

University of Wales Trinity St David

Riverine Habitat Management at Colby

GIS and Habitat Management

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Introduction

History

Colby Lodge was built in 1803 by a local mine owner, John Colby, who as Lt Col of the Pembrokeshire militia saw off the 'Last Invasion' of Britain when the local militia repelled the invading French forces at Fishguard in 1797. At this time, Pembrokeshire coalmining was in its heyday, having begun in Tudor times, before later being eclipsed by the industrial scale of operations in the South Wales valleys.

The estate ownership went through several families but it was from the early 20th century under the stewardship of the Croslands that the development of woodland gardens was begun and for which Colby is known today. In 1965 the estate was split with Colby Lodge and the walled garden being sold to Pamela and Peter Chance and the wider estate and woodland garden being retained by the Crosland's descendent Elidyr Mason until her death in 1979 when it was bequeathed to the National Trust (NT). The Chances also transferred ownership of the estate to the NT with a legacy around the same time. The wider estate and house were now back in single ownership with the NT leasing out the Lodge and Walled garden to the Scourfield-Lewis who created the formal design within the walled garden and commissioned the gazebo within it. At the end of their tenancy the walled garden was returned to the Trust's care with only the lodge and its immediate vicinity remaining as a private house.

Location

The 900-acre (364 hectare) Colby estate is in South Pembrokeshire near Amroth and part of it lies within the Pembrokeshire Coast National Park. The area under direct management of the NT is made up of semi-natural woodland (approx. 50 hectares) and Colby Woodland Gardens (3.5 hectares), all of which are open to the public. The surrounding countryside as shown in Map 1 is dominated by intensively managed farmland, mainly improved grasslands for grazing and silage, with some arable.



Figure 1: Aerial View of Colby estate within wider landscape

Geology and Topography

The geology and topography have played a central role in the development of the site, the geology created a centre of coalmining and provided the wealth to pay for the enhancement of the estate. The estate sits on the South Wales coalfield and remnants of its coalmining past are visible to this day; including the route of the tramway once used to ferry coal trucks to the coast and runs through the grounds to the beach at Amroth which is now used by walkers; as well as disused mineshafts throughout the site.

The bedrock has led to the creation of neutral/acid soils which has influenced the planting of the site and enabled the planting of ericaceous plants, such as *Rhododendron spp.* and *Camellia spp.*, within the garden for which it is now famous.

The topography has helped protect the wooded valleys from being converted to pasture and the historic management to support local industries and its demand for oak for pit props and shipbuilding, led to the dominance of the sessile oak (*Quercus petraea*) throughout the woodlands.

The landscape is centred around two steep-sided valleys whose streams meet within the formal gardens near the Lodge. The steep-sided valleys have made the site increasingly vulnerable to flooding and water erosion in recent times.

