Delivering for Invertebrates in Local Nature Recovery Strategies

Identifying Pressures and Potential Measures

Left: Romney Marsh © Marathon, CC BY-SA 2.0. Right: The leaf beetle *Donacia dentata* © Tatyana Zarubo CC BY-NC

Local Nature Recovery Strategies (LNRS) provide the opportunity for responsible authorities to plan their conservation delivery priorities for many years to come. However, many invertebrate species and assemblages suffer pressures not experienced by other species groups and can require specific measures for their conservation. Buglife's Important Invertebrate Area (IIA) profiles use the Pantheon analytical tool to identify some of the key habitats and microhabitats supporting rare invertebrate assemblages in each IIA. This document draws from these profile resources and outlines the pressures and potential measures that should be considered for invertebrate species and assemblages associated with key habitats and features. For further information on supporting invertebrates in LNRS please see Delivering for Invertebrates in Local Nature Recovery Strategies: A Guide for Responsible Authorities.

Contents:

Woodland and trees

Pressures

- Historical damage of woodland through industrial use and large-scale conifer timber planting resulted in direct habitat loss of native woodland, causing a slow recolonisation rate of invertebrates into some of these areas. In present times, woodlands are still lost to development, agriculture or intensive forestry.
- Secondary woodland, scrub or plantation enclosing and shading out previously open-grown trees.
- Loss of woodland grazing or management such as maintenance of rides or coppicing, can lead to woodlands becoming over-crowded, shaded, and lacking structural variation, which significantly impacts ground flora vegetation that provides valuable nectar and pollen sources for invertebrates.
- Cessation of traditional pollarding of willows leading to removal and collapse.
- Overgrazing and disturbance where deer, squirrel or rabbit populations are high prevents young trees from being recruited creating a uniform tree age structure, reduces ground layer vegetation and creates difficulties for woodland regeneration.
- Important veteran trees and decaying wood sources are often at risk from overzealous management, including the tidying-up of standing and fallen trees and collection of fallen material for firewood. Lack of spatial and temporal continuity of veteran trees can affect the dispersal ability of the associated specialist species.
- Fragmentation of woodlands can lead to inability of invertebrates to move between fragments.
- Invasive non-native species (e.g. Rhododendron, Cherry Laurel, conifers) can negatively affect the vegetation and structural composition of woodlands.
- Ash Dieback and other tree diseases and pests, which are exacerbated by climate change, can result in changes in tree species and age composition.

Potential measures

- Overall, aim for a mix of dead wood, healthy live trees, young saplings, scrub areas and open spaces such as glades, rides or scallops. In addition to the increased light levels in the forest, rides create varied woodland edge microhabitats and allow grasses and wildflowers to regrow.
- Consider long-term age structure, aiming to increase the recruitment of young trees and ensuring a continuity of mature trees. This can be achieved through practices such as coppicing and thinning. Additionally, mark out ‘future veteran’ trees to ensure the existing veterans will be replaced in the future.
- Retain all dead wood, both standing and fallen in situ, and discourage the collection for aesthetic reasons or firewood. Additionally, retain trees showing decay features and do nothing to damage those features.
- Maintain/re-establish light grazing regimes in ancient woodlands to manage understorey vegetation.
- Aim to restock and regenerate native tree species—this creates the important thicket stage habitat and encourages a diversity of food plants and their dependent invertebrates.
- Promote growth of suitable tree species on land between existing woodland sites to extend and reconnect fragmented patches of woodland.
- Control or remove invasive and competitive species such as Rhododendron, Japanese Knotweed and bramble.

Sherwood Forest © Jamie Robins

Wood pasture

Pressures

- Sustained high levels of grazing can result in low wildflower numbers and no recruitment of new trees, causing gaps in tree age structure and no suitable habitat for specialist veteran tree invertebrate species.
- Inappropriate management of hedgerows and field margins can cause gaps in habitat connectivity and a lack of refugia and hibernating sites.
- Over-pruning or removal of veteran trees and clearing of dead wood results in removal of essential invertebrate habitats.
- Grassland 'improvement' through ploughing, re-seeding, fertiliser application, and conversion to arable reduce invertebrate biodiversity through direct habitat loss and reduction in flower and pollen resources.
- Site abandonment and lack of appropriate grazing or cutting pressure causes the spread of competitive species such as Purple Moor Grass and rush (in wetter grassland) and tussocky grass and scrub (in drier grassland), resulting in low structural variation and floral diversity.
- Applications of pesticides and herbicides directly impact invertebrate survival and can alter soil biology, function and soil invertebrate communities.
- In hay meadows, a shift from hay-making (one annual cut) to silage production (multiple cuts a year) disrupts invertebrate life cycles and considerably lowers nectar and pollen availability.
- In grazed grassland, overgrazing or grazing at the wrong time of the year can create uniform and close -cropped sward without much structural diversity, shelter and plant resources for invertebrates.
- In grazed grassland, endectocides used in the treatment of livestock parasites can negatively affect dung beetles and other dung invertebrates.

Potential measures

- Create sensitive and flexible grazing management plans with the aim to create a mosaic of habitats with young trees being recruited and areas of open grassland or heathland ground vegetation. Retain all existing old trees where possible and retain dead wood of all ages, both standing and fallen.
- Retain veteran trees showing decay features and do nothing to damage those features. Additionally, retain all dead wood, both standing and fallen in situ, and discourage the collection for aesthetic reasons or firewood.
- Aim to leave some field margins uncut and hedgerows well-connected – these areas act as refuges for overwintering invertebrates, offer late-season forage, aid connectivity and dispersal and harbor prey species.
- For sites managed by grazing, create flexible management plans with conservation-led stocking densities and timing of grazing, avoiding poaching and under-grazing. If possible, reduce the number of animals or remove grazing between April and August to allow wildflowers to bloom and set seed.
- Avoid damaging land management practices like ploughing, re-seeding, fertiliser/slurry application, winter tilling, and drainage, which damage valuable grassland habitat and reduce plant and invertebrate diversity.
- Aim to establish a diversity of plant species through seeding/green-haying to encourage a wide diversity of invertebrates and their food plants.
- Monitor the extent of problem species such as docks, thistles, rushes, dominant scrub and rank grass. Prevent their spreading by targeted removal, lowering the nutrient loading in the soil and establishing appropriate cutting and grazing regimes.
- In hay meadows, if a late hay cut is not possible try and stagger hay cutting times, leaving some areas in flower at all times and creating a varied structural diversity across the site.
- Where possible, integrate creation of some bare patches or banks within the grassland site, these are essential nesting habitats for solitary bees.

Lichen-running Spider (*Philodromus margaritatus*) © Rudolf Macek

Scrub mosaics

Pressures

- Site abandonment and lack of appropriate grazing or cutting management can lead to closed and uniformly aged scrub, lacking structural variation and early successional areas such as sheltered grasslands.
- The establishment of secondary woodland can shade out scrub species, leading to the development of woodland habitats that lack the forage and basking opportunities of scrub habitat mosaics.
- The introduction of management uniformly across a whole site can lead to the loss of variation in age and structure.
- Clearance of dead and decaying wood removes opportunities for specialist species.
- Large scale tree planting can lead to direct loss of scrub habitat.
- Dominance by a single scrub species can reduce the value of scrub habitats to invertebrates.
- Invasive non-native plant species can become dominant and affect the composition and structure of scrub habitats.
- Inappropriate scrub management can cause gaps in habitat connectivity and a lack of refugia and hibernating sites.
- Burning, whether controlled or uncontrolled, can directly kill invertebrates, as well as eliminate food plants and nesting sites. It also leads to the development of single aged scrub lacking structural variation.
- Diseases and pests, which are exacerbated by climate change, can result in changes in tree species and age composition.

Scrub mosaic at Kings Dyke Nature Reserve, Peterborough © Clare Dinham

- The use of herbicide in scrub management can directly kills invertebrates as well as removing forage.

