IMPORTANT INVERTEBRATE AREA PROFILE

Thames Estuary South

Left: Stray Marshes, Isle of Sheppey © Glyn Baker (CC-BY-SA/2.0) Right: Pride of Kent Rove Beetle (*Emus hirtus*) © Ryszard (CC-BY-NC 2.0)

The Thames Estuary South Important Invertebrate Area (IIA) extends along 77 kilometres of the North Kent Coast from the grazing marshes and estuarine habitats near Whitstable in the east to small woodlands, grasslands and parklands in Metropolitan London in the west. The northern limit of the IIA is the tidal reaches of the River Thames, to the south there are a scattering of sites on the chalk of the North Kent Downs and wetland and parkland habitats in the Medway Valley. The IIA sites fall mainly within the Greater Thames Estuary National Character Area (NCA), with others in the North Kent Plain NCA, North Downs NCA, Inner London NCA, and Wealden Greensand NCA. The IIA sites within the North Downs NCA are within the Kent Downs National Landscape.

The landscape and habitats of the Thames Estuary are the result of deposition and erosion of sediments moving south down the coast of East Anglia and outflow from the Thames and Medway river catchments. It is home to an internationally renowned estuarine habitat mosaic composed of mudflats, intertidal saltmarshes, freshwater grazing marshes, reedbeds, soft rock cliffs and shingle beaches. The complex habitat mosaics sustain exceptional numbers of invertebrates, crustaceans, worms and molluscs, which in turn support internationally important populations of birds. Threatened invertebrates supported in this low-lying landscape include the European Vulnerable Moss Carder Bee (*Bombus muscorum*), the Endangered Duffey's Bell-head Spider (*Praestigia duffeyi*), the Endangered minute moss beetle *Ochthebius lenensis*, and the re-established Dainty Damselfly (*Coenagrion scitulum*). It is also a stronghold for the declining Shrill Carder Bee (*Bombus sylvarum*) and is the only landscape in Britain where the Pride of Kent Rove Beetle (*Emus hirtus*) can be found. The coastal habitats at Faversham also support the only known modern records of the Globally Critically

Endangered rove beetle *Halobrecta princeps* - an endemic species found nowhere else in the world. Much of the estuarine habitat falls within several Sites of Special Scientific Interest (SSSI) including the South Thames Estuary and Marshes SSSI, Medway Estuary and Marshes SSSI, and The Swale SSSI.

There is an atmosphere of remoteness on the marshes where the open landscapes frequently have a backdrop of intense industrialisation. Brownfield sites of former industrial areas such as brick factories, abandoned aggregate extraction sites and military bases are frequent in the landscape, some of which, like the Swanscombe Peninsula SSSI, parts of the Chattenden Woods and Lodge Hill SSSI, and Conyer Brickworks have been derelict long enough to develop important invertebrate assemblages with species such as the European Vulnerable Hairy-saddled Colletes (*Colletes fodiens*) and the Critically Endangered Distinguished Jumping Spider (*Attulus distinguendus*). Though many sites have been lost to development over the years Swanscombe Peninsula and Lodge Hill are now designated as SSSIs.

Away from the coast, the ancient woods and chalk grasslands of the Mid-Kent Downs have their own character with sweeping views over The Weald to the south and the North Kent Plain to the north. The North Downs Special Area for Conservation (SAC) covers IIA sites such as the Wouldham to Detling Escarpment SSSI and the Halling to Trottiscliffe Escarpment SSSI, where the chalk flora supports important invertebrate species including the recently rediscovered Endangered Maidstone Mining Bee (*Andrena polita*), and the Endangered Paradox-knee Spider (*Gonatium paradoxum*). Isolated pockets of chalk grassland around the Medway towns survive in dry valleys where cultivation has been impossible due to steep slopes, such as the Darland Banks and Queendown Warren Kent Wildlife Trust reserves where the Endangered Straw Belle (*Aspitates gilvaria*) and the Endangered Scarlet Shieldbug (*Eurydema dominulus*) have been found.