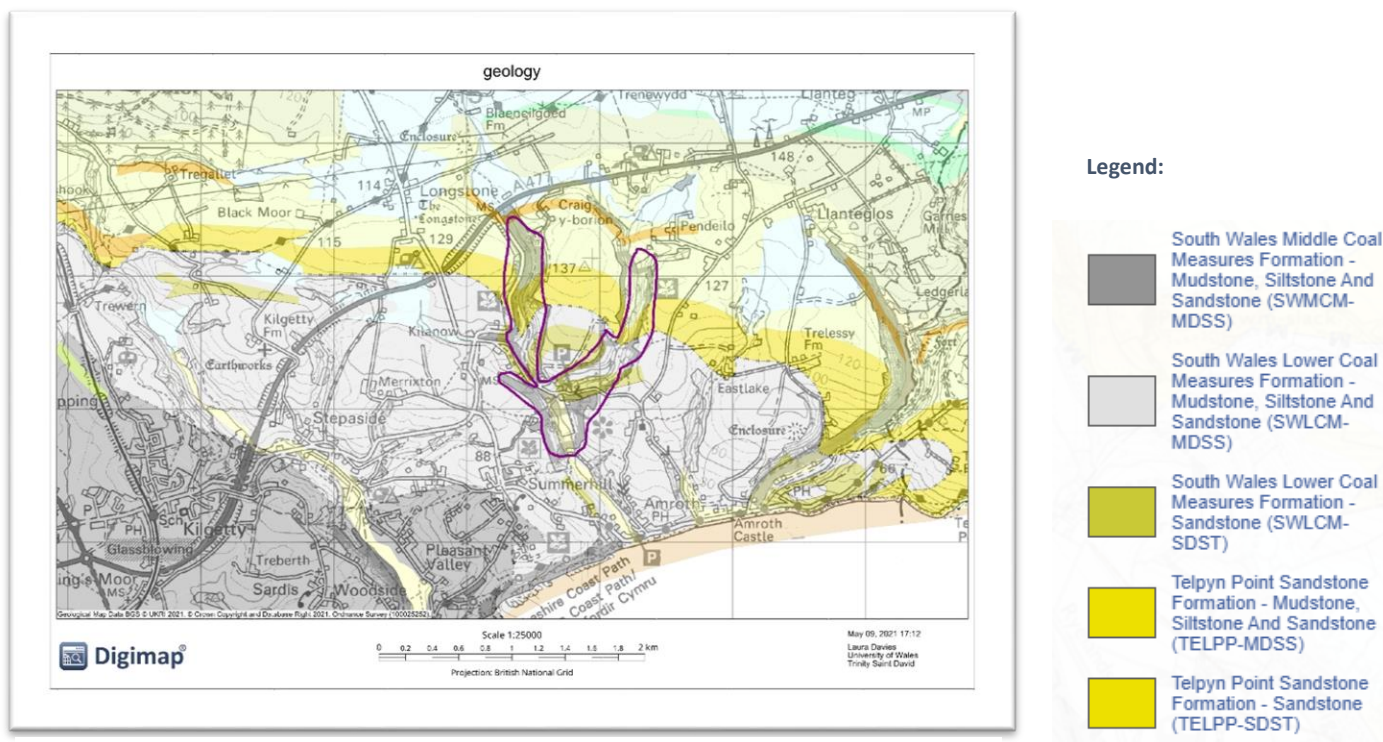


Figure 2: Map showing local geology and South Wales Coalfield

Strategy, Policy and Management

The National Trust has managed this site for 40 years and it receives circa 50,000 visitors per year. Its most recent strategy document running until 2025, **Nature, beauty, history. For everyone, for ever**, puts the environment and nature at the centre of decision-making with a focus of habitat protection and restoration and commits the National Trust to becoming carbon-neutral by 2030.

There is no single management plan for the Colby estate. Most of the 900 acres are farms and farmland leased out by the Trust with environmental conditions attached and overseen by the regional estates manager with input from the Head Gardener, who is responsible for the areas covered by this report with support from three gardeners and volunteers. Because the site is downstream of land that is overwhelmingly farmed, poor agricultural practices such as lack of soil cover during winter; use of excessive inputs; extraction of water from watercourses; runoff from fields all have the potential to impact negatively on the site and its habitats, by driving the eutrophication and silting up of waterways.

Access was provided to a Grassland Management Plan, a Conservation Land Management Plan which covered Craig Y Borion and Little Craig Y Borion Woods and the Head Gardener was interviewed to capture management strategies not formally written down. Site management decisions are driven by a desire to improve biodiversity, the creation of new habitats and the elimination of inputs such as herbicides, pesticides and fertilizer. Herbicides have only been used for the stem-injection of unwanted *Rhododendron ponticum* in recent years. One of the biggest challenges facing the team at Colby is the increasing incidence of flood events over the last 15 years. They now contend with seven or eight major flood events per year where the streams break their banks and inundate the valley floors and meadow.

There is a lack of regular monitoring and surveying. Currently, volunteers from the Rivers Trust count river fly numbers and another volunteer counts meadow flower species in the summer months, otherwise the site is dependent on ad hoc offers of surveys from partner organisations and local ecology groups. In the past several bat species, otters, owls, reptiles, etc have all been surveyed and found at Colby.

In response to the Covid-19 pandemic, the National Trust was impacted by estimated losses of £200 million and a need to make annual savings of £100 million going forward which has resulted in over 500 redundancies nationally. At Colby this will change the way access to the site is managed. There will no longer be ticketed entry sold through the small shop (this has been closed) instead there will be a ticket machine within the carpark, charging per car. The upper carpark which has historically been used by local dog-walkers using tracks in the woods and has always been free access, will also charge for car-parking which undoubtedly will cause resentment. The response will be that existing users of the woods should join the National Trust to enjoy repeat free access to the estate and contribute to its maintenance. The change in admission structure will also potentially impact on visitor numbers and could broaden the demographic of visitors. Only paying £5 for parking will mean a cheap day out for a family compared to previous admission fees but from personal experience of working in paid and unpaid gardens and parks, very often visitors take greater care and have more respect for venues that they have paid a significant fee to enter. It will be interesting to see how the change in admission structure impacts on visitor numbers and demographics and their impact on the maintenance of the site.

