have become of increasing concern since the publication of the original SAC Management Plan: air pollution, disease and climate change. The impact of these issues either currently or in the next 20-50 years are discussed in this section.

Overarching management policy

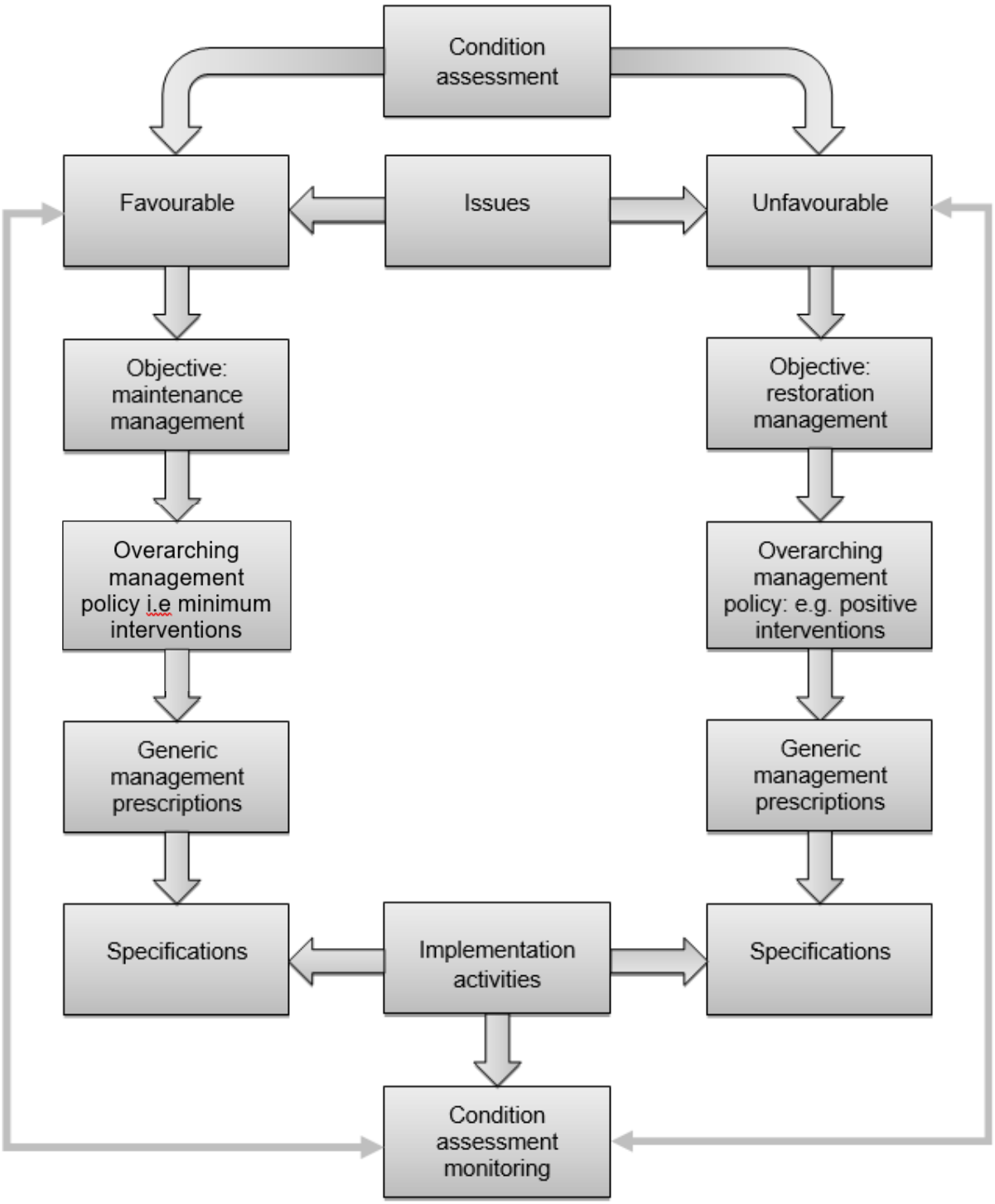
A number of issues may affect the condition of each habitat; the choice of generic management prescriptions to address these issues depends upon the severity of their

impact on habitat (or habitat unit) condition. Overarching management policies have been derived from the nature conservation objectives for each habitat, based upon whether the objective is to maintain a unit in favourable condition, or to restore a unit to favourable condition. Hence condition assessment is the principal determinant from which generic management prescriptions follow.

Relationship between condition assessment, management policy and implementation programmes

The relationship between condition assessment monitoring, overarching management policy and implementation activities by landowners and managers which may take the form of implementation plans or programmes (which will require Natural England's consent) is illustrated in Figure A.

Figure A: The relationship between condition assessment monitoring, overarching management policy and implementation activities



Pasture woodland: issues, generic prescriptions and rationale

Introduction

This section discusses the issues affecting the condition of pasture woodland and sets out the generic management guidance and rationale required both to maintain those units currently in favourable condition and to restore those units currently in unfavourable condition.

While much of this section of the Management Plan is informed by the work of Peterken, Spencer and Field *(Plan for the Ancient and Ornamental Woodlands of the New Forest*, 1999), some areas have been further developed in the light of more stringent requirements to maintain favourable condition under the Habitats Directive and the changes to Forestry Commission management policy with the revised Ministers Mandate (1999-2008).

Overall, there is agreement that minimum intervention is the most appropriate management strategy for pasture woodlands in favourable condition. This means that management will only be carried out where intervention can be justified for the conservation of features of nature conservation or cultural heritage importance which are a significant part of the international value of the pasture woodlands. This implies that in many areas little activity other than maintenance grazing will occur.

Overarching policy

A number of issues may affect the condition of pasture woodland; the choice of management prescriptions to address these issues depends on the severity of their impact on unit condition. The following overarching management policy is derived from the nature conservation objectives for pasture woodland:

- Where the objective is to maintain the unit in favourable condition, then the favoured management option will be one of minimal intervention implemented through a limited series of maintenance operations conforming to the policies and prescriptions as detailed in this section.

- Where the objective is to restore units to favourable condition, then additional management operations may be required in the short term, conforming to the policies and prescriptions as detailed in this section.

Issues affecting pasture woodlands

Table 1: Issues pertaining to management of pasture woodland

Issues pertaining to management required to maintain favourable condition	Issues pertaining to management required to restore favourable condition
Woodland regeneration: the importance of depasturing stock and the impacts of grazing levels	Trapped pre-Inclosure pasture woodland Emergent woodland Open space and shading: pollarding and holly pollarding Potential for the restoration of grazing: impact on flora and fauna
Stock feeding	Tree canopy collapse Tree and shrub recruitment
Stock pesticide treatments	Bracken management
Standing and fallen dead wood: importance as habitat and in woodland regeneration Firewood collection	Inadequate dead wood resource
Native tree management Veteran trees and public safety	Management of regeneration plots
Deer: species and impact	Non-native tree and shrub management
Grey squirrel	Drainage and soil disturbance
Climate change	Recreation: camp sites and car parks
Pests and disease	
Air pollution	

Issue 1: Woodland regeneration: the importance of depasturing and the impacts of grazing levels

Depasturing domestic stock has long played an important role in defining the structure and nature of New Forest pasture woodlands, developing and maintaining a high forest tree

canopy interspersed with glades in a mosaic of other woodland and heathland habitats. The open aspect, long continuity of tree cover and presence of high numbers of ancient trees has resulted in the development of exceptionally rich habitats, particularly for saproxylic invertebrates, epiphytic lichens and bryophytes, fungi and breeding birds. (See Part 1 for description and Part 2 for evaluation.)

In common with other habitats favourable condition depends on grazing pressure being within acceptable levels; neither too high nor too low. The pulsed phases of tree regeneration in response to lower stocking or reduced deer population levels are well documented. Tubbs and Peterken (1965) identify three periods of tree regeneration: 1600-1750 when most of the current large beech, oak and holly originated; 1850-1900 after reduced grazing pressure as a result of implementation of the Deer Removal Act of 1851; and 1940-1960 following wartime pasturage reductions. The last pulse of widespread regeneration ended with increased common rights pasturage on the Open Forest, increased access by ponies and cattle to Inclosures and a rise in deer populations. This does not mean that no regeneration has occurred between these pulses; it manifestly has. For example, between 2000 and 2020 stocking levels according to the Verderers marking fee data have consistently increased from what was an historically high grazing level. This together with high deer numbers, has not prevented active natural regeneration occurring in parts of the pasture woodland complex to this day (Newton, 2010).

It is apparent (e.g. Chatters and Sanderson, 1994) that the severe reduction or absence of domestic stock grazing from wood pasture systems results in the rapid regeneration of trees and shrubs with a consequent loss of open ground and changes in light condition and micro-climate. The special interest features, particularly lichens and bryophytes, respond negatively to such change and the system becomes poorer over time, for nature conservation (e.g. Woodfidley, Roydon Wood).

On the other hand, excessive grazing and browsing, especially in combination with other activities which also reduce habitat structural diversity (particularly removal of dead and fallen trees), can severely limit tree regeneration, at least in the short term. It will also, by reducing flowering, decrease the overall availability of nectar sources for woodland invertebrates and may, if sufficient food sources are not available in nearby enclosed woodland, impact on important invertebrate populations.

Canopy collapse

Over time, as existing trees age and die, woodland cover will gradually retreat if regeneration is absent for long periods. Oak is long-lived, beech less so and it is evident that the older beech dominated stands which originated after the fellings of the late 17th century, are now 250-300 years old and not surprisingly many are disintegrating. They are

undoubtedly increasingly vulnerable to natural events such as the weakening effects of alternate wet and dry hot summers and storms of the kind experienced in 1987 and 1990. There is evidence that a canopy gap which results in the sudden exposure of ageing beech trees accelerates disintegration and death; gaps tend to get larger as trees on the margin are more likely to get blown over or die.

The Forestry Commission survey of 1996 revealed that some 5%, 172ha (hectares), of the pasture woodlands on the Crown Lands show signs of canopy collapse, with some 15% of their area having suffered severe collapse in recent years. The 10 most seriously affected woods are Berry, Bratley, Denny, Eyeworth, Mark Ash, Ridley, Stricknage, Studley, Undersley and Vinney Ridge. (This does not include those sites, e.g. Hollands Wood, where the provision of camp sites has resulted in severe reduction in canopy.) Regeneration is least likely for those woods located on acid soils and dry ridges (Berry, Bratley and Mark Ash Woods), where open ground under current management tends to develop swards of bracken and grass, rather than a protective growth of hawthorn, holly, blackthorn or bramble which readily colonise the more clay-rich soils. While Undersley and Vinney Ridge Woods are located on similar soils, their relatively small size and protected location surrounded by Inclosures offers opportunities for greater control of browsing damage and thus makes them easier sites for nurturing natural regeneration. For woods on the heavier clay soils (e.g. Eyeworth, Studley and Stricknage), conditions for natural regeneration tend to be more favourable—in Stricknage Wood for example, there is a strong representation of younger trees elsewhere in the wood, to confirm that progressive regeneration can be assured.

There can be no regeneration without gaps developing in the canopy, a natural process and many species are dependent upon alternating light and dark phases of open and closed canopy. In the total absence of regeneration woodland cover would over time retreat towards parkland as the canopy decreased to less than 30% cover. It should be noted here that parkland can be a stable habitat over many centuries and one which can be rich and varied in its own right.

Tree recruitment

Recruitment beneath the existing woodland canopy will generally lead to the development of beech while open grassy glades will be colonised with oak. Oak regenerates well in short grass with light cattle grazing, but seedlings often get smothered under bracken, grow poorly among heather and are shaded out under most established trees and shrubs. Heavy masts occur every five to seven years on average, producing enough acorns to overcome predation by pigeons, squirrels and voles. Sapling oaks are browsed to differing degrees by deer, ponies and cattle, though they may survive for decades as bitten down shrubs.

Unlike oak, beech is adapted to grow in shade and saplings can thrive beneath small gaps among dense scrub. Unless the woods are kept open by pasturage, they are likely to

change from dominance by oak to dominance by beech, simply because as time passes, regeneration within the shade of established woodland will favour the shade-bearing beech. In the past this has been artificially amplified by the preferential felling of oak (in support of shipbuilding), the more valuable timber tree.

Birch is native to the Forest and plays an important role in woodland regeneration. It is generally a short-lived tree (though veterans do exist which play an important role in the ecology of the Forest), with abundant tiny seeds that readily colonise suitable habitats. The shading effect of birch is sufficient to seriously suppress dense stands of bracken, but insufficient to inhibit the regeneration of shade-tolerant species such as beech and holly. Where birch has sprung up with oak, the oak is much more likely to persist and eventually replace the birch woods as they slowly succumb to age at about 80-100 years. Birch woods admixed with occasional oak and slowly recruiting beech and holly, will eventually develop as oak-rich pasture woodland, where areas of denser birch give way to open ground or lawn between more widely spaced long-lived trees.

Foresters are concerned that recruitment of oak has been less than necessary to sustain the pasture woodlands. They point to the flushes of regeneration achieved in both World Wars (1914-45), as evidence of the pressure on regeneration from the livestock. While accepting that grazing by livestock is an essential feature for conserving the pasture woodlands, they remain concerned that a static pressure of grazing prevents regeneration. Ecologists maintain that grazing pressure is not static; it varies over time and in their view this variation has to date remained within ecologically acceptable limits for the New Forest ecosystem as a whole. Pulses of regeneration in response to relaxed grazing pressure are followed by periods of reduced regeneration when grazing pressure is higher (e.g. Flower, 1980). Even in the current period of high grazing levels and deer numbers regeneration of oak and beech is apparent in most pasture woodlands (e.g. Redshoot Wood, Woodcrates, Brook Wood and Tantany Wood), particularly where saplings are afforded protection by fallen dead wood and scrub growth. It is ecologists' view that regeneration of oak and beech under a variable grazing regime is sufficient to maintain the special interest features associated with pasture woodland. However, in view of the difference of opinion over regeneration of pasture woodland it is apparent that further monitoring studies would be useful over time to provide more information before agreed definitive conclusions can be reached.

In this regard a recent theory proposed by Vera (1998) and expanded in his book *Grazing Ecology and Forest History* (2000) would appear to be fundamental. His thesis is that the model of the former wildwood being substantially closed canopy forest is incorrect. He argues that the landscape was more probably a mosaic of scrub, grassland and groves of high forest maintained by the grazing of large herds of aurochs, deer, elk and bison. A key part of his argument is that the pollen record has been misinterpreted and is consistent with a landscape that was more like wood pasture than closed high forest.

Vera summarises his theory thus: “Young oaks and other tree species grow up in scrub or in the mantle and fringe vegetation of groves with a closed canopy. The grove advances into the grassland at the speed of blackthorn advancing into grasslands by the underground rootstock. Solitary trees come up together with solitary hawthorns. Within the groves no regeneration takes place because of the shade cast by the canopy. If a gap is formed, grasses will establish there and attract large herbivores. Their grazing and trampling will prevent seedlings from coming up there. So, they prevent the regeneration of trees in gaps of the canopy. As more trees die or are windblown, the grassland increases. In this way, ultimately the grove degenerates into grassland, as is known and described in retrogressive succession. Eventually, light demanding thorny shrubs will establish in the grassland, protecting young trees against the large herbivores. So, the succession is: grassland > thorny shrubs > grove > grassland > thorny shrubs > grove, etc. I call this theory the cyclical turnover of vegetation.”

This theory based on vegetation dynamics at the ecosystem scale is hugely appealing and is highly significant for ecologists and foresters alike. While this model has been subject to critique, it remains a valid working hypothesis for woodland dynamics in the grazed New Forest.

When considering measures to boost the natural regeneration process it must be remembered that the Forest is an extensive system with the ability to manifest and accommodate natural expansion and contraction of wood pasture cover over time. Thus, if local elements are contracting towards a temporary parkland phase (in the face of current high browsing levels), providing other woodlands are expanding elsewhere then intervention may not be required. Sunny, well-lit old trees are richer in a variety of plants and animals than shaded trees, however old or rotten. A long-term view is required.

There has been little in the way of survey in pasture woodlands over the past 20 years. The significant exception has been the work of Newton et al (2010) who carried out woodland surveys in 2005-07 across the New Forest in all classes of woodland. Their aim was to assess the structure, composition and condition of New Forest woodlands. They surveyed 173 woodland units using 50m x 50m randomly allocated plots. They found that browsing levels varied over the woodlands though by the measure they used browsing levels were generally high. Despite this they found that tree regeneration is widespread, though patchy and often at low density. Interestingly, they recorded 41 tree species, though 18 of those were non-native. Holly, hawthorn, birch and beech were most frequently recorded, with oak saplings in just 16% of the plots.

Issue 2: Stock feeding

The provision of animal feed (other than holly browse from the agreed pollarding programme) in pasture woodland artificially increases the feeding capacity of Forest habitats above that which is naturally sustainable, with consequent adverse effects (e.g.

upon ground flora, tree regeneration) and leads to localised nutrient enrichment and adverse changes in plant communities, when unutilised feed is left to decay. Pasture woodland is not an appropriate habitat for stock feeding and there are no recognised sites for commoners' use.

Issue 3: Pesticide treatments

Treatment of domestic stock with certain chemical pesticides may have adverse impacts on many non-target invertebrate groups. Use by the Verderers of a Pyratape wormer (Strongyd-P) may be benign. However, while this is an effective equine wormer it does not affect bot fly infestations—a significant issue for New Forest ponies. Avermectins and closely related products such as milbemycin would appear to be effective against both infestations but are excreted in dung and are active against many invertebrates that colonise dung posing a serious threat to rare invertebrates and species such as bats and birds which rely on invertebrates as an important food source. Benzimadazoles are thought to have a negligible effect on dung fauna, but it is not known how damaging such chemicals are to aquatic crustacea, clearly an important issue in the Forest.

The Verderers grazing scheme is specific on this question in that wormers containing Avermectin must not be used on the New Forest. Animals treated with Avermectin by commoners off the Forest must be kept off the Forest for two weeks following treatment to allow the active ingredients to become inert before livestock are turned out. Commoners wishing to use wormers on the Forest should seek advice from the vet on alternative products.

It remains an area for further research before any statements can be sensibly made about which treatments (if any) are acceptably benign to important invertebrate groups. A project should be initiated which:

- reviews current practice
- reviews the toxicity profiles of current products in use in the Forest and those for which there may be a likely demand in the future
- determines the risk of exposure to dung and aquatic invertebrate communities
- explores alternative management strategies to avoid contamination and where avoidance is impractical ensures that only benign treatments are used on Forest stock

Issue 4: Standing and fallen dead wood: its role as habitat and in woodland regeneration

The importance of dead wood habitat is described in Part 2. Removal of dead wood, either standing or fallen, directly reduces habitat availability for saproxylic invertebrates, fungi and other species and interferes with the crucial natural processes of nutrient recycling through decay and decomposition.

Where there is an issue of inadequate tree regeneration as a result of browsing and grazing levels being too high, the situation is compounded by the collection and removal of dead wood and fallen trees (Morgan, 1991). Crucially, the presence of patches of scrub, brash and fallen trees provide sanctuary from browsing, allowing seedlings to survive and regenerate, during periods of high stocking levels and high deer numbers. However, if such protection is removed then regeneration can reduce to zero and in areas previously affected by windthrow and excessive fallen tree removal, gaps in the tree canopy increase and a more parkland-like structure can develop (e.g. Mark Ash Wood).

Issue 5: Bracken: its impact upon tree regeneration

Bracken today does not enjoy its former status as a desirable product of the Forest. As it is not harvested on anything like the scale of previous centuries, it has probably become more prominent. It undoubtedly has the potential to impact both negatively and positively upon other species and natural processes. Its impact upon tree regeneration in the pasture woodlands may be of local concern, not generally on the heavy soils, where bracken growth is naturally limited, but more on the sands and gravels. While it is true that bracken fronds shade seedlings and bracken litter may smother them, it also plays a significant role in sheltering oak regeneration. Bracken is reduced or eliminated on well used tracks and there are usually other openings through which some saplings may grow. In general bracken tends more to delay rather than prevent regeneration and may act to space out regeneration thereby encouraging large, spreading trees.

Cattle and ponies trample young bracken and litter, and ponies eat it in late July/September when its toxicity level has reduced, so under grazing can prevent sufficient gaps in the bracken stand for trees to establish. Cutting can be indiscriminate and is clearly capable of removing all regeneration from repeatedly cut areas. Pigs are turned out on the Forest under rights of mast to coincide with the autumn fall of acorns and beech mast. In addition to the beneficial impact of removing a high proportion of the green acorns which can be fatal to livestock when eaten in excess, the rooting activities of (non-ringed) pigs can break up deep bracken litter beds and help to provide suitable conditions for tree regeneration.

It is accepted that there is a case for localised bracken control where regeneration is sought especially on the acid soils and dry ridges such as Vinney Ridge or Bratley Wood.

Issue 6: Veteran trees and public safety

Native veteran trees (including old growth holly, birch and hawthorn) and the products which they shed on ageing (leaf litter, twigs, branches, boughs and eventually fallen boles or whole trees) are fundamental to the ecology of the pasture woodlands.

Landowners have a duty of care to protect the public and others from dangerous features on their land under the Occupiers Liability Act 1957. There is a view that veteran trees with extensive quantities of dead standing wood are potentially dangerous especially when in the immediate vicinity of recreational hot spots such as car parks and campsites. These two factors have led to a significant reduction in veteran trees and dead standing wood in the New Forest this century. For example, Cox and Rose (1996) record that 84% of mature trees have been removed from Hollands Wood Campsite since its establishment in the late 1960s. It is apparent that the siting of recreational facilities within pasture woodlands leads to a dramatic decline in the nature conservation value of that woodland (refer to page 45 for more information).

Issue 7: Soil disturbance and drainage: adverse impacts

Considerable levels of soil disturbance occur naturally in woodlands through the agencies of windthrow and the activities of woodland animals. The commoners' right of mast, the right to turn pigs out in the pannage season to take advantage of the autumn seed crop, creates localised seasonal soil disturbance. These are positive impacts providing niche diversification and are important precursors to natural regeneration.

While such processes have contributed to soil disturbance in the past and will continue to do so in the future, the New Forest pasture woodlands have an additional legacy of surface scarring largely attributable to previous activities associated with mechanical timber extraction and provision of drainage systems. Resulting soil compaction and reduction in wetland habitat diversity impoverish the woodlands for wildlife and reduce their capacity to support commonable stock in periods of drought.

Issue 8: Native tree management: species composition and tree morphology

The composition and morphology of native trees and shrubs in the pasture woodlands has evolved in response to a long history of deer browsing, stock grazing, former timber exploitation and physical interventions, e.g. pollarding, which ceased about 150 years ago (Sanderson, 1991). Hence, while oak, beech and holly are in abundance, other species characteristic of ancient woodland in southern England, such as small-leaved lime, are virtually absent. The reintroduction or artificial bolstering of such species is considered inappropriate, and no deliberate introduction of native trees will take place within the pasture woodlands.

However, there is a case for reinstating a pollarding programme on young generation trees to ensure continuity of ancient tree habitats and to retain the character of the woodlands. The large trees characteristic of the pasture woodlands were generated:

- by growing up in relatively open conditions
- as a by-product of pollarding
- by growing for at least 150 years

In the long run, such trees can only remain part of the Forest scene if conditions are created in which new large, spreading trees can develop. Trees can be pollarded for centuries. Even when old and hollow new growth springs vigorously from cut limbs. However, most of the New Forest pollards have not been cut since the early 18th century in the case of oak, the early nineteenth century in the case of beech and the twentieth century in the case of holly. Once pollarding has ceased for this long, new growth after resumed pollarding is less vigorous and the decay is more likely to weaken the trees and, in the case of beech, often results in death.

However, young trees (less than 50 years old) usually respond well to pollarding as is demonstrated by the successful experimental pollarding of holly and beech. It is technically possible therefore to reintroduce pollarding on younger specimens to ensure that a new generation of ancient trees with spreading branches will replace existing veterans in the twenty second century. Pollarding of young beech specimens may prove to be a useful technique of canopy manipulation to favour oak regeneration.

Holly

Holly is present as a dense scrub layer in many pasture woodlands. Its prominence is thought to be a result of the dramatic reduction in deer grazing following the Deer Removal Act 1851. The need to pollard holly to supply winter feed to deer also ended with the implementation of this Act. While it is a characteristic and valued component of the pasture woodlands, supporting important lichen communities and providing nectar source for woodland insects, it can become rather dominant casting dense shade on ground flora and surrounding epiphytic lichen communities. In such situations a loss of species less tolerant of dense shading results (e.g. *Pannaria conoplea* in Shave Wood and *Catinaria grossa* in South Ocknell Wood) and intervention through holly pollarding and/or coppicing is desirable. In the Crown Lands some 26% of all woodland has a dense holly understorey which has been identified as posing a threat to lichen communities (Sanderson, 1997). Consequently, a holly pollarding regime was agreed and implemented annually in selected holly stands in sites where overshading of lichen communities on old growth trees was an issue.

Sanderson has undertaken an extensive review of this practice under contract from Natural England, Forestry England and the National Trust (Sanderson, 2019). His conclusions are that holly pollarding has had positive results for lichen conservation and no negative results. However, there are still large areas of shaded trees supporting important lichen communities still to be pollarded. Important lichen communities, particularly on beech remain threatened.

Pollarded holly seems to recover fully from pollarding in 30-40 years when it is ready for repollarding. While some individual trees inevitably die, most regrow effectively. The exception to this is older hollies which (especially old well-lit pollards) have their own special associated species and that holly holms are an internationally rare woodland type. A new protocol for holly pollarding has been produced in the light of this work.

Issue 9: Deer: impact on pasture woodland

The impacts of deer grazing on woodland biodiversity in Britain is well documented (Gill, 2000). The effect of deer on woodland vegetation reflects the diet of the different deer species as well as the ability of the plants to withstand damage. In general, deer either eliminate or retard the growth of young trees, shrubs and herbs, allowing grasses and a few unpalatable species to dominate.

High grazing pressure by deer suppresses tree regeneration, both by severely reducing seedling density and by delaying growth of the few remaining survivors. Typically, tree species differ in susceptibility to deer. Provided browsing pressures are not high enough to eliminate all seedlings, deer will bring about a change in the species composition of surviving seedlings and saplings. The composition of woodland canopies may then be

affected for several decades, or even centuries and this effect is perhaps the most pervasive impact of deer. In Britain, oak, ash, hazel, rowan and willows are usually found to be the most vulnerable broadleaved species and most likely to be reduced or eliminated by deer browsing. Birch, alder and beech are usually found to be more resistant.

Browsing on trees and shrubs also has an effect on the vegetation structure. Deer reduce the height of low growing shrubs, as well as preventing taller species from reaching full stature. This effect tends to result in a woodland with a simplified vegetation structure, which possesses a ground layer and canopy but a poorly developed or absent middle layer.

Since deer browsing typically reduces both plant species richness as well as simplifying vegetation structure, invertebrate diversity is likely to be reduced by deer, if present at high density. A study comparing an area exposed to deer for 22 years with an adjacent deer-free enclosure in the New Forest revealed many more families of *Coleoptera* and *Diptera* in the area free of deer. These are taxa which typically constitute a substantial proportion of insect species richness in a woodland (Gill, 2000). With such demonstrable effects on plant and invertebrate communities, grazing pressure associated with high deer numbers has a causal effect on many interconnected elements of the woodland ecosystem.

Here it should be noted that the preceding paragraphs have summarily described the impacts of high deer grazing pressure on biodiversity in typical British woodlands. In the 21st century the pasture woodlands of the New Forest are atypical, with extensive grazing systems with depastured livestock now restricted to a limited number of locations and none on the scale of the New Forest. The presence of grazing livestock (and their associated variation in density, type, distribution and duration) prevents clarity about the role and therefore impact that deer browsing and grazing has in New Forest pasture woodlands. (See also Table 9 on differential social, physiological and foraging behaviour and impact on vegetation.)

Nationally there are strong indications that deer populations are rising and expanding. In particular, the fallow population is thought to be rising due to lower mortality (warmer winters) and with does able to breed at an earlier age. Due to the impacts of high deer numbers on conservation and agricultural interests, this represents a considerable challenge for land managers. A co-ordinated landscape approach is required to achieve and maintain a sustainable and healthy population of wild deer.

For the New Forest landscape, we only have reliable deer census data for the Crown Lands of the SAC. In the table below the current estimates of deer numbers across the Crown Lands are provided by Forestry England, with recommended population size for each species (Crown Lands Deer Management Plan; Page, 2013).