The woodlands at Cobham Woods SSSI, and Shorne and Ashenbank Woods SSSI are renowned for their saproxylic invertebrate assemblages, and the historic parkland of Greenwich Park and Beckenham Place Park support the Critically Endangered Small-horned Walckenaer spider (*Walckenaeria corniculans*), Tree Hollow Moth (*Triaxomasia caprimulgella*), the weevil *Rhinoncus albicinctus*, and the Endangered White-letter Hairstreak (*Satyrium w-album*). The River Darent holds a population of the Globally Endangered White-clawed Crayfish (*Austropotamobius pallipes*).

Reasons for selection

The Thames Estuary South IIA supports at least 186 qualifying IIA species of conservation concern. The area supports the following species which are endemic, threatened on a Global or European scale and of Critically Endangered or Endangered status on a national scale:

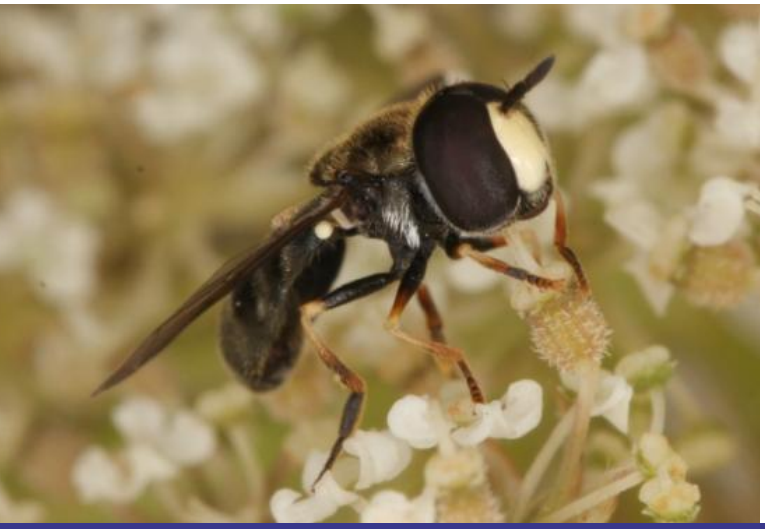
- Globally Critically Endangered endemic rove beetle *Halobrecta princeps*
- Globally Endangered White-clawed Crayfish (*Austropotamobius pallipes*)
- European Vulnerable Moss Carder Bee (*Bombus muscorum*)
- Critically Endangered Small-horned Walckenaer (*Walckenaeria corniculans*)
- Critically Endangered Distinguished Jumping Spider (*Attulus distinguendus*)
- Critically Endangered Stripe-eyed Paragus (*Paragus albifrons*)
- Endangered Paradox-knee Spider (*Gonatium paradoxum*)
- Endangered Duffey's Bell-headed Spider (*Praestigia duffeyi*)
- Endangered Necklace Ground Beetle (*Carabus monilis*)
- Endangered ground beetle *Ophonus puncticollis*
- Endangered minute moss beetle *Ochthebius lenensis*

Distinguished Jumping Spider (*Attulus distinguendus*) © Roman Willi www.endlessfields.ch

- Endangered Scarlet Shieldbug (*Eurydema dominulus*)
- Endangered Long-fringed Mini-miner (*Andrena niveata*)
- Endangered Maidstone Mining Bee (*Andrena polita*)
- Endangered Cliff Furrow Bee (*Lasioglossum angusticeps*)
- Endangered Goldilocks Case-bearer (*Coleophora linosyridella*)
- Endangered Straw Belle moth (*Aspitates gilvaria*)
- Endangered Feathered Beauty moth (*Peribatodes secundaria*)
- Endangered Marsh Mallow Moth (*Hydraecia osseola*)
- Endangered Fiery Clearwing moth (*Pyropteron chrysidiformis*)
- Endangered Heath Fritillary (*Melitaea athalia*)
- Endangered White-letter Hairstreak (*Satyrium w-album*)
- Endangered Pearl-bordered Fritillary (*Boloria euphrosyne*)
- Endangered Norfolk Hawker (*Anaciaeschna isoceles*)