Habitat types and features

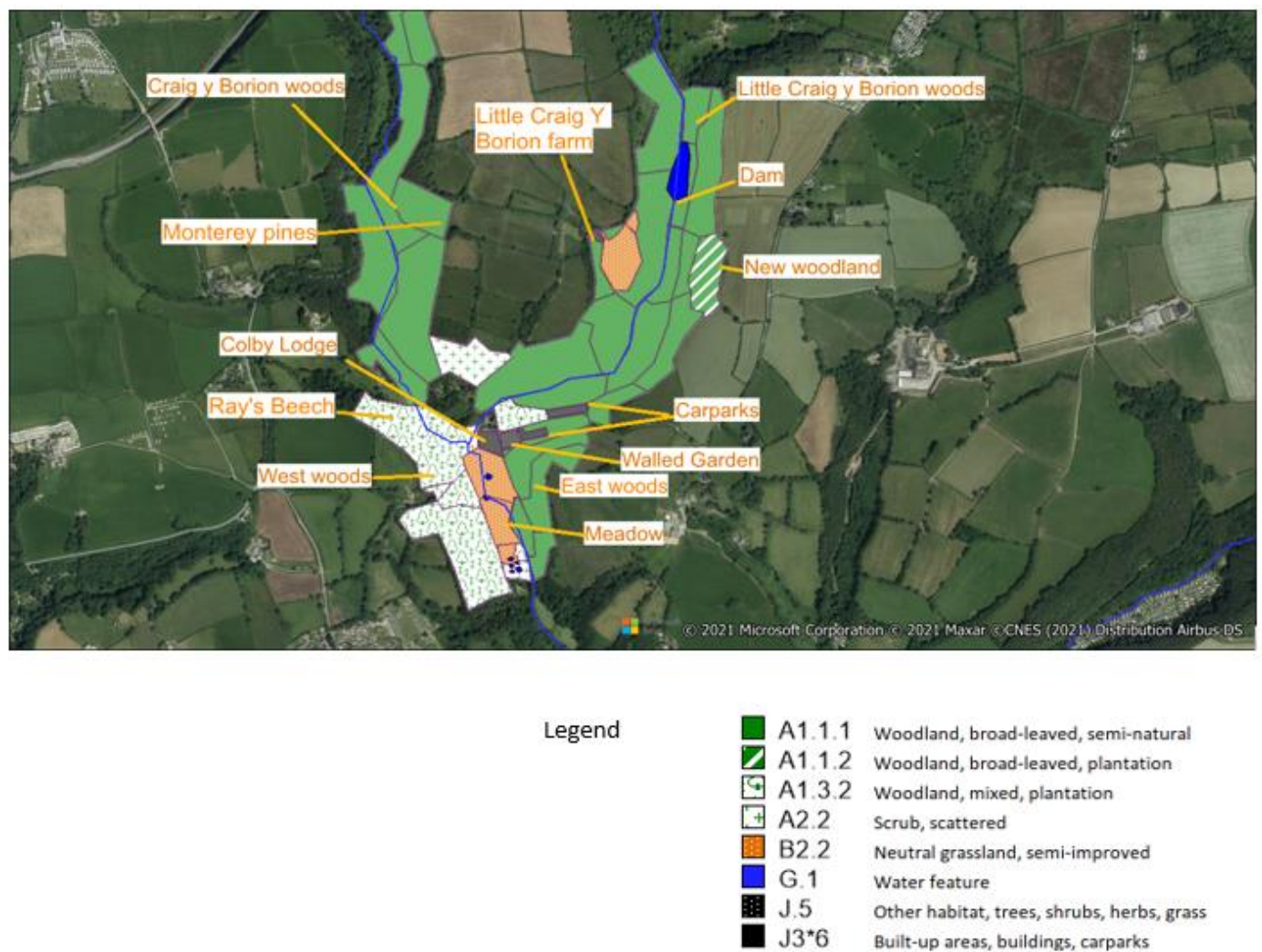


Figure 3 Aerial Overlay showing habitats and features at Colby

Semi-natural woodland

Semi-natural woodland is found in Craig Y Borion (CYB), Little Craig Y Borion (LCYB) and the East Woods (EW) (Figure 3) and has been managed for centuries, initially for oak for the charcoal, coal, and ship-building industries. Following the deforestation due to the demand for wood during the two World wars, the newly created Forestry Commission drove a strategy of planting fast-growing conifers to quickly replace woodland areas. Sitka spruce, Japanese larch, Douglas fir, western hemlocks, Scots pine, Monterey pine, western red cedar were all planted at Colby throughout areas previously dominated by oak coppice at the expense of native hardwoods.