Potential measures

- Management plans should aim to produce a mix of young and mature scrub, within mosaics of early successional habitats, providing blocks of scrub interspersed with sheltered, sunny areas which provide foraging and basking opportunities for invertebrates.
- Aim for a transition between dense scrub through to taller grassland areas to provide diverse vegetation structures for invertebrates. This can be achieved through the rotational management of scrub block edges.
- Regular low intensity management is preferable to large-scale interventions every few years.
- Grazing can help prevent the succession of scrub habitats to secondary woodland.
- Aim for a range of scrub species, to provide blossom and forage throughout the spring and summer period to support a wider range of invertebrates. Where necessary consider planting scrub species that are appropriate for the specific soil type and drainage character of a site.
- Monitor the extent of dominant scrub species to avoid blocks of scrub becoming overly dominant by a single species. Consider opportunities to diversify monocultures of scrub species by planting native species.
- Avoid scrub management in spring and summer months which can affect the availability of forage and destroy nesting habitat. Leave blocks of scrub habitat undisturbed throughout the year to allow invertebrates to complete their lifecycle and to provide areas of shelter.
- Control or remove invasive plant species.
- Retain dead and decaying wood.
- Manage scrub habitats with connectivity with hedgerows and other features in mind.
- See other habitat sections for specific advice on managing scrub as an important component of their habitat mosaics.
- Use scrub control measures that avoid the use of herbicides, such as mechanical removal of root systems.

Grassland (including dry and wet grasslands, meadow and pasture)

Pressures

- Grassland 'improvement' through ploughing, re-seeding, fertiliser application, and conversion to arable reduce invertebrate biodiversity through direct habitat loss and reduction in food plants, flower and pollen resources.
- Site abandonment and lack of appropriate grazing or cutting pressure can contribute to the spread of competitive species such as tussocky grass and scrub (in drier grassland) and Purple Moor Grass and rush (in wetter grassland), resulting in low structural variation and floral diversity and disappearance of the associated invertebrates.
- Applications of pesticides and herbicides directly impact invertebrate survival and can alter soil biology, function and soil invertebrate communities.
- In grazed grassland, overgrazing or grazing at the wrong time of the year can create uniform and close -cropped swards without much structural diversity, shelter and plant resources for invertebrates.
- In grazed grassland, endectocides used in the treatment of livestock parasites can negatively affect dung beetles and other dung invertebrates.
- In hay meadows, mid-July hay cut without leaving an uncut margin, can deplete plant food sources and vegetation cover for invertebrates if applied uniformly and suddenly across a larger landscape.
- In hay meadows, a shift from hay-making (one annual cut) to silage production (multiple cuts a year) disrupts invertebrate life cycles and considerably lowers food plant availability.
- In wet grassland, over-stocking or bringing heavy machinery onto sites in the wetter months causes soil compaction, leading to excessive spread of rush. Changes in the water levels as a result of e.g. land drainage can remove valuable seasonal and permanent wet habitat features for invertebrates.
- Inappropriate management of hedgerows and field margins can cause gaps in habitat connectivity and a lack of refugia and hibernating sites.

Potential measures

- Avoid damaging land management practices like ploughing, re-seeding, fertiliser/slurry application, winter tilling, and drainage, which damage valuable grassland habitat and reduce plant and invertebrate diversity.
- Aim to establish a diversity of plant species through seeding/green-haying to encourage a wide diversity of invertebrates and their food plants
- Monitor the extent of problem species such as docks, thistles, rushes, dominant scrub and rank grass. Prevent their spreading by targeted removal, lowering the nutrient loading in the soil and establishing appropriate cutting and grazing regimes.
- For sites managed by grazing, create flexible management plans with conservation-led stocking densities and timing of grazing, avoiding poaching and under-grazing. If possible, reduce the number of animals or remove grazing between April and August to allow wildflowers to bloom and set seed.
- For sites managed by cutting, try and stagger cutting times, leaving some areas in flower at all times and creating a varied structural diversity across the site. Never carry out late cuts on hay meadows as this is seriously detrimental to floristic interest.
- In wet grassland, avoid compaction by carefully planning stocking densities especially during the wet months and perform any mechanical works required in the dry months of the year.
- Aim to leave some field margins uncut and hedgerows well-connected – these areas act as refuges for overwintering invertebrates, offer late-season forage, aid connectivity and dispersal and harbour prey species.
- Where possible, integrate creation of some bare patches or banks within the grassland site, these are essential nesting habitats for solitary bees.

Shrill Carder Bee (*Bombus sylvarum*) © Steven Falk

Cliff top grassland, heath and scrub mosaics

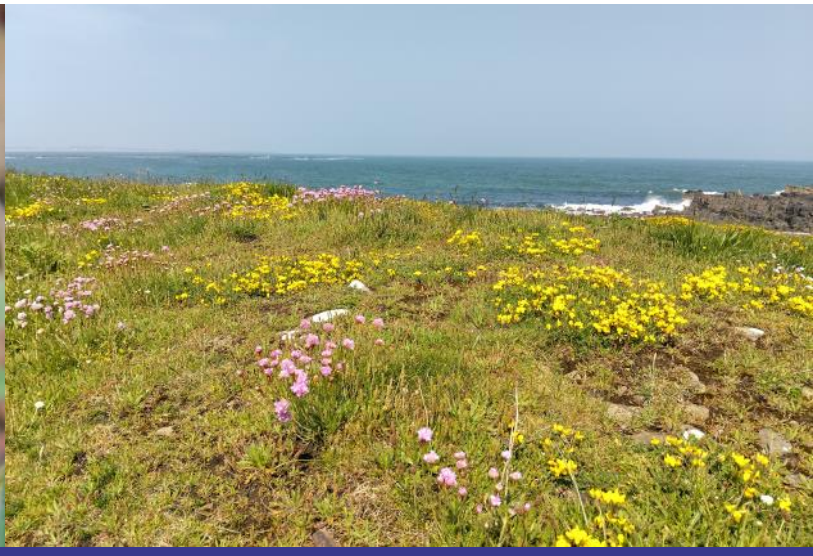
Pressures

- The direct loss of cliff top grasslands to intensive grazing and arable agriculture or development such as sea defences, caravan parks or golf courses, reduces the wildflower-rich habitats that cliff specialists utilise as a source of forage, for overwintering or to disperse between sites.
- Poor management or implementing the same management approach too widely can lead to uniform habitats that lack varied structure, reducing their value for invertebrates.
- Retreating cliff lines on many sections of coast have left only a thin remnant strip of cliff top wildflower-rich grasslands, leading to coastal squeeze.
- Overgrazing or grazing at the wrong time of year can lead to a loss of structural variation and a short sward that lacks the flowers and shelter needed by many invertebrates.
- Although limited scrub or patches of scrub provide important shelter, nectar and pollen, the loss of grazing or other management can lead to areas becoming dominated by thick grass, bracken and scrub at the expense of valuable flowery grassland and bare ground.
- The loss of wet habitat features due to changing hydrology can significantly reduce their value for invertebrates
- Applications of pesticides and herbicides directly impact invertebrate survival, can alter soil biology, function and soil invertebrate communities as well as leach out to the nearby coastal slopes and cliffs.
- While well-structured footpaths receiving moderate use can be of very high value (e.g. by maintaining open bare ground), excessive recreational pressure can alter vegetation communities through trampling, soil compaction and erosion – this can affect habitat continuity.
- Burning, whether controlled or uncontrolled, can directly kill invertebrates, as well as eliminate food plants and nesting sites. Fire is a growing threat to remnant heathlands, with the potential for areas to be irreparably damaged through a single incident.
- Invasive non-native plant species (e.g. Cotoneaster) can negatively affect the vegetation and structural composition of cliff top grasslands.