Table 2: Current estimates of deer numbers across the Crown Lands 2013

Species	Current estimated population size (in brackets: estimate pop. size in 1999)	Recommended population size (Page, 2013-2020)	Current distribution (2019)
Fallow deer	1,500 (2,040)	800	Widespread but numbers concentrated in peripheral beats where moving from non-Forestry England land on to Crown Lands
Red deer	150 (100)	100	Concentrated in two separate herds: majority near Ober Heath Smaller group south of A31
Sika deer	70 (100)	70	Largely confined to an area south of the Southampton to Bournemouth railway
Roe deer	700 (300+)	400	Commonest around Forest fringes and where populations of the herding species (fallow and sika) are lower
Muntjac deer	150	zero	Widespread but at low density. Efforts to prevent population establishment unsuccessful

This table demonstrates that the New Forest now has five established species, despite efforts to prevent colonisation by muntjac. In the Forest, fallow are present in high numbers and widespread. Red and sika are localised and present in fairly low numbers with roe increasing as habitat improves following the reduction in the fallow population. Muntjac are now widespread, taking advantage of areas of increased cover including bracken, bramble and holly as well as restock sites and *Rhododendron*.

From the Natural England condition monitoring programme currently three of the pasture woodlands in the SAC are in unfavourable condition due to deer grazing pressure and at least 16 woodlands are considered to be under significant threat from deer browsing. However, Loosehanger Copse and Langley Wood are both in unfavourable condition due to deer pressure (these are not currently grazed by livestock).

Issue 10: Grey squirrels: impact on pasture woodland

Grey squirrels were imported from eastern North America in the early 20th century. They strip bark from tall saplings and small trees, thus killing leading shoots and admitting rot to trunks and branches. They are particularly attracted to young and planted beech and thus potentially threaten one of the principal species of the pasture woodlands. Bark stripping from the branches and bases of ancient trees has also been recorded and is believed to contribute to their decline. Squirrel damage to existing mature trees does not appear to seriously impair beech recruitment from natural regeneration.

Of primary concern is the impact that grey squirrels have on the long-term continuity of large ancient beech trees. Though the damage inflicted creates rot holes and dead wood habitat in trees at a fairly young age (in some cases creating a young generation of new pollards), it is not possible to predict how long such damaged trees might survive, particularly where damage to the basal root buttresses may weaken the mechanical strength of the trees as they get older and heavier. With so many of the rarer lichen and fungal species dependent upon ancient beech trees it is a concern that damage from grey squirrels may compromise our ability to ensure a continuity of such trees into the future.

This issue becomes more acute when tree regeneration is minimal in the face of high grazing and browsing pressure and removal of fallen trees. In times of high regeneration it is more likely that some trees will reach mature size without serious squirrel damage.

Although some squirrel control continues across the New Forest it has been unable to significantly reduce the size of the population and the damage it causes. In the last 20 years the methods by which squirrels can be controlled have changed, with Warfarin-based baits via hoppers no longer legal practice (2014), but with new humane killers coming on to the market to try to replace this. At present, on the Crown Lands the principal method for squirrel control is with a rifle. In the future it is hoped that the development of an effective immuno-contraception will provide a successful, cost-effective control measure (UK Squirrel Accord, DEFRA).

Issue 11: Regeneration plots: former purpose, current condition and their future

In response to the foresters' view that within the Crown Lands the long-term future of the pasture woodlands was endangered through a lack of regeneration, the New Forest Acts of 1949 and 1964 provided the Forestry Commission with the powers to enclose, plant, thin and fell, in order to promote regeneration. Experimental regeneration plots (ranging in size between 1.6ha and 9ha) were established between 1953 and 1966, covering a total of 287ha (Peterken, Spencer and Field, 1999). Within each plot the existing trees were group felled or heavily thinned and either replanted or left to regenerate naturally. Fencing was not adequately maintained, and the plots have generally been subject to varying levels of

grazing by deer or from commoners' stock incursions over the period. The majority of the regeneration plots were surveyed in 1996 by Spencer who noted four stand classes:

- Stands of mixed planted and self-sown oak, beech and birch (with occasional self-sown natives such as sallow, rowan and ash). Usually closely spaced young high forest stands. Some of these have been thinned to plantation-like stands of oak and beech in recent years.

- Stands similar to the above but with additional planted stems of non-native trees including Scots pine, larch and southern beech.

- Stands similar to above but with additional planted stems of native trees that are considered inappropriate to the site e.g. beech planted within former pure oak stands as at Pinnick Wood and The Noads.

- Stands where the canopy has been thinned rather than clear felled and natural regeneration of birch, holly and some beech (along with rowan, whitebeam and very occasionally oak) have regenerated within the wood.

There is considerable variation in the condition of these plots and the extent to which they are in-keeping with the character of the surrounding pasture woodland. Most provide ideal opportunities for extensive pollard and glade creation to make them indistinguishable from the surrounding pasture woodland. It is accepted that all regeneration plots will be brought (where necessary), to a condition where they can be integrated into the adjacent pasture woodlands. Some of this work remains to be done.

Issue 12: Former wood pasture enclosed within silvicultural Inclosures: issues relating to future management

A: Within the Crown Lands

Of the pasture woodland incorporated within 18th and 19th century silvicultural Inclosures, approximately 400ha remains. Some of this pasture woodland has subsequently been thrown open to grazing as part of historic fence removal or realignment (most recently through 20 years of delivery of Forest Design Plans).

For those areas of pasture woodland that remain enclosed, in practice the majority have been subject to periods of fluctuating grazing pressure from deer and unauthorised incursions of commoners' stock. They maintain most of the characteristics of the Open Forest pasture woodlands and there has been much recent debate on how best to maintain this interest in perpetuity.

Open Forest pasture woodland is dependent on Open Forest grazing management to maintain its special interest. Significant decrease in such grazing, or reliance upon deer grazing alone will not maintain the interest and the priority on such old growth stands is to return them to Open Forest management as soon as is practicable.

It has been suggested that these old growth stands could provide a refuge for species intolerant of high grazing pressure and therefore they should not be returned to the Open Forest. However, such management is incompatible with maintaining the primary international interest features and cannot be sanctioned. The strict control of grazing within selected Inclosures together with diversification of the woodland as described in the Inclosures section of this document will provide conditions for grazing intolerant species. It should be noted that there is a considerable resource of ungrazed semi-natural woodland habitat within the National Park boundary supporting plant and animal communities adapted to such conditions and providing a pool from which possible expansion into suitably created habitat within Inclosure woodland may in time occur.

B: Outside the Crown Lands

Former pasture woodlands have surviving relic old growth features principally at Roydon, Franchise (now owned by the RSPB) and Langley Woods. While these are separated to a greater or lesser extent from the Open Forest, grazing management was reintroduced to Franchise Wood in 2021. The opportunity exists for a landscape approach by extending this grazing management through to Langley Wood. At Roydon Wood the Hampshire and Isle of Wight Wildlife Trust have taken the opportunity to reintroduce managed grazing into former wood pasture habitats.

Issue 13: Emergent woodland: the issue of tree regeneration on adjacent habitats

Following the Deer Removal Act 1851 there was a burst of regeneration within existing woods and on the Open Forest. Regeneration largely comprised beech and oak, which have long since reached the canopy. But in some woods—perhaps the most shaded—it allowed an understorey of dense holly to develop. Regeneration on non-wooded habitats was more mixed and has continued at intervals during the 20th century. The results are ‘emergent woods’. They are well distributed growing up in glades and on existing woods’ margins. Birch woodland is included in this category and also develops as fringes around established blocks of beech and oak woodland.

The propensity of birch to colonise adjacent heaths and lawns has the potential to adversely impact on the favourable condition of these important habitats. It is also seen as a grazing threat. However, natural woodland edge fluctuations are an important aspect of Forest ecology and the transition habitats so created are important for a variety of nature conservation interests. It raises a management issue of when to intervene and remove invading birch, oak and occasionally alder from other habitats, which if left unchecked may

result in a decline in favourable condition of the open habitat. Generally, closed canopy emergent woodland (as opposed to scrub and parkland type habitats) adds little to the value of wood margin habitat.

When considering whether to fell selected trees or scrub which has grown as a result of natural regeneration at the fringe of an existing woodland, the following points should be carefully considered:

- What is the status and condition of the adjoining woodland? For example, is it ancient old growth woodland in good or poor condition or is it more recent in origin. If the former, then consider if the woodland is isolated and undergoing canopy collapse with little or no natural regeneration. Is the management objective to retain that woodland in which case the natural regeneration taking place at the fringes should be conserved, while issues causing the collapse of any natural regeneration inside the woodland should be explored. For example, has fallen dead wood been removed meaning that shelter from grazing is in short supply.

- Are the deer or grey squirrel populations excessive in that area in which case further control measures might be appropriate.

- What is the emergent woodland spreading into. For example, is it species-poor dense bracken or herb-rich *Molinia caerulea* grassland? In the former case there is little merit in terms of habitat protection or improvement in grazing to be made from felling the emergent woodland. In the latter case, this may reduce and break up the continuity of the habitat and impact on the typical and more specialist species associated with the grassland.

- What is the priority in the face of the two points above—to encourage the further development and expansion of the old growth woodland, or to protect the pristine SAC habitat from destruction by secondary woodland expansion?

These are the judgements that need to be made on a case-by-case basis with due consideration to benefits or disbenefits to the adjoining habitats and their condition.

Issue 14: Non-native and reintroduced trees and shrubs

A number of non-native trees and shrubs have in the past either been deliberately planted within the pasture woodlands or have colonised naturally from elsewhere. Spencer (1996) estimates that some 135ha of Crown Land pasture woodland is affected; figures are not currently available from non-Crown Land woodland. The impact of these infestations varies between species and their locations. However, all take up space which could otherwise support native species, may constrain regeneration of native trees and tend to support a

more generalised and less interesting flora and fauna. If allowed to spread, they will inevitably reduce the nature conservation value of the pasture woodlands and other habitats.

Rhododendron ponticum

This is a highly invasive shrub, native of Asia Minor and the Iberian Peninsula, introduced to this country as an ornamental garden species. It has the capacity to cover huge areas of woodland soil in dense monospecific stands excluding all native species. In the pasture woodlands on the Crown Lands 20 years ago there was around 50ha of *Rhododendron*, most extensively around Hincheslea, Malwood, Philipshill and Lyndhurst/Bramble Hill. Most of this is being removed as part of wider restoration works across the Forest.

Gaultheria shallon

An invasive ericaceous shrub from northwest America which spreads inexorably by a system of underground rhizomes. Its leathery leaves resist penetration of herbicides. Once established it dominates the ground and understorey layers of both wood and heath. 20 years ago, there was a major infestation covering up to 12ha south of Fletchers Hill, south of Clumber Inclosure and south of Rhinefield. Concerted effort is still ongoing to try and eradicate the species from here. Small patches are known elsewhere, e.g. on heathland at Roydon Wood.

Cotoneaster

This is a large group of shrubs and small trees which have been in cultivation in the UK since 1824 and are spread by birds which eat the berries and spread the seeds. Once established, they can become dominant to the exclusion of native species. A number of cotoneaster species have become established within the New Forest, particularly in areas such as the former World War I and II airfields where the characteristically acid heathland soils have become more alkaline in character. Work to control cotoneaster has been ongoing since 2015.

Sycamore

A late medieval introduction to Britain and a 19th century introduction to the Open Forest, it seeds freely almost everywhere and has great invasive capacity where conditions are favourable. A local issue in the Forest as grazing has probably constrained its spread. However, small areas e.g. Denny Wood and Matley Wood contain an abundance of sycamore.

In light of the continued influence of ash dieback *Hymenoscyphus fraxineus*, in 2019 Natural England and the Forestry Commission prepared a joint advice paper on the disease

in SSSIs in England and the potential role existing sycamore might have in reducing the impact on those species reliant on an ash canopy:

“Many SSSIs with ash also have a proportion of sycamore. As a non-native tree, sycamore (especially the seed-bearing trees) has been cut out of many SSSI and other nature conservation sites in the past, in an attempt to control its spread—often because of its shady canopy which can limit the rich ground flora associated with ash. However, recent research has shown that sycamore has similarities to ash in some respects, in terms of the species it supports (nearly half of those associated with ash can also use sycamore) and some of its other ecological functions (nutrient cycling) and qualities (such as its similar bark pH—important for some lichens). In European ash forests, sycamore is a native component, and it has now naturalised itself into many UK woodlands. As a veteran tree, sycamore can provide an excellent habitat for bats with its flaky bark and heart rot qualities similar to ash (white rot).

It is likely that where sycamore is present with ash and the ash dies, that sycamore will fill the gaps if left undeterred. We need to consider on a site basis how appropriate this is and whether it is better to have natural regeneration of sycamore or introduced planted stock of other species like oak, lime or beech, which may, in any case, have similar shady canopies to sycamore. Sycamore is more vulnerable to squirrel damage than many native species and this should also be considered if timber production is an objective (NE/FC, April 2019).

While the above approach is unlikely to be relevant in woodlands such as Matley and Denny where ash is uncommon, it may have greater relevance in woodlands such as those along the Avon Water, however ash exists in relatively low numbers within the pasture woodlands and sycamore is known to be incredibly invasive and could lead to a complete change in the canopy structure.

Turkey oak

It was introduced to Britain probably from the Balkans around 1750; though it arrived in the New Forest in the late 19th or early 20th century. It is invasive and is found in pockets throughout the Forest, usually present as a small number of mature trees among a host of younger stems. It is of little timber value as it is prone to warping and shrinkage. More significantly the knopper gall that infests native oaks is dependent upon the presence of turkey oak to complete its life cycle. Turkey oak is also thought to hybridise with both native oaks. Its presence thus compromises the future of native oak in the New Forest and its successful regeneration. In the last 20 years a substantial number of turkey oaks have been removed from the pasture woodlands as part of wider habitat restoration works across the Forest.

Sweet chestnut

Introduced to Britain by the Romans as a source of nuts for food. It was recorded as early as the 14th century in the New Forest in an account roll of Edward III in the form of a chestnut wood. It is now integral to the historic landscape, especially as a component of the 19th century Inclosure plantings. Although its nuts are valued as winter food for wildlife, as a non-native, it does not support the wealth of insects and lichens that are found on mature native oak and beech. It is not very windfirm, tending to fall over when mature and then resprouting vigorously, often creating groves. Sweet chestnut leaf litter is rich in tannins and breaks down very slowly, creating soil conditions that do not favour woodland herbs and mosses. It is not an aggressively invasive species, though does spread slowly on sandier acid soils.

Red oak

Introduced to Britain from North America as an amenity tree. It was widely planted in the 19th century and is found in a number of locations. As with sweet chestnut it does not support a rich insect or lichen community. It is not aggressively invasive but will spread slowly within established woods.

Hornbeam

A 19th century introduction to the Forest and one regarded as a man-assisted arrival of a native species that would have spread to the Forest anyway at some time.

Scots pine

Pollen records show that Scots pine was present locally in southern England 9,000 years ago, becoming extinct from most of the British Isles around 5,500 years ago except in Scotland, locally in northern England and in the Fens (Rackham, 2003). This is reflected in New Forest pollen records (; the presence of Scots pine today has arisen from recently introduced stock (Flower and Tubbs, 1982). A small amount was possibly planted on Adjacent Commons in the 18th century, but there is no written evidence of its presence in the New Forest until 1823 (Tubbs, 1986). It is a highly invasive species which has subsequently spread over heathland and woodland alike, resulting in the need for recurrent management to exert control over its expansion. Where dense stands occur in the pasture woodlands they act as a significant constraint on regeneration of native species and have infilled glades which are important components of woodlands with many woodland species dependent on them. While undoubtedly valued by some as a landscape feature, Scots pine does not support a rich fauna or flora. Where Scots pine is shading veteran broadleaf trees it can adversely affect longevity and health. It is important to allow light to reach veteran trees (Vera, 2000; Widerberg et al, 2012), promoting epicormic growth from dormant buds lower on the tree and providing a lower canopy which enhances the ability of the trees to naturally retrench while maintaining photosynthetic vigour. Deep shade leads to a general loss of lichen and invertebrate interest.

Other tree species

A number of other non-native species have been planted in the pasture woodlands in more recent times. These include various conifer species such as western hemlock, Douglas fir, Lawson cypress and Norway spruce, as well as broadleaf species such as hybrid lime. The majority of conifers occur as limited numbers of self-sown trees, though occasionally they may occur as established tall trees of some stature and should be dealt with in the same way as Scots pine.

Issue 15: Climate change

The generic issue of climate change is addressed in Part 2 under ‘Man-induced trends’.

The specific impacts on pasture woodland have been considered by Natural England et al, 2020. The tables below summarise (for pasture woodland SAC features) the causes, consequences, implications and possible adaptations amid a two degree rise in global temperatures over the next century. In summary, while the overall impact on oak and pasture woodland is assessed as being of ‘Low sensitivity’, beech woodlands (more drought vulnerable) are assessed as being of ‘Medium sensitivity’.

Table 3: Predicted impacts of climate change on Atlantic acidophilous beech woods over the next century given a two degree rise in global temperatures. Sensitivity: Medium (after Natural England 2020). Note: references within this table are contained within Natural England 2020.

Cause	Consequence	Potential implications	Adaptation responses
Drier summers	Drought	Mature beech trees are sensitive to drought and seasonally fluctuating water tables on less suitable soil types. This can lead to reduced growth, die-back and death (Hearn and Gilbert, 1977; Geßler et al, 2007). Reduced abundance of beech specialists (e.g. epiphytes, fungi, invertebrates). Changed ground flora composition.	Reduce the impacts of other pressures, such as pests and diseases, pollutants, overgrazing and development pressures. Reducing deer grazing pressure, for example, allows more flowering and seed setting of ground flora, such as primroses, therefore increasing the potential for populations to survive drought years. Take positive steps in all woodland situations to increase the proportion of decaying wood to ensure resilience of dependent species, the replenishment of soil organic content and the capacity for moisture retention.
Wetter winters	Spring waterlogging	Reduced nutrient uptake and reduced vigour of beech (Carey, 2013; Geßler et al, 2007). Increased susceptibility to summer drought.	
Warmer summers	Prolonged periods of heat	Increased sun scorch, leading to bark death in beech.	
Warmer winters	Fewer frost events	Reduced winter cold periods leading to reduced bud initiation and a possible reduction of beech in parts of Britain.	

Cause	Consequence	Potential implications	Adaptation responses
		Increased fecundity and survival of mammal pests, resulting in more damage to thin barked trees and reduced regeneration. More generations of insect 'pests' per year (Read et al, 2009).	Increase the age structure of high forest to reduce the susceptibility of beech populations to damage from droughts and storms.
Increased frequency of extreme events	High winds	Increased loss of trees to wind blow. Most damage to woodlands is caused by extreme events and the frequency of these is very difficult to predict.	
In combination		Increased prevalence of fungal pathogens, including *Biscogniauxia* species, which cause damaging strip cankers on beech (Hendry et al, 1998).	

Table 3.1: Predicted impacts of climate change on lowland mixed deciduous woodland, including old acidophilous oak woods over the next century given a two degree rise in global temperatures. Sensitivity: Low (after Natural England 2020)

Cause	Consequence	Potential implications	Adaptation responses
Warmer winters		Earlier bud burst, with potential for increased risk of frost damage. Incomplete winter hardening, potentially resulting in more serious winter cold damage.	Reduce the impacts of other pressures, such as pests and diseases, pollutants, overgrazing and development. Reducing deer

Cause	Consequence	Potential implications	Adaptation responses
		Reduced winter chilling, leading to reduced seed germination and natural regeneration of some species. Greater survival of mammal pests (e.g. deer and grey squirrel), resulting in increased grazing pressure and decreased regeneration. Greater overwintering survival of insect pests, leading to increased abundance and pressure.	pressure, for example, allows more flowering and seed setting of ground flora such as primroses, so increasing the potential for populations to survive drought years. Undertake management interventions to encourage and protect regeneration. Consider blocking artificial drainage channels within woodland in areas predicted to experience increased drying out. Undertake contingency planning for outbreaks of new pests or major new disturbance events such as wildfire. When determining the optimal management of sites, consider the requirements of key species such as woodland birds to ensure minimum patch size is retained.
Altered seasonal rainfall patterns	Increased fluctuation in water tables and winter flooding	Increased infection by various soil and water-borne pathogens such as phytophthora. Reduced rooting depth for species intolerant of winter waterlogging, exacerbating the effects of summer drought. Increased likelihood of windthrow if tree root depth becomes restricted by increased rainfall and waterlogging.	
Drier summers	Drought and fire	Shifts in the composition of native woodland communities/types (Broadmeadow et al, 2009a, 2009b). Increased competition from invasive species and the potential establishment of species from further south in Europe e.g. holm oak.	

Cause	Consequence	Potential implications	Adaptation responses
		Shifts in the regeneration patterns of trees. A potential decline in canopy cover. Changes in ground flora composition. Rapid changes in canopy characteristics and composition on very dry sites.	Take positive steps in all woodland situations to increase the proportion and diversity of decaying wood throughout sites. This will ensure both resilience of dependent species and the replenishment of woodland soils' organic content and hence the capacity for moisture retention and provision of other essential ecological functions needed by trees and other species.
Increased frequency of extreme events	High winds Extremes of soil temperature and moisture	Increased frequency of windthrow, leading to losses of mature and veteran trees. The loss of specialist species associated with veteran tree habitat (primarily fungi, invertebrates and lichens). Increased frequency of environmental stress. Potential for widespread tree mortality in years of extreme drought.	
In combination	Increased prevalence of pathogens Increased survival of disease vectors Increased survival of mammal pests such as deer and grey squirrel	Potential loss or significant reduction in the abundance of key canopy species. Limited natural regeneration. Introduction or increased levels of planting of non-native species.	

Cause	Consequence	Potential implications	Adaptation responses
	Changed patterns of woodland productivity		

Table 3.2: Predicted impacts of climate change on wood pasture over the next century given a two degree rise in global temperatures. Sensitivity: Low (after Natural England 2020)

Cause	Consequences	Potential implications	Adaptation responses
Hotter summers		Increased sun scorch leading to bark death of beech. Reduced generation time of insect pests such as oak pinhole borer *Platypus cylindrus* and oak buprestid *Agrilus pannonicus* (Read et al, 2009).	Where possible, reduce the impacts of other non-climatic pressures, such as pests and diseases, pollutants and development pressures. Adjust grazing levels according to environmental conditions to avoid over and undergrazing and compaction. Protect mature and veteran trees from over and undergrazing. Ensure adequate regeneration to establish new generations of trees to replace individuals and species that are lost or likely to be lost under climate change. These new trees should be protected from grazing and competition and should be managed to provide appropriate conditions for saproxylic invertebrates (i.e. decaying wood). Young trees
Warmer winters	Fewer frost events	Greater survival of tree pests, such as grey squirrel and species of deer, resulting in increased browsing and grazing pressure and reduced regeneration (Read et al, 2009). Greater over-wintering survival of insect pests leading to increased abundance and pressure (Ray, Morison and Broadmeadow, 2010).	
Changed seasonal rainfall		Trees rely on mycorrhizal fungi to help resist pathogens and provide nutrients. These fungi may	

Cause	Consequences	Potential implications	Adaptation responses
		be susceptible to drought, waterlogging or changes in soil temperature (Lonsdale and Gibbs, 2002).	may be protected from grazing and browsing by fallen branches and dead wood, giving an additional reason for retaining dead wood. Management of veteran trees to reduce the likelihood of catastrophic failure, for example by reducing the crown to reduce the sail effect in high winds and improving the protection for individual veteran trees. The benefits of undertaking crown works on veteran trees need to be weighed against the risks and the guidance of a suitably qualified arboriculturalist can provide advice. Consider introducing or reinstating pollarding to semi-mature trees less vulnerable to storms and drought, to accelerate the development of veteran tree features and niches for specialist fungi and invertebrates, but consider the risk from crown works, as outlined above. Pollarding to reduce crown density can also help to reduce the possibility of catastrophic failure. The presence of ash dieback should be taken into
Drier summers	Drought Increased risk of fire	Increased loss of mature and veteran trees and loss of associated saproxylic invertebrates, lichens and fungi. Beech is particularly vulnerable because of shallow rooting on soils subject to waterlogging. This may be exacerbated in wood pasture and parkland compared to closed canopy woodland due to increased transpiration rates (Berry, Onishi and Paterson, 2012). Changes in ground flora composition are most likely if canopy trees die. Vulnerability will differ according to local climate, soils and catchment hydrology. Premature death of mature and veteran trees.	
Wetter winters	Raised winter water tables and increased risk of flooding	There is an increased likelihood of wind throw if tree-root depth becomes restricted by increased rainfall and waterlogging on sites with impeded drainage (Ray, Morison and Broadmeadow, 2010).	

Cause	Consequences	Potential implications	Adaptation responses
		The impact of flooding will differ between species, with, for example, willow and alder able to withstand flooding longer than other species.	account when management, pollarding or repollarding of ash trees is being considered. Ensure that standing and fallen dead wood is not cut up and is only moved if absolutely necessary, as it represents a key niche requirement for many specialist species. Trees blown over by storms may grow new stems if the roots are undamaged or the horizontal trunk remains connected to the root system, if left uncut and not 'tidied up' or removed from the site, where there are no safety concerns. Develop fire management plans, especially in wood pasture where the threat of fire is thought to be high, such as those with a bracken-rich or heather understorey. Introduce grazing animals, or other appropriate management, to reduce the amount of litter in sites with a lot of bracken. Develop contingency plans for outbreaks of new pests and diseases and other extreme events. New trees need to be established with sufficient space to grow with open crowns, if they are to provide habitat niches for those species
Increased frequency of extreme events	High winds Extremes of soil temperature and moisture Drought	Increased frequency of wind throw, leading to the loss of mature and veteran trees and an increased break up of large, unstable crowns in veteran trees, particularly those that have fallen out of the pollard cycle. Loss of veteran trees leading to a loss of specialist species associated with veteran tree habitat (primarily fungi, invertebrates and lichens), although insect larvae within trees may be protected from extreme conditions. Greater incidence of environmental stress, resulting in increased susceptibility to other pressures such as pests and disease. See drier summers above. Note that the impacts of a dry summer are exacerbated if it follows a dry winter, meaning that the summer starts with a lower soil moisture content.	
In combination		Increasing prevalence and range expansion of pests such as oak processionary moth *Thaumetopoea processionea*, gypsy moth	

Cause	Consequences	Potential implications	Adaptation responses
		Lymantria dispar and pathogens such as *Phytophora* (Read et al, 2009), leading to the potential loss or significant reduction in key species including oak, beech and ash.	dependent on the specific conditions in the trees, including many lichen species.

Issue 16: Storm damage

The generic issue of storm damage is covered in Part 2 (see 'Factors influencing management'), outlining the impacts of storms and subsequent management in broadleaf woodland in southeast England.

The New Forest pasture woodlands are rather different from these typical unmanaged woodlands in the Southeast. They are the result of hundreds of years of diversification, have uneven age structure from veterans to saplings and a rich epiphytic lichen and bryophyte flora. The woodland invertebrate fauna is second to none with new species being discovered annually. It is not an unmanaged or neglected ecosystem; on the contrary it is the finest remaining example of formerly extensive wood pasturage in the country.

The impacts of a hurricane through the Forest would however be the same as for any other woodland. Trees would succumb, some would be damaged, some would fail, glades or large expanses of open ground would open up. Regeneration would thrive in the presence of a plentiful supply of protective dead wood, scrub, bracken and bramble and sapling would in five to 10 years grow above browse height and form the next generation of forest trees.

While the immediate loss of mature and veteran trees would be regrettable, it must be remembered that this kind of pasture woodland has a cycle of 800-1,000 years; not the 70-150 years for commercial forestry. Continued depasturing of domestic stock would control any vegetation favoured by the sudden release of stored nutrients from disturbed soils.

Issue 17: Pests and diseases

This is not a review of the impact of all known sources of tree health issues in the New Forest. Many diseases, pests and fungi attack trees, but are not fatal by themselves. Trees have evolved to cope with them and, while affecting timber quality, they may actually enhance the ecological value of the tree by allowing a whole range of species to take advantage of the new niches opened up by the source.

For example, ash bacterial canker, now understood to be caused by the bacterium *Pseudomonas savastano*, which destroys the cambium by hollowing out trees and producing characteristic black bulging around hollows. Trees seem able to deal with this disease for long periods and its impact provides valuable roost holes for other wildlife.