Under the “Better Woodlands for Wales” scheme in 2011 the NT began a programme of management to convert all of the conifer plantations on ancient woodland sites back to native woodland through a combination of thinning and clear felling, removal of invasive *Rhododendron ponticum*, improved tracks and paths for management and public access and replacement of boundary fencing. Virtually all the conifers have been removed except for a patch of prominent Monterey pines on a ridge halfway down CYB wood and a patch of European larch at the southern edge of the meadow, at the base of EW. Following the removal of firs, the woodlands are being allowed to naturally regenerate both by necessity due to resources but also design as there is already good regeneration of oak, ash and birch seedlings. This also means that genetically the trees will be of local origin and adapted to the climate compared to nursery-grown saplings.



Photo 1: Typical oak grove in CYB wood showing narrow age profile (NT)

Concern / Attribute	Status	Current management	Critique/Comments/Improvements
Invasive Species – <i>Rhododendron ponticum</i>	Found throughout the wood. (Photo 4)	Eradication where found. Digging out/cutting down and stem injection with herbicide. Use of working parties/volunteers and staff.	The <i>Rhododendron</i> removal is an ongoing battle. It is also a host of the disease Sudden Oak Death <i>Phytophthora ramorum</i> .
Non-native tree species	Occasional sycamore trees with some seeding but large numbers of beech and conifer seedlings. An exception is made for a dense plantation of poor-quality beech known as Ray's Beech at the south of CYB wood near the Lodge.	Retain occasional older sycamore and beech where present. Removal of beech and conifer seedlings. Leave Ray's Beech largely alone as is an historic anomaly.	Dense stands of beech and conifer regen can crowd out under-storey plants. Sycamore can provide similar lichen habitat as a replacement to ash. Could consider thinning to allow beech to mature and open up the canopy to increase diversity in the under-storey. However, locally where the edges of crowded beech plantations are exposed, they tend to go down like dominoes due to the strong prevailing winds although Ray's beech is on the protected side of the valley.
Tree diseases	<i>Phytophthora</i> is present at Colby exacerbated by the spread of <i>R. ponticum</i> .	Removal of Japanese larch which is very susceptible and <i>R. ponticum</i> .	Important to use bio-security measures when clearing infected plants, such as disinfecting tyres, boots and tools and burning plant material where practical, to not spread the disease to other areas. Young trees most affected. Important not to

	Ash die-back also present.	Removal of severely affected trees in public areas.	remove all ash because there will be genetically tolerant individuals. Isolated specimens less susceptible and removing leaf litter surrounding diseased trees can slow down spread.
Age structure	Lack of very old specimens, oak coppice of around 50-60 years old but good regeneration of oak, ash and birch seedlings.	Identifying future specimen/veteran trees to protect from crowding	Very uneven age profile which only time can improve (Photo 1). Important to identify and clear around potential veteran trees throughout the woodland.
Canopy Structure	Mainly oak and birch with some ash. Some areas of clear fell are dominated by birch or bramble with little or no oak seedlings.	Replanting of oaks where missing from regeneration.	Planting acorns collected on site in more open areas or growing on collected acorns to saplings where the vegetation is thicker rather than introduce non-locally provenanced material.
Dead wood	Increasing levels of deadwood in coppiced areas although severely lacking in areas that were clear-felled. (Photo 4)	Leaving all fallen trees and branches and standing dead trees except where hazardous.	Extremely valuable habitat for birds, invertebrates, lichen and fungi but also vital for increasing carbon content and health of soils, improving soil biodiversity. There is a need to inform the public of this strategy because they are used to seeing 'tidy' woods and will assume that the woods are neglected.
Extent of wooded areas	An area of new woodland was created approx. 15 years ago on improved grassland to join up existing woodland. (Photo 2) Mixed plantation of oak and ash with pockets of hazel, birch, field cherry, crab apple. The condition of the oak and ash is poor, with the ash especially suffering from squirrel damage.	Leave alone for 20 years and review. Significant additional native tree planting has taken place along field boundaries on slopes to expand existing woodland. Resulting protected re-gen more successful than planted trees.	The trees have struggled to establish in a very thick and vigorous sward with significant losses. The field slopes and is wet at the lowest point and did not seem to have been planted with willow and alder. Most ash and oak have lost their leader which suggests they are never going to make good specimens. Maybe a better approach would have been planting a majority of birch and hazel (or adding now to replace losses) which have thrived and later adding oak and ash seedlings. New areas protected from livestock gives natural re-gen a chance.
Paths/Access	The main stone track in LCYB runs alongside the stream and is increasingly being flooded each winter. All unsurfaced paths suffer from either flooding or waterlogging. Steps on steep rises made from compacted soil and stone behind pinned logs.	Replacement of log steps when rotted but otherwise little maintenance. Given up replacing stone on main track because of frequency of flooding. On steep tracks some scraps have been dug to hold back water and slow water running	This area is primarily for walkers and dogs and does not receive the footfall of the garden areas. This is a natural habitat and there is not the same expectation for clean and level path surfaces. Good interpretation boards and map panels have been placed at the entrance to LCYB. The scraps are an effective way of preventing paths being washed away although they will remain waterlogged long after the rest of the path has dried out. (Photo 3)