The IIA also supports a large assemblage of nationally Vulnerable species, including Dark Crablet spider (*Ozyptila pullata*) (at its only British location) and Grass Money-spider (*Trichoncus sacxicola*), both found on chalk grassland. Noble Chafer (*Gnorimus nobilis*), which has declined due to a loss of its orchard habitat. The North Kent Marshes are home to the Kentish Clown beetle (*Hister quadrimaculatus*), the dung beetle *Bodilopsis sordida*, the long-legged fly *Poecilobothrus ducalis*, and the Fancy-legged Fly (*Campsicnemus magius*). Large elm trees are still found on the higher ground of the Thames Estuary South IIA where the White-letter Hairstreak has a stronghold.

Stripe-eyed Paragus (*Paragus albifrons*) © P R Harvey



Key habitats for rare invertebrates in IIA

Using the Pantheon analytical tool, we identified some of the key habitats and microhabitats for the selected rare invertebrates and listed a selection of invertebrates associated with them.

- **Short sward and bare ground** (including sward/field layer; exposed sand; litter & ground layer; soil & roots; and stones, boulders, shingle and scree) e.g. the flea beetles *Longitarsus nigrofasciatus* and *Longitarsus absynthii*, the seed weevil *Omphalapion beuthini*, Long-fringed Mini-miner, Small Shiny Furrow Bee (*Lasioglossum semilucens*), Stonecrop Fanner (*Glyphipterix equitella*), Fiery Clearwing, and Small Plain Stiletto (*Thereva fulva*).
- **Tall sward and scrub** (including sward/field layer; litter & ground layer; soil & roots; and dung & carrion) e.g. Great Trident Sunshiner beetle (*Amara strenua*), Necklace Ground Beetle, Spined Zipper (*Zelotes longipes*), Thin Weblet *(Agyneta mollis*), Paradox-knee Spider and Grass Money-spider, Large Buff Case-bearer (*Coleophora ochrea*), Estuarine Flat -body (*Agonopterix putridella*), Scarce Golden-rod Plume, and Stripe-eyed Paragus.
- **Arboreal** (including canopy; foliage; trunk & branches; flowers; honeydew & sap runs) e.g. the moths Hawthorn Bark Tortrix, Feathered Beauty, and Hornbeam Pigmy (*Stigmella carpinella*), Pine Running-spider (*Philodromus emarginatus*), Lichen Running-spider (*Philodromus margaritatus*), and Chobham Comb-foot (*Theridion pinastri*), Vernal Shieldbug (*Peribalus strictus*), the tumbling flower beetle *Mordella holomelaena*, and the broad-nosed weevil *Polydrusus marginatus*.
- **Saltmarsh** (including saltmarsh vegetation; saline silt; and tidal litter) e.g. Duffey's Bell-headed Spider, the moths Goldilocks Case-bearer, Blite Case-bearer (*Coleophora deviella*), and Kent Blite Case-bearer (*Coleophora aestuariella*), the tumbling flower beetle *Mordellistena nanuloides*, the soft-winged flower beetle *Clanoptilus strangulatus*, the weevil *Bagous argillaceus*, and the Striped Horsefly (*Hybomitra expollicata*).