Potential measures

- Enhance existing species-poor grasslands through changes in grazing management and overseeding/ green haying where appropriate, to improve connectivity between small and isolated cliff top grasslands.
- Although valuable in limited amounts or patches, dominant scrub on cliff top grasslands should be removed by cutting or grazing to encourage areas of wildflower-rich grasslands and scrub mosaic. Aim to produce a mosaic of successional stages, from bare ground in short sward areas, through to tall swards with establishing and established scrub.
- Restore species-rich grassland via arable reversion where opportunities occur.
- Employ flexible coastal squeeze solutions, moving inland in line with retreating coastlines to maintain the extent of useful cliff top habitat.
- When reviewing grazing strategies, consider reducing intensity and avoiding spring and summer grazing to enable wildflower species to flower and set seed. Winter grazing can help to encourage a more wildflower-rich sward by controlling grasses

Left: Short-necked Oil Beetle (*Meloe brevicollis*) © Steven Falk. Right: Northumberland coast © Jamie Robins



and creating germination opportunities.
- On agricultural land, create buffers (by planting wildflower strips or leaving tussocky grasses which are cut every 2-3 years) to improve the water quality of freshwater cliff features.
- Manage recreational pressures using fencing and signage to divert people away from sensitive areas.
- Control or remove invasive species.
- Avoid using controlled burning as a tool to manage heathland habitats.
- Create fire-breaks in landscapes vulnerable to frequent fires.

Soft rock cliffs

Pressures

- Cliff stabilisation measures can disrupt the dynamic natural processes of erosion, slumping and slippage impeding the introduction of wildflower seeds to cliff faces from cliff top grasslands and the creation of new nesting habitat including friable bare ground and early successional vegetation stages required by many cliff-dwelling invertebrates.
- Wider water abstraction in the landscape and local artificial drainage to improve pasture and cliff stability can impact on freshwater seepages, cliff face springs, pools, small streams and wet mud, that are crucial to the life cycle of many rare and threatened species.
- Invasive species such as Cotoneaster or *Carpobrotus edulis* outcompete and shade out native species and adversely transform natural vegetation communities, tending to smother the bare ground required by many specialist invertebrates on cliffs and slopes.
- The direct loss or poor management of cliff top grassland, heath and scrub mosaics reduces the wildflower-rich habitats that many cliff specialists utilise as a source of forage, for overwintering or to disperse between sites. See 'Cliff top grassland, heath and scrub mosaics' section.

Potential measures

- Employ flexible coastal squeeze solutions, moving inland in line with retreating coastlines to maintain the extent of useful cliff top habitat.
- On agricultural land, create buffers by planting wildflower strips or leaving tussocky grasses which are cut every 2-3 years to improve the water quality of freshwater cliff features.
- Control or remove invasive species.
- Ensure Shoreline Management Plans recognise the importance of soft cliffs for biodiversity and avoid damaging management. Any activity that changes the natural rate of cliff and slope erosion or extent of bare ground and seepages, such as re-profiling or the introduction of coastal defences, should be avoided wherever possible.
- Maintain cliffs and landslips in a natural state, avoiding any changes to the character of the vegetation especially with respect to the pollen sources, bare ground extent and seepages.
- Prevent the drainage of soft cliffs by surface or sub-surface measures or by inland abstraction, which has a direct impact on the geomorphological functioning of sites.
- See 'Cliff top grassland, heath and scrub mosaics' section for measures to manage and enhance cliff top habitat mosaics.

Left: Six-banded Nomad Bee (*Nomada sexfasciata*) © Steven Falk. Right: Dorset coast © Andrew Whitehouse

Hard rock cliffs

Pressures

- Invasive non-native plant species (e.g. Cotoneaster) can result in the loss of valuable floral resources and food plants for invertebrates on cliff faces and scree slopes, as well as the loss of cracks and crevices that are used by specialist species.
- Climbing of cliffs can destroy cliff vegetation and features, while also discouraging nesting birds that can support an interesting invertebrate fauna associated with carrion and guano.
- Wider water abstraction in the landscape and local artificial drainage to improve pasture and cliff stability can impact on freshwater seepages, cliff face springs, pools, small streams and wet mud, that are crucial to the life cycle of many rare and threatened species.
- The direct loss or poor management of cliff top grassland, heath and scrub mosaics reduces the wildflower-rich habitats that many cliff specialists utilise as a source of forage, for overwintering or to disperse between sites. See 'Cliff top grassland, heath and scrub mosaics' section.

Potential measures

- Control or remove invasive species.
- Manage recreational pressures through signage and fences to divert disturbance away from sensitive areas, and control the climbing of cliffs which can discourage nesting birds and destroy vegetation.
- On agricultural land, create buffers by planting wildflower strips or leaving tussocky grasses which are cut every 2-3 years to improve the water quality of freshwater cliff features.
- See 'Cliff top grassland, heath and scrub mosaics' section for measures to manage and enhance cliff top habitat mosaics.

Jenny's Cove, Lundy Island © Lewis Clarke CC BY-SA 2.0

Heathland

Pressures

- Poor management or implementation of the same management approach too widely can lead to uniform heathland habitats that lack structural and age variation, reducing their value for invertebrates.
- Overgrazing can lead to a loss of heather stands, creating open grass-dominated areas and making them more prone to be invaded by competitive plants such as bracken. Conversely, lack of management or under-grazing can lead to a loss of bare ground, soil disturbance and succession to scrub and woodland.
- The loss of wet habitat features on wet heathland sites, due to drainage or otherwise changing hydrology can significantly reduce their value for invertebrates.
- Habitat fragmentation due to e.g. development pressure or agricultural improvement can create isolated patches of habitat, making the dispersal of invertebrates harder and lowering the genetic diversity of invertebrate populations.
- Fire is a growing threat to remnant heathland sites, with the potential for smaller sites to be irreparably damaged through a single incident.
- Public pressure such as horse riding and motorcycle activity on open heaths, can cause extensive damage and should be controlled.

Potential measures

- Aim to produce a mosaic of heathland successional stages to support the highest number of invertebrates. These should include bare and disturbed ground, moss and lichen-dominated areas, grasses, flower-rich areas and young heather plants, through to tall swards with establishing and established blocks of mature heather, scrub, such as Burnet Rose and scattered trees.
- Aim to establish grazing of appropriate stocking levels, avoiding under or over-grazing, to maintain a mosaic of heathland structure. Cattle tend to produce a more varied vegetation structure than sheep and their greater weight will suppress bracken growth and provide areas of disturbed ground.
- Provide bare ground and early successional vegetation, which provide basking, nesting and hunting opportunities for ground-active


Left: Narrow-headed Ant (*Formica exsecta*) © Alex Hyde / Back from the Brink. Right: Silchester Common, Hampshire © Oswald Bertram CC BY-SA 2.0

invertebrate species as well as opportunities for key early successional flowering species. If grazing is not available, this can be achieved via rotational cutting and scraping of the soil surface to create exposures.

- Consider excluding grazing from some areas all year round to provide permanent cover and opportunities for species using standing stems and seed heads to complete their life cycle. While too much bracken and gorse can be a problem, it does support rare sawflies and flies, so areas of gorse, both shaded and in the open, should be retained.
- Protect existing heath, wet heath, streams and ponds.
- Retain dead and decaying wood.

Upland habitat mosaics

Pressures

- Inappropriate levels of grazing - typically too intensive and with sheep-only can produce a close-cropped and uniform sward that lacks key plants, offers little shelter and prevents regeneration of woody species such as heather.
- Abandonment and neglect of sites, including the cessation of grazing and the dying out of practices such as bracken cutting and use for animal bedding, leads to bracken and gorse dominance and scrubbing over.
- Tree planting can damage important upland habitats for invertebrates, with historic afforestation significantly reducing the extent and quality of habitat mosaic.
- The construction of wind farms and communication masts or land drainage can cause significant hydrological disruption to upland invertebrate habitats.
- Burning, whether controlled or uncontrolled, can directly kill invertebrates, eliminate food plants and nesting sites, simplify the overall vegetation structure and cause erosion of peat.
- Avoid damaging land management practices like ploughing, re-seeding, fertiliser/slurry application, which damage valuable habitat and reduce plant and invertebrate diversity.