		down slope.	
Under-storey	Good mix of under storey vegetation such hawthorn, hazel, holly, ferns, ivy, bluebells, wood anemones, wild garlic in some areas such as under the open canopy of the Monterey pines.	Allowing natural regeneration.	If the canopy is kept fairly open there is a good chance of under-storey plants recolonising. There is also a luxuriant bryophyte (mosses and liverworts) layer in shaded, damp areas and lichen growth on the tree trunks.



Photo 2: 15-year-old plantation



Photo 3: Scrape to prevent water running down steep path



Photo 4: Rhododendron regeneration, standing deadwood and mossy ground flora in LCYG

Management of East Woods

This area runs from the garden entrance alongside the eastern side of the meadow. As a result, although the area is classified as plantation on ancient woodland and ancient woodland, areas nearest to the formal gardens have exotics specimens and underplanting such as Japanese Acers. There area contains the estate's oldest oaks at the top of the slope along the top boundary and the endangered endemic, the Wild Service tree that is indicative of ancient woodland and particularly ancient oak coppice.



Photo 5. View across East Woods showing stumps of removed conifers and garden urn linking to formal garden

Concern / Attribute	Status	Current management	Critique/Comments/Improvements
Invasive Species – <i>Rhododendron ponticum</i>	Found throughout the wood. Many of the rhododendron here originated as rootstock of cultivated varieties as sections of this woodland have been planted with ornamentals due to its proximity to the Lodge and garden.	Eradication where found. Digging out/cutting down and stem injection with herbicide. Use of working parties/volunteers and staff.	The Rhododendron removal is an ongoing battle. Areas of the woodland are extremely steep where the soil is a mix of coal grit and dust and vulnerable to landslides where <i>R. ponticum</i> has been removed. They are allowing for natural re-gen but although the resulting plants will be better established, there may be a case for some planting of shrubs such as holly and hazel which are present further up the bank for stabilization or even using ivy.
Tree diseases	<i>Phytophthora spp.</i> are present at Colby exacerbated by the spread of <i>R. ponticum</i> . Ash die-back present on a large specimen in the meadow close	Removal of Japanese larch <i>Larix kaempferi</i> which is very susceptible and <i>R. ponticum</i> . Tree being monitored until it is unsafe and needing removal.	Important to use bio-security measures when clearing infected plants, such as disinfecting tyres, boots and tools and burning plant material where practical, to not spread the disease to other areas. Important not to remove all ash from this area because there may be resistant individuals amongst regenerating seedlings.