- **Acid & sedge peats** (including wetland vegetation; shallow freshwater pond; wet/damp peat; sphagnum/moss lawn; and deep litter) e.g. Norfolk Hawker, Four-lined Horsefly (*Atylotus rusticus*), Levels Yellow-horned Horsefly (*Hybomitra ciureai*), Fen Sac-spider, the Silver Barred moth (*Deltote bankiana*), the ribbed water beetle *Hydrochus ignicollis*, Jewel Clown (*Saprinus virescens*), and the weevil *Bagous collignensis*.
- **Decaying wood** (including sapwood & bark decay; flowers; heart rot; and fungal fruiting bodies) e.g. Plain Dark Bee (*Stelis phaeoptera*), the longhorn beetles *Gracilia minuta*, *Paracorymbia fulva*, and *Pyrrhidium sanguineum*, Noble Chafer (*Gnomium nobilis*), the bark-gnawing beetle *Nemozoma elongatum*, the ant-like leaf beetle *Vanonus brevicornis*, and the weevil *Cossonus parallelepipedus*.
- **Marshland** (including drawdown zone: mud/shallow litter; shallow freshwater pond; and wetland vegetation) e.g. the weevils *R. albicinctus*, and *Bagous subcarinatus*, the ground beetles *Badister meridionalis*, and *B. peltatus*, the minute moss beetle *Aulacochthebius exaratus*, and the long-legged fly *Chrysotus collini*.
- **Shaded woodland floor** (including woodland litter; and undergrowth) e.g. Small-horned Walckenaer spider, Filmy Dome Spider (*Neriene radiata*), and Red Tongue-spider (*Centromerus capucinus*).
- **Running water** (including unmodified fast flowing streams; bankside trees; drawdown zone: mud/ shallow litter; and exposed riverine sediments) e.g. White-clawed Crayfish, and the water bug *Micronecta minutissima*.
- **Lake** (including lakeside emergent/aquatic vegetation) e.g. the weevil *R. albicinctus*.
- **Sandy beach** (including saline silt) e.g. the rove beetle *Halobrecta princeps*, Shingle Money-spider (*Trichoncus affinis*), and the pin-palp ground beetle *Bembidion nigropiceum*.
- **Sea cliff** e.g. the firebug *Pyrrhocoris apterus.*
- **Upland** (including sward/field layer) e.g. the leaf beetle *Chrysolina cerealis.*

Other habitats that don't have any qualifying species but are important in supporting the wider invertebrate assemblages in the IIA include:

- **Wet woodland**
- **Rocky shore**
- **Exposed chalk**

Habitat Threats and Opportunities

Mudflats and saltmarsh

Threats

- 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 levels rise, fixed sea defences prevent coastal habitats and high-water mark from moving inland, squeezing out intertidal flats, reducing their extent and quality. 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.
- Dredging for navigation has a negative impact on sediment supply and dynamics, and the sediment invertebrates.
- Industrial and agricultural run-off, polluted storm-water discharges, oil spillages or waste tipping can create abiotic areas or encourage the growth of algal mats that will adversely affect invertebrate communities.
- The invasive Common Cord-grass has been extensively planted to stabilise mudflats as a

The weevil *Rhinoncus albicinctus* © AWI Pr (CC-BY-NC)

Dainty Damselfly (*Coenagrion scitulum*) © Axel Gosseries (CC-BY-NC)

prelude to land reclamation and is spreading along the coast, often producing extensive monoculture swards of reduced wildlife value and disrupting the ecology.

- In saltmarsh, abandonment of traditional grazing creates areas dominated by rank grasses in the mid to upper marshes, lowering the botanical diversity. Conversely, introducing grazing onto previously ungrazed sites can impact on assemblages that have developed free of grazing pressures. Grazing by sheep should be avoided as it reduces the structural diversity of vegetation needed for many invertebrates.
- Draining and reseeding in areas behind flood embankments leads to direct losses of saltmarsh communities.

Opportunities

- 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 regimes and transition zones, 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 salts pans, 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 such as human trampling, to allow these habitats to undergo the natural processes of erosion, deposition, and plant growth without intervention.
- Biodegradable tidal debris such as driftwood and seaweed support many invertebrates and should not be removed. Avoid any attempts to 'tidy up' the material. Barbecue fires using driftwood should also be discouraged.
- On high transition zones, prevent excessive scrub encroachment and aim for a mosaic of scrub and open terrestrial habitats.
- On saltmarsh sites that have been 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.
- Creating scrapes and pools in larger homogenous saltmarsh systems can diversify invertebrate opportunities. This is suitable within areas of species-poor and overgrazed saltmarsh, or as part of a managed retreat process.

Wetlands

Threats

- 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.
- 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.
- 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) can prevent establishment of native plants that are used as shelter and food for invertebrates. Similarly, invasive animals such as the American Signal Crayfish (*Pacifastacus leniusculus*) can have drastic consequences for the native White-clawed Crayfish.
- 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.