However, some sources of infection are more serious and are either already present in the New Forest or are highly likely to arrive as the impact of climate change continues to evolve. These have the potential to greatly impact New Forest trees and landscape, and

these are described. Note: the many pathogens currently affecting spruce, larch, pines and other non-native species grown commercially in the Inclosures are not described here.

The information below is largely taken from a series of booklets published in partnership under EU funding by Forest Research 2016.

Oak (all species)

Of a plethora of viruses, fungi and insects which have the capacity to weaken or kill our native oak trees, three are of particular concern at present.

Acute oak decline: This disease is present and active within the New Forest SAC. It is a complex decline disease involving a number of bacterial species which cause bark lesions and a native buprestid beetle, oak jewel beetle *Agrilus biguttatus*. The disease causes a rapid decline in oak trees and can be lethal within five to six years.

An infected tree may be recognised by the dark bleeds of sticky fluid oozing from cracks in the bark (lesions). Note that honey fungus and various species of *Phtophthora* may also cause lesions on oak trees. Only when in the final stages does the canopy appear to become affected and shows marked deterioration compared to healthy trees. The beetle itself is a canopy dweller so rarely seen, but the exit holes of the larvae are apparent on infected trees as characteristic D-shaped holes.

While mainly affecting older trees (50 years upwards), it can also affect trees as small as 12cm dbh (diameter at breast height).

All cases should be reported through Tree Alert (www.forestry.gov.uk/treealert).

Oak processionary moth: Experts believe there is a high threat that it will arrive in the New Forest in the next few years as it spreads out across southeast England. The caterpillars of the oak processionary moth *Thaumetopoea processionea* when present in large enough numbers can defoliate a whole oak crown by feeding on its leaves. This can weaken the trees, making them more vulnerable to attack by other pests or diseases and to environmental stresses such as drought or flood.

Silken white nests appear on tree stems which can be as large as a rugby ball; the caterpillars themselves are harder to see unless observed ‘processing’ en-masse to and from the nests to feed usually around dawn or dusk. The hairs of the caterpillars are highly irritating to humans and should not be touched.

This is a notifiable pest, and any sightings must be reported through Tree Alert. (www.forestry.gov.uk/treealert)

Phytophthora ramorum: Oak is a terminal host to this species—see below under non-specific hosts.

Ash

Ash dieback (*Chalara*) only affects ash trees, all ages of which can be affected. Once established in the tree, the disease is often fatal. This disease is now widespread in southern England, including the New Forest SAC. Of particular concern is the likely impact on veteran ash trees which support rich lichen flora such as are found in Highland Water.

Ash dieback is caused by the fungus *Hymenoscyphus fraxineus* commonly referred to as *Chalara*. The disease will kill a tree either as a direct result of the pathogen, or indirectly by weakening it to the extent where it becomes vulnerable to attack by other pests or pathogens.

Infected trees display diamond shaped lesions on the bark and stems and dead blackened leaves which do not fall off in winter. Spores fall on leaves and infect them causing black necrotic spots which expand into lesions. The fungus enters the leaf stalk and extends to the shoots and ultimately to the tree stem penetrating deeply and kill the bark tissue.

This is a notifiable pest, and any sightings must be reported through Tree Alert. (www.forestry.gov.uk/treealert).

***Phytophthora* spp**. A number of species of *Phytophthora* affect a wide range of native broadleaves in the New Forest. While the impact on commercial forestry has been major, the impact on native broadleaves is slower though ultimately can be fatal.

Phytophthora ramorum is an aggressive fungal pathogen which damages the bark and foliage of both broadleaf and conifer trees. The fungus can only produce spores on certain tree species such as larch and sweet chestnut and in *Rhododendron ponticum* and bilberry. Tree species become heavily infested rapidly and can die within two to three years.

On other species—such as beech, oak and birch—the fungus is unable to produce spores; the host is called a Terminal Host. Infection leads to lesions which secrete dark exudate and gradually kills the inner bark below. If the lesions become extensive and effectively ring bark the tree, then the tree will die.

P. ramorum is a notifiable pathogen and must be reported through Tree Alert (www.forestry.gov.uk/treealert).

Issue 18: Air pollution

A generic discussion on air pollution is covered under Part 2 (see ‘Man-induced trends’).

The pasture woodlands are of international importance for their epiphytic flora and these are particularly susceptible to certain air pollutants.

As described in Part 2, there are some localised impacts on the epiphytic flora of pasture woodlands, but due to the size of the ecosystem and its surrounding land-uses, much of the impacts of air pollution manifested on smaller sites elsewhere are reduced.

In terms of airborne nitrogen-based pollutants on epiphytic lichens, ammonia seems to have the greatest impact. Sanderson (2018) notes that exposure to such pollution favours the domination of yellow lichens on oak twigs with grey lichens dominating in the cleaner air. This is particularly manifested where there is frequently stationary vehicle traffic along certain roads (e.g. Lyndhurst) or where cars are regularly located in high numbers within old growth woodland (e.g. several of the campsites, most notably Hollands Wood). Using Hollands Wood campsite as an example, lower plant communities are impoverished in the campsite area (but not elsewhere in this woodland) due to the removal of tree limbs (public safety) as well as the likely effect of acidification of remaining tree bark due to cars when ‘cold-starting’ during the camping season (Sanderson, 2004).

Issue 19: Recreation

A general description of the current recreational activities and their impacts on nature conservation is given in Part 1. This section focuses on those specific recreational activities which have become significant issues for pasture woodland given their impact on habitat condition.

Most of the recreational activities described in Part 1 occur in the pasture woodlands, albeit usually less intensively than in either the Inclosure or in open habitats (heathland) on the Open Forest. The relatively low intensity of most forms of recreational activity in the pasture woodlands has resulted in only moderate impact and have not thus far contributed to a decline in favourable condition of pasture woodland. However, the location of a number of car parks and three camp sites within pasture woodland units has created a substantial impact on their nature conservation interest.

Car parks and campsites: their impact on pasture woodland

There is a recognised and fundamental incompatibility in locating high concentrations of people, their equipment and vehicles within close proximity of veteran trees. Inevitably, health and safety considerations have resulted in extensive removal or vigorous tree surgery of ancient trees over time in these sites. In addition, the development of campsite

and car park infrastructure and the physical trampling of ground vegetation has dramatically impoverished the ground vegetation, replacing it with artificial tracks, hard stands and species-poor grassland. These impacts are progressive and striking. However, there are other more subtle changes and impacts which contribute to affected units remaining in unfavourable declining condition:

- Reduction in lichen flora from tree removal, pollution, drying out and increased drainage.
- Removal of ground flora and increase in bare and compacted ground.
- Removal of standing and fallen dead wood.
- Long-term impact on regeneration and viability.
- Reduction in capacity to support range of organisms and traditional management.
- Progressive decline.

Location of car parks and campsites in or adjacent to pasture woodland

As a matter of principle, hard recreational facilities cannot be sustained in heavily treed areas of pasture woodland. In the last 20 years a programme of permanent and seasonal car park closures has sought to address some of the conflicts between access provision and conservation of species and habitats.

In the early 2000s there was an opportunity to close the three campsites in pasture woodland (Hollands Wood, Denny and Longbeech) while maintaining overall camping provision by relocating these pitches to New Park. Despite substantial efforts by all parties this opportunity was missed, and camping remains in these woodland locations to the detriment of their habitat condition.

In this section it should also be noted that in recent years various organisations have worked together to manage diffuse recreational use of the Forest. This has primarily been through the introduction of roadside ditching as well as the closure of some lay-bys, allowing improved management of car parking and the associated recreational activities.

Other recreational activities

To date, the other main recreational activities pursued in pasture woodlands (walking, horse riding and unauthorised cycling) have not contributed to a decline in favourable condition. Future planning for improvements in recreational facilities (e.g. formalising of footpaths

through pasture woodland) should recognise the conflict and incompatibility of generating high numbers of people in woodland containing veteran trees.

Increasing levels of new housing developments are planned in and around the New Forest National Park. Footprint Ecology (2020) undertook research on behalf of local planning authorities focusing on understanding the impacts of recreation arising from this development on the New Forest's international nature conservation designations and the potential for mitigation. The resulting six reports were published in May 2020 with the recommendation that a strategic, proportionate and coordinated approach is developed which will require partnership working across a range of local authorities and stakeholders.

The New Forest National Park Recreation Management Strategy Steering Group will continue to work together to manage recreation to improve the condition of any unfavourable pasture woodland units affected by recreation (see New Forest SAC Management Plan Part 1: Section 1.4.5: *Access and recreation in the New Forest*).

Generic management policies and rationale for pasture woodland

For maintaining pasture woodland units in favourable condition

Overarching management policy: Where the objective is to maintain the unit in favourable condition, then the favoured management option will be one of minimal intervention implemented through a limited series of maintenance operations conforming to the generic prescriptions below.

Management prescriptions

Implementation of the Minimum Intervention Policy requires:

- Continued depasturing of commoners' stock (ponies, cattle and pigs) during pannage.
- No stock feeding.
- No use of anti-parasitic drugs likely to damage non-target species.
- No planting of trees, shrubs or herbs.
- A general presumption against fencing, particularly in the long-term.

- No new drainage schemes or maintenance of old or existing drains except where there is a proven requirement under health and safety or protection of dwellings or roads from flooding.

- No felling or lopping of native trees, other than pollarding, will be undertaken unless required for public safety (see below) or to treat regeneration plots or emergent woodland as discussed in Issues 11 and 13 above respectively.

- Continued pollarding of holly on an annual programme to remove shading from important lichen bearing trees. Judgement will be required but a moderately open structure with sparse or patchy shrub layer is the favoured habitat structure of wood warbler and low levels of shading of lower trunks is also important for many epiphytic lichens within an old growth stand.

- Some trees, preferably in the range 5-15cm diameter breast height, may be pollarded. Beech will be preferred while oak may be pollarded around the edge of lawns. In the face of disease, ash will not be subjected to the ‘stress’ of pollarding but will be retained as maidens.

- Targeted control of deer and grey squirrels under Forest-wide programmes and protocols including the Forestry England programme as well as wider landscape management of deer through Local Deer Management Groups. It should be noted that the vast majority of active wood pasture is within the Crown Lands, with small additional areas in the SAC under active restoration programmes at Franchises, Langley and Roydon.

- No fallen trees, limbs or branches, will be removed from pasture woodland on the Open Forest (or within the identified Statutory Inclosures), except where:

    a. Occupiers of dwellings within the Perambulation and built before 1815, when Forest rights were registered, may exercise the privilege of collecting and removing dead wood from the Forest by hand only, for the sole purpose of burning it as fuel in their dwellings. No cutting tools may be employed in the removal and no limbs or branches greater than 15cm in diameter may be removed.

    b. Trees are deemed dangerous; in which case they may be treated according to the guidance below.

    c. The crowns of fallen trees are recognised as a hazard to stock. These will be made safe and the material left in situ.

d. Access is required for stock droving along major tracks and to prevent diversions around blockages which would lead to the development of new tracks.

e. Sales of fuelwood arise from approved programmes including removal of exotics, pollarding, coppicing, clearance of track blockages, restoration of open habitats in 'emergent woodland'.

Sales of fuelwood arise from 'unrestricted woods' under the regulation of the Forestry Commission. (The sustainability of this practice for the unrestricted woods identified as being appropriate for this policy in Peterken, Spencer and Field (1999), will be tested through condition assessment and validation monitoring).

f. Continue to use (and periodically review) the Forestry England New Forest Dead Wood Policy to guide decision making.

g. Management of veteran trees for safety.

Native veteran trees (including old growth holly and hawthorn) and the products which they shed on ageing (leaf litter, twigs, branches, boughs and eventually fallen boles or whole trees) should remain untouched and the crucial natural processes of nutrient recycling through decay and decomposition be allowed to pursue their natural course.

The only justifiable exception to this policy is where veteran trees present a significant danger to the public or property. The focus of this exception will inevitably lie where concentrations of the public and (primarily) their vehicles are placed in close proximity to a veteran tree resource, e.g. along Forest roads, in campsites and car parks.

All landowners have a duty of care to visitors on their land and to take reasonable measures to protect them from foreseeable hazards. Many within the SAC will have internal policies and detailed management practices for discharging these responsibilities. However, the following general principles should be adopted to ensure that over-enthusiastic and unnecessary remedial treatments do not endanger the supply of veteran trees and the dead standing and fallen wood habitats which they provide:

- The condition of veteran trees in locations where they might present a serious danger to the public should be monitored on a regular basis.

- Consider what steps could be taken to remove the concentration of the public from the veteran tree resource, e.g. closure and relocation of car parks and campsites, diversion of foot paths, etc.

- Where treatment of a veteran tree has been justified (on the basis of detailed examination of biological and structural parameters) and the public cannot realistically be removed from its sphere of influence, then the principle of doing the absolute minimum treatment required to restore the tree to a reasonably safe condition must be followed.

Every effort must be made to retain as much of the veteran tree in an upright condition for as long as possible.

- A sustainable remedy is minimal tree surgery where dangerous limbs are removed leaving as much of the crown as possible but ensuring that the tree remains balanced and secure against the wind. Severe pollarding (removal of the crown) of a veteran (which in the Forest will not have been purposely pollarded for over a century) may well kill the tree—almost certainly so in the case of beech. It is essential to leave at least some live branches to maintain the life functions of the tree while it produces new branches. All efforts to avoid undue compaction of the soil around the base of the tree should also be taken.

  There can be very few cases where there is any justification for felling the bole having removed the crown. A hollow standing trunk is normally a very stable feature and provides a rich resource and different suite of niches and environmental conditions to a felled tree. It also lasts a lot longer.

- All material removed from a treated tree should remain in close proximity to that tree. Only where there is a serious risk of such material proving a hazard in sites of high public pressure, should further treatments be considered. Ideally it should be pulled back into the nearest woodland and left to decay and only as a last resort should it be cut up and removed or burnt.

Management following a large storm event

Given the overwhelming national and international importance of New Forest pasture woodlands, it is vital to plan carefully before undertaking any form of management intervention following a large storm event. A storm event of this nature is a natural event, and the pasture woodlands will restore themselves over time. Minimum intervention will be the best policy to pursue in the short and long-term.

However, it is recognized that there will be exceptional situations where some form of management intervention will be required. These are covered in the following prescriptions:

- Any trees which are an immediate threat to public health and safety, a threat to any property or blocking access to public roads and private homes/businesses must be cleared away.

Any health and safety issues must clearly be addressed urgently as a priority. It may be that temporary exclusions to the public and stock through security fencing is the best option in some circumstances, pending further survey and the development of an agreed plan. (If temporary fencing is used, it will be important that stock regain access as soon as is safe to do so which may mean that the priority is to clear access routes for stock to gain entry to the woodland.)

With Natural England, survey and prepare a management plan for each affected woodland to ensure that nature conservation interests and favourable condition is maintained or restored. These plans will consider such issues including:

- The condition of the woodland—density and distribution of fallen trees.

- The ‘need’ (if any) for moving any of the fallen trees in this woodland to maintain a broadly accessible habitat for livestock to graze.

- The provision of safe access along priority routes for commoning and deer management.

- The prevailing ground conditions to allow machinery access (if required).

- The current level of grazing pressure and confidence in successful tree regeneration over time to recruit future canopy cover and thereby perpetuate woodland.

- The ‘need’ (if any) for removing any of the fallen trees from the woodland.

It must be emphasised that more damage can be caused from any post-storm clear-up operation than from the storm itself. Any interventions must be regarded as the exception under the strict guidance and consent of Natural England. Natural England will consider the specific circumstances of each case and will provide advice accordingly. Fundamentally, any impulsive interventions that lack survey and planning must not take place. The plans will consider issues such as retention of fallen timber and fallen dead wood, access for livestock grazing and their husbandry and management of damaged trees. For example, some trees which have been uprooted are likely to die but other will live and some trees will be stood but damaged and provide an important ecological resource. With hindsight, the recovery of Mark Ash as a pasture woodland was compromised by not adopting the approach outlined above and therefore the undue wholesale removal of fallen trees resulted in very limited opportunities for sheltered tree regeneration.

Air quality

The extensive management regimes used in the New Forest SAC are instrumental in buffering against nitrogen-derived air pollutants and critical loads are not generally apparent in key habitat localities. They are of course apparent in certain urban settings such as Lyndhurst High Street, but this a human health concern rather than an ecological one.

Methods of suppressing road-side pollutants used elsewhere using road-side plantings of tall vegetation are not appropriate to the New Forest situation where roads cross extensive SAC vegetation and such planting would be damaging to the SAC features.

Increasing the buffer around the SAC by taking agricultural land from intensive production, possibly through land-use change to extensive woodland planting, will afford greater protection from ammonia pollution.

Selected road closure or campsite relocation, land use changes which are likely to be met with considerable public opposition, would be beneficial.

Restoring units to favourable condition

Management policy: Where the objective is to restore units to favourable condition, then additional management operations may be required in the short term, conforming to the generic prescriptions below.

Management prescriptions

Implementation of the positive management policy for restoring units to favourable condition requires:

A. Promotion of regeneration

Grazing and browsing pressure is inextricably linked to tree regeneration. Before any consideration of artificially promoting regeneration (as outlined below) the reader is encouraged to first refer to the pasture woodland section of this document to understand the mechanisms by which grazing pressure varies over time.

Where units are in unfavourable condition through a lack of tree regeneration and this is unlikely to occur naturally in the foreseeable future, then intervention may be considered through treatments firstly within a grazed situation and secondly using fencing or sowing in an ungrazed situation. Any interventions must be regarded as the exception under the strict guidance and consent of Natural England:

- **'Grazed Regeneration':** Protection of naturally regenerated saplings or pockets of natural regeneration with dead hedging formed from durable oak branchwood or the use of holly or hawthorn brash. Sowing of tree seed of local provenance in natural shelter (dead wood, or scrub) maintaining open grazing.

- **'Ungrazed Regeneration':** Temporary exclusion of grazing animals through provision of temporary fencing and tree shelters, maintained until satisfactory establishment following natural regeneration. Generally, when target trees are two metres tall. Avoid the growth of dense scrub and birch shading out desirable tree species by undertaking management interventions. Sowing of locally collected seed and its subsequent protection as above. This will be most effectively achieved after a good mast year when seed will be abundant. Initial localised ground preparation may be appropriate, and an annual maintenance programme will be required until the trees have become established. Fences must be properly maintained until their removal at the end of 15 years or whenever the trees are no longer at risk from damage by domestic animals or deer. Direct planting and protection of young trees of local provenance may be considered. This will be a last resort and will require the use of New Forest stock grown on in a tree nursery.

The priority is to encourage natural regeneration through the application of appropriate protective measures, over sowing or planting, while maintaining necessary grazing. This is to achieve a natural composition and genetic constitution which can be compromised by planting; and removes the necessity for post-regeneration treatments to prevent excess regeneration and avoid the mistakes apparent from the 1950s 'regeneration plantations' referred to earlier.

In the unlikely event that bracken management is required in woodland in order to restore the unit to favourable condition, specifically on sites where bracken cover is a significant factor in preventing natural regeneration, then localised treatments may be appropriate. Until recently, Asulox (a fern-specific herbicide) was available for targeted uses such as this. Following the ending of the approval to use Asulam for bracken control on 31 December 2012, temporary, annual arrangements have been put in place to allow the use of Asulam for bracken control to continue. Approval has been subject to the terms set out in Emergency Authorisations granted by the Chemicals Regulation Division (CRD) of the Health and Safety Executive. Suitable alternative treatments include repeated mechanical cutting and/or rolling and treatment by enclosing pigs for a limited period within a temporary fence. In the absence of Asulox, the controlled trial of weed wiping with glyphosate may also be an option but may be detrimental to other species. However, it should be noted that pony grazed bracken stands are important centres of tree regeneration; it is only where bracken is particularly dense that regeneration is inhibited. The level of grazing pressure should be considered first in all cases.

B. Treatment of emergent woodland

It is important that the ecological dynamics of natural woodland extension and retraction over time is maintained, within the constraints of needing to maintain primary heathland habitats in favourable condition. Due to the ecological complexity and degree of judgement required to plan sensitive emergent woodland management it is essential that it takes place under the strict guidance and consent of Natural England. Refer to Issue 13 for further explanation.

In principle three treatments are likely to be required depending on the situation:

- Where adjoining habitats (wet and dry grassland, mire and heath) are in unfavourable condition due to the spread of dense birch and scrub from emergent woodland then removal sufficient to restore the habitat in question to favourable condition is necessary.

- Transitions which are not threatening these primary habitats (e.g. emergent woodland over bracken) should not be cleared and the birch/oak will be retained, especially in those areas where the development of young woodland of oak, beech and birch is desired. There is no merit in clear-felling such transitions, but

consideration should be given to managing the emergent woodland to hasten an appropriate structure (e.g. pollarding or thinning) to avoid a rather dull closed canopy woodland edge.

- Early 20th century dense, young canopy woodland which has spread over former or relic primary habitat, e.g. wet and dry grassland and where this primary interest is recoverable, may potentially be removed and the primary habitat restored (subject to other considerations outlined in Issue 13 above).

C. Removal of non-native tree and shrub species

Where units are in unfavourable condition due to the presence of unacceptable levels of non-native trees and shrubs, then intervention is required through their systematic removal to a level not exceeding 1% cover per unit of pasture woodland. In all cases excessive mechanical disturbance to the wood pasture unit must be minimised and this should be the primary consideration in deciding which management technique to use.

Rhododendron ponticum

Complete removal from the whole SAC will continue to be attempted. For areas accessible to mechanical harvesting, then bushes can be dug out and either mulched in situ or transported off site for burning. Regrowth should be treated with an appropriate herbicide (e.g. glyphosate) or further mechanical intervention in the following two years. Where ground conditions are unsuitable for machinery access, bushes should be cut by hand to ground level followed by stump treatment with herbicide. It is acceptable to burn up on the site of former dense *Rhododendron* cover. Any initial changes in vegetation due to nutrient release will be restored by grazing.

Gaultheria shallon

This is an invasive ericaceous shrub from northwest America which spreads inexorably by a system of underground rhizomes. Its leathery leaves resist penetration of herbicides and once established it dominates the ground and understorey layers of both wood and heath. 20 years ago there was a major infestation covering up to 12ha south of Fletchers Hill, south of Clumber Inclosure and south of Rhinefield. Concerted effort is still ongoing to try and eradicate the species from Fletchers Hill and these outlying sites which will require treatment with systemic herbicide until the plant is eradicated. Small patches are known elsewhere, e.g. on heathland at Roydon Wood.

Sycamore

Complete removal from the whole SAC will be attempted. Trees should be harvested where feasible and the stumps treated with systemic herbicide to prevent regrowth. The exception

to this will be where sycamore provides the only alternative to ash in maintaining woodland canopy. Here a more measured approach may be required as the spread of the disease (ash dieback) unfolds. (See Issue 14 for further information.)

Turkey oak

Complete removal from the whole SAC will be attempted. Trees should be harvested where feasible and the stumps treated with systemic herbicide to prevent regrowth. Isolated trees can be felled and left in situ (as dead wood resource), younger stems can be ring barked and retained as dead wood habitat.

Sweet chestnut

The larger stems of sweet chestnut will be tolerated where they form part of a valued historic planting or important landscape or recreational feature, except where they threaten to shade out native species, e.g. at Woosons Hill/Mark Ash where maturing regeneration is over-topping oak and its high tendency to windblow threatens sensitive old beech. Smaller stems will be removed to contain their spread into surrounding woodland. Regrowth of cut sweet chestnut will require treatment with systemic herbicide.

Red oak

The larger trees will be tolerated, except where they threaten to shade out native species. Smaller stems will be removed to contain their spread into surrounding woodland. Red oak forms an important part of several ornamental plantings at Denny and Fancy Piece and within Matley Wood. In these areas the smaller self-sown stems will be removed while retaining the original plantings.

Hornbeam

No action required as this species is considered a native species which is expanding its natural range.

Scots pine

Scots pine will be removed except where they provide shelter to groves of ancient trees, where they form important landscape features (as either small stands or single specimens providing, they are not freely regenerating), or where their removal would be damaging to surrounding woodland structure and soils. In these cases, other methods of control such as ring barking or felling without extraction should be considered.

Light levels should be increased around ancient trees by ‘haloing’. Care will have been taken to avoid sudden exposure, especially with veteran beech, as the tree may have been shaded for many years. Clearance should take place in stages over a number of years.

Conifers and other species

Systematic removal wherever they are found (e.g. poplars, non-native maples, etc.).

D. Treatment of regeneration plots in Ancient and Ornamental (A&O) woodland

All of the A&O regeneration plots were surveyed by Forestry England in 2009 and a plan for each site requiring restoration management was prepared. While it is not appropriate to cover the detail of these plans here, a combination of interventions was proposed including thinning, pollarding selected specimens, removal of non-native trees, glade creation and non-intervention. The aim is to improve the condition of these plots such that they can be integrated in to and ultimately will become indistinguishable from, the adjacent A&O woodland.

E. Former wood pasture requiring intervention

Within the Crown Lands: Where units are in unfavourable condition through a lack of grazing as a result of entrapment within forestry Inclosures then wherever possible there should be a presumption in favour of restoring grazing management.

Outside the Crown Lands: In former pasture woodlands with surviving relic pasture woodland features (e.g. old trees, rich lichen and saproxylic invertebrate features), then there should be a presumption in favour of restoring grazing by domestic stock. However, this can and should be controlled to provide grazing levels which differ from those of the Open Forest to provide an important scientific contrast.

F. Recreational disturbance

Where units are in unfavourable condition through excessive levels of recreational disturbance then appropriate restoration measures will continue to be carefully evaluated and implemented. Such measures are likely to include:

- The closure, redesign or relocation of campsites, followed by pasture woodland habitat restoration.

- The closure, redesign or relocation of car parks, followed by pasture woodland habitat restoration.

The challenge of campsite relocation is a thorny one. As previously described, past efforts to relocate three campsites ultimately failed due to substantial public opposition to the proposals. Since this time there has also been changes in the ownership and management structure of what were once simply Forestry Commission campsites (since the 1970s called Forest Holidays). Subsequently, the campsites have been run as a joint venture with independent operators.

Regardless of the past experiences and challenges of making changes to camping provision in the Forest, ecological surveys demonstrate that campsites within pasture woodland cause degradation of habitat and the resulting assessment that the habitat is in unfavourable declining condition.

Table 4: Locations of campsites in or adjacent to pasture woodland: summary of impact and contribution to unit condition with a prioritised recommendation for action

Campsite	Location	Impact	Condition assessment	Recommendation	Priority
Denny Wood	In pasture woodland	Severe reduction in old trees/dead wood/lichens and ground flora	Unfavourable no change	Relocate campsite/restore pasture woodland	High
Hollands Wood	In pasture woodland	Severe reduction in old trees/dead wood/lichens and ground flora	Unfavourable declining	Relocate campsite/restore pasture woodland	High
Longbeech	In pasture woodland	Severe reduction in old trees/dead	Unfavourable declining	Relocate campsite/restore pasture woodland	High

Campsite	Location	Impact	Condition assessment	Recommendation	Priority
		wood/lichens and ground flora			
Ashurst	In pasture woodland	Severe reduction in old trees/dead wood/lichens and ground flora	Unfavourable no change	Prevent further degradation/restore pasture woodland	Medium
Holmsley	Adjacent to pasture woodland	Minimal	Unfavourable no change	Prevent further degradation/restore pasture woodland	Low
Matley Wood	Adjacent to pasture woodland	Minimal	Unfavourable recovering	Prevent further degradation/restore pasture woodland	Low
Ocknell	Adjacent to pasture woodland	Minimal	Unfavourable recovering	Prevent further degradation/restore pasture woodland	Low

It is appreciated that restoration involving the relocation of major campsites and the restructuring of car parking provision across the Forest are complex issues, requiring considerable research, evaluation and resources (both financial and in terms of provision of alternative locations where intensive forms of recreation are sustainable).

The New Forest National Park Recreation Management Strategy Steering Group will continue to work together to manage recreation to improve the condition of unfavourable pasture woodland units affected by recreation (see New Forest SAC Management Plan Part 1: Section 1.4.5: Access and recreation in the New Forest).

The Recreation Management Strategy proposes the development of a spatial plan for visitor facilities (Strategic Actions 4.1 and 4.2). Any such proposals brought forward through this strategy and associated spatial plan will require extensive consultation; formal compliance with local authority procedures and the Habitats Regulations; and will be the subject of individual detailed plans beyond the scope of this Management Plan.