	to the bottom of the wood.		
Age structure	Some of the oldest oaks are in this woodland, very gnarled, mis-shaped specimens suggesting that they survived because they were not of good enough quality for timber.	Existing older oak specimens which have been falling over in recent years following the sudden removal of conifers. Site now favours a much more gradual removal of firs in this area and a stand of European larch <i>Larix decidua</i> at edge of meadow is being left for the time being.	Losses of older oak specimens following the removal of the shelter of conifers on the least sheltered side of the valley could have been anticipated but here government policy drove the clear-felling of conifer to the detriment of native mature trees. Allowing natural regeneration of the oaks, selecting and giving space to the most promising saplings to reach old age will improve structure in future.
Canopy Structure	There are specimens of the rare native Wild Service tree <i>Sorbus torminalis</i> at the top of this wood which is an indicator of ancient woodland.	Halo-pruning around these trees to prevent shading. Millennial seedbank staff collect any seed that forms. Natural regeneration of oak woodland.	Research suggests creating clearings as the best method for regeneration of wild service trees. In dense canopy the tree's strategy is to grow to a reduced height and diameter and often regenerate vegetatively by suckering but this does not improve the gene pool. These root sprouts are vulnerable to browsing mammals. (Pyttel et al., 2013) There may be a case for deer-proofing this area.
Dead wood	Increasing levels of deadwood in coppiced areas although severely lacking in areas that were clear-felled	Leaving all fallen trees and branches and standing dead trees except where a hazard.	Extremely valuable habitat for birds, invertebrates, lichen and fungi but also vital for increasing carbon content of soils, improving soil biodiversity and health. There is a need to inform the public of this strategy because this area is very much part of the garden experience.
Extent of wooded areas	The only direction to extend this woodland is across the old tramway and into the edges of the meadow.	Small numbers of trees are being planted in this area, particularly internationally endangered exotics.	Increased planting on the edge of the meadow could provide additional protection from prevailing winds which are bringing down elderly exposed oaks prior to removal of the remaining larch.
Planting of exotics	This area although classified as plantation on ancient woodland and ancient woodland as also been planted with non-native ornamental trees and shrubs as well as commercial conifer species.	Ornamental trees, shrubs, herbaceous and bulbs continue to be planted alongside paths. The edges of the woodland adjacent to the meadow continue to be planted with rare and endangered exotics from the National Trust's Plant Conservation Centre.	Climate change and pathogens may reduce some native tree species from the landscape and the only way to replace their ecosystem function is with exotic species. The planting of suitable exotic species which may be better adapted to climate change might need to be considered in a wider woodland management context but managed garden where they can be closely monitored and assessed are the best place to do this although many of our most invasive alien species originated in gardens in the past.

Water Features

The water features comprises of the two streams that flow through CYB and LCYB woods and join in a channel alongside the Lodge; the dam and reservoir, created to power for milling and mining; and a series of older (Trout pond) and recently created ponds within the meadow. (Figure 4)