Opportunities

- Discharges of effluent from the sewer network and other 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/reed) to protect them from run-off, pesticide, and fertiliser drift.
- Aim for structural diversity in and around water bodies, including large beds of submerged vegetation, shorter emergent vegetation, and a succession of marginal vegetation from bare substrate to tall herbage, scrub and trees. This will provide places for invertebrates to shelter, feed and breed in, with sheltered areas also helping to mitigate the impact of increasing summer temperatures and climate change.
- Continue grazing on wetland sites where this is appropriate to avoid them 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 stable water levels in permanent water bodies as extreme fluctuations can be deleterious to some species, however retain temporary pools if these are natural. Try and create a diverse bank profile including gently sloping and steeper margins
- 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 aid species dispersal.

Coastal and floodplain grazing marsh

Threats

- Drainage of marshes for agriculture or development restricts water bodies from naturally

Left to right: Silver Barred (*Deltote bankiana*) © Michał Brzeziński (CC-BY-NC); Four-lined Horsefly (*Atylotus rusticus*) © Mike Kerry (CC-BY-NC); The clown beetle *Saprinus viriscens* © Mark Gurney (CC-BY-NC SA 2.0)



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.

<u>Opportunities</u>

- 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.
- 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.
- 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.

The clown beetle *Hister quadrimaculatus* © Dániel Máté Gergely (CC-BY-NC)


Left: Fancy-legged Fly (*Campsicnemus magius*)© Peter Harvey. Right: Small–horned Walckenaer (*Walckenaeria corniculans*) © Jörg Pageler (CC-BY-NC).

Woodland and trees

Threats

- 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.
- 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.
- Overgrazing and disturbance by deer, squirrel and rabbit populations prevents young trees from being recruited creating a uniform tree age structure, reduces ground layer vegetation and reduces opportunities 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 the climate change, can result in changes in tree species and age composition.

Opportunities

- 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 foodplant-specific invertebrates such as White-lettered Hairstreak on elm.
- 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.
- Promote tree growth of suitable tree species on land between existing woodland sites to extend and reconnect fragmented patches of woodland.
- If replacing conifer plantations for broadleaf woodland, avoid clear-felling but strip-fell or thin out in multiple stages, so creating a mixed woodland habitat mosaic with some canopy cover at all times.
- Retain or plant blocks of flowering trees and shrubs in open sunny conditions to provide nectar sources for invertebrates where absent or limited; relaxing grazing pressure may achieve similar outcomes.

Wildlife-rich brownfields

Threats

- 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 destroy 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.

Opportunities

- 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.

Vernal Shieldbug (*Peribalus strictus*) © Lupoli Roland (CC-BY-NC)

Dry grassland

Threats

- Grassland 'improvement' through ploughing, re-seeding, fertiliser application, and conversion to arable reduce invertebrate biodiversity through direct habitat loss and reduction in foodplants, 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) 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 hay meadows, a shift from hay-making (one annual cut) to silage production (multiple cuts a year) disrupts invertebrate life cycles and considerably lowers foodplant availability.
- 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.
- Inappropriate management of hedgerows and field margins can cause gaps in habitat connectivity and a lack of refugia and hibernating sites.