Riverine woodland and bog woodland: issues, generic prescriptions and rationale

Introduction

In addition to the issues discussed under the pasture woodland section, there are further issues which have the potential to significantly affect the condition of riverine woodland and bog woodland habitats and for which additional generic guidance is required.

Overarching policy

Riverine woodland and bog woodland habitats are subject to the same overarching policy as that for pasture woodland identified under relevant section above. The following issues, prescriptions and rationale are in addition to those identified in the pasture woodland section above. Significant issues additional to those identified under the pasture woodland section above, affecting or having the potential to affect the condition of riverine woodland and bog woodland habitats are listed in the following table and are discussed below.

Table 5: Significant issues affecting riverine woodland and bog woodland. Note some cells have been left deliberately blank

Issues pertaining to management required to maintain favourable condition	Issues pertaining to management required to restore favourable condition
Open space and shading: coppice of alder and sallow	Trapped pre-Inclosure riverine woodland and bog woodland
Climate change	Drainage and soil disturbance
	Over-deepening of watercourses and loss of key habitat features
	Recreation: car parks/riverside walks Bankside erosion

Issue 1: Coppice of alder/sallow stands in riverine woodland

It is apparent from the most cursory examination that many if not most stands of riverine woodland were coppiced to some degree in the relatively recent past. Such a practice produced valuable fuel wood and construction material and promoted ecological diversity

as the light conditions changed over the phases of coppice regrowth. Much of this former coppice is now closed canopy and some is derelict.

While extensive coppice rotations within riverine woodland stands are unlikely to be acceptable today, there is a case for selecting some stands for reinstating a coppice rotation. Of particular relevance here may be the stands of riverine woodland currently trapped within Inclosures and which are likely to remain so in the long-term. In the absence of domestic grazing pressure and provided deer numbers are not excessive, highly diverse fen communities could develop within the cycle of open and closed canopy coppice rotation.

Issue 2: Trapped pre-Inclosure riverine woodland and bog woodland

These are stands of alder and ash woodland which prior to enclosure would have bordered New Forest streams in a rich mosaic of wooded and non-wooded habitats. Enclosure and subsequent forestry activities resulted in significant degradation of these habitats particularly as a result of drainage, over-deepening of adjacent streams, planting of non-native forestry crops (often right up to the banks of the streams) and loss of Open Forest grazing. Where significant remnants exist within Inclosures, the management objective is to restore both the riverine and bog woodland elements and the accompanying fluvial processes of the adjacent stream. (See Issue 3.)

Issue 3: Over-deepening of watercourses: loss of flooding regime and natural features debris dams

Riverine woodland, a Priority Habitat in the Habitats Directive, is defined by its topographical position and hydrology (see Part 1). There are few examples within the New Forest where the hydrology has not been modified by drainage and modifications to river or stream channels and their natural features.

Such modifications are most notable within Inclosures where stands of remnant riverine woodland are perched high above the over-deepened main channel and isolated from essential periodic inundation. Accompanying natural features such as riffles and ponds are much reduced or absent in a canalised channel and the former meanders and floodplain channels are often no more than isolated dry depressions.

On the Open Forest these same features can also be seen in riverine woodland where drainage has taken place, for example along the Avon Water, Fletchers Water, Warwickslade Cutting and Matley Carr (some of which have since been partly restored). In addition, in some Open Forest riverine woodlands the natural stream channel has simply become over-deepened with time by the erosional force of the water from the drainage channel upstream in an Inclosure (e.g. Roe, Hawkhill etc.). In addition to the effects of past drainage, the past practice of excessive removal of naturally forming debris dams

contributed to the unfavourable condition of many stands and effectively prevented the development of a natural restoration process.

The maintenance of, or restoration to, favourable condition for riverine woodland requires that the full expression of fluvial processes be allowed to function within a physically, hydrologically and geomorphologically intact natural or near natural system. Periodic inundation of the riverine woodland stands with their accompanying features (meandering streams and floodplain channels) is essential and in many cases this can only be achieved by raising stream bed levels within channels to bring the water level closer to the top of bank and the associated floodplain. This can be achieved through a combination of restoration options including reintroducing the flow through meanders and infilling the artificial drain and raising bed levels in an artificially incised/dredged but sinuous channel.

Debris dams

Woody debris is generated along wooded catchments from tree death, limb shedding, windthrow and so on. This may form debris dams if large pieces fall across the channel and become wedged, forming an obstruction against which other woody debris can accumulate. This eventually impacts upon the rate and direction of stream flow. Riverine woodland in the New Forest is one of the few places where this natural process still functions along the various catchments.

An excellent review of the effects of woody debris on stream processes, flora and fauna is given in Everett et al (1997). Evidence is presented which demonstrates the value of such material in enhancing channel stability, ameliorating flood peaks, retaining sediment and organic matter and in promoting diversity of physical habitat in the stream. In the New Forest, debris dams play a significant role in enabling seasonal inundation of riverine woodlands (and other wetland habitats), particularly where previous drainage operations and channelisation works prevent this vital process from occurring over significant stretches. In addition, they provide important habitats for a wealth of invertebrates, shelter from predators and important cover for fish and create a diverse physical structure within the stream channel promoting pool and riffle formation. Debris dams can also provide areas of shade and cool water, becoming increasingly important to mitigate effects of climate change.

Debris dams have often been regarded as a threat to fishing interests, commercial forestry including harvesting of fallen wood, animal welfare and a contributor to localised flooding of roads and property. Historic management was rather indiscriminate in the removal of woody debris wherever found with little regard to the ecological or hydrological impact. More recently, the value of debris dams has been fully recognised and the presumption has been to leave them in situ wherever possible.

Issue 4: Climate change

The generic issue of climate change is addressed in Part 2 under ‘Man-induced trends’.

The specific impacts on riverine woodland have been considered by Natural England et al, 2020. The table below summarises for riverine woodland the causes, consequences, implications and possible adaptations given a two degree rise in global temperatures over the next century.

Table 6: Predicted impacts of climate change on selected New Forest SAC habitats and species over the next century given a two degree rise in global temperatures (after Natural England 2020). Note some cells have been left deliberately blank

SAC feature	Cause	Consequences	Potential impacts	Adaptations
Riverine woodland and bog woodland, sensitivity: Medium	Drier summers	Drought	Drying out of sites reliant on rainfall could lead to a change in the dominant tree species and conversion to drier woodland habitat types. The composition of ground flora is also likely to change.	Ensure natural hydrology restored. Monitoring for presence of invasive species and remove where discovered. Retain woody debris.
	Wetter winters		Long-term waterlogging may lead to increased dominance of tree species such as alder and willow and localised changes in ground flora and understorey composition.	
	Warmer winters	Fewer frost events	Increased survival of mammal pests such as deer and grey squirrel, resulting in more damage to thin barked trees and reduced regeneration and an increased risk of colonisation by invasive non-native species. A reduction in alder *Alnus glutinosa*	Ongoing deer and squirrel management.

SAC feature	Cause	Consequences	Potential impacts	Adaptations
			dominance due to the impacts of *Phytophthora* spp. (Ray et al, 2010).	
	Increased frequency of extreme events	Summer and winter flooding	An increase in the frequency of extreme floods could result in the death of older trees and the development of scrubby stands. Access to sites to undertake management may become increasingly difficult. More frequent extreme events could create opportunities for restoring or creating wet woodland as a flood, erosion and water quality management tool.	

Issue 5: Recreation and bankside erosion: potential for restoration

Riverine woodland is a highly attractive habitat for the general public—particularly those with young families. Consequently, where car parks are located in close proximity to stretches of riverine woodland, considerable recreational pressure is exerted locally. This pressure manifests itself in eroded banks, excessive compacted bare ground and impoverished vegetation. Dogs, horses and people entering the water can stir up the sediment, reducing water quality and damaging aquatic plants. In addition, there is sure to be some disturbance to other wildlife, at least locally, along these readily accessible and heavily visited stretches.

Retaining or improving bankside vegetation/root systems will become increasingly important in mitigating the impacts of increased water temperatures in climate change and providing a buffer to increased flows and instream erosion associated with wetter periods.

In order to try to maintain favourable condition and mitigate against climate change, there is a requirement to minimise such disturbance by managing the way people reach these sensitive locations. One option would appear to be closure or reduction in capacity of certain car parks, though this in itself may lead to further problems elsewhere and may not necessarily reduce pressure overall. In the last 20 years the Forestry Commission (now Forestry England), in partnership with other Forest organisations, undertook to manage recreational pressure on habitats such as this through projects including LIFE 2 and PROGRESS. Car parks such as at Ipley Bridge were closed and others such as Balmer Lawn, Wootton Bridge, Ivy Wood and Millyford Bridge were reduced in capacity.

Some of these car parks, as well as others like Puttles Bridge, remain a threat to habitat condition. In future, the work of the New Forest National Park Recreation Management Strategy Steering Group will guide the management of car parking provision and the competing interests of public access and habitat condition (see New Forest SAC Management Plan Part 1: Section 1.4.5: *Access and recreation in the New Forest*).

Generic management policies and rationale for riverine and bog woodland

Note that these are additional to the relevant generic prescriptions applying to pasture woodland.

A: For maintaining riverine and bog woodland units in favourable condition

Overarching management policy

Where the objective is to maintain the unit in favourable condition, then the favoured management option will be one of minimal intervention implemented through a limited series of maintenance operations conforming to the generic prescriptions below.

Management prescriptions

The agreed policy for riverine woodland is that it should be maintained as naturally as possible. This requires that streams and rivers be allowed to flood, their channels be allowed to migrate according to the natural dictates of erosion and deposition and dead wood should be allowed to accumulate and disperse naturally in the channels. Hence the implementation of the minimum intervention policy requires:

- Retention of natural or near natural physical, geomorphological and hydrological regimes.

- Retention of debris dams except where there is a demonstrable risk to the health and safety of humans, commoners' stock or infrastructure and private property. Where management is required to avoid such risks, then an appropriate evaluation and options appraisal should be conducted to determine the degree of intervention required. This may result in minor adjustments, partial removal or even complete removal of debris dams in exceptional cases. Consideration may be given to recoppicing of old alder or willow coppice stands particularly where this will result in the restoration of rich fen communities and their associated invertebrate populations.

B: For restoring units to favourable condition

Overarching management policy

Where the objective is to restore units to favourable condition, then additional management operations may be required in the short term, conforming to the generic prescriptions below.

Management prescriptions

Implementation of the positive management policy for restoring units to favourable condition requires:

1: Where habitats are in unfavourable condition as a result of over-deepening of watercourses, loss of flooding regime and natural features

The management objective is to allow full expression of fluvial processes within a wooded environment by restoration of a more natural physical, geomorphological and hydrological regime. This is likely to require, subject to appropriate considerations of health and safety, animal welfare and road and property damage:

- Removal and/or reinstatement of artificial landforms (e.g. spoil banks) which prevent seasonal inundation.

- Raising of stream bed levels where over-deepened, by appropriate measures (e.g. reinstatement of bed levels using adjacent spoil, imported material or construction of strategically placed debris dams).

- Restoration of former meanders and floodplain channels.

- In Inclosures, where practicable and desirable the reinstatement of commoners' grazing.

In all cases detailed restoration plans will be required to be drawn up by suitably qualified experts in full consultation and in accordance with the New Forest Freshwater and Wetland Restoration Strategy.

2: Where habitats are in unfavourable condition as a result of recreational activities

Where units are in unfavourable condition through excessive levels of recreational disturbance then appropriate restoration measures will be carefully evaluated and implemented. Such measures are likely to include:

Repair and restoration of eroded habitats subject to:

- Application of repairs to eroded surfaces should only be applied where further damage to nature conservation interests will not occur as a result of the repair works.

- The emphasis should be on natural regeneration of vegetation cover rather than import and spread of additional materials.

- There should be a presumption against the building of new permanent paths using imported gravels.

- Programmes to restore ‘eroded’ habitats should be subject to detailed planning and evaluation.

Where such measures are insufficient to restore habitats to favourable condition, then alternatives such as the closing, redesign or relocation of adjacent car parks, followed by habitat restoration, will need to be considered.

In all cases detailed restoration plans will be required to be drawn up by suitably qualified experts and subject to consultation where appropriate.

Heathland communities: wet heath, dry heath, mire, dry grassland, wet grassland, permanent and temporary ponds: issues, generic prescriptions and rationale

Introduction

This section discusses the issues affecting the condition of New Forest heathland habitats, comprising dry heath, wet heath, mire, dry and wet grassland, permanent and temporary ponds and sets out the generic management guidance and rationale required both to maintain those units currently in favourable condition and to restore those units currently in unfavourable condition.

Overarching policy

A number of issues may affect the condition of these heathland habitats; the choice of management prescriptions to address these issues depends on the severity of their impact on unit condition. The following overarching management policy is derived from the nature conservation objectives for dry heath, wet heath, mire, dry grassland, wet grassland, temporary and permanent ponds:

- Where the objective is to maintain the unit in favourable condition, then the favoured management option will be one of continued extensive management, through a series of rotational maintenance operations conforming to the policies and prescriptions as detailed in this section.

- Where the objective is to restore units to favourable condition, then additional management operations may be required in the short-medium term, conforming to

the policies and prescriptions under as detailed in this section.

Issues affecting heathland habitats

Significant issues affecting or having the potential to affect the condition of heathland habitats are listed in the following table and are discussed below.

Table 7: Significant issues affecting heathland habitats. Note some cells have been left deliberately blank

Issues pertaining to management required to maintain favourable condition	Issues pertaining to management required to restore favourable condition
Grazing and conservation management for New Forest heathland habitats Commoners' stock, deer and rabbits Trends in stocking levels Stock feeding	Over and undergrazing Stock feeding Stock pesticide treatments
Vegetation management through prescribed burning and cutting Gorse, bracken, birch and heather management Marketing of New Forest products	Non-native tree and shrub management Gorse, bracken, birch and heather management
Turf cutting	Drainage and wet heath, mire, stream and pond restoration
Heathland habitats and scrub management	Heathland habitats and scrub management
Bare ground	Recreation: car parks Erosion: horse riding and cycling Disturbance: dog walking
Climate change	
Pests and disease	
Air quality	

Issue 1: Grazing and heathland conservation management
(How the differential impacts of the principal grazing animals maintain the habitat mosaic; trends in numbers of commoners' stock; issues of over and undergrazing. Active and potential management measures to address current or potential issues.)

Over most of its range, with the exception of exposed coastal transitions where scrub and tree growth are suppressed, heathland is a complex of community types which left to themselves would eventually become woodland in one form or another. Consequently, the maintenance of species-rich heathland communities in the form and condition we have in the New Forest today requires continual management intervention by man and his domestic animals. The component communities, their origins and development are described in Part 1. Here we are concerned with the impacts of depasturing animals on the Forest heathland communities and the issues arising from such a practice.

It is apparent that the Forest heathland communities are not all subject to the same grazing pressure. The reasons for this are given below, but the outcome is a diverse set of habitats not only adapted to withstand the effects of defoliation and fluctuations in herbivore population numbers, but dependent upon it to retain the special interest associated with each. (It should be noted that not all land within the SAC is subject to commoner grazing rights. Private land may or may not be grazed depending on the wishes and circumstances of the owner.)

Removal or a significant long-term reduction in grazing pressure would cause rapid changes in the plant and animal communities comprising the Forest heathlands. The overall impact would be a rapid expansion to dominance of the more aggressive and competitive species (e.g. *Molinia,* trees and scrub) at the expense of the less competitive species and a dramatic impoverishment of the Forest flora and fauna adapted to the long tradition of Open Forest grazing management (see Byfield and Pearman 1996 for an evaluation of how a lack of appropriate management has caused adverse changes in the distribution of Dorset's rare heathland species). From a nature conservation perspective this would particularly impact on those features of special interest for which the Forest is designated and would therefore be catastrophic and unacceptable.

In the context of the New Forest (as opposed to ungrazed or lightly grazed heathland communities elsewhere) Table 8 shows the level of grazing required to maintain the habitat in favourable condition and what the likely impacts of under or over grazing would be. It demonstrates that the Forest heathland communities and the species which they support, are dependent upon a range of and fluctuations in, grazing pressures. The next section describes how the extensive New Forest grazing system, maintains this variation resulting in the mosaic of communities apparent today.

Table 8: Intensity of grazing required to maintain favourable condition; likely impacts of under or overgrazing. Note some cells have been left deliberately blank

Habitat	Intensity of grazing required to maintain nature conservation interest	Likely impact of no grazing or undergrazing	Likely impacts of overgrazing/overstocking
Dry grassland		Impoverished flora in rank, species-poor sward with dense litter layer, dominated by coarse grasses, expanding scrub canopy	Physical destruction of sward, compacted bare ground, nutrient enrichment from excess dunging and supplementary feed
i. Parched acid	High	Loss of specialist floras (e.g. *Filago minima, Moenchia erecta, Sagina subulata*) and bare ground invertebrates, loss of woodlark	Removal of ground layer, disturbance too high for woodlark
ii. Heathy acid	Medium-High	Dominance of *Molinia* and *Agrostis curtisii*, impoverished flora and loss of woodlark	Removal of ground layer, disturbance too high for woodlark
iii. Moist acid	Medium	Rank swards, loss of woodland glades, impoverished invertebrate fauna, loss of fungi flora	Physical destruction of sward
iv. Neutral green	High	Impoverished flora, loss of *Chamaemelum nobile*	Physical destruction of sward
v. Herb-rich bracken	Medium	Impoverished flora and fauna, increased density of bracken	Physical destruction of sward

Habitat	Intensity of grazing required to maintain nature conservation interest	Likely impact of no grazing or undergrazing	Likely impacts of overgrazing/overstocking
Wet grassland	Medium-High	Loss of species-rich sward top scrub and *Molinia*	Removal of ground layer, poached bare ground
Wet heath	Medium-High	Expansion of *Molinia*, tussocky structure with dense litter layer and impoverished flora. Spread of *Myrica gale*. Loss of *Coenagiron mercurial*	Physical destruction of community, loss of *Sphagnum*, nutrient enrichment
Dry heath	Low-Medium-High	Reduced structural diversity, loss of bare ground, loss of woodlark, loss of prostrate lichen-rich heath	Removal of ericaceous component, replaced by nutrient enriched and impoverished grass dominated community. Loss of Dartford warbler
Mire	Medium-High	Impoverished fauna and flora, increased dominance of *Molinia*, loss of *Coenagrion mercurial*	Physical destruction of community, loss of *Sphagnum*, nutrient enrichment
Temporary ponds	Medium-High	Rank grassy swards and loss to scrub invasion. Loss of specialist flora, e.g. *Littorella uniflora, Pilularia globulifera, Cicendia filiformis, Illecebrum verticillatum,* etc.	Physical destruction of community through poaching and nutrient enrichment

How the differential impacts of the principal grazing animals maintain the habitat mosaic

There is a wealth of literature on the impacts of grazing on New Forest vegetation. Of particular relevance to the New Forest are works by Putman (1986), Ekins (1989), Gill (1987), Tubbs (1986) and the Nature Conservancy Council (1983), which focus on the grazing animals and Clarke (1988) and Sanderson (1995 and 1996) which look at the effects of grazing on heathland vegetation dynamics and diversity from a botanical perspective. Further evidence is available in Sanderson (2017) where the importance of lichen heath is explored.

It is appropriate here to discuss in further detail the impacts of the primary grazing animals (ponies, cattle and deer) on New Forest heathland habitats and for managers to be able to recognise when the regime is achieving the nature conservation objectives, or when through under or overgrazing adjustments may be necessary to maintain or to restore favourable condition. (Options currently or potentially available to manipulate stocking regimes to address problems arising from inappropriate stocking are presented in the generic prescriptions section.)

There are some key points which are highly relevant to this Management Plan which arise from the accumulated literature referred to above. These points are derived from the analysis of the differential social, physiological and foraging behaviour of the key grazing animals and their differential impacts on the New Forest vegetation. They are summarised in Table 9.

Key implications

- Virtually all New Forest heathland habitats require grazing management to maintain the features for which the site is designated. It is without question the most appropriate principal management tool for the Open Forest vegetation. Illingworth (1991) demonstrated that the commoning system is the only really viable way (in terms of cost and physical effort) to effectively graze the Forest habitats which are subject to common rights. There is no evidence to suggest that this analysis does not hold today.

(Provision of extensive grazing on the fragmented enclosed lands within private ownership is an issue dealt with on an individual basis with Natural England and the respective owner/occupier. The issues relating to a lack of grazing on heathland habitats are the same.)

- Ponies, cattle and deer have a differential impact on the various habitats, related to differences in their social behaviour, physiology and foraging behaviour. (See Table 9)

- Hence the Forest habitats are not subject to uniform grazing pressure; they are preferentially and differentially grazed and consequently provide a range of niches for organisms adapted to such an extensive grazing management system. For example, woodlark require a high grazing pressure creating an intimate mosaic of bare ground and short vegetation. They do exceedingly well on the heavily grazed swards at the Bramshaw Commons where the prostrate heath produced by heavy grazing is exceptionally rich in lichens and bryophytes due to abundant light and low incidence of fire. Dartford warbler on the other hand are abundant in more lightly grazed gorse and heather mosaics.

- Cattle and ponies prefer the forage produced on parched acid grassland, moist acid grassland, neutral greens and wet lawns over heathy acid grassland, dry heath, wet heath and mire. Indeed, the animals will only move to less preferred habitats when forage on the favoured grasslands is exhausted. Ekins (1989) estimates that some 50% of all grazing is concentrated on these favoured grassland types comprising some 7% of the available Open Forest area, while some communities such as dry heath, sustain little grazing pressure.

- However, in dry summers when the grasslands parch out, mires and wet heath provide essential lush grazing. In addition, these habitats provide an early bite in late winter when rush growth precedes the onset of grass growth.

- While cattle eat more *Calluna* than ponies they are reluctant to enter wetter habitats and have little impact on mires, other than round the periphery. New Forest ponies are capable of foraging *Molinia* in mires up to belly height without getting stuck. Neither cattle nor ponies will eat *Erica tetralix* or *E. cinerea.*

- Generally, ponies have a greater impact on the vegetation than do cattle. Few ponies move between home ranges, which are centred on a grass lawn. Hence grazing pressure is greatest at the grazing focus where ranges overlap and least at intermediate distances between such places.

Table 9: Differential social, physiological and foraging behaviour and impact on vegetation. Note some cells have been left deliberately blank

Key factor	Elements	Implications for habitats
Social organisation and behaviour	Cattle: Herding animal which moves considerable distances to get the four basic necessities of food, water, shelter and shade. Tolerant of human disturbance. Natural patterns disrupted by supplementary feeding. Unlikely cattle could survive winter without supplementary feed. Do not segregate feeding and dunging.	The more homogenous the home range the larger it needs to be to accommodate all four requirements and the greater the distance cattle will need to travel to satisfy the requirements. Feed openly on suitable habitats. Focuses cattle activity (trampling, feeding and dunging) on small areas of habitat upon which supplementary feed is provided. Dung spread evenly over area of suitable grazing.
	Ponies: matriarchal family group and small social units, with well-defined home range the size of which depends upon availability of four basic necessities of food, water, shelter and shade. Rely on accumulated energy reserves and lowered winter food intake to get through winter.	The more homogenous the home range the larger it needs to be to accommodate all four requirements. No supplementary feed implications.

Key factor	Elements	Implications for habitats
	Little movement between home ranges. Tolerant of human disturbance. Segregate feeding and dunging.	Grazing pressure greatest at the grazing focus where home ranges overlap and least at intermediate distances between such places. Feed openly on suitable habitats. Zone habitat into feeding and dunging area, translocating nutrients.
	Deer: dominant species (fallow) herding but varies throughout year. Intolerant of human disturbance. Rely on accumulated energy reserves and lowered winter food intake to get through winter. Do not segregate feeding and dunging.	Strong preference for woodlands. Secretive and can only feed on open habitats when undisturbed. No supplementary feed implications. Dung spread evenly over area of suitable grazing.
Physiological adaptation	Cattle: ruminant adapted for bulk fermentation of grass, a primary dietary item which is utilised very efficiently. Large mouths, less prehensile lips than ponies, lack upper incisors and hence prefer to wrap their tongue round forage and tear it off rather than biting. Heavy animals with cloven hoofs, reluctant to enter wetter habitats.	Feeds preferentially on grass, for about 60% of the time and does not need to feed at night. Concentrate activity in longer swards (>5cm) to feed effectively, but also rest, ruminate and dung there as they do not have separate latrines. Restricted to dry heath and grassland; will not graze mires.

Key factor	Elements	Implications for habitats
	Ponies: non-ruminant requiring high food intake to compensate for less efficient digestive system. Have upper incisors and prehensile lips adapted to cutting off herbage close to the ground. Hoofed, athletic animals, will feed up to belly depth in water.	Feeds preferentially on grass, for about 80% of the time all through the day and night. Concentrate activity in shorter swards (1-4 cm) away from latrine sites. Feed in mires, wet heath and ephemeral ponds
	Deer: ruminant and efficient processors of food. Lack upper incisors, but small delicate muzzle permits more delicate feeding action.	Probably prefer longer swards around scrub and woodland edges offering some cover.
Foraging behaviour	Cattle: preferentially feed on grass with little seasonal flexibility other than *Calluna* in winter.	Grazing impact restricted to grassland and dry heath.
	Ponies: preferentially feed on grass but varies diet to suit available forage, utilising bracken in September, *Molinia* and *Juncus* in wet heath and mire in late summer, tree leaves in autumn and holly and gorse in winter. Feed in small groups and able to take advantage of small areas and linear areas.	Grazing and browsing impact on all habitats. Even small suitable habitats grazed including linear stream side lawns and road verges.
	Deer: fallow preferentially feed on grass and broadleaves during the summer months but move to mast and browse (bramble, holly, ivy and heather) in winter.	Principal impacts on woodland communities.

Key factor	Elements	Implications for habitats
	Roe are primarily browsing animals feeding on bramble, rose and shrubs. Sika approx. 30% grass, 40% heather and browse in Forest. Red browse more than they graze. Grasses and sedges 29%, heathers, ferns, tree leaves, herbs. Vary throughout the seasons. Muntjac primarily browse bramble, bluebell, dog's mercury, primrose, tree seed and saplings.	

Secondary grazers

Other commonable stock depastured on the Forest include sheep, pigs and donkeys.

Sheep grazing rights apply to a few holdings in the Beaulieu and Bramshaw areas but until the 1970s had not been exercised for many years and it is unlikely that sheep grazing was ever particularly widespread in the Forest. Consequently, its impact has been fairly inconsequential, though it is worth stating here that a significant increase in sheep (however unlikely) on the Forest would have highly detrimental impacts on heathland habitats. Evidence of the impact of sheep grazing on heather cover is manifest in the heather denuded uplands.

Pigs are turned out on the Forest under rights of mast to coincide with the autumn fall of acorns and beech mast. This practice is beneficial in removing a high proportion of the green acorns which can be fatal to stock when eaten in excess and is useful in providing suitable conditions for tree regeneration in the pasture woodlands. It is encouraging to see more commoners exercising their rights of mast today, as evidenced from the Verderers marking fees.

Donkeys continue to be depastured on the Forest, though in increasingly small numbers as former markets (pack, harness and latterly as children's seaside mounts at holiday resorts) die out. Their impact on heathland vegetation is purely local.

In addition to commoners' stock, rabbits and deer undoubtedly compete locally with ponies and cattle for forage, especially on lawns where their impact can be particularly noticeable. However, rabbit numbers fluctuate naturally—they remain susceptible to myxomatosis and other diseases. Land managers and keepers exert population control before impacts become significant in anything other than a localised context.