Potential measures

- As a general rule, aim to create or maintain a mosaic of habitats including bare and open ground, scattered trees, scrub and bracken, grassland and wet areas.
- Scrub management should aim to create and maintain a range of native species, ages and structure. This can be achieved through periodic rotational cutting or grazing.
- While some areas of bracken are beneficial for invertebrates, management may be required where it is becoming dense and encroaching on other habitats. This can be managed through cutting or rolling and maintained by grazing, preferably with heavy livestock.
- Introduce appropriate grazing to maintain open areas of grassland of various sward heights and to control encroaching bracken or scrub.
- Aim to establish a diversity of plant species to encourage species-specific invertebrates.
- Large-scale tree planting should not be undertaken but the scattered regeneration of native tree and scrub species within the habitat mosaic adds to the wildlife value. Planting of individually protected trees or small exclosures can be beneficial where grazing inhibits regeneration or along watercourses

to provide dappled shade.

- Boggy pools, *Sphagnum* lawns, flushes, wet peat and any streams should be retained and not drained or improved, as these will provide habitat for wetland and aquatic invertebrates.
- Restore active hydrological processes to re-wet upland habitats (especially peat bogs) through the blocking of ditches, purchase of additional land, and removal of scrub/tree cover.

Peatlands

Pressures

- Direct loss of peatland through horticultural extraction is currently the biggest threat to this habitat.
- Changes in hydrology caused by drainage ditches or presence of peat cliffs (steep slopes following peat extraction or disturbance) can result in peatland drying out and the loss of water features for invertebrates.
- Low water tables lead to more favourable conditions for scrub and tree encroachment, which in turn leads to the loss of *Sphagnum* habitats through compaction, overshading and increased evapotranspiration of stored water by the scrub.
- Burning, whether controlled or uncontrolled, can lead to total destruction of this habitat and its invertebrates and is not advised.
- Historically, big areas of peatland were lost through incentivised afforestation of conifer plantations. Any peatland habitat left in the vicinity of the plantations or which is being restored from forest to bog, is under the threat of scrubbing over in the absence of an appropriate grazing management plan.
- Competitive species (e.g. Purple Moor Grass, Heather, Rhododendron, Birch) can negatively affect the vegetation and structural composition of peatland habitats.
- Nutrient enrichment through aerial deposition or water run-off can cause increased damage to *Sphagnum* moss.

Potential measures

- Re-wet degraded peatlands to restore active hydrological processes and water tables through the blocking of ditches, purchase of additional land and removal of tree cover.
- Restore damaged and degraded peatland through the installation of peat bunds and reprofiling of sharp edges to reinstate its water-retention abilities.
- Where necessary, introduce conservation grazing to reach an appropriate grazing pressure to control competitive species and tree encroachment, and to create a diverse sward structure.
- Avoid using any kind of burning as a tool to manage vegetation (e.g. heathers) on peatlands. Instead, rewet peatland habitat which can act as a natural firebreak in the wider landscape.
- Keep peatland in favourable condition and avoid it drying out as this can exacerbate tree encroachment and the spread of competitive species.
- Target restoration work around or near to existing high quality peatland sites, to improve connectivity and to provide opportunities for invertebrates to develop resilient populations.
- Control the input of extra nutrients and chemicals inside the whole water catchment area, not only in the core portion of the bog.

Left: White-faced Darter (*Leucorrhinia dubia*) © Steven Falk. Right: Natural England/Peter Wakely

Running water

Pressures

- Water pollution and nutrient enrichment from agricultural run-off (e.g. artificial or natural fertilisers, worm treatments), sewage discharges or chemical water treatment can alter the composition and disrupt the lives of aquatic and semi-aquatic invertebrates.
- Engineering activities such as flood alleviation schemes, straightening of watercourses, dredging, and water storage have modified flows in some rivers and streams, lowered water tables and removed available habitat. This can also include the loss of areas of exposed riverine sediments that support specialist rare invertebrates.
- Barriers such as weirs and dams disrupt natural flow processes and prevent some species from moving freely. Walls and piling prevent the watercourse from spreading onto its floodplain, replenishing wetlands and creating damp habitats.
- Removal of riparian vegetation, particularly trees can result in increased water temperatures which affect cold-loving species. Conversely, excessive scrub encroachment on the channel through the lack of grazing or woodland management can lead to overshading and impact on the dispersal abilities of flying species to adjacent sites.
- Activities such as ploughing and development can increase sediment run-off into streams and rivers, which can contribute to invertebrate declines in various ways e.g. clogging of gills, changes in habitat and prey availability, oxygen and light levels.
- Non-native species such as Himalayan Balsam and Japanese Knotweed can be a particular problem to rivers and their associated wetlands, crowding out other supportive native plant species and habitats for invertebrates.
- Sedimentation and drying, caused by reduced water flow, can result in the deterioration of shingle bank habitats.
- Light pollution disrupts the lives of nocturnal insects and can contribute to insect decline.
- Solar panels adjacent to running water can attract aquatic invertebrates with reflected polarised light appearing as suitable egg laying sites.

Yorkshire Dales river corridor © Jamie Robins

Potential measures

- Monitor water quality and protect running waters from land-borne pollution through negotiations with local farmers and businesses.
- Restore a more natural flow regime by removing barriers (e.g. weirs) and by re-profiling watercourses from fast-flowing, straight and steep channels to meandering shallow channels with varying speed in water flows.
- Establish vegetation buffers and woodland around running waters to improve water quality and habitat for invertebrates – this helps with trapping pollutants in run-off events, stabilises riverbanks, and creates shaded areas.
- Allow some grazing on riverbanks as this creates marginal habitat with tussocky vegetation for roosting and mating, and varied microhabitats along the water edge such as poached areas.
- Keep livestock from entering the watercourse or moving across gravel bars and beaches as this compacts the gravels, increases bank erosion and nutrient concentrations through their faeces.
- Aim to reduce or eliminate the use of artificial lighting around watercourses wherever possible.
- Control or remove invasive species,such as Himalayan Balsam and Japanese Knotweed.
- Patterned, roughened or painted glass, or a horizontal light-blocking grid can be used on solar panels to reduce their attraction to aquatic invertebrates.

Lakes and Freshwater Ponds

Pressures

- Water pollution and nutrient enrichment from agricultural run-off, sewage discharges and other sources can directly kill invertebrates and change the vegetation and structural composition of lakes.
- Excessive water abstraction in the catchment can change hydrological regimes and water tables, removing and modifying available habitat. Repeated fluctuation in water levels can lead to compaction of substrates and changes in species composition.
- Activities such as ploughing and peat cutting can increase soil erosion within the catchment and increase water-borne sediments in lakes. Excessive sediment loading can contribute to invertebrate decline in various ways.
- Fish introduced for angling can have an adverse effect on lake ecosystems by eating the invertebrates that graze algae and keep it in check, encouraging algal blooms.
- Water-borne traffic can damage aquatic plants at the point of launch, or through bankside wave erosion, passage through strands of vegetation, or the cutting action of propellers.
- Invasive non-native species (such as the American Signal Crayfish) can disrupt the ecological balance of water bodies, eliminating native species.
- Endectocides used in the treatment of livestock parasites can negatively affect aquatic invertebrate if the livestock enter the waterbody.