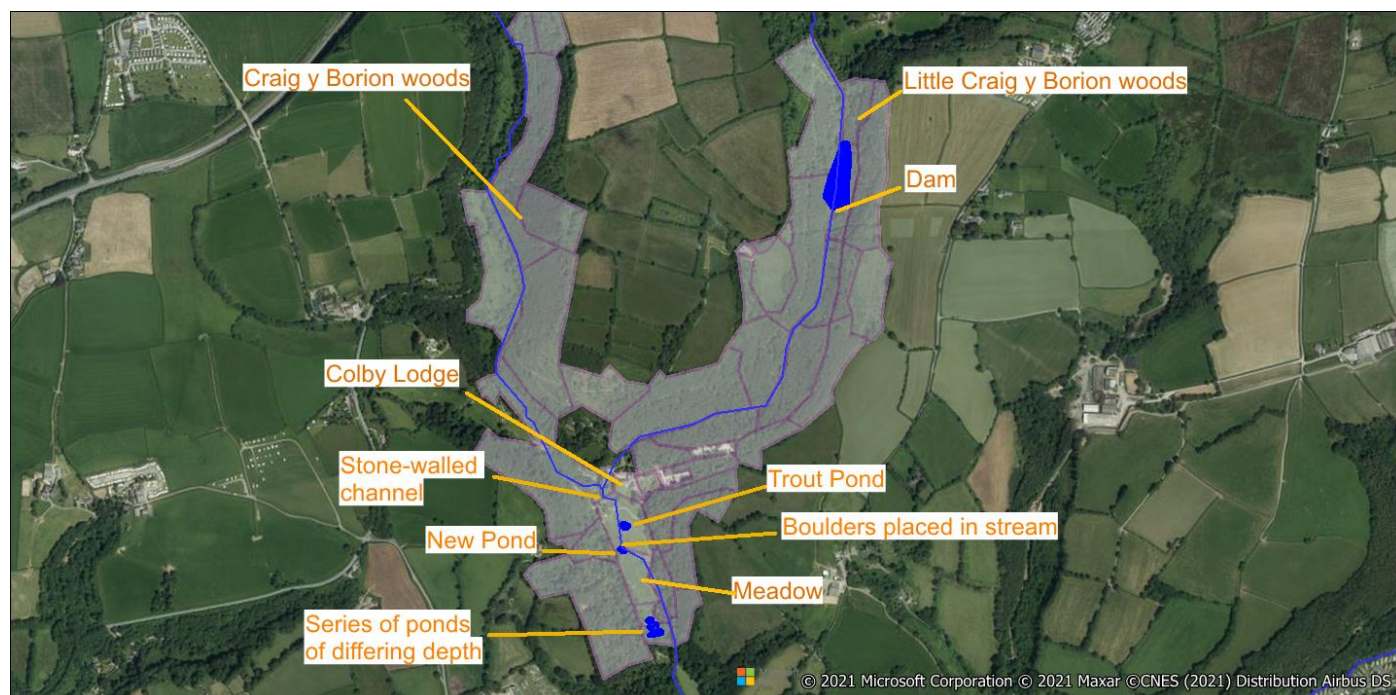


Figure 4: Water features at Colby

Management of Water Features

Concern / Attribute	Status	Current management	Critique/Comments/Improvements
Invasive Species – <i>Himalayan Balsam</i> <i>Skunk Cabbage</i>	Endemic upstream of estate. Seedlings present along stream through meadow and in wetter areas at south end of meadow. Once planted along stream side, most removed but occasional plants found	Physical removal on site before sets seed. Removed where found.	Need to work in partnership with landowners upstream to remove from river system. Only present in small numbers and slow growing so can be dug up. It can regenerate from fragments of root which are inevitably left behind.
Soil Erosion	There is significant silt accumulation in the ponds from agricultural fields up stream.	Ponds desilted every few years. Removing 2/3 of silt each time. Increasing the planting of woodland on field edges. Creation of new ponds and scrapes within the flood meadows to create	There is a field adjacent to the top of the LCYB valley showing poor management. (Photo 6). If this land is Trust owned would be worth retaining and turning into grassland before re-leasing out. The soil trapped within ponds and deposited on the meadow does a good job of protecting the nearby marine habitat from sediment.

		further habitats and slow down stream flow..	
Water quality	According to monitoring, despite run off and soil erosion from farmland upstream (Photo 7), there are good populations of river flies, larvae, trout is present and otters range along the estate streams.	The work of planting steep-sided valleys and agricultural fields has reduced soil erosion and run off. The use of boulders (Photo 9) within the meadow section of the stream and the leaving of fallen trees within across the streams in woodland (Photo 8) slows down the flow of the streams and spreads water out over the meadow allowing it to drop sediment.	The control of stream flow with boulders and fallen trees, use of the flood meadow and ponds by very simple measures has had an impact within the site and benefits the marine environment less than a mile downstream. The Head Gardener would also like to introduce beavers to the estate in the future which could also help control the streams.
Stream bank condition	Near the Lodge the stream is retained within a narrow stone-walled channel which causes erosion of nearby paths when water is forced over the top during flooding events. There are patches of bramble to provide shelter for fish and amphibians. Within the woodlands the stream edges are densely planted. There are numerous fallen trees and branches lying across the streams.	Planting of willow and dogwoods to protect paths and channel water onto grassy shallow hollow. The stream is increasing allowed to make its own course and previously straight sections have been encouraged to meander by widening. Further downstream the banks are being increasingly softened with planting of willows, flag irises and alder to protect the banks and slow down the flow. Patches of overhanging bramble are cut down to the ground every couple of years in rotation to prevent it taking over.	The management is using soft engineering to channel flood waters away from gravel paths to good effect. The watercourse has noticeably become a less formal landscape over the last decade however the sightlines from the Lodge down the meadow have been maintained by regularly coppicing the willows and dogwoods and preventing them from interrupting the historic views.
Stream-fed ponds	There are two stream fed ponds.	The old trout pond has been enlarged and the second pond is recently created and fed by a pile of boulders channelling stream water into it. These ponds are regularly desilted to maintain their extent and depth.	There is a case for extending these ponds (they are both not more than 5m in diameter) to protect nearby paths and provide further wetland habitat but this must be balanced against the loss of species rich meadow and the increased maintenance and removal of quantities of silt which currently is spread over sections of the meadow (increasing nutrients and weed species such as dock and nettle).
Rain-fed ponds	At the south end of the meadow there	Different ponds are occasionally desilted to	These ponds have been a good addition to the meadow, creating new riverine habitats

	is a series of 7 ponds some-interconnected of different depths, only one of which is original. They are rain and floodwater fed and because of their different depths create a variety of habitats drying out to different extents over the course of the summer. They provide spawning grounds for amphibians.	provide a range of depths of water in any season to provide optimum spawning sites.	surrounded by scrubby willow habitat which again helps with the control of flood water.
Dam/Reservoir	The dam allows a steady stream flow through the sluice and at high water a waterfall flows down one side of the dam. The reservoir is quite silted up and at low water levels is a muddy swamp filled with seeded willow scrub. The area behind the dam fills up significantly following rain resembling a mangrove. (Photo 9)	There is little or no maintenance other than the removal of conifer trees from the bank of the dam and the clearance of vegetation from around the stone-built sluice.	This dam within LCYB provides a significant level of flood control and has been made more accessible to the public following the removal of conifers and dense scrub covering the earth and stone structure, revealing more of the site's industrial past.