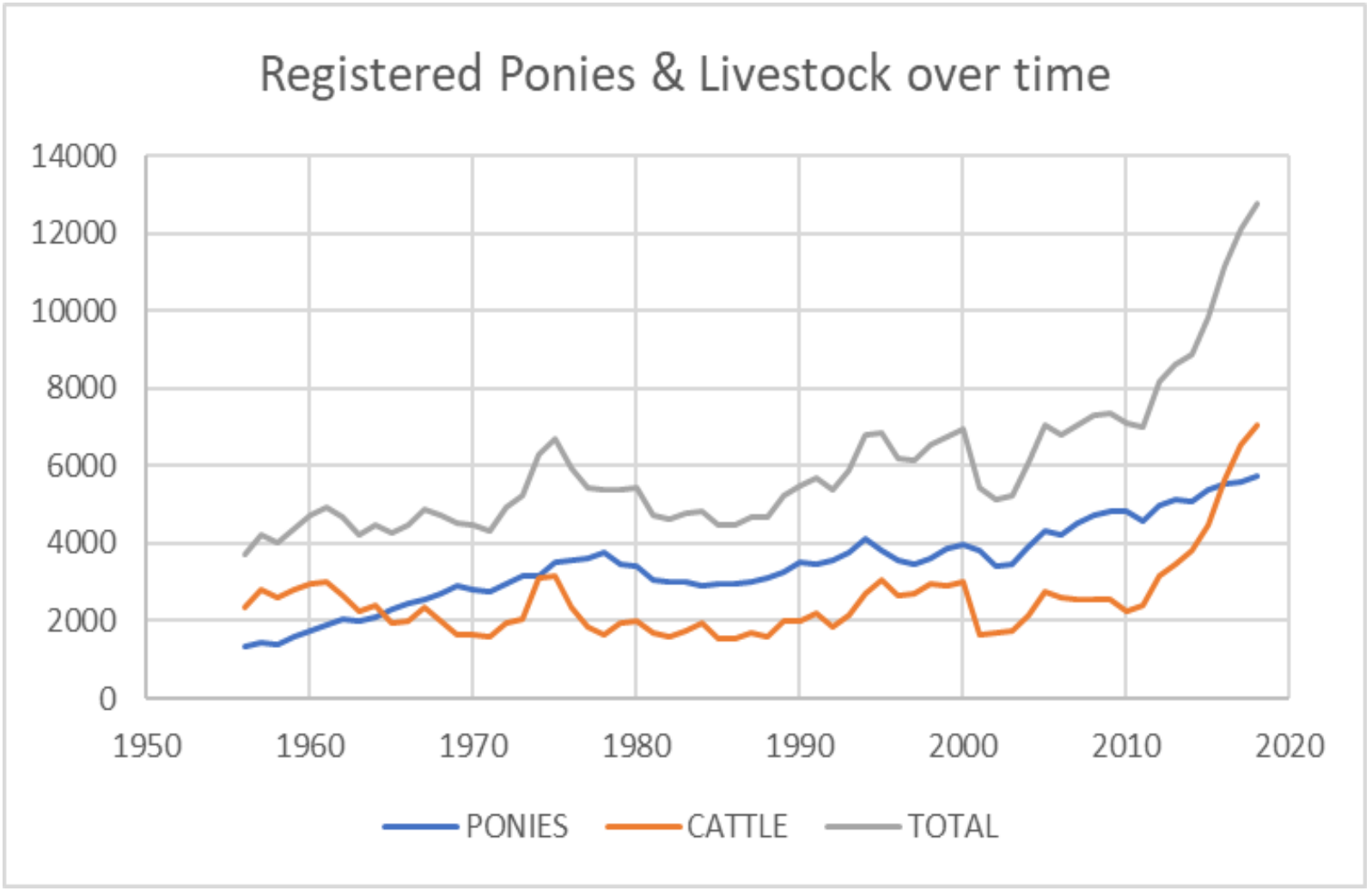
Trends in numbers of commoners' stock depastured on the New Forest 1956-2019

Grazing regimes have varied over the centuries. Figure B illustrates livestock numbers based upon the marking fee register from data available for the 20th-early 21st century. A variety of factors have influenced the numbers of animals marked each year and the data is unlikely to represent the actual number depastured.

It is neither possible nor ecologically desirable to set fixed targets for animal numbers depastured on Forest habitats over the year. The grazing animals are the principal tools with which to achieve the structure and composition of the various habitats whose

favourable condition, as defined by Natural England, will determine whether the levels are appropriate.

Figure B: Fluctuating pattern from best available data for 20th century to early 21st century



Variation in animal numbers is highly advantageous in producing habitat variation which consequently favours one species over another in an ever-varying sequence over time. Numbers are invariably lowest in winter and highest in summer as a proportion of animals, particularly cattle, are traditionally wintered off the Forest. Commoners move their stock on and off the Forest for a variety of reasons throughout the year.

Since the publication of the first version of the SAC Plan in 2001, the number of animals registered under the Verderers marking fee have doubled. In 2001 SAC habitats were in favourable condition with respect to grazing for the features of interest for which the SAC is designated. Figure B shows a fluctuation in the number of animals marked by the Verderers over time with total cattle and ponies varying from around 4,000-8,000 from 1956 to 2010. This accords with the rationale and variation described above.

There are two main factors that are likely to have influenced the numbers of animals marked by the Verderers. Firstly, the cost of marking fees at a time when commoning was largely uneconomical and perhaps the data doesn't include animals depastured but not registered resulting in an under-representation of actual numbers. Secondly, the introduction of grant scheme funding linked to the registration of animals by the Verderers providing an incentive to get animals marked and the data may include animals marked but not depastured resulting in an over-representation of the actual numbers.

The number of Verderers marking fee payments have risen markedly since 2011 most likely in preparation for the introduction of DEFRA's National Basic Payment Scheme (NBPS), administered by the Rural Payments Agency. This was an area-based scheme which paid owners at a rate based on the total area of forage available. This replaced the former Single Farm Payment Scheme which had a less attractive payment rate. To enter the NBPS evidence was required of animal ownership provided by the Verderers marking fee register and pony passports which all equine animals are required to possess.

Between 2011 and 2018 stock numbers appear to have escalated from 8,000 to 13,600.

Since 2011 Natural England have assessed over 28,343ha of the SAC. All units are recorded as favourable as far as grazing is concerned. Between 2001 and 2011 again Natural England records all assessed units as favourable as far as grazing is concerned.

All that can be usefully stated is that within the historical upper and lower stocking levels, experience shows that as far as grazing goes, the individual habitats are maintained in favourable condition. Above this level, there is likely to be an increase in demand for stock feeding—Forest stock lose condition due to lack of forage available. Below this level, it is probable that signs of under grazing and loss of those features for which the Forest is designated would be manifest.

Conclusions

Currently there is not—and there never has been—a way of knowing exactly how many animals are depastured on the New Forest annually, seasonally or daily. It is only through the impact grazing animals have on the SAC habitats as monitored by Natural England and other ecologists, together with the condition of the animals themselves as monitored by the Agisters, that can indicate whether stocking levels are varying over time.

The features for which the SAC is designated are in favourable condition as far as grazing is concerned. Natural England will continue to focus on outcomes for SAC habitats and species and not marking fee registrations to determine ecological condition.

Way forward

The Verderers HLS scheme is due to end in 2021. The Basic Payment Scheme (BPS) is currently being revised by Government.

A bespoke scheme for the New Forest SAC needs to be developed which is fair to all commoners and not linked to a normal farm situation as is the BPS. This should replace the Verderers HLS scheme and the NBPA payments in the New Forest.

The scheme will need to pay for outcomes based on the condition of SAC habitats. This should embrace funding for continuing habitat restoration and where it is unreasonable for Forestry England to pay, resources for ongoing management, especially on restored areas where costs will be higher in early years.

It will not be possible to specify carrying capacity based on seasonal forage, climate change or animal. If ecological vegetation monitoring reveals that grazing pressure is too high to sustain SAC habitats in favourable condition, then numbers of animals needs be reduced and vice-versa.

Hence payments should not be based on headage but habitat condition; and the contribution that the commoner provides to maintain that condition properly rewarded in the light of the contribution they are able to make.

If it is found to be desirable to link stock movements—on and off the Forest on a daily, monthly and yearly basis—then some kind of electronic tagging would appear to be the only practical way of doing so. Such a scheme would be expensive to run and monitor however and would not pick up animals without electronic tags which have been turned out but are not in receipt of any grazing payment. However, as remote monitoring and technology continues to evolve it may well be possible, if not especially desirable, to monitor stocking levels in this way in the future.

Overgrazing and undergrazing

The extensive grazing regime operating differentially over the year means that it is difficult to reach a point where stocking levels—sustainable in the absence of supplementary feed—would cause considerable damage to the various heathland communities. It is only when attempts to support stock in excess of the carrying capacity of the natural vegetation through the provision of supplementary feed, does damage begin to occur.

This implies that New Forest grazing levels can be maintained below the ecologically acceptable upper limits by existing or improved regulation of commoning practice, by the Verderers in conjunction with the commoners and landowners. An increase in stock numbers in excess of utilisable forage would result in the presence of animals in poor condition. Regulation by the Agisters (assisted by the RSPCA and the British Horse Society) should ensure that stock in declining condition are removed from the Forest before this occurs. It is only through artificial interventions, which would raise the feeding capacity of the Forest habitats above their natural capacity, that serious overgrazing resulting in severe damage to habitats would occur. These interventions include the extensive provision of artificial bulk feed, on or adjacent to the Open Forest, or attempts to improve the natural productivity of the Forest habitats with artificial fertilisers, ploughing or reseeding. Such activities would be immediately damaging to the conservation interest and are contrary to the protective legislation.

Statements that the Forest is overgrazed, or undergrazed are commonplace depending upon the objectives (normally unstated) that the authority making the statement may have for the Forest. The management objectives in this Management Plan are designed to maintain (or restore) the various habitats in a defined condition which will enable the existing features for which the site is designated to thrive. Hence, judgements regarding grazing pressure must be made against the habitat attribute targets defined in the Conservation Objectives.

The grazing pressure to which the Forest is subject has created and maintained over the centuries a suite of habitats with a range of niches within them. Those species adapted to that management and those niches have thrived, while those intolerant of high grazing pressure and ill-adapted to the available niches have not thrived. As an illustration, the food plant of the marsh fritillary butterfly is devil’s-bit scabious *Succisa pratensis*, which is abundant on wet grassland in the New Forest. However, while the larval food plant is not limiting, the grazing pressure does not allow the formation of other crucial habitat requirements (e.g. web and pupal refuge) for the butterfly to survive in the Forest. In this instance it would be correct to say that the Open Forest wet grassland is overgrazed if the management objective was aimed at marsh fritillary conservation. It is not. To create suitable conditions for this butterfly on the New Forest, wet grasslands would require a massive decrease in pony and cattle grazing, with the consequent knock-on effects on the commoning community in conjunction with considerable scrub invasion for shelter. This

would result in a dramatic change in sward height and structure which would be totally incompatible for many of the Forest's special interest features. The statement could then justifiably be made that the Forest was undergrazed for those species of highest conservation importance; that the nature conservation objectives are not being met; and that the conservation value is decreasing.

Some Forest habitats are subject to hard grazing (the wet and dry grasslands in particular). That is fine—they need hard grazing to maintain the interest features. However, it is possible to have too much of a good thing and cross the boundary from stocking levels consistent with hard grazing to levels which damage the fabric of the Forest habitats; even for the suite of features for which the Forest is designated. At extremely high stocking levels, particularly where the maintenance of animals is associated with the provision of artificial feed, then signs of overstocking begin to appear. In a minority of cases, the provision of supplementary feed has led to significant changes in heathland vegetation as a result of excessive poaching, trampling and nutrient enrichment. These are generally cases of too many animals of the wrong sort in the wrong place at the wrong time. These are issues which have to be addressed and managed.

Active and potential management measures to address issues resulting from inappropriate grazing pressure or stock management

Unlike common land elsewhere in the country, there are no absolute limits defining numbers of permissible stock associated with individual properties for the New Forest, although a limit could be set by the Verderers should they so choose. (The introduction of 'stints' in southern England is an artefact of the Commons Registration Act which the Forest was fortunate to avoid.) It was formerly a question of custom, or more recently market forces, which has driven stocking levels. While in principle the requirement to maintain habitats in favourable condition should now be the key determining factor, in practice within certain limits, this is flexible over time. Within these limits the operation of market forces, or traditional commoning lifestyles, will determine absolute numbers at any one time.

Issue 2: Pesticide treatments

Treatment of commoners' stock with certain chemical pesticides may have adverse impacts on many non-target invertebrate groups. Current use by the Verderers of a Pyratape wormer (Strongyd-P) may be benign. However, while this is an effective equine wormer, it does not affect bot fly infestations—a significant issue for New Forest ponies. Avermectins and closely related products would appear to be effective against both infestations, but the former pose serious and well documented threats to invertebrates (and the latter is as yet untested). Benzimadazoles are thought to have a negligible effect on dung fauna but it is not known how damaging such chemicals are to aquatic crustacea and hence to populations of nationally scarce species such as fairy shrimp *Chirocephalus diaphanus* and tadpole shrimp *Triops cancriformis.*

The Verderers' grazing scheme is specific on this question in that wormers containing Avermectin must not be used on the New Forest. Animals treated with Avermectin by commoners off the Forest must be kept off the Forest for two weeks following treatment to allow the active ingredients to become inert before livestock are turned out. Commoners wishing to use wormers on the Forest should seek advice from the vet on alternative products.

It remains an area for further research before any statements can be sensibly made about which treatments (if any) are acceptably benign to important invertebrate groups. A project should be initiated which:

- reviews current patterns of pesticide usage
- reviews the toxicity profiles of current products in use in the Forest and those for which there may be a likely demand in the future
- determines the risk of exposure to dung and aquatic invertebrate communities
- explores alternative management strategies to avoid contamination and where avoidance is impractical ensures that only benign treatments are used on Forest stock.

Issue 3: Vegetation management through prescribed burning and cutting New Forest heathland habitats: impact, current practice and future

While grazing is the principal tool for managing heathland habitats, it does require additional interventions to maintain favourable condition across the suite of habitats. For example, while cattle grazing exerts a measure of control over broadleaved tree species it is ineffectual against Scots pine. Without additional measures, including cutting and prescribed burning, Scots pine would quickly become dominant over large parts of the Forest habitats with consequent loss of nature conservation value and available grazing for commoners' animals. While moderate to low grazing levels will prolong the heather building phase and delay the onset of maturity and degeneration, it cannot indefinitely prevent the heather from passing into the later stages of growth phases (Gimmingham, 1992). Finally, while grazing animals make an important contribution to the management of bracken and gorse brakes, further interventions are required to exert control and maintain favourable condition.

Burning: history, effects on flora and fauna, current practice and key points

While burning has probably been a feature of the Forest heathlands for millennia, there has been a demand from the commoning community to burn heathy vegetation since it was

realised that it generally produces a temporary flush of palatable vegetation, particularly grasses (e.g. *Molinia)* over the rather less palatable dwarf shrub heathland plants. From a nature conservation perspective, the objective is to use burning as a complementary and subsidiary tool for grazing, to produce a varied mosaic of age and structure in the heather stands. Such a practice maximises niche diversity providing habitat for a wide range of plants and animals including those which are dependent upon a particular phase of the heather cycle (e.g. silver-studded blue butterfly). Thus, there are significant benefits to both the commoning community and nature conservation from the practice of prescribed burning.

However, burning New Forest heathland is a controversial issue which results annually in expressions of concern from the general public and from ecological commentators to Natural England, Forestry England and the Verderers, who see it as damaging to wildlife or particular genera. Heathland vegetation, when in a condition suitable for burning, may support a rich bird, reptile and invertebrate community, with high profile species such as Dartford warbler, smooth snake and sand lizard appearing to be particularly vulnerable. Such concern is of particular significance in the light of the recent trend in early springs when reptiles are emerging from hibernation in February and Dartford warblers may start to nest during March.

It is important to recognise the distinction between uncontrolled wildfire covering potentially huge areas in an indiscriminate manner which create vast uniform and monotonous expanses of even-aged heather stands and the prescribed burns carried out by experts in the practice. While it is probable that fire has been used as a tool to manage heathland communities for centuries, there is no clear historical record prior to its formal controlled use by the Crown from around 1870. This was largely in response to the need to control invasive Scots pine (a recent introduction) and probably an attempt to replace unauthorised and potentially devastating wildfires with a properly managed burning regime.

Effects of burning on the flora and fauna

Generally, prescribed burning promotes fresh growth of *Ulex europaeus, Molinia* and *Calluna*, removes the suppressive litter layer, checks tree invasion and after an initial flush, depresses nutrient status (especially nitrogen and phosphorus). However, the precise response depends upon the community being burned and the grazing intensity of post-burn treatments. The driest stands, where *Molinia* is a rare component, do not produce a grassy flush but remain substantially bare. *Erica cinerea* then *Calluna* gradually reestablish over two to four years. There is no commoning benefit therefore in burning such stands which also tend to support population centres of the more vulnerable heathland vertebrates (e.g. smooth snake and sand lizard). On the other hand, there is merit for burning some drier stands which produce beneficial bare ground habitats for invertebrates and rich lichen communities prior to the heather canopy reforming as the successional process continues.

Burning of more humid stands results in early dominance by *Molinia* for one to three years followed by reestablishment of first *Erica tetralix* and then *Calluna* in the presence of grazing. Prescribed burning of wet heath and very occasionally mire—particularly where noticeably light grazing has led to an overgrown impoverished community with dense *Molinia* or *Myrica gale*—can be very beneficial.

Gorse stands require management to maintain them in a condition suitable for Dartford warblers and as an important browse and shelter for ponies. Regeneration from seed or the base (a form of coppice by fire) is generally good, the rate of reestablishment depending on the amount of suppressive post-fire grazing. However, very old degenerate gorse stands respond less well, perhaps as a result of burning at lower fire temperatures at ground level, which fail to stimulate regeneration (Sanderson, 1994) but also because old stems are unable to produce so many new shoots.

Burning favours species which have renewal buds in positions which escape the full impact of the fire (e.g. rhizomatous species such as bilberry, tormentil and bracken), or those that resprout from the stem base and are partially protected by the surface humus such as *Calluna*, *Erica cinerea, Ulex minor* and *Ulex europaeus,* or those with renewal buds located at ground level surrounded by layers of old leaf bases such as grasses, sedges and certain rosette species such as *Succisa pratensis* (Gimmingham, 1992). It also favours lichens which are highly fire-adapted. While they survive best with cool fires, where survival in the soil of spores or thallus fragments occur, they also recolonise in about 10 years if the fire was hot. The well-lit hard humus in canopy gaps can only be produced by hard grazing or fire.

Mobile animal species are able to avoid the burn—and since prescribed burning is not permitted outside the legally permitted period of 1 November to 31 March—then impact on ground nesting birds is not generally an issue (though woodlark may nest in suitable sites in early March). (Note that the prescribed burning period can be extended for a further two

weeks into April subject to the approval of Natural England—an extension which has not been applied for many years due to mild springs.) Reptiles hibernating in burrows at the time may escape the effects of fire as litter and soil layers provide excellent heat insulation and the rise in temperature only a few centimetres below the surface during a well-managed fire is minimal.

A comparative review of burning, cutting and swiping in the New Forest was carried out in 2013 (Smith et al, 2013), which further demonstrates the benefits of expertly conducted prescribed burning and foraging harvesting against the practice of swiping. The capacity of burning and forage harvesting to maintain heathland habitats in favourable condition by regenerating vegetation communities in the absence of nutrient enrichment is clearly shown. Conversely the nutrifying impacts of swiping without removal of cut vegetation shows the impacts that increasing levels of plant nutrients can have in terms of changing the vegetation communities to those less important for nature conservation.

Current practice

Since 1949 Forestry England has carried out an annual programme of prescribed burning, at first covering 800-1,200ha annually, dropping to an average of 400ha from 1965. Over the last 10 years the target area to undertake prescribed burning has been a maximum of 350ha but the average delivered over that period has been 184ha. Using the high degree of expertise developed over the years, Forestry England and more recently National Trust staff produce a cool burn which removes the standing vegetation but does not kill the more sensitive plants. March is often the time when conditions for burning are optimal as the soil is still moist, yet the vegetation is dry enough for the fire to carry well. Plant growth is minimal, and most animals are dormant either underground or in spots sheltered from the heat of the fire. The area burned is strictly confined to limit the fragmentation of animal populations. *(See Generic Prescriptions for detailed specification.)*

However, climate change means that the Forest is experiencing ever wetter, warmer winters. Heavier winter rainfall and the associated saturated ground conditions is becoming an issue locally, making burning in January/February and into March more difficult to achieve.

Key points concerning prescribed burning of New Forest heathland habitats

Prescribed burning is an essential complement to the principal grazing management to:

- control invasive Scots pine (and other tree regeneration not controlled by grazing)
- create a mosaic of heathland vegetation structures of different ages to maximise niche separation in all heath types

- regenerate ageing or degenerate heather and gorse brakes

- reduce the risk of wildfire which can be highly damaging due to high temperature burn and extent.

Effectively managed prescribed burning, with due regard to extent, timing, location, habitat condition and species considerations, will not result in significant damage to sensitive plant or animal communities, though inevitably individuals may succumb, despite best practice. In the long-term, 'cool' fires that do not damage the organic content of the soil can be considered carbon neutral or even carbon positive when averaged over a fire cycle (Carbon storage by habitat).

Table 10: Comparison of the impacts of grazing, prescribed burning and cutting

Grazing	Prescribed burning	Cutting
Selective	Non-selective	Non-selective
Removes litter layer	Removes litter layer	Leaves litter layer
Decreases nutrients	Decreases nutrients	Can increase nutrients
Independent of weather	Weather dependent	Independent of weather
Does not control Scots pine	Controls Scots pine	Controls Scots pine though some may regrow
Some impact on bracken	Does not impact on bracken vigour	Repeated cuts depress bracken vigour
Cattle and deer may delay birch regeneration and halt growth of saplings. Can kill seedlings	Coppices birch saplings	Coppices birch
Promotes heterogeneity at all levels i.e. diversifies within and between stands, interrupts heather canopy and creates gaps	Promotes heterogeneity i.e. diversifies stand, interrupts heather canopy and creates gaps especially at the stand level and above	Promotes heterogeneity i.e. diversifies stand, interrupts heather canopy and creates gaps
Unlikely to kill slow-moving animals	Can be fatal to slow-moving animals	Less likely to kill slow-moving animals

Grazing	Prescribed burning	Cutting
May legally operate year-round	Legally restricted to 1 November to 31 March	Generally restricted during bird breeding season 31 March to 1 August

Cutting

Cutting of heathland habitats is the other main management tool to prescribed burning to supplement primary grazing management. Cutting, burning and grazing have different impacts upon the vegetation which are of considerable ecological significance. A comparison is included at Table 10 above.

In the Forest, cutting by tractor mounted swipe is used to make fire breaks along edges of roads to prevent livestock accidents with vehicles and to cut more uniform heather stands or areas containing dense bracken when the cut material will be harvested, and useful byproducts removed. It is also used where it is too dangerous to burn. The Forestry Commission used to cut and bale heather in the 1960s and 1970s for sale in the road building industry, but the practice ceased. However, cutting has taken on a new significance in the Forest with the use of heather bales for mire restoration. Clearly, such mechanised harvesting can only occur on sites where suitable machinery can operate safely. In the past heather, gorse and bracken were harvested by hand by commoners for a variety of uses including bedding, thatching, fodder and foundation material for tracks and roads. Such practices have largely disappeared, requiring more intensive interventions by more modern methods to maintain control. A significant advantage of cutting and harvesting is that it is far less reliant on precise weather conditions than prescribed burning. However, it is a costly operation, though costs may be offset to some extent by sale or effective use of the arising products.

Impact

Heather plants cut in February may grow and flower again in the following August. Species which sprout readily from the base (e.g. broadleaf trees) or have underground rhizomes such as bracken will continue to thrive in the absence of further treatments. However, Scots pine is killed when cut, providing all lower branches are removed.

Swiping/mulching (in contrast to forage harvesting) produces large quantities of debris and does not effectively remove the litter layer. This debris has the potential to inhibit regeneration and increase soil nutrient levels. Sanderson (1994) notes that the rapid flush of *Molinia* growth in the post-burn period attracts grazing animals which quickly control the

Molinia leading to a superior quality of heathland regeneration. Conversely, swiping/mulching does not produce an equivalent scenario, and grazing animals are less attracted to post-cut stands than post-burn stands. Such an impact is likely to be short term, however, grazing animals will eventually hasten the break-up of remaining debris and litter and reduce the potential for serious nutrient enrichment. A comparison of heathland management techniques by Smith et al (2013) found that heathland condition was better on baled and burnt sites when compared to swiped sites. The swiped sites tended to be grassier and supported invertebrate fauna that was more typical of grassland and arable habitats.

Disturbance to ground nesting birds is critical and cutting does not take place in the period 31 March to 1 September. Particular caution is required in relation to woodlark which may nest in suitable habitat from late February; nightjar may continue nesting until late August; and reptiles are emerging from hibernation earlier.

Turf cutting

Turf cutting for fuel or turbary was a widely practised right of common for many centuries until it largely died out at the end of the 19th century as alternative domestic fuels became widely available. The extent of turf cutting was apparently on a quite phenomenal scale (Tubbs (1986) refers to some six million 0.3m x 0.3m turves being cut per annum) and one would expect some significant ecological impact from such a practice and its disappearance. It must have created a significant area of bare ground in the deeper peaty humid soils and thereby had a significant impact in diversifying the vegetation and possibly encouraging a wider range of species within the overall mosaic of bare to revegetated patches. However, in the New Forest, grazing, cutting and prescribed burning together maintain a wide range of habitat conditions and there is little evidence to show that discontinuance of turbary has resulted in the loss of populations of any individual species, with the possible exception of stags horn clubmoss.

There is no significant practical application for the localised resumption of turf cutting in the New Forest for nature conservation reasons, other than the possible use of turf plugs from adjacent spoil heaps in mire restoration projects.

Issue 4: Exotic and native species requiring management or control

Rhododendron ponticum; Gaultheria shallon; Crassula helmsii; birch; common gorse; bracken; Scots pine.

Grazing, cutting and prescribed burning maintain the overall fabric of the heathland in favourable condition. This section describes the issues relating to specific species in the heathland ecosystem which may require additional treatments from time to time.

Non-native species requiring control or eradication

Note that there are a considerable number of exotic species established within the SAC and undoubtedly more will arrive in the forthcoming years. However, many are benign, and this management plan addresses those which require eradication or tight control as a result of their capacity to spread and dominate habitats and affect condition.

Rhododendron ponticum

A highly invasive shrub introduced from Asia as a garden ornamental and currently abundant in private grounds throughout the New Forest, where it is likely to remain a constant source of establishment by seed. It has negligible nature conservation or browse value and casts dense shade which excludes native heathland vegetation. Following removal there may be a period of little heathland regeneration as *Rhododendron* litter and leachates have a sterilising effect on the soil. Considerable progress has been made on its eradication from the open heathland, though pockets still exist.

Cotoneaster

This is a large group of shrubs and small trees which have been in cultivation in the UK since 1824 and are spread by birds which eat the berries and spread the seeds. Once established, they can become dominant to the exclusion of native species. A number of cotoneaster species have become established within the New Forest, particularly in areas such as the former World War I and II airfields where the characteristically acid heathland soils have become more alkaline in character. Work to control cotoneaster has been ongoing since 2015.

Gaultheria shallon

This is an invasive ericaceous shrub from northwest America which spreads inexorably by a system of underground rhizomes. Its leathery leaves resist penetration of herbicides and once established it dominates the ground and understorey layers of both wood and heath. There was a major infestation covering up to 12ha of woodland south of Fletchers Hill near the Rhinefield Hotel however most has been eradicated under the LIFE 3 programme. Small patches are known elsewhere, e.g. on heathland at Set Thorns and Roydon.

Crassula helmsii

An aquatic plant from Australasia which has become invasive in the British Isles in recent decades. First recorded in the New Forest in 1976 in a roadside pond adjacent to houses, it is present in many permanent and temporary ponds throughout the Forest. Surveys by Dr N. Ewald et al (2014) have revealed that of some 700 waterbodies surveyed (ponds, temporary ponds, ditches etc.) some 18% now contain *Crassula helmsii*.

This poses a threat to the native flora and fauna, including the rarities such as *Ludwigia palustris* and *Galium constrictum*. Colonisation of a pond is followed by rapid growth creating a blanket cover which out-competes the native flora. This in turn will have a deleterious impact on the invertebrate communities of that pond either directly, through creating a blanket cover or indirectly through the loss of native plant species upon which the invertebrates depend.

The following is an extract from the excellent paper by Dr Ewald on the impact of *C. helmsii* on New Forest ponds. It is the first such research carried on this species and its effects in the New Forest and once again shows the value and importance of pony grazing in maintaining the ecosystem.