Potential measures

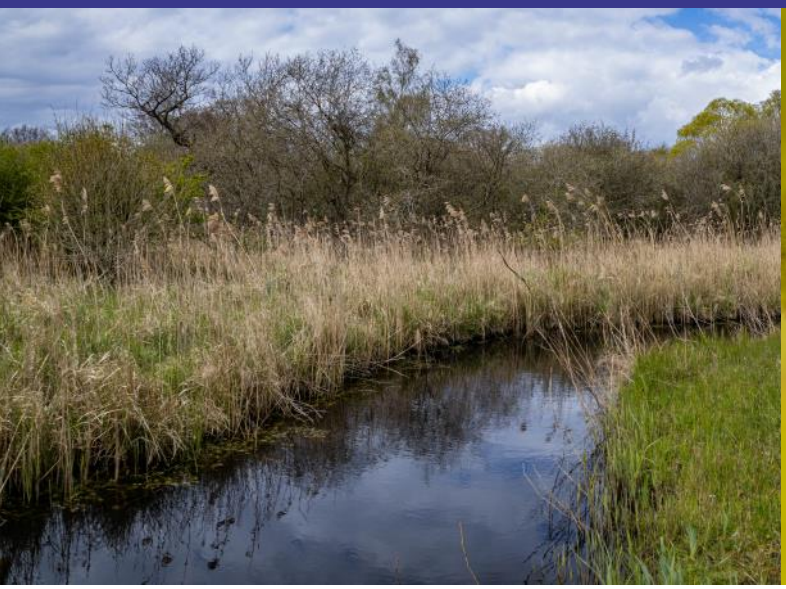
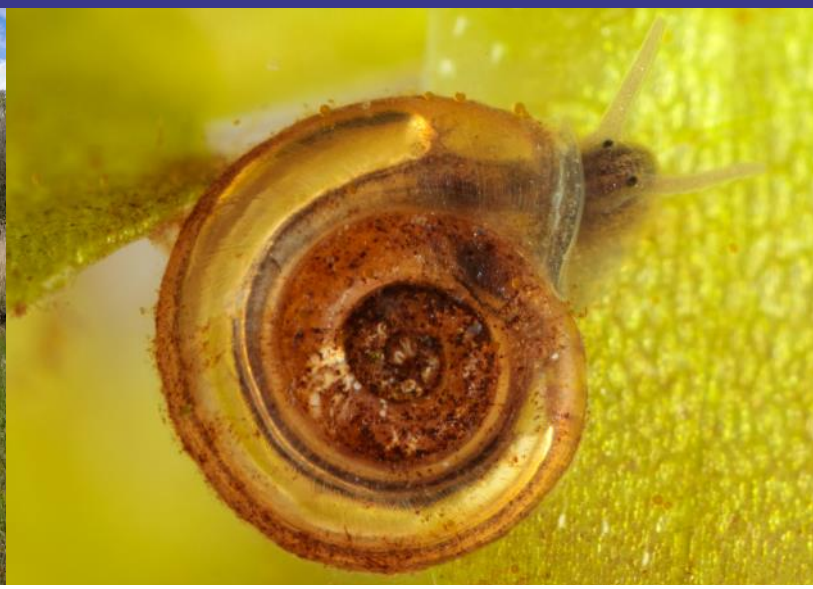
- Discharges of effluent from waste water treatment works and other point sources of pollution should be strictly controlled.
- Work with neighboring landowners to reduce nutrient inputs and maintain the quality of water entering lakes. Additionally, local water companies should be made aware of the sensitivity of lakes to changes in water abstraction patterns or groundwater quality.
- Introduce more sympathetic management practices for invertebrates when reviewing catchment management plans.
- Establish buffers around lakes to maintain or improve water quality by trapping and removing various non-point source pollutants.
- Avoid over-stocking lakes with fish.
- Minimise disturbance from recreational use.
- Control or remove invasive species.
- Alternatives to endectocides should be used wherever possible. Where alternatives cannot be taken, dosing livestock off-site and keeping them out of the catchment for at least 10 days after treatment will reduce the impact of worming treatments on aquatic invertebrates.

Medicinal Leech (*Hirudo medicinalis*) © Ian Boyd CC BY-NC 2.0

Drains, dykes and ditches

Pressures

- Eutrophication and pollution through chemicals, nutrients and sediment from agriculture, sewage discharges and road run-off can directly kill or alter populations of invertebrate and plant species or contaminate surface or ground water, leading to choking of ditches with vegetation, growth of algal mats and a loss of invertebrate interest.
- Invasive and competitive plant species (e.g. duckweed, Water Fern and Floating Pennywort) can prevent establishment of native plants that are used as shelter and food for invertebrates, shade the water column and lead to anoxic conditions due to decomposition of large quantities of organic matter.
- Lack of management of marginal and emergent ditch vegetation can lead to scrub and reed encroachment along the drain margins or dense reed and other emergent vegetation within the channel, shading the watercourse and reducing botanical and invertebrate interest.
- Excessively frequent management such as regular grubbing out of small drains or dredging of main drains removes vegetation and habitat features essential for invertebrates.

Left: Woodwalton Fen © Chris Kirby-Lambert. Right: Little Whirlpool Ram's-horn Snail (*Anisus vorticulus*) © Alex Hyde / Back from the Brink

- Inappropriate ditch management such as over-deepening or abandonment can lead to low habitat value for invertebrates and ditches silting up.

Potential measures

- If considering any change in hydrological regime or water management be sure to understand the sources and quality of the water involved before action.
- Avoid extreme fluctuations in water level (especially complete drying) of ditches and associated waterways throughout the year by protecting the existing ditch network or through changes in the field drainage system and management. However, some high-quality ditches are groundwater fed and often shallow and naturally fluctuating and should never have their water levels raised artificially with inferior quality water. In slow flowing ditches lowering water levels in winter can also help to discourage fish and allow oxygenation of the ditch bed – preventing build-up of anoxic sediment.
- Aim for a patchwork of ditches at different siltation and vegetation successional stages across the site. This is best achieved by adopting a five-year rotational ditch clearing management cycle, where only short sections or only one side of any ditch are cleared in one year and not all adjacent ditches are cleared in the same year. Some ditches may require management on shorter (e.g. three-year) cycles to maintain functionality and good quality due to high siltation rates or rapid succession.
- Create wildlife-friendly and varied ditch profiles by reducing the angle of hard-edged ditches to a slope of around 35° to provide diverse habitat conditions at all water levels and to allow cattle access to ditch margins.
- Discharges of effluent from any sources of pollution should be strictly controlled to ensure water stays clean. For ditches in improved grassland or arable fields establish a buffer strip (e.g. unfertilised tussocky grass) to protect them from run-off, pesticide and fertiliser drift.
- Avoid dredging both sides of large drains at the same time. Manage opposing banks on opposite cycles where possible to ensure some habitat is always retained in the channel.

Wetlands

Pressures

- Water pollution through chemicals, nutrients and sediment from agriculture, sewage discharges and road run-off can directly kill or alter populations of invertebrate and plant species, resulting in a loss of biodiversity.
- Changes in land cover can result in the release of sediment and nutrients into the water body, causing increased eutrophication, siltation, and anoxic conditions. This is further exacerbated by the removal of waterside vegetation and reedswamp that act as barriers to particulate matter and absorb nutrients.
- The direct loss or damage of wetland features to urbanisation or infilling depletes wetland resources for invertebrates in the countryside. It also increases isolation of the remaining wetlands, making colonisation by less mobile species more difficult.
- Poorly considered and inappropriate restoration of gravel pits and other mineral extraction sites (e.g.

encouraging reedbeds and/or planting trees around waterbodies).