Photo 6: Poor agricultural practice (bare soil in winter vulnerable to soil erosion)



Photo 7: Soil erosion from field run-off



Photo 8: Fallen trees and branches left to slow flow of stream in LGYB



Photo 9: Effective use of boulders to slow stream and direct some flow into pond

Grasslands

The grassland is represented by flood meadow south of Colby Lodge and some rough, uncut pasture surrounding LCYB farm (now used as volunteer accommodation) which contains large stands of bramble which is controlled by brush-cutter to keep pathways clear.

Meadow Habitat Management Plan



Photo 10: Colby meadow in early summer

Concern / Attribute	Status	Current management	Critique/Comments/Improvements
Invasive species Bracken, thistles, docks	Some evidence of bracken at woodland edge and docks and thistle where silt has increased fertility.	Brush-cutter for bracken, prevention of flowering by mowing for docks, thistles.	The estate has been very successful at removing pernicious weeds from the meadow although where silt has been dumped, the nutrient level has increased leading to patches of undesirables.
Biodiversity	Meadow diversity is high with a mosaic of meadow habitats (Photo 11) depending on the wetness of the soil. A lack of vigorous coarse grasses such as perennial ryegrass although some thistle and dock.	Each habitat type is managed slightly differently. After 4 years of single hay cuts, the meadow was seeded with yellow rattle and a flower rich seed mix from another NT site. Annual hay cut in late summer with	The meadow is closely monitored and interventions are made to areas such as cutting earlier if docks are increasing. Experience from NBGW suggests that application of green hay can dramatically speed up the increase of biodiversity in newly establish meadows and the NT could use hay from this meadow to improve other grassland areas. To establish orchids from green hay the later the cut, even into September the better as the orchid seed takes a long time to mature.

		hay removed. Piles of grass clippings are created to provide nesting habitat for grass snakes.	
Public Access	The meadow has good public access.	Access is by a series of continuously mown paths and small mown areas for picnicking. The late hay cut means the meadow can be appreciated by visitors for the whole summer.	There is a total lack of interpretation across the site but particularly in the meadow. Accessibility is also about explaining and informing.



Photo 11: Even in early April mosaic of meadow habitats is visible

SWOT Analysis of Colby Management Practices

Strengths	Weaknesses
National Trust commitment to habitat conservation and enhancement. Motivated, knowledgeable staff with long term experience of site. Willingness to experiment and try new techniques. Ability to plan for the long term. Good use of soft engineering solutions to flooding.	Lack of consistent surveying/monitoring. Reliance on volunteers for Rhododendron control. Lack of resources and staff means some areas receive minimal attention. Lack of control over adjacent agricultural land. Lack of interpretation and information for visitors.
Opportunities	Threats
Sharing good habitat management practice with landowners and visitors. Increasing onsite biodiversity and reversing species decline and loss locally. Carbon capture of woodlands and soil mitigating against climate change.	Further loss of funding. Loss of key staff and site-specific knowledge. Climate change driving increased flooding, damage and species loss. Change in NT strategy. Change in visitor numbers both increase and decrease impacting on finances or maintenance. Resentment caused and barrier to access to local walkers by change for car-parking. Spread of future plant pathogens.

Conclusion

The habitats present are overwhelmingly well managed and improving and this should have a positive impact on local biodiversity and the marine habitat downstream and the current strategies should be continued. The current management plans formal and informal are delivering improvements and expanding these principles to other areas such as nearby farmland should be the priority when resources allow rather than the adoption of new practices.

However, the reliance on external partners for occasional survey work is not sufficient to adequately measure change in biodiversity and alter management practices if needed. Comprehensive monitoring could also deliver interpretation topics and education resources which are lacking for the standard visitor to understand the motives behind the changes to management and the more informal appearance of areas of the site.



Photo 12: Creating habitats

Reference

Pyttel, P., Kunz, J., Bauhus, J., 2013. Growth, regeneration and shade tolerance of the Wild Service Tree (*Sorbus torminalis* (L.) Crantz) in aged oak coppice forests. *Trees - Structure and Function* 27, 1609–1619.
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