On average over two thirds of ponds surveyed had less than 70% cover of *C. helmsii* and over a third of ponds had less than 30% *C. helmsii* cover. Therefore, although widely distributed, less than a third of ponds could be described as heavily infested (>75%). The degree to which *C. helmsii* dominated a site was shown to be correlated with a number of different factors, including pH and availability of nutrients. At low pH, the extent of *C. helmsii* was apparently limited and at nutrient-rich sites the extent of *C. helmsii* at a pond was greater. However, confounding factors, such as time since introduction, the complexity and structure of the native plant community and the presence of other competitively dominant native plant species, mean that it is not possible to attribute any one factor to the limited extent of *C. helmsii* at some sites. Further research to answer these questions would be of value. Dominance of *C. helmsii* was shown to have a significant effect on the availability of bare ground and the abundance of native plant species. For every 10% increase in the amount of *C. helmsii*, the amount of bare ground decreased by 6% and the amount of native vegetation by 5%. We could find no evidence that dominance of *C. helmsii* alone had

caused the extinction of any plant species. There was anecdotal evidence at one site where native plant species of conservation importance were no longer recorded—this could not be attributed solely to the presence of *C. helmsii*, but to an overall deterioration in conditions at the site from poor water quality. Many ponds in the New Forest are grazed by commoners' livestock, which is an essential element of the management of these ponds for rare and threatened native species. The intensity of this grazing pressure at some sites maintains an open sward in the pond margin and creates patches of bare ground essential for the germination and growth of native plants. Without this grazing pressure, *C. helmsii* is likely to become dominant but the quality of the ponds would decline regardless because other dominant native species would also increase. There was no significant difference between pond macroinvertebrate communities in ponds with or without *C. helmsii*.

Control of Crassula helmsii

Dr N. Ewald studied the impact of three possible control methods on *C. helmsii*, embracing herbicide, hot foam and a dye.

While the herbicide was initially effective it failed to wipe out the species from the waterbodies tested and within a year or two the species had fully recovered. The other two treatments were only marginally effective.

It would appear that pony grazing, especially in dry summers, is the most effective control and while it will not eliminate *C. helmsii*, it seems to control it to the extent that it cohabits with native species without significant detriment to them.

Many other invasive non-native plants in the New Forest are aquatic and grow vigorously, spread rapidly and out-compete our native species, particularly those that rely on bare mud and peat. They include:

- Himalayan balsam, *Impatiens glandulifera*
- Japanese knotweed, *Fallopia japonica*
- Giant hogweed, *Heracleum mantegazzianum*
- American skunk cabbage, *Lysichiton americanus*
- Parrots feather, *Myriophyllum aquaticum*
- Pitcher plant, *Sarracenia purpurea*

For the past decade The New Forest Non-Native Plants Project has been working hard to control and, where possible, eradicate invasive non-native plants in the SAC. This is a partnership between the Hampshire and Isle of Wight Wildlife Trust, the Environment

Agency, Forestry England, Natural England, the New Forest National Park Authority and The Verderers of The New Forest.

Native species and reintroduced species requiring rotational management

Common gorse, Ulex europeaus

A native and very important component of heathland vegetation, both for nature conservation and for commoners' stock. It supports a wealth of heathland invertebrates and is vital for Dartford warbler. It has the capacity however in the absence of management to become degenerate (and may die) and of less value for wildlife and commoning. As a legume it has root nodules which contain nitrogen-fixing bacteria which have the potential to enrich soils which can ultimately encourage the spread of bracken. It is notorious for colonising disturbed ground.

Bracken, Pteridium aquilinum

A native and important component of the heathland ecosystem in both the positive and negative sense. From a nature conservation perspective, bracken plays an important role in reducing grazing pressure and climatic exposure for plants and plant communities sensitive to grazing (e.g. wild gladiolus) and probably invertebrates also. Sanderson (1998) has highlighted and classified the herb-rich bracken community where scattered bracken on brown earths is intimately associated with species-rich acid grassland. On podzols and associated with heather dominated vegetation bracken is viewed in a negative sense and measures are advocated for its control.

From the commoning perspective, bracken was undoubtedly once a valuable product for animal bedding and was cut on a large scale until relatively recently. The decline of this activity is regrettable and has undoubtedly led to a considerable build-up of bracken litter and decline in pastoral and nature conservation quality on many stands. Bracken is now regarded as something of a problem, due to its capacity to spread and covers swards and reduces the grazing value, but as Sanderson (1998) notes the ecology of grazing and bracken is complex in the New Forest. Grassy bracken stands are only lightly grazed in early summer and the shading effect of bracken fronds preserves a green sward into late summer when many acid grassland communities become very parched. At this time the grassy and herb-rich bracken stands can be a very important source of grazing. There has recently been a revival in cutting bracken for composting though using modern-day mechanical harvesting techniques.

Cox and Bealey (2012) survey of bracken in the Forest incorporated further vegetation surveys, analysis and computer classification/ordination of bracken stands. No fewer than eleven stand types were recognised from dense bracken on deep bracken leaf litter to the herb-rich stands recognised earlier by Sanderson. Their composition, nature conservation

interest, distribution and area are fully described in Cox and Bealey (2012). A synthesis of this work is given in Part 1 under bracken communities.

A key conclusion from the study is the relationship between increasing bracken litter and thatch depth and decreasing botanical species diversity and forage. Areas with significant build-up of dead bracken thatch should be targeted for forage harvesting to improve conditions for nature conservation.

Birch

Two native species, silver birch (*Betula pendula*) and downy birch (*Betula pubescens*) which contribute much to heathland conservation though once again, require control if they are not to become invasive and drive the community towards woodland. A particular issue with prolonged birch cover on heathland is the dramatic changes in soil chemistry, particularly raised levels of pH, extractable phosphorus and exchangeable calcium, which pose real problems for successful heathland reversion (Mitchell et al, 1997).

Scots pine, Pinus sylvestris

Pollen records show that Scots pine was present locally in southern England 9,000 years ago but became extinct from most of the British Isles around 5,500 years ago—except in Scotland and locally in northern England and the Fens (Rackham, 2003). This is reflected in the pollen records of the New Forest (Flower and Tubbs, 1982). Reintroduced to the Forest as an ornamental tree in the 18th century and a forestry species in the 19th century, Scots pine has had a major impact on Open Forest habitats due to its phenomenal capacity to seed and thrive on southern heathland ecosystems. This species has the capacity to cover large areas of heathland habitat and will ultimately create dense woodland conditions to the detriment of the Forest's special interest and open heathland vistas. It is recognised however, that individual discrete pine stands have a place in the New Forest, particularly from a landscape perspective.

Scots pine remains a threat to heathland condition in the New Forest. The programme of felling mature pine on open heathland must continue, as does the programme of cutting and prescribed burning to control seedling expansion which will not be controlled by grazing.

Issue 5: Drainage, impacts and priority for restoration action

In 2001, 71% of the mires systems in the New Forest were in unfavourable condition; (Cooch and Weymouth, 2000). A number of factors led to this including invasion by *Rhododendron* and Scots pine, birch encroachment but principally the legacy of drainage schemes from the 1850s through to the 1980s and subsequent erosion of peat.

Restoration of mire habitats began in the mid-1990s and since then huge progress has been made on techniques and practical restoration of mires and channelised streams.

The impact of wet heath and mire drainage

Pasmore (1977) gives an account of the early history of drainage particularly in relation to the Verderers. The physical and ecological effects have been described in detail by Tuckfield (1976), Tubbs (1986) and Clarke (1988). Three phases of artificial drainage have occurred:

- In the mid-19th century, with the dual motives of drainage of new Inclosures for silviculture and on the Open Forest the compensatory funding of the common by the railways principally used to ‘improve’ grazing

- In the 1920-1930s

- In the recent post-war era up until the 1980s.

The switch from labour-intensive hand-digging to machine dug drains, particularly focussed on timber production in Inclosures and grazing of heathland intensified the impacts, which overall has left the hydrological integrity of the wetland ecosystem severely disrupted resulting in:

- Continuing headward erosion into pristine mire systems.

- Changes in plant communities, impoverished flora and fauna, increase in scrub encroachment.

- Reduced potential for storage of water on the Forest in drought and flood.

- Increased risk of flooding to local communities as the ability to hold water on the Forest is reduced.

- Drying out of headwater streams in summer, with consequent adverse impact on ecology (e.g. fish and invertebrate populations).

- Deeply eroded channels in stream beds cutting through the gravels, leaving other habitats such as riverine woodland high and dry and further increasing flood flows during times of high rainfall.

- Reduced winter flooding of stream side lawns with consequent long-term reduction in nutrients and productivity for commoners' stock.

- Spread of scrub, particularly on spoil banks along streamside lawns, leading to secondary management issues.

- Reduced capacity for the Forest to cope as global temperatures rise, annual climate changes and summers are predicted to become hotter and drier, winters warmer and wetter. The potential for water shortage for commoners' stock in summer and the protection of downstream communities from winter flooding are likely to become increasingly important issues.

- Drainage channels often represent a practical obstacle to Open Forest management. They are a hazard to livestock (in particular cattle), a hazard to riders when drifting of livestock and a barrier to safe use of vehicles when managing these habitats (for example when preparing traces in advance of prescribed burning).

Priority for restoration action

The priority for action lies with those mires supporting pristine communities which continue to suffer headward erosion and lateral peat slumping. Forestry England's innovative mire restoration techniques developed under the LIFE 2 and LIFE 3 programmes has to date been successful in containing further headward erosion on actively eroding mires across a wide variety of sites. Thomas et al (2016) provided a statement of the evidence base with key references to support a restoration programme, it also identifies where there are gaps in the evidence and what is being done to address these gaps. This led to the development of the New Forest Freshwater and Wetland Habitats Restoration Strategy 2019 (Hill, 2019). A partnership forum (the Freshwater and Wetland Restoration Forum) was also established to help shape the next steps, including the development of an evidence and monitoring plan, a communications plan and a restoration plan.

The principal objective is to prevent further active destruction of existing wet heath and mire communities and to restore a natural hydrological regime which will allow them to reacquire over time those features of structure and characteristic freshwater and wetland species which have been reduced or lost and for those features to be sustained in perpetuity. The outcome of restoring hydrology may result in changes in area and habitat type over time providing fully functional transitions from dry to wet heath and further into mire which allow the movement of species between niches.

Issue 6: Wet grassland, productivity and scrub management

Productivity and the importance of seasonal flooding

The wet grasslands in the New Forest are highly productive from both animal forage and nature conservation perspectives. The most productive, again from both perspectives, are those that retain the ability to receive nutrient input from seasonal flooding of adjacent water courses. Since this occurs mainly when the grass is not growing and at a time when animals are grazing adjacent to heathland or wood pasture habitats, there is little overall impact on commoning interests. These are also the lawns that are less prone to scrub invasion.

Lawns adjacent to over-deepened streams are deprived of this annual nutrient enrichment—and scrub invasion, particularly from elevated spoil banks, becomes a management issue. Removal of bank-side spoil, in conjunction with restoring natural channel dimensions, will reconnect the stream with its floodplain, benefiting a range of wetland habitats and species, restoring winter nutrient deposition and reducing scrub invasion. There are also wider benefits of natural flood management reducing flood risk to communities further down the catchment. A catchment-scale approach is required to consider natural processes properly.

Scrub management

For the purposes of this Management Plan, scrub is defined as a vegetation of broad-leaved shrubs and young trees forming an unstable community which is normally a precursor to woodland. (Gorse and bog myrtle are excluded as they are best regarded as an integral component of the dwarf shrub heathland communities.) Four situations are prevalent in the Forest each giving rise to management issues:

- thorn-dominated scrub on richer soils (e.g. wet grassland)
- birch invasion on heathland
- sallow invasion on mire and other wet ground and temporary ponds
- emergent high forest derived from maturing scrub.

Scrub will have been an integral part of the ecological dynamics and economy of the New Forest since the extensive grazing system developed (Sanderson, 1999). From a nature conservation perspective its value lies in presenting a further structural dimension to New Forest habitats of particular value when in transition between open heathland habitats and closed canopy pasture woodland. In this regard it is of great significance to those invertebrate communities with species less tolerant of hard grazing; and for breeding,

feeding and roosting sites for birds. Scrub is of greatest wildlife value when low, dense and flower-rich, rather than tall, straggly and draughty. Scrub of this quality must be regarded as an important component of grassland and pasture woodland complexes and transitions.

Left to its own devices, scrub can become a problem for open habitats given its capacity to spread over species-rich grasslands and shade out ephemeral and permanent ponds and sunny stream edges. The condition assessment templates give upper limits of acceptable scrub cover for respective habitat units. From the commoning perspective, concerns are expressed at the past and potential future losses of grazing from scrub encroachment, particularly on the wet grasslands.

In light of the above, the management objective for scrub is to maintain a good quality scrub component on Open Forest habitats within the limits set by Natural England and to maintain woodland edge/Open Forest transitions—such that sharp boundaries between pasture woodland and open habitats are minimised.

Issue 7: Bare ground

Bare ground within habitats, either in an intimate mosaic with the vegetation or as discrete areas, is an essential component of many New Forest habitats. It is created by the foraging and trampling activities of grazing animals; digging activities of rabbits and other animals; habitat management such as burning; human activities associated with riding, cycling and walking; and through natural erosional processes from drought stress and heavy rainfall often impacting on already disturbed areas.

Bare ground has different environmental characteristics than the surrounding vegetation, providing important conditions for invertebrates at certain stages of their life cycle, as well as providing seed beds and open space for colonising plant species, contributing to the overall ecological dynamics of the Forest. For example, during the day, surface ground temperatures are higher than in the surrounding vegetation, while at night they are lower due to increased radiation. The overall effect is to make exposed soils warmer on east-, south- and west-facing slopes and cooler on north-facing slopes—which, together with a tendency to a drier surface layer, has significant influence on the flora and fauna of the area.

It is important to distinguish between beneficial disturbance of creating bare ground conditions suitable for colonising plants and specialist invertebrates and physical long-term damage to swards and soils. The former will normally be ephemeral and discrete, creating loose soils adjacent to undisturbed vegetation. Extensive grazing, localised rabbit activity and non-intensive recreation (e.g. of the kind which creates bare ground on the sides of hollow-ways and abandoned paths) all create good bare ground.

Damaged ground will normally be of a more permanent nature, often spreading and creating compacted enriched soils which are repeatedly eroded such that they never become available for recolonisation by vegetation or are entirely unsuitable for specialist invertebrates or reptiles. Intensive recreational activities and inappropriate stock management (e.g. intensive supplementary feeding) are likely to result locally in permanent damage to Forest vegetation which may require intervention to repair.

Issue 8: Climate change

The generic issue of climate change is addressed in Part 2 under 'Man-induced trends'.

The specific impacts on lowland heathland, grassland and standing open water habitats have been considered by Natural England et al, 2020. The tables below summarise for these habitat types the causes, consequences, implications and possible adaptations given a two degree rise in global temperatures over the next century.

Table 11: Predicted impacts of climate change on European dry heaths, Northern Atlantic wet heaths and mires over the next century given a two degree rise in global temperatures. Climate change sensitivity: Medium (after Natural England 2020)

Cause	Consequence	Potential impacts	Adaptation responses
Increased mean temperatures	Longer growing season	Dwarf shrubs may become less dominant as other more competitive plants become established. Increased nutrient cycling and insect herbivory could cause grasses to become dominant over dwarf shrubs (Ukreate, 2006; Wessel et al, 2004). Increased length of growing season and activity period of key species, means a reduced window of opportunity to conduct winter management, such as prescribed burning and cutting.	Ensure optimal management through a combination of grazing, cutting and/or prescribed burning to achieve a diverse vegetation structure. Adapt the intensity of management to changing growth characteristics of the heathland, for example, by increasing grazing pressure or burning/cutting cycles. More

Cause	Consequence	Potential impacts	Adaptation responses
		Changes in soil biota (Haugwitz et al, 2014).	intensive management may be required to maintain condition. Ensure fire contingency plans are in place. These may include changes in the design and management of habitats to reduce fire risk, such as firebreaks, fire ponds and the closure of some areas at times of high fire risk. Ensure sufficient management capacity to be able to respond flexibly to changing conditions, such as a reduced window for winter management and wetter conditions preventing winter operations. Consider maintaining broadleaved (not conifer) woodland in localised areas to provide a firebreak or a buffer next to urban areas. Within sites, identify areas that might act as potential refugia to climate change, such as areas with north
Hotter summers	Increased evapotranspiration Potential for increased visitor numbers Increased risk of wildfire	Drying of sites may cause a change in balance of species, particularly on wet heathland areas. Loss of habitat structural diversity and species changes, leading to risk of local-scale species extinction (Brys et al, 2005). An increase in unmanaged access could lead to more erosion on access routes, irreversible damage to vegetation and increased risk of wildfires (Albertson et al, 2010) and increased disturbance of ground nesting birds (e.g. Underhill-Day, 2005). Climate change may have an impact on the amount of carbon stored or emitted from heathlands, as well as increasing fire risk (Alonso et al, 2012).	
Warmer winters		Scarce heathland species such as Dartford warbler or invertebrates (Thomas et al, 2015) could benefit from the warmer conditions. Grass species could become more dominant as a result of increased nutrient availability, leading to a shift from dry heath to acid	

Cause	Consequence	Potential impacts	Adaptation responses
		grassland (Wessel et al, 2004; Jones et al, 2015). Bracken could have a competitive advantage over slower growing heather species, leading to changes in community composition (Chapman et al, 2009; Aspden et al, 2013). Changes in soil biota (Haugwitz et al, 2014).	facing slopes, complex micro-topography, robust hydrology and high species diversity and ensure that these are under optimal management. Maintain structural diversity in the vegetation to provide a wide range of micro habitats and niches, including, where possible, bare ground, areas dominated by mosses and lichens, herbs, dwarf shrubs of diverse age classes, wet heath and mire and scattered trees and shrubs. Ensure hydrological conditions are fully conserved, for example through blocking artificial drainage and reducing abstraction pressure. Increase the area of existing habitat and reduce the effects of fragmentation through targeted recreation and restoration around existing
Drier summers	Drought	Altered community composition. Drying out and loss of wet heath (Carey, 2013). Increased susceptibility to wildfires and risk of resulting peat/soil damage. Surface peat (especially bare peat) could dry out and be vulnerable to wind blow. Wet heathland species such as *Erica tetralix*, could be threatened because of its need for permanently moist conditions. If lost it may be replaced with other *Erica* species.	
Wetter winters	Increased surface runoff Increased nitrogen deposition	Loss of habitat or waterlogging of some areas not normally adjusted to these conditions. Increased vegetative growth (Britton et al, 2001).	

Cause	Consequence	Potential impacts	Adaptation responses
		Loss of nutrient-poor specialist species in favour of more competitive generalists such as grasses (Wessel et al, 2004). The atmospheric deposition of nitrogen increases the sensitivity of heather to drought, frost and heather beetle outbreaks. Reduced opportunity for winter management, such as prescribed burning and cutting.	patches, to increase the core area and reduce edge effects.
In combination		Growth of grasses and the loss of more characteristic plant species will be detrimental for some typical animal species. Key species currently at the northern end of their range such as the smooth snake and sand lizard may benefit as the climate becomes milder (Dunford and Berry, 2012). Loss of typical heathland landscapes.	

Table 12: Predicted impacts of climate change on lowland dry acid grassland over the next century given a two degree rise in global temperatures. Climate change sensitivity: Low (after Natural England 2020)

Cause	Consequence	Potential impacts	Adaptation responses
Hotter summers	Longer growing season	Phenology may change significantly, with flowering and seed setting occurring earlier in season. Community composition may shift to favour southern temperate and Mediterranean continental plant species (Preston et al, 2002). Bracken *Pteridium aquilinum* may spread and dominate some areas (Stewart et al, 2008).	Ensure best practice management of existing stands by maintaining suitable grazing regimes and avoiding over or undergrazing. Monitor and control the spread of potential native and non-native invasive species. Increase the area of dry acid grassland by restoring semi-improved grasslands and recreating habitat on improved grassland and arable land to ensure the expansion and buffering of existing sites and improve the coherence of existing networks. Within sites, identify areas that might act as
Warmer winters	Fewer frost days	Milder winters may reduce frost heaving, which will reduce the amount of bare ground for the regeneration/recruitment of annual plants from the seed bank.	
Drier summers	Drought	Drier conditions will favour stress-tolerant (e.g. deep rooted) and ruderal species due to the increased gaps/bare ground in swards. However, species which are intermediate between stress-tolerant and competitive will be retarded by drier summers. Summer drought may favour annual species over perennials, leading to community change. Oceanic/sub-oceanic species such as bird's-foot *Ornithopus perpusillus*, heath bedstraw *Galium saxatile* and sand spurrey *Spergularia rubra* may decline.	

Cause	Consequence	Potential impacts	Adaptation responses
		Drier summers may favour the spread of dry heath into acid grassland (Berry et al, 2007).	**potential refugia from climate change, such as areas with north facing slopes, complex micro-topography, low nitrogen levels and high species diversity and ensure that these are under optimal management.**
	Wildfire	**Increased incidence of fire, especially in sites that form part of a mosaic with heathland or bracken, could lead to changes in community composition, bare ground and increased vulnerability to invasive species.**	

Table 13: Predicted impacts of climate change on purple moor grass and rush pasture over the next century given a two degree rise in global temperatures. Climate change sensitivity: Medium (after Natural England, 2020)

Cause	Consequence	Potential impacts	Adaptation responses
Higher annual average temperatures	Longer growing season	Increased plant growth leading to altered management requirements, such as stocking density and grazing periods. Earlier onset of the growing season may lead to less favourable conditions for ground-nesting birds that require short swards.	Ensure appropriate management through extensive grazing combined, where required, with scrub management or cutting to ensure that habitats do not develop into rank grassland, scrub or woodland, or conversely, are overgrazed. Expand the resource through the restoration of semi-improved pasture and recreation. Target this to ensure
Hotter summers	Higher evapotranspiration	Reduced water tables (see drier summers)	
Drier summers	Increased soil moisture deficit	Water stress could lead to the loss of individual species and changes in	

Cause	Consequence	Potential impacts	Adaptation responses
		the plant community composition. Drier conditions in late spring could reduce the suitability for breeding waders such as snipe and redshank.	expansion and linkage of existing sites.
Wetter winters	Increased risk of winter flooding and increased nutrient loading Higher winter water table	Increased nutrient inputs from in-washed sediment could lead to enrichment and the loss of nutrient-poor vegetation types. Higher spring soil moisture levels (combined with higher spring temperatures) may increase total biomass and favour more competitive species. Ensuring appropriate levels of grazing may become more difficult.	
More extreme events	Summer and winter flooding	More flooding could lead to a shift in species composition to favour those species able to cope with long-term inundation. Increased nutrient input resulting from flooding with nutrient-rich water will benefit those species able to utilise enhanced levels, with the potential loss of nutrient-poor vegetation. More frequent disturbance could increase	

Cause	Consequence	Potential impacts	Adaptation responses
		susceptibility to the spread of invasive species (Knight et al, 2014). More frequent flooding will make it more difficult to maintain appropriate grazing levels and will make access for management more difficult.	

Table 14: Predicted impacts of climate change on standing open waters over the next century given a two degree rise in global temperatures. Climate change sensitivity: High (after Natural England, 2020)

Cause	Consequence	Potential impacts	Adaptation responses
Increased frequency of storms	Higher intensity rainfall, leading to increased run-off	Increased run-off of sediment and nutrients, leading to eutrophication and sedimentation. Sedimentation can reduce recruitment in some fish species, which require clean gravels for spawning. Eutrophication has the potential to impact upon the entire food web. Fluctuation in water levels causing erosion by waves over a wider area.	In the catchment (and land adjacent to the SAC): Improve natural infiltration of catchment soils and percolation to groundwater, by restoring soil organic matter levels and avoiding soil compaction and capping. Create semi-natural vegetation such as woodland and grassland along critical run-off pathways to slow surface water run-off and aid infiltration of water into the soil.
Sea level rise	Saline intrusion	Loss of freshwater flora and fauna. Forward switch to a turbid algal dominated state. Increased frequency of flips between saline,	

Cause	Consequence	Potential impacts	Adaptation responses
		brackish and freshwater states.	Make sure that any crops grown are appropriate to the erosion sensitivity of the land in order to minimise erosion and siltation of water courses. Restrict nutrient (nitrogen and phosphorus) applications to crops to the minimum necessary for healthy growth, based on methods with high uptake efficiencies. Use low-nutrient livestock feeds with high efficiencies of nutrient uptake. Use Coastal Habitat Management Plans (CHaMPs) to assess which sites are at risk from saline intrusion and whether habitat creation or assisted migration is required. In the standing water body: Manage pollutant loads from effluents to minimise impacts on the natural nutrient status and to minimise concentrations of toxins.
Increased annual average temperatures	Longer growing season	Increased likelihood of eutrophic symptoms where nutrient loads are high, with earlier and longer lasting phytoplankton blooms. Possible increased abundance of cyanobacteria ('blue-green algae') within the phytoplankton community, although this has not always been supported by experimental work, especially in shallow water systems containing macrophytes. Raised phytoplankton productivity causes a reduction in light penetration, competition for carbon dioxide and a decrease in oxygen concentration as phytoplankton decomposes. This can cause a loss of macrophytes and a loss of those fish which are reliant on high oxygen levels. Benthic organisms may also decline due to inhospitable conditions in the benthos and eventually zooplankton will decline as there is no refuge from zooplanktivorous fish as	

Cause	Consequence	Potential impacts	Adaptation responses
		the macrophytes have been lost. This will result in an algal dominated turbid lake with reduced biodiversity. Phenology within the plankton community is likely to change with the potential for mismatches between different components of the plankton community, leading to changes in the relative abundance of species. Possible replacement of submerged macrophyte species by evergreen and/or floating macrophyte species. Successful evergreen species may be non-native, such as New Zealand pygmy weed *Crassula helmsii*. Non-native species, especially those which currently have a more southern and/or eastern distribution, are increasingly likely to colonise and expand their range. The reproductive success of introduced and problematic fish species such as the common carp *Cyprinus carpio* may increase as temperatures increase. Some aquatic	Maintain or restore lake marginal habitat and emergent structure to provide areas protected from wave action. Maintain or restore the natural hydrological regime including action that reduces drainage of surrounding wetlands and allows natural water level fluctuations and flushing rates. Optimise shoreline tree cover to provide some areas of shade. While shading reduces plant growth in standing waters, an ample supply of woody debris and leaf litter is beneficial to some species and buffers against rising water temperatures and therefore a limited amount of shade is beneficial. Manage access and leisure activities to minimise impacts and increase resilience. Promote good biosecurity to slow the spread of invasive non-native species and minimise their chances

Cause	Consequence	Potential impacts	Adaptation responses
		and riparian non-native plant species may become invasive due to improved winter survival rates. Loss of habitat for cold water species and northward spread of some southern species. Potential for changes in pH due to increased weathering.	of colonising the water body and control damaging species already present.
	Lower dissolved oxygen levels	Increased likelihood of deoxygenated conditions at the sediment-water interface, leading to the release of phosphorous from the sediment into the water and a risk of eutrophication. As a result, some invertebrate and fish species may find it difficult to survive low oxygen levels.	
Drier summers	Drought	Greater water level fluctuations leading to increased exposure of the littoral zone (causing stress for some aquatic plant species) and leading to increased erosion lower down the littoral zone. Encroachment of marginal emergent vegetation into the water body. Drying of the marginal vegetation at the outer edge.	

Cause	Consequence	Potential impacts	Adaptation responses
		Longer and more frequent drying out of shallow/small water bodies. While drying out is detrimental to some species, other species such as the tadpole shrimp *Triops cancriformis* thrives in such conditions. Loss of physical connection with other freshwater and wetland habitats. Potential for changes in pH due to changes in hydrological conditions.	
	Decreased summer flushing/longer retention times in summer	Increased nutrient concentrations within water bodies, potentially making it harder to recover from eutrophication.	
Wetter winters	Flooding	Flooding higher up the shoreline, resulting in increased erosion of the shoreline as water levels rise and displace the usual drawdown zone. Increased run-off, sediment and nutrient delivery, leading to sedimentation and eutrophication. Increased winter flushing and shorter retention times in winter, potentially reducing nutrient concentrations lakes in winter if the water entering	

Cause	Consequence	Potential impacts	Adaptation responses
		the lake has a lower nutrient concentration than the lake water.	

Issue 9: Pests and diseases

Pests and diseases of tree species have been covered in some detail in the pasture woodland section. While there are a myriad of pests and diseases with the potential to affect heathland flora and fauna, it is not appropriate to include them here.