- The removal of waterside vegetation and swamp that act as barriers to particulate matter and absorb nutrients can lead to increased eutrophication, siltation, and anoxic conditions.
- Loss of wetland sites due to inappropriately planned tree planting schemes.
- Local water abstraction and drainage schemes can change hydrological regimes and lower water tables, causing shallow wetland features like ponds and lakes that are crucial to the lifecycle of many threatened species to dry out.
- Invasive and competitive plant species (e.g. duckweed *Lemna* spp.) can prevent establishment of native plants that are used as shelter and food for invertebrates.
- Lack of management of vegetation around wetland features can lead to scrub encroachment and succession to woodland, removing valuable wet habitat features for invertebrates. Conversely, overgrazing can produce a close-cropped and uniform sward that lacks many key plants, offers little shelter, and provides few flowers for pollinators.
- Low water tables lead to more favourable conditions for scrub and tree encroachment into wetland habitats.
- Climate change is anticipated to increase the frequency of extreme events (e.g. droughts and prolonged and extensive flooding), increasing the vulnerability of wetland habitats to drying or silt deposition and eutrophication, leading to changing vegetation and structural composition.
- Fish introduced to gravel pits for angling can have an adverse effect on invertebrates through predation.

Large Marsh Grasshopper (*Stethophyma grossum*) © Gilles San Martin (CC BY-SA 2.0)

Potential measures

- Discharges of effluent from the sewer network and other point sources of pollution should be strictly controlled to ensure water stays clean. For wetland features in improved grassland or arable fields, establish a buffer strip (e.g. unfertilised tussocky grass or reed) to protect them from run-off, pesticide spray drift or fertiliser inputs.
- Create new wetlands on previously arable land through re-wetting and sympathetic management. Target habitat creation near to existing high quality wetland sites where possible to improve connectivity and aid species dispersal.
- Ensure well thought out restoration plans for gravel and other mineral extraction sites that account for the value of open waterbodies and wetland features such as small pools and areas of seasonal flooding, avoiding the creation of reedbed and secondary woodland which are of relatively low value for invertebrates.
- Do not allow low quality water onto wetland sites fed by high quality water. If considering any change in hydrological regime or water management be sure to understand the sources and quality of the water involved before action. Impermeable clay bunds can be used to isolate sites from surrounding low quality water.
- Aim for structural diversity in and around water bodies, including large beds of submerged vegetation and a mixture of dense and shorter emergent vegetation, and a succession of marginal vegetation from bare substrate to tall herbage, scrub and trees. This will provide a wide range of places available for invertebrates to shelter, feed and breed in.
- Establish greater awareness of the value of wetland habitats and careful mechanisms to prevent the planting of trees on these sites. Local landowners should be made aware of the sensitivity of wetland to changes in water abstraction patterns, drainage and water quality.
- Continue grazing on wetland sites where this is appropriate to avoid scrubbing over, but reduce the grazing pressure if excessive poaching, erosion and loss of diverse vegetation structure becomes evident. Allow livestock some access to pond margins to create areas of poached ground and bare mud that are important for invertebrates such as craneflies.

- Maintain relatively stable water levels in permanent water bodies, avoiding extreme fluctuations that can be deleterious to some species. However, moderate fluctuation of water level on gently profiled waterbody margins creates habitat that is important for many invertebrates and so should not be prevented. Retain temporary pools where possible
- Try and create a diverse bank profile including gently sloping as well as steeper margins. Provide some shaded areas around wetland features, these provide shade, food and cover for many species as well as help mitigate the impact of increasing summer temperatures and climate change.
- Control or remove invasive species.
- Restore active processes in degraded wetlands through the purchase of additional land, blocking of ditches and removal of scrub/tree cover. Target restoration work near to existing high quality wetland sites to improve connectivity and to provide opportunities for invertebrates to develop resilient populations that are able to colonise new sites.

Coastal and floodplain grazing marsh

Pressures

- Drainage of marshes for agriculture or development restricts water bodies from naturally flooding and depositing silt and nutrients across their floodplain, causing significant changes in vegetation composition and decline in associated invertebrate species.
- Ecologically insensitive flood or sea defence works such as the construction of flood control embankments and channel deepening can lower water tables and cause drying out of floodplain grassland and ditches, impacting aquatic and semi-aquatic invertebrate species.
- Agricultural improvement including cultivation, re-seeding, and fertiliser and pesticide application can be major causes for direct habitat loss. Additionally, eutrophication and pollution from agricultural or industrial run-off can cause contamination of surface or ground water and growth of algal mats, leading to choking of ditches with vegetation and a loss of invertebrate interest.
- Lack of management such as cutting or grazing leads to rank and over-grown ditch banks, development of scrub and eventually carr woodland. Conversely, overgrazing can result in species diversity declines and a homogeneous species composition. Additionally, high soil moisture levels make grazing marshes particularly susceptible to excessive poaching, which can cause soil compaction and colonisation by unfavourable species.
- Inappropriate ditch management such as over-deepening or abandonment can lead to low habitat value for invertebrates and ditches silting up.
- The water regime and invertebrate communities are likely to be impacted by climate change through rising sea levels and changed weather patterns, making marshes more susceptible to invasive plants and erosion.
- In coastal areas, sea level rise can additionally result in direct habitat loss through coastal squeeze and coastal realignment, and increased saline intrusion leading to a shift from freshwater to brackish invertebrate communities.
- Applications of pesticides and herbicides directly impact invertebrate survival and can alter soil biology, function and soil invertebrate communities.
- High soil moisture levels make grazing marshes and wet grassland particularly susceptible to excessive poaching, which can cause soil compaction and colonisation by unfavourable species.
- In wet grassland, over-stocking or bringing heavy machinery onto sites in the wetter months causes soil compaction, leading to excessive spread of rush. Changes in the water levels as a result of e.g. land drainage can remove valuable seasonal and permanent wet habitat features for invertebrates.

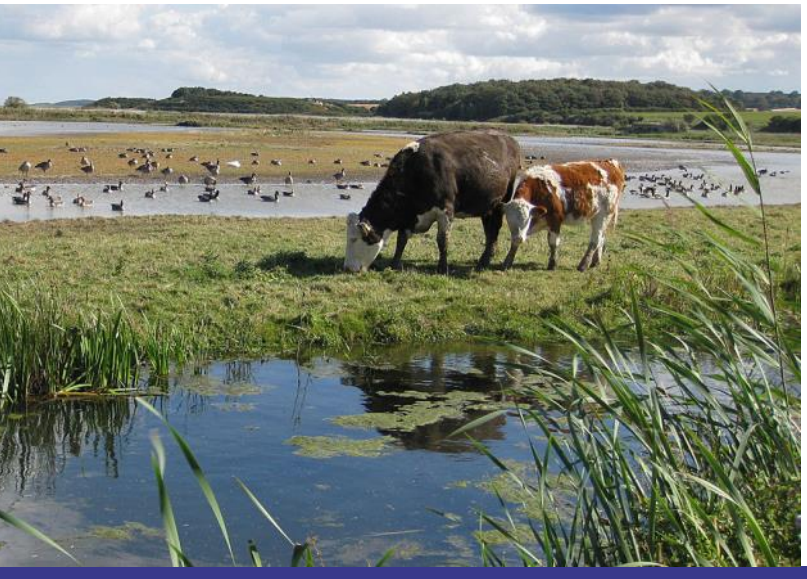
Four-lined horsefly (*Atylotus rusticus*) © Mike Kerry CC-BY NC

- In grazed grassland, endectocides used in the treatment of livestock parasites can negatively affect dung beetles and other dung invertebrates.