Opportunities

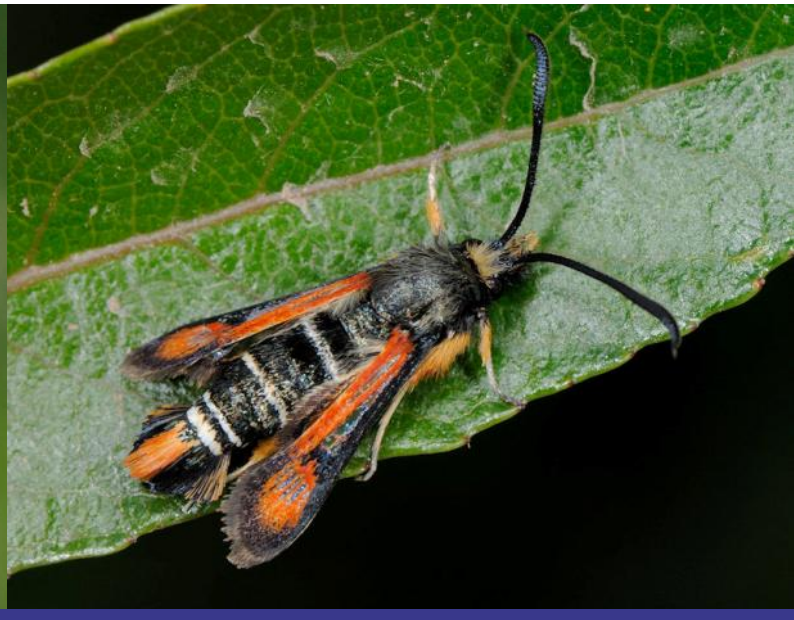
- Avoid damaging land management practices like ploughing, re-seeding, fertiliser/slurry application, winter tilling and drainage, which damage valuable grassland habitat.
- Aim to establish a diversity of plant species through seeding/green-haying to encourage a wide diversity of invertebrates as well as foodplant-specific species in this area such as Rest Harrow moth (*Aplasta ononaria*) on Common Restharrow, and Silky Wave moth (*Idaea dilutaria*) on Common Rockrose.
- For sites managed by grazing, create flexible management plans with conservation-led stocking densities and timing of grazing, avoiding excessive poaching and under-grazing.
- 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 summer 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.
- 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.

Wet grassland (including wet meadows, pasture and wood pasture)

Threats

- 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 rushes resulting in low structural variation and floral diversity.

Left: Long-fringed Mini-miner (*Andrena niveata*) © Alberts Cardona (CC BY 4.0). Right: Fiery Clearwing (*Pyropteron chrysidiforme*) © Paolo Mazzei (CC-BY-NC)




Left: Scarlet Shieldbug (*Eurydema dominulus*) © Axel Gosseries (CC-BY-NC). Right: Maidstone Mining Bee (*Andrena polita*) © Stella_Miel (CC-BY-NC)

- 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, 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 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.
- In wood pasture and parkland, 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. Over-pruning or removal of veteran trees and clearing of dead wood results in removal of essential invertebrate habitats.

<u>Opportunities</u>

- 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 as well as foodplant-specific species in this area such as Scarlet Shieldbug and the weevil *Ceutorhynchus pectoralis* on Cuckoo Flower, and the weevil *Pseudostyphlus pillumus* on Chamomile.
- 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.
- 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.
- 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

The ground beetle *Bembidion nigropiceum* © Zachary Dankowicz (CC –BY-NC)

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.
- In wood pasture and parkland, 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.

Running water

Threats

- 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.
- The introduction and spread of invasive non-native crayfish species, such as the North American Signal Crayfish (*Pacifastacus leniusculus),* has led to White -clawed Crayfish being aggressively out-competed for food and habitat.
- Disease, such as crayfish plague, spread on clothing, equipment and vehicles is one of the causes of the White-clawed Crayfish decline.
- Activities such as ploughing 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 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.

Opportunities

- 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


Left: White-clawed Crayfish (*Austropotamobius pallipes*) © httpswww.flickr.comeos100393636@N07 (CC BY-NC-SA 2.0). Right: Noble Chafer (*Gnorimus nobilis*) © Jakob Jilg (CC BY SA)

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.
- Creation of isolated new refuge sites - known as "Ark sites" - where new populations of White-clawed Crayfish can be established, safe from non-native crayfish and crayfish plague. Ark sites are now recognised as an essential part of any White-clawed Crayfish conservation strategy. An Ark site is an isolated, self-contained site with running water, still water, or both, which can support a healthy, self-sustaining population of White-clawed Crayfish with little need for ongoing management.
- Clean and disinfect waterproof clothing, fishing tackle and water-sports equipment, to prevent the spread of non-native aquatic species and diseases they may carry. Guidance can be found on the Check-Clean-Dry Website.
- 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.

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