However, it should be noted in this section that some pests or diseases can affect the management of the semi-natural habitats, rather than directly affect their flora and fauna. There are a number of livestock pests and disease which pose a threat to depastured animals in the Forest. Notable examples in recent years include the foot-and-mouth outbreak of 2001, the continuing presence of bovine TB. Foot-and-mouth jeopardised commoning activity and the potential loss of commoning animals to such a disease would have a rapid and dramatic deleterious effect on the Open Forest habitats. Foot-and-mouth also forcibly influenced human behaviour through prevention of public access in the Forest for a significant period of time. The absence of human ‘disturbance’ altered some wildlife behaviour during the spring of 2001. In spring 2020, as similar restriction on public access is again in place due to the COVID-19 outbreak, which again may alter animal behaviour during the breeding season.

Issue 10: Air pollution

A generic discussion on air pollution is covered under Part 2 under ‘Man-induced trends’.

While air pollutants have the capacity to increase acidification on heathlands and acid grasslands, there is little evidence to suggest that the New Forest is affected other than very locally. This is due to the extensive ecosystem and the surrounding land use as described in Part 2.

Issue 11: Recreation

A general description of the current recreational activities and their impacts on nature conservation is given in Part 1.

Most of the activities described in Part 1 occur on the heathland habitats. However, the principal impacts are generated by disturbance to sensitive fauna (e.g. ground nesting birds) from walkers and uncontrolled dogs and sward or soil damage from walking horse

riding or cycling. More locally, soil enrichment from dog excrement can be an issue around car parks. Grazing issues arise from livestock worrying, road accidents (although many may not be due to recreation), transfer of diseases, feeding and petting livestock, damage to infrastructure and visitor perceptions and expectations of the New Forest SAC/SPA/Ramsar as an area for recreation.

Recreational disturbance

The principal issue from the nature conservation perspective relates to recreational disturbance on ground nesting birds and wintering birds, (e.g. hen harriers at roost sites) but can also affect mammals, herptiles and invertebrates.

There is a considerable literature concerning the effects of recreation on wild birds and there are some key points which arise from the literature:

Certain ground nesting birds are very vulnerable to disturbance from recreational activities—they are tied to territories for periods of up to three months, during which period individual birds, people and dogs are likely to come into contact. The nature and degree of behavioural response elicited by this contact varies between species. Some become motionless, relying on camouflage to avoid detection (e.g. nightjar), some allow a close approach while others will advance towards an intruder with warning calls (e.g. Dartford warbler) and others will temporarily leave an area altogether (e.g. woodlark).

The distance at which the response is elicited by any given disturbance event varies between individual species, stage of breeding cycle and by a bird’s previous exposure to the disturbance event. For example, breeding raptors as large birds tend to flush at bigger distances and raptors can often be sensitive to people around the nest.

For both nightjar and woodlark, studies have shown recreation use affects the distribution of birds within sites, such that busy areas are avoided and for Dartford warblers, breeding productivity is lower in heather-dominated territories where access levels are high. Disturbance at hen harrier roost sites may cause displacement and prevent birds from roosting (Lake et al, 2020).

A number of studies report that nests are trampled more frequently in disturbed areas than in undisturbed areas, that rates of abandonment of chicks or eggs or deaths to exposure, are higher in disturbed areas; or that rates of egg and chick predation are higher in disturbed areas than undisturbed areas.

While some of the most important ground nesting populations are found in areas where recreational pressure is and has been for some time, considerable, one can only guess at the potential size of their wild bird populations if recreational disturbance were absent.

The impact of recreational activities is likely to be greater where regular easy access for particularly disturbing activities (e.g. uncontrolled dog walking) is provided.

The frequency or severity of individual disturbance events will always reach a point which deters individual birds from settling in an area for feeding, breeding, roosting, forming pairs, nesting, or breeding successfully in any area. Breeding birds of all relevant species are likely to avoid areas with high levels of access rendering suitable habitat unavailable.

The decline in the number of nesting pairs or in their breeding success will at some point have population and nature conservation consequences. There is a greater risk of local extinction for very rare species with small population sizes.

Some disturbance events are more damaging than others. Dogs under close control by a fixed, short length lead are likely to have no more significant an impact on bird populations than their handler. Free-roaming dogs are likely to cause more disturbance to wild birds than an equivalent number of free-roaming humans as they tend to cover more ground and sniff out and chase or destroy eggs or young birds.

The restriction of a given number of humans to a linear route will, in very general terms, tend to be less damaging to a wild bird population than the same number of humans allowed to roam freely (although this may clearly be at the expense of the individuals breeding along the linear route).

Erosion from recreational activities

A review is contained in *A Review of Recreation Pressures in the New Forest* (Clarke, 1999), a study conducted as part of the LIFE 2 programme which aimed to determine the degree of erosion currently evident across New Forest and to identify the habitats most vulnerable to damage from the different types of recreational activities that are pursued within them. 12 areas were identified as having significantly high levels of recreational use.

Trampling from human activities such as walking, cycling, horse riding and verge parking can cause soil compaction, changes to soil hydrology, damage to plants and with heavy use, erosion and compacted bare ground. This leads to reductions in soil invertebrates and changes in plant communities. The effects are most acute near to car parks, access points from the urban fringe and in and around campsites (Sharp et al, 2008; Recreational Pressure in New Forest; Unpublished report for Natural England*).*

It is difficult to predict thresholds at which significant vegetation change will occur but studies have shown that species such as field gentian *Gentianella campestris* and autumn lady's-tresses *Spiranthes spiralis* are impacted by trampling of grasslands (Pascoe, 2013). In contrast species such as yellow centaury *Cicendia filiformis*, marsh clubmoss

Lycopodiella inundata and coral necklace *Illecebrum verticillatum* benefit from light trampling which create and maintain bare ground required by these species.

Heathland vegetation can suffer long-lasting physical damage due to excessive trampling and bogs have particularly soft fragile surfaces and repeated trampling can damage the active bog surface. Wet heaths, flushes/springs, wet or damp grasslands can also be considered sensitive to similar damage as peatlands.

Fire

Wildfires are of increasing concern in the UK and their frequency and magnitude are considered likely to increase in response to climate change. In 2020 Natural England undertook a review into the causes and prevention of wildfire on heathlands and peatlands in England. The review established that wildfires occur particularly on heathlands, and most are the result of human action.

Wildfires are likely to affect ecosystem response and result in loss of vegetation cover and loss of shallow peat soils as well as affect associated species such as reptiles and remove breeding and foraging habitat for a range of species. Wildfires tend to be most common in the summer months when it is most harmful to the habitat; and can take many years to recover depending on the intensity of the fire.

Increasing levels of new housing developments are planned in and around the New Forest National Park. Footprint Ecology (2020) undertook research on behalf of local planning authorities focusing on understanding the impacts of recreation arising from this development on the New Forest's international nature conservation designations and the potential for mitigation. The resulting six reports were published in May 2020 with the recommendation that a strategic, proportionate and co-ordinated approach is developed which will require partnership working across a range of local authorities and stakeholders.

The New Forest National Park Recreation Management Strategy Steering Group will continue to work together to manage recreation to improve the condition of unfavourable heathland units affected by recreation (see New Forest SAC Management Plan Part 1: Section 1.4.5: *Access and recreation in the New Forest*).

Generic management policies, prescriptions and rationale for heathland habitats

For maintaining heathland units in favourable condition

Management policy

Where the objective is to maintain the unit in favourable condition, then the favoured management option will be one of continued extensive management, through a series of rotational maintenance operations conforming to the policies and prescriptions below.

Generic management prescriptions for maintaining heathland habitats units in favourable condition

Continued depasturing of commoners' stock on all Open Forest heathland habitats, or suitable livestock elsewhere, to maintain the differential grazing pressure across the heathland habitats through the preferential feeding behaviour of the principal stock (cattle and New Forest ponies) and periodic fluctuations in overall animal numbers between upper and lower limits. The upper and lower limits are defined not in terms of animal numbers, but in terms of the grazing impact on designated SAC habitats and species as defined and determined by Natural England.

- Tight control on the provision of supplementary feed, restricted to authorised locations on non-sensitive habitats and localities.

- Pesticide treatments: no change in current practice pending further research. Avermectin wormers may not be used on the Forest and animals treated off the Forest must be given sufficient time for the active ingredients to become inert before returning to the Forest.

- Grazing will be supplemented where necessary with prescribed burning in order to:

    i. maintain a mosaic of heathland vegetation structures of different ages to maximise available niche separation

    ii. control invasive Scots pine (and other tree regeneration not controlled by grazing)

    iii. regenerate ageing or degenerate heather and gorse brakes

iv. reduce the risk of wildfire which can be highly damaging due to high temperature burn and extent.

- Grazing will be supplemented where necessary with cutting and (as appropriate) harvesting in order to:

  i. maintain a mosaic of heathland vegetation structures of different ages to maximise available niche separation

  ii. regenerate ageing or degenerate heather and gorse brakes

  iii. control potentially invasive non-native and native species.

- No cultivations, fertilising or reseeding.

- No new drainage schemes or maintenance of old or existing drains except where there is a proven requirement under health and safety or protection of dwellings or roads from flooding, or demonstrable positive impact on grazing particularly with respect to wet lawns, where the nature conservation interest will not be damaged.

Prescribed burning and cutting: agreed specification

The annual cut and burn programme will be subject to the legal requirements of the Heather and Grass etc. Burning (England) Regulations 2007 (Natural England and Defra) which stipulates that prescribed burns will only take place between 1 November and 31 March. This legislation and the accompanying voluntary code set out both the legal framework and the associated good practice. In addition, in the New Forest the cut and burn programme will adhere to the following principles:

- Management of wet heath and the more humid forms of dry heath will aim at an average 23-year treatment rotation. On the Crown Lands the area treated will average out at approximately 300-400ha per year.

- The size of individual prescribed burns/cuts will usually be smaller than 5ha but exceptionally up to 20ha.

- Treatments in succeeding years will be well separated.

- Management of the driest heath (i.e. that which does not produce a grassy flush of *Molinia*) will be carried out only where necessary to encourage regeneration, to avoid senescence.

- Gorse will be cut or burnt, in advance of senescence to encourage regeneration. On selected sites where regeneration fails soils will be appropriately managed to encourage seedling establishment; to mitigate the change in the seasonal weather patterns due to climate change, management of sites known to support ground nesting birds and reptiles should be focused on early in the season and less sensitive habitats towards the end of the legal season (31 March). Checks for any signs of nesting or reptile activity should be undertaken before cutting or burning sites late in the season.

- In the light of the impact of climate change on March prescribed burning programmes, it is necessary to carefully consider burning in late autumn/early winter when stands are dry and vulnerable species are safe. **Cutting and mulching are no substitute for burning.**

Bracken management: agreed specification

This is based on the work of Cox and Bealey (2012) and observation and experience of managing bracken stands on heathland.

- Use of herbicides specific to bracken or ferns in general is currently banned. It also has little effect in controlling bracken in the long-term requiring repeated treatments. In the short term its effect is to kill the bracken and build up the dead litter and thatch layer which smothers out other vegetation to the detriment of nature conservation and forage (grass). Should its use become legal again in the future then careful consideration must be given to its targeted use and effectiveness.

- Forage harvesting is by far the best technique to use for managing bracken in most instances and stand types. By removing dead litter and preventing thatch build up swards beneath can remain diverse and productive while still benefitting from the protective cover of seasonal bracken.

Cox and Bealey (2012) recommend the increased use of forage harvesting from the current 100ha/year to 300-500ha/year to get on top of the areas with deep thatch and poor species diversity and forage. There is an abundance of such stands which are suitable to be managed in this way within the limitations of the available machinery.

It is inevitable that some areas will be cut and harvested annually, some will be cut only periodically and some not at all. This should not be viewed as a problem since all bracken stands of whatever nature are of value for a variety of wildlife communities and different treatments will yield differing results. For example, emergent woodland on scattered bracken should not be cut since to do so will clearly be detrimental to tree and shrub regeneration.

While it is recognised that targeted herbicide use has only limited effect, it remains a legitimate option for land managers across the SAC. The use of legally approved herbicide(s) and their application will be agreed in advance with Natural England. In addition to the approved cutting/forage harvesting methods described above and in the absence of approved herbicides, locally there remains the potential to undertake the following to control areas of species-poor bracken:

- bruising of stems with a suitable roller
- annual cutting
- brush-cutting earlier in growing season.

The application of any of these methods would require the land manager to demonstrate that no ground-nesting birds, reptiles or other vulnerable wildlife are present and again would need to be agreed in advance with Natural England.

For restoring heathland units to favourable condition

Management policy

Where the objective is to restore units to favourable condition, then additional management operations may be required in the short term, conforming to the generic prescriptions below.

Generic management prescriptions for restoring heathland habitat units to favourable condition

A. Where habitats are in unfavourable condition as a result of over or undergrazing

Mechanisms under agri-environment schemes (existing and future) should be used where appropriate to manipulate grazing pressure over time to achieve the desired outcomes.

B. Where units are in unfavourable condition due to the presence of unacceptable levels of non-native trees and shrubs

Where units are in unfavourable condition due to the presence of unacceptable levels of non-native trees and shrubs then intervention is required through their systematic removal to a level not exceeding the targets stipulated for unfavourable species by Natural England (e.g. <1% cover for *Rhododendron ponticum* and *Gaultheria shallon*). In all cases mechanical disturbance to the heathland unit must be minimised and this should be the primary consideration in deciding which management technique to use.

Rhododendron ponticum

Complete removal from the whole SAC will continue to be attempted. Historically large areas of *Rhododendron* have been removed and burnt in situ using tracked excavators. Almost all large patches of *Rhododendron* have now been treated, with only follow-up herbicide spraying required in these areas. Elsewhere, the use of herbicide is favoured over mechanical options. Foliar herbicide application by knapsack (April-October, weather dependent), with checks undertaken for nesting birds and sensitive vegetation prior to application. Larger bushes which cannot safely receive foliar herbicide treatment, in winter will be cut by hand to ground level followed immediately by stump treatment with herbicide. It is acceptable to burn up on the site of former dense *Rhododendron* cover. Any initial changes in vegetation due to nutrient release will be restored by grazing.

Regrowth should be treated with an appropriate herbicide in the following two years.

Gaultheria shallon

Complete removal from the whole SAC will continue to be attempted. Continue with follow-up applications of herbicide Fletchers Hill to ensure the successful eradication of the species from there. Elsewhere, also continue to apply herbicide on those small patches were known to be present.

Scots pine

Scots pine will be removed except where they form important landscape features (as either small stands or single specimens). In the Open Forest, small clumps of Scots pine have value as a landscape feature but should be managed so that the area of tree cover is stable and still has heathland vegetation as ground cover. Where removal would be damaging to surrounding heathland habitats and soils, in these cases other methods of control such as ring barking or felling without extraction should be considered.

Crassula helmsii

Dr N. Ewald studied the impact of three possible control methods on *C. helmsii* embracing herbicide, hot foam and a dye. While the herbicide was initially effective it failed to wipe out the species from the waterbodies tested and within a year or two the species had fully recovered. The other two treatments were only marginally effective.

It would appear that pony grazing, especially in dry summers is the most effective control and while it will not eliminate *C. helmsii*, seems to control it to the extent that it co-habits with native species without significant detriment to them.

Continue to support the work of The New Forest Non-Native Plants Project which has been co-ordinating programmes for the control and, where possible, eradication of invasive non-native plants in the SAC.

C. Where units are in unfavourable condition as a result of artificial drainage

Where units are in unfavourable condition as a result of artificial drainage the management objective is to prevent further active destruction of wet heath, wet grassland and mire communities and to restore the hydrological regime which will allow them to reacquire over time those physical and biological characteristics which have been degraded or lost. This will not only provide suitable conditions for a range of species characteristic of wet habitats but provide the best defence against climate change. This is likely to require:

- the halting of headward erosion into mires and wet heath using appropriate restoration techniques

- the halting of peat slumping from wet heath and mires arising as a result of artificial drainage channels, using appropriate restoration techniques.

- restoration of natural hydrological function at a catchment scale to ensure further erosional nick points are not generated

- the restoration of seasonal inundation and natural drainage of wet grassland to reinstate winter nutrient deposition and reduce scrub invasion. Techniques used will depend on site characteristics but are likely to include reprofiling of artificial landforms (e.g. spoil banks) and raising of bed levels in adjacent streams.

D. Where units are in unfavourable condition as a result of scrub cover, specification for scrub management

Where units are in unfavourable condition as a result of scrub cover the management objective is to maintain a good quality scrub component on open habitats within the limits set by condition assessment and to maintain woodland edge/open habitat transitions such that sharp boundaries between pasture woodland and open habitats are minimised.

Three treatments are likely to be required depending on the situation:

- Where adjoining habitats (wet grassland, mire and heath) are in unfavourable condition due to the spread of dense birch, sallow and scrub from emergent woodland then removal sufficient to restore the habitat in question to favourable condition is necessary. Note: Refer back to Issue 13 under the pasture woodland section above for further advice.

- Transitions which are not threatening these primary habitats (e.g. over bracken) should not be cleared and the birch will be retained to biological maturity, especially in those areas where the development of young woodland of oak, beech and birch is desired. There is no merit in clear-felling such transitions, but consideration should be given to managing the emergent woodland to hasten an appropriate structure (e.g. pollarding or thinning) to avoid a rather dull closed canopy woodland edge.

- Early 20th century dense, young canopy woodland which has spread over former or relic primary habitat, e.g. wet and dry grassland and where this primary interest is recoverable, should be removed and the primary habitat restored. Note: Refer back to Issue 13 under pasture woodland for further advice.

E. Specification for scrub management

- Avoid wholesale removal of scrub from primary habitats as this can be devastating to the fauna dependent upon that habitat. It is better to treat small patches in a rotation so that sufficient good quality habitat is retained at all times. This will vary from location to location and will be a matter of ecological judgement within the limits set by condition assessment. Some protection using cut brash may be necessary to protect regrowth from browsing.

- Retain good quality scrub on primary habitats within condition assessment limits, i.e. that which is dense, low and flower-rich. Aim to treat scrub in rotation to maintain it in good condition.

- Remove poor quality scrub on primary habitats which is tall, straggly and draughty, along with young broadleaves which will result ultimately in dense emergent woodland.

- Consideration should be given to pollarding appropriate specimens of oak and beech particularly dense stands of emergent woodland where creation of an open scrubby transition is desirable.

F. Where units are in unfavourable condition due to the presence of compacted/eroded bare ground

Where units are in unfavourable condition due to the presence of compacted/eroded bare ground (outside the acceptable limits defined in the condition assessment templates), then intervention to repair eroded ground may be appropriate. However:

- Application of repairs to eroded surfaces should only be applied where further damage to nature conservation interests will not occur as a result of repair works.

- The emphasis should be on natural regeneration of vegetation cover rather than import and spread of additional materials. Such an approach may require temporary closure of car parks or recreational ‘hot spots’ to be successful. Furthermore, some temporary fencing for a short period can successfully reestablish natural vegetation e.g. Cadman’s Pool.

- There should be a presumption against the building of new permanent paths using imported gravels.

- In order to avoid unnecessary damage and/or disturbance to sensitive habitats, programmes to restore ‘eroded’ habitats should be subject to detailed planning and evaluation.

G. Guidance on ground nesting birds and recreational disturbance

The aim is to keep people and dogs away from ground nesting birds, or to reduce the potential impact to a level where it does not adversely impact on bird populations. The following management guidance may reduce the impacts:

- Car parks and other popular visitor facilities may need to be subject to seasonal closure or restrictions.

- Visitors should be encouraged to avoid where possible, or at least to move quickly through, sensitive areas and accompanying dogs should be kept under tight control or on leads, when they are likely to have no more significant an impact on wild bird populations than their handler.

- Visitors should be encouraged to stay on well used linear routes particularly during sensitive periods for wild bird populations.

- Increase public awareness of the issue by providing explanatory signs at key access points.

Natural England and the landowners of the SAC will continue to work together through the New Forest National Park Recreation Management Strategy Steering Group to bring any unfavourable heathland units into favourable condition (see New Forest SAC Management Plan Part 1: Section 1.4.5: *Access and recreation in the New Forest*).

Inclosures: issues, generic prescriptions and rationale

Introduction

This section discusses the aims for the management of the New Forest Inclosure habitats (Statutory and Verderers and enclosed ancient semi-natural woodland outside the Crown Lands), the issues affecting their condition and sets out where relevant the generic management guidance and rationale required both to maintain those units currently in favourable condition and to restore those units currently in unfavourable condition.

Within the Crown Lands, Forestry England has recently undertaken a full review of Inclosure management, with a new plan to guide future strategic direction. This plan has been through various consultations and is now the approved New Forest Inclosures Forest Plan 2019-2029.

The direction of the Plan builds on the momentum of the previous 20 years, moving the management of the Inclosures towards favouring native broadleaf over conifer in the light of the outstanding nature conservation value of the New Forest SAC. All plantations were either planted on ancient forest or heathland and the recovery of these SAC habitats is now a priority for Forestry England, as reflected in the Plan.

The principal objective is to maintain or restore SAC habitats under plantations to either broadleaf woodland or heathland. Over the next 30-50 years and as the current crop of conifer matures and is harvested, there will be no further planting of conifer, and its regeneration will be actively controlled to favour broadleaf on sites which were formerly broadleaf and/or pasture woodland.

On sites which were formerly heathland it will be important to keep the conifer plantations clear of any broadleaf regeneration so that on maturity and on the clear-felling of the conifer plantation, the recovery of heathland is not compromised by the presence of broadleaf regeneration and the nutrient issues which it inevitably presents. An exception to this approach is where higher fertility soils which may have been pasture woodland sites pre-dating Drivers Map (1790s), currently heavily dominated by bracken, at the fringes of existing pasture woodland. In such instances it will be more beneficial to let them become emergent pasture woodland rather than actively intervening in creating poor quality heathland. This must of course be in the presence of Open Forest grazing.

In addition, a long-term aim is to manage existing broadleaf plantations for timber production and these areas will remain enclosed.

Principal aims for management of Inclosure woodland

The issues described below relate differentially to the six principal aims for the management of Inclosure woodland. These aims may be summarised as:

1. To maintain or restore designated habitats (e.g. mire, wet heath, dry heath, riverine woodland, trapped pasture woodland and some 18th and 19th century broadleaf plantations) to Open Forest management.

2. To maintain or restore designated habitats which will remain within Inclosures.

3. To restore some 19th century broadleaf plantations (which will remain within Inclosures) to a semi-natural character.

4. Over the next 30-50 years in mixed woodlands, to actively promote the retention of broadleaf through the gradual removal of conifer.

5. To maintain or restore ancient semi-natural woodland on non-Crown Land sites (e.g. Langley Wood, Whiteparish Common, Roydon, Franchises) to favourable condition.

Issues affecting Inclosure woodlands

Significant issues affecting or having the potential to affect the condition of Inclosure Woodland are listed in the following table and are discussed below:

Table 15: Significant issues affecting Inclosure woodlands

Issues pertaining to management required to maintain favourable condition	Issues pertaining to management required to restore favourable condition
Woodland management: Felling and restocking (natural regeneration and planting) Timber extraction, machinery and access, ride management	Management of primary habitats currently enclosed
Climate change	Management of broadleaf woodland
Storms	Non-native tree and shrub management
	Drainage and soil disturbance

Aim 1: Where the aim is to maintain or restore designated habitats to Open Forest management

The designated habitats are those for which the SAC has been designated and include mire, wet and dry heath, wet grassland, pasture woodland, riverine and bog woodland, in addition to those habitats which have reached a significantly advanced stage of development towards becoming SAC habitats. The latter are principally the 18th and 19th century broadleaf plantations which given sufficient time under Open Forest management conditions will develop into old growth pasture woodland.

The issues affecting such habitats relate principally to the cover of non-native or inappropriate species, disruption to landform and hydrology and the management interventions required to restore the habitats to a condition where they can return to Open Forest management.

Restoration of heathland habitats, (wet and dry heath and mire), requires the removal of tree cover, the infilling of drains and the immediate reinstatement of grazing by commoners' stock, together with full integration within the Open Forest cut and burn programmes. Where substantial areas of conifer Inclosure are to be restored to heathland habitats (e.g. the Verderers Inclosures) then considerable disruption to the ground surface, temporary inconvenience to the public and significant changes to the landscape are inevitable. Such issues have been considered as part of the New Forest Inclosures Forest Plan.

Restoration of pasture, riverine and bog woodland also requires the removal of non-native species and may require adjustments to the pre-enclosure drainage pattern. In addition, some sites may require treatment of dense holly or other understorey which in the absence of domestic grazing has created shaded conditions unsuitable for maintaining the special interest features. Early return to Open Forest grazing management is highly desirable.

The early 19th century plantations which have, or will acquire over time, characteristics of pasture woodland will undergo limited interventions to remove non-native species and inappropriate drainage systems. Small-scale, infrequent silvicultural management of the overstorey may improve the biodiversity of such stands and hasten the restoration to woodland more characteristic of the New Forest pasture woodland. Natural processes under Open Forest management are preferred, though after one or two such interventions, enrichment planting of typical native species in what can be monocultures of oak, may be acceptable with the agreement of Natural England.

The New Forest Inclosures Forest Plan will deliver the Restoration to Open Habitats of 290ha of conifer plantation within the Inclosures during the 10-year Plan period (2019-2029) and the conifer removal on Ancient Woodland Sites of 89ha. This contributes to the UK Government's (2017) 25 Year Environment Plan target of restoring 75% of our one

million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long-term.

Aim 2: Where the aim is to maintain or restore designated habitats which will remain within Inclosures

While a significant proportion of existing primary habitats will be returned to Open Forest management, inevitably there will be parcels which will remain trapped within Inclosures. The issues associated with management required to maintain heathland and pasture woodland habitats in favourable condition are described elsewhere. These apply equally to trapped parcels within Inclosures as to the Open Forest or those in private ownership. Grazing and in the case of heathland habitats, cutting and prescribed burning are essential components of management required to maintain favourable condition. Where grazing or burning are not sufficient or possible then cutting and harvesting programmes will need to be increased to maintain open habitats.

Hence, generic prescriptions offer a range of options to substitute for normal Open Forest management. Where possible all primary habitats should be subject to at least periodic grazing. The introduction of managed grazing regimes to certain Inclosures would be ideal. In the meantime, seasonal grazing where Inclosure gates are opened for a period of time over the year is acceptable. Commoners' stock will exercise a similar differential grazing pressure on such Inclosures as they do on Open Forest habitats and both stock and habitats will reap significant benefits. However, to be really effective, periods of summer grazing to gain control over *Molinia caerulea* in addition to winter grazing are to be preferred.

Where it is not practicable to introduce sufficient grazing management to maintain trapped habitats in favourable condition, then rotational cutting and harvesting programmes will have to be significantly increased to substitute for grazing and maintain open conditions.

Aim 3: Where the aim is to restore some 19th century broadleaf plantations to a semi-natural character, but to retain them within Inclosures

These are principally woodland habitats which are derived from broadleaved plantations of varying age mainly on ancient woodland sites. They have retained, developed or have the potential to develop the characteristics of semi-natural woodland. A range of generic prescriptions are given, the choice of which will depend upon the practicalities of implementation and detailed objectives for management. The over-riding principle is that the woodland will be actively managed towards a semi-natural broadleaf character. This means that a wide range of interventions may be desirable including structural diversification through felling and regeneration of broadleaved stands, or in some cases,

enrichment planting of characteristic species not currently present may be appropriate in agreement with Natural England.

The capacity exists within these Inclosures to generate conditions suitable for those groups (flora and fauna) which are not well represented under Open Forest management conditions, and which have declined within the Inclosures and in woodlands elsewhere this century.

Aim 4: Where the short-term aim is to manage mixed woodland of broadleaf and conifer within Inclosures

Over the next 30-50 years in mixed woodlands, the aim is to actively promote the retention of broadleaf through the gradual removal of conifer. The majority of these mixed woodland stands are on richer soils and therefore the gradual removal of conifer will make space for natural regeneration and if appropriate, planting of broadleaf with Natural England's Agreement to further the restoration of broadleaf woodland.