Potential measures

- Ensure that water levels in ditches and associated waterways are reasonably high throughout the year by protecting the existing ditch network and creating new areas e.g. on agriculturally improved land, through changes in the field drainage system and management.
- Low level grazing to maintain plant diversity and open conditions across the floodplain is recommended and best achieved by grazing during the summer months and removing or decreasing the numbers of animals in wet winter conditions. A scattering of scrub can be beneficial to act as assemblage, shelter or hibernation points for invertebrates but avoid excessive scrubbing over.
- Encourage mild poaching and trampling by cattle at ditch margins to achieve diverse marginal vegetation, the creation of bare mud patches that offer temporary or permanent mini-pools, and the formation of a berm which supports many specialised water-transition invertebrates.
- For sites managed by cutting, try to stagger cutting times, leaving some areas in flower at all times and creating a varied structural diversity across the site. Never carry out late cuts on hay meadows as this is seriously detrimental to floristic interest.
- Avoid compaction by carefully planning stocking densities especially during the wet months and performing any mechanical works required in the dry months of the year.
- Aim for a patchwork of ditches at different siltation and vegetation successional stages across the site. This is best achieved by adopting a 5-year rotational ditch clearing management cycle, where only short sections or only one side of any ditch are cleared in one year and not all adjacent ditches are cleared in the same year.
- Create wildlife-friendly and varied ditch profiles by reducing the angle of hard-edged ditches to a slope of around 35° to provide diverse habitat conditions at all water levels and to allow cattle access to ditch margins.
- At coastal sites, maintain a diversity of salinity levels in ditch networks to support a broad range of invertebrates by allowing seepages and leaking sluices, and managing saline incursion and flooding.

Coastal Grazing Marsh at Cley © Pauline E CC BY-SA 2.0



Coastal habitats

Pressures

- The direct loss or damage of coastal habitats to development, sea defences, agriculture, recreation and tourism can reduce the wildflower resources in the landscape.
- Coastal defences that interrupt natural processes can lead to the overstabilisation of sand dunes. Together with abandonment or reduction of stock grazing, rabbit declines and soil enrichment from developing habitats, the bare sand and early successional habitats important for thermophilic invertebrates can be lost.
- Overgrazing can lead to a loss of structural variation, and a short sward that lacks the flowers and shelter needed by many invertebrates. Conversely, abandonment of grazing can lead to scrub encroachment and the loss of important dung resources.
- Non-native invasive plant species (e.g. Buddleia and Sea Buckthorn) can negatively affect the vegetation and structural composition of coastal habitats, as can some ‘native’ species (e.g. pines on sand dunes).
- Beach cleaning, the removal of washed-up seaweed and other strandline material (e.g. driftwood) can remove vital shelter and breeding habitat for specialist invertebrates.
- Rising sea levels threaten to inundate key areas of habitat and lead to the permanent loss of habitat extent where land use prevents inland retreat.

Potential measures

- Avoid development proposals or coastal defence works that threaten coastal habitats and their associated invertebrate fauna.
- Identify opportunities to extend and re-connect patches of coastal habitat, and where coastal habitats can move inland in line with retreating coastlines to mitigate for future losses.
- Control or remove invasive species.
- Remobilisation of sand dunes through scrub control, removal of non-native species, establishment of appropriate grazing levels, restoring natural hydrological regimes, and activities such as bulldozing and mowing of over-mature slacks where necessary.
- Continue long-established grazing on coastal sites, but evaluate the level of grazing pressure and reduce where excessive poaching, erosion and loss of diverse vegetation structure is evident.
- Discourage the burning or removal of strandline material such as driftwood and washed-up seaweed.
- Target restoration work around or near to existing high quality coastal sites, to improve connectivity and to provide opportunities for invertebrates to develop resilient populations.

Coastal Dunes

Pressures

- Conversion of fixed dunes to agricultural land or direct development for housing or golf courses, causes fragmentation of dune habitats and severely modifies the vegetation through re-seeding, fertilising and mowing of the vegetated areas.
- A cessation of grazing (including the light grazing by rabbits) on previously grazed dunes risks an invasion of coarse grasses and scrub, which outcompete the fixed dune vegetation communities and ultimately removes the bare sand and early successional habitats important for thermophilic invertebrates.
- Conversely, overgrazing can lead to a loss of structural variation, and a short uniform sward lacking the flowers and shelter needed by many invertebrates.
- Water abstraction and drainage of adjacent land for agriculture or housing leads to a long-term lowering of the water table and may lead to the loss of specialist dune-slack invertebrate communities as the slacks dry out.
- Beach cleaning can remove the washed-up strandline material such as seaweed and driftwood, removing the vital shelter and breeding habitat for specialist invertebrates.
- Fast-growing and invasive species (e.g. Sea Buckthorn, Buddleia) can smother dunes in a dense thicket of spiny scrub to the detriment of the rest of the flora and invertebrate fauna.
- Excessive pedestrian use, car parking and use of off-road vehicles cause high levels of erosion on dunes, removing the plant resources for invertebrates.
- Engineered sea defences and stabilisation systems, even some distance away, generally interrupt the sediment flow and reduce the natural dynamism of dune systems, and hence their biodiversity.

Potential measures

- Maintain a full range of successional stages of sand stabilisation across the dune system, from mobile sparsely vegetated foredunes, young dunes with dense Marram Grass clumps, to more established dunes with varied vegetation, stable sandy grassland or heath, open sandy areas and dune slacks. This will provide nesting, sheltering and feeding resources for a wide variety of invertebrates.
- Retain and protect any transitions with adjacent habitats such as saltmarsh, mires, woodland or rivers and any other features of interest including seepages, creeks, or areas of wet mud.
- Prevent damage by excessive disturbance or overuse, especially on vulnerable young sparsely vegetated foredunes – these can be periodically fenced off to aid recovery.

Dune Tiger Beetle (*Cicindela maritima*) © Steven Falk

- Retain and encourage small and controlled areas of native scrub and tree species which provide shelter, nectar sources, and overwintering sites for many dune invertebrates. Active management of Sea Buckthorn might be necessary.
- Maintain the water table in dune slacks by avoiding any water abstraction, drainage, or creation of scrapes and pools on nearby land. Additionally, avoid deepening dune slacks to make them permanent – seasonal dune slacks that flood in winter but dry to mossy pools in the summer are especially important for scarce invertebrates.
- Where suitable and required, consider grazing or rotational cutting management to create a diversity of sward heights, to control overgrown areas, or to create more bare ground. Rabbits, where not in excessive numbers, and sheep, while avoiding overgrazing, can be very effective at achieving a vegetation mosaic.
- Retain biodegradable tidal debris.

Bare and vegetated coastal shingle

Pressures

- Shingle is unstable and requires a steady supply of new material. Coastal defence structures, offshore aggregate extraction, or artificial redistribution of material within sites or on adjacent coast interrupt this process. Protective shingle ridges can become depleted thus enabling more frequent breaches and over-topping during storms, inundating low-lying semi-natural habitats and farmland behind.
- Aggregate extraction may result in severe alteration of morphology and vegetation or almost total destruction of major parts of the habitat, and induce changes in water table level.
- Industrial installations, military infrastructure, coastal defence structures, leisure facilities, and housing built on shingle structures destroy vegetation and ridge morphology.
- Shingle vegetation is fragile; the wear and tear caused by access on foot, and particularly by vehicles, causes near permanent damage visible for decades.
- Water extraction can lower the water table affecting the species of plant available to threatened invertebrates.

Potential measures

- Prevent damage by excessive disturbance or overuse by maintaining permanent pathways and tracks to keep footfall and vehicular access along the same routes.
- Retain and encourage small and controlled areas of native scrub and tree species which provide shelter, nectar sources, and overwintering sites for many shingle invertebrates. Active management of willow and bramble might be necessary.
- Maintain the water table by avoiding any water abstraction, drainage, or creation of scrapes and pools on nearby land.
- Where suitable and required, consider grazing or rotational cutting management to create a diversity of sward heights, to control overgrown areas.
- Rabbits, where not in excessive numbers, and sheep, while avoiding overgrazing, can be very effective at achieving a vegetation mosaic.
- Retain biodegradable tidal debris.

Mudflats and saltmarsh

Pressures

- Land reclamation of mudflats and saltmarshes for use as farmland, industrial development, transport infrastructure, and waste disposal sites causes direct removal of the available invertebrate habitat.
- As sea level rises, the presence of fixed sea defences prevents the coastal habitats and high water mark from moving inland, thus squeezing out intertidal flats, reducing their extent and quality. The coastal squeeze and erosion are exacerbated by the increasing frequency of storms and rising seas.