Aim 5: Where the aim is to maintain or restore ancient semi-natural woodland to favourable condition

These are fenced broadleaf semi-natural stands on ancient woodland sites within the SAC but outside of the Crown Lands. Subject to the removal of non-native species and restoration of inappropriate drainage systems, the precise management option followed depends very much on the detailed objectives for the individual site. No remaining sites are large enough to be managed under a policy of complete non-intervention. However, it may be appropriate as part of an overall management strategy. For example, Langley Wood would benefit from further deer reduction and some depasturing of domestic stock in areas rich in old growth, lichen-rich stands (e.g. OutWood). Loosehanger Copse would be more appropriately managed under a system of coppice with standards. Roydon Wood is currently under an ambitious scheme of wood pasture restoration, coppice, high forest management and non-intervention.

Issues related to forestry operations and woodland birds

The restoration over time to favourable condition of primary and secondary habitats within New Forest Inclosure woodlands requires targeted forestry interventions such as thinning and harvesting. The scale of the task, coupled with the water-retentive nature of the gleyed soils within many of the Inclosures means that the flexibility associated with year-round working is desirable. However, such forestry and woodland management operations have the capacity to disturb and destroy protected birds during the breeding season.

Potentially, the most disruptive aspects of forestry are felling and harvesting. Such activities are rotational, i.e. individual compartments are treated on a rotational basis over time (e.g. harvesting operations operate on a five-year cycle for conifer and 10-year cycle for broadleaves). In large woodland system such as the New Forest, actual disturbance is localised to discrete areas and much of this will be implemented outside of the bird breeding season. This means that the potential to impact on overall bird populations, particularly for widespread species, is limited. Careful operational planning should ensure that rare and specially protected species such as honey buzzard remain unaffected and hence the potential for forestry operations to become a nature conservation issue by affecting species at the population level is unlikely to arise.

However, all woodland owners and their forestry contractors are required to operate within the law with respect to wild birds.

Wild birds and the law

The primary legislation affecting wild birds in England, Scotland and Wales is the Wildlife and Countryside Act 1981 and its subsequent amendments. The basic principle of Part 1 of the Act is that all wild birds (with certain exceptions relating to wildfowl, game birds and pest species), their nests and eggs are protected by law. Some rare species are given special protection.

It is an offence to intentionally:

- kill, injure or destroy the nest of any wild bird
- take damage or destroy the nest of any wild bird while in use or being built
- have in one’s possession or control any wild bird (dead or alive) or part of a wild bird, which has been taken in contravention of the Act
- have in one’s possession or control an egg or part of an egg which has been taken in contravention of the Act.

In addition to this general protection, most rare breeding species listed in Schedule 1 of the Act are further protected by special penalties. For these species it is an offence to intentionally disturb any Schedule 1 species while it is nest building or is at, or near, a nest with young, or to intentionally disturb the dependent young of such a bird.

Exceptions

An important defence to any prosecution that might be brought is the exception that where the taking, damaging or destroying of nests has occurred inadvertently as an incidental result of a lawful operation by an authorised person (i.e. the owner or occupier or any

person authorised by the owner or occupier), no offence has been committed. All recognised forest operations are lawful and although these can be carried out in the nesting season and in areas where nests of common birds will perhaps be destroyed, the spirit of the Act is clear-the needless and deliberate destruction of nests with eggs and young is unacceptable and the onus is on the owner to carry out operations in a reasonably sensitive way. The position with regard to Schedule 1 species is slightly different in that intentional disturbance by anyone, including authorised persons, is an offence, but unintentional disturbance in the course of carrying out a lawful activity is not. Advice on planning to avoid disturbance is given below.

Woodlands and breeding bird densities

There is no such thing as a 'typical woodland bird community' and the densities and numbers of birds found in woods varies enormously. Bird census studies indicate that breeding bird densities in woods commonly range from 200-1,600 territories per square kilometre (Fuller, 1995). As a general rule the number of species present increases with woodland size. Also, the number of species and the overall breeding bird density increases as the trees grow bigger and the woodland stand becomes more mature. Bird communities are also richer in woodland habitats that have the greatest structural diversity. Young coppice stands and plantations at the thicket stage are the exceptions to these general rules as they support relatively high bird densities. Woods which contain the following characteristics are more likely to support high densities of breeding birds or species that are scarce in a local or national context:

- large old trees, particularly those with rot holes, cracks under the bark, or hollow trunks. (Such trees are also likely to be important for bats, lichens, fungi and saproxylic insects.)
- dense understorey (0.5-3m height range) of shrubs, coppice regrowth or bramble which provides the nesting habitat for many warblers and other small songbirds
- a predominance of native trees and shrubs with a mixed age structure
- pre-thicket conifer stands less than 15 years old, typically on ex-heathland soils.

Plantations which are less likely to hold high densities or bird species of concern tend to be the following:

- even-aged conifer plantations more than 15 years old. While old conifers can provide nest sites for rare raptors (e.g. honey buzzard), such species use broadleaved trees quite happily
- even-aged broadleaved plantations of between 20 and 60 years with little understorey or field layer

- even-aged lowland coppice of more than 15 years that cast a dense shade resulting in a poor understorey and field layer.

Planning to avoid disturbance to breeding birds

Most, if not all plantations will support some breeding bird interest. However, in the context of the New Forest Inclosures the following should be borne in mind when planning forestry operations:

- The risks associated with causing disturbance to breeding bird communities is highest in plantations which have evolved a more semi-natural structure and composition and lowest in those plantations of uniform even-aged conifer or young (20-60 year) broadleaf.

- In the early stages of restoration of heathland, from dense conifer stands, the risk of causing disturbance to breeding bird communities is low. However, as thinning/clearance progresses and conditions suitable for woodlark or nightjar evolve, the risk of disturbance to these species increases.

- The Schedule 1 species regularly breeding within New Forest Inclosure woodlands are honey buzzard, crossbill and firecrest. Honey buzzard may use nest sites in old conifer or broadleaved trees, while firecrest occur in a variety of broadleaf, conifer or mixed stands. Crossbill favour spruce crops in conifer plantations and are a species subject to periodic irruptions coinciding with spruce crop failure in the boreal forests of northern Europe.

- The main breeding period for most woodland birds is March to August inclusive. However, crossbill may nest in January and firecrest may extend to the end of August. The great majority of resident species lay first clutches (which are generally the most important) in April and May, while summer visitors generally lay their first clutches in May.

- Warm winters and early springs may lead to birds breeding earlier than usual. Conversely, poor spring weather could lead to later nesting or poorer productivity from first broods.

Major operations within ecologically rich areas should take place outside of the main bird breeding season, which is March to August inclusive. Where this is impracticable (e.g. due to poor ground conditions) then it is strongly recommended that preliminary bird survey be carried out to locate nest sites. Where a Schedule 1 species is located then an effective and appropriate disturbance-free zone should be established around the nest. Disturbance-free zones are recommended by the RSPB/Forest Authority (now

Forestry Commission) in their publication *Forests and Birds* (1997), e.g. for honey buzzard between 200 and 600 metres and for crossbill 50 and 100 metres depending upon the stage in the breeding cycle.

Generic prescriptions and rationale for Inclosure habitats

The guidance below reflects current strategic direction and policy.

Where the management objective is to maintain or restore designated habitats to favourable condition and return them to Open Forest management then the following generic guidance is applicable:

The following describes the immediate works, follow-up work and maintenance works required to successfully restore SAC habitats from wooded Inclosure stands. The prescriptions are purely generic. Precise operations will be subject to detailed site planning and site characteristics by the land manager. Where useful a short evidence-based rationale is given for each prescription.

There may well be a variety of habitats to be restored in any particular Inclosure. For example, it may be predominantly dry heath, but with a valley featuring remnant mire or seepages and a stream with some remnant riverine woodland. In such a case refer to the individual generic prescriptions and incorporate them into the final planning/restoration scheme document.

It will often be the case that having completed a restoration scheme and reinstated grazing, a mosaic of SAC habitats will emerge over time embracing heath, lawn and wetland with scattered woodland and scrub emerging subject to stock grazing and deer browsing intensity.

A. Dry heathland restoration

Where the agreed policy in the New Forest Inclosures Forest Plans is to remove tree cover and restore to heathland then the following generic prescriptions should be followed.

Immediate works

The plantation trees should be felled, and the arising timber extracted from the site. Any broadleaved trees growing within the plantation should similarly be cut and extracted for sale to the timber markets. Any *Rhododendron* or other non-native invasive species must

be cut and stump treated with appropriate herbicide as appropriate. Brash may be burned on site or removed for biofuel.

If the remaining brash is extensive, then it will impede the rate of heathland recovery. Historically on most sites the brash was raked and burnt on site.

Each clear-fell is different and consideration will need to be made as to whether the residual stumps and occasionally ridge and furrow (i.e. former plough-lines), represent a significant hazard to future management. For example, will the stumps and undulations be hazardous to the safe management of depastured livestock or to the safe management of the restored habitat through subsequent use of machinery (principally tractors). Forestry England aims to manage restored heathlands in a more sustainable way, by utilising the arisings. This only can be done if ridge and furrow are removed.

Where it is considered unnecessary to remove stumps or plough lines, then over time stumps will rot away and plough lines will eventually erode as grazing animals use the site. However, if funding is available and it is seen as a priority to remove stumps and plough lines, then it will help to speed the recovery of the heathland habitat. The consequent release of nutrients from disturbing the soil profile will encourage the regeneration of native and non-native tree seedlings and may encourage the spread of bracken which will require treatment as below. But the soil disturbance will also expose heathland propagules which various studies have shown can lie dormant for 40 to 70 years under conifer plantations. The disturbance is therefore an important factor in heathland restoration as it can bring buried heathland seeds to the surface and expose them to the light needed for germination.

A decision tool has been developed to guide whether a site requires stump reduction or removal and/or reprofiling of plough lines.

Any drainage ditches must be infilled with available material from the site (e.g. logs, brash and spoil) depending on the scale of the drainage. If the site is to be restored to heathland with wetland attributes (seepage steps, mires streams etc) then particular care needs to be taken and planners should refer to restoration of wetland habitats described in this chapter.

Follow-up works

It is likely that further interventions will be required for a period of about five years. These interventions must remove any regeneration of conifer or broadleaved trees. If the site was bracken invaded to begin with then it is likely that the bracken will recover and become dense if left untreated. Options for control of bracken include an annual cut (where the site allows) or alternative treatments including methods for bruising stems, or the targeted use of a suitable herbicide. It should be noted that research in northern heathlands has shown that, over time annual cutting is as effective in controlling bracken as treating with herbicide (Vandvik, 2008).

Maintenance

The site will be returned to Open Forest management where normal practice to maintain heathland will operate—grazing, with additional cuts and prescribed burns as needed.

B. Wet heathland restoration including seepage mire and valley mire

Immediate works

Map areas of wet heath, valley mire or individual remnant seepage mires or springs including artificial drains.

Aim to keep heavy machinery off the wettest areas if possible but do remove as many trees as is practical. Any trees which have to be left in any extensive mire will fail in time as water levels and hydrology are restored.

The plantation trees should be felled and the arising timber (and where possible brash), extracted from the site. Any broadleaved trees growing within the plantation (e.g. birch, beech or oak), should similarly be cut and extracted for sale to the timber markets. Any *Rhododendron* or other non-native invasive species must be cut and treated with appropriate herbicide.

Any *Rhododendron* or other non-native invasive species must be cut and arisings removed from the site. With appropriate herbicide undertake follow-up treatment of stumps and foliar spraying in correct seasons.

As previously described, where possible the conifer clear-fell operation will also have removed the majority of the brash material. Depending on how wet the site is it may cause least disturbance to leave any remaining harvesting brash on site to decay over time.

With the site cleared it will be possible to more accurately assess the state of any drains and channels which remain after harvesting. Minor channels may well have been infilled with forestry debris and can be left. Major channels however need a more considered approach and should be restored in accordance with the New Forest Freshwater and Wetland Habitats Restoration Strategy or subsequent strategic plans. The aim is to maintain the core of any existing mire habitat—even if it is heavily dominated by *Molinia* at present, then any drains leading from the mire remnant to the respective stream course should be infilled. The materials used for infilling these drainage channels will vary between sites but will include one or more of the following:

- remnant spoil heaps from drainage activities
- brash and log material from the clear-fell

- imported clay and hoggin
- staked heather bales
- brushwood faggots
- live willow or alder material.

These materials and the respective methods for employing them in restoration projects will vary in response to a range of considerations including:

- presence of available materials on site
- accessibility of the drain for importing materials
- angle of slope
- drain bed substrate
- presence of livestock.

The New Forest Freshwater and Wetland Restoration Forum brings together interested parties to agree all aspects of wetland restoration for the remaining damaged sites across the Forest. The methods employed continue to evolve and to be reviewed and detailed information about successful restoration practices can be sought through this Forum or subsequent strategic plans.

Follow-up works

It is likely that further interventions will be required for a period of about five years. These interventions must remove any regeneration of conifer or broadleaved trees. Some adjustments to soakways may be needed to ensure hydrological function is restored, especially if run-off is becoming erosional. Seepages along spring lines may need some further interventions to ensure they are holding water, becoming colonised by typical native species and not eroding.

Maintenance

The site will be returned to Open Forest management where normal practice to maintain wet heathland will operate—grazing, with additional cuts and prescribed burns as needed. Some maintenance of soakways may be necessary if run-off becomes erosional.

C. Stream restoration and the associated floodplain

Since the mid-19th century most Inclosure streams have been over-deepened and straightened in order to move water as quickly as possible off site to allow timber production to be maximised. On the floodplain this has included the use of differing styles of lateral drains including ‘chocolate-block’ style drainage. During the 20th century many of these

drains and the main watercourse have also been culverted along access tracks and rides across the floodplain.

The aim is to restore the stream flow to the historic, natural channel with a stream bed at the natural level. For most Inclosure streams the remnant meanders are present and the natural bed level within them can be readily found when scraping away the accumulated leaf litter and sediment down to the former gravel streambed. In tandem with the restoration of the flow to the natural stream course is the infilling of the existing drain so that a functioning floodplain can also be restored.

Immediate works

Prior to any works, the floodplain should be surveyed for signs of the original water course. Old meanders, oxbows and spoil heaps should be identified and the original channel accurately mapped. Any areas of deep erosion where channel deposits have been washed away should be noted and estimates of quantities for imported material to infill made.

Any conifer plantations should be removed entirely from the floodplain and taken off site. Any *Rhododendron* must be removed and the stumps treated. Stands of native broadleaf may be left though it may be preferable to coppice any willow stands to make access easier. Alder swamps and linear stands of alder should be retained their root system provide a natural structure which binds Forest subsoil (drift material) and halts erosion in the channel and on the floodplain.

The priority is to gain access to restore the channel. The balance and composition of streamside native broadleaves will evolve over time as the restored system becomes established and hydrological conditions stabilise. Some broadleaved species will thrive, others more adapted to drier soil conditions will fail and become useful dead standing wood resource.

If there is sufficient material on site to restore the channel depth and width, then use spoil from original and maintenance dredging of the stream bed to backfill the channel. Old meanders will be dredged, and material backfilled into straightened sections.

If the channel has become very deep in parts as erosion has removed the bed material, then new infill will need to be brought in to help with the realignment and channel infill. The use of occasional clay bunds in the infilled straightened channel will stabilise the system and aid recovery.

With the site cleared of some trees it may allow improved assessment of the existing main drainage channel and the natural remnant meanders. The removal of some trees also allows a better assessment of available material on site (drainage spoil banks).

The materials used and the associated methodology for infilling the main drainage channel and restoring the meandering system will vary between sites. Typically, natural meanders would be prepared by excavating the layers of soft sediment overlaying the natural stream gravels and stockpiling this material on site. Clay plugs would be compacted into the drainage channel to deflect stream flows down the meandering course. Gravels and sediments from the drainage channel (with associated flora and fauna) would be transferred to the meandering channel. The redundant drainage channel can then be infilled with suitable materials including imported clay, hoggin and adjacent bank spoil, to the level of the surrounding floodplain.

In addition to addressing the restoration of the main watercourse, all artificial drainage channels on the floodplain should also be infilled (level to the surrounding land). By infilling all lateral drains and ‘chocolate box’ drains on the floodplain, when in spate the restored stream will successfully occupy the whole floodplain.

The experience and understanding of the application of materials in Forest streams continues to grow. All works should be undertaken in accordance with the New Forest Freshwater and Wetland Habitats Strategy or subsequent strategic plans.

Follow-up works

It is likely that further interventions will be required for a period of about five years. These interventions must remove any regeneration of conifer or non-native species. The reinstated channel should be surveyed for signs of instability and any erosional points noted and addressed if significant.

Ideally out-of-bank inundation in winter and times of high rainfall should be apparent as the system recovers to a working floodplain. Natural debris dams should be left to accumulate material and aid natural functioning of the stream, provided there are no overriding issues affecting stability of the restoration, flooding of property or infrastructure or concerns about health and safety of the public.

Maintenance

When the restored stream has become stable and the hydrological function of the floodplain restored there should be little need for further physical interventions. Over time the stream will evolve subject to changing environmental conditions.

Where possible grazing should be reinstated and the floodplain will eventually settle into a mosaic of quintessential New Forest habitats embracing riverine woodland, grassland and heathland depending on soil type and underlying geology.

D. Ancient and Ornamental (A&O) woodland restoration

Where the agreed policy in the Forest Plan is to restore trapped A&O woodland then the following generic prescriptions should be followed:

Immediate works

The priority in restoring trapped A&O woodland is to get Open Forest grazing back into the woodland. This will mean careful realigning of fences or entire fence removal to allow depastured stock back into the woodland, in a continuum with the Open Forest.

Any felling of non-native species will need to carefully be considered and implemented to ensure mature and veteran trees do not rapidly become exposed to prevailing winds. This will be applicable both at a detailed level when haloing individual trees (a practice that is currently under-used), as well as at a macro level where clearing blocks of conifer immediately adjacent to A&O woodland. Consideration will also need to be given to prevailing soil conditions to ensure damage by forestry machinery is minimised. Any *Rhododendron* invasion must be cut, removed and stumps treated.

Where holly stands have become dense and are blocking light from ancient beech or oak, then they should be pollarded/coppiced following the same prescription as for pasture woodland (refer to pasture woodland section of this document).

Follow-up works

Having removed as much of the non-native plantings or regeneration as possible it will be much easier to assess the state of the A&O in terms of its overall components and where it is deficient. It is likely that substantial pieces of dead standing and fallen wood will be in short supply. In this case fell any dense birch regeneration maybe leaving older specimens to live out their life cycle. Forestry England is committed to increasing dead wood provision both in accordance with their dead wood policy and compliance under the UK Woodland Assurance Scheme (UKWAS) which independently accredits sustainable woodland management. (Note it is the habitat quality of fallen and standing dead wood that is important as well as the overall extent. Arisings from conifer felling are generally too small to be significant. A 500-year-old standing dead oak provides habitat for multiple generations of successional organisms.)

Maintenance

The key is to allow sufficient light and space to allow for the natural regeneration of the ancient woodland using the mechanisms of extensive grazing and native tree regeneration through fallen branches, bramble/scrub and old fallen trees.

E: 19th century oak plantations

The enclosure and planting of forest habitats in the 18th, 19th and 20th centuries are described elsewhere. Successful restoration of the 20th century Inclosures, largely on heathland sites, is well underway. The 18th century oak plantations have diversified over the centuries and are now largely indistinguishable from ancient pasture woodland. The 19th century oak plantations however remain somewhat uniform and species-poor compared to the old growth pasture woodlands elsewhere.

Sanderson (2007) has examined the fragmentation of former old growth pasture woodland caused by the oak plantations and argues that restoration of key areas of the 19th century plantings to Open Forest management, thus linking up these sites with current old growth pasture woodland will do much to restore the old growth lichen communities over the next 100 years or so. While there are occasional veteran trees within these plantations and the younger oak, there is not a continuity of ages to supply new veteran trees as the current ones die off. There is an age gap. However, large scale colonisation starts shortly after 200 years (Sanderson, 2007) and some of these plantations have reached this age and are beginning to support old growth lichen species.

There is also little in the way of diverse habitats under the uniform stands. Some selective enrichment planting of hazel understorey and other species characteristic of the New Forest native woodlands may be beneficial in these circumstances and should be agreed with Natural England.

As evidenced by the 18th century stands management interventions are not necessarily required to diversify these oak plantations. Given sufficient time and if left alone, the stands will diversify as trees grow older and gaps begin to develop naturally following senescence, disease or storm events. However, given the age gap, fragmentation of old growth pasture woodland and the vagaries of climate change some light interventions would help to break up the monocultures and hasten the diversification and ecological robustness of these stands.

If it is decided to intervene in some of these 19th century oak stands then the following generic prescriptions should be followed:

While individual detailed plans will need to be drawn up for each particular stand to take account of existing interest features—particularly developing lichen communities or grazing-sensitive insects, the following generic prescriptions should be applied where the objective is to diversify stands and reduce the fragmentation of the old growth pasture woodland stands in part caused by the original 19th century plantings.

Diversifying habitats within uniform stands can be achieved with selective felling of oak to allow sufficient light to enable ground vegetation recovery. The aim should be to create or

further develop small glades of between 0.2-0.75ha in extent and a maximum of six to eight glades per 10ha of woodland. Some enrichment planting, particularly of lime and hazel and on richer soils, *Chalara*-resistant ash (if it becomes available), would be of immediate benefit. After these initial interventions, review in 20 years to see if further felling is likely to be beneficial. If the area is not regenerating naturally, consider further enrichment planting with native species. All enrichment planting should be agreed with Natural England.

All fallen and standing dead wood should be retained. Where this resource is lacking then some 20% of felled material (as part of the glade development), should be left in situ. The removal of fencing and reinstatement of domestic stock grazing will maintain and further diversify these open formative glades created by felling.

Any significant, artificial drainage channels should be infilled using logs, bank spoil and brash. This disruption in drainage will locally alter the water table and may lead to standing dead and dying trees which will further develop the dead wood resource and allow light to the woodland floor with associated habitat development in sheltered glades.

The removal of fencing and reinstatement of domestic stock grazing will maintain and diversify these formative glades. There will be no need to diversify the woodlands with further tree or scrub planting. Scrub growth will regenerate with sufficient light and around fallen trees and seedlings will regenerate a more diverse tree population over time. Continued deer management will also be required to achieve this regeneration.

E1: Developing pasture woodland from conifer plantations on felled ancient woodland sites

These are sites where conifer was planted on felled ancient woodland sites. It also applies to those sites where old growth woodland was lost to navy felling in the 17th and 18th century, possible sites being enriched bracken stands bordering existing pasture woodland.

Restoration will require natural regeneration under Open Forest management conditions. There may be a need to remove non-native regeneration and ultimately some species enrichment using hazel for example.

F: Grassland restoration including ‘lost lawns’

Most species-rich grassland which has been planted with conifers will not survive the intensive commercial forestry cycle. However, grassland will recover as part of the overall Open Forest mosaic of habitats once tree cover has been removed and grazing reinstated. Over time it will diversify into any of the semi-natural grassland types described in the Management Plan depending on hydrological and soil conditions.

To restore grasslands follow the prescriptions set out in point B ‘Wet Heathland Restoration’ above—including seepage mire and valley mire.

Where the management objective is to maintain or restore designated habitats which will remain within Inclosures then the following generic guidance is applicable:

Undertake restoration and maintenance works as set out in the relevant paragraphs in the section above (where the management objective is to maintain or restore designated habitats to favourable condition and return them to Open Forest management) for dry heathland, wet heathland, streams and their floodplains, A&O woodland and grassland including lost lawns.

To complete restoration or to maintain favourable condition

Designated habitats trapped within Inclosures should receive at least periodic grazing by commoners’ stock if possible.

Where periodic grazing by commoners’ stock is possible

Allow unrestricted access to commoners’ stock by temporarily removing Inclosure fencing or throwing open gates. (Suitable where significant areas of designated habitat remain trapped within Inclosure.)

Where periodic grazing by commoners’ stock is impracticable or insufficient to maintain open habitats

Implement rotational cut and burn maintenance programmes to maintain open habitats, following generic guidance for corresponding Open Forest habitat.

In these instances, the priority for the 20% permanent open space should be those areas containing designated heathland habitats. However, it must be noted that over time heathland habitats treated in this way in the absence of Open Forest management will not become favourable.

In some instances, it may be beneficial to accept an alternative woodland management regime, which on a specific rotation (short-rotation coppice or 120-year shelterwood providing it is done a sufficiently large scale), will produce significant areas of temporary open space. The benefits of this in producing successional light and dark phases of woodland cover are significant for flora and fauna. Such management will also favour light demanding species such as oak which will not do well under woodland systems which do

not produce significant areas of light temporary open space. In this regard selection felling will favour regeneration of beech over oak and should therefore be used sparingly.

Where the management objective is to restore some 19th century broadleaf plantations to a semi-natural character, but to retain them within Inclosures then the following operations are likely to be required

Restoration works

- Removal of non-native species.
- Restoration of topography and drainage channels to pre-Inclosure pattern, or removal of drainage channels as appropriate.
- Treatment of native species as required e.g.: thin stands, retain fallen and standing dead wood, widen rides, manage bracken and scrub to produce structured vegetation suitable for faunal interests.

Maintenance

Where possible allow unrestricted access to commoners' stock by temporarily removing Inclosure fencing or throw open gates, this may be seasonal.

In the absence of commoners' stock grazing, rotational cutting programmes will need to be implemented to maintain 20% permanent open space in glades and rides and to create suitable conditions for woodland flora and fauna which are intolerant of grazing.

Woodland management

The precise silvicultural techniques to be adopted in each stand can be varied according to conditions and the state of the crop, provided the following principles are adopted:

The aim is the maintenance, recreation or restoration of a native broadleaf woodland.

Natural regeneration is to be favoured. Failing that, other techniques (e.g. sowing of locally collected seed or planting), can be considered. Note that where regeneration fails to produce a native cover then such areas might best contribute to the 20% permanent open space.

Removal of the overstorey should be targeted on existing areas of broadleaf regeneration.

Some stands should be put into coppice or coppice-with-standards, but these will be very limited in the Crown Lands.

Any existing veteran trees should be retained for their standing dead wood habitats.

Existing standing and fallen dead wood will be retained (subject to health and safety considerations).

Ground disturbance during extraction and other operations should be kept to a minimum. Restore the site to its former condition, so far as is reasonably practicable, if any damage does occur.

Rides should be kept open and managed as permanent open space.

Where the management objective over the next 30-50 years in mixed woodlands is to actively promote the retention of broadleaf through the gradual removal of conifer

The term mixed woodland covers a range of stand types embracing varying proportions of conifer and broadleaf, often also of varying ages within the stand. Because of the complexity, each stand will require an individual plan, but one which ultimately reduces the proportion of conifer at each thinning intervention (ultimately to arrive at a stand of pure broadleaf over one or more interventions).

Restoration works

- Remove conifer at maturity.
- Inevitably some broadleaf will need to be cut and extracted in order to achieve the conifer felling.
- Treat conifer regeneration accordingly (for example brush-cutting, mowing, mulching).
- Use site-specific measures to encourage natural regeneration of broadleaf (e.g. scarifying, deer exclosure fencing).
- Promote species and age diversity over time in accordance with UK Forestry Standards (UKFS).

Where the management objective is to maintain or restore ancient semi-natural woodland to favourable condition, on non-Crown Land sites (e.g. Langley Wood, Whiteparish Common), the following are likely to be required

Restoration works

Removal of non-native species.

Restoration of appropriate hydrological regimes, through treatments or removal of inappropriate and/or damaging drainage channels.

Maintenance

Management by coppice, coppice-with-standards, high forest rotations or non-intervention depending upon site conditions, character and detailed management objectives.

Reintroduce domestic stock grazing in old growth stands rich in lichen communities while continuing to focus on reducing deer populations.

Climate change

Climate change will have an impact on Inclosure woodlands as in other habitats elsewhere. Some species will benefit from higher summer temperatures and wetter, warmer winters and some will struggle with the changing conditions.

For further information please refer to the generic climate change section in Part 2 of the SAC Plan and more specifically in Part 3 under the sections on pasture woodland and heathland.

Storm event

Within the pasture woodland section of this document, the issues arising from a major storm event and the associated prescriptions have been discussed. However, such a storm event would obviously also have significant implications for woodlands within the Inclosures and so the following provides guidance on management in the aftermath:

- For trapped A&O follow the same prescriptions as outlined in the pasture woodland section of this document, with the principal objective of minimum intervention wherever possible.

- Where the Inclosure Forest Plan has identified stands of planted broadleaf woodland (e.g. 19th century oak) to be managed to develop into old growth broadleaf, the prescriptions in the pasture woodland section of this document should again be followed.

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