- Creation of enclosed bays for amenity or perceived aesthetic reasons destroys mudflats and saltmarshes and the associated invertebrate interest.

Potential measures

- Ensure that natural tidal movements are not impeded and that there is continued presence of brackish pools, ditches and muddy creeks. This could be achieved by re-alignment of sea-defences to allow for expansion of these habitats or by creating a managed breach in the sea wall, where the land can get intentionally flooded, creating more saltmarsh and mudflat habitats. Retain any old flood embankments as retreats for species less tolerant of flood conditions and to act as refugia for hibernation.
- Maintain natural hydrological regime by opening any previously canalised or infilled creeks, creating areas with a varying degree of tidal inundation and salinity.
- Aim to retain a full transition of vegetational stages on saltmarshes, from open saline pools and salt pans, brackish dune slacks, to vegetated terrestrial fringes in upper saltmarsh areas. This will support species of varying salinity tolerance, create a diversity of microhabitats, and provide winter hibernation sites.
- Manage any disturbance to the habitats such as human trampling, to allow these areas to undergo the natural processes of erosion, deposition and plant growth without intervention.
- Biodegradable tidal debris such as wood and seaweed supports many invertebrates and should not be removed. Avoid any attempts to 'tidy up' the material, barbecue fires using driftwood should also be discouraged.

Saltmarsh Globetail (*Sphaerophoria loewi*) © Steven Falk

- On high transition zone, prevent excessive scrub encroachment and aim for a mosaic of scrub and terrestrial open habitats.
- On saltmarsh sites that were historically grazed, reinstate or continue light grazing to prevent grasses from outcompeting other saltmarsh plants and shading out pools and areas of bare mud that provide important invertebrate habitat. Any grazing or cutting of vegetation should be left until late in the season to allow flowering plants to set seed and associated invertebrates to complete autumn activity.
- Avoid introduction of grazing on unmanaged or previously ungrazed sites.
- Freshwater seepages and streams onto saltmarsh should be retained, as they provide rare invertebrate habitat, offering areas of reduced salinity where grasses, rushes and reeds may grow.

Wildlife-rich brownfields

Pressures

- The loss of brownfields, through development, inappropriate reclamation, remediation and management, is causing brownfield habitats to become increasingly fragmented. Over time, this can lead to local extinction events, particularly with scarce species that are poor dispersers.
- The 'greening' of brownfields, involving tree planting or the addition of nutrient-rich topsoil and seeding with grass species removes fine-scale habitat mosaics and inevitably leads to the loss of rare and scarce species.
- Clearing and 'tidying up' brownfields for public access, such as the removal of substrates, can remove valuable habitats for invertebrates.
- The introduction of broad-scale and intensive management, such as cutting large swathes of a site, can disrupt habitat mosaics that are key to brownfield biodiversity. Conversely, an absence of management on long abandoned brownfields can lead to scrub encroachment and the eventual loss of open habitats.
- Invasive non-native species (e.g. Buddleia and Cotoneaster) can negatively affect the vegetation and structural composition of brownfield habitats.


Left: Canvey Wick brownfield © Steven Falk. Right: Distinguished Jumping Spider (*Attulus distinguendus*) © Roman Willi www.endlessfields.ch

Potential measures

- Identify and protect wildlife-rich brownfields when reviewing Local Development Plans.
- Avoid development, reclamation or remediation proposals that threaten brownfield habitats and their associated invertebrate fauna.
- Introduce a positive management regime that is rotational and done in a piecemeal manner in response to site monitoring. This may involve rotationally creating new scrapes or other periodic disturbance.
- The addition of substrates such as industrial spoil, sand or calcareous aggregates will enhance the floral resource by creating different soil conditions and bare substrates for characteristic plant communities to develop.
- Identify opportunities to diversify topographical features through the creation of scrapes, hollows or depressions — these can create localised warm microclimates where there is bare ground, or form shallow ephemeral pools, inundation grassland or permanently wet areas.
- Control or remove invasive species.

Neglected habitats and features

Many invertebrates are associated with specific habitats and features that are not always addressed by broad habitat types and targets. This includes springs and seepages, seasonally wet areas, temporary rivers, bare ground and exposures, exposed riverine sediments, dead or decaying wood, soft rock cliffs or variations in substrate and topography. They can be habitats in their own right or localised features within larger recognisable habitats.

General principles for invertebrate conservation

Habitat mosaics

Diverse invertebrates and assemblages are often associated with specific vegetation structures or habitat mosaics, often only created under appropriate conservation management regimes. It is important to not just consider broad habitats, but how mosaics of traditional habitats can be targets for habitat restoration. Well-known habitats such as chalk grassland, heathland, coastal grazing marsh and wood pasture all have specialist invertebrates that require specific management approaches and subsequent habitat features to reach their full potential to support nationally rare and scarce species.

Light pollution

Two-thirds of invertebrates are partially or wholly nocturnal, and even diurnal species can be impacted by Artificial Light at Night (ALAN). The situation is so serious that light pollution is reducing the nocturnal pollinator visits to flowers by 62% in some areas. ALAN has numerous direct and indirect impacts on invertebrates, including exhaustion, increased predation, and a disrupted ability to navigate. Increased light pollution across all habitats can impact on the invertebrate assemblages that they support.

It is important to consider how the impacts of light spill can be mitigated on habitats through sensitive lighting strategies or screening of developments.

Pesticides

The continued use of ecologically damaging toxins in the environment seriously hampers efforts to reverse nature's recovery. Applications of pesticides and herbicides directly impact invertebrate survival and can alter soil biology, function and soil invertebrate communities.

Approaches for habitat creation and restoration should avoid the use of pesticides where possible, including restoring open habitats, invasive non-native species control, and controlling scrub or woodland regeneration. For further information please visit our Pesticide use in conservation webpage.

Habitat connectivity

Recent insect declines are part of a long-term loss of diversity and abundance caused by habitat loss and fragmentation. The very latest research shows that many of the best wildlife sites are now very isolated, and that a lack of connected habitat across landscapes means that species are marooned on islands of suitable habitat, unable to move in response to environmental pressures such as climate change, and vulnerable to local extinction.

There is a vicious cycle that magnifies the impact of fragmentation on small animals. Not only does it get harder for them to leave one fragment and find another to populate, eventually the likelihood of surviving dispersal attempts becomes very low, and over generations their wings and flight muscles shrink and they stop dispersing. Climate change may also drive reductions in dispersal ability.

To restore wildlife to our countryside we must be ambitious – large areas of high-quality habitat must be created, restored and connected. Wildlife-friendly habitat mosaics must be reinstated at a landscape scale, in some places 'rewilding' would help to create more varied and complex habitats that favour many insect species.

Restored grassland © Leanna Dixon

Our pollinating insects are in particular trouble, thanks to long-term losses in wildflower-rich habitats. But the B-Lines programme aims to restore pollinator populations across the UK. B-Lines is a network of 3 kilometre-wide insect pathways connecting the best remaining wildflower-rich habitats across the whole of the UK, from north to south and east to west. If 10% of the length of the B-Lines network is filled with pollinator habitat, it starts to provide that essential connectivity that wildlife needs to thrive. B-Lines is a national effort to create and restore habitats for pollinators and can be supported by LNRS measures.

Further information

For further information on how to appropriately consider and incorporate invertebrates throughout the LNRS process please see Delivering for Invertebrates in Local Nature Recovery Strategies: A Guide for Responsible Authorities.

Author: Jamie Robins, Melissa Shaw, Lucia Chmurova & Craig Macadam

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https://www.buglife.org.uk/resources/planning-hub/local-nature-recovery-strategy-guidance-in-england/